



JAMES BAY LITHIUM MINE

ENVIRONMENTAL IMPACT ASSESSMENT

JULY 2021 (VERSION 2)
VOLUME 1: REPORT





JAMES BAY LITHIUM MINE ENVIRONMENTAL IMPACT ASSESSMENT GALAXY LITHIUM (CANADA) INC.

PROJECT NO.: 201-12362-00
DATE: JULY 2021 (VERSION 2)



Environmental Impact Assessment submitted to

Environmental and Social Impact Review Committee (COMEX)
(File No.: 3214-14-055)

And to

Canadian Environmental Assessment Agency

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Design recommendations given in this report are applicable only to the project and areas as described in the text and then only if constructed in accordance with the details stated in this report. The comments made in this report on potential construction issues and possible methods are intended only for the guidance of the designer. The number of testing and/or sampling locations may not be sufficient to determine all the factors that may affect construction methods and costs. We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

Overall conditions can only be extrapolated to an undefined limited area around these testing and sampling locations. The conditions that WSP interprets to exist between testing and sampling points may differ from those that actually exist. The accuracy of any extrapolation and interpretation beyond the sampling locations will depend on natural conditions, the history of Site development and changes through construction and other activities. In addition, analysis has been carried out for the identified chemical and physical parameters only, and it should not be inferred that other chemical species or physical conditions are not present. WSP cannot warrant against undiscovered environmental liabilities or adverse impacts off-Site.]

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This limitations statement is considered part of this report.

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TABLES OF CONCORDANCE

Tables 1 and 2 present the concordance between the information presented in the environmental impact assessment (EIA) of the James Bay Lithium Mine project of Galaxy Lithium (Canada) and the requirements set out in the documents titled Guidelines for the Preparation of an Environmental Impact Statement pursuant to the Canadian Environmental Assessment Act, 2012 of the Canadian Environmental Assessment Agency (CEAA) and Directive pour le projet de mine de lithium Baie James of the Ministère du développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC).

In addition, since the filing of the first version of the impact study (2018), the concordance (CEAA) and admissibility (MELCC) of the impact study have been obtained. Table 3 indicates the sections of the impact study where modifications have been made following the responses given to the various ministries as part of the concordance and admissibility analyzes and during the environmental analysis process since the submission of the first version of the impact study (WSP, 2018).

This version of the impact study therefore not only continues an update of the first version based on the optimization of the project design, but also brings together all the information and details submitted to the various ministries since the filing of the first version of the EIA in 2018. This document is considered up-to-date as of the date of its publication.

Table 1 Table of concordance between the sections of the CEAA guidelines and the EIA

Section of the CEAA Guidelines		Corresponding Chapter or Section of the EIA
1. INTRODUCTION AND OVERVIEW		
1.1.	The proponent	1.1; 1.2; 1.6
1.2.	Project overview	1.5; 4
1.3.	Project location	1.4; 1.5.1; 6.1; 6.2; 6.3; 6.4; 8.5.4.1;
1.4.	Regulatory framework and the role of government	2.4; 6.4.3
2. PROJECT JUSTIFICATION AND ALTERNATIVES CONSIDERED		
2.1.	Purpose of the project	2.3
2.2.	Alternative means of carrying out the project	3, 4.14
3. PROJECT DESCRIPTION		
3.1.	Project components	4.1 à 4.12
3.2.	Project activities	4.4 à 4.13
3.2.1.	Site preparation and construction	4.4
3.2.2.	Operation	4.5 à 4.12
3.2.3.	Decommissioning and abandonment	4.13
4. PUBLIC CONSULTATION AND CONCERNS		
	Public consultation and concerns Consultation et préoccupation du public	5
5. CONSULTATION WITH INDIGENOUS NATIONS AND CONCERNS RAISED		
5.1.	Aboriginal nations and consultation activities	5
6. PROJECT EFFECTS ASSESSMENT		
6.1.	Project setting and baseline conditions	6

Section of the CEAA Guidelines	Corresponding Chapter or Section of the EIA
6.1.1. Atmospheric, light and noise environment	6.2.10; 6.2.11; 6.2.12
6.1.2. Geology and geochemistry	6.2.2; 4.1, 4.7
6.1.3. Topography, terrestrial environments and soil	6.2.4; 6.2.5; 6.2.6; 6.2.9
6.1.4. Riparian and wetland environments	6.2.7 et 6.3.1 à 6.3.6
6.1.5. Groundwater and surface water	6.2.6; 6.2.7; 6.2.8
6.1.6. Fish and fish habitat	6.3.3; 6.2.7
6.1.7. Migratory birds and their habitats	6.3.5
6.1.8. Species at Risk	6.3; 8.5.4; 9.1.2.2
6.1.9. Indigenous peoples	2.4; 6.4; 8.6.2
6.1.10. Other changes to the environment arising as a result of a federal decision or due to changes on federal lands, in another province or outside Canada	NA
6.1.11. Human environment	6.4
6.2. Predicted changes to the physical environment	7.2
6.2.1. Changes to atmospheric, sound and light environments	7.2.5; 7.2.6; 7.2.7
6.2.2. Changes to groundwater and surface water	7.2.2; 7.2.3; 7.2.4
6.2.3. Changes to riparian, wetland and terrestrial environments	7.2.1; 7.2.2; 7.2.3
6.3. Predicted effects on valued components	7.2; 7.3; 7.4
6.3.1. Fish and fish habitat	7.2.2; 7.2.3; 7.2.4; 7.3.4
6.3.2. Migratory birds	7.3.5
6.3.3. Species at risk	7.3
6.3.4. Indigenous peoples	7.4
6.3.5. Other valued components that may be affected as a result of a federal decision or due to effects on federal lands, another province or outside Canada	NA
6.4. Mitigation measures	7.1
6.5. Significance of residual effects	7.1 to 7.5
6.6. Other effects to consider	8 et 9
6.6.1. Effects of potential accidents or malfunctions	9
6.6.2. Effects of the environment on the project	9.2.1
6.6.3. Cumulative effects assessment	8
7. SUMMARY OF ENVIRONMENTAL EFFECTS ASSESSMENT	
Summary of Environmental Effects Assessment	7.5
8. FOLLOW-UP AND MONITORING PROGRAMS	
8.1. Follow-up program	10.3; 10.4
8.2. Monitoring Program	10.2

Table 2 Table of concordance between the sections of MDDELCC directive and the EIA

Section of the MDDELCC directive		Corresponding chapter or section of the EIA
1.1	Presentation of the proponent	1.1; 1.2
1.2	Context relating to the project	1.5; 1.6; 2; 4; 6.1.1;
1.3	Purpose of the project	2.3
2.1	Location and route variants	3.1.2; 3.1.3; 3.2.5, 4.14
2.2	Technological variants	3.1.1; 3.2.1 à 3.2.4; 3.3; 3.4, 4.15
3.1	Description of the deposit and the facilities	4.1 à 4.3; 4.11
3.2	Extraction	4.5
3.3	Ore processing	4.6
3.4	Waste and tailings management	4.8
3.5	Water management	4.9
3.6	Water balance	4.9.3 à 4.9.6
3.7	Treatment and discharge of contaminated water	4.9
3.7.1	Water treatment	4.9.1 à 4.9.3; 4.10.2
3.7.2	Effluent(s)	4.9; 4.10.2
3.8	Related developments and projects	
3.8.1	Access infrastructure	4.11.2; 4.11.3
3.8.2	Lodging infrastructure	4.11.4
3.8.3	Transportation and storage of fuels or hazardous materials	4.10.4; 4.13.1; 4.13.3; 4.16.2
3.8.4	Borrow pits	4.4.3; 4.4.5; 4.8.2; 4.9.4
3.8.5	Concentrate transport	4.12
3.8.2	Energy supply	3.4; 3.5; 4.3
3.8.2	Employment and training	1.6.3; 2.3; 4.13, 6.4.3.4
4.1	Study area boundaries	6.1
4.2.1	Biophysical environment	6.2; 6.3
4.2.2	Archeological and cultural potential	6.4.9
4.2.3	Social environment	6.4
5.1	Determination and evaluation of the impacts	7
5.2	Cumulative impacts	8
6. MITIGATION MEASURES, RESIDUAL IMPACTS AND COMPENSATORY MEASURE		
6.1	Mitigation of impacts	7.1 to 7.4
6.2	Residual impacts and compensatory measures	7.1 to 7.5; 8.6.2
7. RISK MANAGEMENT		
7.1	Risks of technological accidents	9.3
7.2	Safety measures	9.3
7.3	Preliminary emergency response plans	9.4
8. MONITORING AND FOLLOW-UP PROGRAM		
8.1	Monitoring program	10.2
8.2	Environmental and social tracking program	10.3; 10.4

Table 3 Identification of bonifications made to the chapters of the EIA updated according to the answers submitted to the different ministries between 2019 and 2020

Section in the Impact Study	Question No.
2.0 Project context and rationale	Federal (concordance): ACÉE-52, ACÉE-53, ACÉE-54 Federal (first series): ACÉE-72 Federal (CCE) CCE-1 Provincial QC-1 QC-2 QC-3
3.0 Project Alternatives	Federal (concordance): ACÉE-55, ACÉE-56 Federal (first series): ACÉE-5
3.1.1 Deposition Methods	Provincial: QC-4, QC-5, QC-6, QC2-2
3.1.2 Location of Waste Rock and Tailings Stockpiles	Provincial: QC-7 Federal (first series): ACÉE-6, ACÉE-7 Federal (CCE): CCE-46
3.3.3 Location of Overburden Stockpiles	Federal (concordance): ACÉE-3
3.4 Power Supply at the Mine Site	Provincial QC-8, QC-10, QC-11, QC-12, QC2-3, QC2-4, QC3-1
3.5 Power Supply for Mobile Equipment	Provincial: QC-13, QC-14, QC2-5, QC3-2, QC3-3
4.0 Project Description	Provincial: QC3-4 Federal (concordance): ACÉE-4, ACÉE-6, ACÉE-7, ACÉE-51 Federal (first series): ACÉE-11,
4.4.2 Logistics	Federal (concordance): ACÉE-59 Federal (first series): ACÉE-20
4.4.3 Quarry and Borrow Pits	Provincial: QC-17, QC-18, QC2-6, QC2-7, QC2-8, QC3-5 Federal (first series): ACÉE-12, ACÉE-50 Federal (CCE): CCE-49, CCE-54
4.4.4 Laydown and Concrete Batch Plant	Federal (first series): ACÉE-13 Federal (CCE): CCE-50
4.7 Geochemical characterization	Provincial: QC-20, QC-21, QC-22, QC-23, QC-24, QC-25, QC-26, QC2-9, QC2-10, QC3-6 Federal (concordance): ACÉE-71, ACÉE-74, ACÉE-75, ACÉE-76, ACÉE-77 Federal (first series): ACÉE-51, ACÉE-52, ACÉE-53, Federal (CCE): CCE-54, CCE-55
4.8 Stockpiles	Federal (concordance): ACÉE-58 Federal (first series): ACÉE-18, ACÉE-42, ACÉE-54 Federal (CCE): CCE-56
4.8.2 Waste Rocks and Tailings	Provincial: QC-6, QC-27, QC-28, QC-29, QC-30, QC-31, QC-32, QC2-1, QC2-2, QC2-12, QC2-15, QC3-8 Federal (CCE): CCE-48

Section in the Impact Study

Question No.

4.8.3 Ore	Provincial: QC2-13 Federal (CCE): CCE-52
4.9 Water Management	Provincial: QC2-11, Qc3-10 Federal (concordance): ACÉE-60, ACÉE-61, ACÉE-62, ACÉE-63, ACÉE-64 Federal (first series): ACÉE-38, ACÉE-39, ACÉE-40, ACÉE-41, ACÉE-75 Federal (CCE): CCE-3, CCE-47, CCE-51, CCE-57, CCE-59
4.9.1 Design Parameters	Provincial: QC-33, QC-34, QC-35, QC-36, QC-45
4.9.2 Infrastructure	Provincial: QC-37, QC-38, QC-39, QC-40, QC2-16, QC3-9 Federal (first series): ACÉE-14, ACÉE-27, ACÉE-45, ACÉE-46
4.9.3 Water Balance	Provincial: QC-42, QC-43, QC-44, QC2-17,
4.9.4 During the Construction Phase	Federal (concordance): ACÉE-9, ACÉE-10, ACÉE-11 Federal (first series): ACÉE-34, ACÉE-35, ACÉE-36
4.10.1 Air Emissions	Provincial: QC-47, QC-48 Federal (first series): ACÉE-66, ACÉE-67, ACÉE-68
4.10.2 Waste Water Discharge	Provincial: QC-49, QC-50, QC-51, QC-52, QC-53, QC-54, QC-55, QC-56 Federal (first series): ACÉE-37
4.10.3 Residual Material	Provincial: QC-16 Federal (first series): ACÉE-19 Federal (CCE): CCE-61
4.10.4 Residual Hazardous Material	Provincial: QC-57, QC-58,
4.11.1 Site Buildings	Provincial: QC-59, QC-60
4.11.2 Site Access Road	Provincial: QC-61, QC-62 Federal (concordance): ACÉE-66 Federal (first series): ACÉE-16
4.11.3 Services Access Roads	Federal (first series): ACÉE-44, ACÉE-74
4.11.4 Accommodation	Provincial: QC-64
4.11.6 Fuel Storage	Provincial: QC-65, QC-66,
4.11.7 Power Line	Provincial: QC-67, QC-68, QC-69, QC2-18 Federal (first series): ACÉE-15
4.11.10 Explosives Magazine	Federal (first series): ACÉE-17, ACÉE-43
4.11.11 Optical Fiber Cable	Provincial: QC-70
4.12 Concentrate Transport to Matagami	Provincial: QC-71 Federal (first series): ACÉE-21

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4.13 Mine Restoration	Provincial: QC-72, QC-73, QC-74, QC-75, QC2-21, QC3-7, QC3-11 Federal (concordance): ACÉE-12 Federal (first series): ACÉE-32, ACÉE-55 Federal (CCE): CCE-30, CCE-31, CCE-53
4.15.1 Air Transport	Provincial: QC-76, QC2-40
4.15.3 Use of a Conveyor System	Provincial: QC-78
4.15.5 Use of the Camp at the Truck Stop	Provincial: QC-77, QC2-20
4.16.2 Sustainable Development Principles Applied to the Project	Provincial: QC-80, QC-81
5.0 Public Hearings	Federal (first series): ACÉE-94, ACÉE-95 Provincial: QC3-34
5.3.6 Consent and Validation of Minutes	Federal (concordance): ACÉE-69
5.4.1.3 2018 – 2021 Period	Provincial: QC-82, QC-83 Federal (concordance): ACÉE-67
5.7.1 Impact Benefit Agreement	Provincial: QC-84, QC-148
6.0 Description of the Receiving Environment	Federal (concordance): ACÉE-50
6.1.2 Local Study Area	Federal (first series): ACÉE-1
6.2.7 Hydrography	Federal (concordance): ACÉE-21, ACÉE-22, ACÉE-79 Federal (CCE): CCE-4A
6.2.8.1 Surface Water	Provincial: QC-89
6.2.8.2 Groundwater Quality	Provincial: QC-91
6.2.9.1 Soil	Provincial: QC-92, QC-93, QC-174, QC-175, QC2-23, QC2-24, QC3-12, QC3-13, QC3-14, QC3-15, QC3-16 Federal (concordance): ACÉE-72 Federal (first series): ACÉE-48, ACÉE-49
6.2.9.2 Sediments	Provincial: QC-95, QC2-25, QC2-26 Federal (first series): ACÉE-57
6.2.10 Air Quality	Federal (first series): ACÉE-58, ACÉE-59 Federal CCE-14
6.2.11 Ambient Noise	Federal (concordance): ACÉE-19-1, ACÉE-19-2, ACÉE-70, ACÉE-80
6.3 Biological Environment	Federal (concordance et 1ere série): ACÉE-24, ACÉE-25, ACÉE-26, ACÉE-27, ACÉE-28, ACÉE-29, ACÉE-30, ACÉE-70, ACÉE-77, ACÉE-78, ACÉE-85, ACÉE-86, ACÉE-87, ACÉE-88), Provincial: QC-90, QC-96, QC-97, QC-98, QC-99, QC-100, QC-101, QC-128, QC2-28, QC2-29, QC2-37, QC2-38, QC2-53, QC2-54, QC3-30, QC3-31 ,
6.4 Human Environment	
6.4.1 Study Area	Provincial: QC-83; QC-85, QC-86

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6.4.4.6 Development Projects	Federal (first series): ACÉE-95b
6.4.5.2 Social Environment	Federal (first series) ACÉE-116
6.4.6 Land Use	Provincial: QC-87, QC-104, QC-110 Federal (concordance): ACÉE-13, ACÉE-14-1, ACÉE-15, ACÉE-31-4, ACÉE-31-5, ACÉE-31-6, ACÉE-32, ACÉE-35, ACÉE-36 Federal (first series): ACÉE-94
6.4.6.1 Current Use of Land and Resources for Traditional Purposes	Provincial QC-85, QC-86, QC-87, QC-102, QC-103, QC2-31 Federal (concordance) ACÉE-31-1, ACÉE-31-2, ACÉE-31-3, ACÉE-31-5, ACÉE-35, ACÉE-42, ACÉE-48 Federal (first series) ACÉE-95, ACÉE-100 ACÉE-88D, ACÉE-91A, ACÉE-96, ACÉE-113
6.4.6.2 Vacations and Recreational Activities	Federal (concordance): ACÉE-36, ACÉE-48 Federal (first series): ACÉE-95
6.4.7.1 Roads	Federal (first series): ACÉE-94
6.4.7.5 Km 381 Truck Stop and Remote Landfill	Provincial: QC-41, QC-103, QC2-20
6.4.8 Landscape	Federal (concordance): ACÉE-13
6.4.9.1 Natural Heritage	Provincial: QC-105, QC-106, Federal (concordance): ACÉE-13
6.4.9.2 Archaeology	Provincial QC-107, QC-108, QC-109, QC2-32, QC2-33, QV3-17, QC3-18 Federal (concordance) ACÉE-13, ACÉE-14 Federal (first series): ACÉE-117 Federal (CCE) CCE-39
7.0 Identification and Assessment of Environmental Impacts	
7.1. Impact Assessment Method	Provincial QC-110 Federal (concordance): ACÉE-13, ACÉE-49 Federal (first series): ACÉE-3, ACÉE-4
7.1.3 Impact Assessment	Provincial: QC-110, QC-111, QC-138 Federal (concordance): ACÉE-68 Federal (first series): ACÉE-76
7.1.1.2 Environmental Components	Provincial: QC-110
7.2.1 Soils	Provincial: QC-112 Federal (first series): ACÉE-56
7.2.2 Hydrogeology	Provincial: QC-113, QC-114, QC2-14 Federal (first series): ACÉE-23, ACÉE-24, ACÉE-25, ACÉE-26, ACÉE-28, ACÉE-30 Federal (CCE): CCEE-1, CCE-2

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7.2.3 Hydrological Regime	Provincial: QC-116, QC-117 Federal (first series): ACÉE-29 Federal (CCE): CCE-4
7.2.4 Water and sediments	Provincial: QC-118, QC-119, QC-120, QC2-34, Federal (concordance): ACÉE-81 Federal (first series): ACÉE-30, ACÉE-31, ACÉE-47
7.2.5 Atmosphere	Provincial: QC-121, QC-122, QC-123, QC2-35, QC3-19, QC3-20, QC3-21 Federal (concordance): ACÉE-33, ACÉE-34 Federal (first series): ACÉE-60, ACÉE-61, ACÉE-62, ACÉE-63, ACÉE-64, ACÉE-65, ACÉE-111 Federal (CCE): CCE-15, CCE-16, CCE-21, CCE-22, CCE-23
7.2.7 Ambient Noise	Federal (CCE): CCE-19, CCE-20
7.2.8 Vibrations and Overpressure	Provincial: QC-124
7.3 Impacts on the Biological Environment	Provincial: QC-19, QC-63, QC-126, QC-127, QC-131, QC-132, QC-133, QC-134, QC-135, QC2-28, QC2-36, QC2-39, QC3-22, QC3-23, QC3-24 Federal (concordance): ACÉE-8, ACÉE-35, ACÉE-37, ACÉE-38, ACÉE-39, ACÉE-40, ACÉE-41, ACÉE-73, ACÉE-74, ACÉE-75, ACÉE-76, ACÉE-83, ACÉE-84, ACÉE-85 Federal (first series): ACÉE-71, ACÉE-73, ACÉE-79, ACÉE-80, ACÉE-81, ACÉE-82, ACÉE-89 Federal (CCE): CCE-5, CCE-6, CCE-11, CCE-12, CCE-13, CCE-24, CCE-37, CCE-61, CCE-62
7.4 Impacts on the Social Environment	Provincial: QC2-43, QC2-44 Federal (concordance): ACÉE-16, ACÉE-17, ACÉE-18, ACÉE-48
7.4.1 Current Use of Land and Resources for Traditional Purposes	Provincial: QC-87, QC-138, QC-139 Federal (concordance): ACÉE-14-2, ACÉE-32, ACÉE-35, ACÉE-42, ACÉE-43, ACÉE-44, ACÉE-45 Federal (first series): ACÉE-95, ACÉE-98, ACÉE-99, ACÉE-10, ACÉE-101, ACÉE-102, ACÉE-104, ACÉE-114, ACÉE-115, ACÉE-116 Federal (CCE): CCE-25, CCE-26, CCE-32, CCE-33, CCE-34, CCE-35, CCE-36, CCE-38

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7.4.2 Infrastructure	Provincial QC-140, QC-141, Federal (first series) ACÉE-92, ACÉE-94, ACÉE-101 Federal (CCE): CCE-27, CCE-28, CCE-29
7.4.3 Perception of the Physical and Natural Environment	Provincial QC-110, QC-136 Federal (concordance) ACÉE-15
7.4.4 Quality of Life	Provincial QC-138, QC-140, QC-142, QC-143, QC-144, QC2-41, QC2-42, QC3-25 Federal (first series) ACÉE-94, ACÉE-101, ACÉE-116 Federal (CCE): CCE-29, CCE-42, CCE-43
7.4.5 Local and Regional Economy	Provincial QC-138, QC-140, QC-145, QC-146, QC-148 Federal (first series) ACÉE-92, ACÉE-93, ACÉE-116
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ABBREVIATIONS AND ACRONYMS

ANFO	Ammonium Nitrate / Fuel Oil
ARIA	<i>Analyse, Recherche et Information sur les Accidents</i> (database)
CAPEX	Capital expenditures
CCME	Canadian Council of the Ministers of the Environment
CBHSSJB	Cree Board of Health and Social Services of James Bay
CDPNQ	<i>Centre de données sur le patrimoine naturel du Québec</i>
CEAA	<i>Canadian Environmental Assessment Act</i>
CFPBJ	Centre de formation professionnelle de la Baie-James
CHRD	Cree Human Resources Department
CMC	Community Miyupimaatisiun (health) Centre
CNG	Cree Nation Government
COMEX	Review committee
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CRRNTBJ	Regional Commission on Natural Resources and the James Bay Territory
CSB	Cree School Board
CTEU-9	Water leaching test
DMS	Dense media separation
EC/ha	Equivalent-couple per hectare
EDOs	Effluent Discharge Objectives
EIA	Environmental impact assessment
EIJB	Eeyou Istchee James Bay
EIJB RG	Eeyou Istchee James Bay Regional Government
EMP	Emergency measures plan
ÉPOQ	<i>Étude des populations d'oiseaux du Québec</i>
EQA	<i>Environment Quality Act</i>
GCC	Grand Council of the Crees
GHG	Greenhouse gas
IAAC	Impact Assessment Agency of Canada
INSPQ	Institut national de santé publique du Québec
ISQ	Institut de la statistique du Québec
ISP	Cree Hunters and Trappers Income Security Program
JBNQA	James Bay and Northern Québec Agreement
LDL	Laboratory detection limit
Li ₂ O	Lithium oxide

LNG	Liquefied natural gas
LPFS	Low-pressure feed system
MABA	Static test to predict acid generation potential
MDDELCC	Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques
MELCC	Ministère de l'Environnement et de la Lutte contre les changements climatiques
MDMER	<i>Metal and Diamond Mining Effluent Regulations</i>
MEND	Mine Environment Neutral Drainage program
MERN	Ministère de l'Énergie et des Ressources naturelles
MFFP	Ministère des Forêts, de la Faune et des Parcs
MIACC	Major Industrial Accidents Council of Canada
MRNF	Ministère des Ressources naturelles et de la Faune
MTQ	Ministère des Transports du Québec
NBC	Natural background content
Non-PAG	Non-potentially acid generating
NRCan	Natural Resources Canada
NTU	Nephelometric Turbidity Units
OPEX	Operating expenditures
PAG	Potentially acid generating
RES	<i>Résurgence dans les eaux de surface</i>
SARA	<i>Species at Risk Act</i>
SDBJ	Société de développement de la Baie-James
SOPFEU	Société de protection des forêts contre le feu
SPLP	Synthetic Precipitation Leachate Procedure
TCLP	Toxicity Characteristic Leachate Procedure
TJCM	Table jamésienne de concertation minière
TOC	Total organic carbon
UGAF	Unité de gestion des animaux à fourrure
URSTM	Unité de recherche et de service en technologie minérale (UQAT)
VCs	Values components
WEDC	Wabannutao Eeyou Development Corporation
WHMIS	Workplace Hazardous Materials Information System
WNS	White-nose syndrome
WSI	Weh-Sees Indohoun
WTP	Water treatment plant

GLOSSARY

Term / Symbol	Description
Accident	Any unforeseen and sudden event that causes or is likely to cause personal injuries or damage buildings, facilities, materials, the environment or living beings.
Acid-generating potential	The acid-generating potential associated with the oxidation of tailings.
Acute toxicity	A biological test result that exceeds the standard threshold of mortality of the tested species. It measures the inherent capacity or potential of a toxic substance to cause adverse effects (mortality) in a living organism. In the present context, it refers to a mine effluent that reaches the acute lethality level.
Anthropogenic	Refers to phenomena that essentially result from man's direct or indirect intervention.
Aquifer	A geological stratum or formation that is sufficiently porous and permeable to stock a significant quantity of water while being sufficiently permeable to allow water to flow freely through it.
Aquifer potential	The capacity to provide a high and sustained flow of groundwater. This potential depends on the geometrical characteristics, hydraulic conductivity and recharge rate of the aquifers.
Auto-ignition temperature	The lowest temperature of a hot surface from which, under certain specific conditions, the ignition of a flammable substance in the form of a mix of gas or vapour with air is possible.
Background concentration	The concentration of a chemical substance that corresponds to said substance's ambient presence.
Banded gneiss	Gneiss in which dark and light decimetric horizons alternate regularly.
Basalt	A volcanic magmatic rock produced by rapidly cooled magma and characterized by the following mineralogical composition: plagioclase (50%), pyroxenes (25–40%), olivine (10–25%) and magnetite (2–3%).
Beaver pond	A body of water that is usually shallow (a few metres deep) and was created by the presence of a beaver dam.
Benthic invertebrates	Small animals that do not have a spine (such as insects and mollusks) and that live at the bottom of water bodies.
Carbon oxide equivalent (CO ₂ eq.)	A unit used to compare the radiative forcing of a GHG to carbon dioxide.
Claim	The only exploration mineral title on public land that confers on its holder the exclusive right to search for mineral substances, with the exception of surface mineral substances.
Compensatory measure	A measure, excluding the planned treatment of the mine's wastewater, aimed at compensating the residual impacts of the implementation of a project.
Concentrate	A substance of value that results from the spodumene concentration process and that contains approximately 6% of lithium oxide (Li ₂ O).
Contaminants	A solid, liquid or gaseous matter, microorganism, sound, vibration, ray, heat, odour, radiation or any combination thereof that is likely to somehow alter the quality of water or the environment.
Contaminated water	Water in which the concentration of any chemical substance exceeds its natural concentration because of mining activities (D019).
Criteria	Concentrations of a contaminant that, if they are exceeded, risk causing a complete or partial loss of the use for which they were established.

Term / Symbol	Description
Dense media separation	A density separation process that uses different material densities to apply gravity separation. This robust process is effective to separate minerals, mineralized bodies and metallic waste.
Deposit	A series of mineral layers in the ground. A mineralized zone that is large enough to justify its commercial development.
Dewatering	The action of evacuating infiltration water from a mine.
Diabase	A mafic igneous, holocrystalline rock that is equivalent to volcanic basalt or plutonic gabbro and is slightly modified by metamorphism.
Dike	A long construction designed to contain water.
Dyke (geology)	In geology, a dyke (or dike) is a tabular body of magmatic rock that has penetrated into a fracture through different layers of rock. Dykes cut through pre-existing rock vertically or quasi-vertically. A dyke can also be composed of sedimentary deposits in a pre-existing fissure.
Drainage system	A system that is used namely to intercept the mine site's drainage water and direct it to treatment units. It can also designate a system used to redirect uncontaminated runoff water to the periphery of the mine site.
Effect	The consequence of an accident: toxic concentration, thermal radiation, thermal load, overpressure.
Effect threshold	A value of toxic concentration (ppm or mg/m ³), thermal radiation (kW/m ²), thermal load ((kW/m ²) ⁴ /3•s) or overpressure (kPa) from which effects on life or health could be observed within an exposed population or structural damage could result.
Effluent Discharge Objectives	The maximum concentrations and loads of different contaminants that may be released into a receiving environment while ensuring the maintenance or retrieval of their uses.
Elevation	The vertical distance measured between a point located on the Earth's surface and a reference surface (usually the mean sea level).
Emission factor	A factor relating activity data to increased or decreased GHG levels.
Exfiltration	The movement of water from a saturated substrate through the surface of this substrate under the effect of a hydraulic gradient.
Expected detection limit	The detection limit associated with the analytical method of a given parameter specified in the list of analytical methods published by the Centre d'analyse environnementale du Québec of the Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques du Québec.
Extraction	The action of removing mineral material from excavation - open pit or underground.
Extraction capacity	The maximum quantity (in tons per day) of material that is extractable under optimal equipment conditions.
Filter press	An intermittently operating filter consisting of a series of flat vertical filtering surfaces into which the pulp to be filtered is injected under pressure. The pulp is released by separating the filter plates.
Final effluent	Mine wastewater that is no longer treated before being released at the discharge point into the receiving environment or a sewer system.
Final effluent discharge point	A point beyond which an operator no longer has control over the final effluent and can no longer improve its quality.
Flammable (or explosive) limits	When mixed with the oxygen in air, certain gasses or vapours emitted by certain liquids are flammable within the limits of a determined concentration range. Said limits are expressed in % by volume in the air with respect to the ambient temperature and atmospheric pressure. They are called: LFL: lower flammable limit (or LEL: lower explosive limit); UFL: upper flammable limit (or UEL: upper explosive limit).

Term / Symbol	Description
Flashpoint (for liquids)	The lowest temperature at which a liquid, at atmospheric pressure, emits a sufficient quantity of vapours to ignite in the presence of a flame.
Flood period	A significant increase in the water flow (and consequently the level) of a watercourse, a lake or a reservoir, most often attributable to precipitations or melting snow.
Flooded area	A terrestrial environment that has recently been affected by a rise of the water level attributable to an external activity, such as the construction of a beaver dam, without, however, having defined limits such as a beaver pond, or presenting hygrophile plants (e.g., rising waters along a lake's shores because of a beaver dam restricting its outflow).
Flow facies	The aspect of a watercourse defined by water height, flow speed and type of substrate. There are eight types of flow facies: waterfalls, cascades, rapids, rises, channels, meanders, basins and estuaries.
Fluvial deposits	Well-stratified deposits carried by a watercourse and composed of gravel, sand and—in lesser proportions—loam, clay and (occasionally) organic matter.
Forest management unit	A basic territorial unit used to manage the forest in such a way as to supply wood processing plants. It is also on the basis of this unit that potential annual sustainable yields are established.
Forest stand	A group of trees that forms a rather homogeneous whole, in terms namely of floristic composition, structure, age and spatial distribution to set is apart from neighbouring stands.
Formation (geological)	A body of rock identified by its lithologic features and stratigraphic position.
Freeboard	The vertical distance separating the embankment crest and the maximum water level in the tailings area.
Freshwater	Water drawn from the natural environment (surface water or groundwater) or from an aqueduct.
Geochemistry	The study of the chemical behaviour of the elements, in particular in rocks (magmatic, metamorphic and sedimentary) as well as in water (coastal and marine) and the atmosphere.
Geological province	A geological province is an extensive continental region that corresponds to a morphostructural set of the terrestrial globe. There are three main types of geological provinces, which are occasionally divided into subtypes: cratons, mountain ranges corresponding to zones of recent orogeny and magmatic provinces.
Geology	A science that includes the study of the parts of the Earth that can be observed directly and the development of hypotheses to reconstitute their history and explain how they fit together. The main geological disciplines are petrography, la mineralogy, la crystallography, volcanology, sedimentology, geochemistry, stratigraphy, tectonics, structure, paleontology and geomorphology.
Geomorphology	The study of the evolution of the Earth's topographic features and the causes of this evolution. This science is midway between geology and geography.
Glaciofluvial deposits	Continental sediments originating from matter ripped off by a glacier and carried by a watercourse.
Global warming potential	A factor that describes the impact of the radiative forcing of one unit of a given greenhouse gas compared to one equivalent unit of carbon dioxide for a defined period.
Gneiss	Metamorphic rock from the continental crust that contains particles of quartz, mica, plagioclase feldspar and (occasionally) alkali feldspar that are all visible to the naked eye.
Greenhouse gas	Gaseous component in the atmosphere, both natural and artificial, that absorbs and re-radiates the infrared radiation of a specific wavelength emitted by the surface of the Earth, the atmosphere and the clouds.
Greenhouse gas source	A physical unit or process that releases a GHG into the atmosphere.
Groundwater flow system	The hydrodynamic characteristics of the movement of groundwater in an aquifer over time.
Hauling road	A road taken by motor vehicles in an open-pit mine.

Term / Symbol	Description
Hazardous material	A material which, by reason of its properties, is a hazard to health or to the environment and which is explosive, gaseous, flammable, poisonous, radioactive, corrosive, oxidizing or leachable or is designated as a hazardous material, and any object classed by regulation as a hazardous material by virtue of the <i>Environment Quality Act</i> .
High water	Elevation of the water level following abundant rainfalls or melting snow or ice.
High-water mark	This line is located at the natural high-water mark, i.e., where the predominance of aquatic plants passes to a predominance of terrestrial plants or, if there are no aquatic plants, where the terrestrial plants stop towards the body of water. This mark delineates the shorelines and shores of lakes and watercourses.
Home range	The area where an animal normally lives and that enables it to satisfy its basic needs.
Hydraulic conductivity	A property of geological materials that characterizes the ease with which they allow the movement of water.
Hydraulic property	Hydraulic properties make it possible to analyze in quantitative terms the capacity of a geological formation to contain water and allow it to flow. These properties depend on the properties of the liquid, i.e., water, and the physical properties of the environment with respect to water storage and flow.
Hydrogeological conditions	A set of elements and characteristics that define the hydrology (groundwater science) and geology of a sector. It includes, among other things, the hydrostratigraphic units, granulometry and hydraulic properties of geological materials as well as groundwater levels and characteristics.
Hydrogeological property	Refer to Hydrogeological conditions.
Hydrogeological unit	A permeable and porous geological unit, delimited by one or several impermeable units, the whole of which has a structure that allows to form and feed, at least temporarily, a groundwater table within the permeable unit.
Hydrogeology	A geological discipline that studies groundwater (the underground flow of water, the search for groundwater, the evaluation of reservoirs, possible catchments and flows).
Hydrostratigraphic units	Geological units (superficial deposits or rocks) that are characterized by a distinct flow of the groundwater in consideration of their respective permeability levels.
Ignition	The state of a burning body.
<i>In situ</i>	Latin expression that means on site.
Invasive alien species	An invasive alien species is a plant, animal or microorganism (virus, bacterium or fungus) that is introduced outside of its natural range. Its establishment and spreading may constitute a threat to the environment, economy or society.
Land use	The traditional and contemporary use of resources and the full occupation of the traditional territory.
Lands in the domain of the State or public lands	Public lands in Québec.
Leaching	The dissolution of certain mineral constituents.
Leaching tests	These tests make it possible to establish the risks associated with the potential leaching of toxic substances into the groundwater table.

Term / Symbol	Description
Lithium	A soft alkaline metal that is silver-white in colour and that has the lowest molar mass and density of all metals. Its lightness and high reactivity make it particularly suitable for use in the manufacturing of batteries as well as in a variety of industrial processes. The applications of lithium are highly diverse and include the manufacturing of glass and ceramics, lubricants, polymers and pharmaceutical products, the purification of air and, recently and especially, the manufacturing of lithium ion batteries.
Lithostratigraphic	In geology, regarding lithostratigraphy, the branch of stratigraphy that analyzes the organization of strata based on lithologic criteria (composition of the sediments or rocks, including physical and chemical characteristics such as colour, mineralogical composition, harness or grain size).
Lixiviation	A technique consisting of using a solvent, namely water flowing in the soil or a substrate containing toxic products, to extract soluble products.
Low water level	The lowest recorded level of a watercourse or any other body of water.
Low-water period	The period of the year during which the flow of a watercourse reaches its lowest level (minimum flow).
Lugeon test	The Lugeon test consists of injecting pressurized water into a cavity comprised of a portion of a drilling of known dimensions and of measuring the injection rate at different pressure levels over a given period.
Marsh	A wetland that is dominated by herbaceous vegetation (emergent, grass-like or broad-leaved) growing in a mineral or organic soil. Shrubs and trees, when present, cover at least 25% of the environment's surface area. A marsh is usually connected to fluvial, riparian and lacustrine areas and its water level varies according to tides, flooding and evapotranspiration. A marsh may be flooded on a permanent, semi-permanent or temporary basis.
Maternity	A fauna breeding site.
Measurement site	The location where water samples are taken to analyze the quality of the final effluent and measure the flow and the pH. The measurement site is located immediately upstream of the final effluent discharge point.
Mine	A set of surface and underground infrastructures, with the exception of pits covered by the <i>Regulation respecting pits and quarries</i> (R.Q. c.Q-2, r.2), designed to extract mineral for economic purpose.
Mine site	A site on which unfolds or had unfolded work to explore or develop a mineral deposit, to extract or process the material. Includes, without limiting the generality of the foregoing, mines, surface infrastructures, storage areas, stockpile areas, and basins as well as adjacent cleared or disrupted sectors.
Mine water	Water, not including domestic wastewater, that is pumped from a mine excavation to keep it dry during exploration and development operations.
Mining lease	A mineral title that confers on its holder, on a given public territory, the exclusive right to mine mineral substances, except for those found on the surface. Since 1966, mining leases have replaced mining claims for new applications to operate.
Mitigation measure	A measure designed to reduce or eliminate the adverse effects of a project.
Modelling	The design of a model, i.e., a diagram representing a defined system, chosen following its intended use, followed by the development of a simulator (or an analogue, digital or other simulation model) of the system.

Term / Symbol	Description
Observation well	A well used to observe, on an episodic or regular basis, a characteristic of the groundwater that may vary: level, chemical quality, temperature, etc. More specifically, a well used to measure the hydraulic load of a water table, in general near its surface, by surveying the depth of the table, and to observe its natural or influenced variations, through periodic measurements (less rigorously than when using a piezometer).
Organic deposits	Deposits that are composed of more or less decomposed organic matter.
Organic matter	A substance of biological origin that results from the decomposition of plant debris, dejections and animal carcasses.
Outcrop	An exposure of rock or mineral deposit that can be seen on the surface, i.e., that is not covered by soil or vegetation.
Outflow	A watercourse that releases the water of a lake or pond.
Overburden	The unconsolidated natural layer of sediments that must be penetrated to reach the economic material, i.e., soil that does not contain any material of value to mining companies.
Peatland	A wetland in which the production of organic matter, regardless of the composition of the plant remains, has prevailed over its decomposition. The result is a natural accumulation of peat that constitutes organic soil. Peatland soil is either poorly or very poorly drained and the groundwater table is usually at the same depth as the soil or close to its surface. There are two main types of peatland—ombrotrophic (bogs) and minerotrophic (fens)—that are fed by different water sources. Peatland may be wooded or not (open). Wooded peatland is covered with trees that measure more than 4 m in height over 25% or more of its surface.
Permeability test	In the case of this impact study, the permeability tests conducted on site consisted of collecting a known volume of water from a well and evaluating how quickly it rises through the water table. How quickly the water rises makes it possible to establish the hydraulic conductivity of a determined horizon.
Piezometer	A tube well with a screened extremity used to measure the piezometric level at a specific point.
Piezometric high	The zone where the elevation of the water table is at its highest.
Piezometric level	The depth of the upper limit of the water table.
Pit	Refers to the excavated zone in the shape of a funnel in the open-pit mining process.
Pit wall	The sides (walls) of the pit.
Pond	A wetland with a water level of less than 2 m during the low-water season. It is characterized by the presence of floating or submerged aquatic vegetation as well as emergent vegetation covering at least 25% of the environment's surface area. Temporary ponds, often called vernal or forest pools, are shallow (< 1 m), isolated and usually fed in water by precipitations, melting or the water table. Ponds retain stagnant water in the spring for a period of approximately two months and then dry out during the summer. Given they are not inhabited by fish, they tend to favour species that are adapted to the recurrent flooddrought cycles such as salamanders and certain frog species.
Post-rehabilitation	The period that follows the end of the rehabilitation work planned to return the receiving environment to a satisfactory state for its protection.
Pumping test	Continuous pumping at a regular flow in a pumped well such as to generate a permanent flow until the water level is stable in the pumped well and the observation wells drilled around the pumped well. This test makes it possible to measure the drawdown of the water table in the observation wells during the pumping (downward flow) and once the pumping has stopped (upward flow) and, in turn, to measure the permeability coefficient.
Radius of impact	The distance measured from the source of an effect to the selected effect threshold.

Term / Symbol	Description
Receiving environment	The environment in which the project unfolds and that is likely to be affected by the completion of the project.
Recharge	The recharge corresponds to the quantity of water that enters the aquifer after infiltrating the surface and renews the groundwater.
Recirculation	Action by which mine wastewater is retrieved to be reused in equipment and processes.
Reduction	The mitigation of flood peaks due to the reduction and lag of the water volumes.
Reference state	The characteristics of an environmental component as they were before the project.
Regular monitoring	The complete environmental monitoring (weekly, three times weekly and acute toxicity) of the final effluent.
Resurgence	Refer to Resurgence water.
Retention basin	A retention structure designed to contain runoff water.
Rim	The edge of a well
Risk analysis	The use of information such as to identify the hazards and estimate the probability and seriousness of adverse effects on people or populations, the environment and property.
Scarification	An operation by which the indurated surface of a pavement (or a layer of pavement) is at once isolated from the pavement's underlying structure and reduced to blocks through ploughing using a machine such as a harrow, a rake arm or a scarifier.
Sediment	An unconsolidated deposit of detritic, chemical or organic origin formed by the grouping of small and larger particles or precipitated matter having been transported separately.
Sedimentation basin	A retention structure designed to retain water long enough for the suspended solids to settle at the bottom of the basin before the water is released.
Seismic	Which relates to earthquakes or which is prone to earthquakes.
Shoreline	The part of a lake or watercourse that extends from the high-water line to the centre of the body of water.
Sorption	The uptake and retention of a substance (the sorbed) on the surface (adsorption) as well as within (absorption, in the broader sense) another substance (the sorbent).
Special status species	Special status species are plant and animal species at risk according to the MDDELCC, i.e., those that are designated as threatened or vulnerable Québec by virtue of the <i>Act respecting threatened or vulnerable species</i> and those that are likely to be designated as such as well as plant and animal species that are at risk in Canada by virtue of the <i>Species at Risk Act</i> .
Spodumene	Spodumene is a silicate of aluminum and lithium. It is the most important mineral making up commercially mined lithium in the world.
Spodumene-bearing pegmatite	The minerals contained in lithium (spodumene, petalite, lepidolite, amblygonite) are namely associated with rocks such as rare-metal granitic pegmatites. These granitic pegmatites often constitute peraluminous instructive complexes.
Spot sample	The volume of undiluted effluent collected at a given time.
Stockpile	Land where mineral substances, topsoil, concentrates or mine tailings are accumulated.
Stratigraphy	The science that studies the succession of sedimentary deposits, generally laid out in layers (or strata). The study of the order in which layers of rock that make up the Earth's crust formed over geological times.

Term / Symbol	Description
Surface mineral substances	Peat; sand including silica sand; gravel; limestone; calcite; dolomite; common clay and argillaceous rocks used in the manufacture of clay products; all types of rocks used as dimension stone, crushed stone, silica or mineral in the making of cement; and every mineral substance that is found in its natural state as a loose deposit, except the tilth, as well as inert mine tailings, where such substances and tailings are used for construction purposes, for the manufacture of construction materials, or for the improvement of soils (<i>chapter I-1, Mining Act</i>).
Surface or superficial deposits	Unconsolidated sediments (clay, sand, gravel, stones, etc.) of various origins, natures, morphologies and thicknesses that rest on the surface of the bedrock.
Swamp	A wetland that is dominated by woody, shrub or tree vegetation (covering more than 25% of the environment's surface area) that grows in a mineral soil that is poorly or very poorly drained. A riverine swamp is seasonally flooded or characterized by a high-water table and a water flow that is high in dissolved minerals. As for an isolated swamp, it is fed by runoff water or resurgences of the water table.
Tailings	Solid or liquid substances, with the exception of the final effluent, resulting from the extraction, preparation, enrichment and separation of an economic material, including the sludge and dust resulting from the treatment or purification of mine wastewater or air emissions. Are considered as tailings the slag and sludge, including sewage sludge, released during the treatment by pyrometallurgy, hydrometallurgy or electroextraction. Are also considered as tailings the substances released during the extraction of a marketable substance from tailings and that correspond to those already defined in the first two paragraphs. Are excluded the tailings resulting from the working of a pit within the meaning of the <i>Regulation respecting pits and quarries</i> (R.Q., c.Q-2, r.2).
Tallyman	A trapper in charge of supervising other trappers and whose primary responsibility is managing animal populations within the limits of the land for which he is responsible.
Topsoil	Surface soil that is composed of a mix of organic matter as well as sand, silt and clay or a combination thereof and that is conducive to vegetation growth.
Traditional activities	Refer to Traditional practices.
Traditional practices (traditional activities)	All of the traditional hunting, fishing, gathering and general activities as well as land and resource use activities for livelihood, ritual and social purposes.
Treatment capacity	The maximum quantity of material (in tons per day) that is treatable under optimal equipment conditions.
Tributary	A watercourse that flows into a larger watercourse or into a lake (affluent).
Unconsolidated deposits	Unconsolidated matter that covers a deposit or the bedrock.
Water table	The underground water table that feeds catchment works. The water table is the first table of groundwater under the soil surface.
Watercourse	Any water mass that flows into a bed at a regular or intermittent rate, including those created or modified by human intervention as well as the St. Lawrence River and the Gulf of St. Lawrence and all seas surrounding Québec.
Watershed	A watershed is a territory, bounded by drainage divides, over which water flows to a single point called an outflow.
Wetland	Wetlands comprise all sites that are saturated with water or flooded during a sufficiently long period to exert an influence on the "soil" and "vegetation" components, to the extent they are present.
Wind erosion	Erosion caused by the wind.
Winter concentration area (or wintering area)	A forest territory of variable size that is used as shelter by a large or small group of crevdis during the winter.

Term / Symbol	Description
	Explosion Hazard.
	Flammable Material.
	Oxidizing.
	Compressed Gas.
	Corrosive.
	Harmful or Fatal.
	Harmful.
	Health Hazard.
	Harmful to the Environment.

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1 INTRODUCTION

1.1 PROJECT PROPONENT

Galaxy Lithium (Canada) Inc. is a fully owned subsidiary of Galaxy Resources Limited (Galaxy Resources), a mid-tier mining company listed on the Australian Stock Exchange (ASX). The firm currently operates the Mt. Cattlin Spodumene Mine in Australia and is developing the Sal de Vida Potash and Lithium Brine Project in Argentina (in an area known as the “lithium triangle”). Thus, Galaxy Lithium (Canada) Inc. (hereinafter called GLCI) is acting as the proponent of the James Bay Lithium Mine project. The contact information of Galaxy in Canada is as follows:

Name of project proponent	GALAXY LITHIUM (CANADA) INC.
Project office	2000 Peel St., Suite 720 Montréal, QC H3A 2W5
Websites	www.gxy.com www.gxy.com / james-bay /
Project manager	Ms. Gail Amyot, Director EHS gail.amyot@gxy.com
Phone number	514-558-1855 / cell.: 514-346-0961
Québec enterprise number (NEQ)	1167071928

1.2 MANDATE OF THE ENVIRONMENTAL IMPACT ASSESSMENT

GLCI has retained the services of WSP for the preparation of the environmental impact assessment (EIA) for the James Bay Lithium Mine project. Contact information for their representative is as follows:

Name of consultant	WSP CANADA INC.
Project office	1135 Lebourgneuf Boulevard Québec, QC G2K 0M5
Website	www.wsp.com
Project director	Ms. Christine Martineau christine.martineau@wsp.com
Phone	418-623-2254
Fax	418-624-1857

1.3 PREAMBLE

An environmental impact assessment (EIA) was prepared by WSP (2018a) and presented to the Canadian Environmental Assessment Agency (CEAAg) and the Québec *Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques* (MDDELCC) in October 2018. While the federal and provincial authorities analyzed the EIA, the project design was also optimized. The results of this optimization are laid out in a preliminary economic study that meets NI 43-101 standards, prepared by G Mining Services (2021). This EIA is based on the updated project design, which was the result of the engineering optimization process. The main modifications made to the report from the 2018 EIA version are highlighted using a different font (Verdana) and presented in bold.

1.4 PRESENTATION OF THE REPORT

This study contains all of the relevant information and analysis components for meeting the directive of Québec's Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC, now known as the Ministère de l'Environnement et de la Lutte contre les changements climatiques or MELCC)¹ by way of the environmental and social protection regime applicable in the James Bay region, established under Chapter 22 of the James Bay and Northern Québec Agreement (JBNQA); for meeting the guidelines of the Canadian Environmental Assessment Agency (CEAAg)² and, by extension, for meeting the requirements of the *Environment Quality Act* (EQA) and the *Canadian Environmental Assessment Act* (CEAA).

In this report, Chapter 1 presents the project proponent and its main consultant, who is responsible for the various environmental approaches. Next, we find the main tenets of its environmental policy and an overview of the **2021 project compared to the 2018 project**. The technical details are presented in Chapter 4.

Chapter 2 describes the project context and justification by highlighting the history of the mining operations and the components enabling its achievement. This chapter also provides the legal and regulatory framework for this project, outlining its legislative features.

Chapter 3 compares the different project alternatives which were analyzed for material deposit sites, such as the areas to stockpile tailings, waste rock and overburden. The alternatives are studied to target each one's advantages and disadvantages, on an environmental, technical, social and economical level.

Chapter 4 presents a detailed description of the project and its various components. This description includes (but is not limited to) mining infrastructure, activities to take place on-site, the deposition plan for waste rock and tailings, water treatment on the mine site, related equipment and infrastructure and the mine rehabilitation plan. Completion schedule and cost of work are also presented, along with project design plans.

Chapter 5 outlines the consultation activities which were conducted among the population from the very start of the project. A communications plan is also outlined. Finally, this chapter highlights the concerns and expectations of the various stakeholders to enhance the project and minimize the adverse effects on the environment and on the population.

Chapter 6 describes the receiving environment—or the various components from the physical, biological or human environments—in the study areas used in assessing the project's environmental and social effects.

The effects on the environment and on humans are identified and assessed in Chapter 7. This assessment considers proposed mitigation measures for each environmental component for the project's construction, operation, rehabilitation and post-rehabilitation phases. An assessment of the project's residual effects, following mitigation, concludes this section.

1 Provincial directive: <https://www.ree.environnement.gouv.qc.ca/dossiers/3214-14-055/3214-14-055-3.pdf>
2 Federal guidelines: <https://aeic-iaac.gc.ca/050/documents/p80141/121718E.pdf>

Chapter 8 deals with the project's cumulative effects for each of the valued components (VCs) of the ecosystem selected. Therefore, all projects, activities or events (past, current or future) which may result in project cumulative effects on these VCs are assessed.

Chapter 9 lists the general procedures for managing the main accidents that may occur during project construction and operation.

Chapter 10 presents an overview of the environmental follow-up and monitoring programs. Monitoring mainly concerns the construction phase and will be worked out at the planning and specifications phase. Among other things, follow-up aims at evaluating the effectiveness of the mitigation measures proposed, confirming whether certain negative effects do in fact occur, verifying compliance with standards and applying solutions, if necessary, to protect the environment or the population.

In addition to the main report presented in two volumes (volumes 1 and 2), this study also includes another volume, regrouping all the appendices (volume 3).

1.5 PROJECT LOCATION

The James Bay Lithium Mine project is located in the Nord-du-Québec administrative region, on the territory of the Eeyou Istchee James Bay Regional Government. It is located approximately 10 km south of the Eastmain River, **130 km east of James Bay and close to the Eastmain village (Map 1-1)**. The project is on Category III lands according to the JBNQA.

The geographical coordinates in UTM (zone 18, NAD83) of the site are presented below:

- X: 358,891
- Y: 5,789,180

The lands subject to the mining claim of the James Bay Lithium Mine project (Project Property) are easily accessed by the **Billy-Diamond highway (formerly the James Bay road)** that connects Matagami and Radisson. This road crosses the James Bay Property at kilometre 381 of the road, close to the truck stop (*relais routier*) managed by the *Société de développement de la Baie-James* (SDBJ) at that kilometre point.

A Phase I Environmental Site Assessment (ESA) was done **by WSP (2018b)** to determine the site's environmental history, i.e. to identify potential and real environmental risks associated with past and present activities carried out on the site and in the immediate area. **A Phase II ESA was then conducted to characterize the remote disposal site (WSP, 2018c).**

1.6 GENERAL PROJECT DESCRIPTION, 2021 VS 2018

The project title is: "James Bay Lithium Mine". The project site is identified on maps with its official title. Of noteworthy mention, there is currently no mine in existence.

The project underwent several changes after the 2018 EIA. The main changes applied to:

- **storage areas: four waste rock and tailings storage facilities instead of a single stockpile in 2018, the overburden and peat stockpile was moved from its 2018 location;**
- **the larger size and smaller number of trucks to transport concentrate and trucks used to carry ore to the crusher compared to 2018;**
- **haul roads to allow for shorter trips compared to what was planned in 2018;**
- **the location of the concentrator, the workers' camp and the service building, which are now closer to the Billy-Diamond highway than they were in the 2018 project;**
- **the location of the explosives warehouse, which was moved further northwest from its location in the 2018 project.**

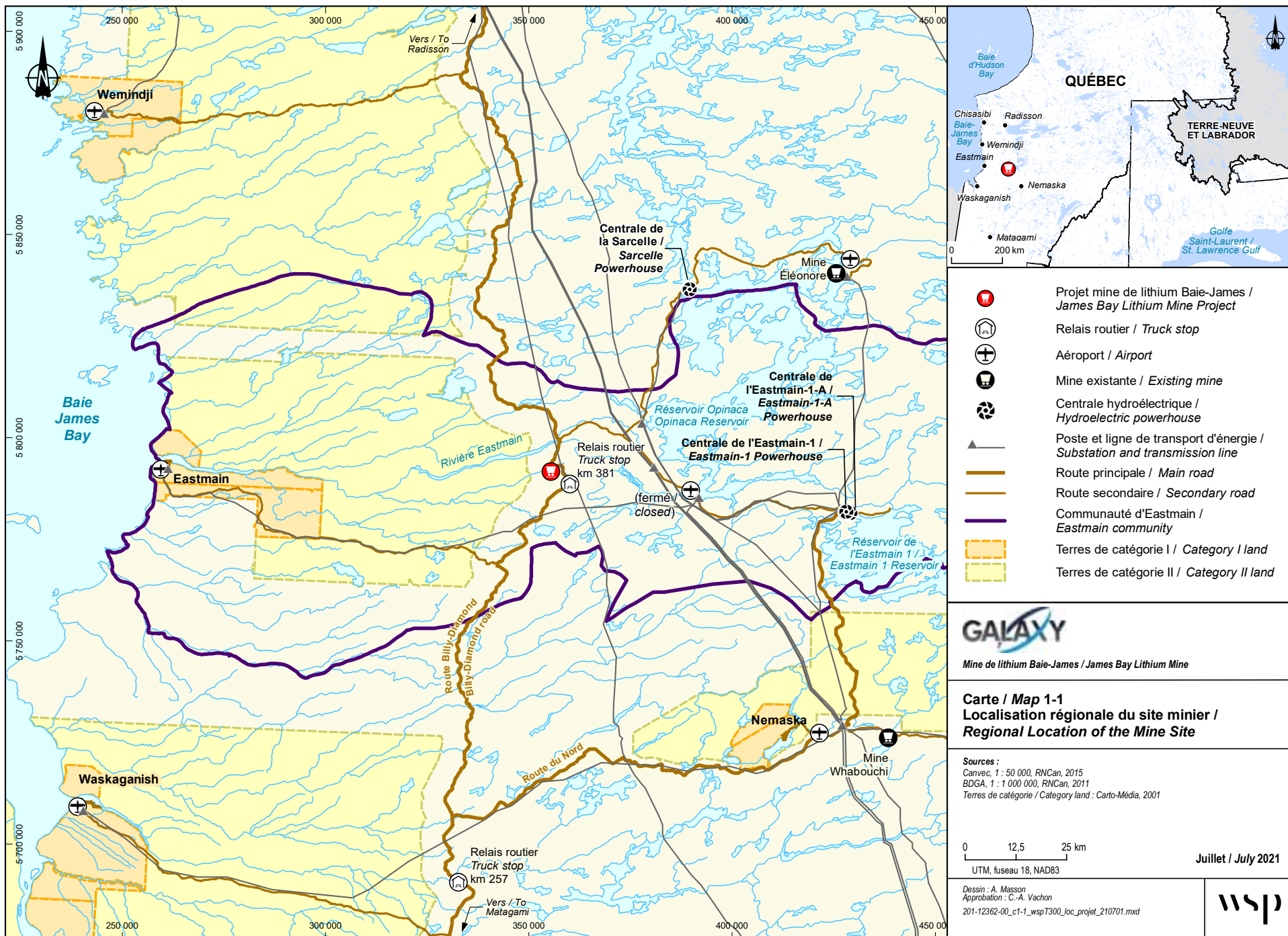
The project details are presented in Chapter 4.

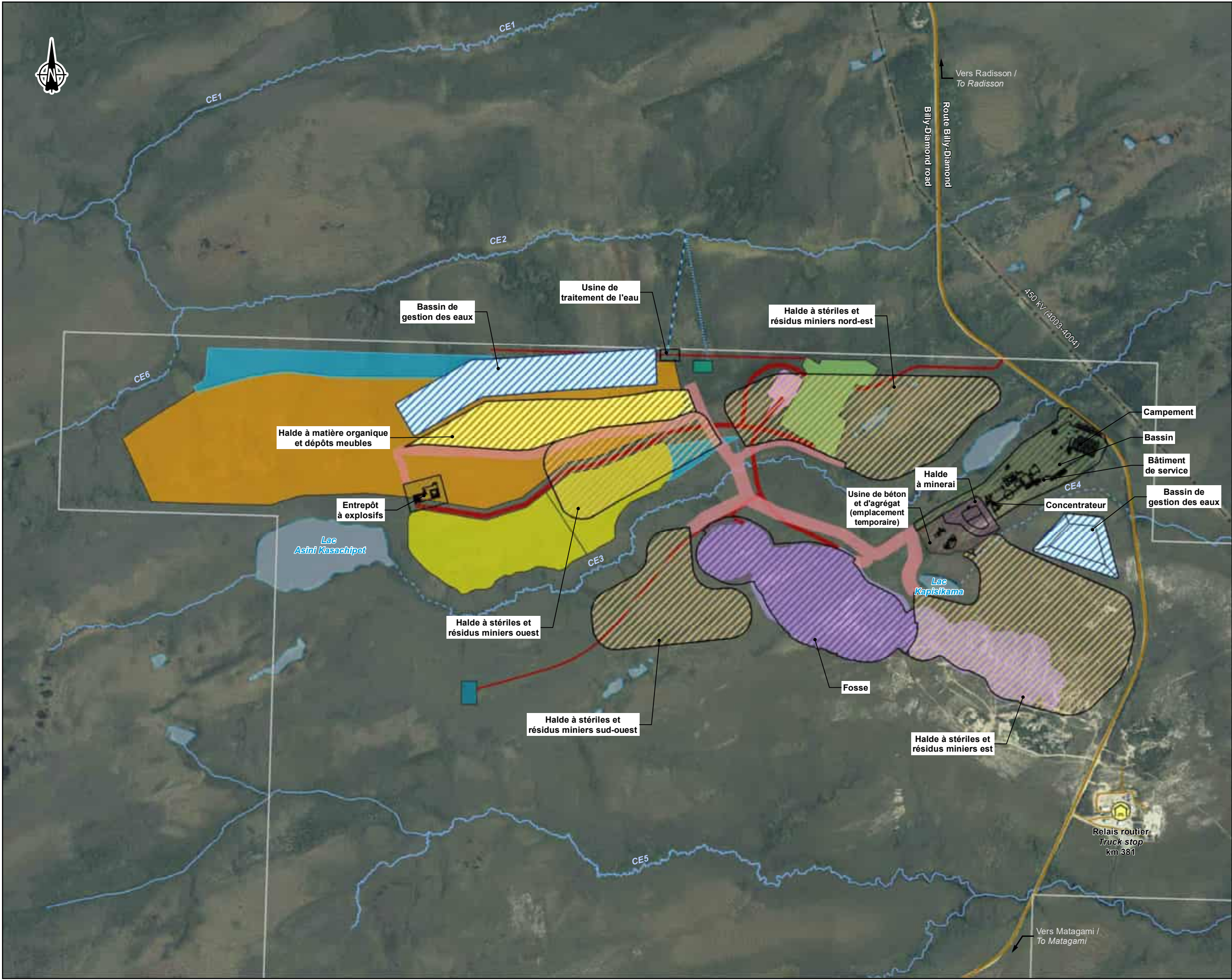
1.6.1 MAIN INFRASTRUCTURE

The following surface infrastructure is planned for the James Bay Lithium Mine project. These are conventional facilities for an open pit mining operation. They include the following:

- a pit;
- a 2,000,000 t/yr spodumene concentrator;
- areas to store and stockpile overburden, topsoil, tailing/waste rock, ore and concentrate;
- raw and process water retention ponds;
- administrative and operations buildings;
- a workers' camp;
- **a location for a water treatment plant (WTP), if needed;**
- facilities for maintenance and repair of mechanical equipment, including spare part warehousing, laboratories and emergency services facilities;
- explosives warehouse.

The list of the main infrastructure considered in this EIA is similar to the list for the 2018 EIA. Map 1-2 shows the comparison.





Limite de propriété / Property limit

Composantes du projet / Project Component

2018 2021

Route / Road

Effluent minier / Mine effluent

Usine de traitement de l'eau / Water treatment plant

Secteur administratif et industriel / Administrative and industrial sector

Fosse / Pit

Halde à minéral / ROM pad

Halde à stériles / Waste rock stockpile

Halde à matière organique / Organic matter stockpile

Entrepôt à explosifs / Explosives magazine

Bassin de rétention d'eau / Water retention basin

Câble de fibre optique / Optical fiber cable

Infrastructures / Infrastructure

Route principale / Main road

Route d'accès / Access road

Ligne de transport d'énergie / Transmission line

Relais routier / Truck stop

Hydrographie / Hydrography

CE3

Numéro de cours d'eau / Stream number

Cours d'eau permanent / Permanent stream

Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream

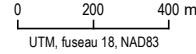
Plan d'eau / Waterbody



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 1-2
Comparaison générale de l'aménagement
du site 2018 vs. 2021 / General Mine Site
Arrangement Comparison 2018 vs. 2021

Sources :
Orthoimage : Microsoft Bing (ESRI, 2017)
Gestim : MRNF Québec, 210315
Données du projet / Project data : Galaxy 2021



Dessin : A. Masson
Approbation : C. Martineau
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Juillet / July 2021



1.6.2 MINING

The James Bay Lithium Mine project consists of setting up a mining operation. The material will be mined from a pit using conventional surface mining methods. Drill rigs and blasting will be used to extract ore and waste rock. Tracked power shovels will be used to load **100 t trucks** that will **carry ore to the concentrator. In 2018, the project was planning for 61.5 t trucks.**

No changes were made to the quantity of ore to be mined or to the quantity of waste rock generated.

1.6.3 PROCESSING

The onsite **ore processing** will consist of a spodumene **concentration process**. The concentrator will allow the spodumene to be separated to obtain approximately 6.0% lithium oxide (Li₂O) concentrate. The selected process involves crushing of the **ore** followed by a dense media separation (DMS).

The project optimization did not include any ore processing changes. The process will remain the same as what was planned in the 2018 EIA.

1.6.4 STORAGE AREAS

Areas to stockpile and store ore, waste rock, dry tailings, spodumene concentrate, overburden and topsoil will be built on the site of the James Bay Lithium Mine project. **Four waste rock and tailings storage facilities (WRTSFs)** will be built to store the waste rock and tailings, **while a single stockpile was planned in 2018.** All storage areas will be set up in such a way as to limit environmental impacts. Surface drainage channels will be built to divert **runoff from areas for stockpiling ore, waste rock / tailings, spodumene concentrate, overburden and topsoil.** The same strategy will be used to control surface water around the infrastructure, namely, the concentrator, buildings and roads.

The stockpiling and storage areas were moved from their 2018 project locations. Their locations were chosen in order to minimize the project's footprint on the environment while reducing waste rock transportation distances.

1.6.5 WATER MANAGEMENT

Process water will be used in the plant. It will be recovered and recycled via the dewatering screens, tails thickener and tails filtration. Recirculation of the water will be facilitated by the fact that no chemical reagents are present in the tailings following processing. Raw water will, however, be used to top up the process water system as required. Raw water shall be directed to the concentrator from the main retention pond.

Surface water runoff will be directed to the raw water storage pond. Appropriate wastewater management will be applied on this project. Before being released into the receiving environment, if required, the effluent will be treated to meet the applicable effluent discharge standards, including those specified in *Directive 019 for the mining industry* (D019) of the MDDELCC (MDDEP, 2012) and the federal *Metal and Diamond Mining Effluent Regulations* (MDMER).

The approach selected for managing process water and runoff remains the same as the one planned in the 2018 EIA.

1.6.6 WASTE MANAGEMENT

The collection and sorting of reusable, recyclable and waste materials (whether harmless or hazardous) will be carried out on site. They will then be managed by specialized contractors and transported off-site to a certified disposal site or to appropriate services.

The selected approach for managing waste materials remains the same as the one planned in the 2018 EIA.

1.6.7 OTHER INFRASTRUCTURE

In addition to site-specific developments, a series of additional equipment and infrastructure projects are also planned to ensure proper management of the site, namely:

- an administrative and operations building;
- an autonomous workers' camp;
- a tank farm for the fuelling of the mining equipment, for heating purposes and for backup generators.

Furthermore, GLCI is planning to connect the mining site to Hydro-Québec's power distribution system by a 69-kV power line. This could require up to 11 km of additional power lines, **depending on** the route set by Hydro-Québec. The site will also be connected to the optic fiber or cellular data network.

The additional infrastructure and equipment needed for the project remain similar to what was planned in the 2018 EIA. The design was simply reviewed to reduce the size of the buildings and the free space between buildings.

1.6.8 SITE REHABILITATION

Following the end of mining operations, rehabilitation measures will be taken to bring the receiving environment back as close as possible to its original state. These measures will involve management of the mining complex, waste rock, tailings and water from the treatment ponds, as well as demolition of the infrastructure and of the administrative and ore processing facilities. A progressive rehabilitation approach will be deployed. A mine rehabilitation plan will be filed with the Ministère de l'Énergie et des Ressources naturelles (MERN) before the start of the mine operations, as provided for under Québec's *Mining Act* (RSQ, c. M-13.1).

The recommended site rehabilitation approach remains unchanged from the one presented in the 2018 EIA.

1.6.9 PROJECT SCHEDULE

In the 2018 EIA, construction work was planned to start in 2020 and the commissioning was planned for 2022. The lifespan of the mine was initially 15 to 20 years.

GLCI **now** plans to start construction work at the mine in **2022** for a commissioning in **2023**. According to the latest forecast, the mine will be in operation for **18,5 years**.

1.7 GLCI'S CORPORATE SUSTAINABLE DEVELOPMENT POLICY

GLCI is firmly committed to limiting environmental impacts resulting from the development of mineral resources, while building a successful business that fully assumes its responsibilities within the communities where it operates.

This commitment is put into practice daily by integrating the social, economic and environmental dimensions to the company's decision-making process and through the ongoing respect of the interests of its many stakeholders. GLCI's commitment toward sustainability is reflected in its environmental and social policies, which are set forth in this section.

1.7.1 ENVIRONMENTAL POLICY

In its environmental policy, GLCI plans to conduct its activities in a manner that respects the environment and all applicable regulations and to implement a management system that will ensure the application of the highest environmental standards possible to its products, services and processes. More specifically, GLCI undertakes to:

- include environmental considerations in all its planning decisions and in its overall business strategy;
- evaluate the potential impact on the environment of all services and processes, from the project design to delivery and disposal;
- develop products and services and operate the facilities in a manner that prevents pollution, improves efficiency, reduces energy consumption, uses renewable resources and minimizes waste by recycling wherever possible;
- promote a culture in which all employees, contractors, suppliers, customers and community members share its commitment;
- respect cultural heritage and the local communities in which it operates;
- aim to continuously improve its environmental management system and performance by taking into account technical developments, scientific understanding, consumer needs and community expectations;
- prevent environmental incidents and have effective emergency plans;
- provide adequate training at all levels, make resource people available and ensure that the policy is well understood and applied;
- comply with applicable legislative and sectoral requirements.

1.7.2 HEALTH AND SAFETY POLICY

In its health and safety policy, GLCI wants to take all possible and feasible measures to ensure the health and safety of its employees and other members of its personnel directly or indirectly involved in the project by eliminating all occupational injuries and diseases. GLCI guarantees that no business objectives will compromise safety. More specifically, GLCI undertakes to:

- make the health and safety of all employees, contractors and the public its top priority;
- promote a culture that obliges and authorizes all employees and contractors to stop work when they deem it to be hazardous;
- provide a work environment that allows each individual to be “able to work”, meaning in a physical, mental and emotional state that allows them to work efficiently, free of risks to their well-being or that of others;
- plan to consult with employees on safety initiatives and measures to prevent accidents;
- offer continuous integration training and instructions to ensure that all employees and contractors understand their responsibilities and GLCI’s expectations with regard to safety;
- provide and update safe work methods for which hazards and risks have been identified and reduced to the lowest level possible;
- ensure that safe work practices are developed, implemented and continuously reviewed;
- ensure that all mobile equipment and fixed facilities are safely operated and maintained;
- ensure that all new substances, activities and processes are assessed for potential risks to health and safety;
- investigate all accidents, incidents or hazards and take corrective measures;
- comply with all applicable legislative requirements and industry standards.

1.7.3 POLICY ON HARASSMENT AND EQUAL ACCESS TO EMPLOYMENT

The principles of equal access to employment are crucial for GLCI. These principles apply to all employees regardless of gender, sexual orientation, family situation, pregnancy, family responsibilities, race, disability, political or religious convictions and age.

Furthermore, GLCI wishes to create a work environment free of harassment and intimidation and to treat all people with dignity and respect. GLCI will not tolerate any discriminatory behaviour whatsoever by anyone on its property.

2 PROJECT CONTEXT AND RATIONALE

2.1 HISTORY OF MINING DEVELOPMENT

Spodumene-bearing pegmatite was discovered on the project mining property in 1964 by Jean Cyr, a prospector, who then staked its boundaries in 1966. The project property was acquired by the SDBJ in 1974, which, after doing additional exploratory work, returned the property to Mr. Cyr on June 10, 1986. Little work was done over the 20 years that followed, except for a few geological compilations and some project conceptual analysis.

In April 2008, Lithium One Inc. signed a letter of intent with the SDBJ to explore a group of claims covering the territory known as the “CYR Lithium-bearing Pegmatite Deposit”. The Lithium One drilling campaigns done in 2008 and 2009 confirmed the presence of large pegmatite dykes, numerous swarms several hundred metres wide, one-kilometre long and up to 150 m deep. The finding of this drilling campaign was that a significant pegmatite resource could be found on this portion of the property.

In 2010, Galaxy Resources signed a memorandum of understanding with Lithium One Inc. (TSX-V LI) to acquire up to 70% of the James Bay Lithium project and to form a joint venture for its development. In accordance with this memorandum of understanding, the joint venture made up of Galaxy (the subsidiary of Galaxy Resources) and Lithium One Inc. was created in 2011, in respect of the joint venture mentioned earlier, and then Galaxy immediately acquired 20% of an undivided interest in the James Bay Lithium Mine project.

In April 2012, Galaxy Resources announced that it intended to take over Lithium One Inc. by way of an arranged transaction to acquire all issued and outstanding common shares of Lithium One Inc., the end result being that once the transaction was completed in July 2012, the rights and interests of Lithium One Inc. to the James Bay Lithium Mine project as well as its Sal de Vida lithium potash brine project in Argentina came under the sole control of Galaxy Resources, as wholly owned subsidiaries. Lithium One thus became a wholly owned subsidiary of Galaxy Resources, which resulted in being delisted from the TSX.

In 2011, GLCI issued a project description for the James Bay Lithium Mine project, but this was suspended in 2012 because the price of lithium had fallen, compromising the viability of the project. A few years later, the significant increase in the demand for lithium and promising forecasts made it possible for GLCI to relaunch its project. A new project description was submitted to provincial and federal authorities in October 2017.

The main activities conducted since the fall of 2017 include:

- further geological drilling leading to new calculations of the resources present in the deposit;
- sterilization drilling confirming the location of the various infrastructures planned;
- geotechnical drilling to evaluate the bearing capacity of the soil beneath the infrastructures;
- progress on the engineering portion of the project (Project Definition Document);
- determination of basic design criteria for the project, more specifically, the positioning of all infrastructures to the west of the James Bay road to avoid any interference with the highway and the Hydro-Québec power line;
- the production of sectoral studies requiring several field surveys to document the physical, biological and human components of the environment into which the project will be inserted;
- the opening of temporary roads and construction of observation wells in conjunction with the above activities;
- discussion regarding partnerships with local and regional organizations, the SDBJ in particular for the lodging of workers during pre-construction phase as well as the rental of work space and space for the core racks;
- negotiations to reach an agreement with Hydro-Québec for the addition of a power line to serve the future facilities;

- developed strong working relationships with local communities, stakeholders and determined local and regional sources of goods and services.

The knowledge drawn from these activities has helped to better define the project and to consider certain issues regarding the project's receiving environment, including:

- the traditional activities practised by the Cree within the study area of the human environment;
- the geotechnical stability of the future waste rock stockpile in relation to the nature of superficial deposits (clay).

On the basis of these activities, an Environmental Impact Assessment (EIA) was submitted to the Canadian Environmental Assessment Agency (CEAAg) and the Quebec *Ministère du Développement durable, de l'Environnement et de la Lutte contre les Changements climatiques* (MDDELCC) in October 2018 (WSP, 2018a).

After the EIA was filed in 2018, federal and provincial authorities requested additional information. While responses were being prepared for these various requests, project optimization work was also done in consideration of technical and environmental constraints and issues raised during discussions with stakeholders since 2018. Additional studies were also done to respond to requests from various government bodies or to better understand the receiving environment and thereby better define the project and its impact on the environment. This new input to the impact assessment consisted of:

- additional discussions and consultations with stakeholders;
- an economic assessment of local Cree communities (WSP, 2019a);
- additional sampling work;
 - Cr(VI) soil content (WSP, 2021a);
 - sediment quality (addition of stations and parameters analyzed) (WSP, 2021b);
- an additional vegetation survey and confirmation of the presence of wetlands (WSP, 2021c);
- a determination of mercury levels in fish (WSP, 2019b);
- geotechnical drilling and hydrogeological characterization (fall 2020 and winter 2021) (SNC-Lavalin, 2020; 2021);
- infrastructure design optimization including rehabilitation of the areas affected, reduction of the size of buildings and other industrial site infrastructure and shortening of distances for transporting ore and waste rock.

2.2 MINING RIGHTS AND LAND TITLE

The site of the James Bay Lithium Mine project is located on Québec public lands (public land belonging to Her Majesty in right of the province of Québec). Wholly owned subsidiaries of Galaxy Resources, including the project promoter, GLCI, are the holders of the mining claims currently comprising the mining property of the project.

The land covered by all 54 claims forming the mining property of the project is 2,163.75 ha in area (Map 2-1). These 54 claims will expire between June 12, **2022**, and **June 20, 2023**. Although they can be renewed for an additional two years, an application for a mining lease under section 100 of the Mining Act (R.S.Q. c. M-13.1) will be filed for the operation of a pit mine and concentrator with an annual production capacity of 2,000,000 t of material. This application will be submitted to MERN in **2022**.

2.3 PROJECT RATIONALE

Galaxy Resources Limited is a spodumene producer in Australia in addition to developing a lithium (saline solution) project in Argentina. Thus, the company has very good experience in the construction and operation of this type of mine as well as a good understanding of the global lithium market. Lithium (**Li**; **atomic number 3**) is the lightest metal in the periodic table. It is a soft silvery-white metal that belongs to the alkali metals group. Lithium is highly reactive and flammable. It is never found in a free neutral state in nature, but often as a compound in minerals, the most common being spodumene, or as an ion in ocean water, as well as in brines and clays. Its lightness and high reactivity make it particularly suitable for use in the manufacture of batteries as well as in various other industrial processes.

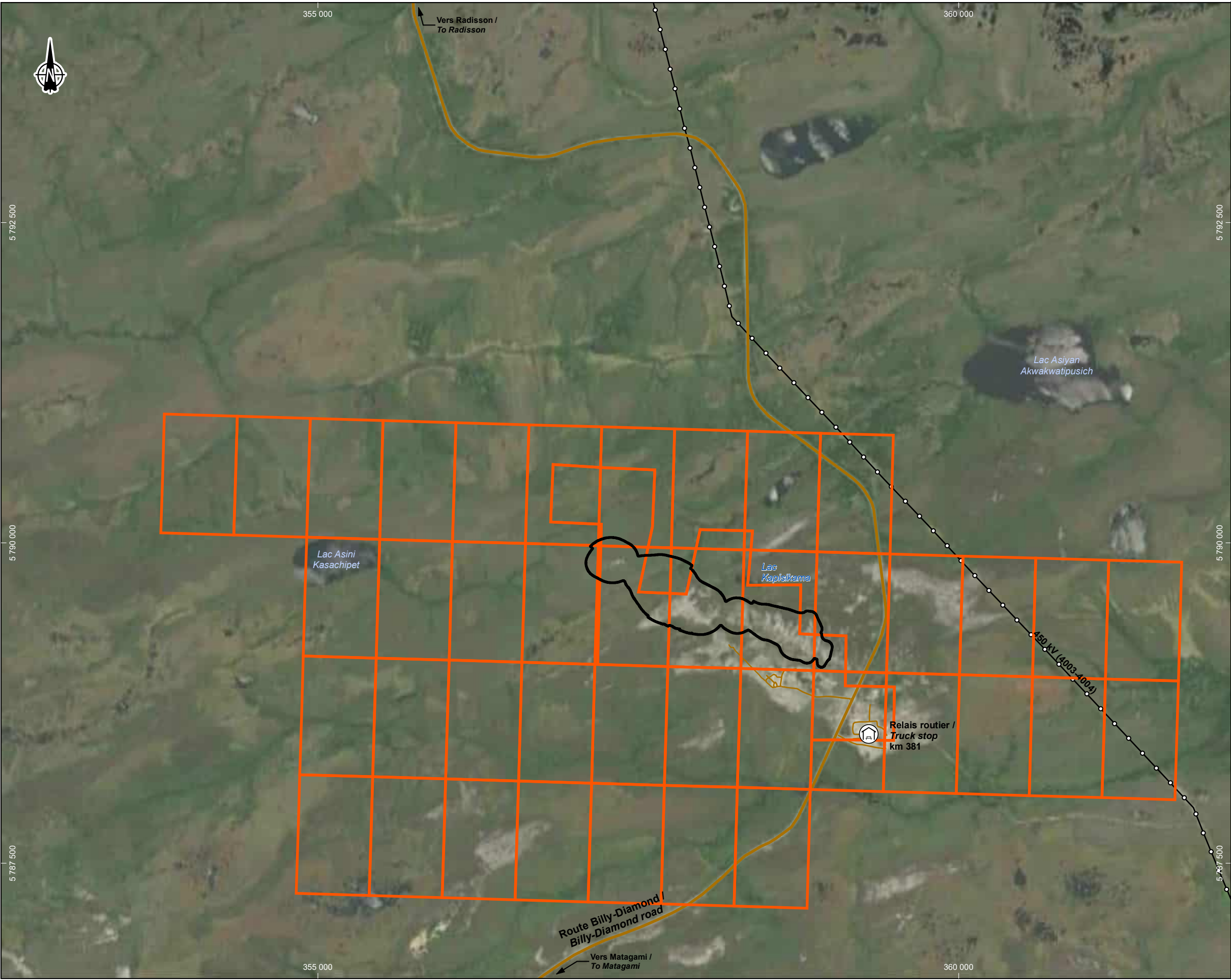
The applications for lithium are highly diverse and include the manufacture of glass and ceramics, lubricants, pharmaceutical polymers and products, air treatment and, recently and very significantly, in the manufacture of lithium-ion batteries. In the past, the bulk of the lithium market was monopolized by glass and ceramics manufacturing. Today, the manufacture of lithium-ion batteries is the largest market for lithium. Hybrid and electric vehicles, portable electronic devices and renewable energy storage systems for homes and businesses are all applications that have grown significantly in recent years.

The available information on the subject all reaches similar conclusions. The production of electric vehicles and mobile devices continues to grow at a rapid rate, and according to many independent organizations this growth is expected to continue. The International Energy Agency, for example, in its annual review¹, forecast fivefold growth in electric vehicle production compared to the fourth quarter of 2019.

The only project currently authorized in the James Bay territory experienced financial difficulties when it faced major technical and financial problems during the execution of the project, despite the quality of the deposit (nearly 40 Mt of measured and indicated resources at 1.4 % LiO₂). Another project, with a smaller deposit, is under consideration in the area. The company's website mentions 26.8 Mt of resources, indicated at 0.85 % LiO₂. This is a low-grade deposit. The GLCI project deposit offers a high-grade material with very good potential, i.e. around 40 Mt of indicated resources at 1.4 % LiO₂. GLCI has experience in the lithium mining industry and plans to use a simple process similar to that of their existing Mt. Cattlin mine in Australia to reduce technological risks; GLCI is therefore confident that its project can be realised with positive economic returns.

Given GLCI's expertise, the growing demand for lithium in the renewable energy sector and the quality of the deposit at the James Bay Lithium Mine project, the implementation of the project as described in this document is justified. The lithium market supporting the project as well as the various advantages related to the James Bay Lithium Mine location are presented in the following sections.

1 <https://www.iea.org/reports/global-ev-outlook-2019>.



 Contour de la fosse / *Open pit*

Propriété des claims / *Claim Owner*

 Galaxy

Infrastructures / *Infrastructure*

 Relais routier / *Truck stop*

 Route principale / *Main road*

 Route d'accès / *Access road*

 Ligne de transport d'énergie / *Transmission line*



Mine de lithium Baie-James /James Bay Lithium Mine

Carte / *Map 2-1*
Claims miniers / *Mining Claims*

Sources :
Orthoimage : Microsoft Bing (ESRI, 2017)
Géolim : MRNF Québec, 210315
Données du projet / Project data : Galaxy 2020

0 350 700 m
UTM, fuseau 18, NAD83

Juillet / *July* 2021

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Approbation : C. Martineau
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2.3.1 LITHIUM MARKET

Global interest in adopting vehicles powered by new energies (electric and hybrid) and the implementation of mass energy storage systems composed of lithium batteries has dramatically increased in recent years. While from 2011 to 2015 there were no major changes in lithium demand and sales of electric vehicles remained insignificant, demand surged toward the end of 2015 in response to commitments from an increasing number of auto manufacturers and the adoption of new government policies (Swiss Resource Capital AG, 2018). In 2016, it was estimated that approximately 190 kt of lithium carbonate equivalent was produced globally and that around 44 % of it was used in the manufacture of batteries. Of the 302 kt of LCE consumed globally in 2020, 173 kt LCE went to the battery sector and 129 kt to other industrial uses. Battery demand for lithium is dominated by the electric vehicle (EV) sector, accounting for almost two-thirds of demand in the same year.

EV adoption levels are forecast to pick up sharply in the second half of the 2020s. As scheduled investment in vehicle electrification is further realized and the market builds scale, the cost of EVs at a cell, battery pack and vehicle platform level are expected to reduce significantly. As a result, the price for EVs is forecast to approach parity with internal combustion engine (ICE) vehicles by the mid-2030s. Non-battery demand for lithium will, for the most part, be for the end use of various lithium chemicals, predominantly lithium hydroxide and carbonate. However, some of the lithium consumed by the glass and ceramics sector will be in the form of a mineral concentrate (spodumene or lepidolite). Material specifications tend to differ between applications. For example, spodumene concentrate used to manufacture ceramics is unlikely to be optimal for processing into battery-grade lithium hydroxide. Based on recent growth projections for all uses, it is estimated that lithium demand will increase to almost 1 Mt LCE by 2025 (Table 2-1).

Table 2-1 Lithium Demand Forecast

000t LCE Demand	2020	2021	2022	2023	2024	2025	2030	2035	2040
Total Non-Battery	129	133	144	153	159	164	190	220	256
CAGR% from 2020							3.9	3.6	3.54
Total Battery	173	253	390	512	663	830	2,062	4027	6618
CAGR% from 2020							28.1	23.3	20.0

Source: Benchmark Mineral Intelligence, 2020 in G Mining Services, 2021

There will be an ongoing need for capacity investment for lithium. Specific to the li-ion battery sector, the overall demand for automotive batteries for EVs will experience sustained growth through to 2025, particularly in China. The demand for lithium globally is projected to grow to more than 2.25 Mt LCE by 2030, of which 2.06 Mt will be used to produce batteries, of which 80 % will be used for electric vehicles. In 2040, the global demand for lithium could reach nearly 6.60 Mt, of which about 6.25 Mt would be used for the manufacture of batteries. Even if the future adoption of EVs is slower than the base case assumption, lithium demand from EV batteries is still estimated to grow at a compound annual growth rate (CAGR) of >36 % between 2020–2025 and by roughly 20 % between 2025–2030.

At any one time, there are numerous brownfield and greenfield lithium capacity projects announced and undergoing development. Some of that number will either never come to fruition or else proceed at a faster or slower pace than projected. In the Preliminary Economic Assessment (PEA) prepared for GLCI, using a detailed analysis conducted by Benchmark Mineral Intelligence (BMI) of both producers and projects, a supply forecast was constructed on a per-company basis for the period 2020–2040. Projects are subjectively designated as either “Highly probable”, “Probable” or “Possible”, based on criteria that may affect the likelihood of project success. Secondary supply accounts for future recycling of Li-ion batteries for raw material extraction, however technologies have not yet reached a commercial stage. Figure 2-1 highlights the necessary as-of-yet unplanned production required to meet the demand forecast through to 2040.

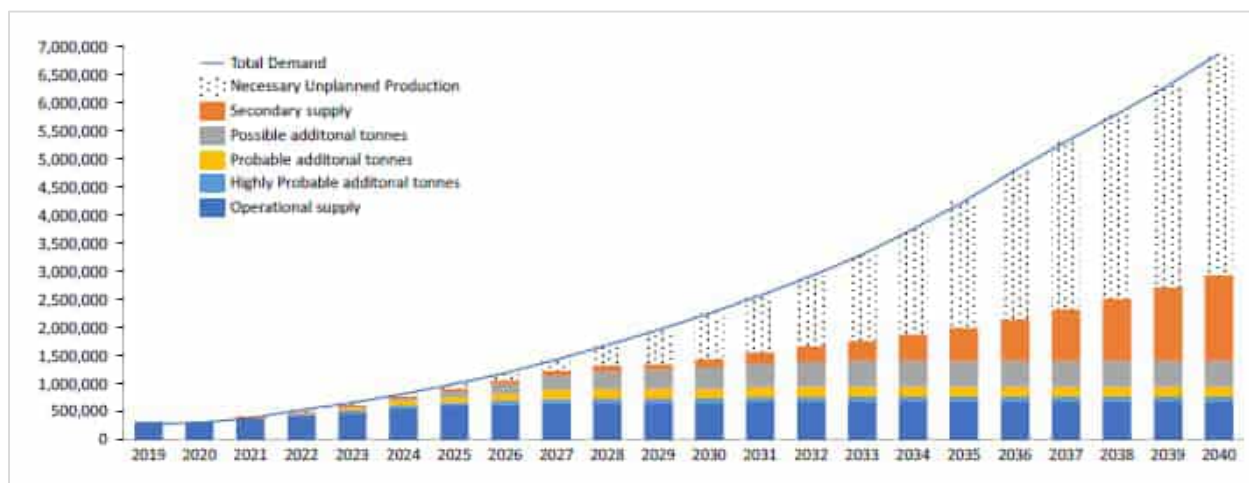
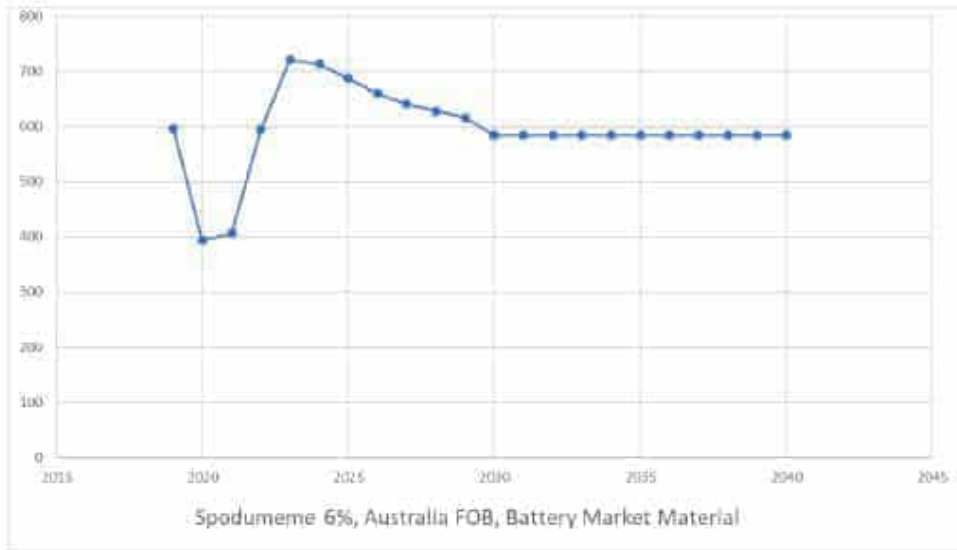


Figure 2-1 Lithium Supply vs Demand (t LCE)

Source: Benchmark Mineral Intelligence, 2020 in G Mining Services, 2021

Relatively high prices for lithium prior to 2018, coupled with increased understanding of lithium technology, and consumer demand in the EV space, have led to increased investment activity in new lithium supply. As a result, based on a pipeline of projects planned to come online and the backlog in existing spodumene inventories, the lithium market is likely to remain in surplus until 2022. In this context, investments in the lithium industry are currently being reduced in order to maintain market equilibrium. In contrast, market forecasts indicate a growing demand. Forecasts for 2023 expect that the lithium market will be in a deficit of around 60,000 t LCE if all “probable” global supply from expected projects comes into operation. This is why, combined with additional challenges at the supply level including the lack of ready-to-start projects, the delays associated with project development and the traditional challenges related to accelerated market entry, it is predicted that the market will fall back into a supply deficit as early as 2023, thus offering a surge in the increase in lithium prices.

For the reasons above, the global average price (US\$/tonne) of LCE peaked in 2018 and fell in 2019 and 2020. According to BMI, the average price of chemical-grade lithium concentrates in 2021 is estimated at USD 405/t (real) free on board in Australia. This price has been used as it is the most recognized reference point available at this time in the market. This price is expected to increase to an annual average of USD 640/t between 2024 and 2028, which aligns with GLCI’s projected first five years of future operation for James Bay Lithium Mine project. BMI predicts that the price will reach a maximum of USD 665/t in 2027, in line with rising chemical prices, before settling out at a long-term average of USD 565/t.



Source: Benchmark Mineral Intelligence, 2020 in G Mining Services, 2021 (2021 update).

The James Bay Lithium Mine project is expected to be commissioned in 2023, amid strong growth in lithium markets. In addition, sustaining costs (including operating costs, royalties, depreciation of capital expenditures, etc.) should be in the lower half of the price curve. Combined with market expectations for lithium prices, the above market conditions justify the economic rationale for the project.

2.3.2 PROJECT RECEIVING ENVIRONMENT

Ore Extraction and Concentrate Production

In regard to the environment into which the project will be inserted, the mine site is located in an area little disturbed by human activity, covered mainly by peatland, a typical vegetation of the James Bay region. One watercourse is present on the northern border of the site; a second is located in the south; and a small boggy lake is found in the centre. With the exception of a truck stop 500 m southeast of the pit, no permanent or temporary dwellings are located within a radius 8 km of the projected facilities. Furthermore, the study area is used by the Cree for their traditional activities, although usage dropped following forest fires in 2005, 2009 and 2013.

From a socioeconomic standpoint, the James Bay area offers a significant pool of labour potential for GLCI. Furthermore, the company **has already spoken** with the James Bay School Board **about its training programs for the mining industry**. Attractive employment prospects will be available to qualified people, not only at the James Bay Lithium Mine, but also in other future similar projects in the region.

The proposed project enjoys a very positive context, the following elements weighing in favour of its completion:

- the growing **global** demand for raw lithium;
- promising market forecasts for lithium chemical products for the battery manufacturing sector (including lithium carbonate and lithium hydroxide), supported by various government policies around the world as well as the new direction being taken by automobile manufacturers;
- the quality and size of the deposit, facilitating the extraction and concentration of material (low overburden and impurities), in addition to significant potential for expansion;
- the presence of hydroelectric facilities nearby, offering an accessible, reliable **and renewable** source of energy;

- the similarity of the James Bay deposit with that of Mt. Cattlin in Australia, making possible transfer of expertise for process development.

In addition, the project offers several advantages from an environmental and socioeconomic standpoint:

- a supply of power for the processing plant from a renewable source (hydroelectricity);
- a contribution to reducing global greenhouse gas (GHG) emissions through the processing of lithium, a raw material in the manufacture of lithium-ion batteries for electric vehicles;
- onsite primary **processing** to concentrate, a high-value-added product;
- the proximity of road transport infrastructure for the export of concentrate;
- the creation of well-paying jobs;
- significant economic impacts for Québec, especially the Nord-du-Québec administrative region.

Concentrate Processing

The project is an upstream mine. GLCI is not considering onsite processing of the spodumene to produce hydroxide or carbonate. The downstream conversation of the spodumene will occur at an (currently unknown), offsite location. The receiving environment where the ore will be mined is, moreover, inadequate for processing concentrate. In making the decision to conduct secondary lithium processing outside of the mining region, consideration was given to the full supply chain all the way through battery and vehicle manufacturers, energy and chemical product supply factors, availability of specialized labour and safety issues. Converting spodumene into lithium chemicals requires large amounts of energy, chemical products and specialized labour.

Major constraints apply to setting up a lithium processing plant in the Eeyou Istchee James Bay territory, which would significantly increase the costs to build and operate it, as well as the environmental risks.

For example, the process requires a regular and substantial power supply, part of which takes the form of natural gas (over 1M GJ/year). Natural gas transported by pipeline is not available in the Eeyou Istchee James Bay territory. Liquefied natural gas (LNG) is available, but at a cost two to three times higher, and requiring cryogenic storage tanks. The same applies to chemical product supply; large quantities would have to be transported and stored in the Eeyou Istchee James Bay territory. In addition to increasing operating expenses, this transportation activity would significantly increase road traffic, greenhouse gas (GHG) emissions and environmental and safety risks. Lastly, the process requires specialized labour that is not available in the Eeyou Istchee James Bay territory.

Given the aforementioned factors, the costs to set up and operate a chemical processing plant in the Eeyou Istchee James Bay territory would be increased on a number of counts, thereby significantly reducing profitability for a project that faces competition on a global level.

2.4 REGULATORY FRAMEWORK

The James Bay Lithium Mine project is in the James Bay agreement territory. The JBNQA was signed in 1975 by the governments of Canada and Québec, the Grand Council of the Crees (GCC) and the Northern Quebec Inuit Association. The JBNQA divides the territory into two zones at the 55th parallel: James Bay and Nunavik. Because of the project's position, legislative provisions associated with the James Bay territory apply. Section 22 of the JBNQA defines the environmental and social protection regime of the Cree people, their societies and communities and their economy in connection with development activities that affect the territory. Schedule 1 of section 22 sets out a list of projects that are automatically subject to environmental assessment.

The territorial regime introduced by the JBNQA is a determining factor governing use of the territory. It divides the territory into Category I, II and III lands. Category I lands are allocated to the Crees for their exclusive use. They may be used for residential, community, commercial, industrial or other purposes. In addition, the Cree have exclusive hunting, fishing and trapping rights there. Category II lands are contiguous with Category I lands. They are part of the Québec public domain. These are lands in which the Cree have exclusive hunting, fishing and trapping rights. Category III lands are all agreement territory lands that are not included in Categories I and II. On these lands, the Cree have the exclusive right to trap fur-bearing animals. Furthermore, certain wildlife species are reserved for their hunting and fishing activities. On these territories, both native and non-native people may engage in hunting and fishing activities. In Category III lands, mining rights belong to the provincial government. The James Bay Lithium Mine project is located on Category III lands.

Section 22 of the JBNQA also defines the process leading to the granting of permits through the agency of the following committees—the evaluation and review committees. The Evaluation Committee, made up of representatives of the Cree nation and federal and provincial authorities, examines the notice of application and prepares guidelines in consultation with the community. The Review Committee (COMEX), made up of representatives of the Cree nation and the provincial government, studies the EIA and recommends whether or not the project should be authorized.

2.4.1 ENVIRONMENTAL ASSESSMENT TRIGGERS

The provisions of the Environment Quality Act (EQA) subject the project to an environmental assessment in accordance with provincial directives. The project must, therefore, undergo environmental assessment under the EQA, which was amended in 2018. The project is also subject to an environmental impact assessment by the Impact Assessment Agency of Canada (IAAC, formerly CEAA), which was also revised in 2019.

Provincial directives and federal guidelines for completing the James Bay Lithium Mine project impact assessment were, however, received in 2018² before the respective regulatory reforms in 2018 and 2019. Consequently, this impact assessment was done based on the directives issued by regulatory authorities and did not take into account recent reforms.

2.4.1.1 ENVIRONMENT QUALITY ACT

Opening of the James Bay Lithium Mine is subject to the provincial environmental impact assessment and review procedure, as provided in section 153 of chapter II of the EQA. This chapter deals with the provisions applicable to the James Bay and Northern Québec region. Schedule A of the EQA lists projects that are automatically subject to the assessment and review procedure. The James Bay Lithium Mine project is subject to the procedure because Schedule A lists “all mining developments, including additions to, alterations or modifications of existing mining developments.”

The nature, scope and extent of the environmental impact assessment are defined in the Directive for the project developed by the MDDELCC².

2.4.1.2 JAMES BAY AND NORTHERN QUÉBEC AGREEMENT

Like the EQA, schedule 1 of section 22 of the JBNQA lists projects that are subject to the assessment process, such as mining projects.

2 Provincial directive: <https://www.ree.environnement.gouv.qc.ca/dossiers/3214-14-055/3214-14-055-3.pdf>
Federal guidelines: <https://aeic-iaac.gc.ca/050/documents/p80141/121718E.pdf>

2.4.1.3 CANADIAN ENVIRONMENTAL ASSESSMENT ACT

The project is also subject to a federal environmental assessment, as required under section 13 of the *Canadian Environmental Assessment Act* (CEAA) (2012) (S.C. 2012, c. 19, s. 52), because **ore** production will exceed 3,000 t/day (par. 16[a]) and the capacity of the concentration plant will exceed 4,000 t/day (par. 16[b]) of the *Regulations Designating Physical Activities* (SOR/2012-147). **For the purposes of applying this Act to environmental assessment, the environmental effects that are to be taken into account in relation to an act or thing, a physical activity, a designated project or a project are listed in section 5(1) of the CEAA (2012).**

The nature, scope and extent of the environmental assessment are defined in the guidelines developed by the Canadian Environmental Assessment Agency³.

2.4.2 APPLICABLE LAWS AND REGULATIONS

At the conclusion of the EIA **analysis**, the final design of the project must comply with provincial and federal regulations applicable to **construction and mining operations, as well as to planned equipment and infrastructure. This legislation requires various permits and authorizations to be obtained. Applications for authorizations and permits, including detailed plans and specifications for infrastructure and facilities, will be submitted when appropriate, after obtaining general project authorization issued by decree.**

The **applicable** legislation governing the project includes a number of laws, regulations, policies and directives, **with the main ones being** specified below.

2.4.2.1 PROVINCIAL

- *Environment Quality Act* and associated regulations:

The EQA stipulates that authorization must be obtained for mining projects. Authorization applications **must comply with** regulations in effect and must be submitted under the terms of the EQA. **The main regulations to which the James Bay Lithium Mine project is subject under the EQA include:**

- ***Clean Air Regulation;***
- ***Regulation respecting the landfilling and incineration of residual materials;***
- ***Regulation respecting hazardous materials;***
- ***Regulation respecting waste water disposal systems for isolated dwellings;***
- ***Protection Policy for Lakeshores, Riverbanks, Littoral Zones and Floodplains;***
- ***Water Withdrawal and Protection Regulation;***
- ***Regulation respecting the quality of drinking water;***
- ***Land Protection and Rehabilitation Regulation;***
- ***Politique de protection des sols et de réhabilitation des terrains contaminés [Policy on the protection of soil and rehabilitation of contaminated land];***
- ***Regulation respecting pits and quarries;***
- ***Regulation respecting industrial depollution attestations.***

- Mining Act.

3 Provincial directive: <https://www.ree.environnement.gouv.qc.ca/dossiers/3214-14-055/3214-14-055-3.pdf>
Federal guidelines: <https://aeic-iaac.gc.ca/050/documents/p80141/121718E.pdf>

- Directive 019 on the mining industry.
- Act respecting occupational health and safety.
- **Other applicable provincial laws and regulations:**
 - ***Transportation of Dangerous Substances Regulation of the Highway Safety Code;***
 - ***Sustainable Forest Development Act;***
 - ***Regulation respecting standards of forest management for forests in the domain of the State;***
 - ***Act respecting the lands in the domain of the State;***
 - ***Petroleum Products Act* and its implementing regulation;**
 - ***Act respecting threatened or vulnerable species;***
 - ***Act respecting the conservation and development of wildlife;***
 - ***Regulation respecting wildlife habitats;***
 - ***Construction Code and Safety Code for the installation of petroleum equipment, both governed by the Building Act;***
 - ***Act respecting explosives* and its implementing regulation.**

2.4.2.2 **FEDERAL**

Other laws should be considered when preparing the impact assessment and obtaining subsequent authorizations. The main ones are as follows:

- *Canadian Environmental Protection Act.*
- *Fisheries Act.*
- **Other applicable federal laws and regulations:**
 - *Navigation Protection Act;*
 - ***Species at Risk Act;***
 - ***Migratory Birds Convention Act;***
 - ***Transportation of Dangerous Goods Act, 1992 and Transportation of Dangerous Goods Regulations;***
 - ***Hazardous Products Act;***
 - ***Explosives Act.***

2.4.2.3 **EYYOU ISTCHEE JAMES BAY REGIONAL GOVERNMENT**

The Eeyou Istchee James Bay Regional Government is also involved in the authorization process. **After obtaining** general authorization (**governmental decree**), additional authorization applications will be filed primarily under the following law:

- *James Bay Region Development Act*

GLCI will file applications for authorization and permits for the construction and operation of the project with the Eeyou Istchee James Bay Regional Government, in particular a certificate of authorization and compliance with regional regulations.

3 PROJECT ALTERNATIVES

To meet the requirements of provincial and federal guidelines, GLCI analyzed alternatives for specific components of its project.

First, some general criteria were established from the outset, thereby influencing the location of infrastructure. It was then determined that all the project's components would be located west of the Billy-Diamond highway, to avoid any interference with these infrastructures, mainly for safety and traffic reasons. This choice also made it possible to minimize the travel distances on site and the scope of transport infrastructure to be built. In addition, since the site is primarily comprised of wetlands, the effort was focused on reducing the overall footprint of the project rather than on the positioning of each of its components. Lastly, safety distances **related to blasting** were also to be considered around the pit, namely, a 200-m radius of total exclusion (no construction) and a 500-m radius of partial exclusion (restricted construction zone).

Therefore, considering the nature and location of the deposit and in the light of the general criteria set out above, **the following aspects were excluded from the alternative study:**

- **Mining and material extraction method:** Exploitation of the resource partially or completely underground has not been assessed since the project targets spodumene pegmatite on the surface. In addition, for **technical and economic** reasons, open-pit mining is the method typically preferred for mining this material.
- **Concentrator location for processing:** In 2018, this component **was** positioned in the only **available** sector located near the pit. The few small areas without a wetland were favoured for geotechnical considerations. In fact, the bearing capacity of the soil at this location was confirmed as adequate for receiving production equipment, without major excavation of existing soil. **In the current project (2021), the concentrator was moved adjacent to Billy-Diamond highway in an area where geotechnical work confirmed the soil's good bearing capacity. This change made it possible to reduce the amount of peat and materials (silt) to be excavated before beginning construction, to eliminate the access road, to shorten the transport distances for ore to the plant as well as for waste rock to the stockpiles, thereby reducing GHG emissions associated with mine operation activities. These changes also made it possible to reduce the surface areas affected. Relocating the concentrator enabled stockpiles to be repositioned near the pit, reducing the transport distances for waste rock to the stockpiles.**
- **Workers' camp site:** In 2018 as in 2021, the **workers'** camp was positioned near the main infrastructure, including the concentrator and the pit, to minimize the transport of workers. In fact, the camp is within walking distance of buildings, which will help to reduce the fleet of vehicles **and thereby reduce the risks of mechanical breakdowns with environmental impacts (e.g., oil leak) as well as** the GHG emissions associated with them.
- **Road alignment:** The site selected in 2018 for the concentrator **was 750 m** from Billy-Diamond highway and outside the exclusion radius of the pit. **Therefore, a 750-m access road had to be built in the peatland, the other** needs being limited to site access and various roads connecting the infrastructures (pit, concentrator, waste rock and overburden stockpiles, water treatment plant, dike and explosives warehouse) for a total of just over 8 km of roads to build. **Unlike 2018, the construction of an access road is not necessary in the current project (2021), and needs are still limited to access to the site and to various infrastructures. The roads to be built are shorter compared to 2018, as distances between infrastructures have been reduced. Two-lane roads are still planned. The principles from 2018 will still be followed, namely: prioritizing the shortest route with a few curves to follow the topography, limit speed and improve driving safety; distancing roads from watercourses by at least 60 m, as stipulated in the Regulation respecting standards of forest management for forests in the domain of the State.**

- **Water supply:** Since the project site is located in an isolated environment, there are only two viable options for the site's water supply: developing a well (or wells) or transporting water to the site. For economic and environmental reasons, the decision was made to develop water supply wells. **According to the hydrogeological characteristics of the area, the aquifer identified as exploitable would be the bedrock aquifer. Based on the studies conducted, the rock permeability varies depending on its nature and degree of fracturing. A water search will help target areas suitable for potable water exploitation and development of open wells in bedrock. Their diameter is to be determined, but will most likely vary between 6 and 8 in, with a depth of 30 to 100 m. It will be possible to withdraw the water volume required for the workers' camp thanks to a submersible pump installed in the well. The number of wells to be developed will depend on the aquifer capacity at the boreholes. At the moment, two wells are proposed. They should be located near the administrative and industrial area.**

Furthermore, the components for an assessment of the technological alternatives or location has been carried out as follows:

- waste rock, tailings and overburden stockpiles (location);
- domestic wastewater treatment (technology);
- mine water management and final effluent discharge points (location).

The alternative analysis conducted as part of the 2018 ESIA for these components is presented in the following sections. The alternative analysis was not redone but the changes related to project optimization are described in detail for each project component included in the analysis.

Finally, an assessment of possible energy sources was conducted for the mine site (process and buildings) and the mobile equipment. **Changes related to the 2021 project are presented, when applicable. It should be noted that as alternative options become available, GLCI will continually evaluate them in an effort to maximize new and innovative mining practices on site, reduce emissions and continually strive toward sustainable mining.**

3.1 WASTE ROCK, TAILINGS AND OVERBURDEN STOCKPILES

The first step in this alternative analysis consists of preselecting the possible deposition methods. Afterwards, the techniques selected undergo a comparative analysis based on different locations.

3.1.1 DEPOSITION METHODS

ALTERNATIVE ANALYSIS (2018)

The alternative analysis conducted in 2018 considered the following deposition techniques at a high level:

- the deposit as a mixture (process tailings with waste rock);
- the use of the pit as a deposit place;
- the hydraulic deposit of tailings (in sludge form) as well as a separation of coarse and fine tailings;
- the production of **filtered** tailings that can be stacked;
- the production of thickened tailings.

The quantities considered for the assessment were 233.4 Mt of waste rock and 36.4 Mt of tailings¹. Since the data concerning the density for these materials were not available at the time of the study, assumptions were made, namely, 2.4 t/m³ for waste rock and 1.7 t/m³ for tailings, giving them volumes of 100 Mm³ and 20 Mm³ respectively. In addition, considering the acid generation potential identified in the preliminary results of the geochemical technical assessment, it was assumed that protection would be installed to prevent leakage to the environment whether it be a stockpile or a retention basin.

1 Based on data available on January 5, 2018. **The discrepancy between the quantities considered for the waste rock deposition method assessment and the geochemical study is due to the availability of data at the time the reports were written. The 233.4 Mt of waste rock refers to a storage capacity that was used in the design of the stockpile in January 2018. Finally, the May 2018 mine plan indicates a total of 133.3 Mt of waste rock (including 5.9 Mt of overburden) that would accumulate in the waste rock stockpile.**

The values used for the design of stockpiles were:

WASTE ROCKS

- In situ rock density= 2.77 t/m³
- Particle size= 0-700 mm
- Void ratio= 35 %
- Apparent density= 2.05 t/m³

TAILINGS

- In situ rock density= 2.77 t/m³
- Particle size= 0-15 mm
- Void ratio= 65 %
- Apparent density= 1.68 t/m³

The hydraulic deposit was rejected from the outset due to limited space on the site and to the absence of favourable topographic features. Moreover, this option would increase the environmental risks because of the sludge lagoons, in addition to increasing the footprint.

The thickened tailings option was not selected in the analysis because the reduction in water content does not provide any technical or economic benefit nor does it contribute to reducing the environmental risk associated with deposits of tailings. In fact, given the particle size distribution of tailings, their water content is low.

Finally, considering the lack of information available on the economic viability of extracting the resources that will be left in the deposit once the operation phase is completed, the deposit-in-the-pit option was not assessed.

Therefore, the remaining management options all involve a stack of dried tailings, either as a mixed deposit (co-disposal) or by arranging a separate deposit for the tailings (co-mingling) in the same stockpile. At this stage, the deposit techniques are considered equivalent for the purposes of the analysis, the co-disposal presenting minor differences with the co-mingling regarding the areas and volumes required.

PROJECT OPTIMIZATION (2021)

Further to the project optimization exercise, a decision was made to pile waste rock and filtered tailings in four co-deposition piles. The advantages of co-deposition include:

- improves physical stability of the stockpile slope in waste rock embankment zones;
- accelerated consolidation and better shear strength of tailings;
- reduced risk of embankment failure and loss of containment of tailings;
- less dust creation and erosion of tailings;
- improved opportunities for progressive closure.

Disposing of tailings and waste rock in depleted areas of the pit was also considered has been selected as part of the new design. Additionally, following kinetic testing of the waste rock and tailings by WSP between 2018 and 2020, which showed to be not potentially acid-generating, it was determined that no protection from leakage into the environment would be required. Details are presented in Chapter 4.

3.1.2 LOCATION OF WASTE ROCK AND TAILINGS STOCKPILES

ALTERNATIVE ANALYSIS (2018)

In total, four scenarios were selected for comparative analysis **completed in 2018**. For calculation purposes, a slope of 2.5H:1V was selected for the waste rock stockpile and mixed material stockpile, while a slope of 5H:1V is applied to the tailings stockpile. Note that no bed or access ramp was considered in the calculations at this stage.

The Pugh decision matrix was selected as a decision support tool. Multi-criteria analysis was conducted to determine the best option for locating stockpile from an environmental, technical, economic and socioeconomic point of view. Criteria were then developed for each of these categories, with the aim of differentiating the options between them. The criteria were measured using quantitative or qualitative indicators. A weight² has been assigned to each of them based on its relative importance within the same category. The categories themselves are also weighted, with the environment considered the most important. Option 1 is defined as the reference scenario with a score of zero for each of the indicators, except for those that were clearly favourable or unfavourable for this scenario from the start. The other three options receive scores of -2 (worse), 0 (neutral) or +2 (best) compared to option 1.

The four options are summarized below and the technical details for each of them are provided on Table 3-1. Their location is shown on Map 3-1.

Table 3-1 Details of assessed stockpile options

Parameter	Option 1	Option 2	Option 3	Option 4	
				North	South
Stockpile capacity (Mm ³)	120	77.5	120	20	100
Stockpile elevation (m)	300	330	280	255	290
Stockpile height (m)	94	128	68	53	84
Retention basin capacity (Mm ³)	1.05	0.43	1.65	0.24	1.05
Required WTP capacity (estimate) (m ³ /s)	0.3	0.3	0.06	0.45	

Option 1

The first option is tailings and waste rock deposit in the form of a mixture. The stockpile is located south of the pit, near the Billy-Diamond highway and the truck stop. Two peripheral ditches collect the water, and an auxiliary pumping station is needed to transport them to the retention basin.

Option 2

Option 2 is tailings and waste rock deposit as a mixture. The stockpile is located on the north side of the pit. The two bodies of water and the mining property line are constraints that reduce the capacity of the stockpile. A peripheral ditch collects water flowing by gravity toward the retention basin.

Option 3

Option 3 is also tailings and rock waste deposit as a mixture. The stockpile is located on the west side of the pit. The stockpile extends outside the property line and encompasses a body of water. For this reason, creek CE3 and the Asini Kasachipet Lake must be dry. No peripheral ditches are required, and the water is directed toward the gravity retention basin.

-
- 2 The weighting factors can vary depending on what is being analyzed (herein the location of stockpiles and the domestic wastewater treatment system). The reason for this is that the cost (economic value), technical feasibility and environmental consequences differ from one infrastructure to another. For example, the estimated budget can be more restrictive or the scope of impacts on the environment more significant for a given infrastructure compared to another.

A weighting grid was used to establish the weighting. The importance of the criteria, or categories of criteria, was determined based on the project description (including deadlines which depend on the technical feasibility and are associated with the environmental process) and characteristics of the receiving environment. The assessment of alternative analysis is an exercise that took place during the pre-project period, completed by a group of experienced professionals who have a good understanding of the components of the project and who have in-depth expertise of alternative analysis for mining projects in northern environments in Quebec and in impact assessment. The weighting attributed to each of the indicators within a given group were arbitrarily assigned by the project team. The weightings assigned to various criteria were selected and agreed upon by the technical experts involved in the alternative analysis and by GLCI representatives.

Option 4

The last option involves the development of two separate stockpiles for tailings and waste rock. The waste rock stockpile is located to the south of the pit, near the Billy-Diamond highway and the truck stop. The tailings stockpiles can be found on the north side of the pit. Each of the stockpiles requires two peripheral ditches. First, a pumping station steers the water from the ditches of the northern stockpile toward its retention basin, then a second pumping station transfers the water from the northern basin to the southern basin.

Table 3-2 presents the alternative assessment summary, Table 3-3a presents the decision matrix by count and **Table 3-3b presents the justification for the weight given to the indicators.** The highest score was assigned to Option 2 with 746 points. This option also offers the best performance from an environmental and socioeconomic point of view. Option 4 was the best in technical terms while Option 1 was the most economical.

Table 3-2 Summary score of the assessment of site alternatives for waste rock and tailings stockpiles

Score	Option 1	Option 2	Option 3	Option 4
Environment	0	110	-90	-60
Technical	0	-65	-40	25
Economic	0	-3	-82	-102
Socioeconomic	-65	190	160	65
Total before weighting	-65	232	-52	-72
Total weighted	-130	746	-326	-391
Note: The weighting factors are: environment = 4, technical = 1, economic = 3, socioeconomic = 2. – A factor of 4 was given to the environment score due to the potential impacts related to the location of stockpiles. The environment score is the most important of the scores considered. – A factor of 1 was given to the technical score, as there is little difference between the location options. The technical score is the least important of the scores considered. – A factor of 3 was given to the economic score, given the financial impact that each location option may have. – A factor of 2 was given to the socioeconomic score as there are only slight variations between options.				

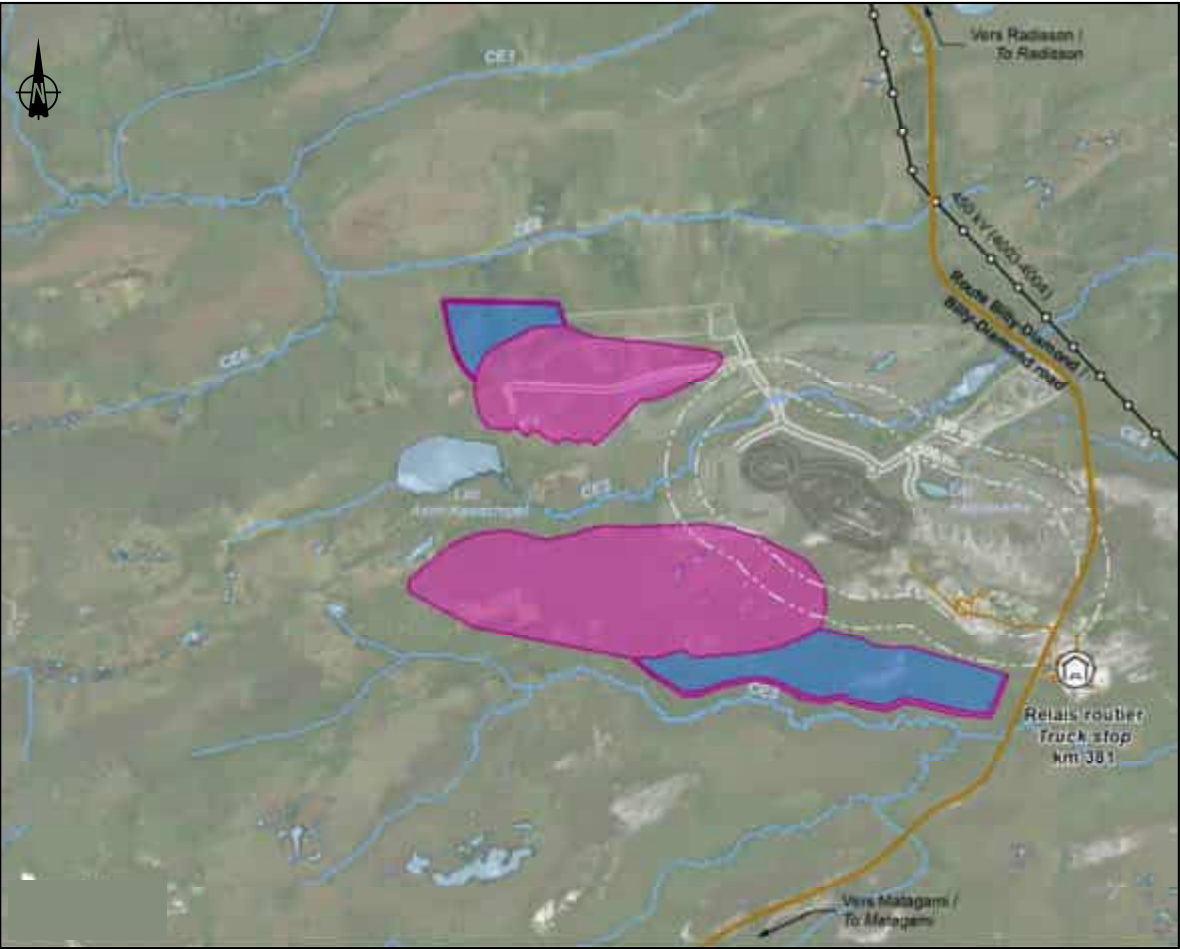
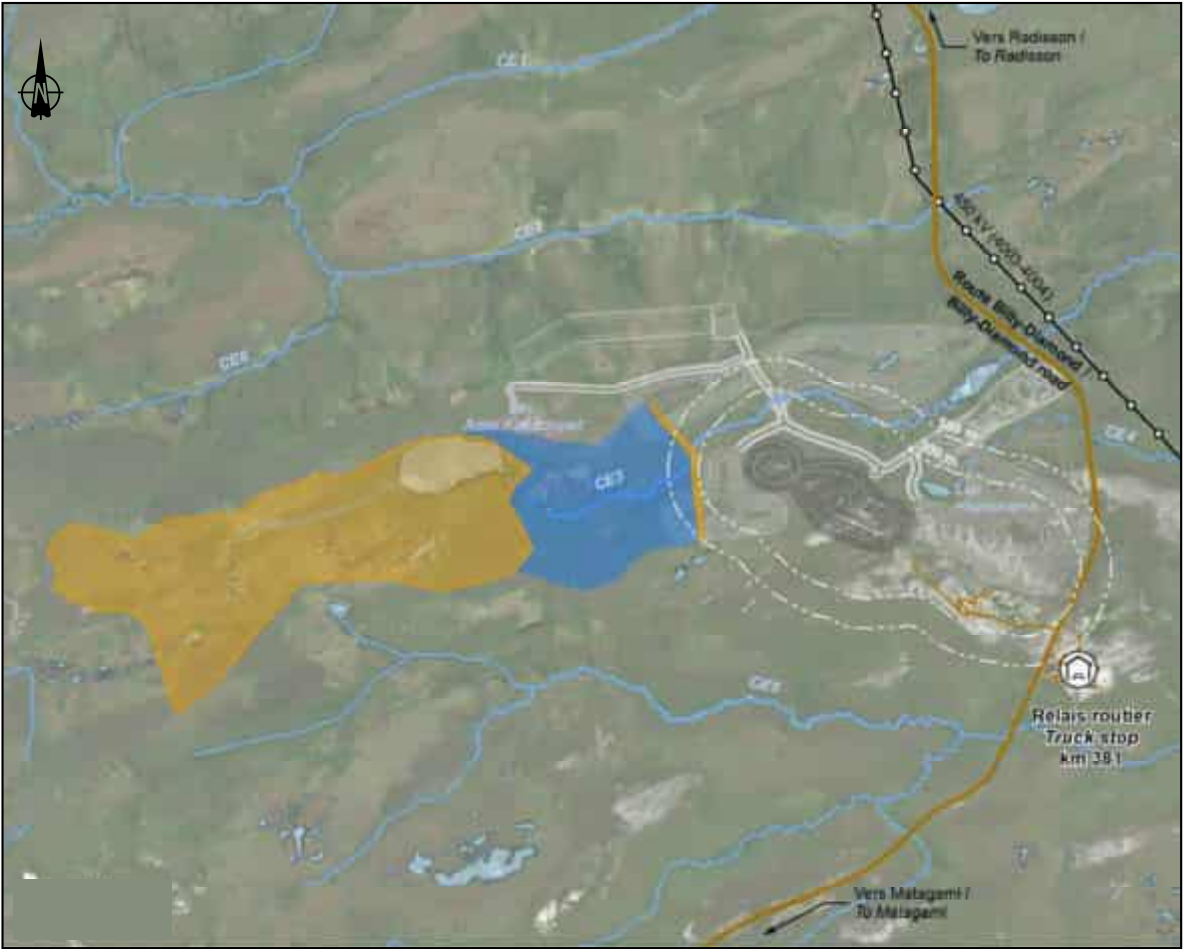
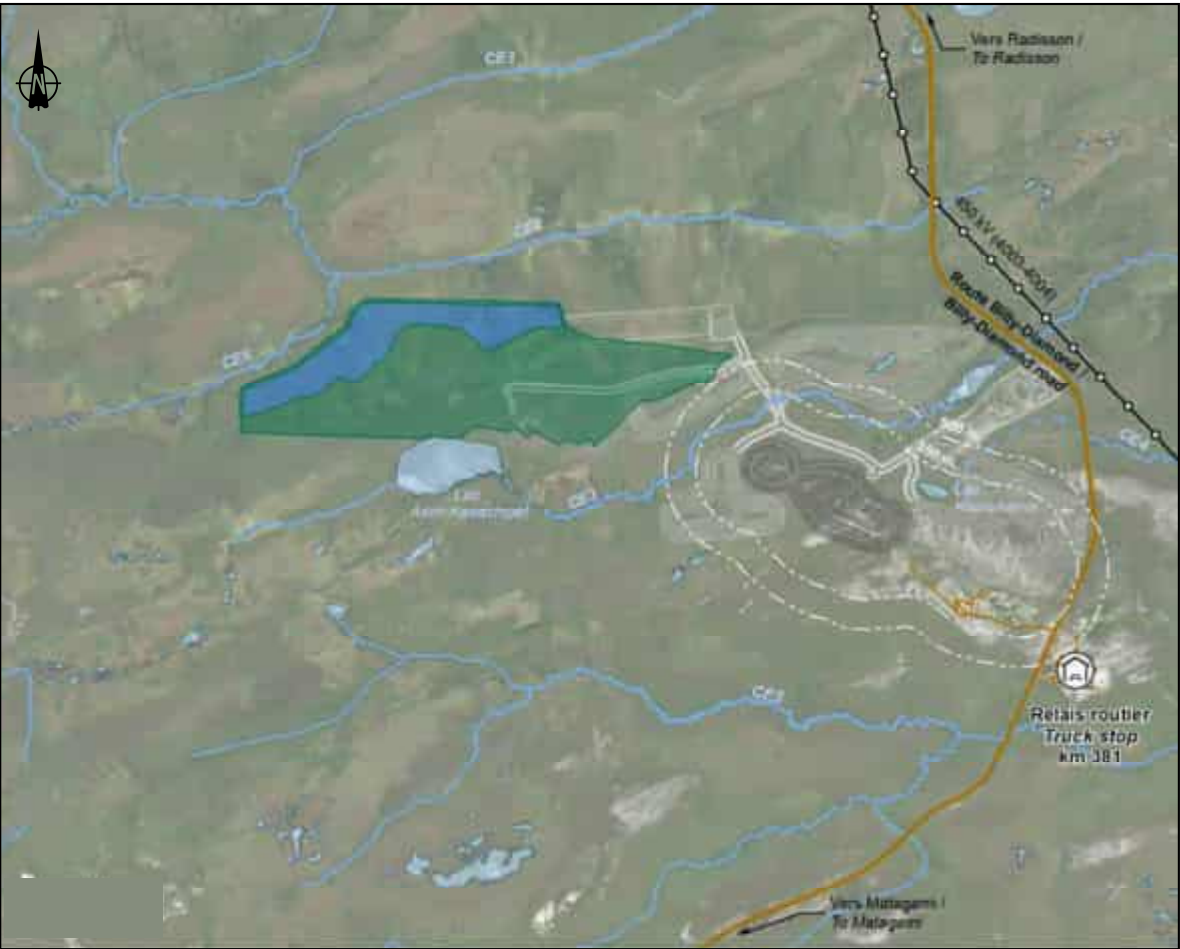
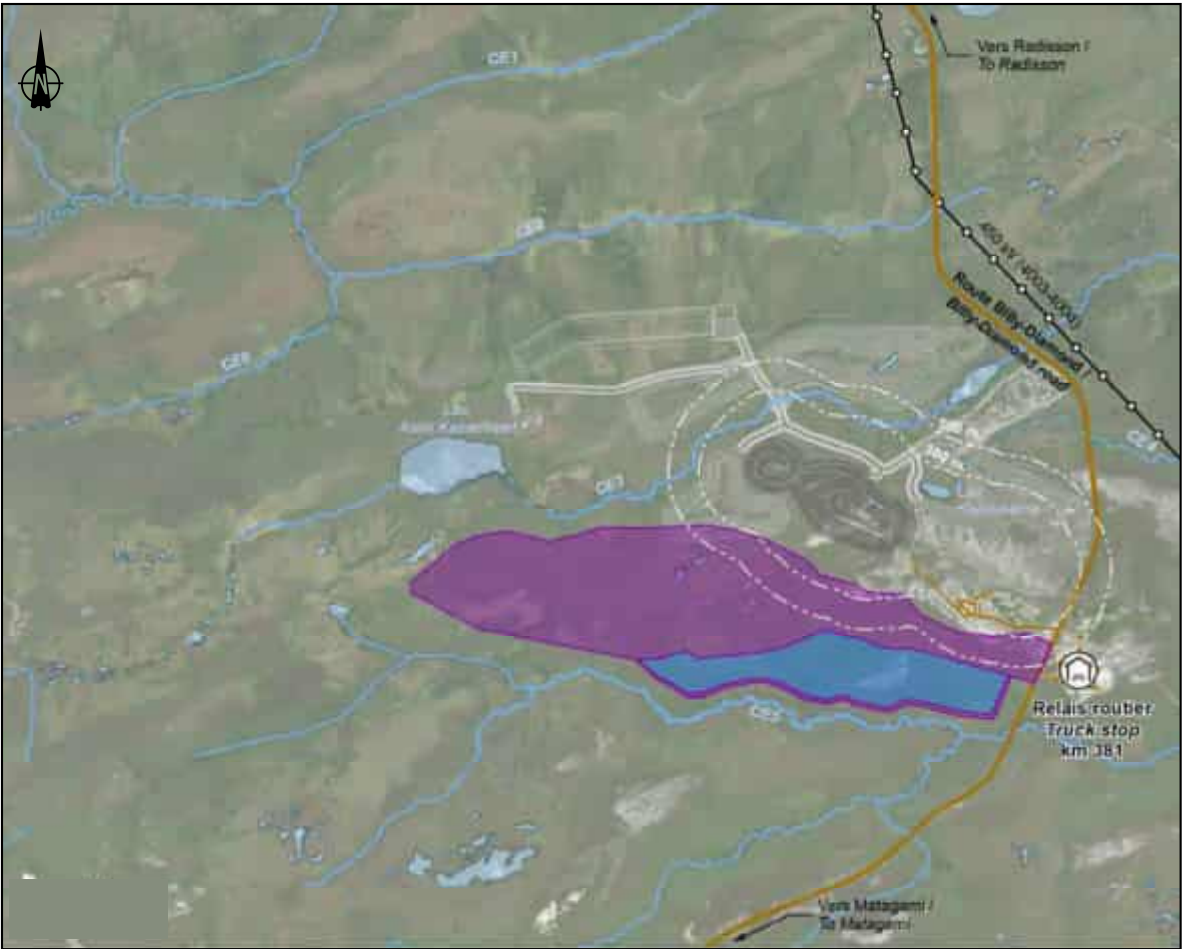
Since the environmental component is the most important category of the assessment, the criteria for wildlife and aquatic habitat put Option 3 at a significant disadvantage, as it requires the destruction of fish habitat. In addition, a permit is required for this option, which leads to delays in the project schedule.

The economic component is also important, especially the indicators with the most weight, the installation of waterproof membranes and closure. These two indicators are unfavourable for Options 3 and 4.

Considering the above, Options 3 and 4 are considered the worst and are abandoned at this stage.

Option 2 is more beneficial than Option 1 from an environmental and socioeconomic point of view. In fact, Option 1 is at a disadvantage because it affects creek CE2 downstream from the stockpile. In addition, certain socioeconomic indicators (atmospheric emissions, noise, traditional way of life and landscape) are unfavourable to Option 1 since the stockpile is located near the truck stop and creek CE5, in addition to presenting the highest final elevation.

At the time of preparation of the project description, the location of the stockpile was to the south of the pit (Option 1). During consultations with the Cree of Eastmain, the tallyman of trapline RE2 indicated that, among the watercourses in the study area, creek CE5 was the one his family valued. The concerns of this stakeholder, in addition to the results of the assessment, led to the selection of Option 2, despite its lack of required capacity (78 vs. 120 Mm³). Option 2 was considered the best and was recommended. Optimization of the design of the stockpile at the engineering stage has made up for the shortfall in volume. **To increase capacity, the surface area of the waste rock stockpile was increased. Specifically, the western section of the basin was eliminated, and the stockpile was extended to the property's northern boundary. This also made it possible to standardize the stockpile's elevation at 300 m.**



Variantes des haldes / Stockpile Alternative

- Option 1 / Option 1
- Option 2 / Option 2
- Option 3 / Option 3
- Option 4 / Option 4
- Bassin de rétention / Retention basin

Composantes du projet (2021) / Project Component (2021)

- Fosse / Pit
- Infrastructures minières / Mining infrastructure
- Zone tampon / Buffer zone

Infrastructures / Infrastructure

- Route principale / Main road
- Route d'accès / Access road
- Ligne de transport d'énergie / Transmission line
- Relais routier / Truck stop

Hydrographie / Hydrography

- CE3 Numéro de cours d'eau / Stream number
- Cours d'eau permanent / Permanent stream
- Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream
- Plan d'eau / Waterbody



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 3-1
Options d'emplacement de la halde à stériles /
Waste Rock Stockpile Location Options

Sources :
Orthoimage : Galaxy août / august 2017
Données du projet / Project data : Galaxy 2020

0 500 1 000 m
UTM, fuseau 18, NAD83

Juillet / July 2021

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c3-1_wspT315_var_halde_210629.mxd



Table 3-3a Multi-criteria analysis for the location of tailings stockpiles¹

Criteria	Indicator	Weight ²	Option 1			Option 2			Option 3			Option 4		
			South stockpile (reference scenario)			North stockpile			West stockpile			2 separate stockpiles		
			Score ³	Weighted result	Justification ⁴	Score	Weighted result	Justification	Score	Weighted result	Justification	Score	Weighted result	Justification
1 Environmental elements														
1.1: Hydrology	Number of affected drainage basins	10	0	0	2 drainage basins	2	20	1 drainage basin	2	20	1 drainage basin	-2	-20	3 drainage basins
1.2: Total ground footprint	Area	10	0	0	3,075,000 m²	0	0	3,097,745 m²	-1	-10	3,624,000 m²	-1	-10	3,822,500 m²
1.3: Fauna and aquatic habitats	Habitat destruction. Impact of the hydrologic budget on watercourses and fish populations.	50	0	0	No habitat destruction. Moderate impact of the hydrologic budget on CE5. Negligible impact of the hydrologic budget on CE3. CE5 is home to the largest fish population of all of the five watercourses inventoried.	2	100	No habitat destruction. Low impact of the hydrologic budget on CE2.	-2	-100	Habitat destruction: 188,500 m² of lake habitat and 2,830 m of watercourses. Strong impact of the hydrologic budget on CE3.	0	0	Effluent in CE5. No habitat destruction. Low to moderate impact of the hydrologic budget on CE5. Very low impact of the hydrologic budget on CE2. Negligible impact of the hydrologic budget on CE3. CE5 is home to the largest fish population of all of the five watercourses inventoried.
1.4: Fauna and terrestrial habitats	Wetlands area	20	0	0	3,003,000 m²	0	0	3,023,960 m²	0	0	3,406,400 m²	-1	-20	3,673,500 m²
1.5: Threatened or vulnerable species	Presence or absence of threatened or vulnerable species	10	0	0	No plant species, mammals, birds, reptiles or fish with a special status.	-1	-10	Presence of a plant likely to be designated threatened or vulnerable. No mammals, birds, reptiles or fish with a special status.	0	0	No plant species, mammals, birds, reptiles or fish with a special status.	-1	-10	Presence of a plant likely to be designated threatened or vulnerable. No mammals, birds, reptiles or fish with a special status.
Subtotal		100		0			110			-90			-60	
Score: -2 = worst, 0 = neutral, 2 = best.														

Table 3-3a Multi-criteria analysis for the location of tailings stockpiles (cont.)¹

Criteria	Indicator	Weight ²	Option 1			Option 2			Option 3			Option 4		
			South stockpile (reference scenario)			North stockpile			West stockpile			2 separate stockpiles		
			Score ³	Weighted result	Justification ⁴	Score	Weighted result	Justification	Score	Weighted result	Justification	Score	Weighted result	Justification
2 Technical elements														
2.1: Stability of the works	Maximum stockpile height	5	0	0	94 m	-2	-10	128 m	2	10	69 m	1	5	53 m (North) and 84 m (South)
2.2: Simplicity of design and construction	Length and height of the levees	5	0	0	h = 6.5 m l = 2.5 km	0	0	h = 5.5 m l = 2.7 km	2	10	h = 6.9 m 1.0 km	-2	-10	h = 6 m l = 5.2 km
2.3: Water management system design	Number of facilities and their capacity	10	0	0	1 pumping station 1 WTP Capacity: 0.3 m³/s	1	10	0 pumping stations 1 WTP Capacity: 0.3 m³/s	2	20	0 pumping stations 1 WTP Capacity: 0.06 m³/s	-2	-20	2 pumping stations 1 WTP Capacity: 0.3 + 0.15 m³/s
2.4: Access roads and hauling roads design	Qualitative assessment (maximum slope, number of water-course crossings)	5	0	0	One watercourse crossing (from the plant to the stockpile), slope of 10%, 90 m of vertical relief	-1	-5	One watercourse crossing (from the plant to the stockpile), slope of 10%, 120 m of vertical relief	0	0	One watercourse crossing (from the plant to the stockpile), slope of 10%, 65 m of vertical relief	-1	-5	One watercourse crossing (from the plant to the stockpile), slope of 10%, 80 m of vertical relief
2.5: Stockpiles design	Stockpile capacity	30	0	0	120 Mm³	-2	-60	78 Mm³	0	0	120 Mm³	2	60	120 Mm³ + available capacity
2.6: Ease of stockpile development	Qualitative assessment	10	0	0	Access: easy, near the James Bay road. Proximity of physical barriers: One section near a watercourse, not contiguous to the property lines. Surface: plan with a slight slope, one section near a watercourse.	-1	-10	Access: surrounded by wetlands, far from any road. Proximity of physical barriers: contour of the stockpile half on the property line or near a watercourse. Surface: slight slope.	-2	-20	Access: surrounded by wetlands, far from any road, watercourse crossing. Proximity of physical barriers: acquisition of land required and encroachment on a lake and watercourse. Surface: slight slope, inside a valley.	-1	-10	Access: surrounded by wetlands, far from any road. Proximity of physical barriers: sections of the contour of the stockpile half on the property line or near a watercourse. Surface: slight slope.
2.7: Land ownership and permits	Qualitative assessment	30	0	0	Inside the property lines, no fish habitat compensation required.	0	0	Inside the property lines, no fish habitat compensation required.	-2	-60	Land acquisition and fish habitat compensation (lakes and watercourses) required.	0	0	Inside the property lines, no fish habitat compensation required.
2.8: Blasting risk management	Presence of infrastructure inside the exclusion zones.	5	0	0	Stockpile partially inside the restricted construction zone.	2	10	Stockpile outside the restricted construction zone.	0	0	Retention basins and levees inside the restricted construction zone.	1	5	One of the two stockpiles partially inside the restricted construction zone.
Subtotal		100		0			-65			-40			25	
Score: -2 = worst, 0 = neutral, 2 = best.														

Table 3-3a Multi-criteria analysis for the location of tailings stockpiles (cont.)¹

Criteria	Indicator	Weight ²	Option 1			Option 2			Option 3			Option 4		
			South stockpile (reference scenario)			North stockpile			West stockpile			2 separate stockpiles		
			Score ³	Weighted result	Justification ⁴	Score	Weighted result	Justification	Score	Weighted result	Justification	Score	Weighted result	Justification
3 Economic elements														
3.1 Capital expenditures (CAPEX)														
3.1.1: Surrounding ditches	Length of ditches	3	0	0	4,150 m (\$3.5M)	1	3	1,150 m (\$1M)	2	6	None	-1	-3	5,700 m (\$4.8M)
3.1.2: Surrounding levees	Volume of levees	4	0	0	205,000 m³ (\$4.7M)	1	4	116,000 m³ (\$2.7M)	2	8	65,000 m³ (\$1.5M)	-2	-8	290,000 m³ (\$6.7M)
3.1.3: Protection for the stockpiles and basins	Total area to seal/keep dry	50	0	0	3,075,000 m² (\$67M)	0	0	3,097,745 m² (\$68M)	-1	-50	3,624,000 m² (\$80M)	-1	-50	3,822,500 m² (\$84M)
3.1.4: Water treatment	WTP capacity	2	0	0	0.30 m³/s (\$2M)	0	0	0.30 m³/s (\$2M)	2	4	0.06 m³/s (\$400K)	-2	-4	0.45 m³/s (\$3M)
3.1.5: Water management														
3.1.5.1: Pumping stations	Number of auxiliary pumping stations	1	0	0	One pumping station to steer the ditch water to the retention basin (\$100,000).	2	2	No auxiliary pumping station required.	2	2	No auxiliary pumping station required.	-2	-2	Two auxiliary pumping stations required (\$200,000): • one from the North stockpile ditches to its retention basin; • one to transfer the water from the North stockpile to the South stockpile facilities.
3.1.5.2: Pipes	Pumping distance	1	0	0	3,345 m from the WTP to the plant and 1,055 m between the ditches	2	2	1,745 m from the WTP to the plant	2	2	1,165 m from the WTP to the plant	-1	-1	5,090 m from the WTP to the plant and 1,055 m between the ditches
3.1.6: Fish habitat compensation and land acquisition	Qualitative assessment	1	0	0	No compensation required. No acquisition required.	0	0	No compensation required. No acquisition required.	-2	-2	Fish habitat compensation required. Land acquisition required.	0	0	No compensation required. No acquisition required.
3.1.7: Closing costs	Area to restore	24	0	0	3,075,000 m² (\$37M)	0	0	3,097,745 m² (\$37M)	-1	-24	3,624,000 m² (\$43.5M)	-2	-48	3,822,500 m² (\$46M)
3.2 Operating expenses (OPEX)														
3.2.1: Transportation of waste rock	Distance from the pit to the stockpiles	7	0	0	3.1 km from pit to stockpile	-1	-7	4.0 km from pit to stockpile	-2	-14	5.3 km from pit to stockpile	0	0	3.1 km from pit to tailings stockpile
3.2.2: Transportation of tailings	Distance from the plant to the stockpiles	7	0	0	2.7 km from the plant to the stockpile	-1	-7	3.4 km from the plant to the stockpile	-2	-14	4.5 km from the plant to the stockpile	2	14	1.9 km from the plant to the tailings stockpile
Subtotal		100		0			-3			-82			-102	
Score: -2 = worst, 0 = neutral, 2 = best.														

Table 3-3a Multi-criteria analysis for the location of tailings stockpiles (cont.)¹

Criteria	Indicator	Weight ²	Option 1			Option 2			Option 3			Option 4		
			South stockpile (reference scenario)			North stockpile			West stockpile			2 separate stockpiles		
			Score ³	Weighted result	Justification ⁴	Score	Weighted result	Justification	Score	Weighted result	Justification	Score	Weighted result	Justification
4 Socioeconomic elements														
4.1: Atmos- pheric emissions	Qualitative assessment at the truck stop	40	-1	-40	Majority of the hauling carried out near the km 381 truck stop	2	80	Majority of the hauling carried out far from the km 381 truck stop	2	80	Majority of the hauling carried out far from the truck stop	1	40	Part of the hauling carried out near the truck stop
4.2: Noise nuisance	Qualitative assessment at the truck stop	25	-1	-25	Majority of the hauling carried out near the km 381 truck stop	2	50	Majority of the hauling carried out far from the km 381 truck stop	2	50	Majority of the hauling carried out far from the truck stop	1	25	Part of the hauling carried out near the truck stop
4.3: Upholding of the traditional lifestyle	Qualitative assessment of loss of hunting, fishing or gathering zones, as well as loss of access.	20	0	0	Pond for active goose hunting and beaver tapping downstream on creek CE5.	2	40	No traditional activity identified in the surrounding area.	2	40	No traditional activity identified in the surrounding area.	0	0	Pond for active goose hunting and beaver tapping downstream on creek CE5.
4.4: Landscape	Qualitative assessment of the perspective and relief, compared with the existing topogra-phy.	10	0	0	Maximum elevation of the stockpile: 300 m	2	20	Maximum elevation of the stockpile: 330 m	0	0	Preliminary result, directly proportional to the maximum elevation of the stockpile: 280 m	0	0	Preliminary result, directly proportional to the maximum elevation of the stockpile: 290 m
4.5: Archaeo-logy	Number of sites with archaeo-logical potential	5	0	0	None	0	0	None	-2	-10	Three sites with potential near the infrastructure	0	0	None
Subtotal		100		-65			190			160			65	
Score: -2 = worst, 0 = neutral, 2 = best.														
Notes:														
1 - All of the waste rock / tailings and overburden alternatives studied are located in areas with comparable surface deposits (peatland and sand). This aspect was therefore not specifically included in the technical analysis because it is of equal value for all sites. However, surface morphology is considered in item 2.6 of the table.														
2 - The “Weight” column contains a value that is determined based on the importance of the indicator. Thus, the more important the indicator, the higher the value in the “Weight” column. The importance of the indicators (i.e., the weight) is determined by experts involved in the alternative analysis who compared all the indicators and discussed the importance of each one. Following the discussions among the experts, a consensus was reached, with the values in the “Weight” column being settled on.														
3 – The “Score” column refers to the evaluated option (either option 2, 3 or 4) compared to option 1, which is the reference option. A value from -2 to 2 is assigned to each of the options. Since option 1 is the reference option, it is considered to have a score of 0. The other options are compared with option 1. The best options are given a 1 or 2 score, and the worst options are given a -1 or -1 score.														
4 – The “Justification” column indicates the elements that led to the score value given.														

Table 3-3b Indicator weight justification

Criteria	Indicator	Weight	Justification
1. Environmental elements			
1.1: Hydrology	Number of affected drainage basins	10	Indicator with a low value as there are only slight variations between the options
1.2: Total ground footprint	Area	10	Indicator with a low value as there are only slight variations between the options
1.3: Fauna and aquatic habitats	Habitat destruction Impact of the hydrologic budget on watercourses and fish populations	50	Indicator with the greatest importance given regulations on the protection of watercourses and fish habitats, as well as the concerns of the stakeholders consulted
1.4: Fauna and terrestrial habitats	Wetlands area	20	Indicator with a high value given the role of wetlands in ecosystems, their ecological value, regulations for their protection and the concerns of stakeholders consulted
1.5: Threatened or vulnerable species	Presence or absence of threatened or vulnerable species	10	Indicator with a low value as there are only slight variations between the options
Subtotal		100	Subtotal of 100 calculated for the environmental elements
2. Technical elements			
2.1: Stability of the works	Maximum stockpile height	5	Indicator with the lowest value as there are only slight variations between options and it has few consequences compared to other indicators
2.2: Simplicity of design and construction	Length and height of the levees	5	Indicator with the lowest value as there are only slight variations between options and it has few consequences compared to other indicators
2.3: Water management system design	Number of facilities and their capacity	10	Indicator with an intermediate value given its complexity compared to other indicators
2.4: Access roads and hauling roads design	Qualitative assessment (maximum slope, number of creek crossings)	5	Indicator with the lowest value as it is less complex than other indicators and it has few consequences compared to other indicators
2.5: Stockpiles design	Stockpile capacity	30	Indicator with the greatest importance given the impacts related to it, which are more significant compared to other indicators

Table 3-3B Indicator weight justification (cont.)

Criteria	Indicator	Weight	Justification
2. Technical elements (cont.)			
2.6: Ease of stockpile development	Qualitative assessment	10	Indicator with an intermediate value given its complexity compared to other indicators
2.7: Land ownership and permits	Qualitative assessment	30	Indicator with the greatest importance given the impacts related to it, which are more significant compared to other indicators
2.8: Blasting risk management	Presence of infrastructure inside the exclusion zones	5	Indicator with the lowest value as it has few consequences compared to other indicators
Subtotal		100	Subtotal of 100 calculated for the technical elements
3. Economic elements			
3.1: Capital expenditures (CAPEX)			
3.1.1: Surrounding ditches	Length of ditches	3	Value determined based on costs compared to other indicators
3.1.2: Surrounding levees	Volume of levees	4	Value determined based on costs compared to other indicators
3.1.3: Protection for the stockpiles and basins	Total area to seal/keep dry	50	Indicator with the highest value as it is most expensive compared to other indicators
3.1.4: Water treatment	WTP capacity	2	Value determined based on costs compared to other indicators
3.1.5: Water management			
3.1.5.1: Pumping station	Number of auxiliary pumping stations	1	Value determined based on costs compared to other indicators, least expensive indicator
3.1.5.2: Pipes	Pumping distance	1	Value determined based on costs compared to other indicators, least expensive indicator
3.1.6: Fish habitat compensation and land acquisition	Qualitative assessment	1	Value set to 1 as there is little or no compensation required based on the options considered
3.1.7: Closing costs	Area to restore	24	One of the most expensive indicators compared to other indicators

Table 3-3B Indicator weight justification (cont.)

Criteria	Indicator	Weight	Justification
3.2 Operating expenses (OPEX)			
3.2.1: Transportation of waste rock	Distance from the pit to the stockpiles	7	Value determined based on costs compared to other indicators
3.2.2: Transportation of tailings	Distance from the plant to the stockpiles	7	Value determined based on costs compared to other indicators
Subtotal		100	Subtotal of 100 calculated for the economic elements
4. Socioeconomic elements			
4.1: Atmospheric emissions	Qualitative assessment at the truck stop	40	Highest value given how important air quality is for health
4.2: Noise nuisance	Qualitative assessment at the truck stop	25	High value given the importance of the truck stop and given the number of people who visit it
4.3: Upholding of the traditional lifestyle	Qualitative assessment of loss of hunting, fishing or gathering zones, as well as loss of access	20	Value based on concerns raised by stakeholders. This is not the highest value since the most popular areas for traditional activities are located away from the infrastructure. Still, maintaining the traditional lifestyle remains one of the most important indicators.
4.4: Landscape	Qualitative assessment of the perspective and relief, compared with the existing topography	10	The landscape continues to be important to people as they move about and rely on landscape features as landmarks.
4.5: Archaeology	Number of sites with archaeological potential	5	There is little archaeological potential in the areas considered for infrastructure. The potential does, however, exist.
Subtotal		100	Subtotal of 100 calculated for the socioeconomic aspects

PROJECT OPTIMIZATION (2021)

As part of the project optimization exercise, the four waste rock stockpiles were positioned near the pit to reduce transportation distances for excavated material. Additionally, two waste rock stockpiles located near the mine will be expanded into the pit once mining of the area is complete. This will reduce the size of the waste rock stockpiles to the north of the mine.

It should be noted that the alternative analysis for the location of the waste rock and tailings storage facilities was not revised as a whole although requested by the Joint Assessment Committee in July 2020. However, following the value engineering exercise, the geochemical characterizations of the materials to be stored as well as the hydrogeological characteristics of the storage sites, in particular the hydraulic conductivity of the underlying stratigraphic units estimated from essays conducted on-site, and the direction of groundwater flow were considered (see Chapter 4).

Finally, the waste rock stockpiles are now partially located within the exclusion zones for blasting activities. However, since traffic on the waste rock stockpiles is not continuous on all 4 stockpiles at once, the decision was made to manage presence on the stockpiles via a specific procedure. Thus, during blasting, it will be important to ensure that no one is in the zone.

3.1.3 LOCATION OF OVERBURDEN STOCKPILES

ALTERNATIVE ANALYSIS (2018)

In 2018, prior to the geotechnical investigations, an area north of the pit had been identified as preferable for accommodating the overburden stockpile. The results of the field campaign made it possible to calculate the volumes of unconsolidated deposits and organic matter (mainly peat) that would have to be stored in this stockpile.

These volumes were considerably higher than anticipated. Therefore, the north footprint had to be increased and the overburden stockpile split up into two stockpiles, one for organic matter and the other for unconsolidated deposits.

At this point, it was agreed that a second mining effluent would be developed in the sector harbouring organic matter and unconsolidated deposits, by delineating drainage basins on the territory. In fact, the stockpiles cover a significant enough overall area that if the runoff water had been pumped toward the main retention basin, it would have modified the nearby water levels and watercourse flows. Furthermore, the geochemical characteristics of the superficial deposits were an indication that the latter were not leaching metals and had no acid generating potential.

A second option was explored west of the pit. A comparative analysis was performed to identify which option would best support the project. The locations of the various options analyzed are illustrated on Map 3-2. The main findings of this analysis were as follows:

- The North option called for a stockpile several metres in height close to the Billy-Diamond highway (which created some worry as to possible problems with visibility on the road).
- Kapisikama Lake, creek CE4 and a special status plant in the North sector also curtailed the available storage options.
- The West option was located further from the pit (longer route for stripping). After an examination, however, it was determined that most of the materials stored in the stockpiles would be peat from the waste rock stockpile and topsoil stripping from the concentrator area.
- The North option was partially located in a terrestrial environment, which would limit losses associated with wetlands.
- The West option was fully within the limits of a single drainage basin, meaning any impacts would have only involved a portion of one watercourse.

After having carefully considered all this information, the West option was selected.

PROJECT OPTIMIZATION (2021)

As part of the optimization exercise, the decision was made to pile the organic material and unconsolidated deposits into a single stockpile. This overburden and peat storage facility (OPSF) was positioned between the west waste rock and tailings storage facility (WRTSF) and the main water management pond (WMP). The location of the OPSF was chosen taking into account the site topography in order to decrease the need for excavation and backfill during construction. This is detailed in chapter 4.

Relocation of the OPSF allowed for the WRTSF to be moved closer to the pit, thereby shortening waste rock transportation distances and reducing GHG emissions.

The second mining effluent, planned in the 2018 design, was removed from the development plan. All water from the site is now directed to the main water management pond and then discharged into the final effluent in CE2 (see Section 3.3).

3.2 DOMESTIC WASTEWATER TREATMENT

3.2.1 DESIGN CRITERIA

The workers' camp must have a domestic wastewater treatment system for personnel during the mine's construction and operation phases. Design criteria were developed to evaluate the various possible treatment technologies. These criteria, based on the number of people requiring service and the requirements of the *Guide pour l'étude des technologies conventionnelles de traitement des eaux usées d'origine domestique* (MDDELCC 2017), are as follows:

System capacity

- Unit flow for a camp: 200 L/pers/d
- Unit flow for the cafeteria: 12 L/pers/d

- Number of meals served in the cafeteria: breakfast 100%, lunch 20%, dinner 100%
- Construction phase:
 - number of people: 280
 - total flow of water to be treated: 280 pers * 200 L/pers/d = 56,000 L/d
- Operation phase:
 - number of people: 150³
 - total flow of water to be treated: 150 pers * 200 L/pers/d = 30,000 L/d

Disposal site (in the case of an absorption or leaching field)

- Maximum grade: 10%
- Depth of rock: > 2.5 m
- Depth of water table: > 2.5 m
- Permeability of site: very permeable and homogeneous on a horizon up to 2.5 m
- Distance of site from bodies of water: ≥ 200 m from a lake and ≥ 100 m from the tributary stream of that lake
- Distance of site from drinking water supply wells: ≥ 100 m

3.2.2 TREATMENT TECHNOLOGIES CONSIDERED

Seepage of treated water into the soil has been preferred from the outset, even though some technologies offer a tertiary treatment option that discharges treated water directly into a watercourse. The environmental requirements for water seepage into natural soil are far less stringent than for discharge into a watercourse, even with tertiary treatment. Considering that the flow to be treated is higher than 10,000 L/d (10 m³/d), the treatment systems considered that include seepage into soil require a low-pressure feed system.

The following four technologies were studied:

- absorption field with a seepage bed for very permeable soil;
- absorption field, Enviro-Septic technology for permeable to very permeable soil;
- modular units combined with mobile units (Bionest SA-10000 and KODIAK technology), with a leaching field;
- rotating biological contactor type modular unit (Ecoprocess, MBBR technology).

The first three technologies may or may not be combined with a retention basin, as described below, to reduce the scale of the treatment system selected. For MBBR technology, since the system cannot be reduced, there would be no benefit to adding a basin.

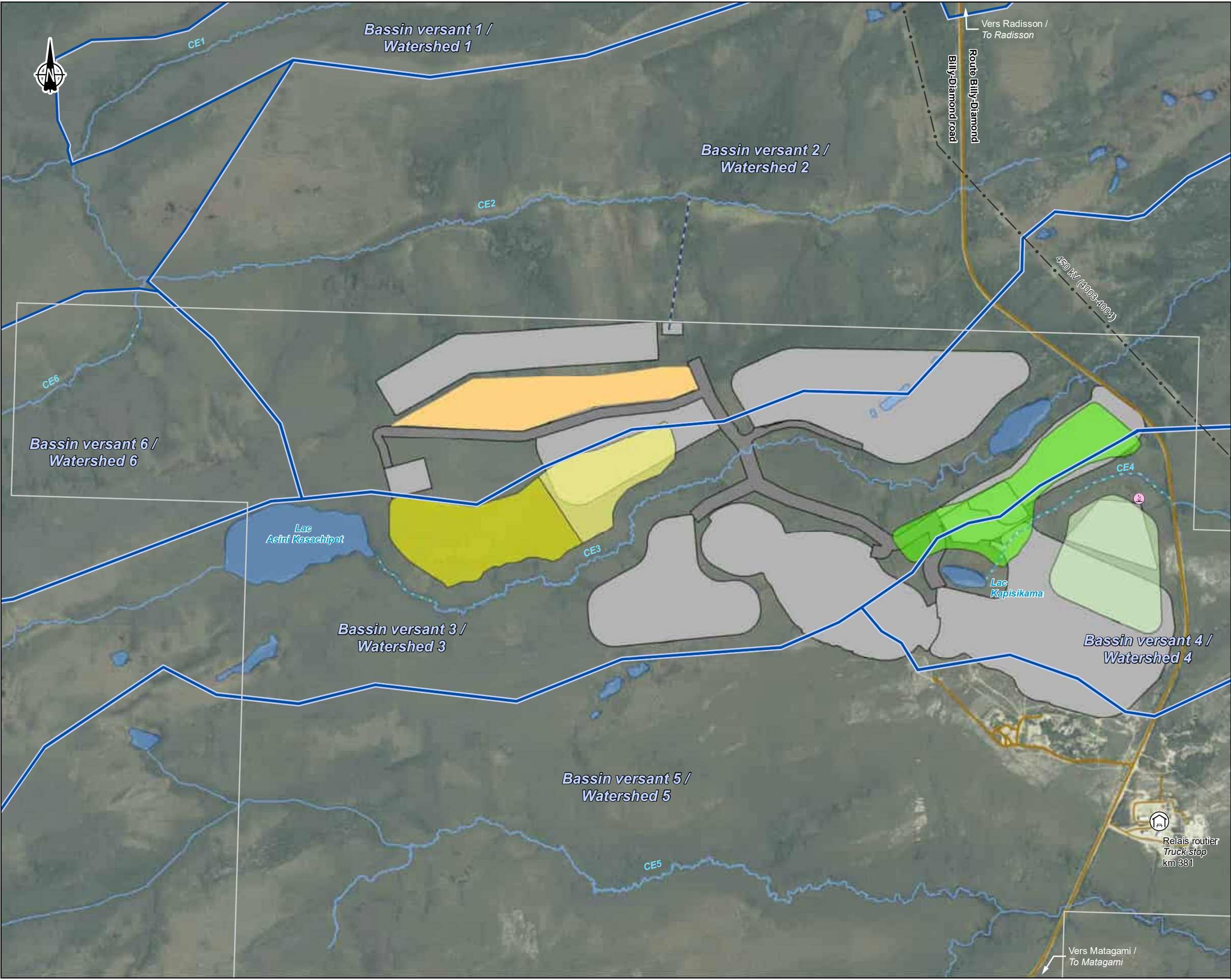
Absorption field with seepage bed

For this conventional technology, the soil thickness below the absorption field after the water table rises must be 0.9 m. This space may have to be increased to 1.5 m depending on the proximity of lakes and watercourses. The natural sand below the seepage bed must be very permeable. A septic tank provides primary treatment upstream. The absorption field is then supplied by a low-pressure feed system (LPFS) and a dosing (pumping) station. The field is divided into three separate areas, each supplied by a force main fitted at the outlet of the dosing station. Each main is shut off one at a time to give one section a break. Regular environmental monitoring is required during the year through sampling below the seepage bed.

Absorption field, Enviro-Septic technology

This advanced secondary treatment absorption field allows for a seepage rate of up to 50 L/m². A smaller soil thickness of 0.3 m is required below the absorption field after the water table rises. The sand filter must meet certain specifications and be certified by a laboratory. Just like the seepage bed, a septic tank provides primary treatment upstream, and the absorption field is then supplied by an LPFS and a dosing station. The absorption field works the same way, meaning that it is divided into three separate areas, each of which is given a break one at a time. Regular environmental monitoring is required during the year through sampling below the seepage bed. Enviro-Septic must visit annually.

3 In 2021, the total flow of water to be treated was calculated for 180 people during the operation phase, giving 36,000 L/d.



Limite de propriété / Property limit

Variante des haldes / Stockpile Alternative

Option nord / North Option

Halde à matière organique / Organic matter stockpile

Halde à dépôts meubles / Unconsolidated deposit stockpile

Option ouest / West Option

Halde à matière organique / Organic matter stockpile

Halde à dépôts meubles / Unconsolidated deposit stockpile

Composantes du projet (2021) / Project Component (2021)

Route / Road

Effluent minier / Mine effluent

Infrastructures minières / Mining infrastructure

Halde à matière organique / Organic matter stockpile

Infrastructure / Infrastructure

Route principale / Main road

Route d'accès / Access road

Ligne de transport d'énergie / Transmission line

Relais routier / Truck stop

Espèce végétale susceptible d'être désignée / Plant Species Likely to be Designated

Carex sterilis

Hydrographie / Hydrography

CE3

Numéro de cours d'eau / Stream number

Cours d'eau permanent / Permanent stream

Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flowstream

Plan d'eau / Waterbody

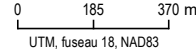
Bassin versant / Watershed



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 3-2
Options d'emplacement des haldes à mort-terrain / Overburden Stockpiles Location Options

Sources :
Orthoimage : Galaxy août / august 2017
Données du projet / Project data : Galaxy 2018



Juillet / July 2021

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c3-2_wspT316_halde_depot_210629.mxd



Fixed unit, Bionest technology with leaching field

This technology is an advanced secondary treatment system whose Bionest treatment components are inserted into a reactor composed of fixed modular units (SA-10000) or mobile units (Kodiak). Both types of unit can be combined depending on the project scope and duration. The group of modular units would be installed permanently to meet needs during the operation phase (30,000 L/d), whereas the group of mobile units could be used temporarily to fill additional needs during the construction phase (26,000 L/d). The treated water would be discharged into a leaching field.

- SA-10000 modular units:
 - oversized septic tank ($V = 2.3 * Q$) required upstream, with pumping station;
 - 3 buried units, measuring 6 m x 2 m x 2 m, with a capacity of 10,000 L/d each;
 - biofilm mounted on filament requiring a recirculation station and forced ventilation;
 - regular environmental monitoring, sampling at Bionest outlet and annual visit by supplier.
- Kodiak mobile units:
 - 3 above-ground units, mounted in insulated containers, with a capacity of 11,000 L/d each;
 - oversized septic tank ($V = 2.3 * Q$) included in each unit;
 - biofilm mounted on filament requiring a recirculation station and forced ventilation;
 - possibility of reselling the units at the end of the construction phase;
 - regular environmental monitoring, sampling at Bionest outlet and annual visit by supplier.
- Leaching field:
 - LPFS-type installation;
 - use of natural soils suitable for seepage;
 - minimum soil thickness of 0.3 m below the field after the water table rises.

Fixed unit, Ecoprocess MBBR technology with leaching field

This treatment solution works with a Moving Bed Biofilm Reactor (MBBR). The treatment process consists of four stages: primary settling, which allows secondary sludge to be stored, a buffer tank, an MBBR-type secondary aerobic treatment and secondary settling. The secondary settling separates the sludge that formed in the biological reactor and discharges clarified water to a seepage area (in this case, a leaching field).

The reactor is designed based on the flow and load to be treated. Installation on the site is fixed and permanent. Regular environmental monitoring is required during the year through sampling at the reactor outlet, and a visit from the supplier is required annually.

Retention basin

A retention basin can be set up to store surplus domestic wastewater during the construction phase for offsite treatment. The basin would have a storage capacity that meets the needs of 130 people for one month, that is, a filling volume of 780 m³ given a daily flow of 26,000 L/d. The collected water would be drained periodically at a rate of one to two tanker trucks per day. During the operation phase, a permanent treatment system would be installed to serve the 150 expected workers. This option requires a prior agreement between the mine and the owner of the sanitary treatment system.

Tables 3-4 and 3-5 summarize the design criteria and features of the various systems studied, depending on whether or not they will be combined with a retention basin.

Table 3-4 Domestic water treatment systems, scenario without basin

Treatment chain components	Absorption field Seepage bed	Enviro-Septic absorption field	Bionest SA-10000 and Kodiak	Ecoprocess MBBR
Grease trap, kitchen (15 m ³)	1	1	1	1
Septic tank	84 m ³	84 m ³	3 X 23 m ³	2 X 46 m ³
Pumping station	1	1	3	1
Sanitary treatment	2,800 m ² seepage 3,700 m ² total to soil (37 m x 100 m) Total load of 30 L/m ² /d for very permeable soil	1,680 m ² seepage 2,200 m ² total to soil (22 m x 100 m) Total load of 50 L/m ² /d for very permeable soil	3 biological reactors SA-10000 (permanent) Flow treated: 30,000 L/d 3 biological reactors Kodiak (temporary)	Ecoprocess MBBR, secondary settling and 8 Ecoflo units
Leaching field with LPFS	Not applicable	Not applicable	560 m ² seepage 725 m ² total to soil (18 m x 40 m) Total load of 100 L/m ² /d for very permeable soil	Included under Ecoflo units
Specific material required	840 m ³ of crushed stone LPFS pipes	1,170 m ³ of laboratory-certified sand filter (quality of natural sand at site to be determined) Enviro-Septic pipes	170 m ³ of crushed stone LPFS pipes	30 m ³ of crushed stone
Estimated budget (purchase and installation)	\$580,000	\$785,000	\$900,000, including resale of Kodiak units	\$580,000
Notes	Hypothesis of very permeable soil available with water table at more than 2.5 m deep. Distance of less than 400 m from camp. Lake and stream more than 200 m away.	Hypothesis of very permeable soil available with water table at more than 1.5 m deep. Distance of less than 400 m from camp. Lake and stream more than 200 m away.	Hypothesis of very permeable soil available with water table at more than 1.5 m deep. Lake and stream more than 200 m away. SA-10000 units can be replaced with a unit built on site. At the end of the construction phase, the Kodiak units can be resold.	Hypothesis of very permeable soil available with water table at more than 1.5 m deep. Distance of less than 400 m from camp. Lake and stream more than 200 m away.

Table 3-5 Domestic water treatment systems, scenario with basin

Treatment chain components	Absorption field Seepage bed	Enviro-Septic absorption field	Bionest SA-10000 and Kodiak
Grease trap, kitchen (24 m ³)	1	1	1
Septic tank	45 m ³	45 m ³	3 X 23 m ³
Pumping station	1	1	2
Sanitary treatment	1,500 m ² seepage 2,000 m ² total to soil (40 m x 50 m) Total load of 30 L/m ² /d for very permeable soil Flow treated: 30,000 L/d	1,200 m ² seepage 1,500 m ² total to soil (30 m x 50 m) Total load of 40 L/m ² /d for permeable to very permeable soil Flow treated: 30,000 L/d	3 biological reactors SA-10000 (permanent - mining operation phase) Flow treated: 30,000 L/d
Leaching field with LPFS	Not applicable	Not applicable	300 m ² seepage 400 m ² total to soil (20 m x 20 m) Total load of 100 L/m ² /d for very permeable soil
Retention basin (1,500 m ³)	1 (35 m x 15 m) Flow to be treated off site: 26,000 L/d	1 (35 m x 15 m) Flow to be treated off site: 26,000 L/d	1 (35 m x 15 m) Flow to be treated off site: 26,000 L/d
Specific material required	450 m ³ of crushed stone LPFS pipes Geomembrane and sand for basin base Access road to basin for tanker truck	800 m ³ of laboratory-certified sand filter (quality of natural sand at site to be determined) Enviro-Septic pipes Geomembrane and sand for basin base Access road to basin for tanker truck	90 m ³ of crushed stone LPFS pipes Geomembrane and sand for basin base Access road to basin for tanker truck
Estimated budget (purchase and installation)	\$575,000	\$735,000	\$765,000
Notes	Hypothesis of very permeable soil available with water table at more than 2.5 m deep. Distance of less than 400 m from camp. Lake and stream more than 200 m away.	Hypothesis of very permeable soil available with water table at more than 1.5 m deep. Distance of less than 400 m from camp. Lake and stream more than 200 m away.	Hypothesis of very permeable soil available with water table at more than 1.5 m deep. Lake and stream more than 200 m away. The three SA-10000 units can be replaced with a unit built on site.

3.2.3 METHODOLOGY

To characterize the alternative technologies for domestic wastewater treatment, indicators were formulated in the categories deemed relevant based on the context and the issues involved in this project (economic, technical and environmental aspects). The following weightings were selected for these categories: economic (5), technical (3) and environment (2). The indicators were then assessed, qualitatively or quantitatively, using a scale from 1 (worst) to 5 (best). **As such, there is no quantitative scale related to these scores, as the options are ranked by their position relative to the others. The justification for these weightings is related to: the significant cost difference for the options to ultimately achieve similar treatment results; the technical advantages and disadvantages of the options; as well as by taking into account an expected minor environmental impact, since the technologies examined are considered effective and have been used for a long time. Thus, for the various analysis criteria, the weights were established as follows (rating from 1 to 5 in ascending order of importance):**

- **Environment:** Equivalent and equally important consideration must be given to the impact on surface water and on groundwater.
- **Technical:** The operability criterion was considered the most important due to the major impact a malfunction caused by poor operation would have. The complexity of equipment operation was considered, along with the time and effort required to maintain and confirm proper operation. The effort and expertise required for the system design/specification were considered important, while those required to design the collection system were less significant. The ease of the validation and approval process in terms of the Regulation respecting the application of section 32 of the Environment Quality Act was considered to have a moderate impact on system selection.
- **Economic:** The upfront purchase cost was considered very important since the system is essential from the very beginning of the project, in addition to all the other construction and equipment procurement expenses before production starts. Use and operating costs for the system are given less consideration since the developer will be in the production phase and will therefore be generating income.

A quantitative analysis was performed for the technologies studied (scenario 1) but was not completed for the combination of these technologies with a retention basin (scenario 2) since the transport costs for emptying the basin were not known at the time the study was performed. The results and the detailed analysis are presented in Tables 3-6 and 3-7.

Table 3-6 Scores for alternative domestic wastewater treatment technologies

Score	Option 1	Option 2	Option 3	Option 4
Environment	1.5	2.5	4.0	4.0
Technical	2.7	2.7	3.0	2.7
Economic	3.4	3.0	2.2	3.3
Total before weighting	7.6	8.2	9.2	9.9
Weighted total	28.2	28.2	28.1	32.3
Note: The weighting factors are: environment = 2, technical = 3, economic = 5.				

The weighting factors given in Table 3-6 are explained as follows:

- A factor of 2 is given to the environment score, **as the impact is the least significant of the various options.**
- A factor of 3 is given to the technical score, which represents a middle value.
- A factor of 5 is given to the economic score, since this is the score with the greatest variation between the options and with the most significant impact.

Table 3-7 Multi-criteria analysis of domestic wastewater treatment technology

Criteria	Weighting	Option 1		Option 2		Option 3		Option 4	
		Score	Weighted result	Score	Weighted result	Score	Weighted result	Score	Weighted result
Environmental aspects									
Impact on surface water quality	3	1.0	3.0	2.0	6.0	4.0	12.0	4.0	12.0
Impact on underground water quality	3	2.0	6.0	3.0	9.0	4.0	12.0	4.0	12.0
Subtotal	-	3.0	9.0	5.0	15.0	8.0	24.0	8.0	24.0
Environmental score subtotal	-	-	1.5	-	2.5	-	4.0	-	4.0
Technical aspects									
Collection system design	1	3.0	3.0	3.0	3.0	3.0	3.0	2.5	2.5
Treatment system design	3	1.4	4.1	1.9	5.8	3.4	10.1	3.0	9.0
S. 32 request	2	1.7	3.3	2.3	4.7	4.0	8.0	4.0	8.0
Operation	5	3.8	19.0	3.3	16.5	2.4	12.0	2.0	10.0
Subtotal	-	-	29.4	-	30.0	-	33.1	-	29.5
Technical score subtotal	-	-	2.7	-	2.7	-	3.0	-	2.7
Economic aspects									
Investment cost	5	3.1	15.6	3.0	15.0	2.3	11.7	4.0	20.0
Operating cost	3	4.0	12.0	3.0	9.0	2.0	6.0	2.0	6.0
Subtotal	-	-	27.6	-	24.0	-	17.7	-	26.0
Economic score subtotal	-	-	3.4	-	3.0	-	2.2	-	3.3

3.2.4 RESULTS

The basin scenario, which entails adding a retention basin to each of the technologies studied, is not considered economically advantageous at this stage since transport and off-site water treatment costs must be considered.

Therefore, of the four alternatives studied in the scenario without a retention basin, the rotating biological contactor (Ecoprocess MBBR technology) seems to be the best choice, all criteria combined. It is also the most economical choice.

Nevertheless, after checking the information available at this stage, it was found that an absorption or leaching field could not be installed in the immediate camp environment. According to the results of the geotechnical surveys, the soil in place is not adequate for the installation of such a system on the mine property. In general, the water table is less than one metre from the ground surface and the desired sand horizon is invariably under a layer of peat 0.7 to 1.5 m thick. For this reason, a tertiary treatment was added to the selected alternative.

Thus, the prospective supplier for the rotating biological contactor could also offer the tertiary treatment unit to comply with the disinfection and phosphorus standards required for direct discharge into a watercourse. This system requires a service building (3 m x 4 m) to accommodate dosage pumps for phosphorus removal and the disinfection unit (UV lamp) at the exit of the Ecoflo.

Additional costs for the addition of this tertiary treatment are estimated at \$21,000 for the equipment only, excluding delivery, installation and annual operating costs.

3.2.5 EFFLUENT DISCHARGE LOCATION

In 2018, the discharge location **was planned in** creek CE3, through the overburden stockpiles' sedimentation basin or directly into the watercourse. The final choice **was to be** made following further work based on technical and environmental considerations (characterization results, field visit, request for Effluent Discharge Objectives [EDOs] to be filed, etc.).

In 2021, the sanitary effluent discharge location was positioned in CE4 to be nearer to the new location planned for the workers' camp.

3.3 MINE WATER MANAGEMENT AND FINAL EFFLUENT DISCHARGE LOCATIONS

In 2018, the project's infrastructure has been positioned to minimize watershed changes (quantities of water to be redirected) and to simplify water management at the site. Thus, since the mining infrastructure was optimized throughout the project design, no alternative analysis was necessary for the position of the mining effluent. The mining effluent site on creek CE2 was selected using videos of the watercourses taken with a drone to position it at the best location along the watercourse, over a 200 m segment. The mining effluent on creek CE3 has been placed near the crossing of the hauling road to facilitate sampling and minimize the footprint. **The effluent discharge locations were positioned on these watercourses in order to retain the current drainage conditions; in other words, respecting the watershed boundaries of the watercourses, while taking into account mine site layout imperatives (i.e., all water that must be treated before being discharged is conducted to a single point on the site). The discharge location on CE3 was chosen because it would have been already affected by the project's development (access road and watercourse crossing), as well as for the purposes of efficiency for monitoring (location to the right of the watercourse crossing by the road).**

In the current project (2021), mining effluent will only be discharged into CE2, in the same location planned for in 2018. There is no effluent anticipated into CE3.

3.4 POWER SUPPLY AT THE MINE SITE

The project, as defined in 2018, required 8.3 MW to power the fixed infrastructure. **Now, in 2021, these power needs have dropped to an estimated 8.01 MW.**

Near the project, Hydro-Québec's network includes three 735-kV transmission lines and a 450-kV line from the La Grande-2 and La Grande-2A generating stations, which travel into southern Québec, and a 315-kV line between the Sarcelle and Eastmain-1 generating stations. Also, a 69-kV line from the Muskeg generating station near the former Opinaca airport heads west to supply the community of Eastmain, running 7 km south of the mine site. Using this renewable energy network to supply the concentrator and other project infrastructure was therefore the first option considered.

The construction of a substation of 75 kV or more and a transmission line of 75 kV or more would require an impact assessment as per the requirements of Schedule A of the EQA. Hydro-Québec would be responsible for this assessment since it owns the network. According to Hydro-Québec's representatives, the time required to obtain authorizations and build the infrastructure for this option, which involves a connection to the 315-kV line, is four years, whereas a connection to the 69-kV line would be two years. To optimize management of the preliminary design studies and permit applications, the option to connect to the 69-kV line has been prioritized. With this option, Hydro-Québec **will be able to** supply a maximum of 7.6 MW.

In 2018, other sources of electricity were considered in order to make up the difference. The choices **were** solar, wind, natural gas, liquefied natural gas (LNG) and propane. Natural gas **was** eliminated since there is no distribution system in the area.

Renewable energy seems attractive at first glance because it minimizes GHG emissions and reduces operating expenses (OPEX). However, because it is direct energy, it must be used as soon as it is produced or accumulated in a battery. Since they are still very expensive, batteries increase capital expenditure (CAPEX).

3.4.1 SOLAR AND WIND POWER

A preliminary **assessment** conducted by a specialized firm (Tugliq) revealed that the installation of solar or wind farms first requires local availability studies to determine sunshine constancy, radiation strength as well as wind speed and constancy. It is also important to consider that a wind farm can interfere with airport radars and requires social acceptance by neighbouring communities, mainly because of its visual impact. An environmental impact assessment is required. Finally, the cost of installing wind or solar infrastructure, including accumulators, is too high for a mine with about an **18-year** lifespan, even for one or two megawatts.

The option of powering a few mobile generators using solar panels with accumulators was quickly assessed. However, the project area yields very low radiant exposure, barely 4 kWh / m² according to Natural Resources Canada databases. Assuming a conversion efficiency of 35 % solar energy to direct current electricity (for polycrystalline solar panels) and then a conversion of 90 % direct current electricity to alternating current, the system's total efficiency would be 31.5 % versus 35 % or more for a generator. Furthermore, the capital cost is considerably higher for a solar system, nearly CAD 2.5 / W versus CAD 1 / W for generators. This excludes energy storage costs. Currently, very few, if any, solar systems exist in northern First Nations communities, precisely because of the mediocre economic feasibility of this type of project in the north.

3.4.2 LIQUIFIED NATURAL GAS AND PROPANE

These two solutions require pressurized tanks on site and could be used for the mobile fleet. **Vehicle conversion costs and fuel costs are about the same. Compared with propane, LNG emits fewer GHGs but is more difficult to obtain.**

In 2018, GLCI contacted Energir, the natural gas and LNG supplier in Québec, to discuss possibly fueling hauler trucks with LNG. The information sent by Energir (2018) indicated that, for an equal MBtu power supply, the percentage of diesel must be kept at 65 %, as there is currently no existing application for fueling trucks of this size with LNG and for keeping the efficiency equivalent to that of diesel. The LNG or RNG (biomethane) effectively reduces GHG, NOx and noise emissions. The use of 35 % LNG reduces GHG by 10 %, while the use of 35 % RNG reduces GHG by 35 %. The fuel cost is equivalent to diesel for the mixed diesel-RNG and 27 % less for the mixed diesel-LNG. The first issue is that this scenario still requires diesel, which will need to be transported to the James Bay region and then stored. The second issue is the transportation and storage of LNG and RNG on the James Bay territory. Energir proposed two options. The first is road transport only: from the transfer station in Montréal, which is a 1460-km round trip, with one delivery every three days to supply a station that would be built in Matagami. From Matagami to the GLCI site, the ore transport trucks would be equipped with NG engines with a driving range of approximately 1000 km, and they would therefore be able to cover the GLCI-Matagami round trip (765 km). The scenario involving the fueling of both the ore transport trucks and the hauler trucks would entail two shipments from Montreal to Matagami every three days, the construction of the station in Matagami and the construction of a station at the GLCI site.

The GHG emissions from transporting the LNG to Matagami are not accounted for in Energir's presentation. The trips every three days represent about 170,000 km or 340,000 km per year, depending on the option. A load of LNG represents 30,000 m³ of LNG or RNG, while a diesel tanker can carry up to 55,000 L, meaning fewer trips given the volume saved.

Consequently, taking into consideration the whole cycle including LNG transportation (and losses during transportation and storage), the anticipated reductions in GHG emissions are negligible. These solutions will increase the project's capital costs without any significant positive impact on the environment, not to mention the additional technological and health and safety risks (accidents). Based on these assessments, a switch to LNG trucks is not as attractive as it would appear initially.

As an alternate power source to the hydropower supplied by Hydro-Québec to meet the demand for the fixed infrastructure at the mine site, propane gas was chosen because of its ease of supply compared with LNG. It **should be** used to heat the buildings in the administrative and industrial sector, which require 1.2 MW. **The 2021 project anticipates using only propane to heat the workers' camp during the construction and operation phases.**

3.5 POWER SUPPLY FOR MOBILE EQUIPMENT

The possibility of obtaining electric motors abroad for hauling and road trucks, as well as for heavy equipment such as excavators and shovels, was examined with a view to reducing GHG emissions. **Mobile equipment (off-road and on-road) accounts for 31 % of the site's diesel consumption, corresponding to 80 % of the CO₂eq emissions during the operation phase. Note that mobile equipment is responsible for 46 % and 42 % of CO₂eq emissions during the site's construction and closure phases, respectively.**

Despite GLCI's willingness, two key issues complicate electrification of the project's mobile equipment: the limited supply of equipment models needed for the project's activities; and the lack of available hydroelectricity from Hydro-Quebec to power the vehicles.

However, because its values include decarbonizing transportation and being a lithium producer, GLCI is interested in establishing a fleet of electric mobile vehicles for its project. The following sections describe the challenges GLCI will have to overcome in order to achieve this.

3.5.1 EQUIPMENT AVAILABILITY

The search for electric options for the main mobile equipment was conducted **with the number one selection criterion being their** respective required capacities, namely:

- Mining trucks: a 60-t to 100-t hauler and a 50-t articulated hauler;
- Excavators: a hydraulic shovel with a bucket capacity of 6 m³ to 11 m³ and an excavator with a bucket capacity of 5 m³;
- 152-mm down the hole drill hammer;
- **Articulated tankers.**

Mining trucks

There are no 100-t electric haulers. Those currently available on the market all have a capacity of **300 t** or more (**200 t for hybrid vehicles**). However, a conversion test was conducted on a 65-t truck used in a Swiss quarry. Based on this prototype, it would cost \$1 million to convert a diesel truck to an electric truck powered by a 600-kWh lithium-ion battery.

Another option would be to power the trucks from an onsite power line. Such a system involves adding a device on the trucks so they can connect directly to the power line, like a tramway. This type of system is usually installed on ramps since loaded trucks consume more energy going back up the slope. This option is advantageous for large-scale projects and is therefore not applicable here. Weather conditions are also a major impediment to installing such a system as freezing rain could lead to power failures.

Graders, Excavators and Loaders

John Deere sells electric or hybrid graders, bulldozers and loaders that have buckets with suitable capacities, however they are not sufficiently robust to withstand the use GLCI intends (handling hard rock such as pegmatite).

Other manufacturers do not offer excavators or loaders of the size GLCI needs. Purchasing them would entail acquiring a larger fleet of such vehicles to meet handling needs, which in turn means more maintenance and a larger maintenance crew, as well as larger workshops and a bigger yard. Komatsu manufactures an electric machine with a 10 m³ bucket and Hitachi sells one boasting 11 m³. These are somewhat larger than those envisioned. This option is still being studied.

Drill rigs

Electric drill rigs were considered. A search for suppliers shows that drill rigs handling **appropriate diameters** to deliver the expected results set out in the blasting plan **could be available within two years**.

Tankers

Research into electric articulated tankers failed to identify any on the market.

Auxiliary vehicles

After extensive investigation, a forklift, buses (2) and pick-up trucks (9) are available in electric versions and will be purchased. However, the telescopic forklifts and flatbed truck are only available in a smaller version than what GLCI requires. Electric versions of other equipment (for snow removal and garbage disposal, as well as fire trucks) could not be found on the market, but a close eye is being kept on their development for possible integration.

3.5.2 COMPARABLE PROJECTS

Most of the electrical mining equipment currently available is used in underground mines primarily because they help reduce ventilation costs.

For comparison purposes, note the Lac-à-Paul project, a phosphate deposit that will be operated as an open-pit phosphate mine in Saguenay–Lac-Saint-Jean. However, the scale of the project is not the same. The expected Lac-à-Paul production is much greater than that of the James Bay Lithium Mine project, i.e., on average, 37 Mt of excavated material per year (with peaks of 60 to 90 Mt) compared with 10 Mt for GLCI. The Lac-à-Paul feasibility study includes Komatsu hydraulic excavators (model PC 5500-6 with a 28-m³ bucket) combined with Caterpillar diesel trucks (model CAT 793F, 226 t). The study shows that the use of electric drill rigs (203.2 mm) is currently being evaluated.

3.5.3 COST-BENEFIT ANALYSIS

A high-level economic assessment was conducted comparing the use of smaller electric shovels available on the market (Komatsu PC 3000, 250-260 t, 10-m³ bucket) with diesel shovels adapted to the project's size (Komatsu PC-1250, 100 t, 5.75-m³ bucket). The costs considered included only the initial outlay and energy consumption. The calculations are presented in Table 3-8⁴.

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- 4 The equipment will be purchased over a 3-year period from the beginning of mine construction. The initial outlay corresponds to acquisition of shovels during the start-up period. Maintenance costs are capital investments needed to maintain mining operations. In this assessment, we estimate that 3 electric shovels and 5 diesel shovels will be required for the entire duration of mining operations. As a result, the initial outlay, for one electric shovel, which has twice the capacity of a diesel shovel, corresponds to the purchase of the first shovel for the first three years of operation. Two other electric shovels will be needed to successfully complete the project (\$3M initially for one shovel + \$12M in maintenance for the 2 other shovels). As for diesel shovels, 1.6 shovels will be needed for the initial period (3 years). Next, 3.3 shovels will be needed to maintain operations to the end of the project, for a total of 5 shovels. Keep in mind that the electric shovel has twice the capacity of the diesel shovel, which explains why 1 electric shovel is needed in the initial period while 1.6 diesel shovels will be needed during the same period, according to the volumes to be processed.

Although it is likely that the differences between diesel and electric machine costs will change in the next 10 years, the data are not robust enough to estimate this difference. Accordingly, the assessment was conducted using only the available data.

It must be emphasized that the amount of electricity available is limited by Hydro-Québec, so replacing diesel equipment with electric equipment is not easily possible.

Table 3-8 Cost-benefit analysis of electric and diesel shovels

Parameter	PC 1250 Diesel	PC 3000 Electric	Difference
Operations (hrs)	288,000	166,000	122,000
Shovel purchase (qty)	5	3	2
Energy cost (\$)¹	21,500,000	7,000,000	14,500,000
Initial outlay (\$)	2,000,000	6,000,000	-4,000,000
Maintenance cost (\$)²	3,900,000	12,000,000	-8,100,000
Financial aspects			
Undiscounted net profit (\$)	2,400,000		
Payback time (years)	15		
Net profit discounted at 5% (\$)	-1,500,000		
Internal rate of return (%)	2.62		
1 Based on the following unit costs: diesel \$0.940/l and electricity \$0.0475/kWh.			
2 Represents the cost of replacing the equipment			

In general, the results are unfavourable for electric equipment. The calculations show a minimal undiscounted net profit with a long payback period. The energy savings would be cancelled out by the additional costs.

Technical notes from Mining Plus (2018) provide research done on LNG equipment and electric equipment. Fully electric and hybrid equipment are only available for 200 t and larger trucks and shovels larger than 20 m³. Depending on the shape and size of the GLCI deposit, smaller trucks will be used.

Pilot tests were conducted on equipment of similar size by Teck Resources in Western Canada, using an LNG-diesel mix, which is necessary to ensure power. The results of these tests were kept confidential, but it appeared that the GHG reductions were not significant. The performance of this equipment in northern conditions is also uncertain.

Replacement kits for electrification and LNG are available and cost around \$1 million for each piece of equipment. However, these modifications void the equipment manufacturers' warranty. The cost and loss of warranty significantly lessen the benefits of operating with such modified equipment. Some mining projects suggest a modified truck in their feasibility study. This truck is half the size of those recommended for GLCI. We will closely monitor the performance of these trucks based on the climate in James Bay. Nevertheless, among the electrical conversion options under consideration, the supercapacitor technology offered by Effenco seems to be the most suitable, particularly because of its adaptability to the requirements of heavy equipment, its ruggedness, its lifespan and its resistance to temperature fluctuations.

Assuming GLCI uses all electric mobile equipment currently available on the market and which currently meets the needs of the project, this would reduce total diesel consumption by 5.9 % compared to the anticipated consumption.

Considering all of the constraints outlined, deploying a fleet of electric mobile equipment that satisfies the needs of the project would lead to a limited reduction in GHGs of 1.8 % of the site's total GHGs (1.127 t CO2eq / 62 t CO2eq). Furthermore, converting the same vehicles so they run on natural gas from Montreal (trucking) would reduce GHG emissions by 2 % compared to running on diesel.

3.5.4 RECOMMENDATION

The market offers a limited choice of electric mining equipment for an open-pit mine like GLCI's. Most of the electric equipment available is for underground facilities due to the savings on ventilation costs. Electric battery trucks are not available for the pits while electric drill rigs and mechanical shovels are available only at capacities that exceed GLCI's needs. Smaller equipment is either no longer available on the market or not recommended by suppliers due to the high cost compared with equivalent diesel equipment. Consequently, given the size of the James Bay Lithium Mine, **most** electric equipment on the market today **is not suitable** for the project and **is therefore not recommended**.

Despite the only slight reduction in GHG emissions that might be achieved by electrifying the site's mobile equipment, GLCI remains on the lookout for any technological advances in the energy sector to reduce its dependence on fossil fuels. As a producer and developer of lithium products used to develop batteries for electric vehicles, GLCI aims to position itself as a pioneer in this field and to implement these new technologies when they become available. As a result, GLCI will certainly seek out available assistance programs and the most fuel-efficient diesel equipment when the time comes to purchase equipment.

4 PROJECT DESCRIPTION

This chapter presents the various infrastructures and technologies proposed for the project. This description takes into account the optimizations that were made to the project described in the 2018 EIA.

4.1 MINERAL DEPOSIT

4.1.1 CHARACTERISTICS OF THE DEPOSIT

The pegmatites found on the property are from the Lower Eastmain Group of the Eastmain River greenstone belt. In 1975, a geological map of the property was prepared by the **Société de développement de la Baie-James (SDBJ)**. It showed that biotite schist and gneisses, together with mafic metavolcanics, dacites, quartzites, meta-conglomerates, meta-gabbros, granites and pegmatites were located on site. In addition, most of the non-intrusive rocks are foliated, striking E-NE, and dipping subvertically. The granites and pegmatites have a more massive appearance. The pegmatites delineated to date are generally parallel to each other and are separated by barren host rock of sedimentary origin, metamorphosed to amphibolite facies (Figure 4-1). An induced polarization and magnetometer survey performed over the property in June 2008 revealed the presence of a diabase dyke.

A total of 18 pegmatite dykes have been found on the property to date, with the potential of additional dykes to be delineated by additional drilling, as based on numerous undefined borehole intersections of pegmatite during the GLCI 2017 drilling program. The mineralization consists essentially of spodumene. Spodumene is a relatively rare pyroxene that is composed of lithium (8.03% Li_2O), aluminium (27.40% Al) and silicon dioxide (64.58% SiO_2). It is found in lithium-rich granitic pegmatites, commonly associated with quartz, microcline, albite, muscovite, lepidolite, tourmaline and beryl. Spodumene is the principal source of lithium found on the project property.

The crystal orientation of the spodumene can be used to identify the orientation of the pegmatites; as the crystal laths are generally perpendicular to the dyke trend or long axis. The SDBJ suggested that the pegmatites intruded in radial fractures emanating from a centre located to the West. It is likely that the spodumene pegmatites are related to a granitic batholith located SW of the property. Spodumene occur as white to greenish prismatic and striated crystals varying from a few millimeters to over 1 meter in length. When it is altered, sericite forms on the surface of the spodumene. As it progresses, the colour changes to brown from the increasing iron oxides adhering to the surface. Spodumene can also alter to a Li-bearing mica in platy aggregates pseudomorphs after spodumene. Microprobe analysis revealed genuine spodumene with the chemical formula: $(\text{Li}_{0.99}\text{Na}_{0.01})\text{AlSi}_2\text{O}_6$, with an iron content of 0.96% (total Fe_2O_3). The SDBJ also identified the major minerals associated with spodumene pegmatites in decreasing order of abundance as: perthitic feldspar, spodumene (25%), quartz, muscovite, apatite, beryl, iron oxides, ilmenite, serpentine, tourmaline and ferrisicklerite or lithiophilite ($\text{Li}(\text{Mn}, \text{Fe})\text{PO}_4$). It was also revealed that the pale green muscovite contains 0.18% Li_2O .

The available data suggests that the pegmatites on the project property are of the rare-element “class”, the lithium, cesium, tantalum ‘family’ and the albite-spodumene ‘type’ according to the classification of Cerny (1991). Most lithium, cesium, tantalum pegmatites are known to have intruded metasedimentary rocks, typically low-pressure amphibolite to upper green schist facies (Cerny, 1991). These pegmatites represent the most highly differentiated and last to crystallizing components of certain granitic melts. Regional zonation of rare metals is generally observed in such pegmatites, resulting from a cogenetic intrusion. This zonation indicates an enrichment of various rare metals in pegmatite dykes as a function of their distance from the cogenetic intrusion.

Spodumene-bearing pegmatites of the project are likely the most differentiated dykes and the most distant from the cogenetic intrusion; the Kapiwak Pluton located to the south of the property (Moukhsil and coll., 2001).

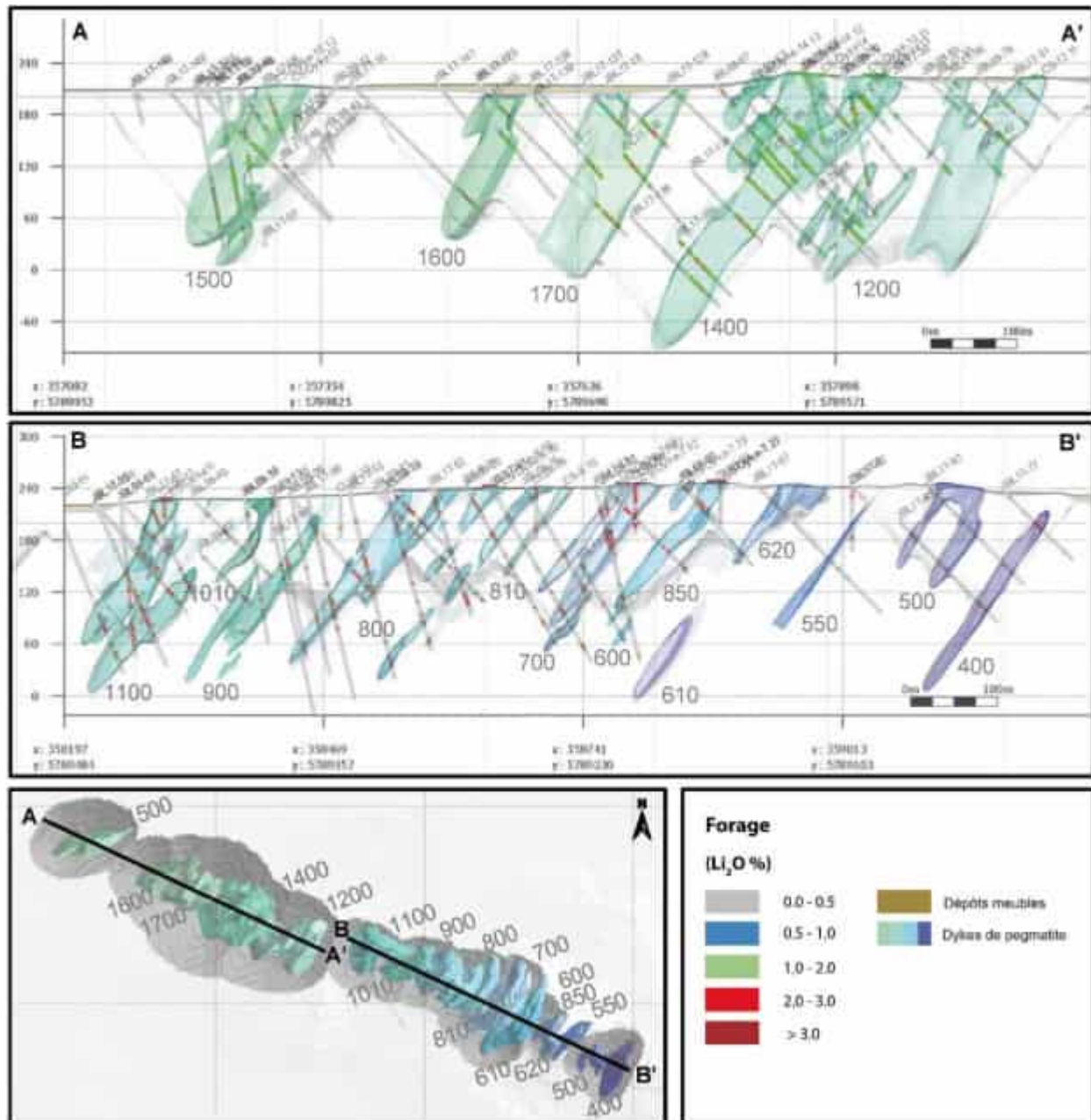


Figure 4-1 Model of pegmatite dykes

Source: SRK, 2018.

Individual pegmatites can form tabular dykes, sills, lenticular bodies, or irregular masses, and most lithium, cesium, tantalum pegmatites show some sort of structural control. Granitic pegmatites are generally more resistant and stand out from its environment, as is the case for the pegmatite in this project. It is easily recognizable due to its pale colour and unusually large crystal size (photo 4-1). The pegmatite dykes of the project are interpreted as being up to 60 m in width and over 200 m in length, generally striking south-southwest and dipping moderately to the west-northwest (215 degrees/60 degrees). Figure 4-2 illustrates a longitudinal view (looking at azimuth 30°) of the pegmatite deposit.



Photo 4-1 Spodumene crystal observed on project property

Source: G Mining Services, 2021.

4.1.2 MINERAL RESOURCES

The mineral resource presented in this section is taken from the **Preliminary Economic Assessment report (G Mining Services, 2021)**. The mineral resource model prepared by SRK considers 102 core boreholes from 2008-2009, 53 channel samples from 2009-2010, and 157 core boreholes drilled in 2017.

A three-dimensional model of the main pegmatite dykes was created (Figures 4-1 and 4-2). SRK concluded that the three-dimensional model is consistent with the drilling data. The bodies were modelled from logged pegmatite intervals, not Li₂O grades, as implicitly derived intrusions or vein contact surfaces. The resulting geological model incorporates 18 pegmatite dykes. Block model quantities and grade estimates for the project were classified according to the CIM Definition Standards for Mineral Resources and Mineral Reserves (2014).

SRK considers that the Li₂O mineralization on the project property is amenable to open pit extraction. SRK considers that it is appropriate to report the mineral evaluation at a cut-off grade of 0.62% Li₂O. There is insufficient material below the conceptual open pit shell to support an underground evaluation. SRK (2018) evaluates the indicated resources of the project to 40,330,000 tonnes at a grade of 1.40 % Li₂O.

4.2 MINE SITE GENERAL ARRANGEMENT

The following section highlights the main project components. The mine site consists primarily of the open pit and the adjacent construction quarry, the **stockpiles** for the combined waste rock and tailings (hereinafter the waste rock stockpile), **the overburden and peat stockpile** as well as the industrial and administrative area (Map 4-1). Details of the various project components are found in the following sections of this chapter.

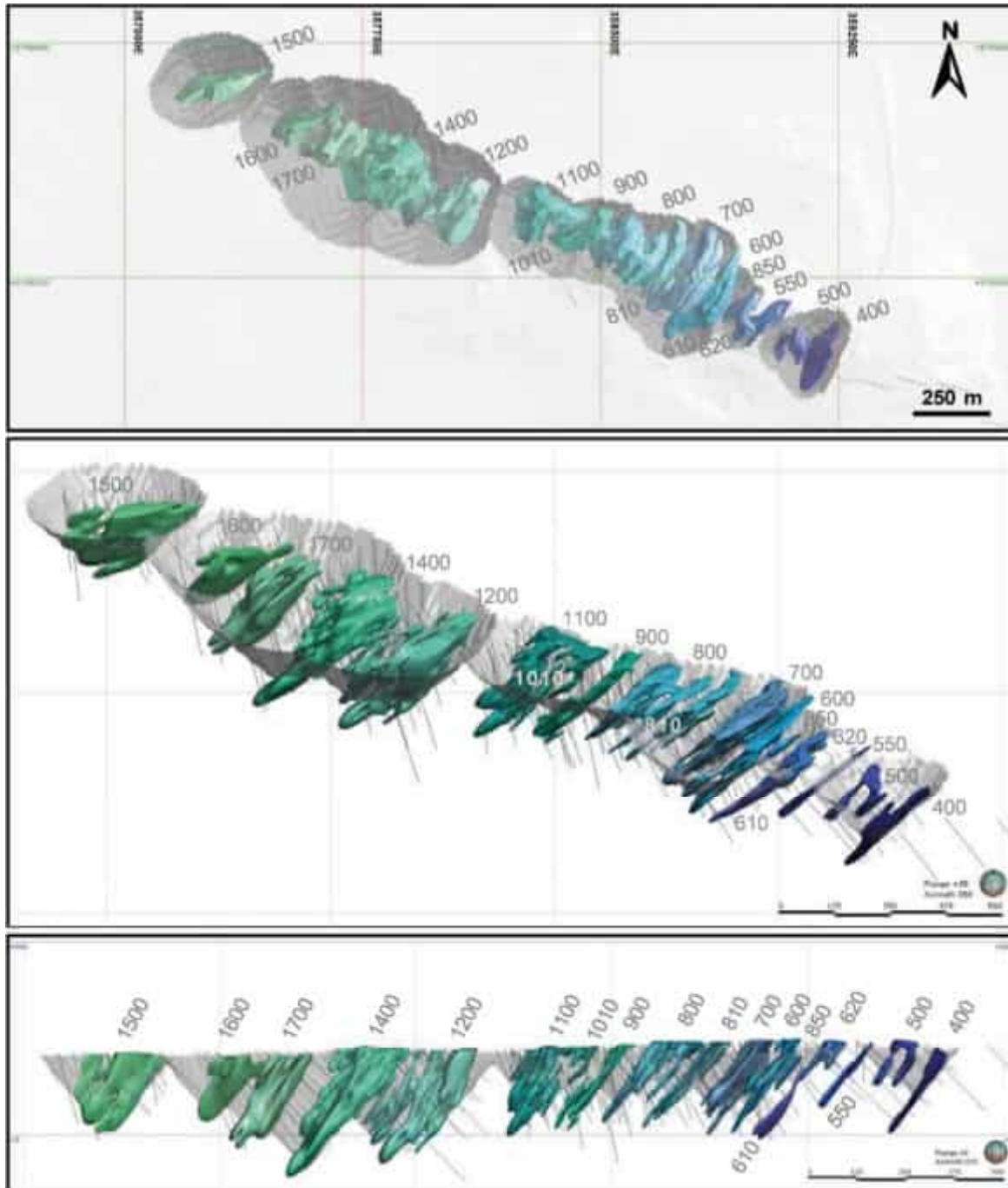


Figure 4-2 Representative cross-sections of pegmatite domains

Source: SRK, 2018.

The industrial and administrative sector includes the ROM pad, the industrial sector, the **mechanical workshop** and warehouses, the administrative buildings and housing.

An explosives storage facility is located at a safe distance from major infrastructure. Finally, there are **roads** for hauling and services.

With respect to water management infrastructure, **the project includes** two water ponds: the **main** one is located **at the northern boundary of the property**, north of the **overburden and peat storage facility**, while the second, **much smaller** one is located **northeast** of the **eastern waste rock and tailings** storage facility (WRTSF). **The water treatment plant (WTP) will be positioned to the east of the north water management pond, if required.** There is a clean water discharge site, to remove water from the north water management pond, which is located in CE2. For the construction phase, a concrete plant will also be erected **southwest of the plant site**. The site will be converted to a dry storage once construction is complete.

Table 4-1 summarizes the surfaces for each of the infrastructures mentioned in this section, for a total of **289.49** ha.

Table 4-1 Surface Areas of Project Infrastructure

Infrastructure	Area (ha)
Open pit	51.09
Waste rock and tailings storage facilities (including berms) - West WRTSF (29.0 ha) - North WRTSF (54.4 ha) - Southwest WRTSF (31.0 ha) - East WRTSF (58.1 ha)	172.05
Overburden and peat storage facility (including berms)	25.36
Industrial and administrative area	15.13
Concrete batch plant (construction phase) / Dry storage area (operation phase)	3.74
Water treatment plant and pumping stations	0.65
Explosives magazine	0.78
Roads and ditches	20.70
Total	289.49

4.3 INDUSTRIAL AND ADMINISTRATIVE AREA GENERAL ARRANGEMENT

The industrial and administrative area includes the following:

- A three-phase crushing circuit (located beside the ROM pad), conveyors and a screening station;
- A crushed material stockpile (in a dome) and reclaim;
- A **dense media separation (DMS)** building (also referred to as the concentrator);
- A storage building for DMS products and chemicals for WTP;
- A tailing thickening reservoir;
- Two **raw** water tanks;

- A tailing loading and stacking station;
- A propane storage area;
- The final product stockpile (spodumene concentrate), in a dome and loadout;
- Various workshops and warehouses;
- A series of administration buildings and laboratory;
- A weighbridge (scale) and gate;
- A high-voltage switchyard;
- A diesel storage area;
- A site-wide fence;
- The worker's camp;
- The residual material building.

Map 4-2 shows the general arrangement of the mine site.

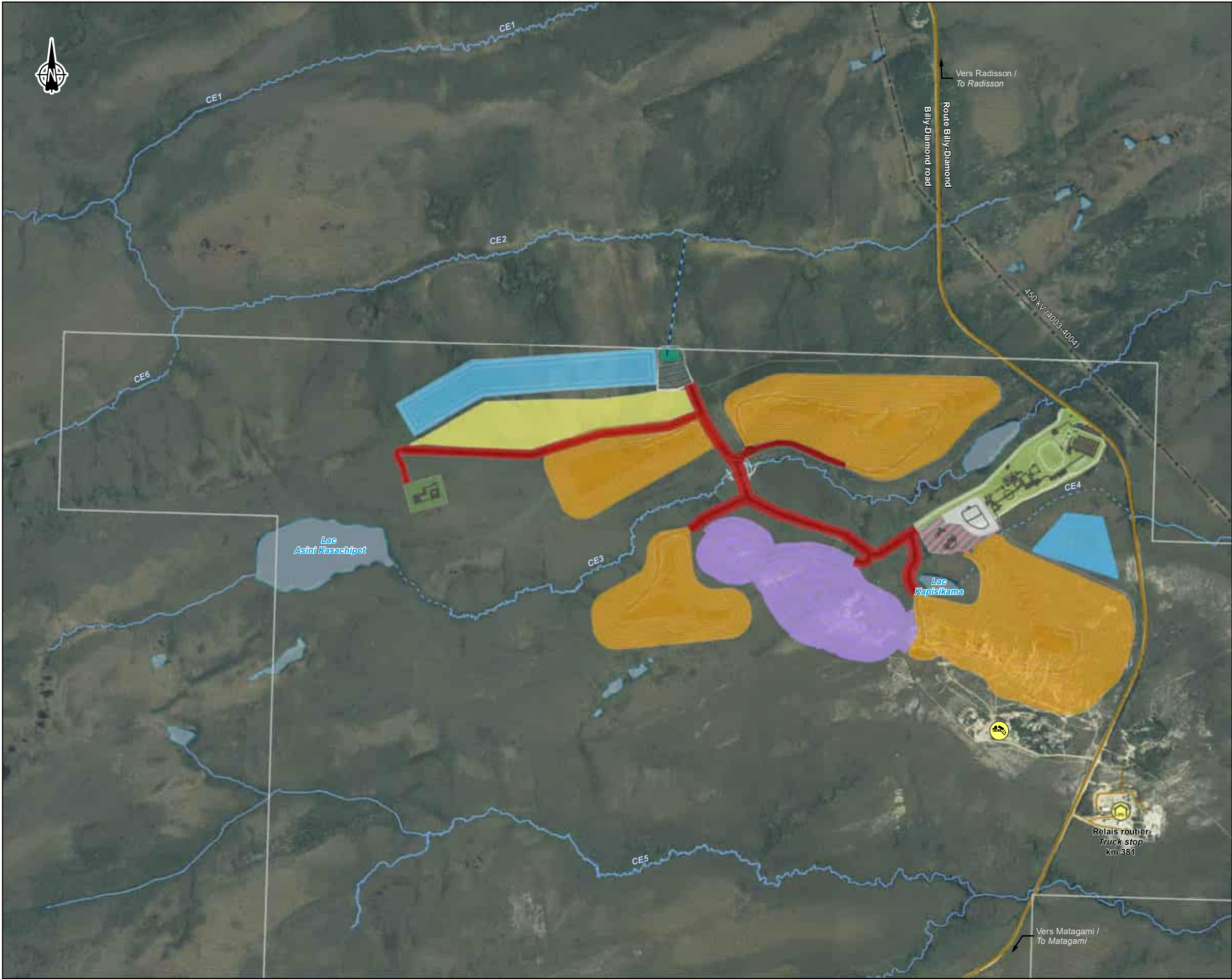
Most of the building foundations will be reinforced concrete. The concentrator building will consist of a steel structure covered by metal plating on the concrete slab and footings. The heavy equipment will be supported by a reinforced heavy-duty foundation.

The workshop and storage buildings will also be included in the DMS building. A two-storey building will be located near the DMS and will include the administrative area, the clinic and the laboratory.

All buildings will be insulated, heated and ventilated. They will include an access door for staff. In addition, the workshop and storage buildings will have a rolling steel door wide enough for a large forklift to pass through.

Some of the plant buildings, with the exception of cold storage facilities, are designed to have a heating-ventilation-air-conditioning (HVAC) system. The HVAC system will be more energy-intensive in the winter, as temperatures can drop to -45°C. Heat from the HVAC units will come from the propane heaters.

The site will be fenced and will include a gatehouse as well as strategically located closed circuit cameras.



- Limite de propriété / Property limit
- Composantes du projet / Project Component**
- Route / Road
- Effluent minier / Mine effluent
- Usine de traitement de l'eau / Water treatment plant
- Secteur administratif et industriel / Administrative and industrial sector
- Fosse / Pit
- Halde à minerais / ROM pad
- Halde à stériles / Waste rock stockpile
- Halde à matières organiques et dépôts meubles / Overburden and peat storage facility
- Entrepôt à explosifs / Explosives magazine
- Aire d'entreposage / Dry storage area
- Usine à béton (temporaire) / Concrete batch plant (temporary)
- Bassin de rétention d'eau / Water retention basin

- Infrastructures / Infrastructure**
- Route principale / Main road
- Route d'accès / Access road
- Ligne de transport d'énergie / Transmission line
- Relais routier / Truck stop
- Lieu d'enfouissement technique isolé / Isolated technical landfill

- Hydrographie / Hydrography**
- CE3

Numéro de cours d'eau / Stream number
- Cours d'eau permanent / Permanent stream
- Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream
- Plan d'eau / Waterbody

GALAXY
Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 4-1
Aménagement du site minier /
Mine Site General Arrangement

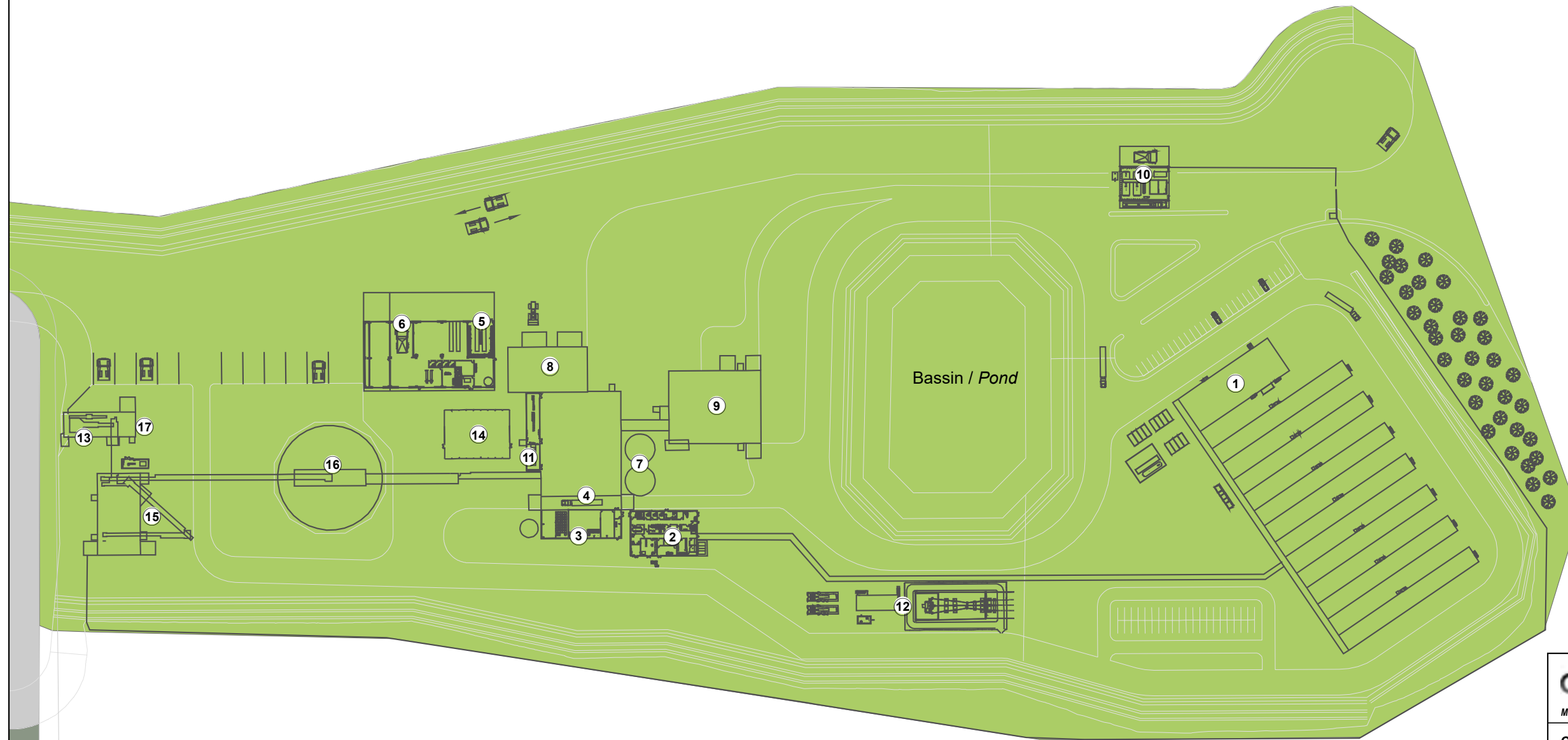
Sources :
Orthoimage : Microsoft Bing (ESRI, 2017)
Géom : MRNF Québec, 210315
Données du projet / Project data : Galaxy 2020

0 200 400 m
UTM, fuseau 18, NAD83

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201-12362-00_c4-1_wspT304_mine_GA_210629.mxd





- ① Campement, Cuisine, Réception /
Camp/Kitchen/Reception
- ② Bâtiment administratif, Clinique, Laboratoire /
Administrative Building, Clinic, Assay Lab
- ③ SMD / DMS
- ④ SMD / DMS
- ⑤ Atelier et station de lavage des camions /
Truck Shop and Wash Bay High Section
- ⑥ Atelier mécanique pour camion (future) /
Truck Shop – future
- ⑦ Réservoir / Tank
- ⑧ Chargement des résidus /
Tailing Loading
- ⑨ Manutention du concentré /
Concentrate Handling
- ⑩ Station de pompage , station-service /
Pump house, fuel station
- ⑪ Chambre électrique SMD /
DMS Electrical Room
- ⑫ Chambre électrique principale /
Main Electrical Room
- ⑬ Bâtiment de concassage /
Crushing Building
- ⑭ Entrepôt /
Warehouse
- ⑮ Concassage secondaire /
Secondary Crushing
- ⑯ Pile de minerai et aire de chargement /
Ore Reclaim and Stock Pile
- ⑰ Chambre électrique - concassage /
Crushing Electrical Room



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 4-2
Aménagement du secteur industriel et administratif /
Industrial and Administrative
Area General Arrangement

0 25 50 m
UTM, fuseau 18, NAD83

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Approbation : C. Martineau
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4.4 PREPARATORY WORK

Preparatory work consists of all the activities that precede the mining activities. **Site development and facility layout will be within one of the WRTSFs and other areas affected during the life of the mine to reduce the footprint (Map 4-3).** The following subsections describe the tasks included in each activity.

4.4.1 TRANSPORT

Air travel will be the primary means of transportation for workers **who live outside the region**. GLCI will **likely** organize charter flights from **Montreal and the Abitibi region** to the Eastmain airport and provide bus service to and from the site. The **Eastmain** airport is located **130 km** away from the project site.

Equipment and supplies will be trucked to the site. Equipment and supplies will be transported through Matagami **via the Billy-Diamond highway**. Minor improvements will be made **to km 382 of the Billy-Diamond highway to improve safety for users**. Turning lanes will be added in to and out of the site at the intersection of the Billy-Diamond highway and the site access road.

4.4.2 LOGISTICS

The worker' camp will be built to house the construction workforce as well as mining, processing, and administration personnel. Most of the buildings to be constructed will be a combination of “flat pack” components which will be assembled into 6 m x 2.6 m modules and containerized accommodation units.

Potable water for the construction camp will be initially trucked onto the site and stored in a potable water tank. Wells will be developed for the operations camp and will be used once they become operational. The same will apply to wastewater treatment. Water management is discussed in detail in Section 4.9.

All equipment and material will be stored on site in laydown areas prior to installation. Contractors conducting work in specific areas will be allocated space for temporary facilities. The location of these areas will be as close as practicable to the workplace and will contain the company-supplied site offices / temporary workshop areas and storage areas (equipment and material). Specific areas will be identified during award of each work package, considering the size and scope of the package and number of personnel. The number of areas established will be minimized to facilitate the provision of services and control traffic into the workplace. All laydown areas are included in the project footprint.

Once the workcamp is built, the contractors will position their trailers in the concrete batch plant area. Mechanical work on machinery will be initially done off-site, then in the MSA, once a leak prevention system is installed. **The mechanical work planned to be done off-site is actually light-duty, minor maintenance mechanical work to avoid having to return to Matagami (which is 381 km away) to do oil changes, tire changes or minor repairs to equipment used for basic site development. This work is scheduled to be performed at the SDBJ truck stop mechanical workshop. As soon as the site's mechanical workshop is set up, all mechanical work will be transferred there. The mechanical workshop is among the first buildings to be set up with the camp. The work added to the truck stop workshop is not significant; the truck stop has the availability to accommodate the few extra trucks and customers. If the SDBJ workshop is overloaded and the GLCI workshop is not ready, equipment requiring minor maintenance will be returned south to Matagami, Rouyn or Val-d'Or for servicing.**

Discussions are currently in progress with the SDBJ to use the km 381 truck stop as an accommodation site to facilitate the construction of the early facilities and initial wings of the worker's camp as well as construction offices and even housing contractors during the operation phase. However, no commitment has been made at this time. As such, if an agreement is not possible the accommodation camp on-site will house the expected 280 workers **during construction**.

4.4.3 QUARRY AND BORROW PITS

Due to the limited amount of construction materials available in the project area, GLCI wishes to use overburden and waste rock for road construction. Contrary to what was planned in the 2018 project, diabase will not be used as a building material. The waste rock will be mined and broken up, then weathered to leach out any metals that may seep for a few weeks. The broken waste rock seepage area will be contained and the water will be collected, monitored and treated if necessary, before being discharged to the environment. For the concrete aggregate, GLCI will purchase its material from a quarry already in operation at km 394.

A sand borrow pit located immediately south of the mine site, west of the truck stop landfill will also be used. However, another borrow pit will have to be opened to meet the sand and gravel requirements. The location of the latter is not known at this time. Potential borrow pits in the area of the mining project were explored in 2019 (Stantec, 2019). Depending on needs, the potential quantities to be mined will be analyzed to validate which site would be the most appropriate. The potential borrow pits pre-identified by Stantec (2019) are located on Map 4-4.

Sandpits are subject to restoration plans defined at the time of their application for authorization under the Environment Quality Act (EQA). Sand pits are generally under non-exclusive permits and their restoration method is included in the operating permit. Each sandpit or portion of a sandpit used will be closed in accordance with the requirements of the permits granted. As part of the sandpit permit applications, surface rights holders, including tallymen, will be involved.

In summary, restoration will be consistent with the objectives specified in Section 38 of the Regulation respecting pits and quarries (RCS), which are:

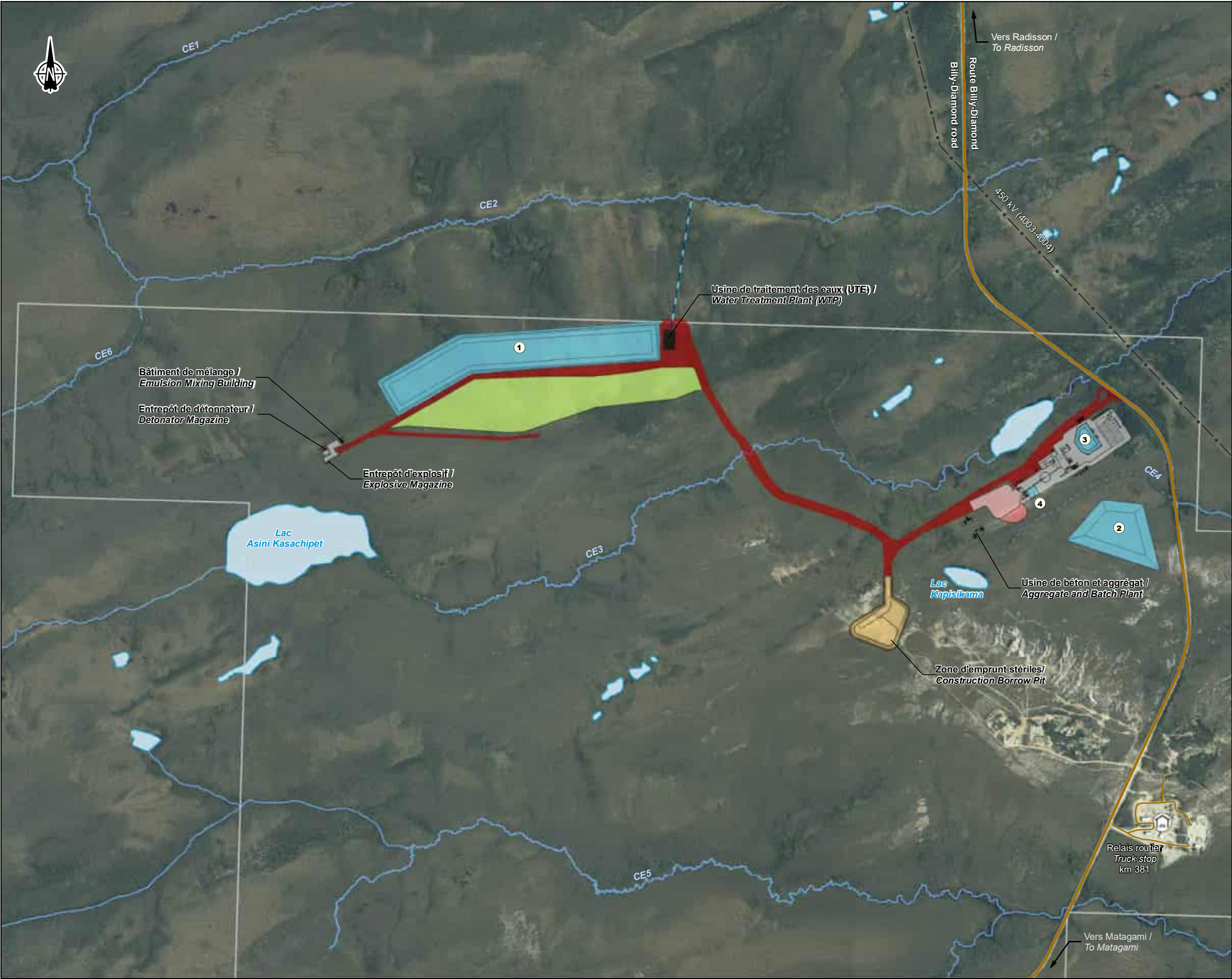
- 1** elimination of unacceptable health risks and ensuring the safety of persons;
- 2** prevention of the release of contaminants that could harm the environment;
- 3** elimination of any long-term maintenance or follow-up;
- 4** restoration of the site to a condition compatible with its future use.

Revegetation of the sites is the preferred option for restoring the sites to as close to their original condition as possible. As for the access roads, the conceptual restoration plan stipulates that their future will be the subject of consultations with local communities, including the tallyman. They could be vegetated in a natural way to maintain access to the territory for users.

Specific measures for site revegetation are as follows:

- Select native plant species that are adapted and appropriate to the hardness zone.
- Prevent the introduction of invasive alien species, eradicate them and monitor their presence annually.
- Add value to non-commercial wood by chipping them and using them to improve the soil.

Vegetation-related measures will promote conditions for the recovery of wildlife habitat naturally. The restoration of the borrow pits is also intended to make the areas accessible to the communities again. Finally, at the end of the restoration work, the surface of the borrow pits will be free of any debris, waste, stumps, unusable equipment, machinery or other such clutter.



Limite de propriété / Property limit

Composantes du projet / Project Component

Effluent minier / Mine effluent

Route / Road

Bâtiment ou usine / Building or Plant

Secteur administratif et industriel / Administrative and industrial sector

Fosse / Pit

Halde à matière organique et dépôts meubles / Overburden and peat storage facility

Halde temporaire de stockage du minerai / Rom Pad

Agrandissement / RomPad expansion

1

Bassin de gestion des eaux / Water management pond

2

Bassin de gestion de la décharge Est / East dump management pond

3

Bassin / Pond

4

Bassin / Rom Pad Pond

Infrastructures / Infrastructure

Route principale / Main road

Route d'accès / Access road

Ligne de transport d'énergie / Transmission line

Relais routier / Truck stop

Hydrographie / Hydrography

CE3

Numéro de cours d'eau / Stream number

Cours d'eau permanent / Permanent stream

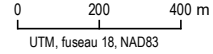
Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream

Plan d'eau / Waterbody

GALAXY
Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 4-3
Aménagement du site minier – Année -1 /
Mine Site General Arrangement – Year -1

Sources :
Orthoimage : Galaxy, août / august 2017
General Arrangement, 2020
Données du projet / Project data : Galaxy 2020



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Composantes du projet / Project Components

- Route d'accès potentielle / Potential access road
- Route d'accès existante / Existing access road
- Source de matériaux d'emprunt / Borrow sources
- Carrière / Quarry
- Infrastructures minières / Mining infrastructure

Infrastructures / Infrastructure

- Route principale / Principal road
- Route d'accès / Access road
- Ligne de transport d'énergie / Transmission line



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 4-4
Localisation des bancs d'emprunts
et des carrières / Localisation of
Borrow Pits and Quarries

Sources :
Orthoimage : Galaxy, août / august 2017
Données du projet / Project data : Galaxy, 2020
Banc d'emprunt / Borrow pit, Stantec, 2019

0 350 700 m
UTM, fuseau 18, NAD83

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Approbation : C. Martineau
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4.4.4 LAYDOWN AND CONCRETE BATCH PLANT

The concrete plant site will be converted to a storage yard during the operation phase. During the construction phase, a mobile crusher and a vibrating conveyor will sort the rocks by size and separate them into different piles. Only the material from the quarry at km 394 will be used in the concrete plant. An aggregate storage area will be located near the plant, within the footprint of the surfaces affected by the mine development. The site will be used to prepare concrete to be poured into the foundations of buildings and tanks in the industrial and administrative sector. Administrative trailers and contractor equipment will also be located in this area.

The locations of the concrete plant and temporary crushing plant are shown on Map 4-1. They are located on a firm plateau southwest of the plant site. The equipment and concrete mixer washing area will be located at the process plant site, within the footprint of the plant pad stormwater management pond. The water that will come into contact with the concrete plant will be directed to a well for the separation of suspended solids and an acid will be added to balance the pH of the water before it is reused as industrial treated water required at the treatment plant.

The mobile concrete plant will be used during the construction phase only. It will operate until the industrial complex and mine infrastructure are built. The machinery required to operate the concrete plant could include truck mixers, a boom truck to handle bags of cement or a loader to feed the plant with sand and crushed stone, and a tank truck to supply the freshwater tank required for cement production.

Contaminated water could come from accidental spills. The collection and decontamination of soil in the event of any accidental spill of petroleum products will be carried out without delay and according to a procedure that will be implemented. In the event of an overflow or spill from the truck wash basin, the site would also be cleaned up immediately. The contaminated material would then be sent for management off-site at a licensed site. Otherwise, there will be no contaminated water discharged or effluent from this plant.

The concrete plant will require a supply of 300 L of water / m³ of concrete produced. The water will be taken from Lake Kapisikama.

Truck mixers and concrete mixer scuppers will be cleaned with pressurized water in an area reserved for this purpose. No soap will be used. The concrete mixer will be brought forward near a water collection and settling pond, equipped with an oil-water separator. This pond will be approximately 10 m by 10 m. It will be constructed of granular backfill extracted from a quarry for which a permit application to MELCC and MERN will be filed. It will be waterproofed with a membrane made of geotextile and HDPE-40 or equivalent, covered with fine gravel. The water will be checked for TSS, oil and grease, pH before being discharged into the environment. Should the pH exceed 9.5 and TSS exceed 25 mg/L when checked, immediate action will be taken to retain and treat the water before discharging it to the environment or the site drainage system.

Dust collectors will be installed on the cement silos and a dust collection system will be set up at the transfer points.

Aggregate will be kept at the storage area identified on Map 4-1 during the construction phase. Aggregates will be stored in such a way that no particles are released into the environment. For example, they could be placed on a concrete slab or a waterproof membrane. Aggregates could also be covered with a waterproof membrane if they are stored outside (not inside the storage facility).

4.4.5 EARTHWORKS

Site earthworks are required **prior to** construction and mining **operations**, to build roads as well as foundations for various infrastructures. Table 4-2 summarizes the quantities for the main earthworks.

Table 4-2 Earthworks quantities

Activity	Unit	Value
Excavation of organic material	m ³	636,200
Excavation of granular material	m ³	1,100,000
Final trimming, grading, profiling	m ³	97,900
Grading and profiling of the land	m ²	213,000
Rock excavation	m ³	675,000
Production of aggregate for earthworks	m ³	127,070
Drainage	m	44,030

Source: G Mining Services, 2021.

4.4.5.1 CLEARING AND EXCAVATION

Clearing and grubbing will be done in areas to be excavated, subgrades to fill embankments, subgrades to concrete slabs and foundation structures and subgrades to roads. Typically, clearing will extend a minimum 3 m beyond the work area footprint. Trees, stumps and shrubs will be cut at approximately ground level. All wood and waste will be removed and disposed of in an approved manner. All stumps, roots, vegetation, other organic and topsoil matter below ground level will be moved to the **overburden and peat storage** facility. **The areas to be cleared include all vegetated areas within the project footprint, as well as an additional 50 m around them (35-m fire protection ring and an additional 15 m for machinery movement).** The resulting holes will be backfilled using suitable fill material, compacted to a maximum modified dry density equivalent to that of the surrounding soil. Under embankments, the backfill will also be compacted. Snow and ice cleared off the construction area will be piled outside of the construction area where it will not affect the construction or any constructed elements during thaw.

All soil that is of soft to medium stiffness, is saturated, disturbed or otherwise deemed unsuitable, will be excavated and moved to the **overburden and peat storage** facility. The unsuitable material will be replaced using suitable bulk or select fill material and compacted to a density equivalent to that of the acceptable surrounding soil.

Excavation will be carried out to ensure effective utilization of material for filling. Material classified as suitable for fill in accordance with construction specifications will be stockpiled separately and securely. Excavations that are steeper than the specified batter slopes for the material being excavated will be adequately supported by bracing and shoring to prevent slides, slips, or cave-ins. Bracing and shoring will comply with all requirements of the relevant statutory legislation and regulations for construction safety.

Surface water flows during the melting seasons will be directed away from the works by means of diversion berms, ditches or other acceptable means and all surface flows in the construction sector will be satisfactorily controlled. Adequate drains, sumps, sheet-piling, pumps and other approved means of dewatering will be used as necessary to remove all free water from excavation. Disposal of water removed from excavations is explained in Section 4.9.

4.4.5.2 BACKFILL

Embankment construction and backfill consists of all earthwork operations necessary to place fill materials using excavated or borrow material to the lines and levels shown on the drawings. The fill material will be free any deleterious materials including:

- Vegetation or timber or any other perishable matter;
- Demolition materials including masonry and concrete rubble;
- Organic or unstable soils;
- Expansive soils subject to high volume change.

Prior to placement of fill, the ground surface will be prepared as mentioned above. The stripped surface will be scarified to a depth of 300 mm where practical so the fill material binds into natural ground. The stripped and scarified surface will be proof-rolled and compacted. Material which cannot be compacted to the required standards will be reworked or replaced.

Embankment fill will be used for construction of all embankments which are not intended to support structures. The moisture content of each layer will be controlled to achieve the specific dry density. Moisture content will be adjusted by watering or by setting aside and turning material to dry. The fill will be compacted following engineering recommendations. Select fill will be used adjacent to foundations, footings, walls, etc., which are below grade, beneath all concrete floor slabs-on-grade and where otherwise shown on the drawings. For embankment fill, the moisture content of each layer will be controlled and compacted.

Following placement, compaction, and removal of excess fill, surfaces will receive a final shaping with a grader or excavator to produce a smooth surface and uniform cross-section. Should delays occur in spreading or compacting fill, the previously compacted layer will be scarified, rewatered if necessary, and recompacted. Should a preceding compacted layer become damaged (e.g. by excessive water ingress), the layer will be removed and replaced with suitable material.

4.4.5.3 BORROW PIT MATERIAL TESTING

Prior to being included in the earthworks, all construction materials from **the borrow pit**, including coarse and fine aggregate and granular materials, will be subject to dry sieve analysis and any other testing necessary to ensure compliance. Tests will be conducted upon establishment of **the borrow pit**.

4.4.5.4 DITCHES

Ditches consist of open channel ditches and seepage drains. Open ditches will be constructed at specified intersections. **No waterproofing or geomembrane material is provided. In addition, there will be directed drainage along the entire length of the ditches.** Changes in grade and line will be gradual. Over-excavation which may lead to channel erosion damage at intersections, pipe entries and the like will be minimized, and will be corrected. Rip-rap or other forms of channel protection will be incorporated where specified on drawings.

Seepage drains will be constructed to the specified cross-section using free-draining granular material with typical grain size in the range of 0.1 mm to 200 mm. Free-draining granular material will comprise an open-graded, hard, durable, angular gravelly rock material with particle sizes in the range of 30 mm to 300 mm. Drainage material will be placed on a grubbed and compacted surface. After placement, the drainage material will be covered with a geotextile separation layer.

4.4.5.5 RIP-RAP

Rip-rap will consist of a course of heavy stone, on bedding, laid to protect slopes or drains. Rip-rap will be hard, durable, angular rock having a specific gravity, when dry, of at least 2.5. Typically, rock size will be not less than 150 mm average dimension nor greater than 500 mm average dimension. Bedding, when required, will consist of sound uniform gravel, evenly graded from 5 mm to 50 mm.

Surfaces on which rip-rap is to be placed will be trimmed to a uniform slope. Rip-rap will be placed in a manner which ensures that the larger rocks are uniformly distributed throughout the protection work and the smaller rocks effectively fill the spaces between the large rocks without leaving any large voids. Laying will commence at the toe of the slope and progress upwards, with each stone being firmly embedded into the slope and against the adjoining stones. The rip-rap will be thoroughly **compacted** as the construction progresses, so that the finished surface is tight and uniform and conforms to the design slope.

4.4.6 POWER SUPPLY

Two emergency diesel generators will be required to provide emergency power to the workers' camp and buildings in the event of a loss of utility supply. These units will be installed early to provide the required power for the workers' camp housing. Small generators will be required on an occasional basis, but only temporarily during construction. Earthwork contractors will provide their own generators.

4.4.7 COMMUNICATION SYSTEM

A fibre link will be installed from the SBDJ km 381 truck stop to a site data room located adjacent to the communications tower. A two-way radio system will also be provided on a communications tower within the construction camp above the mine and plant site. This facility will be built during the initial phase of construction, to provide radio communications during construction and mine pre-stripping operations. The base unit will be solar powered, with sufficient battery backup to give up to five days operations. Hand-held satellite telephones will also be available for use as required and for emergencies.

4.4.8 FUEL SUPPLY

During the initial phase of construction, diesel will be sourced from the km 381 truck stop. At a later stage, contractors will provide their own fuel tanks to replenish their mobile equipment. In the final construction phase, the diesel farms will be operational and used.

4.4.9 SECURITY

One of the early activities will be to secure site **access** and establish security at the entrance to the site. This will allow site operations to proceed without interruption from the public and will ensure that tools and equipment are secured. GLCI will ensure that an ambulance and infirmary are available on site. Discussion are currently in progress with the SDBJ and the CRSSBJ to share medical and ambulance services.

4.5 EXTRACTION

According to the present mine plan, approximately **37 Mt** of material could be extracted at an average grade of **1.30 % Li₂O** and the total waste rock excavation required will be approximately **130 million tonnes** (Table 4-3). As presented in Section 4.1.1, the economic material consists of spodumene-bearing pegmatites. Spodumene is composed of lithium oxides (Li₂O), aluminum oxides (Al₂O₃), and silica (SiO₂). The waste rock is composed of metasediment (84.9 **wt %**), banded metasediment (14.0 **wt %**), mafic volcanic (0.9 **wt %**), feldspar porphyry (0.2 **wt %**), and noneconomical pegmatite (0.1 **wt %**). In addition, almost 6 Mt of overburden will be displaced.

Table 4-3 Composition and quantity of waste rock and overburden

Category	Volume (m ³)	Tonnage (t)
Total waste rock	59,047,447	129,904,382
Overburden	2,900,716	5,801,431
Total	48,931,856	133,260,352

Source: G Mining Services, 2021

4.5.1 OPEN PIT CONFIGURATION

Pit slopes were designed using a geotechnical model composed of geological, structural, rock mass, and hydrogeological models. The rock mass model of the project is based on a geotechnical drillhole database, composed of 171 diamond drillholes. Fourteen boreholes were drilled specifically for the geotechnical design and were oriented and logged in detail during winter 2018. Stability analyses conducted included kinematic analyses and global slope stability analysis using a limit equilibrium approach. Based on a review of the geotechnical drillhole and rock property testing data, major lithologies were assumed to be geotechnical domains.

The primary focus of the pit slope design is to create a safe and economical design at the bench, inter-ramp, and overall slope scale (Figure 4-3). After reviewing and assessing all drillhole and rock property data, material properties were developed using industry-recognized rock mass failure criterion. Slope design sectors were identified and a geotechnical stability assessment was completed for:

- Bench scale using kinematic analysis including planar sliding, wedge sliding, flexural toppling, and direct toppling;
- Inter-ramp angle and height with rock mass classification values and empirical design graphs;
- Overall angle using 2D finite element numerical modelling on seventeen typical sections in various orientations and various parts of the proposed pits.

Based on industry standards, the acceptance criteria for bench stability is a Factor of Safety (FoS) of 1.1 in static conditions. Acceptance criteria for inter-ramp angle and overall angle were selected assuming that the failure consequences would be medium. Typically, a “high” consequence of failure is associated with sensitive infrastructure located near the pit crest (e.g. building, public road). Thus, the following factors were set for safety:

- Inter-ramp angle: 1.2 and 1.0, for static and dynamic failure, respectively;
- Overall angle: 1.3 and 1.05, for static and dynamic failure, respectively.

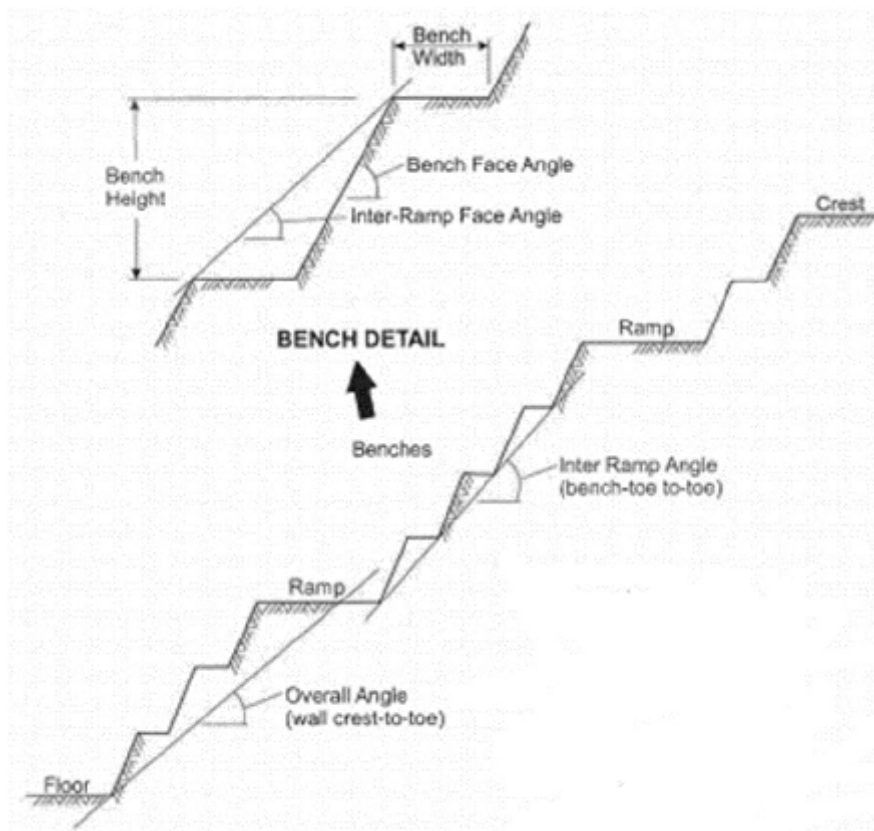


Figure 4-3 Schematic representation of pit geometry

Source: Read and Stacey, 2009.

The bench height was fixed to 10 m with a double bench mining approach, for a combined bench height of 20 m. The recommended bench, inter-ramp angle, overall angle design parameters for the project are presented in Table 4-4.

Table 4-4 Pit design criteria

Variable	Value
Bench height (m)	20
Catch bench width (m)	9
Bench face angle (°)	75
Inter-ramp angle (°)	54
Overall angle (°)	48
Note: Maximum bench stack height: To uncouple slopes, incorporate a 20-m haul road or 20 m wide geotechnical bench below slopes greater than 120 m in height.	

Source: Petram, 2018.

The 20 m berms are designed with a 75-degree face angle with 9 m side catch berms. This results in an inter-ramp angle of 54 degrees and, with the addition of a 20 m wide haul road, an overall angle of 48 degrees. The stability analyses conducted by Petram (2018) for all these parameters demonstrated that the geometry respected all the acceptance criteria, both static and dynamic (when applicable). To manage risks associated with rock fall and adverse effects on mining costs and production, careful blasting practices will be adopted for the project. To uncouple slopes, the design till incorporates a 20 m haul road or 20 m wide geotechnical bench below slopes greater than 120 m in height.

A formal system will be developed in operations to maintain clean bench tops and face scaling immediately after blasting and during excavation to assist the management of rock fall hazards to personnel and equipment. The pit configuration will evolve from its initial configuration at Year 1 until the end of the LOM. Maps 4-5 and 4-6 illustrate the evolution of the mine site for Years 2 and 13.

4.5.2 MINING METHOD

Typical excavator and truck surface mining will be utilized to extract and transport material. A backhoe excavator was selected over a front-end loader as a backhoe provides higher mining selectivity based on the nature of the pegmatite dykes. Backhoe configured excavators were selected as they provide higher productivity and versatility than the front shovel counterpart. The excavator has the added advantage of mining from the bench above without requiring the construction of a ramp.

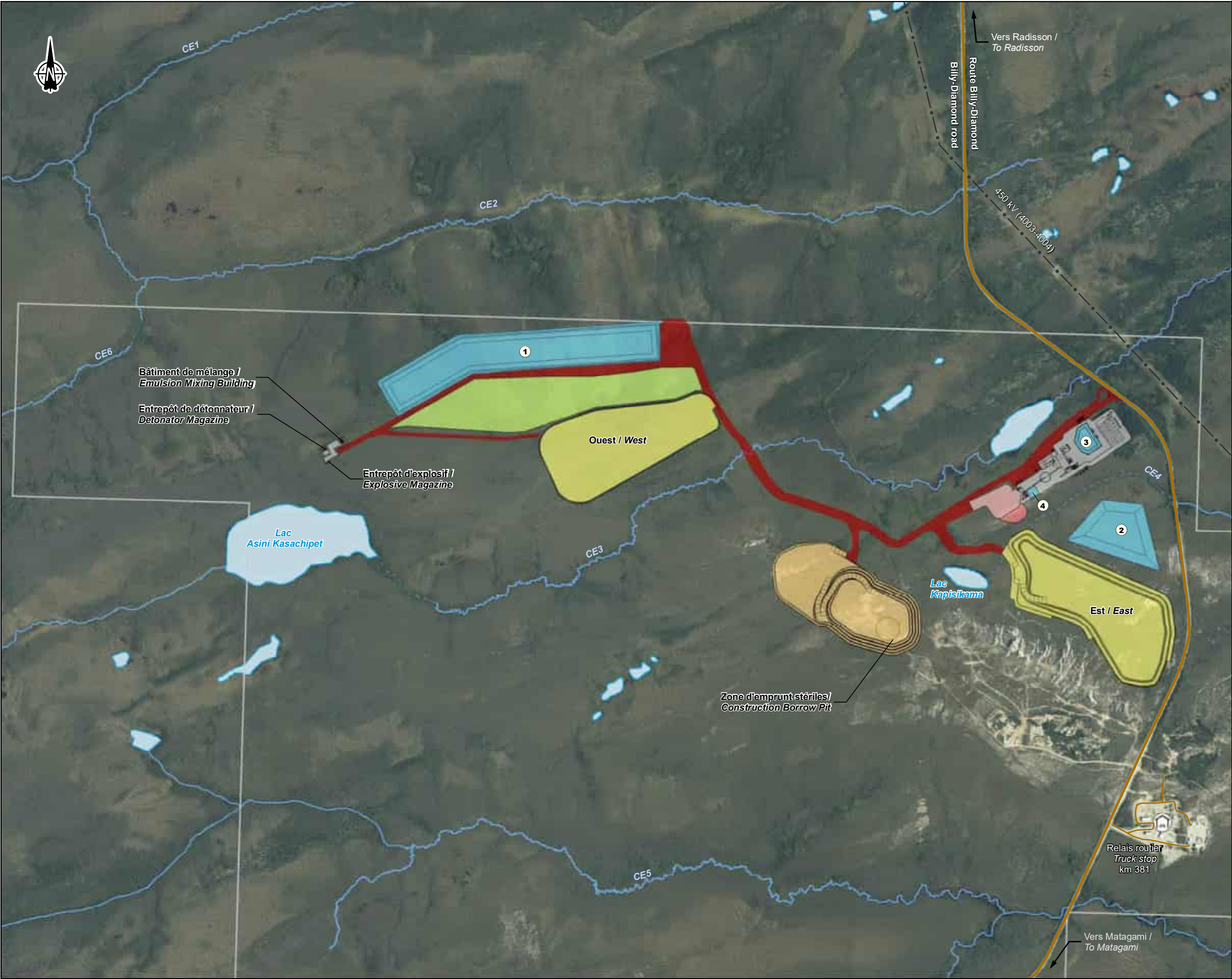
Mining for each bench will start on the hanging wall side of the mineral deposit and progress towards it. Once the material is extracted, remaining waste material on the footwall will be mined out in conjunction with developing an access road for accessing the next bench below. As mentioned in the previous section, the bench will be 10 m high. When vertical dilution is high, the 10 m blast is reduced to 5 m blast for further differentiation.

Material will be sequenced and scheduled utilizing phased pits. This will enable a smooth transition of lower waste stripping during the initial years with a gradual increase later in the mine life. Material will be trucked to the ROM pad. Trucks will transport the ore to the ROM pad located **northeast of the pit**. The overburden and **surface deposits** will be transported by truck and placed in a **specific** stockpile, **as will the waste rock, which will be transported to four separate stockpiles**.

Individual pegmatite swarms (dykes) are narrow in nature and run in the north-east and south-west direction. Deposit will be mined along strike direction (NE, SW) to achieve selective extraction of pegmatite material.

Bulk explosives will be utilized for production blasting. Ammonium Nitrate/Fuel Oil (ANFO) and emulsion explosives will be utilized on a 50/50 volume ratio. During the wet months (May to October), bulk emulsion explosive will be utilized, with the drier months (November to April) utilizing ANFO.

Drill and blast configurations have considered the stand-off distances required to account for fly rock, air blasts, and ground vibrations for buildings and public roads. The mine plan complies with Québec's regulations with respect to maximum of explosives detonated within a fixed time frame and the distance **from** a public or tier infrastructure. Mine design has considered the impact of this restriction with the proximity of the km 381 truck stop. As a result, a small portion of the pit in the south consisting of 2% of the entire ultimate pit volume will require production blasts at 5-m high benches. Drilling will be done on site using diesel powered DTH machines capable of drilling between 89 to 152 mm holes. Blastholes will be drilled at a depth between 5.5 m and 11.5 m (10 m bench with 1.5 sub-drill depth) for all waste rock and for most of the economic material. A small portion of the economic material will have 5.5 m blastholes (5 m bench with 0.5 m sub-drill depth).



Limite de propriété / Property limit

Composantes du projet / Project Component

Effluent minier / Mine effluent

Route / Road

Bâtiment ou usine / Building or Plant

Secteur administratif et industriel / Administrative and industrial sector

Fosse / Pit

Halde à matière organique et dépôts meubles / Overburden and peat storage facility

Halde à stériles et résidus minier / Waste rock tailing storage facility

Halde temporaire de stockage du minerai / Rom Pad

Agrandissement / RomPad expansion

1

Bassin de gestion des eaux / Water management pond

2

Bassin de gestion de la décharge Est / East dump management pond

3

Bassin / Pond

4

Bassin / Rom Pad Pond

Infrastructures / Infrastructure

Route principale / Main road

Route d'accès / Access road

Ligne de transport d'énergie / Transmission line

Relais routier / Truck stop

Hydrographie / Hydrography

CE3

Numéro de cours d'eau / Stream number

Cours d'eau permanent / Permanent stream

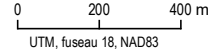
Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream

Plan d'eau / Waterbody



Carte / Map 4-5
Aménagement du site minier – Année 2 /
Mine Site General Arrangement – Year 2

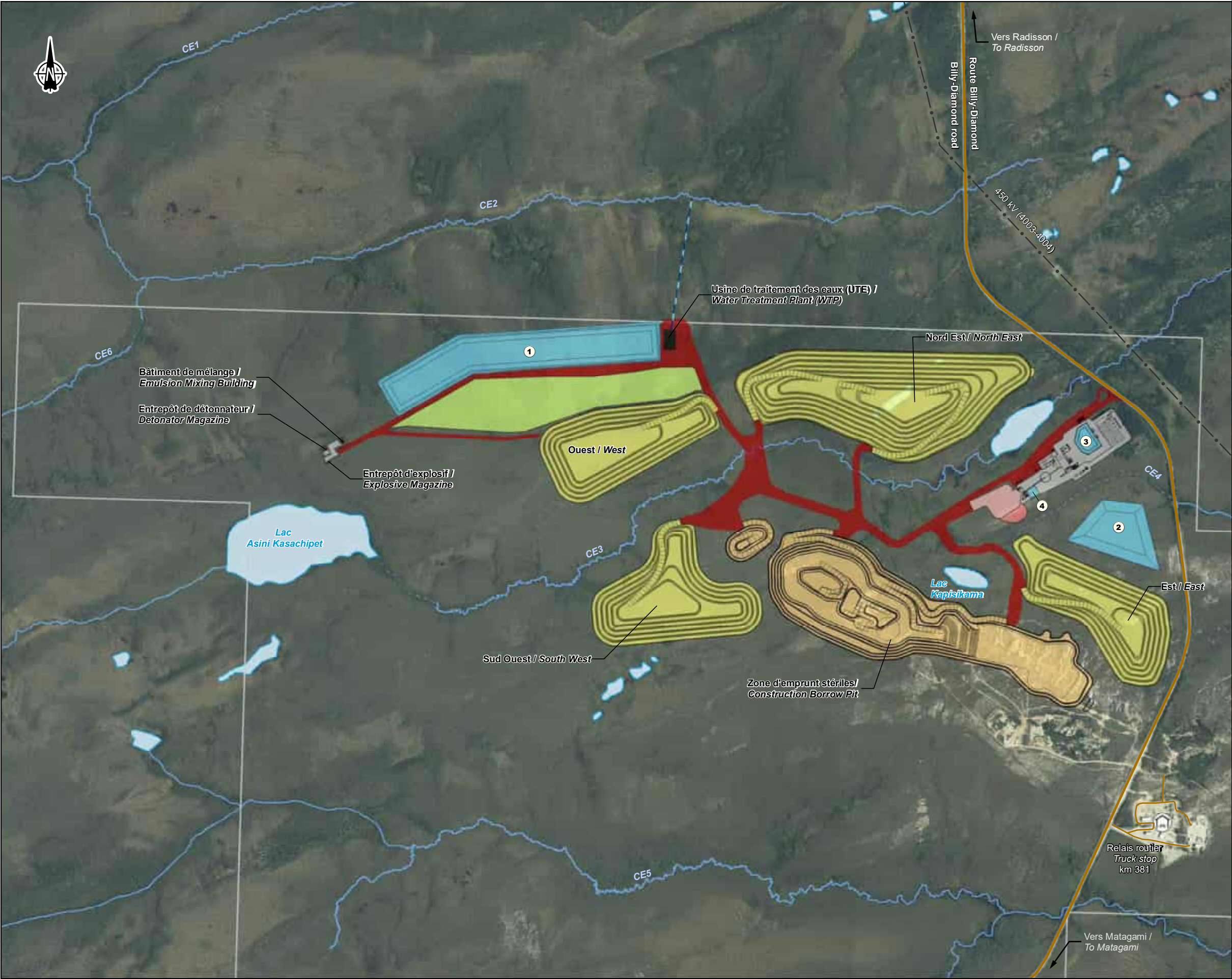
Sources :
Orthoimage : Galaxy, août / august 2017
General Arrangement, 2020
Données du projet / Project data : Galaxy 2020



Juillet / July 2021

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c4-5_wspT307_mine_design_yr2_210629.mxd





Limite de propriété / Property limit

Composantes du projet / Project Component

Effluent minier / Mine effluent

Route / Road

Bâtiment ou usine / Building or Plant

Secteur administratif et industriel / Administrative and industrial sector

Fosse / Pit

Halde à matière organique et dépôts meubles / Overburden and peat storage facility

Halde à stériles et résidus minier / Waste rock tailing storage facility

Halde temporaire de stockage du minerai / Rom Pad

Agrandissement / RomPad expansion

1

Bassin de gestion des eaux / Water management pond

2

Bassin de gestion de la décharge Est / East dump management pond

3

Bassin / Pond

4

Bassin / Rom Pad Pond

Infrastructures / Infrastructure

Route principale / Main road

Route d'accès / Access road

Ligne de transport d'énergie / Transmission line

Relais routier / Truck stop

Hydrographie / Hydrography

CE3

Numéro de cours d'eau / Stream number

Cours d'eau permanent / Permanent stream

Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream

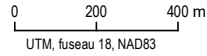
Plan d'eau / Waterbody



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 4-6
Aménagement du site minier – Année 13 /
Mine Site General Arrangement – Year 13

Sources :
Orthoimage : Galaxy, août / august 2017
General Arrangement, 2020
Données du projet / Project data : Galaxy 2020



Juillet / July 2021

Dessin : A. Masson
Approbation : C. Martineau
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Explosive products and blasting accessories will be provided by a third-party contractor. This third-party contractor will be responsible for the storage and blending of explosives on site, and delivery of these products to the drill hole. The contractor will also supply a magazine for blasting caps and accessories, and a separate magazine for boosters and packaged explosive products. Map 4-1 illustrates the proposed location of the explosives magazines.

Equipment fleet requirements are based a hydraulic excavator (backhoe) with a capacity of 7 m³, loading a **100-tonne** rigid frame haul truck. The size selected for the excavator is the largest that still allows the mine to have two excavators, which are required for the multi-pit operations of the project. The **100-tonne** rigid frame haul truck was chosen for the 7 m³ excavator because it can be loaded in **6.5 passes and maintains 75 % efficiency in loading cycles, which means that nearly 10 haul trucks can be loaded per hour**. The haul trucks are needed to transport tailings from the industrial sector **to the stockpiles**. A hopper bin will be utilized at the plant to load tailings onto trucks, as required. Given the lower tonnage of tailings and tighter confines of the hopper area, a 40-tonne articulated truck was selected for this task.

Total fuel consumption for the truck fleet over the life of the project is estimated to be 34.3 million litres.

Secondary equipment will **also** be used to directly support the equipment selected for mine production. The following activities will be carried out by secondary equipment:

- Clearing of spilled rock in mucking areas around excavators;
- Grading of in-pit bench areas for efficient work;
- Grading of stockpile platforms and clearing of rock for efficient truck unloading;
- Clearing of drill pads of any fly rock from previous blasts and mining operations to allow for productive drill patterns and for the safe loading of patterns by the blasting crew;
- Grading and clearing of in-pit ramps and surface haul roads with regards to spill rock and snow along with proper road maintenance, i.e. repairing ruts and allowing for the draining of any standing water.

There will also be auxiliary equipment such as pick-up trucks, passenger wagons (busses), dewatering pumps. **All light vehicles, such as vans and buses, will be electric.** Table 4-5 summarizes the **primary and secondary equipment list (stationary, mobile, heavy-duty, light-duty)** for mining in Year **14**, when the fleet will reach its maximum capacity.

Table 4-5 List of mining equipment – Year 14

Equipment	Quantity
Primary equipment	
100-tonne rigid frame haul truck	9
Hydraulic Excavator (7 m ³)	2
Wheel Loader (10.7 m ³)	1
Production Drill (101-203 mm)	2
Tracked Dozer (436 HP)	2
Grader (4.26 m)	1
40-tonne Articulated Dump Truck (34 kL tank)	1
Wheel Dozer (496 HP)	1
Auxiliary Drill (114-203 mm)	1
Secondary equipment	
Articulated Dump Truck (45 t)	2
Excavator (49 t)	1
Hydraulic Hammer for the 49 t excavator	1
Emulsion Truck	1
Stemming Loader	1
Utility Wheel Loader	2
28-tonne Crane	1
Telehandler	1
Forklift, 4-tonne lifting capacity	1
Mechanic Service Truck	1
Fuel/Lube Truck	1
Lowboy & Tractor	1
Pickups, crew cab	10
Pit Bus for 15 people	1
Electric Welding Machine	2
Mobile Welding Machine	2
Lighting Tower	4
Genset 6 kW	2
Genset 60 kW	1
Diesel Dewatering Pump (25 cm)	2
Trash Pump (8 cm)	4
Diesel Powered Air Heaters	2

Source: **G Mining Services, 2021.**

4.5.3 EXTRACTION SCHEDULE

The pegmatite extraction will follow the concentrator's yearly capacity: **2,000,000 tonnes per year until the year before last**. The last year will complete the production. Table 4-6 summarizes the extraction schedule.

Table 4-6 Extraction Schedule

Material	X 1000 m ³			X 1000 tonnes			Ore Grade % Li ₂ O	Stripping ratio (W:O)
	Ore	Waste Rock	Overburden	Ore	Waste Rock	Overburden		
A-1	68	664	240	184	1,838	479	0.05	9.99
A1	743	1,814	484	2,007	5,025	968	1.34	2.51
A2	741	2,183	0	2,000	6,046	0	1.39	2.99
A3	749	1,858	415	2,022	5,148	830	1.36	2.50
A4	762	1,908	329	2,057	5,286	657	1.37	2.64
A5	741	2,161	7	2,000	5,986	14	1.33	2.43
A6	913	1,908	126	2,464	5,284	252	1.08	2.64
A7	741	1,932	324	2,000	5,353	647	1.31	2.68
A8	741	2,816	525	2,000	7,800	1,049	1.30	3.90
A9	741	3,049	96	2,000	8,445	191	1.30	4.22
A10	730	3,259	1	1,971	9,027	2	1.26	4.56
A11	741	3,196	74	2,000	8,852	148	1.25	4.43
A12	589	3,397	0	1,591	9,409	0	1.22	5.91
A13	657	3,330	0	1,775	9,225	0	1.12	5.20
A14	715	3,274	0	1,930	9,070	0	1.15	4.70
A15	741	2,438	123	2,000	6,754	246	1.31	3.38
A16	741	2,514	160	2,000	6,964	319	1.27	3.48
A17	741	2,166	0	2,000	6,000	0	1.36	3.00
A18	741	2,560	0	2,000	7,092	0	1.35	3.54
Last year	334	470	0	902	1,301	0	1.37	1.44

Source: **G Mining Services, 2021.**

The overburden and waste rock extraction schedule follows the mining plan developed. The volume of waste rock excavated averages **2,345,000 m³** per year, with a maximum of **3,397,000 m³** at Year **12** and a minimum of **470,000 m³** last year. The volume of overburden excavated varies between **1,000 to 525,000 m³** per year. **The extraction schedule does not include mining of overburden for several production years (years 2, 12, 13, 14, 17, 18 and 19).**

The material extraction calculations assume a specific gravity of 2.7 (mean result of the pycnometry assays performed on 30 pegmatite samples) while waste tonnage is calculated using a specific gravity of 2.77 (mean value of the pycnometry assays done on 62 waste rock samples), all lithologies combined. Overburden tonnage is calculated using a specific gravity of 2.0. The specific gravities presented are for in situ material (before excavation).

The grade of the feed material ranges from **0.05-1.39 % Li₂O**, for an average of **1.28 % Li₂O**.

Waste rock tonnage averages **6,495,000 tonnes** per year with a maximum of **9,409,000 tonnes** at Year **12** and a minimum of **1,301,000 tonnes last year**. The LOM's average stripping ratio **ranges from 1.44-9.99**. The overburden and topsoil tonnage averages **290,000 tonnes** per year.

Table 4-7 presents the explosives yearly consumption schedule with a distinction between the consumption from May to October (inclusively) and November to April.

Table 4-7 Explosives consumption

Year	Explosives Consumption (tonnes)		
	May-Oct.	Nov.-Apr.	Total
Y1	1,014	401	1,415
A2	1,289	1,276	2,565
A3	1,218	1,206	2,424
A4	1,586	1,568	3,154
A5	1,766	1,745	3,512
A6	2,229	2,201	4,430
A7	2,229	2,201	4,431
A8	2,251	2,223	4,474
A9	2,422	2,391	4,813
A10	2,430	2,399	4,829
A11	2,387	2,356	4,743
A12	1,715	1,695	3,411
A13	1,250	1,237	2,488
A14	968	960	1,928
A15	808	802	1,610
Last year	1,062	1,050	2,112
Rest of LOM	n.d.	n.d.	n.d.
Notes: The detailed mine extraction schedule is provided for the first 15 years only.			

Source: WSP 2018a.

4.5.4 ROCK TRANSPORTATION

Ore and waste rock will be transported on several haul roads shown on Map 4-1. The haul roads will be 25 m wide and will be on a foundation acceptable for heavy machinery to support the proposed 100 tonne haul trucks. The trucks will exit the pit via one of three ramps: JB1, JB2 or JB3.

The ore will be transported to the crusher located 960 m from JB1 and JB2 and 1200 m from JB3. The ore will be placed in the crusher and sorted, and then sent to the crushed ore pile (in a dome) located in the processing plant area. The waste rock will be transported to one of the waste rock stockpiles. The waste rock will be unloaded according to a predetermined disposal plan and a bulldozer will flatten the incoming material (Section 4.8).

As the haul road crosses the CE3 Creek, a haul bridge will need to be constructed. The bridge will comply with the standards set out in the *Regulation respecting the sustainable development of forests in the domain of the State*. It should be noted that CE3 Creek is not navigable.

4.6 ORE PROCESSING

4.6.1 PROCESS DESCRIPTION

Processing is categorized as a DMS process. The concentrator is designed to process 2 million tonnes per year of spodumene ore, with a nominal concentrate production of spodumene **ranging from 317,107-378,036 tonnes according to the year** (41 t/h). The process design criteria are summarized in Table 4-8. The design criteria were based on industry standards, professional experience, as well as calculations and data provided by GLCI. The simplified process flow diagram is presented on Figure 4-4, while Figure 4-5 presents a more detailed process flow diagram.

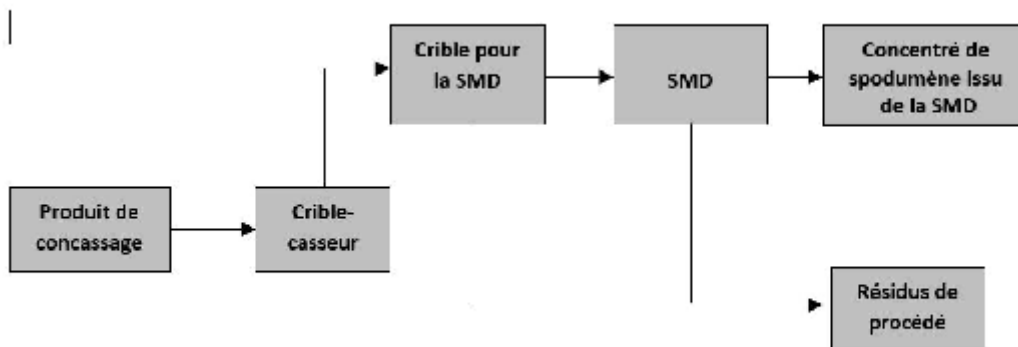


Figure 4-4 Simplified process flow diagram

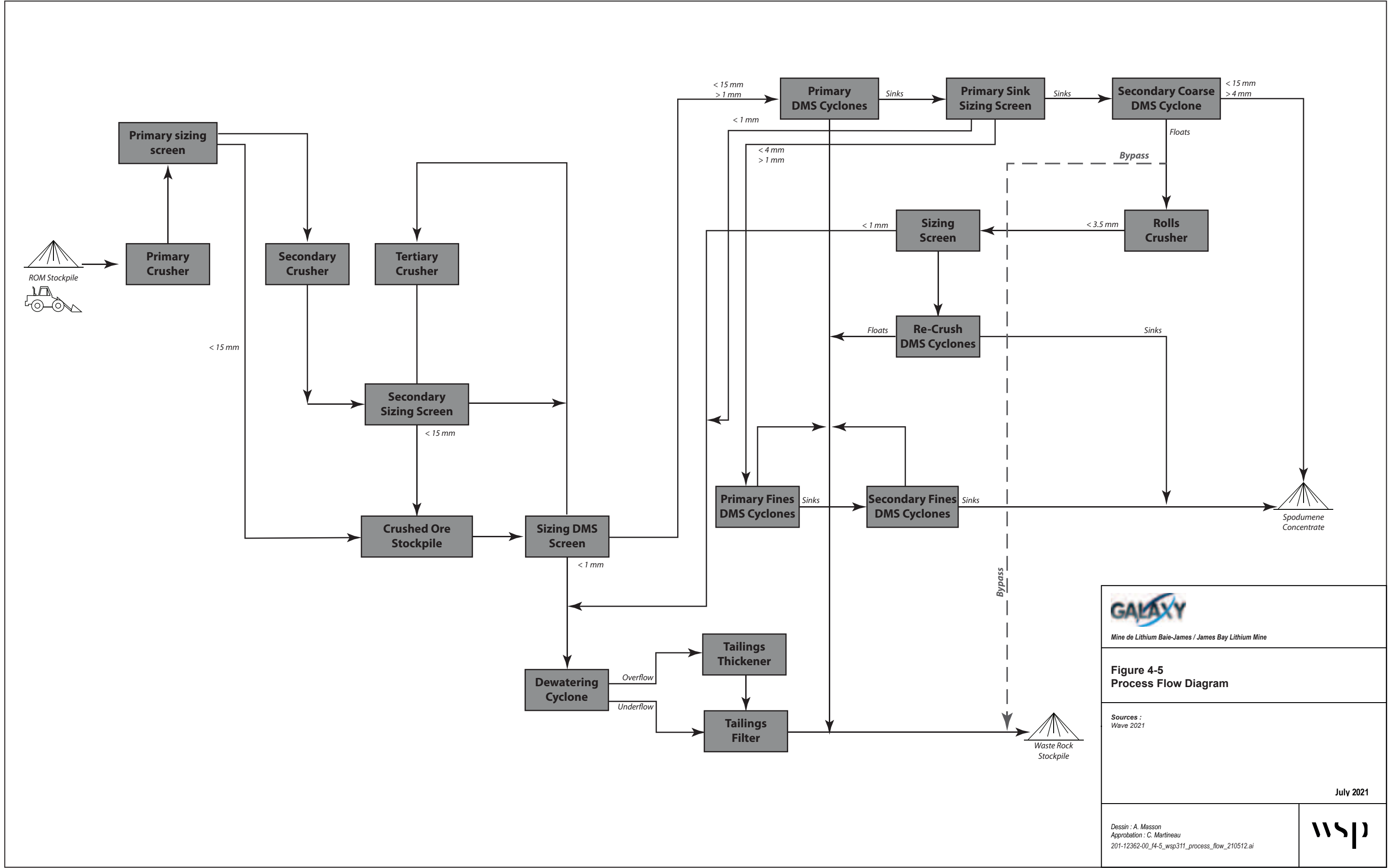
The material is transported from the open pit mine to the ROM pad that has a **minimum** capacity of **20,000** tonnes (loose). It is then fed to the crushing circuit via a front-end loader. The material is then crushed in a three-stage crusher circuit comprising a primary jaw crusher, a secondary cone and tertiary cone crusher closed with a screen to produce the targeted product size.

The ROM feed average humidity is estimated at 5 % while the average humidity of the tailings is estimated at 11.4 %. The following sections describe key circuits of the process in more details.

Table 4-8 Process design criteria

Parameter	Unit	Design Value
Operating Schedule		
Nominal throughput	t/annum	2,000,000
Operating days per year	d	365
Operating shifts per day	no.	2
Hours per shift	h	12
Crushing Operating Schedule		
Crushing circuit overall utilisation	%	68.5
Crushing circuit utilised hours	h	6,000
Required average crushing rate (dry)	dry t/h	333
Required average crushing rate (wet)	wet t/h	344
Design surge factor	%	20
Design crushing rate	wet t/h	412
DMS Circuit Operating Schedule		
DMS circuit utilisation	%	85
Effective daily processing hours	h	20.4
Required average DMS	dry t/h	269
Feed material Characteristics		
Feed grade ^a	% Li ₂ O	1.30-1.46
Product Characteristics		
Recovery	%	66.5
Concentrate grade	% Li ₂ O	6
Nominal lithium production	Li ₂ O t/a	18,850
Lithium concentrate production @ 6.0% Li ₂ O	t/a	310,500
ROM Feed Characteristics		
Specific gravity ^b	t/m ³	2.73
Bulk density crushed feed material	t/m ³	1.7
ROM Sizing		
F ₁₀₀ ^c	mm	700
F ₈₀ ^c	mm	360
a	Feed grade: The initial design was based on the Mineral Resource average grade before the completion of the mine design which lead to the estimation of an average grade of 1.43 %Li ₂ O. The difference is deemed acceptable by the process engineer.	
b	Specific gravity: the proposed design used an earlier study as data source. The difference with the update specific gravity (2.7) is deemed acceptable by the process engineer.	
c	F100 and F80 are dimensions of which 100% or 80% of the material is smaller than a given size.	

Source: **G Mining Services, 2021.**



Mine de Lithium Baie-James / James Bay Lithium Mine

Figure 4-5
Process Flow Diagram

Sources :
Wave 2021

Dessin : A. Masson
Approbation : C. Martineau
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July 2021



4.6.1.1 DENSE MEDIA SEPRATION FEED PREPARATION

The preparatory stages for DMS are designed to classify the ore into distinct size fractions. **The ore is first passed through a primary crusher and then onto a primary sizing sieve. This primary classifier screen is a double deck, inclined, vibrating screen with an upper mesh size of 30 mm and a lower mesh size of 15 mm. Ore smaller than 15 mm is sent directly to the crushed ore reserve. The coarse ore from this screen is directed into a secondary crusher and then fed to a screen identical to the primary screen, with an upper mesh size of 20 mm and a lower mesh size of 15 mm. The undersized ore is then sent to the crushed ore reserve. The oversized ore from the secondary screen is passed through a tertiary crusher and returned to the secondary sizing screen. The ore is thus recycled in the crushing circuit until it is under 15 mm in grain size. The crushed ore is then transferred by a feed conveyor to the DMS area.**

4.6.1.2 DENSE MEDIA SEPARATION

The DMS receives all the feed (>1 mm, <15mm) from the sizing screen. Following the initial preparation steps, the crushed feed material is mixed with ferrosilicon (FeSi) and is pumped to the DMS cyclones. The FeSi slurry acts as a densifying medium which enables the gravity separation of spodumene from minerals with a lower specific gravity. The spodumene typically has a higher specific gravity than the gangue minerals and consequently the spodumene sinks while the gangue material floats.

The DMS cyclone underflow is dewatered and pumped to the magnetic drum for FeSi recovery and water removal. The water removed is re-used in the DMS. This **final** product is the spodumene concentrate that will be prepared for transport.

The DMS cyclone overflow streams go to a wet belt magnetic separator where the ferromagnetic material is separated using a ferromagnetic extraction matrix. Following this separation, the product is dewatered and FeSi recovered. This product corresponds to the tailings. Tailings are sent to the transfer conveyor for processing and thickening.

4.6.1.3 LOADOUT

Tailings are discharged onto the tailings transfer conveyor from the **DMS** streams, sizing screens and the tailings thickening. The material is conveyed via the tailings discharge conveyor to the tailings loadout hopper. Mine haul trucks are cycled to cart the tailings and bring the tailings to the waste rock **stockpiles**.

Dewatered spodumene concentrate travels on the conveyor to the dome where it is loaded onto trucks for shipment to Matagami, where it will be loaded onto trains. **The concentrate will then be transported to another plant where it will undergo a second treatment. At the appropriate time, GLCI will conduct an economic market opportunity analysis for processing in Quebec in accordance with Section 101 of the Mining Act. However, for the purposes of this study, the activities under consideration stop with shipping the concentrate to Matagami.**

4.6.2 SEPARATION MEDIA

Ferrosilicon (FeSi) is an inert media in the DMS process. It is added in the DMS process at a rate of 0.2 t/hours. FeSi comes in bulk one tonne bags. It will be transported to the site and stored in the DMS storage warehouse. In addition to FeSi, sodium nitrite and lime **are used** to prevent corrosion. Sodium nitrite and lime will be shipped in 20 kg bags and as for the FeSi stored in the DMS storage warehouse. As for quantities needed, approximately 0.5 kg of sodium nitrite and 2 kg of lime are needed per tonne of FeSi.

4.6.3 WASTE FILTRATION

The tailings will be filtered before being transported to the waste rock stockpiles. There are two possible sizes of residue: 15 / +4 mm (44.5 % of volume) and -4 / <1 mm (55.5 %).

Both size classes will be dewatered through a sieve to obtain a moisture content of less than 10 % w / w. Each of the residue streams is discharged onto its dedicated conveyor where an automatic sampler takes a sample which is analyzed for moisture content.

4.7 GEOCHEMICAL CHARACTERIZATION

The purpose of the geotechnical tests was to determine the main characteristics of the materials that will be extracted by mining to design the project according to best industry practices. To provide spatial representativeness of rock samples were selected throughout, also ensuring proper spatial representation for tailings testing. The results are presented in greater detail in the *Étude spécialisée sur la géochimie* (WSP, 2018b).

After consulting available drilling reports and based on the recommendations of the project's geologists, four main lithologies were targeted for the geochemical characterization of waste rock, i.e., one pegmatite waste rock unit (I1G), gneiss (M1) and banded gneiss units (M2) and one unit of mafic volcanic rock (V3), which included the basalt unit (V3B). For its part, the economic material is associated with spodumene, which occurs in large crystals in pegmatite intrusions (also part of unit I1G).

Thus, a certain number of samples from the lithologies were analyzed to assess the geochemical behaviour of the five lithological units. The tailings samples characterized in this study were recovered from a bulk sample, on which metallurgical tests representative of those that will be used during operations were performed.

Thus, 10 samples of unit V3B (basalt), 20 of unit M2 (banded gneiss), 21 of unit I1G (pegmatite) and 30 of unit M1 (gneiss) were selected to ensure uniform spatial coverage of waste rock that will potentially be extracted during mining. The samples were not selected to reflect the tonnage of waste rock that will be extracted; rather, the selection was based on the frequency (percentage) the lithological units were crossed during drilling. As well, 28 samples of unit I1G, considered economic material and 12 samples of tailings were selected.

For comparison purposes, some of the tests performed materials were also performed on soil samples collected for an additional project study (WSP, 2018c) to assess their geochemical behaviour and impact on the environment when stored. The results of these analyses were also compared to the criteria for mining sites.

4.7.1 WASTE ROCK

Various static tests were performed on the selected samples to assess their geochemical behaviour. All 81 waste rock samples were analyzed for available metal content. The leaching test was performed on all the samples (80) for which the available metal content exceeded criteria "A" in the Guide d'intervention - Protection des sols et réhabilitation des terrains contaminés (Beaulieu, 2016) to determine the mobility of inorganic analytes.

The results of these analyses show that all the waste rock is considered "low risk" under the D019. In addition, the waste rock from the lithological units is leachable to varying degrees under this same directive. The details of the results for each unit tested following the TCLP are presented in Table 4-9.

Less aggressive leaching testing than the TCLP, i.e., SPLP and CTEU-9, was also performed on the waste rock. The test results indicated leaching of certain metals, mostly arsenic, silver, barium, copper, manganese, nickel, lead and zinc. More extensive leaching was obtained in the CTEU-9 test due to the very fine particle size (100 mesh) of the materials tested. This can result in an increase of the materials' specific surface and in a higher solubility of some metals.

The D019 criterion for arsenic was exceeded in this test for units I1G (4%) and V3B (80%). Although this is not the test recommended by D019 for the characterization of mine waste rock, these exceedances should still be considered because the site conditions are more suited to water leaching than acid leaching. However, this particle size is far from that of the waste rock that will be stockpiled on site. The leachability of the waste rock is not insignificant and should be considered in waste rock management.

The results of the static test to predict acid generation potential (MABA) showed a total sulphur concentration of less than 0.3% for all the waste rock samples of units I1G and V3B analyzed; these are therefore classified as non-potentially acid generating (non-PAG) under D019.

Table 4-9 Test results for waste rock

Unit	Metals >A	TCLP>GWS	SPLP>GWS	CTEU-9>D019	CTEU-9>RES	PAG (D019)
I1G	96%	Mn (95%)	Hg (25%)		Cu, Pb, Zn (100%)	0 %
		Cu, Zn (55%)	Zn (10%)		Mn (90 %)	
		Cd, Pb (5%)	Ag, Ba (5%)		As (25%)	
					Cd (10%)	
M1	100 %	Ba (77%)	Cu (17%)	As (4 %)	Cu (100 %)	30 %
		Zn (63 %)	Zn (13 %)		Ba, Pb, Zn (88%)	
		Ni, Pb (47%)	Ag (8%)		Ag (79 %)	
		Cd (30 %)	Ni (4%)		Cd, Ni (75%)	
		Mn (10 %)			As (71 %)	
		As, Cu (3%)				
M2	100 %	Ba (77%)			Ag, Ba, Cd, Cu, Pb, Zn (100%)	50 %
		Pb (65%)			As (88 %)	
		Zn (55 %)			Ni (75 %)	
		Ni (30 %)			Mn (13 %)	
		Cd (15 %)				
		Mn (5 %)				
V3B	100 %	As, Ba, Ni (100%)	As (100 %)	As (80 %)	As (100 %)	0 %
		Mn (30 %)			Ba, Cu, Ni (80%)	
					Fluorides (20%)	

However, 30% of the samples of unit M1 and 50% of the samples of unit M2 are potentially acid generating (PAG) under D019. Comparing the results to the criteria of the URSTM and MEND, 70% are uncertain, 20% are considered PAG and 10% non-PAG for unit M1, while 40% of the samples of unit M2 are uncertain, 55% are considered PAG and 5% non-PAG. Therefore, the waste rock of unit M1 and M2 would be considered PAG.

Moreover, following the gamma spectrometry test (radionuclides), none of the eight units of waste rock analyzed are considered hazardous materials under the RHM.

4.7.2 PEGMATITE

In all, 28 samples were analyzed for their available metal content and 27 had available metal concentrations that exceeded criteria “A” in the Guide d’intervention (Beaulieu, 2016). The TCLP test was therefore performed on these 27 samples.

When compared to the criteria in Table 1 of Appendix II of D019, the results of these analyses show that 96% of the samples analyzed would be considered “low risk” materials.

However, under D019, the material is considered leachable. As such, 83% of the samples would leach manganese, 50% zinc and 46% copper. Lastly, between 13% and 42% of the samples analyzed could leach arsenic and/or barium and/or cadmium and/or nickel and/or lead. Less aggressive leaching tests than the TCLP, i.e., SPLP and CTEU-9, were also performed on 18 and 4 of the samples respectively. The results of the SPLP test also showed leaching of some metals, specifically arsenic, silver, copper, mercury, nickel and zinc. The results are summarized in Table 4-10.

Just like the waste rock, greater elemental mobility was also observed in the CTEU-9 test, resulting in a greater number of results that exceeded the RES criteria in the Guide d’intervention, specifically, in all the copper, manganese, lead and zinc samples and some exceedances in the silver, arsenic and barium samples. The material is therefore considered leachable according to the various leaching tests performed during the study.

Table 4-10 Test results for pegmatite samples

Metals>A	TCLP>GWS	SPLP>GWS	CTEU-9>D019	CTEU-9>RES	PAG (D019)
96%	Mn (83 %)	Cu, Zn (18 %)		Cu, Pb, Zn (100%)	21 %
	Zn (50 %)	Ag, As, Hg, Ni (6%)		Mn (75 %)	
	Cu (46 %)			Ag, As (25%)	
	Pb (30 %)				
	Ni (21 %)				
	As (17 %)				
	Cd (13 %)				

The results of the MABA static test to predict acid generation potential showed that 79% of the samples are considered non-PAG and 21% are considered PAG under D019.

However, comparing the MABA test results with the requirements in the MEND *Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials* (Price, 2009), 64% of the samples would be considered non-PAG and 36% would be uncertain, while none would be considered PAG.

As such, under applicable regulation, most of the material would be considered non-PAG. Still, according to the MEND criteria, the PAG of 36% of the samples would be uncertain.

4.7.3 TAILINGS

All 12 tailings samples analyzed for total metal content exceeded at least one of criteria “A” in the Guide d’intervention. A leaching test was therefore performed on the 12 samples to determine the mobility of inorganic analytes. The results showed that none of the criteria in Table 1 of Appendix II of D019 were exceeded; the risk of the analyzed tailings is therefore classified as “low.” These results are summarized in Table 4-11.

Table 4-11 Test results for tailings samples

Metals>A	TCLP>GWS	SPLP>GWS	CTEU-9>RES	PAG (D019)
100 %	Cu, Mn (100%)		Ag, Cu, Hg (100%)	0 %
	Cd (33 %)			
	Hg (8 %)			

However, all the samples analyzed showed exceedances of the RES criteria in the Guide d’intervention – Protection des sols et réhabilitation des terrains contaminés (Beaulieu, 2016) for copper and manganese. Moreover, 33% of the samples exceeded the criteria for cadmium while one sample also exceeded the RES criterion for mercury.

In all, five tailings samples were tested using the Synthetic Precipitation Leach Procedure (SPLP). These samples were selected because their exceedance values for the RES criterion were higher or because they exceeded the RES criterion for at least two TCLP parameters. The results of this leaching test showed no exceedance of the criteria in Table 1 of Appendix II in D019, which corroborates the results of the regulatory TCLP test that the level of risk associated with tailings is low.

The water leaching test (CTEU-9) was performed on the same five samples. Its results showed no exceedance of the criteria in Table 1, Appendix II in D019; however, all the samples exceeded the RES criteria in the Guide d’intervention for silver, copper and mercury.

The samples of 12 tailings on which the MABA static tests were performed **showed** total S concentrations of less than 0.3% and are therefore all classified as non-PAG under D019. Also, an analysis of the difference between the gross neutralization potential (GNP) and maximum potential acidity (MAP), as well as the GNP/MAP **ratio**, confirmed that all the samples analyzed are also non-PAG according to URSTM and MEND criteria.

Therefore, according to applicable regulations, the tailings that will be generated on the site would be considered non-PAG but leachable for cadmium, copper, manganese, mercury and zinc. These results **were** considered when designing the tailings storage infrastructure.

4.7.4 UNCONSOLIDATED DEPOSITS

A total of 15 samples from the sand unit and 6 samples from the clay unit were analyzed for their total metal content. The results of the chemical analyses for the sand unit samples showed concentrations higher than the background concentrations established for the Superior Province (criteria “A”) for two parameters: arsenic (13% of samples) and hexavalent chromium (46% of samples).

The results of the chemical analyses for the clay unit also showed concentrations higher than criteria “A” for cadmium (83% of samples) and chromium (33% of samples).

The leaching test was performed on six samples from the sand unit and two samples from the clay unit to determine the mobility of inorganic analytes. For the two clay samples analyzed, the RES criteria in the Guide d’intervention were exceeded for copper, lead and zinc. One of the two samples also exceeded the criteria for manganese. None of the sand unit samples exceeded the criteria.

The two clay samples were also subjected to the Synthetic Precipitation Leach Procedure (SPLP). The two samples exceeded the RES criterion in the Guide d'intervention for barium, copper, lead and zinc.

These results show that the sand unit in the project area is not leachable and that only the clay unit causes metal leaching. The fine particle size of the clay compared to that of the sand may explain the greater metal mobility.

4.7.5 RESULTS OF COLUMN KINETIC TESTS ON WASTE ROCK AND TAILINGS

Column kinetic tests were performed on mine waste rock and tailings samples (WSP, 2019). A flush was performed weekly until week 4 and then every two weeks for a total period of 50 weeks. Two of the columns contained a waste rock sample, one kept saturated at all times and the other kept unsaturated between one flush and the next, while the third column contained a tailings sample and was kept unsaturated between one flush and the next.

The kinetic tests on the waste rock were carried out on a set of samples totalling approximately 26 kg. This sample was composed of 25 different core samples from as many different boreholes and taken representatively in the envelope considered uneconomic (waste rock). The samples were not selected based on their NC/MPA ratio but rather on the spatial distribution of the ore samples. The WSP report dated June 2019 describes how the samples were selected and lists the selected samples. As mentioned in this study report, the samples were selected using the 3D model of the deposit to obtain a good spatial representation of the waste rock. We believe that water quality was not underestimated in this study since the waste rock tested is representative of the bedrock.

The results of these tests are summarized below.

ACID GENERATING POTENTIAL

The results observed in the kinetic tests on the three columns resulted in the following observations regarding the acid generation potential:

- The pH of the leachate for all three columns remained between 7 and 8 for the first 20 weeks of the test and then stabilized between 6.25 and 7.01 until the end of the test.
- SO₄ concentrations remained between 5 and 10 mg/L for the majority of the test for both waste rock columns, while concentrations for the tailings column remained below 1 mg/L.
- The acidity measured in the leachate from all three columns remained near the detection limit throughout the test.
- Only one increase was measured at week 8 for the unsaturated waste rock (12 mg/L) and saturated waste rock (110 mg/L).
- Electrical conductivity was maximum at the beginning of the test and then reached a plateau around week 14 for the three columns, at about 15 µS/cm for the tailings column, 28 µS/cm for the unsaturated waste rock column and 35 µS/cm for the saturated waste rock column.
- The oxidation reduction potential varied throughout the test for all three columns but remained between 500 mV and 75 mV.

Therefore, based on the results obtained from these column kinetic tests, it appears that the acid generation potential of both the saturated and unsaturated waste rock and tailings is insignificant since the pH of all three columns was maintained between 6.25 and 8 throughout the test and the acidity in the leach water remained below the DL throughout most of the test, with similar results in all three columns.

The measured conductivity is also lower for tailings than for waste rock.

Concentrations of SO₄ in solution also remained stable throughout the test. It also appears that the SO₄ concentrations in the tailings leachate are lower than in the waste rock leachate.

The oxidation / neutralization curves were evaluated for these column kinetic tests. The initial concentrations of neutralizing materials are clearly sufficient to neutralize all the SO₄ that could potentially be generated by these materials. Tailings and waste rock are therefore considered non-acid generating.

LEACHING POTENTIAL

COLUMN 1 – UNSATURATED TAILINGS

- Silver concentrations were above the GWS criterion for the first six weeks of testing. They remained below the DL from week 8 onwards (note that the DL [0.00005 mg/L] was greater than GWS [0.00003 mg/L] criterion). A value equal to the DL, and therefore greater than the GWS criterion, was also obtained at week 46. Since this value is a point value and just above the DL, it is not considered to have a significant impact on water quality. It could also be a false positive from the laboratory.
- The D019 monthly average final effluent discharge concentration was exceeded in the initial analysis.
- The copper GWS criterion was exceeded at weeks 0 to 18, 22 and 28. After week 28, concentrations remained below the GWS criterion.
- Iron exceeded the D019 final effluent discharge maximum acceptable concentration in weeks 0 and 2 and exceeded the monthly average acceptable final effluent discharge concentration in weeks 1, 3, 4 and 6. Concentrations then gradually decreased, reaching a threshold near the DL around week 14.
- Manganese exceeded the GWS criterion only between weeks 0 to 4. Concentrations reached a threshold near the DL as of week 14.
- Mercury exceeded the GWS criterion primarily between weeks 0 and 14. As of week 16, concentrations remained below the DL (note that the DL [0.00001 mg/L] was greater than GWS criterion [0.0000013 mg/L]).
- Lead exceeded the GWS criterion in the first 6 weeks of testing. Concentrations stabilized near the DL as of week 10.
- Zinc exceeded the GWS criterion during the first 14 weeks of testing. Concentrations stabilized near the DL as of week 16.
- The arsenic, barium and nickel tests did not exceed the GWS criterion.
- The copper, nickel, lead and zinc tests did not exceed the D019 (average and maximum) final effluent discharge acceptable concentrations.

COLUMN 2 – SATURATED WASTE ROCK MIX

- Only the initial and week 1 analyses results were higher than the DL. Concentrations subsequently remained below the DL (note that the DL [0.00005 mg/L] was greater than the GWS criterion [0.00003 mg/L]).
- Arsenic exceeded the D019 final effluent discharge maximum acceptable concentration at week 3 and the monthly average acceptable concentration at weeks 2, 4, and 6. The GWS criterion was also exceeded in weeks 3 and 4. Concentrations subsequently dropped to a threshold around week 24.
- Barium exceeded the GWS criterion in the initial analysis. However, concentrations stabilize near the DL as of week 2.
- Copper exceeded the GWS criterion in both the initial and week 1 analyses. However, concentrations stabilize below the GWS criterion as of week 2.

- Iron exceeded the D019 final effluent discharge maximum acceptable concentration in the initial analysis and the monthly average concentration in week 1; however, concentrations stabilized near the DL starting in week 2.
- Mercury exceeded the GWS criterion primarily between weeks 0 and 14. As of week 16, concentrations remained below the DL (note that the DL [0.00001 mg/L] was greater than GWS criterion [0.0000013 mg/L]).
- Zinc exceeded the GWS criterion only in the initial analysis. Concentrations then remained near or below the DL.
- The manganese, nickel and lead tests did not exceed the GWS criterion.
- The copper, nickel, lead and zinc tests did not exceed the D019 (average and maximum) final effluent discharge acceptable concentrations.

COLUMN 3 – UNSATURATED WASTE ROCK MIX

- Silver concentrations were above the GWS criterion for the first 12 weeks of testing. They remained below the DL from week 14 onwards (note that the DL [0.00005 mg/L] was greater than GWS [0.00003 mg/L] criterion).
- Arsenic exceeded the D019 monthly average acceptable final effluent discharge concentration in weeks 4 and 6; concentrations remained below the D019 requirements thereafter.
- Barium exceeded the GWS criterion at weeks 0, 2, 4, 5 and 10. However, concentrations stabilize near the DL as of week 14.
- Copper exceeded the GWS criterion between weeks 0 to 12. However, concentrations stabilize below the GWS criterion as of week 14.
- Iron exceeded the D019 final effluent discharge maximum acceptable concentration between weeks 0 and 12. Concentrations dropped to reach a threshold near the DL at week 14.
- Manganese exceeded the GWS criterion only at weeks 2 and 4. Concentrations reached a threshold near the DL as of week 14.
- Concentrations remained below the DL throughout the test, with the exception of the initial analysis (note that the DL [0.00001 mg/L] was greater than the GWS criterion [0.0000013 mg/L]).
- Lead exceeded the GWS criterion at weeks 2, 4 and 6. Concentrations stabilized near the DL as of week 10.
- Zinc exceeded the GWS criterion during the first 12 weeks of testing. Concentrations stabilized near the DL as of week 14.
- The arsenic and nickel tests did not exceed the GWS criterion.
- The copper, nickel, lead and zinc tests did not exceed the D019 (average and maximum) final effluent discharge acceptable concentrations.

Based on these results, although some metals were released in concentrations exceeding the GWS criterion and/or the D019 final effluent discharge requirements, in most cases the release was limited to the first weeks of testing.

Therefore, in the case of the tailings column, the GWS criterion and/or D019 final effluent discharge requirements were not exceeded after week 14, except copper, for which the exceedances ceased after week 28. For the unsaturated waste rock mix column, the GWS criterion and/or D019 final effluent discharge requirements were not exceeded after week 12. For the saturated waste rock mix column, excluding mercury, the GWS criterion and/or D019 final effluent discharge requirement exceedances were limited to the first weeks of testing, up to week 4.

Therefore, at the end of the test, unsaturated and saturated waste rock and tailings appear to exhibit similar behaviour over the test time scale. These results assume that the waste rock and tailings are potentially leachable in the short term, but that metal release is significantly limited and meets the applicable criteria and requirements (D019 and GWS) after an average of 12 weeks. These materials can therefore be considered low risk according to D019 at the end of this period.

Table 4-12 presents a summary of the results.

Table 4-12 Summary of GWS criteria and D019 final effluent requirement exceedances during column testing

Column	Parameter	D019 ^{1, 2} exceedance	GWS exceedance	Stabilization	D019 exceedance at end of test	RES exceedance at end of test
Column 1 - Unsaturated tailings	Silver	-	Weeks 0 to 6, week 46 (0.00005 mg/L)	Week 8	-	No (DL > GWS)
	Arsenic	Week 0 (avg.)	-	-	No	-
	Copper	-	Weeks 0 to 18, 22 and 28	Week 32	-	No
	Iron	Weeks 0 and 2 (max.) Weeks 1, 3, 4 and 6 (avg.)	-	Week 14	No	-
	Manganese	-	Weeks 0 to 4	Week 10	-	No
	Mercury	-	Weeks 0 to 14	Week 16	-	No (DL > GWS)
	Lead	-	Weeks 0 to 6	Week 10	-	No
	Zinc	-	Weeks 0 to 14	Week 16	-	No
Column 2 – Saturated waste rock mix	Silver	-	Week 1	Week 2	-	No (DL > GWS)
	Arsenic	Week 3 (max.) Weeks 2, 4 and 6 (avg.)	Weeks 3 and 4	Week 24	No	No
	Barium	-	Week 0	Week 2	-	No
	Copper	-	Weeks 0 and 1	Week 2	-	No
	Iron	Week 0 (max.) Week 1 (avg.)	-	Week 2	No	-
	Mercury	-	Weeks 0 to 14	Week 16	-	No (DL > GWS)
	Zinc	-	Week 0	Week 2	-	No
Column 3 – Unsaturated waste rock mix	Silver	-	Weeks 0 to 12	Week 14	-	No (DL > GWS)
	Arsenic	Weeks 4 and 6 (avg.)	-	-	No	-
	Barium	-	Weeks 0, 2, 4, 5 and 10	Week 14	-	No
	Copper	-	Weeks 0 to 12	Week 14	-	No
	Iron	Weeks 0 to 12 (max.)	-	Week 14	No	-
	Manganese	-	Weeks 2 and 4	Week 14	-	No
	Mercury	-	Week 0	Week 1	-	No (DL > GWS)
	Lead	-	Weeks 2, 4 and 6	Week 10	-	No
	Zinc	-	Weeks 0 to 12	Week 14	-	No

4.7.6 RESULTS OF COLUMN KINETIC TESTS ON ORE AND DIABASE

Column kinetic tests were conducted on an ore sample and a diabase sample (WSP, 2020), as the latter was being considered for use as backfill material on the site (which is no longer the case for the current project). A flush was performed every two weeks for a total period of 25 weeks. The two columns were kept unsaturated between flushes.

Kinetic tests on the ore were carried out on a sample set totalling 24.886 kg. This sample was composed of 19 different core samples from 12 different boreholes, taken representatively from the mineralized envelope. The samples were not selected based on their NC/MPA ratio but rather on the spatial distribution of the ore samples. The WSP report from March 2020 describes how the samples were selected and lists the selected samples.

The kinetic tests on the diabase were carried out on a sample set totalling 26.612 kg. This sample was made up of 10 core samples from the same borehole. In fact, the number of boreholes intersecting the diabase was limited, and given the mass required to carry out the tests, the choice of samples was limited. The samples were not selected on the basis of their NC/MPA ratio but rather on sample availability. The WSP report from March 2020 describes how the samples were selected and lists the selected samples.

The results of these tests are summarized below (Table 4-13).

ACID GENERATING POTENTIAL

Two test columns were monitored during the kinetic tests, an ore column and a diabase column, both of which were kept unsaturated during the test. The results observed during the kinetic test resulted in the following observations:

- The pH of the leachate from both columns remained near-neutral throughout the test, although slightly alkaline for the diabase column.
- SO₄ concentrations remained between 1 and 14 mg/L during the test for both columns.
- The acidity measured in the leachate from both columns remained below the detection limit throughout the test.
- Electrical conductivity was maximum at the start of the test for both columns and then stabilized around 20 µS/cm for the ore column and 30 µS/cm for the diabase column; these values are consistent with the reduction in dissolved metal concentrations in the leachate throughout the tests.
- The oxidation reduction potential varied throughout the test for both columns but remained between 500 mV and 70 mV.

Therefore, based on the results obtained from these column kinetic tests, it appears that the acid generation potential of both the ore and diabase is insignificant since the pH of both columns was maintained near neutral throughout the test and the acidity in the leach water remained below the DL throughout most of the test as well. Concentrations of SO₄ in solution also remained stable throughout the test.

Table 4-13 GWS criteria and D019 final effluent requirement exceedances during column testing

Column	Parameter	D019 ^{1, 2} exceedance	GWS exceedance	Stabilization	D019 exceedance at end of test	RES exceedance at end of test
Column 1- Unsaturated tailings	Silver	-	Weeks 0 to 6, week 46 (0.00005 mg/L)	Week 8	-	No (DL > GWS)
	Arsenic	Week 0 (avg.)	-	-	No	-
	Copper	-	Weeks 0 to 18, 22 and 28	Week 32	-	No
	Iron	Weeks 0 and 2 (max.) Weeks 1, 3, 4 and 6 (avg.)	-	Week 14	No	-
	Manganese	-	Weeks 0 to 4	Week 10	-	No
	Mercury	-	Weeks 0 to 14	Week 16	-	No (DL > GWS)
	Lead	-	Weeks 0 to 6	Week 10	-	No
	Zinc	-	Weeks 0 to 14	Week 16	-	No
Column 2 – Saturated waste rock mix	Silver	-	Week 1	Week 2	-	No (DL > GWS)
	Arsenic	Week 3 (max.) Weeks 2, 4 and 6 (avg.)	Weeks 3 and 4	Week 24	No	No
	Barium	-	Week 0	Week 2	-	No
	Copper	-	Weeks 0 and 1	Week 2	-	No
	Iron	Week 0 (max.) Week 1 (avg.)	-	Week 2	No	-
	Mercury	-	Weeks 0 to 14	Week 16	-	No (DL > GWS)
	Zinc	-	Week 0	Week 2	-	No
Column 3 – Unsaturated waste rock mix	Silver	-	Weeks 0 to 12	Week 14	-	No (DL > GWS)
	Arsenic	Weeks 4 and 6 (avg.)	-	-	No	-
	Barium	-	Weeks 0, 2, 4, 5 and 10	Week 14	-	No
	Copper	-	Weeks 0 to 12	Week 14	-	No
	Iron	Weeks 0 to 12 (max.)	-	Week 14	No	-
	Manganese	-	Weeks 2 and 4	Week 14	-	No
	Mercury	-	Week 0	Week 1	-	No (DL > GWS)
	Lead	-	Weeks 2, 4 and 6	Week 10	-	No
	Zinc	-	Weeks 0 to 12	Week 14	-	No

Furthermore, oxidation/neutralization curves were conducted to evaluate the long-term acid generation potential of the two columns. This assessment was made by placing the cumulative magnesium, manganese and calcium (neutralizing minerals) loads on the y-axis, based on the cumulative sulphate loads on the x-axis. Furthermore, the initial total composition of neutralizing minerals as a function of the initial sulphate composition was placed on the graph. If the initial composition is above the oxidation/neutralization curve, it is assumed that the material will deplete its sulphur content before depleting its neutralizing mineral content. This is what is observed for the ore and diabase during testing. Ore and diabase are therefore considered non-acid generating.

LEACHING POTENTIAL

COLUMN 1 – ORE

Silver concentrations remained below the DL from week 13 onwards (note that the DL [0.00005 mg/L] was greater than the GWS [0.00003 mg/L] criterion). Values above the DL were measured weeks 0, 6, 9 and 12.

- Mercury concentrations exceeded the DL at weeks 0, 2, 9 and 25 of the test (note that the DL [0.00001 mg/L] was greater than the GWS criterion [0.0000013 mg/L]). Concentrations remained below the DL for all the other test weeks.
- The D019 final effluent discharge maximum acceptable concentration was exceeded at week 0 for the SS.
- Copper, lead and zinc concentrations remained below the RES criteria as of week 1 or 2 of testing.
- No exceedance of the GWS criteria was obtained during the test for all other metals analyzed.
- No exceedances of (average and maximum) D019 final effluent discharge acceptable concentrations were obtained during the test.

COLUMN 2 – DIABASE

- The results of weeks 0, 1, 6, 9 and 11 were greater than the DL. Concentrations subsequently remained below the DL (note that the DL [0.00005 mg/L] was greater than the GWS criterion [0.00003 mg/L]).
- Copper concentrations exceeded the GWS criteria at weeks 0, 1, 3, 6, 7 and 16 but remained below the criteria as of week 17.
- Mercury concentrations exceeded the DL at weeks 0, 2, 3, 22 and 23 of the test (note that the DL [0.00001 mg/L] was greater than the GWS criterion [0.0000013 mg/L]). Concentrations remained below the DL for all the other test weeks.
- Iron concentrations exceeded the D019 final effluent discharge maximum acceptable concentration at weeks 0 and 1 but remained below the latter as of week 2.
- The D019 final effluent maximum acceptable discharge concentration was exceeded between weeks 0 and 8 for the SS.
- Barium, cadmium, lead and zinc concentrations remained below the GWS RES criteria as of week 4 of testing or earlier.
- No exceedance of the GWS criteria was obtained during the test for all other metals analyzed.
- No other exceedances of (average and maximum) D019 final effluent discharge acceptable concentrations were obtained during the test.

Based on these results, although some metals were released in concentrations exceeding the GWS criterion and/or the D019 final effluent discharge requirements, in most cases the release was limited to the first few of testing, which is normal for this type of test. Therefore, for the ore column, no exceedance was observed after week 12 of the test, except for mercury (week 25). For the diabase column, exceedances of the applicable criteria stop after week 11, except for mercury (weeks 22 and 23) and a one-time result at week 16 for copper.

Therefore, mercury concentrations above the GWS criteria (at the DL) were obtained at one point even at the end of the test for both columns. Since there does not appear to be a clear downward trend in mercury behaviour, the ore and diabase would be considered mercury leachable even after 25 weeks. These results assume that the ore and diabase are also potentially leachable, in the short term only, for some metals ([ore: silver, copper, lead, zinc], [diabase: silver, barium, cadmium, copper, iron, lead, zinc]). However, the release of metals is limited.

Table 4-14 presents a summary of the results.

Table 4-14 GWS criteria and D019 final effluent requirement exceedances during column testing

Column	Parameter	D019 ^{1, 2} exceedance	GWS exceedance
Column 1 - Ore	Silver	-	Weeks 0, 6, 8, 9, 12
	Copper	-	Weeks 0 and 1
	Mercury	-	Weeks 0, 2, 3, 9, 25
	Lead	-	Week 0
	Zinc	-	Week 0
Column 2 – Diabase	Silver	-	Weeks 0, 1, 6, 7, 8, 9, 11
	Barium	-	Week 0
	Cadmium	-	Week 0
	Copper	-	Weeks 0, 1, 3, 6, 7, 16
	Iron	Weeks 0 and 1	-
	Mercury	-	Weeks 0, 2, 3, 22, 23
	Lead	-	Weeks 0, 1, 3
	Zinc	-	Weeks 0, 1, 3
	Suspended solids	Weeks 0 to 8	-

4.7.7 TANTALUM PENTOXIDE

In response to the July 2020 CCE request, information on tantalum levels is presented here for information purposes. No additional geochemical characterization of the ore is available. Tantalum is not expected to be mined as part of this project due to the low levels observed.

Tests were conducted to evaluate the possibility of integrating a Ta₂O₅ circuit to produce a marketable tantalum by-product. A total of 96 samples were analyzed for Li₂O and Ta₂O₅. Nine of these samples had Ta₂O₅ levels equal to or greater than 100 ppm, with a maximum of 343 ppm. Three of these samples had Li₂O levels above 0.3%. In all samples analyzed, tantalum is generally found in higher concentrations when lithium levels are lower (Figure 4-6).

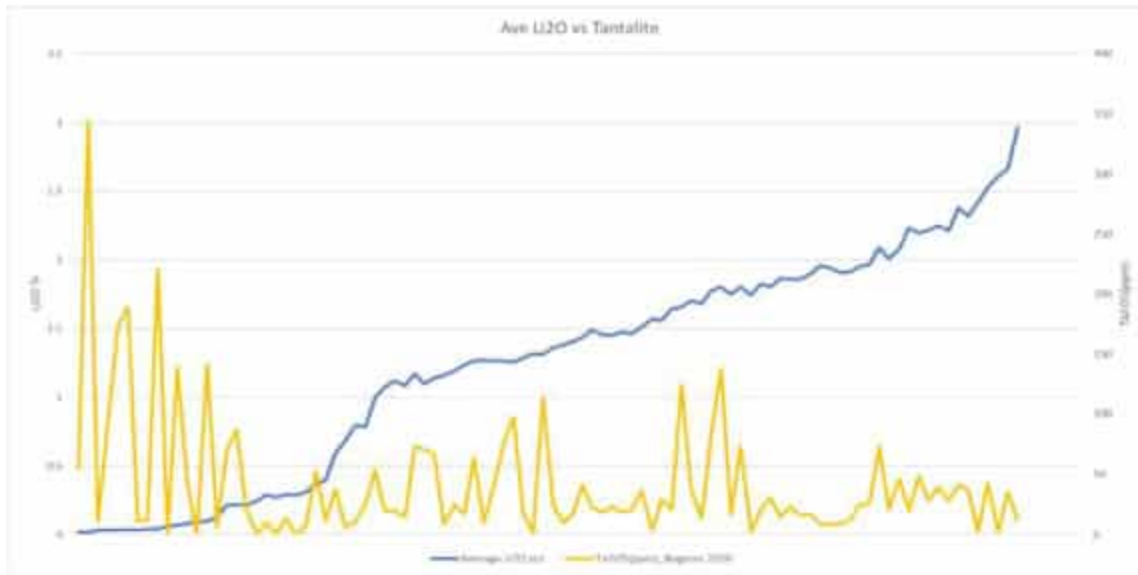


Figure 4-6 Comparison of Li_2O and Ta_2O_5 levels

Source: Galaxy, 2021

Higher concentrations of tantalum were observed mainly at the periphery of pegmatites and/or in small pegmatite dikes (1-2 meters thick). There may be a tantalum distribution pattern. The highest Ta_2O_5 levels (> 200 ppm) from the assays were observed in distal zones of pegmatite mineralization that were not modelled.

Based on these preliminary geological sample assays, the data indicate that less than 10% of the samples have Ta_2O_5 concentrations comparable with the Mt. Cattlin deposit (120-335 ppm in 2019 and 110-350 ppm in 2020). There is insufficient data at this time to recommend that metallurgical testing be undertaken.

4.8 STOCKPILES

The waste rock stockpile as well the unconsolidated deposits and organic matter stockpile are shown on Map 4-1.

The stockpile design is supported by stability tests that include geotechnical studies. These stability tests were performed by Golder Associates Ltd (2021) and can be found in Appendix A. The geotechnical studies include 78 boreholes, 15 piezocones, 79 exploratory trenches, in-situ shear strength measurements of cohesive soils (e.g., clay), laboratory tests (e.g., moisture content, grain size tests, hydrometric tests, plasticity (Atterberg) limits).

Stability tests (limit equilibrium) were carried out for static or pseudo-static conditions, the latter taking into account the seismic hazard in the project area (the project is located in a region with low seismic activity). The seismic hazard value was determined using the 2015 *National Building Code of Canada* Seismic Hazard Calculator (NRCan, 2016). The minimum safety factor required is based on the parameters provided in D019.

The peak horizontal ground acceleration (PGA) at the site is 0.038 g in “firm soils” with a probability of occurrence of 0.02 in 50 years according to D019. The horizontal seismic coefficient k retained for the pseudo-static stability analyzes is considered equal to 50% of the PGA. A value of 0.019 g was selected for the analysis. Key design criteria of the stockpiles are presented in Table 4-15.

A tailings and waste rock disposal strategy was developed based on the **mining engineer’s** estimates. This disposal strategy includes the unconsolidated deposits and organic matter. Figures 4-7 through 4-9 illustrate various cross-sections of the stockpiles and **berms**. **No sealing measures are currently planned under the stockpiles. All materials used for the construction of the stockpiles at the site will come from the pit.**

The next subsections present additional details on the **overburden and peat storage facility, the WRTSFs**, and the ROM pad. It should be noted that in the following sections, the term “upstream” of a dike or berm represents the side that faces the inside of the retain matter (material, water, etc.). “Downstream” of a dike or berm represents the side facing away from the storage infrastructure.

Table 4-15 Stockpiles key design criteria

Parameter	Unit	Design Value
Material acid drainage potential		
Waste Rock	Yes / no	No
Tailings	Yes / no	No
Unconsolidated deposits (inorganic)	Yes / no	No
Organic matter	Yes / no	N/A
Material water content		
Waste Rock	% w/w	3
Tailings	% w/w	12
Unconsolidated deposits (inorganic)	% w/w	15
Organic matter	% w/w	75
Global slope		
Waste Rock and Tailings	H:1V	2.5 H:1V
Unconsolidated deposits and organic matter	H:1V	5 H:1V
Specific dry density (loose)		
Waste Rock	t/m ³	2.2
Tailings	t/m ³	1.70
Unconsolidated deposits (inorganic)	t/m ³	2.0
Organic matter	t/m ³	1.22
ROM (pegmatite)	t/m ³	1.74-1.76
Storage capacities		
Waste rock tonnage	Mt	129.9
Filtered Tailings tonnage	Mt	31.4
Waste rock volume (loose)	Mm ³	59
Filtered Tailings volume (loose)	Mm ³	18.5
Unconsolidated deposits and organic matter (loose)	Mm ³	3.4
Seismic hazard		
PGA: Peak horizontal ground acceleration in “firm soils” with a probability of occurrence of 0.02 in 50 years	G	0.038
K: Horizontal seismic coefficient retained for pseudo static stability analysis	G	0.019

Source: **G Mining Services, 2021.**

4.8.1 OVERBURDEN

According to the available data, the unconsolidated material is composed of a mixed granular deposit with a small fraction of cohesive soil. Because of the heterogeneous properties of the unconsolidated deposits, it was recommended to incorporate a protection layer on the slope surface of the stockpile. This layer will be made of selected granular material, will be a more homogeneous material, and will have better frictional property to ensure the slope stability. This protection layer will be compacted to provide the required shear resistance.

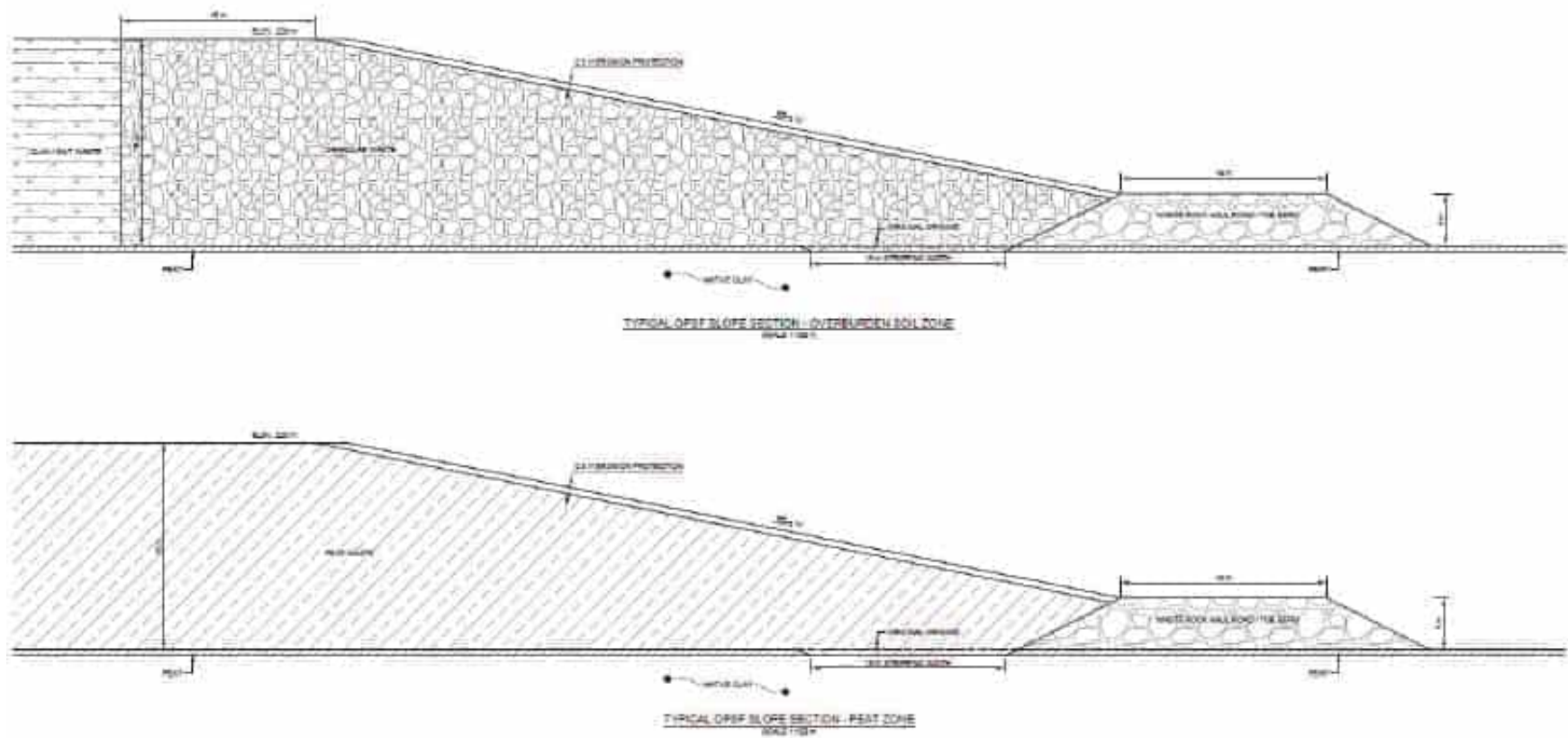


Figure 4-7 Cross-sections of the unconsolidated deposits and organic matter stockpile

Source: Golder Associates Ltd in G Mining Services, 2021

The proposed unconsolidated deposits **and organic matter** stockpile will be a fill with a maximum height (depending on the ground elevation) of approximately **16 m** (Figure 4-7). The maximum elevation of the proposed stockpile is **220 m**. The stockpile will be assembled over the years and its general geometry will be:

- **Perimeter ring width: 15 m;**
- Maximum bench offset: 5 m;
- Maximum bench height: 20 m;
- Local bench slope – 2.25 H: 1V.

Organic material was found in most of the borehole locations and consists of fibrous peat. This material is known to be saturated with water (Mesri and Ajlouni, 2007). Therefore, it is important to consider water management in the stockpile design to allow for easy drainage of this liquid. To this end, a perimeter stone dike (0-1,000 mm) will be built around the stockpile. In addition, access roads, spaced approximately 100 m apart, will be constructed to optimize bulldozer grading. The roads will be used by the trucks to travel safely on the stockpile while unloading the organic matter. A bulldozer can then be used to spread and compact the material. A gentle slope of 6H: 1V is recommended in the vicinity of the stockpile. Figure 4-8 illustrates the unconsolidated deposits and organic matter stockpile geometry. The volumes that will be placed in the stockpile are summarized in Table 4-16 for Reference Years -1, 1, 3, 5, 10, and rest of LOM.

Table 4-16 Cumulative volumes in the overburden and peat storage facility

Reference Years	Unconsolidated Deposit (Mm ³)
Year -1	0.24
Year 1	0.72
Year 3	1.14
Year 5	1.47
Year 10	2.54
Rest of LOM	2.90

Source: G Mining Services, 2021

4.8.2 WASTE ROCK AND TAILINGS

The waste rock and the tailings will be placed in **four stockpiles referred** to in this study as the waste rock **stockpiles (Figure 4-8)**. Also, some of the waste rock will be placed in the northwestern part of the pit when it is mined-out.

The combined waste rock and filtered tailings will be placed at four different stockpiles named “West”, “Northeast”, “Southwest” and “East” as identified on Map 4-1. The waste rock piles have been designed to accommodate a total of 31.4 Mt (approximately 18.5 Mm³) of solid filtered tailings and 129.9 Mt (approximately 59.0 Mm³) of waste rock. The east waste rock stockpile will extend to the southeast end of the pit (after all available reserves have been mined) in order to put waste rock there.

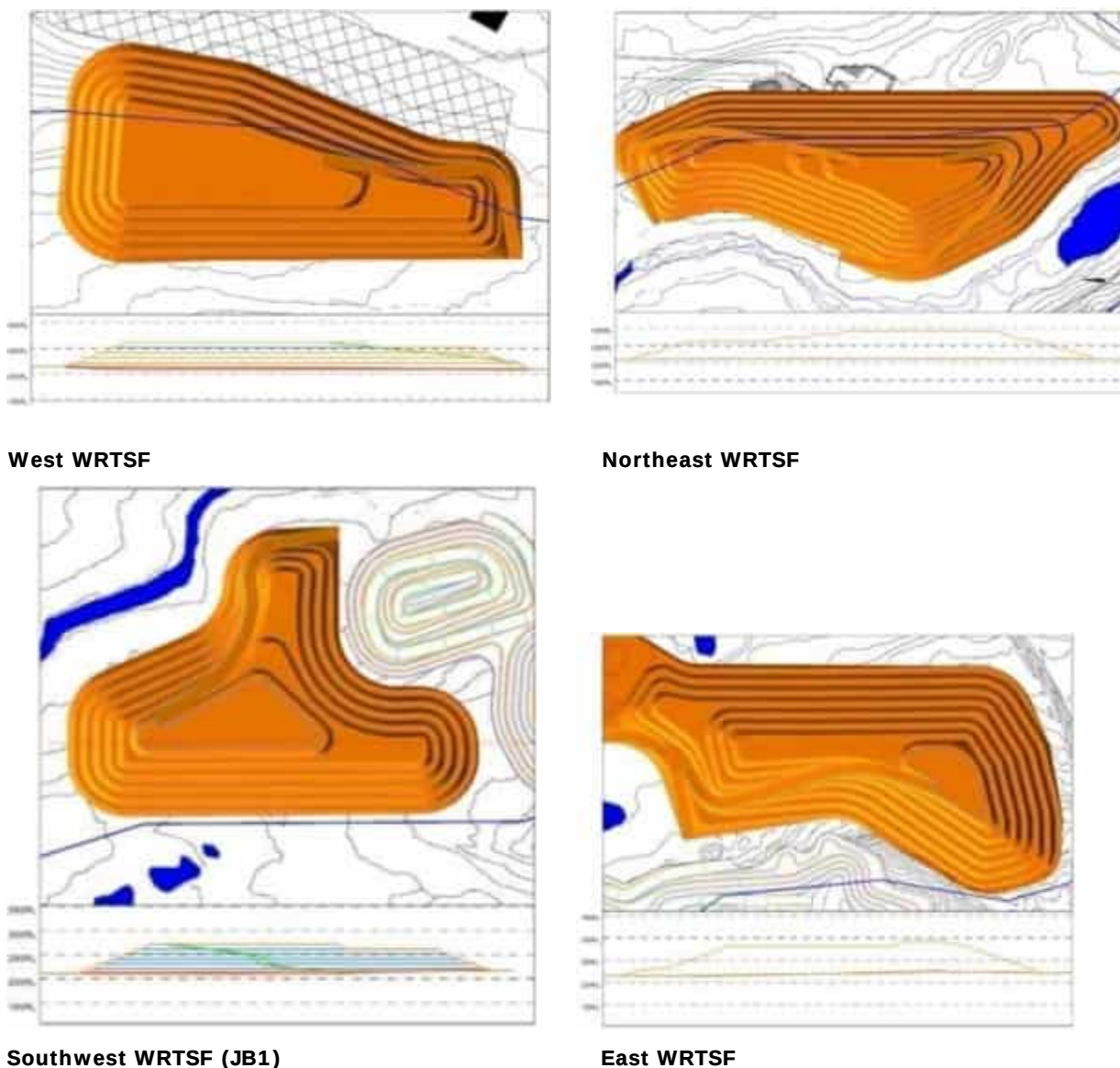


Figure 4-8 WRTSFs Configuration

The WRTSFs were designed taking into consideration the site properties, the design criteria of D019 (MELCC, 2012), as well as the Guidelines for preparing mine closure plans in Quebec (MERN, 2017). The design assumes that the foundation soils have a sufficiently low permeability to meet the maximum infiltration rates allowed by D019. The soils at the proposed sites are described as a non-cohesive granular sand and silt deposit. Infiltration rates measured under the waste rock stockpiles are significantly less than 3.3 L/m²/day (WSP, 2021a).

The location of the WRTSFs was determined to minimize hauling distances from the pit. All stockpiles will be a minimum of 60 metres from the high water mark of streams and lakes, with the exception of the east waste rock stockpile which crosses a segment of an intermittent stream draining Kapisikama Lake. It was already planned that this lake would be drained during the pit operations. The properties of the four WRTSFs are presented in Table 4-17 below.

Table 4-17 Summary of WRTSFs

WRTSFs	Ultimate Footprint Area (ha)	Ultimate Crest Elevation (m)	Maximum Final Height (m)	Slope
West	29.0	260	53	2.5
Northeast	54.4	290	83	2.5
Southwest (JB1)	31.0	270	62	2.5
East	58.1	280	68	2.5

According to the mining plan, the diameter of the blocks will be 900 mm at maximum, with an **average** F50 of **200** mm.

Table 4-18 summarizes the minimum values for slope stability safety factors for waste rock stockpiles recommended in the applicable Canadian Dam Association (CDA) guidelines and D019. For mine closure, surface restoration of the waste rock stockpiles will be required. The Guidelines for preparing mine closure plans in Quebec (MERN, 2017) recommend minimum values for safety factors consistent with those presented in Table 4-18 below.

Table 4-18 Minimum values of the recommended safety factors for the stability of waste rock piles

Conditions	Safety factor
Short term	1.3
Long term	1.5
Pseudo-static	1.1
After an earthquake (if applicable)	1.3

Deposition Plan

The waste rock and tailings will be placed on a solid foundation. **There is no clay under the stockpiles, with the exception of the southwest stockpile where there is a layer of about 1.5 m.** The topsoil and peat will be cleared around the perimeter. These materials will either be stored in the overburden and peat storage facility or temporarily stored nearby for use as material in the progressive restoration of the WRTSF.

Runoff water that has come into contact with the materials stored in the stockpiles will be collected by the ditches around the perimeter of the waste rock stockpiles and redirected to the main collection basin in order to avoid the suspension of sediments in the surrounding waterways. The quality of the water drained by the waste rock / tailings mixture will be monitored throughout the operation, as this water is the main effluent.

The co-disposal method consists of constructing a mixed stockpile by mixing the two types of material at the same site. This method was not chosen based on the geochemical characteristics of the materials to be stored, although the geochemical characteristics of the materials were considered. Stacking will be done under unsaturated conditions. Tailings cells will be constructed within the stockpiles and encapsulated by the waste rock, with a transition layer between the two to prevent particle migration. The detailed design of the interior layout for the placement of waste rock and tailings will be completed later (detailed engineering).

Co-disposal offers the following advantages:

- improved physical slope stability of the stockpile in the waste rock embankment zones;
- accelerated consolidation and improved shear strength of the tailings;
- reduced risk of embankment failure and loss of tailings containment;
- reduced dust generation and erosion of tailings;
- improved opportunities for progressive closure.

The slope will consist of 8.75 m benches for an average resulting slope of 2.3H:1V and berms of at least 5 m. At the top, the slope will be gentle to avoid ponding and prevent water erosion. The stockpiles will reach an elevation of between 260 and 290 m, i.e., between 53 and 83 m above the surrounding natural environment. The volumes that will be placed in the four waste rock and tailings stockpiles are presented in Table 4-19.

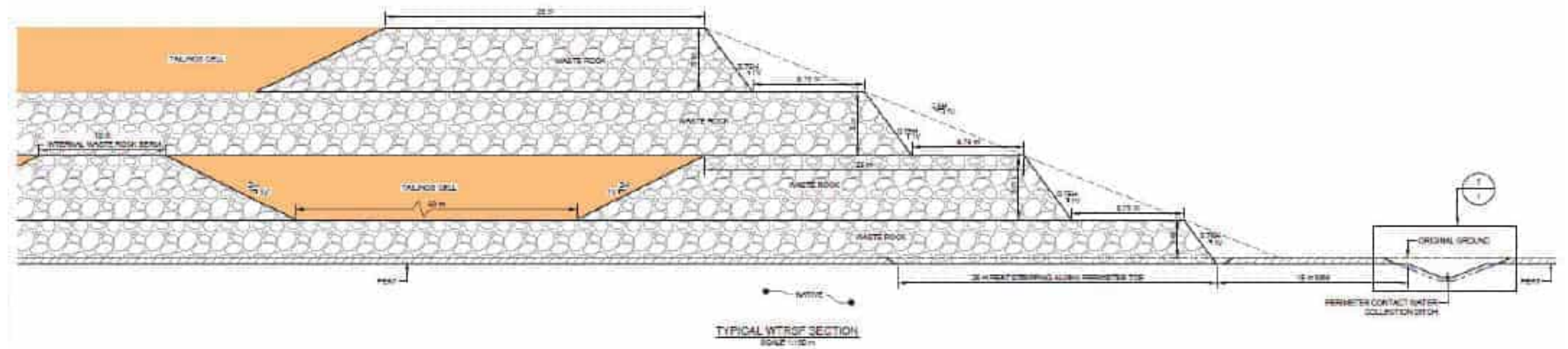


Figure 4-9 Tailings stockpiles - Cross section
 Source: Golder Associates Ltd in G Mining Services, 2021

Table 4-19 Volumes of material placed in the WRTSFs

Reference Year	Waste Rock (m ³)	Tailings (m ³)	Total (m ³)	Waste rock stockpile receiving materials
Year 1	2,284,233	1,000,000	3,284,233	East
Year 2	2,748,020	1,000,000	3,748,020	East
Year 3	2,339,979	1,000,000	3,339,979	East
Year 4	2,402,750	1,000,000	3,402,750	East
Year 5	2,720,712	1,000,000	3,720,712	West
Year 6	2,401,705	1,000,000	3,401,705	West
Year 7	2,433,218	1,000,000	3,433,218	West
Year 8	3,545,455	1,000,000	4,545,455	West
Year 9	3,838,761	1,000,000	4,838,761	West
Year 10	4,103,404	1,000,000	5,103,404	West
Year 11	4,023,522	1,000,000	5,023,522	Southwest (JB1)
Year 12	4,276,935	1,000,000	5,276,935	Southwest (JB1)
Year 13	4,193,224	1,000,000	5,193,224	Southwest (JB1)
Rest of LOM	16,900,214	5,450,860	22,351,074	Northeast
Total	58,212,134	18,450,860	76,662,994	-

Source: G Mining Services, 2021.

Fine Tailings Reclamation Project

The current project design allows for the coarse and fine portions of the tailings to be disposed of together in the WRTSFs. This approach is the cheapest option, but it means losing the ability to process fine tailings in the future, should the opportunity arise. A cost-benefit analysis was conducted by Galaxy to look at the possibility of separating fine tailings from coarser tailings and waste rock so that the processing of fine tailings remains possible in the future to recover Li₂O content.

Figures 4-10 to 4-13 show a preliminary version of the sections of the stockpiles that contain fine tailings cells. For the first 5 years of operation, the fine tailings would be concentrated in the northeast stockpile for possible reuse at the plant. Thereafter, the disposal would be flexible and adjusted annually. There would be no disposal constraints from a geotechnical standpoint. However, fine tailings would not be placed in the pit.

Northeast WRTSF

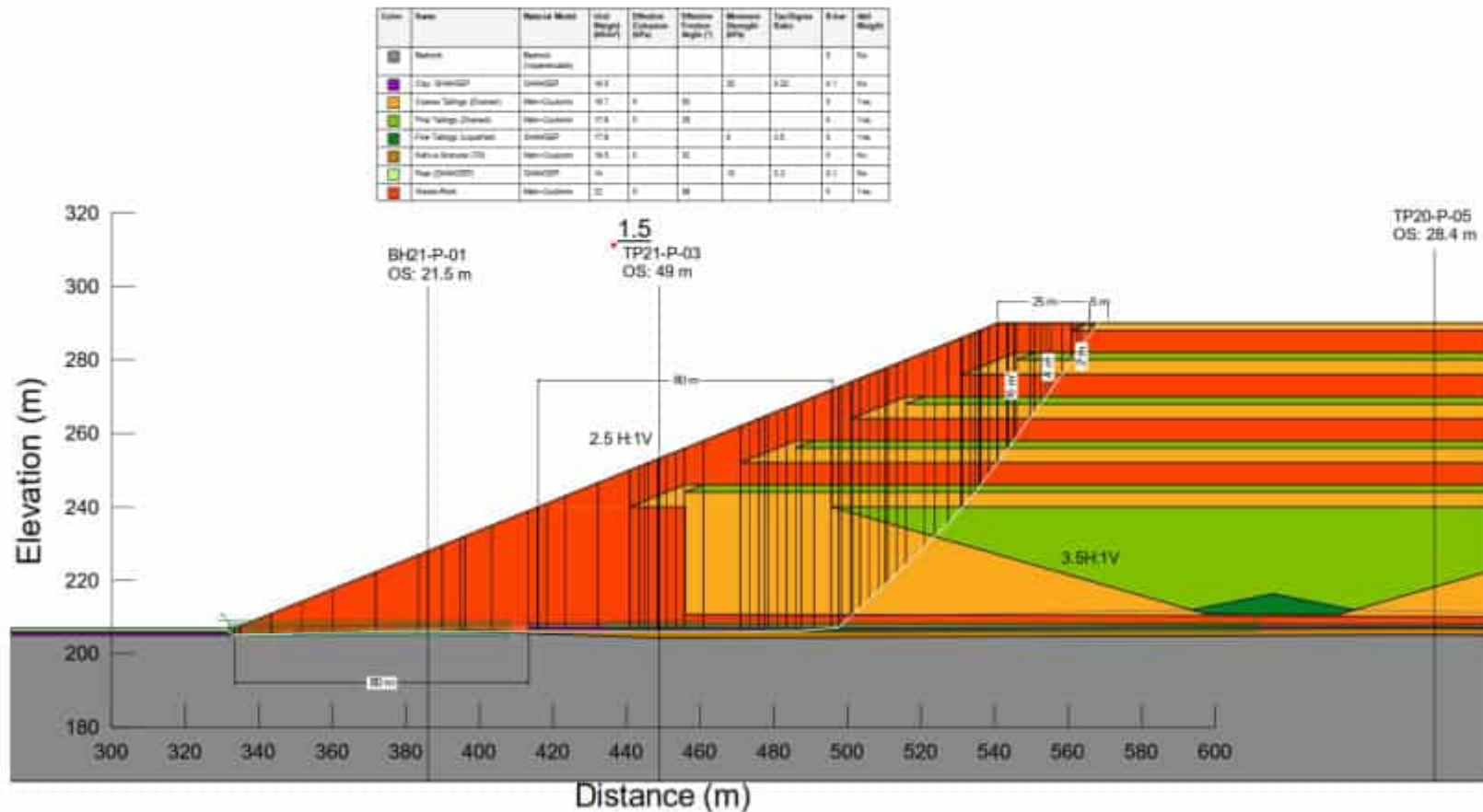


Figure 4-10 Cross-section of the Northeast WRTSF

Northwest WRTSF

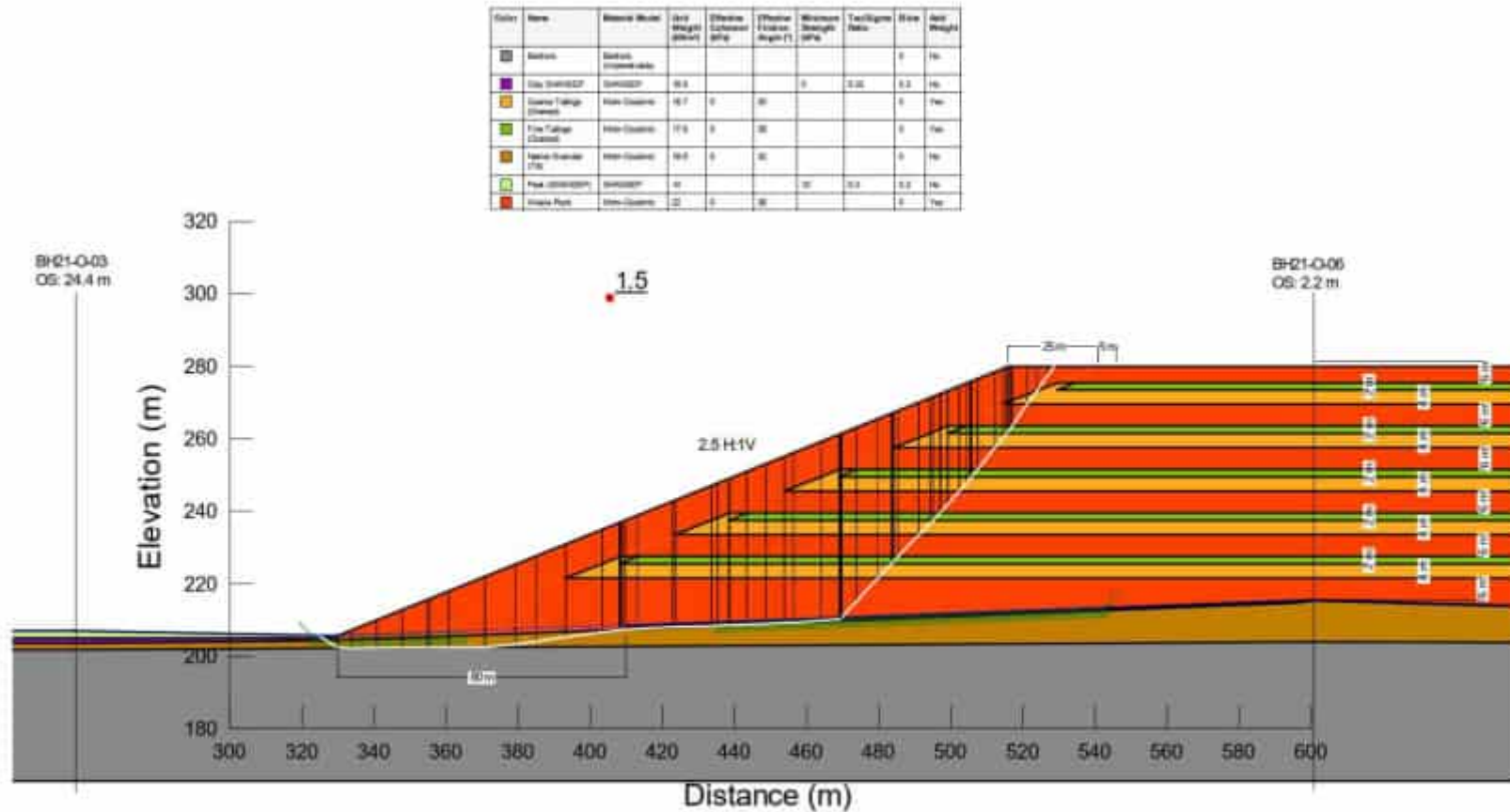


Figure 4-11 Cross-section of the Northwest WRTSF

Southwest WRTSF

Code	Name	Material Name	Unit Weight (kN/m³)	Moisture Content (%)	Shrinkage (%)	Permeability (cm/s)	Compressive Strength (kPa)	Unconfined Compressive Strength (kPa)	Friction Angle (°)	Cohesion (kPa)	Fill Height (m)
1	Concrete	Concrete	24								1.5
2	Gravel (100% crushed)	Gravel (100% crushed)	15.5								1.5
3	Gravel (75% crushed)	Gravel (75% crushed)	15.5								1.5
4	Gravel (50% crushed)	Gravel (50% crushed)	15.5								1.5
5	Gravel (25% crushed)	Gravel (25% crushed)	15.5								1.5
6	Gravel (10% crushed)	Gravel (10% crushed)	15.5								1.5
7	Gravel (5% crushed)	Gravel (5% crushed)	15.5								1.5
8	Gravel (2% crushed)	Gravel (2% crushed)	15.5								1.5
9	Gravel (1% crushed)	Gravel (1% crushed)	15.5								1.5
10	Gravel (0% crushed)	Gravel (0% crushed)	15.5								1.5

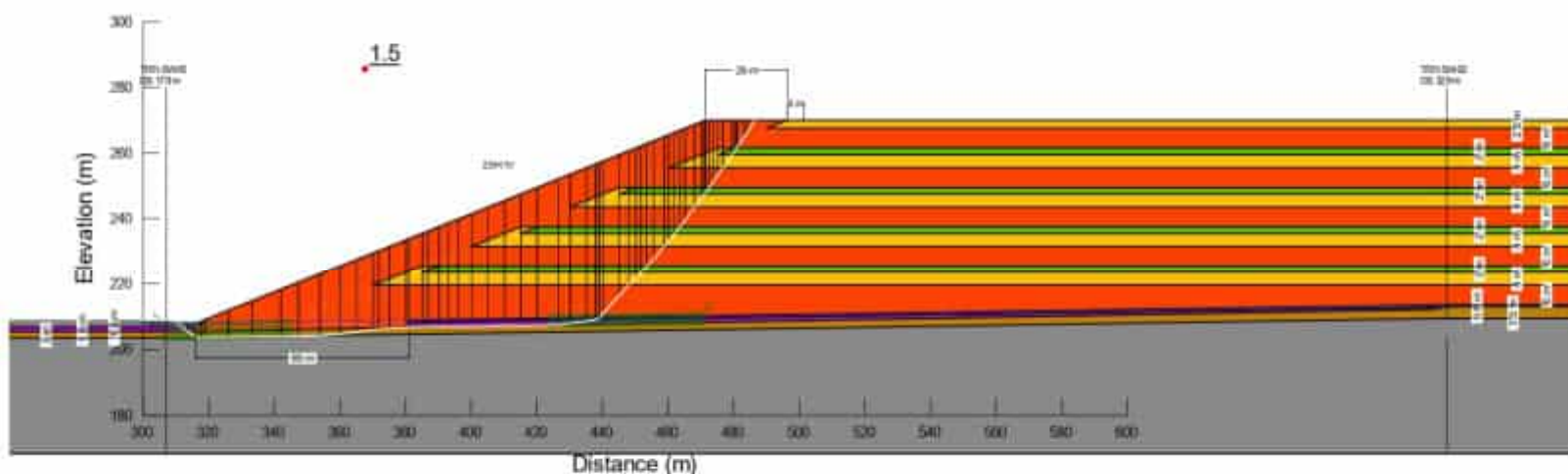
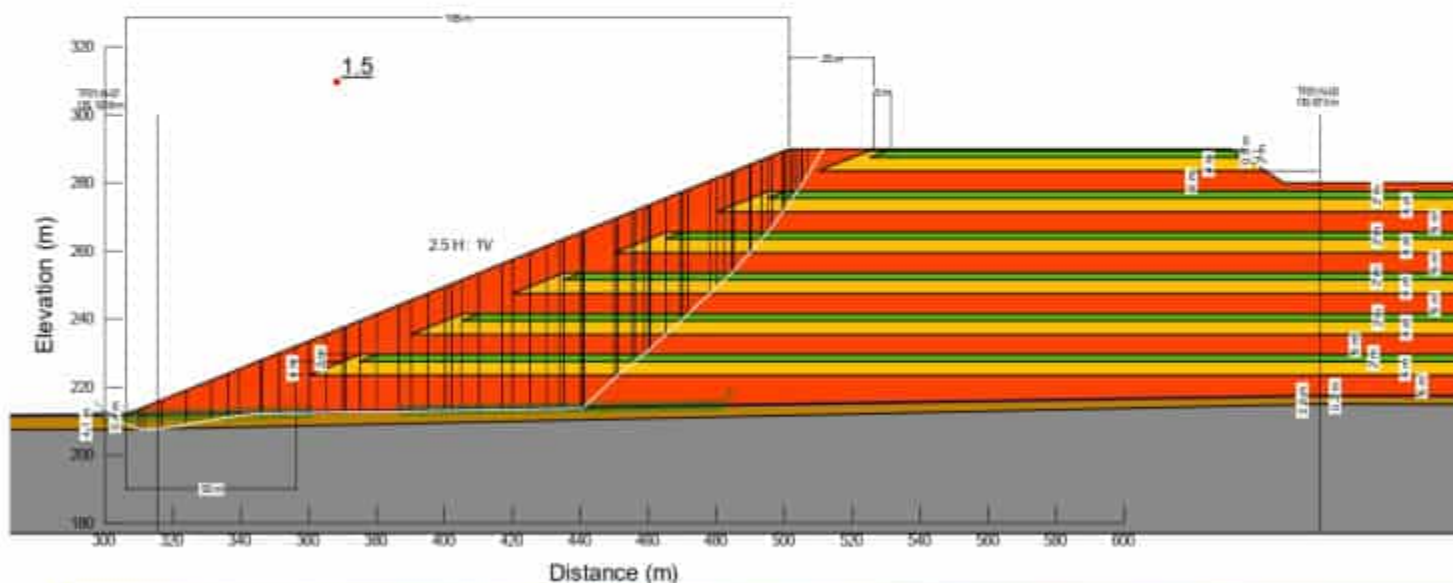


Figure 4-12 Cross-section of the Southwest WRTSF

Southeast WRTSF

Date	Event	Material Name	Unit Weight (kN/m ³)	Moisture Content (%)	Void Ratio	Shrinkage (%)	Swelling (%)	Compaction	Notes
10/10/2020	Baseline	Basement concrete	24.0	0.0	0.0	0.0	0.0	0.0	See
10/10/2020	Concrete 1st pour	Basement concrete	24.0	0.0	0.0	0.0	0.0	0.0	See
10/10/2020	Concrete 2nd pour	Basement concrete	24.0	0.0	0.0	0.0	0.0	0.0	See
10/10/2020	Concrete 3rd pour	Basement concrete	24.0	0.0	0.0	0.0	0.0	0.0	See
10/10/2020	Concrete 4th pour	Basement concrete	24.0	0.0	0.0	0.0	0.0	0.0	See
10/10/2020	Concrete 5th pour	Basement concrete	24.0	0.0	0.0	0.0	0.0	0.0	See
10/10/2020	Concrete 6th pour	Basement concrete	24.0	0.0	0.0	0.0	0.0	0.0	See
10/10/2020	Concrete 7th pour	Basement concrete	24.0	0.0	0.0	0.0	0.0	0.0	See
10/10/2020	Concrete 8th pour	Basement concrete	24.0	0.0	0.0	0.0	0.0	0.0	See
10/10/2020	Concrete 9th pour	Basement concrete	24.0	0.0	0.0	0.0	0.0	0.0	See
10/10/2020	Concrete 10th pour	Basement concrete	24.0	0.0	0.0	0.0	0.0	0.0	See



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Figure 4-13 Cross-section of the Southeast WRTSF

Development and operation of waste rock and tailings storage facilities

A summary of the development and operation of the WRTSFs and water management ponds is presented here:

- **Pre-production (year -1):** Under the proposed development plan, the East Water Management Pond and Phase 1 of the North Water Management Pond will need to be constructed in the production period (i.e., year -1). All waste rock mined during the pre-production period will be used to construct the base drainage layer and perimeter containment berms for the East Waste Rock and Tailings Stockpile. The overburden from the pit stripping and site development will be placed in the Overburden and Peat Storage Facility while the runoff will be collected in the North Water Management Pond (Phase 1).
- **Start-up (years 1 to 4):** During years 1 to 4 of mine operation, waste rock placement will occur in both the East WRTSF and the West WRTSF. Tailings will be placed inside the waste rock cells of the East WRTSF only during the first four years of mine operation. During this period, the waste rock to be placed in the West WRTSF will be used to construct the base drainage layer and perimeter containment berms. Contact water from the East Stockpile (containing both waste rock and tailings) will be collected in the East Water Management Pond and pumped to WRTSF (during the disposal of filtered tailings) and will begin in the Northeast WRTSF (to construct the base drainage layer). There may be a final waste rock disposal in the East WRTSF to cover all exposed tailings and achieve the required external waste rock embankment slopes. Phase 2 of the North Water Management Pond will need to be constructed by Year 5 to collect runoff from the Overburden and Peat Storage Facility, the West WRTSF (containing both waste rock and tailings), and the Northeast WRTSF (containing only waste rock during this period). The East Water Management Pond will continue to collect contact water from the East WRTSF.
- **Years 11 to 13:** In years 11 to 13 of mine operation, the tailings will be placed in waste rock cells in the southwest WRTSF (JB1). During this period, waste rock will continue to be placed in the West WRTSF (to cover all exposed tailings and achieve the required external waste rock embankment slopes) and in the Northeast WRTSF (to construct the base drainage layer and perimeter containment berms prior to tailings disposal). Runoff from the Southwest WRTSF (JB1) will be drained to the open pit where it will be pumped to the North Water Management Pond. Phase 2 of the North Water Management Pond will continue to collect runoff from the West and Northeast WRTSFs. The East Water Management Pond will continue to collect contact water from the East WRTSF.
- **Years 14 to 18.5:** During the final years of mine operation, the tailings will be placed in waste rock cells in the Northeast WRTSF. Waste rock disposal during this period will be primarily in the mined-out open pit (i.e., in the eastern extension of the waste rock and tailings stockpile). There will also be waste rock disposal throughout the WRTSFs to cover all exposed tailings and achieve the required external waste rock embankment slopes. Runoff from the Overburden and Peat Storage Facility, the West and Northeast WRTSFs will flow into the North Water Management Pond (Phase 2). The East Water Management Pond will continue to collect contact water from the East WRTSF. Runoff from the Southwest WRTSF (JB1) will continue to flow to the open pit and be pumped to the North Water Management Pond.
- **Once the planned footprint of each WRTSF has been fully developed (i.e., when the waste rock base drainage layer has been completed),** the waste rock will then be used to construct internal disposal cells in all of the stockpiles where the tailings will then be placed to reach the maximum elevations presented in Table 4-17. The development and elevation of waste rock and tailings piles will be done with care to avoid failure of the underlying clay soil foundation, as needed.

Dikes

The foundations of the planned stockpiles have a natural slope orientation to avoid the construction of berms to contain or direct runoff. A collection ditch is planned in the stockpiles in order to direct the water to the water catchment basins.

4.8.3 ORE

As presented in section 4.6, the blasted material is first stored on the ROM pad. This stockpile has a **minimum** capacity of **20,000** tonnes (loose). The pad is designed to allow the trucks to access, circulate, and place the blasted material on a temporary stockpile. The ROM pad is adjacent to the industrial and administrative area (Map 4-2); the designed geometry of the pad is shown on Figure 4-14.

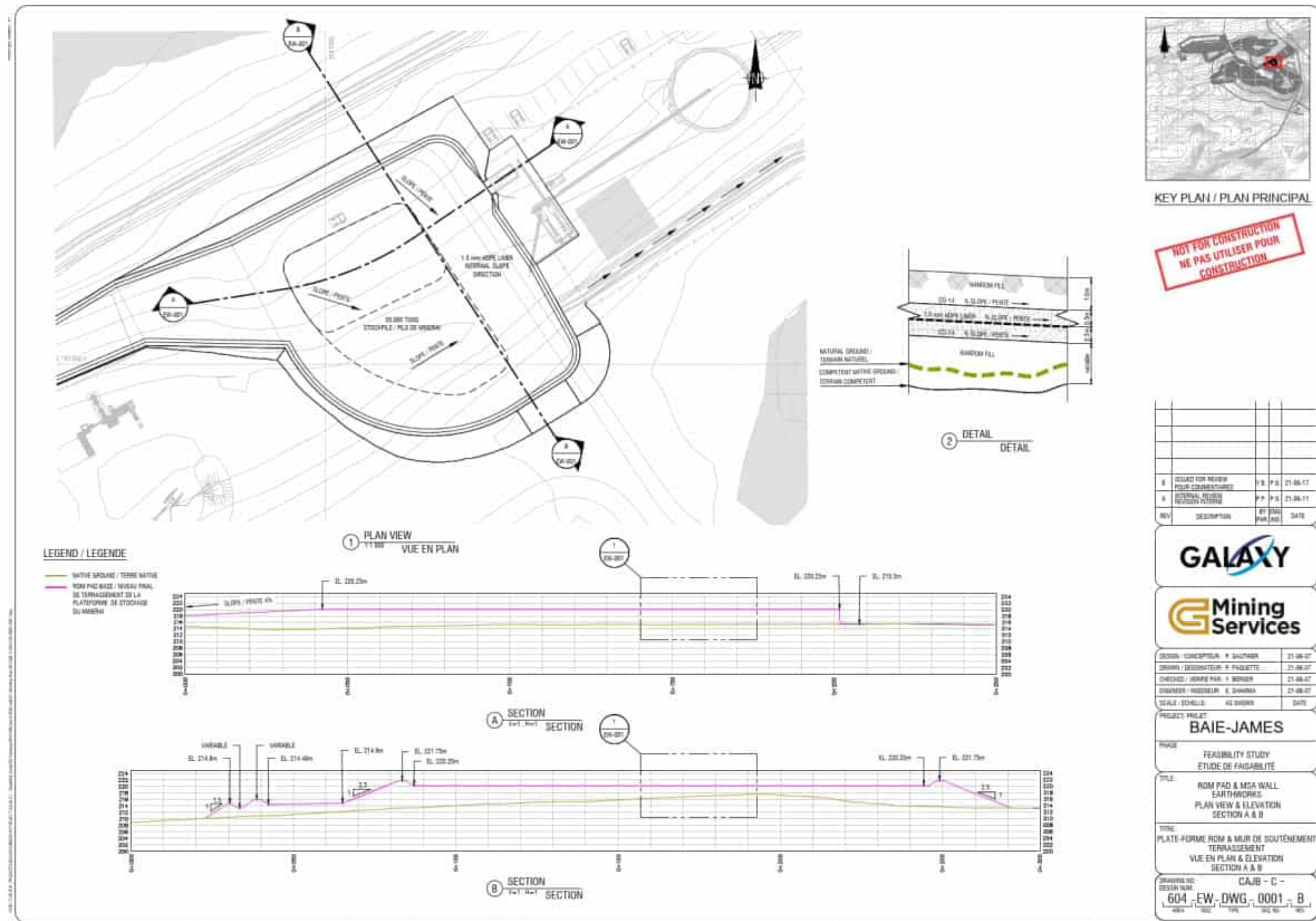


Figure 4-14 Design and cross-sections of the ROM pad

Source: G Mining Services, 2021.

The ore is classified as leachable for various parameters (As, Mn, Cu, Zn, etc.) as defined in D019, and groundwater and surface water protection measures are planned for on-site ore storage. However, ore storage will be sporadic and short-lived, and the ore will then be sent to the processing plant. The ore pile and the industrial water pond (the one located between the camp and the concentrator) will be waterproofed with an HDPE geomembrane. The water draining from the pile will be directed to the industrial water pond and the water from this pond will be redirected to the concentrator.

Construction Material Selection

In order to carry out the activities, i.e., loading the main crusher using a front-end loader, it was proposed that the stockpile crest be at an elevation of approximately 215 m; this is approximately 8 m above the existing ground. In view of the planned volume of the stockpile, an area of approximately 120 m by 140 m is required. In accordance with safety regulations, a perimeter berm with a height greater than the radius of the largest machine wheel is required at the crest. The proposed berm will be 1.5 m high. Stone (0-600 mm) of suitable material will be used to build the stockpile with the required elevation.

Preparation of the foundation soil will include excavation and grading of the site to create a usable and low-maintenance ground surface that does not flood or erode. In order to prevent erosion of the outer slopes, a 200 mm thick layer of plant cover will be laid. For the road surface, a 150 mm thick layer of crushed rock (maximum 80 mm) will be placed on a 650 mm thick base layer of rock (0-450 mm).

Drainage

Site grading will be consistent with the following:

- design a surface water management system for the platform;
- provide an adequate surface slope for the platform to minimize stormwater runoff on the platform.

The ROM pad design includes an impermeable layer. The ROM pad will be graded at a 2% downslope to a gravity ditch and a pumping station (if required in detailed engineering) designed to allow water that has been in contact with the stockpile to be discharged to the sedimentation pond in the industrial and administrative sector. A perimeter ditch will be constructed at the low points of the natural terrain. Where required, a berm will be constructed to direct runoff water to the gravity ditches. The height of the berm will comply with the requirements for water containment structures in D019 as well as the *Safety Code for the construction industry* (Government of Quebec, 2018).

4.9 WATER MANAGEMENT

Water management infrastructure, water balance, and specifics of the main project phases (construction, operations, and rehabilitation) are described in the following sections. The project will include **a single clean water discharge site at the CE2 watercourse**.

4.9.1 DESIGN PARAMETERS

For mining projects in northern Québec, the issues and risks associated with low water reserves can be entirely avoided with well-defined operational procedures and controls. The following elements will be implemented:

- The commissioning of the mine is planned to follow a spring melt event (late May to early June). Even with a low snow-pack year, the spring melt event will generate enough runoff to meet the needs of commissioning without requiring supplementation from natural sources. The risk of delays due to inadequate water reserves can be further alleviated by completing the construction **of the waste rock stockpile water retention basin dike** during the previous summer. This would allow for the accumulation of a few months of rain water prior to winter.

- **The design of the north water retention basin provides for a minimum emergency water supply (liquid and accessible) equivalent to the amount needed to meet the ore processing plant demand of 30 m³ / hr for approximately 50 days.**
- An additional quantity of water must be kept in the **north water retention** basin before prior to the onset of winter. This volume is needed to account for losses due to an **estimated** surficial ice formation **thickness of 2 m** and to a prolonged period (typically from November to **April**) where **liquid** precipitations cease. **The quantity of water to be reserved at the end of November varies with mine site development and is estimated to be 500,000 m³ for operating years 1 through 3 and 1,000,000 m³ for operating years 4 through 19.**

The preliminary design result indicates that the annual water balance for the project is positive even in dry years, and site runoff and pit dewatering water can supply the water demand from the ore processing plant. We expect effluent to discharge to the environment in all operating years. In a subsequent **design** phase, general operational and **regulatory** criteria **will be considered depending on the type of water management infrastructure to be constructed, for:**

- The design flood management;
- The freeboard;
- The water quality standards;
- The water treatment capacity.

Design Flood Management

As specified in the D019, water retention basins associated with tailings and/or **mining** waste rock **management** facilities must be designed to manage the design flood in a 30-day period. This is defined as the contact water volume generated by a 30-day spring melt event with a 100-year return period, combined with the contact water volume generated by a 24-hour rain event with a 1,000-year return period. Also specified in D019, all water management infrastructure without the permanent ability to retain significant water reserves must be designed to safely manage a storm event with a 100-year return period. **Again under D019, retention basin emergency overflow must be designed to discharge a probable maximum flood (PMF).**

The sedimentation basin of the overburden stockpiles is not associated with an area used for the permanent storage of mining waste as defined by D019. No volumetric flood storage requirements are thus imposed. The basin can therefore be regarded as a type of water treatment facility. As such, it must be dimensioned so its effluent will meet water quality requirements.

Freeboard

A freeboard of 1.0 m is recommended by D019 when there are no sensitive receptors downstream of the dike (ecological reserves, water sources, etc.). The freeboard of this project is 1.5 m to account for possible variations with regards to climate change. **No additional calculations were performed to determine the freeboard height.**

Effluent Water Quality Standards

The D019 and the MDMER mining effluent regulations apply to both effluent discharge **locations (CE2 watercourse).**

Water Treatment Capacity

The WTP must be capable of dewatering surplus volumes of water generated by a wet year such that the water level in the basin can be brought down to an established pre-winter target. For this criterion, a wet year is defined as a year with a total precipitation accumulation with a 10-year return period, combined with the supposition that the basin that will receive the water will be at its capacity at the beginning of spring.

4.9.2 INFRASTRUCTURE

Surface water management strategy

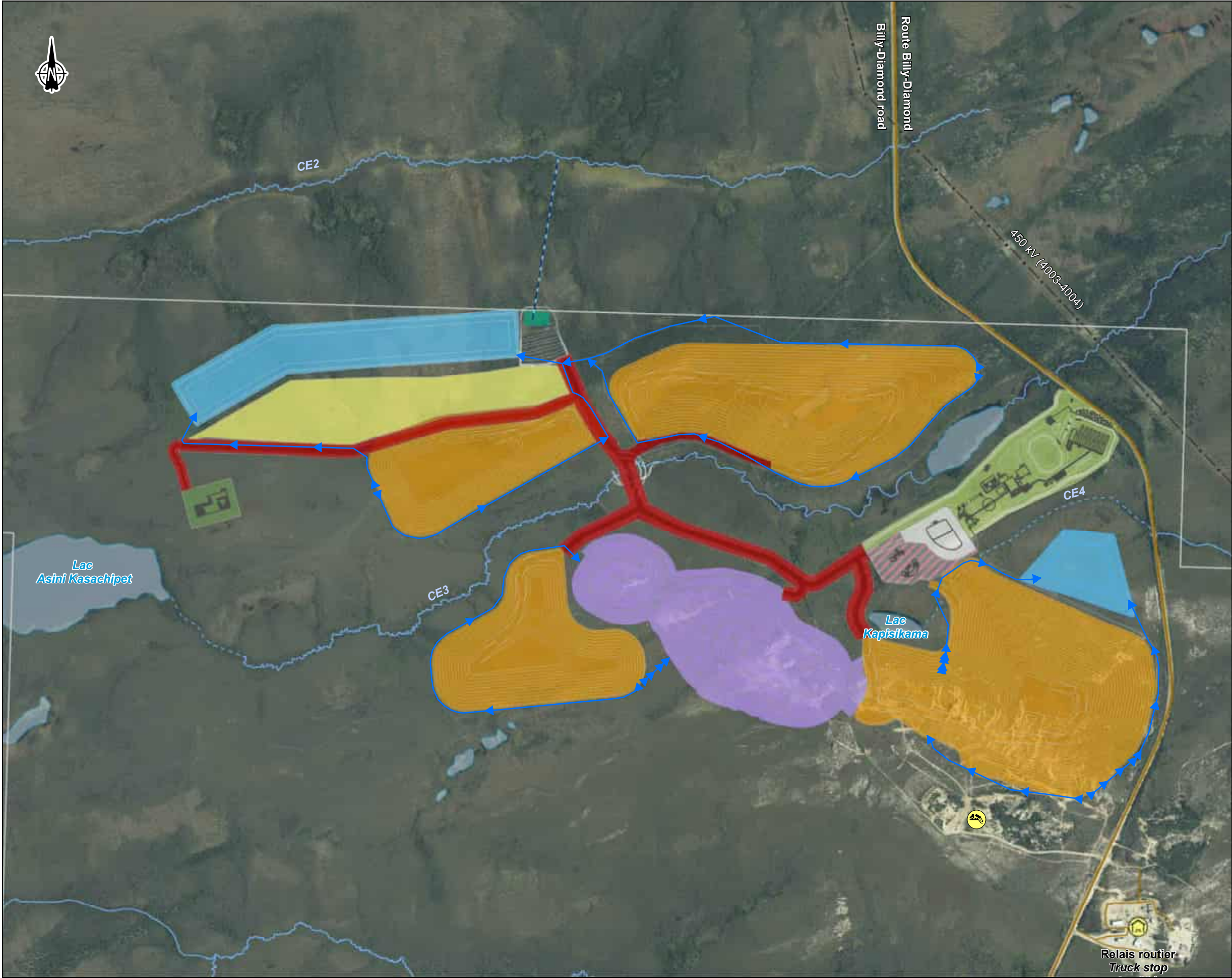
The proposed surface water management strategy for the site has been developed in conjunction with the design of the tailings, waste rock and overburden accumulation areas and in consideration of the proposed preliminary site development. All runoff from precipitation that falls on areas affected by mining is considered “contact water”. Contact water will be collected and stored before treatment (if required) and discharged to the environment (Map 4-7).

The project’s surface water management strategy includes the following:

- Diverting natural runoff around areas affected by mining to limit mixing of natural runoff with contact water.
- Limiting the mixing of natural runoff with contact water (i.e., reducing the volume of contact water requiring management).
- Limiting the risk of contact water discharge to the environment.
- Collecting all runoff and seepage water from tailings, waste rock and overburden accumulation areas. Contact water from these areas will be collected in collection ditches and directed to the water retention basins or the open pit. Water collected in the east water retention basin and the open pit will be pumped to the north water retention basin, which is the main water management pond for the site.
- Prioritize reuse (i.e., recovery) of contact water.
- Have a single final effluent point (CE2 watercourse).

Based on the results of the preliminary engineering study, the north and east retention basins will have a maximum water storage capacity of 1,360,000 m³ and 180,000 m³ respectively, which provides sufficient capacity to contain the design flood recommended by Directive 019 without discharge to the environment during spring melt and to meet process water needs throughout the year.

Sludge will accumulate in the water management ponds throughout the project. We have not yet assessed the expected sludge quantities. This is an operational constraint that should be managed in compliance with applicable laws and regulations. A specialized contractor will remove the accumulated sludge from the ponds if required. This sludge will then be analyzed and managed accordingly.



- Limite de propriété / Property limit
- Composantes du projet / Project Component**
- Route / Road
- Effluent minier / Mine effluent
- Usine de traitement de l'eau / Water treatment plant
- Secteur administratif et industriel / Administrative and industrial sector
- Fosse / Pit
- Halde à minerais / ROM pad
- Halde à stériles / Waste rock stockpile
- Halde à matières organiques et dépôts meubles / Overburden and peat storage facility
- Entrepôt à explosifs / Explosives magazine
- Aire d'entreposage / Dry storage area
- Usine à béton (temporaire) / Concrete batch plant (temporary)
- Bassin de rétention d'eau / Water retention basin
- Sens d'écoulement des eaux / Direction of water flow

- Infrastructures / Infrastructure**
- Route principale / Main road
- Route d'accès / Access road
- Ligne de transport d'énergie / Transmission line
- Relais routier / Truck stop
- Lieu d'enfouissement technique isolé / Isolated technical landfill

- Hydrographie / Hydrography**
- CE3

Numéro de cours d'eau / Stream number
- Cours d'eau permanent / Permanent stream
- Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream
- Plan d'eau / Waterbody

GALAXY
Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 4-7
Gestion des eaux en phase d'exploitation /
Water management during the operation phase

Sources :
Orthoimage : Microsoft Bing (ESRI, 2017)
Géom : MRNF Québec, 210315
Données du projet / Project data : Galaxy 2020

0 150 300 m
UTM, fuseau 18, NAD83

Juillet / July 2021

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c4-7_wspT304_gest_eau_210629.mxd



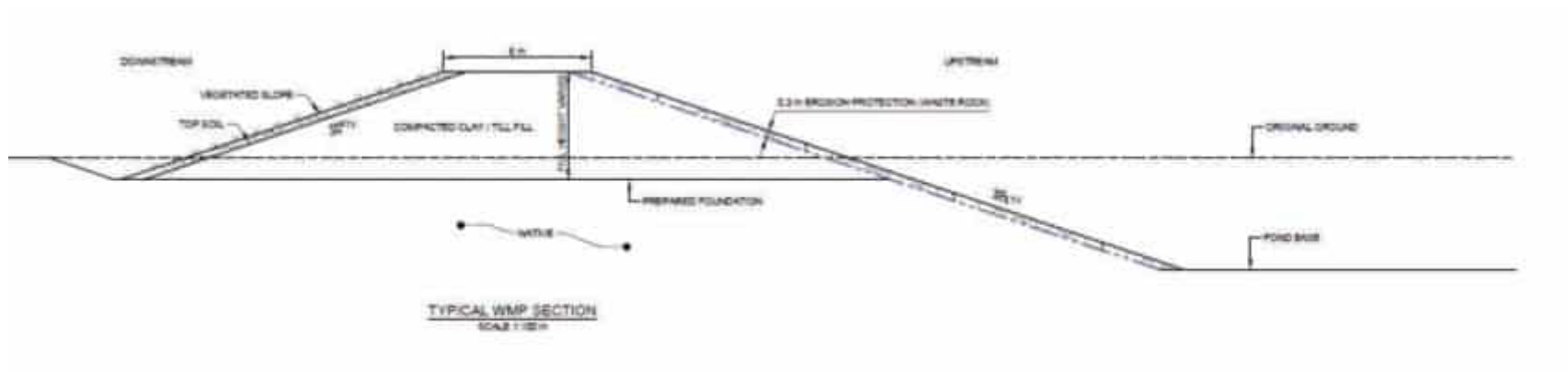


Figure 4-15 Dike cross-section

Source: Golder Associates Ltd dans G Mining Services, 2021.

Water treatment plant

The WTP is designed to treat water from the water retention basin (if measurements show noncompliance).

Based on the water quality modelling results (WSP, 2021b) presented in Appendix B, year 9 of operation may show arsenic concentrations over D019. The effluent will be carefully monitored to ensure that discharged water complies with environmental standards (Chapter 10). When arsenic (or other metal) concentrations approach the maximum environmental standards, the WTP will be constructed and ready to treat the effluent before discharge to the environment to ensure that discharge standards are not exceeded. A WTP construction permit application will be made at the appropriate time before the construction of this treatment unit.

As per D019's definition, waste rocks and tailings are considered as low risk. Therefore, according to this directive, a water treatment plant is not necessary. However, some parameters do not meet the environmental discharge objectives (EDOs). The effluent will be subjected to testing before being discharged to the environment and discharge will be stopped in case of noncompliance with D019 criteria. Absorbents will be available in case of SS or HC contamination. If pH, iron or any other metal exceeds the criterion, batches could be treated directly in the basin.

Considering the low leaching results which are close to the EDO boundary values, it is impossible to determine if it is necessary, and technically possible, to reach the EDO lower boundary values at the moment. We believe that we need to wait for the analysis results following a full year of production before establishing the treatment chain. The project costs integrate space and financial reserve, but we will work out the plant design details only when we know the parameters and intensity of treatment required.

Concerning the disposal of the treated sludge, when disposal is required, it will be analyzed and will either be directed to the tailings and waste rock facility or considered as contaminated soils or residual hazardous materials after discussion with MELCC representatives. The quantity is difficult to estimate, but it will certainly not be comparable to that generated by systems that treat acidic water. There may not even be any treatment sludge.

Mining effluent

The CE2 watercourse **effluent will include:**

- construction of an overflow or channel to allow for flow measurement (e.g., Parshall flume);
- pH, temperature and water outflow monitoring instruments;
- energy dissipation measures to reduce water velocity and minimize sediment disturbance.

These elements will be installed upstream of the watercourse discharge point and will be designed at a later date (during the detailed engineering study).

Sanitary effluent

After treatment, the sanitary effluent will be discharged to CE4 (see Section 4.10.2).

Drinking water well

During the construction phase, tank trucks will supply potable water during the construction of the water wells and water treatment infrastructure. We estimate the drinking water requirement at 63 m³ per day for the maximum number of 280 workers. The water will be stored in a 400 to 500 m³ insulated and heated water tank.

The operation phase will require two to three wells to meet the potable water needs of 41 m³ per day for 150 workers. The potable water supply will include a treatment plant and pipe insulation or heating to the camp and treatment site. **The wells will be located near the workers' camp.**

Based on the area's hydrogeological characteristics, the bedrock aquifer has been identified as being usable. According to the studies carried out, the permeability of the rock varies depending on its nature and its degree of fracturing.

A water search will enable us to target sectors favourable to exploiting potable water and, subsequently, build open wells in the rock. The diameter is to be determined, but will most likely vary between 6 and 8 inches at a depth between 30 and 100 m. A submersible pump installed in the well will be used to draw water for the camp. The number of wells to be constructed will depend on the aquifer capacity at the location of the drill holes. Two wells are currently proposed.

4.9.3 WATER BALANCE

A monthly water balance study was conducted as part of the preliminary engineering study for the project's operation phase, taking into consideration the major project water flows presented in Figure 4-15. The water balance study considers the 19 years of project operation to estimate effluent volumes to the CE2 watercourse and to define a water management strategy for the north water retention basin, ensuring water supply to the ore processing plant. The main water balance study results are as follows:

- The annual runoff volume generated by the site exceeds the process water demand, even under dry weather conditions. There is, therefore, a surplus of water that must be managed at the north water retention basin and discharged as effluent to the CE2 watercourse.
- The proposed operating strategy for the north retention basin keeps the water level below the emergency overflow level, even in wet weather years. This strategy will be reassessed or confirmed in a later phase of the project, taking into consideration the water pumping and treatment system design.

Water will not be drawn from the watercourses. The north water retention basin and the ore storage area raw water basins will supply water for the concentrator, fire protection and dust control (250 m³/day).

Table 4-20 provides an estimate of the annual final effluent volumes to the CE2 watercourse.

Table 4-20 Final effluent volume to CE2

Year of operation	Effluent (m ³) according to the climate scenarios			
	Average historical conditions	Dry year 1:25	Humid year 1:25	Average conditions considering the potential effects of climate change
1	702,400	556,900	849,300	761,900
2	650,500	495,600	807,500	713,400
3	909,100	716,300	1,103,600	985,300
4	1,054,600	705,900	1,406,600	1,202,400
5	1,439,700	1,090,000	1,792,800	1,587,900
6	1,541,500	1,171,100	1,915,500	1,697,100
7	1,721,500	1,311,200	2,135,600	1,891,200
8	1,978,000	1,535,300	2,424,900	2,159,200
9	1,900,800	1,455,400	2,350,500	2,083,000
10	1,891,700	1,447,300	2,342,200	2,074,200
11	1,904,700	1,456,800	2,356,800	2,087,700
12	1,911,500	1,463,700	2,365,100	2,094,900
13	1,785,400	1,366,700	2,209,700	1,958,500
14	1,786,300	1,366,800	2,211,400	1,959,700
15	1,791,300	1,367,200	2,219,500	1,966,000
16	1,811,200	1,385,100	2,241,300	1,986,500
17	1,770,800	1,344,100	2,203,300	1,946,800
18	1,649,300	1,255,000	2,049,000	1,813,800
19	1,464,500	1,070,200	1,864,200	1,629,000

Source: Golder Associated Ltd., 2021.

Table 4-21 presents the average final water effluent discharge volumes on a monthly basis for years 3 and 9 of operation and for the different climate scenarios considered.

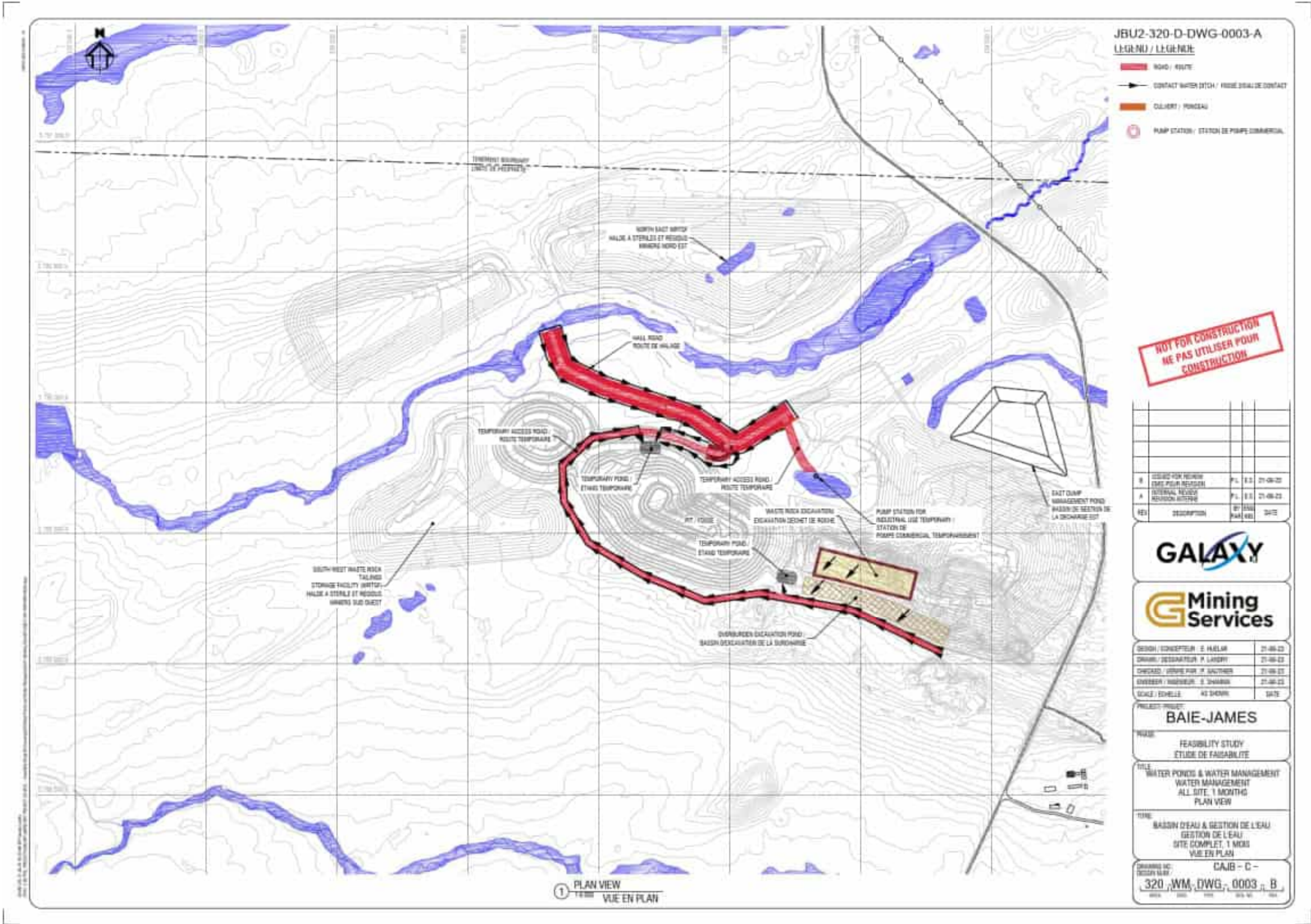
Table 4-21 Final water effluent volume to CE2 per month for years 3 and 9

Month	Effluent (m ³) according to the climate scenarios							
	Average historical conditions		Dry year 1:25		Humid year 1:25		Average conditions considering the potential effects of climate change	
	Year 3	Year 9	Year 3	Year 9	Year 3	Year 9	Year 3	Year 9
1	79,570	152,790	76,830	148,060	82,340	157,560	82,650	158,920
2	76,140	147,110	74,210	143,710	78,100	150,540	78,560	152,150
3	77,540	148,800	75,280	145,010	79,820	152,630	79,160	152,650
4	80,670	155,250	77,670	149,940	83,700	160,610	82,740	159,470
5	0	0	0	0	0	0	0	0
6	0	0	0	0	15,040	94,620	0	0
7	84,000	217,850	0	11,700	155,360	331,330	109,540	284,130
8	95,520	218,420	73,220	167,190	116,430	270,140	101,990	236,120
9	140,300	308,530	109,060	236,100	171,840	381,640	153,310	338,700
10	143,260	317,280	111,320	242,800	175,500	392,470	156,540	348,270
11	45,510	69,560	36,560	53,340	54,500	85,930	50,100	78,790
12	86,540	165,240	82,160	157,580	90,960	172,970	90,960	173,780

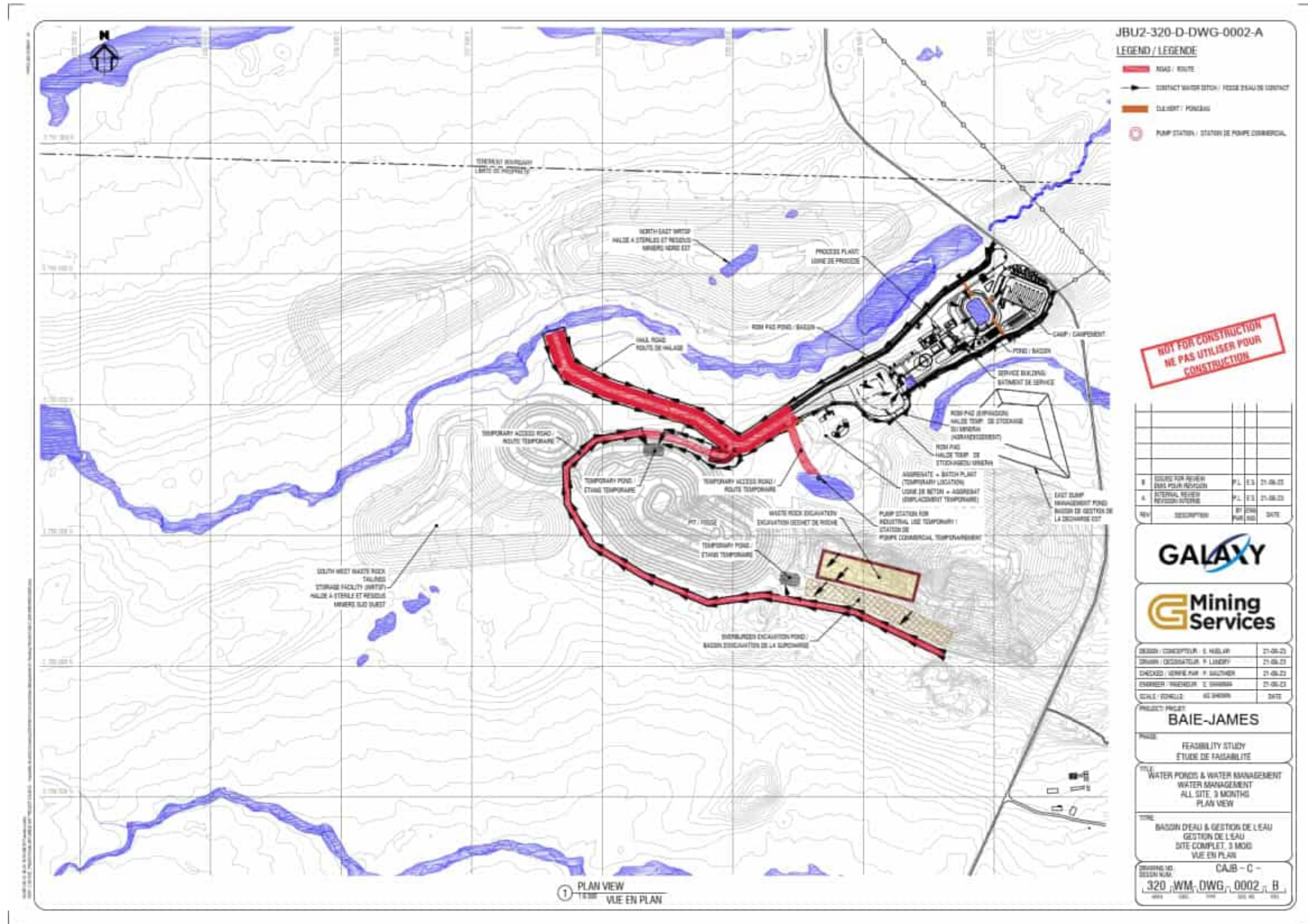
Source: Golder Associated Ltd., 2021.

4.9.4 DURING THE CONSTRUCTION PHASE

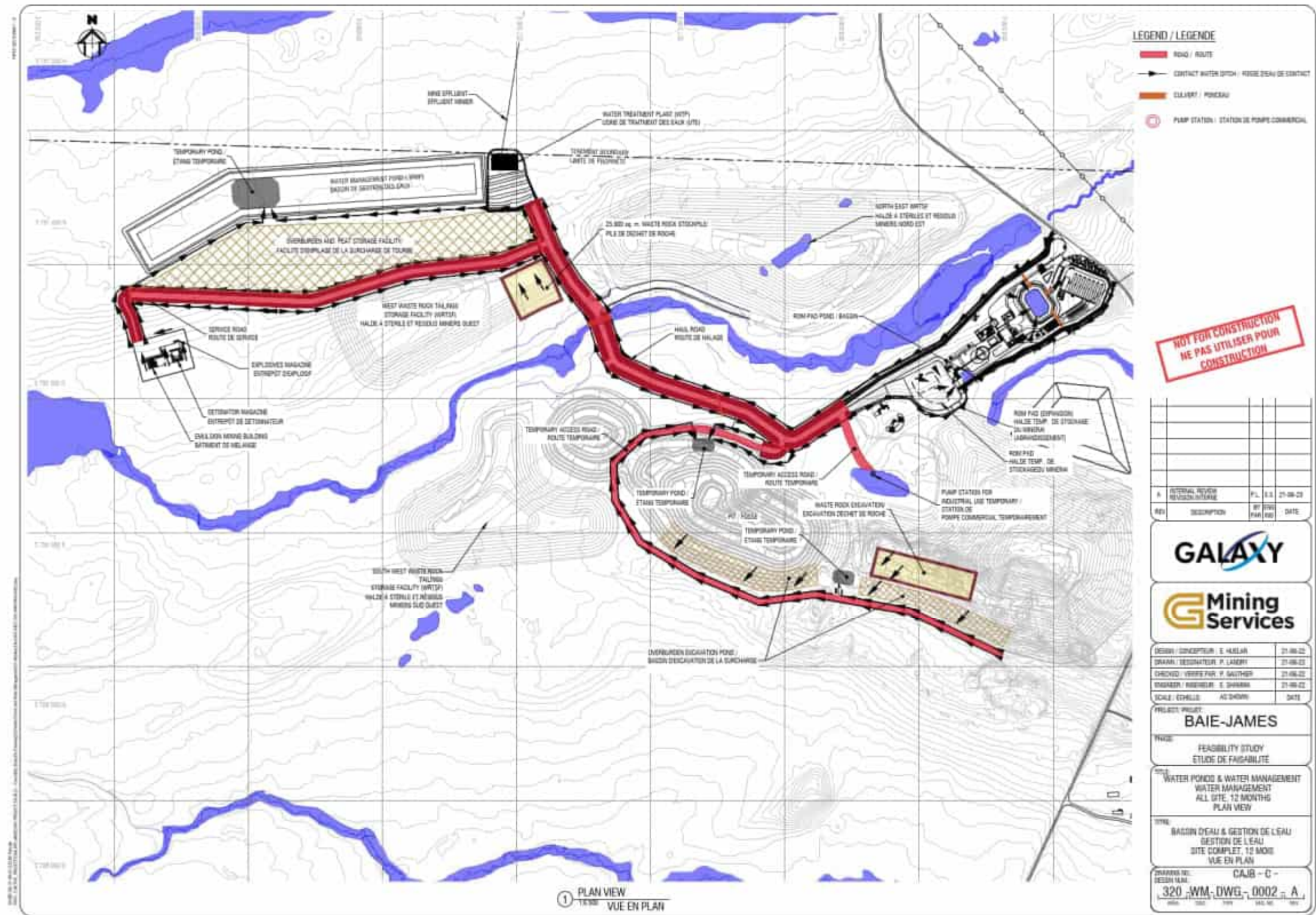
Maps 4-8 to 4-10 show the water management infrastructure planned for the construction phase. The progress of site construction and associated water management infrastructure is presented for months 1, 3 and 12 of the construction phase.



Map 4-8 Water management infrastructure during the construction phase (1st month)



Map 4-9 Water management infrastructure during the construction phase (3rd month)



Map 4-10 Water management infrastructure during the construction phase (12th month)

During construction, water will be managed by the same clean water network as during operation. The collected water will be channelled to the main water management pond. Water will be treated mechanically at the outlet of the collection ditch network. Indeed, the sedimentation of suspended solids (SS) will occur in the basin designed for this purpose. Then, sediment barriers combined with absorbent socks will be installed at the basin's outlet to avoid the discharge of SS or possible petroleum products. This equipment will, therefore, help treat the water at the outlet of the basin before discharge to CE2.

The project plans no watercourse diversion or dewatering activities during infrastructure construction. The project has designed the facilities and the overall mine site footprint to avoid existing watercourses to minimize the impact on the aquatic environment. A single culvert spanning CE03 and reaching the waste rock stockpiles to the north, the organic and overburden stockpile, the north water management pond and the explosives magazine is planned. The design of the culvert will comply with NOR 05¹ and outside the periods defined by the FAU 01² measure, as described in Chapter 7.

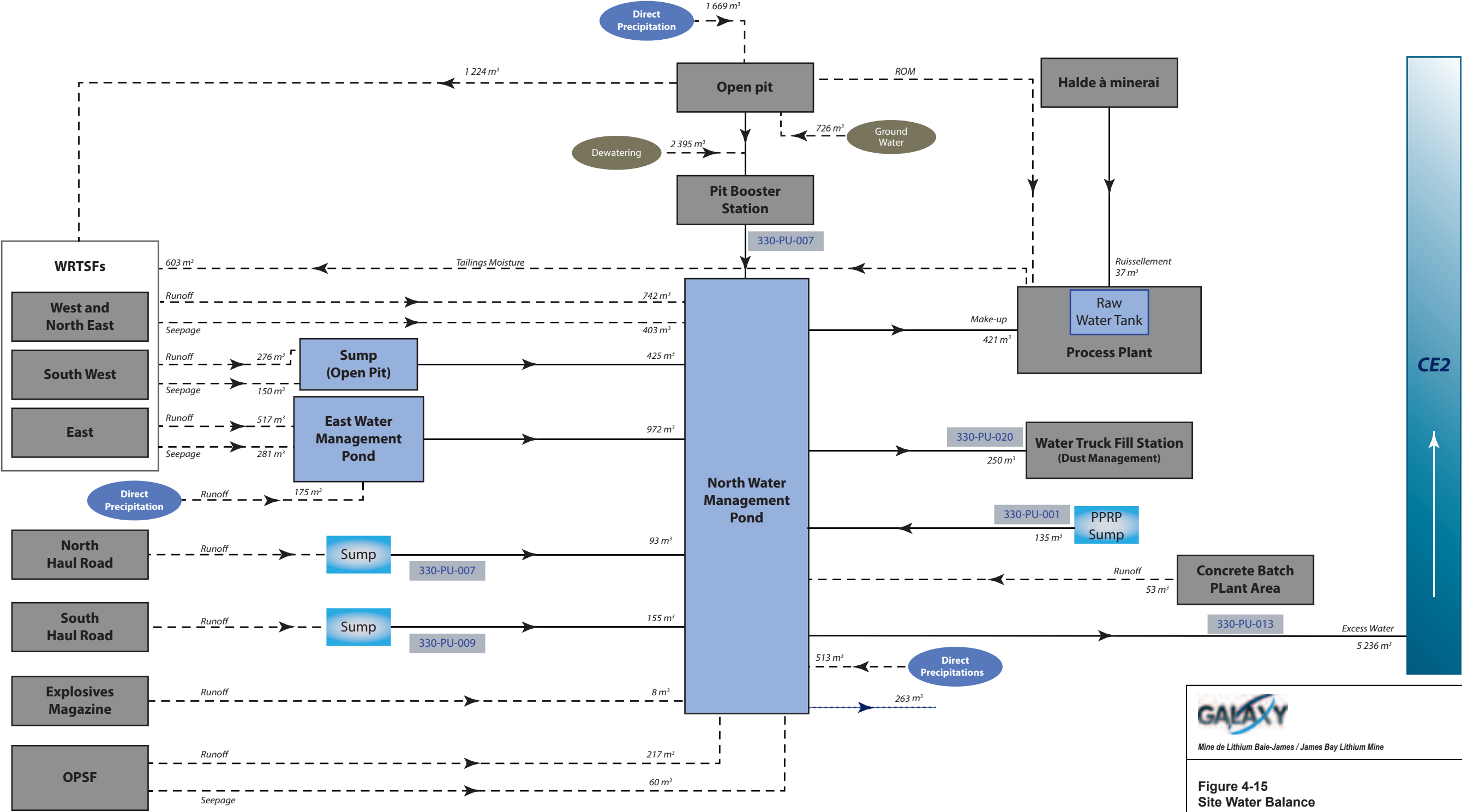
The only water body that will be dewatered is Lake Kapisikama. Construction activities will, however, not cause the dewatering of this water body. The lowering of the water table during the operation phase of the mine will cause dewatering. The development of a compensation plan will address the loss of habitat caused by this dewatering. As required by Section 101 of the Mining Act, the full rehabilitation and restoration plan will be prepared at a later stage and will include the fate of this water body site.

Runoff water and spill control measures will be implemented throughout the construction phase to prevent the introduction of suspended solids (SS) into watercourses (sediment barriers, erosion control mats) as well as contamination of watercourses in the event of an accidental hydrocarbon spill during construction (use of absorbent and recovery materials). Chapter 7 presents these measures. There will be no effluent during the construction phase. All water will be collected in large capacity retention basins. Furthermore, the basin outlets will be equipped with a sediment curtain and a hydrocarbon absorbent sock installed as a preventive measure to contain any accidental spill.

¹ NOR 05: Install culverts or crossing structures designed to maintain the free flow of water (and the free passage of fish). The construction of bridges or the installation of culverts shall not reduce the width of the watercourse by more than 20%, as measured from the natural high-water mark. The base of the lower culvert shall be driven below the natural bed of the watercourse at a depth of not less than 15 cm or 10% of the height of the structure and its ends shall extend beyond the base of the embankment by not more than 30 cm and be adequately stabilized.

Reference: Regulation respecting the sustainable development of forests in the domain of the State.

² FAU 01: Perform work in water outside the different breeding periods of the species present, from September 15 to December 1, inclusively.



Precipitation

Infrastructure

Basin

Sump

Water Treatment Plant

Effluent

Drainage by gravity

Pumping

Pump (pump number)

Evaporation

Flow units : m³/ day

Estimation basis :
Daily flow during wet years, 10 years return period.
Data presented reference years 11 to 16.
Flows applicable to summer months
(June to October inclusively).

GALAXY

Mine de Lithium Baie-James / James Bay Lithium Mine

Figure 4-15

Site Water Balance

Sources :
Golder, 2021

July 2021

Drawing : A. Masson
Approbation : C. Martineau
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wsp

The pit overflow will be constructed with a low permeability core covered in compacted granular material and riprap. The invert of the overflow will be protected with riprap of larger dimension to accommodate higher velocity flow. The preliminary design of this infrastructure will be completed in the closure plan that will be submitted to MERN at a later phase of the permitting process. A preliminary ground water flow model has indicated that the pit would fill with water in between 120 to **180 years (WSP, 2021a)**.

4.10 EMISSIONS, DISCHARGES AND WASTE MANAGEMENT

4.10.1 AIR EMISSIONS

Air emissions types and locations throughout the mining site as summarized in Table 4-22, while those of the industrial and administrative sector are presented in Table 4-23. The noise components of air emissions are associated with drilling, blasting and hauling activities. Noises sources specific to the industrial area are also presented in Table 4-22. A dust management plan for the handling of waste rock and tailings was prepared for the project **by Stantec (2021). Appendix C presents the modelling report and the dust management plan.** Water will be used as a dust suppressant. Several variables have been considered in the design of the spray system, e.g. dust particle size, spray drop size, etc. The following criteria and assumptions were accounted for in the dust management plan:

- Equipment that require dust management;
- Dust suppression will be conducted using a 20 m³ water spray truck;
- To minimize water consumption, the droplet size of the spray system along with pressure will be accounted for;
- Dust reduction factor of 75%;
- Source of water: treated **domestic** water from WTP;
- Road length: 1-) from mine to ROM pad, 2-) from process plant to waste rock stockpile and 3-) from mine to waste rock stockpile;
- Period: from May to September.

The water volume requirements will vary with the various project phases. However, during operation, water requirements will total 500 m³ per day.

The project's GHG emissions have also been estimated. Table 4-24 presents the total direct emissions as estimated. Appendix C details the GHG calculation methods.

The quantity of GHG emissions caused by all direct activities during the construction, operation and rehabilitation phases is **615,200 tCO₂eq**. During the life of the project, the average annual emissions will be **32,379 tCO₂eq**. **During the operation phase, the average annual emissions will be 32,273 tCO₂eq. Indirect project emissions have been estimated at 12,137 tCO₂eq.**

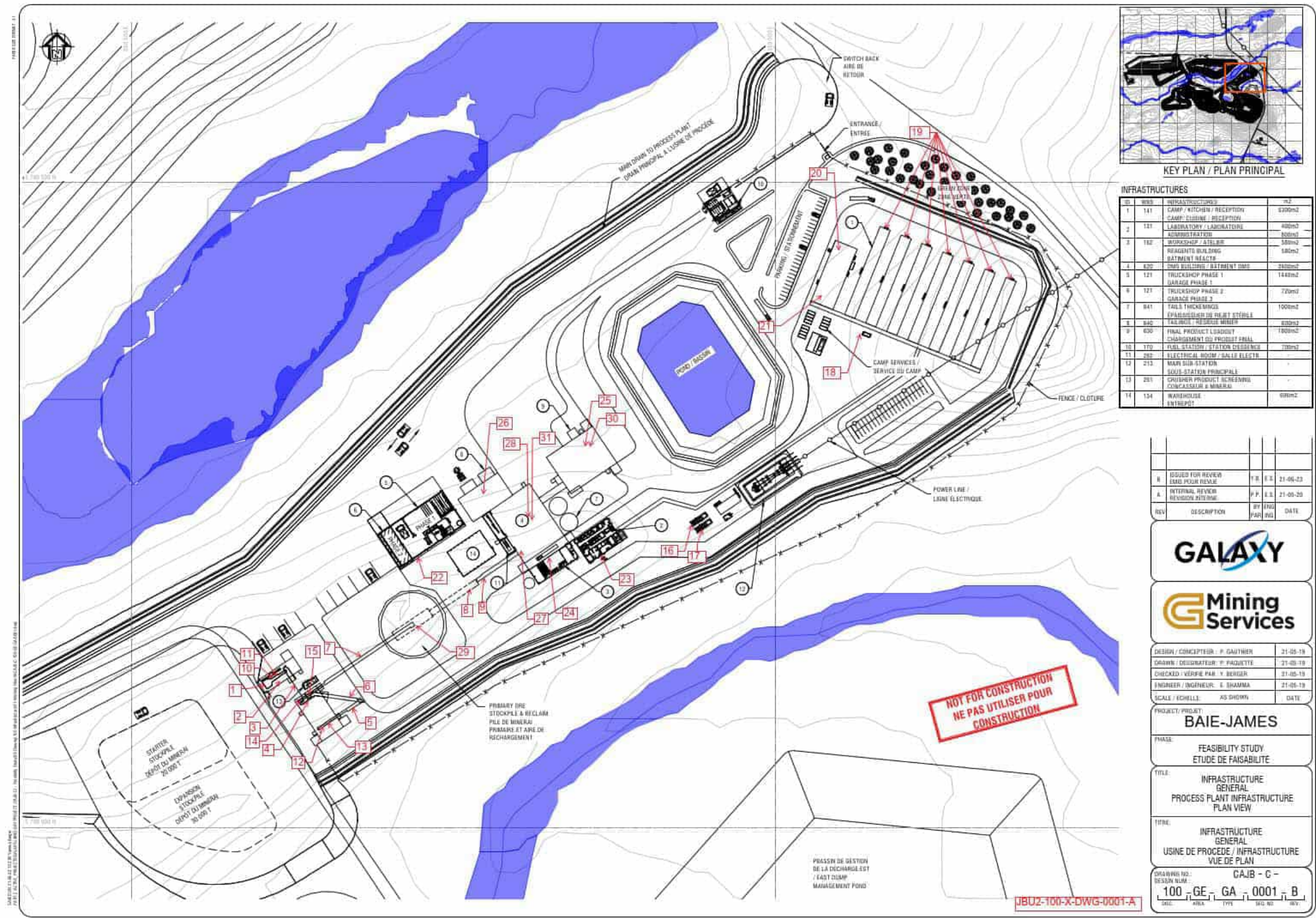
Table 4-22 Mining air emissions – Types and locations

Emission Type	Location	Project Phase
Blast gases	Pit	Operation
	Quarry	Construction / Operation
	Borrow pit	Construction
Dust	Pit	Operation
	Construction quarry	Construction / Operation
	Access roads	Construction / Operation / Rehabilitation
	Haul roads	Construction / Operation / Rehabilitation
	ROM pad	Construction / Operation / Rehabilitation
	Industrial area	Construction / Operation / Rehabilitation
	Waste rock and tailings storage facilities	Construction / Operation / Rehabilitation
	Overburden and peat storage facility	Construction / Operation / Rehabilitation
	Concrete batch plant / Dry storage area	Construction / Operation
Exhaust gas – Fixed equipment	Industrial area	Construction / Operation / Rehabilitation
	Workers' camp	Construction / Operation / Rehabilitation
Exhaust gas – Mobile equipment	Pit	Operation
	Construction quarry	Construction / Operation
	Access roads	Construction / Operation / Rehabilitation
	Haul roads	Construction / Operation / Rehabilitation
	ROM pad	Construction / Operation / Rehabilitation
	Waste rock and tailings storage facilities	Construction / Operation / Rehabilitation
	Overburden and peat storage facility	Construction / Operation / Rehabilitation
	Concrete batch plant / Dry storage area	Construction / Operation
Ventilation	Industrial area	Construction / Operation / Rehabilitation
	Workers' camp	Construction / Operation / Rehabilitation

Source: **G Mining Services, 2021.**

Table 4-23 Air emissions in industrial and administrative area – Types and locations

Emission Type	Area	ID ^a	Source	Project Phase
Dust	Crushing and screening	1	ROM pad	Operation
		2	Primary crushing building dust collector	Operation
		3	Primary screen feed conveyor	Operation
		4	Secondary and tertiary crushing building dust collector	Operation
		5	Secondary and tertiary crusher conveyor	Operation
		6	Secondary screen feed conveyor	Operation
		7	Crushed feed material conveyor	Operation
	Crushed feed material dome	8	Recovery tunnel dust collector	Operation
		9	DMS feed conveyor	Operation
	Tailings and product handling	25	Product storage and loading	Operation
		26	Tailings storage and loading	Operation
Noise	Crushing and screening	10	Vibrating grizzly	Operation
		11	Primary crusher	Operation
		12	Secondary crusher	Operation
		13	Tertiary crusher	Operation
		14	Primary sizing screen	Operation
		15	Secondary sizing screen	Operation
	DMS	27	Sizing screen	Operation
	Recrusher	28	Crusher	Operation
	Crushed ROM pad	29	ROM pad	Operation
	Tailings and product handling	30	Product handling and loading	Operation
		31	Tailings handling and loading	Operation
Noise / Exhaust gas	Main substation	16	Diesel generator no. 1	Operation
		17	Diesel generator no. 2	Operation
	Workers' camp	18	Temporary diesel generator	Construction
		19	Camp and water tank heating	Construction / Operation
		20	Kitchen – ventilation exhaust	Construction / Operation
		21	Administrative buildings kitchen and make-up ventilation unit	Construction / Operation
	Workshops	22	Truck workshop – ventilation exhaust	Operation
Ventilation	Administration building	23	Laboratory – ventilation exhaust	Operation
	DMS building	24	DMS building heating	Operation
a ID: Refer to Map 4-11 for locations of sources of emissions.				



Map 4-11 Air emission sources

GALAXY LITHIUM (CANADA) INC. – JAMES BAY LITHIUM MINE
 ENVIRONMENTAL IMPACT ASSESSMENT – JULY 2021
 CHAPTER 4: PROJECT DESCRIPTION

Table 4-24 Annual and period GHG emissions

Phase / Year	CO ₂ Emissions (tonnes)								
	Direct emissions					Indirect emissions			Total
	Explosives	Road transport (on-site)	Off-road mobile equipment	Stationary combustion	Total direct	Electricity	Off-site transport	Total indirect	Total direct + indirect
Construction (year -1)	152.5	963.1	2,464	10,768	14,348	73.0	4,164	4,237	18,585
Year 1	488.0	3,076	9,669	16,153	29,386	73.0	12,388	12,461	41,847
Year 2	490.8	3,576	9,829	16,153	30,048	73.0	12,388	12,461	42,509
Year 3	488.0	3,945	9,840	16,153	30,426	73.0	12,388	12,461	42,886
Year 4	488.0	4,208	9,839	16,153	30,688	73.0	12,388	12,461	43,149
Year 5	488.0	3,638	9,789	16,153	30,068	73.0	12,388	12,461	42,528
Year 6	488.0	3,385	9,594	16,153	29,620	73.0	12,388	12,461	42,081
Year 7	488.0	3,565	9,590	16,153	29,795	73.0	12,388	12,461	42,256
Year 8	661.8	5,081	11,695	16,153	33,591	73.0	12,388	12,461	46,052
Year 9	648.8	5,367	10,812	16,153	32,980	73.0	12,388	12,461	45,441
Year 10	671.0	5,817	11,424	16,153	34,065	73.0	12,388	12,461	46,526
Year 11	671.0	5,424	11,061	16,153	33,309	73.0	12,388	12,461	45,770
Year 12	671.0	5,657	11,392	16,153	33,873	73.0	12,388	12,461	46,334
Year 13	671.0	6,374	11,675	16,153	34,873	73.0	12,388	12,461	47,334
Year 14	671.0	6,947	11,726	16,153	35,497	73.0	12,388	12,461	47,958
Year 15	549.0	6,738	10,278	16,153	33,718	73.0	12,388	12,461	46,179
Year 16	566.2	7,216	10,474	16,153	34,409	73.0	12,388	12,461	46,870
Year 17	488.0	5,563	9,663	16,153	31,866	73.0	12,388	12,461	44,327
Year 18	554.6	5,848	10,146	16,153	32,702	73.0	12,388	12,461	45,163
Rehabilitation (Year 19)	134.3	1,329	2,321	16,153	19,937	73.0	1,995	2,068	22,005

Energy transition

Efforts are made to reduce GHG emissions, as well as the projected evolution of the power supply for the project. The current mine life cycle is greater than the useful life of a heavy truck, which is 10 years.

For the purpose of the study, the project incorporates the cost associated with the replacement of diesel equipment. However, replacement will certainly occur if power equipment or equipment powered with fuels generating fewer CO₂e emissions becomes available in the next 10 years.

As mentioned in section 3.5.1, after extensive research, a forklift, buses (2) and pickups (9) are available in electric versions and will be acquired. However, the telescopic forklifts and the platform truck are only available in a smaller version than required by GLCI. The electric version of the other equipment (for snow removal, garbage management and emergency units) has not been found on the market but their development is being monitored for possible integration. It should be noted that GLCI would prefer powering its entire mining complex using hydroelectricity, but right now, HydroQuébec cannot guarantee a full supply.

The energy supply plan depends on the power provided by Hydro-Québec and will evolve concurrently. For the purpose of the studies, GLCI has to ensure a year-round supply of power for all its activities.

GLCI remains on the lookout for any technological progress in energy to reduce its dependence on fossil fuels. As a producer and developer of lithium products used in the development of batteries for electric vehicles, GLCI wishes to position itself as a forerunner in this field and to implement these new technologies when they become available. Therefore, GLCI will certainly look for available aid programs and equipment that consumes the least amount of diesel possible when the time comes to purchase its equipment.

4.10.2 WASTE WATER DISCHARGE

The worker' camp will be serviced by a domestic wastewater treatment system with an expected capacity supplying 280 people during the construction phase and 180 people during the operation phase. The treated water requirements are estimated at 56 m³ per day and 30 m³ per day, respectively for the construction and operation phases.

A rotating biological reactor (Ecoprocess MBBR technology from Premier tech) has been chosen for waste water treatment. Considering the nature of the native soils and the proximity to wetlands, it is unlikely that a leaching field will be possible. Therefore the discharge of treated wastewater to a receiving watercourse must be considered.

To that end, the supplier of the Ecoprocess MBBR technology will also supply a tertiary treatment train to meet the disinfection and phosphorus removal objectives required for discharges to a receiving watercourse. This tertiary treatment would be integrated to the proposed unit (equalization tank and Ecoflo units) and it would replace the proposed leaching field. A discharge pipe with an outfall will also be prepared to channel treated wastewater toward the receiving watercourse. A service building (3 m x 4 m) will be required to house the disinfection units (UV lamp) at the outlet of the Ecoflo units and the dosing chambers for phosphorus removal. The treated wastewater will be discharged to the CE4 watercourse.

The domestic wastewater treatment system selected has the ability to treat sanitary water using a biological reactor and will serve for both construction and operations. The treated water will be discharged to CE4 due to the nature of the native soil and the proximity of wetlands. The unit selected can treat the flow during construction (i.e. 56,000 l/d, based on a peak construction labour force of 280 individuals). The flow during the operation phase is lower, at 30,000 l/d, based on an average labour force of 180 individuals. The flow falls below the maximum capacity of the treatment unit.

4.10.3 RESIDUAL MATERIALS

As a rule, GLCI will work to minimize the waste production. However, it will need to be managed on-site. As such as warehouse of residual matter will be built. It will be split into various sectors where different types of residual materials will be stored separately. The warehouse be large enough to allow for a fork-lift to enter through a garage type door to load the material onto trucks. The residual materials will be trucked to an outside facility as managed by a third-party contractor. This party will need to have the required permits and agreements in place with authorised landfill / recycling sites. **GLCI is in contact with Ungava Recycling Inc. of Chibougamau, which currently manages RM from mining sites in the region, namely Éléonore (partially), Nemaska and Renard. The recycling company manages recyclable materials, construction waste, RHM, non-hazardous RM and compostable materials. This contractor searches for sites where it is possible to obtain short, medium or long-term contracts at competitive rates. They even provide on-site services for adequate materials sorting.**

At the moment, recyclable materials, as well as non-hazardous residual materials, could be managed at Chibougamau. Amos could receive putrescible materials while Matagami and Hydro-Québec deny residual materials from other sites. Hazardous residual materials would be managed by one of the contractors servicing the region (Véolia, Sanivac, Amnor and Groupe Gilbert). No residual material loads may leave the site without validation of the transport and disposal permits. Upon signing of a contract with GLCI, Ungava Recycling Inc. would take the required measures to assure GLCI that the appropriate disposal of recyclable and non-recyclable residual materials is conducted. As soon as the contract is signed, a copy (blank, i.e. without cost) will be sent to the MELCC's Representative assigned to the case.

Table 4-25 shows the recommended management approach by RM category.

Table 4-25 Management method, duration and capacity of residual materials storage

Category	Description	Estimated Annual Quantity (Metric Tonne)				Storage Capacity (Metric Tonne)	Storage Site (Site No.)	Type of Storage at the Site	Recommended Management Method ¹	
		Construction		Operation						
			Subtotal		Subtotal					
Recyclable materials	Paper/cardboard	Undetermined	290	165	400	100	25	Packaged, dry storage	Recycling	
	Plastic	Undetermined		130					Recycling or disposal	
	Glass	Undetermined		9					Recycling	
	Metal	Undetermined		95						
	Hardware	Undetermined		0.5						
	Batteries	Undetermined		0.5						
Food waste	Compostable material	167	170	90	92	40		Sealed container	Reuse	
	Cooking grease	3		2					Disposal	
Construction, renovation and demolition debris	Wood, concrete	Undetermined	35	Undetermined	20	10		In a stack outside	Disposal	
	Other (i.e., tires etc.)	Undetermined		Undetermined					Recycling	
Final waste	Voluminous waste, polystyrene foam, packaging, composite objects, etc.	Undetermined	220	Undetermined	480	120		On the ground, dry place On a sealed surface if there is oil/grease	Disposal	
Household hazardous waste	Antifreeze, solvents, aerosols, cylinders, paint, fluorescent tubes, lanterns, etc.	Undetermined	8	Undetermined	16	4	24	Separate place with WHMIS-compliant ventilation and a sealed floor	Disposal	
Used oils, greases, oily water	Coming from various machine shops	0.8	0.8	Undetermined	4	1		Double-floor containers in a ventilated space provided with a containment tank, with sealed floor		
Residual hazardous materials	Containers of additives used to prepare concrete and other products used in construction	Undetermined	0.6	Undetermined	3	1				Separate, ventilated space, with sealed flooring
	Empty containers of chemical products used to treat ore and for the WTP	Undetermined		Undetermined						
	TOTAL		725		1015					

Note 1: No material will be eliminated, reused or recycled on site.

Whether they are for residual materials or for hazardous waste, the measures that are put in place are intended to avoid any discharge or environmental contamination. These measures are compliant with current regulations. Laws and regulations related to the management of residual materials are under provincial jurisdiction under the EQA on hazardous materials (chapter Q-2, r.32 ss. 31, 46, 70.19, 115.27, 115.34 and 124.1) and non-hazardous materials (chapter Q-2, r. 35.1 s. 53.4). As the information above indicates, non-hazardous and hazardous residual materials have different management and storage methods. Hazardous materials will be stored on sealed surfaces and non-hazardous materials that may emit contaminants will be stored in sealed containers. Both warehouses will be dry, protected from the elements and well ventilated. The security of the premises will be ensured.

The estimated quantities of domestic residual material by category are listed in Table 4-26. On-site management and temporary storage of domestic residual material will consist of:

- Used tires: A storage area (on the ground) for used tires will be delimited. Recyc-Québec provides a free on-call service of tire collection (without rims and of standard size) across the Nord-du-Québec region.
- Scrap metal and hardware: A storage area (on the ground) for recyclable scrap metal will be delimited. If the volume of copper, aluminum, batteries (lead) and hardware is significant, a distinct area may be considered to obtain a better resale value. Special attention will be placed to waste which can generate leachate (such as oil, grease, various fluids) and contaminate the environment.
- Cafeteria waste: Waste is directly placed in a container by the cafeteria and cleaning staff without further handling until disposal in a **composter that will be installed on the mine site**.
- Recyclable materials: Cardboard and papers are wrapped then stored in a dry location for recycling. For plastic and glass, the most convenient and cost-efficient management method must be assessed, either recycling or disposal as ultimate waste.
- Ultimate waste: The waste shall be stored in suitable containers as to prevent dispersal and soil contamination until disposal in an authorized site. This category includes: bulky waste, polystyrene foam, packaging, sanitary tissue, composite objects, non-recyclable plastic, rubber, ash and other various domestic containers.

Table 4-26 Estimated quantity of residual materials

Category	Description	Tonnage (t)	
		Construction (15 months)	Operation (per year)
Recyclable materials	Paper/cardboard	119.6	165
	Plastic	94.3	130
	Glass	6.5	9
	Metal	68.9	95
	Hardware	0.4	0.5
	Batteries	0.4	0.5
Food waste	Compostable material	167	90
	Cooking grease	3	2
Construction, renovation and demolition debris	Wood, concrete	35	20
	Others	0.6	0
Ultimate waste	Voluminous waste, polystyrene foam, packaging, composite objects, etc.	220	480
Total		715.6	992.0

Source: WSP, 2018a.

To minimize the RM production, GLCI has chosen to compost the putrescible materials. A composter was added to the project. Such equipment will significantly reduce RM leaving the site. Indeed, the composter requires, in addition to the nitrogen supplied by food scraps, a carbon supply, which can easily be provided by soiled cardboard.

The initial plan was to send the putrescible materials to Amos. The installation of an on-site composter will prevent this trip by truck and the on-site storage of food waste.

In 18 days, the proposed industrial composter produces compost which could be stored over the overburden stockpile for use during the restoration phase. The composter generates CO₂ and would produce approximately 2 m³ of compost a week, which represents 100 m³ per year. The compost could also help stabilize soft materials in the overburden stockpile (peat and clay). GLCI will ensure that it complies with the Quebec Residual Materials Management Policy derived from the EQA by giving priority to management methods for all residual materials produced on site that will have the least impact on the environment. GLCI will see that the selected management methods follow the 4R-D order of priority. As part of the implementation of its management system, GLCI will establish a program and procedures to ensure compliance with the 4R-D principle.

4.10.4 RESIDUAL HAZARDOUS MATERIALS

The HMR applies to the storage of residual hazardous materials. The following measures will therefore be taken:

- the storage site will be constructed and maintained so as to be accessible to emergency teams at all times;
- exterior access paths to the storage site will be provided and usable;
- storage building doors will be operational at all times;
- the building will be laid out so that the doors and passageways are free at all times.

RHM may be arranged in islands depending on the compatibility of the materials. The following aspects will also be attended to:

- the number of islands must equal the number of incompatible groups;
- separation distances or walls between the islands;
- dimensions of passageways for accessing the islands and their compliance so that material-handling vehicles may pass through;
- use of containers for incompatible liquid materials with separate holding tanks for each liquid material.

To set up islands, the following will also be taken into consideration:

- the breadth and height of the islands in order to facilitate identifying materials, viewing containers and evaluating quantities;
- height to ensure worker safety and prevention and the stability of the stacks (to prevent collapsing);
- clearances for handling, height of building roofs, and the operation of sprinklers and detection systems (fire, gas or other) or any other system or equipment inside the building.

As for the residual material, the hazardous waste will be managed in the residual matter warehouse. The quantities of hazardous waste for each category are listed in Table 4-27. On-site management and temporary storage of hazardous waste will consist of:

- Hazardous household waste: The waste is stored in a specific and well-ventilated area until transport to a transfer centre or an Ecocentre.

- Residual hazardous materials containers: The management of such materials is regulated; their proper storage must prevent any accidental spill in the environment. Residual hazardous materials **will be stored one or many** double-floored containers **known as a “marine container”**. **The container will be subjected to regular inspections and managed as required under provincial regulation. The container may hold used hazardous products, unwashed containers of hazardous products, waste oil and grease, rags soiled by hazardous materials, and contaminated soil. The container will be regularly emptied and a storage record will be updated after each new addition or removal of materials.**
- **Products will be placed in containers (barrels or semi-bulk cubic metre bags), which do not react with the disposed materials. Content of the containers will be identified with the date when storage began. Sections reserved for each content type will be identified on the interior walls of the container.**
- **Other than the difference between solid and liquid materials, the residual hazardous materials generated by the mining operations should not be incompatible. For example, liquids will mainly be oils or antifreeze agents; they will not be mixed since their disposal is more expensive if they are. Solvents are almost never found in RHM since they evaporate and mechanics replenish the container, but almost never empty it, unless there is a significant contamination.**
- **Aerosols, as well as fluorescents, will be collected in specific barrels. Paints will be dried before being sent to waste. If large quantities of paint must be disposed of, they will be offered to the community. Procedures (most likely via a Residual Material Management Program) will be established for the appropriate management of hazardous and non-hazardous residual materials. New hazardous materials will be managed in compliance with the National Fire Code of Canada (NFC) and the National Building Code of Canada (NBC) rules (a section of the warehouse will be reserved for these materials).**
- Some types of hazardous household waste must be stored apart to avoid chemical reaction or to minimize hazardous situation (explosion, fire, toxic gas, etc.) with respect to the Workplace Hazardous Materials Information System (WHMIS), and risk assessment.

Table 4-27 Estimated annual quantity of residual hazardous materials

Category	Description	Tonnage (t)	
		Construction	Operation
Hazardous household waste	Antifreeze, solvents, aerosols, cylinders, paint, fluorescent tubes, lanterns, etc.	8	16
Waste oil, grease and oily water	Various from mechanical workshop	0.8	4
Residual hazardous materials	Containers of additives used to prepare concrete and other products used in construction	0.6	0
	Empty chemical vessels for processing and WTP, if necessary	0	3
Total		9.4	23

Source: WSP, 2018a.

The following residual materials are excluded from the hazardous waste quantities provided:

- Sanitary sludge: The sanitary sludge will be emptied every year by a specialized pump truck service.
- Contaminated soils: Typically, soils for decontamination contain contaminants associated with refined petroleum products (diesel, fuel, mineral oil and grease, etc.). They will be managed as required by Québec regulations.
- Biomedical waste: The on-site medical department will have a separate medical waste system.

4.11 OTHER INFRASTRUCTURE

In addition to the mining, processing, and water management infrastructure, the project will require various other components.

4.11.1 SITE BUILDINGS

Wherever practical, containerized and flat-pack type buildings will be used; flat packs will be imported in containers and assembled on site.

Most buildings (service and process) will be constructed using self-supporting insulated type buildings. Containers will be used as storage and offices. The concentrator building and the HVAC systems will be prioritized to support the construction effort through the winter.

Design of the site buildings is part of a global project cost reduction approach. Power supply being a limiting factor, the design and choice of building materials were made by giving priority to energy-saving solutions. However, no specific eco-design principle was applied. Energy efficiency and reduction of RMs are an integral part of GLCI's environmental policy (<https://gxy.com/wp-content/uploads/2020/11/Environmental-Policy.pdf>) and are applicable to all employees and contracting parties: "develop products and services and operate facilities in such a manner that prevents pollution, improve efficiency, reduce energy use, use renewable resources and minimize waste through recycling wherever possible".

GLCI will prioritize the purchase of local products and services as part of its approach for the optimization of economic benefits for the region and surrounding communities and as to promote the local social acceptance of the project. The terms and conditions will be mainly defined in the Impact Benefit Agreement negotiated with the Eastmain Community.

4.11.2 SITE ACCESS ROAD

The proposed **12 m** wide site access road (Map 4-1) will be **50 m** long and composed (from surface to base) of:

- **450 mm** of road base typically 0-56 mm crushed stone, compacted;
- Up to 1.5 m subgrade compacted structural fill.

Topsoil will be stripped and any unsuitable material such as compressible soils will be removed. The ditch system will divert clean water in the environment and direct contact water toward the main water management infrastructure (see Section 4.9.3).

For security reasons, the Billy Diamond Highway will be widened with the addition of turning lanes into and out of the site at the point of contact between the Billy Diamond Highway and the site access road.

MTQ standards (signage, traffic control, drainage, visibility, etc.) will be complied with in the right of way of the Billy Diamond Highway. On the project site, access roads will not necessarily follow MTQ standards (foundation, surface, etc.) since they will be private roads. A traffic plan (considering signage, speed limits, protective berms/guard rails, etc.) will, however, have to be prepared at the detailed design stage. Attention will be given to the intersection with the Billy Diamond Highway.

The SDBJ owns the Billy-Diamond Highway. GLCI will have to discuss the improvements to be made with the SDBJ and have them approve the plans. Nothing has yet been decided regarding the roles of each party, particularly concerning the supervision of the work. However, GLCI will certainly pay for the work.

4.11.3 SERVICE ACCESS ROADS

The site will feature **a single service road leading to the north water management pond and the explosives magazine.**

The proposed roads will be composed (from surface to base) of:

- **450** mm of road base typically composed of 0-**56** mm crushed stone, compacted;
- Up to 1.5 m subgrade compacted structural fill.

Topsoil will be stripped and unsuitable material such as compressible soils will be removed from the footprint. The ditch system will divert clean water into the environment and direct contact water toward the water management infrastructure.

The project footprint presented in the previous sections includes the encroachment area of the project site roads. From the edge of the road surface, 8 m on either side of the road surface has been added to consider the width at the base of the backfill. Table 7-5 (Chapter 7) details the mitigation measures related to the development of the roads on the site. Road routes have been developed to avoid unnecessary encroachment on watercourses by minimizing the number of watercourse crossings. Culvert construction will be completed in compliance with the standards and periods shown in Table 7-5 (Chapter 7).

4.11.4 ACCOMMODATION

The proposed workers camp can house up to 280 workers in construction and **180** workers in operations. Accommodations include the following:

- Dormitories consisting of wings connected with hallways (two of which are temporary for the construction phase only);
- Kitchen and cafeteria;
- Communal room (with sofas, etc.);
- **A gym;**
- Laundry services;
- Emergency generators;
- Potable water treatment system;
- Cold storage in sea containers.

Modular-type buildings will be installed on wood piling or cribbage and connected to each another with hallways. The accommodation camp will be heated with heating furnaces located at various locations. The electricity demand will be higher in summer due to air-conditioning units and the total demand is estimated to 432 kWh. During winter, heating requirements are estimated to approximately 110.3 million BTU (116.4 GJ). Based on this estimation, the propane consumption is estimated to 4,500 litres per day. The propane will be in the industrial area (Map 4-2).

Various options are being discussed with suppliers to minimize the energy demand and environmental footprint of these buildings.

Propane tanks and generators will be installed on concrete slabs and will be grounded following regulations and industry standards. The propane tanks and generators will be fenced, and security systems (e.g. closed-circuit cameras) will be installed.

4.11.5 MINE SERVICES AREA

The mine services area is composed of:

- MINE WORKSHOP, ADMINISTRATION, AND VEHICLES WASH-DOWN (ONE BUILDING);
- MECHANICAL WAREHOUSE;
- LIGHT VEHICLE PARKING;
- Diesel fill and storage.

The insulated building will be a steel structure covered with metal cladding supported by a concrete slab and footings where required. Overhead travelling crane gantries will be installed in some of the working bays for heavy lifting.

All the water collected from washing activities will be directed to a water-oil separator before exiting the water management system. That system will be maintained and emptied regularly with a vacuum truck operated by a certified disposal company.

4.11.6 FUEL STORAGE

The fuel storage area located in the mine services area will consist of:

- two double-walled 150 kilolitre diesel tanks;
- a double-walled 11 kilolitre diesel exhaust fluid (DEF) tank;
- a tank filling area;
- a heavy vehicle service station.

The final design of the petroleum equipment and tanks has not yet been determined. Petroleum equipment and reservoirs shall all be designed as to prevent and contain any potential spillage. The equipment is regulated by the Building Act and subject to a RBQ (Régie du bâtiment du Québec) permit. Figure 4-17 shows the general layout of the fuel farm. It should be noted that compared to the 2018 project, there is no longer a gasoline and diesel tank to supply light vehicles because they will be electric.

An application for authorization will be submitted to the Régie du bâtiment to use tanks for the quantities required, which would exceed the authorized limit of 50,000 L. The fuel storage and distribution facilities will comply with provisions under the Building Code and be managed in compliance with the Safety Code.

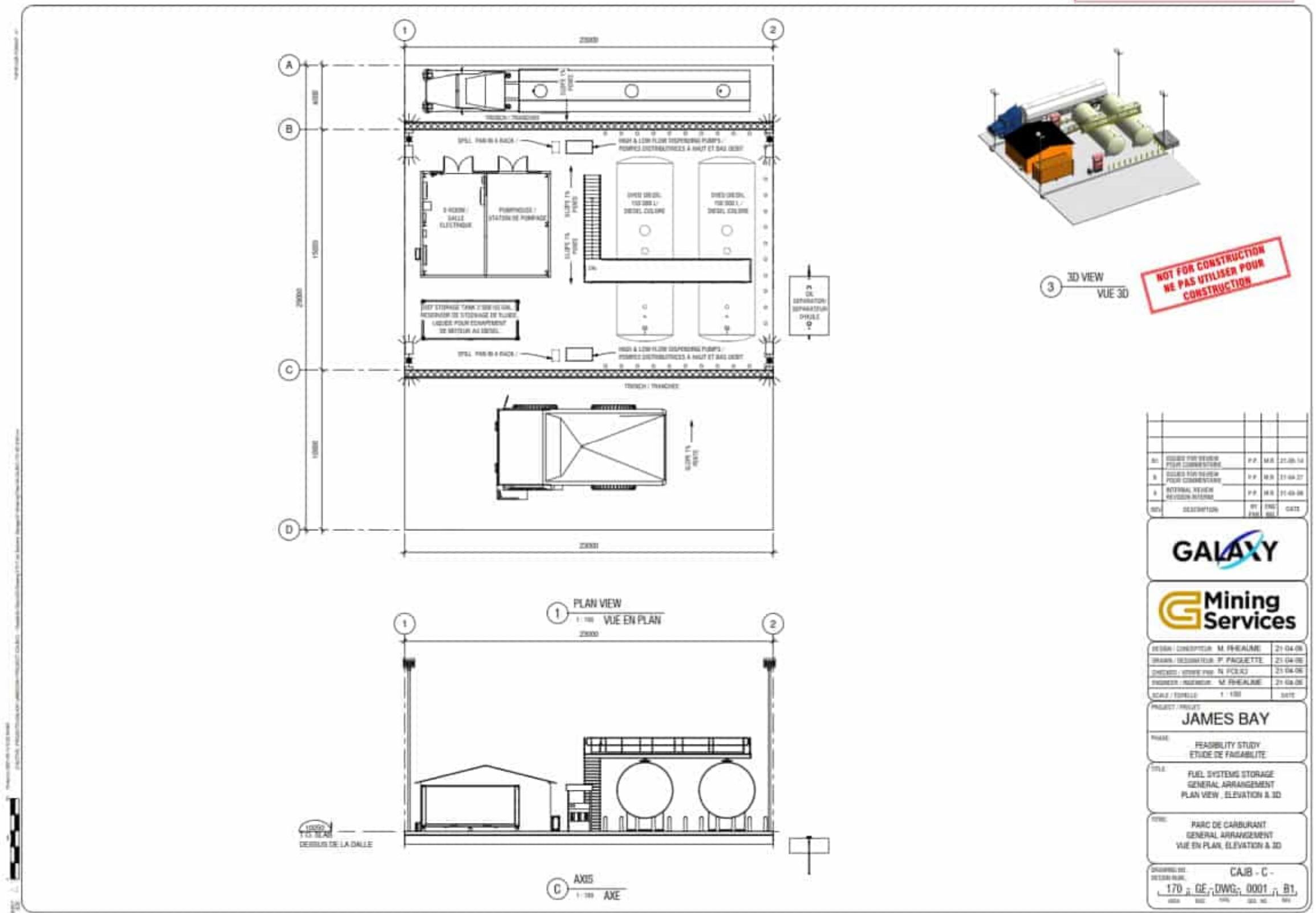


Figure 4-17 Fuel farm layout

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Each service station will be equipped with spill grates that will collect potential spills and direct them to a water-oil separator.

The main tanks will not supply standby generators with fuel. The standby generators will be refuelled by mobile tankers that comply with regulations (e.g. small tankers for on-site use).

4.11.7 POWER LINE

Average electricity demand is estimated at 3.33 MW for the industrial area and 2.95 MW for the workers' camp, for an average demand of 6.3 MW and a peak demand of 7.7 MW during winter. Hydro-Québec is responsible for the commissioning of the 69 kV transmission line from the 69 kV power line (L 614) located 10 km south the project site. This will be the main power supply for the project. This option does, however, have some limitations; even with major upgrades to Hydro-Québec Némiscou's substation, the total available capacity will be limited to just over 7.6 MW. This is the reason why an alternative (i.e. propane) is required for heating the buildings. In addition, intermittent use of generated power to meet the peak demands will be required. The current design will use emergency diesel generators to meet this demand.

A pre-project agreement was signed in 2018 and Hydro-Québec is moving the studies forward. GLCI and Hydro-Québec meet on a regular basis to discuss progress of the studies but there is no negotiation underway.

At present, discussions that were held with Hydro-Québec have mainly revolved around the technical fastening with respect to connection details to GLCI's substation and work deadlines for both parties, namely construction of the line in a timely manner for the electrical supply of the mine site substation.

The objective of the preliminary study currently underway at Hydro-Québec is to evaluate all aspects of the power line project, including power availability, costs, construction and operation schedule and long-term maintenance of the line. In the course of the preliminary study, Hydro-Québec has stated, at various follow-up meetings, that electricity is available and the final study report, which is expected in fall 2021, should confirm this statement.

Hydro-Québec is fully responsible for the design of the line route, as well as the construction and operation of the future power line. To meet the demand, Hydro-Québec will build an approximately 10 km long 69 kV power line. The line route studied by Hydro-Québec follows an existing 450 kV power line for almost 70 % of its route.

In light of the preliminary results of the environmental and technical studies conducted to date by Hydro-Québec, several location criteria were considered to develop the projected line route, which include the following:

- Take advantage of the existing 450-kV DC power line to juxtapose part of the projected line, thereby limiting deforestation and using existing access roads;
- Avoid radii of exclusion around the mining pit;
- Avoid areas valued by Crees, and hunting, trapping and fishing areas;
- Limit impact on wetlands.

In 2019, Hydro-Québec met with the RE2 trapline tallyman and the Eastmain Band Council to present the studied line route and to gather their concerns.

Once the environmental and technical studies have sufficiently progressed, Hydro-Québec will be in position to assess the project impact on human and natural environments, and the landscape, and identify appropriate mitigation measures.

Although no application for an authorization certificate is to be submitted to the Minister under section 160 of the Environment Quality Act, and since 69 kV transmission lines are exempted from the environmental and social impact assessment and review procedure, Hydro-Québec will obtain all required sectoral authorizations and permits from the relevant authorities to build the power line.

After verification and discussions with Hydro-Québec, it was confirmed that there were no opportunities to increase the available power beyond what was discussed in 2018. Furthermore, engineering firms are still working on reducing the project's energy demand. At present, no significant change that would allow a decrease in demand was noted. GLCI remains on the lookout for any reduction opportunity for the various project phases.

4.11.8 HIGH AND MEDIUM VOLTAGE SUBSTATION

Aside from the typical lighting transformers (dry-type, 600 / 120-208 V), the project will require seven oil-filled transformers:

- One oil-filled transformer for the main substation: 69 / 4.16 kV, 10 MVA, oil filled, auto tap changer;
- Six transformers for the plant: 4.16 / 0.6 kV, 2.5 MVA, included between 1 MVA and 2.5 MVA, dry-type, offload tap changer, mounted inside.

All transformers will use a natural convection air cooling system (AN). The oil type is to be confirmed at a later phase but will most likely be Envirotemp™ FR3™ fluid, a natural ester derived from renewable vegetable oils.

4.11.9 BACK-UP GENERATORS

With the total plant demand already at the limits of the local utility's 69 kV system, power generation costs have been considered and mitigation measures have been studied should demand increase. At the process plant, emergency power will be provided by two standby 1.8 MW, 480 V diesel generators located near the main substation. The workers' camp will be directly connected to the generators by limiting intermediate equipment and allowing immediate power in the case of power outage.

4.11.10 EXPLOSIVES MAGAZINE

The explosive storage requirement was designed based on the mining method and powder factor. The storage infrastructure was designed in compliance of all applicable provincial and federal laws and regulations, and in accordance with the best industry practices. The location of the explosives magazine was selected to comply with minimal stand-off distances (Map 4-1). The quantities of explosives stored are found in Table 4-28.

Table 4-28 Estimated stored quantity of detonators and explosives

Explosive Type	Unit	Quantity	Stock (days)
Detonators	#	27,000	28
Ammonium nitrate	kg	158,961	21
Emulsion	kg	76,537	21

Source: WSP, 2018a

As presented in Section 4.5.2, ANFO and emulsion explosives will be utilized on a 50/50 volume ratio. During the wet months (May to October), bulk emulsion explosives will be utilized, with the drier months (November to April) utilizing ANFO.

The magazine area dimension is estimated at 170 m x 80 m, which includes:

- **A mixing building;**
- **An explosives magazine;**
- **Detonator warehouse;**
- Stand-off distance between different classes of explosive;
- Soil barrier;
- Access road;
- Perimeter fence;
- Buffer clearing of 35 m (for forest fire safety).

The ANFO mix shall be made on site in a plant designed, installed and managed by the explosive manufacturer. All permits shall be issued in the manufacturer's name. The plant shall be zero waste, i.e. all waste will be managed so that nothing is discharged into the environment:

- **Wastewater will be treated in an oil-water separator, filtered and reused in the ammonium nitrate solutions;**
- **No discharge into the air;**
- **Sanitary discharges (toilet and sink) will be stored in a sealed septic tank and disposed of outside the site;**
- **Waste oil and other non-recyclable discharges will be disposed of outside the site by an authorized firm for reclamation or disposal;**
- **The plant is completely sealed. All accidental spills and wastewater are contained in a sealed floor drain;**
- **All raw material storage areas are equipped with a secondary containment system;**
- **All outdoor storage tanks are double-walled and equipped with a primary wall leak detection system.**

Trucks containing ANFO will be cleaned inside the plant. Washwater will be sent to the oil-water separator then filtered and reused. At the storage site, there will be separate tanks for gasoline (fuel) and nitrate. The detonators will be stored at the storage site in a special room kept under controlled access as required by the regulations and will not be transported at the same time as the explosives or they will be transported in separate sealed cases. Mixing will be done only before use, directly in the blast hole and not at the storage site. Packaged emulsions, purchased as is from the manufacturer, will be used on rainy days.

GLCI will comply with Quebec and Canada regulations, and apply for and obtain all required permits and authorization for the storage and use of the planned type of explosives.

4.11.11 OPTICAL FIBER CABLE

The cable will be installed along the existing James Bay road and along the site access road at a depth of approximately 1.2 m. The cable construction will require a 300 mm wide clearing and will require two creek crossings and one road crossing. The optical fibre cable between the km 381 truck stop and the project site will be buried. Excavation of the road for burying of the cable is not planned. Rather, directional drilling will be employed so as not to affect the surrounding environment and the existing infrastructure.

4.12 CONCENTRATE TRANSPORT TO MATAGAMI

The spodumene concentrate will be hauled to the transshipment terminal in Matagami, Québec. There, it will be transferred to trains (Map 1-1). Approximately **10 to 12** truckloads per day will be required to haul the daily concentrate production. Transportation will be done during the day **with minor exceptions**.

Transshipment terminal

The transshipment terminal in Matagami is located at 2200 Industrial Boulevard (along Highway 109 south of Matagami), directly in continuity with the Billy-Diamond Highway. Its exact location is 49°44'05.5"N and 77°41'02.4"W.

It has a 4-kilometre rail network and 250,000 m² of space available for storage and transshipment operations. It has a 1,500 m² warehouse and 3,400 tons of silo storage capacity. The warehouse is located directly on the railroad track and has a paved handling area. A weigh station has been installed, with a capacity of up to 100 net tonnes and a length of 27.4 m, equipped with an electronic access system. In 2016, the City of Matagami upgraded 1,200 m of track by replacing ties and levelling the tracks. Approximately 700 m of track remains to be upgraded. Figure 4-18 presents the layout of the transshipment terminal.

We estimate the requirement to be approximately 30,000 m² for this GLCI project. The facilities required for the project are minimal. An exterior dome will be constructed for trucks to unload their cargo. The entire facility will sit on a concrete slab. The dome will be located near the C-56 railroad track on which gondola-type cars will be loaded with a wheeled front-end loader. This operation is conventional, simple and efficient. The only work required for transshipment is the construction of the dome, the official dimensions of which have not yet been determined as the variables of the final scenarios are not yet fully determined.

The partners involved in the transshipment operations are carriers and subcontractors for the actual handling as the City of Matagami's employees will not perform any field operations. The City of Matagami essentially owns and is a manager of the infrastructure.

Note that the transshipment terminal is already in operation and works with many clients such as SDBJ, Newmont-Éléonore, Lafarge-Holcim, Canadian National, Hydro-Québec and the Eeyou Communication Network. This transshipment terminal is the northernmost point in western Quebec to reach the national rail network. For more details and up-to-date images, please visit www.ct-matagami.com.

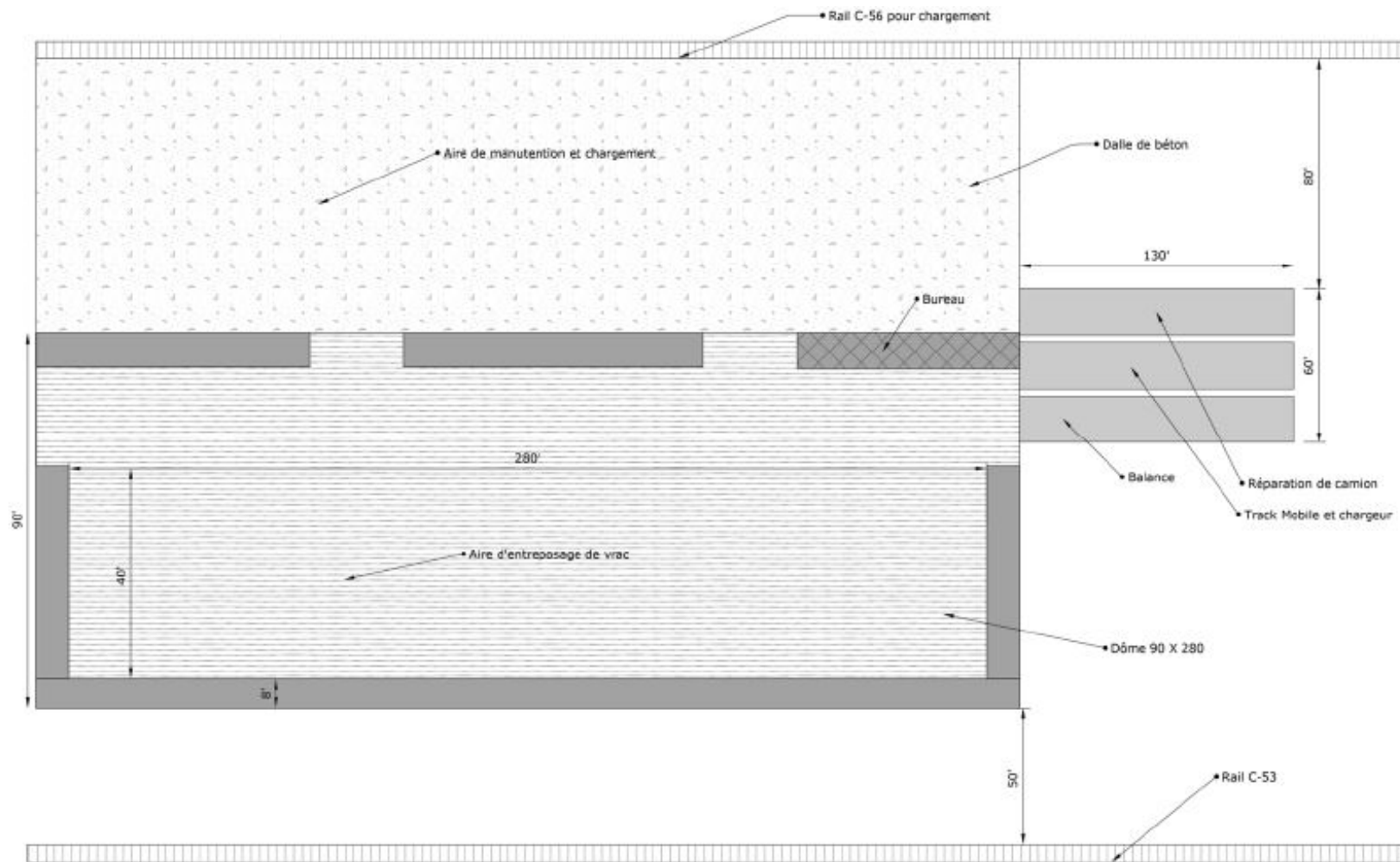


Figure 4-18 Matagami transshipment terminal layout

Source: City of Matagami, 2018.

At the transshipment terminal (managed by a third party), the concentrate will be transported from the rail yard to an undetermined location in southern Québec, to a processing plant or to a port for international shipping.

4.13 MINE RESTORATION

Appendix D presents the prepared conceptual mine closure and restoration plan. The planned state of the site after closure and the mine restoration are presented on Map 4-12.

As required by Section 101 of the Mining Act, the full rehabilitation and restoration plan will be prepared at a later stage. This plan will comply with the requirements of the Guidelines for preparing mine closure plans in Québec (MERN, 2017) and the trapline tallyman will be consulted. Note that the restoration plan must be approved by the MERN and the MELCC before the mining lease is issued.

4.13.1 CONTAMINATED SOILS

Following a definitive cessation of activities, GLCI will be required to undertake a characterization study of the property, as this type of activity falls into one of the categories listed in Schedule III of the *Land Protection and Rehabilitation Regulation* (CQLR, Q-2, r.37). Areas likely to have been contaminated mainly by petroleum, hydrocarbons, and metals will be prioritized. In all areas where petroleum product storage tanks and transfer sites were present during the construction and mining operations, the **ROM pad** and all petroleum product transfer sites will be sampled and analyzed to confirm the degree of contamination.

4.13.2 INFRASTRUCTURE AND BUILDINGS

Site rehabilitation will include the dismantling and demolition of all buildings and surface infrastructure, as well as the electrical and support infrastructure. The foundations will be levelled. The concrete slabs will be washed, perforated or crushed, to ensure proper drainage of water, and covered with reserved materials to promote the growth of self-sustaining vegetation. **The water management ponds will be drained**, sludge will be removed and sent to an authorized disposal facility. Eventually, **the water management ponds will be reinstated** as a wetland.

It should be noted that the management of the dismantling materials will be carried out in compliance with regulations, namely the *Regulation respecting the landfilling and incineration of residual materials* (CQLR, c. Q-2, r.19), as well as the *La gestion des matériaux de démantèlement - Guide de bonnes pratiques* (Courtois and coll., 2003).

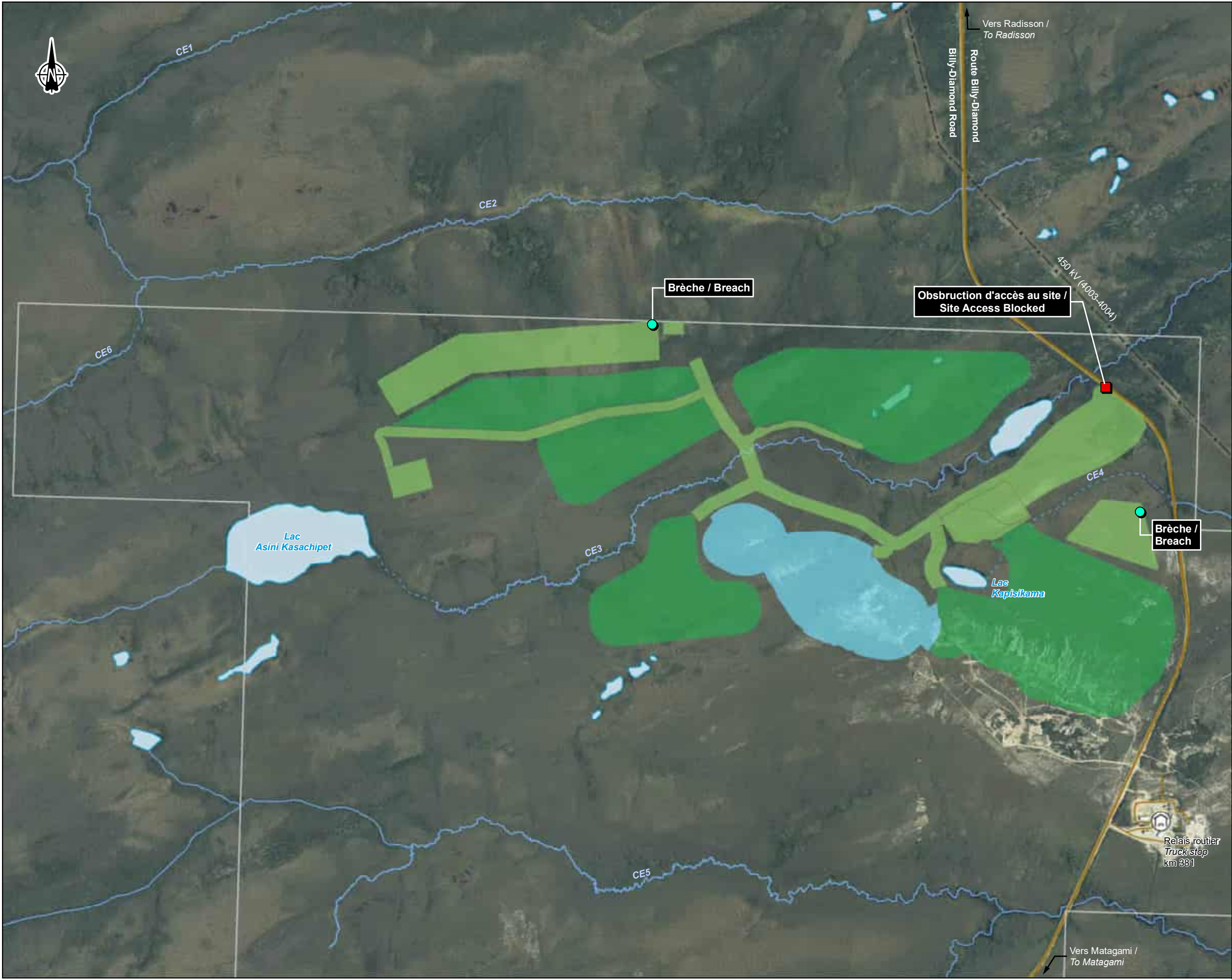
4.13.3 PETROLEUM AND CHEMICAL PRODUCTS, HAZARDOUS WASTE

Upon closure of the mining site, all equipment and heavy machinery will be sold, or drained of any fluids, broken down into parts and sent to an authorized recycling facility. All petroleum tanks and related pipelines will be drained, cleaned and sold, or disposed of in accordance with applicable regulations. No residual hazardous material will be present on the site once mining activities have stopped.

4.13.4 WASTE ROCK STOCKPILES

The waste rock and tailings storage facilities will be remodelled to ensure long-term physical stability and integration into the landscape. Bench slopes will be softened down to 2.5H:1V and the tailings on the stockpiles will be covered with overburden and topsoil to improve revegetation.

Note that water quality monitoring will be conducted during the operation phase and will determine if the actual leaching reactions last longer than the laboratory simulations (Chapter 10). If they do, then the restoration plan will be modified accordingly during operation. Water quality monitoring will also be maintained during the restoration phase to validate the assumption that the tailings will not leach once new material is no longer deposited. In the post-restoration period, the environmental monitoring will have to demonstrate compliance with the requirements of Section 2.11 of Directive 019 on the abandonment procedure for the post-restoration monitoring program.



Limite de propriété / Property limit

Composantes du projet / Project Component

Haltes à stériles revégétalisées /
Revegetated waste rock stockpile

Infrastructures revégétalisées /
Revegetated infrastructure

Fosse remplie d'eau / Pit filled with water

Infrastructures / Infrastructure

Route principale / Main road

Route d'accès / Access road

Ligne de transport d'énergie / Transmission line

Relais routier / Truck stop

Hydrographie / Hydrography

CE3

Numéro de cours d'eau / Stream number

Cours d'eau permanent / Permanent stream

Cours d'eau à écoulement diffus ou intermittent /
Intermittent ou diffused flow stream

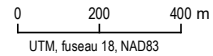
Plan d'eau / Waterbody



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 4-12
Aménagement du site minier après la restauration/
Mine Site After Restoration

Sources :
Orthoimage : Microsoft Bing (ESRI, 2017)
Données du projet / Project data : Galaxy 2020



Juillet / July 2021

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c4-12_wspT309_rehab_210629.mxd



4.13.5 OVERBURDEN AND PEAT STORAGE FACILITY

If topsoil is excavated for rehabilitation purposes (e.g. revegetation), the excavation geometry will allow water flow toward the existing ditch system. The access roads built during topsoil deposition will be revegetated. If slopes of granular material are exposed, they will be softened to allow revegetation.

4.13.6 ROM PAD

There will be no material remaining on the ROM pad after mining has ceased. The surface will be reprofiled to prevent water puddling at the proposed pumping point and then revegetated.

4.13.7 PIT

As provided for in the mining plan, tailings and waste rock will be deposited in the southeast portion of the pit once the mineral resources of interest have been removed. The remainder of the pit will fill naturally with precipitation and groundwater to an equilibrium level with the water table. An overflow and ditches will be constructed to prevent overflow around the pit that could damage the environment. The flow will be channelled to the CE3 watercourse.

The pit will be surrounded by a 2 m high berm, with a ditch built at its foot. Hazard signs will be installed every 30 m in compliance with Section 104 of the *Regulation respecting mineral substances other than petroleum, natural gas and brine*.

4.13.8 WATER MANAGEMENT INFRASTRUCTURE

During the rehabilitation activities, the following modifications of the water management infrastructure will gradually be performed:

- **Construction of a pit overflow;**
 - **Breach of the dike of the main water retention basin;**
 - **Removal of culverts and surface water flows brought back to pre-project conditions;**
 - **Dismantlement of the WTP (after the completion of the post-closure environmental monitoring program).**
-

4.13.9 REVEGETATION

The industrial and administrative area, WTP area **(if necessary)**, waste rock **stockpiles** and the **unconsolidated deposit and organic matter stockpiles** as well as the roads (surfaces and shoulders) will be revegetated to control erosion and restore the site to a natural condition in accordance with the surrounding environment and close to its original conditions. Prior to revegetation, the surfaces will be scarified. They will then be seeded with native herbaceous plants. Necessary measures to promote plant growth will be taken. The remaining organic material in the topsoil stockpile will also be seeded with indigenous herbaceous plants. Revegetation will allow the area to reach a satisfactory condition. This means that once in place, the plants must be hardy, provide long-term viability, and not require other care to ensure their sustainability.

Temporary shutdown

In the event that mining operations are temporarily suspended, GLCI will notify the government authorities in writing of the date operations ceased and anticipated date of resumption in accordance with the regulation.

In compliance with the section on Measures Applicable in the Event of a Temporary Shutdown of the MERN's Guidelines for Preparing Mine Closure Plans in Quebec, GLCI will implement safety measures if mining operations are temporarily suspended for more than six months. These measures are intended to restrict access to the mine site and the various buildings and other structures, as well as to maintain effluent quality control and ensure the physical and chemical stability of the various accumulation and storage areas.

The following measures will be applied during a temporary cessation of mining activities:

- mine site access will be prohibited. A barrier will be installed at the mine site entrance and ensure its safety;
 - a protection berm will be installed around the pit to ensure the safety of land users;
 - an effluent monitoring program will be carried out, including sampling and analysis in compliance with the EQA requirements;
 - measures (visual inspections and water analyses) will be taken to ensure the physical and chemical stability of the various accumulation areas.
-

4.14 PROJECT EXECUTION

Figure 4-19 presents a timeline that covers activities from the submission of the EIA to the end of the post-rehabilitation. The length of time for the main project phases is:

- Construction: **15** months;
- Operations: **18.5** years;
- Rehabilitation: **2 years**;
- Post-rehabilitation: 5 years.

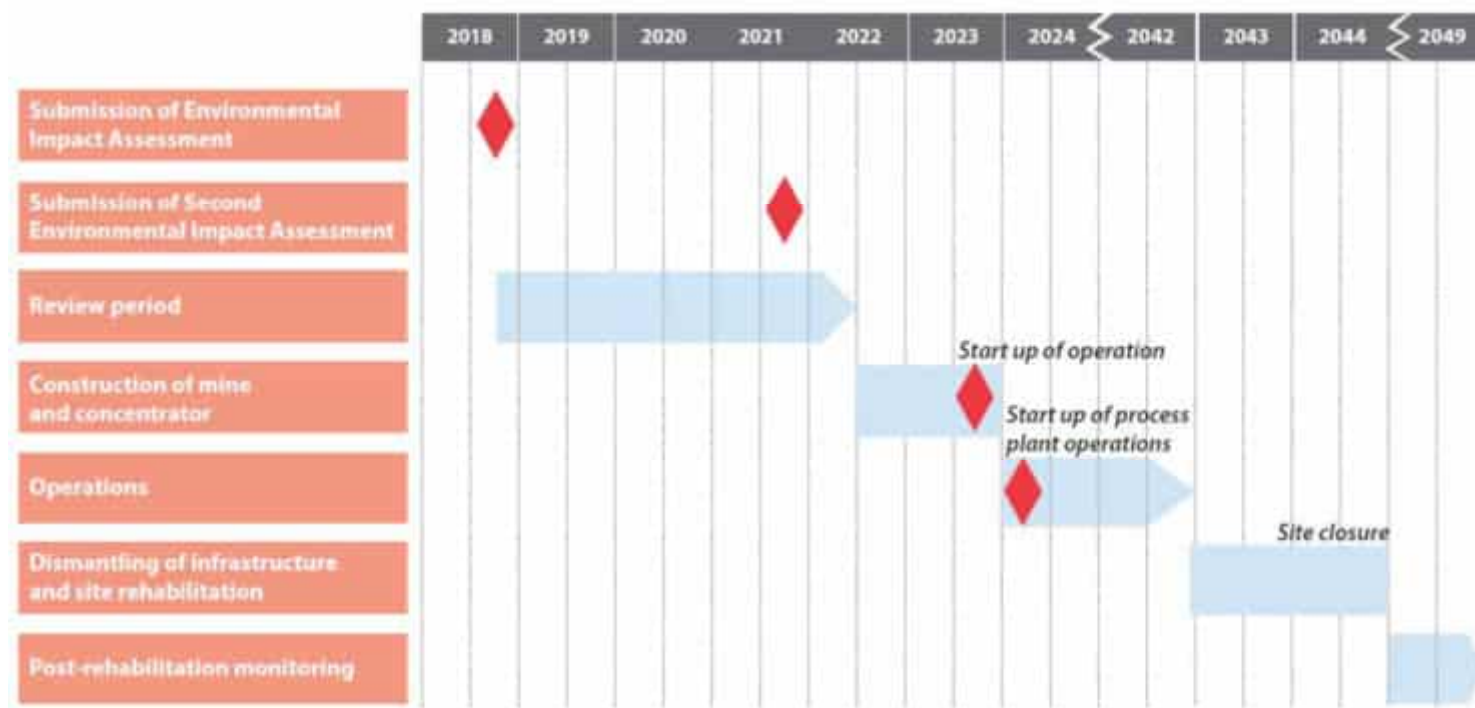


Figure 4-19 Schedule

Most of the workers employed at the mine will work in **10-hour** shifts. They will be on-site 14 days in a row followed by 14 days off. Schedule adjustments may be possible for the Crees that do not require air transport. They will be offered a 7-day in, 7-day off schedule but only for certain positions at the mine. **Management positions as well as the Eastmain community members could have** a four-day work followed by three-day off schedule or a typical five-day work and two-day off schedule (Monday to Friday).

Air travel will be the primary means of transportation for workers. GLCI will organize charter flights from major hubs to the Eastmain airport and will provide a shuttle service to and from the site. The Eastmain airport is located **130 km** away from the project site. **During construction and operation phases, the number of chartered flights and shuttles to reach the mine site is currently planned at 3 or 4 per week depending on the number of employees required. The number of chartered flights will depend on the location of the employees and the agreed terms of employment (particularly regarding fly-in fly-out). GLCI would like to hire as many local workers as possible.**

The construction phase will employ 210 workers, **to reach the maximum of 280 workers**, on average during the **15** months required to build the infrastructure. The first activities will be those associated with civil works such as the opening of the site and building of the first roads. Once the roads and worker's camp are in place, activities in the industrial and administrative area will become possible. As such, the various building structures will be assembled. Following the first months of the structure work, mechanical and electrical jobs will start (around month 6). Civil works account for most of the workforce and will be continuous throughout construction.

Figure 4-20 illustrates the annual number of workers for the various mining operations. **Most of the available jobs will be related to extraction operations. The mine's labour force will peak at 167 in year 14 of operation.**

Table 15.12: Workforce Forecast

Department	Max	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Mine Operations	124	78	81	83	87	88	88	87	86	100	100	100	100	100	104	104	104	100	98	97	88
Mine Maintenance	45	58	59	41	41	41	41	41	41	41	45	41	45	41	45	45	41	45	41	40	31
Mine Geology	10	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	5	7
Mine Engineering	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	7	5
Total Workforce	167	88	142	142	148	147	147	151	158	158	163	158	163	158	167	167	163	163	155	147	129

Figure 4-20 Estimated number of workers during operation

Notes: Mine Operations (*Opérations minières*), Mine Maintenance (*Entretien à la mine*), Mine Geology (*Géologie minière*), Mine Engineering (*Ingénierie minière*)
Source: G Mining Services, 2021

Capital expenditures (CAPEX) for the construction of the project, including processing, mining equipment purchases, infrastructure and other direct and indirect costs are estimated at \$325.75 M (Table 4-29).

Table 4-29 presents the cost breakdown. Detailed information is available in Rapport technique – Évaluation Économique préliminaire NI 43-101 (G Mining Services Inc. 2021).

Table 4-29 Estimated capital expenditures

Component	Expenditures (CAD millions)
Infrastructure	34.60
Energy and electricity	46.80
Water	20.31
Ground operations	9.26
Pit mining operations	36.93
Processing plant	64.51
Construction - indirect costs	45.34
General services	31.91
Pre-production, start-up, commissioning	4.07
Contingency	32.03
TOTAL	325.75

Source: G Mining Services, 2021

4.15 OPTIMIZATION OPPORTUNITIES CONSIDERED IN THE PROJECT

4.15.1 AIR TRANSPORT

As currently defined, the project will use the Eastmain airport to transport workers from southern Québec. Located 130 km west of the worker' camp, this airport is not equipped to receive as many travellers throughout the year. Work will be required, including installing de-icing equipment and a source of fuel supply, to improve the flow of departures and landings.

Another option **considered** is to use the Opinaca airport, 55 km east of the project site. This airport has been closed since 2013 and its facilities have been dismantled but since the runway is still usable, materials could be delivered by a Hercules-type carrier.

GLCI had the two options assessed by specialized consulting firm Octant. Both options, whether the use of the Opinaca airport runway or the Eastmain airport, present benefits and disadvantages.

The Opinaca runway is closer to the site, but is currently closed. The property is classified as a vacant land located on Category III lands and on trapline V35 owned by the Eastmain Community. Thus, occupation and construction permits, as well as land use rights would need to be requested. Furthermore, except for the runway, there is no infrastructure on site; everything would need to be built.

The Eastmain airport is farther away from the site; more hours paid to employees and transport by bus must be considered. Risks of accidents and GHG emissions would be higher.

The existing facilities are insufficient for the following reasons:

- Fuel is not available;
- Ground handling equipment is insufficient;
- De-icing equipment is unsuitable;
- No hangar.

No impact assessment is required for the work to be conducted (addition of equipment and installation of fuel tank). Despite the longer and more expensive transport of employees via the Eastmain airport, and given the timeline for construction work at Opinaca, temporary facilities should be developed at Eastmain to welcome workers for the first few years. It was therefore decided to go forward with the Eastmain airport option based on the CAPEX, and time.

4.15.2 USE OF LNG TRUCKS TO TRANSPORT CONCENTRATE TO MATAGAMI

As mentioned previously, reducing GHG emissions is an inherent priority for GLCI, a producer of lithium, the preferred source for electric vehicle batteries. At the present time, electric vehicles with the capacity required for the project activities are not available. Although LNG is a source of fossil energy, it emits 30% less GHG than diesel, the conventional energy for road transport.

Discussions were held between GLCI and Energir (Quebec's LNG supplier) in 2018, regarding the possibility of using LNG to fuel haul trucks (also valid for trucks transporting the concentrate to Matagami). Calculations under various scenarios for transporting liquefied natural gas to the mine site were then performed to compare the GHG emissions and costs of the alternatives. Thus, considering the full cycle, including the transportation of LNG (and losses during transportation and storage), the anticipated reduction in GHG emissions is minimal. These solutions will drive capital costs of the project up, without having a significant positive impact on the environment. Additional technological and health and safety risks (accidents) must also be considered. Based on this evaluation, LNG-fuelled trucks are not as beneficial a choice as it might seem at first sight. Section 3.4.2 of this study discusses the details of this approach.

4.15.3 USE OF A CONVEYOR SYSTEM TO TRANSPORT EXTRACTED ROCK ON THE MINE SITE

To reduce GHG and dust emissions, the option of installing a conveyor to transport extracted ore and waste rock the concentrator and waste rock stockpile was considered in 2018. With the project optimization, this option is no longer appropriate given the new stockpile locations, which are now closer to the pit.

4.15.4 OPTIMIZATION OF WASTE ROCK STOCKPILE

The location of the waste rock stockpile was the subject of a structured analysis of alternatives that considered various environmental, social and economic factors. Environmental and social factors were considered more than economic factors. The site selected **in 2018 had** construction constraints that significantly **increased** costs.

To reduce construction and operating costs, technical solutions other than those presented **in the 2018 impact assessment project description were studied. Based on this study, the positioning was optimized by moving the stockpiles closer to the pit to reduce transport distances and by limiting encroachment on less suitable areas such as wetlands.**

4.15.5 USE OF THE CAMP AT THE TRUCK STOP

Given the long work hours and difficult living conditions of workers on remote sites, it was decided to set up a camp on the project site so that they can walk to work, develop a sense of belonging to the company and its values and enjoy organized leisure activities that meet their needs. This permanent camp will be able to house **180** workers. More rooms will be added for the construction period **to house an additional 100 workers.**

Additional workers can evidently be lodged at the truck stop. The truck stop has 40 rooms; another 130 rooms will be required during the construction phase. Setting up additional rooms at the truck stop is possible because the sanitary and energy infrastructure can serve up to 250 people. One possible scenario is to set up 130 additional rooms for the construction period and afterwards keep about 40 for GLCI's use during occasional periods of extra visitors (e.g., industrial visits, additional work or general annual maintenance work).

The main problem with using the truck stop is that it is a public facility and alcohol is permitted whereas the worker's camp on the project site will be dry. GLCI is investigating how to manage the different conditions for employees at the truck stop and at the site.

4.16 SUSTAINABLE DEVELOPMENT PRINCIPLES APPLIED TO THE PROJECT

4.16.1 CONCEPT AND PRINCIPLES

In 2006, Québec adopted the Sustainable Development Act (CQLR, chapter D-8.1.1) in which sustainable development "means development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development is based on a long-term approach which takes into account the inextricable nature of the environmental, social and economic dimensions of development activities."

In 2015, the Council of Ministers adopted the Government Sustainable Development Strategy 2015-2020 (MDDELCC, 2015). The 2015-2020 strategy is based on the results of the Government Sustainable Development Strategy 2008-2013 (MDDELCC, 2013) (extended until December 2014) and takes into account the observations and findings of the Rapport sur l'application de la Loi sur le développement durable and the report on the state of sustainable development in Québec for the period from 2006-2012 (MDDEFP, 2013). This strategy presents the government's vision for sustainable development as well as the issues, orientations and objectives that guide the public administration in its sustainable development efforts (MDDELCC, 2018).

In general, all development projects must seek to achieve the government's sustainable development objectives:

- 5 Maintain environmental integrity to ensure the health and security of human communities and life-sustaining ecosystems;
- 6 Ensure social equity to enable the complete fulfilment of all men and women, development of communities and respect for diversity;
- 7 Aim for economic efficiency to create an innovative and prosperous economy that is ecologically and socially responsible.

GLCI is committed to respecting these three sustainable development objectives and will do so by applying its environmental and health and safety policies as presented in Chapter 1.

4.16.2 ACTIONS THAT COMPLY WITH SUSTAINABLE DEVELOPMENT PRINCIPLES

The Québec government sets out 16 sustainable development principles in its legislation on sustainable development (section 6). While the *Sustainable Development Act* does not apply directly to project initiators, special attention was paid to the 16 principles in this Act to ensure they are considered, to the extent possible, at the planning, design and development stages of the project. As a result, many elements respect these principles, as presented below.

Health and quality of life

“People, human health and improved quality of life are at the centre of sustainable development concerns. People are entitled to a healthy and productive life in harmony with nature.”

Through the measures outlined below, GLCI will help promote every individual's right to a healthy and productive life, in harmony with nature. The preservation and improvement of the quality of life of the host community were taken into consideration when planning the activities for the EIA, as evidenced by the content of this report. During the project design, innovative mitigation measures were developed for aspects of activities most likely to upset the local population. The following are just a few examples:

- **Design and location of waste rock stockpiles to reduce the distances over which waste rock and tailings are transported, thereby limiting the amount of dust and GHG emissions;**
- Healthy, balanced menus in the cafeteria for mine workers;
- Banning alcohol consumption at the mine site (including the worker camp);
- **Hiring employees trained in human resources to facilitate worker integration;**
- **Hiring of Cree women, particularly in human resources, to balance the project's impact between genders.**

Concerning the project's impact on quality of life, GLCI is committed to implementing mitigation measures to minimize the effect on health and quality of life. As well, an environmental follow-up program for aspects that directly or indirectly affect health and quality of life is proposed during the mine's construction and operation (Chapter 10).

By implementing employment and training programs for local communities and the surrounding First Nations, GLCI will indirectly contribute to improving the local population's quality of life. GLCI also intends to award contracts to qualified local entrepreneurs, which will drive job creation and economic development in the region.

GLCI will comply with the highest national and international health and safety standards to protect its workers and the surrounding community. An occupational health and safety policy and program will be introduced and presented to contractors prior to construction to ensure worker safety on the job site.

Lastly, as required by the *Mining Act* (CQLR, chapter M-13.1), a rehabilitation plan will be implemented at closure and will improve the aesthetic quality of these sites while restoring them to a satisfactory state, which at minimum will entail:

- eliminating unacceptable health risks and ensuring the safety of persons;
- limiting the production and spread of contaminants likely to affect the receiving environment and endeavouring to eliminate any form of long-term maintenance and follow-up;
- restoring the site to a visually acceptable state;
- restoring the infrastructure site to a state compatible with future use.

Social equity and solidarity

“Development must be undertaken in a spirit of intra- and inter-generational equity and social ethics and solidarity.”

With this project, the Eeyou Istchee James Bay (EIJB) region will benefit from the presence of a company committed to creating opportunities and supporting initiatives that meet the community’s needs and priorities. This support could take the form of community involvement by GLCI and its employees, as well as partnerships, donations and sponsorships for local organizations.

As well, as stated in its policy on harassment and equal opportunity employment, GLCI intends to create a work environment where everyone can develop their talents and be successful.

The project will be developed in a manner that ensures inter-generational equity, with a view to generating benefits that will enhance the lives of future generations. For example, under the procurement strategy, long-term relationships will be established with local businesses to enable them to develop expertise that they will then be able to transfer to new projects or markets. GLCI can therefore serve as a springboard for local suppliers who, once the mine is closed, can continue their activities. Proposals will be analyzed to ensure that the major part of a locally awarded contract is not outsourced to a contractor outside the region.

GLCI has established standards and procedures on discrimination, which must be followed globally. GLCI is currently assessing the possibility of incorporating the Flexible Work Arrangement Standard (Appendix E) currently used in Australia, in order to provide added value to Canadian employees, including women who would benefit from flexible work arrangements.

The inclusion of women in training programs, the hiring of women workers and how to facilitate work-family balance will be more specifically considered and discussed as part of the Impact and Benefit Agreement process. Ongoing consultations will take place throughout the life cycle of the project to assess GLCI’s role in advancing women’s education, training and professional development in relation to the project.

The following is a non-exhaustive list of initiatives that will be undertaken:

- **Ensure a diverse and qualified hiring team.**
- **Establish hiring targets (screening and interview targets) for women.**
- **Share these hiring targets with employment agencies and encourage collaboration to achieve the targets.**
- **Train recruiters and managers to recognize stereotypes and cognitive biases related to the type of work women can do, and what they can do in non-traditional roles.**
- **Adopt a meritocratic process starting from the CV review and selection phase to the final offers.**

- **Expand the skills and pool of potential candidates by broadening the abilities and experience required for non-traditional roles in order to increase the number of potential candidates, expand the pool of candidates for non-traditional roles and include women from the region.**
- **Provide networking opportunities for women to share information and support each other.**
- **Where possible, offer flexible training in terms of time and location.**
- **Provide development assistance for women focusing on specific skills, such as influencing and networking, as well as specialized on-site training and development sessions.**
- **Positions in the community of Eastmain will be available in addition to positions at the mine, to allow women to stay close to their families.**

Environmental protection

“To achieve sustainable development, environmental protection must constitute an integral part of the development process.”

The current form of the project has been deemed to be the least harmful to the environment. Various design and development options were considered to protect the environment as much as possible, specifically, infrastructure development that keeps the facilities in the same watersheds, avoidance of sensitive areas (indigenous and natural) and footprint minimization. **Furthermore, the optimization exercise carried out for the 2021 project helped further reduce the footprint, mainly on wetlands.**

A critical analysis of this project was carried out to determine the effects on the physical, biological and social environments. GLCI and its subject matter experts have identified mitigation measures to reduce these effects. The project’s insertion in the receiving environment is thus favoured and the environmental effects are minimized. Compensation measures have been planned for certain effects that could not be mitigated.

As well, the local population was consulted and suggested many ways to improve the project. **After the impact assessment was submitted to the provincial and federal ministerial authorities, new protection measures were included in the project based on the comments obtained during their analysis of the project.** Some government departments also provided validations that helped the proponent make choices consistent with environmental protection.

Once the authorizations are received, implementation of the mitigation measures by specialists will be ensured by a rigorous monitoring program during construction. All the measures will first have been incorporated into the specifications that will be given to the contractors. Lastly, the proponent will adhere to the environmental follow-up program approved by the authorities and found in the EIA.

Using the recommendations of many varied stakeholders, different forms of environmental protection have been and will be integrated into each project phase, from project development to operation.

Economic efficiency

“The economy of Québec and its regions must be effective, geared toward innovation and economic prosperity that is conducive to social progress and respectful of the environment.”

Thanks to transportation electrification, the lithium industry continues to grow. Rising demand for lithium means the project will be profitable and optimized.

This project will revitalize the regional economy by creating jobs and economic opportunities for local entrepreneurs and attracting huge investments. GLCI’s investment in this project to date illustrates the major impact it can have in the short, medium and long term.

The operating techniques and equipment used will directly affect the complexity of the jobs that will be offered. Employees with specialized training and diverse technical skills will be sought out (mechanical, electrical, electronic, IT). Many employees will need to acquire new skills to work for the company. This is a significant aspect of the project's contribution to Québec's economic development as it offers a unique opportunity to develop local expertise.

Participation and commitment

“The participation and commitment of citizens and citizens’ groups are needed to define a concerted vision of development and to ensure its environmental, social and economic sustainability.”

Since GLCI considers social acceptability a fundamental condition, active citizen participation is essential to the project's development. In this regard, GLCI has put in place proactive voluntary participation mechanisms, allowing all interested stakeholders to express their views on the project and send GLCI their recommendations. Among these mechanisms, the pre-consultation process and the numerous individual meetings that preceded the project allowed GLCI to meet with the citizens and groups concerned. At the meeting, GLCI presented the project in detail, answered questions, addressed concerns and made adjustments to the project.

GLCI's vision of citizen participation and engagement will translate into a project that meets the expectations of the local population.

Access to knowledge

“Measures favourable to education, access to information and research must be encouraged in order to stimulate innovation, raise awareness and ensure effective participation of the public in the implementation of sustainable development.”

Public consultations and information sessions to communicate information on various aspects of the project have been and will continue to be held. An effort has been made to make the communication tools easy to understand (e.g., posters and simplified information sheets). A project website and email address have also been made available to collect questions and comments from the public, as presented in Chapter 5. The website is continuously updated to ensure that people have access to the latest information.

GLCI is in discussions with the Council of the Cree Nation of Eastmain with a view to developing training programs that will allow workers from the community to access jobs at the mine. The first activity, an introduction to mining (Mining 101), was held in July 2018.

Subsidiarity

“Powers and responsibilities must be delegated to the appropriate level of authority. Decision-making centres should be adequately distributed and as close as possible to the citizens and communities concerned.”

Public consultation and participation meetings were held as part of the project planning and the EIA and will continue.

GLCI intends to form a committee to maintain open dialogue with stakeholders and the public. Moreover, GLCI wishes to obtain ISO:14001 accreditation to ensure the implementation of appropriate environmental management systems for an activity of this size.

Intergovernmental partnership and cooperation

“Governments must collaborate to ensure that development is sustainable from an environmental, social and economic standpoint. The external impact of actions in a given territory must be taken into consideration.”

GLCI has had several preliminary meetings with the provincial and federal authorities with a view to aligning the requirements of the various levels of government. The main topics covered were expectations related to the consultations, development of the project infrastructure, the cumulative effects assessment, climate change and GHGs.

Dialogue with the government authorities will continue after the EIA is filed, i.e., throughout the detailed engineering phase, to validate any changes or improvements to the project's current definition.

Prevention

“In the presence of a known risk, preventive, mitigating and corrective actions must be taken, with priority given to actions at the source.”

The way mining is carried out is constantly changing. Practices considered acceptable and that were permitted in the past are not necessarily so today. In the case of the project, the practices will at least meet the requirements of REMMMD, D019 and any other applicable regulations.

The proposed project will promote environmental management of the mine by using a centralized approach to water treatment and a gradual rehabilitation of part of the site.

A risk assessment for accidents or natural events has been completed as part of this EIA and preventive actions have been incorporated into industrial developments and processes to reduce, at the source, the environmental risks associated with HAZMAT storage and use, for example:

- the connection to the Hydro-Québec grid due to economic and environmental considerations (versus the use of diesel);
- on-site storage of minimum amounts of hazardous products required for operations;
- the implementation of measures to minimize the environmental consequences in the event of a spill (e.g., double-walled tanks, concrete slabs under all at-risk infrastructures);
- deforestation of a perimeter of 35 metres around at-risk developments to limit the spread of wildfires around the site.

The results of the risk assessment have been incorporated into the Emergency Measures Plan (EMP) to consider the risks associated with the project.

Lastly, an environmental monitoring and follow-up program has been developed and will be implemented at the start of construction to confirm the anticipated effects of the project.

With respect to the prevention of occupational safety risks, the design team's priority was to reduce staff exposure to potential safety risks by eliminating them at the source, which is very different from an approach that identifies and controls risks. Many of the technologies developed by the industry in recent years have been specifically designed to reduce employee exposure to risks (e.g., emissions, dust). This was evident in GLCI's choice of such equipment as drones, which make it possible to visualize watercourses.

Precaution

“When there are threats of serious or irreversible damage, lack of full scientific certainty must not be used as a reason for postponing the adoption of effective measures to prevent environmental degradation.”

Inherent project risks were reported to GLCI throughout the design phase and corrective measures were implemented. The goal was to reduce all risks to an acceptable level.

Some sector studies conducted as part of the EIA are based on projected scenarios in the operation phase. This is the case for, among others, the studies on noise, vibrations, air quality and hydrogeology, for which modelling was required. In all cases, conservative assumptions were used that represented the worst theoretical case to ensure compliance with existing standards.

Preventively, samples of various media were collected and analyzed for metal content. This baseline condition will make it possible to compare the initial condition with the condition after the project if environmental risks were to be identified later. This includes the quality of surface water, groundwater, soil, sediment and plants likely to be consumed by the Crees.

Protection of cultural heritage

“The cultural heritage, made up of property, sites, landscapes, traditions and knowledge, reflects the identity of a society. It passes on the values of a society from generation to generation and the preservation of this heritage fosters the sustainability of development. Cultural heritage components must be identified, protected and enhanced, taking their intrinsic rarity and fragility into account.”

As part of the impact study, some complementary work pertaining to the cultural heritage was carried out:

- interviews with tallymen and their families to document land use;
- a review of the literature on traditional knowledge, particularly as it relates to medicinal plants;
- visual simulations integrating viewpoints valued by users of the territory;
- a study on the archaeological potential and an inventory of heritage elements.

In this regard, GLCI undertakes to carry out a complementary archaeological study of sites with archaeological potential near the project infrastructure to ensure the heritage is preserved. **The inventory work will be completed in July 2021.**

Biodiversity preservation

“Biological diversity offers incalculable advantages and must be preserved for the benefit of present and future generations. The protection of species, ecosystems and the natural processes that maintain life is essential if quality of human life is to be maintained.”

Thanks to the wildlife and plant inventories carried out during the sector studies, any impact on valued species was, to the extent possible, avoided and when it could not be avoided, mitigation measures were added. Also, the timing of construction, specifically land clearing, has been adjusted to limit the effect on sensitive species on the territory as well as on the bird nesting period.

Respect for ecosystem support capacity

“Human activities must be respectful of the support capacity of ecosystems and ensure the perennality of ecosystems.”

Some components of the project have been planned with a view to limiting GHG emissions. For example, shuttles will be used to transport workers from the Eastmain Cree community to the camp, substantially reducing the number of vehicles on the road and the associated GHG production. **The acquisition of electric auxiliary vehicles (forklifts, buses, pick-up trucks) will also help reduce GHG emissions. There are also plans to install electric vehicle charging stations in the community of Eastmain. The exact location of these stations will be determined in collaboration with the community of Eastmain.**

The size of the trucks to be used on the site has been increased, thus reducing the total number of trucks on site. The waste rock stockpiles were also repositioned during project optimization to reduce transportation distances, thereby reducing GHG production.

Concerning the aquatic environment, the location of the project infrastructure was determined based on the boundaries of the watersheds. Most of the redirected waters will remain within the boundaries of their current watersheds, except for pit dewatering. In addition, **effluent** monitoring is planned to ensure compliance with standards.

Other mining projects near the site were considered in the project design. GLCI has initiated contact with these companies to discuss their lessons learned and adjust its project accordingly.

Finally, it should be remembered that the objective of the project is to extract lithium, which is mainly used in the production of batteries. Although GHG emissions are considered in mining production, the production of batteries for the sale of electric vehicles will have a major effect on the atmospheric carrying capacity.

Responsible production and consumption

“Production and consumption patterns must be changed in order to make production and consumption more viable and more socially and environmentally responsible, in particular through an eco-efficient approach that avoids waste and optimizes the use of resources.”

Throughout the design stage, GLCI chose to optimize its project by implementing measures to reduce resource consumption. GLCI recognizes that the mining industry has left mine sites rehabilitated to the standards of the time, which are not the same as those of today. Consequently, major efforts have been made to carefully plan a cost-effective waste rock and tailings management regime that meets today’s environmental regulatory requirements and minimizes the visual impact for communities. Thus, the **combined waste rock and tailings stockpiles will** reduce the project’s footprint and limit environmental risks.

The optimization of resource use through innovative production techniques has been extensively documented in chapters 3 and 4. As an example, **the water** will be recycled in the process to limit fresh water supply. Concerning rehabilitation of the sites where the infrastructure will be dismantled, the grounds will be decontaminated if necessary and then covered with overburden.

Polluter pays

“Those who generate pollution or whose actions otherwise degrade the environment must bear their share of the cost of measures to prevent, reduce, control and mitigate environmental damage.”

All costs for pollution prevention equipment will be borne by the project and impacts that will not be fully mitigated may be subject to compensation measures. In addition, during the construction phase, contractors will be required to comply with the environmental clauses, failing which they will have to assume the costs to rectify the situation.

GLCI does not expect to be subject to the Québec cap-and-trade system (SPEDE). It would not have to bear any costs related to GHG production. However, it will eventually have to pay the annual fees provided for contaminant emissions, in accordance with the Guide explicatif - Droits annuels exigibles des titulaires d’une attestation d’assainissement en milieu industriel (MDDELCC, 2016).

Internalization of costs

“The value of goods and services must reflect all the costs they generate for society during their whole life cycle, from their design to their final consumption and their disposal.”

GLCI has no control over the value of lithium on the market. However, operating expenses certainly cover the costs associated with conformance to environmental requirements and with payroll taxes in force in Québec and in Canada (for example but without limitation, the Québec Pension Plan, Employment Insurance, CNESST, etc.).

Since 2013, the *Regulation respecting mineral substances other than petroleum, natural gas and brine Mining Act* imposes an obligation to provide a financial guarantee covering 100% of the site rehabilitation cost. The cost of restoring the site has been included in the project’s financial arrangement.

Synergy with other projects

Synergy with other mining projects is very difficult for various reasons. While GLCI is willing to consider coordinated training efforts in the future, this is more difficult in the short term since other projects in the region have different timelines and project schedules because they are in different phases of development than GLCI. As for waste management, it will likely be entrusted to a contractor from the James Bay region. This contractor will coordinate different types of waste collection and ensure proper disposal. There are no opportunities for transportation coordination as there is too much distance between the mining projects. Opportunities have not been considered for ore processing as other mining projects are in competition with GLCI.

5 PUBLIC HEARINGS

5.1 CONTEXT

To adequately explain the project and to engage local communities and stakeholders, GLCI established a stakeholder consultation and engagement process. This initiative made it possible to gather the concerns, views and expectations of local communities concerned by the James Bay Lithium Mine project.

The consultation process was primarily conducted among the James Bay and Eastmain Cree communities, whose territory hosts the proposed project.

The first round of consultation activities was conducted in 2011–2012. This chapter covers both the results obtained during this first series of meetings and the outcomes of the 2017–2018 consultations **prior to submitting the first version of the impact assessment**, in addition to presenting the:

- consultation process objectives and means used;
- stakeholders consulted;
- summary of activities and consultations conducted by the promoter and the key items in their information program and public consultation program;
- compilation of concerns, expectations and recommendations toward the project;
- GLCI's response to concerns and continuation of the consultation process.

Since the first version of the impact assessment, the consultation and engagement process was maintained with the same orientation goals and methods (sections 5.2 and 5.3). Stakeholder consultation activities that took place following the submission of the first version of the impact assessment were added to section 5.4, and their results to sections 5.5 and 5.6. Since the project design was optimized from an economical and an environmental standpoint, consultations took place at the beginning of 2021 to inform the stakeholders about the changes brought to the project. The continuation of GLCI's consultation and engagement process in the coming years is presented in section 5.7.

5.2 PROCESS OBJECTIVES

The consultation and stakeholder engagement process established by GLCI is intended to be transparent and respectful. Its engagement advocates open communication and sustainable business practices in view of sharing values and benefits with the local communities, significantly investing themselves among the latter and building productive relationships with the representatives at all levels of government. GLCI aims to be an exemplary and outstanding corporate citizen with local communities, in Québec and at the federal level.

More specifically, the stakeholder consultation and engagement approach favoured by GLCI has several objectives, namely to:

- complete the description of the social environment using information stemming from the populations on the territory concerned by the James Bay Lithium Mine project (gathering of information from primary sources);
- **complete the description of the biophysical environment, using stakeholder traditional knowledge, especially from the Cree population;**
- identify the concerns and expectations of the James Bay and Cree communities toward the project and on mining development in general on the territory;
- limit potential environmental impacts;
- ensure the health and safety of employees and contractors;

- gather mitigation measure suggestions from the concerned populations or organizations;
 - ensure follow-up of GLCI's engagements toward the stakeholders;
 - maximize the socioeconomic spin-offs and limit the project's impacts on the local communities;
 - maximize employment opportunities and prioritize the hiring of local workers;
 - develop training initiatives and contribute to improving the skills of the local workers;
 - assess and support community development initiatives;
 - provide local communities and stakeholders with consistent, timely and accurate information.
-

5.3 METHODS USED

As part of the consultation process held by GLCI, several communication methods and tools were put in place and used to inform, consult and ensure proper follow-up of engagements with communities and concerned stakeholders. The list of the methods used is presented in this section.

5.3.1 STAKEHOLDER REGISTER

A register of stakeholders and consultation activities has been established so that GLCI can track and follow up on communications, concerns, past activities and future actions with those organizations or communities. The section of the register concerning stakeholder engagement includes the following information: name and contact details of the person, type of stakeholder, agency they represent, consultation activities they have participated in, archiving of e-mails concerning said person and follow-up of actions required by GLCI toward the person. With regard to the data compiled on the consultation activities, the items considered were the following: type of activity held, stakeholder consulted, date of the event, names of the participants, material used, aim of the activity, activity report, actions required by GLCI following the activity and date of completion of said actions.

The register is also considered a tool for archiving e-mails exchanged with the stakeholders, reports of meetings held and material used during consultations (presentations, posters, maps, announcements, etc.).

5.3.2 PUBLIC PRESENTATIONS

To inform and consult the Cree Nation of Eastmain community, two public consultation presentations were offered. The first of such events was held on February 22, 2018. Through this initiative, GLCI sought to present the James Bay Lithium Mine project to the public and to initiate an open and respectful dialogue with the Eastmain Cree community. The second public presentation took place on July 16, 2018, in the form of an open house, thus encouraging members of the community to meet GLCI representatives and learn more about the project. The mining company initiated the meeting largely to present the environmental impact assessment results to members of the community. Each of these activities was highlighted by a PowerPoint presentation and posters presenting the salient features of the project or the key aspects of the EIA. The second public presentation provided information on the project's impact and the proposed mitigation measures.

5.3.3 INTERVIEWS

One-on-one interviews were also scheduled with socioeconomic stakeholders from the James Bay and Eastmain community. These meetings, either by telephone or in presence of the person concerned, were conducted in the manner of a structured interview aimed at surveying their knowledge of the project, obtaining information on their organization, learning the known effects of other mining projects on the EIJ territory, taking into account the potential positive and negative impacts from the proposed mining development, determining whether any cumulative impacts need to be considered and collecting all of the mitigation measures, expectations or concerns recommended by the stakeholders.

5.3.4 GROUP INTERVIEWS

Group interviews with the trapline tallymen and their families were organized during consultations for the EIA. The goal was to know how trapline (RE2) users in the study area use the territory and to know the practices of users on nearby traplines (VC33 and VC35), who also felt concerned. Maps of the traplines were provided to participants so that they could mark up their activities and camps, the drinking water supplies, transportation links and enhancement and preservation sectors. The following information was also gathered: their knowledge of the project, known effects of mining projects on the Cree territory, positive or negative impacts apprehended, impact on the traditional use of the territory, recommended mitigation measures and concerns or expectations voiced by users.

A group interview was also conducted during the consultation of the Cree Board of Health and Social Services of James Bay (CBHSSJB) and of the James Bay Cree School Board (JBCSB). All the stakeholders from these two bodies were invited to the meeting. This approach made it possible to canvass the views of each area of intervention within these organizations.

Two meetings also took place with the Cree Women of Eeyou Itschee Association (CWEIA) to discuss issues affecting women.

5.3.5 FOCUS GROUPS

During the consultation activities held as part of the ESIA, certain members of the Eastmain community were asked to participate in focus group discussions, formed based on the age or gender of participants. At GLCI's request, these meetings were publicized by the municipal administration and the agencies concerned. **Four** focus groups were formed, in total, for the following population categories: youths (7 participants), women (**twice: 2 and 5** participants) and seniors (7 participants). These groups were targeted due to their low turnout to other consultation activities, hence providing a more accurate picture of the concerns and expectations of the Eastmain community. These meetings addressed the participants' knowledge of the James Bay Lithium Mine project; their views on the proposed project; its potential positive and negative impacts; its potential cumulative impacts; the mitigation measures to consider; and any other expectations, concerns or queries members of the community wished to voice.

5.3.6 CONSENT AND VALIDATION OF MINUTES

At the beginning of the consultation activities with land users, a consent form was presented to the participants. The purpose of this form was to give the opportunity to the participants to specify if certain informations was to be kept confidential, such as species or valued sites locations and that they would have the opportunity to validate the summary of the interview.

Reports were drafted following each of the meetings, interviews, presentations or other consultation activities to report on the themes covered and on the discussions between GLCI and respective stakeholders. Summaries of the one-on-one interviews and focus groups were sent for approval to the concerned stakeholders (**including the land users**). **Some of the land users also had the opportunity to comment and validate the summaries produced, during a second round of consultation.**

5.4 INFORMATION AND CONSULTATION ACTIVITIES OF THE STAKEHOLDERS

In its stakeholder consultation process, GLCI focused on two groups in particular:

- the Cree stakeholders, more specifically, those from the Eastmain Cree community;
- the James Bay stakeholders.

5.4.1 CREE STAKEHOLDERS

5.4.1.1 2011–2012 PERIOD

In 2011, the first James Bay Lithium Mine project presentation and information session was held in Eastmain. It should be noted that the Eastmain Band Council had been notified of the project. Following this meeting, GLCI met with the Grand Council of the Crees (GCC) and the Cree Regional Authority (CRA) to initiate the discussion process under the Cree National Mining Policy (GCC et ARC, 2010). This policy requires negotiations with the mining companies to allow for a Cree-integrated approach to mining. At this meeting, the Cree representatives for mining development were identified. In addition, GLCI advised then-chief Edward Gilpin that the proposed environmental baseline sampling program activities would take place on the project site in 2011–2012.

In 2012, a meeting was held between the GCC-ARC representatives and GLCI. Although a Pre-Development Agreement (PDA) was prepared and negotiated and was ready for signature, the project was put on hold due to a collapse in the market price of lithium.

In parallel with the activities undertaken at government and administrative levels, interviews were held as part of the ESIA process with the tallymen of the potentially impacted traplines in Eastmain to document the traditional use of the territory:

- RE2 trapline: Most activities are located along the Billy-Diamond highway. They include moose and goose hunting, beaver trapping, fishing, wood cutting and blueberry picking. Drinking water supplies, snowmobile trails and goose ponds established by the tallyman were identified in this area.
- VC33 trapline: Along the Eastmain River, **this trapline** has valued wildlife areas used for moose hunting, beaver trapping and fishing.
- VC35 trapline: The tallyman needs to pass by km 381 to access his trapline and does not want blasting to block off road traffic on the Billy-Diamond highway. He is also worried about cumulative environmental impacts and the use of the trapline by **mine workers**.
- RE1 trapline: This project area is not used by the tallyman.

Moreover, from February to April 2012, several interviews were conducted in Eastmain with stakeholders from various sectors relating to the economy, the sociocultural world, health, hunting, fishing, trapping, the environment and from focus groups (Table 5-1).

Table 5-1 Calendar of information and consultation activities held with the Cree - 2011–2012

Date	Activity	Stakeholder(s)*
February 2011	Public presentation	Cree Nation of Eastmain
August 2011	Meeting to initiate the discussion process under the Cree Nation Mining Policy	GCC-CRA
November 2011	Meeting for a general presentation of the project	Council of the Cree Nation of Eastmain
February 22, 2012	Group interviews with users of the territory	RE1 – Trapline tallyman, his family and other users of the territory
		RE2 – Trapline tallyman, his family and other users of the territory
		VC33 – Trapline tallyman, his family and other users of the territory
February 22, 2012	Discussion group	Cree Nation of Eastmain – Youth
February 23, 2012	Group interview with users of the territory	VC35 – Trapline tallyman, his family and other users of the territory
February 23, 2012	Discussion groups	Cree Nation of Eastmain – Men
February 24, 2012		Cree Nation of Eastmain – Women
February 27, 2012	Interviews with Eastmain socioeconomic stakeholders	Wabannutao Eeyou Development Corporation (WEDC), Eastmain
February 28, 2012		Economic development services Eastmain
February 28, 2012		Eastmain Nation Youth Council
February 28, 2012		Eastmain Human Resources Development
February 28, 2012		Eastmain housing services
February 29, 2012		Eastmain elders council
February 29, 2012		Eastmain special projects services
March 1, 2012		Eastmain public health services
March 2, 2012		Eastmain police services
April 3, 2012		Cree Board of Health and Social Services of James Bay (CBHSSJB) – national program on alcohol and drug abuse among Indigenous peoples
April 3, 2012	Group interview to validate the meeting minutes on February 22	RE2 – Trapline tallyman, his family and other users of the territory
April 4, 2012	Group interview to validate the meeting minutes on February 23	VC35 – Trapline tallyman, his family and other users of the territory
April 4, 2012	Interviews with Eastmain socioeconomic stakeholders	Eastmain Environmental Health Department
May 8, 2012	Group interview to validate the meeting minutes on February 22	VC33 – Trapline tallyman, his family and other users of the territory
* A calendar of information and consultation activities with the names of the stakeholders met during each activity is provided in Appendix F.		

5.4.1.2 2017–2018 PERIOD

In 2017, GLCI's James Bay Lithium Mine project was relaunched. A second series of meetings were organized with the Eastmain Cree community to inform and consult the stakeholders involved in this mining development. It is primarily aimed at socioeconomic stakeholders, RE2, VC33 and VC35 tallymen¹, the users of the territory of these traplines and members of the Eastmain community. The meetings held are summarized below in Table 5-2a.

Table 5-2a Calendar of information and consultation activities with the Cree - 2017–2018

Date	Activity	Stakeholder(s)*
May 23, 2017	Introductory meeting	Council of the Cree Nation of Eastmain
November 15, 2017	Description of project and overview of environmental assessment	Council of the Cree Nation of Eastmain
February 19, 2018	Introductory meeting and key project updates	CSB and CHRD
February 22, 2018	Public presentation	Cree Nation of Eastmain
April 3, 2018	Meeting	Council of the Cree Nation of Eastmain
April 16, 2018	Group interviews with users of the territory	RE2 – Trapline tallyman, his family and other users of the territory
June 11, 2018		RE2 – Trapline tallyman, his family and other users of the territory
June 12, 2018		VC33 – Trapline tallyman, his family and other users of the territory
June 12, 2018		VC35 – Trapline tallyman, his family and other users of the territory
June 13, 2018	Focus groups with young people and women of the Cree Nation of Eastmain	Cree Nation of Eastmain – young people
June 13, 2018		Cree Nation of Eastmain – women
June 13, 2018	Interviews with Eastmain socioeconomic stakeholders	WEDC
June 13, 2018		CHRD
June 14, 2018		CBHSSJB and CSB
June 14, 2018	Focus groups with elders of the Cree Nation of Eastmain	Cree Nation of Eastmain – elders
July 3, 2018	Interview with regional authority representatives	CBHSSJB
July 16, 2018	Public presentation	Cree Nation of Eastmain
* A calendar of information and consultation activities with the names of stakeholders met for each is provided in Appendix F.		

COUNCIL OF THE CREE NATION OF EASTMAIN

The Council of the Cree Nation of Eastmain met several times during the consultation process. An introductory meeting, at which GLCI representatives presented the company and the James Bay Lithium Mine project, was held on May 23, 2017. Following this presentation, a discussion was held between the **Nation's** council members and mining delegates about the environmental impacts, project schedule, the hiring priority for Cree workers in Eastmain, communication measures put in place by GLCI to inform the community and the possibility of a possible partnership. GLCI suggested setting up a meeting schedule and scheduling four meetings per year between the nation's council and the mining company.

1 It was determined during the exchanges held in 2011–2012 with the RE1 trapline tallyman that he did not feel concerned about the Galaxy project.

A new meeting was organized on November 15, 2017. Its purpose was to present the entire project to the members of the nation's council in more depth using PowerPoint. Concerns were raised during this meeting, including the presence of tributaries near the planned mining site, the project's impact on groundwater and the importance of training Cree workers.

On April 3, 2018, GLCI had a third meeting with the Eastmain nation's council to discuss the Cree community's expectations with regard to the mining project and to pass on the latest updates using PowerPoint. During the discussion period, the members of the nation's council mentioned their lack of knowledge about the mining industry. GLCI offered to arrange a visit to a mining site of a similar size so they could get have better understanding of what this entails, as well offering to facilitate a Mining 101 course in the community.

Members of the nation's council are interested in learning and working with GLCI, but before that, they feel the need to develop a relationship of trust. They also feel some pressure with the established schedule.

They also address the concern that the community will not receive due benefits if the mine is developed. GLCI tries to reassure them by stating that it is important for the mining industry to offer the community most of the job opportunities and possible benefits and that, to do so, it will put a lot of effort into training.

CREE SCHOOL BOARD, CREE HUMAN RESOURCES DEPARTMENT AND CREE BOARD OF HEALTH AND SOCIAL SERVICES OF JAMES BAY

On February 19, 2018, GLCI met with the adult vocational training coordinator for the JBSCB and a representative from the Cree Human Resources Department (CHRD) to present the project and its updates. The meeting ends with a commitment from GLCI. The mining company will work with these stakeholders to organize training and professional development workshops **when there will be more project certainty**.

A second meeting with the Cree Human Resources Department took place on June 13, 2018. The mining project is perceived by CHRD as being positive for the community. Topics discussed at the time of this discussion were training, employment, and the quality of life for workers.

A meeting was held on June 14, 2018, with CSB staff during consultations for the EIA. The CBHSSJB represented by stakeholders from the Community Miyupimaatisiun Centre (CMC) was also present. Maps of the study area as well as the project's general arrangement were presented. Some JBSCB members felt that the proposed mining project by GLCI was an opportunity for them to demonstrate to their students that there is the prospect of a future after graduation; that there are jobs waiting for them. However, most of the stakeholders met also feel that there may be significant adverse effects on the environment as well as on traditional Cree activities and that it is important to ensure that solutions are provided to all the problems before the project moves forward. Questions were also raised about the influence of the market on mining operations, the on-site rehabilitation process, the use of traplines by non-Indigenous workers and the effect of the project at the km 381 truck stop. A major point raised during discussions was the importance of continuing the consultation process. People in the community need to be more informed to be able to understand the scope of the project and understand the impacts that it could have.

An introductory meeting held on July 3, 2018, with the CBHSSJB Assistant Director of Public Health aimed at clarifying the issues associated with health and mining development in Cree territory. Discussions on the mitigation measures that GLCI wanted to put forward were initiated to verify their validity, confirm that they will be relevant and add more as needed.

The concerns put forward by the CBHSSJB revolve mainly around topics related to health, social problems, services offered by their institution and environment. Concerns were felt about the pressure that the mine project could place on community services if GLCI would require their use and the social and health problems that would be created or intensified by this project (alcoholism, drug addiction, removal of children from their family, elderly people left to fend for themselves, etc.). The CMC is also concerned with the potential increase in cancer rates in the community due to the presence of contaminants in the food chain.

MEMBERS OF THE CREE NATION OF EASTMAIN

The Eastmain Cree community was consulted both through public presentations and group discussions organized by age and gender.

To date, two public presentations have taken place. On February 22, 2018, GLCI publicly presented its project to the Eastmain Cree community and began a first honest and respectful dialogue with its population. Other than the presentation of the planned project, information was passed on about the mining company and its ongoing projects, about the latest updates regarding the engineering progress and impact studies on the environment and about the benefits and potential impacts if the project is approved. A list of job and training opportunities was also presented. During the discussion period, GLCI discussed its schedule, the number of estimated jobs for the construction and operation phases, the priority given to the Eastmain community for job opportunities and the use of lithium on the market. The 18 participants at this meeting expressed concern about the presence of watercourses near the project, the impact of pollution (noise, light, dust), the air quality, the effect of the project on road traffic as well as the km 381 truck stop. Users of the RE2 trapline also expressed their concerns about the proximity of the waste rock stockpile to the creek CE5 used. Following this meeting, GLCI took into account the concerns encountered by users and modified the design of its project to minimize the impacts on the creek CE5 by moving the waste rock stockpile to a less frequented area.

Another public presentation was held on July 16, 2018, to present the results of an EIA to the Eastmain Cree community. For the occasion, a series of twelve posters and a PowerPoint presentation were prepared by GLCI. The event was as an open house where community members were invited to learn more about the mining project and its impacts. It was also possible for participants to discuss their concerns, their expectations for GLCI representatives and make their recommendations. In total, 44 people attended this day of information and consultation. The main concerns addressed by the participants were related to the following topics: the quality of drinking water in the study area, more specifically to the km 381 truck stop; wastewater treatment; impact of the project on fauna and flora; potential relocation of the km 381 truck stop; mining development in the James Bay region (especially with respect to lithium); increased traffic on the road network and effects of the project on traffic; employment opportunities; training; waste management; organization of emergency services; lifetime of the mine; operations and processes at the mine site; facilities at the mine site; work camp; work schedules; risks of contamination; taxes on Cree workers at the mine; site rehabilitation plan; effects of the project on fishing and hunting; agreement regarding repercussions and benefits; peat management; and commuting.

As for the discussion groups, three meetings were held on **June 13 and 14, 2018**, each focusing on a category of the Eastmain population based on the gender or age of the participants. The main concerns mentioned by community members during these interviews were the environment; GLCI's schedule; job opportunities; training; cultural and professional issues for Cree workers; sexual harassment; traditional use of the territory; health; benefits for community members; impact follow-up and rehabilitation process.

CREE USERS OF THE TERRITORY

In summary, three tallymen were consulted in 2018 as part of the James Bay Lithium Mine project. These are the RE2, VC33 and VC35 tallymen. Their families and other users of the territory concerned were also present. **VC33 tallyman is historically from the same family as RE2 tallyman. Therefore, VC33 tallyman sometimes uses RE2 trapline for some traditional activities. VC35 tallymen, who is currently affected by Eleonore mine, is concerned about a new project near this trapline.**

The James Bay Lithium Mine project is located on the RE2 trapline. The tallyman of this sector and their family were formally met on two occasions **in 2018**. A meeting took place on April 16, 2018, to update the data collected in 2012, learn about the new use of territory areas for traditional purposes as well as gather user concerns, recommendations and expectations. They are worried about the environmental impacts on fauna and flora. They have the impression that the projected effects of the mine are being minimized. They are concerned about various issues such as the rehabilitation process, the risks of water contamination, the impact of the project on the sturgeon and the extraction process.

A second meeting was organized on June 11, 2018, to validate the information collected during the session that took place in April. New data, recommendations and uses were noted. Other concerns were also raised such as the location of the waste rock stockpile near watercourses, the risk of contamination by the dust generated by blasting activities, the footprint of the mine on the RE2 trapline, the wastewater treatment process and the presence of other types of minerals that could be harmful to the environment.

It should be noted that several other informal meetings were held between GLCI and the cree users of the RE2 trapline to keep them informed of the project's progress and activities held on their territory.

With respect to the VC33 and VC35 tallymen and their families, they were met on two separate meetings on June 12, 2018. The objectives of these interviews were the same as the meetings held with RE2, in other words, to update the data collected in 2012, learn about new areas of use for traditional purposes on the trapline as well as gather the concerns, recommendations and expectations of the users of the territory. Their concerns echo those stated by users of trapline RE2. Other concerns have been added including the impact of the proposed mining operations on regenerating vegetation due to the 2013 fire, the effects on hunting and fishing areas, the challenges associated with the location of the mine on a peatland, the impact of lithium on the environment, the road conditions, territory safety, the priority of indigenous people for job opportunities and the air quality.

Even though the RE1 and RE3 traplines are outside the limits of the study area, both tallymen were invited to the July 24 and 26 meetings, to inform them about the project updates. GLCI keeps all tallymen informed of the activities and progress regarding the project.

WABANNUTAO EYYOU DEVELOPMENT CORPORATION

The Wabannutao Eeyou Development Corporation (WEDC) is an organization owned by the Eastmain community that promotes and improves the economic development of the Eastmain community. The WEDC Executive Director was consulted as part of the environmental impact assessment during an interview held on June 13, 2018. The topics covered by the organization include training and professional development, job and contract opportunities, the Billy-Diamond highway, the environment and traditional use of the territory and the local economy. It is important for WEDC that training be developed within the community, that a partnership be established between Eastmain, the other Cree communities and GLCI to meet the needs of the mining company and that fair trade respects their values and culture be established. From a cultural perspective, WEDC believes it is necessary to train workers on Indigenous cultures, include a cultural village within worker camps and schedule breaks for goose hunting and autumn hunting, two traditional Cree activities.

5.4.1.3 2018-2021 PERIOD

Since the first version of the impact assessment in October 2018, consultations with local communities continued to take place. Meetings were held in 2019 with cree stakeholders. Although the 2020 Covid-19 sanitary crisis have limited the consultations activities, some were held by using videoconferencing platforms in 2020 and 2021. The meetings held are summarized below in Table 5-2b.

Table 5-1b Calendar of information and consultation activities with the Cree - 2018–2021

Date	Activity	Stakeholders
November 2018	Meeting with the Council of the Cree Nation of Eastmain, to present a general update of the project, and the ESIA submission process initiated.	Council of the Cree Nation of Eastmain
December 17, 2018	Presentation of the project	COMEX
December 19, 2018	Introductory meeting	Council of the Cree Nation of Waskaganish
February 28, 2019	Meeting with Cree users of Waswanipi to present project and its influence on traffic increase	Members of the Cree nation of Waswanipi
March 15, 2019	Signature of the PDA	Council of the Cree Nation of Eastmain
June 3, 2019	IBA discussions	Council of the Cree Nation of Eastmain
July 24, 2019	Project update	RE1 – Tallyman
July 25, 2019	Project update	RE3 – Tallyman
July 26, 2019	Inform both tallymen of site works conducted between July 31-Aug 2	RE1 et RE3 – Tallymen
August 27, 2019	Discussion about monitoring committee participation	VC35 – Tallyman
September 18, 2019	First telephone conversation	Cree Women of Eeyou Itschee Association
October 17, 2019	Introduction meeting and discussion about sexual exploitation risks at 381 truck stop.	Cree Women of Eeyou Itschee Association
October 26, 2019	Discussion about project impact and mitigation measures	Cree Women of Eeyou Itschee Association
December 16, 2019	Sharing informations received for tallymen VC33 and VC35 about caribou presence and traditional uses of Eastmain River.	Impact Assessment Agency of Canada, and Cree Nation Government
July 29, 2020	Presentation of the project, updates, discussion about the role of women in mining projects	Cree Nation of Eastmain – women
February 4, 2021	Presentation of project updates and changes	RE2 et VC33 – Tallymen and family
February 8, 2021	Presentation of project updates and changes	VC35 – Tallyman and family
February 9, 2021	Presentation of project updates and changes	Waswanipi community
April 14, 2021	Presentation of project updates and changes – Community consultation	About twenty members and stakeholders of the Cree communities

COUNCIL OF THE CREE NATION OF EASTMAIN

Following the submission of the first version of the impact assessment in October 2018, a meeting was scheduled with the Council of the Cree Nation of Eastmain to present a general update of the project and the submission process initiated for the ESIA.

On March 15, 2019 a meeting took place to sign a Pre-Development Agreement (PDA). Discussions also took place on June 3, 2019 regarding the Impact and Benefit Agreement (IBA).

COUNCIL OF THE CREE NATION OF WASKAGANISH

GLCI met with the Council of the Cree Nation of Waskaganish on December 19, 2018. The project was presented and concerns on the project from the three representatives of the community sent by the Chief were discussed. The representatives mentioned speaking on behalf of the community and the R08 tallyman.

CREE USERS OF THE TERRITORY

Consultations with Cree users of the territory were maintained since 2018.

A meeting was scheduled on February 28, 2019 with tallymen of Waswanipi, holders of the traplines W01, W03, W07, W13, W52, W53 et W54 to present the project and to receive their concerns.

Tallymen from traplines RE1 and RE2 (Eastmain) were invited on July 24, 25 and 26, to hear about the project updates, and activities planned on site during summer 2019.

A conference call between GLCI, the Impact Assessment Agency of Canada and the Cree Nation Government took place on December 16, 2019 to share informations collected by GLCI from VC33 and VC35 tallymen (Eastmain), concerning caribou occurrences and the traditional uses of the Eastmain River.

RE2, VC33 and VC35 tallymen were also kept informed of the most recent updates of the project. They were met by videoconference on February 4 and 8 2021, to present the project update and collect their comments and concerns.

CREE WOMEN OF EYYOU ITSCHÉE ASSOCIATION (CWEIA)

Special efforts were made since 2018 to involve the Cree Women of Eeyou Itsche Association, and to bring forward specific women issues related to the James Bay Lithium Mine project. These efforts resulted in the organization of two meetings, on October 17 and 26, 2019. These meetings, held only between women, aimed at presenting the project and discussing various issues surrounding women, such as sexual harassment, prostitution, rape and others. The Association seemed to be glad to have the opportunity of discussing these issues, especially without the presence of men. It was decided, after the meeting, that discussions should remain open between GLCI and the Association, and that group meetings with women from the communities should be scheduled, in order to discuss non-traditional jobs for women.

MEMBERS OF THE CREE NATION OF EASTMAIN, WASKAGANISH AND WASWANIPÍ

Following the meetings with the CWEIA on October 17 and 26, 2019, it had been mentioned that women discussion groups could be formed to discuss the issue of women employment for untraditional jobs (truck drivers, electricians, carpenters etc.) and other issues surrounding women. A first discussion group took place on July 29, 2020 by videoconference. It was first planned in March 2020 but was cancelled due to Covid-19 restrictions. It was then decided that such meetings should be held again in the future.

Members of the community of Waswanipi were also kept informed of the most recent updates on the project. They were met by videoconference on February 9, 2021, to present modifications on the project, and collect their comments and concerns.

On April 14, 2021, the project updates were also presented during community consultations via videoconference. About twenty Cree community members, stakeholders and community organization representatives were present. It was suggested by participants to repeat this form of activity at a later date.

5.4.2 JAMES BAY STAKEHOLDERS

5.4.2.1 2012 PERIOD

In James Bay communities, interviews were conducted in Matagami in May 2012 with stakeholders from a number of sectors of the municipal government, economic development, territorial management and planning and natural resources (Table 5-3). These meetings identified the concerns and expectations of James Bay stakeholders regarding the project and on mining development in the territory. The stakeholders expressed their support for mining development in their region, but all underscored the importance of establishing conditions to ensure and maximize socioeconomic spin-offs for the region.

Table 5-3 Calendar of information and consultation activities with James Bay stakeholders – 2012

Date	Activity	Stakeholder(s)*
May 14, 2012	Interviews with socioeconomic stakeholders	James Bay regional conference of elected officers (CRÉ), James Bay Local Development Centre (CLDBJ), Regional Commission on Natural Resources and the James Bay Territory (CRRNTBJ)
May 14, 2012		Committee to maximize economic spin-off (COMAX Nord)
May 15, 2012		Municipality of Baie-James
May 15, 2012		James Bay Development Corporation
* A calendar of information and consultation activities (with the names of stakeholders met for each activity) is provided in Appendix F.		

5.4.2.2 2017–2018 PERIOD

Consultations have been conducted since December 2017 with stakeholders from the James Bay community (Table 5-4). The objectives of these ongoing consultations were to meet with the regional organizations concerned to present the project to them and receive the concerns, expectations and recommendations of these stakeholders as well as information useful to the development of the EIA. Details of the meetings and discussions are summarized below.

Table 5-4 Calendar of information and consultation activities held with James Bay stakeholders - 2017–2018

Date	Activity	Stakeholder(s)*
December 19, 2017	Meetings to unveil the project to the various stakeholders	EIJBRG
December 19, 2017		City of Matagami
December 19, 2017		SDBJ
February 5, 2018	Interviews with socioeconomic stakeholders from James Bay	Direction régionale de Services Québec du Nord-du-Québec
February 12, 2018		CFPBJ
February 22, 2018		SDBJ
February 23, 2018		City of Matagami
April 3, 2018		ARBJ
May 23, 2018	Meeting	SDBJ
May 30, 2018	Interview with socioeconomic stakeholders from James Bay	TJCM
July 23, 2018	Meeting	SDBJ
July 23, 2018	Information session	EIJBRG
July 24, 2018	Meeting	City of Matagami
* A calendar of information and consultation activities with the names of the stakeholders met during each activity is provided in Appendix F.		

EEYOU ISTCHEE JAMES BAY REGIONAL GOVERNMENT

GLCI representatives met with the Eeyou Istchee James Bay Regional Government (EIJBRG) on December 19, 2017, to present both the mining company and the James Bay Lithium Mine project. During the discussion period, members of the EIJBRG asked for information about the criteria for determining the profitability of a mine as well as about the state of exploration work and of the proposed mining project. The EIJBRG was also interested in learning GLCI's intentions regarding processing, in finding out if the business planned to process the economic material within the territory and whether the process will be as polluting as that seen in China. The EIJBRG wanted assurance at this meeting that the new regulation to protect peatland, in force since June 2017, would be respected. The regional government also asked questions about the community's receptiveness to the lithium mine project, about use of the Matagami transshipment yard and about the estimated number of jobs during the construction and operation phases.

From January to September **2018**, numerous exchanges (23) and concrete actions were carried out in order to present the project to the members of the EIJBRG Board and, at the same time, to collect and respond to their comments, concerns, and recommendations. GLCI is currently awaiting confirmation; therefore, at the time this report was published, this meeting had not been held. It should be noted that all requested documentation has been sent to the EIJBRG.

CITY OF MATAGAMI

The city of Matagami has had ongoing consultation many times about the James Bay Lithium Mine project. A meeting was held on December 19, 2017, with the mayor, councillors and director of economic development. The meeting was held to present the mining company and the project. Topics addressed following the presentation were processing, infrastructure present on the mining site, the amount of concentrate to be transshipped, the lifespan of the mine, the project schedule, the economic spin-offs and the environmental impacts. The city of Matagami presented the social and economic benefits the municipality offers for a mining project of GLCI's scale. These included the transshipment yard, the various services the city could offer the company (lodging, workers, administration, training for non-Indigenous and Indigenous people, etc.), the advantages of the Billy-Diamond highway and airport service.

A telephone interview also took place with the municipality on **March 19, 2018**; it was represented this time by the mayor of Matagami and its director of economic development. The city of Matagami reiterated that it possessed several socioeconomic features attractive for mining development and said that it wished to participate in the James Bay mining project as a partner. The municipality addressed problems associated with development of the Nord-du-Québec and the mining sector, such as the province-wide scarcity of labour, problems with transportation and logistics and land-use issues. Regarding this last matter, the main concern is that, for logistical reasons, GLCI will establish its administrative headquarters in an urban centre outside the Nord-du-Québec region, such as Val-d'Or or Rouyn Noranda, and that the organization of transportation for its employees would entice residents of Matagami to move south to one of these two cities in order to go work further north for the mine. Commuting is very present in the concerns of the municipality, which indicated that this phenomenon would minimize economic spin-offs for the region, limit job opportunities for the people of James Bay and would not encourage the retention of residents in the territory. The distance of the mining project from the city of Matagami could also have an impact on the community, since workers would have to remain on the mine site during their shift. Furthermore, the city of Matagami would like GLCI to take a firm position prioritizing local labour and service businesses.

An information meeting was also held on July 24, 2018. The city of Matagami took the opportunity to discuss the municipality's transshipment yard and its benefits; the advantages of the Billy-Diamond highway were also put forward. Documents were submitted to GLCI representatives concerning the laboratory project, the transshipment yard and the recent mining symposium. A tour of the transshipment yard took place after the meeting.

JAMES BAY DEVELOPMENT CORPORATION

The SDBJ was also met on December 19, 2017. At this meeting, GLCI representatives presented the mining company and the James Bay Lithium Mine project, which is located near the Km 381 truck stop, an infrastructure owned by the SDBJ. During the discussion period, the matter of the remote landfill used by the SDBJ near the projected mine site was raised. Several concerns were also expressed about the km 381 truck stop, which was recently renovated at a cost of \$3 million, especially the impact of noise and dust on the operation of this business. The SDBJ also reminded the mining company of the suggestion made in 2010 regarding a partnership to relocate the km 381 truck stop if the project were approved. Concerning the Billy-Diamond highway, maintenance of which is part of the SDBJ's mandate, the corporation underscored that it receives financial contributions from the Ministère des Transports, de la Mobilité durable et de l'Électrification des transports (MTMDET) and from Hydro-Québec and that, given GLCI's activities and needs which could increase expenses, the SDBJ might ask the mining company for compensation.

A few months later, on February 22, 2018, a telephone interview was conducted with the SDBJ. The corporation presented its various mandates as well as work and projects underway or planned. It underscored that the development of multiple projects at the same time could greatly drain contractors in the region, resulting in increased costs to maintain the Billy-Diamond highway and other outlying infrastructure. It added that establishment of a mine near the km 381 truck stop could lead to problems for the SDBJ concerning the remote landfill, employee recruitment, potable water (risk of contamination) and reconstruction of the Billy-Diamond highway. The SDBJ also mentioned that the traffic created by this mine, if the project is approved, could encourage the development of a cellular network if demand were significant.

GLCI met with the corporation again on May 23, 2018. At this meeting, the SDBJ presented the main features of the km 381 truck stop in terms of lodging capacity as well as the various services available. The attractions of the Billy-Diamond highway were also mentioned. Topics covered at this meeting were GLCI's proposed agreement to share nursing services, the procedure for temporary GLCI workers staying at the km 381 truck stop, measures that would be put forward for the remote landfill and the possibility of an agreement for organization of the worker camp.

An information meeting was held on July 23, 2018. GLCI representatives presented a recent map of the project to the SDBJ as well as the results of an EIA, supported by posters prepared for the open house held in Eastmain on July 16, 2018. During this meeting, the SDBJ was informed of the potential impact that dewatering of the pit could have on the level and quality of potable water in the wells of the km 381 truck stop. For their part, GLCI members asked the corporation about the depth of these wells, about reconstruction work on the Billy-Diamond highway and about hunting and fishing activities in the area. Regarding this last question, the SDBJ invited the mining company to consult the EIJBRG, which has information on the topic. Sharing of emergency services and procurement were also discussed at this meeting. The SDBJ also mentioned the existence of a GCC budget to develop entrepreneurship among the Cree.

DIRECTION RÉGIONALE DE SERVICES QUÉBEC DU NORD-DU-QUÉBEC

A discussion took place by telephone with the Direction régionale de Services Québec du Nord-du-Québec on February 5, 2018. Two main concerns were voiced by the organization. One was regarding land use. For the Direction régionale de Services Québec, it is important that people who work in the region also live there. There is concern about the impact that commuting could have on municipalities and communities in the Nord-du-Québec, namely the absence of economic spin-offs and the loss of job opportunities. The second concern raised was the prioritization of local labour, which, according to the representative consulted, is an essential measure.

JAMES BAY VOCATIONAL TRAINING CENTRE

The James Bay Vocational Training Centre (CFPBJ) was consulted via telephone interview on February 12. During this meeting, information was obtained about specific mining-sector or applicable training offered by the institution; about partnerships between the CFPBJ and mining companies to provide classes in the mine industry; about the shortage of labour and the difficulty of recruiting both instructors and students; about the impact of the sector on other types of industries; and about vocational training for Indigenous people. For the CFPBJ, it is important that mining companies in the territory and entrepreneurs can contact them if they need training, so the institution can meet these requirements without the workers having to go to Montréal, Québec City or Saguenay for training. The main concern voiced by the CFPBJ was land use. According to the institution, the people of James Bay must be able to remain in the territory and see their numbers grow. The CFPBJ mentioned that Cree labour should not be overlooked and that it is important to consider workers from Indigenous communities. It also suggested that GLCI design its schedules so that workers would move to the region with their family.

JAMES BAY REGIONAL AUTHORITY (ARBJ)

The James Bay Regional Authority was consulted via telephone interview on April 3, 2018. In particular, information was obtained about the state of the construction and mining sectors in James Bay, about mining development initiatives undertaken by the ARBJ and about the concerns of the Authority. In terms of problems for the mining sector, the ARBJ identified a current labour shortage. For the region, it underscored that there are not always spin-offs from mining development and that, despite their contribution to the regional economy, these projects do not encourage residence in the territory due to the work schedules set, which entice commuting. Besides the beneficial economic spin-offs such a project could have on the region and its municipalities, the ARBJ highlighted that the increased road traffic and the impact of the mine on the environment and the integrity of the territory were factors to take into consideration. The ARBJ invited GLCI to participate in a committee to maximize economic benefits (COMAX), an initiative it had implemented and for which it already coordinates many projects in the territory. The Authority also encouraged GLCI to contact the James Bay Mining Roundtable for its EIA, which was done in May 2018.

JAMES BAY MINING ROUNDTABLE

On May 30, 2018, the Table Jamésienne de concertation minière (TJCM) was consulted. Several issues associated with mining development in James Bay were addressed by the organization. The TJCM discussed transportation issues as well as the importance of social acceptability of the project – not only within the territory of the EIJB, but across Québec as well. Concerning labour within the administrative region of Nord-du-Québec, the main issue cited by the TJCM was turnover: the organization said that prioritizing the hiring of local workers is the solution to reducing this phenomenon and that this initiative would make it possible to retain more workers. During the meeting, the TJCM also shared that current elected officials and James Bay residents would like to encourage processing of metals in the James Bay territory and that a project is underway to economically measure and quantify the competitive benefits that James Bay could offer so as to entice projects such as GLCI's to process their concentrate into finished products within the territory. The organization also clearly expressed its expectations of GLCI. The TJCM would like the mining company to collaborate in the northern development process, for it to assume its leadership role, take the time to meet with elected officials of the city of Matagami to evaluate the competitive benefits of the municipality and for its project to contribute to the development of the James Bay territory.

5.4.2.3 2018-2021 PERIOD

No meetings were held between GLCI and the James Bay stakeholders since the submission of the first version of the impact assessment in October 2018. However, meetings are scheduled in the coming year, to present the modifications regarding the optimization of the project.

5.5 CONCERNS, EXPECTATIONS AND RECOMMENDATIONS REGARDING THE PROJECT

Stakeholders' concerns, expectations and recommendations with regard to the James Bay Lithium Mine project were recorded throughout the consultation process. This section summarizes the information gathered during the consultations held in 2011, 2012, 2017 **and from 2018 to 2021**.

5.5.1 CREE STAKEHOLDERS

5.5.1.1 2011-2012 PERIOD

As mentioned, information and consultation activities with representatives of various administrative or public service organizations were held in Eastmain in 2012. In addition, three discussion groups were organized with participants chosen on the basis of age and gender. The main concerns and expectations expressed by the Cree community revolved around the sharing of revenue from mining activities, the project's impacts on water quality and territory resources, training, the effectiveness of the information and consultation process, the effect of mining activities on traditional use of the territory, the rehabilitation and rehabilitation of the mining site and the alcohol problem at the worker camp (Table G-1 in Appendix G).

5.5.1.2 2017-2018 PERIOD

During the second series of consultation meetings held in 2017–2018, stakeholders again expressed their concerns regarding the planned project, along with their expectations and recommendations. This information is summarized in the following paragraphs as well as in Table G-2 (in Appendix G).

In terms of the environment, several stakeholders asked questions regarding the impact of disruptive elements (dust, noise, vibrations, odours, etc.) on wildlife, plant life and water and air quality. Of these disturbances, dust from mining activities appears to be the primary concern. The people met with enquired as to the area within the territory that would be affected or contaminated by this nuisance. The mining project's location near watercourses and peatland led certain Eastmain community members to doubt GLCI's ability to control the risk of contamination. Various other mining processes or activities raised concerns, notably wastewater treatment and drilling and blasting activities. The mining site's rehabilitation and rehabilitation was also a topic that elicited numerous issues. Certain stakeholders also voiced their hope that the mining company would consider the cumulative effects of hydroelectric and mining projects on the Eastmain territory.

A significant number of the concerns that were raised addressed training and employment; granting priority to Cree workers is a major issue in agreements of this type. Some of the stakeholders met with expressed a concern that the mining project might, by hiring numerous workers from the community, bring about the closure of other businesses due to a lack of manpower. Regarding vocational training, members of the Eastmain community asked the mining company to notify them of available jobs and to cooperate with the Cree School Board and HRDC to develop and offer training sessions designed to prepare the community for future employment opportunities in the mining sector. This fear that Cree labour would not be adequately prepared at the time of the project's implementation was repeatedly voiced. In addition, stakeholders noted that some obstacles might prove detrimental to Cree workers, among them requirements regarding the French language, tensions with other Indigenous and non-Indigenous workers and GLCI's expectations concerning professionalism and ethical standards.

As for economic development, the stakeholders brought up the possibility of a partnership with GLCI, questioning the type of business model most likely to favour fair trade and support community development while respecting the region's culture and values. Concerns over economic spin-offs were also expressed. During the consultations with community members, participants shared their worries that the region would not enjoy any of the promised benefits and that none of GLCI's profits would be reinvested in the community. **Stakeholders located outside the Eastmain community also raised concerns regarding the economic spin-offs and compensations they could receive.**

The stakeholders also had issues regarding the mining project's impacts on the community's health and social environment. People from the health sector who were consulted expressed a fear that certain problems might be exacerbated, among them the prevalence of emergency cases, the alcohol and drug addiction rate and the number of cancer cases due to environmental contaminants. The majority of them were particularly interested in learning how GLCI planned to manage problems linked to alcohol and drugs. Adequate budgeting in the event of an increase in disposable income was also a key concern, as participants spoke of how certain community members found it difficult to spend their earnings wisely. This specific issue could also trigger other social problems. Stakeholders also expressed a fear that Eastmain health services would be affected by increased demand due to GLCI's activities in the region. In addition, the people consulted were concerned by the effects of Cree employees' work schedules on their families and on community values. Worries were voiced regarding a possible rise in the number of children placed in foster or other care and seniors left to their own devices due to their loved ones being absent.

As for traditional activities, concerns over the impact of mining activities on hunting, fishing and gathering were shared. **Some concerns were raised regarding the possibility for mine workers to hunt or fish without authorization in the vicinity of the mine. There were also some concerns regarding the security for these workers, considering the potential presence traps in the area.** Concerns as to the effects of mining operations on traditional Cree activities and the resources thus obtained were also voiced during the community consultations. Stakeholders were also curious as to whether GLCI planned to give Cree workers time off so they could hunt geese and moose. The people consulted also wondered how GLCI would deal with any cultural problems at the mine itself.

Most users fear that the project will aggravate impacts caused by other sources. For instance, some people raised concerns about the project adversely affecting the regeneration of vegetation in the area which is only beginning to recover after the forest fires of 2013 or the project contributing to the reduction of resources across the territory initiated by hydropower projects. Another user mentioned that moose are just beginning to come back following the Eastmain 1-A project work, completed in 2013. Users of the VC35 trapline, who have seen a significant portion of their land submerged after the development of the Opinaca Reservoir in the 1980s and were affected by the Eastmain 1 and Eastmain 1-A projects, and by the diversion of the Opinaca and Eastmain Rivers, now fear that the quantity and quality of resources across the land they have left be further affected, more so because a mine is already in operation and another is projected close to their land. One RE2 trapline user mentioned that the taste of beavers has changed since the construction of Billy-Diamond highway due to the associated pollution and fears that the situation will worsen.

RE2, VC33 and VC35 land users also fear the risks of contamination of resources (e.g. sturgeon, beaver or moose) and hydrological network, as well as an increase in cancer rate caused by the presence of contaminants in the food chain. They also worry about the contamination of vegetation, notably because of dust. One user (VC35) is concerned by the impact of increased traffic on health in relation to dust (two users of a camp located close to the road suffer from asthma).

They also apprehended the possible effects of increased traffic on the road's condition and highway safety (mainly Billy-Diamond highway). Questions as to monitoring truck transport of chemicals and the impact of a future spill due to a highway accident were also raised. **Some concerns were also raised regarding rubble that could fall from un-covered trucks and cause damage to vehicles on the road. Vehicles parked along the Billy-Diamond highway could also be damaged by the mining trucks. The impact of the increase of trucking on the road during the hunting seasons was also expressed, notably for the security of children who could be more likely to play around the road at that time of the year, and on the state of the road and its maintenance in winter.**

Lastly, commuting is another issue that raises concerns among the elected officials of Eastmain's Cree community. Members of the Eastmain Cree First Nation are also talking about leaving the community to go live in an urban centre such as Ottawa or Montréal. Increased income (due to the mining project) would provide more people with just this type of an opportunity.

5.5.1.3 2018-2021 PERIOD

Since the first version of the impact assessment in October 2018, consultations with Cree stakeholders continued to take place. The various meetings, described in section 5.4.1.3, allowed to reaffirm some concerns generated by the project.

The issue of road traffic was raised at many occasions. Cree stakeholders wanted to know the efforts made to limit trucking during goose and moose hunting season, and the measures planned to ensure adequate maintenance of the road, considering the traffic increase related to the project. The issue of the security for the vehicles parked along the road was also expressed, especially for winter, when the road is narrower.

The potential use of the land by mine workers, vandalism, or a future growth of the project that would increase the encroachment of the mine on the ancestral land were issues raised by the users of the territory. The proximity of the camps with the road, and the traffic increase associated to the project was also discussed during these meetings, as well as interference with traditional activities.

Concerning socio-economical issues, concerns were raised by the Cree stakeholders regarding employment for individuals with lower education levels. The possibility and the means to receive training was brought-up, to ensure that members of the community could be adequately involved in the project. Apprehensions were expressed that most mine workers would come from outside the communities. It was suggested by some members of the Nation that the capacity and resources of Cree businesses should be assessed and used, rather than favoring a large company with outside workers. Access to employment for single mothers were also questioned, as well issues on sexual harrassments, or any violence against women on site. Furthermore, a strong issue related to the prostitution of girls and women was also discussed, given the presence of the workers' camp. The issue of racism was also raised, and it was suggested by members of the Nation to provide training on Cree culture for workers arriving from outside.

On the environmental level, the main issue was reiterated regarding the project impacts on water quality **on the land, related to the runoff, the mine discharge and the wastewater, and on the ecosystem around the mine**. Also, questions were raised about the visual aspect of the mine once constructed, the rehabilitation of the site **and the waste management**.

5.5.2 JAMES BAY STAKEHOLDERS

5.5.2.1 2012

During the first series of information and consultation activities held in 2012, the main concerns of James Bay stakeholders revolved around several elements: the environment, employment and services, use of the territory, communications, economic spin-offs, training and air transport. Table G-4 (Appendix G) presents a summary of the concerns recorded.

5.5.2.2 2017-2018 PERIOD

During the meetings and exchanges held as part of the 2017 and 2018 consultation of James Bay stakeholders, a number of the concerns raised in 2012 were reiterated, along with new issues and problems regarding lithium processing and road infrastructure.

The stakeholders specifically shared worries regarding the environment and the integrity of the territory. Compliance with the new regulation to protect peatland, the impact of the disturbances due to mining activities and the risk of drinking water contamination during the construction and operations phases were all brought up.

As for the job sector, the stakeholders consulted brought up employee retention problems in the administrative region of Nord-du-Québec. Priority being given to the region's workers, enterprises and services is thus a key issue for James Bay stakeholders. Giving due consideration to Cree workers and their importance was also discussed. Furthermore, worries were voiced that in the event of a mining project, small entrepreneurs or service providers from the region might be unable to retain their employees, who would seek out work with the mining companies.

Numerous other concerns involved issues regarding land or territory use. Commuting and the associated impacts (fewer economic spin-offs, loss of job opportunities for James Bay residents, possible increase in the number of residents remaining in the Nord-du-Québec region, etc.) are one of the regional stakeholders' greatest fears. The site of the mine's administrative and operating hub, along with the logistics of worker transportation, will be critical issues with a potentially major impact.

Worries were also voiced regarding the lack of economic spin-offs for the region. The urban centres of Val-d'Or and Rouyn-Noranda are two hubs often preferred due to their year-round air service. Obtaining such year-round air service is thus a preoccupation for James Bay stakeholders, as well as a priority to ensure the region's ongoing development.

With regards to workforce training, regional stakeholders are calling for GLCI to reveal whether or not it plans to rely on regional vocational training centres/establishments. They would also like to know more about the organization's interest in eventually partnering with the CFPBJ.

On another note, the processing of metals was also discussed, with the people met asking whether the method used would have an impact on the nearby environment and whether any thought had been given to the EIBJ as the site of a future processing plant.

Lastly, concerns were raised regarding the Billy-Diamond highway, its weight-bearing capacity and other capacities as well as the potential impact of the GLCI mining project and the associated increase in traffic on the road's integrity.

Table G-5 (Appendix G) summarizes the concerns of the James Bay stakeholders for the period from 2017 to 2018.

5.5.2.3 2018-2021 PERIOD

No concerns, expectations or recommendations were expressed by James Bay stakeholders for the 2018-2021 period. Meetings scheduled to present the project optimization in the current year will be opportunities to discuss and collect any new concerns, expectations or recommendations for the project.

5.6 GLCI'S RESPONSE TO CONCERNS, EXPECTATIONS AND RECOMMENDATIONS ABOUT THE PROJECT

GLCI has already responded to many concerns, expectations and recommendations voiced by James Bay and Cree stakeholders.

Many steps have been taken to address some of the issues raised by the Eastmain Cree population following regional consultations. Table 5-5 presents the initiatives implemented thus far regarding Cree stakeholders.

Table 5-5 Steps taken to address the Eastmain Cree's concerns

Concerns	Steps taken by GLCI
Lack of stakeholder knowledge of the various aspects of mining operations. Difficulty taking a stance vis-à-vis the project.	- GLCI invited the Eastmain Cree community members and the local tallyman to an organized visit of the Stornoway diamond mine. The visit had to be cancelled on two occasions, due to cancellations by the Cree participants. - An introductory course about lithium and mining operations was offered in Eastmain on July 11, 12 and 13, 2018 (18 participants).
Waste rock stockpile located near a watercourse used by the trapline RE2 (creek CE5) tallyman.	Following consultations and after several options were considered, the waste rock stockpile was relocated north of Asini Kasachipet Lake and south of creek CE2 (Map 3-1). This new site not only addresses the issue raised regarding creek CE5 (watercourse used by inhabitants of the region), namely by moving the waste rock stockpile further away from this watercourse to a watershed not as favoured by users of trapline RE2, but it also moved this mining infrastructure further from the km 381 truck stop. Following the modifications to the project design in 2021, waste rock will now be stored in four smaller stockpiles instead of a large one. The quantity of waste rock will remain the same as planned in the 2018 project. The four stockpiles will be located East of Asini Kaschipet Lake and south of CE2 Creek. They are positioned to have no impact on CE5 Creek.
Presence of GLCI consultants or workers in trapline RE2 without the tallyman's permission.	GLCI agreed and has given the trapline RE2 tallyman advance notice of activities planned on the land.
Training support for Cree workers.	The mining company agreed to work in conjunction with the Cree School Board and HRDC to develop community training designed to prepare the Cree workforce for future job opportunities at the mine.
Impact on the quality of life of Cree workers and their families (problems due to being far from their community).	Work schedules for Cree employees will be tailored to their particular reality. One option would be 7 work days followed by 7 days off.
Impact on traditional activities.	- The noise level of certain activities, such as upkeep of the industrial facility, will be diminished during the goose-hunting season, so as to limit impacts on hunting activities. Lower truck speed during hunting season and raise the workers awareness. - Cree workers will also receive days off during the goose-hunting season. Royalties to Cree Nation Government, that could be redistributed to relocate camps if necessary.

Table 5-6 Steps taken to address the Eastmain Cree's concerns (continued)

Concerns	Steps taken by GLCI
Exacerbation of alcohol and gambling problems among workers.	- The worker camp will be alcohol-free ("dry") during the construction and operations phases. - Video poker machines, regardless of type, will be strictly forbidden at the mining site.
Issue regarding prostitution of girls and women related to the presence of working camp	GLCI plans to work with the Cree Women of Eeyou Itsc'hee Association to develop ways to protect Cree girls and women on the workers' camp. A Cree woman will be hired in the mine's Human Resources office to facilitate interaction with the women. During the operation phase of the mine, workers will be picked up at the airport, controlled at the camp and allowed to leave only with permission. There will be no personal vehicles on site during this period.

The main steps taken regarding the James Bay communities involve the SDBJ and the km 381 truck stop. GLCI agreed to erect a fence around the remote landfill of the SDBJ as well as along the northern side of the road to get there, so that the site will not be impacted by mining activities. On another note, agreements for worker housing and shared emergency medical services are presently being discussed. These potential collaborative efforts constitute actions that would help increase economic spin-offs and better meet the SDBJ's expectations.

GLCI also responded to the ARBJ's suggestion that it consult the TJCM as part of the EIA.

5.7 ONGOING CONSULTATION INITIATIVE AND COMMITMENT TO STAKEHOLDERS

GLCI has agreed to develop and maintain sustainable relationships with stakeholders, to maximize the social and economic benefits of the project while minimizing its environmental impacts. The mining company also is sharing information on the project, specifically by holding open houses, committing to having GLCI's community relations manager spend one week per month in the community, organizing sessions with stakeholders, posting updates on the website, and maintaining direct links with employees. With these commitments, GLCI aims to offer timely and relevant responses to all the comments and concerns voiced with regard to the James Bay Lithium Mine project.

The relationship and exchanges between GLCI and stakeholders will be maintained throughout the life of the project.

5.7.1 IMPACT BENEFIT AGREEMENT

Discussions have been initiated with Cree and Eastmain stakeholders to reach sign an impact benefit agreement. No agreement has been reached thus far, as exchanges are still underway. **However, a Pre-Development Agreement was signed with the Council of Cree Nation of Eastmain on March 15, 2019.**

Furthermore, GLCI has agreed to abide by certain principles, namely to:

- implement sustainable infrastructure projects;
- provide education and training opportunities;
- promote the importance of proper money management to the population;
- favour projects focused education, health and infrastructure;
- make business opportunities available to local entrepreneurs.

5.7.2 MONITORING COMMITTEE

As required under *An Act to amend the Mining Act* (section 101.0.3), **GLCI will establish several committees, including** monitoring committee to foster the participation of the communities involved in the project's execution. This committee will be created prior to the mine's construction and will remain active throughout its life, until the works provided for in the mining site rehabilitation and rehabilitation plan are fully completed.

The committee's membership will be determined as per the regulations established under the Act, and it will comprise at least one representative from the Eastmain **Band Council, the Waswanipi Band Council and Waskaganish Band Council or a deisgned member from their communities**, one from the business community, one from the city of Eastmain and one from the EIJBRG. GLCI would also like to **include the tallymen from RE1, RE2, RE3, VC33, VC35 and R08 or one of their family members** to the monitoring committee.

6 DESCRIPTION OF THE RECEIVING ENVIRONMENT

6.1 GEOGRAPHIC FRAMEWORKS AND PROJECT STUDY AREAS

6.1.1 GEOGRAPHIC FRAMEWORK

The James Bay Lithium Mine project is in the Nord-du-Québec administrative region, on the territory of the Eeyou Istchee James Bay Regional Government. It is located approximately 10 km to the south of the Eastmain River, 100 km east from James Bay, and the Eastmain Cree village (Map 1-1). The project is on Category III lands of the JBNQA.

The central geographical coordinates in UTM (zone 18, NAD83) of the project site are presented below:

- X: 358,891
- Y: 5,789,180

The lands subject to the mining claims of the James Bay Lithium Mine project (Project Property) are easily accessed by the Billy-Diamond highway that connects Matagami and Radisson. This road crosses the project property at kilometre 381 of the road, close to the km 381 truck stop managed by the SDBJ (**Map 2-1**).

6.1.2 LOCAL STUDY AREA

The local study area primarily consists of the mine operating site, **including the footprint of all infrastructure planned under the project, as well as the right-of-way** within which certain components may be influenced by the project. **These components are, more specifically, those related to the physical and biological environments such as soils, water, sediments and flora, to name a few. Looking at the entire mine site as well as the nearby subwatersheds, we see that the study area encompasses and is centred on all elements that should be considered.**

The local study area is located on both sides of **Billy-Diamond highway, at kilometre 381 of the road**, in the same location as the km 381 truck stop. This stop is well known to visitors who take **this road and is located at 52° north latitude.**

The local study area covers an area of 36.9 km², 6.7 km from east to west and 5.5 km from north to south. Map 6-1 shows this area.

6.1.3 OTHER STUDY AREAS

To precisely analyze the impacts of the project, other study areas have been delimited for certain environmental components. The need to consider other study areas is justified by the fact that, in some cases, the project will only influence components that are located near the proposed mine, while for other aspects, the effects will instead be felt on a broader scale than the local study area.

In these specific cases, **for example, for human environmental components or to assess cumulative effects**, the new study areas are presented and justified in **the corresponding sections**.

6.2 PHYSICAL ENVIRONMENT

6.2.1 CLIMATE

The climate of the study area is of subarctic continental type according to Köppen's classification of climates. It is characterized by a very cold and long winter and a short and cool summer with limited precipitation, but which lasts all year long.

The most representative and complete weather station to characterize the climatic conditions of the study area is La Grande Rivière Airport (code: 71827) positioned at coordinates 53° 38' 00'' N, 77° 42' 00'' W, at an elevation of 195 m and located approximately 162 km to the north of the proposed mining facilities. The climate data presented below are taken from the Environment Canada (EC) climate normals directory for the period 1981-2010 (EC, **2021**). Climate normals are averages of weather variables over a predetermined period of 30 years established by the World Meteorological Organization (WMO) providing a consistent and objective comparison of the climate between different regions.

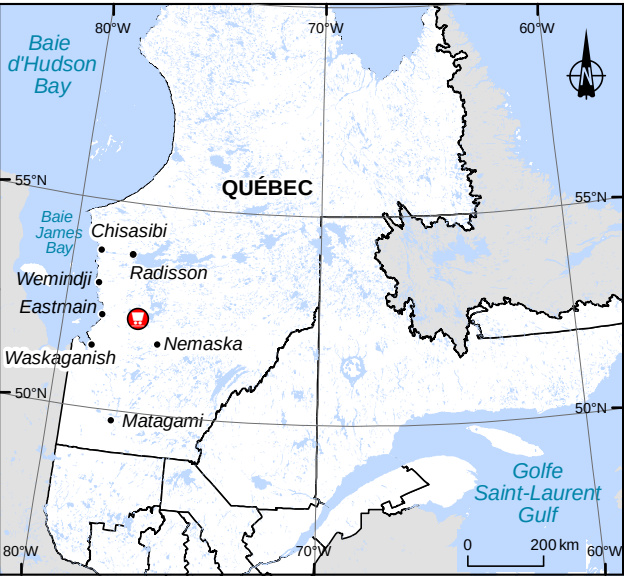
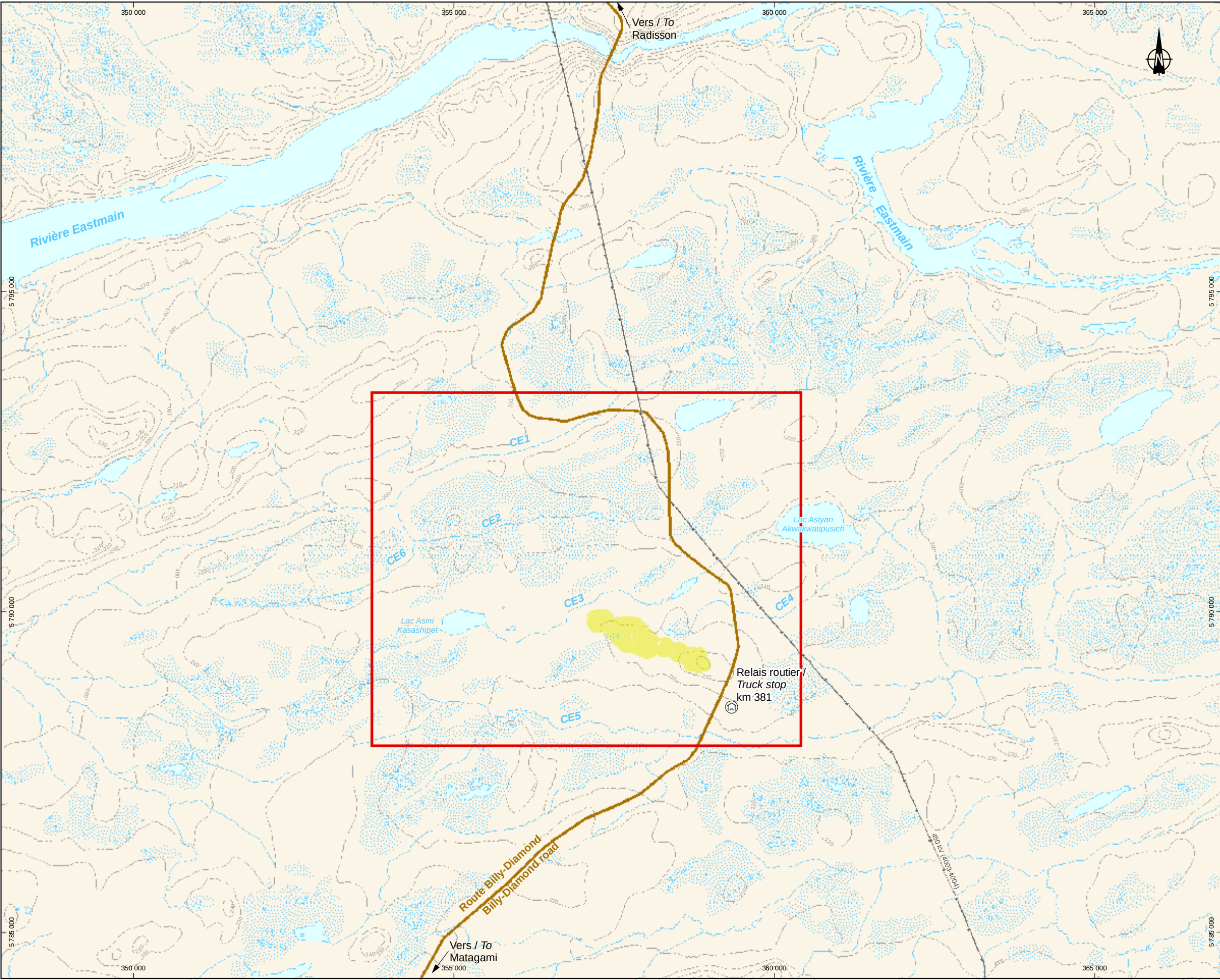
6.2.1.1 TEMPERATURE

The mean, maximum and minimum monthly average temperatures are presented in Table 6-1. The coldest month is January with an average temperature of -23.2°C, and July is the warmest month with an average temperature of 14.2°C. The monthly temperature ranges vary from 6 to 12.5°C, where March is the month with the greatest temperature range.

The extreme temperatures (record) having been recorded at La Grande Rivière Airport station are -44.6°C in February 1979 and 37.3°C in July 2015.

Table 6-1 Monthly average mean, maximum and minimum daily air temperatures at La Grande Rivière Airport station (1981 to 2010 period)

Month	Mean (°C)	Maximum (°C)	Minimum (°C)	Temperature range (°C)
January	-23.2	-18.5	-28.0	9.5
February	-21.6	-15.9	-27.3	11.4
March	-14.5	-8.2	-20.7	12.5
April	-5.0	0.6	-10.6	11.2
May	4.3	10.3	-1.6	11.9
June	10.8	17.3	4.2	13.1
July	14.2	20.4	8.0	12.4
August	13.1	18.6	7.6	11.0
September	8.1	12.3	3.8	8.5
October	1.7	4.8	-1.5	6.3
November	-6.1	-3.1	-9.1	6.0
December	-16.0	-12.0	-19.9	7.9
Annual (average)	-2.9	2.2	-7.9	10.1



Projet mine de lithium Baie-James /
James Bay Lithium Mine Project

Zone d'étude locale / Local study area

Composante du projet / Project Component

Fosse / Open pit

Hydrographie / Hydrography

Numéro de cours d'eau / Stream number

Cours d'eau / Stream

Milieu humide / Wetland

Infrastructures / Infrastructure

Relais routier / Truck stop

Route principale/ Principal road

Ligne de transport d'énergie / Transmission line

Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 6-1
Zone d'étude locale /
Local Study Area

Sources :
CanVec, 2017
Données du projet / Project data, Galaxy, 2021

UTM, fuseau 18, NAD83

Juillet / July 2021

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c6-1_wspT326_ZE_210701.mxd

Table 6-2 shows the average number of days for each month when the maximum temperature is equal to or below and the minimum temperature is above the freezing point. These measurements show that for the period from December to February, on average, only two days are reported with a minimum temperature above 0°C. In turn, the months of June, July, August and September do not show any days with a maximum temperature less than or equal to the freezing point. The proportion of days when a negative temperature has been recorded is 43%.

Table 6-2 Average number of days with temperatures above and below/equal to the freezing point at the La Grande Rivière Airport station (1981 to 2010 period)

Month	Number of days	
	Maximum temperature	Minimum temperature
	$\leq 0^{\circ}\text{C}$	$> 0^{\circ}\text{C}$
January	31	0
February	27	1
March	26	5
April	14	16
May	2	29
June	0	30
July	0	31
August	0	31
September	0	30
October	4	27
November	22	8
December	30	1
Annual (total)	156	209

6.2.1.2 PRECIPITATION

The monthly average precipitation is presented in Table 6-3. The annual precipitation at EC's La Grande Rivière Airport station is 697.2 mm, of which 453.8 mm is rain and 261.3 mm is snow. The month of September is the wettest with 110.6 mm of equivalent precipitation (rain and snow). The least rainy month is February with a total average of 21.9 mm. It is also noted that there can be snowfall on average throughout the entire year, except in July and August.

The maximum daily precipitation recorded at this station is 66.4 mm of rain in August 2000 and 25.8 cm of snow in November 1985. The recurrence of rainfall 1:1000 year (24 h) was assessed at 101.6 mm, whereas the melt 1:100 year (30 days) is 388.5 mm.

6.2.1.3 WIND

Table 6-4 shows the average monthly speeds and prevailing direction of wind between 1981 and 2010 at La Grande Rivière Airport station. The average annual wind speed is 14.5 km/h. The month of September is the windiest with an average speed of 15.9 km/h. The least windy month is January with a speed of 13.6 km/h. The direction of prevailing wind is primarily from a western sector throughout the entire year, except for October, November and December when the prevailing direction is from a southern sector.

The maximum hourly wind speed recorded at La Grande Rivière Airport station is 93 km/h with a southwesterly direction, while the maximum recorded gust is 122 km/h. These values were recorded during October 1984.

Table 6-3 Monthly mean precipitation averages at La Grande Rivière Airport station (1981-2010 period)

Month	Rainfall (mm)	Snowfall (cm)	Total precipitation (mm)
January	0.1	33.1	30.9
February	1.2	23.0	21.9
March	3.4	28.6	29.4
April	12.7	21.0	32.7
May	27.9	11.9	39.0
June	62.6	2.6	65.3
July	78.5	0.0	78.5
August	91.0	0.1	91.1
September	106.9	4.0	110.6
October	56.2	32.4	87.3
November	11.6	60.3	67.9
December	1.7	44.4	42.6
Annual (total)	453.8	261.3	697.2
* The total in mm represents the water equivalent of the melted snow and the rain.			

Table 6-4 Monthly source of wind and average speed at La Grande Rivière Airport station (period from 1981 to 2010)

Month	Average speed (km/h)	Prevailing source	Maximum hourly speed (km/h)	Maximum speed direction
January	13.6	West	57	Northwest
February	13.7	West	56	West
March	14.2	West	72	West
April	14.4	West	63	Southeast
May	14.9	West	61	Southwest
June	15.1	West	65	Southeast
July	13.7	West	65	South
August	14.3	West	65	Southwest
September	15.9	West	74	West
October	15.4	South	93	Southwest
November	15.3	South	74	West
December	13.8	South	67	West
Year (average)	14.5	West	-	-

The seasonal distribution and total wind direction frequencies between 1981 and 2010 are shown in Figure 6-1 as a histogram. Analysis of the histogram indicates that more than 48 % of wind, regardless of the time of the year, varies in direction in a sector from south to west. Winter and summer are the seasons with the greatest wind frequency from the west with values of 22 % and 21 % respectively. The northeastern sector has the lowest total wind frequency with a percentage of 7.6 %. The other wind directions have relatively similar frequencies and do not show much variability. Figure 6-2 presents the wind rose generated from weather data generated using the WRF model (Weather Research and Forecast) and ERA-Interim climate reanalysis generated by ECMWF (European Centre for Medium-Range Weather Forecasts) for the 2011 to 2015 years.

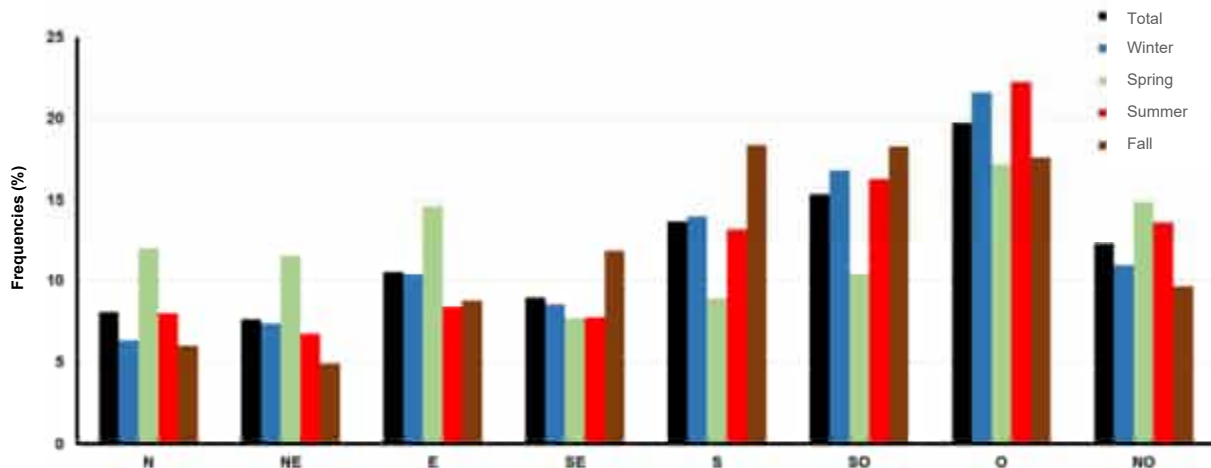


Figure 6-1 Histogram of wind direction frequencies at La Grande Rivière Airport station (period from 1981 to 2010)

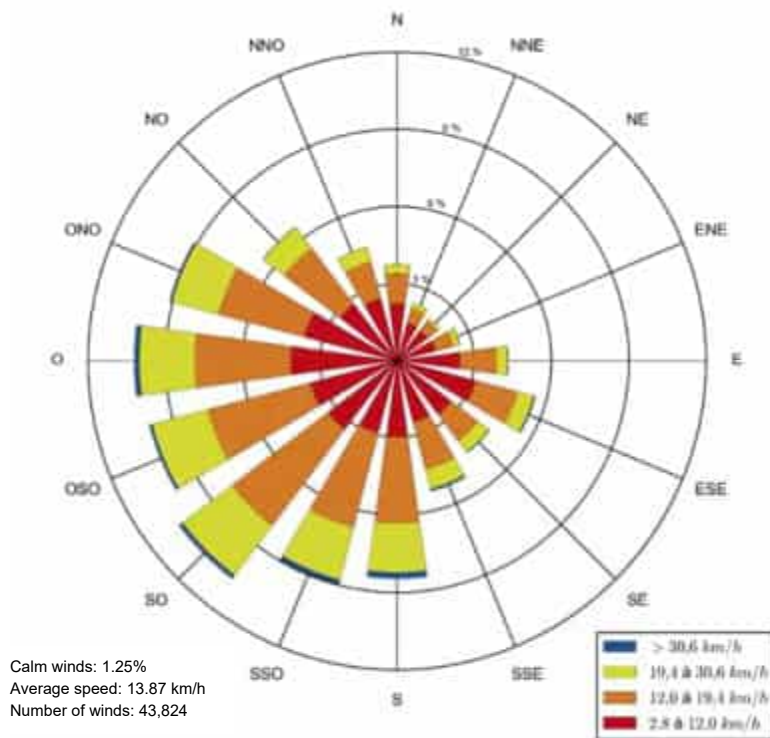


Figure 6-2 Wind rose

6.2.2 GEOLOGY

Located in the heart of the Canadian Shield, the study area is in the northeastern part of the Superior Geological Province and is part of the volcano-plutonic La Grande subprovince (MRNF, 2004) (Map 6-2). This area includes a volcano-sedimentary assemblage assigned to the Eastmain Group.

The study area is part of the Eastmain greenstone belt and, more specifically, lies within the Lower Eastmain Group. It is dominated by metavolcanic rocks (amphibolites of mafic to felsic grade associated with Komo formation), metasedimentary rocks and minor gabbroic intrusions (Broad Oak, 2009 in SRK Consulting, 2010).

The chronology of the assemblage that led to La Grande Subprovince dates back to the Archean era (4.0 to 2.5 Ga). During this period, two phases of volcanic and tectonic deformation occurred. Between the two, the basins of the Auclair formation were formed ($> 2,546 \pm 50$ Ma). A third more recent phase of retrograde metamorphism during the Proterozoic era ($2.5 \text{ Ga to } 0.541 \pm 0.1 \text{ Ga}$) left abundant flecks and dykes. In the study area, the formation is said to date from the second deformation phase, during late-stage or post-tectonic intrusions, at the end of the Archean era ($> 2.697 \text{ Ma}$) (Broad Oak, 2009 in SRK Consulting, 2010).

The Auclair formation dominates the surface geology of the study area (Broad Oak, 2009 in SRK Consulting, 2010). In fact, a paragneiss with metamorphic minerals (probably sedimentary in origin) occupies a large part of this area (Map 6-3). Amphibolized and amphibolite basalts belonging to the Komo Formation outcrop on both sides of the Billy-Diamond highway. Immediately to the south of the basalts is a spodumene pegmatite dyke. More specifically, it is mineralized lithium in solid phase in the form of spodumene, of igneous origin. It is in the Lithium-Cesium-Tantalum (LCT) family and of albite-spodumene type (SRK Consulting, 2010).

In the northeastern portion of the study area, a monogenic to polygenic conglomerate and sandstone denotes belonging to the greenstone belt (Broad Oak, 2009 in SRK Consulting, 2010). Also, a diabase dyke crosses the central portion of the study area on a north-south axis. Finally, we note the presence of felsic and intermediate tuffs at the northern limit border of the study area. Lastly, spodumene consists of white to green prismatic and striated crystals and in the form of lithium-containing mica in pseudomorphic flat aggregates (Broad Oak, 2009 in SRK Consulting, 2010).

6.2.3 STRUCTURE AND SEISMIC ACTIVITY

Eastern Canada is a stable continental region of the North American plate, therefore, has relatively low seismic activity. The Superior Province, in which the study area is located, has overall experienced tectonic stability since **2.6 Ga (Percival, 2007; NRCan, 2017a)**.

Seismic hazard is the most violent ground motion likely to occur in a region, based on a given probability. Ground motions are defined by spectral-acceleration values of the soil that is used in the design of foundations. In the study area, the *National Building Code 2015* establishes the probability of an occurrence at 0.000404 per year. This means that for a 50-year recurrence period, there is a 2% chance that an earthquake will cause greater than expected ground motion (NRCan, 2017b). The site is in a very low seismic hazard area. In this regard, there is no issue regarding the geological aspects of the soil that are discriminating in the study area.

6.2.4 PHYSICAL GEOGRAPHY

The study area is in the James subregion of the Canadian Shield (NRCan, 2006). It occupies the northern part of the Abitibi lowlands and James Bay natural province, near the intersection with the Grande Rivière low hills and Mistassini highland provinces. This natural province has a plain relief slightly inclined toward James Bay (MDDELCC, 2017a).

The topography of Abitibi and James Bay lowlands is low and softened, and elevation ranges from 200 to 350 m. Rocky outcrops are common and often correspond to striated spodumene hills or ridges of dykes rising up to 30 m above the surrounding plain. They are separated by depressions varying from a few hundred meters to more than 10 km. Within the study area, the elevation varies by some tens of metres at the most.

6.2.5 GEOMORPHOLOGY

The study area experienced a complex sequence of quaternary episodes: glaciation, regional readvances, marine and lacustrine invasions. This dynamic left thick fine deposits (clay, silt and fine sand) in the depressions, occupied by peat bogs. The project site is located near organic deposits, rocky outcrops and fluvial deposits (Map 6-4). Moreover, a large part of the surface is covered with peat bogs.

The territory was completely covered by the Wisconsin glacier during the last glacial episode. This ice cover has led to the planing of summits in the region, the overdeepening of valleys and the establishment of glacial deposits in the valleys.

At the project site, the bedrock can be found from a depth of 1.8 m. The rocky surface is covered in some places, with sandy units approximately 3 m thick and whose granulometry varies from fine to coarse. These units are interlayered with gravel beds. In other places, some exploratory trenches have silt and clay beds at the base. These sandy units are covered with a peaty horizon with a thickness varying between 0 and 0.8 m. Also, some areas may be characterized by the presence of isolated islets of permafrost, since the area is in the sporadic permafrost zone. These islets can be found mainly in peat bogs. Given the little difference in elevation in the study area, there is no particular problem regarding the stability of surface deposits.

6.2.6 HYDROGEOLOGY

The assessment of hydrogeological conditions at the project site was carried out using data collected in 2017, 2018, **2020 and 2021** during the investigation campaigns. Compiling data made it possible to determine the different hydrogeological units, to assess the hydraulic properties and to assess the piezometry as well as the quality of the groundwater. Details of the methods used and results are presented in the expert survey on hydrogeology **and in the SNC-Lavalin studies** (WSP, 2018a, **SNC-Lavalin, 2020 and SNC-Lavalin 2021 (report in progress)**). This section summarizes the content of **these studies**.

6.2.6.1 METHODOLOGY

During the hydrogeological and geotechnical work in the fall of 2017 and winter of 2018, 77 drillings were done, including three open-rock wells. Of these, 36 were built into observation wells or piezometers. **A second geotechnical survey was conducted in summer 2020 and winter 2021. As part of this survey, 26 boreholes were drilled and 11 were built into observation wells.** Also, additional stratigraphic surveys (trenches) provided information on the stratigraphy of the study area. The location of the different surveys carried out in the study area is shown on Map 6-5.

During the **2017 and 2018** field campaigns, 36 groundwater samples were taken at 20 wells or piezometers in order to establish the initial environmental state. Soil samples were also collected from the drilling and trench sites **in 2017, 2018, 2020 and 2021**. In addition, the results of surface water samples were used to determine the characteristics of the receiving environments for readjusting the criteria for metals. Finally, permeability tests and a pumping test were performed to obtain the hydraulic properties of different hydrostratigraphic units.

6.2.6.2 HYDROSTRATIGRAPHIC UNITS

The following hydrostratigraphic units were identified, during drilling, from the surface:

- Peat: Several peatlands have developed on the poorly drained surface of very compact marine deposits. They are vast and very numerous, so that they cover the deposits on approximately 72% of the territory. Some peatlands have also developed in the rock and till depressions. The abundance of these wetlands shows poor soil drainage conditions. The peat unit is characterized by organic deposits capable of reaching **4 m** in thickness.
- Littoral sand: In some areas, there are sandy deposits established during the retreat of the Tyrell Sea. These littoral deposits cover the marine deposits. During investigative work, they were rarely identified, except for one area to the south of the pit (PO1 and PO2).
- Clay: A layer of clay deposits (marine deposits) is found on the lower grounds between the rock ridges and till. The thickness of clay deposits can reach 10 m depending on the drilling performed. In the study area, this unit is completely covered by the peat unit.
- Till: In the region, the cover of glacial materials is rather discontinuous. These shapes are elongated and oriented along a WSW-ENE axis that indicates the direction of the regional ice flow. The till of the area is characterized by a very dense material with no apparent structure and by the sporadic presence of sand and gravel lenses. This till consists mainly of silty and gravelly sands with traces of clay. The drillings suggest a thickness of up to 20 m.
- Rock: This unit consists mainly of metasedimentary rocks such as paragneisses and schists as well as mafic and intermediate volcanic rocks such as basalts, andesites, volcaniclastic rocks and, locally, alkaline volcanic rocks.

6.2.6.3 GRANULOMETRIC ANALYSIS

Soil samples were taken during drilling for granulometric analysis. As mentioned earlier, the surface soils identified in the study area are mainly till and clay deposits. Till consists mainly of silty sand with varying proportions of gravel. The clay deposit consists of silt and clay including traces of sand. Table 6-5 presents the results summary for the granulometric analysis performed.

Table 6-5 Summary of results for the granulometric analysis performed

Unit	Number of samples	Average interval (m)	Lithology	Average granulometric results (%)
Clay deposits	25	2.71 to 3.38	Silt and clay, traces of sand	Silt 58.6
				Clay 36.8
				Sand 4.6
Sandy deposits (till)	85	2.61 to 3.3	Silty and gravelly sand, traces of clay	Sand 50.3
				Silt 29.4
				Gravel 18.2
				Clay 2.1

6.2.6.4 HYDRAULIC PROPERTIES OF MATERIALS

The hydraulic properties of the materials were determined for each unit from the work carried out in the study area, namely:

- granulometric analysis (**110** analyses);
- pumping test (one test at well WSP-PW03);
- permeability tests (**64** tests on **30** wells).

All these analyses make it possible to determine parameters, such as the hydraulic conductivity and the storage coefficient depending on the different units encountered.

The permeability contrast between the different units will influence the groundwater flow patterns. Table 6-6 presents the compilation of hydraulic conductivity data per unit determined. The rock unit was subdivided into three entities following field observations and from the geology of the site.

Table 6-6 Compilation of hydraulic conductivity data (m/s)

Lithostratigraphic unit	Minimum	Maximum	Average
Clay deposits	3.56×10^{-12}	1.28×10^{-8}	7.45×10^{-10}
Sandy deposits (till)	4.29×10^{-9}	1.05×10^{-3}	4.90×10^{-6}
Rock (paragneiss)	1.76×10^{-7}	2.27×10^{-4}	1.2×10^{-5}
Rock (spodumene pegmatite)	7.77×10^{-9}	6.07×10^{-7}	9.4×10^{-8}
Rock (amphibolitized and amphibolite basalt)	2.72×10^{-8}	4.70×10^{-5}	2.85×10^{-6}

6.2.6.5 PIEZOMETRIC LEVELS

As part of the work, **49** drillings, including **34** observation wells, were subject to water level measurements on one or more occasions between August 2017, May 2018, **September 2020 and March 2021**. A piezometric map (Map 6-6) was generated using the measurements taken in all wells intercepting the rock in May 2018. All surveys are shown in Table 6-7.

The pit sector represents a piezometric head. Groundwater flow would occur radially from this piezometric head toward the surrounding watercourses. Water levels recorded prior to snowmelt in February 2018 are between 0.03 m and 0.84 m lower than those recorded at the beginning of May 2018, for an average variation of 0.36 m. Surveys carried out at different times of the year (**February, March, May, July and August**) show seasonal variations in water levels.

In the future pit sector, the water depth levels of the bedrock aquifer range from 0.40 to 4.98 m, and the piezometric elevation ranges from 213.03 to 224.89 m. A variation of -0.03 to 0.84 m was observed between August 2017 and May 2018 and a variation of -0.67 to 0.13 m between February 2018 and May 2018 in the wells of this sector.

In the area south of the pit, the water depth levels of the bedrock aquifer range from -0.25 to 1.16 m, whereas the piezometric elevation ranges from 205.6 to 212.98 m. A variation of 0.19 to 0.73 m was observed between February and May 2018 in the wells of this sector.

In the future plant, east stockpile and nearby basin sector, the water depth levels of the bedrock aquifer range from 1.1 to 4.65 m, and the piezometric elevation ranges from 209.15 to 211.74 m. The water depth levels of the surface aquifer were measured in July 2020 at 2.74 m, for a piezometric elevation of 213.31 m. The plant sector is located on a topographic high, which explains the higher water depth levels and higher piezometric level (BH20-P-06 and BH20-P-07).

In the area of the future southwest stockpile, located near pit JB-1, the water depth level measured was measured in March 2021 at 1.26 m, for a piezometric elevation of 209.99 m. This value is similar to the levels measured in the pit sector.

In the future west stockpile and basin sector (located to the north of creek CE3), the water depth levels of the bedrock aquifer range from -0.04 to 1.34 m, and the piezometric elevation ranges from 201.01 to 207.23 m. The water depth levels of the surface aquifer range from -0.04 to 0.99 m and the piezometric elevation varies from 199.64 to 211.93 m. A variation of 0.02 m was observed between February and May 2018 in the WSP-MW8R well.

Finally, in the future **north waste rock** stockpile sector (located to the north of the plant and CE3 creek), the water depth levels of the bedrock aquifer range from -0.03 to 0.86 m, whereas the piezometric elevation ranges from 205.11 to 209.31 m. **The water depth levels of the surface aquifer range from -0.11 to 1.92 m and the piezometric elevation varies from 204.62 to 209.50 m.** A variation of 0.26 to 0.58 m was observed between February and May 2018 in the wells of this sector.

The horizontal gradient in the study area ranges from 0.03 to 0.001.

6.2.6.6 AQUIFER CLASSIFICATION

According to the MDDELCC's *Système de classification des eaux souterraines* (MDDEFP, 2012), groundwater bodies can be class I, II or III based on their hydrogeological properties, quality and use potential. A class I groundwater body is an irreplaceable source of drinking water. A class II hydrogeological formation is a current or potential source of drinking water. Class II formations have an acceptable water quality of sufficient quantity. Lastly, a class III hydrogeological formation cannot be used as a source of drinking water (poor quality and insufficient quantity).

Based on the information collected as part of the investigations for this study, the rock corresponds to a class II fractured aquifer, meaning the aquifer is a potential source of drinking water. The extent of the glaciofluvial deposits (till unit) naturally has good potential as an aquifer. Therefore, it is considered a class II aquifer.

Table 6-7 Piezometric readings

Well number	Well depth (m)	Elevation of the middle of the screen (m)	Height of the rim above ground level (m)	Screened unit	Campaigns 1 and 2			Campaign 3		
					Depth of water level wrt ground level (m)	Piezometric elevation (m)	Date	Depth of water level wrt ground level (m)	Piezometric elevation (m)	Date
WSP-PW01	126.2	-	0.28	Rock	-	-	-	2.70	224.89	May 6, 2018
WSP-PW03	169.5	-	0.80	Rock	4.25	213.01	February 2018	4.22	213.04	May 5, 2018
WSP-MW1R	6.1	200.62	0.86	Rock	-	-	-	0.86	205.11	May 3, 2018
WSP-MW2R	10.8	196.97	1.03	Rock	-	-	-	9.20*	197.82	May 5, 2018
WSP-MW3R	12.2	199.48	0.92	Rock	0.68	209.05	February 2018	0.42	209.31	May 3, 2018
WSP-MW4R	7.6	210.32	0.57	Rock	1.09	215.33	August 2017	0.40	216.02	May 3, 2018
WSP-MW5R	13.1	201.12	0.80	Rock	1.21	212.26	February 2018	0.48	212.99	May 5, 2018
WSP-MW6R	10.7	220.62	0.62	Rock	4.91	224.91	August 2017	4.98	224.84	May 4, 2018
WSP-MW7R	7.8	201.21	0.79	Rock	1.16	207.10	February 2018	0.97	207.29	May 3, 2018
WSP-MW8R	12.2	192.62	0.86	Rock	0.74	202.73	February 2018	0.72	202.75	May 3, 2018
WSP-MW9R	18.9	187.20	0.97	Rock	-	-	-	-0.25	205.60	May 4, 2018
BH-3A	8.23	194.35	0.56	Rock	-	-	-	0.12	201.70	May 2, 2018
BH-10A	11.5	189.24	0.48	Rock	-	-	-	-0.04	200.23	May 1, 2018
BH-15	9.56	195.12	1.08	Rock	-	-	-	0.10	202.03	May 1, 2018
BH-45	4.62	205.82	1.35	Rock	-	-	-	-0.03	208.94	May 1, 2018
BH-47	12.83	205.05	1.36	Rock	-	-	-	1.65	210.09	May 1, 2018
BH21-N-03	10.93	200.86	0.85	Rock	1.11	209.15	March 2021	-	-	-
BH21-O-05	9.05	200.1	0.85	Rock	1.02	207.23	March 2021	-	-	-
BH21-P-04	5.85	205.66	0.98	Rock	1.26	208.85	March 2021	-	-	-
BH21-R-01	8.8	200.16	0.94	Rock	1.05	206.41	March 2021	-	-	-
BH21-W-03	9.05	196.33	0.92	Rock	1.07	202.81	March 2021	-	-	-
BH21-W-04	8.85	193.81	0.94	Rock	0.90	201.01	March 2021	-	-	-

Table 6-8 Piezometric readings (cont.)

Well number	Well depth (m)	Elevation of the middle of the screen (m)	Height of the rim above ground level (m)	Screened unit	Campaigns 1 and 2			Campaign 3		
					Depth of water level wrt ground level (m)	Piezometric elevation (m)	Date	Depth of water level wrt ground level (m)	Piezometric elevation (m)	Date
BH21-W-06	8.8	198.98	0.93	Rock	1.34	205.49	March 2021	-	-	-
BH21-SW-03	5.95	206.80	0.98	Rock	1.26	209.99	March 2021	-	-	-
BH20-P-07	19.71	198.43	-	Rock	4.54	211.74	September 2020	-	-	-
WSP-MW2S	4.57	204.15	0.81	Surface deposits	0.34	206.85	February 2018	0.21	206.98	May 5, 2018
WSP-MW3S	4.3	206.90	0.85	Surface deposits	0.75	208.92	February 2018	0.17	209.50	May 3, 2018
WSP-MW4S	4.4	213.51	0.63	Surface deposits	1.17	215.23	August 2017	0.33	216.07	May 5, 2018
WSP-MW5S	4.6	210.32	0.71	Surface deposits	0.80	212.59	February 2018	0.30	213.09	May 5, 2018
WSP-MW8S	4.3	200.41	0.99	Surface deposits	-	-	-	0.40	202.78	May 3, 2018
WSP-MW9S	4.6	202.28	0.95	Surface deposits	-	-	-	0.10	205.26	May 4, 2018
PO-1	7.28	215.89	0.56	Surface deposits	-	-	-	5.44	216.17	May 4, 2018
PO-2	8.5	214.01	0.57	Surface deposits	5.07	215.36	February 2018	5.74	214.69	May 4, 2018
BH-1	11.43	210.78	0.99	Surface deposits	-	-	-	5.01	215.07	May 1, 2018
BH-10B	8	193.11	0.23	Surface deposits	-	-	-	0.72	199.64	May 1, 2018
BH-14	16	203.86	1.09	Surface deposits	-	-	-	1.23	211.93	May 1, 2018
BH-18	6.32	201.38	0.24	Surface deposits	-	-	-	-0.04	203.72	May 1, 2018
BH-23	11.05	204.75	1.07	Surface deposits	-	-	-	0.66	208.99	May 1, 2018
BH-27	8.18	202.46	1.17	Surface deposits	-	-	-	0.14	204.62	May 1, 2018
BH-29	14.02	202.90	1.30	Surface deposits	-	-	-	1.92	206.68	May 1, 2018
BH-3B	8.23	197.66	0.61	Surface deposits	-	-	-	0.28	201.66	May 2, 2018
BH-31	8.84	205.33	1.36	Surface deposits	-	-	-	0.12	207.91	May 1, 2018
BH-36	8.18	205.84	1.59	Surface deposits	-	-	-	0.57	208.17	May 1, 2018
BH-37	6.63	204.15	1.40	Surface deposits	-	-	-	0.08	208.58	May 1, 2018

Table 6-9 Piezometric readings (cont.)

Well number	Well depth (m)	Elevation of the middle of the screen (m)	Height of the rim above ground level (m)	Screened unit	Campaigns 1 and 2			Campaign 3		
					Depth of water level wrt ground level (m)	Piezometric elevation (m)	Date	Depth of water level wrt ground level (m)	Piezometric elevation (m)	Date
BH-41	6.22	205.38	1.41	Surface deposits	-	-	-	-0.11	207.18	May 1, 2018
BH-49	17.96	199.90	1.40	Surface deposits	-	-	-	4.50	206.90	May 1, 2018
BH-50	5.28	206.32	1.43	Surface deposits	-	-	-	0.39	206.93	May 1, 2018
BH20-P-06	16.21	206.05	-	Surface deposits	2.74	213.31	July 2020	-	-	-
BH21-O-06	13.15	205.75	0.63	Surface deposits	3.5	211.85	March 2021	-	-	-
* Value not stabilized.										

6.2.6.7 AQUIFER VULNERABILITY

The till in the study area is mainly comprised of silty and gravelly sand with traces of clay. It is moderately permeable and has low aquifer potential. The rock is a fractured aquifer, with low potential. The rock aquifer is most vulnerable where the rock is outcropping, in fracture zones or where the granular deposits are thin. Metamorphic rock does not have strong filtering properties. Overall, the rock aquifer should be considered vulnerable, but with a weak potential.

The DRASTIC¹ system for measuring the vulnerability of groundwater reflects the level of contamination risk based on hydrogeological properties. This evaluation method was developed by the United States Environmental Protection Agency (US EPA). The DRASTIC system is based on three basic assumptions:

- the sources of contamination are at ground surface level;
- contaminants move from ground surface level to the aquifer with seepage water;
- contaminants have the same mobility as water.

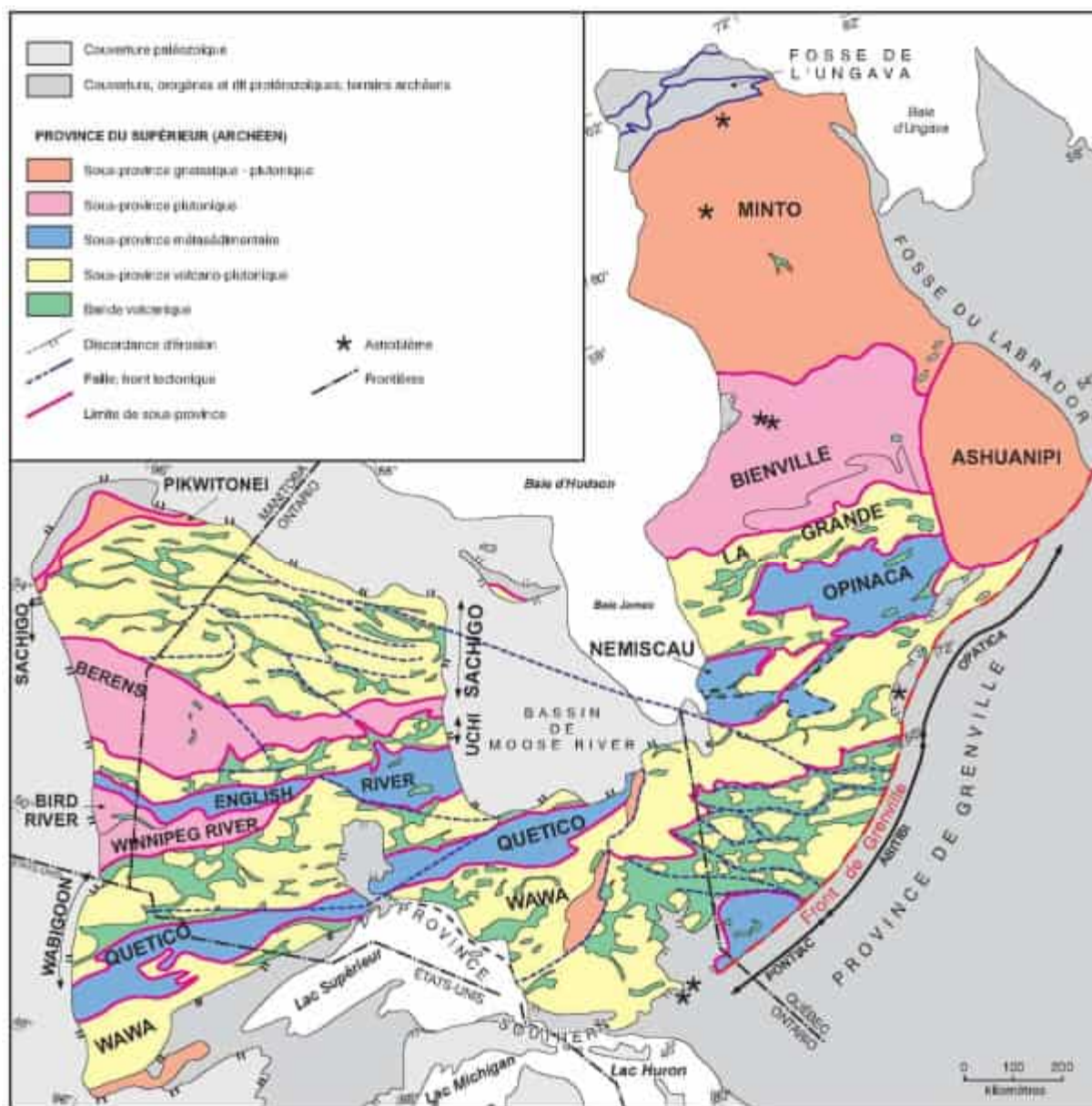
Based on the hydrogeological properties of the site, a groundwater vulnerability index of 137 was assessed for surface deposits and of 105 for the upper portion of the rock, which equates to a medium² level of vulnerability based on the levels described in the *Water Withdrawal and Protection Regulation* (WWPR, section 53). Table 6-8 shows the details of the weighting for each factor.

Table 6-10 Aquifer vulnerability

Unit	Physical parameters	Typical value or interval	Weight	Associated weight	Subtotal	DRASTIC per unit
Till unit	D – Depth to water table	Between 0.0 and 5.7 m	5	9	45	137
	R – Recharge	Between 10 and 30 cm per year	4	7	28	
	A – Aquifer media	Till	3	5	15	
	S – Soil media	Till / clay silt	2	4	8	
	T – Topography (slope)	Slope between 2 and 12%	1	7	7	
	I – Impact of vadose zone	Till or clay	5	5	25	
	C – Aquifer conductivity	Between 0.02 and 29 m/d	3	3	9	
Rock unit	D – Depth to water table	Between 0 and 4.9 m	5	6	30	105
	R – Recharge	Between 0.1 and 15 cm per year	4	5	20	
	A – Aquifer media	Rock: igneous or altered metamorphic/basalt rock	3	4	12	
	S – Soil media	Till / clay silt	2	4	8	
	T – Topography (slope)	Slope between 2 and 12%	1	7	7	
	I – Impact of vadose zone	Till or clay	5	5	25	
	C – Aquifer conductivity	Between 0.0008 and 0.83 m/d	3	1	3	

1 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

2 Vulnerability ratings: Low: a rating equal to or less than 100 for the entire protection zone; Medium: a rating less than 180 for the entire protection zone, unless a low rating has been assigned; High: a rating equal to or greater than 180 in any part of the protection zone (WWPR, section 53).



Source: MRNF, 2004

Map 6-2 Superior Province

6.2.7 HYDROGRAPHY

The local study area is located at the head of subwatersheds with watercourses that flow westward to the north and eastward to the south of the study area (Map 6-7A). This section describes the work done to characterize the hydrography of the sector.

6.2.7.1 WORK COMPLETED

A field campaign was completed in summer 2017 to characterize the five watercourses in the study area, which were named creeks CE1 to CE5 (Map 6-7B). A pluviometer was installed and water level probes were placed in each watercourse to take continuous measurements over the course of slightly more than three months.

Moreover, stream gauging (measurement of flow) took place on three occasions opposite the water level probes. Finally, some bathymetric surveys were completed on creeks CE3 and CE5 as well as in lakes in the study area. Following the evolution of the project and associated studies, a second field campaign was carried out in the summer of 2018 to carry out cross sectional surveys of the creeks CE2, CE3 and CE4 as well as additional gaugings on the six watercourses under study (including CE6).

The characteristic flows of the six watercourses, which are flood flow, monthly and low-water means, were calculated in theory and compared with the measurements taken during the field campaign. The mean monthly flows were estimated using interbasin transfer at the Rivière à l'Eau Claire reference station (090605). The rational method, **as described in the Manuel de conception des ponceaux (MTQ, 2014)**, was used on the pluviometer data from the Grande Rivière A station (7093715) to estimate the flood flow. **The basic equation for this method is as follows:**

$$Q = 0.278 * C * F_L * I * A$$

Where:

Q is peak flow (m³/s)

C is the runoff coefficient

FL is a flood buffer coefficient

I is rainfall intensity (mm/h)

A is the surface area of the watershed (km²)

The runoff coefficient is determined from the average slope of the main watercourse and/or watershed, type of soil and plant cover. In this case, the hydrological soil classification was determined according to ecoforestry maps of the area and the corresponding values published in the Manuel de conception des ponceaux (MTQ, 2014). Consequently, it was determined to be class B soil. Plant cover (woodland, grassland, cropland, urban) was determined from aerial photos. In this case, the watershed is primarily made up of woodland, with many lakes. The average slope of the watershed was determined from digital topographic maps. The flood buffer coefficient reproduces the effect of flood attenuation (lower intensity, but longer duration) by wetlands. It reduces the runoff hydrograph peak by factoring in the proportion of lakes and swamps in the watershed, as well as their location in relation to the watercourse. The duration and intensity of rainfall to be used in the rational method depends on watershed concentration time. IDF (Intensity-Duration-Frequency) data from the La Grande Rivière Airport station was used.

The interbasin transfer method was also used on the Rivière à l'Eau Claire station data **and the Rivière Saint-Louis station (040212)** data for comparative purposes. Low-water flow was estimated using the linear regression method developed by the MDDELCC, adapted for the Nord-du-Québec region. The methodology used to calculate the characteristic flows is provided in detail in the Hydrological technical study (*Étude spécialisée sur l'hydrologie*) (WSP, 2018b).

Finally, the characteristic water levels in the creeks CE2, CE3 and CE4 were estimated by one-dimensional hydraulic modeling using the HEC-RAS software. A total of 54 cross sections were identified and modeled. The models were calibrated using water level and flow data measured in the field in June 2018. More details on the methodology used to mount and calibrate the models are available in the Hydrological technical study (*Étude spécialisée sur l'hydrologie*) (WSP, 2018b).

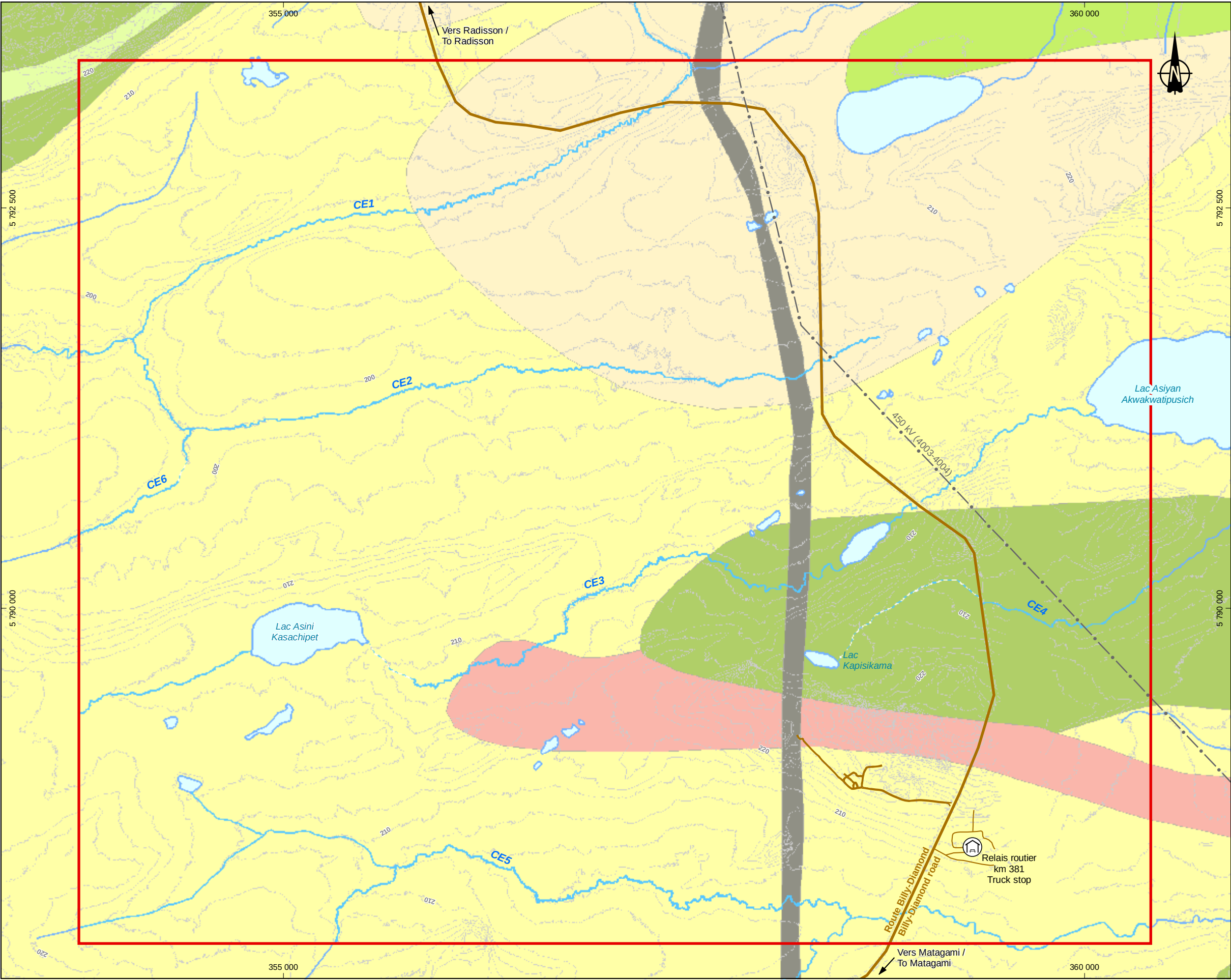
6.2.7.2 WATERSHEDS

The study area is located inside the Eastmain River watershed. It has an area of approximately 46,000 km² and drains water from several lakes and rivers. In the study area, creeks CE1, CE2 and CE6 flow to the west, towards the Miskimatao River, and then join the Eastmain River. Creeks CE3, CE4 and CE5 flow to the east and also join the Eastmain River. **Map 6-7A shows the boundary of the Eastmain River watershed, as well as the boundaries of the local study area subwatersheds.** Note that the study area drainage system represents a very small percentage of the Eastmain River watershed (total of 0.1%).

Map 6-7**B** shows the watersheds of the watercourses in the study area **in more detail**. Table 6-9 shows the surface areas of these watersheds. These are undeveloped, very small and negligibly sloped watersheds as well as many wetlands that cause a significant reduction in watercourse flow. Photos of the watercourses are available in the Hydrological technical study (Étude spécialisée sur l'hydrologie) (WSP, 2018b).

Table 6-11 Surface area of the watersheds of the watercourses studied

Name	Surface area (km ²)
North side (CE1, CE2 and CE6)	20.36
CE1	7.63
CE2	9.07
CE6	3.11
South side (CE3, CE4 and CE5)	48.76
CE3	10.33
CE4	3.03
CE5	27.01



- Zone d'étude locale / *Local study area*
- Courbe de niveau (équidistances 2 m) / *Contour (interval 2 m)*

- Infrastructures / *Infrastructure***
- Route principale / *Main road*
- Route d'accès / *Access road*
- Ligne de transport d'énergie / *Transmission line*

- Géologie / *Geology***
- Pegmatite à spodumène / *Pegmatite with spodumene*
- Conglomérat monogénique à polygénique et grès / *Monogenic to polygenic and sandstone conglomerate*
- Paragneiss à minéraux métamorphiques / *Paragneiss with metamorphic minerals*
- Basalte amphibolitisé et amphibolite / *Amphibolitized basalt and amphibolite*
- Tuf intermédiaire / *Intermediate tuff*
- Tuf felsique à intermédiaire / *Felsic to intermediate tuff*
- Diabase / *Diabase*

- Hydrographie / *Hydrography***
- CE2

Numéro du cours d'eau / *Stream number*
- Cours d'eau permanent / *Permanent stream*
- Cours d'eau à écoulement diffus ou intermittent / *Intermittent or diffused flow stream*

GALAXY
Mine de lithium Baie-James /James Bay Lithium Mine

Carte / *Map* 6-3
Géologie / *Geology*

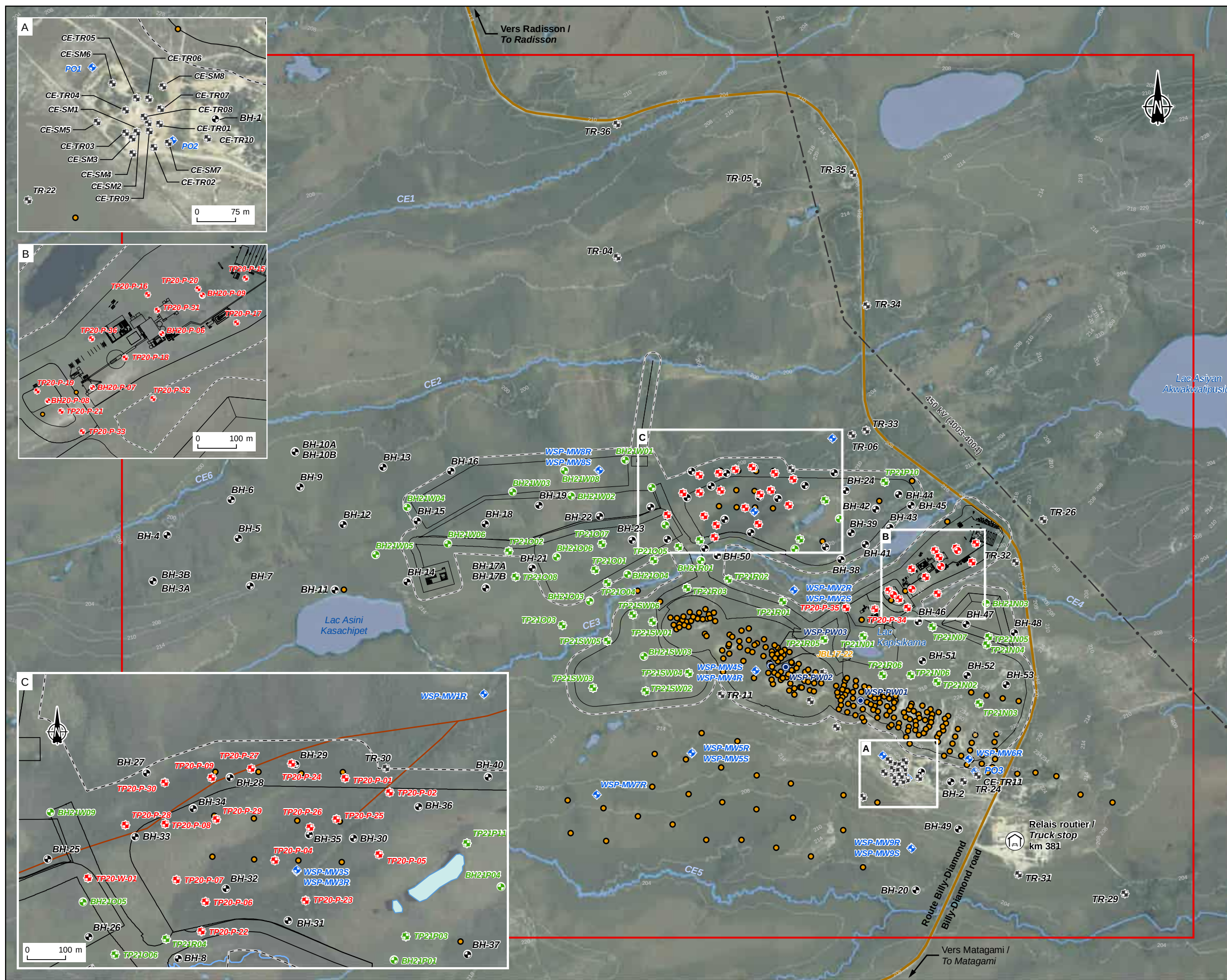
Sources :
Canvec : 1 : 50 000, RNCan, 2015
BDGA : 1 : 1 000 000, RNCan, 2011
Géologie / Geology : Sigeom, 2017

0 240 480 m
UTM, fuseau 18, NAD83

Juillet / *July* 2021

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c6-3_wspT327_geologie_210701.mxd

wsp



— Infrastructures minières / Mining infrastructure

Empreinte de la mine (zone tampon de 50 mètres) / Mine footprint (buffer 50 meters)

Zone d'étude locale / Local study area

206 Courbe de niveau (équidistance des courbes 2 m) / Contour (interval 2 m)

Forage d'exploration / Exploration drill hole

Puits d'observation / Observation well

Puits de pompage / Pumping well

Tranchée antérieure / Previous trench

Tranchée 2020 / Trench 2020

Tranchée 2021 / Trench 2021

Sondage géotechnique antérieur / Previous geotechnical borehole

Sondage géotechnique 2020 / Geotechnical borehole 2020

Sondage géotechnique 2021 / Geotechnical borehole 2021

Infrastructures / Infrastructure

Route principale / Main road

Route d'accès / Access road

Ligne de transport d'énergie / Transmission line

Hydrographie / Hydrography

CE3 Numéro de cours d'eau / Stream number

Cours d'eau permanent / Permanent stream

Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream

Plan d'eau / Waterbody

GALAXY

Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 6-5
Sondages hydrogéologiques /
Hydrogeological Boreholes

Sources :
Orthoimage : Galaxy, août / august 2017
Données du projet / Project data : Galaxy, 2021

0 240 480 m
UTM, fuseau 18, NAD83

Juillet / July 2021

Dessin : A. Masson
Approbation : C. Martineau
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Zone d'étude locale / Local study area

Infrastructures minières / Mining infrastructure

Emprise de la mine (zone tampon de 50 mètres) / Mine footprint (buffer 50 meters)

Nom du puits d'observation / Name of observation well

Profondeur du niveau d'eau p/r sol / Water level depth from ground

Élévation piézométrique (m) / Piezometric elevation (m)

Puits d'observation / Observation well

Courbe piézométrique / Piezometric contour

Sens d'écoulement de l'eau / Direction of water flow

Infrastructures / Infrastructure

Route principale / Main road

Route d'accès / Access road

Ligne de transport d'énergie / Transmission line

Hydrographie / Hydrography

Numéro de cours d'eau/ Stream number

Cours d'eau permanent / Permanent stream

Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream

Plan d'eau / Waterbody

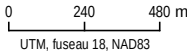
GALAXY

Mine de lithium Baie-James /James Bay Lithium Mine

Carte / Map 6-6

Piézométrie / Piezometry

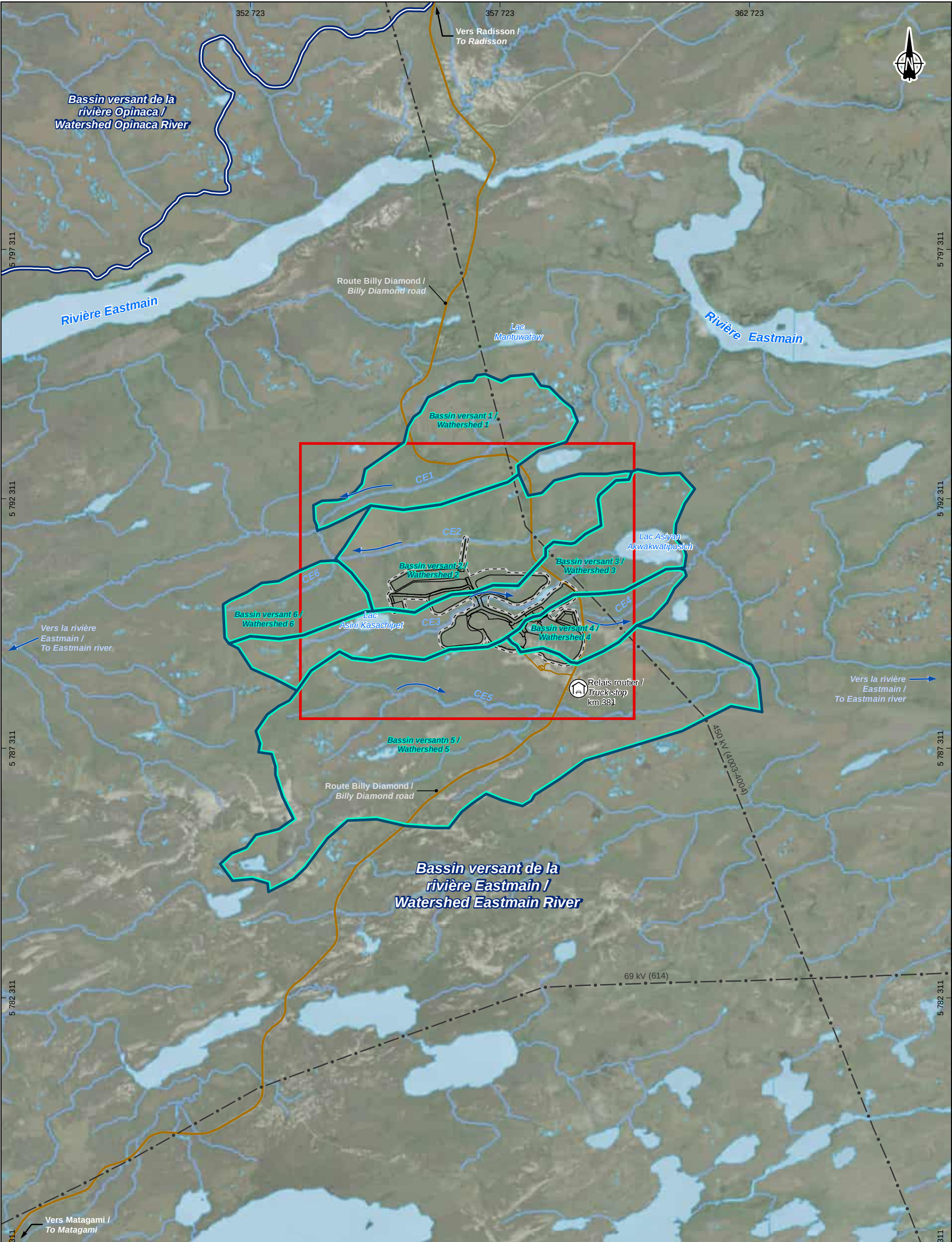
Sources :
Orthoimage : Galaxy, août / august 2017
Piézométrie, WSP 2018
Données du projet / Project data : Galaxy, 2021



Juillet / July 2021

Dessin : A. Masson
Approbation : C. Martineau
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	Infrastructure minière / Mining infrastructure		Cours d'eau à écoulement diffus ou intermittent / Diffused or intermittent flow stream
	Empreinte de la mine (zone tampon de 50 mètres) / Mine footprint (buffer 50 meters)		Plan d'eau / Waterbody
	Zone d'étude locale / Local study area		Sens d'écoulement de l'eau / Direction of water flow
Hydrographie / Hydrography		Infrastructures / Infrastructure	
	Bassin versant / Watershed		Route principale / Main road
	Sous-bassin versant / Subwatershed		Route d'accès / Access road
	Numéro de cours d'eau / Stream number		Ligne de transport d'énergie / Transmission line
	Cours d'eau permanent / Permanent stream		Relais routier / Truck stop



Mine de lithium Baie-James /James Bay Lithium Mine
Mise à jour de l'étude d'impact sur l'environnement

Carte 6-7A
Bassins versants / Watersheds

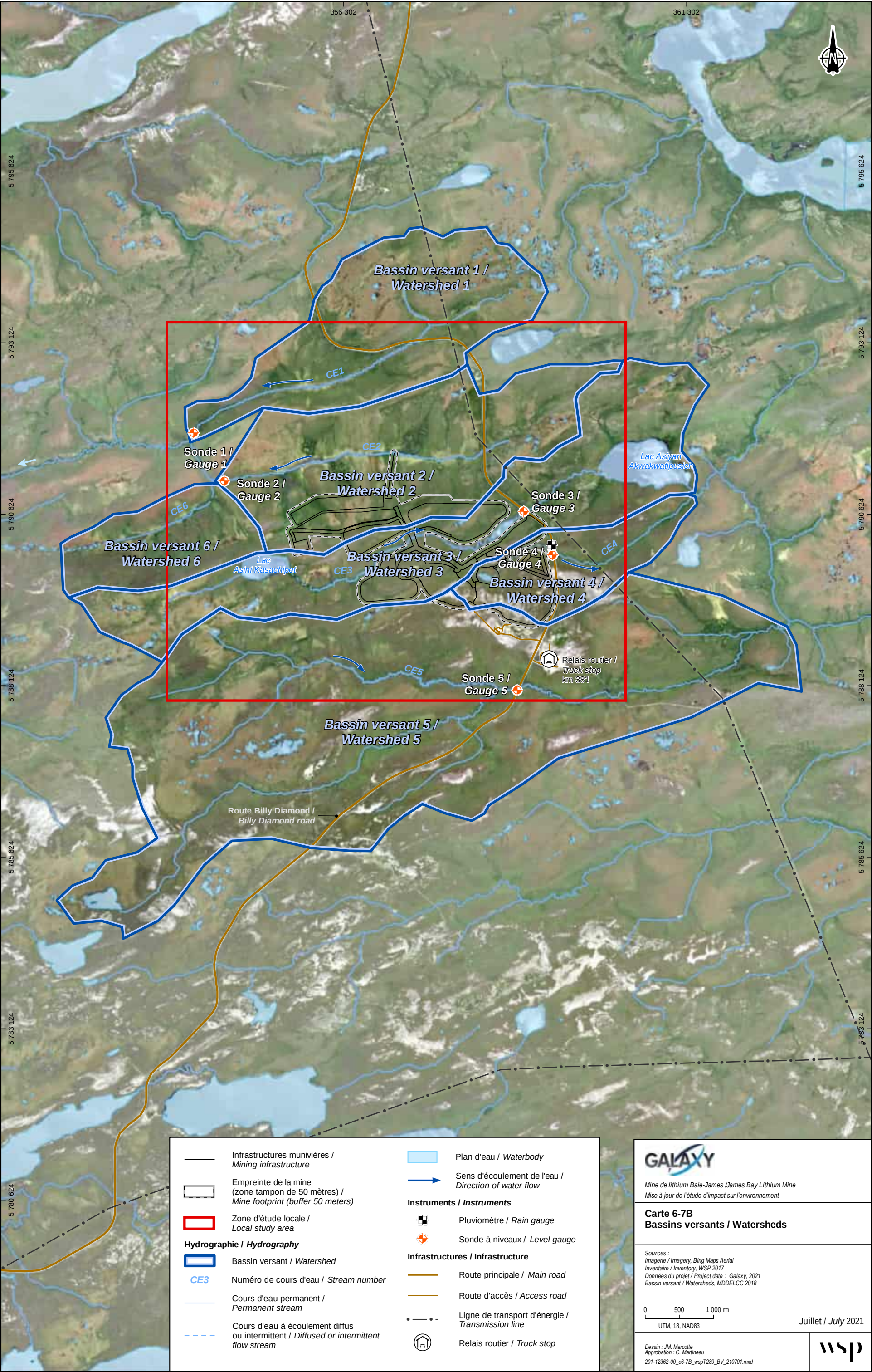
Sources :
Orthoimage, ESRI, DigitalGlobe, juillet 2015
Inventaire / Inventory : WSP 2018
Données du projet / Project data : Galaxy, 2021

0 750 1 500 m
UTM, 18, NAD83

Juillet / July 2021

Dessin : J.M. Marcotte
Approbation : C. Martineau
201-12362-00_c6-7A_wspT288_BV_210701.mxd





Mine de lithium Baie-James /James Bay Lithium Mine
Mise à jour de l'étude d'impact sur l'environnement

**Carte 6-7B
Bassins versants / Watersheds**

Sources :
Imagerie / Imagery, Bing Maps Aerial
Inventaire / Inventory, WSP 2017
Données du projet / Project data : Galaxy, 2021
Bassin versant / Watersheds, MDDELCC 2018

0 500 1 000 m
UTM, 18, NAD83

Juillet / July 2021

Dessin : J.M. Marcotte
Approbation : C. Martineau
201-12362-00_c6-7B_wspT289_BV_210701.mxd



6.2.7.3 CHARACTERISTIC FLOW RATES AND WATER LEVELS

This section presents the estimated characteristic flow rates downstream of the six watercourses in the study area. Table 6-10a shows the mean monthly flow estimated by interbasin transfer. The annual specific flow of watercourses in the study area is estimated to be 18.7 L/s/km².

Table 6-12a Mean monthly flow in the studied watercourses estimated by interbasin transfer

Month	Watercourse flow rate (L/s)					
	CE1	CE2	CE3	CE4	CE5	CE6
January	72	85	97	29	254	29
February	55	65	75	22	195	22
March	47	55	63	18	165	19
April	56	66	75	22	196	23
May	243	288	329	97	859	99
June	246	292	332	98	869	100
July	168	199	227	67	594	68
August	174	207	236	69	617	71
September	171	203	231	68	605	70
October	195	232	264	78	690	79
November	173	206	234	69	612	70
December	115	137	156	46	407	47

Table 6-10b below shows the values of the main factors used in rational method calculations under current conditions. Note that the runoff coefficient C_p may seem low, because it is the mean coefficient for the entire watershed, including lake and wetland areas.

Table 6-10b Factors considered for the rational method – current conditions

	CE2	CE3	CE4	CE5	CE6
% lakes and wetlands	58	29	7.4	28	27
Mean C_p	0.09	0.12	0.14	0.12	0.12
T_c (h)	5.0	7.6	4.4	9.7	4.6
I 25 years (mm/h)	10.2	7.3	11.4	6.0	10.9
F_L	0.58	0.78	0.63	0.59	0.59

Note: The goal of the study was to obtain flow rates to compare current conditions and projected conditions, to assess the effects of the project, and not to be used to size structures (dikes, pits, ponds, pumping stations). These values should therefore not be considered absolute, but used for comparison purposes.

Table 6-11 shows the flood flow as estimated by the rational method. This method was used because it considers the physical characteristics of the watershed, such as the watercourse slope and the buffering due to wetlands and lakes, unlike the interbasin transfer method. The flood flow varied between 0.3 and 1.7 m³/s in the study area over the two-year return period.

Table 6-11 Flood flow in the studied watercourses estimated using the rational method

Return period	Watercourse flow rate (m ³ /s)					
	CE1	CE2	CE3	CE4	CE5	CE6
2 year	0.62	0.67	1.02	0.41	1.71	0.33
10 years	1.00	1.14	1.67	0.71	2.72	0.56
25 years	1.19	1.37	1.99	0.86	3.22	0.68
50 years	1.33	1.54	2.23	0.97	3.60	0.76
100 years	1.47	1.71	2.46	1.08	3.98	0.85

The low-water flows estimated using the linear regression method are presented in Table 6-12. This method was used because it seems to be perfectly adapted for the small watersheds in the Nord-du-Québec region, while still being conservative, and the order of magnitude of the results was validated using the interbasin transfer method (details provided in the sector study).

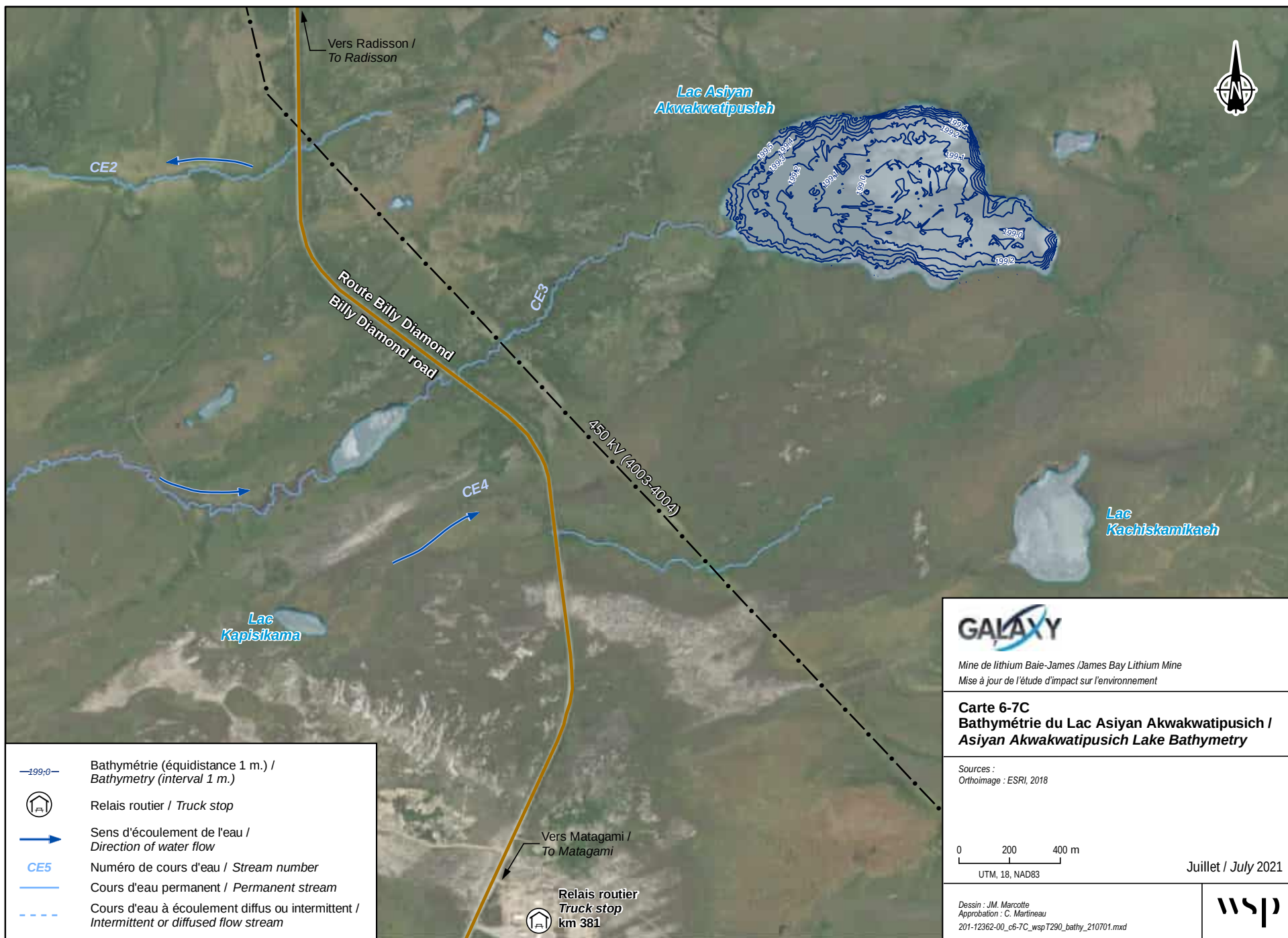
Table 6-12 Low-water flow rates in the studied watercourses estimated using the linear regression method

Period	Watercourse flow rate (L/s)					
	CE1	CE2	CE3	CE4	CE5	CE6
Q _{2,7} annual	13	15	17	5	45	5
Q _{10,7} annual	6	7	8	2	22	3
Q _{5,30} annual	8	10	11	3	30	3
Q _{2,7} summer	31	37	42	12	110	13
Q _{10,7} summer	14	16	19	5	49	6
Q _{5,30} summer	29	35	40	12	104	12

The above-mentioned characteristic flow rates were then entered as a limiting condition upstream of the hydraulic models, to obtain an estimate of the characteristic water levels in creeks CE2, CE3 and CE4. The results of these simulations are presented in the Hydrological technical study (Étude spécialisée sur l'hydrologie) in the form of hydraulic profiles and characteristic waterlines (WSP, 2018b).

6.2.7.4 BATHYMETRY

Basic bathymetry, consisting of one-time measurements taken with an echo sounder, was done in Asiyon Akwakwatipusich, Asini Kasachipet and Kapisikama Lakes and Unnamed Pond 1. These measurements helped determine the mean and maximum depth of the bodies of water surveyed. This data is shown in Tables 27 to 31, as well as in Table 33 of the sector study Aquatic Inventory and Baseline Study (WSP, 2018c). Precision bathymetry was, however, done for Asiyon Akwakwatipusich Lake and the result of these measurements is shown in Map 6-7C below.



6.2.8 SURFACE WATER AND GROUNDWATER QUALITY

6.2.8.1 SURFACE WATER

This section presents the main characteristics of the water quality of watercourses in the study area. The comparison between the results obtained and the surface water quality criteria recognized by provincial and federal governments established a reference point for surface water quality in the study area. The Aquatic Inventory and Baseline Study (*L'étude spécialisée sur l'habitat aquatique*) (WSP, 2018c) provides details on the methodology used, the work carried out and the results obtained.

METHODOLOGY

Surface water sampling took place monthly for nine stations six times between June and November 2017 to have a representation of annual variation. The stations were selected to present representative information on the aquatic environment. The locations of the surface water sampling stations are shown on Map 6-8.

Surface water quality was measured using physiochemical measurements *in situ* and chemical analyses in the lab.

The following *in situ* measurements were taken at each sampling station:

- physiochemical data of the water: temperature (°C), dissolved oxygen (% and mg/L), conductivity (µS/cm) and pH;
- description and photos of the watercourse or body of water at the sampling site.

As for the chemical analyses completed in the laboratory, Table 6-13 shows the median and standard deviation for each parameter for each of the six samples from each station.



Zone d'étude locale / Local study area

Effluent minier / Mining effluent

Effluent sanitaire / Sanitary effluent

Infrastructures minières / Mining infrastructure

Emprise de la mine (zone tampon de 50 mètres) / Mine footprint (buffer 50 meters)

Sites d'échantillonnage / Sampling Sites

Pêche électrique / Electrofishing

Seine / Beach seine

Filet à grandes mailles / Large mesh experimental gill net

Filet à petites mailles / Small mesh net

Filet expérimental / Multi mesh experimental gill net

Grand verveux / Big fyke

Petit verveux / Little fyke

Filet expérimental / Multi mesh experimental gill net (Hg poisson / Hg fish - 2019)

Grand verveux / Big fyke (Hg poisson / Hg fish - 2019)

Petit verveux / Little fyke (Hg poisson / Hg fish - 2019)

Bourolle / Bait trap (Hg poisson / Hg fish - 2019)

Benthos / Benthos

Eau et sédiments / Water and sediments

Sédiments / Sediments

Station de pêche / Fishing station (2012)

Barrage de castor / Beaver dam

Hydrographie / Hydrography

CE3

Numéro de cours d'eau / Stream number

Cours d'eau permanent / Permanent stream

Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream

Sens d'écoulement de l'eau / Direction of water flow

Littoral des cours d'eau / Watercourses shoreline

CE1-S1

Section de cours d'eau / Stream section

Infrastructures / Infrastructure

Route principale / Main road

Route d'accès / Access road

Ligne de transport d'énergie / Transmission line

Relais routier / Truck stop

GALAXY

Mine de lithium Baie-James / James Bay Lithium Mine

Carte 6-8

Stations de pêche, de qualité de l'eau et des sédiments / Fishing, water and sediment sampling sites

Sources :
Orthoimage : Galaxy, août / august 2017
Données du projet / Project data : Galaxy, 2021
Fosse, carrière et entreposage des explosifs / Pit, quarry and explosives magazine : Mining Plus, 2018
Secteur administratif et industriel et aire de minéral / Administrative and industrial sector and ROM pad : Primero, 2018
Banc d'emprunt / Borrow pit, Stantec, 2019

0 240 480 m

UTM, 18, NAD83

Relais routier km 381

Vers Matagami

Dessin : J.M. Marcotte
Approbation : C. Martineau
201-12362-00_c6-8_wspT291_stations_210701.mxd

wsp

Table 6-13 Median and standard deviation for each parameter analyzed over six inventory campaigns

Parameters	Units	Station																	
		1A		1B		2A		2B		3A		3B		4A		5A		5B	
		Median	Deviation	Median	Deviation	Median	Deviation	Median	Deviation	Median	Deviation	Median	Deviation	Median	Deviation	Median	Deviation	Median	Deviation
Basic descriptors																			
Total alkalinity (in CaCO ₃)	mg L ⁻¹	0.5	1.6	4	2	0.5	1.1	1.25	2.16	0.5	2.0	0.75	4.21	2.05	11.09	0.5	2.8	3.5	4.8
Dissolved organic carbon	mg L ⁻¹	31.125	6.155	28.3	5.3	23.4	4.7	28.05	6.28	20.9	8.7	25.7	7.2	22.8	7.3	24	8.6	26.3	5.6
Suspended solids (SS)	mg L ⁻¹	1.125	1.047	1.5	2.0	3	3.8	1.5	1.3	3	1.1	3	1.0	4	1.8	2	2.3	4	3.1
Total dissolved solids	mg L ⁻¹	56	16.2	78	13.4	68	14.5	74	13.7	58	7.1	60	13.8	68	13.4	68	12.3	68	11.6
Turbidity	NTU	0.4	0.2	0.65	1.15	0.9	0.4	0.65	0.79	1	1.0	0.85	0.26	1	2.8	1.4	2.4	1.25	1.02
Hardness (in CaCO ₃)	mg L ⁻¹	3.82	1.77	6.01	1.10	6.61	1.49	5.625	0.857	3.7	1.4	4.07	0.61	6.27	3.14	4.765	1.269	6.37	1.27
Nutrients																			
Ammonia nitrogen (NH ₃ - ^{NH} ₄)	mg N L ⁻¹	0.01	0	0.015	0.008	0.01	0.002	0.01	0.008	0.01	0.010	0.01	0	0.01	0.02	0.0175	0.010	0.01	0.01
Total nitrogen	mg N L ⁻¹	0.312	0.190	0.491	0.184	0.38775	0.127	0.344	0.188	0.329	0.145	0.426	0.101	0.337	0.119	0.15	0.163	0.397	0.135
Nitrates	mg N L ⁻¹	0.005	0.005	0.005	0.100	0.005	0	0.005	0.032	0.005	0.009	0.005	0.011	0.01	0.039	0.005	0.014	0.005	0.065
Nitrites	mg N L ⁻¹	0.005	0	0.005	0.004	0.005	0	0.005	0.006	0.005	0.009	0.005	0.007	0.005	0.010	0.005	0.007	0.005	0.006
Trace phosphorus	mg P L ⁻¹	0.0059	0.0020	0.0122	0.0048	0.0124	0.0031	0.0086	0.0031	0.0065	0.0035	0.0160	0.0037	0.0181	0.0051	0.0084	0.0036	0.0189	0.0058
Major ions																			
Bicarbonates	mg L ⁻¹	0.5	1.6	4	1.7	0.5	1.1	1.3	2.2	0.5	2.0	0.8	4.2	2	10.8	0.5	2.8	3.5	4.8
Bromides	mg L ⁻¹	0.05	0	0.05	0	0.05	0	0.05	0	0.05	0	0.05	0	0.05	0	0.05	0	0.05	0
Calcium	mg L ⁻¹	0.79	0.41	1.43	0.30	1.85	0.43	1.32	0.24	1.18	0.48	1.19	0.20	1.70	1.08	1.37	0.39	1.73	0.38
Carbonates	mg L ⁻¹	0.75	0	0.75	0	0.75	0	0.75	0	0.75	0	0.75	0	0.75	0	0.75	0	0.75	0
Chlorides	mg L ⁻¹	1.64	0.54	1.29	0.50	6.17	3.81	1.44	0.50	0.62	3.57	0.49	0.45	2.72	2.72	0.55	0.41	1.71	0.67
Fluorides	µg L ⁻¹	0	0	0	n/a	0	0	16	n/a	0	0	0	0	29.0	18.4	28.0	11.3	17	n/a
Magnesium	mg L ⁻¹	0.4185	0.1825	0.6265	0.0978	0.4713	0.1034	0.5795	0.0792	0.1840	0.0559	0.2680	0.0412	0.4890	0.1966	0.3300	0.0838	0.4810	0.0962
Potassium	mg L ⁻¹	0.2805	0.2001	0.4185	0.1524	0.3475	0.1506	0.3395	0.1655	0.1840	0.1214	0.1920	0.0841	0.3870	0.2140	0.3340	0.1313	0.3845	0.1234
Sodium	mg L ⁻¹	1.585	0.616	1.545	0.253	4.460	1.768	1.535	0.234	0.494	0.151	0.766	0.284	2.280	1.611	0.966	0.413	1.690	0.426
Sulfates	mg SO ₄ ^{L-1}	0.2015	0.0820	0.2090	0.0835	0.4250	0.2319	0.2020	0.1814	0.3470	0.7040	0.2270	0.1386	1.1800	0.5809	0.2370	0.5209	0.4350	0.2210
Trace metals																			
Aluminium	mg L ⁻¹	0.096	0.029	0.290	0.050	0.280	0.067	0.248	0.042	0.074	0.013	0.192	0.035	0.287	0.115	0.168	0.048	0.199	0.039
Antimony	mg L ⁻¹	0.0000185	0.0000649	0.0000278	0.0000364	0.0000025	0.0000224	0.0000073	0.0000195	0.0000100	0.0000276	0.0000025	0.0000176	0.0000025	0.0000122	0.0000025	0.0000119	0.0000038	0.0036910
Silver	mg L ⁻¹	0.0000015	0.0000149	0.0000015	0.0000010	0.0000015	0.0000071	0.0000015	0.0000016	0.0000015	0.0000055	0.0000015	0.0000022	0.0000015	0.0000012	0.0000015	0	0.0000028	0.0000145
Arsenic	mg L ⁻¹	0.0004	0.0002	0.0009	0.0004	0.0005	0.0002	0.0007	0.0003	0.0018	0.0006	0.0020	0.0005	0.0028	0.0006	0.0008	0.0002	0.0011	0.0006
Barium	mg L ⁻¹	0.002155	0.000726	0.004380	0.000875	0.006845	0.001443	0.003900	0.000804	0.002430	0.000876	0.003820	0.000891	0.009010	0.001476	0.003600	0.000980	0.004815	0.001008
Beryllium	mg L ⁻¹	0.0000045	0.0000019	0.0000115	0.0000068	0.0000115	0.0000034	0.0000095	0.0000039	0.0000030	0.0000189	0.0000095	0.0000065	0.0000220	0.0000064	0.0000083	0.0000018	0.0000120	0.0000034
Boron	mg L ⁻¹	0.00165	0.00086	0.00225	0.00103	0.00195	0.00082	0.00215	0.00156	0.00015	0.00156	0.00015	0.00137	0.00215	0.00086	0.00140	0.00071	0.00140	0.00082
Cadmium	mg L ⁻¹	0.0000125	0.0000028	0.0000160	0.0000057	0.0000215	0.0000082	0.0000150	0.0000044	0.0000120	0.0000080	0.0000230	0.0000039	0.0000300	0.0000065	0.0000183	0.0000048	0.0000180	0.0000038
Chromium	mg L ⁻¹	0.0005675	0.0001607	0.0009800	0.0002058	0.0012800	0.0003330	0.0008900	0.0002270	0.0005700	0.0002303	0.0009000	0.0002274	0.0010300	0.0002344	0.0008600	0.0003877	0.0009850	0.0001937
Cobalt	mg L ⁻¹	0.0001145	0.0000375	0.0003980	0.0001795	0.0004315	0.0001405	0.0003835	0.0002020	0.0000600	0.0000310	0.0001890	0.0000427	0.0005020	0.0001506	0.0001258	0.0000466	0.0002230	0.0000900
Copper	mg L ⁻¹	0.00027	0.00033	0.00029	0.00028	0.00057	0.00031	0.00032	0.00008	0.00019	0.00006	0.00038	0.00010	0.00064	0.00016	0.00035	0.00013	0.00030	0.00012
Iron	mg L ⁻¹	0.63	0.28	1.37	0.52	1.81	0.89	1.16	0.54	1.52	0.67	1.62	0.39	2.34	0.63	2.17	0.60	1.94	0.75
Lithium	mg L ⁻¹	0.0005	0.0005	0.0015	0.0008	0.0005	0.0002	0.0010	0.0007	0.0005	0.0002	0.0045	0.0023	0.0100	0.0029	0.0005	0.0002	0.0008	0.0006
Manganese	mg L ⁻¹	0.02495	0.00641	0.04655	0.01714	0.04465	0.01466	0.04640	0.01828	0.02140	0.00628	0.02480	0.00180	0.01985	0.00229	0.01485	0.00419	0.02535	0.00843
Mercury	mg L ⁻¹	0.000001	0	0.000001	8.165E-07	0.000001	0	0.000001	8.165E-07	0.000001	1.3416E-06	0.000001	1.2247E-06	0.000001	0	0.000001	3.5355E-07	0.000001	0
Molybdenum	mg L ⁻¹	0.000035	0.000045	0.000050	0.000036	0.000035	0.000016	0.000040	0.000028	0.000020	0.000021	0.000060	0.000026	0.000080	0.000106	0.000038	0.000068	0.000040	0.000030
Nickel	mg L ⁻¹	0.000175	0.000092	0.000655	0.000169	0.000630	0.000156	0.000550	0.000118	0.000150	0.000066	0.000380	0.000113	0.001320	0.000336	0.000230	0.000115	0.000425	0.000120
Lead	mg L ⁻¹	0.000375	0.000132	0.000355	0.000131	0.000503	0.000170	0.000315	0.000124	0.000440	0.000151	0.000510	0.000102	0.000460	0.000137	0.000343	0.000064	0.000375	0.000121
Selenium	mg L ⁻¹	0.00004875	0.000169	0.0000775	0.0001828	0.000125	0.00016033	0.000225	0.00022796	0.00015	0.00008036	0.0000575	0.00019268	0.000275	0.00018521	0.00013	0.00012192	0.0001225	0.00015214
Strontium	mg L ⁻¹	0.00898	0.00389372	0.0171	0.00343492	0.02185	0.00663639	0.01635	0.00292552	0.0095	0.00343635	0.0115	0.00220162	0.02785	0.01402023	0.014475	0.00316808	0.01805	0.0043967
Uranium	mg L ⁻¹	0.0000025	0.0000058	0.0000145	0.0000063	0.0000205	0.0000064	0.000011	0.0000039	0.0000025	0.0000121	0.000013	0.000006	0.000044	0.0000212	0.0000138	0.0000047	0.000019	0.0000064
Vanadium	mg L ⁻¹	0.00001	0.00013	0.00001	0	0.00001	0.00007	0.00001	0	0.00001	0	0.00001	0.00027	0.00001	0	0.00001	0.00008	0.00001	0.00011
Zinc	mg L ⁻¹	0.0046	0.0009	0.0045	0.0007	0.0060	0.0019	0.0051	0.0013	0.0037	0.0015	0.0032	0.0010	0.0051	0.0026	0.0030	0.0011	0.0035	0.0008

SURFACE WATER QUALITY CRITERIA

To put the natural concentrations observed in 2017 into context, they have been compared to the most stringent surface water quality criteria (CCME, 2017; MDDELCC, 2017b). These criteria are the following:

- MDDELCC:
 - Criterion to prevent the contamination of aquatic organisms (CPC[EO]);
 - Chronic aquatic life criterion (CVAC).
- Canadian Council of Ministers of the Environment (CCME):
 - Water quality recommendations (fresh water), protection of aquatic life – long-term effects.

CONCENTRATIONS OBSERVED

In the study area, we found only two potential human sources of surface water contamination: a remote landfill and a truck stop with a gas station. Otherwise, the study area is natural and is not affected by any forms of pollution that originate directly from human activity. Considering the location and isolated nature of these potential sources of contamination, the concentrations of the different parameters measured in the surface water of the watercourses in the study area correspond to levels of natural origin.

In situ measurements

The physiochemical measurements were taken *in situ* using a multiparameter probe. The measured pH values varied between 3.37 and 6.27. The pH values were therefore lower than the two MDDELCC criteria and the CCME recommendation (between 6.5 and 9) at all the stations. These results show that the surface water is more acidic than the water quality recommendations/criteria. The nature of the soil in the study area is likely to explain these deviations. Flooding of vegetation and forest soil consumes dissolved oxygen and releases minerals and nutritious elements, including carbon dioxide (CO₂), which contributes to the acidification of water. This acidification also slows down the decomposition of organic material.

During campaigns 1, 2 and 4, the dissolved oxygen concentration varied between 0.94 and 9.30 mg/L. These concentrations are lower than the CCME recommendation for each sampled station. Values lower than the CCME recommendation and the MDDELCC'S CVAC criteria were also recorded at certain stations during other sampling campaigns. Similar to the pH measurements, the amount of dissolved oxygen is also outside of the bounds recommended by the CCME or the MDDELCC and can also be explained by the nature of the soil found in the area, which acidifies the surface water and decreases oxygen concentration.

Basic descriptors, major nutrients and ions

Overview

Based on the surface water analysis, the following observations can be made:

- Alkalinity is low, the median value is 0.75 mg/L. Therefore, this water can be qualified as fresh water. This fact explains the low ion concentrations that were observed.
- The number of suspended solids is low, with a median value of 3 mg/L, whereas the normal range is between 2 and 53 mg/L (MDDELCC, 2016).
- The amount of dissolved organic carbon is high, with a median value of 25.7 mg/L, whereas the normal range is between 2.3 and 11.2 mg/L (MDDELCC, 2016). These values can be explained by the ubiquitous presence of peatlands, which are an important source of organic carbon, within empty drainage basins.
- Water in these watercourses is clear, with a median value of 0.9 NTU, whereas the normal range is between 0.6 and 26 NTU (MDDELCC, 2016).
- The amount of all nutrients is low and all within the lower limits of the respective normal ranges for these parameters (MDDELCC, 2016).

Comparison to applicable criteria

During campaign 4 at station 4A, only one sample did not respect the CVAC criterion for nitrites. As this was a single sample and the concentrations of this element had been weak at other points in time and geographic locations, contamination cannot be excluded as an explanation of this excess. Sampling of nitrogenous elements is sensitive to external contamination.

Finally, except for nitrites at station 4A during campaign 4, the concentrations of basic descriptors were below the reference criteria for all stations and all sampling campaigns.

Metals

Overview

The levels of dissolved metals were generally low. Of the 25 metals analyzed, aluminum, iron, manganese and strontium were found to have the highest levels.

The greatest concentration of aluminum (0.486 mg/L) was measured at Station 4A during the 6th campaign. The expected metal concentration range in surface water is between 0.012 and 2.25 mg/L (Jones and Bennett, 1986). Significantly, the same station had the highest concentration of arsenic observed (0.00316 mg/L) on two separate occasions, during the 2nd and 3rd campaigns.

Usually, in Canadian surface water, iron levels are less than 10 mg/L, but they can vary between 0.001 and 90 mg/L (NAQUADAT, 1985). The most significant level of iron (3.90 mg/L) was observed at Station 2A during the 3rd campaign.

Manganese levels in Canadian surface water vary between 0.01 and 0.4 mg/L (NAQUADAT, 1985). The highest median concentrations for this metal were observed at Stations 1B (0.04655 mg/L), 2A (0.04465 mg/L) and 2B (0.04640 mg/L).

Based on an American study (Skougstad and Horr, 1963), levels of strontium vary normally between 0.007 and 13.7 mg/L. The highest median concentration for this metal were observed at Stations 1B (0.171 mg/L), 2A (0.02185 mg/L), 2B (0.01635 mg/L), 3B (0.0115 mg/L) and 4A (0.02785 mg/L).

According to the different sources available, the concentration of dissolved minerals is within a natural range for Canadian surface water.

Comparison to applicable criteria

Concentrations of dissolved metals exceeding CCME and MDDELCC criteria were observed at nine sampling stations. Levels of aluminum, arsenic and iron exceeded the MDDELCC's CPC(EO) criterion at many stations. This is the most restrictive criteria. In addition, levels of aluminum and iron do not respect CCME recommendations in most samples. Table 6-14 indicates the number of cases of exceeded criteria and recommendations.

The natural content of beryllium and lead in the surface water of the study area seems generally higher than the MDDELCC's CVAC criterion since the concentration of these metals exceeded this criterion's threshold in many samples.

The highest concentration of beryllium (0.000027 mg/L) was measured at Station 1B during the first campaign. Station 2A had the highest concentration of lead (0.00079 mg/L) during the 3rd campaign.

In total, five metals exceeded one and/or both MDDELCC and/or CCME recommended criteria in the majority of samples collected at different stations. In fact, in addition to beryllium and lead, most of the collected samples indicated that the natural concentration of aluminum, arsenic and iron in surface water is greater than at least one criterion of water quality. There does not appear to be any variation between seasons, although mercury concentration exceeded the MDDELCC's CPC(EO) criterion only during the first sampling campaign in June 2017.

In addition, seven samples exceeded the CPC(EO) criterion for manganese over the six campaigns at different stations, and five more samples for mercury, but only in June.

Table 6-14 Number of surface water samples exceeding criteria

Parameter	Number of samples exceeding criteria		
	CPC(EO)	CVAC	CCME
Physicochemical parameters (<i>in situ</i>)			
Oxygen	-	14	24
pH	32	32	32
Nutrients			
Nitrites	0	1	0
Trace metals			
Aluminium	45 (5 duplicates)	0	56 (5 duplicates)
Arsenic	55 (4 duplicates)	0	0
Beryllium	0	41 (3 duplicates)	0
Iron	58 (5 duplicates)	6 (1 duplicate)	58 (5 duplicates)
Manganese	7	0	0
Mercury	5	0	0
Lead	0	58 (5 duplicates)	0
Notes: CPC(EO) – <i>Critère de prévention de la contamination de l'eau ou des organismes aquatiques</i> (Criterion to prevent the contamination of aquatic organisms). CVAC - <i>Critère de vie aquatique chronique</i> (Chronic aquatic life criterion). CCME – Canadian Council of the Ministers of the Environment.			

RADIONUCLIDES

A radionuclide analysis of surface water was carried out in May 2018 on two separate samples taken in creeks CE2 and CE3. Only uranium 234 and 238 and thorium 228 were detected. The results show that radionuclide levels are below the standards prescribed by Canadian guidelines for managing naturally occurring radioactive materials.

SEASONAL VARIATIONS

For basic descriptors, turbidity and suspended solids (SS) show similar trends. Some increase in concentrations for these parameters can be observed in late July and September.

In terms of nutrients, total nitrogen showed the same overall trend over the six campaigns. Nitrite levels generally increased in September and then declined in October and November. Phosphorus levels remained relatively constant throughout the period.

No particular trend can be detected for major ions. However, carbonate, calcium, magnesium and sodium showed stable levels over the entire sampling period.

Finally, for trace metals, elements that vary in their levels over time are antimony, beryllium, boron, cobalt, copper, molybdenum and selenium. However, no real trend is noticeable.

6.2.8.2 GROUNDWATER QUALITY

This section presents the main characteristics of groundwater quality in the study area. The comparison between the results obtained and recognized groundwater quality criteria establishes a baseline for the quality of groundwater in the study area. The Hydrogeological Technical Study (*L'étude spécialisée sur l'hydrogéologie*) (WSP, 2018a) details the methodology, work and the results.

METHODOLOGY

A total of 36 groundwater samples were collected from 20 observation wells or piezometer installations to determine the current status (baseline condition before work) of the site's hydrogeological environment. Sampling work was done in three separate campaigns. Sample wells and test dates are listed in Table 6-15 and shown on Map 6-5.

Table 6-15 List of sampled wells

Survey	Test date	Survey	Test date
PO1	2017-08-31	WSP-MW4S	2017-08-31
	2018-05-04		2018-05-05
PO2	2017-08-31	WSP-MW5R	2018-05-05
	2018-05-04		2018-02-04
WSP-PW03	2017-08-31 (1)	WSP-MW5S	2018-05-05
	2017-08-31 (2)		2018-02-04
	2017-08-31 (3)	WSP-MW6R	2017-08-31
	2018-02-04		2018-05-04
	2018-05-05	WSP-MW7R	2018-05-03
WSP-MW1R	2018-05-03		2018-02-04
WSP-MW2R	2018-05-05	WSP-MW8R	2018-05-03
WSP-MW2S	2018-05-05		2018-02-05
	2018-02-04	WSP-MW8S	2018-05-03
WSP-MW3R	2018-05-03	WSP-MW9R	2018-05-04
	2018-02-04	WSP-MW9S	2018-05-04
WSP-MW3S	2018-05-03	BH-10R	2018-05-02
	2018-02-04	BH-10S	2018-05-02
WSP-MW4R	2017-08-31		
	2018-05-05		

Analytical program

The choice of parameters was based on the risks associated with the use of the site and on the requirements of D019 (MDDEP, 2012). Groundwater samples were analyzed for one or more of the following:

- inorganic compounds (total cyanides, fluorides, nitrates, nitrites, total sulphides);
- C10-C50 petroleum hydrocarbons (PH);
- major ions (bicarbonates, calcium, carbonates, chlorides, magnesium, potassium, sodium and sulphates);
- dissolved metals (scanned);
- acid-soluble metals (pumping test);
- physiochemical parameters (alkalinity, conductivity, hardness, suspended solids, pH, total dissolved solids);
- radionuclides (U-238, U-234, Ra-226, Pb-210, Th-232, Ra-228 and Th-228) – 2 samples.

Water quality criteria

Considering the groundwater at the study site could end up in surface water, the results of chemical analysis were compared to the criteria for resurgence in surface water, or RSW (*résurgence dans les eaux de surface*, or RES) in the *Guide d'intervention: Protection des sols et réhabilitation des terrains contaminés* from the MDDELCC (Beaulieu, 2016). Potential recipients are streams and lakes. RSW quality criteria are calculated from the *Critères de qualité de l'eau de surface au Québec* (Surface water quality criteria in Quebec) (MDDEFP, 2013). The value selected for each parameter corresponds to the lowest of the following four values:

- 1 X CVAA - *Critère de vie aquatique aiguë* (Acute aquatic life criterion)
- 100 X CVAC - *Critère de vie aquatique chronique* (Chronic aquatic life criterion)
- 100 X CPCO - *Critère de prévention de la contamination des organismes aquatiques* (Criterion to prevent the contamination of aquatic organisms)
- 100 X CFTP - *Critère de faune terrestre piscivore* (Fish-eating wildlife criterion)

The MDDELCC has established groundwater threshold alerts at concentrations that predict resource loss and risk to health, consumption and the environment. For a site located upstream of a body of water, the MDDELCC imposes a threshold equal to 50% of the value of RSW criteria. Since the study site is less than 1 km from several streams and lakes, a threshold alert of 50% was applied.

RESULTS

Physicochemical parameters

Conductivity, pH, dissolved oxygen and temperature measurements were taken *in situ* using a YSI probe during well sampling. The pH values measured in groundwater samples ranged from 4.38 to 8.98. The lowest pH of 4.38 was recorded in the WSP-MW8S well during the May 2018 campaign; and the highest pH of 8.98 was recorded in the MW05R well in February 2018. Electrical conductivity levels are generally low and range from 4 µS/cm to 543 µS/cm, indicating that the water in the study area is low in minerals. Conductivity tends to be lower in groundwater coming from unconsolidated deposits and higher in water from rock wells. Temperatures measured during the various sampling campaigns varied between 0°C and 10°C.

Major ions

Analyzing major ions makes it possible to describe different types of groundwater and compare water quality. The Piper diagram illustrates the similarities and differences between water samples and provides correlations. Figure 6-3 shows the proportion of major ions for all sampled wells. Generally, wells located in recharge areas have higher proportions of carbonates and calcium. When the waters have been in contact for awhile with the geological formations, chlorides, sulphates, sodium and/or potassium enrichment occurs downstream. Most samples from rock wells and wells in unconsolidated deposits have a similar geochemical signature, i.e., $\text{Ca}^{2+} + \text{Mg}^{2+}/\text{HCO}_3$ (calcium and magnesium bicarbonate) water types. Five samples (PW03 [3], MW5R and MW2R) have a sodium and potassium bicarbonate geochemical signature and a sample (MW5R) consists of sodium and potassium sulfate.

Metals

Of the samples analyzed during the sampling campaigns, 15 exceeded the RSW criteria for one or another of the following metals: silver, copper, manganese and zinc. In addition, 15 additional samples exceeded the alert threshold for one or another of the following metals: silver, barium, copper, manganese and zinc.

If we compare the results with drinking water criteria, some metals would exceed the criteria or recommendations. These are mainly arsenic (all samples exceed criteria except for three samples taken from unconsolidated deposits), aluminum and manganese.

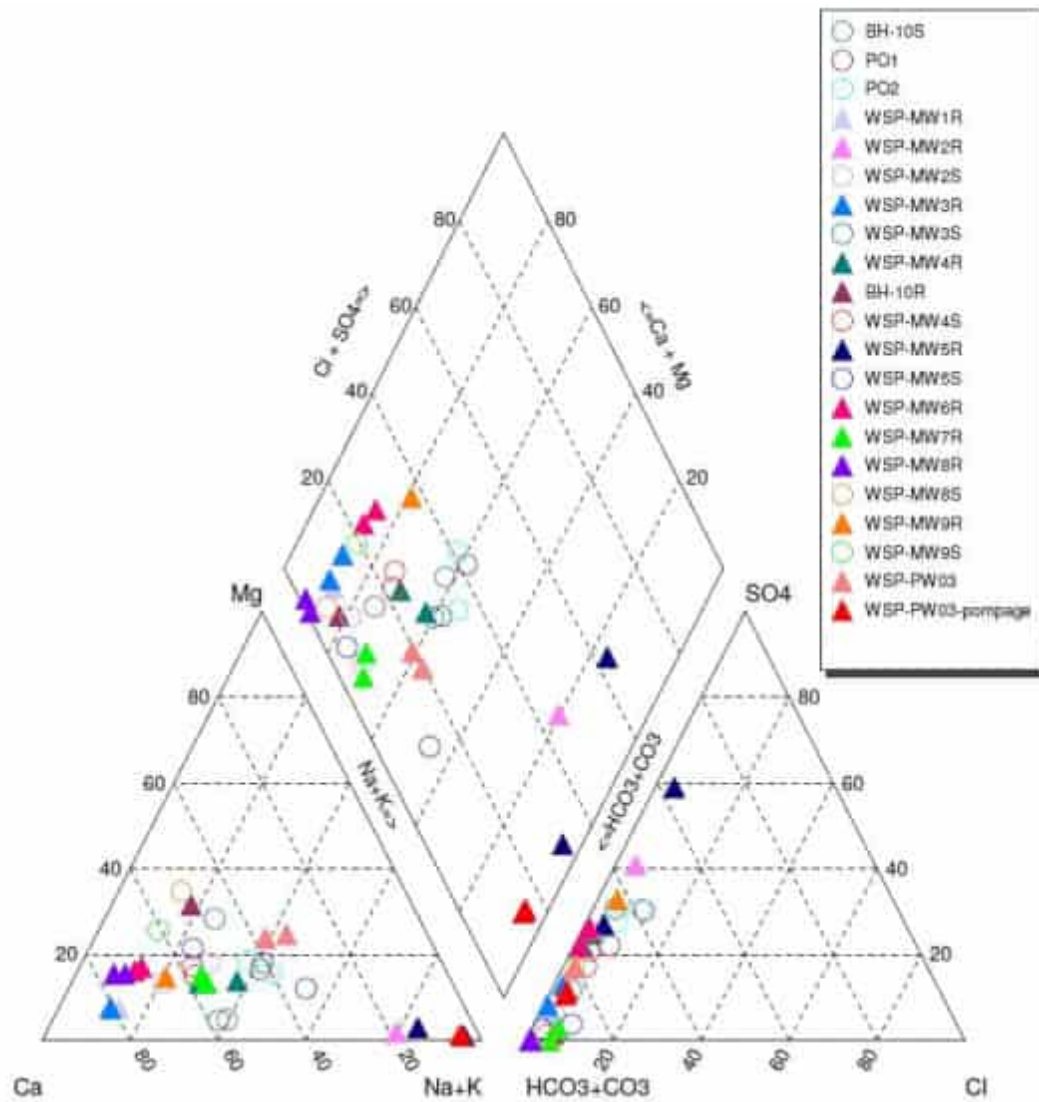


Figure 6-3 Ternary diagram showing the amounts of major ions in each of the groundwater samples

Table 6-16 shows the number of threshold alerts exceeded and the RSW and drinking water sample criteria.

Table 6-16 Number of analyzed groundwater samples exceeding criteria

Parameter (TA/RSW/DW µg/l criteria)	2017–2018 campaign		
	Threshold Alerts (TA)	Resurgence in surface water (RSW)	Drinking water (DW)
Aluminium (- / - /100)	-	-	12/36
Silver (0.015/0.03/100)	4/36	1/36	0
Arsenic (170/340/0.3)	0	0	Only three samples <u>were below</u> drinking water criterion.
Barium (54/108/1000)	3/36	0	0
Copper (0.75/1.5/1000)	28/36	9/36	0
Manganese (275.5/551/50)	8/36	5/36	12/36
Zinc (8.5/17/5000)	8/36	2/36	0

Other parameters

Ammonia nitrogen, cyanides, fluorides, nitrates, nitrites and total sulphides were analyzed in all samples. All samples had a concentration below RSW criteria or the laboratory's detection limit.

Radionuclides

The various natural radionuclides, and their levels in the water, depend on the geological nature of the watershed and subsoil. Natural levels found in groundwater are due to the levels of radionuclides found in geological formations. Radionuclide analysis was conducted in February and May 2018 on two groundwater samples from wells intercepting different geological units, WSP-PW03 and WSP-MW7R. The levels of radium-228, thorium-230, radium-226, lead-210 and potassium-40 were all below detection limits. For thorium-232, levels were below the detection limit in WSP-PW03 and 0.01 Bq /L in WSP-MW7R. For uranium-234 and uranium-238, levels ranged from 0.001 to 0.02 Bq /L. For thorium-228, the levels varied between 0.5 and 0.6 Bq /L.

NATURAL BACKGROUND LEVELS

From the statistical analysis results, metal natural background levels (NBLs) were evaluated. The calculated values offer an initial concentration that represents the natural environment before development.

Parameters for which natural background levels were assessed are aluminum, arsenic, barium, copper, iron, lithium, manganese, **nickel**, **lead** and zinc. Copper, barium, manganese and zinc exceeded the RSW or threshold alert and more than 50% of the samples were above the laboratory's limit of detection (LOD). **Arsenic, nickel and lead did not exceed RSW or threshold alert criteria, but the background level gave a representative picture of the study site. Aluminium, iron and lithium did not** have any RSW or threshold alert criteria, but the results provided an estimate of the natural levels.

Using the Shapiro-Wilk test, an evaluation of the normality determined that all the above parameters followed a normal or log normal distribution. **The summary of the background levels measured is presented in Table 6-17.**

Table 6-17 Calculation of natural background levels of metals in groundwater

Parameter/Lithology unit	Natural background levels (µg/L)	
	Unconsolidated deposits (till)	Rock
Aluminium	<u>284.2</u>	<u>182.0</u>
Arsenic	<u>7.8</u>	<u>94.1</u>
Barium	30.9	32.4
Copper	1.4	2.6
Iron	3,399	1,993
Lithium	8.8	266.1
Manganese	<u>295.5</u>	<u>327.2</u>
Nickel	3.3	3.2
Lead	0.2	0.1
Zinc	10.3	8.7

LEGEND:

100	: Calculated NBL Value > RSW Criterion
100	: Calculated NBL Value > Threshold Alert
100	: Calculated NBL Value > Criterion / Drinking Water Recommendation

Anticipated exceedances

Depending on the analysis performed, barium, copper, manganese and zinc may on occasion exceed the RSW criterion or the threshold alert in some wells. For silver, the concentrations show that natural levels could exceed the criteria. However, the number of analyses with concentrations below detection limits was too great to perform a statistical analysis for this parameter.

6.2.9 SOIL AND SEDIMENT QUALITY

6.2.9.1 SOIL

NATURAL BACKGROUND LEVELS

Evaluation of soil quality in the study area was based mainly on *Lignes directrices sur l'évaluation des teneurs de fond naturelles dans les sols* (Ouellette, 2012) and on *Guide de caractérisation physicochimique de l'état initial des sols avant l'implantation d'un projet industriel* (MDDELCC, 2015). Natural background levels (NBLs) were determined based on soil samples taken at **114** soil sampling sites (**66** exploration trenches and 10 drilling sites) spread out over the study area (Map 6-4).

The surveys were conducted in areas unaffected by anthropogenic activities, based on available information. In addition, samples were taken from natural, undisturbed stratigraphic units. The **updated** Soil Background Concentration Technical Study (*L'Étude spécialisée sur la teneur de fond naturelle dans les sols*) (WSP, **2021a**) details the methodology used, the work carried out and the results obtained.

Four stratigraphic units are frequently found in the natural soils of the study area. First, a horizon of topsoil or peat is present at the surface. Beneath this unit, the natural soils are made up of an alternation of three main stratigraphic units. The first is composed of coarse sand to sand and gravel, containing pebbles and sometimes blocks. The second unit is composed of fine sand to silty sand, containing a little gravel in places. Last, a third unit of silt to clayey silt is sometimes found, mainly at depths. Thus, the calculations leading to the determination of NBLs were conducted using analysis results obtained on stratigraphic units described as being coarse sand (**74** samples) and fine sand (**50** samples), these being more widespread and thus most representative of the soils in the study area.

A separate statistical analysis was performed on the two stratigraphic units considered—the coarse sand unit and the fine sand unit—to establish the background levels. This analysis was carried out based on the analysis results of total metal contained in the soil samples. The NBLs were assessed based on the statistical analysis. The calculated values provided an initial level representative of the natural environment. Because of the substantial proportion of samples below the laboratory limit of detection (LOD), the following parameters were excluded from the analysis:

antimony, silver, arsenic, cadmium, chromium, cobalt, copper, tin, mercury, molybdenum, nickel, lead and selenium.

The statistical analysis was thus performed for aluminum, barium, calcium, iron, lithium, magnesium, manganese, potassium, titanium and vanadium. Silicon, sodium, strontium and zinc were also analyzed, but only for the coarse sand unit.

Normal background levels were calculated for these parameters using the upper whisker method. The NBL was **also** assessed for each parameter analyzed by setting the upper confidence limit at 95% of the **95th** percentile of the distribution of levels. For the parameters for which an adjusted NBL was not calculated, the generic criterion “A” of the *Guide d’intervention* was set as the natural background level. The results obtained are presented in Table 6-18.

The results of the chemical analyses obtained on the coarse sand unit samples showed levels higher than the background levels established for the Superior Geological Province (generic “A” criteria) for two parameters: arsenic (two samples) and hexavalent chromium (six samples). For hexavalent chromium (Cr VI), two samples showed levels that fell between two criteria—“B” and “C”—and four samples showed levels above the “C” criterion. For the fine sand unit, the chemical analysis results also showed concentrations above generic “A” criteria for arsenic (two samples) and above the “B” criterion for Cr VI (one sample). For all the other parameters analyzed, no generic criterion is defined in the MDDELCC Guide.

CONCENTRATION IN HEXAVALENT CHROMIUM

During the 2018 characterization, three analyzed samples showed Cr VI levels that fell between the “B” and “C” criteria and four showed Cr VI levels above the “C” criterion. After these were detected, the MELCC requested a special analysis for Cr VI in order to define the extent of its presence in the soil (WSP, 2021b).

In 2020, concentric samples were taken around three trenches that showed levels of hexavalent chromium that exceeded the Guide d’intervention’s generic “B” criterion in 2018. All samples collected from a 50 m radius around the three trenches showed hexavalent chromium levels below the Guide d’intervention’s generic “A” criterion, when analyzed using ion-exchange chromatography. It is possible that levels detected in samples during characterization in 2018 can be attributed, in full or in part, to interference from the method of analysis used (colorimetry).

It therefore seems reasonable to conclude that the higher Cr VI concentrations obtained in 2018 can be attributed to false positives from the method, or at least, that the results of this additional characterization demonstrate that this higher hexavalent chromium level, if it existed, was an isolated event limited to three sectors investigated. Consequently, there is no reason to believe that there is a hexavalent chromium problem on the site.

REMOTE LANDFILL

A Phase II Environmental Site Assessment (ESA) was done in summer 2017 at the remote landfill close to the project site (Map 6-4) (WSP, 2018d). According to the results of the assessment, the estimated volume of buried residual materials (paper, plastic, metal, wood, fabric) is 756 m³.

Soils with levels of C₁₀-C₅₀ petroleum hydrocarbons and total sulphur exceeding the generic “A” criteria of the MDDELCC *Guide d’intervention* and with levels of metals exceeding the limits set out in Schedule I of the *Regulation respecting the landfilling and incineration of residual materials* (RLIRM) were updated during the work. These soils, the preliminary volume estimate of which is approximately 3,000 m³, are in contact with the residual materials of the remote landfill and are considered non-compliant for an industrial site because of their level of lead.

Also, soils whose surface level of chromium VI lay in the “B-C” range of the generic criteria were also updated in the survey performed at the base of a heap of treated-wood poles. The volume associated with this type of contamination was assessed at 5 m³.

Table 6-12 Calculation of background levels of metals in soils

Parameter/Lithological unit	Natural background level (mg/kg)	
	Coarse sand unit	Fine sand unit
Aluminum	12,535.0	6,060.5
Antimony	-	-
Silver	0.5	0.5
Arsenic	5	5
Barium	50	27.5
Cadmium	0.9	0.9
Calcium	2,410.0	3,238.3
Chromium	100	100
Cobalt	30	30
Copper	65	65
Tin	5	5
Iron	14,118.0	11,725.0
Lithium	10.5	8.9
Magnesium	4,455.0	3,106.5
Manganese	146.6	108.0
Mercury	0.3	0.3
Molybdenum	8	8
Nickel	50	50
Lead	40	40
Potassium	1,528.8	1,189.1
Silicon	1,356.3	-
Selenium	3	3
Sodium	127.5	-
Strontium	12.5	-
Titanium	823.8	690.5
Vanadium	27.5	15
Zinc	12.5	150

LEGEND:

100	: NBL value = <i>Guide d'intervention</i> criterion “A”
100	: NBL value calculated using the upper whisker method

6.2.9.2 SEDIMENTS

This section presents the main characteristics of sediments quality in watercourses in the study area, to determine their current contamination level based on various criteria of sediment quality recognized by the provincial and federal governments. In each watercourse, a sampling station made up of five substations was established. The location of stations is shown on Map 6-8. The Aquatic Inventory and Baseline Study (*Étude spécialisée sur l'habitat aquatique*) (WSP, 2018c) provides details of the methodology used, the work carried out and the results obtained.

Two complementary sediment sampling campaigns were done after the 2018 Aquatic Inventory and Baseline Study. Additional sediment samples were collected in September 2019 to analyze sulphur levels, since this parameter had been omitted in the 2018 study. Samples were also collected from two additional stations in July 2020— CE2-C and CE2-D—in order to have three stations exposed downstream of the effluent, as recommended by the MELCC.

GRANULOMETRY

In all the granulometric analyses performed, samples were generally dominated by the fraction associated with sand, except for **four** samples taken from creek CE2 (station 2A, sample CE-2A-3: 47.9%; station 2B, sample CE-2B-2: 26.4%; **station 2C: 23.3%; and station 2D: 24.4%**) and one taken from creek CE5 (station 5B, sample CE-5B-5: 43.0%). The proportions of sand varied from 41.0% (station 2B, sample CE-2B-3) to 89.1% (station 2B, sample CE-2B-5). On average, the samples were composed of approximately **58% sand, 26% silt and clay and 16% gravel**.

The granulometry of some samples from creeks CE2 to CE5 could not be determined because they were composed exclusively of organic material (peat). These were samples CE-3A-1 to CE-3A-5, CE-3B-1 to CE-3B-5, CE-2A-4, CE-2B-1, CE-5B-3 and CE-5B-4, as well as the sample from creek CE4.

CHEMICAL CHARACTERISTICS

Tables 6-19 and 6-20 present statistics describing the levels measured in sediments as well as the sediment quality criterion.

The analysis results were compared with the sediment quality criteria of ECCC and the MDDELCC (Environment Canada and MDDEP, 2007) and Canadian sediment quality guidelines from the CCME. The criteria and recommendations are:

- ECCC and MDDELCC:
 - rare effect level (REL);
 - threshold effect level (TEL);
 - occasional effect level (OEL);
 - probable effect level (PEL);
 - frequent effect level (FEL).
- CCME:
 - interim sediment quality guidelines (ISQGs);
 - threshold effect level (TEL).

Integrative parameters

The analysis results for total oils and greases ranged from below the detection level at station 5B (sample CE-5B-5) to 11,830 mg/kg at station 3A (CE-3A-2). The average value of samples analyzed was **1,949.3 mg/kg**, but the standard deviation was relatively large (**2,626.65 mg/kg**). With regard to petroleum hydrocarbons, the results were below the detection limit at several stations and the maximum value was 940 mg/kg at station 5B (sample CE-5B-1). The average value was **151.44 mg/kg** and the standard deviation was **200.37 mg/kg**.

At Asiyan Akwakwatipusich Lake, the total oil and grease level was 937 mg/kg and below the detection limit for petroleum hydrocarbons. No sign of past contamination was visible. However, it is plausible that this contamination might come from the road lying upstream of this lake.

No criterion or guideline is provided for total oils and grease or for petroleum hydrocarbons (C₁₀-C₅₀).

The presence of C₁₀-C₅₀ petroleum hydrocarbons can generally be explained by a spill occurring further upstream contaminating sediment, but may also be a false positive when the soil analyzed is rich in organic matter. When soil with high organic matter content is analyzed for C₁₀-C₅₀ PH, the measured concentration may be overestimated. Soil that is rich in natural organic compounds can contain, among other things, hydrocarbons that are not from petroleum (biogenic hydrocarbons), but that interfere in the C₁₀-C₅₀ chromatographic region, despite purification steps required in the analytical method. This possibility means that certain results may turn out to be false positives (MDDELCC, 2016).

Inorganic parameters

Total organic carbon (TOC) values measured ranged from 0.38% at station 5B (sample CE-5B-5) to 90.70% at station 3A (sample CE-3A-2). The average value was 16.67%. The average humidity of the samples analyzed was 55.66%. The total sulphur values measured ranged from below the detection limit at station 2A (sample CE-2A-1) to 16,700 mg/kg at station 3B (sample CE-3B-2). The average value was 1,481 mg/kg. At Asiyan Akwakwatipusich Lake, the TOC level was 2.9%.

There is no criterion or guideline for TOC and humidity.

Trace elements and heavy elements

Analysis results for thallium showed levels below the detection limit. Analysis results for titanium showed the greatest variability, with values ranging from **20 mg/kg** at station **3A** (sample CE-3A-2) to **4,060 mg/kg** at station **2D** (sample CE-2D-D), with an average of **611 mg/kg** and a standard deviation of **774 mg/kg**.

At Asiyan Akwakwatipusich Lake, the highest level was for titanium (932 mg/kg) and the lowest for thallium (7.5 mg/kg).

As with the integrative parameters and inorganic parameters, no criterion or guideline is defined for trace elements and heavy elements.

Metals and metalloids

Arsenic levels ranged from 0.75 mg/kg (half the detection limit) to 115 mg/kg for the sample from creek CE4. The average was **13.09 mg/kg**, while the standard deviation was **22.04 mg/kg**. Thus, up to **29** samples containing natural levels above the rare effects level (REL) criterion were observed. This is the most restrictive criterion, set at 4.1 mg/kg. Arsenic is the substance showing the greatest number of natural levels above the corresponding criterion.

Total chromium levels measured ranged from 1 mg/kg (half the detection limit) to **89 mg/kg** (station **2D**, sample CE-2D-D). The average was **28.20 mg/kg**, while the standard deviation was **22.73 mg/kg**. Comparing the samples against the REL criterion, total chromium presented **14** values above the criterion, which is set at 25 mg/kg for this substance.

Cadmium values ranged from 0.15 mg/kg (half the detection limit) to **1.0 mg/kg for the sample from creek CE4**. Thus, **ten** samples presented natural levels above the REL criterion.

Mercury levels ranged from 0.01 mg/kg (half the detection limit) to 0.20 mg/kg (station 5B, sample CE-5B-4). Four of these samples presented levels above the REL criteria.

Lead levels ranged from 2.5 mg/kg (half the detection limit) to 46 mg/kg (station 5A, sample CE-5A-5). Three samples presented levels above the REL criteria. Copper levels ranged from 2.5 mg/kg (half the detection limit) to 33 mg/kg (station 3B, sample CE-3B-4). **Three** of these samples presented levels above the REL criterion.

Zinc levels ranged from 5 mg/kg (half the detection limit) to 82 mg/kg (station 2D, sample CE-2D-D). Just one of these samples presented levels above the REL criterion.

For Asiyan Akwakwatipusich Lake, the cadmium level was 0.45 mg/kg, above the REL criterion. Total chromium level was 48 mg/kg, above the TEL criterion. Finally, the mercury level was 0.1 mg/kg, thus above the REL criterion.

Radionuclides

An analysis of radionuclides was performed on sediments taken at stations 3B and 5B. This was performed on a homogenate of five samples taken from each station. This led to the finding that radionuclide levels were below the standards set out in the Canadian guidelines for the management of naturally occurring radioactive materials. For Asiyan Akwakwatipusich Lake, only radium 226 in sediments was analyzed in 2012. The level of this substance was below the Canadian guidelines for the management of naturally occurring radioactive materials (WSP, 2018c).

Table 6-19 Average and standard deviation of levels measured in sediments

Substances	CE-2A		CE-2B		CE-2C		CE-2D		CE-3A		CE-3B		CE-5A		CE-5B			
	CE-1A	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	CE-4	Average	Standard deviation	Average	Standard deviation
Metals and metalloids																		
Aluminum (mg/kg)	3,500	5,336	2,162	4,634	1,825	6,249	693	21,160	7,969	2,035	1,185	2,884	2,113	2,580	3,658	447	4,436	2,297
Antimony (mg/kg)	3.5	4	0	4	1	3.5	0	3.5	0	4	0	4	1	3.5	4	0	4	1
Silver (mg/kg)	0.25	0.25	0	0.25	0	0.25	0	0.25	0	0.25	0	0.25	0	0.25	0.25	0	0.25	0
Arsenic (mg/kg)	5.1	10.2	3.9	0.8	1.3	8.6	3	5.4	0.4	7.9	3.6	2.4	1.7	115.0	45.1	33.2	4.7	11.7
Barium (mg/kg)	27	51	20	31	8	40	5	114	5	24	11	22	12	23	17	9	30	15
Beryllium (mg/kg)	0.5	0.5	0	0.5	0	0.5	0	0.5	0	0.5	0	0.5	0	0.5	0.5	0	0.5	0
Bismuth (mg/kg)	2.5	2.5	0	2.5	1	7.5	0	7.5	0	2.5	0	2.5	1	2.5	7.0	5	2.5	1
Boron (mg/kg)	5	6	2	5	1	5	0	5	0	11	4	6	2	14	254	155	5	61
Cadmium (mg/kg)	0.15	0.15	0	0.15	0	0.15	0	0.75	0.05	0.15	0	0.15	0	1	0.66	0	0.15	0
Calcium (mg/kg)	948	2,722	1,209	1,788	521	5,714	1,771	3,806	82	7,678	2,556	3,980	1,768	12,400	1,289	4,540	2,373	1,276
Total chromium (mg/kg)	14	26	11	23	9	24.5	3	83	3	12	8	15	11	9	25	10	23	9
Cobalt (mg/kg)	2	3	2	3	1	2.75	1	11	0	2	1	2	1	1.5	2	0	3	2
Copper (mg/kg)	9	15	6	3	2	4.25	1	21	2	11	6	15	11	7.0	3	2	6	4
Tin (mg/kg)	2.5	2.5	0	2.5	1	2.5	0	2.5	0	2.5	0	2.5	1	2.5	2.5	0	2.5	1
Iron (mg/kg)	5,240	8,658	3,114	7,382	2,495	16,538	1,702	35,020	16,366	11,984	3,505	6,418	3,527	12,700	275,000	155,372	7,448	60,434
Magnesium (mg/kg)	1,610	2,658	910	2,568	952	2,146	426	13,180	4,655	779	549	924	948	576	208	258	2,374	1,101
Manganese (mg/kg)	53	107	41	84	25	142	35	445	103	100	32	56	35	27	265	223	88	60
Mercury (mg/kg)	0.04	0.02	0.01	0.01	0.00	0.09	0	0.01	0	0.05	0.06	0.08	0.04	0.09	0.01	0.03	0.05	0.08
Molybdenum (mg/kg)	1	1.0	0	1.0	0	1.0	0	1.0	0	1.0	0	2.0	2	27	1.0	11	1.0	4
Nickel (mg/kg)	6	11	4	8	3	8	1	34	2	5	3	6	5	7	3	3	9	4
Lead (mg/kg)	2.5	8.7	4.5	2.5	0.8	8	2	8	0	3.4	1.8	3.6	2.3	5.0	28.8	16.7	3.4	5.7
Potassium (mg/kg)	815	1,557	635	1,048	317	980	190	7,530	2,727	121	317	440	530	131	41	47	1,114	537
Silicon (mg/kg)	357	406	99	367	120	590	29	628	218	469	267	547	188	396	833	386	358	69
Selenium (mg/kg)	0.5	0.5	0	0.5	0	0.25	0	0.25	0	0.7	0	0.5	0	0.5	1.1	1	0.8	1
Sodium (mg/kg)	60	136	55	113	47	362	151	1,308	288	55	10	106	61	104	27	35	60	22
Zinc (mg/kg)	17	42	15	10	7	38	10	75	5	13	7	10	6	12	13	10	14	6
Integrative parameters																		
Total oils and greases (mg/kg)	501	857	311	384	122	1,481	879	150	0	5,676	3,904	5,488	1,908	4,420	367	1,660	557	544
Petroleum hydrocarbons (C10 to C50) (mg/kg)	50	365	246	50	80	50	0	50	0	266	210	141	103	151	50	41	240	360
Inorganic parameters																		
Total organic carbon (%)	3.49	4	2	2	1	21	3	0.64	0.16	50	27	53	20	4.5	5	1	5	3
Humidity (%)	30.6	46	17	26	9	83.7	2.6	35.9	2.4	88	15	85	29	79.5	48	14	44	18
Total sulphur (mg/kg)	1,250	400	173	-	-	780	425	1,452	1,165	-	-	4,960	6,796	1,300	180	130	920	676
Trace elements and heavy elements																		
Lithium (mg/kg)	6	10	4	10	4	10	0	29	2	1	3	2	2	1	1	0	13	6
Thallium (mg/kg)	7.5	7.5	0	7.5	3	0.5	0	0.5	0	7.5	0	7.5	3	7.5	7.5	0	7.5	3
Strontium (mg/kg)	5	25	13	12	5	44	8	38	1	27	8	31	18	659	9	265	10	104
Titanium (mg/kg)	359	526	176	506	217	571	51	2,440	906	115	101	258	220	190	170	66	428	201
Uranium (mg/kg)	10	10	0	10	4	10	0	10	0	10	0	10	4	10	48	32	10	9
Vanadium (mg/kg)	12	23	8	25	13	15	0	53	2	9	5	11	8	30	76	23	13	9
Note: Sediments were sampled only once at stations 1A and 4.																		

Table 6-20 Number of criteria exceeded in sediment samples analyzed

Substances	CCME ^a				Environment Canada and MDDEP ^b			
	ISQG	TEL	PEL	REL	TEL	OEL	PEL	FEL
Arsenic (mg/kg)	20	0	6	29	20	14	6	5
Cadmium (mg/kg)	9	0	0	10	9	0	0	0
Total chromium (mg/kg)	7	0	0	14	7	5	0	0
Copper (mg/kg)	0	0	0	3	0	0	0	0
Mercury (mg/kg)	1	0	0	4	1	0	0	0
Lead (mg/kg)	2	0	0	3	2	0	0	0
Zinc (mg/kg)	0	0	0	1	0	0	0	0
a:	Summary table of Canadian sediment quality guidelines.							
b:	Criteria for the assessment of freshwater sediment quality.							

6.2.10 AIR QUALITY

According to the National Pollutant Release Inventory (NPRI), the closest industrial activities are over 100 km away from the project site. Due to the project's location, air quality in the sector is then considered very good.

No air quality measurement data is available to characterize the study area ambient environment.

However, in its mining instruction guide, the **MELCC** proposes a set of specific initial levels for mining projects that are in northern areas (north of the 51st parallel) and remote from other sources of atmospheric contaminant emissions. These initial levels are presented in Table 6-21a.

Table 6-21a Initial levels for northern projects

Compound	Period	Ambient level (µg/m ³)
Total particulate matter (TPM)	24 hours	40
Fine particulate matter (PM _{2.5})	24 hours	15
	1 year	4.5 ^a
Breathable particulate matter (PM ₁₀)	24 hours	21.8 ^b
	1 year	5.5 ^b
Carbon monoxide	1 hour	600
	8 hours	400
Nitrogen dioxide (NO ₂)	1 hour	50
	24 hours	30
	1 year	10
Sulphur dioxide (SO ₂)	4 minutes	40
	1 hour	21 ^c
	24 hours	10
	1 year	2
a:	Level calculated based on data from Pémonca station.	
b:	Value calculated by interpolation with TPM and PM _{2.5} .	
c:	Based on the initial 4-minute concentration, converted for a one-hour period using the inverted formula of the <i>Clean Air Regulation</i> .	

To compare these levels with data from an existing network of air quality measurement stations for a similar environment, data was analyzed from the northernmost stations of the *Réseau de surveillance de la qualité de l'air du Québec* (Quebec Air Quality Monitoring Network, RSQAQ). The Radisson Station was selected from this group as the most representative of the study area. Station positions are illustrated in Map 6-9. Resulting initial concentrations are presented in Table 6-21b below.

Table 6-21b Initial particulate matter concentrations at the northernmost RSQAQ stations

Station name	Admin. region	Station no.	Substance	Initial concentration ^[1] (µg/m ³)		Mean annual concentration			24 hour concentration – 98th percentile		
				Annual	24 h	2017	2018	2019	2017	2018	2019
Lac-Édouard	4	4750	TPM	8.7	31.8	11.6	9.1	5.3	50.1	26.2	19.0
Radisson	10	10200	TPM	6.4	26.6	-	7.9	4.9	-	36.4	16.9
Lac-Édouard	4	4750	PM _{2.5}	5.0	11.7	4.9	4.4	5.7	11.5	11.7	11.9
Radisson	10	10200	PM _{2.5}	2.8	7.0	2.4 ^[2]	2.3	3.3	7.7 ^[2]	5.9	8.1
Pémonca	2	2610	PM _{2.5}	4.0	9.7	4.1	3.7	4.0	9.9	9.8	9.2
Senneterre	8	8450	PM _{2.5}	4.3	11.9	4.0	4.7	4.2	10.8	13.3	11.7

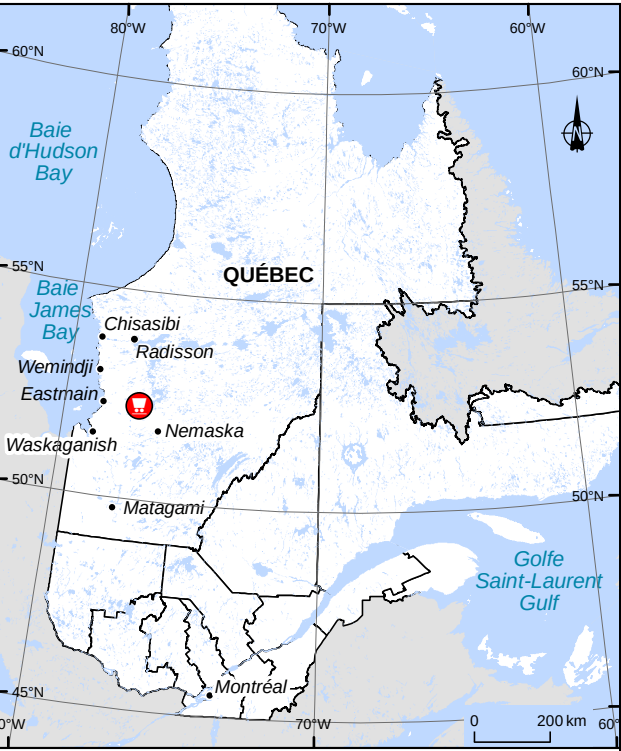
[1] Calculated from a three-year mean based on the MELCC method in accordance with section 202 of the Clean Air Regulation.

[2] 774 hourly measurements are available at this station for 2017. Statistics are for guidance only.

The compilation results show that the initial concentrations of 40 µg/m³ and 15 µg/m³ for total particulate matter (TMP) and PM_{2.5}, respectively, appear to be adequate, and even conservative, to characterize the study site.

For annual concentrations of PM_{2.5}, no initial concentration is specified in the mining instruction guide. An initial concentration of 4.5 µg/m³ is therefore suggested, based on measurements in past years at the Pémonca station. For breathable particulate matter concentrations under 10 µm (PM₁₀), no initial concentration is specified in the mining instruction guide. Initial concentrations based on interpolation between concentrations of TPM and PM_{2.5} are therefore suggested. For the purposes of this calculation, an annual TPM concentration of 8 µg/m³, assessed at Lac-Édouard Station³ was used. Initial concentrations of 21.8 µg/m³ for the 24-hour period and 5.5 µg/m³ for the annual period were obtained this way. The comparison with the Radisson Station data shows that these concentrations are adequate, and even conservative, to characterize the study site.

3 Based on the average of 2012-2015 annual data at Lac-Édouard Station



- Projet mine de lithium Baie-James / James Bay Lithium Mine Project
- Station de mesure de la qualité de l'air / Air quality station
- Infrastructures / Infrastructure**
 - Relais routier / Truck stop
 - Ligne de transport d'énergie / Transmission line
 - Centrale hydroélectrique / Hydroelectric powerhouse
 - Route / Road



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 6-9
Stations de mesure de la qualité de l'air /
Air Quality Stations

Sources :
Canvec : 1 : 50 000, RNCan, 2015
BDGA : 1 : 1 000 000, RNCan, 2011

0 20 40 km
UTM, fuseau 18, NAD83

Juillet / July 2021

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c6-9_wspT328_station_air_210701.mxd



Forest fire impact on air quality

Forest fires have a major impact on air quality, both locally and regionally. Smoke from the fires and a complex mixture of carbon dioxide (CO₂), suspended particles, water vapour, carbon monoxide (CO), organic compounds (such as acrolein and formaldehyde), oxides of nitrogen (NO_x) and various minerals.⁴ Table 6-21c lays out the generic emission factors estimated by the US EPA⁵ that may be associated with emissions from a forest fire. They are provided in kg of emissions of one substance per tonne of combustible material.

Table 6-21c Generic emission factors that may be associated with forest fires

Substance	Emissions factor (kg/tonne)
CO ₂	1,521
CO	144
PM _{2.5}	12
PM ₁₀	14
NO _x	3.1
VOC	6.8

While fires produce significant amounts of carbon monoxide and carbon dioxide, particulate matter is the main issue as fine particles can be transported for hundreds of kilometres.

In order to evaluate the impact of forest fires on air quality, forest fire mapping provided by the Québec Ministère des Forêts, de la Faune et des Parcs (MFFP) was analyzed. The data in this mapping relate to all forest fires that took place in Québec for the period from 1972 to 2017.

Table 6-21d presents statistics compiled for fires raging within 200 km of the study site. The data represents the sum of the surface areas burned in km², more specifically the total area per year and per month. For example, in 1972, a total area of 768 km² was burned within a 200 km radius of the site, including 11, 20 and 737 km² for the months of April, May and June, respectively. The compilation of this data shows that the intensity of the fires is very variable from one year to the next. Figure 6-4 also illustrates this large variation. The areas burned during 1983 and 2013 were particularly large.

4 https://www.inspq.qc.ca/pdf/publications/1679_ImpactsSanitParticulesIncendiesForet.pdf
5 <https://www3.epa.gov/ttn/chief/ap42/ch13/related/firerept.pdf>

Table 6-21d Area burned by month and year within 200 km of the study site

Year	Area burned (km ² per month)							Total for the year
	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	
1972		11	20	737				768
1973			55		756			811
1974			6	7				13
1975		1	8	27				36
1976			130	249		23		401
1977			4	164		1	2	171
1978			4	11				15
1979			10	3	6			19
1980	49	79			17			145
1981				384	1,047			1,431
1982			71					71
1983			1,731	3,966				5,697
1986			258					258
1987								0
1988		64						64
1990					24			24
1991								0
1992								0
1993								0
1994			1					1
1995			2					2
1996			508					508
1997			343					343
1998				20				20
2000		1						1
2001			40	8	178			227
2002				76				76
2003			255	4	98			357
2004			4	9	10			23
2005			2,070	603				2,674
2006		270	536	1				807
2007		85	78	88				251
2008				7				8
2009			1	531	1			533
2010		1	439	577				1,017
2011		7	7	4	34			53
2012		30	144	12				187
2013			498	9,357				9,855
2014		27	168	11				206
2015			11	1				12
2016			1	48	1			50
2017			54		1			55
Total	49	576	7,459	16,907	2,174	23	2	27,191
Max	49	270	2,070	9,357	1,047	23	2	-

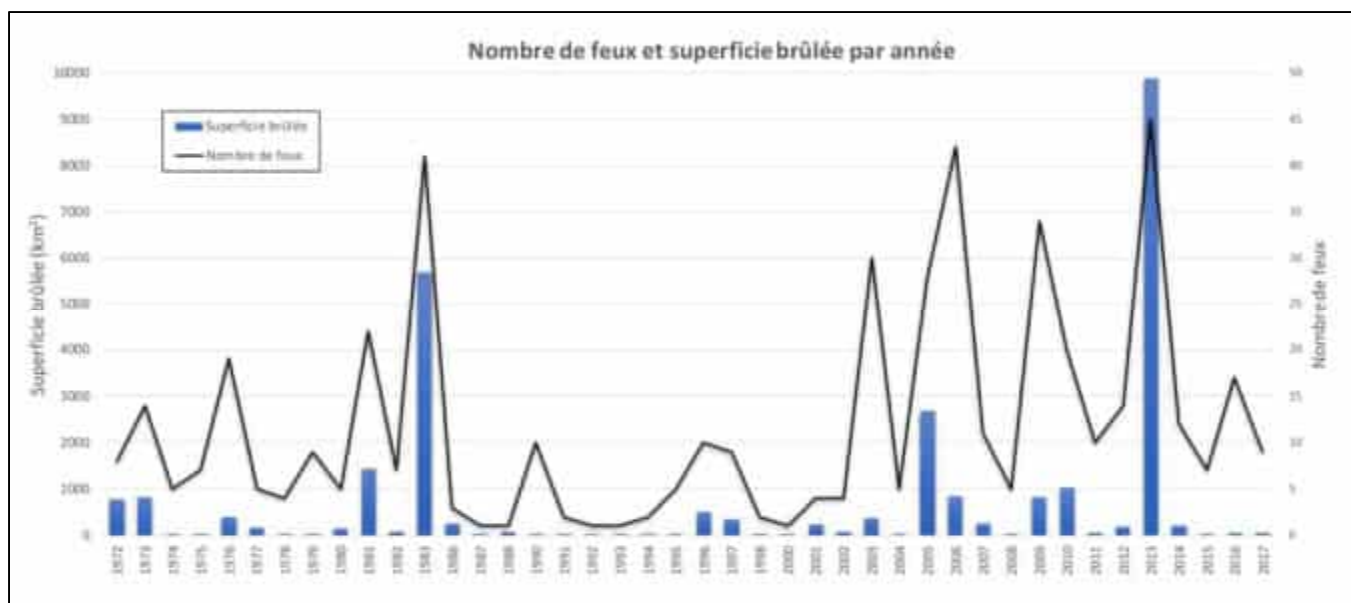


Figure 6-4 Number of fires and area burned per year within 200 km of the study site

Table 6-21e presents a classification by magnitude of each fire. This compilation shows that the majority (96% of cases) of fires caused burns of less than 75 km². Only a few major fires of more than 750 km² have occurred since 1972. A more detailed analysis shows that of the six fires of more than 750 km², three occurred on the same date in 2013. These fires are therefore probably connected.

Table 6-21e Classification by magnitude of fire within 200 km of the study site

Classification (km ²)	Number of fires (1972-2017)
$x < 75$	402
$275 > x > 75$	45
$750 > x > 275$	13
$1,500 > x > 750$	3
$x > 1,500$	2

With respect to quantifying the impact of forest fires on air quality using results from a complete atmospheric dispersion study, we are of the opinion that the high variability of the fires in terms of both intensity and frequency would not permit the establishment of valid baseline concentrations comparable to the concentrations obtained under section 202 of the Clean Air Regulation.

6.2.11 AMBIENT NOISE

The project site is close to two main sources of noise: the Billy-Diamond highway and the km 381 truck stop. The surrounding environment is otherwise made up of predominantly softwood terrestrial vegetation and peatland.

Measurements of the soundscape were taken in 2011 at the project site, close to the road and at the km 381 truck stop. These measurements are still considered representative for **2021, since the measurement conditions are similar. There have been no changes to the physical or geographic environment, and no new industry has been set up near the measurement points. Furthermore, according to SDBJ traffic reports, there have not been any significant increases in traffic on the Billy-Diamond highway. In 2014, the total number of vehicles was 56,139, while it was 55,632 in 2017. No more recent data is available (this was checked in December 2020).** The sound readings were taken at seven stations (P1 to P7) between October 7 and 9, 2011 (Map 6-10).

Ambient noise levels were not measured at Cree community camp sites. These camps are located at distances ranging from 5.4 km to 11.4 km, as the crow flies, from the central point of the project. At these distances, the noise impact of GLCI Lithium operations would be practically non-existent (in other words, the 45 dBA contour line is reached well before reaching the Cree camps). Consequently, these receptors were not considered in simulations.

Table 6-22 shows the equivalent sound levels recorded at the measuring stations for both periods of the day. The equivalent continuous sound level (L_{Aeq}) represents the average noise level during the measurement period. Minimum and maximum sound levels are also presented.

Table 6-22 Sound measurement results

Measuring point	Noise level (dBA)					
	Day (07:00 to 19:00)			Night (19:00 to 07:00)		
	L_{Aeq}	Maximum	Minimum	L_{Aeq}	Maximum	Minimum
Point 1	48	56	29	32	36	26
Point 2	38	48	31	-	-	-
Point 3	56	83	35	-	-	-
Point 4	45	59	35	-	-	-
Point 5	44	59	24	48	70	20
Point 6	61	86	32	-	-	-
Point 7	48	67	39	47	66	38

Residual noise at the project site varied between 38 and 48 dBA during the day and between 32 and 48 dBA at night. Recorded levels at the km 381 truck stop were: 48 dBA during the day and 47 dBA at night. The Billy-Diamond highway is the most important source of noise in the study area, with average sound levels of 56 and 61 dBA during the day at points 3 and 6 respectively, with maximum values reaching 83 dBA and 86 dBA. **The peaks observed at points 3 and 6 (see charts in Appendix 6-2-11 and Map 6-10) are associated with passing vehicles. Between vehicle passings, the noise level drops to around 35 dBA. The influence of road traffic noise then decreases based on distance from the road.** No nighttime sound reading was taken at these two stations.

Geographic range of noise sources

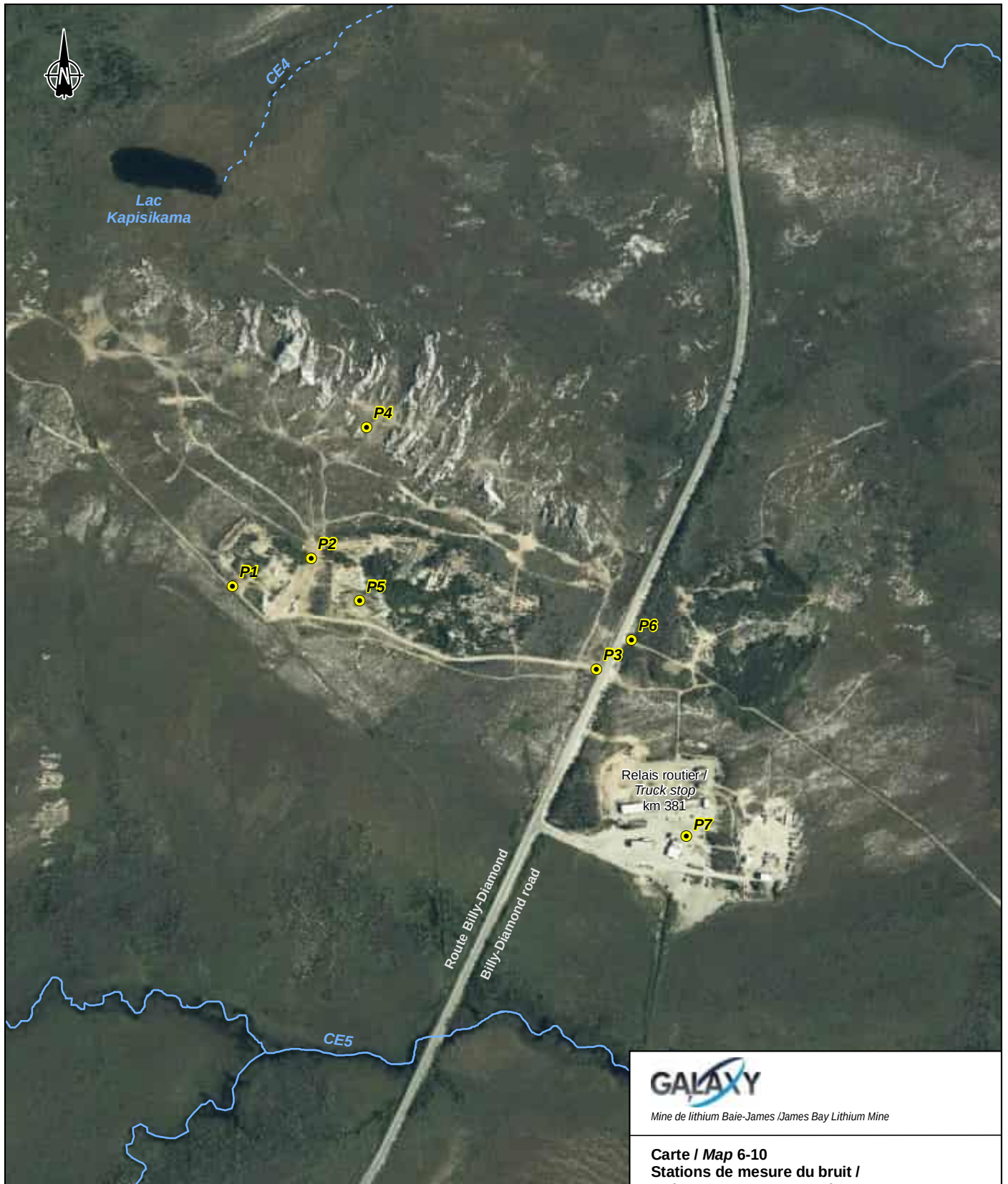
The geographic range of road traffic noise is based on two main variables. The first variable is the intensity of the noise source, i.e. the speed of passing vehicles and traffic volume. The higher the intensity of the noise source, the greater the geographic range. The second variable is the intensity of existing ambient noise other than noise from the road. The higher this is, the lower the geographic range due to the masking effect of other noise sources (e.g. birds singing, leaves rustling with wind, etc.). In summary, if we take a day during the cold season with no wind, when there are no birds or insects, the geographic range will be much greater than during a windy day or when birds or insects are making noise. Based on the results of the noise measurements, we can expect the geographic range of road traffic noise to be less than 1 km most of the time, because the sound coming from the Billy-Diamond highway is relatively low at measurement points P1, P2 and P4, which are about 600 m away from the road.

Variations over time

Unless there is a significant increase in road traffic, the level of traffic noise coming from the Billy-Diamond highway will remain similar over time. Reference noise variations come mainly from seasonal periods and weather conditions. As explained in the previous period, the soundscape will vary based on weather conditions, especially wind with the rustling of leaves or rain and wildlife noises (animals, birds and insects). The increase in road traffic is expected to be around 15%. This will create a 0.6 dBA increase in road noise, which is inaudible. A 100% increase, or traffic doubling, would mean a 3 dBA increase, which would start to be audible.

Criteria

For the study area, the noise criteria that apply are those of Zone IV of the document *Traitement des plaintes sur le bruit et exigences aux entreprises qui le génèrent* (MDDEP, 2006), namely 70 dBA, except at campsites and the km 381 truck stop. At these two sites, the criteria to be respected are 55 dBA during the day, 50 dBA at night, or the residual noise level, if higher.



- Numéro de station /
 Station number
 P5
 Station de mesure du bruit /
 Noise measurement station
- CE5
 Numéro de cours d'eau / Stream number
 Cours d'eau permanent / Permanent stream
 Cours d'eau à écoulement diffus ou intermittent /
 Intermittent or diffused flow stream



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 6-10
Stations de mesure du bruit /
Noise Measurement Stations

Source :
 Orthoimage : Galaxy, août / august 2017

0 100 200 m
 UTM, fuseau 18, NAD83

Juillet / July 2021

Dessin : A. Masson
 Approbation : C. Martineau
 201-12362-00_c6-10_wspT329_bruit_210701.mxd



6.2.12 ARTIFICIAL LIGHT AT NIGHT

The artificial light at night study area is shown on Map 6-11. The Billy-Diamond highway crosses this area from south to north. It includes the Billy-Diamond highway km 381 truck stop, the sole emitter of nocturnal artificial light in the study area. This zone also includes the main sensitive receptors that could be affected by the light emitted by project infrastructure. These sensitive receptors are the permanent and temporary Cree camps.

Sky clarity and intrusive light are measurable parameters that can be affected by an increase in nocturnal artificial light. To classify sky clarity and intrusive light conditions of the study area, a classification system developed by the International Commission on Illumination (CIE, 2003), with measurable limits defined by Narisada and Schreuder (2004), was used. This system provides four classification zones:

- very-low-luminosity sector (national parks or protected sites);
- low-luminosity sector (industrial, residential or rural areas);
- medium-luminosity sector (industrial or residential neighbourhood);
- high-luminosity sector (downtown and shopping areas).

Sky clarity limits are measured in mag/arcsec²; the higher the value, the better the sky clarity. Limits for intrusive lights are measured in lux; the higher the value, the stronger the intrusive light.

Data from the *New World Atlas of Artificial Night Sky Brightness* by Falchi and coll. (2016) were used to present current sky brightness conditions in the study area. These data were imaged using a colour chart indicating sky brightness level, dark grey being the brightest sky and red the least bright for the sector under study. The values in this colour chart are in mag/arcsec² and the results obtained can be compared against measurements taken in the field. Data for the sector of the study are presented in Map 6-11.

The km 381 truck stop on the Billy-Diamond highway is the sole emitter of nocturnal artificial light in the study area and it can be seen clearly. Little light is emitted by the km 381 truck stop and its effect on sky clarity fades rapidly with increasing distance. The project site is located within this area of influence, given its proximity to the truck stop.

In comparison with southern Quebec, where sky clarity is of poor quality because of the presence of many large cities, sky clarity in northern Quebec is excellent. Except for a few scattered small sectors, either villages or electrical facilities, practically the whole of northern Quebec has optimal sky clarity, that is, a sky entirely unaffected by artificial light.

6.2.12.1 FIELD READINGS

Readings were taken in the field to obtain spot measurements of sky clarity, the presence of intrusive light and photographs of surrounding nocturnal landscapes. Measurements of sky clarity can also be used to validate the data provided in the 2016 *New Atlas*. Sampling stations were selected to be representative of the area, with particular attention to sectors likely to be affected by the project and light-emitting sources already present. Stations numbered with R represent sensitive receptors, those with E important sources of artificial light emissions and those with P project sectors. Measurements of intrusive light on the ground were obtained using a light meter (model TES 1336A) which provided results in lux for every station.

6.2.12.2 RESULTS

SKY CLARITY

The results of sky clarity measurements taken at each station are presented in Table 6-23 and Map 6-11. Based on the results obtained, each station was assigned to a CIE classification zone for sky clarity.

Table 6-23 Results of sky clarity measurements

Station ¹	Description	Measurement at zenith (mag/arcsec ²)	CIE zone
R1	Cree camp that seems no longer used	21.83	C1
R2	Forest trail close to Amiskw Matawaw Lake	21.89	C1
R3	Permanent Cree camp used year-round	21.78	C1
R4	Billy-Diamond highway south of the truck stop	21.70	C1
R5	Cree camp that burned down in 2002	21.72	C1
R6	Temporary Cree camp on the shores of the Eastmain River	21.74	C1
R7	Track to the east of Billy-Diamond highway	21.75	C1
R8	Billy-Diamond highway north of the Eastmain River	21.79	C1
E1	Km 381 truck stop on the Billy-Diamond highway	21.31	C2
P1	Project site	21.67	C1
1	R: receptor; E: emitter; P: project.		
2	Narisada and Schreuder 2004.		

The results show that there are two CIE environmental zones within the study area. Except for station E1 at the km 381 truck stop, all stations presented sky clarity measurements of above 21.4 mag/arcsec² and thus fall into CIE zone C1, representing sectors that are very little affected by nocturnal artificial light.

A reading of 21.31 mag/arcsec² was obtained at station E1, indicating that the area immediately around the truck stop lies within the CIE zone C2, that is, a sector of low luminosity. This was the lowest sky clarity reading taken during the surveys. It should be kept in mind that the truck stop is the only light emitter inside the study area. The effect of the light emitted by the truck stop fades very quickly, as shown by the measurement taken at station P1 (project site) at only 1.1 km from the truck stop, with a value of 21.67 mag/arcsec² (CIE zone C1). The highest sky clarity measurement was obtained at station R2, with a value of 21.89 mag/arcsec².

In summary, except for the area immediately around the truck stop, the entire study area is part of CIE zone C1. This is an area which is largely unaffected by nocturnal artificial light and in which sky clarity is excellent. As mentioned earlier, this type of sky is not found in or close to urbanized areas. It is totally absent from southern Quebec. However, this sky clarity is very common in northern Quebec.

INTRUSIVE LIGHT

The results of intrusive light measurements on the ground, taken at each station, are set out in Table 6-24. Based on the results obtained, each station was assigned to a CIE classification zone for intrusive light. These results show that, except for the km 381 truck stop, no intrusive light was measured at the various stations.

A value of 0.12 lux was measured at E1 (truck stop), which puts it in CIE environmental zone E2, that is, a low-luminosity sector. No intrusive light was measured at the other stations in the study area, putting them in CIE zone E1. As with sky clarity, except for the area immediately around the truck stop, the entire study area is part of the CIE zone E1.

Table 6-24 Intrusive light measurement results

Station ¹	Description	Intrusive light (lux)	CIE zone
R1	Cree camp that seems no longer used	0	E1
R2	Forest trail close to Amiskw Matawaw Lake	0	E1
R3	Permanent Cree camp used year-round	0	E1
R4	Billy-Diamond highway south of the truck stop	0	E1
R5	Cree camp that burned down in 2002	0	E1
R6	Temporary Cree camp on the shores of the Eastmain River	0	E1
R7	Track to the east of Billy-Diamond highway	0	E1
R8	Billy-Diamond highway north of the Eastmain River	0	E1
E1	Km 381 truck stop on the Billy-Diamond highway	0.12	E2
P1	Project site	0	E1
1 R: receptor; E: emitter; P: project.			

NOCTURNAL LANDSCAPES

As mentioned earlier, there is only one emitter of nocturnal artificial light affecting the nocturnal landscapes within the study area, namely the km 381 truck stop on the Billy-Diamond highway. Photographs of this emitter were taken from several viewpoints.

Photo 6-1 was taken close to station P1 (project site) towards the truck stop. The small luminous halo generated by the km 381 truck stop facilities can be clearly seen. An aurora borealis was visible in the sky at the time the photo was taken. Photo 6-2 shows a view of this aurora borealis from station R4. The truck stop and the small luminous halo it creates are also visible on this photograph. In addition, Photo 6-2 clearly shows the starry sky that was present during the night when surveys were made, demonstrating the quality of the nocturnal landscapes in the study area.



Photo 6-1 Luminous halo created by nocturnal artificial light emitted by the truck stop seen from station P1



Photo 6-2 View of the km 381 truck stop and an aurora borealis seen from station R4

6.3 BIOLOGICAL ENVIRONMENT

6.3.1 VEGETATION

Vegetation surveys were carried out between July 24 and 31, 2017, **and July 30 and 21, 2020**. The objective of these surveys was to characterize and delineate land and wetland plant groups, check for the presence of threatened or vulnerable plant species (or species likely to be designated as threatened or vulnerable) and seek out any plant species of traditional interest for Indigenous people. A baseline characterization for metals in certain plants with a traditional use was also performed. **The** method used along with **the** findings are described in greater detail in the Terrestrial Vegetation Baseline Study (*Étude spécialisée sur la flore*) (WSP, 2018e) **and the supplemental technical note (WSP, 2021c)**.

6.3.1.1 METHODOLOGY

PLANT GROUP CHARACTERIZATION AND DELINEATION

Prior to the field surveys, a photo interpretation of the plant groups in the study area, which included 2011 data taken by WSP, was conducted. Following the photo interpretation, the two environments (land and wetland) were spatially illustrated using polygons.

During the planning phase, survey plots were placed within each land or wetland group polygon. For the larger groups, several plots were provided for to ensure a better assessment.

The survey carried out between July 24 and 31, 2017, validated the limits, the naming and the characterization of the groups identified at the time of the photo interpretation or during prior characterization work. Data entry records from the *in situ* database developed by WSP were completed in the field, which made it possible to note characteristics of the site habitats (WSP, 2018e). Data for each plot were gathered over a radius of around 10 m, representative of the general environment. Particular care was taken during **the survey** to ascertain the presence of invasive exotic plant species.

The survey was primarily **completed** in the areas where the project infrastructure would be located. A total of 98 plots (comprised of 81 complete plots and 17 validation plots, all of them dispersed within 57 polygons) were surveyed (Map 6-12).

The July 2020 survey was done to complete coverage of the environments that may be affected after the project footprint was changed and to validate the 2017 survey results. The addition of survey plots was also in response to a request from the MELCC in order to clarify information on certain sectors. Eight plots in seven polygons were surveyed using the same method as was used in 2017.

WETLANDS

Wetlands have particular botanical, biophysical and hydrological characteristics (Bazoge and coll., 2015). Table 6-25 provides a non-exhaustive list of the criteria or **elements** to consider when identifying wetlands.

The wetlands observed in the study area were validated in the field following their delineation through photo interpretation. Because of this area's vast size, the **boundary** of the wetlands was not surveyed over their entire perimeter. Where photo interpretation results were inaccurate, changes to wetland boundaries were made by applying the botanical method, which considers all the previously cited elements to establish **this boundary**.

The study area's location in a Northern environment must, however, be considered when establishing the group's water balance. The list of mandatory and optional plants in the 2015 guide *Identification et délimitation des milieux humides du Québec méridional* (Bazoge and coll., 2015) was originally drawn up for southern Quebec and may hence be inaccurate in Northern environments. This is in part due to the fact that the water status of certain plant species varies according to their latitude. Such is the case for the black spruce (*Picea mariana*), which can be mostly found in the wetlands of the south yet is a dominant species in both land and wetland environments in northern Quebec. In those instances where the vegetation does not allow for determining a group's water balance, biophysical and hydrological factors, along with soil characteristics, are key.

Table 6-25 Wetland characterization criteria

Type	Criteria
Botanical	• Dominance of mandatory and optional plants in wetlands
Biophysical	• Water line (wharf, rocks, trees, etc.) • Waterborne debris – Deposit of sediments • Sulfurous odour (rotten eggs) in the ground • Depressions covered by a blackish litter generated by the faulty decomposition of organic matter • Rhizosphere effect (oxidation around the roots) – marked spots for the first 30 cm underneath the surface • Erosion of tree bark • Exposed shrub and tree roots • Moss lines on trunks • Hypertrophied stumps • Hypertrophied lenticels • Relatively shallow root systems • Adventitious roots
Hydrological	• Flooded ground surface • Waterlogged soil for the first 30 cm

The swamps and peatlands were mainly identified on the basis of the thickness of the sod layer. Peatlands are characterized by an organic surface layer (sod) in excess of 30 cm; below that, groups are considered swamps or marshes, depending on the type of vegetation present.

SPECIAL-STATUS PLANT SPECIES

A list of the species likely to be found in the study area was drawn up prior to proceeding with the field surveys. In conjunction with the available database on study area habitats (2011 surveys, 2017 photo interpretation), the following works helped to establish the list of potential species:

- a guide created by the Centre de données sur le patrimoine naturel du Québec (CDPNQ) and the MDDELCC: *Les plantes vasculaires en situation précaire au Québec* (Tardif and coll., 2016);
- *Flore laurentienne* (Frère Marie-Victorin and coll., 2002);
- *Guide de reconnaissance des habitats forestiers des plantes menacées ou vulnérables - Abitibi-Témiscamingue et Nord-du-Québec (secteur sud-ouest)* (Labrecque and coll., 2014);
- the guide entitled *Plantes rares du Québec méridional* (Sabourin, 2009);
- the book *Sedges of Maine – A Field Guide to Cyperaceae* (Arsenault and coll., 2013).

The information gathered made it possible to identify 15 species that could possibly be present in the study area habitats. While surveying, the search for special-status plant species mainly focused on the plant habitats and groups likely to host these taxa, i.e.:

- the banks of watercourses;
- open or wooded fens;
- wet meadows;
- rocky outcrop areas;
- open sandy areas.

A request was also submitted to the CDPNQ to obtain a list of the special-status species located in a radius of about 20 km from the centre of the study area.

PLANT SPECIES OF TRADITIONAL INTEREST FOR INDIGENOUS PEOPLE

The traditional use of plants by Cree communities in James Bay was investigated by reviewing the literature. This included looking over the various articles and databases listing the plants used by these communities, to prepare the most comprehensive list possible (Upirety and coll., 2012). **When consulting with Cree land users, who used traplines RE2, VC35 and VC33, the issue of plant use was also brought up.** The species' scientific and common names (in French, English and Cree) were also noted. Information was obtained on the growth habits of these plants (trees, shrubs, herbaceous plants and mosses) as well as the plant parts used by Cree communities.

CHEMICAL CHARACTERIZATION

A baseline characterization of the metals in some of the plants with traditional uses was also conducted to identify the initial concentration of certain metals in the various plants present at the project site. The sector sampled is adjacent to the planned project infrastructure. The initial characterization generated a profile of the metal content of the structural tissues (leaves, fruit, branches) of the six plants species found at the study site, namely:

- blueberry (*Vaccinium spp.*);
- Labrador tea (*Rhododendron groenlandicum*);
- sheep laurel (*Kalmia angustifolia*);
- alder (*Alnus spp.*);
- black spruce (*Picea mariana*);
- tamarack (*Larix laricina*).

The field sampling activities in the study area were done on September 25, 2017. A total of 30 composite samples of structural tissues (leaves, fruit, branches), five for each plant species, were gathered in the study area and sent to the laboratory to analyze for 24 different metals. The samples were obtained at 11 stations located in various habitats at the project site. The location of the sampling stations are shown on Map 6-12.

6.3.1.2 RESULTS

PLANT GROUPS

On a regional scope, the study area is situated at the northeastern boundary of the Abitibi and James Bay Lowlands natural province, a zone characterized by large even plateaus dotted with hills and featuring vast fens and bogs often beginning at the shores of James Bay and extending 100 km inland (DUC, 2016). The surveys done confirm that the habitats in the study area are in line with this description.

The main factor in the forest dynamics of the region is the fire cycle (MFFP, 2017a). Forest fires therefore have a major impact on plant group structure and composition.

The mapping of recent fires (1970 to now) in the study area by MFFP (2020) shows forest fires caused by lightning in 2005, 2009 and 2013 (Map 6-13). The 2009 burn covered a smaller portion of the study area, having mostly impacted the western section. The 2005 and 2013 fires, however, wreaked havoc on large sections of the study area, among them the zone near the km 381 truck stop and the project sector. Evidence of the recent fires is still visible, notably through the sparse nature of the newly growing black spruce and jack pine.

In spite of the ecosystem's adjustment to the dynamics of the forest fires, successive fires over the past 15 years have impacted the study area to the point where the short- and long-term development of existing stands could be disrupted. In fact, a greater number of repeated disturbances could significantly curtail their regeneration.

Map 6-12 shows the plant groups present in the study area and Table 6-26 illustrates the size of the plant groups within this area.

Land environments

Land environments account for **668.11** ha—or a mere **18.2%**—of the study area. Field surveys allowed for specifying the data obtained from photo interpretation and reclassifying the land environments into 10 distinct groups.

In general, the land groups are mostly found along and east of the Billy-Diamond highway (Map 6-12). Land groups are primarily found on sloped terrain on thin soil containing less than 15 cm of organic matter or directly on sand, and even on rocky outcrops. The rock at these sites is usually observed less than 30 cm from the surface.

The presence of rocky outcrops and the many recent forest fires have resulted in the lack of a tree stratum in several land groups. The rocky outcrops, scrubland, green alder, burns and dry stripped zones are thus dominated by their shrub layer.

As for the scrubland and burns, their shrub layer is mainly comprised of the jack pine and black spruce regenerated after the forest fires. In these groups, the trembling aspen (*Populus tremuloides*) and white willow (*Salix sp.*) are usually found alongside the two dominant softwood species. Underneath, there is often velvetleaf huckleberry (*Vaccinium myrtilloides*) and sheep laurel (*Kalmia angustifolia*), which further attest to the more xeric water balance of these groups.

Land alder, i.e., groups dominated by green alder (*Alnus alnobetula subsp. crispa*), are most often observed on steep roadside slopes or on sites that were stripped or filled in during the construction of the roads. The alder is thick and nearly monospecific.



— Infrastructures minières / Mining infrastructure

— Empreinte de la mine (zone tampon de 50 mètres) / Mine footprint (buffer 50 meters)

— Zone d'étude locale / Local study area

Infrastructures / Infrastructure

— Route principale / Main road

— Route d'accès / Access road

— Ligne de transport d'énergie / Transmission line

— Relais routier / Truck stop

Hydrographie / Hydrography

— Cours d'eau permanent / Permanent stream

— Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream

— Littoral des cours d'eau / Watercourses shoreline

Espèce végétale susceptible d'être désignée / Plant Species Likely to be Designated

— Carex sterilis

Parcelle d'inventaire / Survey Plot

— P-15 Parcelle (numéro de parcelle) / Plot (plot number)

— PF-09 Station d'échantillonnage des végétaux (numéro de station) / Plant sampling station (station number)

Peuplements terrestres / Terrestrial Vegetation

— Affleurement rocheux / Rock outcrop

— Arbustaie / Scrubland

— Aulnaie crispé / Alder forest

— Boisé / Woodland

— Dénudé sec / Dry barren land

— Pessière noire à lichen / Black spruce lichen forest

— Pessière noire à aulnes / Black spruce alder forest

— Pinède grise / Jack pine forest

— Anthropique / Anthropogenic

— Brûlis / Burnt area

— Végétation terrestre dans l'emprise / Terrestrial vegetation in right-of-way

Peuplements humides / Wetland

— Plan d'eau / Waterbody

— Tourbière arbustive / Shrubby peatland

— Tourbière boisée / Treed peatland

— Tourbière ouverte / Open bog

— Végétation humide dans l'emprise / Wetland in right-of-way

GALAXY

Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 6-12
Groupements végétaux et espèces floristiques à statut particulier / Plant Community and Special Status Plant Species

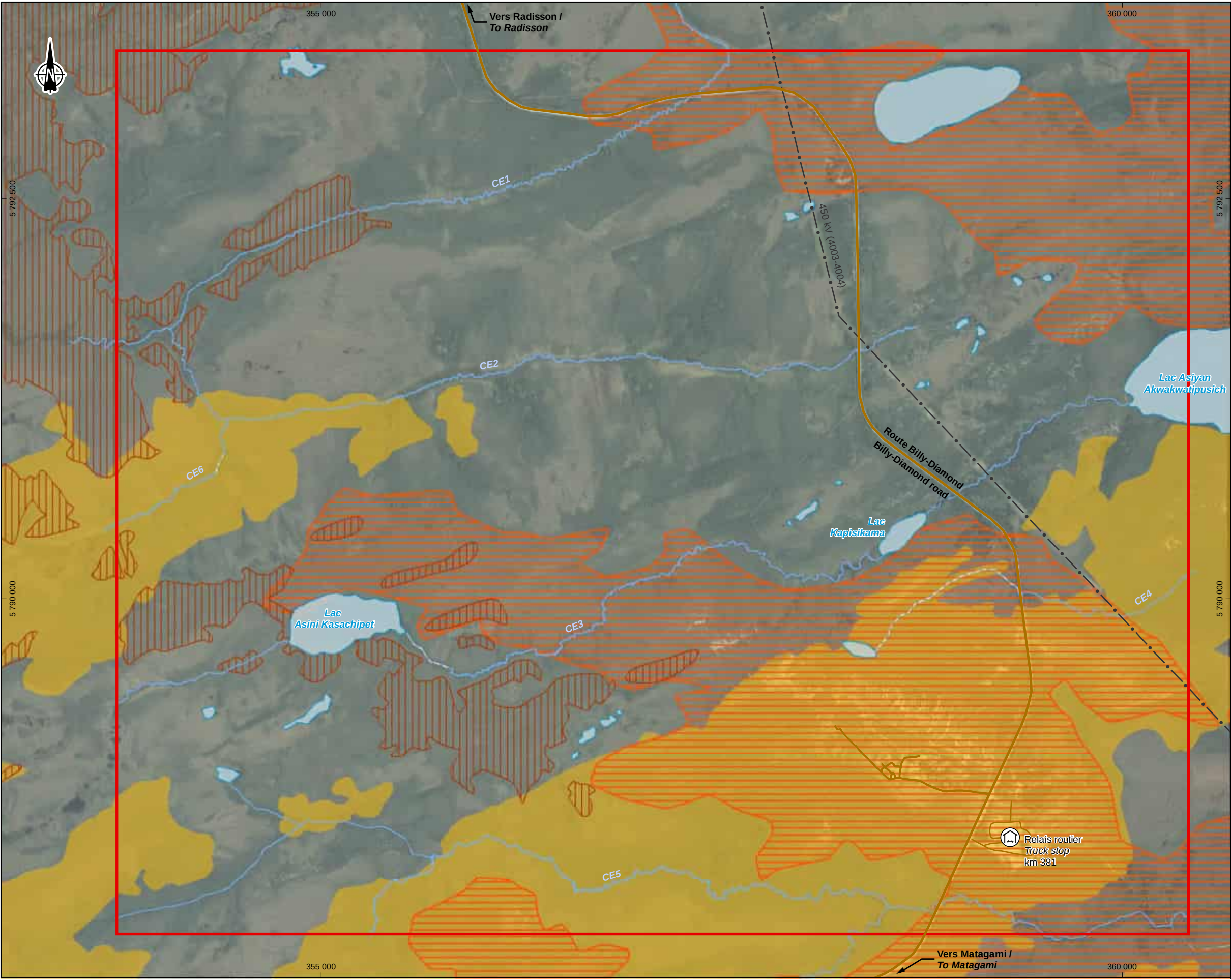
Sources :
Orthoimage : Galaxy, août / august 2017
Inventaire / Inventory : WSP 2017
Données du projet / Project data : Galaxy, 2021

0 240 480 m
UTM, fuseau 18, NAD83

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c6-12_wspT071_vegetation_210701.mxd

Juillet / July 2021

wsp



- Zone d'étude locale / Local study area**
- Feux (année) / Fire (year)**
- 2005
 - 2009
 - 2013
- Infrastructure / Infrastructure**
- Route principale / Main road
 - Route d'accès/ Access road
 - Ligne de transport d'énergie / Transmission line
 - Relais routier / Truck stop
- Hydrographie / Hydrography**
- CE3 Numéro de cours d'eau / Stream number
 - Cours d'eau permanent / Permanent stream
 - Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream
 - Plan d'eau / Waterbody



Mine de lithium Baie-James /James Bay Lithium Mine

Carte / Map 6-13
Feux de forêt récents /
Recent Forest Fires

Sources :
Orthoimage : Galaxy, août / august 2017
Feux de forêt / Forest fires : MFFP Québec, 2018
Inventaire / Inventory : WSP 2017

0 240 480 m
UTM, fuseau 18, NAD83

Juillet / July 2021

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c6-13_wspT331_feux_210701.mxd

wsp

Table 6-26 Plant groups identified in the study area

Plant groups	Surface area (ha) in the study area	Representativeness (%)
Terrestrial environment		
Rocky outcrop	41.25	1.1
Scrubland	241.64	6.6
Green alder	7.66	0.2
Wooded area	4.58	0.1
Burns	161.65	4.4
Dry barren	21.40	0.6
Land footprint	10.13	0.3
Black spruce-lichen stand	114.61	3.1
Black spruce-moss stand	49.69	1.4
Jack pine stand	15.51	0.4
Terrestrial environment subtotal	682.99	18.2
Wetlands		
Wetland footprint	15.94	0.4
Shrub peatland	747.95	20.3
Wooded peatland	800.54	21.8
Open peatland	1,326.52	36.1
Wetland subtotal	2,743.96	78.6
Hydrous environment		
Wetland footprint	0.48	0.0
Lake	67.03	1.8
Pond	6.06	0.2
Hydrous environment subtotal	73.57	2.0
Human environments		
Human environment subtotal	43.52	1.2
Total	3,676.15	100.0

The black spruce-lichen stand and the jack pine stand are the two main land groups observed in land wooded areas. In both cases, the velvetleaf huckleberry, sheep laurel and regenerating black spruce are generally the dominant species in the shrub layer; spruce stands, in turn, are often home to Labrador tea (*Rhododendron groenlandicum*). Lichen dominate the muscinal stratum and moss is usually found in slight depressions.

The other undefined wooded areas correspond to land plant groups identified during the photo interpretation of the study area but not physically visited during the field surveys. They are notably located outside of the priority zones targeted for the project infrastructure implementation. Given the limited diversity of the habitats identified during the field surveys, it would be reasonable to assume that these undefined groups mostly consist of blackspruce-lichen stands and jack pine stands.

The study area also includes human environments (over 43.52 ha or 1.2% of the surface area), among them the km 381 truck stop facilities, the Billy-Diamond highway, the off-road trails and the access roads for drilling activities, as well as a remote landfill.

Wetlands

Wetlands prevail in the study area, covering **2,890.95 ha (78.6%)** of the total surface area being studied. Following the field surveys, the wetland plant groups of the study area were classified into four types: open peatlands, shrub peatlands, wooded peatlands and the wetland zones in the right-of-way for Hydro-Québec transmission lines. Some larger ponds were also found inside the peatlands.

The wooded and shrub peatlands of the study area are mainly marked by the presence or absence of a tree cover. Black spruce and heath account for the vast majority of the vegetation found in both groups. Heath is mostly comprised of Labrador tea and leatherleaf (*Chamaedapne calyculata*) and the herb layer includes three-leaved Solomon's seal (*Maianthemum trifolium*) and some sedge grasses, among them water sedge (*Carex aquatilis* var. *aquatilis*), few-seeded sedge (*Carex oligosperma*) and three-seeded sedge (*Carex trisperma*). Onsite observations appear to indicate that the shrub peatlands are actually young wooded peatlands.

On the territory being studied, shrub peatlands distinguish themselves from open peatlands, first because of much thicker regenerating black spruce, sometimes in conjunction with tamarack (*Larix laricina*). In the open peatlands, the shrub layer is generally dominated by heath. In the overall study area, the continuity among the various types of peatlands results in the creation of large wetlands where open, shrub and wooded peatlands converge. Also, some of the bigger shrub peatlands include smaller areas comprised of open peatlands with ponds.

The propagation of forest fires over the past two decades has impacted the distribution of wooded and shrub peatlands in the study area. Today, they are increasingly found in the northern part of the study area, which happens to be the section least affected by the recent burns. Notably, some of the open peatlands identified at the site are in fact former wooded peatlands that have burned in the recent past.

While most of the open peatlands are not very diversified (comprised mostly of heath), some of the ones located along watercourses consist of a greater variety of grass species and shrubs. The same could be said about the richness of the plant association in the shrub peatlands located along watercourses, where tamarack usually prevails over black spruce as far as the regeneration of shrub species is concerned. These more diversified bordering peatlands correspond to fens, which differ from bogs depending on their water supply. Bogs are wetlands essentially supplied by rainwater (rain and snow), while the water supply of fens also includes **runoff** water enriched by minerals culled from the soil of neighbouring habitats (Leboeuf and coll., 2012). Because of this variance in water supply, bogs are more acidic and host fewer nutrients than fens; this has an impact on the composition and diversity of the area's vegetation.

Fens are hence able to rely on a vaster wealth of species. In addition to heath and tamarack, speckled alder (*Alnus incana* subsp. *rugosa*), scrub birch (*Betula glandulosa*), sweet gale (*Myrica gale*) and willows (*Salix* sp.) are all found in the shrub layer of these fens. The herb layer is dominated by sedge, which includes several species of sedge grass (*Carex aquatilis* var. *aquatilis*, *Carex canescens*, *Carex lenticularis* var. *lenticularis*, *Carex oligosperma*, *Carex pauciflora*, *Carex rostrata*, *Carex trisperma*) and cottongrass (*Eriophorum angustifolium* subsp. *angustifolium*, *Eriophorum vaginatum* var. *spissum*, *Eriophorum virginicum*). The fens located next to calcium-rich soil will contain a particularly wide variety of plant species (Grondin and coll., 2005).

The bogs in the study area are nevertheless the largest and most frequently encountered groups. The surveys carried out made it possible to confirm that these environments have characteristics typical of the wetlands and peatlands encountered throughout the James Bay territory (Payette and Rochefort, 2001).

Hydrous environments, which include lakes and watercourses (drainage bed and adjacent wetlands comprising the littoral), cover 73.57 ha or 2.0% of the study area.

Functions of wetlands

The wetlands identified in the study area fulfill functions of biodiversity conservation, with peatlands offering food, shelter and reproduction potential for living species, including some species of wildlife with protected status (Section 6.3.7) such as the common nighthawk and the rusty blackbird, which could use these environments and be found in the bogs during their nesting seasons according to Robert et al. (2019). The habitat function is also supported by the biogeochemical processes of the bogs, which help provide characteristics sought by these species. Wetlands identified in the study area also fulfill biogeochemical functions, including the export of nutrients and organic matter. Bogs help to sequester carbon and mitigate the effects of climate change. Carbon is notably stored in decaying matter, which accumulates over time (Hanson et al., 2008). Peatlands can also play a role in regulating water levels with their water retention capacity, which prevents water from flowing quickly to a receiving watercourse, promoting retention and evaporation.

SPECIAL-STATUS PLANT SPECIES

The CDPNQ registers include no mention of threatened or vulnerable plant species within a 20-km radius of the centre of the study area.

The surveys determined that most of the groups (wetland and land) had a very limited potential for comprising threatened or vulnerable plant species, mainly due to the environment's weak biodiversity and numerous disturbances such as severe forest fires, which significantly modified the plant communities in the study area over the last few years. Based on the data regarding habitats in the study area and the preferred habitats of special-status species gathered during the 2017 surveys, Table 6-27 depicts the potential presence of the 15 species targeted prior to the surveys being conducted. **No new special-status plant species, however (April 2021) were identified during the 2017 and 2020 surveys.**

INVASIVE EXOTIC PLANT SPECIES

Invasive exotic plant species are comprised of plants introduced into zones outside of their natural distribution areas and which could threaten the new environment and its biodiversity. Given their dispersion capabilities and rapid growth, these species have competitive advantages over native species, allowing them to prevail within the plant community of a given environment and possibly even locally eliminate certain native species.

No invasive exotic plant species was observed in the study area during the surveys. While the issue of invasive exotic plant species is not as widespread in northern Quebec as in other areas, care should be taken to ensure that they do not propagate further.

Table 6-27 Plant species with a special status identified in or near the James Bay region or located near or potentially present in the study area

Common name	Latin name	Provincial / federal status	Priority status/ranking ¹	Habitat	Potential presence
Great northern aster	<i>Canadanthus modestus</i>	Likely/none	S2	- Mostly wetlands (sandy shores, wet meadows, swamps) - Occasionally on land (urban terrain) - On limestone soil - Conducive to sun-loving plants	Low
Calypso	<i>Calypso bulbosa</i> var. <i>americana</i>	Likely/none	S3	- Palustrine (swamps, wooded fens) and land (coniferous/softwood forests, mixed-wood forests) environments - Conducive to plants that thrive in the shade	Low
Ojibway waterwort	<i>Elatine ojibwayensis</i>	Likely/none	S1	- Banks of rivers and streams, marshes. Usually in shallow water - Conducive to sun-loving plants	Low
Northern twayblade	<i>Neottia borealis</i>	Likely/none	S2	- Land environment - Coniferous forests, rocky outcrops - On alkaline soil - Conducive to plants that thrive in the shade	Low
Purple meadow-rue	<i>Thalictrum dasycarpum</i>	Likely/none	S2	Boggy banks, glades and wet meadows	Low
Northern gooseberry	<i>Ribes oxycanthoides</i> subsp. <i>oxycanthoides</i>	Likely/none	SH	- Rocky or gravel shores - Sometimes on exposed sand - Conducive to sun-loving plants	Low
McCall willow	<i>Salix maccalliana</i>	Likely/none	S2	- Rocky and gravel lake shores, swamps, wooded peatlands (bogs/fens) - Conducive to sun-loving plants	Medium
False mountain willow	<i>Salix pseudomonticola</i>	Likely/none	S1	- Rocky and gravel shores, swamps, wooded bogs - Conducive to sun-loving plants	Low
¹ S ranking (sub-national): score assigned to an element at the provincial or federal level which designates priority in regard to conservation (scores range from S1 to S5, in order of decreasing priority). Elements ranked S1, S2 and S3 are considered precarious. A score of SH denotes what is deemed an historical occurrence, meaning that no such occurrence has been observed or noted over the past 40 years.					

PLANT SPECIES OF TRADITIONAL INTEREST FOR INDIGENOUS PEOPLE

The plant survey was conducted while paying particular interest to the presence of plants traditionally used by the Cree people. The documents referred to (Upreti and coll., 2012), **along with the information gathered through consultations with communities, produced a list of 546** species or groups of species that are potentially used for medicinal purposes by Indigenous people throughout Canada.

Overall, 27 of the plants present in the field are used by the Cree. Five of them are tree species, 16 of them shrub species, five more of them herbaceous species and the remaining one, a nonvascular muscinal species (Table 6-28). **This list also includes mushrooms that grow after a fire (see Section 6.4.6.1).**

The species with medicinal uses observed in the field are common to both the study area and this part of the Quebec territory.

Table 6-28 Vascular and nonvascular plants traditionally used by the Cree found in the study area

Scientific name	French name	English name	Cree name	Parts used
Trees				
<i>Larix laricina</i>	Mélèze laricin	Tamarack	Waachinaakan	Inner bark
<i>Picea mariana</i>	Épinette noire	Black spruce	Inaatuk	Cones
<i>Pinus banksiana</i>	Pin gris	Jack pine	Ushichishk	Cones and inner bark
<i>Populus tremuloides</i>	Peuplier faux-tremble	Trembling aspen	Mitos, mitosinipiah	Inner bark
<i>Prunus pensylvanica</i>	Cerisier de Pennsylvanie	Pine cherry	Pasuwiymayatik, pasisawimin, pusawemina	Bark and roots
Shrubs				
<i>Alnus alnobetula</i> subsp. <i>crispa</i>	Aulne crispé	Green alder	Mathato	Leaves
<i>Alnus incana</i> subsp. <i>rugosa</i>	Aulne rugueux	Mountain alder	Utuspii	Bark
<i>Andromeda polifolia</i> var. <i>latifolia</i>	Andromède glauque	Glaucous-leaved bog rosemary	Kakouboushk	Small branches
<i>Empetrum nigrum</i> subsp. <i>nigrum</i>	Camarine noire	Crowberry	Askiminasiht, ebshjimend	Fruit
<i>Gaultheria hispidula</i>	Petit thé	Creeping snowberry	Unknown	Leaves and fruit
<i>Juniperus communis</i> var. <i>depressa</i>	Génévrier commun déprimé	Juniper	Kaahkaachiiminaahtikw	Roots
<i>Juniperus communis</i> var. <i>megistocarpa</i>	Génévrier commun	Juniper	Kaahkaachiiminaahtikw	Roots
<i>Juniperus horizontalis</i>	Génévrier horizontal	Creeping juniper	Ahaseminanatik, masekesh, masikeskatik	Small branches and fruit
<i>Kalmia angustifolia</i>	Kalmia à feuilles étroites	Sheep laurel	Ushipikwh	Leaves
<i>Rhododendron groenlandicum</i>	Thé du Labrador	Labrador tea	Kachebuk	Leaves
<i>Rubus idaeus</i>	Framboisier sauvage	Raspberry	Athoskan, athoskunatikwah, ayosikan, uyooskan, ayuwskun, ayooskunak, anosh'kanek	Stems, roots and fruit
<i>Salix bebbiana</i>	Saule de Bebb	Willow	Nipisigibi, nipisiah, nipisi, nipisis, atikwupamuk, wekope, nepiseatik, nepise, nipistakwah	Small branches, stems and inner bark
<i>Salix planifolia</i>	Saule à feuilles planes	Tea-leaved willow	Waskayabaduk	Bark
<i>Salix sp.</i>	Saules	Willow	Utusphi	Inner bark

Table 6-28 Vascular and nonvascular plants traditionally used by the Cree found in the study area (cont.)

Scientific name	French name	English name	Cree name	Parts used
<i>Vaccinium myrtilloides</i>	Bleuet	Blueberry	Sipikomin, ithinimina, yinimin, iyinimin, inimena	Stems, roots and fruit
<i>Viburnum edule</i>	Pimbina	Low bush-cranberry	Moosomina, mosomina, moosominahtik	Small branches, buds, stems and leaves
Herbaceous				
<i>Equisetum sylvaticum</i>	Prêle des bois	Horsetail	Mistatimosoy, okotawask, enskowusk, kiychiwiykusk	Whole plant
<i>Geocaulon lividum</i>	Comandre livide	Northern comandra	Unknown	Fruit
<i>Maianthemum canadense</i> subsp. <i>Canadense</i>	Maïanthème du Canada	Wild lily-of-the-valley	Sosowipukosak, soskopukwagoh	Leaves
<i>Nuphar variegata</i>	Grand nénuphar jaune	Yellow pond lily	Waskitipak, oskitipak, waskutamo, waskatamo, waskatamow, oskotamo, pwakumosikum	Whole plant
<i>Sarracenia purpurea</i>	Sarracénie pourpre	Pitcher plant	Ayigadash	Whole plant
Mosses				
<i>Sphagnum fuscum</i>	Sphaigne brune	Peat moss	Uske, muskak, askiyah, mikaskwahkawow, asaskumkwa, eskiya, awasistche	Whole plant

CHEMICAL CHARACTERIZATION

Six traditionally used species were selected to undergo chemical analysis. It should be noted that there are no threshold criteria for the parameters analyzed for these plants. At this time, no standard has been set by the Canadian Council of Ministers of the Environment (CCME) or the **MELCC** for the presence of metals in vegetation. In the case at hand, the analysis therefore serves only to document the baseline concentrations of metals present in the leaves/needles, fruits and branches of the six species sampled in the study area.

Table 6-29 compares the means among all samples for the different parameters measured. This table also provides the mean total for each parameter for the 30 samples as well as the standard deviation for each parameter among the species averages.

Overall, the chemical characterization of the 30 samples of six plant species showed that the concentrations measured in the leaf, branch and fruit tissues were relatively low and indicated a growth environment that was affected little by local or regional industrial activities. Table 6-29 nonetheless reveals that, of the 24 metals analyzed, seven showed elevated average concentrations: aluminum (98 mg/kg), barium (53 mg/kg), boron (10.1 mg/kg), iron (60 mg/kg), manganese (626 mg/kg), strontium (28 mg/kg) and zinc (38 mg/kg). These seven metals showed higher concentrations across all plant species analyzed. The plant species found on the site are nonetheless adapted to these metal-bearing soils and are therefore capable of tolerating high metal concentrations. Plants can regulate the input of metals in soil and thereby reduce its toxicity.

Table 6-29 Comparison of means for parameters measured in the tissues of six plant species

Parameter	Blueberry (mg/kg)	Labrador tea (mg/kg)	Sheep laurel (mg/kg)	Alder (mg/kg)	Black spruce (mg/kg)	Tamarack (mg/kg)	All samples (mg/kg)	Standard deviation (mg/kg)
Aluminum (Al)	200	30	51	108	155	42	98	69
Antimony (Sb)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	-
Silver (Ag)	0.031	0.004	0.007	0.010	0.019	0.009	0.013	0.010
Arsenic (As)	0.137	0.032	0.061	0.090	0.067	0.070	0.076	0.035
Barium (Ba)	44	62	49	76	34	54	53	15
Beryllium (Be)	0.004	0.002	0.002	0.015	0.002	0.002	0.004	0.005
Boron (B)	6.5	9.2	7.5	11.0	7.4	19.1	10.1	4.7
Cadmium (Cd)	0.098	0.005	0.006	0.022	0.016	0.037	0.031	0.035
Chromium (Cr)	0.261	0.039	0.064	0.170	0.049	0.039	0.104	0.092
Cobalt (Co)	0.217	0.023	0.022	4.452	0.101	0.044	0.810	1.786
Copper (Cu)	5.2	4.5	6.0	9.1	3.2	2.4	5.1	2.4
Iron (Fe)	115	34	30	107	36	36	60	40
Lithium (Li)	0.124	0.010	0.015	0.842	0.089	0.020	0.183	0.326
Manganese (Mn)	980	660	255	516	726	618	626	239
Mercury (Hg)	0.005	0.005	0.006	0.005	0.013	0.012	0.008	0.004
Molybdenum (Mo)	0.130	0.036	0.144	0.596	0.014	0.012	0.155	0.223
Nickel (Ni)	1.57	0.47	1.22	5.54	0.99	0.74	1.75	1.90
Lead (Pb)	0.672	0.175	0.246	0.331	0.180	0.148	0.292	0.198
Selenium (Se)	0.04	0.03	0.05	0.01	0.03	0.33	0.08	0.12
Strontium (Sr)	16	18	33	57	16	28	28	16
Titanium (Ti)	3.2	1.0	0.8	1.7	1.5	1.3	1.6	0.8
Uranium (U)	0.008	0.002	0.001	0.003	0.003	0.002	0.003	0.002
Vanadium (V)	0.258	0.040	0.045	0.143	0.057	0.043	0.098	0.088
Zinc (Zn)	44	25	26	48	55	30	38	13

Table 6-29 also compares the means for the different parameters measured among all samples for the species collected. We note that, compared with other species analyzed, blueberries showed particularly high concentrations of aluminum (200 mg/kg), iron (115 mg/kg) and manganese (980 mg/kg). The alder tissue samples, on the other hand, showed an elevated average concentration of aluminum (108 mg/kg), barium (76 mg/kg), iron (107 mg/kg) and strontium (57 mg/kg) compared with the other plant species. In black spruce, average concentrations of aluminum (155 mg/kg) and zinc (55 mg/kg) were significantly higher than the total average results compiled for all species. Among Labrador tea, sheep laurel and tamarack, none of the three stood out significantly for the parameters analyzed versus the total mean.

6.3.2 TERRESTRIAL FAUNA

6.3.2.1 LARGE FAUNA

SPATIAL BOUNDARIES AND METHODOLOGY

Three species of large mammals are likely to frequent the study area: caribou (*Rangifer tarandus caribou*), moose (*Alces alces americana*) and black bears (*Ursus americanus*). **The grey wolf, sometimes considered to be a fur-bearing animal, is also likely to use the study area.**

Caribou, and woodland caribou especially, are a sensitive component of the natural environment. This species benefits from dual protection, at both the federal and provincial levels. For these reasons, a study area for large fauna was defined primarily with caribou in mind. The study area corresponded to a 50-km radius from the centre of the proposed mine, which amounts to an area of roughly 7,850 km² (Map 6-14). This limit was established in accordance with the guidelines for managing woodland caribou habitat (Équipe de rétablissement du caribou forestier du Québec, 2013a),⁶ which specify in point 6 that the minimum area of units of analysis for the habitat disturbance rate for woodland caribou is 5,000 km².

Activity of large fauna in the study area was determined based on different information sources, i.e., data from various government organizations, scientific articles and reports published on mammals in the area or on species biology, and on an aerial survey.

The Direction de l'aménagement de la faune du Nord-du-Québec of the MFFP confirmed that the moose and caribou survey was very limited in the study area. The only aerial survey data available from regional authorities were from a survey of moose per plot in hunting zone 22, conducted in 1991. The region, including the study area, was not formally covered by a survey devoted to woodland caribou. Casual observations of caribou were done during the 1991 survey, but they did not allow definite differentiation between migratory and woodland caribou. Telemetry positions reveal low activity of woodland and migratory caribou in the study area in recent decades. However, it should be noted that locations of collared caribou do not give a full picture of all **individual caribou** frequenting the territory. **Consequently**, the absence of caribou in a given sector does not mean the species is absent from the area.

Based on this information, and to better document use of the area of the proposed mine by caribou and moose, an aerial survey of large fauna was done in the winter of 2018 in a portion of the study area. The survey area selected for caribou covered an area of 1,600 km² and the survey area for moose covered 100 km².

⁶ The ECCC Recovery Strategy for the Woodland Caribou recommends evaluating the effects of a project taking spatial scope into account, which includes range, as defined in Appendix J of the species recovery program. The project is located in the QC6 conservation unit, which is 621,562 km² in area. Since unit QC6 covers the majority of the range of woodland caribou in Québec, it would be unrealistic to analyze the effects of the project for the whole unit.

The method used was an exhaustive survey of the area. The survey techniques were defined based on the two target species. The survey plan for caribou involved doing equidistant overflights in a north-south direction, spaced 1.75 minutes of longitude (approximately 2 km) apart, consistent with the method used by the MFFP (Courtois and coll., 2001). This overflight was done at an altitude of roughly 200 m and at a maximum speed of 140 km/h. Identification of caribou trails and their characterization, including the counting and classification of animals (sex and age group), was done during a single helicopter overflight phase. Moose were surveyed by means of equidistant 500-m transects, applying the method used by the MFFP (Courtois, 1991).

The navigator/observer was responsible for guiding helicopter movements as well as for entering each observation using a sequential number. This was done using a Touchbook portable computer, in a record specially designed for this purpose. Records and photos were automatically geo-referenced in the database and figured in the flight plan on the screen, thereby preventing duplication of observations collected. Despite the fact that the field campaign targeted primarily caribou and moose, signs of presence or observations of other species of interest identified during overflights, such as grey wolves, were also noted.

The survey was done March 4 to 6, 2018, inclusive. Despite a sometimes partly cloudy sky, visibility allowed clear identification of the trail networks, even for small fauna (hares, ptarmigan). The very open forest environment, due largely to past fires, facilitated the detection of trail networks and animals in general.

CARIBOU

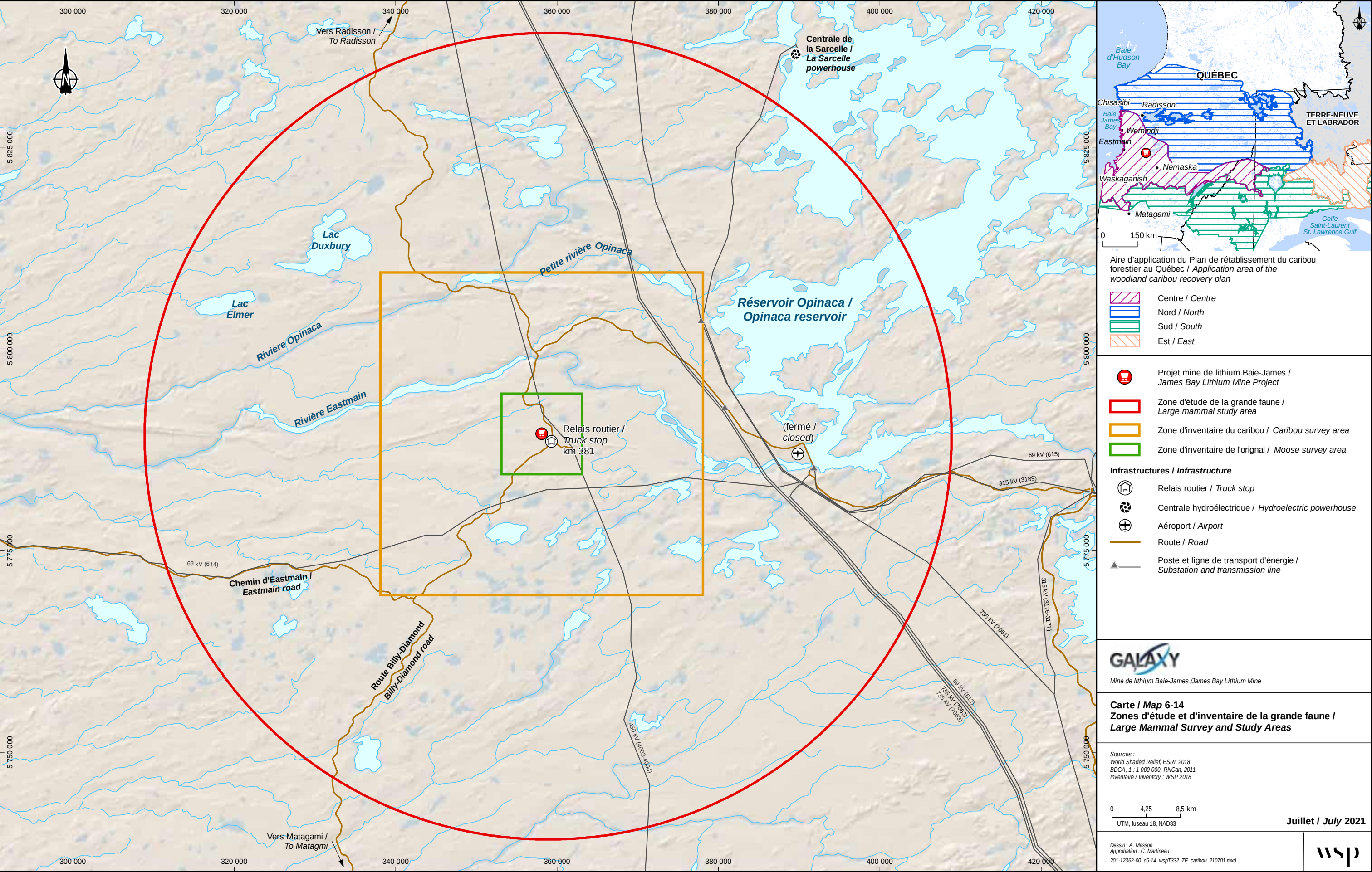
The report of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) established a national consensus regarding the different designatable units of caribou in Canada. Québec is home to a significant portion of designatable unit no. 6 “boreal caribou” (COSEWIC, 2011), whose distribution in the boreal forest extends from Labrador across Québec, toward Ontario and the prairie provinces to the Rockies and Northwest Territories. At the provincial level, boreal caribou are also known as “woodland caribou.”⁷ The status of woodland caribou is distinct from that of eastern “migratory caribou” (unit no. 4), which includes the George River and Leaf River populations (herds). The study area is located in the overlapping area of the ranges of the woodland and migratory caribou of the Leaf River population (Couturier and coll., 2004). Therefore, animals of these two designatable units are likely to frequent the project study area.

Federal context for woodland caribou

In response to COSEWIC recommendations (2002), woodland caribou were listed as a threatened species in Canada under the *Species at Risk Act* in June 2003. In developing its recovery strategy, ECCC adopted a probabilistic assessment approach to the level of self-sustainability of populations, based on the capacity of the range to sustain a population of woodland caribou. This approach focuses on assessing three key indicators: the demographic trend of the population, its size and the level of disturbance of the range. Therefore, a population judged to be self-sustaining will have a stable or growing demographic trend, a size exceeding the critical level and a low to moderate level of disturbance within the range occupied.

According to the strategy adopted, ECCC determined a disturbance rate of 35% to be moderate and corresponding to a likelihood of self-sustainability of 0.60. However, it must be considered that the 0.60 threshold is a minimum, since the likelihood that the population will not be self-sustaining remains significant at 0.40. The probabilistic approach applied by ECCC in 2008 was updated in 2011 to consider new data and analytical methods (Environment Canada, 2008 and 2011). Notably, this update revealed, with even greater clarity, that 70% of the variation recorded in recruitment of woodland caribou populations is explained by a single variable, the habitat disturbance rate, which includes human and naturally induced (forest fires) disturbances.

⁷ This designation will be used from this point onward in the environmental impact assessment.



For each local population, the recovery strategy for the woodland caribou in Canada (EC, 2012) designates the essential caribou habitat (conservation unit) based on three local factors: the habitat location, area and type. Of the six conservation units selected by Québec in the analysis of the federal recovery strategy, three were assessed as non-self-sustaining, two as self-sustaining and one as being of uncertain status.

The project study area is included in conservation unit QC6, an area of 621,562 km² that represents most of the range of woodland caribou in Québec (Table 6-30). The disturbance rate in this unit was evaluated at 30% and the analysis concluded that it is likely that the population occupying it is self-sustaining.

Table 6-30 Level of disturbance and likelihood of self-sustainability for six conservation units used in the woodland caribou federal recovery strategy for Québec

Conservation unit or local population (Québec and Labrador)	Area (km ²)	Level of disturbance (%)		Undisturbed habitat (%)	Likelihood of self-sustainability Risk assessment
		Forest fire	Human activity		
QC1- Val-d'Or	3,469	0.1	60	40	Unlikely: NSS
QC2- Charlevoix	3,128	4	77	20	Very unlikely: NSS
QC3- Pipmuacan	13,769	11	51	41	Unlikely: NSS
QC4- Manouane	27,164	18	23	61	As likely as not: NSS/SS
QC5- Manicouagan	11,341	3	30	67	Likely: SS
QC6- Remainder of occupied area	621,562	20	10	70	Likely: SS
Notes: NSS: not self-sustaining; NSS/SS: not self-sustaining or self-sustaining; SS: self-sustaining Text in bold indicates the conservation unit affected by the project. Disturbances where fire and human activities overlap were counted only once. Buffer zones of 0.5 km were applied to disturbances caused by human activities. The status of these units remained unchanged between the 2011 and 2012 Environment Canada surveys.					

Sources: Environment Canada (2011 and 2012).

Provincial context for woodland caribou

Woodland caribou were designated as vulnerable in Québec in February 2005 under the *Act respecting threatened or vulnerable species* (Order in Council 75, 2005). As a result, Québec proceeded, within its areas of jurisdiction and obligation, to develop and implement a provincial woodland caribou recovery strategy prepared by the Équipe de rétablissement du caribou forestier du Québec, a team which consists of various specialists and organizations involved in protecting this species. An initial Québec woodland caribou recovery strategy was developed for the period 2005–2012 and a second was submitted to Québec authorities in May 2013 (Équipe de rétablissement du caribou forestier du Québec, 2008 and 2013b). The recovery team also prepared guidelines for managing woodland caribou, a first version of which was tabled in 2010, followed by a revised version in 2013 (Équipe de rétablissement du caribou forestier du Québec, 2010 and 2013a). The project study area is in the central portion of the area of application of the Québec woodland caribou recovery strategy (Map 6-14).

Density, demography and land use

Woodland caribou live in very low densities, ranging from one to two animals/100 km², according to surveys conducted in the 1990s (Courtois, 2003). Between 2000 and 2010, the MFFP intensified its woodland caribou survey efforts to harmonize, among other things, forest activities with maintenance of this species. The surveys conducted during this period in the range counted nearly 3,000 caribou over 190,234 km², for an average of 1.5 caribou/100 km² (Équipe de rétablissement du caribou forestier du Québec, 2013b).

Woodland caribou populations present in the Nord-du-Québec region are defined according to the patterns of land use by individual animals. Although most animals remain within the territory used by their population, there is nonetheless some movement of individuals between these populations (especially during rut or in spring). Despite these movements between populations, most of these individuals return to winter with their parent population. Membership of an individual to a given population is therefore determined by their location in the month of February each year. Even though most individuals return to winter with their parent population, it occasionally happens that some caribou “migrate” from one population to another.

The woodland caribou of the local population (herd) dubbed Nottaway, which occupies the territory north of Matagami, are the most likely to frequent the study area of the project. Note, however, that there may be exchange of individuals between this population and that of Témiscamie and Assinica populations. A report of a woodland caribou recovery study done by a work group from the Comité scientifique du Nord-du-Québec provides relevant scientific data, particularly regarding the Nottaway population (Rudolph and coll., 2012). It concludes that this population, like those of Témiscamie and Assinica further east, is considered not self-sustaining. An exhaustive survey was done covering the range of the Nottaway woodland caribou herd in 2016 (Szor and Brodeur, 2017). Based on the results of this survey, the population of the Nottaway herd was estimated to be 308 individuals, applying a detection rate of 85% (Courtois and coll., 2001).

The drop in the recruitment rate and the survival rate of adult females along with a disturbance rate higher than the threshold required to ensure persistence of the populations are the key elements supporting this conclusion. Legal and illegal hunting can also play an important role in woodland caribou mortality in the area where the mining project is planned. The study area is part of hunting zone 22, where the simultaneous presence of migratory and woodland caribou is likely in winter. However, before February 1, 2018, hunting of migratory caribou was permitted in sector B of hunting zone 22, north of the study area.⁸ Even though this hunt targeted primarily migratory caribou, taking of woodland caribou was probable, especially in winters when migratory caribou frequented more southerly areas (Jean and Lamontagne, 2005).

Telemetric data was obtained from the MFFP, specifically its woodland caribou monitoring program. The purpose of this monitoring is to increase knowledge about the distribution, abundance, trend and dynamics of woodland (boreal) caribou populations to inform and support the decisions regarding the management and conservation of this species. The acquisition of telemetric data represents only one of the numerous components of the program. The telemetric data is used, among other things, to establish the range of the various populations, describe the patterns of land use, estimate the survival rates of the various segments of the population and locate individuals in order to obtain bioindicators for the assessment of the population trend.

Considering that the “female” segment of the population is the one having the biggest impact on the demography of woodland caribou populations, the current monitoring is essentially geared towards females. Thus, the data presented is not necessarily representative of the “male” segment of the population. Also, a very small proportion (<5%) of each woodland caribou population is equipped with telemetric collars. These collars are, as much as possible, evenly distributed across the range of the population. It is important to bear in mind that the absence of telemetric data in the area does not necessarily mean the absence of caribou. Since the behaviour of the woodland caribou is gregarious, especially during winter, it is important to consider that a telemetric localization at a specific location can in fact reflect the presence of several caribou.

⁸ The migratory caribou hunt has been banned indefinitely in Québec since February 1, 2018.

Consequently, according to information provided by MFFP representatives, a single woodland caribou with a telemetric collar frequented the study area from December 2008 to the end of March 2009 (Map 6-15). In the opinion of one MFFP representative,⁹ analysis of movement patterns appeared to show that it was an individual from the Assinica population which, for whatever reason, made a rather atypical move and found itself in the area east of Eastmain, historically used by the Nottaway population. Given that migratory caribou were present in this same area in December 2008, it is possible that this individual followed a group of caribou moving north and was found in this area as a result.

The MFFP's survey and telemetric monitoring methods are standardized across Québec and represent the best available information sources at the provincial level. This information, provided by provincial and territorial authorities, formed the foundation of the estimate of the average size of the local population in the scientific assessment to designate critical habitat for the boreal population of woodland caribou (*Rangifer tarandus caribou*) in Canada (2011 update), presented in Appendix F of the Recovery Strategy for the Woodland Caribou, Boreal Population. Even though the data may display certain biases, it makes it possible to establish the range of the various populations and to describe the patterns of land use by assessing the density of occurrence points. Hence, the data reflects the best representation of the use of the study area by the woodland caribou, which reveals a very low level of use by the boreal caribou.

Casual observations of signs of caribou presence in the study area were also compiled by the MFFP in September and November 2013. Two caribou were also observed in mid-July 2014 and three at the end of June 2015. The dates of these observations lead to the belief that they were woodland caribou, since migratory caribou are generally not found in this area at those times of year. However, this finding should be qualified, because sometimes migratory caribou in a weakened state or that have suffered injuries do not migrate toward their calving area and remain in their wintering area.¹⁰ It is therefore not certain that signs of presence and casual observations of caribou in the study area were of woodland caribou. Current knowledge therefore indicates that woodland caribou have used the study area very little over the past decade.

Migratory caribou, on the other hand, are likely to frequent the study area in winter, from mid-November to mid-March, in search of food. Telemetric monitoring data provided by the MFFP indicate that, over the past decade, individuals from the Leaf River population frequented the study area during two periods: December 16, 2013, to March 6, 2014, and December 20, 2015, to February 8, 2016 (Map 6-15). This activity occurred within a 20 km and wider radius from the centre of the proposed mine. They were primarily concentrated in the northeast portion of the study area, on the periphery of the Opinaca Reservoir.

The aerial survey done in March 2018 by WSP over a 1,600-km² portion of the study area did not detect the presence of caribou. It should be noted that during this survey, two Cree participants mentioned that the study area generally had not been frequented by caribou for several years, except a few observations in the Opinaca Reservoir area during periods when migratory caribou usually occupy the area (November to March). Furthermore, the tallyman and his family indicated in April 2018 that caribou are uncommon along the traplines and that, when present, they are generally found in the southern sector of the study area, more than 20 km from the proposed mine.

Habitat conditions of woodland caribou

No ecoforestry database published by the MFFP is available for this area of Québec. The information databases available to characterize the environment are: vegetation (softwood stands) and wetlands from the *Programme d'inventaire forestier du Québec nordique (PIEN)* as well as forest fires (since 1980) and work carried out as part of the EIA of the GLCI James Bay Lithium Mine project (photo interpretation and vegetation surveys conducted in July 2017 by WSP). Information obtained through photo interpretation and the WSP survey provides greater accuracy than information from the PIEN. They were, therefore, used to analyze and describe the biophysical characteristics of different types of habitat frequented by woodland caribou to accomplish their life processes in the study area.

⁹ E-mail from Guillaume Szor, Biologist, Direction de la gestion de la faune du Nord-du-Québec, MFFP, April 20, 2018.

¹⁰ Personal conversation with Serge Couturier, Biologist, Ph.D.

Federal habitat criteria

The project site is located within the southeastern borders of the Hudson Plains Ecozone (Figure 6-5). The caribou populations likely to use the projected mining site area are located mainly in the Central and Eastern Boreal Shield Ecozones, while the project is located in the Hudson Plains Ecozone. We should therefore consider the biophysical characteristics of critical caribou habitat in these three ecozones.

Descriptive terms for caribou habitat (Appendix H of the Recovery Strategy for the Woodland Caribou, Environment Canada, 2020) indicate criteria that are difficult to transpose on the sector plant databases available. The wintering period is a critical one for woodland caribou looking for nutritional resources. Biophysical characteristics of broad-scale and winter critical boreal caribou habitat, in the three ecozones that may be used by Nottaway and Assinica caribou populations, are presented below (Tables 6-31 and 6-32).

Table 6-31 Biophysical characteristics of critical boreal caribou habitat in the Boreal Shield (East), Boreal Shield (Centre) and Hudson Plains Ecoregions

Broad-scale habitat description
Boreal Shield (East): • Coniferous and feather moss forests in poorly drained environments and highlands made up of mature coniferous trees with an abundance of terrestrial lichens. Black spruce, jack pine and balsam fir stands with an abundance of lichens. • Bodies of water and wetlands (swamps, swampy areas with tamaracks). • Mountains or undulating terrain. • 300 m elevation. • Intermediate normalized difference vegetation index values. • Selection of old burned areas (more than 40 years old).
Boreal Shield (Centre): • Lowlands dominated by black spruce in the final successional stage and highlands dominated by jack pine. Bodies of water and wetlands (swamps, swampy areas with tamaracks). • Black spruce lowlands with open canopy. • Low density jack pine or final successional stage black spruce forests and peatlands dominated by black spruce or tamarack with an abundance of terrestrial lichens and a moderate amount of arboreal lichens. • Caribou also use areas with sandy to loamy soil, ranging from dry to wet, and with shallow soil covering bedrock. • 300 m elevation. • Intermediate normalized difference vegetation index values. • Selection of old burned areas (more than 40 years old).
Hudson Plains: • Environment generally selected to reduce predation risk. • Muskegs, largely shrubbed, and forests of mature coniferous trees with an abundance of lichens. • Shorelines of deep lakes and rivers (birch trees). • Poorly drained areas dominated by sedges, mosses and lichens, as well as open black spruce and tamarack forests. • 150 m elevation. • Intermediate irregularity levels and intermediate values on the normalized difference vegetation index.

Source: Environment Canada, 2020

Table 6-32 Biophysical characteristics of critical caribou habitat in the wintering period in the 3 ecozones considered

Ecozone	Description of winter habitat
Hudson Plains	- Dense forests of mature coniferous trees with lichens and wetlands. - Peatlands, mainly open bogs, with terrestrial lichens. - Large patches of intermediate and mature black spruces, muskegs, largely shrubbed, and mixed coniferous stands, all used towards the end of winter.
Boreal Shield (Centre)	- Broad ranges of contiguous forest dominated by black spruce. - Open forests of coniferous trees or forests with lower tree density, an abundance of terrestrial and arboreal lichens and low quantities of snow (e.g. shoreline) are also selected.
Boreal Shield (East)	- Wooded wetlands. Caribou use the highland tundra to rest. - Dry, bare mountainous terrain, wetlands, forests of mature coniferous trees with lichens, balsam fir stands, dense spruce stands and mixed spruce and fir forests that are over 40 years old selected in the southern regions. Caribou can be observed near frozen bodies of water. - The use of mature forests protected from harvesting increases the possibility of encountering wolves, who choose the same habitat in winter. - Areas with shallow snowfall selected at the end of winter.

Source: Environment Canada, 2020

Based on the general habitat description presented above, the plant communities represented by black spruce forests (with lichen or moss), jack pine forests or wooded peatlands are those that best meet the large-scale habitat conditions for woodland (boreal) caribou. Shrubby peatland and open bogs were, however, assessed because they may be used during calving, post-calving and rutting periods.

With regard to the biophysical characteristics reported above that come from recovery strategy, the strategy itself states:

Biophysical characteristics vary between and within ranges. Since the biophysical characteristics presented in the recovery strategy were developed on a national level based on each ecozone and ecoregion, and not each local population, each provincial or territorial authority could develop or will develop over time a more detailed description of the biophysical characteristics necessary in each range.

Consequently, the knowledge acquired by the *Gouvernement du Québec* since the recovery strategy was implemented should be considered first when analyzing biophysical characteristics of critical caribou habitat for populations likely to use the projected mining site.

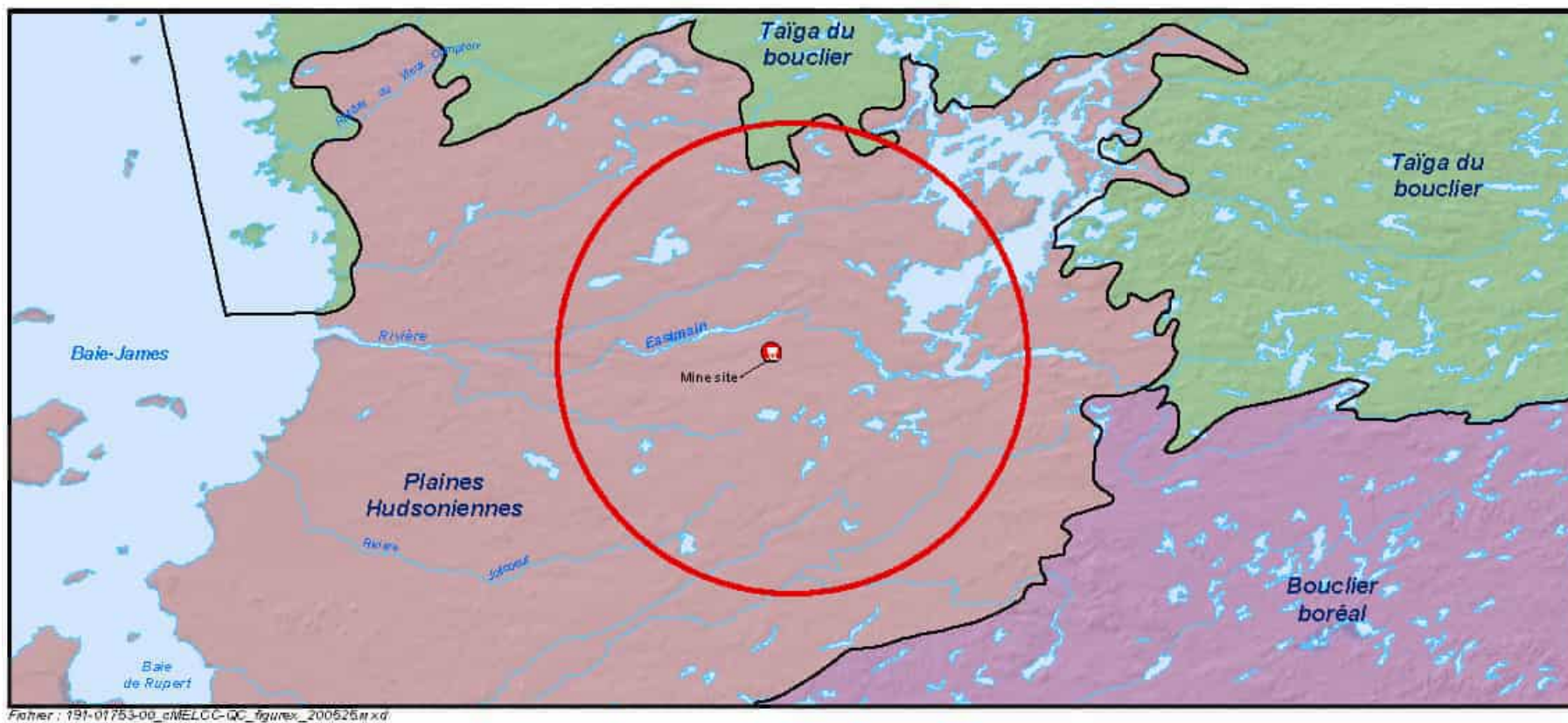


Figure 6-5 Project location by ecozone

Provincial habitat criteria

On a provincial level, the woodland caribou has been designated as a priority species for acquiring knowledge over the last three decades by the Gouvernement du Québec. Since 1990, many scientific studies have been done in Québec, including about 30 master's or doctoral degrees focused on the following four themes:

- effects of forest management and human disturbance;
- habitat selection and use;
- population dynamics;
- effects of predation.

Based on this new knowledge, the Québec woodland caribou recovery strategy was revised in 2013 (Équipe de rétablissement du caribou forestier du Québec, 2008 and 2013a) and guidelines were developed for woodland caribou habitat management (Équipe de rétablissement du caribou forestier du Québec, 2013b). Telemetric data acquired between 1998 and 2019 added additional details, particularly regarding the selection and use of habitats, which are considered in these studies. It also bears mentioning that in 2018, the MFFP started implementing a major program for the surveying and telemetric monitoring of woodland caribou populations across the entire range of the populations of this species. The goals of this program were to expand knowledge on population numbers, range, abundance and trends. These criteria are the main indicators to assess population self-sustainability as prescribed in the species recovery strategy (Environment Canada, 2012) and in the caribou recovery strategy. Ultimately, monitoring will be continued over the long term for each population. The analysis of the effects of the James Bay Mine project in the EIA (WSP, 2018f) was mainly based on this new knowledge, which is the most recent knowledge currently available.

In order to prioritize critical sectors that need to be protected for woodland caribou, as part of the strategy for logging and protected area creation, Québec's leading specialists brought their contemporary scientific knowledge together to do a major study on woodland caribou habitat selection in Québec's boreal forests. This study highlighted the characteristics of habitats selected for the species' main functions, thereby providing greater understanding of the needs of caribou. Habitat selection analysis helped to map out the sectors that offer the most advantageous habitat for caribou by determining the probability of occurrence relative to the species based on models that best describe habitat selection. Within this study, the sector identified as the James Bay region covers around 105,000 km² and includes the ranges of the Nottaway, Témiscamie and Assinica local caribou populations (herds) in areas subject to forestry activities. Caribou tracked in this sector were primarily in the area located east of James Bay and west of Mistassini Lake. This sector is the most representative habitat that can be selected by caribou likely to use the area of the projected mine. This study demonstrated that, to meet these annual needs, woodland caribou need a very large annual home range (often > 1,000 km²). Habitat selection analysis in the aforementioned study demonstrated the importance of different environments for establishing annual and seasonal woodland caribou home ranges. The study mentions that the results obtained generally matched what had been previously documented in Québec (Courtois et al. 2008; Courbin et al. 2009; Hins et al. 2009).

The main observations on habitat selection were as follows:

- Dry, bare environments have the greatest and most consistent influence on sector use by caribou, both annually and for each of the seasons.
- During the wintering period, caribou seem to primarily select dry bare lands as well as softwood stands that are 40 or more years old with no significant distinction for spruce stands, open or closed fir forests, or other softwoods.
- In winter, wetlands are heavily selected in sectors where they are abundant; these environments seem to be particularly sought out in winter by caribou in the James Bay area.

- Stands of mature softwoods that are 40-80 years old and 80 or more years are also sought out by caribou, both annually and seasonally.
- Open softwood forests (25-40% coverage) made up of spruces and firs are generally selected more often than closed forests, particularly on an annual basis and during rutting.
- Bare wetlands were selected most often during calving season and rutting, but their use by caribou seems limited, because they are selected less when they are more available.
- Young stands that are 5-40 years old, sectors that have been subject to recent logging or fires, and mixed-wood or hardwood stands are very rarely selected at any point in the year.

Multiple authors recognize that during habitat selection, woodland caribou prefer peatlands, mature softwood stands containing lichens and other lichen-rich sites (Équipe de rétablissement du caribou forestier du Québec, 2013a). It is also a recognized fact that caribou avoid recently disturbed environments (Moreau *et al.*, 2012). In summer, woodland caribou mainly live in softwood forests that are over 50 years old (Courbin *et al.*, 2009; Hins *et al.*, 2009; Lantin, 2003), peatlands and dry, bare lands (lichen tundra).

Maps were produced for each of the seasons and for the full year, identifying the sectors with characteristics sought out by caribou. According to the authors, the synthesis map produced by combining the habitat selection information from different seasons is the most representative of the potential of a sector's woodland caribou occurrence, because it factors in all of the sites that are the best for meeting the needs of woodland caribou in terms of habitats on an annual basis. Based on the results of this study, a map was produced to show the relative probability of occurrence for woodland caribou, using the habitat selection model developed by Leblond *et al.* (2015). This map identifies sectors where the caribou habitat is of adequate quality. This map (6-17) shows that the project area has a moderate to low relative probability of occurrence for woodland caribou.

Spatial distribution and heterogeneity of habitats play important roles in adequately meeting the needs of boreal caribou over the annual cycle. The importance of large forested tracts in meeting the needs of caribou, especially in winter, is well established. The "large areas of contiguous forests" criterion is, however, part of the biophysical characteristics of critical boreal caribou habitat in the Boreal Shield (Centre) Ecoregion. The characteristics of the Boreal Shield (East) Ecoregion also includes "large patches of intermediate and mature black spruce."

It should be noted that in Québec, the management strategy for protecting woodland caribou is based on conserving large tracts of coniferous trees (Courtois *et al.* 2004, 2008). The results of the most recent studies demonstrate the importance of maintaining a certain degree of heterogeneity in habitats within these forests. Protecting large forest tracts is mainly designed to protect winter habitats, which are also often selected during calving and rutting. It was demonstrated that woodland caribou occurrence probability varied from 40-48% in 100 km² forests and from 53-62% for 250 km² forests (Lesmerises, 2011). A minimum surface area of 500 km² is necessary to reach a 75% probability of occurrence, while maximum probability of occurrence is reached with a surface area of over 1,000 km². It was also noted that mature coniferous tree forests outside of large forest tracts are also heavily selected, especially during rutting and while raising young. Lastly, the study concluded that the large surface area of space used annually by caribou indicated that the current size of protected forest tract recommended by Courtois *et al.* (2004), at 250 km², is insufficient for long-term woodland caribou conservation.

Current disturbances in the study area sector

Map 6-16 presents potential caribou habitats as well as recent fire disturbances around the local study area.

Current permanent human disturbances were simulated by projecting a 500 m zone of influence around the human components in the territory. The components causing permanent human disturbance selected were the Billy-Diamond highway, the 450 kW power transmission line and the km 381 truck stop. The land inside the zone of influence around these components is not considered potential caribou habitat. Consequently, the 1% of surface area covered by planned mine infrastructure and the 14% covered by the 500 m zones of influence around it were excluded from potential woodland caribou habitat.

Calculation was carried out to determine the critical habitat (type-wise) for woodland caribou in the mine footprint (Map 6-16). Table 6-33 summarizes the results of the boreal caribou habitat analysis.

In the zone of influence around the proposed mine and outside of permanent human disturbances, the natural (undisturbed) environment is composed of biophysical elements, a very large proportion of which do not meet broad-scale habitat criteria for boreal caribou. This situation is common for the landscape surrounding the mine project. Overall, the area has very little mountainous relief or undulating terrain that is useful for, among other things, the winter habitat of boreal caribou.

Table 6-33 Analysis of potential boreal caribou winter habitat and calving habitat in the portion of the zone of influence of the planned mine outside of permanent human disturbances

	Zone influence (1 122,8 ha)					
	Total		perturbé feu		non perturbé	
Habitat potentiel en période hivernale	ha	%	ha	%	ha	%
Pessière noire à lichen	17,6	1,6%	0,6	0,1%	17,0	1,5%
Pessière noire à mousse	-				-	
Pinède grise	-				-	
Tourbière boisée	203,0	18,1%	36,4	3,2%	166,7	14,8%
Dénudé sec	14,7	1,3%			14,7	1,3%
Sous-total	235,3	21,0%	37,0	3,3%	198,3	17,7%
Habitat potentiel de mise bas, de poste mise-bas et de rut						
Tourbière arbustive	216,0	19,2%	66,7	5,9%	149,3	13,3%
Tourbière ouverte	506,6	45,1%	390,1	34,7%	116,4	10,4%
Sous-total	722,5	64,4%	456,8	40,7%	265,7	23,7%
Total habitat potentiel annuel	957,9	85%	493,8	44%	464,0	41%
Autres groupement non retenus comme habitat potentiel						
Lac ou mare	21,3	1,9%			21,3	1,9%
Affleurement rocheux	30,8	2,7%			30,8	2,7%
Anthropique	3,2	0,3%			3,2	0,3%
Arbustaie	95,0	8,5%			95,0	8,5%
Brûlis	14,6	1,3%			14,6	1,3%
Sous-total	165,0	14,7%			179,6	14,7%
	1122,8	100,0%	493,8	44,0%	643,7	56,0%

Broad-scale habitats are highly fragmented and generally represent small islets of black spruce lichen forest and treed peatland. Their spatial distribution, among other things, does not satisfy the criterion of large areas of contiguous forests as winter habitat for boreal caribou. Moreover, the topography of the area is generally uniform. We can therefore assume that there is no potential winter habitat for boreal caribou in the mine footprint nor in its 500-m zone of influence.

Again looking at the portion of the planned mine's zone of influence outside of permanent human disturbances, broad-scale habitat covers 235.3 ha, or 21.0% of the study area. Of this area, 37 ha, or 3.3% of the study area, was affected by recent fires. Broad-scale habitat that was undisturbed by recent fires covers 198.3 ha or 17.7% of the zone of influence undisturbed by permanent human disturbances.

With regard to shrubbed peatlands and open peatlands that could serve as habitat for calving periods, post-calving periods and rutting periods, they cover 216 and 506.6 ha, respectively, or 19.2% and 45.1% of the zone of influence of the planned mine that is undisturbed by permanent human components. Of this peatland, a proportion of 40.7% of the study area was affected by recent fires. Consequently, the total area of peatland unaffected by the fires was 265.7 ha, or 23.7% of the zone of influence of the mine that is undisturbed by human components.

Available calving habitat within the project's zone of influence currently offers a very low probability of being selected by females during this period, especially since this type of environment (shrubby or open peatland) is very common both near the project footprint and over the entire James Bay region.

The probabilistic approach applied by ECCC and updated in 2011 (Environment Canada, 2011) clearly showed that 70% of the variation recorded in recruitment of woodland caribou populations is explained by a single variable that encompasses the human and natural (forest fire) disturbance rates. Therefore, analysis of the habitat disturbance rate appears to be a relevant indicator to characterize current conditions of the habitat in the study area.

The current habitat disturbance rate was also assessed across the study area, within a 50-km radius from the centre of the proposed mine, representing an area in the range of 7,850 km² (Map 6-16). For this simulation, the total disturbance footprint was determined based on the combined effects of fires that occurred over the past 40 years and various human disturbances in the buffer zone (500 m). This assessment method is based on ECCC's demonstration, in which the use of a 500-m buffer zone to map man-made features provided a better representation of the combined effects of heightened predation and avoidance on boreal caribou population trends across the country (Environment Canada, 2011). The habitat disturbance rate within a radius of 5-50 km from the centre of the proposed mine was assessed to identify the variation at different scales (Table 6-34).

First, there are no forestry activities for industrial purposes in the study area, which preserves it from major human disturbances caused by the harvesting of wood substance and the presence of logging road networks. Human disturbances of the habitat are primarily associated with industrial areas (mines), hydroelectric production, linear structures (roads, power transmission lines) and with some land uses.

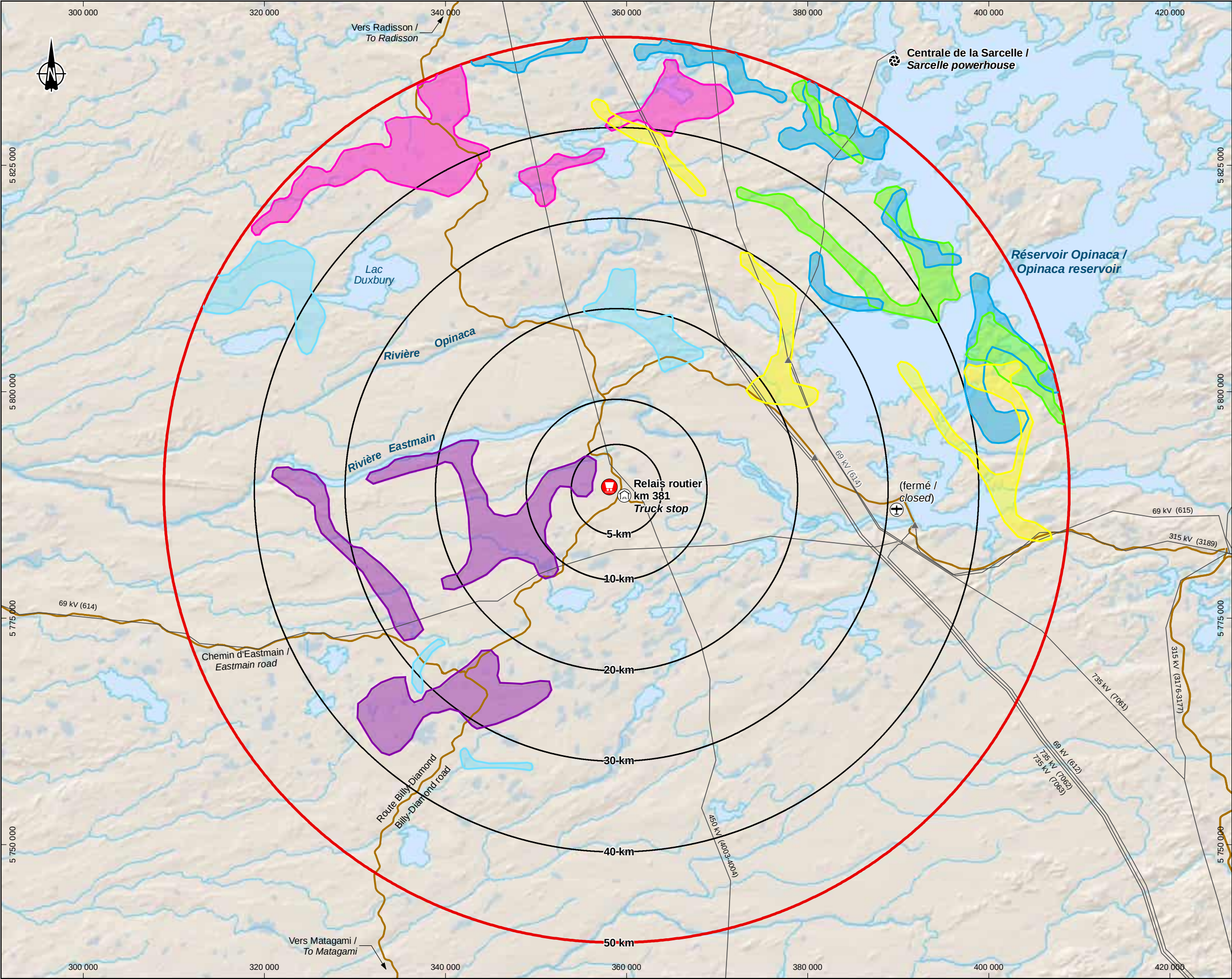
Overall, man-made features disturb 7% of the study area. The km 381 truck stop of the Billy-Diamond highway, near the proposed mine, concentrates human activity and constitutes a significant source of woodland caribou habitat disturbance in this area.

However, the main source of caribou habitat disturbance in the study area is of natural origin. It is associated with large forest fires that have affected the study area over the past 40 years. Fires alone have disturbed caribou habitat in the study area at a rate of 66%. These fire-burn areas overlap with the majority of areas disturbed by man-made features, such that the total percentage of disturbance (natural and human) in the study area is assessed at approximately 68%.

Table 6-34 Analysis of disturbance rates of woodland caribou habitat within a 5-50 km radius from the centre of the proposed mine

Distance from centre of the mine (km)	Type of disturbance	Area (ha)	Disturbance (%)
5	Size of area	7,854	100%
	Human	2,013	26%
	Natural	7,052	90%
	Natural and human	7,231	92%
10	Size of area	31,416	100%
	Human	5,235	17%
	Natural	26,545	85%
	Natural and human	27,089	86%
20	Size of area	125,664	100%
	Human	14,403	12%
	Natural	110,831	88%
	Natural and human	112,049	89%
30	Size of area	282,743	100%
	Human	30,320	11%
	Natural	229,500	81%
	Natural and human	232,594	82%
40	Size of area	502,655	100%
	Human	44,386	9%
	Natural	370,337	74%
	Natural and human	376,379	75%
50	Size of area	785,396	100%
	Human	57,874	7%
	Natural	520,181	66%
	Natural and human	531,550	68%

A certain proportion of the burned areas likely have the potential for self-regeneration and can provide conditions suitable for the woodland caribou in the future. However, during the March 2018 aerial survey, the regeneration observed in these areas was characterized as “very poor” (Photos 6-3 and 6-4). This situation can be explained by the fact that a large portion of the territory was subject to successive fires. Young stands and unproductive land are sensitive to natural regeneration occurrences due to limited seed production and become especially vulnerable under short fire cycles (short interval between two disturbances) (Mansuy, 2013).



Projet mine de lithium Baie-James / James Bay Lithium Mine Project

Zone d'étude de la grande faune / Large mammal study area

Caribou / Caribou

Localisation du caribou migrateur par période hivernale / Location of Migratory Caribou in Winter Period

Décembre 2007 à avril 2008 / December 2007 to April 2008

Décembre 2009 à février 2010 / December 2009 to February 2010

Décembre 2010 / December 2010

Décembre 2013 à mars 2014 / December 2013 to March 2014

Décembre 2015 à février 2016 / December 2015 to February 2016

Caribou forestier / Woodland Caribou

Localisation du caribou forestier (décembre 2008 à mars 2009) / Location of woodland caribou (December 2008 to March 2009)

Infrastructures / Infrastructure

Relais routier / Truck stop

Centrale hydroélectrique / Hydroelectric powerhouse

Aéroport / Airport

Route / Road

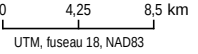
Poste et ligne de transport d'énergie / Substation and transmission line



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 6-15
Occurrence de caribous / Caribou Occurrence

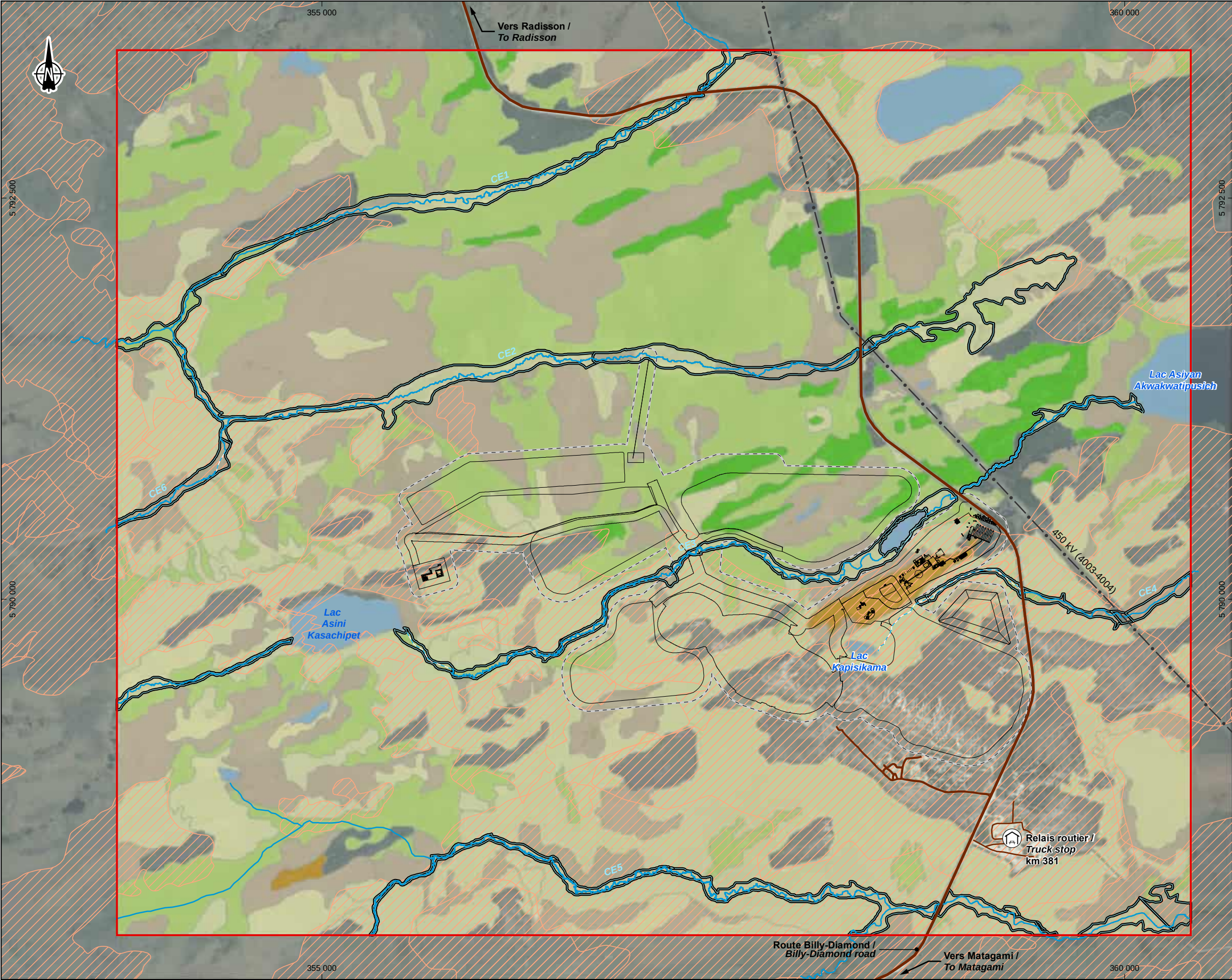
Sources :
World Shaded Relief, ESRI, 2018
BDGA, 1 : 1 000 000, RNCan, 2011
Caribou : MFFP, 2017, © Gouvernement du Québec



Juillet / July 2021

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c6-15_wsp7333_caribou_210701.mxd





- Infrastructures minières / Mining infrastructure
- Emprise de la mine (zone tampon de 50 mètres) / Mine footprint (buffer 50 meters)
- Zone d'étude locale / Local study area
- Zone de perturbation naturelle (feux de forêt) / Natural Disturbance (forest fire)
- Infrastructures / Infrastructure**

Route principale / Main road

Route d'accès / Access road

Ligne de transport d'énergie / Transmission line

Relais routier / Truck stop
- Hydrographie / Hydrography**

CE3

Numéro de cours d'eau / Stream number

Cours d'eau permanent / Permanent stream

Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream

Littoral des cours d'eau / Watercourses shoreline
- Habitat à grande échelle / Large-scale habitat**

Pessière noire à lichen / Black spruce lichen forest

Tourbière boisée / Treed peatland

Dénudé sec / Dry barren land
- Habitat potentiel en période de mise bas, de post mise-bas et de rut / Potential calving, post-calving and rutting habitat**

Tourbière arbustive / Shrubby peatland

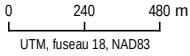
Tourbière ouverte / Open bog



Mine de lithium Baie-James / James Bay Lithium Mine
Mise à jour de l'étude d'impact sur l'environnement

Carte / Map 6-16
Perturbation de l'habitat potentiel du caribou boréal /
Woodland caribou habitat disturbance

Sources :
Orthoimage : Galaxy, août 2017
Inventaire / Inventory : WSP 2017
Données du projet / Project data : Galaxy, 2021



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The location of the projected mine represents one of the sectors in the study area that is most disturbed by human and natural elements. For example, within a 5-km range from the centre of the mine, approximately 92% of the area is disturbed. Fires have disturbed approximately 90% of this sector while human factors generate 26% of the disturbances. Within a 10 km range from the centre of the mine, 86% of the area is disturbed. Fires cover approximately 85% of the latter while human disturbances are responsible for approximately 17%.



Photo 6-3 **Recent fire area – 2011-2016**



Photo 6-4 **Poor-regeneration fire area – 2001-2010**

The relative probability of occurrence of woodland caribou, based on the habitat selection model by Leblond and coll. (2015), provides another indicator to assess the environmental conditions in terms of habitat for the woodland caribou. This indicator was incorporated in the identification of priority areas to create vast protected areas for the woodland caribou. It is noted, however, that although this mathematical model of habitat selection by a group of individuals incorporates many environmental characteristics, it does not necessarily indicate the real distribution of the species in the area. The model also does not consider the real regeneration conditions of burned forest areas over the last decades. The projected mine area generally presents a medium to low relative probability of woodland caribou occurrence (Map 6-17).

Areas providing the highest probabilities of occurrence are generally residual forest islands formed after forest fires. The habitat available within a 10-km radius of the centre of the projected mine is very fragmented. On this matter, ECCC specifies that to ensure self-sustainability for the local populations, they must have access to continuous tracts of undisturbed habitat with the biophysical characteristics needed to meet their needs during their life cycle (Environment Canada, 2012). Therefore, due to its high disturbance rate, the study area offers poor habitat conditions for woodland caribou.

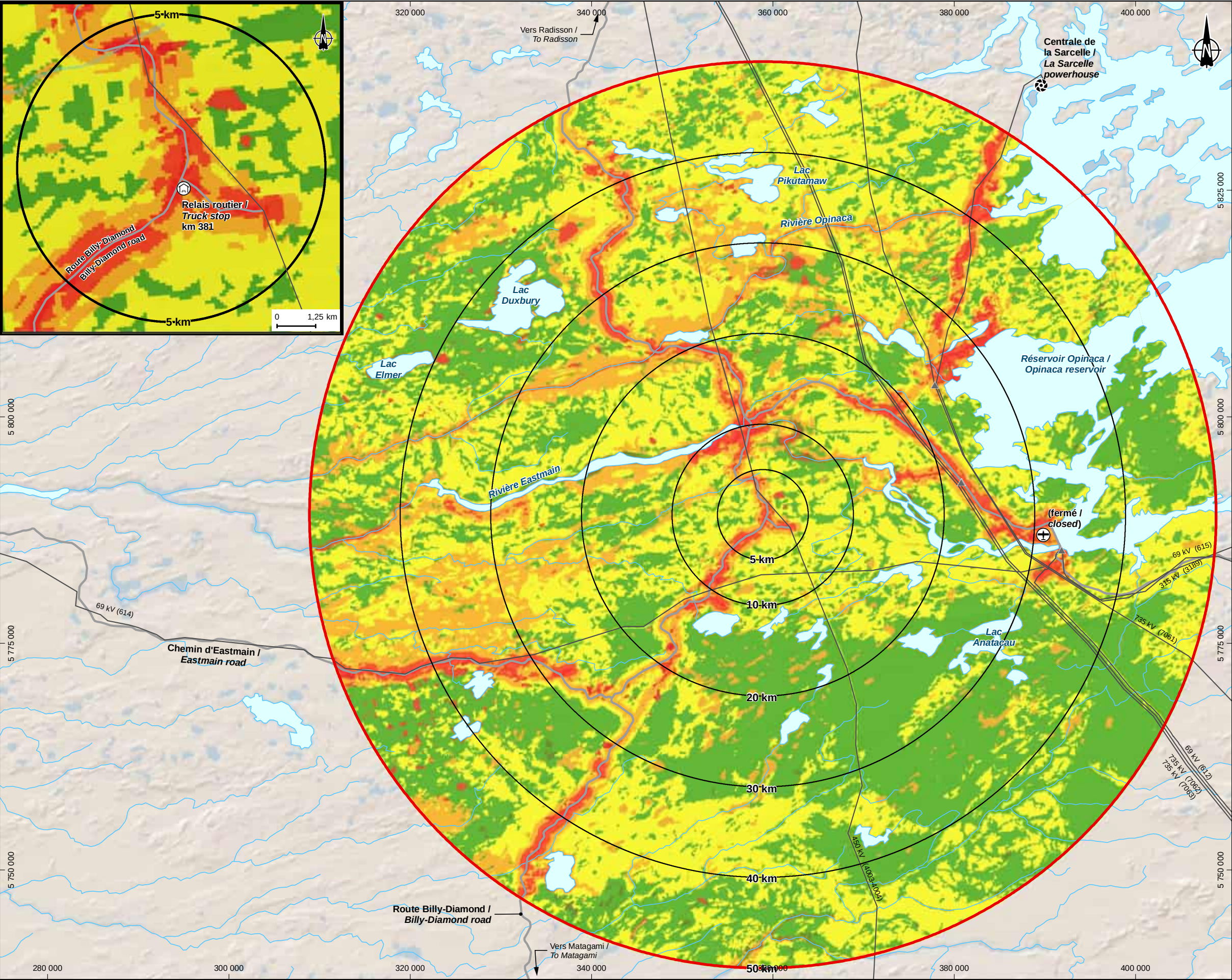
MOOSE

The low moose density in Québec's boreal forest is mainly due to an unproductive habitat. It is during winter that low food availability and quality are the most critical. The moose's typical winter habitat is almost always made up of mixed stands, where the arrangement of the coniferous and deciduous trees provides it with cover in proximity to feeding areas.

Fire, which is a disturbance factor in the region's plant dynamics (CRRNTBJ, 2010), can increase the quantity of browse available. Several years after a fire, regeneration in burn areas containing a large proportion of tree or shrub species, constitute rich feeding habitats (Courtois and coll., 1996; Samsom and coll., 2002). The scarcity of birch, poplar and mixed stands could explain the moose's increased use of old burn areas and river scrubland in the Nord-du-Québec region (Maltais and coll., 1993). However, we should note that large expanses of burn areas have little cover to provide shelter.

The forest species that moose seek out as food sources are white birch and willow in the summer and balsam fir in the winter (Dussault and coll., 2002, 2004; Samsom and coll., 2002). Deciduous mixed forests and regenerating forests serving as food sources, interspersed with mature stands offering cover, provide suitable habitats for moose. Mixed forest stands, deciduous forest stands and shrub swamps are scarce in the study area. Scrubland and burns, with or without regeneration, are low-quality environments that are dominant in the landscape of the study area. With regard to the calving period, the preferred habitats are lake and watercourse banks, coniferous forest stands and hilltops.

The March 2018 moose survey, initially planned on a 100-km² area, was performed instead over a larger area of 1,600 km². The environment is largely bare due to forest fires and contains small islands of residual forests primarily concentrated along watercourses. These islands, especially when they contain stems from deciduous or shrub species, are the only areas that provide suitable conditions to meet the moose's cover and nutritional requirements during winter. Several watercourses and lakes are present within the study area. However, the limited availability of mature coniferous forest stands constitutes a deficiency in terms of moose habitat suitability, namely, as cover during winter.



Zone d'étude de la grande faune/
Large mammal study area

Caribou forestier / Woodland caribou
Probabilité relative d'occurrence / Relative probability of occurrence

Faible / Low

Élevée / High

Infrastructures / Infrastructure

Relais routier / Truck stop

Centrale hydroélectrique / Hydroelectric powerhouse

Aéroport / Airport

Route / Road

Poste et ligne de transport d'énergie /
Substation and transmission line

GALAXY
Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 6-17
Probabilité relative d'occurrence du caribou forestier /
Woodland Caribou Relative Probability of Occurrence

Sources :
BDGA, 1:1 000 000, 2014
MDDELCC, avril 2015

0 4,25 8,5 km
UTM, fuseau 18, NAD83

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In light of this situation, the survey method used in the 1,600 km² area was adjusted to better detect moose in woodlands appearing to provide more suitable conditions for wintering, by reducing flight speed and altitude and by carrying out a full coverage above the latter. We can therefore infer that moose wintering areas were detected in the 1,600-km² area with an accuracy rate comparable to the 100-km² area where moose-specific survey standards were applied. A reasonable effort was made to count and classify the number of animals for all moose tracks observed. When estimating density per 10 km², an 80% observation rate was used to estimate the number of individuals.

Table 6-35 provides a summary of the data gathered on moose during the March 2018 field campaign. A total of four individuals (three females and one calf) were sighted in a single wintering area inside the moose-specific survey area (Map 6-18), which corresponds to an estimated density of 0.5 moose/10 km². Twenty wintering areas were detected and 34 moose were counted across the 1,600-km² caribou survey area. Applying an 80% observation rate to individuals, 43 moose inhabited this area for a density of about 0.27 moose/10 km². This density is comparable to that reported in the scientific literature.

Table 6-35 March 2018 moose survey data compilation and density estimate

Moose winter range	Female	Male	Fawn	Undetermined	Number observed	Estimated number based on an 80% visibility rate	Density estimate per 10 km ²
In the 100-km² survey area							
M-1	3	0	1		4	5	
Subtotal	3	0	1	0	4	5	0.50
Outside the 100-km² survey area							
M-2	-	1	-		1	1	
M-3	1	-	1		2	3	
M-4	1	-	1		2	3	
M-5	1	-	-		1	1	
M-6	1	-	-		1	1	
M-7	-	1	-		1	1	
M-8	3	-	1		4	5	
M-9	1	-	1		1	1	
M-10	1	-	-		1	1	
M-11	2	-	-		2	3	
M-12	1	-	1		2	3	
M-13	-	1	-		1	1	
M-14	-	1	-		1	1	
M-16	-	-	-	2	2	3	
M-17	-	-	-	1	1	1	
M-18	-	1	-		1	1	
M-19	1	-	1		2	3	
M-20	2	1	-		3	4	
M-21	1	-	-		1	1	
Subtotal	16	6	6	3	30	38	0.25
Total in the 1,600-km² area	19	6	7	3	34	43	0.27

The moose density in hunting zone 22, which the study area is a part of, is among the lowest in Québec. It was estimated at 0.26 moose/10 km² in 1991 and at 0.31 moose/10 km² in 1997. Applying a 3% growth rate from 1991 to 2012, the moose population is estimated at 0.5 moose/10 km², or 9,872 individuals (Morin, 2015). In hunting zone 22, an average of **120** moose per year were hunted from **2016 to 2020** (MFFP, **2021**). Among these, based on slaughtering data provided by the MFFP, an average of 15 moose per year were sampled in the large fauna study area.

BLACK BEAR

No specific survey of the black bear has been performed in the study area. However, signs of the presence of individual bears were observed during some surveys targeted at other wildlife groups. The black bear is hunted for its meat and fur. In the territory located north of the 50th parallel, however, this practice is for the exclusive use of Indigenous people. They primarily use trapping to capture the animal (Lamontagne and coll., 2006).

In hunting zone 22, the black bear population density was estimated at 0.2 bears/10 km² in 2003. This density represents a population of approximately 5,600 bears (Lamontagne and coll., 2006). The study area for large fauna is found in fur-bearing animal management unit (FAMU) 92. In the last five seasons for which data is available (**2015-2016 to 2019-2020**), a total of **three** fur pelts were sold (MFFP, **2021**).

In fall, the black bear primarily uses bare lands, areas where heath plants are dominant, recent burns and lichen-free peatlands. In spring, it can also be found in hardwood and mixed forests and shrubland, swamps, marshes, watercourses and lakes (CRRNTBJ, 2010; Tecsult Inc., 2005).

In the study area, the availability of food used by black bears is likely determined by the occurrence of wetlands and disturbed habitats. These are key to produce small fruits on which the bear relies to build up its fat reserves (Samson, 1996). Disturbed habitats are primarily represented by habitats undergoing regeneration following two fires. Moreover, Cree users reported that bears visit the remote landfill in search of food, making this a good hunting area for this species. In short, the overall study area represents a potential suitable habitat for black bears.

GREY WOLF

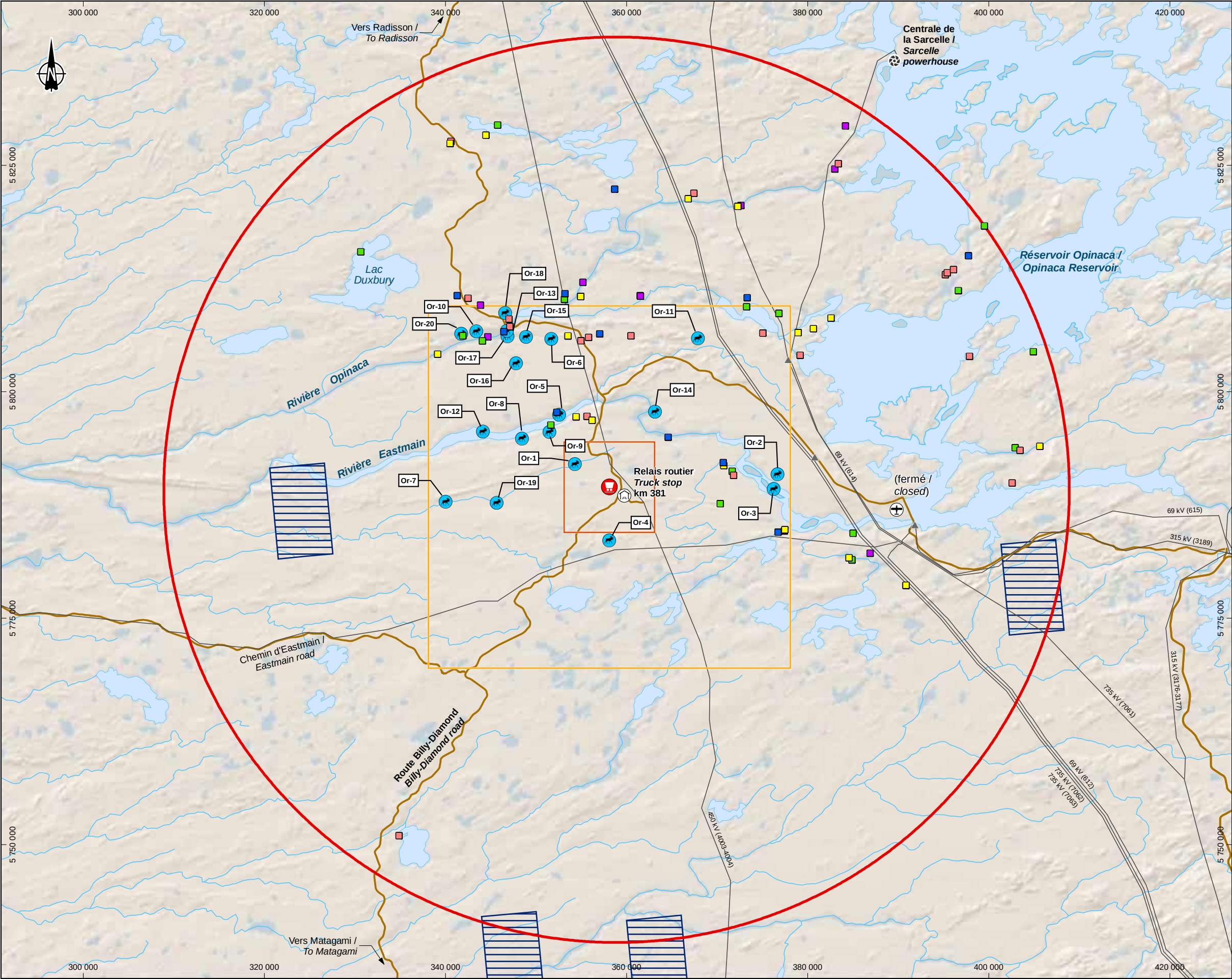
Although the grey wolf (*Canis lupus*) is more often linked to fur-bearing animals than to large mammals, it nevertheless represents one of the main predators of moose and caribou. During the field inventories performed, namely, the March 2018 aerial moose and caribou survey, no signs of wolf activity were observed in the study area. However, the tallyman mentioned a wolf pack sighting in August 2018 near the km 381 truck stop.

6.3.2.2 SMALL WILDLIFE

Based on available data and distribution ranges presented in the documents consulted (Banfield, 1977; CRRNTBJ, 2010; FAPAQ, 2003; MFFP, 2016; Prescott and Richard, 2004), 20 species of small terrestrial wildlife potentially occur in the study area. Table 6-36 lists these species.

Among these species, two have a special status:

- the least weasel (*Mustela nivalis*), which is on the list of species likely to be designated as threatened or vulnerable in Quebec (MFFP, 2006a);
- the wolverine (*Gulo gulo*), designated as threatened in Quebec (MFFP, 2006b) and endangered in Canada (Government of Canada, 2017).



Projet mine de lithium Baie-James / James Bay Lithium Mine Project

Zone d'étude de la grande faune / Large mammal study area

Zone d'inventaire du caribou (1 600 km²) / Caribou inventory area (1 600 km²)

Zone d'inventaire de l'orignal (100 km²) / Moose inventory area (100 km²)

Original / Moose

Site d'inventaire / Survey site

Or-2 Numéro du site / Site number

Sites d'abattage de l'orignal (MFFP, 2017) / Moose kill sites (MFFP, 2017)

2013

2014

2015

2016

2017

Parcelle d'inventaire de l'orignal (MFFP, 1991) / Moose survey plot (MFFP, 1991)

Infrastructures / Infrastructure

Relais routier / Truck stop

Centrale hydroélectrique / Hydroelectric powerhouse

Aéroport / Airport

Route / Road

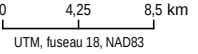
Poste et ligne de transport d'énergie / Substation and transmission line



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 6-18
Points d'occurrence et sites d'abattage de l'orignal / Moose Occurrence Points and Kill Sites

Sources :
World Shaded Relief, ESRI, 2018
Base cartographique / Cartographic base, BDGA, 2011
Original / Moose : MERN, 2017, © Gouvernement du Québec



Juillet / July 2021

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c6-18_wspT335_orignal_210701.mxd



Table 6-36 List of small terrestrial wildlife species potentially present in the study area

Species*	Scientific name
Long-tailed weasel	<i>Mustela frenata</i>
Least weasel	<i>Mustela nivalis</i>
Wolverine	<i>Gulo gulo</i>
Canadian beaver	<i>Castor canadensis</i>
Red squirrel	<i>Tamiasciurus hudsonicus</i>
Northern flying squirrel	<i>Glaucomys sabrinus</i>
Ermine	<i>Mustela erminea</i>
Snowshoe hare	<i>Lepus americanus</i>
Grey wolf	<i>Canis lupus</i>
River otter	<i>Lontra canadensis</i>
Canadian lynx	<i>Lynx canadensis</i>
Woodchuck	<i>Marmota monax</i>
American marten	<i>Martes americana</i>
Striped skunk	<i>Mephitis</i>
Fisher	<i>Martes pennanti</i>
American porcupine	<i>Erethizon dorsatum</i>
Muskrat	<i>Ondatra zibethicus</i>
Red fox	<i>Vulpes vulpes</i>
Eastern chipmunk	<i>Tamias striatus</i>
American mink	<i>Mustela vison</i>
* Species in bold have a special status.	

Sources: Banfield, 1977; CRRNTBJ, 2010; FAPAQ, 2003; MFFP, 2016; Prescott and Richard, 2004.

LEAST WEASEL

The least weasel is North America's smallest carnivore. It belongs to the mustelidae family and is related to the ermine (*Neovison erminea*) and to the American mink (*Mustela vison*). In North America, the least weasel lives almost everywhere in Canada and adapts to very diverse habitats. It occupies the tundra or the coniferous forest to the north but prefers, in the more southern areas, open environments such as prairies, wet meadows, swamplands, watercourse banks and brush (MFFP, 2001a). In Québec, though the distribution area is vast, sightings of this species are rare (MFFP, 2001a) and abundance poorly known. It is found in the Nord-du-Québec region, but likely in very localized areas. Its presence was namely reported in the Eastmain area (FAPAQ, 2003). A study to identify weasel carcasses trapped by the Cree was conducted by the MRNF's Direction régionale du Nord-du-Québec from 2009 to 2011. During this period, a total of 1,021 weasels were sent to the Aménagement de la faune office in Chibougamau. Of this number, 671 were analyzed and a single specimen, captured near Eastmain, proved to be a least weasel (CRRNTBJ, 2010). This rarity can, however, be explained by its secretive habits and small size (FAPAQ, 2003). No weasel is reported in the 2015–2016 trapping data for UGAF92, which Eastmain and the study area are part of (MFFP, 2016).

WOLVERINE

The wolverine is the largest terrestrial member of the mustelidae family (Environment Canada, 2016). Though the species is often considered extinct, several sightings in the area have been reported **within the last 20 years** (FAPAQ, 2002). Its distribution range is mainly confined to the north of the province and it is a very secretive species. The wolverine is a solitary animal and primarily a scavenger, whose survival relies on the availability of abundant food resources (COSEWIC, 2014; Environment Canada, 2016), and that thrives in ecologically intact areas with abundant and diverse prey and other carnivores (COSEWIC, 2014). This means that food is an integral component of this species' habitat (Cardinal, 2004), which must offer adequate food sources throughout the year, mainly in the form of small prey such as rodents and the snowshoe hare, as well as carcasses of large ungulates like moose, caribou and muskoxen (COSEWIC, 2014). Reductions in ungulate populations, which are significant prey in winter, has likely contributed to the wolverine's shrinking range (COSEWIC, 2014). Consequently, in the project region, the only two ungulate species likely to contribute to the wolverine's presence are caribou and moose. As mentioned in the previous pages about potential moose and caribou presence, however (Section 6.3.2.1), the study area offers poor habitat conditions for these species, given the level of disturbance of the natural environment. Wildlife surveys done in 2017 also showed that other wolverine prey species (breeding birds, small rodents; Environment Canada, 2016) are also largely absent from the study area (Sections 6.3.2.3 and 6.3.5.2). Consequently, in the absence of sufficiently abundant and diverse prey, the real potential for wolverines to be present in the study area is not considered to be significant. The habitat requirements of non-reproductive individuals seem relatively independent of the environment's biophysical attributes, the determining factor being prey availability (Environment Canada, 2016). In 2006, a systematic survey over 100,000 km² in the Abitibi and James Bay Lowlands natural province identified two potential wolverine track networks some dozen kilometres from La Sarre and Matagami (Environment Canada, 2016; Fortin, 2006).

6.3.2.3 SMALL MAMMALS

METHODOLOGY

Small mammal surveys were conducted for this project in 2011 and 2017. The methodology used, described in detail in the Terrestrial Wildlife and Avifauna Baseline Study (*Étude spécialisée sur les faunes terrestre et avienne*) (WSP, 2018g), is based on the *Protocole pour les inventaires de micromammifères* (Jutras, 2005) developed at the time by the MRNF. This methodology relies on the use of grill traps set up in typical habitats of the study area. During habitat selection, special attention was paid to the potential presence of the rock vole (*Microtus chrotorrhinus*) and of the southern bog lemming (*Synaptomys cooperi*), two species likely to be designated as threatened or vulnerable in Quebec (MFFP, 2006a).

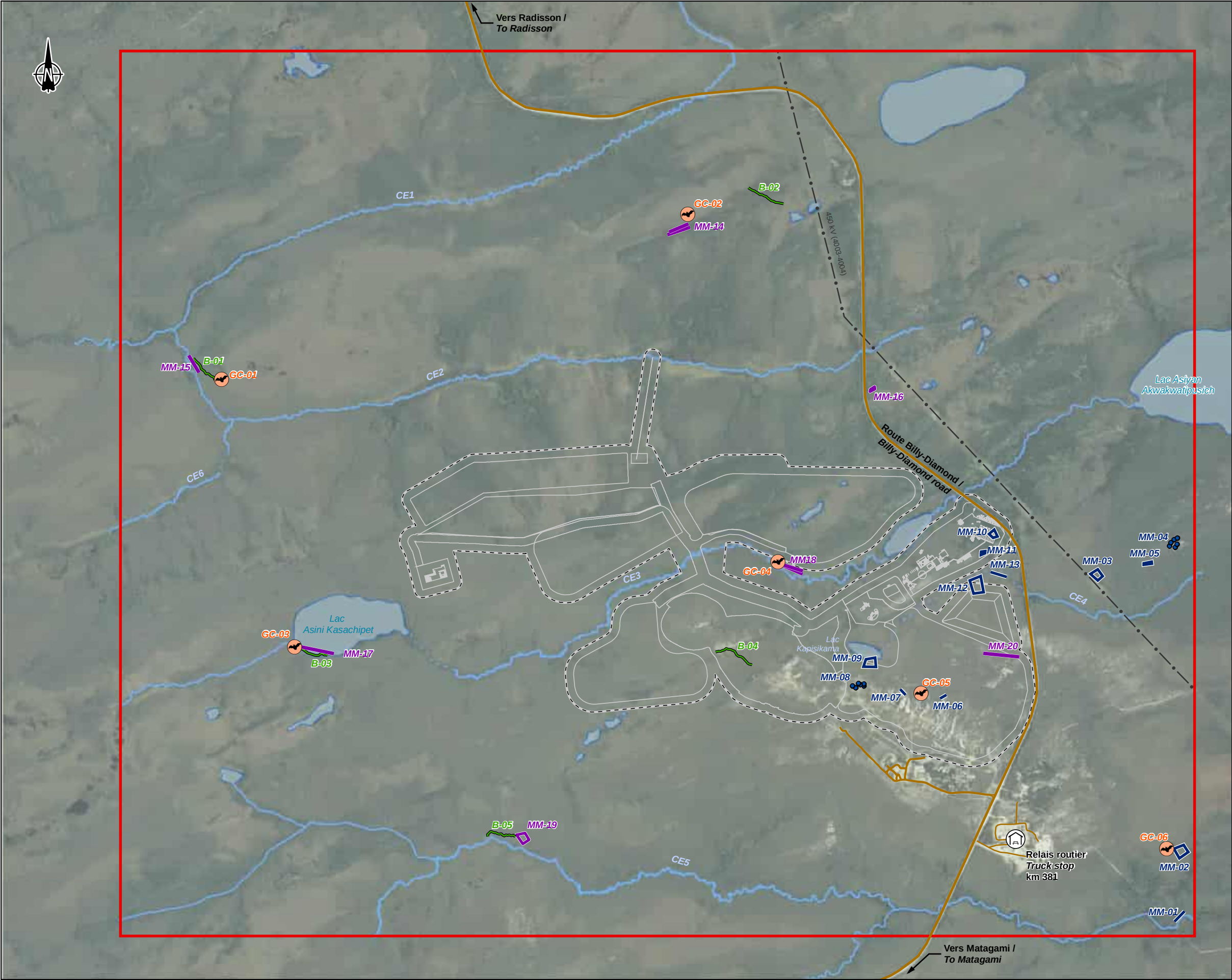
In 2011, 13 trapping sectors were surveyed in the study area's southeast quarter. The traps were set up and monitored during six to nine consecutive days, from September 21–29, 2011. In 2017, seven additional trapping sectors were inventoried to complete the initial coverage of the study area. The traps were set up and monitored during five consecutive days, from September 19–25, 2017. Given the nature, layout and area of habitats targeted in the study area, use of standard trapping grids was sometimes unsuitable, namely, in presence of linear landscape elements (downslopes, watercourses, etc.). Consequently, depending on the shape and area of environments surveyed, a combination of standard grids, half-grids, transects and aggregates was used in this study. The location of the trapping areas is presented on Map 6-19.

RESULTS

2011 survey

The trapping effort, calculated in number of trap-nights, represents the trapping pressure exerted on an environment or area. A trapping effort of 5,781 trap-nights was carried out for the overall study area in 2011.

During the survey, 117 specimens, belonging to eight different species, were sampled. Three of these species were insectivores: the cinereous (*Sorex cinereus*), smoky (*Sorex fumeus*) and pygmy (*Sorex hoyi*) shrews. The five other species belonged to the family of rodents: the Gapper's red-backed (*Clethrionomys gapperi*), meadow (*Microtus pennsylvanicus*) and rock voles (*Microtus chrotorrhinus*), the eastern heather vole (*Phenacomys ungava*) and the deer mouse (*Peromyscus maniculatus*). Among these species, only the rock vole is on the list of species likely to be designated as threatened or vulnerable in Québec (MFFP, 2006a).



- Zone d'étude locale / Local study area
- Infrastructures minières / Mining infrastructure
- Emprise de la mine (zone tampon de 50 mètres) / Mine footprint (buffer 50 meters)
- Inventaires / Inventory**

(GC-XX)

Station d'inventaire acoustique des chiroptères / Bat listening station

(B-XX)

Bardeau à couleuvres / Grass-snake shingle

(MM-XX)

Secteur de piégeage des micromammifères (2017) / Small mammal trapping sector (2017)

(MM-XX)

Secteur de piégeage des micromammifères (2011) / Small mammal trapping sector (2011)

Infrastructures / Infrastructure

Route principale / Main road

Route d'accès / Access road

Ligne de transport d'énergie / Transmission line

Relais routier / Truck stop

Hydrographie / Hydrography

CE3

Numéro de cours d'eau / Stream number

Cours d'eau permanent / Permanent stream

Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream

Plan d'eau / Waterbody
-
- Mine de lithium Baie-James /James Bay Lithium Mine
- Carte / Map 6-19**
Sites d'inventaire de la faune terrestre /
Terrestrial Fauna Survey Sites
- Sources :
Orthoimage : Galaxy août / august 2017
Inventaire / Inventory : WSP 2017
- 0 240 480 m
UTM, fuseau 18, NAD83
- Juillet / July 2021
- Dessin : A. Masson
Approbation : C. Martineau
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-

2017 Inventory

In 2017, trapping efforts included 2,141 trap-nights for additional surveys performed in the study area.

Only nine specimens belonging to two species were sampled during this survey: the cinereous shrew, an insectivore, and the deer mouse, belonging to the rodent family.

Species and habitats

During the 2011 survey, burns were already present in the study area; fewer and not as widespread as in 2017, they formed a mosaic of habitats with the unaffected environments. In these conditions, unaffected habitats represented refuges from which small mammals could recolonize the fire-affected environments (Trottier and coll., 1989). In 2011, a good species diversity was still present in the favourable habitats, but the densities of small mammals observed were already low. Several other fires occurred in the sector over the following years, some of which affected vast areas. Hence, in 2017, most of the study area was characterized by relatively recent burns. The forest fires do not only have short-term impacts like the death and escape of individuals, but also mid- and long-term ones, in cases of intense or recurrent fires, causing the disappearance and/or modification of current habitats (Morris and coll., 2011; Trottier and coll., 1989). Mature forest environments, notably, which are a core element of the habitat of several micromammal species, have virtually disappeared from the study area. Between 2011 and 2017, the number of species surveyed has dropped from eight to two, with a nearly five time lower capture rate.

Rock Vole

The 2011 survey led to the identification of the rock vole, a species likely to be designated threatened or vulnerable in Québec (MFFP, 2006a). Although its distribution range is widespread across the province, the rock vole remains one of the most rarely seen mammal species in eastern Canada (Prescott and Richard, 2004). As its name indicates, it is closely associated with the presence of rocky outcrops, boulders or rock piles, often in mixed or coniferous forests near water sources. **The rock vole's habitat can also include certain open environments without forest cover, such as cutover areas that are less than a year old, small clearings and transition zones between open environments and mature forests (Duhamel and Tremblay, 2013). The rock vole is, however, primarily a woodland species that prefers to live in mixed-wood stands or mature softwood stands. It seems to prefer to live in areas where forest cover is sparse and the shrub stratum is somewhat dense (Duhamel and Tremblay, 2013). All of these environments—cutover, clearings and transition zones—are directly related to the presence of forest stands, which tends to confirm the presence of the species for forest and forest-adjacent habitats.**

The MM-07 sector, a forest stand downslope of a rock mound, totally matched the species' habitat requirements. **This was also the only habitat in the study area where the species had been observed in 2011 (WSP, 2019a).** However, the entire rocky outcrop sector was struck by several forest fires since 2011 and the remaining habitat no longer has the characteristics that made it suitable for this species (total loss of forest cover). **The mature forest stands that were still present in the study area during the first small mammal survey in 2011, during which the rock vole was observed, disappeared and no suitable habitat for this species was present during the 2017 survey. With regard to the plants that make up the main part of its diet, we find species that are likely to grow after a fire, such as blueberries (*Vaccinium angustifolium*) and other members of the *Vaccinium* genus, as well as some members of the *Rubus* genus, but also and especially species more associated with woodlands, such as the Canadian bunchberry (*Cornus canadensis*), the bluebead lily (*Clintonia borealis*) and the wild lily-of-the-valley (*Maianthemum canadense*) (Duhamel and Tremblay, 2013). The plants identified in the study done in Québec by Goodwin (1929), cited by Duhamel and Tremblay (2013), specifically the heartleaf foamflower (*Tiarella cordifolia*), the sweet white violet (*Viola incognita*), the Canadian bunchberry and the wild lily-of-the-valley are all primarily woodland species. These results also tend to confirm the importance of woodland features in the rock vole's preferred habitat.**

Since mature forest environments virtually disappeared from the study area (WSP, 2019a) after repeated fires, the accumulation of wood debris on the soil and the presence of certain plant species that grow after fires will not meet the habitat needs of this species over the short- or medium-term.

Due to its specific habitat preferences, the rock vole lives in small, isolated colonies throughout its distribution area (Banfield, 1977; Christian and Daniel, 1985; Daniel, 1980; Desrosiers *et al.*, 2002; Duhamel and Tremblay, 2013; Kirkland and Jannett, 1982; Prescott and Richard, 2004). Moreover, it seems that this species is generally characterized by a low population density (Banfield, 1977; Daniel, 1980; Desrosiers *et al.*, 2002). These attributes make the rock vole especially vulnerable to habitat disturbance. **Rock vole population densities are still subject to interannual variability, as is the case for most members of the cricetidae family (French and Crowell, 1985; Etnier, 1989). Janette (1990) suggests, however, that this species does not follow the 3-4 year cycles usually seen in this family. It would seem that rock vole populations count fewer individuals, but that they remain more stable over time (Jannett, 1998).**

It therefore remains possible that a dip in population affecting all small mammal species and all habitats present contributed to the fact that virtually no animals were captured over the entire study zone in 2017. It is also possible that some rock voles survived fires that destroyed their habitat, even though this species does not live entirely underground, but rather digs shallow burrows and creates paths between rocks (Desrosiers and coll., 2002). Yet, while this behaviour, combined with the insulating effect of sometimes thick snow cover, likely helps shelter individuals from predators and extreme weather (Timm et al., 1977), it is unlikely that it provides effective protection from the repeated fires that affected the study area.

Consequently, and in light of the extent of the forest fires that affected the study area, the species is unlikely to still occur there. **Furthermore, during the aerial caribou surveys done in March 2018, it was observed that the burned areas were characterized by very poor regeneration (WSP, 2018g). This situation can be explained by the fact that a large portion of the area was affected by successive fires and forest stands are particularly vulnerable to short fire cycles (short intervals between two disturbances) (Mansuy, 2013). It is therefore unlikely that the forest component will be restored before the end of the project and, in light of the above, it does not seem necessary to include small mammal surveys in the monitoring program.**

Southern bog lemming

The southern bog lemming is a rodent from the cricetidae family. A significant portion of its distribution range is found in Canada, from Manitoba up to Nova Scotia (Fortin and coll., 2004). In Québec, its range covers the southern part of the province (Desrosiers and coll., 2002), where it is generally found in low density, although peaks of abundance are occasionally observed (Fortin and Doucet, 2003). It can also be found in peatlands where sphagnum and heath shrubs are most dominant, in grassy marshes and the moist mixed forests surrounding these habitats (Desrosiers and coll., 2002). It also occurs in fields, prairies, and clearings due to forest clearcut, and among rocks where moss is abundant (Desrosiers and coll., 2002).

Although the species was not caught during the 2011 and 2017 surveys, it is potentially found in the area. However, in light of habitat disturbance by forest fires in the study area—notably, the disappearance of most mature forest environments, including around wetlands—this species is unlikely to occur there.

6.3.3 AQUATIC COMMUNITY

6.3.3.1 ICTHYOFAUNA

Preliminary sampling campaigns of ichthyofauna were conducted in 2012 and more complete samples were taken in 2017. The Aquatic Habitat Baseline Study (*Étude spécialisée sur l'habitat aquatique*) (WSP, 2018c) provides details on the methodology, work and results. This section summarizes the content of the sector study. **In addition, a supplemental survey was done in 2019 for the purpose of verifying mercury levels in fish tissues.** The ichthyofauna sampling sites (fish and benthos) are illustrated on Map 6-8.

FISH COMMUNITY

2012 SURVEY

In all, 166 fish from six species were caught during the survey conducted in 2012 as part of the project. The white sucker was the most abundant species and was found in three lakes and watercourses surveyed in the study area. The yellow perch was caught only in Lake Kapisikama; no other species was caught in this lake. The yellow perch were small, a sign of the poor quality of the habitat. Brook trout were caught in creeks CE4 and CE5. Table 6-37 presents a summary of the 2012 catches.

2017 SURVEY

The survey strategy used in 2017 was designed to cover the fish habitat of the study area (not covered in 2012) and to obtain a representation of the various types of habitats available. The survey campaign of fish communities and their habitats was conducted from September 7 to September 14, 2017. The results are presented below by lake and watercourse in the study area.

Asiyan Akwakwatipusich Lake

Although a survey was not conducted in 2017 in Asiyan Akwakwatipusich Lake, some characterization work was carried out. Initially, a drone was used to take video images of the lake and a bathymetry was conducted. The banks of the lake are generally steep and a small section of about 50 metres shows signs of erosion on the north shore. In this location, the bank shows signs of slumping. Flood zones covered with herbaceous plants and shrubs are present in this lake on either side of the mouth of watercourse CE3 as well as on its eastern side. These zones may be suitable for northern pike spawning. Northern pike was one of the three species caught in this lake in 2012, along with white sucker and lake chub (Table 6-37). **Table 6-38 presents the main morphometric and physicochemical characteristics of the lake.**

Table 6-37 Data summary for fish caught in 2012

Species	Lake Asiyen Akwakwatipusich			Lake Kapisikama		Expansion of creek CE3		CE3		CE4		CE5		
	CACO	COPL	ESLU	PEFL	CACO	COPL	CUIN	CUIN	SAFO	CACO	COPL	CUIN	ESLU	SAFO
Number	57	5	6	38	4	3	20	5	2	18	2	1	2	3
Average size (TL, cm)	32.9	11.4	44.7	12.1	15.1	10.5	4.1	5.9	9.5	20.7	12.5	4	25.5	20
Standard deviation (cm)	5.4	2.5	11.9	1.7	3.4	1.8	1.1	0.7	0	4.3	0.7	-	14.8	8.7
Maximum size (cm)	46	15	58	15.5	18	12	5.5	7	9.5	35	13	-	36	26
Minimum size (cm)	17	9	23	9	11.5	8.5	1	5	9.5	16	12	-	15	10
TL: Total length. Species: CACO: white sucker; COPL: lake chub; ESLU: northern pike; PEFL: yellow perch; SAFO: brook trout; CUIN: brook stickleback.														

Table 6-38 Morphometric and physicochemical properties of Asiyen Akwakwatipusich Lake

Area (ha)	62.6
Perimeter (km)	3.6
Average depth (m)	1.0
Maximum depth (m)	1.0
Date of physicochemical surveys	June 30, 2012
Water temperature (°C)	15.3
Dissolved oxygen (%)	55
Conductivity (µS/cm)	8
pH	6.4
Water transparency (m)	Not available



Asini Kasachipet Lake

The aquatic habitat of Asini Kasachipet Lake is very homogeneous. The substrate of this body of water is dominated by silt. Scattered boulders, often protruding from the surface of the water, are observed. On the bank, sand and pebbles dominate the substrate. The aquatic vegetation consists mainly of large yellow-pond lilies (*Nuphar variegata*). The vegetation on the banks of the lake consists mostly of black spruce (*Epicea mariana*), tamarack (*Larix laricina*), heath as well as herbaceous plants and peat moss.

A fishing effort involving four net-nights and two seine searches was deployed in this lake in 2017. The brook stickleback was the only species caught.

The survey results show that Asini Kasachipet Lake is not very productive and fish usage is limited since only the brook stickleback seems to frequent this body of water. The outlet of the lake, creek CE3, does not have any apparent outflow, which could limit upstream migration. The shallowness of the lake and its high acidity could explain its limited use by aquatic fauna.

Table 6-39 presents the main morphometric and physicochemical properties of Asini Kasachipet Lake.

Table 6-39 Morphometric and physicochemical properties of Asini Kasachipet Lake

Area (ha)	18.6
Perimeter (km)	1.9
Average depth (m)	0.75
Maximum depth (m)	1.0
Date of physicochemical surveys	September 9, 2017
Water temperature (°C)	10.6
Dissolved oxygen (%)	84
Conductivity (µS/cm)	7
pH	3.7
Water transparency (m)	0.3



Kapisikama Lake

The aquatic habitat of Kapisikama Lake is homogeneous. This lake, which is ringed by a floating bog mat, has a substrate made up exclusively of decomposing organic matter. The aquatic vegetation consists primarily of yellow pond-lilies. On the bank, the vegetation consists of heath, herbaceous plants and peat moss. The lake does not have a direct outlet. Instead, it drains through its surrounding bog and ultimately into creek CE4. Table 6-40 summarizes the morphometric and physicochemical properties of Kapisikama Lake.

Table 6-40 Morphometric and physicochemical properties of Kapisikama Lake

Area (ha)	1.2
Perimeter (km)	0.55
Average depth (m)	2
Maximum depth (m)	3
Date of physicochemical surveys	September 8, 2017
Water temperature (°C)	12.5
Dissolved oxygen (%)	92 (surface) and 77
Conductivity (µS/cm)	9
pH	4.6
Water transparency (m)	0.5



Experimental fishing in this lake was done based on the Canadian Wildlife Service's multi-species survey protocol (2011). The fishing effort totaled six net-nights (four large-mesh and two small-mesh) and was set up to cover all types of habitat. Method details are presented in Section 2.3 of the Aquatic Inventory and Baseline Study. The description of this body of water, a headwater lake surrounded by peatland, indicates that the effluent (flowing into CE4) is diffuse and that no runoff was visible during the field visit. This lake is therefore considered isolated, which rules out the possibility that fish could migrate from the CE4 creek to the lake and vice versa. No fish were caught in the CE4 creek upstream of the Billy-Diamond highway (formerly the James Bay road).

Yellow perch was the only fish species caught in Kapisikama Lake. This species is found at the northern edge of its distribution area (Scott and Crossman, 1973), although catching yellow perch at this latitude is not exceptional. The population is isolated, and individuals are small and low weight, attesting to the poor habitat. The results of the 2017 and 2012 catches are comparable. The average size of individuals was slightly larger, 12.1 cm versus 11.27 cm (Table 6-41).

This species' allopatric presence in this region is surprising, but it remains possible that this species was isolated in the lake in the past. The lake is shallow and relatively acidic, which indicates conditions that are not very favourable for a number of fish species. **It is, however, somewhat likely that the low diversity of fish in this lake is due to special conditions of the lake and that other, smaller species may be present without being caught.**

The survey results show that Kapisikama Lake is not very productive and fish usage is limited. Its isolation, shallowness and high acidity could explain its limited use by aquatic fauna.

Table 6-41 Data summary for fish caught in Kapisikama Lake

Parameter	Yellow perch
Number of catches (n)	81
Average length (TL; cm)	11.27
Standard deviation (cm)	1.49
Minimum (cm)	8
Maximum (cm)	14
TL: Total length	

Unnamed Pond 1

The fish habitat of Unnamed Pond 1 is comparable to that of Kapisikama Lake. When the survey was conducted in September 2017, a fishing effort involving experimental gill netting representing one net-night was used in this lake, but no fish were caught.

Table 6-42 summarizes the main information concerning this body of water.

Table 6-42 Morphometric and physicochemical properties of Unnamed Pond 1

Area (ha)	0.6
Perimeter (km)	0.46
Average depth (m)	2
Maximum depth (m)	3
Date of physicochemical surveys	September 12, 2017
Water temperature (°C)	13 to 14
Dissolved oxygen (%)	83 (surface) and 67
Conductivity (µS/cm)	8
pH	4.2
Water transparency (m)	2.5



Creek CE1

Creek CE1 is a permanent stream that flows from the vast bog complex east of Billy-Diamond highway. This watercourse drains from east to west. Within the study area, this watercourse is very homogeneous. It is a meandering stream with a low flow rate of less than 0.2 m/s. The average width of the flow channel is 2.2 m and that of the littoral (measured at the natural high-water mark – NHWM) is 51 m. Its average depth is one metre. The substrate is dominated by fine particles. The water is highly coloured.

The first upstream portion of the watercourse, located at the end of the study area, is 3,670 m in length and flows through a fen. The banks of the watercourse are consequently loose and mainly composed of peat moss, heaths and herbaceous plants. Two beaver dams were observed. The average channel width is 2.5 m, ranging from less than 1 m to over 6 m. The littoral width is, on average, 60 m, ranging from 18 m to 97 m. The facies are made up of meandering channels.

The second section of the watercourse is located immediately downstream of the first section and ends at the confluence with CE2. This section is 1,600 m long and characterized by very dense forest cover that almost entirely closes over the stream. The channel and littoral are narrower, averaging 1.75 m (ranging from 1.4 to 2.4 m) and 40 m (ranging from 27 to 56 m), respectively.

No fish survey was taken in this watercourse in 2017. Through a sampling campaign in 2019, a station on creek CE1 (Map 6-8) caught five species of brook trout, averaging 1.61 cm in length, with a minimum length of 1.43 cm and a maximum length of 1.84 cm. Individual brook stickleback have also been seen in CE1 (WSP 2019b).

Creek CE2

Creek CE2 is a permanent stream, which like creek CE1, flows from a bog located east of Billy-Diamond highway. This watercourse drains from east to west. Within the study area, this watercourse is very homogeneous. It is a meandering stream with a low flow rate ranging from 0.04 m/s (August) to 0.19 m/s (October). The average width of the flow channel is 2.4 m and that of the littoral (measured at the NHWM) is 63 m. The average depth is more than one metre. The substrate is dominated by fine particles, although larger particles are found (gravel, stone and pebble) in some very specific areas. During the surveys done in September 2017, the pH was acidic (between 3.5 and 3.8), conductivity varied between 16 and 17 $\mu\text{S}/\text{cm}$ and concentrations of dissolved oxygen were low (between 36% and 42%). The water is highly coloured. **This watercourse can be divided into two sections based on the nature of the banks.**

The first portion of the watercourse is the upstream portion, over 5,600 m in length, flowing through a fen across the study area. Thus, the banks of the watercourse are very loose and mainly composed of peat moss, heaths and herbaceous plants. A total of five beaver dams were observed. The average channel width is 2 m, ranging from just 60 cm to 3 m. The littoral width is, on average, 66 m, ranging from 22 m to 127 m. The waterway channel is u-shaped. The depth can reach up to 1.75 m. The substrate is composed of silt and decomposing organic matter. The facies are made up of meandering channels.

The second section of the watercourse is located immediately downstream of the first section and is 580 m long. It is characterized by denser forest cover and a narrower littoral. The watercourse channel is wider at nearly 4 m on average and features more gradual slopes than those seen in section 1. Although the substrate is mainly made up of fine particles, in some spots, we can see the presence of larger substrate components (gravel, stone and pebble). The littoral width ranges from 40 to 49 m, with an average width of 45 m. Two beaver dams were observed.

The surveys yielded **three** fish species: the brook trout (*Salvinus fontinalis*), the lake chub (*Couesius plumbeus*) and the brook stickleback (*Culaea inconstans*). The brook trout was found in creek CE2 even though the habitat is not suitable for salmonids (prevalence of fine particles, low current, low concentration of dissolved oxygen and low pH). No adequate spawning area for brook trout was observed in this watercourse. **Brook stickleback were observed in creek CE2 but were not counted.** Table 6-43a presents the catch details from 2017 while Table 6-43b shows the catch details from 2019.

Table 6-43a Data summary for fish caught in creek CE2 - 2017

Parameter	Brook trout	Lake chub
Number of catches (n)	6	2
Average length (TL; cm)	17.6	11.5
Standard deviation (cm)	3.9	2.1
Minimum (cm)	14	10
Maximum (cm)	23	14
TL: Total length.		

Table 6-43b Data summary for fish caught in creek CE2 - 2019

Parameter	Brook trout
Number of catches (n)	15
Average length (TL; cm)	20.5
Standard deviation (cm)	2.3
Minimum (cm)	17.8
Maximum (cm)	23.8
TL: Total length.	

Creek CE3

Creek CE3 is a permanent stream that flows from Asini Kasachipet Lake. This watercourse drains from west to east. Within the study area, it is very homogeneous and runs 6,800 m. For the portion west of Billy-Diamond road, it is a meandering stream winding its way through a fen. Flow rates are low, ranging from 0.30 m/s in June, to 0.10 m/s in August to 0.27 m/s in October. East of the road, the topography becomes more accentuated, forcing the watercourse into a sequence of small rapids and pools before flowing into Asiyan Akwakwatipusich Lake. The average width of the flow channel is more than 20 m. The littoral width (measured at the NHWM) is 54 m. The average depth is more than one metre. The substrate is dominated by fine particles. During the September 2017 inventories, the pH was acidic (between 4.09 and 4.7), conductivity was between 12 and 13 $\mu\text{S}/\text{cm}$ and concentrations of dissolved oxygen ranged from 57% to 82%. The water is highly coloured. Two beaver dams were noted along this body of water. **This watercourse can be divided into seven distinct sections based on the nature of the banks and the channel. Sections located to the east of the Billy-Diamond highway were characterized through photo interpretation and the LIDAR survey.**

The first section is the portion starting immediately downstream of Asini Kasachipet Lake. This section, which is 379 m long, is characterized by the lack of distinct flow channel at the time of the surveys in late summer 2017. The watercourse seems to flow through dense vegetation made up of peat moss, heaths and black spruce. A flow channel does, however, become visible during high-flow periods. The average littoral width is 37 m (ranging from 27 to 47 m).

Starting with the second section, which is over 2,700 m long, a distinct channel bed can be observed. The u-shaped flow channel is relatively straight and is just over a metre wide on average. The average littoral width is 35 m (ranging from 21 to 61 m). In this section, the watercourse crosses treed peatland.

The third section of the watercourse, which is 1,870 m long, is characterized by the disappearance of forest cover and the widening of the channel and littoral. The watercourse channel is still u-shaped, with an average width of 3.5 m (ranging from 2.4 to 5.5 m). The littoral is made up of open peatland on both banks. The littoral width ranges from 32 m to over 100 m, averaging 54 m.

The fourth section of creek CE3 features a widening. The body of water covers a surface area of 3.3 ha with 1,100 m of shoreline. This body of water is also surrounded by a floating bog mat. The depth never exceeds 2 m. The substrate is made up exclusively of decomposing organic matter. We observed the presence of yellow pond lilies. The bank slope was steeper, thus limiting the littoral width which is less developed on the south shore of the body of water.

The fifth section, located immediately between the lake and the Billy-Diamond highway, has characteristics similar to section 3. A beaver dam is located immediately upstream of the road. A culvert is located on the watercourse and can be navigated by fish. The flow inside this culvert has no characteristics that would obstruct the free passage of fish.

The sixth section, which starts to the east of the Billy-Diamond highway, offers some contrast due to its more pronounced topography. Small rapids are present along the length of this 900-m section. The flow channel is narrow, at about 1 m wide. The vegetation along the banks is made up of conifers (black spruce and tamaracks) and health shrubs. It was impossible to establish the littoral width of this section because of the presence of a shore fen (see Section 2.1.3: Fish habitat). It was decided instead to apply a uniform strip 10 metres wide based on field observations in 2012, LIDAR data and satellite images.

The last section starts where the watercourse crosses a sector of fen immediately downstream of Asiyan Akwakwatipusich Lake. At this location, the channel and the littoral widen and the watercourse resumes a meandering flow before emptying into the lake. The width of the channel ranges from 9 to 13 m (average of 10.7 m) and the littoral width ranges from 31 m to over 100 m with an average width of 54 m.

The fishing efforts in 2017 yielded four species in creek CE3: the brook trout, white sucker, brook stickleback and lake chub (Table 6-44). Furthermore, while the brook stickleback does not appear in the results of the catches made in the expanded CE3, it is likely that the species is present. Fish of this size could not be caught because of the nets used.

Table 6-44 Data summary for fish caught in creek CE3

Parameter	Brook trout	White sucker	Brook stickleback	Lake chub
Number of catches (n)	2	3	80	4
Average length (TL; cm)	23.5	22.3	4.2	11.9
Standard deviation (cm)	3.5	5.25	0.8	1.0
Minimum (cm)	21	17	3	10.3
Maximum (cm)	26	27.5	6.5	13
TL: Total length				

Creek CE4

Creek CE4 is fed by runoff from the peatlands surrounding Kapisikama Lake. This watercourse starts where a visible flow channel appears, just over 700 m upstream of Billy-Diamond highway (Map 6-8). The flow runs through vegetation; the flow channel appears and then disappears between tree roots. Within the study area, the watercourse runs 2,600 m. It flows from west to east. The substrate consists of fine particles only and the depth does not exceed 0.3 m. Flow rates are low, about 0.01 m/s. During the September 2017 surveys, the pH was acidic (4.58), conductivity was 21 µS/cm and the concentration of dissolved oxygen was 68%. The water is highly coloured. No beaver dam was noted along this watercourse. After crossing the road, the flow channel becomes permanent. Creek CE4 reaches the outlet of Asiyan Akwakwatipusich Lake outside the study area. **Creek CE4 can be divided into three distinct sections.**

The first section is the 700 first upstream metres of the watercourse. As mentioned, in this location there is an intermittent flow channel less than one metre wide. The littoral is an average of 29 m wide, ranging from 15 to 43 m. Trees and shrubs colonise the littoral and cover the flow channel almost completely. The culvert crossing the Billy-Diamond highway seems blocked and could prevent fish from crossing this culvert.

The second section, starting at the Billy-Diamond highway, is 1,400 m long. At this point, the flow channel becomes visible and is an average of 2.4 m wide, ranging from 0.9 m to 3.9 m. The littoral is dominated by trees and shrubs along with herbaceous plants colonizing the immediate shore. The littoral width ranges from 55 m to 93 m for an average of 77 m.

Lastly, based on the spring 2018 field surveys (hydraulic surveys), a third section was added between Kapisikama Lake and the upstream portion of section 1. However, due to the fact that the watercourse is intermittent and that it sometimes flows underground and through a bog, it is impossible to get a littoral measurement for this section.

In 2017, an electrofishing effort was conducted in the watercourse section west of Billy-Diamond highway. The fishing effort was conducted in a 100-metre section of sites with no barriers (Map 6-8). No fish were caught.

Creek CE5

Creek CE5 is a stream that flows from a peatland complex west of the study area (Map 6-8). This watercourse drains from west to east. Within the study area, it is homogeneous and runs over 7,000 m. It ultimately flows into the Eastmain River, more than 10 km downstream of the study area. Like the other watercourses described earlier, it is a meandering river that crosses fens. Flow rates are fairly low, ranging from 0.2 m/s in June to 0.05 m/s in August to 0.2 m/s in October. Progressing downstream, the channel and littoral gradually widen. The average width of the flow channel is 4.8 m. The average width of the littoral (measured at the NHWM) is 77 m. The substrate is dominated by fine particles. During the September 2017 inventories, the pH was acidic (5.16), conductivity was 16 µS/cm and the concentration of dissolved oxygen was 63%. The water is highly coloured. Six beaver dams were noted along this watercourse. **This watercourse can be divided into two distinct sections based on the nature of the channel and the banks.**

The first section, located upstream, is a meandering section 2,800 m long through treed fens. The channel is relatively narrow with an average width of 1.3 m (ranging from 1.2 to 1.4 m) and is u-shaped. In this section, visually, flow rates are higher. The substrate is exclusively composed of fine particles and is no more than 0.5 m deep. The average littoral width is 7 m (ranging from 1.4 m to 13.4 m). The vegetation is dominated by trees and shrubs.

The second section starts where the watercourse's littoral becomes characterized by the presence of open fens. This section is 4,300 m long. The river becomes very meandering in this section and its flow rate slows. The flow channel broadens to an average width of 7 m (ranging from 1.4 m to 13.4 m). The average depth is over 1.5 m. The substrate is made up of fine particles. The littoral is wide, ranging from 9 m to 116 m (average of 57 m). Vegetation is mainly dominated by peat moss and herbaceous plants.

During the survey campaign, a hoop net was set up in this watercourse, resulting in 74 catches. Five fish species were caught: trout perch, white sucker, brook stickleback, lake chub and northern pike (Table 6-45). The lake chub accounted for more than 60% of the catch. The large flood plains dominated by herbaceous vegetation along this watercourse on either side of Billy-Diamond road could be used during the spring floods for northern pike spawning.

Table 6-45 Data summary for fish caught in creek CE5

Parameter	Trout perch	White sucker	Brook stickleback	Northern pike	Lake chub
Number of catches (n)	2	23	3	1	45
Average length (TL; cm)	8.5	17.1	6	34.5	11.9
Standard deviation (cm)	0.7	2.6	0.5	-	1.0
Minimum (cm)	8	11.5	5.5	-	10.3
Maximum (cm)	9	21.5	6.5	-	13
TL: Total length					

MERCURY LEVELS

The July 2019 field sampling campaign (WSP, 2019b), resulted in an analysis of initial mercury concentrations in the tissue of fish near the discharge point of creek CE2 and one of its tributaries CE1 (Map 6-8). The results of this sampling campaign are presented in Table 6-46.

Table 6-46 Mercury concentrations measured in the fish analyzed

Station no.	Fish ID	Unit	Detection threshold	Concentration	Station average	Station CV
CE1-1A	16	mg/kg	0.01	0.097	0.080	16%
	17	mg/kg	0.01	0.075		
	18	mg/kg	0.01	0.084		
	19	mg/kg	0.01	0.063		
	20	mg/kg	0.01	0.082		
CE2 (near the road)	01	mg/kg	0.01	0.18	0.120	34%
	02	mg/kg	0.01	0.13		
	03	mg/kg	0.01	0.12		
	04	mg/kg	0.01	0.1		
	05	mg/kg	0.01	0.095		
	06	mg/kg	0.01	0.11		
	07	mg/kg	0.01	0.069		
	08	mg/kg	0.01	0.1		
	09	mg/kg	0.01	0.06		
	10	mg/kg	0.01	0.21		
	11	mg/kg	0.01	0.145		
	12	mg/kg	0.01	0.13		
	13	mg/kg	0.01	0.15		
	14	mg/kg	0.01	0.082		
	15	mg/kg	0.01	0.093		

The concentration presented for CE2-11 is an average of 2 duplicates of 0.13 and 0.16 mg/kg

When we compare the results obtained with the fish consumption recommendation criterion adopted by the MELCC (no consumption restrictions when $\leq 0.29\text{mg/kg}$, MELCC 2019), we see that, even though all fish have some level of mercury, no sample exceeded the comparison criterion.

6.3.3.2 BENTHIC COMMUNITY

Three sampling campaigns of benthic organisms were conducted in 2017: one in July (July 24-31), a second in September (September 5-14) and a final one in October (October 8-12). The locations of the sampling stations are shown on Map 6-8. Benthos samples were collected at depths not exceeding 0.5 m. For stations 1A, 2A and 5B, the substrate was dominated by sand with, in the case of stations 1A and 2A, a large proportion of silt and clay. The substrate of station 3B was made up exclusively of organic matter.

In total, 48 species or taxa were identified in the four stations sampled. In July, three to four taxa or species were identified in stations 1A, 2A and 3B, while 14 were identified for station 5B. In September, between two and five taxa or species were identified in stations 1A, 2A and 3B, while 10 were identified for station 5B. In October, only five species were counted in station 1A while 16 to 19 were counted for the three other stations.

Table 6-47 shows the variation in the abundance per taxon according to the sampling period for the four stations sampled. Insects made up a significant proportion of the benthic community during the three campaigns. The prevalence of bivalves, oligochaeta and acari remained relatively similar. In September, ostracods accounted for almost a third of the organisms, whereas they were less prevalent in July and October.

Table 6-47 Main taxa collected by sampling campaign

Taxon	July (%)	September (%)	October (%)
Bivalves	7	16	11
Oligochaeta	6	10	12
Acari	6	1	1
Ostracods	3	28	12
Insects	78	45	64

Table 6-48 shows the abundance, diversity (Shannon index), richness and tolerance to pollution of the organisms identified by station and sampling campaign. In July and September, station 5B had the most abundant, rich and diversified benthic community. Station 1A had the least abundant benthic community for the three campaigns.

Of the four stations sampled, the benthic community was least abundant, rich and diverse in September and richest in October. Lastly, the tolerance of the identified organisms to pollution was generally high and remained fairly constant during the three campaigns.

Table 6-48 Descriptors of benthic invertebrate communities

Station	July				September				October			
	Abundance	Diversity	Richness	Tolerance	Abundance	Diversity	Richness	Tolerance	Abundance	Diversity	Richness	Tolerance
1A	22	0.76	3	7.6	2	0.69	2	7.0	5	1.61	5	7.4
2A	20	1.39	4	6.0	31	1.22	5	9.1	195	2.00	19	8.2
3B	8	1.39	4	7.0	8	1.04	3	8.5	51	2.43	16	7.6
5B	85	2.59	14	6.0	46	1.94	10	7.6	131	2.07	16	6.8
Average	34	1.5	6	7	22	1.2	5	8	96	2.0	14	8

6.3.4 HERPETOFAUNA

6.3.4.1 METHODOLOGY

The northern edge of the distribution area of most herpetofauna species in Québec is more southern than the study area, for both amphibians and reptiles. As such, only a few species were relatively common to the latitude of this project, including the American toad (*Anaxyrus americanus*), spring peeper (*Pseudacris crucifer*) and mink frog (*Lithobates septentrionalis*) among anurans, and the common garter snake (*Thamnophis sirtalis*) among reptiles.

Since no at-risk herpetofauna species were anticipated in the study area, the survey efforts in their regard consisted of opportunistic searches in potentially suitable habitats. The methodology used for the herpetofauna survey is described in detail in the Terrestrial Wildlife and Avifauna Baseline Study (*Étude spécialisée sur les faunes terrestre et avienne*) (WSP, 2018g).

A survey of garter snakes was conducted in suitable habitats throughout the study area, more specifically, buffer strips exposed to the sun, where these animals are likely to seek warmth. This survey was conducted using the asphalt shingle method and active searching, as recommended by the MFFP (Larochelle and coll., 2015). As such, 126 shingles were installed on July 8 and 9, 2017, and surveyed on five occasions until their removal on September 24 and 25, 2017. These surveys were conducted on sunny days when garter snakes would be most attracted to the shingles. Opportunistic surveys of available shelters (rocks, debris, etc.) were also conducted concurrently with the shingle surveys and other inventory activities. The locations of the shingle transects are illustrated on Map 6-19.

6.3.4.2 RESULTS

Only two anuran specimens, representing two species, were observed or heard during the field trips in 2017. The two species were the American toad (*Anaxyrus americanus*) and the wood frog (*Lithobates sylvaticus*). These two species had also been observed during the surveys in 2012, **along with the mink frog (*Lithobates septentrionalis*)**. These species are common and widespread in Québec.

The survey conducted by the asphalt shingle method and by active searching in suitable habitats did not reveal any **reptile** specimens in 2017; however, the exuvia of a garter snake was found on the Route du Nord, in a culvert. Based on its known distribution area, only this **reptile** species was likely to be found in the study area. An opportunistic observation of a specimen was collected during the surveys conducted in 2012. It was a common species widespread in Québec. No turtles or signs of turtle eggs were detected during field trips in the study area.

Despite our searches in suitable habitats and during periods favourable for detecting urodeles (salamanders and newts), no specimens of this group were observed.

6.3.5 AVIFAUNA

Bird surveys were conducted in 2017 for this project, including aerial surveys of waterfowl, a survey of terrestrial breeding birds and a targeted search of species at risk. These surveys were conducted from June 7 to July 10, 2017. The methodologies used for these surveys are described in detail in the Terrestrial Wildlife and Avifauna Baseline Study (*Étude spécialisée sur les faunes terrestre et avienne*) (WSP, 2018g).

A survey of terrestrial breeding birds was also conducted in 2012 in a portion of the study area. However, since the habitats surveyed have changed dramatically due to fire, only the species surveyed was considered and presented in the section titled *Previous Surveys*.

Map 6-20A illustrates the location of avifauna survey stations, surveyed plant groups and mine site infrastructure. Map 6-20B illustrates this same information, this time with mine site infrastructure.

6.3.5.1 WATERFOWL AND AQUATIC BIRDS

METHODOLOGY

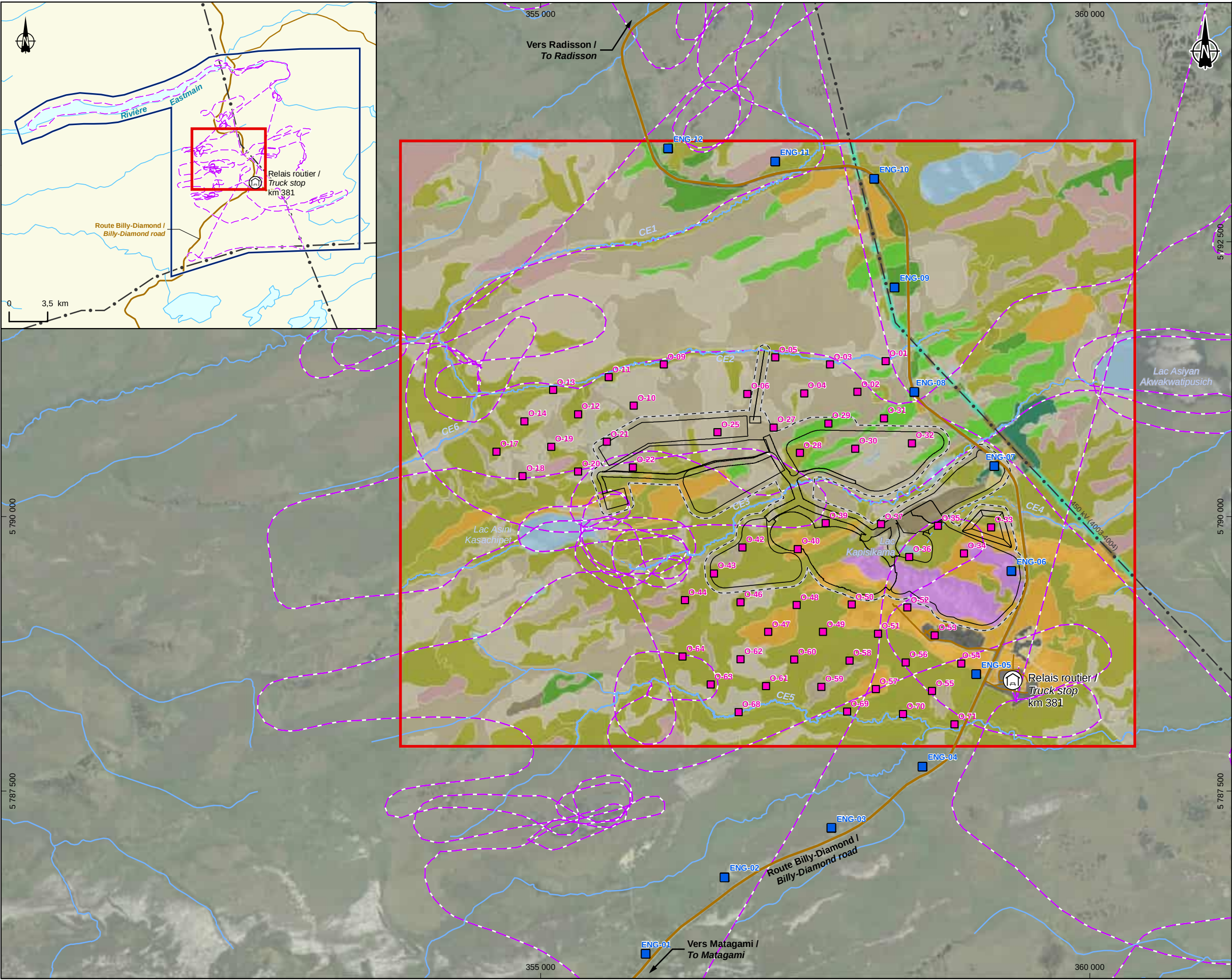
The waterfowl and aquatic bird surveys were essentially conducted by a helicopter flyover. The expanded study area for the helicopter survey is illustrated on Map 6-20A. The specimens observed on the ground during other field activities were also noted.

The aerial survey was conducted on June 7, 2017, with a view to covering all the bodies of water in the expanded study area (Map 6-20A). The surveys were flown at low altitude and at reduced speed, as proposed by the method used by ECCC in the *Black Duck Joint Venture* (Bordage and coll., 2003). During this survey, special attention was paid to the presence of birds of prey. Lastly, a request was submitted to the Canadian Wildlife Service (CWS) to check whether data relevant to the project were available in the *Eastern Waterfowl Monitoring Program* database.

RESULTS

The aerial survey revealed just 47 specimens of eight species of waterfowl and aquatic birds (Table 6-49). In addition, an osprey (*Pandion haliaetus*) flying over the Eastmain River was observed.

No notable area of concentration was observed since the few specimens noted were relatively dispersed in the study area. All the specimens observed were adults except for one immature sandhill crane (*Grus canadensis*). The most abundant species was the Canada goose (*Branta canadensis*) with 19 individuals counted.



- Zone d'étude locale / Local study area
- Zone d'étude pour la sauvagine et les oiseaux aquatiques / Study area for wildfowl and waterfowl
- Infrastructures minières / Mining infrastructure
- Empreinte de la mine (zone tampon de 50 mètres) / Mine footprint (buffer 50 meters)

- Inventaires / Inventory**
- ENG-08 Station d'inventaire nocturne des engoulevents / Nighthawk listening station
 - O-33 Station d'écoute des oiseaux chanteurs / Songbird listening station
 - Inventaire de la sauvagine / Wildfowl survey

- Hydrographie / Hydrography**
- CE4 Numéro de cours d'eau / Stream number
 - Cours d'eau permanent / Permanent stream
 - Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream

- Infrastructures / Infrastructure**
- Route principale / Main road
 - Route d'accès / Access road
 - Ligne de transport d'énergie / Transmission line
 - Relais routier / Truck stop

- Peuplements terrestres / Terrestrial Vegetation**
- Affleurement rocheux / Rock outcrop
 - Arbustaie / Scrubland
 - Aulnaie crispé / Alder forest
 - Boisé / Woodland
 - Dénudé sec / Dry barren land
 - Pessière noire à lichen / Black spruce lichen forest
 - Pessière noire à aulnes / Black spruce alder forest
 - Pinède grise / Jack pine forest
 - Anthropique / Anthropogenic
 - Brûlis / Burnt area
 - Végétation terrestre dans l'emprise / Terrestrial vegetation in right-of-way

- Peuplements humides / Wetland**
- Plan d'eau / Waterbody
 - Tourbière arbustive / Shrubby peatland
 - Tourbière boisée / Treed peatland
 - Tourbière ouverte / Open bog
 - Végétation humide dans l'emprise / Wetland in right-of-way



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 6-20A
Sites d'inventaire de la faune avienne /
Avifauna Survey Sites

Sources :
Orthoimage: Galaxy, août 2017
Inventaire / Inventory: WSP 2017
Données du projet / Project data : Galaxy, 2021

0 350 700 m
UTM, fuseau 18, NAD83

Juillet / July 2021

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c6-20A_wspT296_1_avienne_210701.mxd





- Infrastructures minières / Mining infrastructure
- Empreinte de la mine (zone tampon de 50 mètres) / Mine footprint (buffer 50 meters)
- Inventaires / Inventory**
- ENG-08

Station d'inventaire nocturne des engoulevents / Nighthawk listening station
- O-33
- Station d'écoute des oiseaux chanteurs / Songbird listening station

Infrastructures / Infrastructure

—

Route d'accès / Access road

• - -

Hydrographie / Hydrography

CE3

—

- - -

Peuplements terrestres / Terrestrial VegetationAffleurement rocheux / Rock outcropArbustaie / ScrublandAulnaie crispé / Alder forestBoisé / WoodlandDénudé sec / Dry barren landPessière noire à lichen / Black spruce lichen forestPessière noire à aulnes / Black spruce alder forestPinède grise / Jack pine forestAnthropique / AnthropogenicBrûlis / Burnt areaVégétation terrestre dans l'emprise / Terrestrial vegetation in right-of-way**Peuplements humides / Wetland**Plan d'eau / WaterbodyTourbière arbustive / Shrubby peatlandTourbière boisée / Treed peatlandTourbière ouverte / Open bogVégétation humide dans l'emprise / Wetland in right-of-way

Mine de Lithium Baie-James / James Bay Lithium Mine

6-20B
Sites d'inventaire de la faune avienne /
Avifauna Survey Sites

Sources :
Orthoimage : Galaxy, août 2017
Inventaire / Inventory : WSP 2017
Données du projet / Project data : Galaxy, 2021
Fosse, carrière et entreposage des explosifs / Pit, quarry and explosives magazine : Mining Plus, 2018
Secteur administratif et industriel et aire de minéral / Administrative and industrial sector and ROM pad : Primero, 2018
0 185 370 m
UTM, fuseau 18, NAD83

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c6-20B_wspT297_f_avienne_mine_210701.mxd

Juillet / July 2021



Table 6-49 Results of aerial surveys of waterfowl and aquatic birds – June 2017

Species (n = 8)	Number of specimens	Species (n = 8)	Number of specimens
Canada goose (<i>Branta canadensis</i>)	19	Common merganser (<i>Mergus merganser</i>)	5
Black duck (<i>Anas rubripes</i>)	5	Sandhill crane (<i>Grus canadensis</i>)	8
Ring-necked duck (<i>Aythya collaris</i>)	1	Surf scoter (<i>Melanitta perspicillata</i>)	4
Common goldeneye (<i>Bucephala clangula</i>)	1	Green-winged teal (<i>Anas crecca</i>)	4

In addition to the waterfowl and aquatic bird specimens counted in the aerial survey, 33 individuals representing six species were noted during the ground survey activities in 2017 (Table 6-50). The most abundant waterfowl and aquatic bird species observed on the ground were Wilson's snipe (*Gallinago delicata*), the common loon (*Gavia immer*) and the solitary sandpiper (*Tringa solitaria*).

Table 6-50 Results of ground surveys of waterfowl and aquatic birds – June 2017

Species (n = 6)	Number of specimens	Species (n = 6)	Number of specimens
Wilson's snipe (<i>Gallinago delicata</i>)	11	Sandhill crane (<i>Grus canadensis</i>)	2
Solitary sandpiper (<i>Tringa solitaria</i>)	6	Common loon (<i>Gavia immer</i>)	7
Greater yellowlegs (<i>Tringa melanoleuca</i>)	5	Green-winged teal (<i>Anas crecca</i>)	2

6.3.5.2 TERRESTRIAL BREEDING BIRDS

METHODOLOGY

Terrestrial breeding birds, including the rusty blackbird, the olive-sided flycatcher and the bank swallow, the common nighthawk and the short-eared owl were surveyed through listening stations (Blondel and coll., 1970; Environment Canada, 1997 and 2007). About 60 stations were set up in the habitats in the local study area for this purpose (Map 6-20A) and each was visited once between July 5 and 10, 2017, inclusively. **Maps 6-20A and 6-20B show the different survey stations based on the type of stand and environment identified. An effort was made to ensure that survey stations were present in all environments identified through photo interpretation of publicly available satellite images. This survey effort was done despite the fact that the project is located outside of harvested forest area and the fact that the ecoforest data available was incomplete and dated from before the forest fires.**

Given the relative homogeneity of the environments, the stations were divided into three habitat categories: wetlands (31 stations), open habitats (18 stations) and softwood stands (9 stations). **The relatively low densities and species richness of the birds surveyed at each station also highlight the importance of grouping environments together into categories with a maximum number of stations.** A survey using listening stations was also conducted at a preliminary stage of the project, from June 30 to July 4, 2012.

Listening stations were visited early in the morning, between 05:15 and 10:30, in conditions with no rain and little to no wind. At each visit, a five-minute listening period was observed. During this period, each bird or group of birds observed was identified and assigned a radius distance from the observer: 0-50 m or over 50 m. Observations of flying birds or observations at distances of beyond 50 m were used to build out the list of species, but not to estimate abundance or density.

Since field ornithologists were fully aware of the list of at-risk species likely to use the study area, they were on the lookout for them and prepared to identify their presence, even while travelling from station to station.

Maps 6-20C to 6-20G show the positions of survey stations on maps of potential habitat for each of the five at-risk migratory species present or potentially present that are targeted in this study. They demonstrate the effort to distribute the stations in the way that is best suited to detecting these species in the study area, allowing for sufficient coverage of these habitats and optimizing the likelihood of detection.

For nighthawks, a nocturnal survey outing, on a clear day, was conducted on July 6, 2017, to take advantage of the species' increased activity periods during the full moon. This survey used ten listening stations along Billy-Diamond road (Map 6-20E), which were surveyed according to the protocol developed by the Regroupement QuébecOiseaux (2015). **The survey started at least 30 minutes before sunset, as soon as the moon was visible, to end no later than moonset. Each listening point consisted of two consecutive three-minute periods. If short-eared owls were present along the route, this species could also have been detected that evening. Both of these species could also be encountered opportunistically during surveys for passerine nesting birds or other survey work done for this project.**

Aside from the field surveys conducted in 2012 and 2017, the Regroupement QuébecOiseaux was asked to provide data from the Étude des populations d'oiseaux du Québec (ÉPOQ; Larivée, 2017) and SOS-POP (SOS-POP, 2018) data banks.

Table 6-51 outlines the documentary sources and methodology used for the acquisition of avifauna survey data. Since these surveys are based on standard and recognized methods, the results obtained are considered reliable and in accordance with the reality of the study area.

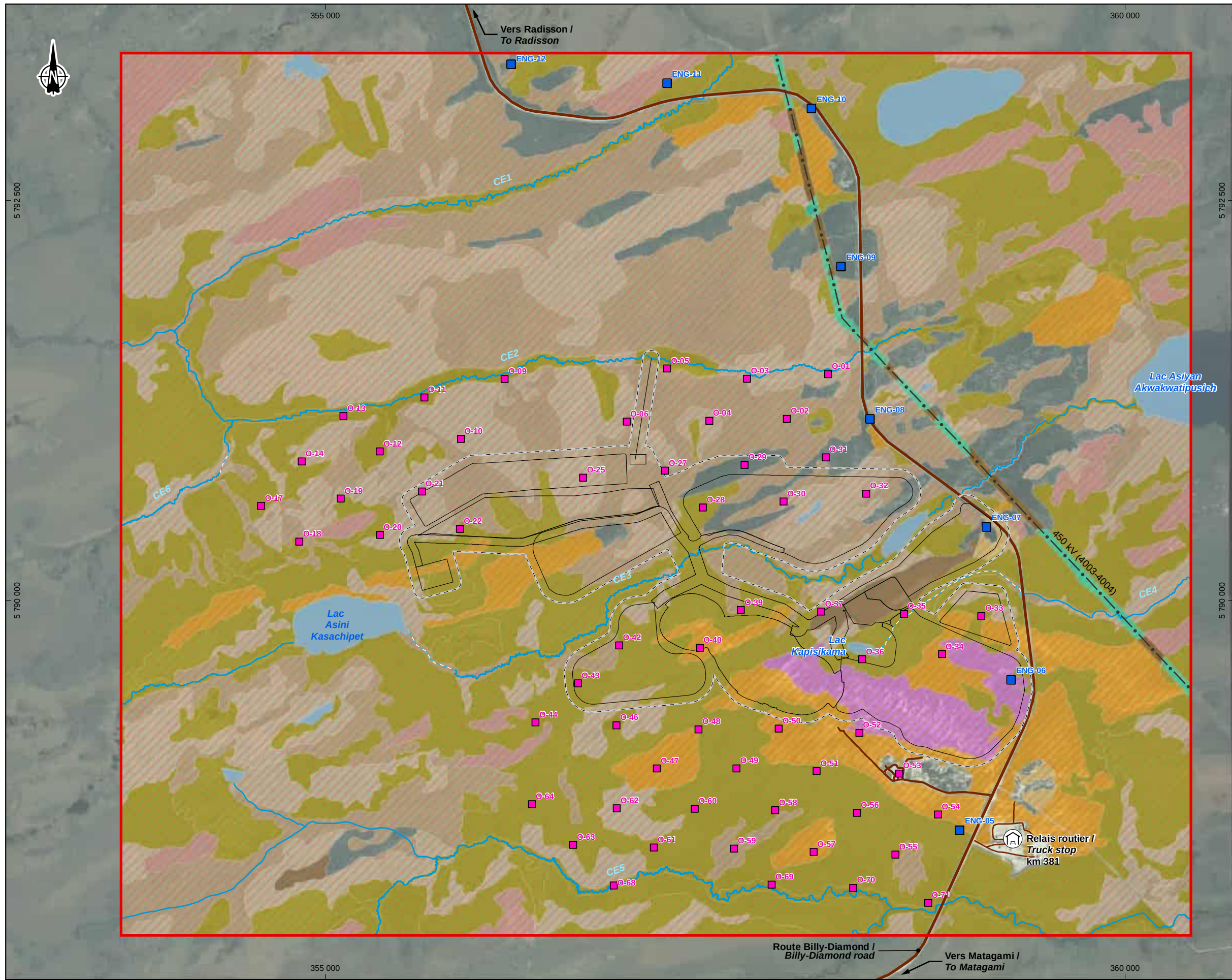
Table 6-51 Methodologies of avian surveys carried out as part of the project and sources of additional data used

SURVEY	METHODOLOGY	DATA SOURCE	HIGHLIGHTS
James Bay Lithium Mine project			
Spring migration of waterfowl (2017)	Survey carried out by helicopter on June 7, 2017, using the Black Duck Joint Venture method (Bordage and coll. 2003). Length of the overflight, 132 km.	WSP, 2018g.	Only 47 specimens of eight waterfowl and aquatic bird species were observed, plus one osprey. No significant concentration areas.
Waterfowl nesting (2017)	Additional observations by ground stations in July 2017.	WSP, 2018g.	33 additional individuals representing six species.
Terrestrial breeding birds (2017)	Listening station method (Blondel and coll., 1970; Environment Canada, 1997 and 2007), conducted over 58 stations from June 30 to July 4, 2017.	WSP, 2018g.	472 individuals representing 32 species.
Nighthawks (2017)	Nocturnal listening station method (Regroupement QuébecOiseaux, 2015). Ten stations surveyed on July 6, 2017, along Billy-Diamond highway.	WSP, 2018g.	3 individuals detected, two of which were above the truck stop.
Terrestrial breeding birds (2012)	Listening station method conducted over 32 stations in 2012.	WSP 2018g. Data included in the impact assessment but not analyzed due to subsequent changes in the environment due to fires.	42 species
Rose Lithium-Tantalum Mine project			
Spring migration of waterfowl (2017)	Survey carried out by helicopter in May 2012, using the Black Duck Joint Venture method (Bordage and coll. 2003).	WSP, 2017.	20 species of aquatic birds, of which 13 are anatidae 6 species of birds of prey
Terrestrial breeding birds	Listening station method (Blondel and coll., 1970; Environment Canada, 1997 and 2007), conducted over 108 stations between 2012 and 2016.	WSP, 2017.	31 species.

Table 6-51 Methodologies of avian surveys carried out as part of the project and sources of additional data used (cont.)

SURVEY	METHODOLOGY	DATA SOURCE	HIGHLIGHTS
ÉPOQ data bank			
	Daily observation sheet from 1981 to 2015 for the study area. Number of sheets: 15. Number of mentions: 186	List produced by Marie-France Julien of Regroupement QuébecOiseaux on 01/31/2018.	64 species

WSP. 2017. Rose Lithium-Tantalum | Environmental Impact Assessment. Document produced for the Critical Elements Corporation. Project no.: 111-17853-01. 858 p.



- Infrastructures minières / Mining infrastructure
- Emprise de la mine (zone tampon de 50 mètres) / Mine footprint (buffer 50 meters)
- Zone d'étude locale / Local study area
- Habitat potentiel du hibou des marais / Potential habitat of short-eared owl

Inventaire / Inventory

- ENG-08 Station d'inventaire nocturne des engoulevents / Nighthawk listening station
- O-33 Station d'écoute des oiseaux chanteurs / Songbird listening station

Infrastructures / Infrastructure

- Route principale / Main road
- Route d'accès / Access road
- Ligne de transport d'énergie / Transmission line
- Relais routier / Truck stop

Hydrographie / Hydrography

- CE3 Numéro de cours d'eau / Stream number
- Cours d'eau permanent / Permanent stream
- Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream

Peuplements terrestres / Terrestrial Vegetation

- Affleurement rocheux / Rock outcrop
- Arbustaie / Scrubland
- Aulnaie crispé / Alder forest
- Dénudé sec / Dry barren land
- Brûlis / Burnt area
- Végétation terrestre dans l'emprise / Terrestrial vegetation in right-of-way

Peuplements humides / Wetland

- Plan d'eau / Waterbody
- Tourbière arbustive / Shrubby peatland
- Tourbière boisée / Treed peatland
- Tourbière ouverte / Open bog
- Végétation humide dans l'emprise / Wetland in right-of-way



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 6-20C
Habitat potentiel du hibou des marais
et sites d'inventaire / Potential Habitat of
Short-Eared Owl and Survey Sites

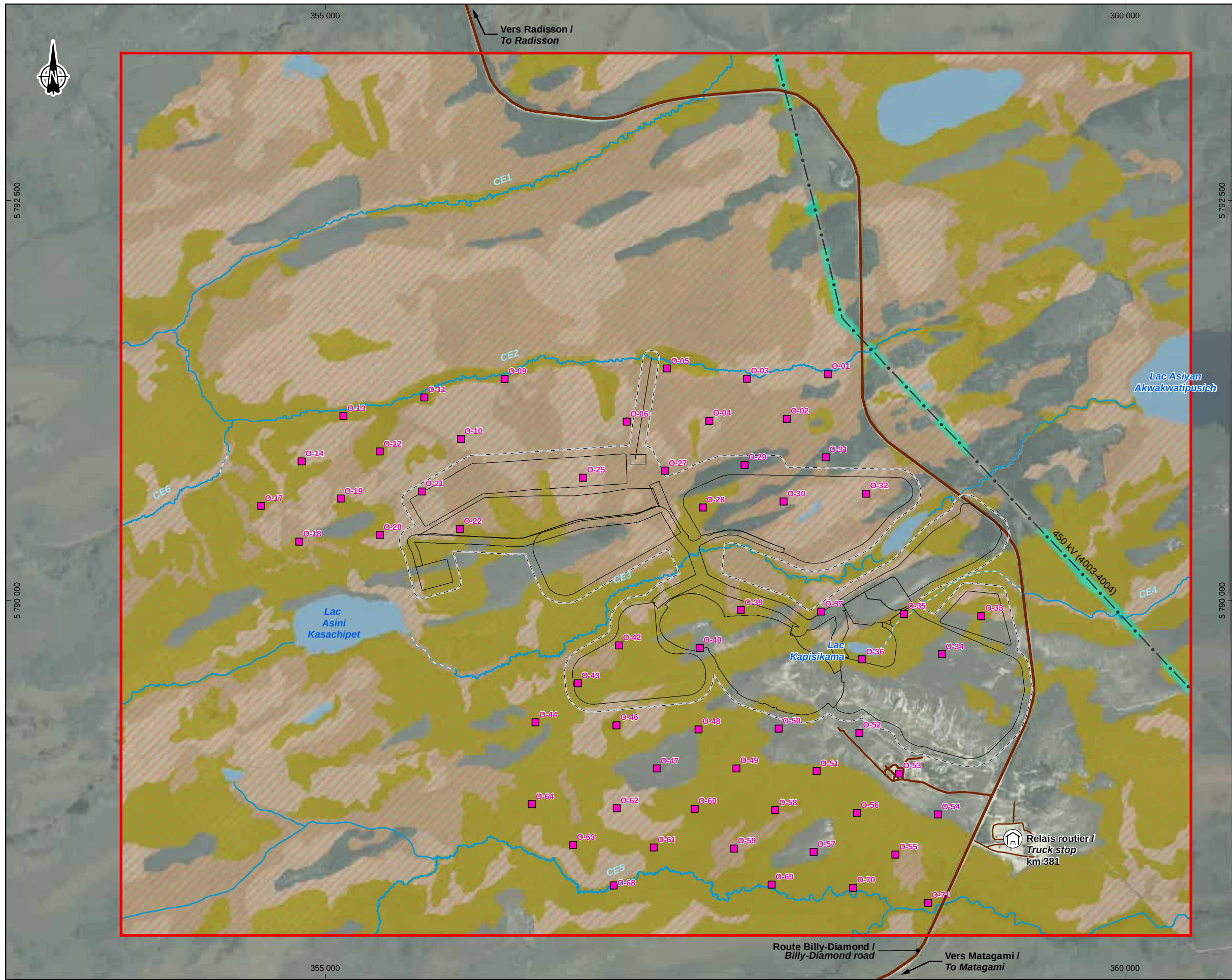
Sources :
Orthoimage : Galaxy, août 2017
Inventaire / Inventory : WSP 2017

0 240 480 m
UTM, fuseau 18, NAD83

Juillet / July 2021

Dessin : A. Masson
Approbation : R. Duhamel
201-12362-00_c6-20C_wspT291_hibou_210701.mxd





- Infrastructures minières / Mining infrastructure
- Empreinte de la mine (zone tampon de 50 mètres) / Mine footprint (buffer 50 meters)
- Zone d'étude locale / Local study area
- /// Habitat potentiel pour le quiscala rouilleux / Potential habitat of rusty balckbird

- Inventaire / Inventory**
- O-33 Station d'écoute des oiseaux chanteurs / Songbird listening station

- Infrastructures / Infrastructure**
- Route principale / Main road
 - Route d'accès / Access road
 - Ligne de transport d'énergie / Transmission line
 - 🏠 Relais routier / Truck stop

- Hydrographie / Hydrography**
- CE3 Numéro de cours d'eau / Stream number
 - Cours d'eau permanent / Permanent stream
 - - - Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream
 - Plan d'eau / Waterbody

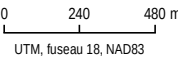
- Peuplements humides / Wetland**
- Tourbière arbustive / Shrubby peatland
 - Tourbière boisée / Treed peatland
 - Tourbière ouverte / Open bog
 - Végétation humide dans l'emprise / Wetland in right-of-way



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 6-20D
Habitat potentiel du quiscala rouilleux et sites d'inventaire / Potential Habitat of Rusty Blackbird and Survey Sites

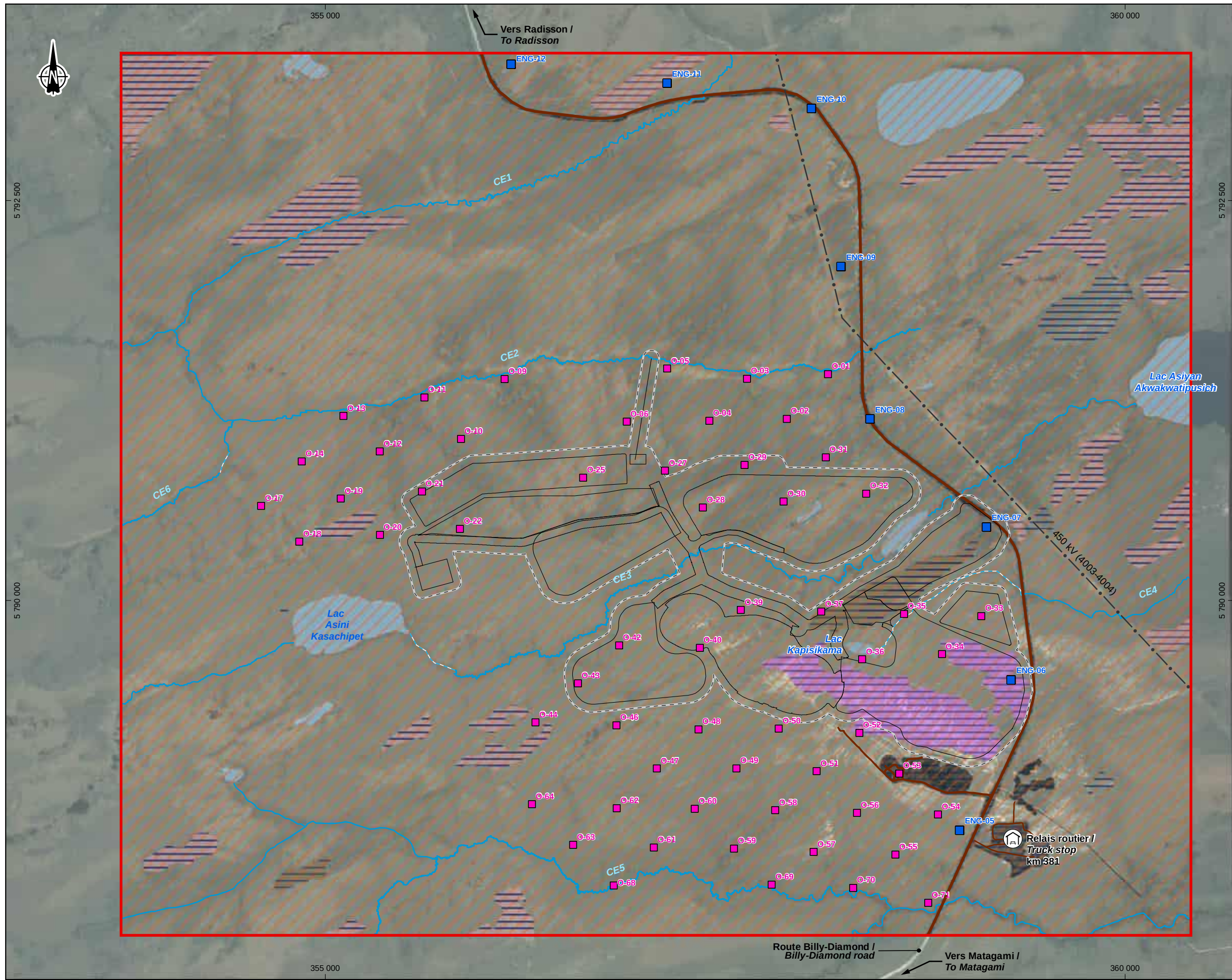
Sources :
Orthoimage: Galaxy, août 2017
Inventaire / Inventory: WSP 2017



Juillet / July 2021

Dessin : A. Masson
Approbation : R. Duhamel
201-12362-00_c6-20D_wspT292_quiscala_210701.mxd





- Infrastructures minières / Mining infrastructure
- Empreinte de la mine (zone tampon de 50 mètres) / Mine footprint (buffer 50 meters)
- Zone d'étude locale / Local study area
- Habitat de nidification pour l'engoulevent d'Amérique / Nesting habitat of Common Nighthawk
- Habitat d'alimentation pour l'engoulevent d'Amérique / Feeding habitat of Common Nighthawk

Inventaire / Inventory

- ENG-08 Station d'inventaire nocturne des engoulevents / Nighthawk listening station
- O-33 Station d'écoute des oiseaux chanteurs / Songbird listening station

Infrastructures / Infrastructure

- Route principale / Main road
- Route d'accès / Access road
- Ligne de transport d'énergie / Transmission line
- Relais routier / Truck stop

Hydrographie / Hydrography

- CE3 Numéro de cours d'eau / Stream number
- Cours d'eau permanent / Permanent stream
- Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream

Peuplements terrestres / Terrestrial Vegetation

- Affleurement rocheux / Rock outcrop
- Arbustaire / Scrubland
- Dénudé sec / Dry barren land
- Pessière noire à lichen / Black spruce lichen forest
- Brûlis / Burnt area

Peuplements humides / Wetland

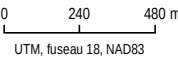
- Tourbière arbustive / Shrubby peatland
- Tourbière ouverte / Open bog



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 6-20E
Habitat potentiel de l'engoulevent d'Amérique
et sites d'inventaire / Potential Habitat
of Common Nighthawk and Survey Sites

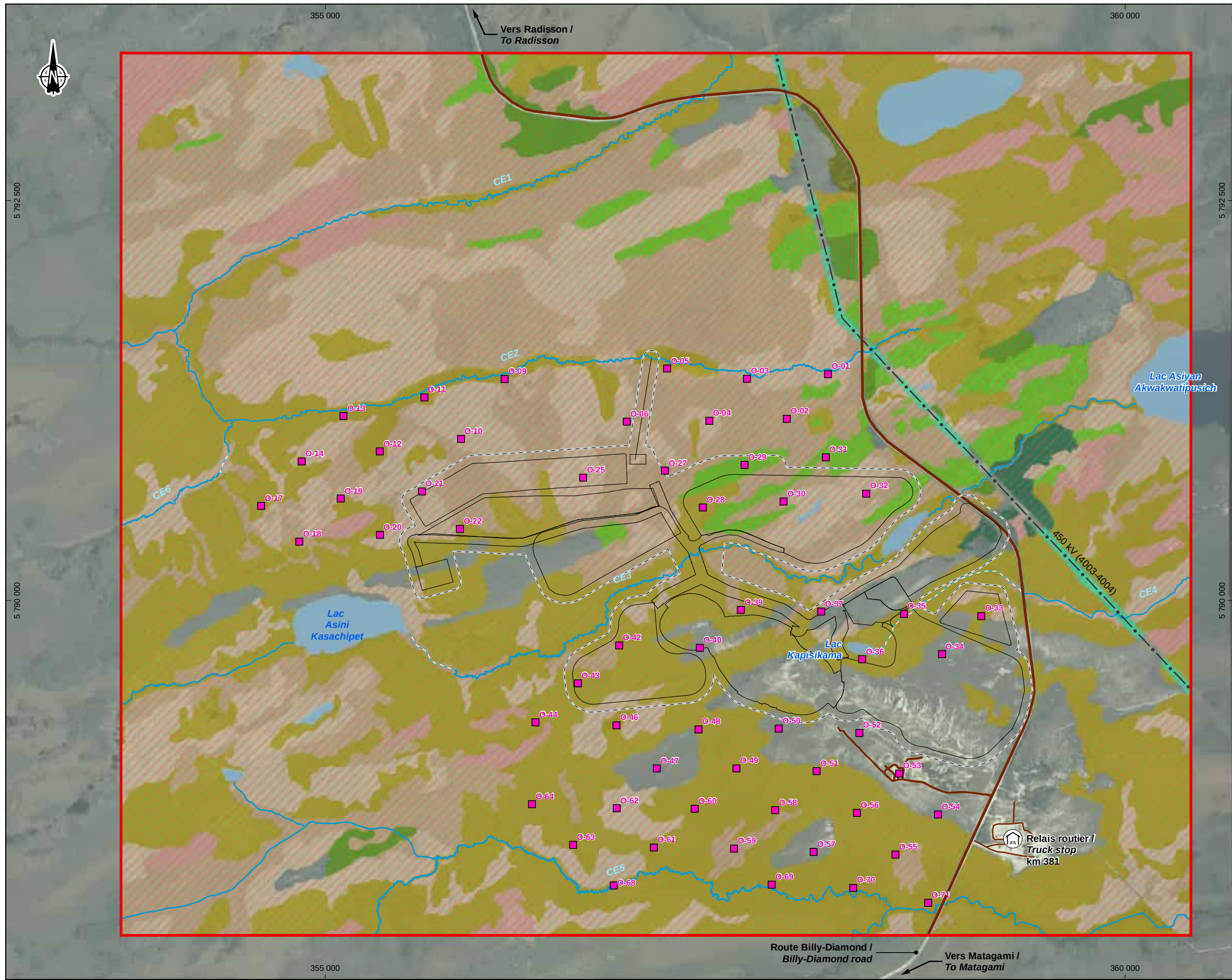
Sources :
Orthoimage : Galaxy, août 2017
Inventaire / Inventory : WSP 2017



Juillet / July 2021

Dessin : A. Masson
Approbation : R. Duhamel
201-12362-00_c6-20E_wspT293_engoul_210701.mxd





— Infrastructures minières / Mining infrastructure

▭ Empreinte de la mine (zone tampon de 50 mètres) / Mine footprint (buffer 50 meters)

▭ Zone d'étude locale / Local study area

/// Habitat potentiel du Moucherolle à côtés olive / Potential Habitat of Olive-sided flycatcher

Inventaire / Inventory

■ O-33 Station d'écoute des oiseaux chanteurs / Songbird listening station

Infrastructures / Infrastructure

— Route principale / Main road

— Route d'accès / Access road

••• Ligne de transport d'énergie / Transmission line

Ⓜ Relais routier / Truck stop

Hydrographie / Hydrography

CE3 Numéro de cours d'eau / Stream number

— Cours d'eau permanent / Permanent stream

- - - Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream

Peuplements terrestres / Terrestrial Vegetation

Boisé / Woodland

Pessière noire à lichen / Black spruce lichen forest

Pessière noire à aulnes / Black spruce alder forest

Pinède grise / Jack pine forest

Brûlis / Burnt area

Peuplements humides / Wetland

Plan d'eau / Waterbody

Tourbière arbustive / Shrubby peatland

Tourbière boisée / Treed peatland

Tourbière ouverte / Open bog

Végétation humide dans l'emprise / Wetland in right-of-way

GALAXY

Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 6-20F

Habitat potentiel du moucherolle à côtés olive et sites d'inventaire / Potential Habitat of Olive-Sided Flycatcher and Survey Sites

Sources :

Orthoimage : Galaxy, août 2017

Inventaire / Inventory : WSP 2017

0 240 480 m

UTM, fuseau 18, NAD83

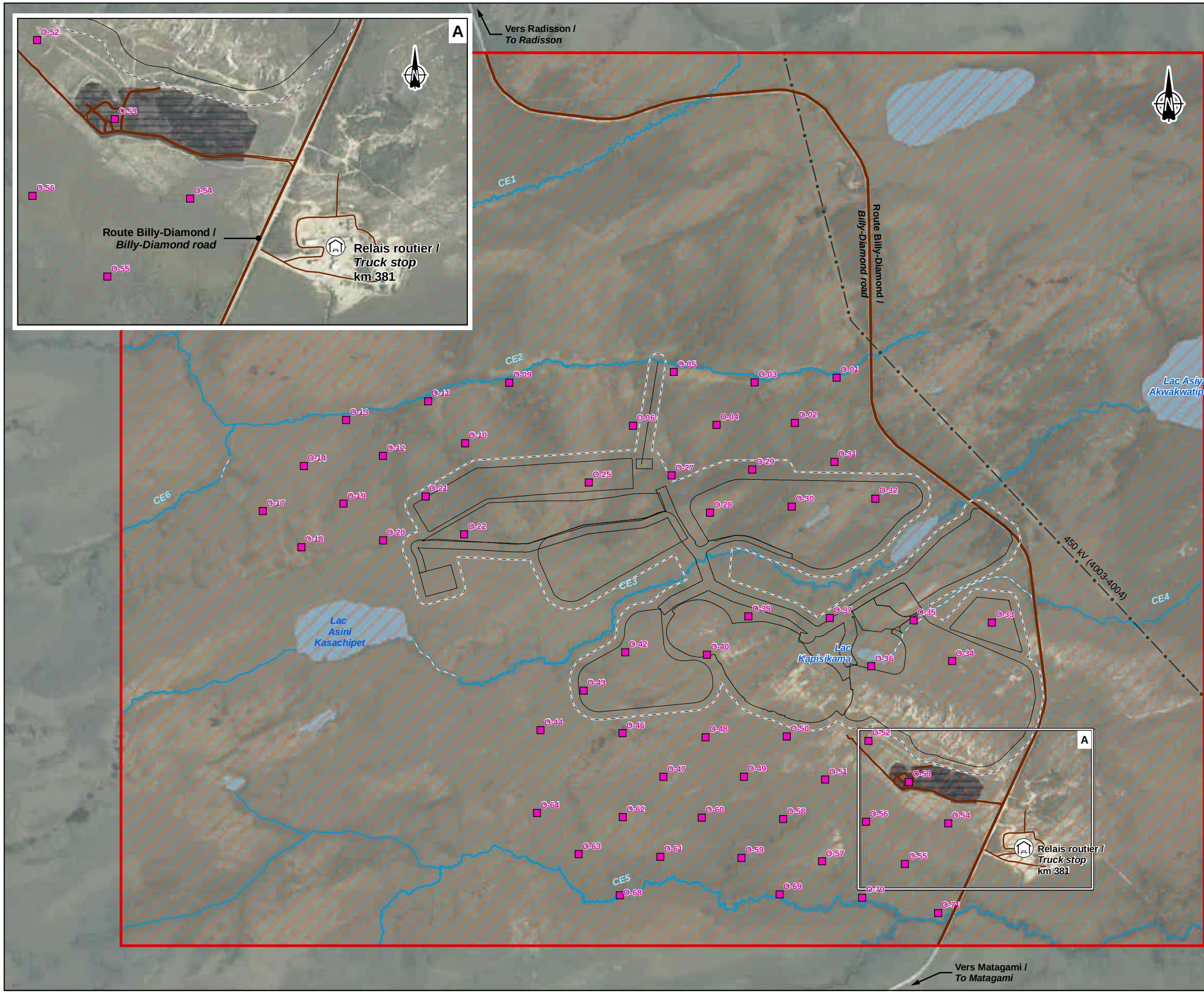
Juillet / July 2021

Dessin : A. Masson

Approbation : R. Duhamel

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wsp



- Infrastructures minières / Mining infrastructure
- Empreinte de la mine (zone tampon de 50 mètres) / Mine footprint (buffer 50 meters)
- Zone d'étude locale / Local study area
- Habitat de nification de l'hirondelle de rivage / Nesting habitat of Bank swallow
- Habitat d'alimentation de l'hirondelle de rivage / Feeding habitat of Bank swallow

Inventaire / Inventory

- O-33 Station d'écoute des oiseaux chanteurs / Songbird listening station

Infrastructures / Infrastructure

- Route principale / Main road
- Route d'accès / Access road
- Ligne de transport d'énergie / Transmission line
- Relais routier / Truck stop

Hydrographie / Hydrography

- Cours d'eau permanent / Permanent stream
- CE3 Numéro de cours d'eau / Stream number
- Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream
- Plan d'eau / Waterbody

Peuplements terrestres / Terrestrial Vegetation

- Anthropique / Anthropogenic



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 6-20G
Habitat potentiel de l'hirondelle de rivage
et sites d'inventaire / Potential Habitat of
Bank Swallow and Survey Sites

Sources :
Orthoimage : Galaxy, août 2017
Inventaire / Inventory : WSP 2017

0 240 480 m
UTM, fuseau 18, NAD83

Juillet / July 2021

Dessin : A. Masson
Approbation : R. Duhamel
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RESULTS

Listening station survey in 2017

Four hundred seventy-two (472) individuals were detected during the listening station survey, representing 32 species of terrestrial breeding birds (Table 6-52). Since the objective of the listening station survey was also to estimate the density of indicated breeding pairs per hectare (IP/ha) in the habitats potentially affected by the project, we established densities for the three categories of habitats studied: wetlands, open habitats and softwood stands. The category with the largest number of species was the wetland habitat with 23 species detected, followed by the open and softwood stand habitats with 16 and 11 species, respectively. The densest category in breeding pairs was found in open habitats, at 6.97 IP/ ha, followed by softwood stands and wetlands, with 5.93 and 3.96 IP/ha, respectively, all species combined (Table 6-52).

Of breeding birds, the dark-eyed junco (*Junco hyemalis*) was most abundant in softwood stand and open habitat stations, with 2.19 and 1.49 IP/ha, respectively. The density of the white-throated sparrow (*Zonotrichia albicollis*) was the same as that of the dark-eyed junco (1.49 IP/ha) in open habitats, while it ranked second, with 1.27 IP/ha, in softwood stands. The white-throated sparrow was also the most abundant species in wetland habitats, with 0.84 IP/ha, followed by the dark-eyed junco with 0.82 IP/ha. In short, these two species are dominant in the three habitat categories studied. They are also the species that showed the greatest consistency from one station to another, followed by the hermit thrush (*Catharus guttatus*) and Lincoln's sparrow (*Melospiza lincolnii*). These are all abundant species common to these latitudes.

Table 6-52 Density of terrestrial breeding birds in habitats surveyed in 2017

Species (n =32)	Density (IP/ha)		
	Wetlands (31 stations)	Open habitats (18 stations)	Softwood stands (9 stations)
Two-barred crossbill (<i>Loxia leucoptera</i>)	0.12	-	-
White-crowned sparrow (<i>Zonotrichia leucophrys</i>)	-	0.35	-
White-throated sparrow (<i>Zonotrichia albicollis</i>)	0.84	1.49	1.27
Song sparrow (<i>Melospiza melodia</i>)	obs	-	-
Le Conte's sparrow ¹ (<i>Ammodramus leconteii</i>)	obs	-	-
Lincoln's sparrow (<i>Melospiza lincolnii</i>)	0.35	0.78	0.28
Swamp sparrow (<i>Melospiza georgiana</i>)	0.14	-	-
Savannah sparrow (<i>Passerculus sandwichensis</i>)	0.31	-	-
Fox sparrow (<i>Passerella iliaca</i>)	obs	-	-
American crow (<i>Corvus brachyrhynchos</i>)	-	obs	-
Common raven ¹ (<i>Corvus corax</i>)	obs	obs	obs
Swainson's thrush (<i>Catharus ustulatus</i>)	-	0.07	0.14
Veery (<i>Catharus fuscescens</i>)	-	obs	obs
Hermit thrush (<i>Catharus guttatus</i>)	0.10	0.85	0.85
Tree swallow (<i>Tachycineta bicolor</i>)	0.31	-	-
Cedar waxwing (<i>Bombicilla cedrorum</i>)	0.06	0.21	-
Dark-eyed junco (<i>Junco hyemalis</i>)	0.82	1.49	2.19
American robin (<i>Turdus migratorius</i>)	0.18	0.42	0.07
Boreal chickadee ¹ (<i>Parus hudsonicus</i>)	-	-	obs
Grey jay (<i>Perisoreus canadensis</i>)	0.04	0.14	-
Alder flycatcher (<i>Empidonax alnorum</i>)	obs	obs	obs

Table 6-52 Density of terrestrial breeding birds in habitats surveyed in 2017 (cont.)

Species (n =32)	Density (IP/ha)		
	Wetlands (31 stations)	Open habitats (18 stations)	Softwood stands (9 stations)
Wilson's warbler (<i>Cardellina pusilla</i>)	0.10	-	-
Palm warbler (<i>Setophaga palmarum</i>)	0.06	0.18	0.71
Yellow-rumped warbler (<i>Setophaga coronata</i>)	obs	-	-
Common yellowthroat (<i>Geothlypis trichas</i>)	0.23	0.50	-
Tennessee warbler (<i>Oreothlypis peregrina</i>)	-	0.28	-
Black-backed woodpecker (<i>Picoides arcticus</i>)	obs	-	-
Northern flicker (<i>Colaptes auratus</i>)	obs	obs	obs
Rusty blackbird (<i>Euphagus carolinus</i>)	0.14	-	-
Ruby-crowned kinglet (<i>Regulus calendula</i>)	0.08	0.21	0.14
Grey jay (<i>Perisoreus canadensis</i>)	-	-	obs
Winter wren (<i>Troglodytes hiemalis</i>)	0.08	-	0.28
Number of species	25	18	14
Total density (IP/ha)	3.96	6.97	5.93
Obs: Too few observations to establish a breeding pair density.			

Table 6-53 shows the distribution of the listening stations by habitat type. As in Table 6-52, this distribution over three categories—wetlands, open areas and softwood stands—largely reflects the relative availability of these environments in the local study area and on the property affected by the project (Table 6-53), in that over 50% of the stations are located in the most common habitat (wetlands), while open areas and softwood stands, which are less abundant in the local study area and on the property affected by the project, represent 31% and 15.5% of stations, respectively. Although station distribution overestimates the availability of these two types of habitats in the local study area, it is a necessary compromise to obtain a sufficient number of stations in the least represented habitat, i.e. softwood stands unaffected by fire.

Table 6-53 Distribution of the types of habitats for songbird surveys and distribution of the listening stations

Type of habitat	Surface area of the study area		Surface area of the property affected by the project		Surface area of the project footprint		Distribution of the survey stations	
	ha	%	ha	%	ha	%	N	%
Wetlands	2,872	79.8	1,234	76.3	280	76.4	31	53.5
Open areas	542	15.1	342	21.1	76	20.7	18	31.0
Softwood stands	184	5.1	42	2.6	11	2.9	9	15.5

Nighthawk survey

There are two types of nighthawk in Québec: the common nighthawk (*Chordeiles minor*) and the eastern whip-poor-will (*Antrostomus vociferus*). On the evening of the survey, only the common nighthawk was detected, at station Eng-06. Two more were also observed a few times between July 5 and 10, 2017, above the km 381 truck stop. The nighthawk appears on the list of species likely to be designated as threatened or vulnerable in Québec (MFFP, 2006a). It is also considered threatened at the federal level and appears in Schedule 1 to Canada's *Species at Risk Act* (SARA) (Government of Canada, 2017).

Other opportunistic observations

Six more bird species were sighted during field trips in 2017: Bonaparte's gull (*Chroicocephalus philadelphia*), the hen harrier (*Circus cyaneus*), the sharp-tailed grouse (*Tympanuchus phasianellus*), the Nashville warbler (*Oreothlypis ruficapilla*), the eastern bluebird (*Sialia sialis*) and the northern mockingbird (*Mimus polyglottos*). The last two species were sighted on the edge of the km 381 truck stop. If we include the species detected during the surveys of waterfowl, aquatic birds and terrestrial breeding birds, 53 bird species were detected in the study area in 2017.

Listening station survey in 2012

The listening station survey conducted in 2012 revealed the presence of 41 species (Table 6-54). The few differences between the species detected in 2012 and in 2017 may be due to the effect of forest fires in the study area between these two periods.

6.3.5.3 DATA FROM AVAILABLE DATA BANKS

Although the SOS-POP data bank has no data on the study area, some useful information was found in the ÉPOQ data bank. Data from the *Programme de suivi de la sauvagine de l'Est* does not extend north of 51° 15' N and as such does not cover the study area.

A comprehensive list of bird sightings recorded in the study area was extracted from the ÉPOQ data bank (Larivée, 2017). This data covers a period of more than 30 years, from 1981 to 2015 (Table 6-55). Despite the time span covered, only 186 mentions covering 64 species were recorded in the study area. These are divided into five observations in spring, 147 in summer and 34 in the fall. There are no winter observations.

In addition to the information from the ÉPOQ data bank, the results reported in the environmental assessment of the Rose Lithium-Tantalum Mine project (WSP, 2017) were also consulted. This project is located approximately 60 km southeast of the James Bay Lithium Mine project. These surveys also included a helicopter survey of waterfowl and other aquatic birds, including birds of prey, as well as a survey of terrestrial forest birds, in spring. The methodology used was comparable to the methodology adopted for this project.

The richness of terrestrial birds in the James Bay Lithium Mine project is similar to that observed for the Rose Lithium-Tantalum Mine project (WSP, 2017), located slightly to the northeast of the current project, which reports high aquatic bird richness and density. However, since forest environments are more widespread and the categories of habitats considered for the density estimate are not the same, data harmonization between the two projects remains difficult and inevitably biased.

Table 6-52 combines data from both surveys (WSP, 2017 and WSP, 2018g) as well as data saved in the ÉPOQ data bank from 1981 to 2015.

Nevertheless, although the inclusion of the species detected during the Rose Lithium-Tantalum Mine project (WSP, 2017) and surveys carried out in 2012 for the James Bay Lithium Mine project provide a more detailed picture of the seasonal richness of the avifauna in the study area before the fires, it does not provide a better assessment of the short-term effects of the James Bay Lithium Mine project, since the current environment inside the study area is disrupted and it is in this environment that the short-term effects of the project will be felt. Furthermore, it cannot be assumed that the area will recover naturally at a rapid pace, nor that new fires will not occur in the near future.

6.3.5.4 SPECIAL STATUS BIRD SPECIES

Among the bird species surveyed in the study area, there are three species at risk in Quebec or in Canada: the common nighthawk, the rusty blackbird (*Euphagus carolinus*) and the bald eagle. The first one nests in burned over areas, bare habitats and flat roofs (Poulin and coll., 1996), all widely available in the study area. The second frequents swamps, beaver ponds and peatlands (Environment Canada, 2014), all of which are still well represented habitats in the study area and the surrounding areas. Both these species were detected in 2012 and 2017. As for the bald eagle, one 2007 sighting of which is recorded in the ÉPOQ data bank (Larivée, 2017), the species was not detected during the 2012 and 2017 surveys.

Table 6-54 Species detected during the 2012 breeding bird survey

Species (n = 41)	Sighted in 2017	Species (n = 41)	Sighted in 2017
Two-barred crossbill (<i>Loxia leucoptera</i>)	Yes	Dark-eyed junco (<i>Junco hyemalis</i>)	Yes
Wilson's snipe (<i>Gallinago delicata</i>)	Yes	American robin (<i>Turdus migratorius</i>)	Yes
White-throated sparrow (<i>Zonotrichia albicollis</i>)	Yes	Boreal chickadee ¹ (<i>Poecile hudsonicus</i>)	Yes
Lincoln's sparrow (<i>Melospiza lincolni</i>)	Yes	Grey jay (<i>Perisoreus canadensis</i>)	Yes
Swamp sparrow (<i>Melospiza georgiana</i>)	Yes	Alder flycatcher (<i>Empidonax alnorum</i>)	Yes
Savannah sparrow (<i>Passerculus sandwichensis</i>)	Yes	Yellow-bellied flycatcher (<i>Empidonax flaviventris</i>)	No
Fox sparrow (<i>Passerella iliaca</i>)	Yes	Wilson's warbler (<i>Cardellina pusilla</i>)	Yes
American tree sparrow (<i>Spizella arborea</i>)	No	Palm warbler (<i>Setophaga palmarum</i>)	Yes
Red-tailed hawk (<i>Buteo jamaicensis</i>)	No	Yellow-rumped warbler (<i>Setophaga coronata</i>)	Yes
American crow (<i>Corvus brachyrhynchos</i>)	Yes	Nashville warbler (<i>Oreothlypis ruficapilla</i>)	Yes
Common nighthawk (<i>Chordeiles minor</i>)	Yes	Northern waterthrush (<i>Parkesia noveboracensis</i>)	No
Common starling (<i>Sturnus vulgaris</i>)	No	Yellow warbler (<i>Setophaga petechia</i>)	No
Merlin (<i>Falco columbarius</i>)	No	Common yellowthroat (<i>Geothlypis trichas</i>)	Yes
Herring gull (<i>Larus argentatus</i>)	No	Black-backed woodpecker (<i>Picoides arcticus</i>)	Yes
Common raven ¹ (<i>Corvus corax</i>)	Yes	American three-toed woodpecker (<i>Picoides dorsalis</i>)	No
Brown creeper (<i>Certhia americana</i>)	No	Northern flicker (<i>Colaptes auratus</i>)	Yes
Hermit thrush (<i>Catharus guttatus</i>)	Yes	Common loon (<i>Gavia immer</i>)	Yes
Greater yellowlegs (<i>Tringa melanoleuca</i>)	Yes	Rusty blackbird (<i>Euphagus carolinus</i>)	Yes
Sandhill crane (<i>Grus canadensis</i>)	Yes	Ruby-crowned kinglet (<i>Regulus calendula</i>)	Yes
Tree swallow (<i>Tachycineta bicolor</i>)	Yes	Winter wren (<i>Troglodytes hiemalis</i>)	Yes
Cedar waxwing (<i>Bombycilla cedrorum</i>)	Yes		

Table 6-55 Seasonal distribution^[1] of bird species according to various surveys (WSP, 2017^[2]; WSP, 2018g) within the study area and sightings recorded in the ÉPOQ data bank^[3] from 1981 to 2015

Species*	Spring	Summer	Fall
Northern goshawk (<i>Accipiter gentilis</i>)		x	
Osprey (<i>Pandion haliaetus</i>)	x	x	
Wilson's snipe (<i>Gallinago delicata</i>)		x	
Two-barred crossbill (<i>Loxia leucoptera</i>)		x	
Red crossbill (<i>Loxia curvirostra</i>)		x	
Canada goose (<i>Branta canadensis</i>)	x		x
White-crowned sparrow (<i>Zonotrichia leucophrys</i>)		x	x
White-throated sparrow (<i>Zonotrichia albicollis</i>)		x	x
Song sparrow (<i>Melospiza melodia</i>)		x	
Lincoln's sparrow (<i>Melospiza lincolnii</i>)		x	
Swamp sparrow (<i>Melospiza georgiana</i>)		x	
Fox sparrow (<i>Passerella iliaca</i>)	x	x	
American tree sparrow (<i>Spizella arborea</i>)		x	
Hen harrier (<i>Circus cyaneus</i>)		x	
Red-tailed hawk (<i>Buteo jamaicensis</i>)	x	x	x
Rough-legged hawk (<i>Buteo lagopus</i>)	x		
Mallard (<i>Anas platyrhynchos</i>)		x	
American wigeon (<i>Anas americana</i>)	x		
American black duck (<i>Anas rubripes</i>)	x		
Northern shoveler (<i>Anas clypeata</i>)	x		
Spotted sandpiper (<i>Actitis macularius</i>)		x	
Solitary sandpiper (<i>Tringa solitaria</i>)		x	
American kestrel (<i>Falco sparverius</i>)		x	
Common nighthawk (<i>Chordeiles minor</i>)		x	
Common starling (<i>Sturnus vulgaris</i>)		x	
Merlin (<i>Falco columbarius</i>)		x	
Ring-necked duck (<i>Aythya collaris</i>)	x		
Common goldeneye (<i>Bucephala clangula</i>)	x		
Ruffed grouse (<i>Bonasa umbellus</i>)	x	x	
Ring-billed gull (<i>Larus delawarensis</i>)	x		
Herring gull (<i>Larus argentatus</i>)	x	x	x

[1] None of the documentary sources available covers the winter season.

[2] Including data from the 2012 breeding birds survey for the James Bay Lithium Mine project.

[3] List produced by Marie-France Julien of Regroupement QuébecOiseaux, on 01/31/2018.

Table 6-55 Seasonal distribution^[1] of bird species according to various surveys (WSP, 2017^[2]; WSP, 2018g) within the study area and sightings recorded in the ÉPOQ data bank^[3] from 1981 to 2015 (cont.)

Species*	Spring	Summer	Fall
Greater yellowlegs (<i>Tringa melanoleuca</i>)		X	
Common raven (<i>Corvus corax</i>)	X	X	X
Common merganser (<i>Mergus merganser</i>)	X	X	X
Great blue heron (<i>Ardea herodias</i>)	X		X
Great horned owl (<i>Anas americana</i>)	X		
Brown creeper (<i>Certhia americana</i>)		X	
Swainson's thrush (<i>Catharus ustulatus</i>)		X	X
Hermit thrush (<i>Catharus guttatus</i>)		X	X
Sandhill crane (<i>Grus canadensis</i>)	X	X	
Hooded merganser (<i>Lophodytes cucullatus</i>)	X	X	X
Short-eared owl (<i>Asio flammeus</i>)	X		
Tree swallow (<i>Tachycineta bicolor</i>)		X	
Cedar waxwing (<i>Bombycilla cedrorum</i>)		X	
Dark-eyed junco (<i>Junco hyemalis</i>)		X	X
Willow ptarmigan (<i>Lagopus lagopus</i>)		X	
Common scoter (<i>Melanitta nigra</i>)	X		
Surf scoter (<i>Melanitta perspicillata</i>)	X		
Velvet scoter (<i>Melanitta fusca</i>)	X		
American robin (<i>Turdus migratorius</i>)		X	X
Boreal chickadee (<i>Poecile hudsonicus</i>)		X	X
Grey jay (<i>Perisoreus canadensis</i>)		X	X
Yellow-bellied flycatcher (<i>Empidonax flaviventris</i>)		X	
Alder flycatcher (<i>Empidonax alnorum</i>)		X	
Bonaparte's gull (<i>Chroicocephalus philadelphia</i>)	X	X	
Wilson's warbler (<i>Cardellina pusilla</i>)		X	
Palm warbler (<i>Setophaga palmarum</i>)		X	
Yellow-rumped warbler (<i>Setophaga coronata</i>)		X	X
Nashville warbler (<i>Oreothlypis ruficapilla</i>)		X	
Magnolia warbler (<i>Setophaga magnolia</i>)		X	
Northern waterthrush (<i>Parkesia noveboracensis</i>)		X	
American redstart (<i>Setophaga ruticilla</i>)		X	

[1] None of the documentary sources available covers the winter season.

[2] Including data from the 2012 breeding birds survey for the James Bay Lithium Mine project.

[3] List produced by Marie-France Julien of Regroupement QuébecOiseaux, on 01/31/2018.

Table 6-55 Seasonal distribution^[1] of bird species according to various surveys (WSP, 2017^[2]; WSP, 2018g) within the study area and sightings recorded in the ÉPOQ data bank^[3] from 1981 to 2015 (cont.)

Species*	Spring	Summer	Fall
Yellow warbler (<i>Setophaga petechia</i>)		x	
Common yellowthroat (<i>Geothlypis trichas</i>)		x	
Black-and-white warbler (<i>Mniotilta varia</i>)		x	
Tennessee warbler (<i>Oreothlypis peregrina</i>)		x	
Mourning warbler (<i>Geothlypis philadelphia</i>)		x	
Orange-crowned warbler (<i>Oreothlypis celata</i>)		x	x
Bufflehead (<i>Bucephala albeola</i>)	x		
Black-backed woodpecker (<i>Picoides arcticus</i>)		x	
American three-toed woodpecker (<i>Picoides dorsalis</i>)		x	
Hairy woodpecker (<i>Picoides villosus</i>)	x		
Northern flicker (<i>Colaptes auratus</i>)		x	x
Yellow-bellied sapsucker (<i>Sphyrapicus varius</i>)		x	
Buff-bellied pipit (<i>Anthus rubescens</i>)			x
Common loon (<i>Gavia immer</i>)		x	
Bald eagle (<i>Haliaeetus leucocephalus</i>)	x	x	
Golden-crowned kinglet (<i>Regulus satrapa</i>)		x	
Ruby-crowned kinglet (<i>Regulus calendula</i>)		x	x
Common teal (<i>Anas crecca</i>)		x	x
Red-breasted nuthatch (<i>Sitta canadensis</i>)		x	
Common tern (<i>Sterna hirundo</i>)		x	
Pine siskin (<i>Spinus pinus</i>)		x	
Mourning dove (<i>Zenaida macroura</i>)		x	
Winter wren (<i>Troglodytes hiemalis</i>)		x	
Philadelphia vireo (<i>Vireo philadelphicus</i>)		x	

* Data in bold comes from the Rose Lithium-Tantalum project impact assessment (WSP, 2017).

6.3.6 BATS

Québec is home to eight bat species, **five of which** are resident because they remain in **the** latitudes **of the** **province** during the winter and three of which are described as migratory since they overwinter farther south. However, in Québec, even resident species migrate during the fall season, although for shorter distances than in the case of so-called migratory species.

[1] None of the documentary sources available covers the winter season.

[2] Including data from the 2012 breeding birds survey for the James Bay Lithium Mine project.

[3] List produced by Marie-France Julien of Regroupement QuébecOiseaux, on 01/31/2018.

6.3.6.1 EXISTING DOCUMENTATION

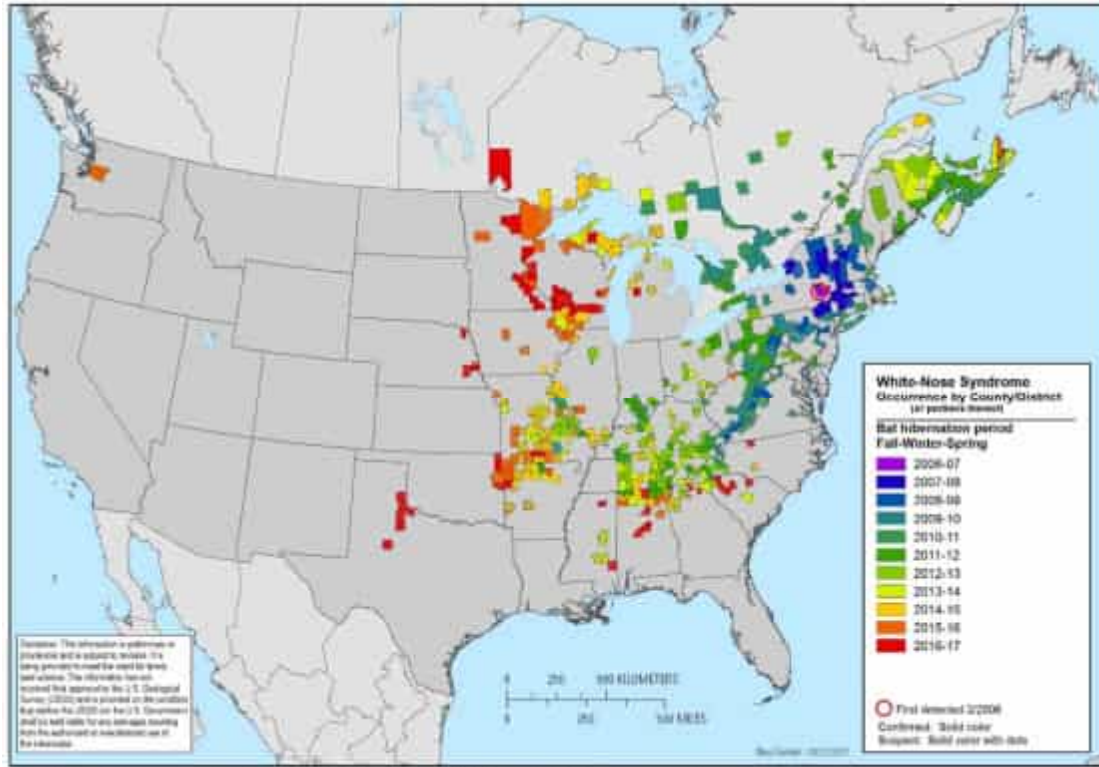
According to the geographic distribution of bat species in Québec (Jutras and coll., 2012), established based on data from the CDPNQ, the study area is potentially frequented by five of the eight bat species present in Québec: the northern myotis, the little brown myotis, the big brown bat, the hoary bat and the eastern red bat (*Lasiurus borealis*). According to this data, there are no silver-haired bats in the study area: their geographic range stops about 200 kilometres farther south.

Surveys conducted between 2003 and 2009 by the *Réseau québécois d'inventaires acoustiques de chauves-souris* (Jutras and Vasseur, 2011) at Bourbeau Lake, approximately 300 kilometres southeast of the study area, confirmed the presence of four of these five species. Only the eastern red bat was not listed. The dominant species in the Réseau's surveys are the hoary bat (54.7% of records collected between 2003 and 2009) and bats of the genus *Myotis* (39.6% of records). In addition, a survey conducted as part of the impact study for the Whabouchi project, about 100 kilometres southeast of the study area, identified bats of the genus *Myotis* as well as “the hoary bat [...] and/or the eastern red bat [...].” Moreover, a little brown myotis maternity colony of approximately 300 individuals was recorded in this area, and the *Ministère des Ressources naturelles* has confirmed that hoary bats have been observed near Lac du Spodumene (Nemaska Lithium, 2013).

In general, little data is available on bats in the northern environment. The northern limit of their distribution is difficult to define (Environment Canada, 2015). It is possible that the distribution limit for some species may extend farther north than estimates show. In fact, the data collected by our team on the Côte-Nord and in Labrador indicate that the eastern red bat, the northern myotis and the little brown myotis are found up to the 54th parallel, well beyond their known distribution (Brunet, personal communication). It is not known, however, whether these were resident breeding individuals or merely extralimital observations.

A dramatic increase in bat mortality has been observed since 2006–2007 in abandoned mines and natural caves in the northeastern United States. Most of the affected bats showed unique external signs, as some parts of the body, mainly the snout, were covered with a whitish fungal infection, hence the name white-nose syndrome (WNS) (MFFP, 2017b). WNS is spreading rapidly and now affects more than 15 states in the northeastern United States. In Canada, the provinces of Ontario, New Brunswick and Québec have also been also affected. WNS is therefore a major international issue for bat conservation. It is estimated that more than a million bats have succumbed to this syndrome since its discovery, attesting to the magnitude of this disease (MFFP, 2017b). Most North American bat species may be affected by WNS. However, the little brown myotis, the northern myotis, the big brown bat, the tri-coloured bat (*Perimyotis subflavus*) and the Indiana bat (*Myotis sodalis*, absent in Québec) have been especially affected in the northeastern United States and Ontario (MFFP, 2017b). The presence of WNS has been confirmed in Nord-du-Québec (Map 6-21A). Most of the species affected by WNS are insectivorous and cave dwelling.

In 2014, due to the spread of this disease, the tri-coloured bat, the little brown myotis and the northern myotis were classified as “endangered” in Canada and listed in Schedule 1 of SARA (Government of Canada, 2014).



Map 6-1A Spread of WNS in North America

6.3.6.2 ACOUSTIC MONITORING

METHODOLOGY

In 2017, a bat survey was conducted in the study area using fixed acoustic monitoring, a technique based on the protocol developed for bat surveys in the context of wind projects (MRNF, 2008). This methodology is used to collect point-by-point information on bat activity using automated monitoring stations.

Six monitoring stations were set up to document the habitats most favourable to the activities of potentially present bat species, more specifically, sites suitable for breeding, foraging or roosting, as well as potential movement or migration corridors. These monitoring stations are shown on Map 6-21B. The desired key habitats were associations characterized by the presence of or proximity to two or more of the following:

- open areas;
- mature forests;
- watercourses and bodies of water;
- wetlands.

The stations were set up between July 6 and July 9, 2017, and removed on September 24 and 25, 2017. They were therefore active during the bat breeding season (early June to late July) and the beginning of the migration period (mid-August to mid-October).

The methodology used for this survey is described in detail in the Terrestrial Wildlife and Avifauna Baseline Study (*Étude spécialisée sur les faunes terrestre et avienne*) (WSP, 2018g). **Map 6-21B indicates the location of monitoring stations as well as potential habitats.**

RESULTS

The acoustic monitoring conducted during the breeding and migration periods in 2017 confirmed the presence of *Myotis* bats as well as two other species, for a total of just 68 passes recorded:

- *Myotis* bats (4.41% of records);
- big brown bat (*Eptesicus fuscus*) (1.47% of records);
- hoary bat (*Lasiurus cinereus*) (86.76% of records).

Of the total, 7.35 % of records were undetermined because the calls were too short to enable identification of the species.

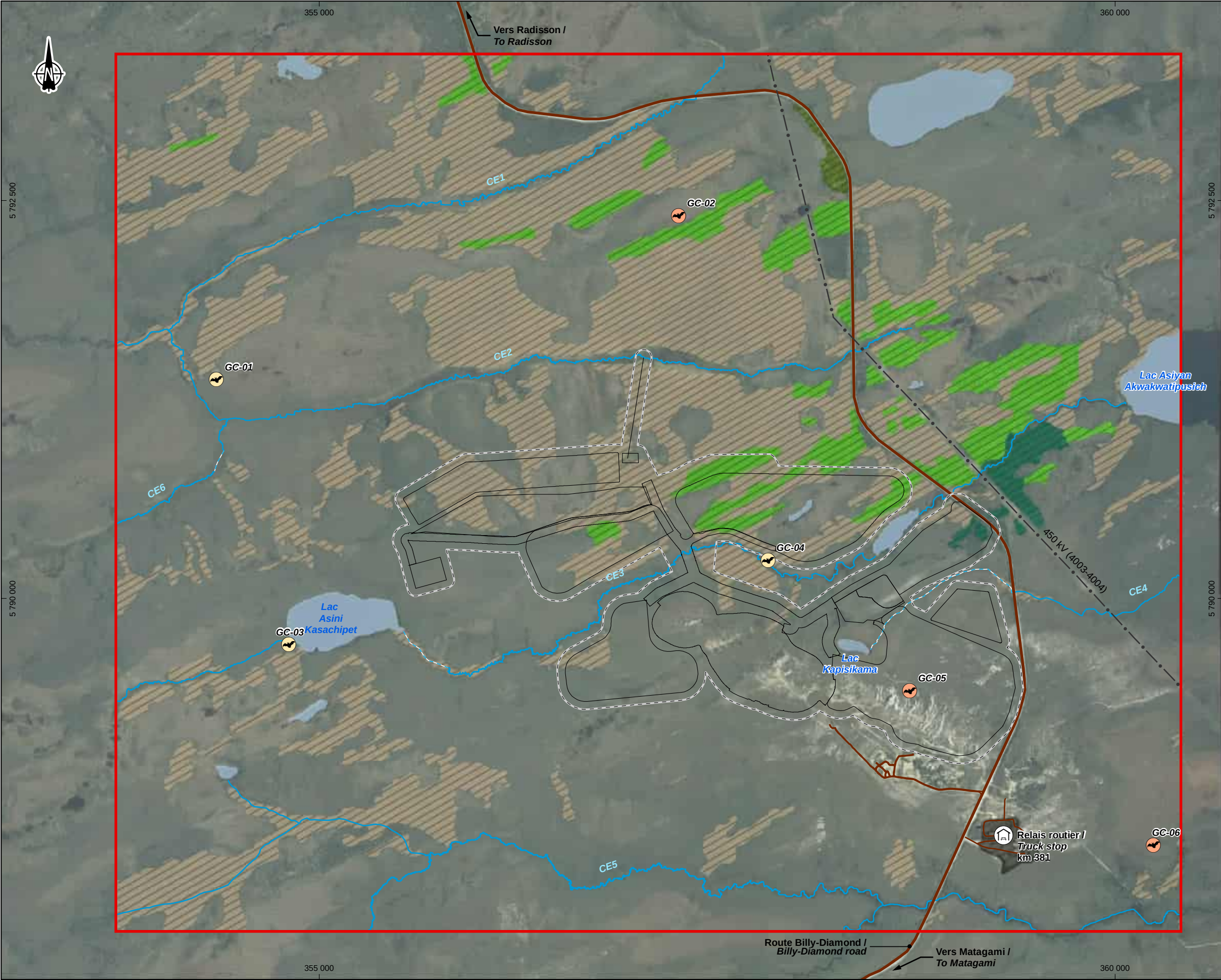
Except for station GC-03, which was only active during the migration period after a technical problem, the five other stations were active for 20-40 nights during the breeding period and for 10-38 nights during the migration period. The entire survey consisted of 261 station-nights. All of the data collected was analyzed, which went far beyond what was required by the province (MRNF, 2008). Despite this survey effort, only three *Myotis* bat calls were recorded, accounting for one pass at 3 stations, which can be explained by the general poor environment and the northern nature of the study site. Such a small number of calls cannot lead to the conclusion that the environment is heavily used; the bat detected could have been on the move. The results of the bat survey did not raise any issues that would call for additional surveys.

These results are consistent with those obtained by the Réseau québécois d'inventaire acoustique de chauves-souris in Abitibi (Jutras and Vasseur, 2011) and the survey conducted for the Wabouchi project (Nemaska Lithium, 2013) concerning the presence of *Myotis* and two other species, as well as for the dominance of the hoary bat.

However, considering the survey effort (261 station-nights), few passes were recorded for the various bat species.

Most of the species surveyed during this inventory were arboreal (Tremblay and Jutras, 2010): the hoary bat, which is a migratory species, essentially roosts in trees, while *Myotis* bats use trees, buildings and rocky structures (Tremblay and Jutras, 2010). For its part, the big brown bat roosts instead in buildings or rocky structures (Tremblay and Jutras, 2010) but also in mature trees with cavities (woodpecker holes, crevices, etc.) (Willis and coll., 2006). Arboreal bats typically look for large, wide-diameter trees (Tremblay and Jutras, 2010).

Consequently, mature forests are particularly suitable for daytime roosts and breeding sites for the at-risk species surveyed in the study area. We know that bats choose swamps, bogs, beaver ponds, lakes and watercourses as hydration and foraging habitats (Taylor, 2006). Consequently, the association of watercourses, bodies of water and other wetlands with mature forests are generally a key habitat for bats. While the presence of watercourses and/or wetlands characterized each monitoring station, mature forests have almost completely disappeared from the study area due to forest fires in the last decade. This probably explains the low bat presence.



- Infrastructures minières / Mining infrastructure
- Empreinte de la mine (zone tampon de 50 mètres) / Mine footprint (buffer 50 meters)
- Zone d'étude locale / Local study area

- Chauve-souris / Bat**
- Station d'inventaire acoustique des chiroptères / Bat acoustic monitoring station
 - Présence confirmée de chauve-souris du genre *Myotis* / *Myotis* bat presence confirmed
 - Habitat potentiel de repos et de reproduction de la petite chauve-souris brune et de la chauve-souris nordique / Habitat (roost sites) of Little Brown *Myotis* and Northern *Myotis*

- Infrastructures / Infrastructure**
- Route principale / Main road
 - Route d'accès / Access road
 - Ligne de transport d'énergie / Transmission line
 - Relais routier / Truck stop

- Hydrographie / Hydrography**
- CE3 Numéro de cours d'eau / Stream number
 - Cours d'eau permanent / Permanent stream
 - Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream
 - Plan d'eau / Waterbody

- Peuplements humides / Wetland**
- Tourbière boisée / Wooded bog

- Peuplements terrestres / Terrestrial Vegetation**
- Boisé / Woodland
 - Pessière noire à lichen / Black spruce lichen forest
 - Pinède grise / Jack pine forest
 - Anthropique / Anthropogenic



Mine de lithium Baie-James / James Bay Lithium Mine
Mise à jour de l'étude d'impact sur l'environnement

Carte / Map 6-21B
Habitat potentiel de repos et de reproduction de la petite chauve-souris brune et de la chauve-souris nordique et sites d'inventaire / Habitat (roost sites) of Little Brown *Myotis* and Northern *Myotis* and survey sites

Sources :
Orthoimage : Galaxy, août 2017
Données du projet / Project data, Galaxy 2021
Inventaire / Inventory: WSP 2017

0 240 480 m
UTM, fuseau 18, NAD83

Juillet / July 2021

Dessin : A. Masson
Approbation : P. Marcoux-Viel
201-12362-00_c6-21B_wspT298_myotis_210701.mxd



6.3.6.3 SEARCH FOR HIBERNACULA

Documentary research was conducted to evaluate the potential presence of bat wintering habitats in the study area and in a one-kilometre surrounding buffer zone. We looked for natural cavities or mine openings potentially suitable for this type of habitat. Various sources were consulted, more specifically, the geomining information system (MERN, 2017), internal databases, photos and videos taken during wildlife surveys, as well as the regional offices of the MERN and MFFP.

An analysis of the documents showed that there are no natural cavities or mine openings in the area (Bellemare and Germain, 1987; Gauthier and coll., 1995; McCann, 2014). According to Christine Lambert of the *Direction de la protection de la faune du Nord-du-Québec*, the most northern hibernacula in Québec is found at the Bruneau mine, about 250 km south of the study area.

Hibernation sites must have an appropriate ambient temperature, one that is cold enough to sufficiently decrease the bat's metabolic rate but warm enough that it doesn't freeze to death. The interior ambient temperature of a mine or cave depends in large part on the average annual temperature of the region. Therefore, the 0°C isotherm, the line connecting all points where the average annual temperature is 0°C, would be the theoretical limit above which it would not be likely to find a hibernaculum since the temperature of cavities or mine openings would be too low for bat needs. The presence of hibernacula above this theoretical limit should not, however, be ruled out since microclimate conditions could explain special cases (Gauthier and coll., 1995). Still, this theoretical limit makes it possible to assess the potential of the study site, which is located about 250 km north of the 0°C isotherm (MDDELCC, 2018a).

Consequently, since no natural cavity or mine opening was found in the sector and since it is located beyond the theoretical limit described above, we believe that there is no likelihood of bat hibernacula in or around the study area.

6.3.6.4 SPECIAL STATUS BAT SPECIES

MYOTIS BAT

Until WNS arrived, the genus *Myotis* was most abundant in eastern Canada (Broders and coll., 2003; Delorme and Jutras, 2006; Jutras and coll., 2012). In Québec, this genus includes the little brown myotis, the northern myotis and the eastern small-footed myotis, the latter never having been surveyed in Abitibi.

The little brown myotis and the northern myotis are two of the five resident species in Québec. They remain in their foraging and breeding habitats until fall (Brunet and coll., 1998; Prescott and Richard, 2004), at which point they move to their wintering habitat, usually in caves or old mine openings (Banfield, 1977; Mc Duff and coll., 2001). In the eastern part of their distribution area, *Myotis* bat populations have been decimated by WNS. This disease was first detected in Canada in 2010 and to date has caused a 94% overall decline in numbers of known hibernating *Myotis* bats in Nova Scotia, New Brunswick, Ontario and Quebec hibernacula (MFFP, 2017b).

The northern myotis is usually found in boreal forests (Broders and coll., 2003; Owen and coll., 2003), while the little brown myotis is found in a greater variety of habitats such as riparian, forest or anthropogenic sites (Prescott and Richard, 2004). In summer, the two species may use both tree structures (natural cavities or those excavated by woodpeckers, cracks under the bark, etc.) and buildings or rock structures as roosts for resting or rearing their young (maternity colonies) (Tremblay and Jutras, 2010).

In the study site, the little brown myotis and the northern myotis could use trees as roosts such as the mature trees present in treed peatlands, wooded areas, black spruce stands with lichen and jack pine stands. They could also use the buildings present in anthropogenic areas (381 truck stop), but this sector will not be affected by the work.

Bats are also someone opportunistic, and can use wetlands and bodies of water to meet their feeding needs as easily as they can mature forests. Wetlands will be affected by the projects. Peatlands, however, which form the entirety of the environments affected, are not generally feeding sites of choice for bats, because open water is not always available there and the acidity of the environment is not favourable to producing large quantities of insects.

HOARY BAT

The hoary bat is also a migratory species found in Québec (MFFP, 2001b) and the largest bat species in Canada. It occupies one of the largest distribution areas, from the Atlantic to the Pacific coast, a part of Canada and extending south to the northern part of South America, including Bermuda and the Greater Antilles (MFFP, 2001b). Although the hoary bat is even found in spruce domains, it is rare in Québec. Acoustic monitoring carried out at the end of the 1990s revealed its presence in a few locations in Estrie, Montérégie, Outaouais, Abitibi-Témiscamingue, Mauricie, Nord-du-Québec, Saguenay-Lac-Saint-Jean, Bas-Saint-Laurent, Gaspésie (Charbonneau and coll., 2011; MFFP, 2001b) and the Capitale-Nationale region (Charbonneau and Tremblay, 2010). It usually lives in wooded and semi-wooded areas and mainly hunts moths over glades and bodies of water. In summer, it roosts in trees. In fall, it migrates south to the U.S. and the Caribbean to overwinter (MFFP, 2001b).

A forest-dwelling species, it goes out late in the night to hunt, rarely comes in contact with humans and is difficult to see. The threats faced by this species are not well documented. Loss of habitat due to a reduction in snag numbers could have a negative impact, as could human disturbance of its wintering habitat in caves and mines. Just as for the silver-haired bat, it may suffer the effects of the fight against forest insect pests (MFFP, 2001b). Loss of habitat, WNS and the development of wind energy are also threats that could affect hoary bat populations (Tremblay and Jutras, 2010).

EASTERN RED BAT

Like the previous species, the eastern red bat is a migratory species (MFFP, 2001c). It is found across North America, including southern Canada and as far as the southern part of Central America and Bermuda. In Québec, the eastern red bat is even found in spruce domains. In summer, it usually roosts during the day by hanging from a tree or bush branch. At night, it hunts insects such as fog-basking beetles, grasshoppers, moths and flies. In early September, eastern red bats migrate as a group to the southeastern United States and northeastern Mexico. It then hibernates in tree foliage, hollow trees containing old woodpecker holes or under loose bark. It returns to our latitude around the end of May, where the female gives birth to two or three pups between early June and July (Tremblay and Jutras, 2010).

Since it is a species that is rarely seen or identified, its population trend in Québec is not known (MFFP, 2001c). Data compiled since the mid-1990s has confirmed its presence in small numbers in all the administrative regions of Québec (Tremblay and Jutras, 2010). The fight against insect pests could have a negative impact on this bat, as can loss of habitat and the development of wind energy (MFFP, 2001c; Tremblay and Jutras, 2010).

6.3.7 REVIEW OF SPECIAL STATUS SPECIES

Based on the review of the territory, the search for species by geographic distribution and the survey data considered, there could be special status species in or around the local study area. This section looks at species with protected status whose presence has been confirmed or that have significant potential to use the territory. Special status species have been identified in the following faunal groups: land mammals, avifauna and bats.

A review of lists of special status species, from COSEWIC and from Schedule 1 of the Species at Risk Act, helped produce a list of species that are at risk or of special concern and that are present or potentially present in the study area. A review of this list resulted in the removal of the Canada warbler, because the study area is beyond its known range (AONQ, 2019). Likewise, the study area is outside of the known range of the tri-coloured bat, so it was also removed. In fact, according to the tri-coloured bat recovery strategy (Environment Canada, 2015), the project study area is located over 500 km to the north of the tri-coloured bat's known range. Other sources also set the northern boundary of the tri-coloured bat's range even further south (Tremblay and Jutras, 2010; Jutras and coll., 2012). Furthermore, the species was not recorded during the 2017 survey (see Section 6.3.6).

Table 6-56 presents the species selected and the likelihood of their presence in or around the reference study area.

Table 6-56 Status and current likelihood of presence of species that are at risk or of special concern in the study area

Species	SARA status	COSEWIC status	Potential presence based on range and habitat availability	Current likelihood of presence
Short-eared owl	Special Concern	Special Concern	Yes, but no individuals identified during survey campaigns	Low, given the current availability of their prey
Rusty blackbird	Special Concern	Special Concern	Yes	Confirmed
Canada warbler*	Threatened	Threatened	No	Nonexistent – beyond known range
Common nighthawk	Threatened	Special Concern	Yes	Confirmed
Olive-sided flycatcher	Threatened	Special Concern	Uncertain, but no individuals identified during survey campaigns	Low – at the boundary of known range
Sand martin	Threatened	Threatened	Yes, but no individuals identified during survey campaigns	High
Boreal caribou*	Threatened	Threatened	Possible	Low, given the current condition of their available habitat
Migratory caribou*	None	Endangered	Possible	Low, given the current condition of their available habitat
Wolverine*	Special Concern	Special Concern	Possible	Low, given the current availability of their prey
Tri-coloured bat*	Endangered	Endangered	No	Nonexistent – beyond known range
Little brown myotis	Endangered	Endangered	Yes	Confirmed presence of the <i>Myotis</i> genus
Northern myotis	Endangered	Endangered	Yes	Confirmed presence of the <i>Myotis</i> genus
* Species that are at risk or of special concern that were not selected as potentially present, given their known range or the current condition of their available habitat in the study area.				

Surveys conducted for this project covered all species on the list, as well as potential habitats for the species considered. Survey and habitat characterization efforts, particularly in the area directly affected by the project, seem adequate to assess the potential presence of these species.

These areas are presented in Table 6-57, as are the characteristics of the habitat of each species at risk or of special concern in the study areas. Maps 6-20C to 6-20G as well as 6-21 show the location of potential habitats as well as the listening stations for breeding birds and bats.

Table 6-57 Potential habitats of species at risk or of special concern and present or potentially present in the study area and surface areas located within the project footprint

Species	Habitat characteristics	Surface area within the study area (ha)
Short-eared owl	The short-eared owl uses a wide variety of open habitats, including arctic tundra, prairies, peatlands, marshes and former pastures. It also sometimes reproduces on farmland. Its preferred breeding sites are dense prairies, as well as tundra made up of areas of small willows. It is thought, however, that the main factor in its choice of local habitat, in both summer and winter, is the abundance of food.	3,387.46
Rusty blackbird ¹	The rusty blackbird nests in boreal forests where the species prefers the edges of wetlands, such as streams with low flow rates, peatlands, marshes, swamps and beaver ponds and the borders of pastureland. In wooded regions, the rusty blackbird is rarely found in the interior of the forest. In winter, the rusty blackbird mainly occupies wet woodlands and, to a lesser extent, farmed fields.	2,891.43
Common nighthawk ¹	The common nighthawk nests in a wide variety of open habitats on land without vegetation, such as dunes, beaches, recently logged forests, burned areas, deforested areas, rocky outcrops, bare rocky terrain, prairies, pastures, peatlands, marshes, lakeshores and riverbanks. The species is also present in coniferous forests with or without deciduous trees. Since European colonization of eastern Canada and the eastern U.S., the common nighthawk has likely benefitted from newly cleared habitats following large-scale deforestation. The appearance of gravel-covered roofs contributed to the expansion of the common nighthawk's territory in North America.	2,667.34
Olive-sided flycatcher	The olive-sided flycatcher is most often associated with open areas containing living trees or large standing dead trees that can be used as perches, with the species needs to look for food. This bird generally lies in wait for its prey, insects, on a high dominant perch from which it takes off to swallow them mid-flight, then come back to perch again. Open areas may consist of clearings in the middle of the forest, forest edges located near natural openings (such as rivers or swamps), or areas cleared by humans (such as a forest that was cut down), burned forest or openings inside old forest stands, as these forests are characterized by mature trees and large numbers of dead trees. It has been demonstrated that birds nesting in logged habitats have less reproductive success than those that nest in natural open areas. As a general rule, the habitat is either a coniferous forest or a mixed forest. In a boreal forest, the most favourable habitat is most likely to be located in or around wetlands. Although the area covered by old stands has clearly diminished over the 20 th century, it would seem at first glance that the surface area covered by the olive-sided flycatcher's habitat has remained more or less constant, since logging continues to create open areas that attract the birds. Recent studies indicate that these spaces are less favourable to reproduction.	3,310.56

Table 6-57 Potential habitats of species at risk or of special concern and present or potentially present in the study area and surface areas located within the project footprint (cont.)

Species	Habitat characteristics	Surface area within the study area (ha)
Sand martin	The sand martin reproduces in a wide variety of natural and man-made sites with vertical slopes, including the watercourse banks, cliffs along lacs and oceans, aggregate quarries, road cuts and soil embankments. It looks for substrate made up of a mix of sand and silt to dig its nesting burrows. Nesting sites tend to be short-lived as slopes change constantly due to erosion. They are often located near open land environments used for food in flight (e.g. prairies, fields, pastures and farmland). Vast wetlands serve as nighttime community roosting sites after reproduction and during migration and in winter.	9.27
Little brown myotis	The little brown myotis utilizes a diverse range of habitats depending on its diverse needs and the seasonal cycle. Hibernacula are essential habitats for the little brown myotis. These are generally subterranean openings (abandoned mines, caves, wells, tunnels, etc.) with adequate conditions (temperature between 2 and 10°C, over 80% humidity). For summer habitats, it uses rocky crevices, mature trees (mainly large trees just starting to decompose) and buildings to roost or form maternity colonies. When favourable sites are available, females tend to gather together and form maternity colonies. With regard to food, bats are highly mobile and can travel large distances every night to get to their feeding sites. These sites are in environments where there are high insect concentrations, such as ponds, swamps, bodies of water, mature forests. Bats are opportunistic, and change feeding sites as insects emerge. They can even feed by traveling among several different sites. They also have a diverse range of feeding habitats, based on the availability of prey.	943.59
Northern myotis	Like the little brown myotis, the northern myotis can use subterranean openings as hibernacula. For daytime roosts, maternity colonies and feeding sites, it seeks roughly the same environments as the little brown myotis, although it has a greater preference for forest environments as feeding sites.	943.59
1 Presence confirmed during surveys.		

Sources: Recovery strategies (MFFP), Status reports and recovery strategies for each species (ECCC)

Lastly, general knowledge about the residences, seasonal movement, travel corridors, habitat needs, critical habitats and life cycles, abundance and regional distribution of species at risk or of special concern that are likely to be found in the study area or affected by the project is largely described in the status reports and recovery strategies of the species in question. Table 6-58 summarizes the major points of what is known on each subject within the study area.

Table 6-58 Known information for species at risk and of special concern and present or potentially present in the study area with regard to their residence, life cycle, seasonal movement and travel corridors

Species	Residence	Seasonal movement	Travel corridors	Life cycle
Short-eared owl	Summer	Spring and fall migrations	Unknown locally	Likely local breeding
Rusty blackbird	Summer	Spring and fall migrations	Unknown locally	Presence confirmed and likely local breeding
Common nighthawk	Summer	Spring and fall migrations	Unknown locally	Presence confirmed and likely local breeding
Olive-sided flycatcher	Summer	Spring and fall migrations	Unknown locally	Possible local breeding
Sand martin	Summer	Spring and fall migrations	Unknown locally	Possible local breeding
Little brown myotis	Summer ¹	Spring and fall migrations	Unknown locally and not detected during surveys	Presence of Myotis genus confirmed locally
Northern myotis	Summer	Spring and fall migrations	Unknown locally and not detected during surveys	Presence of Myotis genus confirmed locally

Sources: Recovery strategies (MFFP), Status reports and recovery strategies for each species (ECCC)¹¹

6.4 HUMAN ENVIRONMENT

6.4.1 STUDY AREA

The human environment study area aims to generate a relevant record of the current and future activities of the Cree First Nations members affected by the project and of other territory users. The study area for this specific project comprises the easternmost part of the RE2 trapline (Map 6-22) and is demarcated to the north and east by the boundaries of the RE2 trapline (Map 6-22). To the south, it includes a zone around Amiskw Matawaw Lake that is used by the tallyman's family. And lastly, its western boundary is a little more than 13 kilometres from the project site. **The southwest boundary of the human environment study area is adjacent to the northeast boundary of the RE3 trapline. The human environment study area includes the local study area used to assess the project's impact on most of the components of the physical and biological environment.**

This study area, given the type of activities planned during the mine development phase, will make it possible to adequately evaluate the project's potential impact on the territory users' present or planned activities.

The Cree territory users who participated in the 2017–2018 consultation sessions were questioned with regard to the boundaries of the human environment study area. The RE2 trapline tallyman's family explained that they could not respond to such a query, for they were unaware of the project's impacts at the time of the consultations **in 2017-2018.**

¹¹ <https://mffp.gouv.qc.ca/la-faune/especes/especes-menacees-vulnerables/retablissement/>
<https://www.canada.ca/fr/environnement-changement-climatique/services/registre-public-especes-peril.html#summary-details3>
https://wildlife-species.canada.ca/registre-especes-peril/sar/assessment/status_f.cfm

Some users of the territory comprising the two adjacent traplines (VC33 and VC35) mentioned that they would have preferred a larger study area including the northern bank of the Eastmain River, which is where their families practise traditional activities. **Although the Eastmain River is not an environmental component likely to be affected by the project activities, the portion of the northern bank of the Eastman River was considered because of the concerns raised by the tallymen adjacent to the study area (VC33 and VC35) since their families practise traditional activities in this location.**

Furthermore, although the RE1 trapline tallyman participated in the meetings GLCI set up since 2012, this land has not been part of the current study zone since the initial study zone was modified in 2012. The project activities will not have any impact on the RE1 trapline.

Regarding the landscape, the human environment study area takes into account a radius of 7 to 15 kilometres around the project site. Studying the landscape over this particular area allows for understanding the structure of the landscape and defining its units.

A specific study area was used to assess the archaeological potential. The boundaries of this area, which covers a total of 56.6 km², are shown on Map 6-22.

6.4.2 OVERALL CONTEXT

The study area is in the Nord-du-Québec administrative region, a region that includes cities, Northern villages, Cree villages and Indigenous land. The region's territories are subject to distinct administrative management procedures depending on whether they are located north of the 55th parallel (the Kativik Regional Government territory) or south of it (EIJBRG) (Gouvernement du Québec, **2021a**). The study area is in the EIJBGR territory and more specifically on the Eastmain Cree community's territory (Map 1-1).

Established in 2014, the EIJBGR is Québec's only regional government. In addition to the nine Nord-du-Québec Cree communities, it also includes the four James Bay communities of Chibougamau, Chapais, Lebel-sur-Quévillon and Matagami, along with the three James Bay localities of Valcanton, Radisson and Villebois (GREIBJ, **2021**). Of all these geographical entities, which were part of the Municipality of Baie-James prior to the establishment of the EIJBGR, the two villages closest to the study area are Matagami (278 km) and Chapais (313 km) (insert of Map 1- 1).

The two closest Cree villages to the study area are Eastmain and Nemaska, which are respectively 100 kilometres and 82.5 kilometres away (Map 1-1). Each community is administered by a band council and the communities as a whole are governed by the Grand Council of the Crees (GCC). Each community has its own representatives from various regional or governmental bodies, among them the Cree Nation Government (CNG), the Cree Trappers' Association, the Cree Nation Youth Council and the Cree Hunters and Trappers Income Security Board.

In 2016, the village of Eastmain comprised 200 occupied private lodgings (Statistics Canada, 2017). The village also includes the council's administrative building, a courthouse (Photo 6-5), a fire station, a police station, a medical clinic run by the Cree Board of Health and Social Services of James Bay (CBHSSJB) (Photo 6-6), a wellness centre, a first responder station (Photo 6-7), the Cree Trappers' Association's regional office (Photo 6-8), a school belonging to the Cree School Board (*Wabannutao*), a daycare centre, a community centre (the *Multi-Services Day Center*), a sports centre with a skating rink, a gas station with a mechanic's shop, a hotel and restaurant (Photo 6-9), a bank, a post office, a community radio station, an airport and a general and grocery store (*Northern*). The village also has water and septic services.



Photo 6-5 Eastmain courthouse



Photo 6-6 Cree Board of Health and Social Services of James Bay



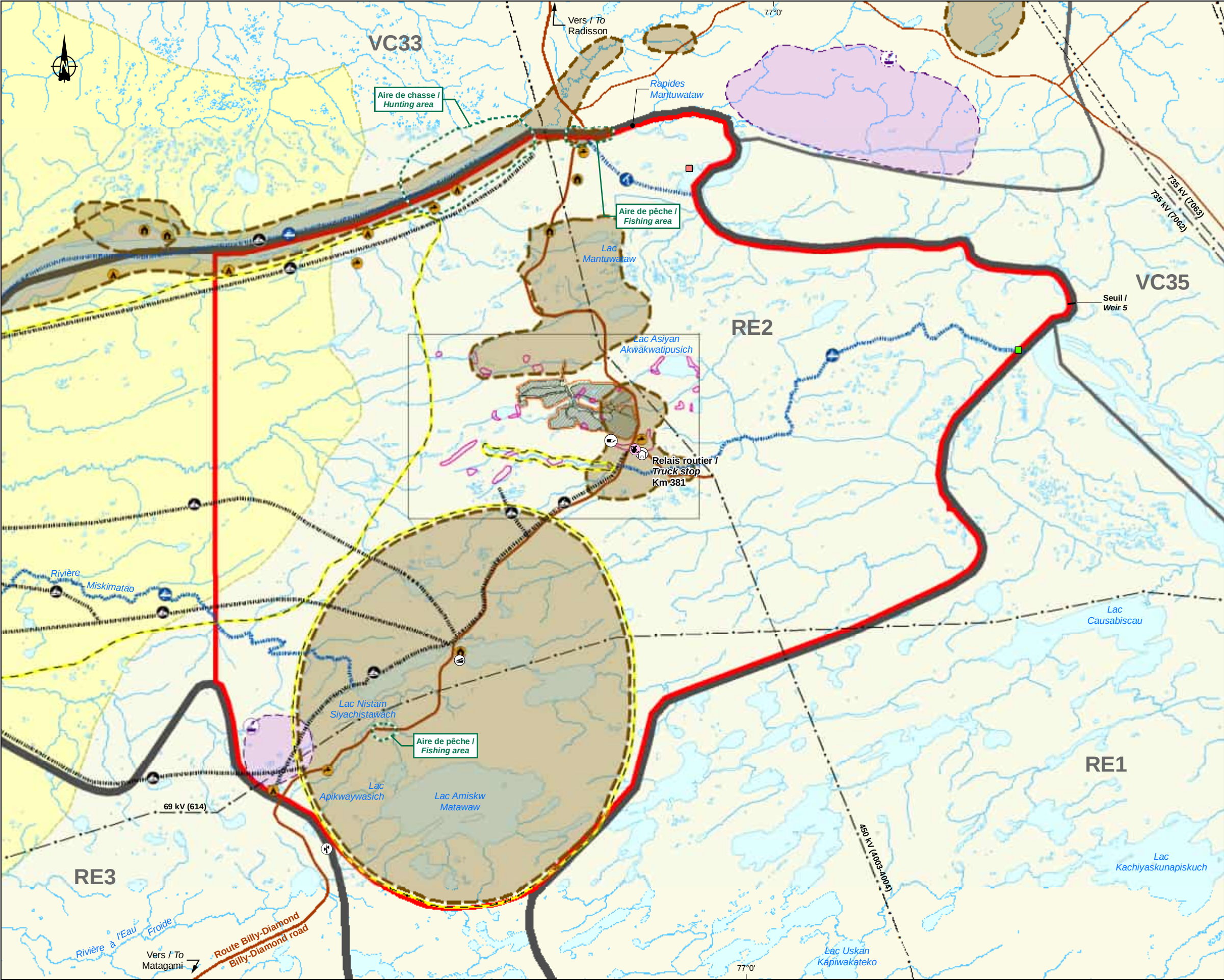
Photo 6-7 First responder station



Photo 6-8 Cree Trappers' Association regional office



Photo 6-9 **Eneyaauhkaat Lodge**



Infrastructures minières / Mining infrastructure

Superficie de déboisement / Clearing area

Périmètre d'exclusion des activités traditionnelles / Perimeter of exclusion from traditional activities

Infrastructures / Infrastructure

Route principale / Main road

Route d'accès / Access road

Ligne de transport d'énergie / Transmission line

Relais routier / Truck stop

Tour de télécommunication / Telecommunication tower

Lieu d'enfouissement en territoire isolé (LETI) / Remote landfill

Rampe de mise à l'eau / Boat ramp

Utilisation du territoire par les Cris / Cree Land Use

Campement permanent cri / Cree permanent camp

Campement temporaire cri / Cree temporary camp

Source d'eau potable / Drinking water source

Aire de chasse, de trappage ou de pêche / Hunting, trapping or fishing area

Aire de cueillette / Berry picking

Sentier de motoneige / Snowmobile trail

Parcours de navigation / Navigation route

Portage / Portage

Aire valorisée / Valued area

Utilisation du territoire par les allochtones / Non-Natives Land Use

Aire d'activité / Activity area

Baux de villégiature / Recreational Lease

Fins de villégiature / Recreational use

Fins d'abri sommaire en forêt / Rough forest shelter

Archéologie / Archaeology

Site archéologique / Archaeological site

Zone de potentiel archéologique / Archaeological potential area

Limites / Limits

Zone d'étude du milieu humain / Social environment study area

Zone d'étude du potentiel archéologique / Archaeological potential study area

Terre de catégorie II / Category II land

RE2 Terrain de trappage / Trapline

GALAXY

Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 6-22

Composantes du milieu humain / Social Environment Components

Sources :
Canvec, 1 : 50 000, RNCan, 2015
BDCA, 1 : 1 000 000, RNCan, 2011
Terres de catégorie / Category land : Carto-Média, 2001
Donnée du projet / Project data : Galaxy, 2021
Inventaire / Inventory : WSP, 2018

0 1,25 2,5 km
UTM, fuseau 18, NAD83

Juillet / July 2021

Dessin : A. Masson
Approbation : K. Neumann
201-12362-00_c6-22_wspT303_comp_MH_210701.mxd

WSP

6.4.3 TERRITORY PLANNING AND DEVELOPMENT

Nearly all of the human environment study area considered for the purposes of this project is found on Category III lands, and a northwest portion of this area cuts into Category II lands (Map 6-22). Management and development of the resources on the territory's Category II and Category III lands is jointly ensured by three primary authorities: the CNG, the EIJBRG and the MERN.

The EIJBRG is also able to declare its authority as a Regional County Municipality (RCM).

Various development agencies are also involved in regional planning, among them the Cree Regional Authority (James Bay) and the SDBJ.

6.4.3.1 CREE NATION GOVERNMENT AND GRAND COUNCIL OF THE CREES (EEYOU ISTCHEE)

In January 2014, by virtue of *An Act respecting the Cree National Government* (R.S.Q., c. G-1.031, previously the *Act Respecting the Cree Regional Authority*, c. A-6.1), the **Cree Regional Authority** became known as the Cree Nation Government. This authority can exert municipal competence (local or regional county) over some or all Category II lands. The Eeyou Planning Commission (EPC) has been mandated with preparing a regional plan for the use of Category II lands and resources (Secrétariat aux affaires autochtones, 2016). The CNG represents the Crees as required under the JBNQA in areas such as the environment, the hunting, fishing and trapping regime, and economic and community development (GCC, **2021a** and Hydro-Québec, 2004). The CNG's headquarters are in Nemaska.

The mandate of the **Grand Council of the Crees (GCC)** is two-fold, consisting of defending the interests of the Québec Cree Nation at the provincial, national and international levels, and of overseeing the implementation of the JBNQA (of which it is a signatory). The GCC's Board of Directors is made up of a chairman and vice-chairman, elected by popular vote, as well as the chiefs of each of the nine Cree communities, and one other representative from each community. Washaw Sibi, the members of which had yet to form a Cree community, was named as the 10th Cree nation by the General Assembly of the Grand Council of the Crees; although their chief and an elected representative have a voice at the Grand Council, the community's status is not officially recognized by the government (GCC, **2021a**).

The CNG and GCC are two separate legal entities, but they have a similar composition and are managed as a single organization by the Cree Nation (GCC, **2021a**).

6.4.3.2 EEYOU ISTCHEE JAMES BAY REGIONAL GOVERNMENT

The EIJBRG adopted the urban planning regulations that had come into force under the prior Municipality of Baie-James. These regulations notably earmarked the various uses of the different parts of the Category III lands. The territory being studied straddles zones 52-02-R and 52-03-C of zoning regulation no. **213**¹² (EIJBRG, **2020**). More specifically, the planned mining infrastructure is in zone 52-03-C, where the main businesses are vehicle sales and services, accommodations and food services. Other types of uses are also authorized in this sector: resource development, industrial activities (trade, services and industries with a moderate impact, public utility equipment), leisure/recreation (parks and green spaces; intensive and extensive use) and public/institutional uses. Mining activities are thus permitted.

Regarding zone 52-02-R, the primary activity is resource development. Other authorized uses include vacation spots (scattered), industrial activities (public utility equipment), leisure/recreation (parks and green spaces; intensive and extensive use; hunting and fishing camps), public and institutional uses and conservation activities.

12 The adoption of zoning regulation no. 213 on December 14, 2020 replaced zoning regulation no. 79.

6.4.3.3 MINISTÈRE DE L'ÉNERGIE ET DES RESSOURCES NATURELLES

The MERN has the goal of managing and ensuring the sustainable development of Québec's energy and mineral resources as well as its overall territory (**Gouvernement du Québec, 2021b**). It is involved in the territory's development and resource management for this very purpose. Public land use plans (PLUPs) and the Regional Plan for Public Land are the MERN's two primary tools for the management and development of public land.

Determining the best use of the public land involves establishing the government's main orientations in terms of public land protection and development. The Regional Plan for Public Land, in turn, seeks to identify, in conjunction with regional stakeholders, principles and conditions for ensuring a harmonious use of public land.

According to the MERN, there are currently no PLUPs or Regional Plans for Public Land in force for the Nord-du-Québec region.

6.4.3.4 ADMINISTRATION RÉGIONALE BAIE JAMES

The CRE (Conférence régionale des élus de la Baie-James) was the Gouvernement du Québec's main contact for regional development matters. At present, in the Nord-du-Québec administrative region, the tasks of a CRE (regional council of elected representatives) are split between the Administration Régionale Baie James (ARBJ), the CNG, the EIJBRC and the Kativik Regional Government. The ARBJ notably has the mandate of promoting cooperation among the regional partners. The following people sit on its Board of Directors: the mayors of Chapais, Chibougamau, Lebel-sur-Quévillon and Matagami, four members from the municipal councils of each of these cities (chosen by their respective councils), and the heads of the local councils of the villages of Radisson, Valcanton and Villebois (ARBJ, **2021**).

The five-year James Bay development plan (*Plan quinquennal jamésien de développement 2015-2020*) (ARBJ, 2015) recommends nine orientations, 20 action items and 20 development. The objectives notably include financial support for innovative and feasible projects that involve rare earths. Other objectives involve (to varying degrees) the James Bay Lithium Mine project:

- reducing the percentage of workers in the natural resources sector who are obliged to commute;
- increasing the number of companies with a policy promoting the hiring of James Bay workers;
- increasing the number of new training programs adapted to the employment sector;
- increasing the number of women following study programs in non-traditional occupations;
- implementing measures to facilitate the transportation of merchandise within the Nord-du-Québec region;
- increasing the number of active entrepreneurs in the James Bay territory.

The ARBJ has entered into framework agreements and special agreements with the Gouvernement du Québec regarding the key principles of the regional development strategy. One such special agreement concerns the Table jamésienne de concertation manière (TJCM).. This body's mission revolves around supporting and upholding the mining industry's sustainable development in the James Bay territory while also promoting significant socioeconomic spin-offs for territory residents (**TCJM, 2021**).

6.4.3.5 SOCIÉTÉ DE DÉVELOPPEMENT DE LA BAIE-JAMES

Created by the *Gouvernement du Québec* in 1971, the SDBJ has the mission of promoting the sustainable economic development, natural resource development and long-term development of natural resources other than the hydroelectric resources managed by Hydro-Québec on the James Bay territory (SDBJ, 2017).

The SDBJ is active in two major sectors, namely economic development and services. Its economic development role mainly consists of identifying, attracting and supporting business projects through a special investment fund. Its activities in the services sector focus on managing transportation infrastructure on behalf of Hydro-Québec and the *Ministère des Transports du Québec (MTQ)*. Over time, the SDBJ's expertise and regional presence have resulted in its being awarded mandates for the management of over 50% of the regional road network, an airport and two airfields (SDBJ, 2017). The SDBJ is notably responsible for maintenance of the Billy-Diamond highway, which crosses the study area, and administration of the km 381 truck stop, located east of the mining project.

6.4.4 REGIONAL AND LOCAL ECONOMY AND POPULATION

This section addresses the socioeconomic situation of the EIJB territory compared to the Nord-du-Québec region and the province as a whole. For each theme, data is first provided for the Cree communities, then for the EIJB communities.

6.4.4.1 POPULATION

CREE COMMUNITIES

In 2016, the nine Cree communities comprising the Eeyou Istchee James Bay (EIJB) territory represented were home to 17,141 residents, compared to 12,629 in 2001 (Table 6-59). In 2016, in fact, the Cree represented over one third (38.5%) of the population of the Nord-du-Québec region. Eastmain, the Cree community affected by this project, consisted of 866 people in 2016, which placed it in seventh position (from a demographic standpoint) among the Cree communities on the EIJB territory. The percentage change in the community's population between 2001 and 2016 was 41.3%, which is higher than that of other Cree communities on the EIJB territory.

Table 6-59 Population of Cree communities, Nord-du-Québec and Québec – 2001, 2006, 2011 and 2016

Territory	Population (individuals)				Variation 2001–2016 (%)
	2001	2006	2011	2016	
Chisasibi	3,467	3,972	4,484	4,872	40.5
Eastmain	613	650	767	866	41.3
Mistissini	2,597	2,897	3,427	3,523	35.7
Nemaska	566	642	712	760	34.3
Oujé-Bougoumou	553	606	725	737	33.3
Waskaganish	1,699	1,864	2,206	2,196	29.3
Waswanipi	1,261	1,473	1,777	1,759	39.5
Wemindji	1,095	1,215	1,378	1,444	31.9
Whapmagoostui	778	812	874	984	26.5
Cree communities*	12,629	14,131	16,350	17,141	35.7
Nord-du-Québec	38,757	39,817	42,579	44,561	15.0
Québec	7,237,479	7,546,131	7,903,001	8,164,361	12.8
* Population living in Cree communities (Indigenous and non-Indigenous).					

Sources: Statistics Canada (2007, 2012 and 2017).

It should be noted that the population residing in EIJB Cree communities is also very young (Table 6-60). In 2016, close to one third (31.4%) of the Cree population was aged 14 and under (Figure 6-6). This proportion was close to twice that recorded in Québec (16.3%), and stood at 27.5% for Nord-du-Québec, also a high figure. In the Eastmain Cree community, this age group (0–14) had a proportion of 34.1%, higher than the average of the population aged under 15 in the EIJB territory. Conversely, in the same period, the 65-and-over age group was less well represented in the EIJB (5.5%) and Nord-du-Québec (7.7%) communities than in the whole of Québec (18.3%).

For the **2019-2020** year, inter-regional net migration in EIJB was almost nil, standing at -0.31%, representing the loss of **54** persons. During this period, these persons moved mainly to the **Laval, Montérégie** and Centre-du-Québec regions (ISQ, **2021a**).

According to the Institut de la statistique du Québec (ISQ), the population of Cree communities should continue its demographic growth over the coming years. Between **2016 and 2041**, it should increase by **30.5%** to reach a total of **22,600** persons. In comparison, the population of Nord-du-Québec and Québec should increase respectively by **16.6%** and **13.7%** over the same period (ISQ, **2019a**). In regard to households, between **2016 and 2041**, their number should increase by close to **60%** in Cree communities, compared with **26%** for Nord-du-Québec and **15.6%** for Québec (ISQ, **2019b**).

Table 6-60 Age-group distribution of the population in Cree communities, Nord-du-Québec and Québec – 2016

Territory	Population by age group									
	0–14		15–54		55–64		65 and over		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
Cree communities	5,385	31.4	9,670	56.4	1,175	6.9	940	5.5	17,170	100
Nord-du-Québec	12,270	27.5	24,520	55.0	4,325	9.7	3,445	7.7	44,560	100
Québec	1,333,260	16.3	4,136,760	50.7	1,199,145	14.7	1,495,195	18.3	8,164,360	100
Note:	All data in this table has been subjected to random rounding to a multiple of 5 by Statistics Canada. Since totals were rounded separately, they do not necessarily match the sum of the rounded figures.									

Source: Statistics Canada, 2017.1

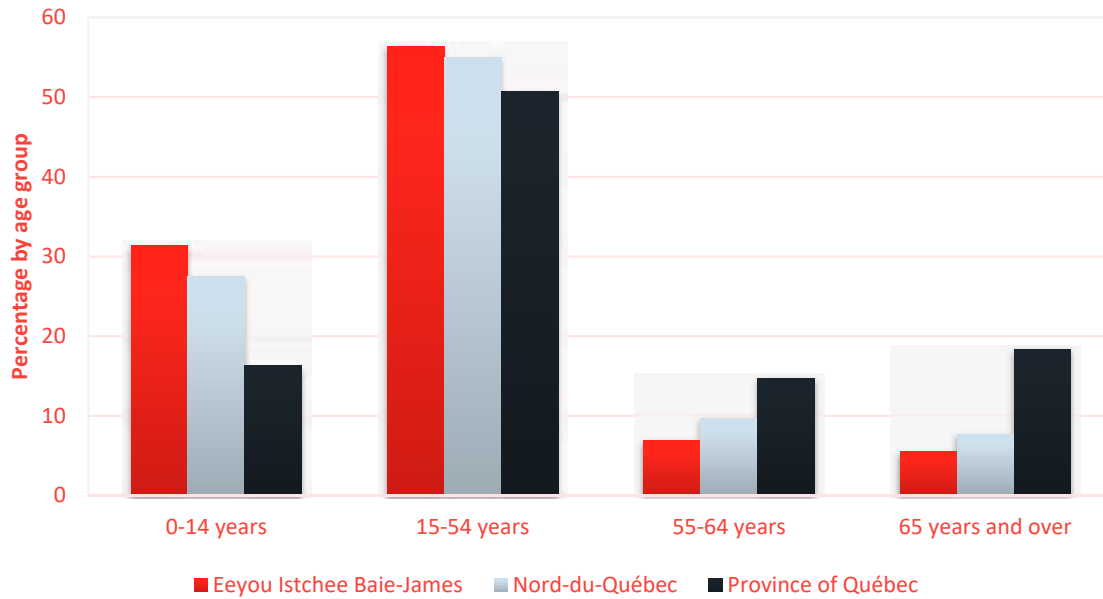


Figure 6-6 Population distribution by major age groups in Cree communities, Nord-du-Québec and Québec – 2016

Source: Statistics Canada, 2017.

JAMES BAY COMMUNITIES

In 2016, the population of James Bay communities was 14,232 persons. Chibougamau was the largest population centre with 7,504 persons, and Lebel-sur-Quévillon, with a population of 2,187, was in second place (Table 6-61). Unlike that of Cree communities, the population of James Bay communities is shrinking. Between 2001 and 2016, James Bay communities lost 12.8% of their population.

Table 6-61 Population of James Bay communities, Nord-du-Québec and Québec – 2001, 2006, 2011 and 2016

Territory	Population (individuals)				Variation (%) 2001–2016
	2001	2006	2011	2016	
Chapais	1,795	1,630	1,610	1,499	-16.5
Chibougamau	7,922	7,563	7,541	7,504	-5.3
Lebel-sur-Quévillon	3,236	2,729	2,159	2,187	-32.4
Matagami	1,939	1,555	1,526	1,453	-25.1
Villages	1,422	1,394	1,303	1,589	11.7
James Bay communities	16,314	14,871	14,139	14,232	-12.8
Nord-du-Québec	38,757	39,817	42,579	44,561	15.0
Québec	7,237,479	7,546,131	7,903,001	8,164,361	12.8

Sources: Statistics Canada 2007, 2012 and 2017.

A reading of the population data from the 2016 census shows that the James Bay population has an age-group distribution similar to that of Québec, although it has a smaller proportion of persons aged 65 and over, and slightly higher proportions of the three other age groups (Table 6-62). The James Bay population differs, however, from that of Nord-du-Québec, since the latter is influenced by the high level of young people among the Cree population. Also, the average age of the James Bay population in **2019** was **41.1** years, compared with **32.8** for the Nord-du-Québec region and **42.4** for Québec (ISQ, **2021b** and **2021c**).

Table 6-62 Age-group distribution of the population of James Bay communities, Nord-du-Québec and Québec – 2016

Territory	Population by age group									
	0–14		15–54		55–64		65 and over		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
James Bay communities	2,470	17.4	7,460	52.4	2,280	16.0	2,020	14.2	14,230	100
Nord-du-Québec	12,270	27.5	24,520	55.0	4,325	9.7	3,445	7.7	44,560	100
Québec	1,333,260	16.3	4,136,760	50.7	1,199,145	14.7	1,495,195	18.3	8,164,360	100
Note:	All data in this table have been subjected to random rounding to a multiple of 5 by Statistics Canada. Since totals were rounded separately, they do not necessarily match the sum of the rounded figures. In addition, because of rounding, totals do not always equal 100%.									

Sources: Statistics Canada (2017)

Regarding migration, inter-regional net migration involving the James Bay population shows a loss of **224** persons for the years **2019–2020**. Most of these people went to the **Montréal or Côte-Nord regions, or elsewhere in the Nord-du-Québec region (but not in the James Bay area)** (ISQ, **2021a**).

According to the ISQ, the demographic decline of the James Bay population should continue between **2016 and 2041**. By **2041**, the James Bay population should have declined by **9.0%** since **2016**, to number **12,800** people. In contrast, the population of Nord-du-Québec and Québec should increase by **16.6%** and **13.6%** respectively between **2016 and 2041** (ISQ, **2019a**). The number of James Bay households should diminish by **6.6%** between **2016 and 2041** (ISQ, **2019b**).

6.4.4.2 EDUCATION LEVELS

CREE COMMUNITIES

In 2011, there were 4,810 Cree aged 15 and over who held at least one secondary-education diploma, amounting to 44.2% of the population of Cree communities, as against 77.8% in Québec (Table 6-63). In 2016, the number had risen to 5,715 Cree, or 48.7% of the population, compared with 80.1% for Québec. Thus, although the graduation rate increased by 4.5 percentage points between 2011 and 2016, the education level of the Cree population remains distinctly lower than the level for Québec.

Moreover, Cree student participation in postsecondary studies is low. Among other things, this translates into a 2016 university degree rate (all cycles taken together) that is lower in Cree communities (8.8%) than in the population of Québec (24.1%). However, the number of university graduates rose from 880 in 2011 to 1,030 in 2016. The greatest increase since 2011 has been seen in college studies, where the variation rate is 26.3%, followed by vocational training with a rate of 19.5%.

According to the JBCSB, in **2017-2018**, there were **511** students enrolled in postsecondary education. **Of this number, 379** were studying at a general and vocational college (CEGEP), **119** at a university and **13** at another training centre. (JBCSB, **2020**).

Table 6-63 Highest level of education attained by the population aged 15 and over in Cree communities and in Québec – 2011 and 2016

Level of education	2011			2016			Variation 2011-2016	
	Cree communities		Québec	Cree communities		Québec	Cree communities	Québec
	Number	%	%	Number	%	%	%	%
No high-school diploma	6,080	55.8	22.2	6,015	51.3	19.9	-1.1	-7.9
High-school diploma or some postsecondary studies	1,200	11.0	21.7	1,340	11.4	21.5	11.7	1.6
Diploma or certificate from a trade school (vocational training)	1,515	13.9	16.2	1,810	15.4	16.9	19.5	6.8
Collegiate diploma or certificate or some university studies	1,215	11.2	16.6	1,535	13.1	17.6	26.3	8.3
University diploma, certificate or degree	880	8.1	23.3	1,030	8.8	24.1	17.0	5.9
Total	10,890	100	100	11,730	100	100	-	-
Note: All data in this table has been subjected to random rounding to a multiple of 5 by Statistics Canada. Since totals were rounded separately, they do not necessarily match the sum of the rounded figures. In addition, because of rounding, totals do not always equal 100%.								

Sources: Statistics Canada (2012 and 2017).

JAMES BAY COMMUNITIES

In 2016, the level of education was lower in James Bay communities than in the rest of Québec. In total, 73% of residents aged 15 and over had at least one secondary-level diploma, compared with 80.1% for Québec. The discrepancy is greater at the university level. Only 1,360 James Bay residents (12.1%) had a university education (all cycles taken together), that is, about half the proportion in the Québec population (24.1%). However, it should be noted that graduation rates have been increasing since 2011 (Table 6-64). Among James Bay graduates, most hold a vocational diploma, both in 2011 (23.5%) and in 2016 (26.9%).

Table 6-64 Highest level of education attained by the population aged 15 and over in James Bay communities and in Québec – 2011 and 2016

Level of education	2011			2016			Variation 2011–2016	
	James Bay communities		Québec	James Bay communities		Québec	James Bay communities	Québec
	Number	%	%	Number	%	%	%	%
Without high-school diploma	3,220	31.6	22.2	3,025	27.0	19.9	-6.1	-7.9
High-school diploma or some postsecondary studies	1,775	17.4	21.7	1,995	17.8	21.5	12.4	1.6
Diploma or certificate from a trade school (vocational training)	2,395	23.5	16.2	3,015	26.9	16.9	25.9	6.8
Collegiate diploma or certificate or some university studies	1,530	15.0	16.6	1,805	16.1	17.6	18.0	8.3
University diploma, certificate or degree	1,255	12.3	23.3	1,360	12.1	24.1	8.4	5.9
Total	10,175	100	100	11,195	100	100	-	-
Notes: 2011 data does not include the population of Matagami aged 15 and over. Data from the National Household Survey was removed for reasons of data quality or confidentiality. All data in this table has been subjected to random rounding to a multiple of 5 by Statistics Canada. Since totals were rounded separately, they do not necessarily match the sum of the rounded figures. In addition, because of rounding, totals do not always equal 100%.								

Sources: Statistics Canada (2012 and 2017).

Regarding high-school graduation among James Bay residents, available data **for the Commission scolaire de Baie-James** shows that in **2018** the rate stood at **63.9%** after five years of schooling. **The rate after seven years was not available for 2018 (MEES, 2019).**

The *Centre de formation professionnelle de la Baie-James* (CFPBJ), in Chibougamau, has two other points of service, one at Lebel-sur-Quévillon and the other at Matagami. It offers a set of study programs in a number of sectors, particularly in the mining sector. Programs offered are determined in collaboration with the *Commission de la Construction du Québec*, the *Agence de santé régionale or Emploi-Québec* in order to ensure that they meet the region's needs for labour. CFPBJ programs of interest to the mining industry are the following: Diamond Drilling, Drilling and Blasting, Mining, and Mining Machinery Operations programs (CFPBJ, 2021). The CFPBJ also works in concert with mining companies to adapt its training programs to their situation and needs. Thanks to this collaboration, field training periods are organized on partner mining sites, enabling students to learn in their future working environment (Sonia Caron, CFBJ, telephone interview, February 2018).

6.4.4.3 INCOME

CREE COMMUNITIES

Disposable Income Per Capita

In **2017**, disposable income per capita in Cree communities was **\$27,582**, which is **\$5,208** more than the figure in **2013** (Table 6-65). Although the income levels are lower than what is seen regionally and provincially, the increase between **2013 and 2017** was greater for the Cree than for the Nord-du-Québec region (**\$3,913**) and for Québec as a whole (**\$3,052**) (ISQ, **2020a**). Per capita disposable income consists of employment income and government transfers, such as Employment Insurance, Old Age Security, Social Assistance and Québec Pension Plan benefits, minus taxes and other contributions.

The proportion of per capita income from government transfers for the Cree in **2017** was higher than that of Nord-du-Québec and Québec as a whole (ISQ, **2020a**).

Income of Employees Aged 25 to 64

In **2017**, median employment income for workers from 25 to 64 years old in Cree communities was **\$41,184** (Table 6-65). Since **2013**, income for this group of workers has increased to **\$37,710** for a **9.2%** rise. By comparison, income for employees between 25 and 64 years old in Québec was **\$41,058** in **2017** (ISQ, **2021d**).

Median Family Income

Median after-tax income of couple-families in Cree communities increased from **\$81,979** in **2013** to **\$88,620** in **2017**, an increase of **8.1%** in four years (Table 6-56). The increase is **roughly the same** as that observed in Nord-du-Québec (**8.3%**) and higher than Québec as a whole (**7.4%**). In **2017**, the median income of Cree families was higher than the level in Nord-du-Québec (**\$87,380**) (ISQ, **2020b**).

Table 6-65 Disposable income per capita, income of workers from 25 to 64 (and couple-family median income in Cree communities, Nord-du-Québec and Québec – 2013-2017

Territory	Income (\$)					
	Disposable per capita		Employees from 25 to 64 years old		Median for couple-families	
	2013	2017	2013	2017	2013	2017
Cree communities	22,374	27,582	37,710	41,184	81,979	88,620
Nord-du-Québec	23,452	27,365	37,533	41,469	80,655	87,380
Québec	25,968	29,020	37,793	41,058	70,009	75,210

Sources: ISQ (**2021d**, **2020a**, **2020b**, **2019**)

The Income Security Program for Cree Hunters and Trappers

In 1976, the JBNQA established the Cree Hunters and Trappers Income Security Program (ISP) to encourage the Cree, by providing income support, to continue their traditional hunting, fishing and trapping activities. For the **2017–2018** period, the participation rate across the entire EIJB territory was **13.4%**, **compared to 13.9% in 2016–2017 and 15.2% in 2015–2016**. The rate is also lower than the 2009–2010 rate of 14.9%. In Eastmain, the percentage of ISP participants was **8%**, **representing a second year in a row of decreasing rates**. There were **68** people (**52** adults and **16** children, equal to **39** family units) from Eastmain enrolled in ISP in **2017–2018**. Note that ISP provided average incomes of nearly \$17,000 per claimant (i.e., family unit) in 2016–17 (OSRCPC, 2010 and **2019**).

JAMES BAY COMMUNITIES

Disposable Income Per Capita

Per capita disposable income in James Bay communities was **\$31,921** in **2017**, up **\$3,385** from **2013** (Table 6-66) (ISQ, **2020a**). This income is higher than Québec as a whole (**\$29,020**) and the Nord-du-Québec region (**\$27,365**) (ISQ, **2020a**).

Income of Employees Aged 25 to 64

In **2017**, the median employment income of James Bay workers from 25 to 64 years old was **\$51,657**. The income for this group of workers is increasing, with a growth rate of **11.6%** for the period **2013–2017**. **For the same period**, the Québec population's median employment income increased by **8.6%**, from **\$37,793** to **\$41,058** (ISQ, **2021d**).

Median Family Income

A James Bay couple-family's median after-tax income increased from **\$80,686** in **2013** to **\$86,540** in **2017**, an increase of **7.3%** in four years. This increase is lower than that in Nord-du-Québec (**8.3%**), but **equivalent** to the provincial rate (**7.4%**). A James Bay couple-family median after-tax income is **roughly the same (\$80,686 in 2013)** as the region's for the same period (**\$80,655**) **but was lower in 2017 given the regional income of \$87,380 (ISQ, 2020b)**.

Table 6-66 Disposable income per capita, income of workers from 25 to 64 and couple-family median income in the James Bay communities, Nord-du-Québec and Québec (2013–2017)

Territory	Income (\$)					
	Disposable per capita		Employees from 25 to 64 years old		Median for couple-families	
	2013	2017	2013	2017	2013	2017
James Bay communities	28,536	31,921	46,302	51,657	80,686	86,540
Nord-du-Québec	23,452	27,365	37,533	41,469	80,655	87,380
Québec	25,968	29,020	37,793	41,058	70,009	75,210

Sources: ISQ (2021d, 2020a, 2020b, 2019)

6.4.4.4 LABOUR MARKET

From 2012 to **2020**, the participation rate¹³ for the Côte-Nord–Nord-du-Québec region increased from **60.8%** to **63.0%** while the employment rate¹⁴ gained **almost** two percentage points, ranging from 56.4% to 58.1%. The unemployment rate¹⁵ dropped from 2015 to 2016, from 9.8% to 8.7%, after an increase in 2014–2015. **For the 2017–2019 period, the unemployment rate dropped from 5.8% to 4.8%, but rose back up to 7.6% in 2020. The 2020 rate is comparable to the rate of 7.7% observed in 2012 (ISQ, 2021e).**

CREE COMMUNITIES

The Cree labour force, 15 years old and over, reached 7,665 people for all Cree communities in 2016. The participation rate for all Cree communities was 67.7% with almost identical rates for men (68.5%) and women (67.0%). The participation rate was 73.0% for Eastmain (420 working people). Participation rates of men and women for Eastmain in 2016 differed by 1.1 percentage points (72.2% for men and 73.3% for women).

Of the working population, the employed represented 6,445 people for all communities (employment rate 57.8%), including 385 in Eastmain. According to Statistics Canada, the number of employed women was generally higher than men.

In 2016, there were 1,225 unemployed people in all Cree communities, with an unemployment rate of 15.0%. More men than women were unemployed (785 versus 425). In Eastmain, the number of unemployed was 40, with an unemployment rate of 9.5% (Statistics Canada, 2017).

¹³ The participation rate is the working population as a percentage of the total population 15 years old and over.

¹⁴ The employment rate (also called the employment-population ratio) reflects the number of people working relative to the population 15 years old and over.

¹⁵ The unemployment rate represents the number of unemployed in relation to the working population.

JAMES BAY COMMUNITIES

In 2016, the unemployment rate for the entire James Bay communities population was 9.0%, higher than Québec (7.2%) (Statistics Canada, 2017). The rate is higher for men (10.1%) than for women (6.9%). The situation is partly due to problems in the forestry industry, a sector employing mainly men. However, participation and employment rates, 66.7% and 61.0% respectively, were higher than those in the rest of Québec (60.5% and 56.7%). According to ISQ data, in **2018**, the James Bay population included **6,150** workers from 25 to 64 years old (ISQ, **2021f**).

In the **last** half of **2017**, among the **51** occupations in demand in the Nord-du-Québec region, six were associated with the mining sector: underground production and development miners, mining and quarrying supervisors, work site and industrial mechanics, **mine** technicians, mining engineers and geologists (Emploi-Québec, 2017).

6.4.4.5 STRUCTURE OF THE ECONOMY

CREE COMMUNITIES

The structure of the Cree economy is mainly based on the tertiary sector, particularly band councils and school and health institutions. However, traditional hunting, fishing and trapping remain important to Cree communities.

In 2016, almost two thirds (62.8%) of the Cree labour force with experience¹⁶ worked in the following categories: business, finance and administration, sales and services, education, law and social services, community and government services. The trade, transportation and machinery categories accounted for 13.7% of the experienced labour force, 2.6 percentage points lower than in 2011. Occupations in the primary sector accounted for 4.6% of the EIJB workforce in 2016, compared with 1.6% in Québec. The processing, manufacturing and utilities sectors accounted for only 0.9% of the experienced labour force in 2016, compared to 4.9% for Québec (Statistique Canada, 2017).

The Council of the Cree Nation of Eastmain **employed** about 75 people in **2021**. It is divided into eight departments: Administration and Human Resources, Public Works, Public Safety (Public Safety and Fire Protection), Public Health which includes First Responders and “Healing” Departments, Special Projects, Department of Culture, Youth, Sports and Recreation, Housing and the Police (Première Nation d’Eastmain, **2021**).

Economic activities in Eastmain are primarily related to service sectors, restaurants, transportation (including airport management), construction (three companies), trapping and to a lesser extent, trade as well as outfitter sectors (**GCC, 2021b**). The Wabannutao Eeyou Economic Development Corporation's (WEDC) mandate is to foster the development of businesses in the community. It also manages a variety of businesses including a hotel, restaurant, cell phone service store, amusement centre, construction company, gas station and mechanical workshop (Craig William, WEDC, ind. interview, June 2018).

JAMES BAY COMMUNITIES

When it comes to the economy, James Bay communities are largely dependent on the energy, mining and forestry sectors. The economic structure of the James Bay communities remained relatively identical from 2006 to 2011. Jobs in management, business, finance and administration, science and sales and services accounted for 56.7% of the experienced labour force (15 years old and over) in 2006 and for 59.7% in 2011. However, in 2016, the same sectors experienced a significant drop to 44.9%. Trades, transportation and machinery jobs accounted for about 21% of the experienced labour force in 2006 and 2011. A decrease to 18.5% is evident in 2016. Elsewhere, jobs in the primary sector experienced significant growth in 2016 (7.1%) compared to 2006 (5.9%) and 2011 (3.2%). The experienced labour force in the primary sector remains larger in proportion than in the rest of Québec (1.6%).

¹⁶ Individuals 15 years old and over who were employed or unemployed during the week prior to Census Day, and last worked for a salary or by contract in 2005 or 2006.

Machinery rental makes up a large part of business for construction companies in James Bay communities. Construction and transportation contracts derive mainly from mining and forestry companies, but really took off during Eastmain-1 and Eastmain-1-A–Sarcelle–Rupert hydroelectric projects. In contrast, residential construction is slowing down due to population declines (CREBJ, not dated).

6.4.4.6 DEVELOPMENT PROJECTS

Mine projects

The EIJB territory is currently under the scrutiny of several mining companies for exploration or extraction. **The MERN (2021 a, b and c) lists multiple mine projects including Rose (Critical Elements Lithium Corporation) and Whabouchi (Nemaska Lithium), as well as the Eau Claire project (Eastmain Resources/Fury Gold Mines).**

The Rose lithium-tantalum mining project by Critical Elements Corporation is located 60 kilometres southeast of this project and is currently undergoing an environmental assessment. **This project is currently undergoing review by the Environmental and Social Impact Review Committee, or COMEX (2021a). In April 2021, the joint committee reviewed the comments received during public consultation on the provisional version of the environmental assessment report and potential conditions in order to prepare the final version of its report. The Rose project will also require the relocation of a 315-kV electrical transmission line and the construction of a substation. This project is also undergoing review by COMEX (2021b).**

The Whabouchi mining project by Nemaska Lithium completed its environmental assessment and is currently at the pre-construction phase (**MERN, 2021a**); it is located more than 100 kilometres southeast of the James Bay Lithium Mine project and will mine a spodumene deposit.

The Eau Claire gold deposit exploration project is located about 80 km east of the James Bay Lithium Mine project. This project is currently in the exploration phase (Fury Gold Mines, 2021).

Billy-Diamond highway

The Billy-Diamond highway repair program, set up by the SDBJ, has been underway since 2015. The Plan d'action nordique 2020-2023 includes continuing phase 1 repair work on the Billy-Diamond highway, aiming to bring 50% of the asphalt pavement to satisfactory condition (Gouvernement du Québec, 2020). In June 2020, the cost of the repair program was \$333.9 million (Secrétariat du Conseil du Trésor, 2021).

Access to housing

Since 2011, the GCC and Cree communities have developed the Cree Nation Housing Strategy to meet community members' urgent need for affordable, adequate housing. The Strategy is in keeping with an amendment made to the 2017 Cree Nation Governing Agreement eliminating Cree land grant terms for private property. This way, community members become true property owners while participating in the real estate market.

The program, with the help of the Government of Canada, focuses on private homeownership. With this program, Cree homeowners build wealth while Cree business owners grow their business. In addition, the initiative opens up community housing to low-income people, seniors and young people. The GCC has also invested \$100 million to create the Homeownership Initiative Fund to subsidize construction of new private homes by and for community members. The GCC has also invested large amounts in infrastructure for drinking water, wastewater treatment facilities and civil engineering projects (GCC, 2020).

Cree business activities

During the 2017–2018 consultations, some Cree users of the territory also mentioned that they had recently started the commercial harvest of wild mushrooms in the human environment study area. **In addition, a very preliminary outfitters project was mentioned. In recent consultations with users of the territory, they also mentioned their wish for controlled ecotourism development.**

6.4.5 QUALITY OF LIFE AND WELL-BEING

According to the World Health Organization, health is defined as: “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.” This vision of health is characterized by a search for balance between individuals and their environment, such as will optimize their well-being. In this context, health results from a constant interaction between individuals and their environment, with a range of dimensions determining their state of health. These dimensions are called determinants of health, which are the factors, within the population and/or at the individual level, that will change or improve health, depending on their state (INSPQ, 2014).

For the Cree, this “complete state of well-being” is known as *miyupimaatisiun*, and is not only the result of determinants of health, but also the product of a balance among several social, economic and environmental factors (nature, diet and social balance). This vision of health as a multidimensional and interdependent totality is a holistic vision of health (INSPQ, 2014).

According to the GCC, the Cree population groups that could potentially be concerned by the development of projects on EIJB territory are as follows:

- workers employed on the projects;
- workers employed by businesses offering services and supplies to the projects;
- the spouse(s), children and families of workers;
- users of the territory near the projects;
- the communities whose territory is affected by the projects;
- local health and social services;
- the Cree Nation;
- other populations (GCC, 2011).

A brief overview of the primary determinants of health among the Cree that could be affected by the project is presented in the sections that follow.

6.4.5.1 LIFESTYLE

Every year, in its annual report, the Cree Board of Health and Social Services of James Bay (CBHSSJB) presents the state of health of the population. In its 2019-2020 annual report, the CBHSSJB (2020a) named several factors related to the health of the Cree population.

On one hand, large socioeconomic inequities between the Cree population and the population of Québec continue to impact health results. Life expectancy increased by about five years over two decades but continues to be lower than that of the rest of Québec. It is 74 years for Cree men and 80 years for Cree women compared to the Québec averages, which are, respectively, 80 and 84 years.

The high level of psychological distress is 38% in this population compared to 28% for the rest of Québec. This has an impact on propensity for smoking. Despite a drop from 53% in 1991 to 43% in 2015, smoking rates are about twice as high as they are in Québec. Alcohol abuse is three times higher than in the rest of the province (57% versus 19%). Rates of cocaine and marijuana use are also higher than those in the rest of the province.

Cancer diagnosis and deaths remain lower than or roughly the same as the Québec averages. Kidney cancer, which is relatively rare elsewhere, is the most frequently diagnosed cancer in the region, followed by lung cancer and colorectal cancer. Cancer diagnoses among the Cree population occur at a younger age than in the rest of Québec (60 years versus 68 years).

Diabetes and its consequences are the most common chronic diseases, as well as those that are growing fastest in the region. Diabetes rates rose from 2% in 1983 to 27% by late 2017, affecting nearly 3,000 people. Over the last 15 years, new cases of diabetes have remained stable, reflecting lifestyle changes made to stay in good health. At the same time, nearly one in five diabetics is under 40 years of age.

6.4.5.2 SOCIAL ENVIRONMENT

SOCIAL ISSUES

Social issues that come up repeatedly in the literature and in consultation meetings held for the James Bay Lithium Mine project revolve primarily around alcohol abuse, theft and vandalism associated with young people, the use of illegal drugs, child neglect and domestic violence.

The causes of excessive alcohol consumption are many. Some point to socioeconomic problems such as idleness, the rapid transition from one way of life to another, lack of income, and frustrated aspirations as underlying causes of the high demand for alcohol, and likely for drugs (INRS, 1998). It appears that abusive alcohol consumption and the associated social issues are tied to the same types of variables in Indigenous communities as among non-Indigenous people. These variables include the person's age, their degree of social integration in the community, social policies, the legal context, and so on; it is the particular combination of these factors that creates the specific problems and their increased prevalence among Indigenous people (May, 1996).

Furthermore, based on several studies done of First Nations, gambling is a veritable “scourge” among Indigenous people. The effects of gambling are much more evident in the context of poverty in which many Indigenous people find themselves, and compound other serious social problems. The problem is particularly acute in urban settings (INSPQ, 2010).

SENSE OF BELONGING AND SOCIAL COHESION

There are different definitions of a sense of social connectedness. A majority of researchers agree that it involves a dimension of acceptance (feeling of being understood and respected) and of intimacy, attachment and proximity with other people (Richer and Vallerand, 1998). Furthermore, social cohesion can generally be defined as the result of processes (socialization, participation, interaction, etc.) by which individuals share values and standards of conduct, which provide a sense of belonging to the group. This cohesion leads individuals to trust others and to share resources. It therefore involves living as a group, a sense of sharing, of common good and participation in civil society (Helly, 1999). It is often associated with the level of mutual aid, traditions and language spoken.

The Cree in the EIJB territory show a strong sense of belonging to their community. In 2003, 82% of Cree experienced a sense of belonging (qualified as “somewhat strong” or “very strong”). This proportion is significantly higher than that found among French-speaking Quebecers (56%) (CBHSSJB and INSPQ, 2008). This sense of belonging is equally developed among young and older people. The near absence of immigration seen in the EIJB territory may contribute to the strong general sense of belonging: population growth in the territory is the result of a combination of high fertility and rising life expectancy (INSPQ, 2006).

Social cohesion in Cree communities is higher than that seen in Québec overall. In 2001, a third (32.3%) of Cree aged 15 years or older cared for the elderly without compensation, compared with 17.7% of Quebecers. This proportion is similar for both men and women. Despite the changes experienced in the Cree Nation in recent years, it remains very attached to traditional activities and to use of the Cree language, which may contribute to the social cohesion of the Cree nation. Indeed, in 2003, a very high proportion (89%) of Cree spoke mainly Cree at home. Furthermore, most Cree can carry on a conversation in English and some also speak French (CBHSSJB and INSPQ, 2008).

TRADITIONAL LIFESTYLE

With the development of numerous major projects in the EIJB territory since the 1970s, the culture and identity of the James Bay Cree have been under significant pressure, characterized by several changes related to contemporary life. As development of projects in the EIJB territory is pursued, the GCC expects that Indigenous communities will be increasingly exposed to non-Indigenous people. Development of the territory must therefore go forward with respect for the traditions and culture of First Nations, meaning efforts to heighten awareness must be put in place so that non-Indigenous people are more enlightened and familiar (GCC, 2011).

Furthermore, the GCC has identified passing on Cree culture to young people as a priority in order to preserve the language, knowledge, traditions and abilities of elders. The Cree nation has several organizations that aim to preserve and promote Cree culture and identity: the Department of Traditional Pursuits, Cree Regional Authority (CRA), Aanischauuukamikw Cultural Institute, Cree Native Arts and Crafts Association, and the local cultural coordinator present in each community (GCC, 2011).

SOCIAL INEQUITY

Women, young people, and elders in the Eastmain and Waskaganish Cree communities face special challenges. This section presents a selection of socioeconomic data (Statistics Canada, 2017).

The situation faced by young people, with regard to education, training and jobs, is at the center of multiple issues in Cree communities:

- **As in many Indigenous communities in Québec, the Eastmain and Waskaganish Cree communities feature a high proportion of the population under age 30: 60.1% and 56.9%, respectively, in 2016, compared to 33.8% in Québec overall.**
- **The dropout rate observed by the Cree School Board is 67.7% (74.0% for boys and 62.2% for girls). Although this is one of the highest dropout rates in Québec, we can see progress when comparing with 2008-2009 data (MEES, 2018).**
- **Over 60% of 15-24-year-olds experience a high degree of psychological distress, versus 36% in Québec (CBHSSJB, 2020).**
- **The proportion of individuals age 15 and older that are unmarried and not living in common-law marriage is higher in the communities in question (57.4% in Eastmain and 52.5% in Waskaganish) than in the province overall (43.7%) (Statistics Canada, 2017).**

The situation of single-parent families is another issue that should be considered:

- **There is a higher proportion of single-parent families in Eastmain and Waskaganish than among Québec families overall, at 41.5% and 34.3%, respectively, versus 16.8% in Québec.**
- **The proportion of single-parent families with three or more children is nearly four times higher in Waskaganish (35.1%) and nearly two times higher in Eastmain (17.5%) than in Québec overall (9.2%).**
- **In both Cree communities concerned, the median income of single-parent families is lower than that of couple-families with children (\$56,064 lower in Eastmain and \$40,277 lower in Waskaganish) (Statistics Canada, 2017).**

Statistics on Indigenous women in both communities demonstrate the following:

- **Employment rates for women (70.0% in Eastmain and 53.5% in Waskaganish) are proportionally higher than those for men (63.0% in Eastmain and 44.1% in Waskaganish), while these gaps are smaller in Québec overall (62.5% for men versus 60.2% for women) (Statistics Canada, 2017).**
- **Birth rates are twice as high in Cree communities as on average in Québec (INSPQ, 2014).**
- **About one in five births involves a mother age 20 or younger (CBHSSJB, 2020).**

According to 2011 statistics from the Ministère de la Santé et des Services sociaux du Québec (MSSS), the James Bay Cree region had rates of genital chlamydial and gonococcal infection that were 7 and 11 times higher, respectively, than the average rates across Québec, indicating high transmission rates among the Cree population (INSPQ, 2014).

6.4.5.3 HEALTH AND SOCIAL SERVICES

The CBHSSJB, in partnership with the Ministère de la Santé et des Services sociaux du Québec (MSSS), manages and organizes health and social services in the nine communities of the Cree Territory of James Bay (MSSS Administrative Region 18) (CBHSSJB, **2020b**).

The CBHSSJB manages all establishments providing health and social services in the region. Establishments under its responsibility are the regional hospital in Chisasibi and the **Community Miyupimaatissium (health) Centres (CMCs)**, located in each of the nine Cree communities. The CMCs provide general medical services, home care, dental care and social services. The Chisasibi Hospital has 29 beds, 17 of which are used for active care. A hemodialysis unit has nine beds (CBHSSJB, **2020b**).

During the meeting with CBHSSJB Eastman representatives, the latter presented several problems the organization is currently facing in responding to the needs of the population. Difficulties with nurse recruitment, and the availability of only one ambulance, were mentioned.

6.4.6 LAND USE

The traditional knowledge of the Cree population was considered in the consultations done at the start of the project in 2011-2012 and in 2017-2018 in order to document the use of the land and resources and establish a natural and cultural heritage baseline.

This process involved conducting interviews with tallymen and their families, users of the territory and elders. A review of literature on traditional knowledge, particularly for medicinal plants, and visual simulations integrating valued viewpoints were additional activities that helped form a comprehensive description of how the land is used.

The Eastmain, Waskaganish and Waswanipi communities were also consulted. Consultations and additional work led to deeper knowledge of the environment, discussions about stakeholder concerns and expectations for the project, and identification of major project challenges and sensitive elements. Considering that the resources are an important food source for Indigenous people and that hunting, fishing and gathering have greater traditional meaning (lifestyle), traditional knowledge has also enhanced the description of components of the biophysical environment.

Consultations with land users also touched on the presence of burial sites, sites of archeological interest or other sites that are important for natural or cultural heritage, as well as any components that are of value for their scientific, social, historical or aesthetic importance. For burial sites, in particular, none were listed in the project area, but several sites were identified further downstream, along the Eastmain River. Based on the information provided by the communities, there are no sacred or ceremonial sites, objects or things within the study area.

Components related to land use include water quality (especially the Eastmain River and creek CE5), air quality, soil quality, quality of wildlife in general (beavers, moose, geese, sturgeon, trout, porcupines in particular), quality of plants consumed by users and animals (including medicinal plants and berries), as well as land integrity.

In addition, two Cree joined the field teams as land users during surveys, so that the teams could benefit from their knowledge of things like accessible trails to reach sampling stations. This also encouraged sharing of information and instructions.

The land users pointed out information and observations about certain species of wildlife that are of traditional interest in the sector, specifically: migrating and woodland caribou, moose, beavers, geese, sturgeon and porcupines. The information gleaned shows that sites of memory continue to be actively transmitted, which helped identify cultural landscapes. These were approached through valued areas (see Section 6.4.6.1) and are made up of three main sectors: the Eastmain River, creek CE5 and the area consisting of multiple lakes near Amiskw Matawaw Lake.

Some sectors carry greater cultural importance, due to the strong connection to the territory and their generational attachment or because of the abundance of certain resources. Land users wish to protect these valued areas for their cultural, historical or subsistence aspects, and where knowledge is transmitted. These sites are presented and described in section 6.4.6.1. With regard to past land use, it is mainly addressed in section 6.4.9 on archeology.

6.4.6.1 CURRENT USE OF LAND AND RESOURCES FOR TRADITIONAL PURPOSES

The EIJB territory has nine Cree communities. The only community found in the project study area is the Eastmain community.

Since the creation of beaver reserves in the 1930s, the Cree territory has been divided in traplines. Each trapline is under the responsibility of a tallyman who, each year, supervises the dividing of the resources to use and areas to preserve to ensure renewal of the species sampled.

The territory of the Eastmain community includes 15 traplines. The planned mining infrastructure is located on the RE2 trapline occupying 5.8% of the Eastmain community's total trapping territory of 15,668 km².

The principal activities carried out on the traplines are hunting, fishing and trapping of fur-bearing animals. They take place year-round, according to specific practices and timetables. Visiting the trapline is also considered a revitalizing and curative activity for users. Trapping activities usually are usually done in fall and winter. Winter is also a good time for hunting or snaring small wild game (such as ptarmigan or hare) and for hunting moose. Users of these camps are also ISP recipients, which means they spend at least four months per year on the land.

In fact, the food collected on the territory, mainly in the study area for RE2 trapline users, is starting to come back since the lull imposed by the forest fire. According to some users, a large part of their food comes from what they gather on the trapline, and when they stay there, this is their main food source. Traditional food is also brought back into the community and shared during celebrations such as birthdays or feasts. Generally, some users mentioned they consumed less traditional food since the forest fire and some said they had to turn to other traplines to supply themselves. Therefore, traditional food consumption was estimated at about once a week. The quantity of these foods depends on hunting success and activities per season. For example, goose is consumed more often in spring, moose in fall, and fish in summer and fall.

The territory considered for the project and the area around it is currently used by family members of the RE2 trapline tallyman, mainly to hunt moose and geese, to fish and trap, and to gather berries and other plants. Brian Weapenicappo has been the RE2 trapline licensee since he replaced his uncle Clarence Mayappo as tallyman in 2014. Several members of his extended family are occasional or regular trapline users.

The RE2 trapline is located 25 kilometres east of the village of Eastmain and spans 90 kilometres. It is bordered to the north by the Eastmain River. The study area, located in the trapline's eastern section, covers nearly half of its area. This is the most frequented section since it is crossed, from north to south, by the Billy-Diamond highway. The km 381 truck stop and two transmission lines are in this part of the trapline.

Two permanent encampments are found in the study area, along the Billy-Diamond highway. One of these, built in 2016 and located 7 kilometres northwest of the project site, includes a single camp. The second encampment, less than 10 kilometres south of the project site, includes four camps and a tipi.

Some temporary encampment sites are also present along the Eastmain River. Tents can be set up there, when needed, mainly during moose hunting or for fishing.

RE2 trapline users report that the entire trapline is good habitat for beavers, although older users that were consulted report that the beaver population has been dropping since the Billy-Diamond highway was built. Generally speaking, the wetlands are valued because of the presence of beavers.

RE2 trapline users particularly value the Eastmain River, creek CE5 and the area made up of multiple lakes near Amiskw Matawaw Lake due to the abundant resources that continue to meet their needs and their attachment to these sites going back generations.

MOOSE HUNTING

Moose hunting is carried out in the study area, but there are few sites specific to this activity since the moose population is scattered across the territory. However, the sector of the Eastmain River (in the study area) and Billy-Diamond highway remain especially used for this activity.

CARIBOU HUNTING

Caribou hunting was probably more important in the past than it is now, due to the low caribou population that exists today. Consultations with RE2, VC33 and VC35 trapline users indicated that there had not been any recent woodland or migratory caribou hunts in the study area by the users consulted, because there have not been any caribou there. Historically, caribou have been hunted along the entire Eastmain river.

Users of the RE2 trapline land mentioned that there are fewer and fewer migratory caribou on the land since the 2013 forest fires, and that none were observed in 2018-2019.

Woodland caribou are sometimes sighted south of the RE2 trapline (west of the Billy-Diamond highway), but none were seen this year.

GOOSE HUNTING

Various locations in the study area are frequented for goose hunting, primarily east of the Billy-Diamond highway. This activity is practised near watercourses, namely, on former borrow pits that have become attractive to the geese, at certain lake outlets and at stream crossings along the Billy-Diamond highway. Nearly ten of these sites were identified in the study area's human environment (grouped per sector on Map 6-22). In spring, users often spend close to one-month goose hunting on the trapline with family members. In fall, hunting is carried out more sporadically, generating less interest or family gatherings. The tallyman has plans for a goose hunting pond project on the Eastmain River (close to the sturgeon spawning ground community project). The increasing number of hunters on the trapline calls for developing new hunting areas.

TRAPPING

Users mentioned that the study area, and more specifically the sector around the km 381 truck stop, has always been a great place for beaver trapping. However, few beavers were trapped recently since the resource needs to regenerate following the 2013 forest fire. The same is true of the other trapping sectors on the trapline. The trapline's western part, which includes the study area's western part, is considered a beaver conservation zone, where the population can regenerate before it moves elsewhere on the trapline. Users rarely frequent this sector.

Another sector appreciated for its wealth of resources is in the southern part of the study area, within a radius of 5 kilometres around the main camp and its lakes. This sector is regularly used year-round.

Fur-bearing animal captures by Cree trappers are documented yearly by the Cree Trappers' Association. In 2015-2016, the main species collected and documented for the Eastmain community are, in rank of importance and including number of specimens: marten (55), beaver (47), moose (20), black bear (14), muskrat (12), lynx (12), fox (various species) (7), and otter (6) (CTA, 2016).

The 2013 forest fire affected a large part of the trapline, leading to a decrease in its use and in the wildlife resources collected on the land, including porcupines, caribou, beavers and moose. However, with renewed plant growth and the return of resources, users are gradually getting back to their normal activities, which they expect to continue in the future.

FISHING

Fishing is mainly practised on two lakes in the study area's southern portion. The intersection of the Billy Diamond highway and Eastmain River (in the study area's northern part) is also well frequented for fishing activities. Fishing is also practised on the CE5, along the road, requiring no navigation. Sturgeon, pike, walleye and whitefish are fished there. The community has plans for a sturgeon spawning ground enhancement project in the vicinity. This will limit fishing on this site for the time needed to ensure its sustainability. This resource seems to have been affected by the diversion of the Eastmain River in 1980, and seems to be starting to come back to this river.

GATHERING

The use of plants and berries for food and medicinal purposes was also mentioned by users of the RE2, VC33 and VC35 traplines who were consulted.

The gathering of blueberries and plants is carried out in various locations on the territory. Blueberries are primarily gathered in sectors that were affected by forest fires, namely in the Billy-Diamond highway sector where access is easy.

The community also gathers mushrooms in the same Billy-Diamond highway sector for a commercial project.

WATER SUPPLY

When staying at their main camp, users primarily get their water supply from the km 381 truck stop. During consultations, land users identified other water sources used for drinking water or for food purposes when travelling on the territory. No additional information was provided about the nature, quality or use of these water sources. Four other sources were identified in the study area: three close to the Eastmain River and one in the southern part of the trapline.

TRAVEL

In addition to using the Billy-Diamond highway and several short access roads linked to it (and mainly travelled by quad), travelling in the study area is mainly done by snowmobile. Thinning of the trapline by the 2013 forest fire facilitated travelling everywhere on the territory, without the need for snowmobile trails.

NAVIGABLE WATERWAYS

The Director of the Eastmain Environmental Department and RE2, VC33 and VC35 trapline users were interviewed to learn what waterways are used to practise traditional activities, as well as to learn more about their past and present use. For this purpose, maps showing the waterways within the study area, as well as the project area on a larger scale, were used. Users said that creeks CE2, CE3 and CE4, as well as Kapisikama and Asini Kasachipet Lakes, were not used.

Based on information gathered from trapline users, the navigable waterways used for long trapping trips are (Map 6-22):

- the Eastmain River up to Weir 5 (except for the Mantuwataw Rapids, which can be bypassed with a portage);
- Nistam Siyachistawach Lake (southwest of the study area);
- Amiskw Matawaw Lake (southwest of the study area);
- the Miskimatao River (southwest of the study area).

Only the downstream part of stream CE5, a river accessible from the Billy-Diamond highway, is sometimes navigated by canoe for trapping and hunting, and often has been in the past for trapping and to get to the Eastmain River (east of the study area).

There has been little travel on Miskimatao River and the eastern part of creek CE5 in recent years. Travel is possible from the Billy-Diamond highway to the Eastmain River; westward on the Miskimatao River or eastward on the CE5 stream.

The uses mentioned for the other small creeks (CE2, CE3, CE4, CE5 [upstream of the road]) and Kapisikama Lake are snowmobile trapping in winter or goose hunting in spring where they intersect with the road (either by snowmobile or by vehicle).

EASTMAIN RIVER

The VC33 trapline tallyman mentioned during interviews that he used the Eastmain River and continued to use certain nearby sectors for various activities, like other trapline VC33 users. In winter, when there is ice cover, they are able to reach the trapline from the community. When the river is free of ice, it is navigable in some locations, but since it was diverted by Hydro-Québec, it is no longer possible to reach trapline VC33 by boat from the community. The river remains generally harder to navigate because of the low water level.

Eastmain River remains important to VC33 trapline users and their families because it is the site of many activities, including transmitting traditional knowledge to young generations. Users gather and feed themselves with pike, trout and beaver from the river. It was mentioned, however, that the river is much less used now because of the low water level, making the river muddier and the fishing worse since the Hydro-Québec facilities were set up.

Various sectors of the Eastmain River are good for hunting geese and moose and fishing. Trapping may take place for other fur-bearing animals when these resources are present.

Near the Rupert River, Rapin Stream, which empties into the river near the Eastmain River bridge, is used for various activities. Four family camps were built between this stream and the road to the east of the Billy-Diamond highway (road to the former Opinaca airfield). This camp is located 5 km northeast of the Eastmain River. In 2018, trapline users were planning to build a new camp there. A community camp was also located along the Eastmain River.

Although the Eastmain River was diverted in 1980, it is an important cultural landscape for the Cree. Its heavy use historically and its importance as a main navigation route (a historical site and a source of subsistence for past generation) create a strong attachment to this river, which is still used for its resources.

MINING ACTIVITY

GLCI owns **54 claims covering an area of 2,163.75 ha and corresponding** in part to the site of the projected mining infrastructure (Map 2-1). Besides the claims belonging to other owners, no other mining title is present in the study area.

6.4.6.2 VACATIONS AND RECREATIONAL ACTIVITIES

There are two MERN vacation lot leases in the study area along the Eastmain River. One of these leases, issued for a cottage, is approximately 4 kilometres east of the Billy-Diamond highway. The second lease, issued for a rustic shelter, is located 13.5 kilometres east of the Billy-Diamond highway (Map 6-22).

The section of the study area located in Category III lands is included in hunting and fishing zone 22, which spans a vast territory from Mistissini in the south to Whapmagoostui in the north, and from James Bay in the west to the Caniapiscau Reservoir in the east, excluding Category I and II lands. In this area, hunters must abide by the hunting rules that apply in the area. According to MFFP data **(2021), an average of 120 moose per year were hunted in this zone from 2016 to 2020** (MFFP, 2021). Concerning fishing, some restrictions apply for Category II lands and on fishing methods used, and certain fish species are for exclusive use by Indigenous peoples (MFFP, 2017c).

Furthermore, Québec is divided into 96 fur-bearing animal management units (FAMU). FAMU 92 is affected by the study area. It has the same boundaries as the territory belonging to the Eastmain Cree community. It corresponds to an area where trapping is for the exclusive practice of Indigenous peoples as per the *Regulation respecting beaver reserves* (R.R.Q., 1981, c. C-61, r. 31) and the *Act Respecting Hunting and Fishing Rights in the James Bay and New Québec Territories* (CQLR, chapter D-13.1) (MFFP, 2016). **Available data indicates that a total of 234 beaver pelts, 6 otter pelts, 13 Canadian lynx pelts, 110 marten pelts, 3 black bear pelts, 1 muskrat pelt, 26 red fox pelts and 1 mink pelt were sold over the last five seasons (2015-2016 to 2019-2020) (MFFP, 2021).**

During consultations, Indigenous users of the territory mentioned that hunting and fishing are practised by some non-Indigenous in the study area, mostly at the junction of the Billy-Diamond highway and Eastmain River. **There are, however, fewer non-Indigenous users who practise recreational hunting and fishing in the study area. Since 1980, the development of the James Bay highway network has led to an increase in recreational activity in the territory (tourism, sport hunting and fishing), especially since the Billy-Diamond highway was opened to non-Indigenous populations in 1986. Yet these activities are still mainly concentrated in the southern portion of James Bay and to the east of the Robert-Bourassa power station. In 1991, monitoring was done to assess the impact of sport hunting and fishing on animal populations, and this monitoring counted nearly 11,000 vehicles at the entry of the Billy-Diamond highway (Hydro-Québec Production, 2001).**

According to the Fédération des pourvoiries du Québec, there is no outfitting business in the study area (FPQ, not dated).

The Fédération québécoise du canot et du kayak does not list any canoeable route in the study area (FQCK, 2005). Note that a boat launch ramp is installed near the Billy-Diamond highway, at Nistam Siyachistawach Lake.

6.4.6.3 QUARRIES, SANDPITS AND CONTAMINATED SOILS

None of the sites in the study area are listed in the MDDELCC's *Répertoire des dépôts de sols et résidus industriels* or the *Répertoire des terrains contaminés* (2018b and c).

According to Phase I of the ESA carried out in the project's sector **(WSP, 2018h)**, two quarries were operated at an unknown date prior to October 1982, one on the site of the current remote landfill and/or close to it, and another north of the km 381 truck stop.

6.4.7 INFRASTRUCTURE

6.4.7.1 ROADS

The main roadway is the Billy-Diamond highway, which crosses the study area from south to north for 30.8 kilometres. This road, originally built to provide access to the hydropower project sites in the 1970s, spans 620 kilometres, crosses the EIJB territory and is an extension of Route 109 (Tourisme Baie-James, 2012). The road begins at Matagami and ends at Radisson. **The road is entirely paved, maintained and cleared of snow in winter. According to SDBJ data,¹⁷ about 57,000 vehicles use Billy-Diamond highway, on average, every year, for an average annual daily traffic of 314 vehicles, factoring in round trips. About 31% of these vehicles are heavy-duty vehicles of various types.**

The road does not cross any Indigenous town or community and is on Category III lands. There are 20 Cree traplines associated with the communities of Eastmain (2 traplines), Waskaganish (7 traplines), Nemaska (4 traplines) and Waswanipi (7 traplines) that are crossed by the road or located within 2 km of it.

The Billy-Diamond highway has not been a provincial highway since 2002 and is now administered by the SDBJ. Many Indigenous communities, including Eastmain, Waskaganish, Wemindji and Chisasibi, can be reached by **this road**, which is also used by their members to travel. Two forks in the road, one at kilometre 275 (North toad) and another at kilometre 544 (Trans-Taiga toad), lead, respectively, to the municipality of Chibougamau and to the Caniapiscau Reservoir.

The Sûreté du Québec ensures road safety on Billy-Diamond highway except for areas under the jurisdiction of Cree communities, which are under the responsibility of the Cree police force.

6.4.7.2 AIRPORTS

There is no airport in the project area. The airfields closest to the project site are the airports located at the Eastmain River (97 km), Nemiscau (88 km) and the Éléonore mine (85 km), which is near the Opinaca Reservoir (Map 1-1).

6.4.7.3 POWER LINES

There are two power lines near the human environment study area. From north to south, the 4003-4004 circuit (450 kV) crosses the study area where it cuts through the Billy-Diamond highway in three places. The 614 (69 kV) circuit crosses the study area from east to west at its southern part. Neither of these two power lines crosses the planned mining infrastructure (Map 6-22).

6.4.7.4 TELECOMMUNICATIONS

Most of the EIJB territory is served by Hydro-Québec's telecommunications network via a microwave link and a regional fibre-optic network owned by Eeyou Communications Network, a not-for-profit telecommunications corporation that provides broadband carrier services for the Cree communities and municipalities of the James Bay region (Eeyou Communications Network, 2017). There is no telecommunications infrastructure in the study area. The closest infrastructure is south of the study area, between the Billy-Diamond highway and Amiskw Matawaw Lake (Map 6-22).

17 Data on traffic using Billy-Diamond road compiled for 2014-2017. E-mail communication, Jean Nouvellet, Société de développement de la Baie-James, May 2018.

6.4.7.5 KM 381 TRUCK STOP AND REMOTE LANDFILL

There is a truck stop in the study area at km 381 of the Billy-Diamond highway. It offers lodging, food services, meeting room rental and mechanical troubleshooting (SDBJ, 2017). A convenience store, a laundry room, a cafeteria, a motel, two garages and a gas station are also part of this complex located on Block 27 of the Eastmain River watershed, a 100-hectare site owned by the SDBJ since 1994.

The truck stop gets its drinking water supply from two **active** artesian wells located in the western part of the site. **Groundwater extraction at the km 381 truck stop is the only point listed within a two-kilometre radius of the pit and is the main source of drinking water supply for land users.** Buildings and other truck stop infrastructure are listed on Map 6-23.

There is a remote landfill near the proposed pit, linked to the activities of the km 381 truck stop. This remote landfill was authorized on July 18, 2006, by the **Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC)**. However, the site has been used for waste management since December 5, 1983. Before that, it served as a quarry. Until 2011, the waste brought to this site was buried in trenches and later incinerated in containers. A lease was issued to the SDBJ by the MRNF in 2012 (Raymond Thibault, SDBJ, ind. interview, February 2018, and Alain Coulombe, SDBJ, ind. interview, May 2018). The phase I environmental site assessment (**WSP, 2018h**) and the phase II environmental site characterization (**WSP, 2018d**), provide greater detail on this remote landfill.

6.4.8 LANDSCAPE

6.4.8.1 COMPONENT TYPES

The landscape survey and analysis method used in this project is based on Hydro-Québec's landscape study method for transmission and distribution lines and station projects (Hydro-Québec, 1992) and the MTQ's visual assessment method for transport infrastructure integration (MTQ, 1986).

The description of the landscape is based on data from surveys of the biophysical and social environments conducted in 2011, 2017 and 2018, as well as on information gathered from various documents such as aerial photos and maps. Field visits were made to inventory the landscape (topography, plants, land use, visual fields).

REGIONAL LANDSCAPE

At the regional level, the project site is in the northern part of the natural province of the James Bay Lowlands. This province consists of an immense peat plain which, to the east of Waskaganish, becomes more fragmented due to an increased presence of scattered bodies of water and rocky mounds. The lower reaches of several large rivers (including the Eastmain, Nottaway, Broadback and Rupert) form the largest part of the hydric network while a dense but poor drainage system crosses the plain. Many ponds but few lakes are found around the bogs.



Infrastructures du relais routier / *Truck Stop Infrastructure*

- ➕ Puits d'eau potable / *Potable water well*
- ① Cafétéria et centre administratif / *Cafeteria and administrative office*
- ② Garage d'entretien / *Maintenance garage*
- ③ Poste à essence / *Fuel station*
- ④ Buanderie / *Laundry*
- ⑤ Logement des employés / *Employee residence*
- ⑥ Motel / *Motel*
- ⑦ Maison SDBJ / *SDBJ house*
- ⑧ Maison Hydro-Québec / *Hydro-Quebec house*
- ⑨ Dôme pour sable et sel de voirie / *Road sand and salt dome*
- ⑩ Entrepôts / *Warehouse*
- ⑪ Génératrices / *Generators*
- ⑫ Carothèque de Galaxy / *Galaxy's core racks*



Mine de lithium Baie-James /James Bay Lithium Mine

Carte / *Map 6-23*
Relais routier du km 381 /
Km 381 Truck Stop

Source :
Image Galaxy, 2017

0 20 40 m
UTM, fuseau 18, NAD83

Juillet / *July* 2021

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c6-23_wspT337_relais_routier_210701.mxd



Two Cree villages, Waskaganish and Eastmain, are home to most of this province's population. These villages are located near James Bay on the banks of the Rupert River and Eastmain River, respectively.

LANDSCAPE IN THE STUDY AREA

The Billy-Diamond highway forms the backbone of the study area from north to south over an approximate distance of 31 kilometres. Most of the traditional activity sites (camps and hunting, fishing and trapping areas) as well as a **truck stop** and secondary roads are connected to it. There are several snowmobile trails that converge on the larger lakes in the southern portion of the study area (Map 6-24).

A natural mosaic characterizes most of the landscape in the study area following a complex pattern generally oriented east-west. This mosaic is composed of various types of plant communities, burns from past years, rocky outcrops and bare soil. The plant communities are very diverse and include terrestrial vegetation (scrubland, woodland, spruce stands, pine stands) and wet growth (shrubby, wooded or open peatland). The woody vegetation is about 10 m high in this region.

The topography of the study area is divided into three distinct parts. The incised valley of the Eastmain River borders the northern limit of the area with an elevation of 175 m to 200 m, while a plateau dominates the landscape to the south with an elevation of 225 m to 250 m. There is a large plain between the valley and the plateau, at an elevation ranging from 175 m to 225 m. It occupies the largest part of the study area. The plain and the plateau are dotted with hills characterized by rocky outcrops. These hills can reach an elevation of about 240 m on the plain and about 280 m on the plateau.

A network of lakes and rivers of different sizes forms the natural fabric of the landscape. The largest lakes are clustered south of the study area in the plateau area, while smaller lakes are scattered to the northeast, on the plain.

The landscape in the study area alternates between open views (bodies of water, open peatland, rocky outcrops, bare soil), no views (blocked by the landscape or by dense groups of coniferous trees) and partial views (burned areas with burned trees still standing, deciduous trees in winter). The hills are natural visual landmarks in the study area, while power transmission towers and the Billy-Diamond highway are anthropogenic visual landmarks.

The landscape in the study area is used for traditional activities or for transit (more specifically, via the Billy-Diamond highway). Cree camp users, as well as hunters, fishers, trappers and visitors to the truck stop are considered temporary fixed observers. Users of the territory travelling on the Billy-Diamond highway, snowmobile trails and navigable bodies of water and watercourses are the main moving observers.

The landscape in the study area is not legally protected.

6.4.8.2 LANDSCAPE UNITS

The identification and analysis of landscape units make it possible to grasp the challenges of the study area both on a visual and human scale. A landscape unit is a separate and homogeneous section of territory characterized by a cluster of similar visual elements. The study area was thus divided into five types of landscape units taking into account the homogeneity of the permanent elements and dominant visual characteristics. These units were defined mainly by the topography and land use, the components least sensitive to the effects of forest fires. The five types of landscape units in the study area are:

- valley;
- plain;
- plateau;
- power line;
- road.

Tables 6-67 to 6-71 describe these landscape units based on the following components:

- limits and specific land use;
- routes;
- land use elements or elements of recognized aesthetic interest;
- topography;
- hydrography;
- vegetation;
- spatial organization;
- observers (within the unit);
- visual field;
- view quality and visual points of view.

VIEW QUALITY AND VISUAL POINTS OF VIEW. VALLEY LANDSCAPE UNIT

The valley landscape unit includes the Eastmain River. It is visually isolated from the study area by its incised position (Map 6-24 and Photo 6-10).

The unit is used for hunting, fishing and its sources of drinking water.

Table 6-67 Valley landscape unit

Component	Description
Limits and specific land use	The valley landscape is located north of the study area and is mainly formed by the lower Eastmain River, its banks, the Mantuwataw Rapids and Weir 5 farther upstream.
Roads or transport routes	- The river is a shipping route with a portage path in the vicinity of the Mantuwataw Rapids. - The Billy-Diamond highway crosses the unit for approximately 50 m. From this road, a service road runs west along the river valley. The Billy-Diamond highway bridge straddles the river below the Mantuwataw Rapids. - A power line straddles the river downstream of the bridge. - A snowmobile trail runs along part of the river valley.
Land use elements	- Three temporary Cree camps on the south shore of the Eastmain River, downstream of the Mantuwataw Rapids. - Two wildlife areas used for hunting, fishing or trapping as well as one spawning area and one valued area.
Topography	Somewhat incised compared to the adjacent territories, the valley is at an elevation of 150 m to 175 m.
Hydrography	Several small bodies of water flow into the Eastmain River, which flows into James Bay about 90 km to the west.
Vegetation	The unit is characterized by woody vegetation and burns.
Spatial organization	The Eastmain River is the backbone of the valley and is a geographical landmark in the study area. The towers of a power line and the Billy-Diamond highway bridge are the unit's notable landmarks.
Unit observers (within the unit)	- Users of temporary Cree camps, hunters and fishers (temporary fixed observers). - Transiting users on the Eastmain River, the Billy-Diamond highway and snowmobile trails (mobile observers).
Visual field	The typical visual field is limited where the river valley is concerned. It is deep in the direction of the river and open views are limited by the topography or woody vegetation.
View quality and visual points of view	- The view quality of the unit is based on its natural appearance. - Except for the Billy-Diamond highway bridge, the unit is visually isolated from the study area.



Photo 6-10 Valley landscape unit, view from an elevated rocky outcrop

PLAIN LANDSCAPE UNIT

This landscape unit forms a vast plain that encompasses the project site. The plain is dotted with some elevated rocky outcrops, small hills and power transmission equipment that is visible from afar (Map 6-24 and Photo 6-11). The unit is used for traditional activities and for transit.



Photo 6-11 Plain landscape unit, view from an elevated rocky outcrop on the plain

Table 6-68 Plain landscape unit

Component	Description
Limits and specific land use	The plain landscape unit runs between the Eastmain River to the north and an elevated plateau to the south. Most of the unit is characterized by a natural mosaic and includes the project site.
Roads or transport routes	- The Billy-Diamond highway crosses the unit for about 16 km. Some service roads run west and east from the Billy-Diamond highway. - Two snowmobile trails. - Two long navigable watercourses between Eastmain River, upstream of Weir #5 and the vicinity of the project site, as well as the Miskimatao River, which meets up with the Eastmain River. - A power line crosses the unit for approximately 17 km.
Land use elements	- One permanent Cree camp near the Billy-Diamond highway. - Three wildlife areas used for hunting, fishing or trapping and three valued areas.
Topography	- The unit is at an elevation ranging from 175 m to 225 m. - Several hills stand out from the plain forming an elongated pattern. Some reach an elevation of 240 m.
Hydrography	Meandering streams drain the plain, which contains several small scattered bodies of water.
Vegetation	The plain vegetation (woodland, scrubland, spruce stands, pine stands, burns and peatland) creates alternating visually open, filtered or closed spaces. Vegetation at the project site and nearby areas has been altered mainly due to successive forest fires. North of the site, however, there is peatland (open, shrubby or forested) and some patches of coniferous trees near the James Bay highway that were not affected by the fires.
Spatial organization	Aside from the Billy-Diamond highway, the spatial organization is dependent on a large, barely perceptible grid. Hills, elevated rocky outcrops, power transmission equipment and the Billy-Diamond highway form visual landmarks.
Unit observers (within the unit)	- Users of the permanent Cree camp, hunters, fishermen and trappers (temporary fixed observers). - Transiting users use the Billy-Diamond highway, snowmobile trails and watercourses (moving observers).
Visual field	The unit has highly variable visual fields. Where there are trees, the visual field is limited in depth and opening, and the views are closed. Where there are rocky outcrops, bare soil, open peatland or bodies of water, the visual field is open, as are the views. Where there are burns, the visual field is reduced and the views are filtered.
View quality and visual points of view	- The visual quality of the unit is based on its natural appearance. - The depth of the views depends on the height and density of the vegetation, which is highly variable. - The elevated rock outcrops are visible from afar and offer panoramic views. The Billy-Diamond highway offers views towards the unit.

PLATEAU LANDSCAPE UNIT

The plateau landscape unit dominates the study area in height and its topography is a little more pronounced than that of the plain. The plateau contains the largest lakes and some hills (Map 6-24 and Photo 6-12). The unit is used for traditional activities and for transit.

Table 6-69 Plateau landscape unit

Component	Description
Limits and specific land use	The plateau landscape unit forms the southern part of the study area. Most of the unit is characterized by a natural mosaic.
Roads or transport routes	- The Billy-Diamond highway crosses the unit for about 13 km. Some service roads run eastward from the Billy-Diamond highway. - Several snowmobile trails converging on Nistam Siyachistawach Lake. - The Miskimatao River between Eastmain River and Nistam Siyachistawach Lake. - A power line crosses the unit for approximately 20 km.
Land use elements	- One permanent Cree camp near Nistam Siyachistawach Lake. - One wildlife area used for hunting, fishing or trapping and one large valued area.
Topography	- The unit is at an elevation ranging from 225 m to 250 m. - Several hills stand out from the plateau forming an elongated pattern. Some reach an elevation of 280 m.
Hydrography	The watercourses are rather straight and there are several large lakes.
Vegetation	The vegetation (woodland, scrubland, spruce stands, pine stands, burns and peatland) creates alternating visually open, filtered or closed spaces.
Spatial organization	Aside from the Billy-Diamond highway, the spatial organization is dependent on a large, barely perceptible grid. Hills, elevated rocky outcrops, power transmission equipment and the Billy-Diamond highway form visual landmarks.
Unit observers (within the unit)	- Users of the permanent Cree camp, hunters, fishermen and trappers (temporary fixed observers). - Transiting users use the Billy-Diamond highway, snowmobile trails and bodies of water and watercourses (moving observers).
Visual field	The unit has highly variable visual fields. Where there are trees, the visual field is limited in depth and opening, and the views are closed. Where there are rocky outcrops, bare soil, open peatland or bodies of water, the visual field is open, as are the views. Where there are burns, the visual field is reduced and the views are filtered.
View quality and visual points of view	- The visual quality of the unit is based on its natural appearance. - The depth of the views depends on the height and density of the vegetation, which is highly variable. - The elevated rock outcrops are visible from afar and offer panoramic views. The Billy-Diamond highway offers views towards the unit.



Photo 6-12 Plateau landscape unit, view from an elevated rocky outcrop on the plain towards the plateau

POWER LINE LANDSCAPE UNITS

The power line landscape units (LI01 and LI02) are long corridors that cross the landscape in the study area. (Map 6-24 and Photo 6-13). The controlled vegetation and power transmission equipment in these corridors contrast with the surrounding natural landscape. The towers are important visual landmarks of the landscape in the study area.

Table 6-70 Power line landscape units

Component	Description
Limits and specific land use	- Landscape units LI01 and LI02 include power transmission equipment and cut across the Billy-Diamond highway in some places. The towers rise well above the treetops. Controlled vegetation under the equipment forms a corridor about 55 m wide. - The LI01 power line landscape unit crosses the study area along a north/south axis for about 20 km. It is usually east of the Billy-Diamond highway. Unit LI02 crosses the study area along an east-west axis for approximately 20 km and runs perpendicular to that of the Billy-Diamond highway.
Roads or transport routes	Each unit is accessible by a secondary road via the Billy-Diamond highway and controlled vegetation allows access to the equipment.
Land use elements	- Unit LI02 cuts across one wildlife area and a large valued area. - Unit LI01 cuts across three wildlife areas.
Topography	The units follow the terrain while avoiding the highest hill peaks.
Hydrography	The units straddle many watercourses.
Vegetation	Vegetation is cut regularly and is generally lower than adjacent natural vegetation.

Table 6-70 Power line landscape units (cont.)

Component	Description
Spatial organization	- The spatial organization of the units is governed by the routes of the power lines. - The part of the power transmission structures that extends beyond the treetops creates landmarks in the landscape.
Unit observers (within the unit)	The main observers are mobile.
Visual field	The visual field is generally deep but limited in opening due to the presence of trees on both sides of the lines.
View quality and visual points of view	The visual quality of the units is based on the plant diversity created by the maintenance of the rights-of-way and the deep views.



Photo 6-13 Power line landscape unit, view from the Eastmain River valley towards the power transmission equipment

ROAD LANDSCAPE UNIT

This unit consists of a stretch of the Billy-Diamond highway and its surroundings, including diverse vegetation and a rest area (Map 6-24 and Photo 6-14, 6-15). The Billy-Diamond highway is the backbone from which the James Bay landscape has generally been viewed and experienced since 1970, at least by non-Indigenous people. Its path follows the natural terrain and offers views of the region from certain stretches.

Table 6-71 Road landscape unit

Component	Description
Limits and specific land use	The road landscape unit includes a stretch of approximately 31 km of the Billy-Diamond highway and its surroundings (30 m wide on both sides of the road). It crosses the study area from north to southwest following a sometimes winding path. It includes a truck stop at km 381 of the 620 km Billy-Diamond highway. The truck stop is an important geographical landmark for travellers and its buildings are the largest in the study area. There are also abandoned borrow pits whose tracks fade with natural revegetation.
Roads or transport routes	Some service roads are attached to the Billy-Diamond highway and lead to different activity areas.
Land use elements	The road is near the permanent Cree camps in the study area. It cuts across most of the wildlife areas and crosses a large valued area.
Topography	The road follows the topography of its receiving environment while being elevated by at least 1 m because of its sizeable infrastructure.
Hydrography	The road drains into ditches.
Vegetation	The roadside is typically vegetated. Vegetation cover has colonized the road shoulders, which consist of a fine granular material. Vegetation in the surrounding area and on the shoulders is highly varied, like that of the entire study area. However, it often has more trees than the surrounding natural environment.
Spatial organization	- The spatial organization of the unit is governed by the fairly winding path of the road. - Where present, woody vegetation forms a visual screen. - The visual landmarks of the road are located in adjacent landscape units (elevated rock outcrops, hills, towers).
Unit observers (within the unit)	The main observers of the unit are mobile and are the users of the Billy-Diamond highway.
Visual field	The visual field is more or less deep in the centre of the road, depending on how winding it is, and its opening is limited or filtered by vegetation.
View quality and visual points of view	- The visual quality of the road is based on its natural appearance and deep views. The deepest views are from the high points of the road and where there is no woody vegetation. - The diversity of the visual framing of the Billy-Diamond highway helps heighten perception of the landscape.



Photo 6-14 Road landscape unit



Photo 6-15 Road landscape unit

6.4.9 HERITAGE AND ARCHAEOLOGY

6.4.9.1 NATURAL HERITAGE

With the adoption of Bill 46 and its sanction in March 2021, the *National Heritage Conservation Act* (NHCA) was amended to address three goals (MELCC, 2021a):

- accelerate the process of creating protected areas;
- broaden the range of natural environment protection tools;
- more broadly involve the citizens and Indigenous in the creation and management of protected areas.

The planned areas will receive permanent protected status, abolishing the provisional protected status step. The amendment of the NHCA also introduces a new mechanism for areas north of the 49th parallel by assigning them a new designation as northern conservation areas, along with a public participation process and public register specifically for northern areas.

With regard to potential protected area projects, the following stakeholders were consulted: the Eastmain Band Council, the Protected Land Use and Planning Committee and the Commissioner of the Nation of Eastmain (Raymond Shanouch), the Director of the Eastmain Environmental Department and the Société du Plan Nord (SPN). The MELCC protected areas map (2021b) was also consulted. It was concluded that there are no protected areas in the study area.

6.4.9.2 ARCHAEOLOGY

Indigenous traditional knowledge has been collected for consideration through consultations with Cree land users and elders since 2012. The information was collected to better understand their means of travel and land resource development strategies. The accounts provided by the inhabitants teach us and provide information on trails they have taken, camps they have used and experiences they have lived or have been told. Traditional Indigenous knowledge is critical to understanding the past and present human landscape. By combining the experiences of Cree inhabitants with the experience of archaeologists equipped with related knowledge useful to understand past events, it is clear that the findings will be more in line with what the past human occupation at this location could have been.

Moreover, in meetings with land users, their family members, and elders, interview matrices were used to direct these discussions, including questions about the location of places of birth, burial sites, artifacts or former camps that could have been seen in the past, which led to discussions about past use of the land around km 381.

The data collected helped to assess the territory's archaeological potential. Spaces and sectors known for their fur-bearing animal trapping, wetlands with peatlands suitable for hunting, and geomorphological and drainage characteristics were all considered in order to identify archaeological areas. Traditional Indigenous knowledge was also considered and respected. The knowledge acquired by studying the descriptions and accounts of Cree users was also considered.

In the Arkéos study (2018), the process of determining areas with archaeological potential also involved considering locations with spaces that could accommodate human occupation, i.e. a spaces that stood out from the ubiquitous wetlands in the study area. In such an environment, strategically well-placed locations for utilizing resources or establishing camps (bivouac to base camp) are generally located on well-drained elevated areas. These two characteristics remain key in selecting potential archaeological areas for the study area in question.

The natural and archaeological heritage baseline is detailed in the archaeological potential study by Arkéos (2018), as it identifies the locations where human occupation would have been possible at different times since the retreat of the Laurentide Ice Sheet.

In short, the study conducted for the James Bay Lithium Mine project, **helped to** evaluate the archaeological potential in the distinct study area, shown on Map 6-22 (Arkéos, 2018). The following text outlines this study.

The findings of the study were as follows:

- Hydrographic and topographic features may have made Indigenous groups interested in using the study area. The study area straddles two secondary watersheds that flow more or less parallel to the Eastmain River in opposite directions. These watersheds would have been good alternatives to bypass a section of the Eastmain River that has rapids. Otherwise, populations may have been likely to occupy the area in order to use resources found there, particularly the wetland wildlife.
- An archaeological survey was conducted for the 450-kV power line that runs through the study area. Two nearby areas were visited, the crossings of the Eastmain River and the Pontax River. This survey did not uncover any archaeological sites.
- However, ancient human presence in the study area is evidenced by both the toponymy and the existence of at least one archaeological site (FbGg-1) east of the hill where the pit will be built (about 400 m). **This site is near the km 381 truck stop.**

In total, 27 areas with prehistoric archaeological potential have been targeted within the study area. These sites are those that are most likely to contain remains attesting to a human presence from prehistoric time up to the twentieth century. These areas of archaeological potential are shown on Map 6-22. **They also include potential in connection with camp sites and remains.**

After a public presentation in Eastmain in July 2018, participants were informed that a characterization study would be done on areas of archaeological potential that were likely to be affected by the project, but the participants did not respond with any specific comments.

Field validation and demarcation of areas of archaeological potential found within the projected project footprint are planned for summer 2021. This work will confirm the archaeological potential of the target sites, and, if needed, recommend additional mitigation measures.

The RE2 trapline tallyman, or his representative, will accompany the team of archaeologists during the field validation.

Lastly, the archaeological strategy implemented will consider how to manage discoveries and collections.

MANAGEMENT OF DISCOVERIES

The importance of the discoveries will be assessed by archaeological consultants based on the value of the movable and immovable remains from a local, regional and national perspective. The protection of heritage discovered will always be a priority. In that respect, the project shall be modified, to the extent possible, to avoid disruption to the archaeological sites discovered. If the project cannot be modified and a discovery is threatened, the plan is to conduct an archaeological excavation and implement necessary measures for subsequent analysis of the data collected and dissemination of the findings. If the cultural material found is of interest, the collection may be presented to the Cree nation through an exhibit. The discoveries will therefore be showcased through scientific publications ("archaeological" review) and a travelling museum exhibit for the Cree nation.

COLLECTION

The archaeological collection shall be cleaned and inventoried by the consultant, if need be. If objects require a specific conservation treatment, a request for assistance to the *Centre de conservation du Québec* will be made. The collection may later be given to the Aanischaaukamikw Cree Cultural Institute, in Oujé-Bougoumou, after agreement with the Ministère de la Culture et des Communications.

Before the archaeological survey takes place in summer 2021, archaeology experts from the Cree Nation Government and the RE2 trapline tallyman will validate the selected areas of archaeological potential. If needed, areas of archaeological potential may be adjusted based on their feedback.

7 IDENTIFICATION AND ASSESSMENT OF ENVIRONMENTAL IMPACTS

7.1 IMPACT ASSESSMENT METHOD

The general approach used to identify, analyze and mitigate environmental impacts (or improve them when these are positive) relies on a sound knowledge of the project and the receiving environment, on the experience acquired during the construction, operation or follow-up of similar projects. The approach covers the following elements:

- Knowledge of the project allows us to identify sources of impact based on the technical properties of the structures to be built and work to achieve (construction phase), operation modes (operation phase) and rehabilitation work (rehabilitation phase), when necessary, in addition to the activities and timelines associated with the various phases.
- Description of the environment (physical, biological and human) allows us to understand the project's environmental and social context and identify its most sensitive components.
- The consultation of stakeholders affected by the project allows us to survey their expectations and concerns, in addition to gaining a thorough knowledge of the environment, which leads to, considering the knowledge acquired on the receiving environment, an identification of the major issues linked to the project.
- Experience acquired during the execution of past projects provides information on the nature and intensity of impacts associated to this type of project, and on the effectiveness of the mitigation, improvement and compensation measures normally used.
- Concurrently, these different types of knowledge automatically mitigate the number and magnitude of the impacts likely to occur, since the project is subject to an optimization process at its planning stage.

Note that differences in views between experts **in charge of the impact assessment** and the population concerned by the project, **particularly members of the First Nations**, can arise at the impact assessment stage. The following sections report these differences, among other things, when these were observed.

Comments gathered during consultations with Tallymen, land users and other members of the Cree Nations, mainly from Eastmain and Waskaganish, were taken into account at various stages of the impact assessment: identification of environmental components likely to be affected by the project, delineation of the assessment area, assessment of anticipated impacts, and selection, improvement and addition of proposed mitigation measures.

Furthermore, at the suggestion of the Eastmain Cree Nation, in order for members to improve their mining knowledge and to better assess the impacts of the project, an introductory course on mining and lithium was offered to the community by Galaxy on July 11, 12 and 13, 2018. Additional project development briefings were conducted throughout the development of the project (Chapter 5).

Appendix I details the mitigation measures proposed by the Cree First Nations and other regional stakeholders, and how Galaxy took them in account throughout the consultation process and project optimization.

7.1.1 KEY ELEMENTS

7.1.1.1 SOURCES OF IMPACT

The sources of impact represent project components likely to have effect on the environment. We can distinguish them, based on whether they are linked to the construction, operation or rehabilitation phase. The construction phase will not only include mining complex construction activities (infrastructure), but also preliminary activities required to mine the deposit (clearing, stripping of overburden and surface waste rock, etc.). The sources of impact also take into account the presence and functioning of the project's infrastructure, throughout its operation and also during rehabilitation work to ensure site closure according to regulations established.

Some sources of impact are negative while others are positive. Table 7-1 presents the sources of impact related to the project.

Table 7-1 Project impact sources

Construction phase	
Site preparation and infrastructure construction	Stripping of natural soils, clearing, excavation and grading work, work in aquatic environment. Presence of site trailers and construction of temporary or permanent infrastructure (buildings, storage areas, access roads, mining infrastructure foundations, construction of buildings and of road for ore transport, etc.).
Water management	Management of runoff or other on the site during construction work.
Hazardous and waste materials management	Handling, management of hazardous and waste materials to eliminate, recycle or reuse. Also, management of accidental spilling of hazardous waste related to overall activities.
Transportation and traffic	All transportation on site, refueling as well as local traffic and on the Billy-Diamond highway . Also, use of equipment (bulldozers, drills, excavators, etc.) required on the site.
Economic development and presence of workers	Hiring of labour and presence of workers at the mine, purchase of goods and materials and granting of contracts for various services.
Operation phase	
Presence and operation of the pit	Process plant feed material and waste rock drilling, blasting and extraction activities.
Other infrastructure and equipment in operation	Concentrator, garage for mechanical maintenance, administrative offices, water treatment plant, explosive warehouse , worker camp, generators, etc.
Management of process plant feed material, overburden and waste rock	Storage of process plant feed material, overburden, waste rock and tailings in accumulation areas intended for that purpose, disposal of tailings in mined-out portions of the pit and ongoing restoration when possible.
Water management	Dewatering of the pit, management of water at the plant, on the mining site and toward a natural environment (final effluent).
Hazardous and waste materials management	Handling, management of hazardous and waste materials to eliminate, recycle or reuse. Also, management of accidental spilling of hazardous waste related to overall activities.
Transportation and traffic	All transportation on the site, refuelling, local traffic on the Billy-Diamond highway and transporting of spodumene concentrate to Matagami, and use of heavy equipment on the site (bulldozers, drills, excavators, etc.).
Economic development and presence of workers	Hiring of workforce and presence of workers at the mine, purchase of goods, services and materials for mining operations.

Table 7-1 Project impact sources (cont.)

Rehabilitation phase	
Infrastructure dismantling	Work linked to the dismantling of plant and related facilities.
Pit rehabilitation	Flooding and securing of the pit.
Water management	Water intake and wastewater treatment, if necessary and rehabilitation of site, etc.
Hazardous and waste materials management	Handling, management of hazardous and waste materials to eliminate, recycle or reuse. Also, management of accidental spilling of hazardous waste related to overall activities and soil decontamination work if necessary.
Transportation and traffic	All transportation on the site, demolition materials to be removed from the site, local traffic on Billy-Diamond highway , as well as use of heavy equipment on the site (bulldozers, drills, excavators, etc.).
Economic development and presence of workers	Hiring of workforce for site rehabilitation and purchases required for completion of the work.

7.1.1.2 ENVIRONMENTAL COMPONENTS

Identifying the environmental components, using inventories from the study area, will serve to draw up of a list of elements from the physical, biological and social environments likely to be affected by one or several sources of impact related to the project. These components are presented in Table 7-2.

Since a valued component is considered to be an element of scientific, social, cultural, economic, historical, archaeological or aesthetic importance, the elements valued by the First Nations were considered in the EIA. The main elements valued by the Cree First Nations are included in the corresponding environmental components, and concern:

- **water quality (particularly the Eastmain River and creek CE5);**
- **air quality;**
- **soil quality;**
- **fauna quality in general (in particular beavers, moose, geese, sturgeon, trout and porcupines);**
- **quality of vegetation consumed by users and animals (including medicinal plants and berries);**
- **territorial integrity;**
- **quality of life at the camp (health, dust, noise).**

7.1.2 ANTICIPATED IMPACTS OF PROJECT

Project impacts are determined using a grid that establishes links between sources of impact and environmental components. The exercise allows us to identify the environmental components likely to be affected by the facilities or activities planned.

Environmental protection measures integrated from the moment of project design are considered in determining potential impacts. The grid on impact interrelationships is presented in Table 7-3. Each box in the grid shows the project component from which the potential impact can occur on an environmental component.

7.1.3 IMPACT ASSESSMENT

Impact assessment consists in determining, during the various stages of the project, the significance of the anticipated impacts on the physical, biological and social environment. This assessment considers measures incorporated at project design, in addition to applicable mitigation and improvement measures, and focuses on impacts that persist following application of these measures, that is, residual impacts.

Three criteria are analyzed to measure the significance of the impact:

- Intensity of impact;
- Extent of impact;
- Duration of impact.

Details of the assessment criteria are presented below.

Table 7-2 Identification of environmental components of project

Physical environment		
Soil		Physicochemical and stratigraphic properties of surface deposits and vulnerability of soil to erosion and contamination and their stability.
Water	Hydrogeology	Natural gravity flow (water table) or induced (draining or pumping) of groundwater.
	Hydrological regime	Movement and renewal of surface water, watercourse hydrology and hydraulics.
	Water and sediments	Physicochemical properties of surface water, groundwater and sediments and their vulnerability to contamination.
Air	Atmosphere	Physicochemical properties of air, including dust concentration and GHG emissions.
	Artificial light at night	Ambient night-time lighting level
	Ambient noise	Ambient noise level properties.
	Vibrations and overpressure	Air pressures and velocity of ground vibrations during blasting.
Biological environment		
Vegetation and wetlands		Land plant groups, hydrous environments, including species at risk from the study area.
Fauna	Large fauna	Moose, caribou, bears and their habitats.
	Small fauna and herpetofauna	Small land mammals and their habitats, including species at risk and species trapped by the Cree. All amphibians and reptiles.
	Ichthyofauna	Fish populations and their habitats.
	Avifauna	All bird species and their habitats, including species at risk.
	Bats	All chiroptera species (bats) and their habitats, including species at risk.
Social environment		
Current use of land and resources for traditional purposes		Traditional hunting, fishing, trapping and gathering activities by Indigenous people.
Infrastructure		Billy-Diamond highway, km 381 truck stop and SDBJ.
Perception of physical environment		Air and water quality, ambient noise, night-time lighting, vibrations and overpressure.
Quality of life		Lifestyle, social environment and health-care services.
Local and regional economy		Jobs and businesses.
Heritage and archaeology		Natural heritage (protected areas), areas of archaeological potential and incidental findings.
Landscape		Landscape units and visual integrity.

Table 7-3 Grid on anticipated impact interrelationships

			Construction phase					Operation phase					Rehabilitation phase							
			Site preparation and infrastructure construction	Water management	Hazardous and waste materials management	Transportation and traffic	Economic development and presence of workers	Presence and operation of the pit	Other infrastructure in operation	Management of economic material, overburden and waste rock	Water management	Hazardous and waste materials management	Transportation and traffic	Economic development and presence of workers	Dismantling of infrastructures	Rehabilitation of the pit	Water management	Hazardous and waste materials management	Transportation and traffic	Economic development and presence of workers
Environmental components	Physical environment	Soil	—		—				—		—			—			—			
		Hydrogeology	—	—				—	—	—	—			—	—	—				
		Hydrological regime	—	—				—	—	—	—			—	—	—				
		Water and sediments	—	—	—	—		—	—	—	—	—		—	—	—	—	—	—	
		Atmosphere	—		—	—		—	—	—		—		—	—			—	—	
		Artificial light at night	—			—		—	—	—			—		—				—	
		Ambient noise	—			—		—	—	—			—		—	—			—	
		Vibrations and overpressure	—					—												
	Biological environment	Vegetation and wetlands	—		—	—		—		—		—			+				—	
		Large fauna	—		—	—	—	—	—				—	—	—				—	—
		Small fauna and herpetofauna	—	—	—	—		—	—			—			—		—	—	—	
		Ichthyofauna	—	—	—	—		—		—	—				—		—		—	
		Avifauna	—			—		—	—	—		—			—				—	
		Bats	—			—		—	—	—			—		—				—	
	Social environment	Use of land and resources for traditional purposes	—			—	—	—	—	—		—	—	—	—				—	—
		Infrastructure				—	+						—	+					—	+
		Perception of physical environment	—	—		—		—	—	—	—		—		—	—	—		—	
		Quality of life	—			—	+	—	—	—			—	+	—	—			—	+
		Local and regional economy					+							+						+
		Heritage and archaeology	—					—		—										
		Landscape	—			—		—	—	—			—		—	—			—	
Note — indicates a negative impact and + a positive impact.																				

INTENSITY OF IMPACT

Intensity of impact indicates the severity of disturbance on the environmental component studied.

This analysis considers the environmental component's properties (namely its sensitivity and resilience in the face of change) as well as its enhancement. The value associated with the environmental component considers its ecosystemic (only biological environment) and/or socio-economical role, as well as, the value assigned to it by the stakeholders consulted.

The environmental components which are subject to legal or regulatory protection, for which the protection is subject to a consensus or which play an essential role in their environment (ecosystem, sociocultural or economic environments, etc.) are considered as highly valuable. On the contrary, environmental components that fail to generate interest and whose conservation and protection are of little concern to the environment are considered as invaluable.

There are three levels of impact intensity:

- **High intensity:** the impact endangers the environmental integrity of the component or substantially or irreversibly changes the component or its use.
- **Moderate intensity:** the impact leads to a reduction in the quality or use of the component but does not compromise its environmental integrity.
- **Low intensity:** the impact imperceptibly destroys or changes the quality, use or integrity of the component in the environment.

Concerning the landscape, impact intensity is based on level of absorption and insertion of the project's equipment and structures in its environment.

EXTENT OF IMPACT

Extent of impact is based on the size of the territory or proportion of inhabitants affected. Extent can be regional, local or isolated:

- **Regional extent:** the impact affects the entire study area (or area larger than the study area) or a large proportion of its population **or several municipalities/villages in the region.**
- **Local extent:** the impact **affects a large proportion of the local study area within, near or some distance from the project footprint, or it is felt by a limited proportion of the population of the study area or surroundings.**
- **Isolated extent:** the impact affects a small area or a few individuals in the **local study area or it is only felt by a small proportion of the population (a few individuals) in or around the study area.**

Concerning the landscape, extent of impact is related to the observers' level of perception of the equipment and structures in the landscape.

DURATION OF IMPACT

Duration of impact refers to the period of time for which the impact of the project will affect the environment. These criteria include intermittence. Impact duration can be long, moderate or short:

- **Long-term:** the impact persists on a continuous or discontinuous basis during the entire project duration **(construction and operation, about 18 years).** This is often a permanent and irreversible impact.
- **Moderate-term:** **the impact is felt temporarily, continuously or discontinuously during the construction phase as well as during the operation phase, but rather discontinuously. These are reversible impacts which still manifest themselves several months after the end of construction work and which could also affect the restoration period.**

- **Short-term: the impact is felt temporarily, discontinuously during the construction phase only or may slightly exceed the end of the construction phase, or only very limited and discontinuously during the operation phase. These are reversible impacts, the duration of which varies between a few days and a few months.**

For the landscape component, duration indicators are the same as those used for the other components.

MITIGATION, IMPROVEMENT AND COMPENSATION MEASURES

Note that the sound integration of the project in its environment is favoured as of the planning and design stage, thanks to the implementation of criteria or optimizations aimed at protecting the environment **and reducing impacts of the project on the components valued by the First Nations. The comments collected during consultation activities with tallymen, land users and First Nations communities throughout the project, made it possible to validate, improve and add measures.**

Therefore, mitigation measures aim to limit the negative impacts of the project on the environment, while improvement measures instead increase the positive impacts. As for compensation measures, these are implemented to compensate the loss or permanent disturbance of some environmental components.

The different measures are identified during the impact assessment exercise for each of the environmental components and allow for a more accurate assessment of the significance of the impacts.

An impact can either be positive or negative. However, only the significance of a negative impact is assessed. This significance is based on intensity, extent and duration of the disturbance. On completion of the assessment, significance is qualified as minor, moderate or major. If the assessment concludes to a significance less than minor, the impact is qualified as negligible.

ASSESSING IMPACT SIGNIFICANCE

As mentioned previously, significance of impact is the result of an overall judgment on the effect of a source of impact on an environmental component, **following application of the mitigation or improvement measures.**

Impact significance incorporates criteria linked to intensity, extent and duration and can be major, moderate or minor, as shown in Table 7-4. The impact significance rating grid is symmetrical since it includes the same amount of impacts of major significance as it does of minor significance (7 in each case) and 13 possibilities of moderate significance impacts.

For the landscape, although intensity and extent indicators differ from the other components, the same impact significance rating grid is used.

Moreover, when certain physical components fall within a regulatory framework, the latter is into account during impact analysis, although it disregards the notions of intensity, duration and extent. For example, the ambient noise impact analysis is based on Instructions Note 98-01 (MDDEP, 2006). Nonetheless, depending on the receiving environment, assessment criteria used to establish the significance of an impact will not be considered uniquely. In the end, the analysis is based on the same method as the one presented above.

Note that for some of the Cree having participated in consultation activities on intensity, extent and duration, the impact assessment differs and hence, significance could be greater for them. **It is mentioned in the text, when it is the case.** To respond to the concerns and worries **of the First Nation communities**, mitigation or improvement measures have been planned, including several environmental follow-ups to study component trends and assess the efficacy of the measures, as well as, communication methods to keep stakeholders informed of the results of these follow-ups. Furthermore, Galaxy remains open to reviewing the mitigation measures implemented and to adjusting them throughout the life of the project to adequately address the concerns of the stakeholders.

PRESENTATION OF RESULTS

For each environmental component identified and for each phase of the project, if applicable, the analysis and assessment of anticipated impacts are presented as follows:

- Source(s) of impact.
- Mitigation measure(s).
- Description of impact.
- Assessment of impact, if the impact is of a negative type.

For ease of reading, the mitigation measures for each project component are identified by a distinct code. The definitions of these mitigation measures can be found in Table 7-5, preceding the impact analysis. The same mitigation measure codes will be used in the impact analysis and assessment exercise (Table 7-5). Lastly, a summary of the impacts is presented at the end of the chapter. The results of the impact significance for each phase of the project are presented.

Table 7-4 Impact significance rating grid

Intensity	Extent*	Duration	Significance
High	Regional	Long	Major
		Moderate	Major
		Short	Major
	Local	Long	Major
		Moderate	High
		Short	Moderate
	Isolated	Long	Major
		Moderate	Moderate
		Short	Moderate
Moderate	Regional	Long	Major
		Moderate	Moderate
		Short	Moderate
	Local	Long	Moderate
		Moderate	Moderate
		Short	Moderate
	Isolated	Long	Moderate
		Moderate	Moderate
		Short	Minor
Low	Regional	Long	Moderate
		Moderate	Moderate
		Short	Minor
	Local	Long	Moderate
		Moderate	Minor
		Short	Minor
	Isolated	Long	Minor
		Moderate	Minor
		Short	Minor
* For the landscape, the regional extent corresponds to a large area, the local extent corresponds to a limited area and the point extent to a small area.			

Table 7-5 List of applicable mitigation measures

Code	Description
Profile and ground surface	
SUR 01	Mark out the boundaries of the planned earthworks, restrict the areas of deforestation and soil stripping as well as cutting areas to the footprint of the required infrastructure (road, pits, stockpiles, basin, etc.).
SUR 02	Mark out access, paths and work areas before undertaking work, and prohibit parking and movement of machinery and vehicles outside of those areas.
SUR 03	Rehabilitate creek banks disturbed by the work as early as possible to minimize erosion and sedimentation. If it is impossible to permanently stabilize disturbed surfaces before winter, implement temporary protection measures.
SUR 04	In watercourse crossing areas, perform deforestation work immediately before construction to minimize erosion.
NOR 01	Restore work areas and stockpiles by levelling surfaces, covering them with natural soils, scarifying or seeding them to support revegetation. Stabilize reworked areas, embankment slopes, overburden stockpiles, etc., as work progresses. Reference: D019 for rehabilitation phase
Soil, water, and sediment quality	
QUA 01	Ensure that enough emergency kits for the recovery of petroleum products and chemicals are available in sensitive locations.
QUA 02	Through frequent inspections, ensure that machinery is in good working order (clean with no contaminant leaks) and that fuel and lubricant tanks are perfectly sealed. Any discovered leaks require immediate repairs to the tank in question.
QUA 03	The usual precautions should be taken during maintenance (draining, greasing, etc.) and refuelling of machinery on site to avoid any accidental spills. Maintenance is to be permitted only in authorized locations intended for that purpose (garage, mechanical workshop); refuelling is to take place in specifically designated areas.
QUA 04	In the case of temporary storage of contaminated excavated material, take all the necessary actions to preserve the integrity of the surrounding soil and water and ensure the safety of workers (put piles on a sealed or impermeable surface, cover piles, restrict access to these piles, etc.).
QUA 05	Continuously stabilize or protect exposed surfaces as soon as possible in order to reduce the transport of suspended solids (revegetation) and to limit the leaching of materials.
QUA 06	Establish a well system on the periphery of the mining infrastructure to measure the drawdown and the rise of the water table in the sector of the pit.
QUA 07	Carry out development work likely to alter the water quality of watercourses outside the snowmelt period (April 15 to June 15).
QUA 08	Limit the transport of fine particles in the water environment beyond the immediate work area by an effective means (sediment traps, sediment barriers, turbidity curtain, etc.).
QUA 09	Build a temporary bridge for machinery if crossing a watercourse is required. Set up bridging or an ice-bridge when building a trail across a watercourse or fish habitat (ref. NOR 05).

Table 7-5 List of applicable mitigation measures (cont.)

Code	Description
Soil, water, and sediment quality (cont.)	
QUA 10	Equip all fixed equipment containing oils and/or fuel (lighting tower, generator, crusher, sifter, etc.) located less than 60 m from a watercourse or body of water with a leakproof recovery system. Equipment must be equipped with absorbents for quick and effective response in the event of an accidental spill.
QUA 11	Temporary facilities (e.g. construction site trailer, access road, storage areas, waste site) must be located more than 60 m from a watercourse.
QUA 12	Any vehicle and machinery maintenance is prohibited outside the designated areas.
QUA 13	Refuel the vehicles and machinery at the places designated for this purpose and according to the good practices in force.
QUA 14	Monitor the quantity and quality of the water from the drinking water supply well of the km 381 truck stop and provide drinking water to the truck stop or drill a new drinking water well in the event that the drawdown renders the drinking water well of the truck stop unusable.
QUA 15	Manage the explosives warehouse so that there are zero releases: - Sanitary waste will be collected in a sealed pit and disposed of externally; - Used oils and other non-recyclable discharges will be disposed of externally by an authorized company for reclamation or disposal; - Trucks containing ANFO will be washed inside the building and the wash water will be sent to the oil separator and then filtered and recycled.
NOR 02	Manage excavation waste according to their degree of contamination and in accordance with the requirements of the <i>Soil Protection and Rehabilitation of Contaminated Sites Policy</i> . Reference: Q-2, r. 37 – <i>Land Protection and Rehabilitation Regulation</i> : Schedules I and II and Response Guide – Soil Protection and Contaminated Sites Rehabilitation: Table 5 – Soil recovery methods authorized in Québec
NOR 03	Dispose of contaminated excavation according to the contaminated soil management grid in the Intervention Guide. If disposal in the stockpile is a possible option, Galaxy will apply to the Ministry for authorization and will not act until authorization is obtained. Reference: Q-2, r. 18 – <i>Regulation respecting the burial of contaminated soils</i> : Schedule I and Guide – Soil Protection and Contaminated Sites Rehabilitation: Schedule 5 – Excavated soil management grid; Section 6.4.3.1 List of authorized treatment facilities
NOR 04	Dispose of surplus or unusable excavation waste (clay, silt, gravel, rock) with due care and in accordance with the <i>Protection Policy for Lakeshores, Riverbanks, Littoral Zones and Floodplains</i> and D019 to ensure adequate separation from water environments.
NOR 05	Install culverts or crossing structures designed to maintain the free flow of water (and the free passage of fish). The construction of bridges or the installation of culverts shall not reduce the width of the watercourse by more than 20%, as measured from the natural high-water mark. The base of the lower culvert shall be driven below the natural bed of the watercourse at a depth of not less than 15 cm or 10% of the height of the structure and its ends shall extend beyond the base of the embankment by not more than 30 cm and be adequately stabilized. Reference: <i>Regulation respecting standards of forest management for forests in the domain of the State</i>
NOR 06	Install a minimum of three observation wells in the selected locations around the stockpile to verify groundwater quality upstream and downstream. Reference: D019, section 2.3.2.1

Table 7-5 List of applicable mitigation measures (cont.)

Code	Description
Soil, water, and sediment quality (cont.)	
NOR 07	Surround mining infrastructure pits so that drainage and runoff are transported to a basin and then treated as needed before being released into the environment. In addition, runoff outside activity areas shall be captured by drainage pits, built around the components of the mine site to prevent these waters from encountering sources of contamination (dilution prohibited). Reference: D019, section 2.1.5
NOR 08	Before discharging effluent water, ensure it will be done in accordance with the standards. Reference: <i>Metal and Diamond Mining Effluent Regulations</i> , sec. 4 and Schedule 4 and D019, section 2.1.1.1
NOR 09	In the event of an accidental spill, stop the leak as soon as it is spotted, contain the product and recover it using suitable equipment (absorbent sheets, flanges, drain covers, etc.). Immediately notify the Minister Excavate contaminated soil, place it in a sealed container and dispose of it in accordance with the hazardous materials management program. Advocate for quicker interventions to prevent deep infiltration. Reference: <i>Environment Quality Act</i> , Sec. 21 and <i>Regulation respecting hazardous materials</i> , Sec. 9
NOR 10	Set aside overburden and segregate the topsoil for reuse when redeveloping disturbed areas. Reference: D019, section 2.6
Atmosphere	
AIR 01	Regularly water roads, work areas, and stockpiles by moistening them to prevent resuspension and dust emission and ensure that recordings of the application of water and dust suppressants is kept during construction and operation of the site. The frequency and intensity of watering the roads will thus be adapted to weather conditions and results from monitoring of air quality.
AIR 02	Avoid unnecessary engine idling to reduce noise and disturbances from exhaust gas, smoke, dust, or any other contaminants likely to come from the machinery.
AIR 03	Limit the vehicle speed on the various sites as well as for mine operations.
AIR 04	Instead of burning, proceed as much as possible with chipping tree removal residue and clear brush at the work site and then spread.
AIR 05	Optimize stripping according to the real needs of the operation so as not to overexpose unused stripped surfaces in relation to wind erosion and/or to restrict, as needed, access to these surfaces if they are not used during long periods of time.
AIR 06	Monitor total particulate matter (TPM), respirable particles (PM10), fine particles (PM2.5) and crystalline silica, especially near the truck road, from the start of operations.
AIR 07	Ensure regular maintenance of dust collectors in order to maintain a purification efficiency at all times.
NOR 11	Ensure that vehicle and machinery exhaust systems are in good condition and function optimally to minimize contaminant emissions into the air, and ensure that the same is true for dust control systems for equipment and machines that are equipped. Reference: <i>Clean Air Regulation</i> , Sec.6

Table 7-5 List of applicable mitigation measures (cont.)

Code	Description
Artificial light at night	
LUM 01	Restrict the emission of light toward the sky using fixtures that produce a simple and uniform lighting that would meet the real lighting needs with a luminous flux that would be directed toward the surface to be illuminated;
LUM 02	Limit the period and duration of the use of the lights at night.
LUM 03	Install fixed lights to avoid light spilling out of the spaces to be illuminated and pay attention to the orientation of portable lights and lighting from mobile sources.
Ambient noise	
SON 01	Ensure that motorized equipment (trucks, loaders, bulldozers, backhoes, etc.) are equipped with efficient silencers and are in good condition.
SON 02	Inspect the machinery regularly to ensure that the exhaust systems are in good condition to limit noise emissions.
SON 03	Develop a mound with waste rock at the southern perimeter of the east WRTSF so as to have a screen effect between the mobile equipment circulating at the top of the stockpile and the truck stop at km 381. This mound will evolve according to the elevation of the stockpile.
NOR 12	The reference noise level of a fixed source associated with a mining activity shall be assessed in accordance with the requirements of Instruction Note 98-01. Reference: D019, section 2.4.1
Vibrations and overpressure	
VIB 01	Notify all employees and the public about the blasting schedule.
VIB 02	For blasting activities, maintain a maximum of four holes exploding in 8 ms to ensure compliance with the vibration criteria of D019.
VIB 03	To limit overpressure, perform blasting activities in the absence of thermal inversion and carrier wind, when activities will be carried out within 800 m of the km 381 truck stop.
VIB 04	Use blasting mats and a collar height of at least 5 m when the blasting will be carried out within 500 m of the km 381 truck stop and the James Bay Road, to limit rock projections.
VIB 05	Set up a vibration and noise self-monitoring system during blasting operations.
NOR 13	Comply with the maximum distances and loads during blasting to adhere to the criteria of D019 and the threshold guidelines regarding the use of explosives in or near Canadian fisheries waters. Reference: D019, section 2.4.2 and Fisheries Act, para. 35(2) and Guidelines for the use of explosives in or near Canadian fisheries waters, p. 6, paragraphs 8 and 9.

Table 7-5 List of applicable mitigation measures (cont.)

Code	Description
Vegetation and wetlands	
VEG 01	Carry out tree clearing to direct their fall into the areas to be cleared. Do not leave any logging residues in watercourses and areas not affected by the work.
VEG 02	Choose native plant species suitable for mine site rehabilitation and appropriate to the hardness zone.
VEG 03	To prevent the introduction of invasive alien plant species (IAPS), clean the excavation machinery or vessels before using them on site.
VEG 04	Recover tree species with commercial value, enrich other types of wood by chipping them and using them to condition soil.
VEG 05	Verify the potential introduction or not of invasive alien plant species annually up to two years after completion of work and one year after restoration , and quickly eradicate, wherever possible, any new occurrences of invasive alien plant species observed.
VEG 06	Make a clay berm all along the stripped areas to prevent the drainage of peatlands on the periphery of infrastructure.
VEG 07	Build a clay berm along the stripped areas to avoid drainage of the peat bogs on the periphery of the infrastructure.
NOR 14	Maintain a riparian protection area of 10 to 15 m, depending on the side slope, around wetlands, watercourses, and waterbodies. Reference: Protection Policy for Lakeshores, Riverbanks, Littoral Zones and Floodplains, Sec. 3.1 and 3.2
NOR 15	Develop a compensation project for the loss of wetlands or water. Reference: <i>Act respecting compensation measures for the carrying out of projects affecting wetlands or bodies of water</i> , Sec. 2
Fauna	
FAU 01	Perform work in the water outside of the various reproduction periods of the species present, i.e., from July 1 to August 31 for brook trout, and from July 15 to April 15 for northern pike.
FAU 02	Prohibit or place maximum restrictions on deforestation activities between May 1 and August 15 to limit impacts on fauna during the main nesting periods.
FAU 03	Identify and report areas with the highest risk of collision with large mammals through adequate signage.
FAU 04	Prior to the demolishing a building or other facility, carry out an inspection (concealed spaces) to verify its possible use as maternity or dwelling place by bats. Where appropriate, protective measures will be taken to ensure the survival of bats.
FAU 05	Ensure workers are aware that it is important not to feed animals and not to leave food lying around so as not to attract wildlife near work areas.
FAU 06	Establish deterrents in the event of birds using the water management ponds.
FAU 07	Limit the use of borrow pits as nesting sites for birds by softening the slopes and by using deterrents. If nesting does occur, create a no-go zone until nesting is complete.

Table 7-5 List of applicable mitigation measures (cont.)

Code	Description
Fauna (cont.)	
FAU 08	Limit wildlife access to food waste by installing a composter and lids on garbage cans.
NOR 16	Develop a compensation project for the loss of fish habitat. Reference: <i>Act respecting the conservation and development of wildlife</i> , Chapter IV.1; Lignes directrices pour la conservation des habitats fauniques; <i>Fisheries Act</i> , Sec. 35(2)b and <i>Metal and Diamond Mining Effluent Regulations</i> , Sec. 27.1 (if deposit of deleterious substances into fish habitat)
Use of land for traditional purposes	
UTT 01	Ensure workers are aware of traditional practices of Indigenous communities and activities of Indigenous users of the territory.
UTT 02	Establish and maintain a communication plan to inform the public, users, and municipal authorities about the start and progress of work.
UTT 03	Conduct beaver dam inspections at regular intervals to identify any changes to the CE2 water level and flow, and notify the community of these changes.
UTT 04	Prohibit hunting and recreational fishing by mine site workers, with a clause in the contract, and appropriate disciplinary measures.
UTT 05	Provide a fund in the IBA with the Cree Nation of Eastmain to finance intergenerational knowledge transfer initiatives.
UTT 06	Encourage activities (such as stopping production to maintain machinery for around 10 days) that limit wildlife disturbance and road traffic during goose hunting season and facilitate breaks from traditional activities for Cree workers.
Infrastructure	
CIR 01	Establish a traffic management plan, including appropriate signage in specific areas, indicating speed limits and snowmobile and ATV crossings.
CIR 02	Secure developments at risk for land users by adding fencing.
CIR 03	Maintain at all times public routes free of any obstruction of debris, waste, dirt, sediment, etc.
CIR 04	Establish, together with the Tallyman, an area closed to traditional activities for security purposes.
CIR 05	Restrict machinery traffic to work areas.
CIR 06	Prohibit mine site access during a temporary cessation of mining activities.
CIR 07	Establish a protective berm around the pit to ensure the safety of land users during closure in accordance with the guidelines in section 4.5.2 of the Guide de préparation du plan de réaménagement et de restauration des sites miniers au Québec (2017).

Table 7-5 List of applicable mitigation measures (cont.)

Code	Description
Infrastructures (cont.)	
CIR 08	Conduct appropriate training of truck drivers and confirm their licenses, qualifications and completion of applicable training programs. Train drivers assigned to the transport of hazardous materials on the transport of hazardous materials (TDG). Educate all drivers on the risks of using the Billy-Diamond highway, land use by Crees near the road, winter driving and night driving. The applicable number of transport hours must be respected. Conduct quarterly driver training and meetings to discuss driver safety, awareness and hot spots.
CIR 09	Install running recorders in the trucks.
CIR 10	Maintain a record of driver training files.
CIR 11	Perform routine inspections to check the condition of the vehicle before setting off. Trucks shall have adequate lighting, clean windows and mirrors, and be maintained to allow unobstructed vision. Inspections will be recorded.
CIR 12	Consider weather conditions before leaving or going to the project site.
CIR 13	Develop procedures for the proper management of truck breakdowns on the road.
CIR 14	Establish a radio communication protocol between the drivers, the site and the transshipment yard.
CIR 15	Monitor accidents along the road to see if there is a recurrence, validate and identify problems, if any, and propose corrective measures. Record all problems encountered on the road in the mine's global incident management log.
CIR 16	Avoid any animal intrusion into the container space for the management of WM (waste materials). The container itself will not allow access to animals and access to the container storage area will also be controlled by screens or fencing.
Perception of physical environment	
PER 01	Post monitoring and follow-up reports on environment quality annually on a dedicated website and present them to the tallymen if requested.
Quality of life	
VIE 01	Establish an ongoing dialogue with the public through an internal community relations group and communication program.
VIE 02	Establish and implement a Galaxy Lithium Code of Ethics and ensure that all workers are well informed of its contents.
VIE 03	Prohibit alcohol and drug consumption in the worker camp at the site.
VIE 04	Offer healthy and balanced menus (low in sugar and trans fat) in the worker camp's cafeteria.
VIE 05	Establish with the representatives of the Cree community an annual calendar of the main traditional activities and set time slots for production stoppages based on their participation in these activities. Grant leave requests during traditional business periods.

Table 7-5 List of applicable mitigation measures (cont.)

Code	Description
Quality of life (cont.)	
VIE 06	Prohibit all forms of video lottery and gambling at the site.
VIE 07	In collaboration with the Cree liaison officer and the CBHSSJB, implementation by the Galaxy's human resources department of a social issue awareness program for workers, including sexual harassment, prostitution, alcohol and drug use, gambling, money management, violence and any other issue that may arise during mine operation.
VIE 08	Offer suitable working conditions for pregnant women by complying with the Commission des normes, de l'équité, de la santé et de la sécurité du travail (CNESST) program "For a Safe Maternity Experience".
VIE 09	Provide STBBI testing services to workers and their families, in collaboration with the CBHSSJB.
VIE 10	Ensure that telephone and /or Internet services are available at the camp to encourage workers to contact their families.
VIE 11	Authorize family visits for workers staying on the mining site during special occasions.
VIE 12	Have zero tolerance for violence on employee housing and work sites, and enforce disciplinary measures if someone is found guilty of violence or harassment.
VIE 13	Reserve a section of the workers' camp for women to protect their privacy.
VIE 14	Have at least one woman present at the camp on Galaxy's human resources team to facilitate discussions with Cree and non-Cree female workers.
VIE 15	Set up a system for receiving and processing complaints before construction begins and until closure. A report on the nature of complaints received by Galaxy, and the manner in which they were dealt with, will be presented to the members of the monitoring committee at each meeting.
VIE 16	Maintain good relations between Galaxy and Cree First Nations.
VIE 17	Prevent food and material waste at the mine and offer the surplus, if any, to Cree aid groups through the Environment Committee.
VIE 18	At the request of and in collaboration with the Council of the Eastmain Nation, a ceremony of gratitude for Mother Nature will be held at the future mine site before construction begins.
VIE 19	According to the rules of the Km 381 truck stop and Galaxy policies, zero tolerance of prostitution, and request police intervention if a case is reported.
VIE 20	Galaxy's human resources department records cases involving calls to police on the files of Galaxy employees and subcontractors.
VIE 21	Inclusion of terms and conditions regarding hours and benefits of Cree workers in the Impact and Benefit Agreement (IBA) with the Cree Nation of Eastmain.
VIE 22	Formation of a follow-up committee, which will include representatives of the Eastmain and Waskaganish Cree Nations, the James Bay Eeyou Istchee Regional Government, and the tallymen of traplines RE1, RE2, RE3, VC33, VC35 and R08. Tallymen who own traplines north of the Eastmain River will be invited to sit on the monitoring committee and on other committees, if they deem it appropriate.

Table 7-5 List of applicable mitigation measures (cont.)

Code	Description
Local and Regional Economy	
ELR 01	Establish a regional purchasing policy that would prioritize local and regional companies in the competitive bidding process where the skill and price are competitive.
ELR 02	Offer training programs to local workers when possible , to fill mine positions. Organize training in partnership with DCHR to give Cree Nation workers access to jobs at the mine.
ELR 03	Prioritize the Cree workforce, followed by the regional workforce, with equal skills, for the available positions.
ELR 04	Develop a memorandum of understanding and partnership agreement for Indigenous participation in the project (agreement on repercussions and benefits).
ELR 05	Implement mechanisms to integrate workers, particularly for members of Indigenous communities (information sessions, human resources representatives, employee assistance program, etc.).
ELR 06	A communication committee and the Galaxy human resources department will communicate with local stakeholders and go to schools to present the positions available at the mine.
ELR 07	Regularly update forecasts regarding the duration of operations and announce in advance the closure of the mine.
ELR 08	Develop an Employee Assistance Program to provide closure transition support (e.g. reclassification assistance committee for workers).
ELR 09	Participate in a committee to maximize economic benefits (COMAX).
ELR 10	Work with the Council of the Cree Nation of Eastmain to ensure the greatest number of Cree recruits.
ELR 11	Train recruiters and managers to recognize stereotypes and cognitive biases related to the type of work women can do, especially in non-traditional roles.
ELR 12	Adopt a meritocratic hiring process, from the resume review and selection phase to final offers.
ELR 13	Be flexible in the time and place of training offered for accessing employment, when possible.
ELR 14	Provide development assistance for women focused on specific skills, such as influencing and networking. Provide specialized on-site training and development sessions. Provide networking opportunities for women to exchange information and support each other.
ELR 15	Offer jobs in the community of Eastmain in addition to those at the mine, so that women can be close to their families.
ELR 16	Submit to the MELCC a detailed program for monitoring the impacts on the human environment, which will include monitoring the impact on training, employment and the economy of regional communities.
ELR 17	Encourage training and employment among young people by giving presentations in the region's schools (high schools and CEGEPs), in collaboration with the schools and school boards concerned. Galaxy will inform students of all employment opportunities in the mining sector that result from graduation. To do this, posters presenting job opportunities at the Galaxy mine will be hung in schools and public buildings, and career days will be held that involve different types of mining workers. Guided tours of the mine will also be offered to local students.

Table 7-5 List of applicable mitigation measures (cont.)

Code	Description
Local and Regional Economy (cont.)	
ELR 18	Hiring of a liaison officer from the Cree Nation of Eastmain during all project phases. Their role will be to inform the Cree population of the jobs and contracts offered by the company, to ensure Cree workers are successfully integrated with other mine site workers, to share the concerns of the Cree population with the company, including land users, and to help find solutions for conflicts.
Heritage and Archaeology	
ARC 01	Ensure workers are aware of the obligations regarding fortuitous archaeological discoveries.
ARC 02	Communicate with the tallyman of trapline RE2, the Council of the Eastmain Nation, and the Culture and Language Department of the Cree Nation Government in the event that an artifact is discovered.
NOR 17	Report to the officials of the various building sites any fortuitous discovery and halt work at the location of the discovery until it can be fully assessed. Officials must notify the Minister of it without delay. Obtain formal authorization from these officials before resuming work. Reference: <i>Cultural Heritage Act</i> , Sec. 74
NOR 18	Have a professional assess any archaeological sites discovered to determine the extent of work required (e.g., excavation) to protect archaeological discoveries. Reference: <i>Cultural Heritage Act</i> , Sec. 76
NOR 19	Obtain an archaeological research permit to conduct any excavations or surveys of the property or archaeological sites. Reference: <i>Cultural Heritage Act</i> , Sec. 68
Landscape	
PAY 01	Shape the top of waste rock stockpiles to round and integrate them into the landscape.

7.2 IMPACTS ON THE PHYSICAL ENVIRONMENT

7.2.1 SOILS

CONSTRUCTION PHASE

SOURCES OF IMPACT

- Site preparation and infrastructure construction.
 - Hazardous and waste materials management.
-

MITIGATION MEASURES

Mitigation measures SUR 01 to SUR 04, QUA 01 to QUA 04, QUA 08 to QUA 13 should be applied, as well as standards NOR 02 to NOR 04, and NOR 09 described in Table 7-5.

DESCRIPTION OF IMPACT

In the site preparation stage, erosion occurs during deforestation, grubbing, grading, development, fill/excavated material operations, as well as during the construction of watercourse crossing structures. Soil erosion and sediment transport are greatly influenced by soil conditions, slope, and precipitation patterns.

The environmental site assessments (phases I and II ESA) (WSP, 2018a and 2018b) revealed that residual materials (paper, plastic, metal, wood, fabric) were observed at the remote landfill. However, the remote landfill sector is located outside planned works and in this sense, the risks of soil contamination by contact with the remote landfill soils are unlikely or non-existent.

Risks of soil contamination are also possible, mainly because of the potential leak of petroleum products or accidental spills from equipment. The impact of a potential spill would be, among other things, based on the volume of contaminants spilled, the uniqueness (spill) or the repetition (leak) of the problem. In the event of a spill, the actions provided for in the emergency action plan will be implemented quickly, which will help to limit the extent of the contamination. These measures focus on prevention by regularly checking equipment and adding emergency devices that will allow for a quick response in case of an accident. In addition, in the event of a spill, the emergency plan will be quickly implemented, which will reduce the extent of contamination and prevent the contamination of groundwater. Losses or spills of hydrocarbons or other products are generally one-time events and accidental.

Moreover, environmental surveillance activities are especially important in the prevention and effectiveness response in case of a spill, and some preventative measures will also reduce the risk of major spills, like the implementation of double-walled tanks.

IMPACT ASSESSMENT

For all the reasons mentioned above, the intensity of this impact is considered low since soil quality is not likely to change. The extent is considered local given that soil contamination or erosion would occur in an area confined to the incident site or areas of the site in operation. The duration is short since it will be possible to immediately respond to decontaminate the site quickly or dispose of contaminated soil in a short time. For soil erosion, its duration is also short because it may occur during the entire construction period. The extent of the impact on the soil during the construction phase is considered **minor**.

OPERATION PHASE

SOURCES OF IMPACT

- Management of economic material, unconsolidated deposits, and waste rock.
 - Hazardous and waste materials management.
-

MITIGATION MEASURES

Mitigation measures SUR 01 and SUR 02, QUA 01 to QUA 05, QUA 10, QUA 12 should be applied, as well as standards NOR 02 to NOR 04, NOR 09 and NOR 10 described in Table 7-5.

DESCRIPTION OF IMPACT

The risks of soil contamination in case of accidental spills are the same as during the construction phase. In addition, since the hydrocarbon tanks will be above ground, the risk of a leak going unnoticed for a relatively long time is unlikely. Also, as with the construction phase, environmental monitoring activities will prevent the anticipated impacts.

IMPACT ASSESSMENT

The application of mitigation measures will minimize the potential impacts on the soil during the operation phase. Overall, the intensity of this impact is considered low. Its extent is local since sediment erosion and transport may occur at any mine site. The duration is medium since the impact may occur during the life of the mine, a period of approximately **18** years. Overall, the significance of the impact on the soils during the operation phase is considered **minor**.

REHABILITATION PHASE

SOURCES OF IMPACT

- Infrastructure dismantling.
 - Hazardous and waste materials management.
-

MITIGATION MEASURES

In the rehabilitation phase, mitigation measures SUR 02, QUA 01 to QUA 04, QUA 07, QUA 08, QUA 12 and standards NOR 01 to NOR 04 and NOR 10 in Table 7-5 must be met.

DESCRIPTION OF IMPACT

Overall, the impact of activities during the rehabilitation phase will be approximately the same as that of the construction phase, until the site is completely restored.

As the rehabilitation materializes, hazardous materials not required will be removed from the site, recovered and returned to suppliers, sold to a third-party or disposed of by firms authorized to manage these materials. The aboveground tanks will be removed from the site and the soils beneath these will be characterized. In case of contamination, they will be handled in accordance with the laws and regulations in force. The footprints of the rock storage area and those supporting the infrastructure will be characterized, and if the soil meets the quality criteria, they will be left in place. If not, they will be excavated and handled in situ or even transported to an authorized contaminated soil treatment site.

The dismantling of infrastructures can also contribute to soil erosion (scarification of roads, dike retreat, etc.).

Finally, to avoid leaving an environmental legacy behind, the rehabilitation plan provides that the entire site will be characterized to determine whether the soil is contaminated, as per the criteria set by the **MELCC**. If so, it will be handled in accordance with the laws and regulations in force.

IMPACT ASSESSMENT

The application of mitigation measures will minimize the potential impacts on soil contamination and erosion. As a result, the intensity of the contamination phenomena is considered low. Its extent is local and could occur throughout the mine site. The duration will be short since the impact will only be felt during the closure phase. The significance of the impact on the soil during the rehabilitation phase is considered **minor**.

POST-REHABILITATION PHASE

Only waste rocks and tailings in the stockpiles will be left on the site after its rehabilitation. As mentioned in Section 4.7, the results of the kinetic tests conducted on these materials show that they are considered low risk in accordance with D019 and non-potentially acid generating. Consequently, acid or contaminated mine drainage following the site rehabilitation is not anticipated.

A site environmental characterization will be conducted at the closure of work. Samples will be collected and analyzes will be conducted. A contaminated soil management plan will be established if soil contaminated beyond applicable criteria or background levels is higher than the criteria "A" in the Guide d'intervention (MELCC) is identified during the characterization.

Soil that does not comply with the applicable criteria will be excavated and managed in accordance with its level of contamination which depends on the applicable regulations. Samples will be collected from the excavation walls and bottoms as to confirm soil left in place comply with the applicable criteria.

Once the site has been restored, the impacts will be non-existent, since no mining activity likely to alter the soil quality will be taking place.

7.2.2 HYDROGEOLOGY

CONSTRUCTION PHASE

SOURCES OF IMPACT

- Site preparation and infrastructure construction.
- Water management.

MITIGATION MEASURES

Standard mitigation measures SUR 01 and SUR 02 will be applied to reduce the project's impact on hydrogeology. These mitigation measures consist mainly in minimizing the increase in runoff, as this change may affect the seepage rate and, to a lesser degree, the local flow regime. The following measures will also be applied: QUA 01 to QUA 04, QUA 10 to **QUA 13**.

DESCRIPTION OF IMPACT

During soil excavation to develop or install various infrastructure, the surface water seepage regime will be altered. It may be limited or higher depending on the type of development. Also, if the groundwater body is reached during excavation, the water will have to be pumped out, thereby altering groundwater flow locally.

IMPACT ASSESSMENT

During the construction phase, the intensity of the impact is deemed low given that minor changes to the flow regime will be noted. The mitigation measures to be applied will reduce the anticipated impacts. The extent is limited since the impacts will be felt near the work areas. The duration will be short because groundwater flow will rebalance once the work is completed. In short, the significance of the residual impact on the groundwater flow regime will be **minor**.

OPERATION PHASE

SOURCES OF IMPACT

During the operation phase, activities likely to affect the groundwater flow regime are essentially the following:

- Presence and operation of the pit;
- Other infrastructure in operation;
- Management of economic material, overburden and waste rock; and
- Water management.

MITIGATION MEASURES

The QUA 06 measure will be applied to monitor anticipated changes in the local flow regime, and the drawdown and rise of the water table. **QUA-14 will be applied as a monitoring measure to determine the quantity and quality of water in the truck stop drinking water supply well.** In addition, NOR 06 provides that a network of monitoring wells will be established on the periphery of the mining infrastructure.

DESCRIPTION OF IMPACT

Pumping activities required for pit dewatering will lead to changes in the groundwater flow regime, particularly near the pit, and may alter the recharge and resurgence rates in some watercourses near the site. During the various operation phases, the groundwater level in the pit will be maintained through pumping near the bottom of the pit. The groundwater piezometric surface will therefore be gradually lowered to allow for dry operations.

A lowering of the water table in the bedrock and in unconsolidated deposits will therefore be observed around the pit. The effects of dewatering activities on the groundwater flow regime are controlled by hydrogeological features, that is, the hydraulic properties of geological formations, and the link between them and the surface water system. These features are particularly complex in hydrogeological systems with fissured rock environments, like those found on the site. That is why digital modelling is customary in such cases to represent the hydrogeological system and assess the potential impacts of dewatering activities.

Hydrogeological modelling was conducted to assess the impact of pit operation on the surrounding environment (water table drawdown) and to estimate the volume of water pumped when the pit is in the final operation stage. According to the modelling results, the anticipated groundwater drawdown will be at a maximum near the pit, decreasing as the distance from the pit increases.

Appendix J of the sectoral study (WSP, 2021a) provides details of the modelling work. The results indicate that the dewatering flows at the end of operation would be 1,700 m³/day. When operation wraps up, the water table drawdown is expected to be virtually nil at approximately **2 km east of the pit (Map 7-1)**. **For the south and west sectors, the drawdown would be almost nil at a distance of 500 to 900 m from the pit walls. In the northwest sector, the retention basin will create a slight local increase in the groundwater level of about 0.5 m (negative drawdown on Map 7-1).**

The only groundwater user listed in the sector is located approximately 700 m from the pit boundary (potable water wells at the km 381 truck stop), that is, within the edge of the potential water table drawdown area. **The estimated water level drawdown in the sector is less than 2 m.** The impact on the wells should therefore be negligible. In addition, the water table drawdown area will be developed gradually as the pit develops. There will therefore be enough time to gather geotechnical and piezometric data with a monitoring system in place, which will make it possible to foresee potential problems and take corrective action where necessary.

The results also show that the impact on lakes and watercourses would involve reduced **base flow between 1 and 64 %, meaning a decrease in average flow between 0 and 2 %**. Groundwater contribution to the base flow of watercourse CE4 would become very low.

Lake Kapisikama, located less than 200 m from the pit, will be impacted and will no longer be supplied by groundwater **as of year 4**. The four-fold reduction in the surface area of the watershed of this lake will also decrease surface water inflow. The lack of groundwater contribution and the reduced surface water inflow will cause the lake's water level to drop.

The stockpiles will not affect groundwater flow. A permeable drainage layer at the base of the stockpiles will drain water towards the ditches. In the area of the stockpiles north of creek CE3, the ditches will result in a slight drawdown of the water level. Only the overburden stockpile and retention basin will result in a slight increase in water level (see Map 7-1). The percolation flows under all stockpiles were calculated to ensure that they comply with the D019 standards. All stockpiles have percolation flows below the 3.3 l/m²/d criterion with a maximum of 0.15 l/m²/d.

IMPACT ASSESSMENT

During the operation phase, changes in the flow regime are related to pit operation. The intensity is deemed moderate given that a significant water table drawdown is planned around the pit. The extent of the impact is deemed local because the changes to the groundwater flow regime will occur within a radius of up to 1.7 km around the pit. The duration of the impact will be long because the flow regime will be altered throughout the operation phase. In short, the significance of the residual impact on hydrogeology is deemed **moderate**.

REHABILITATION PHASE

SOURCES OF IMPACT

- Infrastructure dismantling
- Pit rehabilitation.
- Water management.

MITIGATION MEASURES

No additional mitigation measures are planned during the rehabilitation phase other than monitoring of the drawdown and rise of the water table (QUA 06). A network of wells established on the periphery of the mining infrastructure will be kept and studied after operations end.

DESCRIPTION OF IMPACT

Stopping pit dewatering activities at the end of the project will cause the groundwater level to rise back to its initial position. The final rise in the groundwater level will depend on the conditions of equilibrium for the formation of a lake inside the pit. The groundwater flow regime is expected to essentially return to its original state once the pit is filled, except in the south portion of the pit where the lake level will be below the currently measured groundwater level.

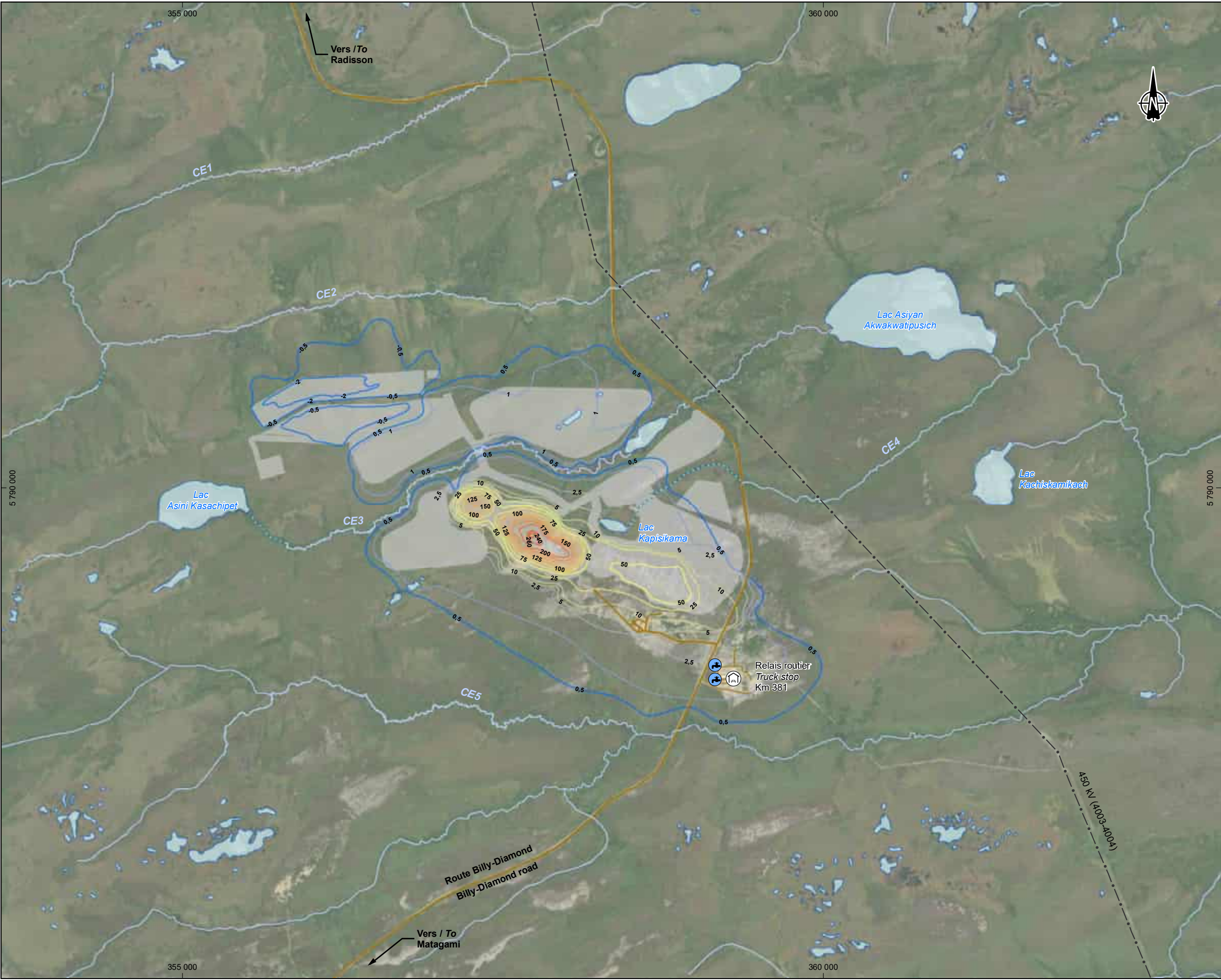
The impacts noted during the operation phase are similar for the rehabilitation phase as concerns the waste rock stockpile. The piezometric level will begin to recover as soon as mining operations end. In the post-operation phase, waste rock stockpiles will drain slowly under the effects of gravity to reach a new permanent equilibrium. The length of the recovery period will depend on hydrogeological conditions.

IMPACT ASSESSMENT

During the rehabilitation phase, the intensity is considered moderate because groundwater will continue to accumulate in the pit. The extent is deemed local because the effect will be felt within a radius of up to 1.7 km around the pit. Its duration is estimated to be long because it will take a number of years for the rock formation to return to a state of equilibrium. In short, based on the assessed impacts, the significance of the impact on hydrogeology is deemed **moderate**.

POST-REHABILITATION PHASE

Stopping pumping activities will have a positive effect on hydrogeology in the post-rehabilitation phase, allowing a new natural equilibrium to be gradually reached in the environment. The pit is expected **to fill up in 120 to 180 years**.



Composantes du projet (2021) / Project Component (2021)

Emprise de la mine / Mine footprint

Rabatement / Drawdown

- 0,5 m (Faible / Low)
- 1 m
- 2,5 m
- 5 m
- 10 m
- 25 m
- 50 m
- 75 m
- 100 m
- 125 m
- 150 m
- 175 m
- 200 m
- 240 m (Élevé / High)

Infrastructures / Infrastructure

- Route principale / Main road
- Route d'accès / Access road
- Ligne de transport d'énergie / Transmission line
- Relais routier / Truck stop
- Source d'eau potable / Drinking water source

Hydrographie / Hydrography

- CE3 Numéro de cours d'eau / Stream number
- Cours d'eau permanent / Permanent stream
- Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream



Mine de lithium Baie-James /James Bay Lithium Mine
Mise à jour de l'étude d'impact sur l'environnement

Carte / Map 7-1
Rabatement du niveau d'eau, dénoyage final /
Water level drawdown, final dewatering

Sources :
Orthoimage : World Imagery (ESRI, 2018)
Rabatement / Drawdown, WSP 2021

0 300 600 m
UTM, fuseau 18, NAD83

Dessin : A. Lemay
Approbation : S. Bottier
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7.2.3 HYDROLOGICAL REGIME

CONSTRUCTION PHASE

SOURCES OF IMPACT

- Site preparation and infrastructure construction.
 - Water management.
-

MITIGATION MEASURES

Mitigation measures SUR 01, SUR 03, SUR 04, QUA 07, QUA 09 and QUA 11 will have to be applied in order to limit the impact on the hydrological regime in the study area during the construction phase, along with standards NOR 01, NOR 05, NOR 07, NOR 14 and NOR 15, described in Table 7-5.

DESCRIPTION OF IMPACT

The development of surfaces (deforestation, excavation, topsoil stripping, backfilling, grading of surfaces, etc.) for the construction of various mining facilities and infrastructure, and the construction of drainage ditches and watercourse crossing structures will likely alter the natural flow of surface water locally. Moreover, soil compaction could limit water seepage into the soil, thus promoting increased surface runoff.

Kapisikama Lake will supply the water for the operation of the temporary concrete plant during the construction phase. The withdrawal of water could result in a decrease in the lake's water level. However, the operation period will dewater the lake as a result of pit dewatering. The potential change in water level in the headwater lake feeding an intermittent watercourse will have a much smaller impact than the dewatering during the operation phase. The description of the drawdown of the water table leading to dewatering of the lake from Year 4 onwards is presented in Section 7.2.2, while the following section discusses the impact on the hydrological network during the operation phase.

IMPACT ASSESSMENT

Since small areas relative to the total watershed surface (approximately 5%) will be affected by the construction work, and considering the planned mitigation measures, only minor changes to the hydrological regime are anticipated. The intensity of the impact is therefore considered low. It will be limited in scope since it will be in a small area where construction will take place, and its duration will be short since it will be limited to the construction phase. The significance of the impact on the hydrological regime during the construction phase is therefore **minor**.

OPERATION PHASE

SOURCES OF IMPACT

- Presence and operation of the pit.
- Other infrastructure in operation.
- Management of economic material, overburden and waste rock.
- Water management.

MITIGATION MEASURES

Mitigation measures SUR 01, QUA 05 and UTT 03 will have to be applied to limit the impact on the hydrological regime in the study area during the operation phase, along with standards NOR 01, NOR 05, NOR 07, NOR 08 and NOR 14, described in Table 7-5.

DESCRIPTION OF IMPACT

During the operation phase, all contact water on the mining site will be collected by a network of ditches and pumping stations, directed to a retention basin and then pumped out into effluent located on creek CE2 after passing through the WTP, **as required**. Map 7-2 shows the location of proposed infrastructure as well as the delineation of watersheds in the study area under the projected conditions, while Table 7-6 shows the project's impact on the areas of the watersheds under study.

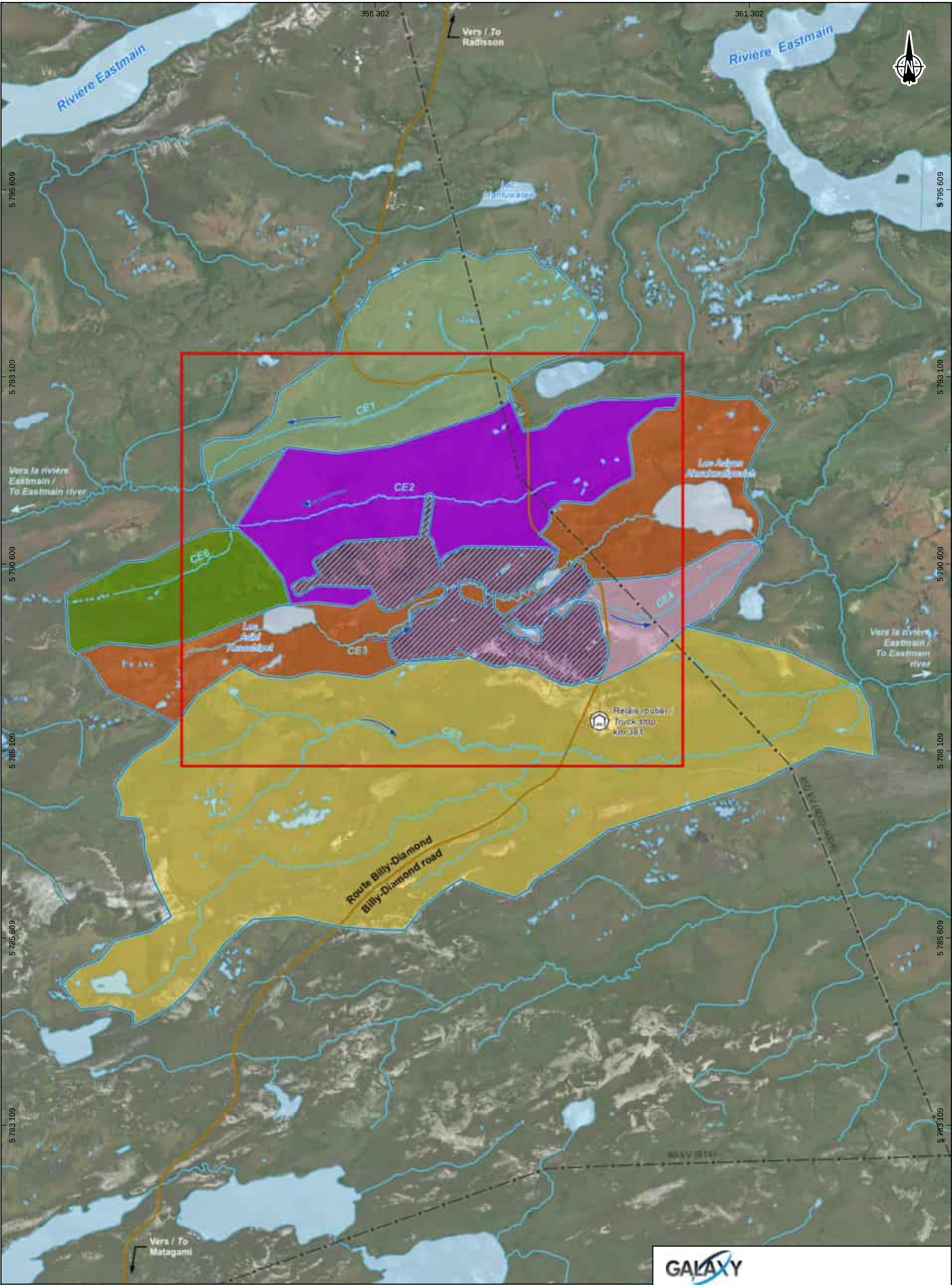
Impacts on the watersheds

The watersheds of creeks CE1 and CE6 are unaffected by the project. Considering natural runoff only, the watershed of creek CE2 is **16%** smaller; however, since it will be receiving the main mining effluent, its total surface area will increase by **340%**. The watersheds of creeks CE3, CE4 and CE5 will be **encroached upon by project infrastructure**, which will reduce their surface areas by **18%**, **33%** and **1%**, respectively. **We can also note that for the mine effluent in creek CE2, the natural watershed at the projected conditions is 4.1 km².**

A comparison with points located further downstream of the watercourses reveals that the impacts are mitigated because the surface area of the northern part (at the junction of CE1, CE2 and CE6) is increased by **16%**, whereas the tributary surface area of the southern part (**at the junction of CE3, CE4 and CE5**) is reduced by **6%**.

Table 7-6 Impact of the project on watersheds in the study area

Body of water	Size (km ²)		Difference (%)
	Current state	Future state	
Northern part	19.81	22.88	+16
CE1	7.63	7.63	0
CE2	9.07	12.14	+34
• Natural – outside project footprint	9.07	7.64	-16
• Project infrastructure	-	4.50	-
CE6	3.11	3.11	0
Southern part	48.76	45.70	-6
CE3	10.33	8.49	-18
CE4	3.03	2.02	-33
CE5	27.01	26.79	-1



	Zone d'étude locale / Local study area		Bassin versant 5 / Watershed 5	Infrastructures / Infrastructure	
Hydrographie / Hydrography					Route principale / Main road
	Limite de bassin versant / Watershed limit		Bassin versant 6 / Watershed 6		Route d'accès / Access road
	Bassin versant 1 / Watershed 1		Cours d'eau permanent / Permanent stream		Ligne de transport d'énergie / Transmission line
	Bassin versant 2 / Watershed 2		Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream		Relais routier / Truck stop
	Ruissellement sur le site vers l'effluent CE2 / Site runoff to CE2 effluent		Numéro du cours d'eau / Stream number		
	Bassin versant 3 / Watershed 3		Sens d'écoulement de l'eau / Direction of water flow		
	Bassin versant 4 / Watershed 4		Effluent minier / Mine effluent		

Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 7-2
Bassins versants aux conditions projetées / Future Watershed Limits

Sources :
Image, Bing Maps Aerial
Inventaire / Inventory, WSP 2021
Données du projet / Project data : Galaxy 2021

05001000 m

UTM, fuseau 18, NAD83

Juin 2021

Dessin : A. Masson
Approbation : E. Sormain
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Impact on the flows and levels

Typical flows under future conditions were estimated using the same methodology as the one for flows under current conditions, described in the hydrological technical study (*Étude spécialisée sur l'hydrologie*) (WSP, 2018b). Additions to these natural flows include the expected effluent discharge rate into creek CE2 and the influence of the water table drawdown through pumping around the pit. It should be noted that due to the very flat and marshy (peat bog) nature of the watersheds studied, uncertainty remains about the evaluation of typical flows and impacts on them. The values should therefore be considered with caution. No water extraction from the watercourses will occur for the purposes of the project during the operation phase.

Table 7-7 shows the average effluent discharge volumes in the operation phase (year 9) under average conditions (considering the effects of climate change) as well as under dry conditions (Golder, 2021).

Table 7-7 Average monthly effluent flows

Month	Average conditions with climate change (year 9) (m ³)	Dry conditions (1 : 25 years) (m ³)	Wet conditions (1 : 25 years) (m ³)
January	158,920	148,060	157,560
February	152,150	143,710	150,540
March	152,650	145,010	152,630
April	159,470	149,940	160,610
May	0	0	0
June	0	0	94,620
July	284,130	11,700	331,330
August	236,120	167,190	270,140
September	338,700	236,100	381,640
October	348,270	242,800	392,470
November	78,790	53,340	85,930
December	173,780	157,580	172,970

Source: Golder, 2021.

According to the findings of the hydrogeological study (WSP, 2021a), dewatering the pit will have a small impact and low-water flows in the upstream portion of creeks CE3 and CE4 and to a lesser extent in creeks CE2 and CE5 (section 7.2.2). Creek CE1, further from the pit, should not be impacted.

Table 7-8 shows an estimate of the impacts on the typical flows of watercourses in the study area. For creek CE2, substantial increases are anticipated in summer low flows (**an increase of 3 to 8 times their approximate values**) and in average flows during nearly all months (**up to 80 % in winter and approximately 50 % in fall**) due to the presence of mining effluent. In contrast, average monthly flows in the **beginning of summer (May and June)** decrease by approximately **16 % since no effluent discharge flow is expected**. Flood flows are slightly higher for the weakest recurrences (**+9 %** for the 2-year flood), but slightly lower for the strongest (**-5 %** for the 100-year flood) **as a result of the reduction from the on-site water management system**.

In the southern part, all typical flows are expected to decrease in all watercourses. For CE3, the decrease is **37%** for low-water flows, **20%** for average flows and **22%** for flood flows. For CE4, affected by pit dewatering, the decrease is more than **97%** for low-water flows, **35%** for average flows and **35%** for flood flows. Lastly, only a slight decrease of 1 to **3%** in typical flows is expected for CE5. Although the percentage change may seem very large, given the order of magnitude of the flows involved (approximately 0.01 m³/s to 0.3 m³/s), the values are nonetheless low.

The impact on water levels in creeks CE2, CE3 and CE4 was assessed using one-dimensional hydraulic modelling with HCE-RAS software. The methodology used to build and calibrate the model, and to run the simulations, is detailed in the specialized study on hydrology (WSP, **2018c**), which also contains a map of the model domain.

It should be noted that since the local watercourse slope is very gentle and the floodplain is closely connected to the low-flow channel, a change in flow entails a very small water level change in these watercourses. It therefore appears that, due to the presence of natural log jams or beaver dams, the control sections are the main factor influencing water levels in the study area, which limits the project's impacts on those levels. The simulations that were run represent the current state of the watercourse as surveyed in 2017 and 2018. However, these conditions could change if the controls move, disappear or are altered.

Table 7-8 shows the project's impacts on the water levels of watercourses in the study area. For creek CE2, no significant impact is expected upstream of the mining effluent discharge point. Downstream, water levels are expected to rise 3 to 13 cm during summer **and winter** low flow due to the presence of effluent. The average monthly flows are slightly higher **from December to April, with a maximum of 10 cm increase in the effluent level in March. The impact is lower from May to November, with expected variations from -2 cm to +2 cm.** Flood levels are higher for the weakest recurrences (+3 cm to **approximately +8 cm** for the 2-year flood) and less so when the recurrence increases, even decreasing slightly for the 100-year flood downstream of the watercourse. For creek CE3, the simulations that were run show negligible impacts downstream of the mining effluent. Upstream of this point, a slight decrease in water levels is expected: 1 cm **to 3 cm** for low-water **and average levels and up to 7 cm** for 100-year flood levels. For creek CE4, the impact was assessed solely downstream of James Bay road, with an observed decrease of 2 to 9 cm in all typical levels. **During low-water periods, the decrease in flow is such that it is expected that there will be no flow, but simply water basins, the level of which level is maintained by the hydraulic controls present on the watercourse.**

Table 7-8 Impact of the project on typical flows of watercourses in the study area

Impacts (%)									
		CE1	CE2	CE6	Northern part	CE3	CE4	CE5	Southern part
Low-water flows	Q _{2,7} annual	0%	+345%	0%	+158%	-37 %	-97 %	-3 %	-15 %
	Q _{10,7} annual		+720%		+330%				
	Q _{5,30} annual		+526%		+241%				
	Q _{2,7} summer		+153%		+70%				
	Q _{10,7} summer		+368%		+168%				
	Q _{5,30} summer		+163%		+75%				
Average monthly flows	January	0%	+54%	0%	+25%	-20 %	-35 %	-1 %	-7 %
	February		+80%		+37%				
	March		+87%		+40%				
	April		+78%		+36%				
	May		-16%		-7%				
	June		-16%		-7%				
	July		+37%		+17%				
	August		+27%		+12%				
	September		+49%		+22%				
	October		+40%		+18%				
	November		-1%		0%				
	December		+32%		+15%				
	Annual		+23%		+11%				
Flood flows	2 years	0%	+9%	0%	+4%	-22 %	-35 %	-1 %	-11 %
	10 years		0%		0%				
	25 years		-3%		-1%				
	50 years		-4%		-2%				
	100 years		-5%		-2%				

Given the increases in flow expected in creek CE2, attention was paid to the impact on velocities in the low-flow channel. In some sections, we note a slight reduction in velocities due to the local effects of controls. However, we see an increase in velocities in the creek overall. Consequently, for a two-year flood, there is an estimated increase in the range of **50%** immediately upstream from the effluent (from 0.04 m/s to 0.06 m/s), to 25% at the level of the junction with CE6 (from 0.12 m/s to 0.15 m/s). For the 100-year flood, the increase is more limited, ranging from **11%** at the level of the effluent (from 0.09 to 0.10 m/s) to 12% at the level of CE6 (from 0.17 to 0.19 m/s).

Concerning the average monthly flows, the maximum increase observed in March is in the range of **100%** (from 0.03 m/s to 0.06 m/s). Nonetheless, it should be noted that, despite this high-percentage increase, the order of magnitude of velocities remains very low, never exceeding 0.4 m/s for each scenario simulated – which is explained by the very gentle slope of the watercourse and the large flood plains connected to the low-flow channel. The increase in velocities therefore should not cause erosion in the watercourse, nor any major morphological changes.

Table 7-9 Impact of the project on watercourse levels in the study area

Simulated conditions		Northern part CE2	Southern part	
			CE3	CE4
Low-water flows		from +3 cm to +13 cm, depending on the sections	from -1 cm to -3 cm, depending on the sections	water basins maintained by the existing hydraulic controls but no flow
Average monthly flows	May to November	from -2 cm to +2 cm maximum of -3 cm in May/June	from -1 cm to -3 cm, depending on the sections	from -8 cm upstream to -3 cm downstream
	December to April	≈ +4 cm max of +10 cm at the level of the effluent and +6 cm downstream (March)		
Flood flows	2 years	≈ +3 cm, depending on the sections	from -3 cm to -5 cm, depending on the sections	from -6 cm upstream to -4 cm downstream
	100 years	from +3 cm (at the effluent) to -2 cm (more downstream)	≈ -7 cm upstream from Billy Diamond Highway from -3 cm to -5 cm downstream from Billy Diamond Highway	from -2 cm to -6 cm, depending on the sections
Notes:		Impacts are negligible when the variation is approximately 0 cm (≈ 0 cm). For this reason, results for the northern part are presented from the effluent site on creek CE2..		

Lake Kapisikama will gradually dewater as mining progresses, starting in Year 4. Indeed, the lowering of the water table by pumping mine water will result in a marked decrease in groundwater supply to this lake and creek CE4 (Section 7.2.2).

Impact on navigability

The impact on navigation (canoes) was also considered for the study area watercourses. However, the current strong presence of beavers in the study area constitutes an obstacle to navigation, with numerous dams observed during the field inventories, the locations of which and their ability to be crossed may vary depending on the year and beaver activity. For creek CE4, we expect that the flow will be intermittent during low water periods, which could compromise canoe travel. For creeks CE2 and CE3, the variations of levels and velocities expected in these small watercourses are not major (mainly because we do not expect strong decreases in water levels), so no significant degradation of potential navigation conditions is anticipated.

Climate change impacts on hydraulics and hydrology

In recent years, several studies have been done in Québec to determine the probable impacts of climate change in different regions (URSTM, 2017). Table 7-10 summarizes the climate changes predicted in these studies.

Table 7-10 Climate change outlook to 2050 in James Bay

Indicator	1981–2010 average	Outlook to 2050
Average winter temperature (December to February, °C)	-18.46	-13.3
Annual minimum temperature (°C)	-38.96	-29
Frost-free days (number)	150	179
Annual precipitation (liquid and solid, mm)	835	946
Annual precipitation of 99th centile (extremes, mm)	19	23
Accumulation of precipitation during extreme events (mm)	220	290
Days with accumulation of precipitation > 10 mm (number)	6	8
Average summer temperature (June to August, °C)	12.96	16.15
Maximum annual temperature (°C)	27.88	31.39

Source: URSTM, 2017.

According to this study, in the James Bay outlook to 2050, a minimum, average and maximum increase in temperature is anticipated, slightly more marked in winter than summer, along with an increase in the number of frost-free days. Furthermore, total annual precipitation is expected to increase (liquid and solid). However, in winter, this increased precipitation will be compensated by the rise in temperature that will reduce the maximum snowcover. The thaw season should start earlier than at present, and the floods produced by snow melt could also occur earlier, with slightly lower maximum flows. Last, extreme precipitation events could be more frequent and greater in intensity.

The calculation of the flows presented in the analysis of the project's impacts on the hydrology and hydraulics of the watercourses in the study area does not include climate change (except in the effluent discharge flows, which does include climate change). This choice was made to highlight the project's impacts, isolating them from climate change impacts, which would occur even in the absence of the project. Note that the flows presented were not used to determine structures sizes (dams, ditches, basins, culverts, pumping stations, etc.) since these were not on-site flow calculations but downstream of the mine site.

However, based on the information presented above, we can expect extreme precipitation events to be more frequent and intense, resulting in increasing peak flows due to extreme rainfall events. Thus, for creeks CE3, CE4 and CE5, climate change could reduce the project's impact by mitigating the decrease in peak flows due to extreme rainfall events presented above. However, for creek CE2, the predicted flow increase can be expected to be somewhat greater than that presented.

These qualitative considerations about climate change effects have been considered in the project's impact assessment. However, given the current state of knowledge available on the climate change effect in the region, a quantitative assessment of the impact of climate change with a high level of precision is not realistic. A more detailed analysis does not appear to be relevant for assessing the project's impact on the flood flows of the watercourses in the study area.

IMPACT ASSESSMENT

The impact assessment was conducted considering the most critical configuration, as well as the overall footprint of the project, dewatering flows from the pit and effluent discharge into CE2. The impact was evaluated in terms of the contributory area for the six watercourses of the study area, characteristic flows and water levels. Although changes will occur in the watersheds of the study area that will lead to significant changes in characteristic flows of the watercourses, the impact on the water levels and velocities of the watercourses remains moderate due to the land configuration (very flat and marshy with many controls). The intensity of the impact on the hydrological regime of the watercourses of the study area is therefore considered to be moderate. Its extent is considered local, since not all of the watercourses in the study area will be impacted, and for those that are, the effect on water levels and velocities becomes negligible at the boundary of the study area. The duration is long, since the impacts will occur during all phases of operation. The significance of the impact on the hydrological regime during the operation phase is therefore **moderate**.

REHABILITATION AND POST-REHABILITATION PHASE

SOURCES OF IMPACT

- Infrastructure dismantling.
 - Pit rehabilitation.
 - Water management.
-

MITIGATION MEASURES

Mitigation measures SUR 03, QUA 07, QUA 09 and QUA 11 will have to be applied in order to limit the impact on the hydrological regime in the study area during the rehabilitation phase, along with standard NOR 01, described in Table 7-5.

DESCRIPTION OF IMPACT

The rehabilitation phase involves decommissioning and returning the site to its original condition (backfilling, grading of surfaces, revegetation, securing of the site, temporary works and structures, etc.). During this phase, the dismantling of facilities could change the natural flow of surface water, such as the removal of roads and pumping stations for runoff.

Once rehabilitation of the site is complete, the infrastructure for water management on the site will be dismantled (retention pond, WTP, effluent, **culverts and ditches**), which will make it possible for watercourses **in the study area** to return **to their original watersheds in terms of area**. **Furthermore**, the suppression of mining effluent by pumping will make it possible for creek CE2 to return to a natural flow regime. The presence **of the revegetated stockpiles** (steep slope) will **nonetheless** have a permanent impact on the topography of watersheds **CE2, CE3 and CE4**, formerly very flat and marshy, resulting in greater reactivity to precipitation. **In other words, the concentration time of these watersheds will decrease slightly, and the unit peak flow rate will increase slightly. Efforts will be made, however, to encourage the wetland creation, where possible, in low slope areas to limit this peak flow increase.**

Table 7-11 presents the exact watershed areas for the restoration phase. Creek CE2 will be restored to its original area and creek CE5 very close to its original area (-1 %). We expect no significant impact on the characteristic flows of these watercourses compared to pre-project conditions. The creek CE4 watershed will be permanently encroached by 9 % and we can assume that the characteristic flows in creek CE4 will then be approximately decreased proportionally to this decrease in area, compared to pre-project conditions.

Concerning creek CE3, the pit presence in the watershed should be noted. During the first part of the post-rehabilitation phase, the pit will progressively flood by natural precipitation and overflow is not expected in approximately the first 100 years (according to the hydrogeological study estimates). It should be recalled that during the operation phase (see previous section), in addition to the loss of watershed for certain watercourses due to the mining infrastructure, pit dewatering will play a part in exacerbating the decrease in base flows of the watercourses under study, especially creek CE3. During the rehabilitation phase, after stoppage of pumping and with the gradual filling of the pit, creek CE3 base flow shall gradually recover. The watershed of creek CE3 will then have a surface area of approx. 9.78 km² at Asiyan Lake outlet, at the confluence with creek CE4, which constitutes a decrease of 5 % as compared to current conditions. We can estimate that characteristic flows of creek CE3 will be approximately reduced proportionately with this reduction in area as compared to pre-project conditions.

Then, after approximately one hundred years, it was estimated that the pit will be full and may potentially start discharging excess precipitation like a natural lake would do. The overflow, the exact characteristics of which are unknown at this stage of the project, shall be directed towards creek CE3. The watershed of creek CE3 will therefore increase to about 10.79 km² at the Asiyan Lake outlet, representing an increase of 4 % as compared to current conditions. We can assume that the approximate increase in characteristic flows of creek CE3 will be proportional to the increase in surface area. However, the presence of the lake created by the pit flooding, along with efforts to create wetlands on the site, will cause a reduction in peak flows during periods of high hydraulicity.

Table 7-11 Impact of the project on the watersheds in the study area during rehabilitation

Water body	Area (km ²)		Difference (%)
	Current condition	Post-Rehabilitation	
North part	19.81	19.78	0
CE1	7.63	7.63	0
CE2	9.07	9.04	0
CE6	3.11	3.11	0
South part	48.76	47.77 (0-100 years) 48.78 (> 100 years)	-2 (0-100 years) 0 (> 100 years)
CE3	10.33	9.78 (0-100 years) 10.79 (>100 years)	-5 +4
CE4	3.03	2.76	-9
CE5	27.01	26.84	-1

IMPACT ASSESSMENT

Since the areas affected are as large as during operations and changes are expected to the hydrological regime. **Essentially, the changes are to approximate the hydrological conditions that existed before the mine project was implemented. However, two watercourses will not return to their original conditions, and runoff conditions on the site will change slightly. For these reasons,** the intensity of the impact is therefore considered moderate. Its extent will be local, since the impacts will occur within the local study area and its duration long, since the change will be permanent. The significance of the impact on the hydrological regime during the rehabilitation phase is therefore **moderate**.

7.2.4 WATER AND SEDIMENTS

CONSTRUCTION PHASE

SOURCES OF IMPACT

- Site preparation and infrastructure construction.
 - Water management.
 - Hazardous and waste materials management.
 - Transportation and traffic.
-

MITIGATION MEASURES

Standard mitigation measures QUA 01 to QUA 04, QUA 08 to QUA 13, NOR 02 to NOR 04, NOR 07 to NOR 09 will be applied to reduce the impact of the project on water quality and sediments. These measures are presented in Table 7-5. Measures SUR 01 to SUR 04 will also help to monitor the impacts on the quality of water and sediments.

DESCRIPTION OF IMPACT

During the construction phase, road transport, heavy machinery traffic, use of refuelling sites and temporary storage or handling of hazardous and waste materials will constitute potential sources of accidental spills that could contaminate the water and sediments. However, the risk of accidental spills is reduced by the application of mitigation measures. These measures will be aimed on prevention thanks to a regular monitoring of the equipment and the addition of emergency devices that allow for prompt response in the event of an accident. An accidental spill, if it occurs, will saturate the soils with contaminants at the spill site. If a significant volume is released, a portion of the product that has not adhered will migrate down into the groundwater table or toward the surface water, leaving a floating or sinking pure phase, depending on the liquid, and partly dissolving in the water. Therefore, it will be important to take swift action in the event of an accidental spill and recover the contaminated soils.

Contaminated groundwater will flow as per the local hydrogeological network. The impact of a potential spill will be, among other things, based on the volume of contaminants spilled, the uniqueness (spill) or the repetition (leak) of the problem and aquifer vulnerability at the spill site. Risk of a major spill at the site will be close to zero and the significance of the impact even lower since the volumes of potential spills linked to machinery will be limited. In addition, in the event of a spill, the cleaning and reporting procedure or emergency plan will be implemented, which will reduce the extent of the contamination and prevent contamination of the groundwater.

Moreover, access roads and routes will have to be maintained to ensure the safety of the workers. Use of ice melters to ensure the safety of routes during winter, could increase the salt concentration in surrounding soil and affect the quality of water and sediments. Seepage of surface water into the soil could carry a portion of these ice melters toward the groundwater table. Groundwater salinity could increase beneath the access roads in places where aquifer is most vulnerable. Considering that ice melters are rarely used and considering the dilution, dispersion and retention phenomena, a significant increase in groundwater salinity is highly unlikely. The ice melter used will be approved by the MTMDT and MELCC.

IMPACT ASSESSMENT

During the construction phase, the intensity is low, whether for risks linked to spills, or those linked to petroleum products or other hazardous materials. The mitigation measures to be applied will efficiently reduce the anticipated impacts. The extent is local given that the contamination would occur in an area confined to work site. Its duration is rated as short since it is limited to the period of construction. In short, the significance of the impact is **minor**.

OPERATION PHASE

SOURCES OF IMPACT

- Presence and operation of the pit.
 - Other infrastructures in operation.
 - Management of economic material, overburden and waste rock.
 - Water management.
 - Hazardous and waste materials management.
 - Transportation and traffic.
-

MITIGATION MEASURES

Standard mitigation measures QUA 01 to QUA 06, QUA 12, NOR 02 to NOR 04, NOR 06 to NOR 09 will be applied to reduce the impact of the project on the quality of water and sediments. These measures are presented in Table 7-5.

DESCRIPTION OF IMPACT

Use and maintenance of the machinery during the operation phase could affect the quality of water and sediments. Development of the sites designated for the project's different infrastructure and the site's normal operations will require the use of vehicles, equipment and heavy machinery. Use, maintenance and transporting of this equipment will emit certain substances into the environment. Potential of leaks or accidental spills during use will increase the risk of contamination of water and sediments by hydrocarbons or other contaminants. The petroleum product storage area and mechanic's shop pose an additional risk. Consequently, leaks at these installations could generate a contamination of the water and sediments. Nevertheless, the impact of these leaks would usually be limited if quickly detected and managed.

The waste rock stockpiles could be a source of impact according to the geochemical properties of waste rock and tailings. Therefore, during operation, runoff percolates through the stockpile and could leach some metals. As presented in Section 4.7.1, waste rock is "low risk" under D019. In addition, according to this same directive, waste rock from all lithologic units would be considered leachable, at varying degrees. Results from tests on tailings, when compared to D019 criteria, reveal that all tailing samples were also considered to be "low risk". Pit dewatering water could also contain metals. With drainage around the stockpiles to collect precipitation water percolating through the tailings and waste rock, and a percolation flow that complies with D019 below the stockpiles, surface and groundwater as well as sediments around the site will be preserved from contamination that may come from this source. All contact water from the site will be collected by the ditch system, pumped to the main water retention basin located on the northwest side of the site. Runoff from the organic and overburden stockpiles will also be collected and conveyed to the same retention basin where particulate matter will settle. The dewatering water from the pit will also be pumped and directed into the site's main water retention basin.

The pumps will be electric and the response time in the event of a hazardous product spill will be fast enough that the impacts associated with potential contamination are considered to be almost nil.

Following the analyses to be performed on the water in the main retention basin, a water treatment plant could be used to treat the water to remove or reduce contaminants that may exceed the D019 criteria. Based on the latest modelling (WSP, 2021b), the pH at the retention basin effluent is expected to remain between 7.4 and 7.7, and the metal concentrations in the effluent below the monthly average concentrations recommended by D019. However, water quality may exceed the criterion for arsenic under dry conditions. Arsenic concentrations are predicted to meet D019 generally in May and June but will exceed the criterion (0.2 mg/L) as precipitation decreases during the summer months around Year 8. Therefore, arsenic treatment may be required under dry conditions beginning in Year 8 of operation.

The water that was in contact with pit walls and waste rock, and then returned into the natural environment, will undergo treatment beforehand. The MDMER authorizes effluents if the pH is between 6 and 9.5, if the concentration ranges in the effluent do not exceed the authorized limits, and if the effluent has proven to be non-toxic. In addition, the effluent must comply with the criteria of D019 and the EDOs which will be specifically established for the project. Therefore, while in compliance to EDO standards, negative impacts on water quality will be limited. The quality of the surface water and groundwater will be monitored in real time throughout the mining operations. The details of the program are presented in Chapter 10.

IMPACT ASSESSMENT

During the operation phase, intensity is low because the protection measures implemented to prevent spills and the migration of contaminated water toward the natural environment will be sufficiently effective. Extent is local since several bodies of water in the study area are affected by the project. During operation, the impact is felt on a discontinuous basis, therefore the duration is moderate. The significance of the residual impact on water and sediments is considered **minor**.

REHABILITATION PHASE

SOURCES OF IMPACT

- Infrastructure dismantling
 - Pit rehabilitation.
 - Water management.
 - Hazardous and waste materials management.
 - Transportation and traffic.
-

MITIGATION MEASURES

Standard mitigation measures SUR 01, SUR 03, SUR 04, QUA 01 to QUA 04, QUA 07, QUA 08, QUA 10 to QUA 12, SUR 03, NOR 01 to NOR 04, NOR 09 to NOR 10 will be applied to reduce the impact of the project on the quality of water and sediments. These measures are presented in Table 7-5.

DESCRIPTION OF IMPACT

During the rehabilitation phase, general decommissioning activities, management of hazardous and waste materials, water management and transport could have a negative affect the quality of water and sediments. Therefore, the impacts described in the construction phase also apply to the rehabilitation phase.

Moreover, the impacts are like those in the operation phase in regard to the waste rock stockpile, main retention basin and its WTP treatment prior to its return in the receiving environment, since water infrastructure will remain in place in spite of site rehabilitation, and this, until the effluent meets D019 requirements.

IMPACT ASSESSMENT

Similarly to during the construction period, **negative impacts linked to the risks of contamination of groundwater by accidental spill and the spreading of ice melters in the winter are expected during the rehabilitation phase. Moreover, impacts are like those in the operation phase in regard to the waste rock stockpiles since infrastructure will remain in place in spite of site rehabilitation.** The mitigation measures that will be applied will efficiently reduce the anticipated impacts and hence, the intensity is low. The extent is local since the work will be confined within the limits of the local study area. The duration is short since site rehabilitation will be conducted over a one-year period. The significance of the impact on the quality of water and sediments is therefore considered to be **minor**.

POST-REHABILITATION PHASE

During the post-rehabilitation phase, the pit will gradually fill up with water. Due to reduced groundwater inflow, the pit lake recharge will mainly come from precipitations. The quality of the pit lake water could deteriorate since part of the water from precipitations will be exposed to the rock walls.

Modelling results for the quality of the water that will accumulate in the pit (WSP, 2021b) show that the water quality will meet the D109 guidelines when the pit is full, before natural discharge to the environment. When the pit is full of water, the pH will remain at 8 and dissolved arsenic below the D019 criterion of 0.2 mg/L. However, during backfilling, arsenic levels will exceed D019 until year 62 post-closure.

In addition, post-rehabilitation activities will recreate surface runoff conditions similar to initial conditions. The groundwater flow regime is expected to essentially return to its original state. The pit lake will have an outflow toward creek CE3. When the infrastructure for water management on the site is dismantled, the surface water's physicochemical nature will return to its initial condition.

7.2.5 ATMOSPHERE

CONSTRUCTION PHASE

SOURCES OF IMPACT

- Site preparation and infrastructure construction.
- Hazardous and waste materials management.
- Transportation and traffic.

MITIGATION MEASURES

Mitigation measures AIR 01 to AIR 05 and standard NOR 11 described in Table 7-5 will be applied.

DESCRIPTION OF IMPACT

During the construction phase, contaminant emissions in the air related to the project are primarily linked to truck traffic, unloading of materials, soil stripping and the deployment of equipment (WSP, 2018c). Deterioration of air quality can have effects on the health of the fauna and flora through deposition and on human health through inhalation. The extent of the effects depends on amount of contaminants emitted into the atmosphere and duration of exposure to contaminants.

The results of the modelling survey on human sensitive receptors identified, reveal that the standards of the *Clean Air Regulation* (CAR) and Canadian Ambient Air Quality Standards (CAAQS) for gaseous compounds and total particulate matter are met with the exception of the Canadian **nitrogen dioxide** standard **for the one-hour period** (Stantec 2021). The modelling survey therefore shows that the deterioration of the quality of the atmosphere by gaseous compounds **extends beyond the project boundary and reaches the primary land users. Concerning** particulate matter, **it will be confined** to the site and its immediate environment and **will not affect** the primary users. The combined effects on human health, fauna and flora are **considered low** for the construction phase.

In addition, in regard to GHG emissions, it was calculated that the project's construction activities (**18 months**) will emit **27.9 tCO₂eq** (Stantec, 2021, Appendix C).

IMPACT ASSESSMENT

The impact of the dust and other disturbances on the quality of the atmosphere during construction is considered low intensity based on the remoteness of the planned activities versus the nearest sensitive receptors. Nevertheless, certain disturbances (dustfall, for example) may be felt in some sections of the study area, conferring a local extent to this impact. In addition, the sectors in question can vary depending on the day, based on weather conditions since the disturbances will necessarily be dependent on the winds. The duration of this impact is short since it is limited to the period of construction. The impact on the quality of the atmosphere during the construction phase is therefore considered to be of **minor** significance.

OPERATION PHASE

SOURCES OF IMPACT

- Presence and operation of the pit.
- Other infrastructure in operation.
- Management of economic material, overburden and waste rock.
- Hazardous and waste materials management.
- Transportation and traffic.

MITIGATION MEASURES

Mitigation measures AIR 01 to **AIR 07** and the NOR 11 standard described in Table 7-5 will be applied.

DESCRIPTION OF IMPACT

The impact associated to an increase in particles and metals in the air during the operation phase, was determined by an air dispersion modelling survey of contaminants for Year 14 of operation. The detailed results during the operation phase are presented in the air dispersion modelling study (Stantec, 2021). The scenario was developed such as to represent the worst conditions during operation.

The study concludes to the modelling of occasional exceedances of the total particle standards from the *Clean Air Regulation*, at the limit of the application of standards and criteria, as identified as 300 m away from operations. Exceedances are mainly found **south** of the pit. However, for all sensitive receptors, no exceedance from the standard is expected.

For all metals and gaseous compounds, the maximum concentrations meet standards and criteria, and this, both at the limit of application and at sensitive receptors **with the exception of the Canadian nitrogen dioxide standard for the one-hour period. The modelling for nitrogen dioxide shows that the air quality degradation extends beyond the project boundary and reaches the primary users.**

Crystalline silica **also shows** criteria exceedances (one-hour and yearly). Exceedances **of the application limit** are infrequent for the one-hour criterion. **However, no exceedances are observed at sensitive receptors.** For the yearly criterion, the only inhabited sensitive receptor exhibiting an exceedance is the km 381 truck stop. Concentrations modelled at other inhabited receptors such as the Cree camps nearby the site, are all below the limit value.

The dust management plan implementation (Stantec, 2021) will ensure the monitoring of the concentrations emitted into the atmosphere and the application of appropriate mitigation measures to limit the impacts.

During the operation phase, several activities such as road transport, traffic, operating of machinery, and propane use, are likely sources of gaseous contaminants, including GHG emissions. GHG emissions linked to mining activities were estimated annually and for the entire project duration (Appendix E). The estimation is based on Galaxy's data for the different mining activities and considers direct and indirect sources. **During the operation phase, the average annual emissions will be 32,273 tCO₂eq. Indirect emissions from the project are estimated at 12,137 tCO₂eq annually.**

IMPACT ASSESSMENT

Despite the exceedances of certain standards and criteria at the sensitive receptors, the intensity of the impact on the quality of atmosphere during the operation phase is considered to be low intensity because **of the application of the dust management plan.** The extent of this impact is local since the impacts are felt nearby the mining activities, within the local study area. Lastly, the duration of this impact is considered to be moderate and will continue to be felt throughout the years the mining site will operate. In short, the impact of the project on the quality of the atmosphere is considered of **minor** significance.

REHABILITATION PHASE

SOURCES OF IMPACT

- Infrastructure dismantling
 - Pit rehabilitation.
 - Hazardous and waste materials management.
 - Transportation and traffic.
-

MITIGATION MEASURES

Mitigation measures AIR 01 to AIR 03 along with the NOR 11 standard described in Table 7-5 will be applied.

DESCRIPTION OF IMPACT

The impact on the quality of the atmosphere during the mine rehabilitation phase is linked to the same activities as in the construction phase, although the latter are less likely to emit dust. However, as for the other project phases, **the degradation of the quality of the atmosphere will be felt in the periphery of the site and in its immediate environment.**

IMPACT ASSESSMENT

The impact of the dust and other disturbances linked to the quality of air during the rehabilitation phase is considered to be low intensity due to the significant reduction in industrial activities. The extent is local since it could spread all over the mining site and its periphery. In regard in the anticipated negative impacts, its duration is short because the rehabilitation work will be completed within a few years. The impact on the quality of the atmosphere during the rehabilitation phase is therefore considered to be of **minor** significance.

POST-REHABILITATION PHASE

Once the site has been restored, impacts will be non-existent, since no mining activities that would affect the quality of the atmosphere will be taking place.

7.2.6 ARTIFICIAL LIGHT AT NIGHT

CONSTRUCTION PHASE

SOURCES OF IMPACT

- Site preparation and infrastructure construction.
 - Transportation and traffic.
-

MITIGATION MEASURES

Mitigation measures LUM 01 to LUM 03 (Table 7-5) will be implemented to minimize the project's impact on artificial light at night.

DESCRIPTION OF IMPACT

Activities that involve fixed or mobile lighting during the construction phase could result in the emission of artificial nocturnal light into the sky and work site limits, which are likely to disturb nocturnal landscapes and have an impact on the biological and social environments on the periphery. Light levels from these facilities and the use of mobile equipment have not been modelled, since this is a temporary situation and the sources will emit very little light compared with developments in the operation phase.

IMPACT ASSESSMENT

The intensity is considered low. The extent is considered localized, since artificial nocturnal light emitted during the construction phase will affect a small area in the study area. The duration is short. The significance of the impact during the construction phase is considered **minor**.

OPERATION PHASE

SOURCES OF IMPACT

- Presence and operation of the pit.
 - Other infrastructure in operation.
 - Management of economic material, unconsolidated deposits, and waste rock.
 - Transportation and traffic.
-

MITIGATION MEASURES

Mitigation measures LUM 01 to LUM 03 (Table 7-5) will be implemented to minimize the project's impact on artificial light at night.

DESCRIPTION OF IMPACT

To accurately assess the impact that **planned facilities in the operation phase** will have on artificial nocturnal light, a photometric modelling of the light levels was carried out using AGI32 lighting analysis software, version 18.3 (AGI32 Light Analyst, Illumination Engineering Software).

This modelling was conducted as part of the 2018 EIA and was presented as an appendix to that EIA (WSP, 2018c). The modelling has not been redone to account for changes to the project as the anticipated impact will be of the same order of magnitude as that predicted in 2018.

The addition of new nocturnal light sources related to the project's facilities will locally alter the sky brightness conditions. The results of light to the sky show a low-intensity light level. The average calculated at 100 m above the tallest building in winter is 0.2 lux for the entire local study area. The light points in the sky are concentrated above the administrative and industrial area (maximum level reached 8.3 lux), stockpiles (approximately 6 lux), and to a lesser extent above the pit (approximately 1 lux), since the light is found under the present elevation of the soil around the pegmatite mound. Road-related lighting also projects low light onto the sky (approximately 0.5 lux). These changes in the brightness of the sky will locally alter the environmental area, which is currently representative of a sector that is slightly impacted by the brightness (C1) toward an area characteristic of a low-brightness sector (C2). **Although the infrastructure (administrative and industrial sector as well as the stockpiles) have been positioned closer to the truck stop compared to the 2018 project,** the additional supply of light should not be sufficient to alter the environmental area attributed to the truck stop, which is already C2 because of the lighting already present at the site.

Expected changes in the brightness of the sky will have very little effect on the sky glow. The effects will only be visible near lit areas. The change will be barely perceptible on all other sensitive receptors in the study area, including permanent Cree campsites. Local alterations in the brightness of the sky will have very little effect on the uses of the territory (traditional or otherwise) on the periphery for facilities planned for the mine's operation.

The addition of new nocturnal light sources in connection with the facilities required by the project will not result in the emission of light trespass. The modelisation results show that light levels at 1.5 m from the ground at limits of the local study area will be zero. The light is only concentrated at the edge of the lit areas. Therefore, no impact of a light trespass source is expected on the quality of life for humans, their uses of the territory (traditional or otherwise), on the periphery of facilities planned for the mine's operation.

Side views **were** modelled in **2018** using two sensitive receptors, the km 381 truck stop and the permanent Cree camp to the south. The results of the visual side simulation **then showed** that at the km 381 truck stop, the light emitted by future facilities will not be directly visible due to the area's rugged topography, which limits the direct view into the site. On the other hand, a slight sky glow will be perceptible in the sky, which will locally impact the quality of the nocturnal landscape in the area. The same observation can be made at the permanent Cree camp. The glow will be more visible in the presence of clouds, this is the artificial nocturnal light emitted by ground facilities, which has the effect of increasing the visibility of sky glows in addition to reducing the brightness of the sky. **These results are still considered valid in the 2021 design.**

In the context of the project, the environmental effects of artificial nocturnal light on the biological environment are considered insignificant due to the low level of light generated to the sky and the absence of light trespass at the limits of the local study area.

IMPACT ASSESSMENT

During the operation phase, the probable residual impacts of the project on artificial light at night mainly affect the social environment. Effects on the biological environment will be minor due to the low level of light generated to the sky and the absence of artificial light at the limits of the local study area. Therefore, the expected impacts are more specifically assessed on the **brightness of the sky** and **nocturnal landscapes**. The impact intensity on artificial light at night is considered low, since the brightness of the sky and quality of the nocturnal landscapes will be slightly altered, and it is unlikely that these changes affect users of the area. The extent is considered local considering that the impact will be concentrated on the site itself and a few hundred metres around. The duration is medium, since the impact will only be felt during the operation phase and is not permanent. The significance of the impact during the operation phase is considered **minor**.

REHABILITATION PHASE

SOURCES OF IMPACT

- Infrastructure dismantling
 - Transportation and traffic.
-

MITIGATION MEASURES

Mitigation measures LUM 01 to LUM 03 (Table 7-5) will be implemented to minimize the project's impact on artificial light at night.

DESCRIPTION OF IMPACT

The activities mentioned above that involve fixed or mobile lighting during the rehabilitation phase could temporarily result in the emission of artificial nocturnal light into the sky and work site limits, which is likely to disturb nocturnal landscapes and have an impact on biological and social environments on the periphery. The light levels from these facilities and the use of mobile equipment have not been modelled, since this is a temporary situation and the sources will emit very little light compared to the facilities that will be present during the operation phase, in the same place.

IMPACT ASSESSMENT

During the rehabilitation phase, the facilities that will be lit and the use of equipment and machinery that will require lighting for operations and worker safety will be temporary and emit very little artificial nocturnal light. The intensity is considered low. The extent is considered local, since the artificial nocturnal light emitted during the rehabilitation phase will affect a small area in the local study area. The duration is short. The significance of the impact during the rehabilitation phase is considered **minor**.

POST-REHABILITATION PHASE

As the activities on the site will be completed during the post-rehabilitation phase, no impact is anticipated on artificial light at night.

7.2.7 AMBIENT NOISE

CONSTRUCTION PHASE

SOURCES OF IMPACT

- Site preparation and infrastructure construction.
- Transportation and traffic.

MITIGATION MEASURES

Mitigation measures SON 01 and SON 02 as well as NOR 12 described in Table 7-5 will be applied.

DESCRIPTION OF IMPACT

A simulation during the construction phase was set up during the busiest periods in terms of equipment and noisy work simultaneously. The scenario includes **the construction of the mining complex and the start of pit operations**, when there will be the most trucks at the site. At this stage of the project, the construction methods and details (number, type of equipment, etc.) are not exactly known. Hypotheses were necessary to be able to establish the most likely scenarios to occur on the same day. **Appendix H presents the modelling methodology and results.**

The noise criteria for the daytime period are based on a 12-hour period. It was considered in the model that the work would only be done during the day (between 7 a.m. and 6 p.m., **with a one-hour break**), for a 10-hour period. Galaxy does not foresee any problems in complying with the noise standard of 55 dBA between 7:00 a.m. and 7:00 p.m.

IMPACT ASSESSMENT

The impact intensity is considered low since the sound impacts assessed during the construction phase comply with the **MELCC** criteria for construction sites. The extent is considered local considering that the impact will be felt on the periphery of the mine site, including the km 381 truck stop. Its duration is short and it will spread over the entire construction. The significance of the impact on the ambient noise during the construction phase is therefore considered **minor**.

OPERATION PHASE

SOURCES OF IMPACT

- Presence and operation of the pit.
 - Other infrastructure in operation.
 - Management of economic material, unconsolidated deposits, and waste rock.
 - Transportation and traffic.
-

MITIGATION MEASURES

Mitigation measures SON 01 to SON 03 as well as NOR 12 described in Table 7-5 will be applied.

DESCRIPTION OF IMPACT

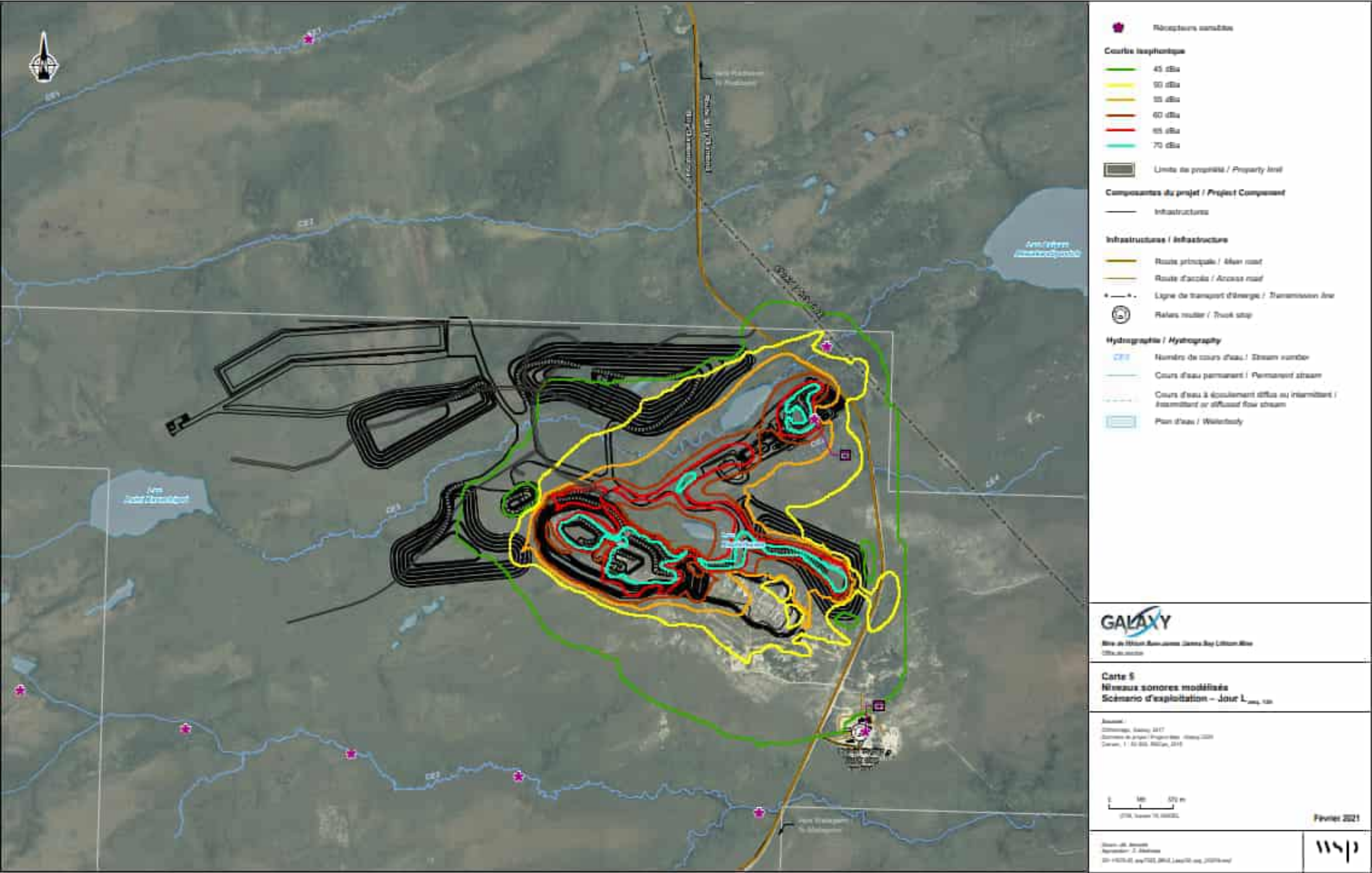
To assess the extent to which noise may be detrimental to well-being, sound criteria have been established within D019. This directive indicates average hourly sound levels for the diurnal and nocturnal periods that should not be exceeded. These values are based on the prescriptions of Instruction Note 98-01 on noise of the MDDELCC, according to the uses permitted by a municipal zoning by-law. The project falls within zone IV (non-sensitive area) and the applicable noise criteria are 70 dBA at night, except for the Cree camp and the km 381 truck stop, and 55 dBA during the day or residual noise, if higher. For those two other sites, the criteria are 55 dBA at night and 50 dBA during the day.

A simulation of sound propagation to assess the project's noise emissions with tailwinds was conducted in year **12** of the operation (**in 2035**), the year when the production level would be the highest. Map 7-3 presents the iso-contours of noise as modelled during the operations. **Appendix H presents** the detailed results of this modelling from a separate study (**WSP, 2021c**). The most restrictive noise level to be met is that generated during the nocturnal period and it is set at **45 dBA** ($L_{Aeq\ 1h}$). Considering all of the mine's emission sources, its maximum sound impact for the nearest sensitive receptor is assessed at **44 dBA** (km 381 truck stop).

For the transport of the concentrate using the Billy-Diamond highway, particular attention was paid to the sensitive areas that could be located near the road between the mine and Matagami and where the ambient noise level would be disturbed by the addition of transport trucks to the current traffic. A 1 % per year increase in traffic was observed between 2014 and 2017 on the Billy-Diamond Highway. This same 1 % per year increase was applied to determine the current and 10-year traffic flows. The impact resulting from the change in traffic by the addition of concentrate trucks was determined according to the noise impact assessment grid of the Politique du bruit routier of the Ministère des Transports du Québec. According to this assessment grid, the noise impact produced by the Galaxy project's increase in traffic on Billy-Diamond highway is not significant and will therefore not be felt in the study areas.

IMPACT ASSESSMENT

The impact intensity during the operation phase is considered low, since the sound impact is in accordance with the limit of 50 dBA at night, even in tailwind conditions, considering all sources of noise are simultaneously active. The extent of this impact is local because it will encompass the entire mining site as well as a zone of influence on the periphery of it. This impact will be of short duration and intermittent, occurring during the operation period, approximately **18** years. Overall, this impact is considered of **minor** importance.



Map 7-3 Modelled Noise Levels – Operation Phase – LAeq1h

Source: WSP, 2021c.

REHABILITATION PHASE

SOURCES OF IMPACT

- Infrastructure dismantling
 - Pit rehabilitation.
 - Transportation and traffic.
-

MITIGATION MEASURES

Mitigation measures SON 01 and SON 02 as well as NOR 12 described in Table 7-5 will be applied.

DESCRIPTION OF IMPACT

As with the construction phase, the rehabilitation methods and details (number, type of equipment, etc.) are not exactly known. The results modelled during the construction phase are in accordance with the standards, and the work required during rehabilitation is similar to that during construction.

IMPACT ASSESSMENT

The impact intensity is considered low since sound impacts during the rehabilitation phase will be in accordance with D019. The extent is considered local given that the impact will be felt on the periphery of the mine site. Its duration is short, since all of the activities in the rehabilitation phase will take place over a period of one year. The significance of the impact on the ambient noise during the rehabilitation phase is therefore considered **minor**.

POST-REHABILITATION PHASE

As there will be no more activity at the site during the post-rehabilitation phase, there will be no impact on the ambient noise.

7.2.8 VIBRATIONS AND OVERPRESSURE

CONSTRUCTION PHASE

SOURCE OF IMPACT

- Site preparation and infrastructure construction.
-

MITIGATION MEASURES

Mitigation measures VIB 01 to VIB 04 and NOR 13, described in Table 7-5, will be applied.

DESCRIPTION OF IMPACT

Blasting is planned during the construction phase for the **pit** operation. These activities will cause vibration and air overpressures.

IMPACT ASSESSMENT

The intensity of the impact is considered low, since the activities during construction will be marginal. Its extent is considered local given that vibration and air overpressures could be experienced in the periphery of the **pit**. Its duration is short, since the impact will be felt intermittently, during blasting. The significance of the impact of vibration and air overpressures during the construction phase is therefore considered **minor**.

OPERATION PHASE

SOURCE OF IMPACT

— Presence and operation of the pit.

MITIGATION MEASURES

Mitigation measures VIB 01 to VIB 04 as well as NOR 13, described in Table 7-5 will be applied.

DESCRIPTION OF IMPACT

The impact assessment was carried out considering the use of a load of **175** kg of explosives per hole 152 mm in diameter, an explosive density of 1.2 t / m³ and a solid packing collar height of 3 m.

The vibration criterion of D019 for structures and sensitive human areas is 12.7 mm/s. Assuming a maximum of four holes exploding in 8 ms, the threshold is respected for the nearest structures, which are the km 381 truck stop (**6.3** mm/s), the industrial sector (**7.7** mm/s) and the worker camp (**4.0** mm/s). For fish, the criteria established in the *Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters* (Wright and Hopky, 1998) is a pressure of 100 kPa in their swim bladder. This pressure is reached at a distance of **133** m from the detonation, assuming the same parameters indicated above. Since the minimum distance between the pit and the nearest watercourse will be **230** m (creek CE3), the detonations will be compliant. As indicated in the specialized study on the aquatic habitat (WSP, 2018d), there are no spawning grounds or potential spawning sites in creek CE3. However, creek CE5 has a potential to have spawning ground. The criterion is 13 mm/s in a spawning ground during the period when eggs are incubating. A vibration level of 3.9 mm/s is calculated in the pit location closest to creek CE5 (**920** m), which is compliant.

Regarding air overpressures, the criterion of D019 is 128 dB for sensitive populated areas. The air overpressure calculation is **119** dB for the km 381 truck stop and **116** dB at the worker camp. The calculations assumed the absence of temperature inversions and tailwinds. These parameters could therefore increase the values by 10 dB, under certain conditions. As a result, mitigation measure VIB 03 will make it possible to maintain the thresholds within adequate levels.

Furthermore, flying rock during blasting will be minimized by using blasting mats and a stuffing collar at least 5 m high when done in sensitive sectors.

IMPACT ASSESSMENT

The intensity of the impact is considered low, since the level of vibration and air overpressures assessed during the operation phase comply with the criteria of D019 and Fisheries and Oceans Canada. Its extent is considered local given that vibration and air overpressures may be experienced on the periphery of the mining site, at the km 381 truck stop and along the James Bay road. The duration will be short, since the impact will be felt intermittently, at the time of blasts. The significance of the impact of vibration and air overpressures during the construction phase is therefore considered **minor**.

REHABILITATION PHASE

Does not apply, since there will be no activity that could generate vibration and air overpressures during rehabilitation work.

POST-REHABILITATION PHASE

Does not apply since there will be no more activity on the site.

7.2.9 COMPARISON OF THE DESCRIPTION OF THE IMPACTS ON THE PHYSICAL ENVIRONMENT 2018 VS 2021

This section summarizes the changes to the current impact description and assessment compared to those described in the 2018 EIA. Table 7-12 summarizes the components of the physical environment in the study area and, by project phase, shows the changes to the description and assessment of impacts based on the 2018 and 2021 projects, where applicable.

Table 7-12 Comparison of the project impact description and assessment on each physical component of the local study area

Component	Phase	Change to the impact description	2018 project impact importance	2021 project impact importance
Soil	Construction, operation and rehabilitation	-	Minor	Minor
Hydrogeology	Construction	-	Minor	Minor
	Operation, rehabilitation and post-rehabilitation	The hydrogeological modelling has been updated to reflect non-significant changes	Moderate	Moderate
Hydrological regime	Construction	Water will be drawn from Lake Kapisikama to feed the mobile concrete plant	Minor	Minor
	Operation, rehabilitation and post-rehabilitation	Watershed area and flow impact calculations have been updated to reflect non-significant changes	Moderate	Moderate
Water and sediments	Construction	-	Minor	Minor
	Operation and rehabilitation	Water quality modelling of the contact water catchment basin has been updated. The treatment applicable to the WTP does not result in a change to the residual impact.	Minor	Minor
Atmosphere	Construction, operation and rehabilitation	The general movement of infrastructure to the east does not result in significant changes.	Minor	Minor
Artificial light at night	Construction, operation and rehabilitation	-	Minor	Minor
Ambient noise	Construction and rehabilitation	-	Minor	Minor
	Operation	Noise modelling has been updated and noise levels remain similar at the receptor. The increase in noise due to transportation on Billy-Diamond highway has been considered and no significant changes are anticipated.	Minor	Minor
Vibrations and overpressure	Construction, operation and rehabilitation	-	Minor	Minor

7.3 IMPACTS ON THE BIOLOGICAL ENVIRONMENT

7.3.1 VEGETATION AND WETLANDS

CONSTRUCTION AND OPERATION PHASES

SOURCES OF IMPACT

- Site preparation and infrastructure construction.
 - Presence and operation of the pit.
 - Management of process plant feed material, overburden and waste rock Transportation and traffic.
 - Hazardous and waste materials management.
-

MITIGATION MEASURES AND COMPENSATION

Mitigation measures VEG 01 to VEG 07, SUR 01 to SUR 04, QUA 01 to QUA 05, QUA 10 to QUA 12 should be applied, as well as standards NOR 02 to NOR 04, NOR 10 and NOR 15, described in Table 7-5.

To make up for inevitable losses of wetlands, a compensation program will be developed to comply with MELCC requirements (NOR 15). This program will be prepared and presented to the MELCC with the application for mining authorization **for the construction of the project.**

A compensation program to make up for the inevitable losses of wetlands will be developed to comply with MELCC requirements (see Measure NOR 15) and will be submitted to the MELCC as part of the authorization of construction work application. The detailed wetland compensation plan proposed by Galaxy will comply with MELCC requirements for mining projects in the Nord-du-Québec territory. The proponent has already committed to preparing a compensation plan that will be developed in close collaboration with the MELCC and the Eastmain Cree community, and will therefore take into account the expectations and requirements formulated by the latter.

A meeting with local stakeholders is planned for the six months following the issuance of the Order, to gather concerns and suggestions and to specify the preferred compensation options. Following the consultations, the main avenues for compensation will be presented to the MELCC and stakeholders for preliminary analysis. The results of this analysis will guide the development of the final compensation plan that will be produced as part of the environmental authorization applications for the construction phase.

It is currently too early to detail the projects, works or measures that could be included in the compensation plan, but it is possible to outline the general strategies that could guide the development of the compensation plan. The creation or restoration of different types of wetlands will be targeted, which will promote specific biodiversity and habitats. Environmental gains could result by increasing the presence of regionally rare environments. These measures will have to establish environments that will fulfill, at maturity, the ecosystem functions specific to northern wetlands, including carbon sequestration. The focus will be on local and regional projects based on the expectations of the affected communities.

It is important to note that the northern and isolated context of the project means that there are currently few projects under development in which the proponent could offer its participation to enable their realization. However, the compensation plan could include helping to restore abandoned mine sites in the Nord-du-Québec region. Financial contributions for research could also be considered, particularly with regard to acquiring fundamental and applied knowledge on boreal wetlands in Northern Quebec through partnerships with various researchers from universities, such as Nicole Fenton (UQAT), NSERC-UQAT Industrial Chair on Northern Biodiversity in a Mining Context, and Line Rochefort (ULaval), Industrial Research Chair in Peatland Management. Finally, financial compensation may be part of a set of compensatory measures.

Once all the steps have been completed and discussions have been held with the Eastmain Cree community, including the Tallymen and land users, as well as the MELCC on possible compensation projects, a detailed version will be submitted to the MELCC after the order authorizing the project is issued.

DESCRIPTION OF IMPACT

DIRECT AND INDIRECT IMPACT ON VEGETATION AND WETLANDS

The anticipated impacts on vegetation are primarily related to the destruction and modification of natural habitats. These impacts will be caused by the deforestation and excavation necessary to prepare the site and by the construction of temporary or permanent infrastructure. It is important to note that the construction of waste rock and overburden stockpiles as well as expansion of the pit will take place continuously during the operation phase. To provide an overview of the area of natural environments that will be affected by the construction of all infrastructure, it was considered relevant to merge the construction and operation phases in describing the impact.

The work required for future development of mining infrastructure will result in the transformation of roughly 145 ha of terrestrial environment and 305 ha of wetlands. **It should be noted that the project optimization has made it possible to completely avoid encroachment into the plant groups that are part of the hydric environments, with the exception of a large peat bog pond.** Table 7-13 lists the area of natural environments affected for all project infrastructure, by type of grouping observed in the study area. **Table 7-14 shows the affected areas as well as the stripped areas around the infrastructures, i.e. a 50-m buffer strip that includes the 35-m protective zone that will be stripped to protect the infrastructures from potential forest fires.** The initial condition of these environments prior to activities is generally non-degraded.

In addition to areas directly affected by work, the development of the site and projected infrastructure will have an indirect impact on plant communities preserved. On the one hand, work will fragment ecosystems and could lead to changes to plant communities bordering the infrastructure **beyond the 35-m protection zone, which is why an additional 15 m was considered in the calculation of the impacted plant area (see previous paragraph).** On the other, the establishment infrastructure will isolate some wetlands areas and change the drainage pattern on the work site. Under these conditions, some wetlands could be subject to more or less significant changes, in particular partial dewatering in the periphery of drainage ditches. Note that building of a small clay berm along stripped areas will reduce the effect of this indirect impact. Monitoring of vegetation on the periphery of infrastructure during the first years will allow better evaluation of this anticipated impact. Details are presented in Chapter 10.

Low probability impacts

Besides direct encroachment on land, other sources of impact could affect vegetation and wetlands. The management of hazardous and waste materials could lead to accidental spills of hydrocarbons into the environment, mainly associated with refuelling or breakdown of machinery. Appropriate work practices will be put in place to prevent accidental spills, and should they occur, the contaminated soil will be managed in a manner consistent with existing regulations. Recycling and recovery of non-hazardous waste materials will be promoted during the construction phase. Therefore, the environmental risks related to spills are low and, if they occur, will be limited to the work site.

Also, machinery transportation and traffic on the work site could accidentally introduce or propagate invasive alien plant species (IAPS) within the territory. The rather rigorous climatic conditions in the study area will nonetheless limit the growth potential of some invasive species present mainly in the south of the province. Mitigation measures are planned to reduce the risks of introduction and propagation during construction and operation activities.

According to information gathered from Tallymen and their families (traplines RE2, VC33 and VC35) and other land users (Jamesian communities and the Eastmain Cree, see Chapter 5, Section 6.4.6 and Appendix G of the ESIA), the Tallymen's traditional use of local flora consists mainly of gathering blueberries and mushrooms. The list of plants for traditional use in Table 6-28 includes a large number of taxa and should be considered exhaustive since it includes more species than those confirmed for use during interviews with local community members. All of these species are abundant and common around the mine site and throughout the James Bay territory. Although individuals of these species will be lost during construction directly at the project site, they will remain present around the project site throughout the project.

IMPACT ASSESSMENT

The application of mitigation measures will minimize the potential impacts on vegetation and wetlands. However, despite the fact **that the species and wetlands identified are common and abundant throughout the area** and that the impacts will be reduced by optimizing the project at the early design stage, the areas affected will be significant. For these reasons, this impact is considered moderate. However, it is important to note that its extent is local, since deforestation will affect only the mine site **and a thin strip around the footprint**. The duration is medium since the impact may occur during the life of the mine, a period of approximately 20 years. Overall, the significance of the impact on vegetation and wetlands during the construction and operation phases is considered **moderate**.

Table 7-13 Area of terrestrial environments and wetlands directly affected by type of project infrastructure¹

Type of infrastructure	Rocky outcrop (ha)	Human (ha)	Scrubland	Speckled alder	Dry stripped	Black spruce stand with lichen (ha)	Jack pine forest	Shrub peatland (ha)	Wooded peatland (ha)	Open peatland (ha)	Lake	Total per infrastructure
Waste rock stockpile	34.823		18.812			13.499		27.048	32.642	44.569	0.651	172.042
Overburden pile								11.458	21.026	18.233		50.717
Pit	11.545		16.423						0.350	22.777		51.095
Storage yard					3.063			0.089		0.591		3.743
ROMPAD					2.742							2.742
Industrial and administrative sector		0.055		0.784	6.691		0.939	0.983	0.967	4.709		15.128
Explosives storage facility								2.933		0.573		3.506
Water treatment plant								0.254	0.398			0.652
Ponds			3.931					13.264	13.479	4.231		34.904
Access	0.269		1.002		1.858	0.002		4.079	3.716	9.769		20.695
Total by natural environment	46.637	0.055	40.168	0.784	14.353	13.501	0.939	60.109	72.576	105.451	0.651	355.224

¹ Areas do not include the 50 m indirect impact zone around the infrastructures because the areas are only related to the infrastructure footprint..

Table 7-14 Areas of terrestrial, wetland and water environments directly affected

Terrestrial environment	<i>Study area</i>	<i>Area directly affected (ha)</i>
Rocky outcrop (ha)	53.55	52.17
Human (ha)	43.52	0.86
Scrubland	241.64	53.00
Speckled alder	7.66	1.71
Dry stripped	21.40	17.56
Black spruce stand with lichen (ha)	114.61	18.12
Jack pine forest	15.51	1.61
Subtotal	497.90	145.03
Wetlands and water environments		
Shrub peatland (ha)	747.95	72.33
Wooded peatland (ha)	800.54	91.19
Open peatland (ha)	1326.52	140.69
Lake	67.03	0.65
Subtotal	2942.04	304.87
Total	3439.94	449.90

REHABILITATION PHASE

SOURCE OF IMPACT

- Transportation and traffic.
- Decommissioning of infrastructures.

MITIGATION MEASURES

Mitigation measures VEG 02, VEG 03 and VEG 06, QUA 01 to QUA 04, QUA 10 to QUA 12 should be applied, as well as standards NOR 02 to NOR 04 and NOR 10, described in Table 7-5 will be applied during the rehabilitation phase.

DESCRIPTION OF IMPACT

This phase includes the restoration of the site, including the **revegetation** of the various infrastructures. In short, the pits and other stripped surfaces will be revegetated in order to stabilize the site and allow for **the complete revegetation** of the site as quickly as possible.

Clay berms will need to be removed to re-establish connectivity between the restored environments and the surrounding natural environments.

Transportation and traffic will continue to be a potential vector for the introduction and propagation of invasive alien plant species. The application of mitigation measures will nonetheless reduce this risk to a negligible level.

IMPACT ASSESSMENT

The impact on vegetation during the closure phase is positive overall. As a result, an impact assessment is not required.

POST-REHABILITATION PHASE

After rehabilitation of the site, impacts will be nonexistent, since no mining activities likely to alter the quality of vegetation and wetlands will take place.

7.3.2 LARGE FAUNA

CONSTRUCTION AND OPERATION PHASES

SOURCES OF IMPACT

- Site preparation and infrastructure construction.
- Presence and operation of the pit.
- Other infrastructure in operation.
- Management of process plant feed material, overburden and waste rock Hazardous and waste materials management.
- Transportation and traffic.
- Economic development and presence of workers.

MITIGATION MEASURES

Mitigation measures SUR 01 to SUR 04 should minimize the areas affected, i.e. the footprint of required infrastructure (road, pits, stockpiles, basin, etc.). Overall, measures FAU 03, FAU 05, **FAU 08**, SON 01, CIR 01 to CIR 03, and LUM 01 to LUM 03 will help reduce disturbance of these **species likely to be present in the project area**.

If, despite the demonstration of the very low probability of caribou using the area, a caribou was observed near or in the project's area of influence, its presence would be reported to the person in charge of operations and the person in charge of the environment. The information would be validated and, if necessary, employees that may be in contact with the individual would be informed of the situation in order to increase their level of vigilance and limit the risk of disturbance or collision. The regional wildlife protection officers' office would also be notified. If the wildlife protection officers, in cooperation with Galaxy, determine that there is a risk to a caribou in the area of the mine or Billy-Diamond highway, Galaxy will propose adjustments to its operations to limit the risk of disturbance and collision until the risk is eliminated. For example, transporting the ore in convoys of several trucks to reduce the need for regular truck traffic. Furthermore, as soon as the authorizations are received, the proponent undertakes to create a joint working group (Galaxy, Eastmain and Waskaganish) to discuss any follow-up to be performed for this species. The frequency of these meetings will be determined later with the participants. This species is also included in the general fauna monitoring described in Chapter 10.

DESCRIPTION OF IMPACT

Two large mammal species are likely to frequent the mining project area: moose (*Alces alces americana*) and black bears (*Ursus americanus*). **Although the presence of woodland caribou (*Rangifer tarandus caribou*) is not likely, as described in section 6.3.2.1, the potential effects of the project on this species were also analyzed and documented in this section to validate the relevance of considering this species in the project impact assessment.**

The project will result in the loss of approximately 145 ha of terrestrial vegetation and 305 ha of wetlands during site preparation, and the construction and operation phases, including a 50-metre buffer area around the infrastructure, i.e. 35 m of planned deforestation and an additional 15 m of indirect impact. The project's main direct impacts on large fauna are habitat loss and fragmentation.

Woodland Caribou

Habitat loss and alteration

The study area is located in overlapping ranges of the Assinica population of woodland and migratory caribou of the Leaf River population (Couturier and et al., 2004). Woodland caribou are listed as a threatened species in Canada under the *Species at Risk Act*. They are also designated as vulnerable in Québec under the *Act respecting threatened or vulnerable species*. Since caribou, and more specifically woodland caribou, are a sensitive component of the natural environment, the study area for large fauna was defined primarily with this species in mind. However, no caribou were observed during the field survey, and data from radio collars did not show the mine area to be frequented by this species. Furthermore, subsequent forest fires have destroyed the vegetation. Return of this vegetation, and consequently of caribou habitat, is likely to take longer than the duration of the project (section 6.3.2.1). **With the expectation that fire-disturbed habitat will revert to suitable habitat within a few decades, the construction and operation of the mine will not result in any permanent destruction of existing or future habitat. As shown on Map 4-12, the waste rock stockpiles and tailings and all infrastructure are to be revegetated during the rehabilitation phase.**

The main threats to woodland caribou, identified in Chapter 4 of the *Woodland Caribou Recovery Strategy* and potentially related to the Galaxy project, are habitat alteration (loss, degradation or fragmentation) caused by human activities, and predation.

Fragmentation of caribou habitat caused by the project will be minimal, and concentrated in an area approximately 5 km in length. In total, the project will result in the loss of 340 ha of potential caribou habitat, including a 50-metre buffer area. The area of large-scale habitat affected by the project is approximately 127 ha, while potential calving, post-calving and rutting habitat is approximately 213 ha (Map 6-16A).

The habitats on either side of the infrastructures do not offer any exceptional conditions for caribou. The plant communities and biophysical conditions present in the area are widespread throughout the James Bay region. The environment in the project's area of influence is greatly disturbed by recent fires and/or the presence of existing infrastructures, in particular the Billy-Diamond highway, the truck stop and the hydropower transmission line. However, linear infrastructure, such as roads, can obstruct movement and fragment caribou habitat (St-Laurent et al., 2012). By obstructing movement, a road can lead to a loss of functional habitat, in addition to contributing to its fragmentation (Renaud et al., 2010). The effect of a road as an obstacle to caribou movement or the fragmentation of its functional habitat is proportional to the volume of traffic on it. Ultimately, Mahoney and Shaefer (2002) suggest that it is the construction of the road and its use by vehicles, rather than the physical structure itself, that would actually negatively impact caribou, especially during critical phases of their life cycle.

Therefore, the proximity of the proposed mine site to existing infrastructures (Billy-Diamond highway, power line, truck stop at km 381), which are sources of human activity, the small size of the proposed mine site, which allows caribou to easily go around the project site, and the low quality of the habitats within and around the zone of influence of the mine site, should minimize the effect of woodland caribou habitat fragmentation.

Predation

The increase in caribou predation due to deforestation and the presence of infrastructures such as access roads is associated with two phenomena: an increase in predator density and an improvement in their travel conditions. Deforestation by natural (fire) or anthropogenic (logging) causes in the boreal forest rejuvenates the forest landscape and promotes the development of hardwood species (leafing). These early stages of forest regeneration provide quality habitat for moose, which promotes an increase in their density, but in turn increases the density of their main predator, the grey wolf (*Canis lupus*). Consequently, the increase in wolf density increases predation pressure on woodland caribou, which are vulnerable to this predator. Deforestation also promotes the development of berry bushes, thereby also providing favourable conditions for an increase in black bear densities (Brodeur et al., 2008), another major predator of woodland caribou, primarily of fawns (Pinard et al., 2012). These effects of deforestation on habitat, and ultimately on wolf and black bear populations, are now recognized as a major cause of the decline in woodland caribou in North America, as predation has been identified as one of the main factors limiting caribou populations (Équipe de rétablissement du caribou forestier du Québec, 2013). This phenomenon has already been observed throughout most of the woodland caribou's range.

Studies also show that the probability of encounters between woodland caribou and wolves increases near linear structures. Authors mention that linear corridors, such as roads, allow wolves to travel at greater speeds and be more efficient in hunting, thereby increasing their predation pressure on large ungulates (Équipe de rétablissement du caribou forestier du Québec, 2013). At low densities of use, roads can sometimes serve as seasonal travel corridors, but their use ceases with the construction of major roads, such as paved highways, or when the potential for encounters with wolves and humans increases (Nellemann et al. 2000).

The mine infrastructure does not include linear features that allow predators to travel at higher speeds and improve hunting of large ungulates such as woodland caribou. In addition, the current intensity of human activity in the sector likely already deters wolves from frequenting this area, as it does for caribou. Thus, the current probability of encounters between woodland caribou and wolves is essentially zero in this area and the mining project will not significantly change this probability.

Collision and disturbance

The increase in traffic flow on the Billy-Diamond highway caused by the project will be slight (10-12 trucks per day), and the potential for caribou to be present on the highway is low (Map 6-17). Environment Canada's *Woodland Caribou Recovery Strategy* indicates that vehicle collisions are not nationally identified as a significant threat to woodland caribou (Environment Canada, 2012). Trucking related to the mine will occur during the daytime, which further reduces the risk of collisions. Caribou, like most large fauna species, are generally more active between dusk and dawn (Parks Canada, 2017) and most collisions occur during this period of reduced visibility (MTQ, 2010). Areas with the highest risk of collision with caribou will be identified by adequate signage. Furthermore, if caribou are observed in the project sectors, these observations will be recorded and may be sent to the MFFP so that they can be added to the current monitoring of the movements of radio-collared caribou. It will then be possible to identify whether one or more caribou are likely to be calving or wintering near the mine's area of influence. If so, exceptional measures will be agreed upon with the MFFP to mitigate the impacts on these caribou.

In addition to the impacts on caribou that may result from habitat alteration or predation, certain other activities may alter the natural behaviour of woodland caribou, in particular avoidance of the area. They could be affected by artificial lighting, noise, dust, and vibrations during blasting, and by human presence. To reduce these potential impacts, in particular, motorized equipment will be outfitted with high-performance mufflers in good condition to minimize noise disturbance. Blasting will be carried out during the day to minimize disturbance at night, while lighting will be limited to nighttime and installed in such a way as to prevent light from spreading out beyond the site. Light is not expected to have much of an impact on woodland caribou. To the best of our knowledge, there are no scientific studies that document the impact of light on woodland caribou. Chapter 4 of the “Woodland Caribou (*Rangifer tarandus caribou*) Recovery Strategy, Boreal Population, in Canada - 2012” identifies a low to medium level of concern for noise and light disturbance. The potential impacts of light will not extend beyond a 500-metre area of the mine, either from on-site lighting or lighting from ore transport trucks. Mitigation measures are planned to further reduce the potential impact of light. This also applies to dust emissions. No significant impact on woodland caribou is therefore expected. It should be noted that woodland caribou avoid man-made disturbances and that the likelihood of caribou being present in the study area or near the project footprint is very low. Current knowledge indicates that the species has used the study area very little over the past decade, be they woodland or migratory caribou. As a result, this sensitive component does not appear threatened by transportation, construction or operation activities, and therefore no impact on caribou is anticipated.

Moose and Black Bears

Moose, a common species in southern Québec, are very rare in the sector, with an estimated density of 0.5 moose/10 km² (Morin, 2015). As for black bears, the population density was estimated to be 0.2 bears/10 km² in 2003 (Lamontagne et al., 2006). However, disturbed environments, well represented by those undergoing regeneration following three fires, offer good habitat potential for black bears in the study area. The loss of habitat associated with the project footprint for these two species is therefore not significant.

However, as with caribou, the site preparation stage of the construction and operation phases could result in accidental death of these large fauna species through vehicle collisions. To minimize this risk, areas with the highest risk of collision with large fauna will be identified by adequate signage (FAU 03). Movements of large fauna near the project's periphery could also be altered by artificial lighting, noise, dust and vibrations during blasting, and by human presence. To reduce potential noise impacts, motorized equipment will be outfitted with high-performance mufflers in good condition, and blasting will be carried out during the day to minimize disturbance at night. Mitigation measures are also planned to limit the impact of light on fauna.

To avoid attracting animals, including black bears and wolves, with food resources or household waste, measures are planned to prevent the accumulation of food waste, such as installing a covered compost bin. Fauna, including predatory species, will not be able to access waste materials because the waste containers will be covered (FAU 08). There are no plans to install fencing around the site where household waste will be managed. Waste materials that may attract animals will still be managed in such a way to prevent any animal from entering into the storage area. Furthermore, workers will be made aware of the importance of not feeding animals or leaving food lying about so as not to attract wildlife, especially bears, near work areas. Animals are not likely to be attracted to the site due to the noise and continuous activity. To ensure the safety of personnel, the site will be under constant surveillance and if an animal is seen on the site, appropriate measures will be taken to scare it off. Finally, waste materials will be sent off-site to a landfill in Amos.

IMPACT ASSESSMENT

For all sources of impact identified during preparation, construction and operation, applying the mitigation measures proposed will help reduce the intensity, extent, duration and significance of the residual impact on **large fauna**. The intensity of the impact is therefore considered low. Its extent is local since the impact will essentially be limited to the mine site. The duration is considered medium, since the impact will extend over the life of the mine **on a continuous basis**. Overall, the significance of the impact on large fauna during the construction phase is therefore considered **minor**.

REHABILITATION PHASE

SOURCES OF IMPACT

- Infrastructure dismantling
 - Transportation and traffic.
 - Economic development and presence of workers.
-

MITIGATION MEASURES

As in the site preparation, infrastructure construction and operation phases, mitigation measures FAU 03 and FAU 05, SON 01, CIR 01 to CIR 03, and LUM 01 to LUM 03 should minimize the immediate impact of rehabilitation work on large fauna while limiting the footprint of infrastructure to be decommissioned and restored (pits, stockpiles, basin, etc.).

DESCRIPTION OF IMPACT

In light of the work involved, the impact of certain activities during the rehabilitation phase will be essentially the same as during the construction and operation phases. Therefore, some activities associated with rehabilitation work (artificial lighting, noise, dust, risk of spills, human presence, etc.) are likely to alter the natural behaviour of large fauna and their movements. Several preventive measures will nonetheless be implemented to minimize the impacts of rehabilitation work on large fauna.

IMPACT ASSESSMENT

For all sources of impact identified during rehabilitation, application of the mitigation measures proposed will help reduce the intensity, extent, duration and significance of the residual impact on large fauna. The intensity of the residual impact is therefore considered low. Its extent is local since the impact will essentially be limited to the mine site. The duration is considered short term since the impact will be limited to the duration of the rehabilitation work. Overall, the significance of the impact during the rehabilitation phase is considered **minor**.

POST-REHABILITATION PHASE

To the extent that restored habitats could be used quickly by the species generally associated with them, the side benefits of rehabilitation work potentially will be high for large fauna. This hypothesis is all the more plausible given that the estimated diversity and density of these species, prior to implementation of the project, was relatively low in the study area.

7.3.3 SMALL FAUNA AND HERPETOFAUNA

CONSTRUCTION AND OPERATION PHASES

SOURCES OF IMPACT

- Site preparation and infrastructure construction.
 - Presence and operation of the pit.
 - Other infrastructure in operation.
 - Management of process plant feed material, overburden and waste rock Water management.
 - Hazardous and waste materials management.
 - Transportation and traffic.
-

MITIGATION MEASURES

Mitigation measures SUR 01 to SUR 04, QUA 01 to QUA 05, QUA 07 to QUA 13, AIR 01, AIR 02, LUM 01 to LUM 03, SON 01, VEG 01, VEG 02, FAU 02 and FAU 05 will have to be applied, as well as standards NOR 02 to NOR 05, NOR 08, NOR 09 and NOR 14, described in Table 7-5.

DESCRIPTION OF IMPACT

The construction and operation phases of the project are considered together, insofar as the nature of impacts on fauna will be essentially the same during these two phases. Indeed, outside of preparation and construction work, the pit and stockpiles will be created continuously during operation.

The different species of small fauna and herpetofauna whose presence was confirmed or is possible in the study area frequent a wide variety of terrestrial, wetland and aquatic habitats. During the site preparation step, and then the operation phase, the project will result in an overall loss of land and wetland habitats suitable for small fauna and herpetofauna of roughly **450 ha**, **145 ha** of which will be land vegetation and 305 ha wetlands. The total final impacts have been taken into consideration, **including a 50-metre buffer area around the mine infrastructure (35 m of direct loss and 15 m of potential loss due to edge effect)**. For most small fauna species, the movement of individuals whose home range overlaps the infrastructure footprint will increase, at least temporarily, the density on the periphery of the study area, where similar habitats exist.

For small mammals and herpetofauna, whose ability to move is lower, it is probable that the development and construction work will lead to the death of individuals. These deaths should nonetheless be compensated rapidly by annual recruitment, given the high fertility that generally characterizes these fauna components. Species that prefer open areas will be better able to compensate for deaths in the areas cleared within the project footprint.

Potential impacts are also anticipated on water management. Several species of herpetofauna, as well as some small fauna, such as beavers, muskrats and river otters, live in wetlands or in water during one or more phases of their development. As a result, activities of the construction phase that change local hydrology, transport particulates or otherwise alter wetlands or aquatic environments could have an impact on these species. Several preventive measures will nonetheless be implemented to minimize impacts on wetlands and aquatic environments.

Risks of contamination of natural environments are also possible, mainly because of potential leakage of petroleum products or accidental spills from equipment. The impact of a potential spill will depend on, among other things, the volume of contaminants released, and whether the problem is a one-time incident (spill) or repeated (leak). In the event of a spill, the measures provided for in the emergency action plan will be implemented quickly, which will help to limit the extent of the contamination and prevent contamination of groundwater. Losses or spills of other products are generally one-time chance occurrences. The environmental monitoring activities will facilitate prevention and increase the effectiveness of intervention in the event of a spill. Some preventive measures will also reduce the risks of a major spill, such as the use of double-walled tanks.

Indirect impacts will also be associated with the disturbance of several species of small fauna and herpetofauna. In particular, disturbance will be caused by the heightened nighttime noise and lighting, and by increased dust and vibration during blasting. The effects will be felt mainly by species with small home ranges. Species that are more mobile will likely adapt their home ranges, when possible, by avoiding the work area footprint and/or by moving to favourable habitats located nearby.

Noise can have a negative effect on certain mammals (Shannon et al., 2015). In general, noise and human presence will temporarily limit the use of the work area and periphery by wildlife (avoidance). Feeding, reproduction and raising of young will also be disturbed for some species, depending on the period when these activities occur. The effects will be felt mainly by species with small home ranges. Motorized equipment will be outfitted with high-performance mufflers in good condition to minimize noise disturbance.

Several species, including the vast majority of anurans, are nocturnal, and increased nighttime lighting could have negative effects (disturbance of behaviour and circadian rhythm, increased risk of predation, avoidance, etc.). Nonetheless, some species are also predators, and the artificial lighting could, in these cases, heighten their feeding success. More light could also affect their behaviour and reproduction, which could have negative effects on the survival of these species. Furthermore, anurans are virtually immobile, for the most part, and depend on their respective habitats, wetlands in particular. It is therefore very difficult for these species to move and change habitats following an increase in nighttime lighting. This dependence on their habitat could compromise the survival of these species in the presence of artificial light. However, several mitigation measures, related to the extent, duration and type of lighting will be implemented to reduce this impact.

There will also be a risk of collision due to traffic on the construction site. Some small fauna species, such as foxes, could be attracted by food resources or household waste. To minimize this risk, workers will be made aware of the importance of not feeding animals or leaving food lying about so as not to attract wildlife, especially bears, near work areas. The impacts expected on small fauna and herpetofauna will be minimal due to the low population densities found in the study area during the 2017 field survey. Despite the potential presence of some species with a special status in the study area or near the project footprint, none appear to be significantly affected by the construction and operation activities.

IMPACT ASSESSMENT

Implementing mitigation measures will minimize the potential impacts on small fauna and herpetofauna during the construction and operation phases. Overall, the intensity of this residual impact is considered low. Its extent is local since the impact will essentially be limited to the mine site. The duration is medium, since the impact may occur during the life of the mine, a period of approximately 20 years. Therefore, the residual impact on small fauna and herpetofauna during the construction and operation phases is considered **minor**.

REHABILITATION PHASE

SOURCES OF IMPACT

- Infrastructure dismantling.
 - Water management.
 - Hazardous and waste materials management.
 - Transportation and traffic.
-

MITIGATION MEASURES

The mitigation measures SUR 02, SUR 03, QUA 01 to QUA 04, QUA 07 to QUA 13, AIR 01, AIR 02, LUM 01 to LUM 03, SON 01, VEG 02, FAU 01 and FAU 05 will have to be applied along with standards NOR 01 to NOR 05, NOR 08, NOR 09 and NOR 14, recorded in Table 7-5.

DESCRIPTION OF IMPACT

The impact of activities during rehabilitation will be essentially the same as that during the construction and operation phases, except that there will be no loss of habitat. Therefore, the risks of alteration of aquatic environments (hydrology, particulates) or of contamination of natural environments (leaks or spills) will be present, although minimized by the mitigation measures put in place. Indirect impacts will also be associated with the disturbance of some species of small fauna and herpetofauna (noise, lights, human presence), as will risks of collision associated with traffic on the site.

The impacts expected on small fauna and herpetofauna during the rehabilitation phase will be less significant than for most species, whose densities were already very low during the field surveys done in 2017 and which will tend to avoid areas where human activities will be concentrated in the preceding phases.

IMPACT ASSESSMENT

Application of mitigation measures will minimize the potential impacts on small fauna and herpetofauna. As a result, the intensity of this residual impact is considered low. Its extent is local since the impact will essentially be limited to the mine site. The duration will be short, since they will only be felt during the rehabilitation phase. Overall, the significance of the impact on small fauna and herpetofauna during the rehabilitation phase is therefore considered **minor**.

POST-REHABILITATION PHASE

After rehabilitation of the site, positive impacts on small fauna and herpetofauna are expected, since new natural habitats will be available.

7.3.4 ICHTHYOFAUNA

CONSTRUCTION PHASE

SOURCES OF IMPACT

- Site preparation and infrastructure construction.
- Water management.
- Hazardous and waste materials management.
- Transportation and traffic.

MITIGATION MEASURES

Mitigation measures **FAU 01**, SUR 01, SUR 03, SUR 04, QUA 01 to QUA 04 and QUA 07 to QUA 13 will have to be applied to limit the impact on ichthyofauna in the study area as well as standards NOR 02 to NOR 05, NOR 09, NOR 13 to NOR 16, described in Table 7-5.

DESCRIPTION OF IMPACT

During the construction phase, site preparation and infrastructure construction, water management, hazardous and waste materials management, transportation and traffic could have a negative effect on ichthyofauna.

Construction and site preparation activities, as well as circulation of machinery near watercourses and bodies of water, are likely to result in increased suspended solids in the water. Application of the aforementioned measures will limit this increase.

The culverts will be installed in accordance with NOR 05 and outside the periods defined by FAU 011, which will not have any permanent effects on this component. Only creek CE3 will be directly affected by culvert construction (Map 4.3). Other culverts or ditches will be present on the site and will serve to move contact and runoff water to the water management ponds. As these culverts are located on the contact water management route, they will not touch any natural watercourse. The location of these culverts and drainage ditches is identified on Map 4-10 (Chapter 4). The progressive development of dikes, road ditches and water retention ponds is likely to change the natural flow in the environment. This could lead to some modification of fish habitat.

In addition, during the work, there is a risk of accidental spills of petroleum hydrocarbons associated with use of the machinery. These risks are mainly related to refueling or breakdown of the machinery. Despite the implementation of preventive measures, **there is still** a risk of accidental spills during construction **but the risk** is low with application of these measures. Such a spill, if it occurred, would contaminate the **receiving environment** at the spill site. At this time, the actions defined in the emergency response plan would be implemented. If a significant volume is released, a portion of the product that has not adhered to the soil particles could migrate through surface runoff to water bodies and courses. Appropriate work practices will be put in place to prevent accidental spills, and should they occur, the contaminated soil will be managed in a manner consistent with existing regulations. The magnitude of the effect will depend on the nature of the product and its concentration. Environmental risks associated with spills are low and, if they do occur, will be limited to the work site.

A community sturgeon spawning ground project is planned at the intersection of Billy-Diamond highway and the Eastmain River, 10 km north of the site. This gave rise to certain concerns from land users as to its sustainability should the mining project be carried out. This project is currently awaiting funding. However, no impact is anticipated on the spawning ground, considering that the study area's drainage system only represents a very small percentage of the Eastmain River watershed (0.1% in total). In addition, during operation, runoff water will be collected and transported to retention ponds, and treated if necessary, before being discharged. Water quality will thus be ensured, and will be subject to a monitoring program.

IMPACT ASSESSMENT

Since only small areas will be affected by the construction work, and in light of the planned mitigation measures, only minor changes to the hydrological regime are anticipated. The intensity of the impact is therefore considered low. The extent will be site-specific since it will be in a small area where the construction work will be carried out near water and the duration will be short term as it will occur only during the construction phase. The significance of the impact on the hydrological regime during the construction phase is therefore **minor**.

1 Culvert layout plans will be provided to the IAAC when available at the detailed engineering stage.

OPERATION PHASE

SOURCES OF IMPACT

- Presence and operation of the pit.
 - Water management.
 - Hazardous and waste materials management.
-

MITIGATION MEASURES

Mitigation measures **FAU 01**, SUR 01, SUR 03, SUR 04, QUA 01 to QUA 04 and QUA 06 to QUA 13 will have to be applied to limit the impact on ichthyofauna in the study area as well as standards NOR 02 to NOR 09 and NOR 13 to NOR 16, described in Table 7-5.

DESCRIPTION OF IMPACT

During the operation phase, the presence of the pit, water management, and hazardous and waste materials management could have a negative effect on ichthyofauna. Throughout the operation of the mine, it will be necessary to accumulate contact water in water management **ponds**. This water will be pumped into creek CE2 after passing through the WTP, **is necessary. The location of the final effluent discharge point was determined based on watercourse homogeneity, inventory results, technical aspects (pipe length) and related costs.** The mine effluent will at minimum meet the criteria established by D019, the REMMMD and the EDOs. **The sanitary effluent, after treatment of wastewater from the buildings located in the industrial and administrative sector, will be discharged into creek EC4.**

As presented in sections 7.2.2 and 7.2.3, changes to the watersheds, flows and levels are anticipated. The lowering of the water table due to pit dewatering **could also** affect the watercourses in the study area. Table 7-15 summarizes the anticipated changes for bodies of water and watercourses and their potential consequences on fish and fish habitat.

As in the construction phase, there is a risk of accidental spills of petroleum hydrocarbons associated with machinery use. Such a spill, if it occurred, would contaminate **the receiving environment**. At that time, the actions defined in the emergency response plan would be implemented. If a significant volume is released, a portion of the product that has not adhered to the soil particles could migrate through surface runoff to water bodies and courses. The magnitude of the effect will depend on the nature of the product and its concentration. Environmental risks have been addressed in the emergency response plan, and procedures will be established to minimize the extent.

Kapisikama Lake will gradually dry out as the pit expands. This lake has a population of yellow perch. **However, it is recognized that the habitat is not optimal for this species, as described in section 6.3.3.** A fish habitat compensation plan will be developed (NOR 16) to address this impact. **This plan could include relocation of fish from the lake to favourable habitat. The details of this plan have not yet been assessed. The compensation plan will also include a study of the initial state of the lake (diagnosis) as well as the yellow perch population. If relocation is preferred, the plan methodology will describe the research conducted to identify suitable relocation sites and the selection criteria used (e.g. isolated, unproductive headwater lake where no green newt, other sensitive amphibian populations or fragile ichthyological communities have been identified).**

IMPACT ASSESSMENT

In the operation phase, the impact on ichthyofauna is associated with changes in water quality, the drawdown of the water table, the encroachment of the infrastructure on the watercourse watersheds and the water returned to the environment from mining effluent. The intensity is considered low since the impact is not significant after application of the mitigation measures and dissipates quickly in the environment. The extent of the impact is considered **isolated** since it is felt **in specific sectors** of the study area. The duration of the impact is **long term** as the changes will be felt throughout the operation period **and beyond (Kapisikama Lake)**. In short, the significance of the residual impact on ichthyofauna is considered **minor**.

REHABILITATION AND POST-REHABILITATION PHASE

SOURCES OF IMPACT

- Infrastructure dismantling Water management.
 - Transportation and traffic.
-

MITIGATION MEASURES

Mitigation measures SUR 02 to SUR 04, QUA 01 to QUA 04 and QUA 07 to QUA 13 will have to be applied to limit the impact on ichthyofauna in the study area as well as standards NOR 01 to NOR 09, described in Table 7-5.

DESCRIPTION OF IMPACT

The rehabilitation phase involves decommissioning and returning the site to its original condition. During this phase, the dismantling of facilities and circulation of machinery near bodies of water and watercourses may alter the natural flow of surface waters from time to time. Removal of the roads and pumping stations may have the same effect on runoff, leading to an increase in suspended solids in the water. Application of the aforementioned measures will limit this increase.

Table 7-15 Project impact on water courses and bodies of water in the study area

Creeks / Bodies of water	Source of impact	Anticipated impact on the water environment	Effect on fish and their habitat
Lake Kapisikama	Decrease in watershed size and water table drawdown due to pit dewatering	Gradual drying up of the lake, from the fourth year of the beginning of the work	Loss of 12,220 m ² of fish habitat.
CE1	No impact	N/A	N/A
Lake Asini Kasachipet	No impact	N/A	N/A
CE2	Presence of mining effluent and decrease in natural flow on a part of the watershed	<u>Summer</u> Increased flows Increase in average and low water levels <u>Flood</u> Increased flow Increase in level Increase in velocity <u>Winter</u> Decrease in average monthly and low flow Imperceptible effect on levels	No anticipated change in habitat functions. Increases in velocity should not cause erosion or morphological changes in the watercourse.
CE3	Decrease in natural flow on a part of the watershed	Decrease in average low and flood flows Slight decrease in levels between Lake Asini Kasachipet and in segments S1 and S2, which dissipates downstream	No anticipated change in habitat functions. Despite an expected decrease in flows (average and low) on two segments , these changes will result in only a slight decrease in levels.
CE4	Decrease in watershed size and water table drawdown due to pit dewatering	Decrease in all flows, mainly substantial for low flow Downstream of Billy-Diamond highway, a decrease in low water levels over the first 350 m. This decrease gradually dissipates after 1,500 m.	The decrease in level could lead to a loss of fish habitat during low water levels. However, due to the shape of the channel (U-shape), this decrease should cause only a small reduction in limited space.
CE5	Decrease in watershed size	Small decrease in flows producing imperceptible changes in level	No anticipated change in habitat functions.
CE6	Decrease in watershed size	Decrease in flows	Despite an expected decrease in flows, these changes will result in only a slight local decrease in levels. No anticipated change in habitat functions.
Note: Only the downstream portion of the Billy-Diamond highway culvert is considered a fish habitat on creek CE4.			

As in the other project phases, there is a risk of accidental spills of petroleum hydrocarbons associated with use of the machinery. As previously indicated, corrective actions and the proposed mitigation measures will limit the impact of such a spill.

Once the site is restored, the water management infrastructure will be dismantled on site (retention basin, WTP, effluent), allowing creeks CE2 and CE6 to return to their original watersheds in terms of surface area. The removal of the mine effluent will make it possible for creek CE2 to return to a natural flow regime. The pit will progressively fill with water from natural precipitation, creating a lake with an outflow toward creek CE3. There will therefore be permanent encroachment of the CE4 and CE5 watersheds. The CE3 watershed will permanently increase with the addition of the lake resulting from the pit flooding. However, no overflow is foreseen in the first 100 years, time needed to fill the pit. Decommissioning of the collection ditches at the foot of the stockpiles will also allow the watershed to return to a natural drainage scheme closer to the original pattern.

IMPACT ASSESSMENT

Since the affected areas are small compared to the surface **available**. The changes at close-out will be permanent. The intensity of the impact will be low, the extent will be limited and the duration will be long. The significance of the impact on ichthyofauna during the rehabilitation/post-rehabilitation phase is therefore **minor**.

7.3.5 AVIFAUNA

CONSTRUCTION AND OPERATION PHASES

SOURCES OF IMPACT

- Site preparation and infrastructure construction.
- Presence and operation of the pit.
- Other infrastructure in operation.
- Management of process plant feed material, overburden and waste rock Water management.
- Transportation and traffic.

MITIGATION MEASURES

Some construction and infrastructure operations, in particular deforestation and soil stripping, are likely to affect birds. Mitigation measures SUR 01, SUR 02, SUR 03 and SUR 04 will help minimize the areas affected. During breeding season, measures FAU 02, **FAU 07**, SON 01, LUM 01 to LUM 03 will help reduce the risk of incidental take of birds, their eggs and their nests. Protective measures **FAU 06**, QUA 05, QUA 08, QUA 09, NOR 07 to NOR 09, NOR 13, NOR 14 and VEG 01 will help mitigate the potential effects of the work on waterfowl and other aquatic or shore birds. Finally, mitigation measures LUM 01 to LUM 03 will reduce the effect of lights on nocturnal migrants. The mitigation measures are described in Table 7-5.

DESCRIPTION OF IMPACT

The inventories presented in section 6.3.5 made it possible to establish the specific diversity of avian species found in the study area. The various habitats were divided into three categories: wetlands, open areas and softwood stands. The latter two categories are a part of terrestrial environments. The species diversity of these environments was 25 species in wetlands, 18 species in open areas and 14 species in softwood stands. These species, presented in chapter 6, correspond to the species potentially affected by the project.

Loss or degradation of habitat for common and special status species

Avifauna frequents a wide variety of terrestrial wetland and aquatic habitats in the study area. At the site preparation stage and during construction and operation, certain activities will contribute to a loss of approximately 450 ha of terrestrial and wetland habitats, i.e. 145 ha of terrestrial habitat and 305 ha of wetlands, despite the proposed mitigation measures, **including a 50-metre buffer area around the mining infrastructure. Furthermore, the targeted use of a borrow pit, outside the study area, is planned and could involve clearing land for its opening and operation. This clearing would result in a loss of habitat suitable for birdlife. The location of this potential borrow pit remains to be confirmed.**

It is also expected that the temporary loss of habitat associated with the project will be largely revegetated and restored at the end of the project, thus restoring habitat for avian fauna, albeit potentially different from the original habitat. For example, the flooded portion of the pit could become attractive to waterfowl, while certain portions of the stockpiles and exposed areas could be favourable to common nighthawk, and the steep slopes of the borrow pits could be favourable to bank swallows. In addition, the natural recovery of fire-affected habitats, in conjunction with mine operations, will contribute to a gradual increase in the potential of the study area for avian wildlife.

Potential impacts are also anticipated on water management. Several species of avifauna frequent aquatic or riparian environments during one or more phases of their development. Consequently, activities that alter the hydrology of watercourses, contribute to the migration of fine particulate matter or otherwise alter aquatic or wetland environments will affect these species. Various preventive measures will nevertheless be implemented to minimize the impact of the project on aquatic and wetland environments. **The various ponds (Map 4-1) could be used by avian fauna during operations. However, the use of these ponds will not be attractive, since they will be bordered by roads, and there will be no food sources for avian fauna. Furthermore, natural bodies of water will be available nearby and more attractive to fauna. Mitigation measures, such as scaring (FAU 06), will also help prevent avian fauna from using the ponds.**

Disturbance and accidental death

Site preparation, construction and operation activities could lead to incidental bird mortality through incidental take, i.e. injuring, killing or disturbing birds or destroying or disturbing their nests or eggs, especially during deforestation work. In addition to harming birds, nests or eggs, incidental take can have long-term consequences for bird populations due to the cumulative effect of many incidents. There will also be a risk of collision due to traffic on the construction sites.

In addition to the mortality that may result directly or indirectly from the preparation, construction and operation of the mine, these activities are likely to change the natural behaviour of birds and cause them to move to the periphery of the affected areas. Thus, for most of the bird species, the movement of individuals whose home range overlaps or borders the infrastructure right-of-way could increase, at least temporarily, densities on the periphery of the study area, where similar habitats exist. Despite the loss of natural environments, stripped soil, pit walls and stockpiles may be used by species that nest in open areas.

Birds within or near the project footprint could be disturbed by the artificial lighting. In particular, some nocturnal bird species may be negatively affected (e.g. disturbance in circadian rhythm and behaviour, increased risk of predation, avoidance). This artificial lighting could also cause nocturnal migrants to deviate from their flight path. In summer, however, some predatory species may benefit from this lighting to improve their feeding success. Mitigation measures addressing the extent, duration and type of lighting will be implemented to reduce this impact.

Noise, dust and vibration during blasting could also disturb some birds during breeding season, especially songbirds, which will have to adapt to changes in the sound environment. Motorized equipment will be outfitted with high-performance mufflers in good condition to minimize noise disturbance.

Special status species

Only the Rusty Blackbird as a special status species was observed during the 2017 surveys. It was only observed in wetlands at a density of 0.14 EC/ha. The Rusty Blackbird nests in open wetlands such as bogs, swamps, marshes and ponds (Avery 2020; Environment Canada 2014), which is consistent with several potential habitats found in the study area, primarily open bogs. On average, 35 nesting pairs of Rusty Blackbirds could be affected by the project, if all the wetlands inventoried are considered.

Finally, despite the potential presence of special status species in the study area or near the project footprint, none appear to be directly affected by the construction and operation of the mine. It should also be noted that the expected impact on avifauna in general will be lessened given the relatively low diversity and density of birds observed in the study area during the 2017 surveys. As well, all the previously proposed mitigation measures will help to significantly mitigate the project's impact on avifauna.

The potential effects of the project on species with special status in the study area, as well as their potential loss of habitat, are identified in Table 7-16.

Table 7-16 Potential Effects of the Project on Bird Species at Risk and of Special Concern Present and Potentially Present in the Study Area Based on Currently Recognized Threats

Species	Potential Effects of the Project
Short-eared owl	The project will result in the loss of 428.66 ha of habitat likely to support the nesting or presence of this species. However, the primary factor influencing local habitat choice in both summer and winter would be food abundance (COSEWIC 2008; ECCC 2018). As such, the density of small mammals is extremely low in the study area, which has been heavily disturbed by recent forest fires, suggesting that short-eared owls are unlikely to nest in the area in the short term, i.e. until the natural area and small mammal populations have recovered. The species was not detected during the project's inventories. Overall, the main threats to the species, including disturbance from human activity, habitat loss and alteration due to wetland drainage, urban expansion and intensive agriculture, increased nest predation due to habitat fragmentation, collisions with vehicles, utility cables and barbed wire fences, and the use of pesticides such as organochlorines (COSEWIC, 2008; ECCC, 2018), are absent or of low significance in the Project study area. Considering the low probability that short-eared owls will frequent the sector, and the planned mitigation measures (see section 7.3.5), the potential effects of the project on this species are considered insignificant.

Table 7-16 Potential Effects of the Project on Bird Species at Risk and of Special Concern Present and Potentially Present in the Study Area Based on Currently Recognized Threats (cont.)

Species	Potential Effects of the Project
Rusty Blackbird	The project will result in the loss of 304.22 ha of habitat likely to support the nesting or presence of this species. However, the biggest threats to the rusty blackbirds are the transformation of Mississippi Valley floodplain forests, where the species primarily winters, for agricultural or human habitation purposes (COSEWIC 2008). In addition, rusty blackbird populations are likely affected by crop pest control programs that have been ongoing in the south-eastern United States since the 1970s. Finally, degraded wetland quality and invasion of wetlands by dominant species, such as red-winged blackbirds, may also affect rusty blackbirds (COSEWIC 2008; Environment Canada 2015a). Although other habitat losses could occur on the breeding grounds due to activities such as wetland alteration and hydropower reservoir creation, overall, we consider the main threats to the species to be absent or of low significance in the project study area. Considering the planned mitigation measures, the potential effects of the project on this species are considered insignificant.
Common Nighthawk	The project will result in the loss of 353.83 ha of habitat likely to support the nesting or presence of this species. However, bare areas resulting from mine operations and tailings disposal could potentially contribute to increased nesting areas. No reasons have been identified for the decline in common nighthawk populations, but it may be partly related to the decline in insect populations that the species preys on (COSEWIC 2007a). Given the widespread declines observed in other insectivorous bird species, it is assumed that reduced food sources caused by widespread pesticide use has contributed to the decline. Habitat loss and modification, including reforestation of abandoned farmland and logged forests, fire control, intensive agriculture and the gradual reduction in the number of buildings with flat roofs covered with gravel in urban areas, may also have contributed to declines in some areas. Increased predation by domestic cats, striped skunks, raccoons, American crows and ravens may be contributing to the decline of the species, especially in urban areas. Other possible factors include motor vehicle collisions and climate change (COSEWIC 2007a; Environment Canada 2016a). Overall, the main threats to the species are absent or of low importance in the project study area. Consequently, considering the planned mitigation measures (see section 7.3.5), the potential effects of the project on this species are considered insignificant.
Olive-sided Flycatcher	The project will result in the loss of 324.59 ha of habitat likely to support the nesting or presence of this species. The species is most often associated with open areas that contain live trees or large snags that serve as perches, necessary for foraging (COSEWIC, 2007b). The causes of the decline in olive-sided flycatcher populations are thought to be related to habitat loss and alteration. Olive-sided flycatchers are generally associated with sparse vegetation cover, suggesting that they may respond positively to forest management activities such as timber harvesting. Recent studies suggest, however, that logged stands are less conducive to reproduction than stands that grow after a fire. Habitat alteration and loss in the areas where this migratory bird winters could also pose significant threats to these populations. Declining insect populations, either at breeding or wintering sites, may also be an important factor; other insect-feeding bird species in flight have shown similar declines (COSEWIC 2007b; Environment Canada 2016b). Overall, the recognized threats to the species are absent or of low importance in the project study area. However, although it is located at the northern boundary of the olive-sided flycatcher's nesting range, the habitat and forest fires in recent years would be favourable to the species, although it was not detected during the inventories carried out in 2012 and 2017. Considering the planned mitigation measures (see section 7.3.6), the potential effects of the project on this species are considered insignificant.

Table 7-16 Potential Effects of the Project on Bird Species at Risk and of Special Concern Present and Potentially Present in the Study Area Based on Currently Recognized Threats (cont.)

Species	Potential Effects of the Project
Bank Swallow	There is no habitat within the project footprint that would support the nesting or presence of this species. The Bank Swallow breeds in a wide variety of natural and man-made sites with vertical slopes, including riverbanks, cliffs along lakes and oceans, aggregate quarries, road cuts and soil piles. It seeks out substrates consisting of a mixture of sand and silt to dig its nesting burrows (COSEWIC, 2013). Although no single threat appears to be responsible for the decline of the Bank Swallow, the cumulative effects of several factors may be contributing to the decline. There is a clear loss of breeding and foraging habitat, especially from erosion and flood control projects (dams), aggregate management activities, conversion of pasture to cropland and deforestation (COSEWIC, 2013). Destruction of nests during aggregate excavation can also pose a significant threat in some areas. Climate change may reduce winter survival or reproductive potential, while widespread pesticide use may cause a decrease in the abundance or diversity of flying insects (COSEWIC, 2013). Threats during migration and on the wintering grounds are largely unknown, but knowledge of these threats may be essential understand the decline of the species. Regionally, the large James Bay reservoirs may have destroyed previously used nesting sites. Steep riverbanks and sandbanks, such as quarries and borrow pits excavated for road and dike construction, however offer an abundance of potential nesting sites. Overall, the main threats to the species are absent or of low importance in the project study area. It should also be noted that the species was not detected during the surveys conducted in the study area in 2012 and 2017. Therefore, the potential effects of the project on this species are considered insignificant.

IMPACT ASSESSMENT

For all sources of identified effects on **common and special status** birds during construction and operation, the application of the proposed mitigation measures will help reduce the intensity, extent, duration and significance of the impact. The intensity of the impact is therefore considered low. Its extent is local since the impact will essentially be limited to the mine site. The duration is considered medium-term, since the impact will extend over the life of the mine **and a restoration effort to regenerate the habitat over several lost areas**. Overall, the significance of the impact during the construction and operation phases is considered **minor**.

REHABILITATION PHASE

SOURCES OF IMPACT

- Infrastructure dismantling Transportation and traffic.

MITIGATION MEASURES

Mitigation measures SUR 01, SUR 02, SUR 03 and NOR 01 should minimize the impact of the rehabilitation work, while limiting it to the infrastructure to be dismantled and restored (pits, stockpiles, basin, etc.). Measures FAU 02, SON 01 and LUM 01 to LUM 03 will also help reduce the risk of incidental take of birds, their eggs and their nests. Measures QUA 07, QUA 08, NOR 14 and VEG 01 will help mitigate the potential effects of the work on waterfowl and other aquatic or shore birds. The mitigation measures are described in Table 7-5.

DESCRIPTION OF IMPACT

Considering the work involved, the impact of rehabilitation activities will be essentially the same as during construction and operation. Thus, some of the activities associated with rehabilitation work (artificial lighting, noise, dust, risk of spills, etc.) are likely to disturb the natural behaviour of birds and temporarily cause them to move to the periphery of the affected areas. Various preventive measures will nevertheless be implemented to minimize the impact of the rehabilitation work on the terrestrial, wetland and aquatic environments.

IMPACT ASSESSMENT

For all sources of identified impacts during rehabilitation, the application of the proposed mitigation measures will help reduce the intensity, extent, duration and impact of the residual impact on birds. The intensity of the residual impact is therefore considered low. Its extent is local since the impact will essentially be limited to the mine site. The duration is considered short term since the impact will be limited to the duration of the rehabilitation work. Overall, the significance of the impact during the rehabilitation phase is considered **minor**.

POST-REHABILITATION PHASE

Since restored habitats can quickly be used by the species generally associated with them, we consider that the expected benefits of the rehabilitation work could be high for birds. This assumption is all the more plausible since bird diversity and density before the project were relatively low in the study area. **For example, in the post-restoration period, the flooded portion of the pit could become attractive to waterfowl, while certain portions of the stockpiles and areas exposed during construction could be favourable to common nighthawk, and the steep slopes of the borrow pits could be favourable to bank swallows.**

Table 7-17 presents, for each of the at-risk avian species potentially present, the main predicted effects of the activities carried out during the construction, operation and closure / restoration phases with regard to the habitats of these species. The preferred habitats available in the study area for each of these species are presented in tableau 6-57 (chapitre 6).

SUMMARY OF KEY EFFECTS ON HABITAT FOR AT-RISK BIRDS

Table 7-17 Main Effects of the Project on Nesting Habitat for At-Risk Birds

Species	Phase		
	Construction	Operation	Close-out / Restoration
Common Nighthawk	Loss or alteration of habitat	Loss or alteration of habitat Likely habitat creation	Likely habitat creation
Short-eared owl	Loss or alteration of habitat	Loss or alteration of habitat	Potential habitat creation
Bank Swallow	Loss or alteration of habitat	Loss or alteration of habitat Potential habitat creation	Potential habitat creation
Olive-sided Flycatcher	Loss or alteration of habitat	Loss or alteration of habitat Potential habitat creation	Potential habitat creation
Rusty Blackbird	Loss or alteration of habitat	Loss or alteration of habitat	Potential habitat creation

7.3.6 BATS

CONSTRUCTION AND OPERATION PHASES

SOURCES OF IMPACT

- Site preparation and infrastructure construction.
 - Presence and operation of the pit.
 - Other infrastructure in operation.
 - Management of process plant feed material, overburden and waste rock Transportation and traffic.
-

MITIGATION MEASURES

In order to minimize the residual impact of the sources identified during the construction and operation phases, mitigation measures SUR 01, SUR 02, AIR 02, SON 01, VEG 02, FAU 02 and FAU 04 as well as standards NOR 07 to NOR 09 and NOR 13, described in Table 7-5, will be applied.

DESCRIPTION OF IMPACT

The surveys identified three species of arboreal bats in the study area (Tremblay and Jutras, 2010). As mentioned earlier (section 6.3.1), the study site has been greatly affected by several forest fires in the recent past. Consequently, there is little or no tree stratum in several parts of the study area (rocky outcrops, scrubland, alder, burns, stripped zones, open peatlands and treed peatland), **which significantly reduces the potential for the presence of quality roosts and maternity colonies. The very low frequency of use of the site by bats of the genus Myotis, highlighted during the inventory carried out in 2017 (see section 6.3.6.2), is also a testament to the poor quality of the habitats present in relation to the needs of these species.** Still, the wooded peatland and spruce-lichen stands show some potential for daytime roosts. However, it is limited due to the small diameter of the black spruce. Consequently, deforestation and other activities related to the construction of work and storage areas will result in a direct and indirect loss of **110.92 ha of habitat for these two types of environments. This loss of habitat therefore represents the main source of impact of the project for chiropteran species.**

It should be noted that there are many alternative habitats of equal or greater quality across the regional landscape for daytime roosts, maternity and feeding sites. Thus, the loss of these environments will likely result in a displacement of the populations of these species to alternative sites. According to the recovery strategy for the little brown myotis, northern myotis and tricoloured bat (EC, 2015), loss of habitat is one of the biggest threats, second only to white-nose syndrome, which has largely decimated these species in Québec. This loss of habitat could cause bat mortality if arboreal bats are present during deforestation activities. However, considering the mitigation measures applied and the sparse population observed during the 2017 survey, this risk is minimal.

Wetlands are usually considered key habitats to meet the food needs of bats as they typically contain a large quantity of prey (Grindal et al. 1999). In all, **305 ha** of wetlands will be directly affected by the project. The loss of these sites could lead to increased movement to alternative feeding sites. However, it should be mentioned that peatland, which makes up all of the affected wetlands, is generally not the preferred feeding sites of bats. Free water surfaces are not common in wetlands and their acidity is not conducive to the production of large quantities of insects.

Changes in the habitat structure could also affect the bats' use of the environment. However, this impact is more difficult to characterize and quantify since numerous factors are involved and their effects vary by species. For example, forest fragmentation can lead to the creation of linear features that will be used by certain species (EC, 2015). Bats generally use linear forest structures to guide their movements (Grindal and Brigham, 1998; Henderson and Broders, 2008). Forest edges along the cuts, as well as road rights-of-way and other linear features are therefore potential corridors for movement. The effects of habitat fragmentation appear to vary by species and by the nature and extent of the fragmentation itself (Ethier and Fahrig, 2011; Segers and Broders, 2014). It is, however, clear that changes to the habitat structure could change the use of the area by bats.

Activities that cause noise, vibration and dust, such as earthwork, excavation, transportation and construction, could disturb the local bat population. Since bats use echolocation during their movements and to catch prey, anthropogenic noise, particularly at high frequencies, could interfere with these activities. The impact of this type of disturbance varies by species since each one uses its own echolocation frequency range (Bunkley et al., 2015). The noise generated by road traffic covering a frequency band of up to 50 kHz but mostly between 1 Hz and 20 kHz (Schaub et al., 2008) will probably cause more disturbance in species using relatively low echolocation frequencies. For this project, the species using such frequencies are the hoary bat and the big brown bat. In terms of daytime roosts, noise could also affect the bats by disturbing their sleep. Consequently, in the vicinity of the infrastructure, the quality of roosts for local populations may decrease and sites may even disappear, causing individuals to move to similar habitats in the surrounding area.

Similarly, vibrations caused by certain activities close to key habitats such as maternity colonies could lead to reduced reproductive success, causing the bats to leave the area in search of other sites (EC, 2015; McCracken, 2011). That said, no maternity colonies were found on the project site and the likelihood of their presence is low. This is because, depending on the species, bat maternity colonies are found in large-diameter snags, buildings or rock faces. In light of the forest fires and nature of the plant communities present in the project footprint, few snags are suitable for maternity colonies. And although there are rock faces in some sectors, they are rarely frequented by bats and are therefore unlikely to be used to form maternity colonies. The construction of new buildings could, depending on their configuration and accessibility for bats, result in the creation of roosts (daytime, hibernacula or maternity).

Since bats are nocturnal, they are more likely to be disturbed by artificial light (Stone et al., 2015). In particular, it seems that the presence of artificial light would disturb the movements of some species (Stone et al., 2009) and could lead them to less than optimal flight paths. These alternative flight paths could require them to expend more energy and make them more vulnerable to predators (Stone et al., 2015). However, it is difficult to assess the real effect for this project as the impact of a change in flight path varies depending on the surrounding environment. Some bat species such as the big brown bat and bats of the genus *Myotis* often use artificial light sources for feeding purposes, as they attract a large number of flying insects (Rydell, 1992; Stone et al., 2015).

In short, since the current environment is not favourable to these animals (greatly disturbed by forest fires) and the low population density observed during the 2017 surveys, the residual impact of the mine construction and operation will be minimized. **Table 7-18 summarizes the potential effects on special-status bat species.**

Considering the very low frequency of use of the site by bats of the genus *Myotis*, the poor quality of the available habitats and the planned mitigation measures, the potential effects of the project on the populations of little brown bats and northern bats are considered insignificant.

Table 7-18 Potential Effects of the Project on Bat Species at Risk and of Special Concern Present and Potentially Present in the Study Area

Little brown bat	110.92 ha of habitat likely to provide daytime roosting and/or maternity habitat for these species will be lost as a result of the project. According to the recovery strategy for little brown bats and northern bats (Environment Canada, 2015b), habitat loss is the biggest threat to these species, after white-nose syndrome. This loss of habitat therefore represents the main source of impact of the project for these two species. However, the potential for the presence of quality roosts and maternity sites is limited, given the recent forest fires and the reduced diameter of the trees on the study site. The very low frequency of use of the site by bats of the genus <i>Myotis</i>, highlighted during the inventory carried out in 2017 (see section 6.3.6.2), is also a testament to the poor quality of the habitats present in relation to the needs of these species. It should be noted that there are many alternative habitats of equal or greater quality across the regional landscape for daytime roosts, maternity and feeding sites. Thus, the loss of these environments will likely result in a displacement of the populations of these species to alternative sites. Considering the very low frequency of use of the site by bats of the genus <i>Myotis</i>, the poor quality of the available habitats and the planned mitigation measures, the potential effects of the project on the populations of little brown bats and northern bats are considered insignificant.
Northern bat	

IMPACT ASSESSMENT

In light of the mitigation measures, the generally unfavourable environment for bats and their presence in small numbers, the residual impact of the project during construction and operation is considered low, even considering the special status of the hoary bat and bats of the genus *Myotis*. Since the effects of the project are largely confined to the mine site, the extent of the impact is considered local. The duration of the impact is considered medium term as most of the issues will only be present during the mine's useful life. Consequently, the significance of the residual impact on bats during the construction and operation phases is considered **minor**.

REHABILITATION PHASE

SOURCES OF IMPACT

- Infrastructure dismantling Transportation and traffic.

MITIGATION MEASURES

In order to minimize the residual impact of the project during the rehabilitation phase, mitigation measures SUR 02, AIR 02, SON 01, VEG 02 and FAU 04, described in Table 7-5, will be applied.

DESCRIPTION OF IMPACT

Unlike the construction and operation phases, no loss of natural habitat will occur during the rehabilitation phase. When mining projects are involved, loss of habitat usually has the greatest impact on bats. Similar to the construction and operation phases, disturbances associated with vibrations, noise and light will occur during this phase. However, the application of mitigation measures will minimize their impact.

Nevertheless, buildings installed during the mine activities could possibly be used as roosting sites by bats (daytime roosting and/or maternity and/or hibernacula). For this reason, before any building or installation is dismantled, it must be inspected to check whether the site is used by bats (FAU 04). If necessary, steps will be taken to minimize the impact of any such demolition. Consequently, the demolition of buildings will have no residual impact.

IMPACT ASSESSMENT

For the same reasons as for the construction and operation phases, the intensity of the project's impact during the rehabilitation phase is considered low as no loss of habitat is anticipated. The extent of the impact is local since the effects will only be felt at the mine site. The duration of this impact will be short term as it will not continue past this phase. Hence, the significance of the impact on bats during the rehabilitation phase is **minor**.

POST-REHABILITATION PHASE

Over time, the impact of the project during this phase will be positive for bats as they are expected to return to new natural habitats.

7.3.7 COMPARISON OF IMPACTS ON THE BIOLOGICAL ENVIRONMENT 2018 VS. 2021

This section is intended to summarize the changes to the current description and assessment of impacts compared to those described in the 2018 EIA. Table 7-19 lists the components of the biological environment in the study area and, based on the project phases, indicates the changes made to the description and assessment of impacts based on the 2018 and 2021 projects, if applicable.

Table 7-19 Comparison of the description and assessment of the impact of the project on each of the biological components of the local study area

Component	Phase	Change to the description of the impact	Impact significance according to the 2018 project	Impact significance according to the 2021 project
Vegetation and wetlands	Construction and operation	– <i>Carex sterilis</i> is no longer considered a flora species of special status – The area related to the loss of vegetation and wetlands is similar	Moderate	Moderate
Large fauna	Construction and operation	– Improvement of the description of impacts on caribou – Update of affected habitat areas with new 50-metre buffer area around infrastructure – Addition of mitigation measure FAU08	Minor	Minor
Large fauna	Rehabilitation	-	Minor	Minor
Small fauna and herpetofauna	Construction and operation	– Update of affected habitat areas	Minor	Minor
Small fauna and herpetofauna	Rehabilitation	-	Minor	Minor
Ichthyofauna	Construction	– Improvement of the impacts of the construction of ditches and culverts – Impact assessment of the sturgeon spawning ground project – Addition of FAU01 to the mitigation measures	Minor	Minor
Ichthyofauna	Operation	– Details of the impacts of the drying up of Kapisikama Lake and mitigation measures – Addition of FAU01 to the mitigation measures	Minor	Minor
Ichthyofauna	Rehabilitation	-	Minor	Minor

Table 7-19 Comparison of the description and assessment of the impact of the project on each of the biological components of the local study area (cont.)

Component	Phase	Change to the description of the impact	Impact significance according to the 2018 project	Impact significance according to the 2021 project
Avifauna	Construction and operation	Update of affected habitat areas Impacts of the use of water management ponds Impacts on status bird species Addition of mitigation measures FAU 06 and FAU 07	Minor	Minor
Avifauna	Rehabilitation and post-rehabilitation	Use of ponds Impacts of rehabilitation on the habitats of status species	Minor	Minor
Bats	Construction and operation	Update of affected habitat areas Impacts on status species	Minor	Minor
Bats	Rehabilitation	-	Minor	Minor

7.4 IMPACT ON THE SOCIAL ENVIRONMENT

7.4.1 CURRENT USE OF LAND AND RESOURCES FOR TRADITIONAL PURPOSES

Impacts on the current use of land and resources for traditional purposes were analyzed in two specific areas: the project study area and the area along the Billy-Diamond highway (between the project and Matagami) in order to distinguish between impacts related to the transportation of ore concentrate from the project site to Matagami via the Billy-Diamond highway and impacts related to transportation and traffic on the mine site.

7.4.1.1 STUDY AREA

CONSTRUCTION PHASE

- Site preparation and infrastructure construction.
- Transportation and traffic.
- Economic development and presence of workers.

MITIGATION MEASURES

Mitigation measures UTT 01 to UTT 06, CIR 01, CIR 02, CIR 04, **CIR 07, CIR 16 and VIE 05** will have to be applied, in addition to nuisance reduction measures AIR 01 to AIR 05, SON 01, LUM 01 to LUM 03, and VIB 01 to VIB 04. These are set out in Table 7-5.

DESCRIPTION OF IMPACT

The traditional activities of Cree users on the territory of the study area could be disrupted during the construction phase. According to consultations with **land users and members of the Cree First Nations**, several large animal species are hunted in the study area, particularly **moose, black bear and caribou. Small game and furbearer species are also hunted (porcupine, lynx, fox, beaver, marten, otter, muskrat), as** are waterfowl. Fishing, trapping, and snaring (hare, etc.) are also practised and could be affected by the species temporarily avoiding or abandoning the area. **Although their traditional harvesting activities may be impacted by the construction, it was nonetheless difficult for users to fully assess the extent of the project's impacts. It should be noted that the study area also includes areas valued by land users because of the quality of the sites, abundance of certain resources, or strong generational ties and attachment to the land.**

Land users say they are concerned about noise, vibrations and air pollution that could be harmful to wildlife and vegetation, which have been regenerating since the forest fire in 2013. On the one hand, noise would disturb wildlife, which might abandon the area. As such, trapping, moose hunting and small game hunting, which usually take place within a certain radius of the mine project site, may have to be relocated. Finding new traplines and small game hunting sites may require users to invest both time and travel costs. On the other hand, according to the land users, pollution from mining activities could affect the fauna and flora, and therefore the health of users who consume them. Such users will then prefer to move to another area to carry out harvesting activities in an area protected from industrial activities. However, they point out that animals move about and that they are still likely to find animals with a poorer quality meat within a fairly wide radius.

The loss of trapping and small game hunting space could be temporarily mitigated by the probable increase in population density around the mine site. In fact, for most bird species, the movement of individuals whose home range overlaps or borders the infrastructure footprint could, at least temporarily, increase in density on the edge of the study area, where similar habitats exist (section 7.3.3).

For waterfowl and goose hunting specifically, users mention that the noise and odours from the mine could drive geese away and could even affect their migratory route. The fear is that geese will avoid the areas where hunting is usually done. In this case, users will have to move to other areas, which could involve searching for new hunting sites and investing time and money in travel, as well as unsuccessful transitional hunting seasons. However, some users think that geese would not be disturbed too much by the noise and do not feel that they would need to change hunting locations. Some users mention that geese may feed on vegetation contaminated by particles from the mine that are carried by snow and absorbed by plants, or contaminated by pollution that may accumulate in the soil. These users would be reluctant to feed on geese that lived within a certain radius of the mine.

Concerning migratory caribou, users mentioned that their numbers are decreasing and that sightings of them in the area have been rare since the 2013 forest fire. They do not mention any particular impacts related to the mine's activities. According to one land user, woodland caribou should not be particularly affected, since their range is located to the south of the study area boundary and they do not travel northward. No one brought up any effects the project might have on migratory caribou during the consultations.

The construction could also lead to the loss of use of portions of the territory **and areas** where the mining infrastructure will be located **which are valued** for such traditional activities as berry picking and beaver trapping, although other areas far from the project's sphere of influence are also conducive to these activities on the RE2 trapline. The tranquility of the area, especially the Cree camps located around the mining site itself, could also be affected by mine construction activities. People who are used to performing traditional activities in the projected infrastructure sector could find their safety compromised by the site's new use. **Furthermore, the periods during which such traditional activities are practised could be impacted by the construction schedule.** To allow them to adapt their practices to these new conditions, land users will be informed before the work begins and of its progress. Galaxy will ensure that construction workers are made aware of the Crees' traditional way of life and their practices on the territory. **In addition, a schedule of the main traditional activities will be drawn up with representatives of the Cree Nation of Eastmain, and construction shutdown times will be scheduled according to these activities.**

The presence of new roads for access to the site, facilities and explosives depot will not result in any significant change to access to the territory since these roads will not be accessible to land users. In addition, disturbances associated with increased traffic on the Billy-Diamond highway will be mitigated by a traffic management plan that will include the installation of signage indicating the site and requiring compliance with speed limits. In addition, for security reasons, prior to the start of work, an exclusion zone for traditional activities will also be established near the mine site, in collaboration with the RE2 trapline Tallyman. **Furthermore, a fire strip barrier will surround the project site, which will also serve to limit access. The tallyman and his family will be able to manage this fire strip barrier to ensure their safety.**

The site's high-risk facilities will also be secured by a fence installed around the industrial and administrative sector, which includes the ore stockpile, concentrator, mechanical workshop and warehouses, as well as the administrative buildings and the camp. Fences will also surround the tanks and generators. Finally, there will be a fence around the explosives depot. Other measures to restrict access to the site and to the household waste disposal infrastructure are planned. Household waste will be sorted and then sent to composting (the composter will be located in a container), or managed by a specialized company that will take care of recycling or landfilling off-site. Waste that may attract animals will be managed in such a way as to avoid any animal intrusion into the area reserved for this purpose. In the event that an intrusion occurs, scaring techniques will be implemented or, if necessary, the tallyman will be called in to implement appropriate measures that will be determined according to the situation.

Users also fear accidental spills and water pollution, which could disrupt or interrupt their fishing activities, especially on the Eastmain River. They mention that the study area has always been attractive to beaver populations, although it is taking time for this resource to be re-established after a forest fire. Users are concerned that regenerating vegetation may be contaminated or that water may be polluted by spills and that this may seriously disrupt the resource. Trapping activities would then be reduced. Several mitigation measures will be implemented to limit the risk of an accidental petroleum hydrocarbon spill, particularly in the emergency response plan. Procedures will be established to prevent spills and limit their impact (Chapter 9).

The assessment of ecotoxicological risks to human health performed by Sanexen (2018) considers traditional activities as an exposure scenario and concludes that the risks to the population are negligible for all exposure scenarios. All substances likely to be released into the air by the mining operations were considered in the risk assessment. The information available at the time of writing up the study did not identify or rule out additional substances that might be released in aqueous discharges from the mine.

Human receptors make little to no direct use of creeks CE2 and CE4 into which mining and sanitary wastewater will be discharged.

Some activities at the mine site raise questions because they are new, temporary, ad-hoc or exceptional, regardless of the phase. Means of communication will be set up to respond **to issues** efficiently and thus reduce their intensity. Communications will be encouraged through various means: the **Galaxy website, newsletters, monitoring and oversight committees, a Cree liaison officer, and other means. Committee members will also be invited to share the information they receive with community members. Lastly, Galaxy will set up a system for receiving and processing complaints before construction begins, which will continue until closure. It will be able to handle complaints from land users, if any arise. A report on the nature of complaints received by Galaxy, and the manner in which Galaxy handled them, will be presented to the members of the monitoring committee at each meeting.**

As for recreational water quality, no significant change is anticipated in human health. In addition, no anticipated change is likely to affect navigation on the navigable waterways in the study area, either on the Eastmain and Miskimata rivers, or on the lakes near Lake Amisk Matawaw. As for creek CE5, which is little navigated by users, the anticipated changes will not be significant enough to affect navigation.

IMPACT ASSESSMENT

For all the reasons mentioned above, the intensity of this impact is considered moderate since the project will cause disturbances on the territory despite the mitigation measures planned to reduce the potential negative effects. The extent of the expected residual effects is local since the effects are likely to be felt by land users who frequent the study area, i.e. the RE2 trapline tallyman's family. The duration will be short term. Thus, the significance of the impact on land use during the construction phase is considered **moderate, although some Cree users of the mine site area may perceive it to be greater.**

OPERATION PHASE

SOURCES OF IMPACT

- Presence and operation of the pit.
- Other infrastructure and equipment in operation.
- Management of process plant feed material, overburden and waste rock Water management.
- Transportation and traffic.
- Economic development and presence of workers.

MITIGATION MEASURES

Mitigation measures UTT 01 to UTT **06**, CIR 01, CIR 02 and CIR 04, **CIR 07, CIR 16 and VIE 05** will have to be applied, in addition to nuisance reduction measures AIR 01 to AIR 05, SON 01, LUM 01 to LUM 03, and VIB 01 to VIB 04. These are set out in Table 7-5.

DESCRIPTION OF IMPACT

Traffic on the road network, noise, vibration and mine activities could disturb some wildlife species of interest near the mine site and road infrastructure, causing them to move to quieter sectors. **Users of RE2, VC35 and VC33 mentioned that odours could also have a repellent effect on geese.** Hunters and trappers may therefore have to change their practices and move as well.

Furthermore, the peacefulness of the area, particularly on the periphery of the mine site, could diminish because of the operations, as could the Cree users' sense of safety when engaging in traditional activities in the sector.

Although an increase in noise levels during construction and operation will be noticeable in the vicinity of the project (particularly at the on-site worker camp and truck stop) compared to the current situation, it will remain below the permissible noise limits of 45 dBA. Thus, for the Cree encampments, which are farther from the project site (i.e., located at distances ranging from 5.4 km to 11.4 km as the crow flies from the project site), the noise impact of the increase in noise levels related to operations would be insignificant (WSP, 2021c).

In addition, as mentioned during the 2017-2018 consultation, their perception of the quality and taste of the wildlife hunted on the land near the mine could be affected, leading them to lose interest in this portion of their trapline (Chapter 5). **Also, water is an element that is highly valued by the First Nations because of its vital importance on and for the territory. Users fear that regular mine operations may result in water pollution due to mining effluent and due to precipitation and water runoff from the mine site. For this reason, the mine effluent (which also includes the mine site runoff that will be collected and pumped into the water management basin) discharged into CE2, as well as sanitary wastewater discharged into CE4, will be treated as necessary prior to being discharged into the environment and water quality will be monitored.**

In focus groups, elders and youth indicated that working at the mine could interfere with traditional Cree activities and could deprive youth of broader exposure to traditional Cree culture. Galaxy will implement measures to encourage the practice of traditional activities for its Cree workers and will include a fund in the IBA to support initiatives to pass traditional knowledge from one generation to another.

Concerns about use of the land by non-indigenous people were also raised. In this respect, just like in the construction phase, hunting, trapping and fishing will be prohibited both for workers housed at the Galaxy worker camp and for contractors. These restrictions will be included in contractor service contracts and employee employment contracts. It should be noted that mine workers' typical rotating schedule does not encourage these activities since workers work long hours every day (12 hours per day) and they do not have any time off during their work stay.

Firearms and fishing equipment will not be permitted on chartered flights used by workers travelling to the mine by air, which will be the case for the majority of workers. Employees travelling to the mine by road will be required to stop at the mine entrance to identify themselves and declare that they are not carrying any hunting or fishing equipment. All incoming and outgoing vehicles will be systematically searched, as on most industrial sites.

Disciplinary measures will be imposed on employees and subcontractors who do not comply with the clauses of their contracts. The importance of complying with regulations on hunting, fishing and trapping on the territory will also be discussed during employee orientation days. If employees wish to visit an outfitter on their days off, they will be responsible for obtaining the necessary permits in accordance with the regulations in effect. In addition, if employees ask to do specific fishing activities, a plan could potentially be developed.

It should be noted that the employment or business income of Cree workers associated with the project could be partly allocated to the practice of traditional activities such as hunting, fishing and trapping. During the Eastmain1A–Rupert project, it was found that the increase in income among the Cree population was used to pay for the costs associated with more stays in the territory (Hydro-Québec Production, 2015). Consequently, for the Cree communities, the project could lead to increased land use and the practice of traditional activities for Cree workers hired at the mine. **According to the INSPQ (2014), an increase in income among younger workers may encourage them to acquire hunting and fishing equipment and may increase their participation in traditional activities.**

IMPACT ASSESSMENT

The application of mitigation measures will minimize the potential impact on land use during the operation phase. Overall, the intensity of this impact is considered moderate. The extent of the expected residual effects is local since the effects are likely to be felt by Cree land users who frequent the study area, i.e. the family of the RE2 trapline tallyman. The duration is medium-term since the impact may persist throughout the operation phase. Overall, the significance of the impact on land use during the operation phase is considered **moderate, although Cree users of the mine site area may perceive it to be greater.**

REHABILITATION PHASE

SOURCES OF IMPACT

- Infrastructure dismantling Water management.
 - Transportation and traffic.
 - Economic development and presence of workers.
-

MITIGATION MEASURES

Mitigation measures UTT01 to UTT04, CIR01, CIR02 and CIR04 will have to be applied as well as disturbance reduction measures AIR 01 to AIR 05, SON 01, LUM 01 to LUM 03, and VIB 01 to VIB 04. These are described in Table 7-5.

DESCRIPTION OF IMPACT

The effects of mine rehabilitation activities will be similar to those of the construction and operation phases but the duration will be shorter: temporary disruption of Cree users' traditional activities, peacefulness of the site, diminished sense of safety.

The restoration plan was discussed with the RE2 tallyman and his family. A video showing visual simulations of the mine and closure operations was also presented. The tallyman's family expressed a desire to have the pit backfilled with waste rock. This recommendation has been considered and is now part of the project.

When the site is restored, users may be interested in keeping the roads to have better access to the territory for trapping or hunting activities. However, this aspect was not discussed during consultations.

IMPACT ASSESSMENT

The application of mitigation measures will minimize the potential impact on land use during the rehabilitation phase. Consequently, the intensity is considered low. Its extent is local since it affects Cree land users in the study area. The duration will be short term as the impact will only be felt during the rehabilitation phase. The significance of the impact on land use during the rehabilitation phase is considered **minor.**

POST-REHABILITATION PHASE

Following revegetation of the waste rock stockpile and other rehabilitation activities, it is reasonable to believe that during the post-rehabilitation phase, part of the land affected by the mine will be reused and re-appropriated for traditional activities. It should be noted, however, that the Cree users interviewed during the consultations remain skeptical in this regard since they believe it will not be possible to reuse the restored site because of potential contamination (Chapter 5). Galaxy is committed to restoring its mine site in accordance with MERN requirements, which aim to see sites restored to a satisfactory state, including limiting the production and propagation of contaminants likely to harm the receiving environment, eliminating unacceptable risks to health and ensuring the safety of people (MERN, 2017). **To this end, the restoration plan will be prepared in accordance with the requirements of the Mining Act, particularly section 101, and in compliance with the requirements of the Guide for preparing mine closure plans in Québec (MERN, 2017). When preparing this plan, the tallyman will also be consulted. It should be noted that the restoration plan must be approved by MERN and MELCC before the mining lease is issued.**

Communication will continue, as will environmental monitoring. The impact of the project on current use of land and resources for traditional purposes in the post-rehabilitation phase is considered **positive**.

7.4.1.2 AREA ALONG BILLY-DIAMOND HIGHWAY

CONSTRUCTION PHASE

SOURCES OF IMPACT

- Transportation and traffic.

MITIGATION MEASURES

Mitigation measures NOR 11, SON 01, UTT 01, UTT 02, CIR 01, CIR 03, CIR 08 to 15, VIE 01, VIE 05, VIE 15 must be applied. These are described in Table 7-5 of the EIA.

DESCRIPTION OF THE IMPACT

The selected area is near the Billy-Diamond highway between kilometre 381 and Matagami and covers a distance of approximately 385 km and a radius of 2 km on either side of the highway. There are no villages near the road, although camps are set up there. The nearest community is Nemaska, 77.5 km from the Billy-Diamond highway. The road crosses or comes within 2 km of twenty Cree traplines belonging to the Cree Nations of Eastmain (2 traplines), Waskaganish (7 traplines), Nemaska (4 traplines) and Waswanipi (7 traplines). The selected area is frequented by Cree people who use the traplines adjacent to the highway (GENIVAR-WASKA Consortium, 2015). The presence of a road access facilitates the establishment of Cree camps and the development of areas for traditional activities (hunting, fishing and trapping) nearby. Thus, in addition to the presence of camps, the roadside may be used for parking, movement (on foot, snowmobile or ATV), activities, or to reach other trails.

During the construction period, traffic generated by the project will be a source of nuisances caused by noise and dust, as well as an increased risk of accidents, and a source of disturbances. As a result, some users may find their traditional activities disrupted or their peace and quiet and sense of security affected. An adaptation period will be necessary. We should also note that since the Billy-Diamond highway is entirely paved, some disturbances such as noise and dust pollution will be limited.

Furthermore, users of the study area are already used to trucks being present on the road. Galaxy has also already met with land users to share information about the project, the expected impacts and planned management measures. It gathered their concerns and expectations, particularly in relation to their travel habits, the main access sites to the camps, snowmobile trails and animal crossings. Routine mitigation measures will also be applied to limit nuisances associated with airborne contaminants and noise. In addition, a traffic management plan will be implemented. Galaxy will provide appropriate signage starting from the Billy-Diamond highway to announce its operations site.

Galaxy workers and contractors will be educated on traditional Cree practises to minimize disturbance. Galaxy will operate an effective complaint management and tracking system to address any issues that the local population may raise.

IMPACT ASSESSMENT

For the reasons mentioned above, the intensity of this impact is considered low; although users' activities and peace of mind will be disrupted by nuisances caused by the project, the practise of these activities will not be threatened. An adaptation period will be necessary for users to adjust their practises to these changes. The extent of the expected residual effects is regional, since the effects are likely to be felt by users of the 20 affected traplines who frequent the study area. The duration is short. Hence, the significance of the impact on land use during the construction phase is considered minor.

OPERATION PHASE

SOURCES OF IMPACT

- Transportation and traffic.

MITIGATION MEASURES

Mitigation measures NOR 11, SON 01, UTT 01, UTT 02, CIR 01, CIR 03, CIR 08 to 1, VIE 1, VIE 05, VIE 15 must be met. These are described in Table 7-5 of the EIA.

DESCRIPTION OF THE IMPACT

The effects felt during the operation period will be similar to those felt during construction, i.e., a disruption of traditional activities, of a sense of security, and of the peacefulness of the area, followed by a period of adaptation and adjustment, which will have begun during the construction period. During the operation period, 10-12 trucks per day will use the Billy-Diamond highway to transport lithium concentrate to Matagami.

The standard mitigation measures implemented during the construction phase will continue to be applied during the operation phase and will accelerate the adaptation period for users. The planned mitigation measures will also ensure the safety of users of the Billy-Diamond highway and of the area bordering the highway.

IMPACT ASSESSMENT

The intensity of the impact of project-related transportation on traditional uses along the Billy-Diamond highway is considered minor since, despite the nuisances that the project will cause, users will be able to continue their activities after an adaptation period, even if it means relocating certain activities if they consider it preferable. The extent of the feared residual effects is regional since the effects are likely to be felt by users of the 20 affected traplines who frequent the study area. The duration will be long term. Hence, the significance of the impact on land use during the construction phase is considered moderate.

7.4.2 INFRASTRUCTURE

CONSTRUCTION PHASE

SOURCES OF IMPACT

- Transportation and traffic.
 - Economic development and presence of workers.
-

MITIGATION MEASURES

Mitigation measures CIR 01 to CIR 03 and AIR 03, along with standard NOR 13 must be applied. They are indicated in Table 7-5.

DESCRIPTION OF THE IMPACT

The anticipated impacts on infrastructure include potential impacts on the Billy-Diamond highway linked to workers' travel and transporting machinery and heavy vehicle traffic during construction. This 620-km road is the main road in the study area, and was originally designed to withstand regular traffic from heavy vehicles. It is maintained by the SDBJ. According to consultations held with the SDBJ (**in 2018**), the road has been worn down somewhat since its construction; however, the restoration program **to remedy this situation will be completed 2021**.

Certain mitigation measures will therefore be implemented by the SDBJ in connection with this scheduled rebuilt, primarily to reduce the impact on traffic. It will be critical to establish good communication between the SDBJ and Galaxy in order to prevent potential inconveniences to road users. **Galaxy also committed to discussing winter road maintenance with the SDBJ.**

As a result of the Billy-Diamond highway's capacity to withstand heavy vehicle traffic, the anticipated travel of heavy vehicles for the project during the construction phase is unlikely to result in damage or premature deterioration of the road. In addition, Galaxy is committed to keeping public roadways free of obstructions, damage, trash, dirt, sediment, etc. at all times. It is estimated that during the construction phase, which will take place over a 15-month period, 1,800 trips will be made on the Billy-Diamond highway. These trips will be in addition to the 55,500 trips counted on this road for the year in 2017, which represents a 2.2% increase.

As stipulated in Section 6-4, there is a rest stop located in the study area: the km 381 truck stop. Like the Billy-Diamond highway, the km 381 truck stop is part of the SDBJ's assets. Since it offers services such as lodging, restaurants, meeting room rental, mechanical services and laundry services, the km 381 truck stop may very well see an increase in business during the construction period. It is also expected that certain mining services (primarily emergency medical services) will be provided in conjunction with the km 381 truck stop services; however, an agreement has yet to be signed.

During consultations held in 2017-2018, the SDBJ said that it was concerned with the capacity of the **remote landfill** located 190 m from the anticipated pit and whether it would be able to handle the quantity of waste generated by the increased use of the truck stop. This remote landfill has been in use for 35 years, and is still in operation. It only receives waste from the km 381 truck stop; the volume varies according to use. However, as noted in Chapter 4, the waste generated by the mine will not be processed at the remote landfill but **will be sorted and sent off-site**, and the traffic expected at the truck stop at km 381 should not have a negative impact on the landfill site. Moreover, to prevent safety issues, Galaxy will secure the SDBJ's remote landfill by erecting a fence around it. Consequently, there is no anticipated impact on this infrastructure.

IMPACT ASSESSMENT

The remaining residual impact on infrastructure primarily pertains to increased travel on the Billy-Diamond highway during construction. The intensity of this impact is deemed to be low, since the increase will be minor. The extent of the effect will be regional, since it will be felt over the portion of the Billy-Diamond highway from km 381 to Matagami. The duration will be short, limited to the construction phase. The significance of the impact on the infrastructure during the construction phase is considered to be **minor**.

OPERATION PHASE

SOURCES OF IMPACT

- Transportation and traffic.
 - Economic development and presence of workers.
-

MITIGATION MEASURES

Mitigation measures AIR 03, VIB 02 to VIB 04, and CIR 01 to CIR 04, **as well as CIR 08 to CIR 10** must be applied, in addition to standard NOR 13. They are indicated in Table 7-5.

DESCRIPTION OF THE IMPACT

Given that the Billy-Diamond highway is an important roadway, that it was designed to withstand regular heavy vehicle traffic, and that the SDBJ **will complete** road repair work in **2021** prior to the start of mine operations, project vehicle traffic during the operation phase is unlikely to result in damage or premature deterioration of this road. **However, if the increase in traffic associated with the project resulted in the need for repairs, Galaxy would discuss this with the SDBJ, since they manage maintenance on the road. Galaxy will take care of repairs directly related to the project.**

During each week of the operation phase, the Billy-Diamond highway will sustain: 154 truck trips for mine production transport (**77 round trips**), 35 truck trips for procurement, and 12 bus trips (6 one-way trips) to transport workers between the Eastmain airport and the mine site. This means that **10,452** trips will be added to the 55,500 trips recorded in 2017 on the Billy-Diamond highway, representing an **18.8% annual** increase. It should be noted that the 3% annual increase corresponds to very short bus trips (approximately 20 km) between the Eastmain access road and worker camp. Furthermore, these trips will be spread out during daytime hours, for the most part.

However, this increase in traffic will require a change in Billy-Diamond highway users' habits: they will need to be doubly careful since they will share the road with more vehicles, many of which will be heavy vehicles. That being said, with the mitigation measures that will be implemented, drivers should be able to quickly adapt to the additional traffic that will be generated.

Despite a smaller number of workers during the operation phase, the km 381 truck stop will still experience a higher usage rate than before the mining project began, which in turn will make the services offered even more profitable. In fact, a large number of contractors and subcontractors who have short-term assignments at the mining site would be able to stay at the km 381 truck stop.

At the beginning of the operation phase, users of the Billy-Diamond highway and Route 109 in Matagami may have to adapt to the increased number of heavy vehicles travelling to the transshipment centre due to the increased risk of accidents, dust and pollution generated by these trucks. Where appropriate, routine traffic mitigation measures on the Billy-Diamond highway will be extended along Route 109 up to the transshipment site. The site's safety measures and standards will then be applied and will mitigate disturbances linked to this increase in activity.

IMPACT ASSESSMENT

- The residual impact on infrastructure during the operation phase relates more specifically to the increase in traffic on the **Billy-Diamond highway and on Route 109, mainly in Matagami**. Overall, the intensity of this impact is deemed to be quite low, since the volume of traffic generated by the mining activities will be spread out over the entire day, and night travel will be infrequent. Its extent is regional since the impact will extend along the entire route **from km 381 of the Billy-Diamond highway to Matagami**. The duration is short since, within a few years, the Billy-Diamond highway users will be accustomed to the presence of the mine and will have adapted to the new volume of traffic. Globally, the significance of the impact on the infrastructure during the operation phase is considered to be **minor**.

REHABILITATION PHASE

SOURCES OF IMPACT

- Transportation and traffic.
 - Economic development and presence of workers.
-

MITIGATION MEASURES

Mitigation measures CIR 01 to CIR 04 must be applied. They are set out in Table 7-5.

DESCRIPTION OF THE IMPACT

During the rehabilitation phase, which will be spread out over time, approximately 1,800 trips will be taken on the Billy-Diamond highway. These trips will be marginal, since the discontinuation of the mining activities will result in a global decrease in the number of trips. Furthermore, customer traffic at the km 381 truck stop will be similar to that observed during the construction phase due to the number of workers present. The resulting economic benefits will have a positive impact.

IMPACT ASSESSMENT

- Just as with the construction and operation phases, the residual impact on infrastructure during the rehabilitation phase primarily pertains to traffic on the Billy-Diamond highway, between km 381 and Matagami. The intensity is considered to be low, given the decrease in traffic that will occur as compared to the conditions during the operation phase. Its extent is regional and duration will be short, since the impact will only be felt during the rehabilitation phase. Thus, the significance of the impact on the infrastructure during the rehabilitation phase is considered to be **minor**.

POST-REHABILITATION PHASE

Once the site has been restored, impacts will be non-existent, since no mining activities that would be likely to affect infrastructure will take place.

7.4.3 PERCEPTION OF THE PHYSICAL AND NATURAL ENVIRONMENT

CONSTRUCTION PHASE

SOURCES OF IMPACT

- **Site preparation and infrastructure construction.**
- **Water management.**
- **Transportation and traffic.**

MITIGATION MEASURES

Mitigation measures PER 01, UTT 02, CIR 01, CIR 02, CIR 04, CIR 05, VIE 01, VIE 15 and VIE 22 must be applied, in addition to the measures intended to protect the soil (SUR 03 and SUR 04) and decrease atmospheric emissions (AIR 01 to AIR 05), noise (SON 01), water contamination (QUA 01 to QUA 05, QUA 07 to QUA 13), night-time lighting (LUM 01 to LUM 03), vibrations and air overpressure (VIB 01), and all relevant standards (NOR 2 to NOR 5, NOR 8, NOR 9, NOR 11, NOR 13 and NOR 14). These are set out in Table 7-5.

DESCRIPTION OF IMPACT

Activities associated with the construction phase will cause various nuisances that could affect the perception of the quality of the air, light and sound environment, as well as the quality of groundwater and surface water, and, more generally, the integrity of the territory. Moreover, even if regulatory requirements are met, the vibrations felt by Cree users of the territory who engage in activities in the area of the mine, or by workers at the km 381 truck stop and its visitors, could exacerbate the perception that the territory is no longer the same and its quality has declined. It should be noted that before construction begins, land users will be informed of when it will start and of its progress. Furthermore, an area closed to traditional activities near the mining site will be established in collaboration with the Tallyman, thereby limiting the use of this sector.

Since the site is in an isolated area, the current air quality in the area studied is very good. During the construction phase, activities to prepare the site and to build infrastructure will change the air properties since there will be an increased suspension of particulate matter in the air. However, results of the air dispersion modelling study show that the standard will be met at the sensitive receptors. In this regard, users of traplines RE2, VC33 and VC35 believe that the project's effects on air quality will be felt in a wider area, beyond the radius used for modelling. In addition, the people we met raised the issue of the effects of dust accumulation on plants and dust infiltration into the soil, and the effects that ingesting these plants might have on the quality of wildlife resources, such as beaver, moose and geese. Furthermore, people have observed deformities in moose and attributed them to radiation from power lines near their feeding grounds.

Regarding ambient noise, the only current anthropogenic contributors of noise in the local study area are the Billy-Diamond highway and the km 381 truck stop. During construction, the standards set out will be met. The noise modelling study that was done shows that noise levels during operations (under the worst operating conditions) will be compliant (WSP, 2021c). The construction activities planned will be smaller in scale than those simulated. Thus, noise levels will increase, but will still be acceptable. As with air quality, Cree land users believe that the radius used to measure the project's effects on the noise climate is too small and that noise will be perceived within a wider area. They are also concerned about the effects of noise on the migratory routes of geese.

Since the site is in a remote location, sources of vibrations within the study area are nearly non-existent. Vibrations may occur during construction in conjunction with quarry operations. However, blasting operations will be less significant than during the operations phase. Currently, it is expected that vibration thresholds at the km 381 truck stop will be acceptable, as well as the other sensitive areas surrounding the pit. These elements confirm that activities of a lesser scale will also be acceptable. However, some may still feel vibrations when blasting occurs. For their part, Cree land users are concerned that vibrations could have an impact on sturgeon because of the presence of a new spawning site on the Eastmain River, which could be disturbed. The people we met believe that sturgeon are more sensitive to environmental disturbances than humans and that they could feel vibrations in the water that are imperceptible to humans. It should be noted, however, that this site is 10 km north of the project site and that the vibration waves from blasting do not reverberate that far.

In the study area, the only current artificial lighting at night comes from the km 381 truck stop. It emits very little light and the effect it has on the night sky fades quickly as you drive away from it. Some changes are expected since artificial lighting will be added to Galaxy's facilities during construction.

During the consulting activities that took place from 2017-2018, SDBJ's representative expressed a concern that the mining activities, from the start of construction through the end of rehabilitation, may affect the km 381 truck stop's drinking water supply, sourced from artesian wells on its property. It should also be noted that Cree land users also draw their drinking water from the same location when they stay at their camps. There are two drinking water sources in this location. Construction activities are not likely to affect the drinking water supply at the km 381 truck stop.

As for surface water, current conditions measured in the study area are representative of natural environments, even though they have quite high acidity levels and contain certain metals due to the presence of peatlands and to the nature of the rock and unconsolidated deposits. At the sampling stations inventoried, the surface water is generally unaffected by human activity. No change to the surface water quality is anticipated during construction. The risks of accidental spills remain, but Galaxy's emergency response plan allows for those to be dealt with quickly, if such an event were to occur. Cree land users were particularly worried about the risk of accidental spills because the mine's topography is higher than the Eastmain River. They are concerned about a possible contamination of this river, other small waterways (particularly creek CE5, which is an area users value), peatlands and groundwater, which they believe could occur through percolation. They are also concerned about the effects this potential contamination may have on animal resources, including fish. They also questioned the effectiveness of the treatment of the water discharged with effluent and mentioned that even if it is treated, the discharged water will not have the same quality as it had originally. Still on the subject of the project's effects on surface water and groundwater, the Cree people who frequent this territory are concerned about the impact on water flow.

The tranquility of the area, especially the Cree camps located close to the mining site itself, could also be affected by construction activities. People who are used to performing traditional activities in the projected infrastructure sector could find their safety compromised by the site's new use. In fact, during consultations with Cree land users, concerns were also raised about safety both on the road (accidents, road deterioration) and in the camps based on concerns about break-ins due to the presence of workers. However, the Cree land users and workers at the km 381 truck stop will be able to view the survey and environmental monitoring reports that will monitor the status of the situation in terms of water, air, noise and soil. Furthermore, beginning with the construction phase and throughout the entire project period, mechanisms will be put in place so that worrisome situations can be reported to and handled by Galaxy.

Finally, some Cree people may think that the integrity of the land they knew has been altered. This perception could be reduced by involving Cree users in the development of mitigation measures. This would allow them to regain some control over the changes made in the territory and could promote acceptance of the change.

IMPACT ASSESSMENT

The intensity of this impact is deemed to be low due to the activities specific to the construction phase, which will produce less disturbance. Furthermore, the mitigation measures will decrease the potential negative effects. The extent of the expected residual effects is deemed to be local, since they will likely only be felt by Cree land users who access certain specific sectors around the mining site, as well as the dozen or so workers and visitors at the km 381 truck stop. The duration is short. Thus, the significance of the impact on the perception of the physical environment during the construction phase is considered to be minor.

It should be recalled that, although the modelling results show that impacts will remain within the scope of the modelling, Cree users in the area believe that some nuisances during the construction period will be felt within a wider perimeter than the one used to perform the air quality and noise climate modelling studies. In addition, the effects of construction activities on their negative perception of environmental and water quality will continue over time since they consider these changes to be irreversible. Thus, according to their assessment, despite the low intensity, the extent of residual effects would be local and long term; therefore, the significance would be moderate. Environmental monitoring will ensure that impacts related to construction activities are not prolonged over time.

OPERATION PHASE

SOURCES OF IMPACT

- Presence and operation of the pit.
 - Other infrastructure in operation.
 - Management of process plant feed material, overburden and waste rock Water management.
 - Transportation and traffic.
-

MITIGATION MEASURES

Mitigation measures PER 01, UTT 02, CIR 01, CIR 02, CIR 04 to CIR 06, and VIE 01 must be applied, in addition to the measures intended to decrease air emissions (AIR 01 to AIR 05), noise (SON 01), water contamination (QUA 01 to QUA 05, QUA 07 to QUA 13), night-time lighting (LUM 01 to LUM 03), vibrations and air overpressure (VIB 01 to VIB 04), as well as all relevant standards (NOR 2 to NOR 9, and NOR 11 to NOR 14). These are set out in Table 7-5.

DESCRIPTION OF IMPACT

During the operation phase, operations are likely to cause more nuisances than during the construction phase, and therefore affect the perception of the quality of the air, light and sound environment, and the quality of groundwater and surface water, and, more generally, the integrity of the territory. In addition, the vibrations felt by Cree land users who engage in activities in the area of the mine, and by employees at the km 381 truck stop and visitors who stop there, could exacerbate the perception that the territory is no longer the same, and its quality has diminished. As stipulated for the construction phase, the number of Cree land users in the mining sector will be decreased with establishment of an area closed to traditional activities.

The impacts described for the construction phase are similar to those for the operation phase. Thus, air quality will be altered by mining operations since an increase in suspended particulate matter will change the air properties. However, results of the air dispersion modelling survey show that the standard will be met at the sensitive receptors. As for noise, the noise modelling study shows that noise levels during operations (under the worst operating conditions) will be compliant (WSP, 2021c). Thus, noise levels will increase, but will still be acceptable. It should be recalled that, like for the construction period, users of traplines RE2, VC33 and VC35 believe that the project's effects on the air quality and noise climate will be felt over a wider area than the one used for modelling. They also worry about the accumulation of dust on plants and the infiltration of dust into the soil, and the effects that ingestion of these plants may have on the quality of wildlife resources. Furthermore, people have observed deformities in moose and attributed them to radiation from power lines near their feeding grounds. Finally, they are also concerned about the effects of noise on the migratory routes of geese.

Since the site is in a remote location, sources of vibrations in the study area are nearly non-existent. Vibrations will occur when blasting takes place in the pit. The vibration thresholds at the km 381 truck stop and other sensitive areas surrounding the pit will be acceptable. When the values calculated were close to the limits, mitigation measures were added to ensure the thresholds were not exceeded. However, some may still feel vibrations when blasting occurs. As mentioned above, Cree land users are concerned that the vibrations could have an impact on sturgeon because of the presence of a new spawning site on the Eastmain River, which could be disturbed. The people we met believe that sturgeon are more sensitive to environmental disturbances than humans and that they could feel vibrations in the water that are imperceptible to humans.

In the study area, the only current artificial lighting at night comes from the km 381 truck stop. However, some changes are anticipated since artificial lighting will be added to Galaxy's permanent facilities, in addition to that needed for operations.

As previously indicated, SDBJ had expressed a concern that mining activities may affect the km 381 truck stop's drinking water supply. The specialized hydrogeology report demonstrated that groundwater lowering associated with the pit will be minimal where the wells are located (WSP, 2018a). In that respect, Galaxy has agreed to monitor the groundwater levels and verify the results of the hydrogeological modelling.

According to the INSPQ, the issues of water quality, quantity and access are the Cree's primary concerns (INSPQ, 2014). As mentioned for the construction period, Cree land users showed that they were particularly concerned about the risks of accidental spills because the topography of the mine is elevated in relation to the Eastmain River. They fear that the river may be contaminated, in addition to the contamination of other small waterways (especially creek CE5, which is an area users value), peatlands and groundwater, which they feel could occur through percolation. They are also concerned about the effects this potential contamination may have on animal resources, including fish. They also questioned the effectiveness of the treatment of the water discharged with effluent and mentioned that even if it is treated, the discharged water will not have the same quality as it had originally. Still on the subject of the project's effects on surface water and groundwater, the Cree people who frequent this territory are concerned about the impact on water flow.

To that end, the watercourses in the study area were subjected to chemical analyses (water and sediments) within the context of a specialized study on aquatic habitat (WSP, 2018e). The watercourses in question run from east to west, toward the Eastmain River. They hydrographic system in the local study area represents a very low percentage of the Eastmain River's watershed (0.1 % total). During operations, run-off water from the entire site will be captured and channelled to water retention basins. If necessary, the water will be treated at the water treatment plant before it is discharged into the environment. Under future conditions, water quality will be ensured by means of a monitoring program. Furthermore, D019, MDMER and EDO requirements will also be met.

As is the case during the construction phase, the tranquility of the premises, especially in the Cree camps located around the mining site itself, could also be affected by mine activities. People who are used to performing traditional activities in the projected infrastructure sector could find their safety compromised by the site's new use. The communication measures put in place during the construction phase will continue during the operation phase. Environmental monitoring and follow-up reports will also be made available. For safety purposes, the area closed to traditional activities that is established in collaboration with the Tallyman during the construction phase will be maintained.

Lastly, like for the construction period, some Cree people may feel a sense of loss related to the alteration of the integrity of the territory they knew. This perception could be reduced by involving Cree users in the development of mitigation measures. This would allow them to regain some control over the changes made in the territory and could promote acceptance of the change.

IMPACT ASSESSMENT

During the operation phase, the intensity of this impact is deemed to be moderate since activities specific to this phase will feature a higher number of sources of disturbance. That being said, the mitigation measures will decrease the potential negative effects. The extent of the expected residual effects is deemed to be local, since they will likely only be felt by Cree land users who access specific sectors around the mining site, as well as the dozen or so workers and visitors at the km 381 truck stop. The duration is long, although the impacts may not be continuously felt. Thus, the significance of the impact on the perception of the environment during the operation phase is considered moderate.

It should be recalled that Cree users in the area believe that some nuisances during the operating period will be felt within a wider perimeter than the one used to conduct the air quality and noise climate modelling studies. In addition, the effects of the mine's operations on their negative perception of environmental and water quality will continue over time since they consider these changes irreversible.

REHABILITATION PHASE

SOURCES OF IMPACT

- Infrastructure dismantling Water management.
 - Transportation and traffic.
 - Economic development and presence of workers.
-

MITIGATION MEASURES

Mitigation measures PER 01, UTT 02, CIR 01, CIR 04, CIR 05, VIE 01, VIE 15 and VIE 22 must be applied, in addition to the measures intended to protect soil (SUR 03 and SUR 04) and decrease air emissions (AIR 01 to AIR 03), noise (SON 01), water contamination (QUA 01 to QUA 05, QUA 07 to QUA 13), nighttime lighting (LUM 01 to LUM 03), and all relevant standards (NOR 1 to NOR 9, NOR 11, NOR 12 and NOR 14). These are set out in Table 7-5.

DESCRIPTION OF IMPACT

During the rehabilitation phase, the risks of disturbance will be, for all intents and purposes, the same as for the construction phase.

IMPACT ASSESSMENT

Application of the mitigation measures will minimize the potential impacts on the risks of disturbances during the rehabilitation phase. As a result, the intensity is considered low. Its extent is deemed to be local, since it pertains to Cree land users in the sector surrounding the mine, as well as the km 381 truck stop workers and customers. It will be of short duration, as the impact will only be felt during the rehabilitation phase. The significance of the impact on territory use during the rehabilitation phase is considered to be minor.

POST-REHABILITATION PHASE

The negative perception associated with the site remains, is one element that was brought out during the consultation activities that took place within the Eastmain community in 2017-2018. The concerns pertain to possible contamination of the lakes and watercourses surrounding the mine, the effect on resources (fish, wildlife, plants or other natural resources) used for traditional purposes, as well as its effect on human health. Some people are also worried about the potential effects on future generations. The potential impacts on the perception of the physical environment during the post-rehabilitation phase are negative. All in all, implementation of the rehabilitation plan complies with MERN requirements, and the monitoring program arising out of those should help to minimize this impact.

7.4.4 QUALITY OF LIFE

The impacts of the project on the quality of life and well-being were assessed for the Cree First Nations as well as for the community of Matagami, given the transport and transshipment activities planned during the operation phase, in response to the request issued by the MELCC during the analysis of the 2018 ESIA.

7.4.4.1 CREE FIRST NATIONS

CONSTRUCTION PHASE

SOURCES OF IMPACT

- Site preparation and infrastructure construction.
 - Transportation and traffic.
 - Economic development and presence of workers.
-

MITIGATION MEASURES

Mitigation measures UTT 01 to UTT 05, CIR 01, **CIR 02, CIR 04, CIR 05, CIR 08 to CIR 16**, VIE 01 to VIE 22, **ELR 05, ELR 06, ELR 13 and PER 01** must be applied. They are indicated in Table 7-5.

DESCRIPTION OF THE IMPACT

Cree Community Values

One fear often mentioned by stakeholders met during public consultation activities was of seeing community values that are very important to the Cree (mutual assistance, support, etc.) disappear or diminish to give way to individualism. They also fear the same for traditional activities (e.g.: hunting); some Eastmain community members are afraid interest will decrease.

Therefore, the feeling of loss or damage to the Cree cultural identity is one of the project's expected impacts on the quality of life. Use of the territory for traditional purposes is more than just the Cree's livelihood. It provides their identity, and translates into a deep feeling of belonging to the land. This is the place that holds their collective and individual memories, important events, births and deaths, legends and beliefs. In this respect, preparing the land and building infrastructure may affect some members of the Cree communities and contribute to a feeling of progressive loss of their traditional way of life and cultural identity. **For elderly people in particular, who have lived the traditional Cree way of life since their youth and who are deeply attached to carrying on the traditions and passing down Cree identity, the project could be a disruptive event in the territory, in addition to other events they have witnessed since the development of the James Bay territory. This could lead them to oppose the project and to develop mistrust toward it and its promoter. For many elderly people, the well-being of James Bay Cree territory residents depends on more than material well-being; it depends on having access to the territory and maintaining subsistence activities (INSPQ, 2014).**

In addition, population subgroups of the Eastmain and Waskaganish Cree Nations, particularly women, youth and elders, could also suffer negative impacts or, conversely, benefit from positive impacts related to mining development. In this respect, the study area corresponds to the territorial boundaries of each of these two communities. Galaxy is committed to adopting a series of measures to enhance the positive impacts and mitigate the negative impacts of the project during the construction phase on the Eastmain and Waskaganish subgroups of the Cree Nations population.

Road Safety

Transportation related to construction activities could also lead to Billy-Diamond highway users feeling less safe and to the perception of an increased risk of accidents, a concern that was primarily raised by women, **representatives of the Waskaganish community** and land users during consultations held in June 2018. Road safety on Billy-Diamond highway is ensured by Sûreté du Québec. The police stations in the cities of Matagami and Radisson provide these services. Furthermore, Galaxy will establish a traffic management plan to minimize inconveniences associated with the increased road traffic. **This plan is an integral part of Galaxy's operations management system, which includes Environmental, Health and Safety standards.**

All work phases, including field campaigns, are subject to a risk analysis. The results of the risk analyses lead to the implementation of procedures which all employees and contractors involved in the work must follow. These procedures also include the transportation management plan.

As part of the Galaxy management system, a transportation management plan and a communications management plan will be developed. The content of these plans has not yet been developed, but it will include a list of stakeholders with the topics to be covered, the frequency of events, the means of communication and a person responsible for implementation. There is currently a journey management plan for the pre-construction period, which will be modified for the construction period and then for the operation.

By implementing this plan, Galaxy will ensure that security features are in place, including:

- signage and traffic checks, measures and procedures;
- vehicle specifications (speed controllers, low-reflection lights and covered trucks);
- routine inspection procedures and other transportation-related requirements, such as weather conditions when traveling;
- radio communication protocols;
- records of any problems encountered (breakdowns, road conditions, presence of animals, etc.).

In addition, accidents along the route will be monitored to determine if there is a recurrence, to verify and identify problems, if any, and to propose corrective measures. The transportation management plan will also include mandatory driver training, logbooks and safety awareness programs.

It will also include a description of on-site and off-site roads (width, number of lanes, speed limits, lighting and maintenance), on-site and off-site fleets (frequencies and loads), potential travellers to the site (suppliers, workers, contractors, visitors, concentrate transporters), and rules to be followed, such as training, procedures, signage, receiving and handling complaints.

More specifically, for traffic on the mine site, measures already planned are signs identifying the site from the Billy-Diamond highway and the presence of a gatehouse with a guard to control access. The gatehouse will be located at the entrance to the work site / mine (depending on the phase of the work), approximately 50 m from the Billy-Diamond highway. It should be noted that the northern and western boundaries of the work site / mine are not easily accessible, and a 30 m strip of land will be cleared to protect the infrastructure from the risk of forest fires. On the south side, there will be a fence between the truck stop waste dump and the mine site, in this case the pit.

In addition, the traffic plan will be developed in collaboration with land users. Galaxy will be sure to take recommendations from land user consultations into consideration and to obtain relevant information and details about the various measures that were identified. Thus, the plan will take into account the travel habits of the land users and the main access sites to camps, snowmobile and ATV trails, and animal crossings, or any other site or element of interest to the stakeholders. The traffic management plan will be reviewed, updated, and enhanced as necessary, at least annually, including any changes and incidents that occur.

Specific measures will be taken to inform truck drivers of concerns raised by Cree stakeholders regarding the safety of the population and land users, particularly during periods of hunting and trapping activities, which may take place along roadsides. Concerns were also raised about disturbance to wildlife and what impact it may have on traditional activities. In fact, any other measures likely to be effective in addressing the Crees' concerns could be implemented.

The intersection of the Billy-Diamond highway and the truck stop will be a key element of the traffic management plan. Truck drivers will be made aware of the importance of exercising caution at this location in order to limit road sharing conflicts. The truck stop will remain available to road users for refuelling and access to water.

Integration of Cree workers

Difficulties with integrating the Cree workers into the working environment could be experienced during the construction phase; there is also the risk of tension between them and the construction contractors' non-Cree workers. Experience gleaned from other projects on the EIJB territory, most notably that experienced by workers at the Troilus mine, brought to light the challenges that come with integrating Cree workers into the working environment. This population is faced with having to adapt to issues relating to language, management, work schedules and cultural habits (Roquet, 2008).

The project will also intensify relationships between members of the Eastmain communities and the construction contractors' non-Cree workers. In certain projects, the situation led to tensions stemming from cultural and contextual misunderstandings, not to mention prevailing prejudices that exist between the two groups. Galaxy will develop a code of ethics for its workers, and the construction contractors' workers will also need to follow it. The population will be able to share their comments and concerns with Galaxy at any time through an internal community relations department.

Health

Lastly, health and social service providers met during the consultation activities shared their concerns regarding the pressure that the Eastmain community's health services may feel, due to accidents that could occur during construction.

A health care and emergency medical service will be set up at the time of construction to serve the project's workers. Galaxy will operate it independently on its site. In accordance with the First-aid Minimum Standards Regulation (RLRQ A-3.001, r.10), a nursing service with a first aid room and first aid attendants must be provided for the Galaxy workers' camp. Therefore, no significant additional pressure will be put on the Cree First Nations health system.

An agreement with the SDBJ is currently being developed so that this service can be offered jointly with that of the truck stop at km 381, given their proximity. The Nemaska and Eastmain medical services, which are under the jurisdiction of the CCSSBJ, are the closest geographically to the truck stop. The CCSSBJ currently provides medical services to the truck stop from Radisson and may soon provide ambulance services to the truck stop.

Galaxy is still in communication with the CCSSBJ and, as suggested, will contact the Council of the Cree Nation of Eastmain, to discuss how to collaborate with CCSSBJ ambulance services. There is a willingness on both sides to collaborate, but no decision has been made yet.

If needed, Galaxy's medical service will be able to assist truck stop employees and residents with emergencies and major accidents. However, Galaxy's medical service cannot become a local medical centre that is accessible at all times. Finally, the problem of risky sexual behaviour (early pregnancy, STIs, teenage mothers) and concerns related to prostitution due to the influx of workers are more specifically addressed in the operations phase, although they are also present during the construction phase.

IMPACT ASSESSMENT

- Application of the mitigation measures will minimize the potential impacts on the quality of life during the construction phase. Overall, the intensity of this impact is deemed to be low, since it is recognized that difficulties will not be felt as strongly at the start of the project as they will during operation. Its extent is regional, since it affects Cree mine workers and the Eastmain and Waskaganish Cree communities. Lastly, the duration of the impact is short. Globally speaking, the significance of the impact on the quality of life during the construction phase is considered to be **minor**.
- **Regarding negative impacts on women, youth and elderly people in the Eastmain and Waskaganish communities during construction, the effects will be minimized by applying mitigation measures. Since Galaxy will implement its mitigation measures during the first few months of the construction phase, the impact's intensity will be low. Its extent is regional since it affects the Cree communities of Eastmain and Waskaganish. Lastly, the duration of the impact is short. Overall, the significance of the impact on women, young people and elderly people in the affected communities during the construction phase is considered minor.**

OPERATION PHASE

SOURCES OF IMPACT

- Presence and pit mining.
- Other infrastructure in operation.
- Management of process plant feed material, overburden and waste rock Transportation and traffic.
- Economic development and presence of workers.

MITIGATION MEASURES

Mitigation measures UTT 01 to UTT 06, CIR 01, CIR 02, CIR 04, CIR 05, CIR 08 to CIR 16, VIE 01 to VIE 22, ELR 05, ELR 06, ELR 07, ELR 08, ELR 13 and PER 01 must be applied. They are indicated in Table 7-5.

DESCRIPTION OF THE IMPACT

Cree Community Values

The impacts described for the construction phase, such as feelings of loss and damage to the Cree cultural identity, Billy-Diamond highway users' increased sense of being unsafe, and difficulties integrating Cree workers into the workplace, could also be felt during the operation phase.

Galaxy will continue to implement mechanisms for integrating workers since it was demonstrated that the tensions felt were the biggest issue within the context of long-term employment (operation phase), as workers are together for a longer period of time. Non-indigenous workers will be sensitized to the Cree **First Nations** traditional practises **and to cultural diversity**. Thus, within the context of more long-term relationships, problematic interethnic relationships could deteriorate over time. However, the relatively long duration of the employment, provided that the relationships are good, constitutes an opportunity to bring the two groups of workers closer together. **An intercultural training component in the orientation program is also planned.**

With the implementation of the employment equity and workplace harassment policy, the company is committed to equity in terms of gender, sexual orientation, family status, family responsibilities, ethnic origin, disability, political or religious beliefs and age. No form of harassment or discrimination will be tolerated, as stated in the company's policies. Disciplinary measures will be imposed according to the severity of the actions committed.

Studies conducted by Hydro-Québec as part of the Eastmain-1-A-Sarcelle-Rupert project demonstrated that implementing appropriate measures such as discussions, cultural awareness programs and creating a respectful work climate promotes the integration of workers into the workplace (Hydro-Québec and SDBJ, 2009; Roquet, 2008).

These studies also brought to light that separation from family is the main job difficulty that Cree workers mentioned. **The work schedules specific to mining projects (during both construction and operation phases), and more specifically the extended stays on the project site, have health and social impacts on families, women and children (INSPQ, 2014).** During consultations, particularly with the CCSSSBJ and the CSCBJ, some participants expressed concern about the effects that Cree workers' work schedules could have on families, including a possible increase in the removal of children from their families or seniors left to fend for themselves because their loved ones are absent. The project could be associated with a reduction in the amount of time that Cree workers employed on the project will be able to devote to caring for elderly people in their network, or for children in their family.

Single-parent families, the heads of which are generally women, are numerous in Cree communities. Work-life balance may therefore be a challenge for women employed at the mine, as well as for the partners of mine workers. In addition, the INSPQ mentions that the high birth rate in Cree First Nations increases the chances that an employee will be pregnant or breastfeeding during her employment period. Galaxy is planning many measures to mitigate the project's impact on work-life balance for both female Cree employees and women in the Cree communities, including the possibility of working in the company's offices located in the Eastmain community.

Galaxy will also attempt to take these concerns into consideration by offering workers flexible schedules, particularly by allowing them to take leave for family reasons.

In addition, in order to allow Cree workers to maintain their cultural traditions, Galaxy will establish an annual schedule of the main traditional activities before the construction phase and will schedule its production shutdowns so as **to do maintenance work during periods of about ten days**, according to their participation in these activities, **namely hunting geese in the spring and hunting moose in the autumn. These production shutdowns will limit disturbances to wildlife during the goose-hunting season and facilitate traditional activities for Cree workers. Another measure will be to promote the possibility of taking days off during these periods. Other measures will also be possible, after discussion with the monitoring committee, if concerns are expressed. Galaxy wants to ensure that all Cree workers are satisfied with their living environment at the worker camp and with their overall quality of life, particularly by offering reasonable accommodations and flexible work schedules. Shift rotations for Cree employees may vary depending on the type of job and will not necessarily follow the shift patterns commonly used at other mine sites. This is also intended to make jobs more accessible to Cree people, especially women, and to promote work-life balance for employees, especially those with elderly family members or dependent children. As mentioned above, Galaxy will not discriminate in any way during its hiring process. The possibility of adjusting work shifts will be studied in greater detail at a later stage and following further consultations.**

It should be noted that the creation of a Cree cultural village inspired by the Éléonore mine initiative in the Wemindji territory is not likely. The Galaxy project area does not allow for as much infrastructure as the Eleonore project, and the ground is 75% wetlands.

Social issues

The possible increase in social problems, such as alcohol and drug consumption or compulsive gambling, among Cree workers or in Cree communities, was an anticipated impact raised by those interviewed during public consultations. It seems that the connection between employment and drug and alcohol abuse is not a given. In fact, abusive consumption is associated with less regular employment and lower income, while moderate consumption is correlated with better income (French and Zarkin, 1995). As a general rule, regular employment is also a key determinant of health, both physical and mental, and is associated with better lifestyle choices (Thériault and Gill, 2007). Nevertheless, for people who already abuse drugs and alcohol, an increase in income could facilitate access.

These issues may sometimes be linked to other issues such as domestic violence, the victims of which are most often women. For its part, the INSPQ (2014) indicates that certain social and psychological problems, such as drug addiction, unemployment, discrimination and depression, can lead to bouts of violence in some people. The consumption of alcohol and drugs, as well as violence, are prevalent in the James Bay Cree territory and seem to affect young adults in particular (INSPQ, 2014).

To prevent the development or growth of such social problems, Galaxy will prohibit any consumption of alcohol or drugs in the worker camp and any form of video lotteries or gambling on site. Galaxy is also in discussions with the SDBJ to ensure compliance with applicable truck stop regulations and proper monitoring of alcohol and drug use. Measures will also be implemented to prevent violence at the mine site and in the Cree communities of Eastmain and Waskaganish.

Galaxy has a policy that requires its employees and those of its contractors and business partners to be physically, mentally and emotionally fit to work and not pose any risk to their own or others' wellbeing, and will apply this policy at its mine site. The policy requires, among other things, that supervisors or managers assess the fitness for duty of employees under their supervision, either by observation or testing. Galaxy has a travel management procedure in place, according to which every trip its employees, contractors and business partners make to the mine site will be recorded. Galaxy checks the identity of its itinerant workforce at the mine site. Currently, this procedure applies to the pre-construction period, and will be updated for the construction and operation periods.

Concerns about sexual harassment of women were also raised in focus groups. The Cree First Nations have proposed that workshops be organized for Cree and non-Cree workers to prevent sexual harassment. It was also suggested that a grievance process be set up. Galaxy does not tolerate any form of harassment or discrimination in its corporate policies and provides for disciplinary measures to be imposed based on the severity of the acts. Other measures intended to create and maintain a healthy and respectful work environment will help prevent these types of problems from occurring. Galaxy will ensure that its liaison officer is able to maintain a relationship of trust with Cree employees so they can more easily confide in him / her when necessary, and that appropriate measures are put in place. In addition, the Human Resources Department, which will include at least one Cree woman, will ensure the wellbeing of its employees, including Cree women, and provide support and follow-up to women who are victims of harassment. Galaxy has also contacted the Cree Women's of Eeyou Istchee Association (CWEIA) and future discussions will focus on implementing additional measures to promote the creation of a safe environment that is free of sexual harassment for Cree women.

Galaxy employees are expected to remain at the worker camp during their shifts, and no transient visitors are allowed on the site. Since some employees of contractors will be staying at the truck stop, which is owned and operated by the SDBJ, the truck stop's rules will have to be respected. If women or men at the km 381 truck stop appear to be engaging in prostitution, the staff in charge of the truck stop will contact the police. Galaxy acknowledges that police brutality against women has been reported in the past, including in Val-D'Or. Any calls to the police involving Galaxy employees or contractors will be recorded and tracked by the human resources department.

Health

Other significant discrepancies have been observed with regard to the health condition of the Cree and of First Nations peoples in general, as compared to the rest of the Québec population. These discrepancies are especially pronounced in terms of life expectancy, intentional and unintentional trauma, the prevalence of many chronic illnesses (e.g.: diabetes, obesity, hypertension) and infectious illnesses, as well as psychological distress (Secrétariat aux affaires autochtones, 2018). To this effect, Galaxy will propose measures to encourage healthy lifestyle habits such as healthy and balanced meals (low in sugar and trans fats) or the installation of a gym at the worker camp site.

The mining development project could also generate or increase risky sexual behaviours and unwanted pregnancies, and exacerbate problems associated with the higher incidence of STIs in James Bay Cree communities. In addition, mining development may accentuate a higher birth rate among teenage mothers and less educated women, and concerns about prostitution at the km 381 truck stop. In this context, Galaxy has planned a series of measures to mitigate these impacts and is working with the Cree Women of Eeyou Istchee Association to organize a focus group to develop plans for safety, communication and best practises and to reach out to qualified women interested in working.

Quality of life

One of the possible negative effects associated with getting a well-paying job at the mine is excessive debt in Cree households. **Young employees who are at their first job may be at greater risk of experiencing debt problems (INSPQ, 2014).** The income could facilitate access to credit for purchasing items. Case studies have shown that this issue was observed in several communities (El Kreshi, 2009). Galaxy's human resources department will work with Cree workers to help educate them on smart money management.

An anticipated impact is an improvement in workers' and certain community households' quality of life. The project will provide jobs for people from various socioeconomic groups within the Cree population, such as specialized and non-specialized workers, adults and youth alike. In all, **a maximum of 167** workers will need to be hired to meet the mine's requirements. It is also important to emphasize that the jobs offered during the operation phase will be full-time and long-term. Income from these jobs and contracts awarded to Cree businesses will contribute to improving the quality of life for not only Cree workers, but also a large part of the Cree communities' population, **including women and young people.**

Seniors are the least likely to personally experience positive impacts associated with the economic benefits of the project since they are not directly involved in the jobs and contracts offered by Galaxy. However, they could benefit from an improved quality of life in their families, and investments in the community (new services or infrastructure) linked to the funds negotiated in the IBA with Galaxy. However, impacts related to the emergence of family tensions or polarization of opinions could potentially be felt by seniors especially. In fact, since the benefits of the project mainly relate to employment and contracts, tensions could arise within the Cree First Nations, between those who benefit from these advantages and those who do not, or who experience more negative effects related to a sense of loss of territorial integrity.

Lastly, the potential increase in the Cree households' income could also have a positive effect on the Cree population's health. It is a known fact that income level is one of the most significant determining factors of health. The Public Health Agency of Canada indicates in its second report on Canadians' health that as the level of income rises, Canadians are known to be less ill, have a longer life expectancy and better overall health (ASPC, 2013).

The end of the operation phase will lead to a gradual decrease in the number of workers. This downturn in workforce requirements could result in a decrease in income for some, and for others, job loss or change. Some employees may have more difficulty finding a job with the same salary level that they had at the mine. Worry associated with having to draw unemployment and loss of employment could lead to behavioural and health problems for affected workers and their families. Some of the health problems that occur could include an increase in alcohol and drug abuse. Through its communication program, Galaxy will notify their workers, ahead of time, of when they expect work to end, so that they can prepare themselves. Galaxy will also offer an Employee Assistance Program to provide closure transition support (worker reclassification assistance committee).

IMPACT ASSESSMENT

Application of the mitigation measures will minimize the potential impacts on the quality of life during the operation phase. Overall, the intensity of this impact is considered moderate. Its extent is regional, since the impact will be felt by Cree workers and the Cree **First Nations** of EIJB. The duration is medium since the impact may occur during the life of the mine, a period of approximately 18.5 years. The significance of the impact on the quality of life during the operation phase is considered to be **minor**.

Applying mitigation measures will also minimize the negative impacts on women, young people and elderly people in the Eastmain and Waskaganish communities during operation. Overall, the impact's intensity is considered low during operation since the developer will have had time to implement the various mitigation measures and confirm their effectiveness since the beginning of the construction phase. Its extent is regional since it affects the Cree communities of Eastmain and Waskaganish. Finally, the impact's duration is medium. Therefore, the significance of the impact on women, young people and elderly people in the affected communities during the operation phase is considered moderate. It should be noted, however, that this impact has a positive aspect in terms of the increased quality of life associated with obtaining long-term employment and contracts.

REHABILITATION PHASE

SOURCES OF IMPACT

- Infrastructures dismantlement.
- Pit rehabilitation.
- Transportation and traffic.
- Economic development and presence of workers.

MITIGATION MEASURES

VIE 04, VIE 06 to VIE 10, VIE 12 to VIE 17, VIE 19 to VIE 22, ELR 05, 07, ELR 08 and PER 01 must be applied. They are indicated in Table 7-5.

DESCRIPTION OF THE IMPACT

During the rehabilitation phase, there will be more or less the same number of jobs available at the mining site as there were for the construction phase. Just as for the operation phase, the impacts on quality life – primarily integration and social problems – will continue to be felt during the rehabilitation phase.

However, this phase will be characterized by substantial income and significant monetary gains. The type of work planned for the rehabilitation phase, however, primarily pertains to earthwork and landscaping, which generally requires hiring local suppliers. Thus, the rehabilitation phase of the project should have a beneficial impact on the region in terms of labour and purchasing goods, services and materials. Cree workers and suppliers will be able to maintain good levels of income during this period, which will in turn help them to maintain a good quality of life.

IMPACT ASSESSMENT

Application of the mitigation measures will minimize the potential impacts on the quality of life. The intensity is considered to be low, since the operation phase will have resolved the most concerning issues. Its extent is regional, since it affects all Cree mine workers, as well as the EIJB's Cree communities. It will be of short duration, as the impact will only be felt during the rehabilitation phase. Thus, the significance of the impact on the quality of life during the rehabilitation phase is considered to be **minor**.

POST-REHABILITATION PHASE

Site closure will allow a portion of the territory affected by the mine to be re-used and re-appropriated. These activities will have a positive effect since they will mitigate the negative effects associated with the sense of loss felt with presence of the mine's remains and changes made to the territory.

7.4.4.2 MATAGAMI

OPERATION PHASE

SOURCES OF IMPACT

- **Transportation and traffic in Matagami, including increased activity at the transshipment station.**
 - **Economic development and presence of workers.**
-

MITIGATION MEASURES

Mitigation measures AIR 02, NOR 11, SON 01, CIR 01, CIR 08 to CIR 15 and VIE 01 must be applied. These are described in Table 7-5.

DESCRIPTION OF THE IMPACT

Increased activity at the transshipment station will result in increased truck traffic. The transshipment station belonging to the City of Matagami is located approximately 4 km southwest of the urban core of Matagami, on Route 109. There is a 3-km rail network, 250,000 m² of storage space and almost as much land ready for development (Matagami Transshipment Station, 2021).

However, since the nearest residential neighbourhoods are located 400 m from the road and about 4 km from the transshipment station, the contribution of the traffic to the noise generated by the project should not particularly inconvenience the residents. In addition, a forest cover separates the road and the transshipment station from the town of Matagami, thus attenuating the range of the noise. In addition, transportation is mainly planned to take place during the day.

At the beginning of the operation phase, users of the Billy-Diamond highway, which becomes Route 109 in Matagami, may have to adapt to the increased number of heavy vehicles travelling to the transshipment centre because of the increased risk of accidents, dust and pollution caused by these trucks. As with the mine site, the transportation management plan and the communications management plan will also apply to travel between the transshipment centre and the mine site.

IMPACT ASSESSMENT

The intensity of the impact on the quality of life in Matagami is considered low. During the first few years of operation, citizens will have to adapt to the nuisances caused by the increase in traffic. However, they are already familiar with heavy vehicle traffic on the Billy-Diamond highway and Route 109. Moreover, the transshipment site is located at a good distance (4 km) from the city.

Its extent is local since the effects are likely to be felt by users of the Billy-Diamond highway and Route 109 mainly in Matagami. The duration is medium, since the period required for road users to adapt may be spread over a few years. Thus, the significance of the impact on the quality of life in Matagami is considered to be minor.

7.4.5 LOCAL AND REGIONAL ECONOMY

CONSTRUCTION PHASE

SOURCE OF IMPACT

- Economic development and presence of workers.
-

MITIGATION MEASURES

Mitigation measures ERL 01 à ERL 06 ELR09 to **ELR 15, ELR 17, ELR 18 and VIE 07** must be applied. They are indicated in Table 7-5.

DESCRIPTION OF THE IMPACT

Mine construction could have significant economic benefits for Cree and James Bay businesses (increase in local demand for goods and services). In fact, numerous services necessary at each construction stage may be able to be subcontracted to local or regional businesses. Furthermore, the construction phase needs may provide opportunities for joint ventures.

The project currently represents an investment of more than approximately **\$362.5** million. Of that amount, purchases within Québec could total approximately **\$290** million during the construction phase. Area socioeconomic stakeholders that were met emphasized the importance of the project's economic benefits for the Cree and James Bay communities, most particularly in terms of benefits for the businesses. It is also important to highlight the additional revenue this project will generate for the Grand Council of the Crees and the **Cree Nation** of Eastmain.

Numerous improvement measures have been proposed to favour awarding contracts to local and regional businesses, particularly a purchasing policy that would prioritize local and regional businesses in calls for bids and a memorandum of understanding about the consequences and advantages of Cree participation (for royalties and jobs). Business opportunities associated with mine construction will have a positive impact on maintaining and developing Cree businesses and on EIJB communities' economies. **Galaxy wants to create a partnership with the Cree Nation of Eastmain, particularly by developing a protocol for the participation of Cree workers, including women and young workers.**

The construction expenses of the mine will also contribute to the creation of jobs, particularly for EIJB communities and most especially for Eastmain. The work will be spread over an 18-month period and will require **many workers. The number of employees required will not be constant during the construction phase.** It should be highlighted that many Cree and James Bay workers acquired good experience in the construction industry, primarily within the framework of Hydro-Québec's Eastmain-1 and Eastmain-1-A–Sarcelle–Rupert projects.

Many improvement measures have been proposed to favour hiring Cree workers, **including women and young workers**, and to reduce obstacles or constraints on employment (e.g., worker integration mechanisms such as information sessions and a Cree job counsellor, etc.), particularly through the Impact and Benefit Agreement (IBA) being developed with the Eastmain **Cree Nation**.

Furthermore, participation in mine construction will empower EIJB community members to improve their job skills, employability and qualifications. **It should be noted that the employment rate of Cree women is higher than that of men and, as a result, obtaining a job during mine construction does not automatically represent a positive impact for women. However, for women who wish to work in non-traditional fields, it represents an opportunity for employment and skills development. Considering that compensation for jobs during the construction phase may be higher than that of some jobs offered in the community, the impact may be financially beneficial at the individual level, although it may be a drain on skilled workers from the communities to the mine site (see the operation phase impact assessment).**

Experience acquired during the construction phase will be helpful to those who, when construction is complete, wish to find a new job on the job market. Furthermore, job prospects, not only at this mine but in other mining extraction projects in the region, could entice some of the youth to sign up for training or pursue their education toward a career or trade.

Several measures have been proposed with the goal of allowing Eastmain community members to acquire the skills necessary for the jobs offered during the construction period. In this regard, Galaxy proposes, in partnership with the Cree Human Resources Department (CHRD) and the Cree School Board (CSB), to develop training and development programs to fill positions at the mine. **These will begin after provincial and federal environmental approvals are issued.** Lastly, one of the project's positive effects on businesses and the workforce is associated with the development and enhancement of local and regional expertise.

IMPACT ASSESSMENT

For all of the aforementioned reasons, the project impact associated with the local and regional economy during the construction phase is deemed to be **positive**.

OPERATION PHASE

SOURCE OF IMPACT

- Economic development and presence of workers.
-

MITIGATION MEASURES

Mitigation measures ERL01 to ERL08 must be applied. They are set out in Table 7-5.

DESCRIPTION OF THE IMPACT

The project will generate economic benefits in the Cree community during the operation phase. Annual operating expenses will be approximately \$118 million. Not only could the mine's activities help with business development for existing local companies, they could also help create new businesses to meet the mining company's needs for goods and services (such as professional services, equipment, repair services, etc.).

Furthermore, we should recall that with getting jobs at the mine and having contracts awarded to EIJB businesses, we can speculate that the active Cree population's income will increase, which would lead to an increase in individuals' personal spending and ultimately stimulate the communities' economies. Business opportunities associated with mine operation will have a positive impact on maintaining and developing Cree businesses and on EIJB communities' economies.

The mine operation is expected to create **direct employment. Over the first five years, the number of workers is expected to be between 95 and 270. In addition, indirect jobs**, for a period of about 18 years, could be partially filled by members of the Cree communities. For those who do get a job at the mine, it would be safe to speculate that their quality of life, and that of their families, will improve. The participation of local workers in the project will have a positive impact on the labour market not only of the EIJB communities, **but also of sub-groups of these communities, especially women and young workers, through the implementation of measures to encourage their hiring.**

Participation in mine operation will empower many EIJB community members to improve their job skills, employability and qualifications. Experience acquired during the construction phase will be helpful to those who, when operations end, wish to find a new job on the job market.

Job prospects, not only at this mine but in other mining extraction projects in the region, could entice some of the youth to sign up for training or pursue their education toward a career or trade. Cree who have worked at the mine, and have acquired new professional and social skills, will be able to act as new positive role models and encourage youth to pursue their education. One of the positive effects that the project will have on the labour force is associated with the employability of community workers, as well as the development and enhancement of local and regional expertise.

As in the construction phase, Galaxy intends to propose, in partnership with the DCHR and the Cree School Board, the development of specialized training and development programs to fill mine positions. These programs may be offered in Cree communities and conducted by Galaxy depending on the progress of the project and the certainty of its completion. All stakeholders involved are discussing the best approaches to recommend and are working to find appropriate solutions to the challenges of scheduling, location and language barriers. The updated feasibility study currently underway will specify the types of jobs and training required.

In addition, discussions are underway with the Cree Nation of Eastmain specifically concerning the recruitment and training of Cree workers. If objectives are identified and defined for the hiring and training processes, they will be included in the Impact and Benefit Agreement (IBA). Galaxy is committed to working with the Cree Nation of Eastmain to secure as many Cree recruits as possible.

To this end, workshops could be organized to present employment and training opportunities and to encourage people to create and submit CVs. These actions will be the subject of a communication plan that will be drafted together with the Cree Nation of Eastmain. As part of this communication plan, a list of foreseeable jobs will be circulated after the feasibility study is updated and the IBA is signed. The plan will also be sent to the JBNQA Administrator.

Galaxy also plans to implement specific activities to promote employment and training in the mining industry among young people, including presentations in high schools and CEGEPs to showcase job opportunities. This will allow young people in the region to benefit from the job and contract opportunities offered by Galaxy at both the mine and the Matagami transshipment centre, and thus remain in the region. Discussions will be held with representatives of the educational institutions and all stakeholders involved to ensure that the targeted objectives, which may change over time, are met.

However, socio-economic stakeholders consulted in the context of mining projects emphasize the issue of school dropout associated with jobs requiring few or no qualifications. Galaxy will be sure to stress the importance of obtaining professional qualifications to take advantage of the jobs offered. Galaxy will also be sure to inform young people of all the opportunities that come with graduation and employment in the mining sector, including for girls. Promoting opportunities for students to work in the mining sector, as well as with local and regional suppliers, will encourage them to continue their education in order to take advantage of employment opportunities, and will also encourage them to stay in the region.

By helping to increase their employment rate and income, the project can benefit young workers. According to the INSPQ (2014), job creation among young people is a major challenge for development projects among the Cree population in order to ensure the sustainability of their communities. Investments in education also help boost self-esteem and slow down migration to urban areas.

Since the labour pool in the Eastmain community is limited, the project could place a strain on human resources, which would be an obstacle for other employers in this community in terms of recruiting and/or retaining personnel. It is also possible that businesses and services would need to adjust their salaries and social benefits in an effort to prevent their staff members from leaving. In fact, the appeal of good job conditions could lead to Cree businesses losing their employees to the mine. People will see the opportunity to increase their income and thus improve their quality of life.

The “fly in, fly out” system, common in the mining sector, allows workers to fly to work, rather than having their families move close to their place of work. The geographically isolated location of the Galaxy mine site also makes this system attractive to workers. To recruit the candidates it needs, the company will offer the system that best meets its labour needs.

When equally qualified people apply, Galaxy intends to prioritize the Cree workforce first, and then the regional workforce, for the positions it needs to fill. The same applies to contractors and suppliers of services or goods. Measures to prioritize employment and businesses at the local and regional level (Cree and non-indigenous communities) are planned and will also contribute to the project's positive impact on the economy of the City of Matagami.

An increased workforce may also be needed to develop the transshipment station and to receive concentrate on a daily basis in connection with this increased activity. The local economy of Matagami could also be stimulated due to the necessities of maintaining trucks and the needs of the drivers (food, lodging). Services and shops will see an increase in their business. Thus, the transportation and transshipment of concentrate in Matagami should be a beneficial contribution to the local and regional economy. The Galaxy project will allow for the development of transshipment infrastructure in Matagami, which will have significant repercussions for the city. Also, among the improvement measures suggested by the City of Matagami, Galaxy will participate in an economic benefits maximization committee (COMAX), so that the region can take maximum advantage of the project's repercussions.

In response to concerns about the boom and bust phenomenon and its effects, Galaxy will work with the community to ensure that the community benefits from positive economic and social impacts. Toward the end of the operation phase, an assistance program will be provided to help support employees during the transition to closure (worker reclassification assistance). Furthermore, as highlighted, Galaxy will regularly update forecasts regarding the length of operation and announce the end of mine operation ahead of time, in order decrease expectations and prepare workers.

IMPACT ASSESSMENT

Just as with the construction phase, the project impact associated with the local and regional economy during the rehabilitation phase remains **positive**.

REHABILITATION PHASE

SOURCE OF IMPACT

— Economic development and presence of workers.

MITIGATION MEASURES

Mitigation measures ERL01, and ELR03 to ERL06 must be applied. They are set out in Table 7-5.

DESCRIPTION OF IMPACT

During the rehabilitation phase, mining activities will decrease considerably compared to the operation phase. However, some businesses may still be awarded contracts associated with the rehabilitation activities, most notably work to dismantle the infrastructure and restore/redevelop the land.

Within the context of its rehabilitation activities, Galaxy will continue to favour awarding contracts from requests for proposals to businesses within the region – primarily Cree – when skills and price are competitive. Mine rehabilitation will also have an impact on jobs because it will require workers to be hired. Galaxy will prioritize hiring workers from the region for site requalification.

IMPACT ASSESSMENT

As with the construction and operation phases, the project impact associated with the local and regional economy during the rehabilitation phase remains **positive**.

POST-REHABILITATION PHASE

During the post-rehabilitation phase, activities at the mine will have ceased. Thus, apart from monitoring the site, no other activities are likely to have any impact on the economy.

7.4.6 HERITAGE AND ARCHAEOLOGY

DURING THE CONSTRUCTION PHASE

SOURCE OF IMPACT

- Land preparation and infrastructure construction.
-

MITIGATION MEASURES

Mitigation measure ARC01, **ARC 02** and standards NOR17 to NOR19 must be applied. They are indicated in Table 7-5.

DESCRIPTION OF THE IMPACT

During the construction phase, the operations likely to impact historical, cultural and archaeological heritage are connected to land preparation and infrastructure construction. It should be recalled that there are no protected areas in the study area and because of this, natural heritage is not considered in the current component.

Several construction activities, like topsoil removal and land preparation, are likely to expose archaeological or historic ruins. An archaeological potential study was conducted to determine the areas of interest related to the remains associated with the ancient human presence. To date, one prehistoric archaeological site associated with Amerindian occupation is currently known due to an incidental discovery at the km 381 truck stop (FbGg-1) located **outside the project site**, on the edge of the hill selected for mining development. In addition, 27 areas of archaeological potential have been identified in the archaeology study area. The likelihood of finding ruins of archaeological or historical interest therefore exists. **Archaeological survey work is planned for the end of July 2021. The archaeological potential in the areas that may be impacted will thus be clarified. Furthermore, Galaxy will communicate any artifact discovery to the RE2 tallyman, the Council of the Cree Nation of Eastmain and the Cree Nation Government Department of Culture and Language.**

Galaxy will make workers aware of their obligations regarding incidental archaeological discoveries and will apply the standards and regulations in effect.

IMPACT ASSESSMENT

Due to its legal protection under the Cultural Heritage Act, and because of the importance it holds for First Nations, this component is important for the community. The degree of intensity of this impact is considered low because the mitigation measures that will be implemented, **including results of archaeological surveys**, will allow the site to be documented before construction. The extent of the impact will be minimal since it would be experienced only on a few sites with remains. The duration of the impact will be long. The importance of the impact on heritage and archaeology during the construction phase is **minor**.

OPERATION PHASE

SOURCES OF IMPACT

- Presence and pit mining.
-

MANAGEMENT OF PROCESS PLANT FEED MATERIAL, OVERBURDEN AND WASTE ROCK MITIGATION MEASURES

Mitigation measure ARC01 and **ARC 02** and standards NOR17 to NOR19 must be applied. They are indicated in Table 7-5.

DESCRIPTION OF THE IMPACT

During the operation phase, the activities likely to impact historical, cultural and archaeological heritage are related to presence and pit mining, as well as the management of the economic material, the unconsolidated deposits and waste rock. Just like during the construction phase, Galaxy will make workers aware of their obligations regarding incidental archaeological discoveries and will apply the standards **and regulations in effect**.

IMPACT ASSESSMENT

Just like during the construction phase, the degree of severity of this impact is considered low because of the mitigation measures that will be implemented, which among other things will allow the site to be documented before construction. The extent of the impact will be minimal since it wouldn't be experienced at many sites with remains and the duration will be long. The importance of the impact on heritage and archaeology during the construction phase is **minor**.

REHABILITATION PHASE

Since rehabilitation work will not open new areas, there is no impact on heritage and archaeology.

POST-REHABILITATION PHASE

After the site rehabilitation, impacts will be non-existent since there will not be mining operations likely to modify the heritage and archaeology.

7.4.7 LANDSCAPE

DURING THE CONSTRUCTION PHASE

SOURCE OF IMPACT

- Land preparation and infrastructure construction.
- Transportation and traffic.

MITIGATION MEASURES

Measures SUR 01 to SUR 04, AIR 01, AIR 03 and AIR 05 must be applied. They are indicated in Table 7-5.

DESCRIPTION OF THE IMPACT

The anticipated impact on the landscape is mostly related to the transformation of the character of the landscape and changing the observer's visual range. The impact is caused by land preparation and infrastructure construction work. During the construction phase, operations will alter the natural character of a large swath of the project site's landscape. Transportation and dust generated by construction work will cover the project site during land preparation.

IMPACT ASSESSMENT

The application of mitigation measures to control the footprint of the work will minimize the potential impact on the landscape and the visual range during construction phases. The severity of impact is considered low. The extent is local since the impact on the visual range will be limited to the local study area. The duration of the impact is short because of the length of the construction period. Overall, the severity of the impact on the landscape during the construction phase is considered **minor**.

OPERATION PHASE

SOURCE OF IMPACT

- Presence and mining the pit.
 - Other infrastructure in operation.
 - Management of ore, unconsolidated deposits and waste rock.
 - Transportation and traffic.
-

MITIGATION MEASURES

Measures SUR 01 to SUR 04, AIR 01, AIR 03 and AIR 05 must be applied. They are indicated in Table 7-5.

DESCRIPTION OF THE IMPACT

In the operation phase, the addition of the pit and rock stockpiles will transform the nature of the landscape significantly and on a large scale. Transportation and the dust created will be concentrated between the pit, rock stockpiles and buildings. The highest planned building will rise **to 27 m above** the site. Its roof height will reach the same level as the tops of the tallest hills on the plains.

Operation of the pit and waste rock stockpiles **will** continue throughout the phase. **Extraction operations in the pit will** result in the removal of a large part of an elevated rocky outcrop. After the first few years, operations will be on the pit floor, several metres below ground level. The rock wall, south of the pit and facing north, will look out over the area like the elevated rocky outcrop that the pit will have replaced. **The waste rock and tailings storage facilities (WRTSFs) will have respective heights of 53 m for the west stockpile (elevation 260 m), 83 m for the northeast stockpile (elevation 290 m), 62 m for the southwest stockpile (elevation 270 m) and 68 m for the east stockpile (elevation 280 m).** The flat tops of **the four stockpiles will dominate** the hills of the landscape. The **organic** and unconsolidated waste rock stockpile will be paired with the **north flank of the northwest waste rock and tailings stockpile and will rise to approximately 16 m (elevation 220 m).** The ore stockpile will be approximately **8 m high (elevation 215 m).**

The upper parts of the buildings, the southern rock wall and the stockpiles will characterize the landscape and will become visual landmarks. From several observation points, the tree line or topography may obscure all or part of the project components. However, note that depending on the dynamics of forest fires, existing vegetation can change and the visual integration of the installations can be altered accordingly.

The character of the landscape is essentially based on natural components. The installations and industrial aspect of the project contrasts with the landscape's natural appearance. However, the planned buildings will resemble the infrastructure of the nearby km 381 truck stop. The **WRTSFs will dominate** the landscape and their flat tops will create a new focal point in the landscape.

Observer groups in the study area are temporary fixed and mobile ones. There are no permanent residents in the study area. Note that the visual range of observers located in the valley area will not be altered due to the topography restricting the view of the project site.

Buildings will be located at a minimum distance of **6 km** from permanent Cree camps and **about 2 km** from the km 381 truck stop. Standing in a clear foreground, the visual range of temporary fixed observers staying in the area will be altered at the intermediate plane (from 0.5 km to 3 km distance) and in the background (from more than 3 km away) by the projected buildings. **Most of them** will also be located **within a wildlife area** and at a distance of **a little more** than 2 km north of a valued area. Standing in a clear foreground, the visual field of temporary fixed observers visiting wildlife and protected areas will be altered **in the foreground (from 0 km to 0.5 km distance)**, in the middle ground and in the background by the projected buildings.

The south wall of the projected pit will be located at a minimum distance of 6 km from permanent Cree camps and will not be visible from the km 381 truck stop. Standing in a clear foreground, the visual range of temporary fixed observers staying in the area will be changed in the background by the south wall of the projected pit.

The **closest** waste rock stockpiles will be located at a minimum distance of 5 km from permanent Cree camps (**northwest stockpile**) and **approximately 700 m** from the km 381 truck stop (**east stockpile**). Standing in a clear foreground, and because of the relative height of the waste rock stockpile, the visual range of the temporary fixed observers staying in the area will be significantly altered in the middle range and in the background by the rock stockpiles. Also, **the east stockpile will be located within a wildlife area** and at a distance of **approximately 900 m** from a valued area. **The northeast stockpile will be adjacent to the same wildlife area.** Standing in a clear foreground, and taking into account the relative breadth of the stockpiles, the visual field of temporary fixed observers visiting the area will be significantly altered **in the foreground**, middle ground and background by the stockpiles.

Users taking the Billy-Diamond highway make up a large group of observers. In general, buildings will be located **about 400 m away (approximately 150 m for the closest building)**, the south wall of the pit **about 300 m (at its maximum use)** and the closest WRTSF (east) **approximately 40 m**. Standing on the west side of the road, the visual field is deep at the road axis and its opening is limited. This visual range configuration is more typical from the project site and to the north. **However**, the visual field of mobile observers will be modified by the project components and operations **located near the Billy-Diamond highway**. Note that only the visual field of mobile observers travelling south toward the project site **will also be** affected by **these components**. However, standing in a clear foreground, the visual field will be changed in the middle ground and in the background by **the project components and operations that will exceed** the treetops or ground elevation.

In some places, the road's twists and turns, as well as high elevation from the project site, provide for significant views of project components more than 3 km away. The visual range of mobile observers will be altered by the project components in the background. Furthermore, the visual range of snowmobile trail and waterway users is typically significant at the main roadway and its opening is limited or obstructed by the terrain or tree growth. The visual range of these mobile observers will be little changed by the project components. The visual range of boaters on large water bodies prized for fishing, located more than 8 km from the project site and slightly concealed, have their view limited by the topography. The visual range of these mobile observers will be changed little or not at all in the background by taller sections of project components.

Note that the seamless integration of the project into its surroundings has been considered since the planning and design stage. **Although some** infrastructure will be built **near** the Billy-Diamond highway, a natural buffer zone will be maintained between **this road** and the infrastructure. This area includes vegetation and an elevated rock outcrop that will preserve the visual setting of the road at the project site.

The WRTSFs and the highest buildings, the tops of which will rise above the hills of the plains by a few dozen meters, will be the project component that can especially modify area the visual field of study area observers from observation points that have open, framed or partially obscured views of the site. However, note that rock stockpiles will only be able to change the visual range of observers from the moment they become visible beyond ground elevation or existing vegetation, which is destined to change quickly due to forest fires.

Visual simulations were performed based on the 2018 infrastructure configuration but were not updated with the new layout. According to these visual simulations, it is still possible to anticipate the effects of components of the project on the visual field of observers at the end of operations **before the site is returned to its natural state or the implementation of mitigation measures planned for the rehabilitation phase.** Photos make it possible to evaluate the most significant effects of the project on the landscape and on observers' visual field by comparing the current and future states of the site.

IMPACT ASSESSMENT

Considering the harmonious integration of the project starting from the planning and design stage, deploying mitigation measures to limit the construction work's footprint and revegetating the slopes of the **WRTSFs** will, as they are implemented over time, minimize the potential impact on the landscape during the operation phase. The presence of the WRTSFs and the pit will profoundly transform the character of the natural landscape. The severity of the impact is considered medium. **When the infrastructure is visible in the foreground of the visual field of Billy-Diamond highway users, the intensity of the impact would be considered high at certain points.** The extent is local since the visual field impact **will extend to the foreground, to the medium range visual field and to the background.** The duration of the impact is long term because of the permanency of the **WRTSFs** in the landscape. Overall, the significance of the impact on the landscape in the operation phase is considered **moderate and occasionally major.**

REHABILITATION PHASE

SOURCES OF IMPACT

- Infrastructures dismantlement.

REHABILITATION PHASE

SOURCES OF IMPACT

- Infrastructures dismantlement.
- Pit rehabilitation.
- Transportation and traffic.

MITIGATION MEASURES

Measures SUR 02, AIR 01, AIR 03 and PAY 01 must be applied, as well as standard NOR 01. They are indicated in Table 7-5.

DESCRIPTION OF IMPACT

During this phase, infrastructure dismantling, reshaping the top of the **WRTSFs** and site revegetation will progressively reduce the site's industrial nature and help restore the landscape to its original natural state. These operations will improve the visual appeal of the site and its components at a scale equal to the natural landscape and mitigate the effects on an observer's visual range. The transportation required to conduct the work will be temporary.

The conceptual restoration plan has been updated to reflect the optimization of the mine development plan. This update will be presented to the Councils of the Cree Nations of Eastmain and Waskaganish, and to the affected tallymen of the Eastmain community for their comments, suggestions and concerns. A detailed restoration plan will then be prepared in due course to take into account the comments of relevant government analysts and representatives of the surrounding communities. It should be noted that MERN consults with indigenous communities prior to granting mining leases. These consultations address the restoration plan in particular. Galaxy therefore plans to consult the affected Cree First Nations about its remediation plan to ensure that their comments and suggestions are incorporated and to prevent delays in issuing the mining lease.

IMPACT ASSESSMENT

The application of mitigation measures to monitor the work will minimize the potential impact on the landscape and the visual range during the rehabilitation phases. The severity of impact is considered low. The extent is local since the impact on the visual range will be limited to the local study area. The duration of the impact is short because of the length of the rehabilitation period. Overall, the severity of impact on the landscape during the construction phase is considered **minor**.

POST-REHABILITATION PHASE

After the restoration of the site, the revegetated rock stockpiles and the pit will remain, to the trained eye, a testament to the industrial past of the site's landscape. The impact on the landscape and on the observer's visual range is generally a positive one. Consequently, an impact assessment is not required.

7.4.8 COMPARISON OF IMPACTS ON THE HUMAN ENVIRONMENT 2018 VS. 2021

This section is intended to summarize the changes to the current description and assessment of impacts compared to those described in the 2018 EIA. Table 7-20 shows the human environment components of the study area and, according to the phase of the project, indicates the changes made to the description and assessment of impacts based on the 2018 and 2021 projects, where applicable.

Table 7-20 Comparison of the description and assessment of the project's impact on each of the human components of the local study area

Component	Phase	Change to the description of the impact	Impact significance according to the 2018 project	Impact significance according to the 2021 project
Current use of land and resources for traditional purposes	Construction, operation and restoration	- Enhanced description of impacts on the component - Analysis of impacts on the component done in two specific areas: project study area and area along the Billy-Diamond highway - Addition of mitigation measures UTT 05, UTT 06, CIR 03, CIR 07 to CIR 16, NOR 11, VIE 01, VIE 05 and VIE 15	Moderate	Moderate
Current use of land and resources for traditional purposes	Post-restoration	Enhanced description of impacts on the component	Positive	Positive

Table 7-20 Comparison of the description and assessment of the project's impact on each of the human components of the local study area (cont.)

Component	Phase	Change to the description of the impact	Impact significance according to the 2018 project	Impact significance according to the 2021 project
Infrastructure	Construction and operation	- Enhanced description of impacts on the component - Addition of mitigation measures CIR 08 to CIR 10 - Withdrawal of mitigation measure VIB 01	Minor	Minor
Infrastructure	Rehabilitation	-	Minor	Minor
Perception of physical and natural environment	Construction	- Addition of the natural area to the component - Enhanced description of impacts on the component - Addition of mitigation measures CIR 01, CIR 02, CIR 05, CIR 06, VIE 15, VIE 22, SUR 03 and SUR 04 - Withdrawal of mitigation measure VIB 01	Minor	Minor, considering the short duration in the impact assessment Moderate according to the Cree users' assessment since they believe the duration of the impact will be long
	Operation	- Addition of the natural area to the component - Enhanced description of impacts on the component - Addition of mitigation measures CIR 01, CIR 02, CIR 05, CIR 06, VIE 15, VIE 22, SUR 03 and SUR 04 - Withdrawal of mitigation measure VIB 01	Minor	Moderate considering a local scope by Cree users
	Rehabilitation	- Addition of the natural area to the component - Addition of mitigation measures CIR 01, CIR 05, VIE 15, VIE 22, SUR 03 and SUR 04	Minor	Minor
Quality of Life	Construction	- Analysis of the impacts on the component for the Cree First Nations - Enhanced description of impacts on the component - Addition of mitigation measures UTT 02 to UTT 05, CIR 02, CIR 04, CIR 05, CIR 08 to CIR 16, VIE 07 to VIE 22, ELR 05, ELR 06, ELR 13 and PER 01	Minor	Minor

Table 7-20 Comparison of the description and assessment of the project's impact on each of the human components of the local study area (cont.)

Component	Phase	Change to the description of the impact	Impact significance according to the 2018 project	Impact significance according to the 2021 project
Quality of Life (cont.)	Operation	– Analysis of the impacts on the component for the Cree First Nations – Enhanced description of impacts on the component – Addition of mitigation measures UTT 02 to UTT 05, CIR 02, CIR 04, CIR 05, CIR 08 to CIR 16, VIE 07 to VIE 22, ELR 05, ELR 06, ELR 07, ELR 08, ELR 13 and PER 01	Moderate	Moderate
	Operation	– Analysis of the impacts on the component for the community of Matagami – Enhanced description of impacts on the component – Addition of mitigation measures AIR 02, NOR 11, SON 01, CIR 08 to CIR 15	Moderate	Minor
	Rehabilitation	– Addition of mitigation measures VIE 07 to VIE 10, VIE 12 to VIE 17, VIE 19 to VIE 22, ELR 05, ELR 07, ELR 08 and PER 01	Minor	Minor
Local and Regional Economy	Construction and operation	– Enhanced description of impacts on the component – Addition of mitigation measures ELR 09 to ELR 15, ELR 17, ELR 18 and VIE 07	Positive	Positive
	Rehabilitation	-	Positive	Positive
Heritage and Archaeology	Construction and operation	– Archaeological survey work planned for July 2021 – Addition of mitigation measure ARC 02	Minor	Minor
Landscape	Construction	-	Minor	Minor
	Operation	– Updated impact description and assessment	Moderate	Moderate to major
	Rehabilitation	– Updated impact description with details on the remediation plan	Minor	Minor

7.5 ASSESSMENT OF THE ANTICIPATED IMPACTS

An assessment of the project's anticipated residual impacts is summarized in Table 7-21 presented in the following pages.

Table 7-21 Assessment of residual impacts

Environmental component	Project phase	Potential source(s) of impact	Description of impact	Mitigation measures and/or applicable standards	Significance of residual impact			Significance of residual impact
					Intensity	Extent	Duration	
Physical environment								
Soil	Construction	• Site preparation and infrastructure construction. • Hazardous and waste materials management.	• Risk of soil erosion. • Risks of soil contamination due to the potential leak of petroleum products or accidental spills of hydrocarbons or other products.	SUR 01 to SUR 04, QUA 01 to QUA 04, QUA 08 to QUA 13, NOR 02 to NOR 04 and NOR 09	Low	Local	Short	Minor
	Operation	• Management of economic material, overburden and waste rock. • Hazardous and waste materials management.	• Risks of soil contamination due to the potential leak of petroleum products or accidental spills of hydrocarbons or other products.	SUR 01 and SUR 02, QUA 01 to QUA 05, QUA 10, QUA 12, NOR 02 to NOR 04, NOR 09 and NOR 10	Low	Local	Moderate	Minor
	Rehabilitation	• Infrastructure dismantling Hazardous and waste materials management.	• Risk of soil erosion. • Risks of soil contamination due to the potential leak of petroleum products or accidental spills of hydrocarbons or other products.	SUR 02, QUA 01 to QUA 04, QUA 07, QUA 08, QUA 12, NOR 01 to NOR 04, and NOR 10	Low	Local	Short	Minor
Hydrogeology	Construction	• Site preparation and infrastructure construction. • Water management.	• Alteration of runoff flow patterns, surface and groundwater on the periphery of infrastructure.	SUR 01, SUR 02, QUA 01 to QUA 04, QUA 10, and QUA 11 to QUA 13	Low	Isolated	Short	Minor
	Operation	• Presence and operation of the pit. • Other infrastructure in operation. • Management of ore, surface deposits and waste rock. • Water management.	• Water table drawdown due to pit dewatering. • Alteration of runoff flow patterns, surface and groundwater on the periphery of infrastructure.	QUA 06, QUA 14 and NOR 06	Moderate	Local	Long	Moderate
	Rehabilitation and post-rehabilitation	• Infrastructure dismantling Pit rehabilitation. • Water management.	• Natural flooding of pit. • Alteration of runoff flow patterns, surface and groundwater on the periphery of infrastructure.	QUA 06	Moderate	Local	Long	Moderate
Hydrological regime	Construction	• Site preparation and infrastructure construction. • Water management.	• Localized change in the natural flow of surface waters. • Possible increase in surface runoff due to a decreased infiltration caused by soil compaction.	SUR 01, SUR 03, SUR 04, QUA 07, QUA 09, QUA 11, NOR 01, NOR 05, NOR 07, NOR 14, and NOR 15	Low	Isolated	Short	Minor
	Operation	• Presence and operation of the pit. • Other infrastructure in operation. • Management of ore, surface deposits and waste rock. • Water management.	• Encroachment of drainage basins in the study area by project infrastructure decrease their surface area. • Changes in mean and low flows of watercourses in the study area due to pit dewatering. • Changes in the water levels of watercourses in the study area.	SUR 01, QUA 05, UTT 03, NOR 01, NOR 05, NOR 07, NOR 08, NOR 14, and NOR 14	Moderate	Local	Long	Moderate
	Rehabilitation and post-rehabilitation	• Infrastructure dismantling Pit rehabilitation. • Water management.	• Localized change in the natural flow of surface waters.	SUR 03, QUA 07, QUA 09, QUA 11, and NOR 01	Moderate	Local	Long	Moderate

Table 7-21 Assessment of residual impacts (cont.)

Environmental component	Project phase	Potential source(s) of impact	Description of impact	Mitigation measures and/or applicable standards	Significance of residual impact			Significance of residual impact
					Intensity	Extent	Duration	
Water and sediments	Construction	• Site preparation and infrastructure construction. • Water management. • Hazardous and waste materials management. • Transportation and traffic.	• Risk of change in the quality of water and sediments related to the spreading of ice melters in the winter. • Risks of contamination of water and sediments due to the potential leak of petroleum products or accidental spills of hydrocarbons or other products.	SUR 01, SUR 03, SUR 04 , QUA 01 to QUA 04, QUA 08 to QUA 13, NOR 02 to NOR 04, and NOR 07 to NOR 09	Low	Local	Short	Minor
	Operation	• Presence and operation of the pit. • Other infrastructure in operation. • Management of ore, surface deposits and waste rock. • Water management. • Hazardous and waste materials management. • Transportation and traffic.	• Risk of contamination of water and sediments by metal leaching and by the ingress of contaminated water under the waste rock stockpile. • Risks of contamination of water and sediments due to the potential leak of petroleum products or accidental spills of hydrocarbons or other products.	QUA 01 to QUA 06, QUA 12, QUA 13 and QUA 15 , NOR 02 to NOR 04, NOR 06, and NOR 09	Low	Local	Moderate	Minor
	Rehabilitation and post-rehabilitation	• Infrastructure dismantling Pit rehabilitation. • Water management. • Hazardous and waste materials management. • Transportation and traffic.	• Risk of changes in the quality of water and sediments related to the spreading of ice melters in the winter. • Risk of contamination of groundwater by metal leaching and by the ingress of contaminated water under the waste rock stockpile. • Risks of groundwater contamination due to the potential leak of petroleum products or accidental spills of hydrocarbons or other products.	SUR 01, SUR, 03, SUR 04 , QUA 01 to QUA 04, QUA 07, QUA 08, QUA 10 to QUA 12, SUR 03, NOR 01 to NOR 04, NOR 09, and NOR 10	Low	Local	Short	Minor
Atmosphere	Construction	• Site preparation and infrastructure construction. • Hazardous and waste materials management. • Transportation and traffic.	• Deterioration of the quality of the atmosphere by gaseous compounds and total particulate matter limited to the site and its immediate environment.	AIR 01 to AIR 05, and NOR 11	Low	Local	Short	Minor
	Operation	• Presence and operation of the pit. • Other infrastructure in operation. • Management of ore, surface deposits and waste rock. • Hazardous and waste materials management. • Transportation and traffic.	• Increase in concentrations of particulate matter and metals in the air. • Increase in greenhouse gas emissions.	AIR 01 to AIR 05, and NOR 11	Low	Local	Moderate	Minor
	Rehabilitation	• Infrastructure dismantling Pit rehabilitation. • Hazardous and waste materials management. • Transportation and traffic.	• Deterioration of the quality of the atmosphere by gaseous compounds and total particulate matter limited to the site and its immediate environment.	AIR 01 and AIR 02, and NOR 11	Low	Local	Short	Minor
Artificial light at night	Construction	• Site preparation and infrastructure construction. • Transportation and traffic.	• Temporary emission of artificial light into the sky and work site limits, which is likely to disturb nocturnal landscapes and have an impact on the biological and social environments on the periphery.	LUM 01 to LUM 03	Low	Isolated	Short	Minor
	Operation	• Presence and operation of the pit. • Other infrastructure in operation. • Management of ore, surface deposits and waste rock. • Transportation and traffic.	• Changes in light at night by adding artificial light could cause local changes in the brightness of the sky and generate light trespass.	LUM 01 to LUM 03	Low	Local	Moderate	Minor
	Rehabilitation	• Infrastructure dismantling Transportation and traffic.	• Temporary emission of artificial light into the sky and work site limits, which is likely to disturb nocturnal landscapes and have an impact on the biological and social environments on the periphery.	LUM 01 to LUM 03	Low	Local	Short	Minor

Table 7-21 Assessment of residual impacts (cont.)

Environmental component	Project phase	Potential source(s) of impact	Description of impact	Mitigation measures and/or applicable standards	Significance of residual impact			Significance of residual impact
					Intensity	Extent	Duration	
Physical environment (cont.)								
Ambient noise	Construction	- Site preparation and infrastructure construction. - Transportation and traffic.	Increased ambient noise levels at the work site.	SON 01, SON 02 and NOR 12	Low	Local	Short	Minor
	Operation	- Presence and operation of the pit. - Other infrastructure in operation. - Management of ore, surface deposits and waste rock. - Transportation and traffic.	Increased ambient noise levels due to mining activities.	SON 01 to SON 03 , and NOR 12	Low	Local	Short	Minor
	Rehabilitation	- Infrastructure dismantling Pit rehabilitation. - Transportation and traffic.	Increased ambient noise levels.	SON 01, SON 02 and NOR 12	Low	Local	Short	Minor
Vibrations and overpressure	Construction	Site preparation and infrastructure construction.	Vibrations and overpressure generated during blasting when the construction quarry is in operation.	VIB 01 to VIB 04 and NOR 13	Low	Local	Short	Minor
	Operation	Presence and operation of the pit.	Vibrations and overpressure generated during blasting when the pit is in operation.	VIB 01 to VIB 04 and NOR 13	Low	Local	Short	Minor
	Rehabilitation	No impact.						
Biological environment								
Vegetation and wetlands	Construction and operation	- Site preparation and infrastructure construction. - Presence and operation of the pit. - Management of economic material, overburden and waste rock. - Hazardous and waste materials management. - Transportation and traffic.	- Direct alteration and loss of natural environments (land and wetland environments) as a result of the work. - Indirect impacts on plant communities preserved through development of the site and planned infrastructure.	VEG 01 to VEG 07, SUR 01 to SUR 04, QUA 01 to QUA 05, QUA 10 to QUA 12, NOR 02 to NOR 04, NOR 10 and NOR 15	Moderate	Local	Moderate	Moderate
	Rehabilitation	- Transportation and traffic. - Infrastructure dismantling	Potential introduction of invasive alien plant species.	VEG 02, VEG 03 and VEG 06, QUA 01 to QUA 04, QUA 10 to QUA 12 NOR 02 to NOR 04 and NOR 10	Overall positive impact			
Large fauna	Construction and operation	- Site preparation and infrastructure construction. - Presence and operation of the pit. - Other infrastructure in operation. - Management of ore, surface deposits and waste rock. - Hazardous and waste materials management. - Transportation and traffic. - Economic development and presence of workers.	- Incidental mortality of large fauna individuals that may occasionally occur due to collisions with vehicles during preparation, construction and operation work. - Alteration of the natural behaviour of large fauna and its movements.	SUR 01 to SUR 04, FAU 03, FAU 05, FAU 08 . SON 01, CIR 01 to CIR 03 and LUM 01 to LUM 03	Low	Local	Moderate	Minor
	Rehabilitation	- Infrastructure dismantling Transportation and traffic. - Economic development and presence of workers.	Alteration of the natural behaviour of large fauna and its movements.	FAU 03 and FAU 05, SON 01, CIR 01 to CIR 03 and LUM 01 to LUM 03	Low	Local	Short	Minor

Table 7-21 Assessment of residual impacts (cont.)

Environmental component	Project phase	Potential source(s) of impact	Description of impact	Mitigation measures and/or applicable standards	Significance of residual impact			Significance of residual impact
					Intensity	Extent	Duration	
Biological environment (cont.)								
Small fauna and herpetofauna	Construction and operation	• Site preparation and infrastructure construction. • Presence and operation of the pit. • Other infrastructure in operation. • Management of ore, surface deposits and waste rock. • Water management. • Hazardous and waste materials management. • Transportation and traffic.	• Loss of approximately 450 ha of land and wetland habitat specific to small fauna and herpetofauna. • Mortality of small fauna and herpetofauna individuals and small mammal species. • Risks of natural environment contamination, mainly because of the potential leak of petroleum products or accidental spills from equipment. • Disturbance of small fauna and herpetofauna individuals, mainly due to noise, nighttime lighting, dust, vibrations and human presence. • Risks of collision related to site traffic.	SUR 01 to SUR 04, QUA 01 to QUA 05, QUA 07 to QUA 13, AIR 01, AIR 02, LUM 01 to LUM 03, SON 01, VEG 01, VEG 02, FAU 02 and FAU 05, NOR 02 to NOR 05, NOR 08, NOR 09 and NOR 14	Low	Local	Moderate	Minor
	Rehabilitation	• Infrastructure dismantling Water management. • Hazardous and waste materials management. • Transportation and traffic.	• Disturbance of small fauna and herpetofauna individuals, mainly due to noise, nighttime lighting, dust, vibrations and human presence. • Risks of collision related to site traffic.	SUR 02, SUR 03, QUA 01 to QUA 04, QUA 07 to QUA 13, AIR 01, AIR 02, LUM 01 to LUM 03, SON 01, VEG 02, FAU 01 and FAU 05, NOR 01 to NOR 05, NOR 08, NOR 09 and NOR 14	Low	Local	Short	Minor
Ichthyofauna	Construction	• Site preparation and infrastructure construction. • Water management. • Hazardous and waste materials management. • Transportation and traffic.	• Risk of changes to the natural flow of water that may alter fish habitat to a certain degree. • Risk of accidental spills of petroleum hydrocarbons associated with machinery use.	FAU 01 , SUR 01, SUR 03, SUR 04, QUA 01 to QUA 04, QUA 07 to QUA 13, NOR 02 to NOR 05, NOR 09 and NOR 13 to NOR 16	Low	Isolated	Short	Minor
	Operation	• Presence and operation of the pit. • Water management. • Hazardous and waste materials management.	• Loss of fish habitat. • Risk of accidental spills of petroleum hydrocarbons associated with machinery use.	FAU 01 , SUR 01, SUR 03, SUR 04, QUA 01 to QUA 04, QUA 06 to QUA 13, NOR 02 to NOR 09 and NOR 13 to NOR 16	Low	Isolated	Long	Minor
	Rehabilitation and post-rehabilitation	• Infrastructure dismantling Water management. • Transportation and traffic.	• Limited change to the natural flow of surface waters and increase in suspended solids in water. • Risk of accidental spills of petroleum hydrocarbons associated with machinery use.	SUR 02 to SUR 04, QUA 01 to QUA 04, QUA 07 to QUA 13 and NOR 01 to NOR 09	Low	Isolated	Long	Minor
Avifauna	Construction and operation	• Site preparation and infrastructure construction. • Presence and operation of the pit. • Other infrastructure in operation. • Management of ore, surface deposits and waste rock. • Water management. • Transportation and traffic.	• Loss of approximately 450 ha of land and wetland habitat specific to avifauna. • Risk of incidental bird mortality due to incidental take. • Risks of collision related to site traffic. • Mortality of avifauna individuals. • Alteration of the natural behaviour of birds and their movements. • Disturbance of avifauna individuals, mainly due to noise, nighttime lighting, dust, vibrations and human presence. • Risks of natural environment contamination, mainly because of the potential leak of petroleum products or accidental spills from equipment.	SUR 01 to SUR 04, FAU 02, FAU 06 , FAU 07 , SON 01, LUM 01 to LUM 03, QUA 05, QUA 09, QUA 08, NOR 07 to NOR 09, NOR 13, NOR 14 and VEG 01	Low	Local	Moderate	Minor
	Rehabilitation	• Infrastructure dismantling Transportation and traffic.	• Alteration of the natural behaviour of birds and their movements.	SUR 01, SUR 02, SUR 03, NOR 01, FAU 02, SON 01, LUM 01 to LUM 03, QUA 07, QUA 08, NOR 14 and VEG 01	Low	Local	Short	Minor

Table 7-21 Assessment of residual impacts (cont.)

Environmental component	Project phase	Potential source(s) of impact	Description of impact	Mitigation measures and/or applicable standards	Significance of residual impact			Significance of residual impact
					Intensity	Extent	Duration	
Biological environment (cont.)								
Bats	Construction and operation	• Site preparation and infrastructure construction. • Presence and operation of the pit. • Other infrastructure in operation. • Management of ore, surface deposits and waste rock. • Transportation and traffic.	• Direct and indirect habitat loss. • Potential mortality of tree bat species if present during deforestation activities. • Disturbance of wetlands (peatlands) potentially resulting in greater movements to alternative feeding sites. • Changes to the habitat structure potentially changing bats’ use of the area. • Disturbance of local bat populations, mainly due to noise, nighttime lighting, dust, vibrations and human presence. • Risks of natural environment contamination, mainly because of the potential leak of petroleum products or accidental spills from equipment.	SUR 01, SUR 02, AIR 02, SON 01, VEG 02, FAU 02 and FAU 04, NOR 07 to NOR 09 and NOR 13	Low	Local	Moderate	Minor
	Rehabilitation	• Infrastructure dismantling Transportation and traffic.	• Disturbance of local bat populations, mainly due to noise, nighttime lighting, dust, vibrations and human presence. • Risk of bat mortality that may occur during the dismantling of buildings, wells or exploration drifts used as roosts by bats (day and/or maternity and/or winter roost).	SUR 02, AIR 02, SON 01, VEG 02 and FAU 04	Low	Local	Short	Minor
Social environment								
Current use of land and resources for traditional purposes	Construction	• Site preparation and infrastructure construction. • Transportation and traffic. • Economic development and presence of workers.	• Temporary disruption of the traditional activities of Cree users on territory in the study area. • Loss of use of portions of the territory where mining infrastructure will be located for the practice of certain traditional activities (e.g., berry picking and beaver trapping).	UTT 01 to UTT 06, CIR 01, CIR 02,CIR 04, CIR 07, CIR 16, VIE 05, AIR 01 to AIR 05, SON 01, LUM 01 to LUM 03 and VIB 01 to VIB 04	Moderate	Local	Short	Moderate
	Operation	• Presence and operation of the pit. • Other infrastructure in operation. • Management of ore, surface deposits and waste rock. • Water management. • Transportation and traffic. • Economic development and presence of workers.	• Disruption of the traditional activities of Cree users on territory in the study area. • Loss of use of portions of the territory where mining infrastructure will be located for the practice of certain traditional activities (e.g., berry picking and beaver trapping).	UTT 01 to UTT 06, CIR 01, CIR 02, CIR 04, CIR 07, CIR 16, VIE 05, AIR 01 to AIR 05, SON 01, LUM 01 to LUM 03 and VIB 01 to VIB 04	Moderate	Local	Moderate	Moderate
	Rehabilitation	• Infrastructure dismantling Water management. • Transportation and traffic. • Economic development and presence of workers.	• Disruption of the traditional activities of Cree users on territory in the study area.	UTT01 to UTT04, CIR01, CIR02 and CIR04, AIR 01 to AIR 05, SON 01, LUM 01 to LUM 03 and VIB 01 to VIB 04	Low	Local	Short	Minor
Current use of land and resources for traditional purposes along the Billy-Diamond highway	Construction	• Transportation and traffic.	• Temporary disruption of the traditional activities of Cree users along the Billy-Diamond highway. • Disturbances of Cree users by noise and dust and increased risk of accidents.	UTT 01, UTT 02, CIR 01, CIR 03, CIR 08 to 15, SON 01, VIE 01, VIE 05, VIE 15, NOR 11	Low	Regional	Short	Minor
	Operation	• Transportation and traffic.	• Temporary disruption of the traditional activities of Cree users along the Billy-Diamond highway. • Disturbances of Cree users by noise and dust and increased risk of accidents.	UTT 01, UTT 02, CIR 01, CIR 03, CIR 08 to 15, SON 01, VIE 01, VIE 05, VIE 15, NOR 11	Low	Regional	Long	Moderate

Table 7-21 Assessment of residual impacts (cont.)

Environmental component	Project phase	Potential source(s) of impact	Description of impact	Mitigation measures and/or applicable standards	Significance of residual impact			Significance of residual impact
					Intensity	Extent	Duration	
Social environment (cont.)								
Infrastructure	Construction	• Transportation and traffic. • Economic development and presence of workers.	• Increased traffic on Billy-Diamond highway.	CIR 01 to CIR 03, AIR 03 and NOR 13	Low	Regional	Short	Minor
	Operation	• Transportation and traffic. • Economic development and presence of workers.	• Increased traffic on Billy-Diamond highway.	AIR 03, VIB 02 to VIB 04, CIR 01 to CIR 04, CIR 08 à CIR 10 and NOR 13	Low	Regional	Short	Minor
	Rehabilitation	• Transportation and traffic. • Economic development and presence of workers.	• Increased traffic on Billy-Diamond highway.	CIR 01 to CIR 04	Low	Regional	Short	Minor
Perception of physical environment	Construction	• Site preparation and infrastructure construction. • Water management. • Transportation and traffic.	• Risk of disturbances related to changes in air quality, artificial light at night and noise, and groundwater and surface water quality that may affect Cree users of the territory who practise activities in the mine sector or workers at the km 381 truck stop and its patrons.	PER 01, UTT 02, CIR 01, CIR 02 , CIR 04, CIR 05 , VIE 01, VIE 15, VIE 22 , AIR 01 to AIR 05, SON 01, QUA 01 to QUA 05, QUA 07 to QUA 13, LUM 01 to LUM 03, VIB 01, NOR 2 to NOR 5, NOR 9, NOR 11, NOR 13 and NOR 14	Low	Local	Short	Minor
					Low	Local	Long1	Moderate
	Operation	• Presence and operation of the pit. • Other infrastructure in operation. • Management of ore, surface deposits and waste rock. • Water management. • Transportation and traffic.	• Risk of disturbances related to changes in air quality, artificial light at night and noise, and groundwater and surface water quality that may affect Cree users of the territory who practise activities in the mine sector or workers at the km 381 truck stop and its patrons.	PER 01, UTT 02, CIR 01, CIR 02 , CIR 04 to CIR 06 , VIE 01, AIR 01 to AIR 05, SON 01, QUA 01 to QUA 05, QUA 07 to QUA 13, LUM 01 to LUM 03, VIB 01 to VIB 04, NOR 2 to NOR 9 and NOR 11 to NOR 14	Moderate	Isolated	Short	Minor
Rehabilitation	• Infrastructure dismantling Water management. • Transportation and traffic. • Economic development and presence of workers.	• Risk of disturbances related to changes in air quality, artificial light at night and noise, and groundwater and surface water quality that may affect Cree users of the territory who practise activities in the mine sector or workers at the km 381 truck stop and its patrons.	PER 01, UTT 02, CIR 01 , CIR 04, CIR 05 , VIE 01, VIE 15, VIE 22, SUR 03 and SUR 04 , AIR 01 to AIR 03, SON 01, QUA 01 to QUA 05, QUA 07 to QUA 13, LUM 01 to LUM 03, NOR 1 to NOR 9, NOR 11, NOR 12 and NOR 14	Low	Local	Short	Minor	
Quality of life – Cree First Nations	Construction	• Site preparation and infrastructure construction. • Transportation and traffic. • Economic development and presence of workers.	• Feeling of loss and damage to the Cree cultural identity. • Decreased sense of safety among Billy-Diamond highway users. • Cree workers’ difficulty integrating into the working environment.	UTT 01 to UTT 05 , CIR 01, CIR 02, CIR 04, CIR 05, CIR 08 to CIR 16 , VIE 01 to VIE 22, ELR 05, ELR 06, ELR 13 and PER 01	Low	Regional	Short	Minor
	Operation	• Presence and operation of the pit. • Other infrastructure in operation. • Management of ore, surface deposits and waste rock. • Transportation and traffic. • Economic development and presence of workers.	• Feeling of loss and damage to the Cree cultural identity. • Decreased sense of safety among Billy-Diamond highway users. • Cree workers’ difficulty integrating into the working environment.	UTT 01 to UTT 06 , CIR 01, CIR 02, CIR 04, CIR 05, CIR 08 to CIR 16 , VIE 01 to VIE 22, ELR 05 to ELR 08, ELR 13 and PER 01	Moderate	Regional	Moderate	Moderate
	Rehabilitation	• Infrastructure dismantling pit rehabilitation. • Transportation and traffic. • Economic development and presence of workers.	• Feeling of loss and damage to the Cree cultural identity. • Decreased sense of safety among Billy-Diamond highway users. • Cree workers’ difficulty integrating into the working environment.	VIE 04, VIE 06 to VIE 10, VIE 12 to VIE 17, VIE 19 to VIE 22, ELR 05, 07, ELR 08 and PER 01	Low	Regional	Short	Minor
Quality of life – women, youth and elders from the communities of Eastmain and Waskaganish	Operation	• Presence and operation of the pit. • Other infrastructure in operation. • Management of ore, surface deposits and waste rock. • Transportation and traffic. • Economic development and presence of workers.	• Feeling of loss and offence to Cree cultural identity. • Decrease in the feeling of safety for users of the Billy-Diamond highway. • Difficulties in integrating Cree workers into the workplace.	UTT 01 to UTT 06, CIR 01, CIR 02, CIR 04, CIR 05, CIR 08 to CIR 16, VIE 01 to VIE 22, ELR 05 to ELR 08, ELR 13 and PER 01	Low	Regional	Moderate	Moderate
Quality of life – community of Matagami	Operation	• Transportation and traffic in Matagami, including the increase of activity in the transshipment yard. • Economic development and presence of workers	• Risks of disturbances due to traffic increase on the Billy-Diamond highway and on Road 109 in Matagami.	AIR 02, NOR 11, SON 01, CIR 01, CIR 08 à CIR 15, and VIE 01	Low	Local	Moderate	Minor

Table 7-21 Assessment of residual impacts (cont.)

Environmental component	Project phase	Potential source(s) of impact	Description of impact	Mitigation measures and/or applicable standards	Significance of residual impact			Significance of residual impact
					Intensity	Extent	Duration	
Social environment (cont.)								
Local and regional economy	Construction	Economic development and presence of workers.	- Increased local demand for goods and services. - Hiring of local workforce. - Development and enhancement of local and regional expertise.	ERL01 to ERL06, ELR 09 to ELR 15, ELR 17, ELR 18 and VIE 07	Positive impact			
	Operation	Economic development and presence of workers.	- Local demand for goods and services. - Hiring of local workforce. - Development and enhancement of local and regional expertise.	ERL01 to ERL08	Positive impact			
	Rehabilitation	Economic development and presence of workers	- Local demand for goods and services and for workforce. - Hiring of local workforce.	ERL01 and ELR03 to ERL06	Positive impact			
Heritage and archaeology	Construction	Site preparation and infrastructure construction.	Fortuitous discovery of remains of archaeological or historical interest.	ARC01, ARC 02 and NOR17 to NOR19	Low	Isolated	Long	Minor
	Operation	- Presence and operation of the pit. - Management of economic material, overburden and waste rock.	Fortuitous discovery of remains of archaeological or historical interest.	ARC01, ARC 02 and NOR17 to NOR19	Low	Isolated	Long	Minor
	Rehabilitation	No anticipated impact.						
Landscape	Construction	- Site preparation and infrastructure construction. - Transportation and traffic.	Transformation of the character of the landscape and change to observers’ visual field.	SUR 01 to SUR 04, AIR 01, AIR 03 and AIR 05	Low	Local	Short	Minor
	Operation	- Presence and operation of the pit. - Other infrastructure in operation. - Management of ore, surface deposits and waste rock. - Transportation and traffic.	Transformation of the character of the landscape and change to observers’ visual field.	SUR 01 to SUR 04, AIR 01, AIR 03 and AIR 05	Moderate to High ²	Local	Long	Moderate to Major2
	Rehabilitation	- Infrastructure dismantling Pit rehabilitation. - Transportation and traffic.	Potential impacts on landscape and visual field.	SUR 02, AIR 01, AIR 03 and PAY 01	Low	Local	Short	Minor

1 Cree users of the sector consider as irreversible the changes caused by construction activities to their negative perception of the quality of the environment and water. Thus, according to their assessment, the duration of the impact would be long.

2 When the infrastructures are visible in the foreground of the field of vision of the users of the Billy-Diamond road, the intensity and the importance of the impact would be considered from time to time strong

8 ASSESSMENT OF CUMULATIVE EFFECTS

8.1 LEGAL FRAMEWORK AND GENERAL NOTIONS

As per the requirements of the *Canadian Environmental Assessment Act*, 2012 (CEAA, 2012), a project's cumulative environmental effects must be analyzed with regard to the valued environmental components (VECs) and valued social components (VSCs). The *Environment Quality Act* (LQE) also addresses the fact that cumulative effects¹ must be taken into consideration during the environmental assessment phase of a project. To meet these requirements while also complying with the provisions of the Guidelines for the Preparation of an Environmental Impact Statement, and with the provisions of the provincial guideline titled *Directive pour le projet de mine de lithium Baie-James* (file 3214-14-055), the cumulative effects of this project were **assessed**.

8.2 METHOD FOR ASSESSING CUMULATIVE EFFECTS

8.2.1 GENERAL APPROACH

The analysis of cumulative effects is based on the method described in the Practitioner's Guide created for the CEAA (Hegmann and coll., 1999) and the CEAA's related Operational Policy Statement (ACÉE, 2015). The document titled *Addressing Cumulative Environmental Effects* (ACÉE, 2018) was also consulted.

The main steps of the method used are the following:

- identification of the environmental VCs, i.e., the environmental components valued by experts or by the populations concerned, and likely to be changed or affected by the project;
- definition of each VC's spatial and temporal boundaries, as well as the indicators for describing their evolution;
- identification, description and selection of past, present or future projects, actions or events that could potentially interact or have interacted with a VC;
- description of the reference status for each VC selected;
- description of the historic trends for each VC selected;
- definition of the cumulative effects for each VC selected;
- development of mitigation measures and processes for monitoring cumulative effects.

To be subject to an assessment of cumulative effects, a VC must:

- be highly valued by experts or by the populations concerned;
- be identified or protected by law;
- be prone to changing due to the effects of various elements -- both associated with or external to the project;
- be analyzable, based on reliable and adequate data, in terms of both the reference status and historical trends.

1 In this chapter, the terms "cumulative impacts" and "cumulative effects" have the same meaning. The only difference is that *impact* is preferred by the **MELCC** while *effect* is used by the **IAAC**. To make this chapter easier to read, *effect* will be used and considered as a synonym for *impact*.

8.2.2 IDENTIFICATION OF THE VALUED COMPONENTS TO STUDY

The assessment of the project effects made it possible to identify the main issues and the repercussions on natural and social environment components. It also allowed for understanding the primary concerns of the James Bay population and Cree communities touched by the project, that were recorded at the information and consultation sessions held with the local population and representatives of the various organizations concerns. Taken together, these two elements enabled the identification of the VCs associated with the project and, ultimately, the selection of those that would be subject to an assessment of cumulative effects.

As it stands, the assessment of cumulative effects is contingent on the VCs having potential for cumulative effects with other projects or actions in the areas where these effects will be examined.

8.2.3 DEFINITION OF SPATIAL AND TEMPORAL BOUNDARIES

This step involves establishing the spatial and temporal boundaries of the VCs selected to better structure their analysis.

8.2.3.1 SPATIAL BOUNDARIES

The spatial boundaries must contain a territory that, while not overly vast, is large enough to comprise all the areas where cumulative effects could occur (Hegmann and coll., 1999). If the territory is too small, certain impacts could be omitted. The areas of influence of the various projects or actions considered (past, present and future) must be established while fixing boundaries beyond which any cumulative effects would essentially be negligible. Spatial boundaries can be tailored to each VC selected. Choosing spatial boundaries thus requires:

- understanding the spatial distribution of the effects of the project being examined;
- identifying similar effects associated with other projects, activities, events, etc. and which are superimposed in space;
- ensuring that the boundaries consider VC abundance and distribution;
- making sure that the boundaries are environmentally and socially acceptable;
- confirming that the boundaries allow for data collection and analysis for each VC involved.

According to Hegmann and coll. (1999), spatial boundaries must be flexible. It is best, in fact, to establish multiple spatial boundaries that expand or retract based on the social and ecological relationships observed and the VCs analyzed.

8.2.3.2 TEMPORAL BOUNDARIES

As for temporal boundaries, two markers (one in the past and one in the future) must be identified. In theory the marker for the past precedes the effects of the actions or projects analyzed, while the marker for the future corresponds to the moment when the environmental conditions that existed prior to the project are restored or when a certain equilibrium is achieved (Hegmann and coll., 1999).

Boundaries in the past should be selected by giving due consideration to:

- the importance of selecting a period for which there is enough information available about the VCs to adequately describe the initial condition or reference status;
- the moment when the effects associated with a proposed action first occurred;
- the moment when effects similar to those of concern first occurred;
- the moment when the various uses of the territory were established;
- the pre-disruption conditions (historical reference point).

Boundaries in the future should be selected by giving due consideration to:

- the end of the project operation period;
- the period following the end of the project and reclamation of the site;
- the period following the reclamation of VCs to their post-disruption condition;
- the availability of information regarding other projects.

In practice, it bears remembering that when one goes back over long periods (more than 10 years) or looks forward into the future (more than 5 years), it becomes harder to obtain information, which means subsequent analysis can become increasingly speculative. Because of this, forecasts become increasingly uncertain the longer the projection period of the cumulative effects extends. It is generally accepted that the probability of occurrence associated with future projects or actions beyond 10 years is very hard to accurately predict (Bérubé, 2007).

8.2.4 IDENTIFICATION, SELECTION AND DESCRIPTION OF PAST, PRESENT AND FUTURE ACTIVITIES, PROJECTS AND EVENTS

During the assessment of cumulative effects, it is critical that the most comprehensive inventory possible be completed, based on the available information as well as on the projects, activities and other interventions likely to have had an effect on, be currently affecting or to one day impact the VCs selected for analysis. This assessment must be conducted within the defined spatial and temporal boundaries and comprise:

- all projects, regardless of type;
- all human actions, regardless of type;
- all events, regardless of type;
- the laws and regulations of the three main governments involved (Eeyou Istchee James Bay Regional Government, Québec Government and Government of Canada), all of which influence or are likely to influence the VCs being examined.

The next step consists of identifying the actions, projects, events and laws and regulations that could have had a significant effect on the respective VCs, and of briefly describing the influence in question using indicators. The analysis of cumulative effects only concerns the negative effects ensuing from an action (Hegmann and coll., 1999).

Indicators are known elements that allow for translating the influence of various previously mentioned actions or interventions both spatially and temporally. VCs can themselves be indicators (Hegmann and coll., 1999).

8.2.5 DESCRIPTION OF THE REFERENCE STATUS

The reference status corresponds to the situation that existed x number of years prior (i.e., the temporal boundary situated in the past). The description of this status is part of the available information, but may be very limited for certain VCs. This is the reason why the available data must be taken into consideration when setting the temporal boundaries for each VC.

8.2.6 DESCRIPTION OF HISTORIC TRENDS

Historic trends ensue from the analysis of the joint influence of the most important projects, actions and events. These trends incorporate the findings associated with the actions identified as having the potential to substantially impact VCs and are expressed from the reference status up until the completion of the project impact assessment.

8.2.7 IDENTIFICATION AND IMPORTANCE OF CUMULATIVE EFFECTS

This step focuses on establishing, for each VC, whether or not there are cumulative effects or a potential cumulative effect. The decision in this regard rests on the following elements:

- historic trends;
- likely or current projects, actions and events (within the previously defined temporal boundary for the future).

According to Hegmann and coll. (1999), determining the importance of the effects within the context of an assessment of cumulative effects is basically the same as when doing so within an impact assessment. In other words, cumulative effects can be assessed in terms of their intensity, duration and scope. The integration of these criteria then makes it possible to designate a project's cumulative effects as important, unimportant or unknown. Residual effects of high or very high importance are deemed important, while those with a medium, low or very low importance are considered unimportant.

The analysis of cumulative effects can incorporate quantitative analysis and discussions of qualitative elements. A qualitative analysis is carried out in the absence of a technical quantitative analysis or when examining qualitative elements is deemed relevant. The analysis of cumulative effects is nonetheless essentially a qualitative analysis. It concerns resources that will have a residual effect following the implementation of mitigation measures identified during the project impact assessment phase.

The cumulative effect will be considered important if the experts believe that the project will significantly diminish the existing VC. Inversely, the cumulative effect will be considered unimportant if the VC is not significantly influenced by the project's actions. If there is insufficient information such that it becomes impossible to form an opinion as to the project's cumulative effect on a component, the cumulative impact will be considered unknown.

Hegmann and coll. (1999) indicated that the following issues must be considered when assessing the probability that a project's implementation would have a cumulative effect:

- Are the environmental effects harmful?
- Are the harmful environmental effects significant?
- Are the significant and harmful environmental effects likely to occur?

8.2.8 MITIGATION MEASURES AND MONITORING PROGRAMS

This last step involves an assessment of each VC to determine whether the identified cumulative effect calls for mitigation measures and additional environmental monitoring programs other than those proposed in the project's environmental assessment.

8.3 PROJECT ISSUES

The assessment of cumulative effects considers some of the project issues that came to light following public consultations and interviews with stakeholders from James Bay and Cree communities **since 2017** as well as during the EIA (chapter 5). The project issues considered are:

- protecting the quality of the environment (quality of the water, the air, the soil, and the wildlife and its habitat);
- protecting the biodiversity (threatened or vulnerable species and their habitats);
- upholding the integrity of traditional activities;
- ensuring sanitary conditions at and around the project site;
- safeguarding the Cree community's well-being.

It must be remembered that other issues may surface during various communication activities concerning the project.

8.4 IDENTIFICATION OF VALUED COMPONENTS

As indicated in Schedule 2 of the *Canadian Environmental Assessment Act* (which refers to subparagraph 5(1) a) and subsection 5(3)), the valued components to be considered when assessing a project's cumulative effects could include:

- fish and fish habitat;
- migratory birds;
- species at risk;
- all other relevant components.

According to the MDDELCC (**now the MELCC**) guideline for the project, the valued components to consider when assessing cumulative effects should be associated with project issues, namely:

- use of the territory by the Cree population;
- the region's socioeconomic situation;
- the community's use of the sector for cultural purposes;
- recreational and tourism activities, particularly sport hunting and fishing;
- the plant and wildlife species at risk;
- the wildlife and its habitat;
- climate change.

Furthermore, and still as per **these same guidelines**, the impact of the workers' presence on wildlife must be taken into consideration, as must the repercussions this presence could have on future hunting and fishing by the Cree population. On another note, the traditional knowledge of the communities concerned must be included when assessing cumulative environmental effects.

As part of this specific project, **three** VCs were selected for an analysis of cumulative effects; the Chiroptera (bats) at risk, **bird species at risk** and traditional use of the territory by the Cree. **It bears noting that several occurring, and potentially occurring, species at risk and of special concern in the study area were not considered as valued components for the cumulative effects analysis due to the low potential for the presence of these species and the low abundance of individuals in the area. These species include wolverine, least weasel, rock vole, southern bog lemming, woodland caribou (boreal population) and caribou (eastern migratory population)².** Fish and birds were not selected, due to few individuals and limited varieties having been identified during the field inventories. The moose inventory also attested to a similar trend. The effects of the project were thus assessed as minor and only slightly likely to influence the VCs on a larger scale. In addition, the interviews of the **James Bay region's socioeconomic stakeholders** indicated that there were no recreational and tourism activities practised by non-Indigenous people and no cultural activities near the site. **However, Cree users of trapline RE2 indicated that non-Natives have often hunted moose and fished on the Eastmain River and near the Billy-Diamond highway.** There are, however, boat launches, the closest of which is 9 km from the mining site.

Even though the overall project impact on bats is judged to be minor, this species was nonetheless selected as a VC for the analysis of cumulative effects, chiefly for the reasons indicated hereafter. Firstly, the presence of bat species with a special status in the project zone was confirmed during the 2017 inventories, as was their low numbers. Secondly, the presence and rapid spread of the **white-nose syndrome (WNS)** in Québec, now heralded as the key factor behind the decline of bat populations in northeastern North America (section 8.5.5.2), has made bats more vulnerable to cumulative effects than any other wildlife species found in the area being studied.

2 Detailed information on the low potential for the presence of the caribou is presented in Section 6.3.

Although the significance of the residual effect of the overall project is considered minor for birds, bird species at risk were selected as a VC for the cumulative effects analysis mainly for the following reasons. First, two species were confirmed as present in the local study area. Also, some special status bird species may be potentially occurring in the local study area given that it contains their preferred habitats. The project deforestation and footprint will result in potential temporary or permanent habitat loss for bird species at risk occurring and potentially occurring in the local study area. The precarious status of these species combined with the loss of potential habitat makes them more vulnerable to cumulative effects than other bird species present in the study area.

The traditional use of the territory by the Cree was also selected as a VC for the analysis of cumulative effects, given that this use is linked to project issues, was identified as a concern during the public consultations, and will be somewhat significantly impacted by the project (impact of medium importance during the construction and operation phases). Also, other specific activities (past and future) have had, are having and will have an effect on this component. Comparatively, traffic, in spite of impacting the quality of life and having been noted as a concern during the public consultations, was not selected as a VC. In fact, the project will require that 25 additional trucks travel over the road network each day during the operation phase; according to the traffic statistics compiled by the SDBJ (section 8.5.3), this represents an increase of 16% in the number of vehicles travelling on these roads.

8.4.1 SPATIAL AND TEMPORAL BOUNDARIES

Table 8-1 illustrates the selection criteria, spatial and temporal boundaries and indicators for each VC selected for the assessment of cumulative effects. Because of each VC's specific characteristics, there may be variations in the spatial and temporal boundaries.

Table 8-1 Temporal and spatial scope, selection criteria and indicators for the VCs selected for the assessment of cumulative effects

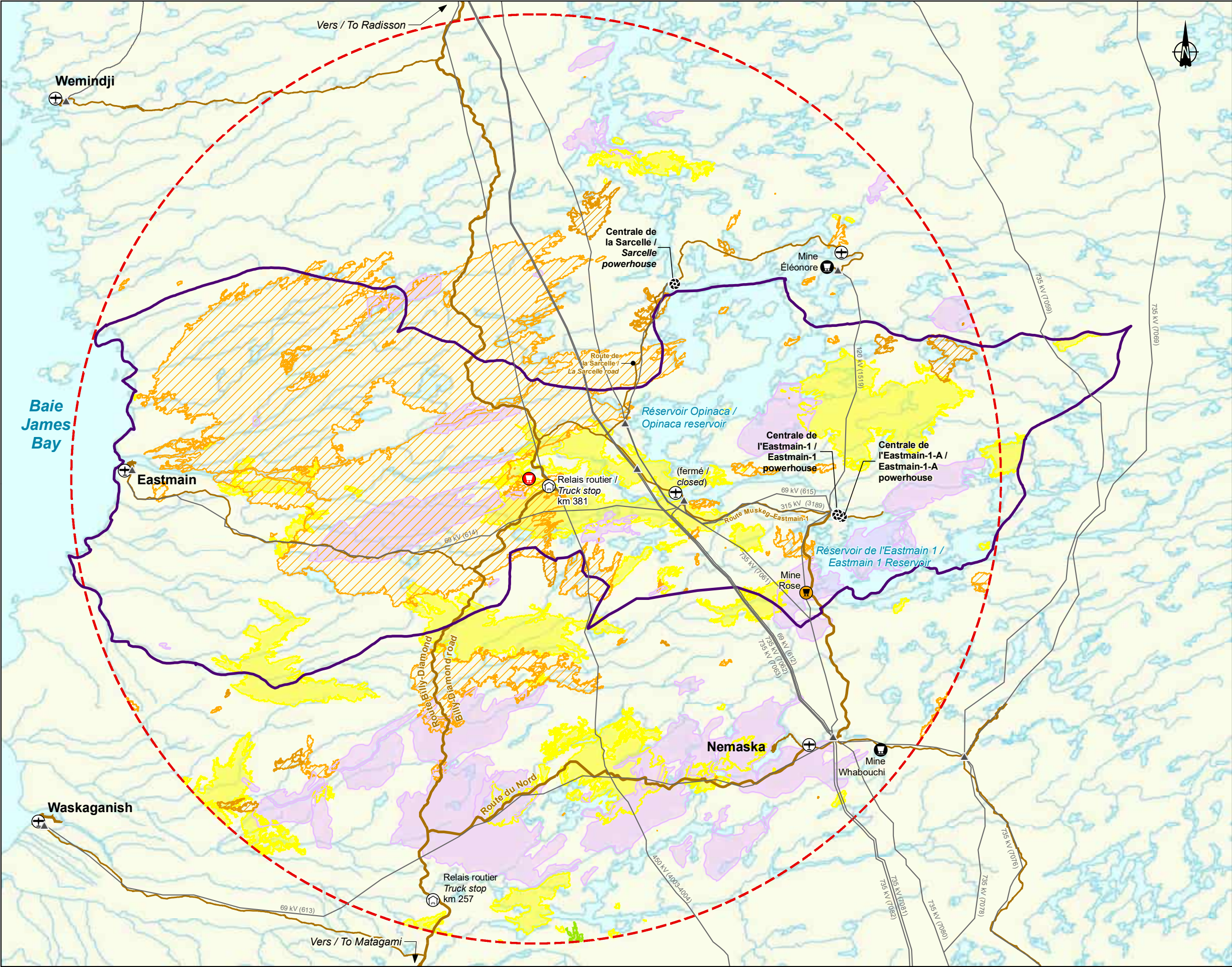
VCs	Selection criteria	Indicator	Temporal scope	Spatial scope
Biological environment				
Bats	Special status species	Number of sightings of the following species: • Hoary bat • Eastern red bat • Northern long-eared bat • Little brown myotis	2003–2028	Radius of 110 km around the project site
Bird species at risk	Species at risk	Population and distribution range assessment of the following species: • Common Nighthawk • Short-eared Owl • Bank Swallow • Olive-sided Flycatcher • Canada Warbler • Red-necked Phalarope • Rusty Blackbird • Yellow Rail	1989–2028	Radius of 110 km around the project site
Social environment				
Traditional use of the territory by the Cree	Activities valued by the Cree (hunting, fishing, trapping, gathering, and cultural, family and healing gatherings)	Use of the territory	1980–2028	The territory of the Eastmain community as well as the traplines assigned to the latter

Maps 8-1 and 8-2 show the limits of the two study areas used for the analysis of cumulative effects. On the one hand, the study area defined for the assessment of cumulative effects on use of the territory includes the territory of the Eastmain community as well as the traplines assigned to the latter. On the other hand, the study area designated for assessing the cumulative effects on bats **and the bird species at risk** corresponds to the territory included within a radius of 110 km around the planned mining site.

8.4.2 VALUED COMPONENTS

8.4.2.1 BATS (CHIROPTERA)

Four bat species were selected as VCs due to their special status at the federal and provincial levels. These include the hoary bat, the northern myotis and the little brown myotis, whose presence in the study area was confirmed during the 2017 surveys. Also selected was the eastern red bat, a bat species with a special status at the provincial level and which could potentially be found in the study area (Jutras and coll., 2012).



Projet mine de lithium Baie-James /
James Bay Lithium Mine Project

Infrastructures / Infrastructure

Relais routier / Truck stop

Aéroport / Airport

Mine existante / Existing mine

Mine projetée / Projected mine

Centrale hydroélectrique /
Hydroelectric powerhouse

Poste et ligne de transport d'énergie /
Substation and transmission line

Route principale / Main road

Autre route / Other road

Limites / Boundary

Zone d'étude des effets cumulatifs sur
l'utilisation du territoire par les Cris d'Eastmain /
Eastmain Crees traditional landuse
cumulative effect study area

Zone d'étude des effets cumulatifs sur les
chiroptères et les espèces aviaires en péril /
Bat and bird at risk cumulative effect study area

Feux de forêt / Forest Fire

1980 à / to 1989

1990 à / to 1999

2000 à / to 2009

2010 à / to 2018


Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 8-1
Perturbations naturelles /
Natural Disturbance

Sources :
Canvec, 1 : 50 000, RNCan, 2015
BDGA, 1 : 1 000 000, RNCan, 2011
Feux de forêt / Forest fire, MFFP, 2018

Cartographié par / mapping by : WSP

0 9 18 km
UTM, fuseau 18, NAD83

Juillet / July 2021

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c8-1_wspT314_feux_210702.mxd



Considering that most bats (*Chiroptera*) frequenting the study area will travel several hundred kilometres during the spring and autumn migratory periods, it is difficult to identify a precise area for the cumulative effects. Given the movement patterns of bats, and the different projects underway or upcoming in proximity to the project site which may have had or may have an impact on the bats, the spatial boundary considered for the cumulative effects assessment spans an area of approximately 110 km around the project (Map 8-1). However, to dispose of a minimum of data to establish the baseline condition and past conditions of bat populations, data from the Réseau québécois d'inventaires acoustiques de chauves-souris (Réseau) have been considered, although collected at Lac Bourbeau, approximately 300 kilometres southeast of the study area. The temporal boundary corresponds to the 2003 survey, the first one conducted by the Réseau in the Nord-du-Québec region; the future temporal boundary corresponds to 10 years, since the likelihood of occurrence of another project (or another source of impact) in the study area beyond this limit is too speculative.

The indicator selected is the number of counts surveyed for the targeted species in the cumulative effect study area. However, in light of the scarcity of data for this VC in the region, and since the methodologies used vary from one study to another, caution is required when considering this indicator.

8.4.2.2 BIRD SPECIES AT RISK

Eight bird species at risk were selected as VC because they have a special status at the provincial or federal level. These include the Common Nighthawk (*Chordeiles minor*), Short-eared Owl (*Asio flammeus*), Bank Swallow (*Riparia riparia*), Canada Warbler (*Cardellina canadensis*), Olive-sided Flycatcher (*Contopus cooperi*), Yellow Rail (*Coturnicops noveboracensis*), Red-necked Phalarope (*Phalaropus lobatus*) and Rusty Blackbird (*Euphagus carolinus*). The bird inventory confirmed the presence of the Common Nighthawk and the Rusty Blackbird in the local study area. The area and its vicinity could potentially contain other species since potential habitats for these species are present. Table 6-56 in Chapter 6 lists the occurrence or potential occurrence of only five bird species at risk in the local study area. Three species were added to those considered for the cumulative effects analysis, including the Canada Warbler, the Red-necked Phalarope and the Yellow Rail, because the ranges for these species overlap with the study area considered for the cumulative effect assessment.

Given the similarities between birds and bats (flight, range, migration, etc.), both groups consider the same spatial boundaries, i.e., a 110 km radius around the James Bay lithium mine project's central point. Bird Conservation Regions (BCRs) are ecologically distinct regions in Canada with similar bird communities, habitats and resource management arrangements. Data to determine the status of bird species at risk in the cumulative effects area were obtained from two BCRs, one with data from 1970 and the other from 1989. The year 1989 was therefore chosen as the past temporal boundary, whereas the future temporal boundary corresponds to 2028, as was the case for bats.

The indicator selected is the assessment of the BCR selected species populations that affect the cumulative effects study area, and the ranges of these species. This indicator should be interpreted with caution, however, as population data is incomplete or absent for some species in the BCRs, and bird ranges do not necessarily support their presence.

8.4.2.3 TRADITIONAL USE OF THE TERRITORY BY INDIGENOUS PEOPLES

The traditional use of the territory by the Eastmain Cree VC refers to the overall traditional practices, which mainly include the hunting, fishing and trapping activities of desired species, but also all other activities using the territory and its resources for ritual or social purposes.

Although use of the territory by the Cree has evolved over the years, this fundamental component of their culture is still as important as ever because of its heritage value. As a result, the link the Cree have with the recognized ancestral territory remains essential, above all, to the transmission of their culture to future generations. **Also of note is the planned sturgeon spawning ground located at the east corner of the highway and the Eastmain River. The community is concerned that the project will impact the future spawning ground and would like to ensure that there is no impact. However, given the distance of the project from the proposed spawning ground, no impact is anticipated.**

From the 1980s onwards, the Cree witnessed important changes to the territory they occupied. These are linked to energy development, involving several diversions of watercourses and the establishment of Hydro-Québec dams, and to mining development. The year 1980 was therefore selected as past temporal scoping and the future scoping was set at 2028. **Beyond this boundary, it is very difficult to make projections based on existing documentation (master plans, development strategies, etc.).**

Moreover, the analysis of the cumulative effects on this VC covers the overall territory frequented by the Eastmain Cree. The considered territory extends over almost 240 km from Eastmain village. The width of the considered territory extends from 40 to 95 km (Map 8-2).

8.5 PROJECTS, ACTIVITIES OR EVENTS LINKED TO VECS AND VSCS

The most comprehensive survey possible of past, present and future projects, activities and events, both local and regional, was conducted by means of a review of available documentation. Many websites, including those of the **MELCC**, James Bay Advisory Committee on the Environment (JBACE), **IAAC**, MFFP, Hydro-Québec, EIJBRG, etc., and some environmental impact assessment reports on projects within the same territory or in proximity to that of the mining project (e.g., the Rose lithium-tantalum mining project by Critical Elements Corporation, the Whabouchi mining project by Nemaska Lithium, and Hydro-Québec's Eastmain-1-A-Sarcelle-Rupert project) were consulted for information on the relevant effects of these projects.

Table 8-2 shows the list of projects, activities and events (past, present and future) for each of the selected VCs. This list has been categorized in five themes:

- Infrastructure and services;
- Development of natural resources;
- Use of the territory (hunting and sport fishing activities);
- Wildlife or protected territory;
- Disturbances, natural and other.

8.5.1 INFRASTRUCTURE AND SERVICES

This theme regroups the key infrastructure for roadways, power transmission lines and hydroelectric production. It specifically shows the Eastmain-Sarcelle-Rupert complex project facilities which are largely contained in the study areas of the cumulative effects of the project.

Table 8-2 Projects, activities and events likely to have an impact on the VCs

Projects, activities and events	Past	Present	Future	Bats	Bird species at risk	Use of the territory
Infrastructure and services						
Development of the Eastmain community (since 1980)	X			• Loss of, and changes in habitats • Increased disturbance	• Loss of, and changes in habitats • Increased disturbance	• Increased fauna sampling effort • Change in use of territory and resources • Loss of territory
Diversion of the Eastmain River (1980)	X	X	X	• Loss of and changes in habitats • Increased disturbance	• Loss of and changes in habitats • Increased disturbance	• Increased fauna sampling effort • Change in use of territory and resources • Loss of territory
Construction of La Grande hydroelectric complex, Phase II (1987–2002) Presence of worker camps	X	X	X	• Loss of and changes in habitats • Increased disturbance	• Loss of and changes in habitats • Increased disturbance	• Increased fauna sampling effort • Change in use of territory and resources • Loss of territory
Construction of Eastmain-1 complexes (2002–2006) Presence of worker camps	X			• Loss of and changes in habitats • Increased disturbance	• Loss of and changes in habitats • Increased disturbance	• Temporary increase in fauna sampling effort • Change in use of territory and resources • Loss of territory
Construction of Eastmain-1-A–Sarcelle–Rupert complexes (2007–2010) Presence of worker camps	X			• Loss of and changes in habitats • Increased disturbance	• Loss of and changes in habitats • Increased disturbance	• Temporary increase in fauna sampling effort • Change in use of territory and resources • Loss of territory
Operation of the Eastmain-1 (2007) and Eastmain-1-A–Sarcelle–Rupert (2012) (diversion bays and reservoirs) Presence of worker camps	X	X	X	• Loss of and changes in habitats	• Loss of and changes in habitats	• Change in use of territory and resources
Opinaca Airport (construction around 2002, now closed)	X			• Loss of and changes in habitats • Increased disturbance	• Loss of and changes in habitats • Increased disturbance	• Change in use of territory and resources
Eleonore Airport (construction in 2014)	X	X	X	• Loss of and changes in habitats • Increased disturbance	• Loss of and changes in habitats • Increased disturbance	• Outside the study area on use of the territory
Eastmain Airport (construction in 1986, rehabilitation in 2013)	X	X	X	• Loss of and changes in habitats • Increased disturbance	• Loss of and changes in habitats • Increased disturbance	• Opening of territory • Increased fauna sampling effort • Change in use of territory and resources
Nemiscau Airport (construction around 2002)	X	X	X	• Loss of and changes in habitats • Increased disturbance	• Loss of and changes in habitats • Increased disturbance	• Outside the study area on use of the territory

Table 8-2 Projects, activities and events likely to have an impact on the VCs (cont.)

Projects, activities and events	Past	Present	Future	Bats	Bird species at risk	Use of the territory
Rehabilitation of Billy-Diamond highway (2005–2018)	X	X	X	• Loss of and changes in habitats • Creation of potential movement corridors	• Loss of and changes in habitats • Creation of potential movement corridors	• Opening of territory • Increased fauna sampling effort • Change in use of territory and resources
Access road to the Eastmain community (construction in 1994, in rehabilitation since 2011)	X	X	X	• Loss of, and changes in habitats • Creation of potential movement corridors	• Loss of and changes in habitats • Creation of potential movement corridors	• Opening of territory
Construction of the Nemiscau–Eastmain-1 Road (2002)	X	X	X	• Loss of and changes in habitats • Creation of potential movement corridors	• Loss of and changes in habitats • Creation of potential movement corridors	• Opening of territory
Construction of the Muskeg–Eastmain-1 Road (2007)	X	X	X	• Loss of and changes in habitats • Creation of potential movement corridors	• Loss of and changes in habitats • Creation of potential movement corridors	• Opening of territory
Optimization of the Muskeg–Sarcelle Road (2008)	X	X	X	• Loss of and changes in habitats • Creation of potential movement corridors	• Loss of and changes in habitats • Creation of potential movement corridors	• Opening of territory
Optimization of the Sarcelle–Mine Eleonore Road (winter road in 2010, permanent road in 2011)	X	X	X	• Loss of and changes in habitats • Creation of potential movement corridors	• Loss of and changes in habitats • Creation of potential movement corridors	• Opening of territory
Construction/Optimization of secondary roads	X	X	X	• Loss of and changes in habitats • Creation of potential movement corridors	• Loss of and changes in habitats • Creation of potential movement corridors	• Opening of territory
Truck stop at km 381 (reconstruction in 2013)	X	X	X	• Increased disturbance	• Increased disturbance	• Increased fauna sampling effort
Nemaska-Eastmain, Nemaska–La Grande 2, Nemaska–Waskaganish, Eastmain, la Sarcelle and Eleonore transmission lines	X			• Loss of and changes in habitats • Creation of potential movement corridors	• Loss of and changes in habitats • Creation of potential movement corridors	• Opening of territory
Relocation of a 315-kV line and construction of a station (linked to the Rose lithium-tantalum mining project)			X	• Loss of and changes in habitats	• Loss of and changes in habitats	• Change in use of territory and resources
Development of natural resources						
Mining exploration activities	X	X	X	• Increased disturbance	• Increased disturbance	• Opening of territory • Change in use of territory and resources

Table 8-2 Projects, activities and events likely to have an impact on the VCs (cont.)

Projects, activities and events	Past	Present	Future	Bats	Bird species at risk	Use of the territory
Eleonore Mine	X	X	X	- Loss of and changes in habitats - Increased disturbance	Loss of and changes in habitats Increased disturbance	Outside the study area on use of the territory
Whabouchi Mine (under development)		X	X	- Loss of and changes in habitats - Increased disturbance	Loss of and changes in habitats Increased disturbance	Outside the study area on use of the territory
Rose lithium-tantalum mining project (under development)			X	- Loss of and changes in habitats - Increased disturbance	Loss of and changes in habitats Increased disturbance	- Increased fauna sampling effort - Change in use of territory and resources
Use of the territory (non-Indigenous peoples)						
Sport hunting and regulations that apply to Zone 22 (hunting and fishing)	X	X	X	Increased disturbance	Increased disturbance	Potential disturbance of hunting, trapping and fishing activities (greatly reduced by regulations in effect)
Granting of rustic shelter leases for sport hunting and fishing (as of 1982)	X	X	X			Potential disturbance of hunting, trapping and fishing activities
Wildlife or protected territory						
Granting of a special status under the <i>Act Respecting Threatened or Vulnerable Species</i>	X	X	X	Protection of the four special-status bat species (occurring and potentially occurring)	Protection of habitats Protection of occurring or potentially occurring bird species at risk	
Implementation of regulatory and legal provisions: - Migratory Birds Convention Act (1985) - Migratory Birds Convention Act (1994) - Migratory Birds Regulations - Regulations Amending the Migratory Birds Regulations (2002) - Environment Quality Act (1972) - Act Respecting The Conservation And Development Of Wildlife (1993) - Federal Policy on Wetland Conservation under the Canadian Environmental Assessment Act (1991)	X	X	X	Protection of habitats Protection of occurring or potentially occurring bat species at risk	Protection of habitats Protection of occurring or potentially occurring bird species at risk	
Creation of Bird Conservation Regions (BCR) (1999)	X	X	X		Protection of habitats Protection of occurring or potentially occurring bird species at risk	

Table 8-2 Projects, activities and events likely to have an impact on the VCs (cont.)

Projects, activities and events	Past	Present	Future	Bats	Bird species at risk	Use of the territory
Creation of the Weh-Sees Indohoun Corporation (2002)	X					Regulation of non-Indigenous activities in view of preserving the wildlife and fish heritage for future generations.
Abolishment of Weh-Sees Indohoun Special Zone (April 2018)		X	X			Increased fauna sampling effort
The Paix des Braves Agreement, Nadoshtin and Boumhaounan agreements, Agreement on Governance in the EIJB Territory and La Grande Alliance	X	X	X			- Helps the Cree participate more in resource development and take charge of their own development. - Allows completion of the Eastmain Rupert diversion project.
Disturbances, natural and other						
Forest fires (cyclical phenomenon)	X		X	Loss of, and changes in habitats	Loss of, and changes in habitats	- Disturbance of animal and plant sampling activities - Change in use of territory and resources - Temporary loss of territory
White-nose syndrome (detected in Québec in 2010)	X	X	X	High levels of mortality in hibernating populations		

8.5.1.1 HYDROELECTRIC INFRASTRUCTURE AND CHANGE IN RIVER SYSTEM

Based on the impact assessment study of the Eastmain-1-A and Sarcelle stations and the Rupert diversion (Hydro-Québec Production, 2004), the hydroelectric facilities of the La Grande complex led to significant permanent changes in the terrestrial, wetland and aquatic environments on the James Bay territory.

Phase I of the La Grande complex, from 1973 to 1985, resulted in the building of nine reservoirs and two diversion channels. Two more reservoirs were added with Phase II of the project (1987–1996), and the commissioning of the Eastmain 1 reservoir in 2006, less than 2 km from the Rose mine project site, has effectively completed the La Grande complex. Afterwards, the development of the Eastmain–Sarcelle–Rupert complex, completed in 2012, involved additional changes on the territory, particularly on the territory being studied for the current project.

The development of these two complexes (La Grande and Eastmain-1-A–Sarcelle–Rupert) caused the flooding of several environments, and in addition to the building of vast reservoirs, triggered various hydrological changes such as the flooding of lakes and watercourses, flow changes (stoppage, reduction or increase) to 13 rivers and raising of water level of lakes in the diversion channels (Hydro-Québec Production, 2004). In 2010, while the La Grande complex reservoir flooded 11,280 km² of terrestrial environments, the Rupert diversion bays of the Eastmain–Sarcelle–Rupert complex had likewise flooded 188 km² of terrestrial environments. This complex, which impacted 36 trapping lands linked to six Cree communities, touches a much broader territory than that of the project. The study areas of the project’s cumulative effects are entirely contained in that of the Eastmain-1-A–Sarcelle–Rupert project.

Table 8-3 shows the proportion of environment types after the completion of the La Grande complex, and Eastmain-1-A–Sarcelle–Rupert project.

Table 8-3 Proportion of environment types after the completion of the La Grande complex and Eastmain-1-A–Sarcelle–Rupert generating stations

Condition of environment	Size (km ²)		
	Aquatic environment	Terrestrial environment	Total
Natural condition	35,000 (10%)	315,000 (90%)	350,000 (100%)
After La Grande complex	46,280 (13%)	303,720 (87%)	350,000 (100%)
After the Eastmain-1-A-Rupert project	46,468 (13%)	303,532 (87%)	350,000 (100%)
Note: Proportion of environment types in the Eastmain-1-A–Sarcelle–Rupert project study area.			

Source: Hydro-Québec Production (2004)

The construction of the Eastmain-Sarcelle-Rupert complex required the erection of many permanent and temporary facilities, namely:

- the Eastmain-1-A and Sarcelle generating stations;
- four dams and 74 dikes, five instream flow release structures incorporated to certain retaining structures for diversion bays (Nemiscau-1, Nemiscau-2, Ruisseau-Arques, Lemare and LR-51-52);
- one spillway and eight hydraulic structures on the Rupert River;
- a 2.9-km transfer tunnel between the upstream and downstream diversion bays and nine channels with a total length of approximately 7 km;
- Two 315-kV transmission lines (one 101-km line between the la Sarcelle and Eastmain-1 power plants and one 0.5-km line between the Eastmain-1 and Eastmain 1-A stations);
- a permanent road network (131 km) and some temporary construction roads;
- six camps for workers: two used previously during the construction of the Eastmain-1 facility, and four new ones (Hydro-Québec Production, 2012).

8.5.1.2 ROAD TRANSPORTATION AND POWER TRANSMISSION INFRASTRUCTURE

Prior to 1974, the road network was concentrated in the southern part of James Bay. With the building of the La Grande complex to the north and forest operations to the south, it has increased significantly in the James Bay territory, playing a key role in the gradual opening up of the region (Hydro-Québec Production, 2004).

The transportation infrastructure in the study areas of the project's cumulative effects was especially marked by the rehabilitation of the Billy-Diamond highway (620-km long). Built in 1971 and opened to the public in 1986, this road extends from Matagami to Radisson, and provides access to the Robert-Bourassa generating station. It has been undergoing reconstruction since 2005. As shown in Table 8-4, other works are underway or upcoming in 2018.

Then, in 1993, came the construction of the Route du Nord; the latter is a gravel road linking Chibougamau to the Billy-Diamond highway and is located just south of the cumulative effect study areas. In 1994, the access road to the Eastmain Cree Community took shape. This road joins the Billy-Diamond highway, covering 102.4 km. It has been in reconstruction since 2011 to improve the intersection with the Billy-Diamond highway, refill and fix deformations, excavate ditches, bypass km 38, pave km 0 to 30, and complete new surfacing treatment. A second 30-km section will be paved in upcoming years (central). Toward 2002, the road connecting Nemiscau to Eastmain-1 was built and then, in 2007, came the road linking the Muskeg cogeneration plant to Eastmain-1. Expansion of the road leading to La Sarcelle occurred in the same period.

Table 8-4 Situation of reconstruction on the Billy-Diamond highway

Kilometres targeted by the work	Date of work	Nature of work	Constraints	Section included in the study areas
Km 38, Waswanipi River Bridge	May 28 to August 16, 2018	Bridge refurbishment	Maximum load (70 T) Potential traffic	No
Km 144 to 200	May 28 to October 30, 2018	Replacement of culverts, pavement rehabilitation and pulverization work. Other work underway.	Maximum load (62 T) Single-lane traffic Alternating traffic controlled by lights Slowdowns	No
Km 306, Pontax I Bridge	June 26 to August 10, 2018	Bridge refurbishment	Maximum load (62 T) Single-lane traffic Alternating traffic controlled by lights Slowdowns	Bats: Yes Use of territory: No
Km 312, Pontax II Bridge	July 26 to August 10, 2018	Bridge refurbishment	Maximum load (62 T) Single-lane traffic Alternating traffic controlled by lights Slowdowns	Bats: Yes Use of territory: No
Km 380 to 480	August 13 to 24, 2018	Resurfacing of shoulders	Single-lane traffic	Bats: Yes Use of territory: Km 380 to 428
Km 0 to 620	July 23 to August 13, 2018	Pavement marking	Slowdown	Bats: Km 244 to 530 Use of territory: Km 333 to 428

Source: SDBJ (2018).

In addition, many access roads to hydroelectric facilities (substations, power plants, dikes, dams, transmission line rights-of-ways, borrow pits, etc.) form a discontinuous network of several hundred kilometres within the James Bay territory affected by hydroelectric development (Hydro-Québec Production, 2004).

Three airports are also found in the study area for the social environment. That of Eastmain is located 100 km from the project, **while that of Nemiscau is located farther than 85 km. Although now closed, the Opinaca airport** is within about 30 km **of the project site**. It served mainly construction workers of the Eastmain-1 and Eastmain-1-A–Rupert project and those of Les Mines Opinaca until an **Éléonore airport** was constructed near it. **This airport is located approximately 85 km northeast of the project site**. Since 2014, a permanent road has also provided access to the Opinaca mine from the end of the road leading to the Sarcelle generating station.

The territory affected by the Eastmain-1-A–Rupert hydroelectric project already had seven high-voltage power lines in 2004 (six 735-kV lines and one 450-kV direct current line). Connected to this network, several different voltages supply various consumption points, such as workers' camps, villages and mines. They cover a total of 6,508 km, to which are added, for the Eastmain-1-A–Rupert project, two lines at 315 kV (totalling 160 km), a temporary line at 69 kV (42 km) and distribution lines to temporary camps for workers and permanent structures (60 km). (Hydro-Québec Production, 2004) A 315-kV line between the Eastmain-1 and Eastmain-1-A switching yards, and between the Sarcelle and Eastmain-1 substations was constructed in 2011 (Hydro-Québec Production, 2017). A 315-kV transmission line crossing the Rose mining project site will be moved to allow completion of the project.

Previously powered by diesel generators, the truck stop at km 381 is now connected to the Hydro-Québec network **by a 25 kV power line**. Studies are underway to assess the electricity demand for the James Bay Lithium Mine project. GLCI plans to connect to the Hydro-Québec power distribution system via a 69-kV line. Depending on the route set by Hydro-Québec, this connection could require up to 11 km of additional power lines.

8.5.2 DEVELOPMENT OF NATURAL RESOURCES

This theme covers various forest and mining activities, past, present and future.

8.5.2.1 FORESTRY ACTIVITIES

Since 1980, forest clearcuts done in the study area were associated primarily with the completion of various projects. Cuts were done for the purposes of borrow pits (sandpits or quarries) to build road right-of-ways and power transmission lines, to prepare construction sites, and to set up worker camps. Several headrace areas were also deforested prior to flooding. However, these cuts are not considered entirely to be forestry activities since they were related to the various projects listed above and had been considered.

No commercial timber harvesting was done in the cumulative effect study areas.

8.5.2.2 MINING ACTIVITIES

Since 2007, several mining exploration activities have been done in the territory and, more specifically in the cumulative effect study areas. In 2018, numerous mining exploration rights are pending near the GLCI mining project site. However, little information is available and accessible regarding the mining exploration activities (MERN, 2016).

One mine is operating and two others are being developed within a 110-km radius of the project. Les Opinaca Mines, a wholly owned subsidiary of Goldcorp Inc., operates the Éléonore mine, an underground gold deposit near the Opinaca Reservoir. Opened in 2011, this mine is located 85 km northeast of the project. It is accessible year-round via an access road roughly 60 km long and connected to the north end of the access road to Hydro-Québec's Sarcelle generating station. According to the 2014 Goldcorp Annual Report, it was expected to be one of the largest gold mines in Canada in 2018, with a capacity of 7,000 t of ore daily (Goldcorp, 2015).

Projects under development include the Rose lithium-tantalum mining project (Critical Elements Corporation), located 60 km southeast of the project site. It will be an open-pit spodumene mine with a targeted production rate of 4,600 t/day. Operation of this mine is expected to span 19 years, for a total project duration of roughly 22 years. The Whabouchi mining project (Nemaska Lithium) is located more than 100 km southeast of the project. It has been in development since 2016 and will exploit a spodumene deposit. This mine is currently in the preproduction stage.

In addition, numerous deposits are located outside the cumulative effect study areas. Indeed, close to the Whabouchi mining project, there are several less advanced projects, primarily under study at the exploration stage, targeting spodumene-bearing pegmatite on or near the surface (MRNF, 2011; Noka Resources, 2016). So other lithium mining projects could see light of day in the Nemiscau-Eastmain sector.

There is also the Troilus mine, 280 km southeast, which could soon return to operation; it ceased activities in 2010, after some 15 years of open-pit mining of copper, gold and silver. In addition, about 15 mines are located further from the project, between 250 km and 350 km away.

8.5.3 USE OF THE TERRITORY BY NON-INDIGENOUS PEOPLE

This theme covers sport fishing and hunting activities and the associated recreation infrastructure. These involve primarily use of the territory by non-Indigenous people.

Since 1980, development of the Billy-Diamond highway has resulted in increased recreational activities within the territory (tourism, sport fishing and hunting), especially since the opening of the Billy-Diamond highway to non-Indigenous people in 1986. However, these activities have remained concentrated primarily in the southern portion of James Bay and east of the Robert-Bourassa hydroelectric facilities. In 1991, a follow-up done to evaluate the impact of sport fishing and hunting on animal populations recorded nearly 11,000 vehicles at the entrance to the Billy-Diamond highway (Hydro-Québec Production, 2001). Traffic statistics compiled by the SDBJ showed 56,139 recorded trips on the Billy-Diamond highway in 2014 and 55,632 in 2017 (personal communication with the SDBJ, 2018).

Some activities, such as snaring of hares, trapping, and fishing of sturgeon and whitefish, are reserved exclusively for beneficiaries of the JBNQA throughout the territory. Hunters and fishers who are not JBNQA beneficiaries are subject to the laws and regulation in force in the territory and must hold a sport hunting or fishing licence from the Québec Government, applicable on all Category III land. Before April 1, 2018, and since 2002, different regulations applied to the hunting sectors of Weh-Sees Indohoun (WSI) and Eastmain, in which the project is located. To hunt and fish on Category I and II lands, authorization must have been issued by the Band Councils concerned.

In the past, recreational hunting and fishing activities in the project sector were practised mostly by Hydro-Québec workers involved in building the Eastmain-1-A and Sarcelle hydroelectric projects, and the Rupert River diversion. However, there are far fewer of these workers since construction work associated with the Eastmain-Sarcelle-Rupert complex finished, and the MFFP believes that the vast majority of these workers have left the territory. **However, according to the Cree users interviewed during the consultation sessions in 2018, some non-natives use the territory for moose hunting and fishing. These activities are practiced mainly along the Billy-Diamond highway, particularly at the intersection of the Eastmain River and on certain lakes near the highway.**

According to the Québec Original website (Tourisme Québec), there are three outfitters within a 150-km radius of the project site, but it is possible that some small Cree outfitters were not recorded. Some families have opened outfitter's camps, or plan to do so to offer guided hiking, hunting and fishing trips (Goldcorp, not dated). However, little information is available on this matter. During the 2017–2018 consultation conducted for this EIA, a very preliminary outfitting project was mentioned by users of trapline VC35. This trapline is located northeast of the project, on the north shore of the Eastmain River.

According to the EIA of the Whabouchi mining project (Nemaska Lithium, 2013), a series of land rights were issued to non-Indigenous people by MERN in the Whabouchi mining project. About 10 km north of the project site, there is a vacation lot lease. Including this lease, 16 vacation lot leases are located within the borders of the study area of the cumulative effects on use of the territory. (Map 8-2) Some 20 km northeast of the study area there is a vacation lot lease for rustic shelters. Including this lease, there are three vacation lot leases for rustic shelters in the study area.

8.5.4 WILDLIFE OR PROTECTED TERRITORIES

This theme covers the territories with special protection status, as well as the management, conservation or recovery plans by the governments of Québec and Canada for the protection and management of wildlife species and habitats.

8.5.4.1 WILDLIFE RESERVES, SANCTUARIES AND BIODIVERSITY RESERVES

No wildlife reserve is located within the study areas of cumulative effects.

On the other hand, biodiversity reserves are planned within the JBNQA territory. The primary objective of these planned reserves is to maintain biodiversity in the terrestrial environment. For each biodiversity reserve planned, a conservation plan is developed. Within biodiversity reserves, mining activities and forest management are prohibited. The end date of temporary protection varies from one reserve to the next, and ranges between 2018 and 2025.

The planned Paakumshumwaau-Maatускаau biodiversity reserve follows a proposal by the Cree community of Wemindji who want to preserve the watersheds of the Vieux-Comptoir and Des Peupliers rivers, a territory that has traditionally been used by the Cree Nation for over 3,500 years (Gouvernement du Québec, 2010). Located roughly 32.5 km north of the Cree village of Eastmain, the planned reserve is located outside the study area of the cumulative effects of land use, but falls within that for bats. The temporary protection of the reserve is slated to end on June 11, 2020. **However, the government intends to protect this territory permanently. If all steps leading to the permanent status being granted are not completed by June 11, 2020, the necessary steps will be taken to extend the provisional protection status in compliance with the provisions of the Natural Heritage Conservation Act (CQLR, chapter C-61.01).**

The planned Waskaganish biodiversity reserve is approximately 40 km east of the Cree village of Waskaganish. It covers an area of 1,062.7 km² and includes five islands located at the Pontax River mouth and represent habitats of great ecological interest because they are at the transition between salt and fresh water. It also includes ecotones on the edge of Rupert Bay, which are likely to be home to special flora and fauna.

The planned Chisesaakahikan-et-de-la-rivière-Broadback biodiversity reserve is approximately 150 km northeast of the town of Matagami. This reserve covers 4,977.9 km², and it was originally created to ensure that biodiversity and associated natural and cultural resources are protected and maintained.

These three proposed biodiversity reserves are outside the cumulative effects study area for land use but are included within the area for bats.

At the time of the summer 2018 public consultations, Eastmain community representatives wished to propose that the Québec government recognize a significant portion of RE2 as a protected area under the *Natural Heritage Conservation Act*.

8.5.4.2 OTHER PROTECTION

GRANTING OF A SPECIAL STATUS

On December 17, 2014, at the recommendation of COSEWIC, the Government of Canada added three species of bats to the List of Wildlife Species at Risk in Canada (Appendix I *Species at Risk Act*): little brown bats (*Myotis lucifugus*), northern long-eared bats (*Myotis septentrionalis*) and tri-coloured bats (*Perimyotis subflavus*). These three bat species have been designated as “endangered” because of the imminent threat to their survival posed by white-nose syndrome (Gouvernement du Canada, 2014). **Schedule I of the Species at Risk Act includes the eight bird species selected. The Short-eared Owl, Red-necked Phalarope, Rusty Blackbird and Yellow Rail are listed as “Special Concern” and the Common Nighthawk, Bank Swallow, Olive-sided Flycatcher and Canada Warbler are listed as “Threatened” (Government of Canada, 2021).**

In Québec the eastern red bat appears on the list of wildlife species likely to be designated as threatened or vulnerable under the *Act respecting threatened or vulnerable species* (Gouvernement du Québec, 2006). However, it should be noted that there are no specific protective measures for the eastern red bat, either in Québec or Canada. **Concerning special-status birds, the Yellow Rail is “threatened” while the Common Nighthawk, Short-eared Owl, Olive-sided Flycatcher, and Canada Warbler are “likely to be designated as threatened or vulnerable” (MFFP, 2021).**

LAWS AND REGULATIONS

The implementation of regulatory and legal provisions contributes to the protection of wildlife species and their habitats. These include:

- *Migratory Birds Convention Act, 1985* (replaced by the *Migratory Birds Convention Act, 1994*);
- *Migratory Birds Regulations*;
- *Regulation Amending the Migratory Birds Regulations* (2002);
- *Environment Quality Act* (1972);
- *Act Respecting The Conservation And Development Of Wildlife* (1993);
- Federal Policy on Wetland Conservation under the *Canadian Environmental Assessment Act* (1991).

BIRD CONSERVATION REGION

The North American Bird Conservation Initiative (NABCI) was founded in 1999 to address concerns about the decline of many once-common species. NABCI partners Canada, Mexico, and the United States have identified “ecoregions” based on common and appropriate ecological principles for birds to plan, implement, and evaluate conservation actions across North America. Bird Conservation Regions (BCRs) are the baseline areas from which biological planning is conducted to develop bird conservation strategies in North America. Recommended actions in BCR strategies and conservation priorities are used to develop guidelines and beneficial management practices that promote compliance with the Migratory Birds Convention Act, 1994. Canada has 12 BCRs, with several divided into sub-regions (Government of Canada, 2017).

EYYOU MARINE REGION

Commonly known as the Cree Offshore Agreement, the Eeyou Marine Region Land Claims Agreement is the product of a decade of negotiations concerning the rights and obligations of the Cree and the Government of Canada in the Eeyou Itschee offshore region. This marine region, traditionally occupied and used by the Cree, is known as the Eeyou Marine Region.

This treaty recognizes ownership and other rights in some sectors off the coast. It also constitutes a recognition by the Cree of the application of certain Canadian laws in these sectors. All Cree appearing in the register prepared by the JBNQA are automatically entered as beneficiaries of this agreement, whether they live on the coast or inland.

WEH-SEES INDOHOUN

In October 2003, the WSI was implemented by the Québec Government, Hydro-Québec and the Grand Council of the Cree under the Boumhounan and Nadoshtin agreements. The objective was to create a special hunting and fishing zone and apply specific sport hunting and fishing measures during construction of the Eastmain-1 and Eastmain-1-A–Sarcelle–Rupert hydroelectric projects.

Starting in 2015, this area was managed by the WSI subcommittee, which was made up of representatives of the Cree Nation government, Cree communities included in this area (Nemaska, Waskaganish, Wemindji, Eastmain, Mistissini), the Cree Trapper's Association, the MFFP as well as the Hunting, Fishing and Trapping Coordinating Committee (WSI, not dated). The management measures implemented in the WSI zone, such as access rights and the fish catch registration system, ensured the capture of important information for supervising the health and exploitation of populations following increased opening of the territory. With the aid of the information collected, management measures were periodically reviewed to ensure their effectiveness (WSI, not dated).

The WSI zone was made up of two sport hunting and fishing sectors: the Weh-Sees Indohoun sector and the Eastmain sector. While moose hunting was prohibited at all times in the Eastmain sector, it was authorized (with some restrictions in the WSI sector). Having a total area of 16,656 km², these two sectors included Category I and II lands of the Nemaska Cree Nation, and Category III lands (WSI, not dated).

The MFFP officially abolished the WSI zone in the spring of 2018, since most workers on the large Hydro-Québec hydroelectric development projects had left the territory. According to information amassed since 2003, this abolition will not affect the sustainability of wildlife resources (MFFP, 2018).

Among the most notable changes arising from the abolition of the WSI zone is that sport fishers are no longer required to obtain an access right to fish in the rivers and bodies of water located within this zone. They are nonetheless required to have a fishing licence from the Québec government, and to respect catch and possession limits and the regulations in force, depending on the sector. In regard to sport hunting, hunters who are not beneficiaries of the JBNQA are now subject to the laws and regulations in force in this territory and must hold a hunting licence from the Québec government.

PAIX DES BRAVES, NADOSHTIN AND BOUMHAOUNAN AGREEMENTS, AGREEMENT ON GOVERNANCE IN THE EIJB TERRITORY AND LA GRANDE ALLIANCE

In 2002, Québec and the Cree signed the Agreement concerning a new relationship between the Gouvernement du Québec and the Crees of Québec. The Paix des Braves established the modalities of a forest regime adapted to the James Bay territory. Specific modalities for logging were put in place, such as the implementation of block cuttings. The Nadoshtin and Boumhounan agreements created, respectively, in the Eastmain-1 and Eastmain-1-A-Rupert projects, mechanisms to manage road access and the use of fish and wildlife resources (by the WSI) as well as to ensure that the Cree have opportunities for contracts 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 of Eeyou Istchee and the Québec Government in July 2012. The EIJBRC aims to harmonize relations between the Jamesians and the Cree in the area of governance of the EIJB territory, and to enable the two communities to contribute significantly to the prosperity of the territory (Chapter 6).

In the spirit of the Paix des Braves, “La Grande Alliance” is a Memorandum of Understanding for collaboration and consolidation of socio-economic ties between the Cree Nation and Quebec government to connect, develop and protect the territory”. Its objective is to build a promising project for the strategic, predictable and sustainable development of the territory to:

- **guarantee the long-term protection of the territory (protected areas);**
- **improve the standard of living (housing, electricity and internet);**
- **extend the transport network (rail, road, port and airport).**

This project is proposed by the Cree community and will make it possible for First Nations, governments and private companies to work together to develop society through natural resources (La Grande Alliance, 2021).

8.5.5 DISTURBANCES, NATURAL AND OTHER

This theme covers natural disturbances that may have affected one or more VCs; in the present case, these are forest fires and the white-nose syndrome.

8.5.5.1 FOREST FIRES

As mentioned in the EIA of the Eastmain-1-A–Rupert project (Hydro-Québec Production, 2004), forest fires occasionally affect Cree traplines and terrestrial ecosystems. Areas for the study of cumulative effects are located entirely within northern zones protected by SOPFEU.

A number of fires have occurred in the James Bay territory since the 1970s (RNCAN, 2017). Between 1975 and 2003, an area of 5,933,272 ha was destroyed by fire in the James Bay territory (Nemaska Lithium, 2013). In all time periods, lightning has proved to be the primary cause of forest fires.

In June 2013, the largest forest fire in the province’s history occurred at James Bay (2,196,455 ha). That fire mainly affected land belonging to the Eastmain Cree community, forcing the evacuation of some 350 people from the community (Radio-Canada, 2013). SOPFEU does not generally intervene north of the 51st parallel, except when a fire threatens persons or property deemed essential for public safety. This was the case for Eastmain in 2013. At this time, the km 381 truck stop caught fire.

Some 68 fires occurred within a radius of 110 km around the project site between 1980 and 2016. Among the largest fires to occur within the territory were those of 2013 (584,000 ha), 2005 (208,708 ha), 2006 (44,026 ha) and 2010 (35,122 ha).

8.5.5.2 WHITE-NOSE SYNDROME

The WNS is a fungal infection affecting bats, particularly cave-dwelling species, in northeastern North America, including Québec. It is characterized by massive bat mortality, often associated with the observation of a whitish fungal growth on certain parts of the body, mainly the snout, of infected bats (MFFP, 2016b; MFFP, 2017).

Discovered during the winter of 2006–2007 in Howe Cave in the State of New York, WNS reached Ontario and Québec in 2010. Since WNS is spreading with great rapidity, at about 300 km/year, the affected areas and the number of threatened bats is increasing steadily year by year. Today, WNS thus represents the principal threat to bat populations in northeastern North America.

8.6 ANALYSIS OF CUMULATIVE EFFECTS ON VCS

8.6.1 BATS

8.6.1.1 PROJECTS, ACTIONS OR EVENTS

Past, current and future projects, actions or events that may have had or could have an effect on bats (*Chiroptera*) are set out in table 8-2. The main elements that may have affected or could affect the evolution of bat populations are discussed below.

Aside from wind energy projects, which may cause bat mortality directly through collision or barotrauma (Arnett and coll., 2008; Baerwald and coll., 2008), the potential effects of anthropogenic development projects on bat populations mainly involve habitat loss (Tremblay and Jutras, 2010). Human activity can also cause disturbance to individuals, particularly through emissions of light, noise and vibration (Bunkley and coll., 2015; EC, 2015; Stone and coll., 2015).

There is no existing wind farm within the spatial boundaries defined for the assessment of cumulative effects on bats and, based on available information, no wind energy project is currently planned for this area.

On the other hand, development of anthropogenic activity in the region has over time led to habitat loss for bats, mainly through deforestation of mature forest stands and encroachment on wetlands and hydrous environments (watercourses). This is particularly the case for mining activities, hydroelectricity projects, road and airport infrastructure, and energy transmission lines. To a lesser extent, hunting and the opening of the territory to human activity contribute to an increase in sources of disturbance for bats (light, noise, vibrations). Moreover, hydroelectricity projects such as the La Grande complex have also led to habitat loss through artificial flooding.

In parallel with the development of these anthropogenic activities, particularly during recent decades, measures have been taken to ensure the protection and management of wildlife species and natural habitats. Laws and regulations formulated for these purposes have gradually been integrated into anthropogenic development activities. This is particularly the case for conservation plans, the designation of conservation areas, and the creation of parks and reserves. Some of these activities are potential sources of positive effects for bat populations.

In regard to natural disturbances, forest fires constitute a source of habitat loss for bats. These fires, generally caused by lightning, shape the region's forest dynamics (Nemaska Lithium, 2013). Several major forest fires have occurred in the study area, particularly the fire of 2013, which affected close to 15% of its area. The loss of large-diameter trees and snags in mature forest environments, which bats prefer, has a negative effect on the bat VC.

As mentioned earlier, one of the major sources of impact for bat populations is WNS, which was first detected in Québec in 2010 (MFFP, 2017). This syndrome is spreading rapidly and is now present in over 15 northeastern U.S. states, its impact demonstrated by the fact that over 1 million bats are estimated to have succumbed to the disease since its discovery (MFFP, 2016a). Most North American bat species may be affected by WNS. However, bats of the genus *Myotis*, the big brown bat and the tri-coloured bat have been particularly badly hit in the northeastern United States and Ontario (MFFP, 2016b). Since the winter of 2010–2011, the first observations of WNS have been recorded in bat populations of Québec, including those of the Nord-du-Québec region (MFFP, 2017). Although the significance of its effect on bat populations in the region has not yet been assessed with precision, the disease has so far caused an overall decline of 94% in known numbers of *Myotis* bats hibernating in Nova Scotia, New Brunswick, Ontario and Québec (EC, 2015). WNS is therefore a major event in terms of its cumulative effects.

8.6.1.2 BASELINE CONDITION

There is little data available to provide a relevant baseline condition for bats in the region. Since the earliest data concerning bat populations in Northern Québec date from 2003, that year has been taken as the past temporal boundary for the assessment of the project's cumulative effects on the bat CV. According to the latest figures published by the Réseau in its CHIOPS newsletter (Jutras and Vasseur, 2011), bats of the genus *Myotis* accounted for 5 of the 7 records collected in the Nord-du-Québec region in 2003 (71.4%). The two other species identified in this region were the hoary bat (1 record, 14.3%) and the big brown bat (1 record, 14.3%). Only the eastern red bat was not identified in the 2003 survey.

In regard to data obtained during the acoustic survey conducted by WSP in 2017, the survey confirmed the presence of bats of the genus *Myotis* (4.41% of records), the big brown bat (1.47% of records) and the hoary bat (86.7% of records), for a total of 68 passes recorded. Considering the survey effort (261 station-nights), few passes were recorded for the various bat species (section 6.3.6.2).

8.6.1.3 HISTORICAL TRENDS

Information on bats in the Nord-du-Québec region is very scarce and fragmentary, making it difficult to define historical trends concerning populations of the various species of bats. Data from the Réseau provide annual monitoring between 2003 and 2009, but the numbers of observations are too small to allow a useful comparison of relative numbers from one year to another. However, the presence of species identified by the Réseau, namely bats of the genus *Myotis*, the hoary bat and the big brown bat, was confirmed in almost every year during this period, except for 2004 and 2008, when the big brown bat was absent from records collected (Jutras and Vasseur, 2011). Moreover, the presence of these species was confirmed during the 2017 acoustic survey.

The main impact on bat populations is undoubtedly the appearance of WNS, which was first identified in Québec in 2010 (MFFP, 2016a) and has been observed since the winter of 2010–2011 in the Nord-du-Québec region as far as Chibougamau (MFFP, 2016b). As mentioned earlier, WNS has caused significant mortality (94% of known numbers) in resident bat populations, particularly those of the genus *Myotis*.

Since 2003, the effects of anthropogenic development projects on bat populations have largely come as a result of habitat loss (Tremblay and Jutras, 2010). Whether infrastructure and services projects (e.g., the Eastmain 1 reservoir, and the Nemiscau and Opinaca airports) or mining projects (Éléonore and Whabouchi), all such projects entail deforestation and encroachment on wetlands and hydrous environments (watercourses), which constitute potential sources of habitat loss and modification for bats. These projects are also associated with the creation of roads and/or energy transmission corridors that also contribute to habitat loss, but which can also be sources of positive effects for bats. This is because, as they travel from one site to another, bats generally use linear gaps in the forest structure for guidance, such as road or power line rights-of-way (Grindal and Brigham, 1998; Henderson and Broders, 2008).

Deforestation activities associated with anthropogenic development projects constitute the only sources of forest operations within the spatial boundaries considered for this CV. Like forest fires, deforestation activities also contribute to the fragmentation of forest habitats and result in the creation of linear elements that are used by certain species of bats (EC, 2015).

In 2012, recognizing the massive mortality of bats caused by WNS, COSEWIC recommended that three bat species be classified “endangered”: the tricoloured bat, the little brown myotis and the northern myotis. This status was reviewed and confirmed in November 2013 (COSEWIC, 2014), and these species were added to Schedule 1 of the SARA on December 17, 2014 (COSEWIC, 2016; Gouvernement du Canada, 2014). The little brown myotis and the northern myotis had not previously been granted any special provincial or federal status.

In conclusion, because of the lack of specific data on regional population dynamics, there is no clear trend for the study area under consideration. It can therefore only be supposed that the population is suffering a decline similar to that in the rest of Québec, because the main cause of this decline seems to be WNS.

8.6.1.4 CUMULATIVE EFFECTS

The main threats facing bats are habitat loss, wind energy developments and WNS (Tremblay and Jutras, 2010). Given the absence of wind energy projects in the region, the potential negative effects of human development projects essentially involve habitat loss.

The assessment of the James Bay Lithium Mine project's impact in terms of habitat loss and disturbance for bat populations concluded that the residual effect is of minor significance, even considering the fact that bats of the genus *Myotis* and the hoary bat are species with a special status. Also, because of forest fires, most of the natural environments that will be affected by the project are characterized by the absence or virtual absence of a tree stratum. These environments are therefore not the most propitious for the bat species identified in the study area, which are essentially arboreal. In addition, considering the planned remediation activities, habitat loss is not likely to compromise the integrity of local populations. Moreover, if deforestation is not carried out during the breeding season, the fact that there are sufficient replacement habitats of similar quality in the region means that the effect of this habitat loss will not prove significant for bat populations.

Past, present and future actions likely to lead to habitat loss in the area include projects leading to the disappearance of mature forest stands or wetlands and hydrous environments, or potential travel corridors (encased valleys, lakeshores, watercourses, etc.). Essentially, these are represented by the creation of the Eastmain 1 reservoir and the Eastmain-Sarcelle-Rupert complex, the Nemiscau and Opinaca airports, the Whabouchi and Éléonore mining projects and the roads and energy transmission lines associated with them. Their effects are nevertheless limited in terms of surface area in view of the spatial boundaries considered for the assessment of cumulative effects.

Moreover, the presence of a portion of the territory belonging to three planned biodiversity reserves in the study area for the cumulative effects assessment represents a positive impact for bats and birds through the increase in conservation areas, including their habitats of interest.

Forest fires have caused, and will likely continue to cause, substantial habitat loss inside the spatial and temporal boundaries considered, particularly with regard to forest stands. Thus, when compared with losses caused by forest fires, the anticipated habitat loss caused by the present project is very minor.

Again, in connection with natural disturbances, the appearance of WNS has already caused and will probably continue to cause substantial mortality in resident bat populations, particularly in species of the genus *Myotis*. Because the fungus attacks bats during the hibernation period, they die of exhaustion before winter's end (Chauve-souris.ca, 2018). Very little data is available regarding the location of hibernation sites in the Nord-du-Québec region. The northernmost known hibernation site lies a little to the north of Lebel-sur-Quévillon. Nevertheless, since bats can cover hundreds of kilometres to reach their hibernation site, the risk that species of hibernating bats identified in the study area will be affected by WNS during the hibernation period is high, which could cause a marked fall in the number of bats present in the study area. As a guide, in hibernation sites in the United States, the recorded decline in the species that are present in Québec stands at 91% for the little brown myotis (*Myotis lucifugus*), 98% for the northern myotis (*Myotis septentrionalis*), 41% for the big brown bat (*Eptesicus fuscus*), 75% for the tri-coloured bat (*Perimyotis subflavus*) and 12% for the eastern small-footed myotis (*Myotis leibii*) (Chauve-souris.ca, 2018). Consequently, the effects of the white-nose syndrome constitute heavy pressure on bats of the genus *Myotis* within the spatial and temporal boundaries considered.

Finally, the anticipated cumulative effects of the project on bats are judged to be negligible and will consist mainly in a **slight** increase in disturbance of bats near the site, as well as occasional loss and modification of the habitat. For this reason, the cumulative effect on bats is deemed to be of low magnitude, local scope and long duration. The importance of this cumulative effect is definitively deemed to be minor. The project will therefore not entail substantial cumulative effects on bats (*chiroptera*).

8.6.1.5 MITIGATION MEASURES AND FOLLOW-UP

No additional mitigation measures or additional environmental follow-up beyond those proposed in the specific environmental assessment are required for this component.

8.6.2 BIRD SPECIES AT RISK

8.6.2.1 PROJECTS, ACTIONS OR EVENTS

Table 8-2 provides an inventory of past, current and future projects, actions or events that may, or could, have an effect on bird species at risk. These are essentially the same projects, actions or events that could affect bats. The main elements that may or could have a cumulative effect on changes in the populations of bird species at risk are discussed below.

Most projects related to new linear and non-linear infrastructure and its extension result in habitat changes and losses and disturbance to terrestrial birds and consequently to species at risk. This is particularly the case for projects involving road and secondary road construction, hydroelectric complex construction and substation and power line construction and relocation (building construction, linear structures, land surface flooding and human presence). For example, the Eastmain-1-A/Rupert project resulted in a decrease in passerine bird breeding pairs and a permanent loss of terrestrial and wetland environments at the local level (Hydro-Québec Production, 2004). However, the presence of reservoirs, such as Eastmain-1 and Opinaca, may benefit other species such as waterfowl.

Some bird species are sensitive to the presence of roads (traffic, noise, etc.). Furthermore, vehicles on these roads can cause fatal collisions (Villard et al., 2012). The main roads in the study area considered for cumulative effects are the **Billy-Diamond highway, the access road to the community of Eastmain, the Nemiscau-Eastmain-1 road, the Muskeg-Eastmain-1 road, the Muskeg-Sarcelle road, the Sarcelle-Mine Éléonore road, as well as the various secondary roads.** Other infrastructure can also cause bird disturbance and even mortality, such as airports and their associated airstrips.

Recreational use of the area, i.e., by outfitters, hunting and fishing activities and the granting of leases for rustic or resort shelters, may have resulted in a loss of habitat and an increase in disturbance for certain bird species that nest there. Note, however, that recreational land use is relatively low in the study area. The creation of a network of permanent corridors, associated with access roads to these various facilities, may also have a negative effect on certain migratory bird species by increasing nest predation and disturbance of certain species (Askins, 1994; Jordan, 2000). However, the change in habitat through the creation of roads or trails may benefit some species associated with open areas. Waterfowl hunting and fishing (due to human presence on bodies of water) are the main elements that can have a negative effect on migratory birds in the study area selected for the cumulative effects analysis.

Natural resource development generally results in the changes to and loss of nesting habitats (NABCI, 2012). Mining-related projects have the greatest potential impact on terrestrial bird populations in the area. However, only two active mining projects fall within the cumulative effects study area for bird species at risk (110 km radius around the project site). These are the Nemaska Lithium Inc. Whabouchi mining project and the Éléonore mine.

Forestry activities also have an effect on bird communities, causing habitat losses for several species. Note, however, that logging is prohibited above the 51st parallel. The deforestation activities in the study area are mainly related to the construction of various projects (e.g. reservoirs, dams, work camps, roads, power lines, etc.).

Concerning natural disturbances, the effects do not strictly involve nesting habitat loss. This is the case for forest fires and windfall where different bird species or communities may establish themselves after the disturbance. Indeed, Imbeau et al. (1999) suggest that recently disturbed areas would be characterized by associations of open habitat species. Fires would also benefit special-status species such as the Common Nighthawk and Olive-sided Flycatcher. Several major wildfires have occurred in the study area, including the 2013 fire that affected nearly 15% of the study area.

Some events have resulted in the implementation of regulatory and legal provisions to protect species and their habitats. These include:

- *Migratory Birds Convention Act*, 1985 (replaced by the *Migratory Birds Convention Act*, 1994);
- *Migratory Birds Regulations*;
- *Regulation Amending the Migratory Birds Regulations* (2002);
- *Environment Quality Act* (1972);
- *Act Respecting The Conservation And Development Of Wildlife* (1993);
- Federal Policy on Wetland Conservation under the *Canadian Environmental Assessment Act* (1991).

Note also that the creation of a network of Bird Conservation Regions (BCRs) (1999) allows for the implementation of conservation plans.

Some projects, such as the creation of national park reserves (e.g. Assinica), biodiversity reserves and protected areas, could benefit migratory birds. Migratory birds would benefit indirectly through the protection of their habitats. The Assinica Wildlife Reserve is located south of the cumulative effects study area for this VC.

8.6.2.2 BASELINE CONDITIONS

BCRs are ecologically distinct regions in North America with similar bird communities, habitats, and resource management arrangements (NABCI, 2015). They are defined by the Commission for Environmental Cooperation (CEC) and based on a hierarchical, soft-scaled framework of nested ecological units.

The GLCI Mine Project area falls within BCR 7, the Taiga Canadian Shield and Hudson Plain region (Environment Canada, 2013a). However, the cumulative effects area also covers BCR 8 (Environment Canada, 2013b), the boreal coniferous forest, which is very representative regarding bird communities, particularly for forest bird species. Considering the limited data available, the determination of baseline conditions and the description of historical trends in the status of bird species at risk for the territory covered by the study area is based on data from the Québec portion of BCR 7 and 8 (Figures 8-1 and 8-2).



Figure 8-1 Bird Conservation Region (BCR) 7

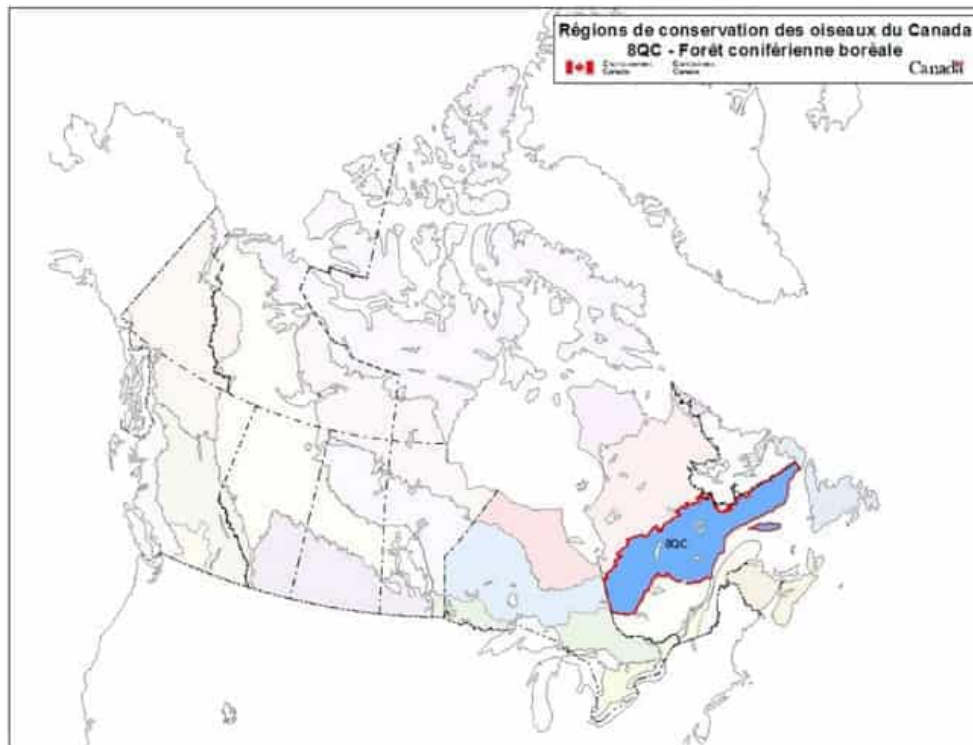


Figure 8-2 Bird Conservation Region (BCR) 8

Data to establish the status of bird species at risk in the area considered for cumulative effects are from 1970 for BCR 8 and 1989 for BCR 7. These years were therefore selected for the baseline condition. Table 8-5 presents the annual index for BCR 7 and BCR 8 for the first inventory year and the most recent inventory year for which data are available (2017) (Smith et al., 2019). The annual index represents the average number of individuals recorded per inventory route.

Species selected include the Common Nighthawk, Short-eared Owl, Bank Swallow, Olive-sided Flycatcher, Canada Warbler, Red-necked Phalarope, Rusty Blackbird, and Yellow Rail.

For BCR 7, the annual index in 1989 is higher than in 2017 for all species for which data are available. For BCR 8, the 2017 annual index is lower than the 1970 annual index for all species except Olive-sided Flycatcher, for which the 2017 annual index is slightly higher (Table 8-5).

Table 8-5 Annual Index of Special Status Species for BCR 7 in Canada and BCR 8 in Québec for the First and Last Inventory Years

SPECIES	BCR 7		BCR 8	
	Annual index ¹		Annual index ²	
	1989	2017	1970	2017
Common Nighthawk	0,10	0,03	0,09	0,07
Short-eared Owl	N/A	N/A	0,03 (1980)	0,03
Bank Swallow	N/A	N/A	17,90	0,98
Olive-sided Flycatcher	0,87	0,75	0,30	0,33
Canada Warbler	N/A	N/A	0,98	0,63
Red-necked Phalarope	0,47	0,07	N/A	N/A
Rusty Blackbird	3,93	2,97	0,32	0,07
Yellow Rail	N/A	N/A	N/A	N/A

Source: Environment Canada, 2013a; 2013b; Smith et al., 2019

N/A: Data not available

- 1: The annual index used is that of BCR 7 for Canada, since no data for BCR 7 in Québec is available. Note also that no data was available for the Short-eared Owl, the Bank Swallow and the Canada Warbler.
- 2: The annual index used is that of BCR 8 for Quebec, except for two species for which no data is available. The Canadian BCR 8 data was used for the Rusty Blackbird and Short-eared Owl. No data was available for the Red-necked Phalarope and the Yellow Rail.

8.6.2.3 HISTORICAL TRENDS

There is little specific data available to establish a baseline condition for population of bird species at risk at the regional level. Therefore, data from BCR 7 and 8 was used. Note, however, that population trends are not available for some BCR 7 species (Table 8-6). Furthermore, no data was available for the Yellow Rail and very little for the Red-necked Phalarope.

Therefore, the Québec portion of BCR 7 is likely to contain 45,000 Bank Swallows, 42,000 Olive-sided Flycatchers, and 2,200,000 Rusty Blackbirds, representing 10.4 %, 45.9 %, and 94.5 % of the Québec population, respectively (Table 8-6). Thus, this BCR accounts for the bulk of the Rusty Blackbird breeding population.

A total of 26,000 Common Nighthawks, 2,000 Short-eared Owls, 210,000 Bank Swallows, 39,000 Olive-sided Flycatchers and 220,000 Canada Warblers would occupy BCR 8, representing 88.9 %, 5.4 %, 48.4 %, 42.6 % and 4.1 % of the Québec population, respectively (Table 8-6). Therefore, BCR 8 accounts for the bulk of the Common Nighthawk's breeding population in Québec.

Table 8-6 Historical Trend for Terrestrial Birds of Valued Status

SPECIES	POPULATION (NUMBER)				POPULATION PROPORTION				BCR 7 POPULATION TREND (%) ¹		BCR 8 POPULATION TREND (%) (%) ²	
	BCR 7 / QC	BCR 8 / QC	Québec	Overall	BCR 8 - QC / Overall (%)	BCR-8- QC / Québec	BCR 7- QC / Overall (%)	BCR-7- QC / Québec	Short term (2007-2017)	Long term (1989-2017)	Short term (2007-2017)	Long term (1970-2017)
Common Nighthawk	0	26 000	29 250	21 687 388	0,1	88,9	0,0	0,0	-1,84	-4,37	1,76	-0,68
Short-eared Owl	0	2 000	37 000	605 854	0,3	5,4	0,0	0,0	N/A	N/A	-0,27	-0,71 (1980-2017)
Bank Swallow	45 000	210 000	434 000	7 911 294	2,7	48,4	0,57	10,4	N/A	N/A	-6,91	-6,00
Olive-sided Flycatcher	42 000	39 000	91 500	2 839 921	1,4	42,6	1,48	45,9	0,48	-0,62	0,11	0,19
Canada Warbler	0	220 000	456 900	2 598 487	8,5	48,2	0,0	0,0	N/A	N/A	2,71	-0,94
Red-necked Phalarope	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-6,22	-6,56	N/A	N/A
Rusty Blackbird	2 200 000	96 000	2 328 100	6 777 257	1,4	4,1	32,5	94,5	-0,82	-1,03	-3,59	-3,33
Yellow Rail	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

1 The population trend used is that of BCR 7 for Canada, since no data for BCR 7 in Québec is available. No data was available for the Short-eared Owl, the Bank Swallow and the Canada Warbler.

2 The population trend used it that of BCR 8 for Québec, except for two species for which population trends were unavailable. The Canadian BCR 8 data was used for the Short-eared Owl and Rusty Blackbird.

Population size was estimated in number of indicated pairs (IPs).

Sources: Environment Canada, 2013; Partners in Flight Science Committee, 2019; Smith et al., 2019.

8.6.2.4 CUMULATIVE EFFECTS

This section presents the cumulative effects on the eight selected bird species at risk.

COMMON NIGHTHAWK

For the Common Nighthawk, changes in insect populations, habitat changes and losses, chemical use, and climate change are considered the primary causes of decline (Blancher et al. 2007; Nebel et al. 2010). Forest operations and forest fire control are also important factors associated with the species population declines (COSEWIC 2007a).

Potential habitat for this species occurs within the project footprint (363.64 ha: 47.34 ha temporary loss and 316.30 ha permanent loss), but also outside of this area, i.e., within the area considered for the cumulative effects assessment.

The inventories detected the species, and at least one breeding pair may use the local study area. The infrastructure construction will result in habitat losses for the species. During the closure, the mine remnants may be available for Common Nighthawk until the trees are large enough to cause canopy closure. Eventually, when the restored habitats have matured, the landscape composition should be similar to what was present before the project and will be subject to the natural dynamics of the area. In conclusion, the mining project will have a positive effect on the Common Nighthawk during the reclamation phase by creating a greater amount of open habitat than was initially present. No effect is anticipated once the reclamation is completed and the habitats have reached maturity.

Therefore, the project's cumulative effect on the species will be low, as replacement habitat is available in the vicinity of the project and the project will create new habitat.

SHORT-EARED OWL

The main threats to Short-eared Owls are, in general, habitat loss and degradation (agriculture, urban and commercial development, energy production, and mining), activities that threaten individuals, nests, and eggs (grazing, mowing and harvesting, pesticides, collisions), and climate change (Environment Canada, 2016).

Potential habitat for this species occurs within the project footprint (443.83 ha: 29.42 ha temporary loss and 414.41 ha permanent loss). However, the inventories did not detect any specimens. Note also that large open peatlands are available outside the planned infrastructure sector. Thus, the cumulative effect of the project on this species will be low, due to the low effect of the project itself on this species.

BANK SWALLOW

The Bank Swallow nests on vertical slopes with substrates composed of a mixture of sand and silt. The primary threats to Bank Swallow populations include loss of breeding and foraging habitat, erosion, aggregate management activities, conversion of pastureland to cropland or afforestation, nest destruction, climate change, pesticides and various threats to migration and wintering grounds (COSEWIC, 2013).

Only 1.31 ha of permanent habitat loss is anticipated. Since the project will impact a small area of potential habitat and the inventories have not detected the species, the cumulative effect of the project on this species is low, due to the low direct effect of the project on this species.

OLIVE-SIDED FLYCATCHER

For the Olive-sided Flycatcher, forest operations, forest fire control, and changes to wintering habitats are identified as causes for the species' decline (Altman and Sallabanks 2012; COSEWIC 2007b). However, in the study area, past forest fires may have benefited the species. Since the species has not been reported, the project's cumulative effect is based on the loss of available habitat for the species, which corresponds to 375.32 ha (22.91 ha temporary habitat and 352.41 ha permanent habitat). However, the inventories did not detect any Olive-sided Flycatchers despite being a species that sings over great distances. Therefore, the project's cumulative effect on this species will be low, due to the low direct effect of the project on this species.

CANADA WARBLER

The main threats to the Canada Warbler include changes to nesting, migration and wintering habitats, forest operations, shrub cutting, energy and mining exploration and operations, overgrazing, reduced insect availability, and collisions. The importance of each of these threats varies across the species' range (Environment Canada 2015). The project will impact 116 ha (17.91 ha temporary loss and 98.11 ha permanent loss) of potential habitat. Since the Canada Warbler has not been reported in the study area although potential habitat is present, the cumulative effect of the project on the species is low. Note also that the study area is located at the northern limit of its nesting range.

RED-NECKED PHALAROPE

The main threats to the Red-necked Phalarope include climate change, the accumulation of contaminants in the Arctic environment, increased industrial activities and the loss of vegetation due to the snow goose population growth (COSEWIC, 2014). The potential habitat loss caused by the project is about 352.41 ha (permanent loss only). Note, however, that based on the known range of the species, it would be surprising if the Red-necked Phalarope nested in the study area (QBBA, 2020). Indeed, breeding populations are found in the eastern and northern portions of Quebec. Thus, the cumulative effect of the project on the species is considered very low.

YELLOW RAIL

The main threats to the Yellow Rail include habitat loss or degradation, the presence of exotic, invasive or introduced species, accidental deaths and changes in ecological dynamics or natural processes (Environment Canada, 2013c). The potential habitat loss caused by the project is 254.30 ha (permanent loss only). Note, however, that based on the known distribution of the species, it would be surprising if the Yellow Rail nested in the study area (QBBA, 2020). Indeed, breeding populations are mainly found along the James Bay coast in northern Québec. Thus, the cumulative effect of the project on the species is considered very low.

RUSTY BLACKBIRD

The main threats to the Rusty Blackbird are conversion of wetlands in the wintering, migration and nesting areas (south of the boreal region), deforestation, "blackbird" control programs, changes in surface hydrology, mercury contamination and acidification of wetlands, climate change, wetland dewatering, and disease and parasites (Environment Canada, 2014).

The inventories detected the Rusty Blackbird in the local study area. Approximately 35 pairs of this species are estimated to be potentially impacted by the project, specifically in open peatlands. Furthermore, the project will impact 352.41 ha (0.06 ha temporary losses and 353.41 ha permanent losses) of potential habitat. However, some pairs could nest on the periphery of the infrastructure zone since several potential habitats are found there. Therefore, the cumulative effect of the project on this species is low.

8.6.2.5 MITIGATION MEASURES AND FOLLOW-UP

Section 10.4.11.4 presents the wildlife follow-up program for birds. No additional mitigation measures or environmental monitoring is required for this component.

8.6.3 LAND USE FOR TRADITIONAL PURPOSES

8.6.3.1 PROJECTS, ACTIONS OR EVENTS

The year 1980 was used as the anterior temporal boundary to assess the project's cumulative effects on the VC land use for traditional purposes by the Eastmain Crees. This was the year in which this community's Crees saw the biggest changes made to the land due to Hydro-Québec's diversion of almost the entire flow of the Eastmain River to the La Grande watershed via the Opinaca reservoir.

Many actions, projects or events have affected land use since then. All these events and their gradual combination have contributed to changes in land use practises over the years. Since the signing of the JBNQA, land and resource use for traditional purposes, more specifically hunting, fishing and trapping, has changed significantly. Over the years, the Eastmain Crees have had to adapt their habits to this environment, which has undergone major changes since the construction of the La Grande and Eastmain-Sarcelle-Rupert complexes.

Four of Eastmain's fifteen traplines have been affected by reservoirs and river alterations related to the La Grande complex. An area of 916 km² was flooded and 274 km of rivers (Eastmain and Opinaca) were diverted. These two stretches of river are fed only by their tributaries. These changes have dramatically altered the activities of the Eastmain Crees in these areas despite corrective work to maintain wildlife. For instance, the diversion of the Eastmain River has reduced its flow by 90% (Hydro-Québec, 2001).

Although some parts of the land have been abandoned because of the major changes they have undergone, the construction of roadways and power lines has greatly facilitated access to other parts. For example, power line rights-of-way offer easy access to hunting, fishing and trapping, and are widely used by the Crees. The development of the power transmission system has therefore had an impact on the opening of the territory but to a lesser extent than the road network (Hydro-Québec Production, 2004). It should be noted that as part of the development of the Eastmain-Sarcelle-Rupert complex, almost the entire Sarcelle-Eastmain-1 315-kV transmission line and Muskeg-Eastmain-1 access road were erected on land belonging to the Eastmain Cree community (Hydro-Québec and Société d'énergie de la Baie-James, 2012).

The presence of worker camps also disrupted the tranquility of the Eastmain Crees and sometimes increased pressure on the resource. Some Cree users were particularly concerned about overfishing in popular lakes. For example, in 2011, there were 6,531 sport fishing trips in the special zone managed by WSI, for a total of 1,328 anglers. These anglers came from the Eastmain, Sarcelle, Habitations Trans-Énergie (near Nemaska) and other worker camps (Hydro-Québec Production, 2012). Note that in the WSI special zone, workers (or other non-Cree anglers) caught 34% fewer fish in 2011 than in 2010 (23,102 fish in 2011 compared to 34,844 in 2010; Hydro-Québec Production, 2012).

The presence of non-Indigenous workers can also lead to a decreased sense of security for the Crees. Concerns are sometimes raised about traffic accidents or vandalism (COMEX, 2013). However, the disruption caused by workers of the hydroelectric projects diminished once construction of the Eastmain-1-A-Rupert project was completed. The Eastmain camp, located 70 km northeast of the project site, had 837 beds at the beginning of 2011 and less than half at the end of the year. The Sarcelle camp, located at the northern edge of the study area, housed between 450 and 600 workers in 2011 and closed in 2012.

In 2014, a 450-unit camp was set up for the Éléonore mine (85 km northeast of the project), which had 1,200 workers in 2015. All mining activities in the region (including any related road and air traffic), whether past, present or potential, have or could affect the traditional activities of Crees using the land, especially if the effect is felt nearby and in the near term. Currently, only the Opinaca Éléonore mine (in operation) is within 110 km of the mine project site. In addition, the Whabouchi mine, located more than 100 km southeast of the project, has been under construction since 2016 and was scheduled for commissioning in 2018. However, at the time of the assessment, it was still not open.

Forest fires in the study area since 1980 (about 68) have also influenced land use by the Crees. A fire in 2013 alone destroyed a large part of the Eastmain Crees' land. In an article published by *La Presse* (July 5, 2013), an Eastmain Cree lamented the consequences of the fire, which prevent the Crees from practising their traditional activities. He also pointed out that 8 of the 15 traplines in his community were burned to the ground (Sioui and Côté, 2013). In addition to limiting trapping activities, it is not unreasonable to assume that forest fires can cause substantial property loss (destruction of camps and equipment).

8.6.3.2 BASELINE CONDITION

In 1980, more than a third of Crees lived permanently in villages. This reality extended beyond Eastmain; nearly two thirds therefore use the territory over long periods. This sedentarization of a growing proportion of the population and the creation of villages are the direct consequences of the advent, in the 1950s, of paid employment and government health, education and social services programs. Despite the external cultural influences resulting from this sedentarization, in 2000 approximately 30% of Cree families regularly engage in traditional activities (Hydro-Québec Production, 2001).

In the early 1980s, the land was already divided into traplines used by Crees. This division of the land is the result of the creation of beaver reserves in the 1930s and 1940s (Hydro-Québec Production, 2004). The Crees still hold exclusive rights to trap fur-bearing animals. To get to their traplines, some use canoes, others fly, while others use snowmobiles or land vehicles when there are roads. Transportation and equipment costs are mainly covered by income derived from trapping and government benefits. However, the high cost of travelling to remote traplines combined with sedentarization have led to decreased use of these traplines (Hydro-Québec Production, 2004).

Also in the 1980s, the construction of the La Grande hydroelectric complex resulted in changes to various watercourses in the study area. The change with the greatest impact on members of the Eastmain community was the diversion of the Eastmain River, which left just 446 km for hunting, fishing and trapping.

The development of the La Grande complex also brought about changes in the Crees' fish consumption habits. Although it remains an important food source for the James Bay Crees, the discovery in the 1980s of high mercury levels in fish in the La Grande complex reservoirs caused them to change their harvesting and fish consumption practises. It is against this backdrop that in 1986 the Crees signed the Mercury Agreement, which aims to minimize the potential effects of mercury on their health and to preserve their lifestyle and traditional activities. This agreement also provides, where appropriate, for Hydro-Québec to undertake work to reduce mercury concentrations in fish (Hydro-Québec, 2018). Despite the Agreement, a 2010 study found that about 70% of James Bay Crees consume local fish less than once a week.

Like Québec as a whole, the individual income of Crees more than doubled between 1981 and 2001 (Hydro-Québec Production, 2004). Crees who regularly trap face new financial obligations such as housing children during the school year, paying rent or buying motorized equipment. The social context of the Cree community has changed significantly in recent years. For example, there is a sharing of authority between the tallymen and elders, who traditionally were the most influential figures in the community, and Cree administrators and politicians (Hydro-Québec Production, 2004).

8.6.3.3 HISTORICAL TRENDS

Since the signing of the JBNQA, land and resource availability has changed mainly due to hydroelectric projects, the development of road and electricity networks, and fires. However, the JBNQA, the Paix des Braves and the Nadoshtin and Boumhounan Agreements recognized the Crees' right to harvest and allowed for the enactment of provisions protecting this right and encouraging hunting, fishing and trapping (Hydro-Québec Production, 2004). This special legal framework also encouraged the Cree government to develop a mining policy to establish guidelines for exploration and mining activities based on sustainable development that respects the Crees' rights and interests. This policy aims to ensure Cree participation in mining activities on the territory, including exploration, extraction and mine closure projects (GCC and ARC, 2010).

Further, the Agreement on Governance in the Eeyou Istchee James Bay Territory, signed in 2012, now allows the Cree Nation Government to assume broader responsibilities with respect to municipal management and management of land and resources on Category II lands (Secrétariat aux affaires autochtones, 2016).

As mentioned above, the changes to the land entailed adaptations in terms of its use, such as traditional activities, sedentarization and human use of the territory.

Between 1975 and 2004, land and resource availability was changed by the hydroelectric projects. In regard to the cumulative effects, the diversion of the Eastmain and Opinaca rivers around 1980, along with the flooding of the areas occupied by the Opinaca and Eastmain reservoirs, and later by the Rupert diversion bays, caused loss of land used by the Crees. It also led to the development of new areas or increased use of traditional areas.

Some users have turned away from areas used by the community or families mainly due to lower fishing or hunting success or fears of mercury contamination. One of the first changes to the land affecting the communities contemplated by the study area on the cumulative effects on traditional land use is the diversion of the Eastmain River to the La Grande River watershed via the Opinaca Reservoir. This diversion resulted in the loss of fishing sites, including one in a nearby estuary that was used by the community. If they cannot adapt to the land changes, users must turn to other activity areas and, according to the COMEX report (2013), many Crees are still in the process of adapting to new activity areas. During the project consultation, one user stated that the Eastmain River diversion had resulted in a deterioration in sturgeon quality but that he was beginning to notice an improvement in this regard.

However, the road network, corrective work and numerous mitigation and enhancement measures have reduced the impact of hydroelectric development on resources and facilitated access to them. For example, various measures have been put in place by Hydro-Québec to encourage the continuation of spring goose hunting, which is still highly valued by the Crees; namely, four new goose hunting ponds on the Eastmain traplines (in areas affected by the Eastmain-1-A-Sarcelle-Rupert project) and four redeveloped ponds (which had been developed during Phase I of the La Grande complex). In addition, approach corridors and foraging areas for geese have been cleared (Hydro-Québec and SDBJ, 2012). Goose hunting also takes place on the James Bay coast and in some ponds, as well as along the roads and reservoirs created. Most of it takes place on the shores of the Eastmain 1 and Opinaca reservoirs.

Although in the past resource proximity dictated camp locations, today road proximity is also a factor (Hydro-Québec Production, 2001). In fact, most of the camps replaced as part of the Eastmain-1-A mitigation measures were built along roadsides. Accesses and snowmobile and ATV trails were also built as part of the project's mitigation or compensation measures (Hydro-Québec and SDBJ, 2012). Access routes, roads and trails now make it easier to access the territory. In addition, because of improved employability in the communities, long stays on the territory have increasingly given way to more frequent and shorter stays. Thanks to roadways, weekend trips can be easily envisioned. Thus, corrective work and mitigation measures aimed at improving access and wildlife harvesting by the Crees have made it easier to travel to certain parts of the modified territory.

Billy-Diamond highway runs directly east of the project and has been undergoing repairs since 2015. Combined with the 2013 reconstruction of the km 381 truck stop, this repair makes this area of James Bay a top tourist attraction.

Lastly, nature and adventure tourism is growing, and the Crees are working together to develop cultural and adventure products showcasing their knowledge of the land and their traditional way of life. The Crees rely on the vitality of their traditions and way of life in developing their tourism offer (Tourisme Baie-James, 2016).

8.6.3.4 CUMULATIVE EFFECTS

According to the impact assessment, the project would have a moderate residual effect on Cree land use. For Cree users, the loss of tranquility in the area surrounding the project could lead to avoidance of some popular areas or disruption of traditional activities. It should be noted that there will be a permanent worker camp at the mine site, which is on the RE2 trapline, and that it will house 150 employees during the operating period. The presence of these mainly non-Indigenous workers may cause Cree users to worry about contamination or disturbance of the natural environment **and wildlife, including piscifuna**. Mine activities may create the same kind of fears. These concerns could eventually lead to avoidance of certain areas near the mine or a decrease in harvesting of certain animal or fish species. It should be noted, however, that GLCI will not allow mine workers to hunt or fish.

Furthermore, the consultations with land users also raised concerns about the presence of workers regarding safety, both on the road (accidents, road degradation) and for break-ins in the camps.

Of the previous projects on the territory, those that most affected land use near the project site are the diversion of the Eastmain River and the creation of the Eastmain 1 reservoir and Eastmain-Sarcelle-Rupert complex. The COMEX report (2013) on the public consultations held following construction of the Eastmain-1-A and Sarcelle powerhouses and the Rupert diversion states that, without denying the project's significant impacts on the territory and its inhabitants, the proponent took the necessary measures to mitigate the residual effects to an acceptable level. It states that one of the most important issues for the Crees in all the James Bay development projects reviewed by COMEX is protection of the Cree traditional way of life as it evolves. In that light, it considers that the real challenge is to ensure the Crees can continue to practise their traditional activities and can adapt to the altered environments. The changes brought about by the new hydroelectric developments (Eastmain-1 and Eastmain-1-A/Sarcelle/Rupert) may lead to a decline in some species and an increase in others as nature seeks to return to equilibrium in the coming years. At the same time, the Cree population is growing (from 2,500 at the beginning of the 20th century to over 17,700 today³), and non-Indigenous people are showing an ever-increasing interest in hunting and fishing on the territory. "At this rate, the environment and natural resources may no longer be able to meet the population's needs as they did in the past. New solutions must be found to prevent overharvesting of wildlife" (COMEX, 2013).

3 Crees residing and not residing in Cree communities.

Among the current or future projects that could affect land use by the Eastmain community are the Rose lithium-tantalum mining project by the Critical Elements Corporation. The anticipated effects of this project on land and resource use are quite similar to those of this project: disruption of hunting, trapping, gathering practices and firewood collection, and changes to access to the territory. Once the various mitigation measures were put in place (hunting and fishing ban), the residual effect on land and resource use was evaluated as low and non-significant.

The completion of the Rose lithium-tantalum project will change current land and resource use, particularly within the RE1 traplines, which are used by many members of the Eastmain community. Located 60 km northwest of the proposed Rose mine, the present project affects RE2 users, including those who had to adapt their use of the land to the Eastmain River diversion in 1980. These users expressed concern about the project's impact on sturgeon, which had already been significantly affected by the diversion. The tallymen of nearby traplines (VC33 and VC35) also expressed concerns that echoed those of the users of traplines RE1 and RE2, particularly concerning the effects on hunting grounds (section 5.5.1). Note also that one user (VC35) mentioned that, although the advent of hydroelectric projects in the territory resulted in a sharp decline in available resources, he still managed to obtain traditional food (mainly fish, beaver, moose and geese), particularly along the Eastmain River. Moreover, moose were beginning to return to the area following the construction of the Eastmain-Rupert-Sarcelle Complex. These Eastmain users were therefore particularly affected by the changes in their traplines and are concerned that the available areas may be altered again. Although the territory is still vast and can enable the relocation of harvesting activities (hunting, fishing, trapping), the Crees need to invest time and resources in finding and adapting to new harvesting sites.

The sector's users worry about the risks of contamination of resources and the hydrological network and an increase in cancer rates caused by contaminants in the food chain. They point out that contaminated animals move around the territory. They also fear contamination of vegetation (medicinal plants, berries or plants consumed by wildlife), particularly by dust and snow that infiltrates the soil. This concern is even more significant among Cree users who feel that they could also be affected by the impacts of the Éléonore mine operations and the Rose Lithium-Tantalum mine project since they are located between these three mines (or mine projects). The users are also concerned that other projects will be added in the vicinity.

Some users were concerned that the project would exacerbate impacts caused by other sources. For example, many expressed concerns that the project would interfere with vegetation regeneration in the area, which is just beginning to recover from the 2013 forest fires. An RE2 trapline user mentioned that the taste of beaver has changed since the construction of the Billy-Diamond highway because of associated pollution and is concerned that the situation will continue to worsen. Furthermore, tallymen associate deformities they have seen in moose with certain herbicides in the existing power line right-of-way and are concerned that the use of such products will continue. Therefore, the territory's developing power lines may accentuate a risk for some users and a loss of activity area. Indeed, some users feel that radiation from power lines impacts wildlife and vegetation and the users themselves avoid these areas for fear of electric shocks. In general, the users surveyed during the consultations feel that the mine's anticipated effects have been minimized and that they will be felt more in the future.

The deforestation associated with the mine's construction and its related infrastructures will result in the loss of additional territory for users although, given the legislation in effect, it will be revegetated in the long term (about 30 years) and will probably be used again for hunting, gathering and trapping. However, some of the users consulted wonder whether the resource that will be there will not still be contaminated years later.

With respect to natural disturbances, forest fires have caused, and are likely to cause, temporary disruptions to traditional Cree activities and even material losses for some members of the community.

Although individually, the project and each of the other projects on the territory may have overall low residual effects on the VC land use for traditional purposes by the Crees, they each result in changes to parts of the traplines (increased traffic, noise and light disturbances, changes in air and water quality, pressure on the resource, avoidance of the area and land loss) which, cumulatively, can disrupt Cree activities in the long run. However, although the projects mentioned will change the way these activities are practised on the territory, they will not prevent their continuation.

The cumulative effect on land use is limited to a small area. It will be especially felt by families who use the trapline where the project is located (RE2). The cumulative effect on this VC could increase with completion of the potential mining projects in the area, despite taking Cree users into consideration in the various compensation plans and mitigation measures planned. Noise, light, dust, increased traffic, loss of wildlife habitat and related traditional activities will affect a growing number of users for each new project on the territory, especially since the number of users is expected to continue growing.

Several major forest fires have occurred in the study area, particularly the fire of 2013, which affected a large part of Eastmain land. Temporary loss of land has an adverse effect on this VC.

With respect to the project in relation to other **past significant sources of impact that occurred and that significantly affected the use of land and resources**, particularly the major hydroelectric projects and forest fires, the cumulative effect on the Crees' current use of the land and resources is considered of low intensity, point-like in extent and long-term in duration; therefore, low. The cumulative effect of the project on Cree use of the land for traditional purposes is therefore non-significant.

8.6.3.5 MITIGATION MEASURES AND FOLLOW-UP

Given that the expected cumulative effect on the VC is non-significant, no mitigation measures other than those in Chapter 7 are necessary and no special follow-up is required.

8.7 RESULTS OF THE CUMULATIVE EFFECTS ASSESSMENT

The cumulative effects analysis for the **three** valued components indicates that the project's adverse cumulative effects on the **traditional use of the territory by** the Eastmain Cree community, **on the bird species at risk** and on the bats in the study areas (spatial scope) for the time periods used (temporal scope) is non-significant.

As a result, no additional mitigation measures or environmental follow-up programs beyond those proposed in the specific assessment of this project are required.

9 ACCIDENT RISK MANAGEMENT

During the construction, operation, infrastructure demolition and project site rehabilitation phases, there are risks that potentially hazardous events could impact environmental components.

Unexpected events occurring independently of the activities or conditions normally associated with a project's performance are considered accidents or malfunctions.

The first line of defence against accidents and malfunctions is the introduction of best practices in the areas of health and safety and environmental protection. Potential accidents and malfunctions are associated with risks that will continue to exist despite the strict implementation of exemplary management systems. Should such events occur despite prevention efforts, it will then be important to minimize environmental impacts through planning, the development of effective mitigation measures and the implementation of an ERP.

Being located a fair distance from any permanent dwellings, the James Bay Lithium Mine project poses very little risk to the populations in the area in the event of an accident, the only exception being the truck stop. An accident could nonetheless impact the persons and property at the site, as well as the environment. The site's location, far from resources that could be deployed, makes it important to identify risks and ensure that resources are put in place to be able to respond diligently and confidently in the event of a major accident.

These measures were incorporated into the design, planning and implementation phases and will therefore be in place throughout the life of the project. The purpose of implementing such measures is to reduce the likelihood of unforeseen accidents and malfunctions occurring. The implementation of preventive measures will also reduce the impact of potential accidents. This approach is part of a stewardship initiative aiming to reduce risks at the source while mitigating their impacts on the environment.

GLCI is committed to ensuring that the risk management process ensures that the plausible consequences of any accident scenarios that have been identified are sufficiently reduced to keep risk levels as low as reasonably achievable.

9.1 ASSESSMENT OF RISK OF MAJOR ACCIDENTS

9.1.1 RISK DETERMINATION METHOD

The analysis of the risks of major technological accidents associated with the project seeks to identify the major accidents likely to occur, assess their possible impacts on the community and the environment, and determine the project's acceptability in terms of risk. It also serves in the development of protective measures designed to prevent the worst-case scenarios (accidents or malfunctions) that could realistically occur or to limit their frequency and impacts.

The notion of risk comprises the following elements:

- hazards that arise in the accident scenarios;
- the severity of the consequences for the accident scenarios;
- the probability of occurrence of the accident scenarios.

The approach adopted complies with the requirements of the **MELCC's** guide to the analysis of major technological risks, *Analyse de risques d'accidents technologiques majeurs* (Théberge, 2002) (hereinafter referred to as the **MELCC Guide**). The analysis also adheres to the main recommendations of the Conseil pour la réduction des accidents industriels majeurs' publication entitled *Guide de gestion des risques d'accidents technologiques majeurs* (2017).

The first steps consist of identifying the sensitive elements in the environment, along with the external hazards linked to the activities, infrastructure or equipment at the site, and determining the history of accidents at similar sites. The next step is to develop accident scenarios associated with the identified risks.

Subsequent steps will entail identifying the potential consequences of the scenarios identified and estimating the probabilities of occurrence. Safety measures designed to eliminate or reduce the risk of accidents will also be established. A risk management plan including an ERP will also be developed to manage any residual risks that cannot be eliminated.

The methods used during the various steps are detailed further in the following subsections.

9.1.1.1 HAZARD IDENTIFICATION AND DEVELOPMENT OF ACCIDENT SCENARIOS

Hazard identification requires drawing up a list of the hazards associated with the project. The method adopted is based on analysis of the following three categories of potentially hazardous elements:

- products that could be found inside the facilities examined;
- equipment and operations;
- external events (i.e., not connected to the processes), whether natural or not.

This identification will subsequently be used to identify worst-case scenarios along with their causes and the preventive and control measures in place.

9.1.1.2 EVALUATION OF SEVERITY OF CONSEQUENCES FOR VARIOUS ACCIDENT SCENARIOS

The severity of the consequences for each worst-case accident scenario identified was determined by experts.

9.1.1.3 ESTIMATION OF THE PROBABILITIES OF OCCURRENCE

The various accident scenarios were analyzed to determine probability. These probabilities were established mainly on the basis of accidents at similar sites in past years.

9.1.1.4 DETERMINATION OF RISK LEVELS

Risk levels are established based on criteria that take into account the incident's severity of consequences and probability of occurrence.

PROBABILITY CLASSES

Probability of occurrence signifies the likelihood that an identified hazard will result in an incident or accident.

The scores for expressing the probability of occurrence of an incident or accident were developed by taking historical events into account whenever possible. The classes are defined in Table 9-1.

Table 9-1 **Classes of probability of occurrence**

Probability class	Definition
Very high	Common event: can occur more than once a year Will occur in the short term
High	Highly probable event: can occur less than once a year Could occur several times during the facility's operation
Moderate	Probable event: could occur less than once every five years Could occur once during the facility's operation
Low	Improbable event: could occur less than once every 20 years Could occur; has occurred within the industry somewhere in the world
Very low	Highly improbable event: can occur less than once every 100 years Not impossible, based on what we currently know, but also not an incident encountered anywhere in the world over numerous years of operation. Would occur only in exceptional circumstances

LEVEL OF SEVERITY OF CONSEQUENCES

The elements that can be considered when determining the level of severity are as follows:

- People: health and safety of workers at the site and of people located within the impact radius at the time of the incident;
- Environment: impacts on the environment (water, air, soil, fauna, flora);
- Property: damage to infrastructure and property, and impact on operations.

The levels of severity of the consequences are established based on the descriptions in Table 9-2.

The level of severity of each element considered (people, environment and/or property), is determined. The overall level of severity, however, is the highest one. For example, a specific accident could have a low level of severity with regard to property but a high level in terms of the environment. The accident's overall level of severity would then be considered high.

RISK LEVEL

Once the probability of a risk occurring and the associated level of severity have been established, the matrix in Table 9-3 can be used to determine the risk level of a given event.

The risk level thus identified takes into consideration the preventive and mitigation measures that have been put in place, so long as these are robust and reliable.

Table 9-4 presents risk acceptability criteria.

Table 9-2 Levels of severity of consequences

Level of severity of consequences	Community	Workers	Environment	Property
Very high	- Several neighbours significantly impacted - Possible evacuation of the community - Significant impacts on lifestyle (traditional use of the land, access to roads and services)	Loss of human life due to direct exposure	- Regional contamination of watercourses, soil, air or groundwater - Disruptions affecting animal and/or plant species at a regional level - Contamination of the aquifer and drinking water supply	- Major damage to property rendering buildings not usable - Operations interrupted for more than a month
High	- Several neighbours possibly impacted - Measurable impacts on lifestyle (traditional use of the land, access to roads and services)	Permanent disability	- Contamination of watercourses, soil, air or groundwater over an area that extends beyond the site - Disruptions affecting animal and/or plant species over an area that extends beyond the site - Local contamination of the aquifer	- Major damage to property, rendering buildings not usable - Operations interrupted for a month
Moderate	- Some neighbours potentially impacted - Minor impacts on lifestyle (traditional use of the land, access to roads and services)	- Serious injury - Temporary disability	- Minor local contamination of watercourses, soil, air or groundwater over the short term, but which could possibly extend beyond the site - Disruptions affecting animal and/or plant species over an area close to the site, presence of habitats with sensitive elements or presence of animal or plant species with special status	- Substantial damage - Operations interrupted for a week
Low	Some nearby individuals possibly impacted	- Injuries requiring medical assistance - Injuries resulting in modified work duties - Diminished quality of life - Minor illness	- Major incident with impacts within the site boundaries - Some of the animal and/or plant species present at the site negatively impacted	- Minor damages - Operations interrupted for a day
Very low	No measurable impact on the community	- Injury requiring first aid - Slightly diminished quality of life (slight discomfort)	- Minor incident - No risk of contamination of sensitive environments (watercourses, wetlands) - No disruptions affecting animal and/or plant species	- No damages - Operations interrupted for 12 hours or less
Notes: In the event of a spill, levels of severity are determined in ascending order (minor, major, significant, very significant). These levels of severity consider the overall quantity spilled as well as the type and characteristics (toxicity, flammability, etc.) of the product involved. A contained hazardous material spill is a spill that can be controlled or contained to the site itself through the onsite implementation of mitigation or preventive measures.				

Table 9-3 Risk levels

Level of severity of consequences	Very high	Moderate	High	Very high	Very high	Very high
	High	Moderate	Moderate	High	Very high	Very high
	Moderate	Low	Moderate	Moderate	High	Very high
	Low	Low	Low	Moderate	Moderate	High
	Very low	Very low	Low	Low	Moderate	Moderate
		Very low	Low	Moderate	High	Very high
	Probability of occurrence					

Table 9-4 Acceptability criteria

RISK LEVEL	DEFINITION
Very high	Unacceptable risks that could potentially result in serious damage. Management is alerted to such risks and must ensure that alternative solutions are implemented.
High	Risks calling for preventive control measures and risk reduction plans as well as a reassessment of risks at regular intervals.
Moderate	Risks that have been reasonably reduced but that remain subject to a continuous improvement approach designed to achieve the lowest possible degree of risk while maintaining acceptable economic conditions, considering knowledge and practices, as well as the vulnerability of the facilities' environment.
Low	Acceptable risks. Control measures must exist and be in effect. Regular monitoring is necessary.
Very low	Negligible risks.

9.1.2 IDENTIFICATION OF SENSITIVE ELEMENTS IN THE ENVIRONMENT

Sensitive elements in the environment that must be taken into consideration during this technological risk analysis are those that, given their proximity, could be impacted in the event of a major accident at the project site. These include the local population, public spaces, infrastructure and sensitive or protected environmental elements. The identification of sensitive elements is limited to a radius of about 1.5 km around the project site (Map 9-1).

9.1.2.1 HYDROLOGY

The project site is located inside the Eastmain River drainage basin, which covers an area of approximately 46,000 km² and drains water from several lakes and rivers.

Three watercourses flow near the facilities (CE2, CE3 and CE4). Creek CE2 flows to the west, running north of the **main water collection pond** before joining the Eastmain River (Map 9-1). Creeks CE3 and CE4 flow to the east and also join the Eastmain River.

9.1.2.2 BIOLOGICAL ENVIRONMENT

VEGETATION

The surveys carried out as part of the EIA indicated that most of the groups (wetland and land) had a low potential of occurrence for species designated or likely to be designated as threatened or vulnerable. **No** special status plant species were identified during the surveys carried out **on the site of the project, according to the 2020 updated list of plant and wildlife species likely to be designated as threatened or vulnerable.**

TERRESTRIAL FAUNA

Three species of large mammals are likely to frequent the project zone: caribou, moose and black bear. **The grey wolf, sometimes considered to be a fur-bearing animal, is also likely to use the project zone.**

Twenty small terrestrial fauna species could also be found in the project zone. Two of these species have a special status: the least weasel, which is on the list of species likely to be designated as threatened or vulnerable in Québec, and the wolverine, a threatened species in Québec and a species considered as endangered in Canada.

Of the small mammal species captured in the study area, only one – the rock vole – is on the list of species likely to be designated as threatened or vulnerable in Québec. **Its preferred habitat, however, seems to have disappeared between 2011 and 2017.**

FISH AND FISH HABITAT

Seven species of fish have been seen in surveys of the watercourses in the study area. They are brook trout (CE1, CE2, CE3, CE4), lake chub (CE2, CE3, CE5, Asiyan Akwakwatipusich Lake), white sucker (CE3, CE5, Asiyan Akwakwatipusich Lake), brook stickleback (CE1, CE2, CE3, CE4, CE5, Asini Kasachipet Lake), northern pike (CE5, Asiyan Akwakwatipusich Lake), trout-perch (CE5) and yellow lake perch (Kapisikama Lake).

AVIFAUNA

Among the bird species present in the study area, there are three species at risk in Québec or in Canada: the common nighthawk, rusty blackbird and bald eagle. The first one nests in burnt areas and on barren land, which are widely available near the project site. The second frequents swamps, beaver ponds and peatlands, all of which are still well-represented habitats in the project zone. As for the bald eagle, suitable habitats for feeding and nesting are available, although the species was not detected during the 2012 and 2017 surveys.

CHIROPTERA

The presence of *Myotis* and two other species of bats (the big brown bat and the hoary bat) has been confirmed. However, considering the survey effort (261 station nights), the number of observations recorded for the various chiroptera species was very low.

Moreover, since no natural cavity or mine opening was found in the sector, the possible presence of a bat hibernaculum in or around the project site is considered null.

9.1.2.3 HUMAN ENVIRONMENT

INFRASTRUCTURE

The Billy-Diamond highway, a 620-km stretch of road linking Matagami and Radisson, is a continuation of Route 109. Its original purpose was to provide access to major hydroelectric project sites in the 1970s. Many Aboriginal communities, among them Eastmain, Waskaganish, Wemindji and Chisasibi, can be reached by this road, which their population also uses to travel.

Except for a rest area at kilometre 381, there are no other populated areas on the outskirts of the project site. The truck stop offers travellers accommodations, food and meals, meeting facilities and vehicle repair services (SDBJ, 2017). It includes a convenience store, laundromat, cafeteria, motel, two garages and a gas station.



- Composantes du projet / Project Component**
- Route / Road
 - Effluent minier / Mine effluent
 - Station de pompage / Pumping station
 - Fosse / Pit
 - Halde à stériles et résidus miniers Sud-Ouest / South West Waste Rock Tailings Storage Facility
 - Halde à stériles et résidus miniers Nord-Est / North East Waste Rock Tailings Storage Facility
 - Halde à stériles et résidus miniers Ouest / West Waste Rock Tailings Storage Facility
 - Halde à stériles et résidus miniers Est / East Waste Rock Tailings Storage Facility
 - Halde à matière organique et dépôts meubles / Overburden and Peat Storage Facility
 - Halde à minerai / ROM pad
 - Usine de procédé / Process plant
 - Bassin de gestion des eaux / Water Management Pond
 - Bassin de gestion des eaux / Water Management Pond
 - Câble de fibre optique / Optical fiber cable
- Infrastructures / Infrastructure**
- Route principale / Main road
 - Route d'accès / Access road
 - Ligne de transport d'énergie / Transmission line
 - Lieu d'enfouissement en territoire isolé (LETI) / Remote landfill
- Hydrographie / Hydrography**
- Cours d'eau permanent / Permanent stream
 - Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream
 - Plan d'eau / Waterbody
- Récepteurs sensibles / Sensitive Receptor¹**
- Campement de travailleurs / Worker's camp
 - Relais routier / Truck stop
 - Sentier de motoneige / Snowmobile trail
 - Aire de chasse, de trappage ou de pêche / Hunting, trapping or fishing area
 - Aire valorisée / Valued area
 - Cours d'eau valorisé / Valued stream
 - Source d'eau potable / Drinking water source
 - Site archéologique connu / Known archaeological site

¹ Lorsqu'il s'agit d'une aire ou d'une composante linéaire, le pictogramme représente le point le plus rapproché des infrastructures du projet.
The pictogram denotes the closest point to the project infrastructure in the case of a surface or a linear component.



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 9-1
Composantes sensibles du milieu /
Sensitive Environmental Components

Sources :
Orthoimage : Galaxy, août 2017
Données du projet / Project data : Galaxy, 2021

0 300 600 m
UTM, fuseau 18, NAD83

Juillet / July 2021

Dessin : A. Masson
Approbation : D. Thiffault
201-12362-00_c9-1_wspT115_RS_composante_210702.mxd



CURRENT USE OF THE LAND AND RESOURCES FOR TRADITIONAL PURPOSES

Nine Cree communities are found on the EIJB territory. One of these, the Eastmain community, is in the project zone. It has 15 traplines. The planned mining infrastructure will be located mostly on trapline RE2, which accounts for 5.8% of the total area of the Eastmain community traplines (15,668 km²). The project will not **directly** affect any other traplines.

NATURAL AND CULTURAL HERITAGE

The truck stop zone includes a known archaeological site. In addition, 27 zones of prehistoric archaeological potential have been identified in a radius of approximately 1.5 km around the project infrastructure. These sites, illustrated on Map 6-22 in Chapter 6, represent the areas most likely to comprise remains attesting to a human presence from prehistoric times up to the twentieth century.

9.1.3 HISTORY OF ACCIDENTS

The history of accidents points to potential hazards and can be used to create accident scenarios for risk assessment purposes. This information can also help improve the design of infrastructure and the associated equipment, determine the necessary safety equipment and better define the risk management plan.

The Analyse, Recherche et Information sur les Accidents (ARIA) database of the French Ministry of Ecology and Sustainable Development's risk and industrial pollution analysis office was consulted online.¹

This search was not meant to be exhaustive but was carried out to identify potential accident scenarios, establish their causes and possible consequences and estimate their probability of occurrence. Furthermore, all the identified accidents did not necessarily occur on sites with the same characteristics as the project site (type of mine [pit or underground], ore mined, type of process used, operating conditions, etc.).

9.1.3.1 MINING ACCIDENTOLOGY

Given that mining activity involves many more substances than merely lithium, the ARIA database search was expanded to cover mining operations in general. The search encompassed accidents that occurred since January 2000 during the following activities:

- B.07.10: iron ore mining;
- B.07.21: uranium and thorium ore mining;
- B.07.29: mining of other non-ferrous metal ores;
- B.08.99: other mining activities.

The search results are included in Table 9-5.

Accidents are classified by type of event (dike breaches, landslides or ground collapses, release of contaminated water into the environment, fires, explosions and others).

Since January 2000, **47** mining-related accidents were recorded. These accidents consisted of:

- landslides, ground collapses, slumping (13 accidents, or around 29.5% of all incidents);
- dike breaches or storage basin overflows (**8** accidents, or around **17%** of all incidents);
- explosions (**9** accidents, or around **19.1%** of all incidents);
- fires (**7** accidents, or around **14.9%** of all incidents);
- contaminant spills or leaks (**6** accidents, or around **12.7%** of all incidents);
- non-classified occurrences (4 accidents, or **8.5%** of all incidents).

1 www.aria.developpement-durable.gouv.fr

No incident is listed in the ARIA database for sites where extractive activities are carried out, for the following activities:

- **exposure to ionizing radiation;**
- **fire affecting a propane tank;**
- **formation of a propane vapor cloud;**
- **theft of explosive material.**

Table 9-5 Accidentology related to mining activity

Date	Country	ARIA o.	Description of incident	Causes (if known)
Dike failure				
25/01/2019	Brazil	53027	In the early afternoon, one of three dams holding liquid waste from iron mine operations broke. A breach in the embankment structure of 86 m in height caused its destruction and resulted in a spill of 12.7 million m3 of toxic effluents. A destructive wave of mud buried the administrative buildings on the site and a part of the village downstream.	Poor design
05/11/2015	Brazil	47369	At 15:30 a breach developed in an iron ore tailings dam. Emptying of the reservoir was begun, but the structure broke at 16:20. The entire impoundment emptied into the valley downstream, causing the rupture of a second dam. A mudslide (approximately 60 M tonnes) engulfed a village of 620 inhabitants. The operator alerted some residents by telephone, but its list was incomplete. It had no alarm sirens as required by good mining practice. No plan to alert or evacuate the public was in place. The incident led to 19 deaths and an environmental disaster. Weak seismic shocks were recorded in the area on the day of the accident, but no link with the rupture of these embankment dams was established. The dam, at the limit of its capacity, was in the process of having its height raised. Accident scenarios had greatly downplayed the volume of the flow of tailings in the event of a rupture: they were based on the 2008 construction height of 45 m, while the dam was twice as high on the day of the accident.	Poor design and structural failure
04/08/2014	Canada	45566	A dike at a storage pond for mining effluent at a copper and gold mine broke. The contents flooded into Hazeltine Creek and Polley Lake and Quesnel Lake downstream. The pond contained copper, nickel, arsenic, lead, selenium and cadmium. The authorities prohibited consumption and use of 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 mineshaft. An investigation was launched by the mining authorities. In 2013, the pond concerned had received 326 t of nickel, 177 t of lead and 18,400 t of copper and copper compounds.	-
23/04/2009	France	36208	Two landslides occurred on the sides of a 600,000 t retention pond for ultimate wastes at an abandoned gold mine upstream of the Gourg Peyris River, a tributary of the Rieussec River, which empties into the Orbiel River. The containment dike was ripped open over a distance of 25 m in two places, leaving solid materials high in arsenic, cyanide, lead and other heavy metals exposed to the open air. Since the pond had been fitted with an impermeable bottom (geotextile), the tailings (which had been covered with vegetated soil to prevent it from being carried off by the wind) had become saturated with water during heavy rains. The pond contents became heavier, exceeding the pond's ability to contain them, leading to the landslides. During the last years of the mine's operation, the pond had been raised several metres above its original level. A dike had also been built downhill as protection in the event of landslides and subsequently enlarged following ground movement. Operations at the ore extraction and processing facility were shut down permanently in 2004. Under an agreement signed between the site operator and the French government in July 2010, the government acquired ownership of some of the most highly polluted lands as well as responsibility for decontamination of the site, in return for a substantial contribution from the operator. Remediation of the site was overseen by the ADEME (the agency overseeing the environment and energy) between 1999 and 2008, at a cost of close to €50 million. The 80 years of mining activity at the site had caused long-lasting arsenic pollution (ARIA 4446, 25267) of the soils and the Orbiel River, whose water was not fit for consumption (affecting a total of 20 municipalities). The sale of thyme and leafy vegetables was also prohibited over an area encompassing five municipalities.	Landslide

Table 9-5 Accidentology related to mining activity (cont.)

Date	Country	ARIA no.	Description of incident	Causes (if known)
30/04/2006	China	31750	At a gold mine near Miliang in Shaanxi province, the dike of a tailings pond was breached, releasing water laden with potassium cyanide (KCN) into the Huashui River, which was polluted over more than 5 km. The flooding triggered a landslide that destroyed about 20 houses at the base of the dam, and 17 people went missing. The quantity of KCN spilled is not known. Since the levels of the chemical exceeded national criteria, local authorities asked residents not to drink water from the river and ordered five towns downstream to test water quality and organize water supply for affected residents. According to mine officials, the search for missing residents did not begin until five days after measures to combat pollution of the watercourse. Calcium hydroxide and bleach were added to the water in an attempt to reduce the concentration of cyanide by converting it to cyanates through oxidation.	-
11/09/2002	Philippines	39967	On August 27, heavy rains caused two effluent holding ponds to overflow at a copper and silver mine that had been operated between 1980 and 1997. The ponds were 120 m high and had a total capacity of 110 Mm³ of consolidated tailings. An inspection found that spillways had overflowed and suffered erosion, and that effluent had been discharged into Mapanuepe Lake and the St. Thomas River downstream. On September 5, the department of the environment and natural resources (DENR) deemed a sudden failure of the two dams unlikely and estimated that, in the event of a breach, Lake Mapanuepe would be capable of dealing with the overload caused by the release of an estimated maximum 9 Mm³ of water. On September 11 at 13:00, a leak appeared in the damaged spillways, causing a limited volume of sludge to discharge. 250 families from three neighbouring villages were evacuated as a precaution, followed by 750 more on September 12 because of the constant rain. The operator brought in heavy pumping equipment from another mining company to pump water out of the pond and began repair work. Heavy rains in July and August had caused the volume of impounded water to increase beyond the spillway evacuation capacity. The mine had been abandoned in 1997, three years ahead of the initially planned date, because of the unstable slopes and annual flooding.	Impoundment overflow Heavy rainfall
08/09/2000	Sweden	21970	An effluent holding pond at a copper mine failed over a length of 120 m, releasing 2.3 Mm³ of sludge into a 15 Mm³ settling pond lying immediately downstream. The settling pond level rose by 1.2 m, and to preserve its stability the operator opened it and released 1.5 Mm³ of slurry into the Leipojoki and Sakijoki rivers, whose beds were covered with a whitish deposit over 8 km. An estimated 23 kg of copper was released in the effluent. On December 4, a second release of 1.5 Mm³ of liquid – containing 9 kg of copper – from the settling pond was made to lower the level of the pond by 1 m and prevent it from breaking. Repair work, which began immediately after the failure, lasted three months. Because of the resultant pollution, a judicial investigation against the operator was initiated by the public prosecutor of Lulea on September 12, 2000. On October 8, 2001, the investigating commission reported that the accident was caused mainly by shortcomings during the construction and operation of the dam and, to a lesser degree, heavy rainfall (which did not, however, exceed the values that had been taken into account in calculating the structure's dimensions). The procedure for monitoring the pond, which was in line with standards at the time of its construction (which began in 1968), proved insufficient and failed to detect the high pore pressure in the body of the dam, despite leaks and local instabilities observed on the side of the structure. The commission brought to light violations of construction permits by the operator during the building of the dam. It recommended instrumentation and tighter monitoring of mining and hydraulic structures that could cause substantial damage to property and persons at the site concerned and the rest of the country.	Poor design and heavy rainfall

Table 9-5 Accidentology related to mining activity (cont.)

Date	Country	ARIA no.	Description of incident	Causes (if known)
30/01/2000	Romania	17265	At a plant opened in May 1999 to reprocess gold-bearing tailings, a waste settling pond ruptured after a 25 m-long crack developed. 287,500 m ³ of effluent containing cyanide (400 mg/L, or 115 t in total) and heavy metals (Cu, Zn) contaminated 14 ha of land and polluted the Sasa River. A “wave of cyanide” 40 km long flowed over the Lapus, Szamos, Tisza and Danube rivers. Cyanide levels reached 50 mg/L in the Lapus, 2 mg/L in the Yugoslav portion of the Tisza (February 12) and 0.05 mg/L in the Danube delta, 2,000 km downstream of Baia Mare (February 18). Romania, Hungary, Yugoslavia, Bulgaria and Ukraine were impacted.	Design flaw, unfavourable weather conditions
Collapse/Landslide				
01/03/2012	France	44758	A geologist was examining an outcrop uncovered during digging of an unshored trench at a gold mine. For some unknown reason, a landslide occurred and the geologist was buried at the bottom of the trench.	Landslide
08/05/2011	Turkey	42972	Internal embankments collapsed in two places at a reservoir of cyanide-containing water at a silver ore processing plant. No leak was detected on the external banks. Activity at the plant was halted and 250 residents were evacuated. The external embankment was reinforced. A group of experts determined that there was no risk of total rupture. A new reservoir was built to hold the tailings. Production resumed after 20 days of stoppage. Operating losses were estimated at \$30 million (€21 million).	Embankment collapse
27/06/2010	Ghana	38555	A gold mine collapsed following heavy rainfall at Dunkwa-on-Offin. The mine, which had been abandoned by its owners, was being operated clandestinely. According to press reports, 136 miners were present at the time of the accident: 15 were found alive, 32 were found dead, and 89 were reported missing. Rescuers installed pumps to clear the mine entrance, but operations were hindered by bad weather. The three owners of the mine were taken into custody.	Collapse Heavy rainfall
21/07/2009	South Africa	36939	At midday, the ground collapsed at a platinum mine operated at a depth of over 1,000 m. Nine miners were killed.	Collapse
05/06/2009	China	36583	At around 15:00, a landslide occurred in a mining region: several million cubic metres came away from a mountainside, burying dwellings and the mining zone located in the valley over a length of 600 m and a width of 300 m and damming the Wujiang. At least a dozen dwellings were buried under 40 m of materials, and several areas of the city suffered cuts in electricity and communications. In the eight days following the disaster, major equipment was deployed for rescue operations and to re-establish the course of the river. Many shafts were drilled in an unsuccessful attempt to reach a tunnel in the mine located at a depth of between 150 m and 200 m in which the authorities estimated that miners could have survived for 5 to 7 days with air and water. On June 12, the authorities reported 42 deaths and 63 missing persons, including the 27 miners.	Landslide
23/04/2009	France	36208	This incident is described in the previous section (dike breaches).	Landslide
12/11/2008	Guinea	35532	A collapse occurred at an open-pit gold mine. At least 14 clandestine workers were killed and, according to witnesses, many others were injured. These gold washers were working illegally without safety measures in shafts abandoned by the mine operator. No official report was provided by local authorities, but this did not rule out a large number of victims given the number of clandestine workers on the site.	Collapse
06/05/2008	Indonesia	34567	A landslide occurred in the evening at a gold and copper mine; 12 miners were killed and at least 15 others were reported missing.	Landslide
13/10/2007	Colombia	33747	A rockslide occurred at an open-pit gold mine near Suarez in the southwest part of the country, killing 21 miners and injuring 24 others.	Rockslide

Table 9-5 Accidentology related to mining activity (cont.)

Date	Country	ARIA no.	Description of incident	Causes (if known)
23/07/2002	Zimbabwe	22840	Following a collapse at a gold mine that had been abandoned since 1940, between 15 and 20 clandestine miners were reported missing. Rescue operations were hindered by the instability of the land in the area.	Collapse
08/01/2002	Congo	21708	A mine collapsed at a peak time, burying dozens of diggers and merchants who had come to supply them. A total of 39 persons were killed or reported missing.	-
24/11/2001	Colombia	21710	The collapse of an abandoned gold mine resulted in numerous victims being buried under tons of mud: 47 bodies were recovered, but the number of victims was considered tentative according to local emergency services. A further 32 people were injured.	Collapse
09/04/2001	Zambia	20673	Ground movement occurred at a copper mine. A slope collapsed, burying 10 miners.	Landslide
Release of contaminated water into the environment				
04/07/2018	France	56140	The French National Forests Office observed pollution in Kokioko Creek, where there was a gold mining site. The levels of suspended matter were 4,800 times higher than the levels permitted by law. The site ponds were open, allowing muddy water to flow directly into the creek. The mud overflow increased turbidity, which reduced oxygen levels, formed a seal over the soil, cut off the air supply to plant life and led to the destruction of natural habitat and biodiversity.	Site remediation in rainy weather
06/08/2015	United States	46802	The Environmental Protection Agency was conducting a technical study to assess water release from an old gold mine, methods of treating this water and possibilities for site remediation. While agents were excavating above the old mine entrance, pressurized water began leaking and flowed into the nearby watercourse. Approximately 11,500 m ³ of orange-coloured water laden with lead, copper, arsenic, iron and zinc polluted downstream watercourses over 160 km. The authorities prohibited navigation, swimming, watering of farm animals and the consumption of water from specific collection points. Lead and arsenic levels were respectively 12,000 and 26 times higher than acceptable levels.	-
06/08/2014	Mexico	45640	Approximately 40,000 m ³ of sulphuric acid and heavy metals spilled from a copper mine effluent storage pond. The coloured discharge polluted two rivers over 150 km, and 20,000 people were deprived of drinking water for many days. The operator poured 100 t of calcium hydroxide into the watercourses to neutralize the effluent. Other leaks were observed during the month of September. Measuring campaigns were conducted in the adjacent border country. The mining company spent €120 million on clean-up operations. The authorities imposed a €2.5 million fine on the operator. The Mexican federal environmental agency launched an investigation into the accident. The mine operator considered that the spill was due to heavy rainfall causing the pond to overflow. Government authorities challenged this explanation.	Storage pond leak Heavy rainfall
04/06/2014	France	45987	Sulphuric acid (H ₂ SO ₄) leaked through a flange at an abandoned uranium mine. 20 m ³ of the chemical were contained in the storage pond and then pumped out by a specialist company. The pond had to be repaired. The flange concerned had been corroded by the acid. Contrary to what the operator believed, it was not made of stainless steel. The operator replaced the PE tank with another made of HDPE. The authorities responsible for inspecting classified facilities were notified.	Poor design

Table 9-5 Accidentology related to mining activity (cont.)

Date	Country	ARIA no.	Description of incident	Causes (if known)
05/05/2014	France	45256	During a transfer operation at around 23:00, almost 100 m³ of effluent of pH 1.1 laden with hydrochloric acid and metals leaked at a metallurgical plant. The spill reached a river, causing its total acidification to dip below a pH of 3 and killing over 1,000 fish. The leak was not discovered until 13:30 the next day and was stopped at 14:00. Fishing and swimming were prohibited. The classified facilities inspection authorities and elected officials visited the site. The plant was shut down temporarily. Local residents expressed their displeasure following this new spill, similar pollution having occurred in 2009. A rain advisory necessitated the use of an isolated transfer circuit for work that had not been sufficiently checked before being brought back into service. The system was partially open following removal of a valve and the leak was not discovered during the operator's routine inspection round at shift changeover.	Procedure/organization
08/03/2005	France	29390	Lead pollution was detected at a small village close to an abandoned lead and zinc mine that had been closed since 1991. According to press reports, samples revealed levels of metals 5 to 13 times higher than European standards. While awaiting additional analysis, a municipal decree banned the consumption of fruits and vegetables in the community, as well as the use of water from private springs for food-related purposes. The mayor ordered that cellar entrances be sealed off and recommended that floors be washed rather than swept while dry. As a precautionary measure, children under 10 were screened for lead poisoning.	Contaminant leak
09/07/2017	France	49980	A fire broke out around 04:30 on fixed equipment for transporting ore over a distance of 11 km at a mining facility. Operator agents detected and extinguished the fire. The fire damaged 350 m of conveyor belt and metal frame.	Malice
08/05/2012	France	42146	At an acid production unit at a nickel extraction plant, water in some pipes cause them to corrode, leading to a leak of sulphuric acid (H₂SO₄). The metal was attacked by the acid, causing hydrogen (H₂) to form. The plant was evacuated. Between 50 and 100 t of acid were collected from the plant's "first flush" ponds before being directed to the waste processing unit. The acid that could not be recovered was neutralized with calcium hydroxide and limestone and then pumped out. No environmental impact was recorded. The classified facilities inspection authorities visited the premises.	Poor condition of pipes (corrosion)
06/08/2010	China	38775	At 17:00, fire broke out at the bottom of a gold mine in which 329 miners were working: 279 managed to get out on their own. Emergency services evacuated the remaining miners, with the exception of seven who were reported missing. The human cost was nonetheless heavy: 16 deaths by asphyxiation in the mineshaft or in hospital and several dozen injured. An electrical cable may have been the cause of the fire, which was not brought under control until 08:30 the following morning. According to press reports, the manager of the mine, which was operated legally, was arrested.	Electrical defect
01/06/2009	South Africa	36550	82 miners working illegally died by asphyxiation when a fire broke out at an abandoned gold mine. 294 other illegal workers living and working at the disused mine at 1,400 m below ground were arrested during operations to recover the bodies of the victims. South African miners' unions requested a government inquiry to look into the question of whether the site had been secured by the last official operator. According to the unions, working conditions at mines in general do not comply with all legal safety requirements.	

Table 9-5 Accidentology related to mining activity (cont.)

Date	Country	ARIA no.	Description of incident	Causes (if known)
Fire				
27/09/2008	France	35578	At around 22:00, fire broke out at a disused 1,000 m ² building that had been in the process of being demolished for the past two months. The building had housed the heating plant of a former potash mine. The fire, which spread through the wooden floors and electrical shafts, gave off thick smoke. After cutting off the power supply, firefighters brought in 26 men and heavy equipment, including two high-capacity tankers to address a shortage of water on the site. Aside from this water shortage, the dilapidated condition of the premises and the instability of the floors complicated the work of the emergency responders, who could not get inside the building even with the use of independent breathing apparatus. The fire was brought under control within 30 minutes, and the emergency response ended at around 02:00. The chosen hypothesis was that thieves had broken in to steal metal and set fire to rubber-sheathed cables in order to recover copper. The site had been placed under video surveillance and was equipped with an alarm system that failed to work.	Malice (fire for the purpose of theft)
26/11/2004	China	28654	Fire broke out at five iron mines: the number of casualties was estimated at 68. The fire started at a private mine and then spread to four other mines, all connected, trapping about 100 miners. Accidents are frequent in China and kill over 7,000 miners annually, according to official figures. Initial investigations suggested that an electrical cable was the cause of the fire.	Electrical defect
20/09/2000	Ukraine	18771	Two accidents occurred successively in the same region: the first fire broke out apparently because of noncompliance with safety rules. It caused the death of a miner, who was asphyxiated by gases. The second fire led to the evacuation of 24 miners. It was quickly contained and there were no victims.	Human error
01/10/2013	Germany	44844	A controlled explosion was set off 700 m deep at a potash mine at 13:10. The release of carbon dioxide killed three employees; four others were rescued. The dust rose to the surface and settled in the surrounding area. Activity at the site was halted. The operator ventilated the entrances and repaired the technical facilities.	-
20/06/2009	China	36397	At around 03:20, a violent explosion rocked a plant producing quartz sand (300,000 t/year) and processing quartz crystals located in the Fengyang district of eastern China. 16 employees were killed and 44 people, most of them local residents, were injured. The plant was destroyed, leaving behind a crater. According to a Chinese official agency, the manager, who was arrested, had illegally stockpiled 7 t of explosives in the offices.	Illegal storage of explosives
12/12/2008	Russia	35883	An explosion occurred at an apatite mine (apatite is a calcium phosphate mineral used in fertilizer production). 12 workers were killed and 6 others were injured. 55 t of explosives made up of a mixture of ammonium nitrate, aluminum powder and used oils, placed at several points in the mine for use in blasting, were reportedly set on fire accidentally during excavation work. A judicial inquiry was opened to look into the alleged violation of safety rules during mining work.	Human error, failure to comply with health and safety rules
26/11/2007	Ecuador	34188	A dynamite store at a gold mine exploded; 7 miners were killed, 40 injured, and 30 reported missing. Rescuers suggested a short-circuit in the mine's electrical network as a possible cause.	Dynamite store Electrical short circuit
20/04/2005	Zambia	29698	An explosion occurred at an explosives factory located on the site of a copper mine. Initial reports stated that more than 50 people were killed. Preliminary findings suggested that those in charge had not observed basic safety rules. The authorities requested that an investigation be opened.	Human error, failure to comply with safety rules

Table 9-5 Accidentology related to mining activity (cont.)

Date	Country	ARIA no.	Description of incident	Causes (if known)
Explosion				
15/12/2003	Poland	26061	43 miners were injured, two of them seriously, in an explosion at a copper mine at a depth of 670 m. The apparent cause of the accident was the transportation of 2 t of dynamite. Fire spread to a vehicle carrying 2 t of dynamite (domino effect). Temperatures were thought to have reached 1,000 °C.	Transportation of explosives
08/05/2001	South Africa	20682	An explosion at a gold mine at a depth of 800 m killed at least 12 miners. A search for missing workers was launched, but the work of rescuers was complicated by the absence of a list of personnel present at the bottom of the mine at the time of the accident. An investigation was launched to determine the causes of the explosion.	-
15/03/2001	Russia	18804	Two miners were killed and two others injured when 21 t of explosives stored in a mine at a depth of 200 m exploded accidentally. An investigation was launched to determine who was responsible for the accident.	-
15/05/2000	South Africa	19205	An explosion at a gold mine killed 7 workers.	-
Other				
18/11/2014	Russia	46033	A flood caused a 40 m diameter crater to form at a potash mine. Employees were evacuated and operations stopped. This mine extracts 10% of global production, approximately 3 Mt per year.	-
15/03/2012	Finland	43054	An employee taking samples close to an ore-processing plant at a nickel, zinc, cobalt and copper mine died after being asphyxiated by hydrogen sulphide (H ₂ S). The victim was not wearing a gas detector or respiratory protection. Atmospheric measurements in the area indicated 50 to 300 ppm of H ₂ S. An investigation was carried out by the police and the government body responsible for investigating industrial accidents. The plant was shut down. The H ₂ S, used to purify the solution produced by bacterial leaching of ore stockpiles, had leaked outside the plant after a sample that had been taken was left open on a pre-neutralization tank. In the tank, lime sludge had reacted with the effluent already present and formed carbon dioxide (CO ₂), which pushed out the H ₂ S that was already present. No gas detector was installed outside the buildings, despite the fact that in the two weeks preceding the accident high levels of H ₂ S had been detected in the area of the accident. The area was marked out, but not all personnel likely to be in the area had been warned of the danger. In addition, the absence of preventive maintenance meant that H ₂ S measuring systems were not functioning properly. It also transpired that the ore purification process was new and that the operator, seeking to obtain an extremely pure finished product, had used excessive quantities of H ₂ S.	Human error and the absence of protective measures
08/10/2009	China	37188	At around 09:15, an accident occurred at a tin mine involving two elevators carrying workers. A cage crashed to the bottom of the shaft, killing 26 of the 31 miners present and injuring the remaining five. A malfunction of the braking system reportedly caused the two elevator cages to collide and then one of them to fall. The vice-governor visited the site and the government ordered an immediate check of workplace safety throughout the province.	Technical failure
03/02/2002	China	21858	Six miners died of carbon monoxide poisoning at a gold mine and 30 others were hospitalized. Some workers lost consciousness after they had come to rescue other workers located at a depth of 270 m.	

9.1.3.2 ACCIDENTS AT THE AUSTRALIAN MT CATTLIN SITE

Between April 2016 and December 2017, 26 spills of more than one litre occurred **at the Galaxy Ressources' Mt. Cattlin site in Australia**. These spills involved hydraulic oil (15), diesel (5), used oil (2), gear oil (1), metal (1), process water (1) or slurry (1). The largest volume spilled was 150 litres. No spills reached the boundaries of the site.

No information has been sent to us about environmental incidents occurring after December 2017.

9.2 IDENTIFICATION OF HAZARDS

External hazards are events from natural or anthropogenic sources that may affect the proper functioning or integrity of a site.

9.2.1 EXTERNAL HAZARDS OF NATURAL ORIGIN

9.2.1.1 EARTHQUAKES

Eastern Canada is in a stable continental region of the North American plate and therefore has relatively low seismic activity. On the Natural Resources Canada simplified Québec seismic hazard map (NRCan, 2017a), the study area is part of zone 1 (very low risk) on a scale of 5 (very high risk).

A magnitude 3 earthquake is strong enough to be felt in the surrounding area, while a magnitude 5 earthquake generally marks the threshold at which an event is likely to cause damage.

In the study area, the *2015 National Building Code* established the probability of a seismic event at 0.000404 per year. This means that, for a 50-year recurrence interval, there is a 2% chance that an earthquake will cause greater than expected ground motion (NRCan, 2017b).

NRCan has listed all earthquakes in Canada between 1663 and 2012 (NRCan 2017c). Earthquakes with a magnitude greater than 5 and where the epicentre was closest to the study site occurred approximately 630 km from the site, one to the southeast and the other to the southwest. They were 5.9 (1988 – Saguenay) and 6.1 (1935 – Québec border – Ontario – Temiskaming region) magnitude earthquakes respectively.

It should be noted that all the project's structural facilities will meet the earthquake resistance standards of the *Québec Construction Code* and the *National Building Code of Canada*. Therefore, the risk of an earthquake with major consequences in the study site is considered low.

9.2.1.2 FLOODING

Flooding typically occurs upstream of a crest (rise in water levels or narrowing of banks) that impedes water drainage. The formation of ice jams can also contribute to flooding by obstructing water drainage, particularly at the points where watercourses narrow during the spring freshet.

There are no significant watercourses near the project site that could produce a major flood. In the event of heavy precipitation, local accumulations could occur. The water would then be drained by the drainage system in place.

9.2.1.3 TERRAIN INSTABILITY

Terrain instability can generally be attributed to relief and the nature of the soils (Landry, 2013). Sloping may lead to a landslide when the materials in place 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 earthflow, are related to soil types, made of plastic or heterogeneous materials. Moreover, areas filled with heterogeneous materials may be prone to soil instability as a result of settlement or subsidence.

Given the small difference in elevation in the study area, there are no problems with regard to the stability of surface deposits.

9.2.1.4 EXCEPTIONAL WEATHER CONDITIONS

Exceptional weather conditions in the form of heavy rainfall, hail or high winds may occur during the summer. In winter, such conditions may include heavy snowfall, high winds and ice storms. These phenomena are caused by particular conditions associated with temperature and humidity gradients between different air masses.

The consequences of these exceptional weather conditions may be direct or indirect. In fact, wind, precipitation, snow and ice may result in overloads and directly jeopardize the integrity of buildings or equipment.

Building and equipment designs will be in accordance with the current codes and regulations to withstand the overloads created by extreme weather conditions. In addition, excessive snow and ice loads will be removed, as needed. Extreme weather conditions, however, remain a plausible accident scenario that should be considered.

9.2.1.5 FOREST FIRES

The MFFP is the entity that deals with forest fire management in Québec. The ministry is supported by the Société de protection des forêts contre le feu (SOPFEU) on fire prevention, detection and firefighting. It should nonetheless be noted that, at this latitude, forest fire control is partial (northern protection zone). The fight against forest fires in this area is carried out through agreements only or in support of emergency preparedness. Therefore, control operations take place mainly near infrastructures such as villages, energy production and processing facilities, etc.

The project area is considered to be a region in which forest fires are the most active and in which some of the largest fires were recorded. From 1840 to 2013, a fire occurred on average every 3.5 years somewhere along the Billy-Diamond highway over a distance of 340 km. Burnt areas cover 2.4% of the land area each year over the past century, and fires spanning over 90 km have occurred every 20-30 years (Erni and coll., 2016).

The MFFP keeps annual records of forest fires in Québec. These records were consulted and show the following:

- In 2005, forest fires reached within one kilometre of the project site from the northeast and the south. These fires affected 23,208 ha and 39,267 ha respectively. The km 381 truck stop had been impacted.
- In 2009, many forest fires were observed to the west and southwest of the project site and one reached within approximately one kilometre to the southwest.
- In 2013, a forest fire burned an area of 501,689 ha, forming a tongue facing southwest/northeast and reaching the km 381 truck stop. The fire passed within one kilometre of the project site.

Map 6-13 shows the areas impacted by these fires in the project area.

In addition, many studies indicate that increasing GHG concentrations in the atmosphere should increase the conditions conducive to forest fires, increasing both the number of fires and their severity (Girardin and Terrier, 2015). Therefore, the risk of a forest fire in the project area is considered very high.

9.2.2 ANTHROPOGENIC EXTERNAL HAZARDS

9.2.2.1 AIR TRANSPORT

No active airport is located near the site. The airfields closest to the project site are the airports located at the Eastmain River (97 km), Nemiscau (88 km) and the Eleonore Mine, which are located to the northeast of the Opinaca Reservoir (85 km).

The risk of a plane crash is higher in the landing and take-off zones. For large aircraft, this area extends over approximately 8.5 km from the end of the runways and is approximately 5 km wide. For small aircraft, this area corresponds to a circle of approximately 4 km around the centre of the runway (De Grandmont, 1994). The project site is located outside any aerodrome landing or take-off zones.

In addition to these areas covering the immediate periphery of an airport, the risk of an accident is also higher in corridors used for air traffic. With the exception of these areas, the probability of a plane crash at a specific location is considered very low.

9.2.2.2 POWER TRANSMISSION LINES

Two transmission lines are present near the site. From north to south, the 4003-4004 circuit (450 kV) runs along the Billy-Diamond highway and cuts it in two. The 614 circuit (69 kV) crosses the territory from east to west, approximately 7 km to the south.

9.2.2.3 REMOTE LANDFILL

A remote landfill is located to the south of the planned pit. It is connected to the activities at the km 381 truck stop. The site has been used for residual materials management since December 5, 1983. Before this use, a quarry was located at the same place. MRNF (now MERN) issued a lease in 2012 to the SDBJ. This site will be fenced.

9.2.3 HAZARDS RELATED TO THE ACTIVITIES ON SITE

The main hazards identified on the site are related to the following activities:

- operation of an extraction pit;
- operation of a spodumene mill;
- using radioactive sources;
- operation of a water treatment plant;
- storage and use of petroleum products;
- storage and use of propane;
- storage and use of chemical products;
- storage and use of explosives;
- mechanical maintenance activities;
- use of oil-filled electrical transformers;
- storage areas for ore, overburden, topsoil and waste rock;
- presence of a containment dike;
- transporting of hazardous materials and concentrates.

9.3 ACCIDENTS AND MALFUNCTIONS

The following sections detail the hazards that have been identified and the assessment of their severity and probability. Table 9-10 presents a risk analysis summary for the project.

9.3.1 OPEN-PIT MINING

This section covers the risks associated with the extraction pit. Two accident scenarios have been identified:

- pit flooding;
- falling rocks along the walls of the pit.

9.3.1.1 PIT FLOODING

Water ingress is an inherent hazard in mining operations. With respect to the pit, surface water or groundwater may enter the pit as a result of rock damage caused by blasting or damage to the rock structure showing excessive cracking, leading to a flow of water into the pit or major flooding. Excess water ingress into the pit will then have to be pumped, requiring operations at the pit to be interrupted.

Prevention and control measures

The following prevention and mitigation measures will be put in place to reduce the risk of pit flooding:

- completion of geological and geotechnical studies to characterize the site;
- monitoring of effects of blasting (in pit) for the formation of excessive cracking;
- installation of pumps to bring back the water to the surface;
- diversion of rainwater from areas not affected by mining operations to the extent possible to prevent them from reaching the mine pit;
- the designer's operating work guide will be followed;
- an inspection program based on the designer's specifications will be implemented.

Probability of occurrence

Pit flooding by water ingress could occur, as this type of incident occurred at similar sites. The probability of occurrence is deemed **low**.

Severity

The consequences of such a flood could potentially entail injuries, including permanent disability and the cessation of pit operations for up to one month. The severity level is deemed **high**.

Estimated risk level

The inclusion of components and severity brings the level of risk of pit flooding by water ingress to **moderate**. The risk level is based on risks for workers and property.

9.3.1.2 FALLING ROCKS AND LANDSLIDES ALONG PIT WALLS

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of falling rocks and landslides along pit walls:

- completion of geological and hydrogeological studies to characterize the site;
- design of pit slopes in accordance with the *Regulation respecting occupational health and safety in mines* (R.S.Q. c. S-2.1 r.14);
- monitoring of potential of landslides or falling rocks in the pit;
- sizing of horizontal and vertical bearings so as to ensure the stability of the extraction pit's slope.

PROBABILITY OF OCCURRENCE

Falling of rocks or unconsolidated deposits along the walls of the pit may occur. The accident history has shown that this type of accident has already occurred a number of times at similar sites. Given the preventive measures taken, the probability of occurrence is deemed **low**.

SEVERITY

This type of accident may cause injuries that can lead to permanent disability and significant economic losses. The severity level is deemed **high**.

ESTIMATED RISK LEVEL

Inclusion of the probability and severity components brings the level of risk of falling rocks or landslides along the walls of the pit to **moderate**. The risk level is based on risks for workers and property.

9.3.2 ORE PROCESSING

This section covers the risks associated with ore processing.

The ore processing approach planned for the site will entail a spodumene concentration process. The selected process involves crushing of the ore followed by dense-media separation (DMS).

Three accident scenarios have been identified:

- fire;
- exposure to ionizing radiation;
- dust emissions.

9.3.2.1 FIRE

A fire could occur at the ore processing facilities. The causes could be:

- welding on equipment with an interior rubber lining;
- conveyor belt friction;
- short-circuit or overheating of an electric motor;
- use of defective heating equipment or supplementary heating systems;
- negligence during hot work.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of fire:

- maintenance of conveyors to prevent belt slippage and friction;
- Installation of thermally controlled sprinklers on conveyors and a water flow alarm system connected to the fire station;
- monitoring of welding on equipment with interior rubber lining;
- design based on National Fire Protection Association (NFPA) standards;
- fire extinguishers at each drive unit for conveyors as well as in all areas with a risk of fire;
- hydraulic firefighting system and fire hydrants;
- sprinkler systems in offices and shops;
- creation of a fire brigade;
- continually updated emergency response plan that includes a fire response procedure.

PROBABILITY OF OCCURRENCE

A fire could occur at the future facilities, as this type of incident has already occurred at similar sites. However, it is not likely given the preventive measures in place. The probability of occurrence is deemed **low**.

SEVERITY

Generally speaking, when a fire takes place at a building, the consequences primarily concern the health effects associated with thermal radiation and toxic fumes. The severity level of a fire may vary, but it can lead to severe injuries or permanent disability.

It can also cause economic losses (cessation of operations, substantial damage to expensive equipment, etc.).

In the event of an incident that spreads beyond the buildings and infrastructure, the natural environment could be impacted. The main impacts anticipated would be dead vegetation, disruption of forest growth as well as short- or long-term habitat loss or loss of plant species conducive to the presence of a number of wildlife species. Wildfires affect the ecological role of forests in all respects: species, stand and landscape. Water quality at affected watercourses may also be impacted by spills of particulate matter and other contaminants into the water.

The severity level is deemed **high**.

ESTIMATED RISK LEVEL

Inclusion of the probability and severity components brings the level of risk for a fire to **moderate**. The risk level is based on risks for workers, the environment and property.

9.3.2.2 EXPOSURE TO IONIZING RADIATION

Nuclear gauges will be used to measure pulp density at the ore treatment plant (concentrator). Between 10 and 15 gauges of different sizes are expected to be used. They will all use gamma rays. This equipment is governed by regulations administered by the Canadian Nuclear Safety Commission.

An incident resulting in exposure to ionizing radiation could occur in the event of a fall or collision involving a nuclear gauge or during a fire.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of exposure to ionizing radiation:

- periodic leak tests on nuclear gauges;
- securing of gauges by double fastening to a fixed and supporting structure;
- installation of gauge protection from shocks;
- identification of nuclear gauges using notices in compliance with regulations;
- application of radiation safety manual requirements;
- preventive maintenance of gauges to prevent breakage and premature wear;
- training for the fire brigade and certification for firefighters as first responders in the event a nuclear gauge breaks;
- continually updated emergency response plan comprising a procedure for an incident involving a nuclear gauge.

PROBABILITY OF OCCURRENCE

Accidental exposure to ionizing radiation may occur in exceptional circumstances. This is a very unlikely event. As a result, the probability of occurrence is deemed **very low**.

SEVERITY

Exposure to ionizing radiation could cause injury to exposed workers, up to and including permanent disability. The severity level is therefore deemed **high**.

ESTIMATED RISK LEVEL

Inclusion of the probability and severity components brings the level of ionizing radiation exposure risk to **moderate**. The risk level is based on risks for workers.

9.3.2.3 DUST EMISSIONS

Dust will be released during crushing and conveyance operations.

The ore processing plant will be equipped with dust extractors, where required, to control emissions of dust into the air. However, a breakdown or improper handling could lead to the accidental emission of dust into the air.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of exposure to dust:

- preventive dust extractor maintenance;
- monitoring of pressure inside filters;
- channelled dust extraction system;
- water spray in tailing handling areas and on roads;
- inspection program.

PROBABILITY OF OCCURRENCE

Dust emission and exposure could occur during the facility's operation. This is therefore a probable incident. As a result, the probability of occurrence is considered **moderate**.

SEVERITY

Such emission is likely to affect the health of nearby workers. Spodumene is the most likely product to be emitted, but it is not highly toxic.

Dust emitted in manoeuvring and handling areas may reduce visibility. Environmental impacts will be limited to the property. Vegetation around manoeuvring and handling areas could be affected locally. The severity level is therefore considered **low**.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the level of dust exposure risk to **moderate**. The risk level is based on risks to workers and the environment.

9.3.3 WATER TREATMENT PLANT

A WTP will be built **when deemed necessary to the east of the main water management pond**, in the northern part of the site. It will be designed to treat **all drainage water from the site that is collected in the main water management pond**, when its quality does not meet regulatory criteria.

A water treatment system malfunction could cause the accidental discharge of harmful substances into the final effluent. A discharge of untreated or partially treated mine water could contaminate stream CE2 waters and violate the MDMR and D019. This non-compliant discharge could be due to a design or operation flaw, human error or mechanical failure.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of non-compliant discharge into the final effluent:

- verification of treatment effectiveness through periodic analyses;
- ongoing pH and turbidity monitoring: instrumentation connected to the site automation network, available in the plant control room.

PROBABILITY OF OCCURRENCE

A non-compliant discharge into the final effluent could potentially occur, as this has already happened at similar sites. The probability of occurrence is therefore considered to be **low**.

SEVERITY

Spills of substances harmful to the environment could impact animal and/or plant species over an area that extends beyond the site.

Potential impact on wetlands

The discharge of raw (untreated) effluent will have a potential impact on the quality of CE2 stream waters.

Potential impact on benthic fauna

The potential effects on the benthic community would be contamination potentially leading to mortality, decreased benthic abundance and diversity, as well as lower recruitment (eggs and larvae), food consumption and growth rates.

Potential impact on fish fauna and its habitat

Fish may ingest very toxic substances and transmit them to the predators that eat them. A hazardous material spill in an aquatic environment may seriously hinder the next generation of fish.

Generally speaking, fish populations can be affected by a spill at different times of the year if their habitat or their prey is affected in terms of reproduction, rearing, feeding, migration and wintering.

Fish capable of moving within their habitat and potentially relocating to an environment less exposed to contaminants in the event of a spill are less likely to feel the effects of such an event, except during the reproduction and egg incubation period.

The severity level is therefore considered **high**.

RISK LEVEL

The inclusion of the probability and severity components brings the level of risk of non-compliant discharge into the final effluent to **moderate**. The risk level is based on risks to the environment.

9.3.4 STORAGE AND USE OF PETROLEUM PRODUCTS

During the construction phase, diesel will be supplied by truck. There are no plans to install a diesel tank.

Three diesel tanks will then be used, each with an 80,000 L capacity. Installation of these tanks is expected to happen in the southeastern part of the industrial sector. These tanks will be above ground. Annual diesel consumption is expected to be 14.8 million litres.

Fuel will be delivered by tanker trucks. Table 9-6 shows the diesel characteristics.

Table 9-6 Diesel characteristics

Product	State	Flash point (°C)	Self-ignition temperature (°C)	Flammable limits		Reactivity	Classification
				LFL	UFL		
Diesel	Liquid	>40	>225	0.7	6	Strong oxidizers and strong acids	

Produced during the distillation of oil, diesel is composed of various hydrocarbons in series C₁₀ and higher. It is a clear, yellow liquid. It is not very volatile at ambient temperature, but may emit vapours that form an explosive mix with the air when heated. Diesel is less dense than water (density of 0.85) and is water-insoluble.

The danger of flammability associated with flammable products is related to:

- the product's emission into the air in proportions found within the flammability range;
- the presence of an ignition source.

Diesel is not currently listed in the *Environmental Emergency Regulations* (EER) as a substance with potential to cause a major technological accident. However, it is listed in an amended version of this regulation. The stated threshold quantity is 2,500 metric tonnes. The quantity expected to be stored is therefore lower than this threshold.

Hydraulic and lubricating oils as well as greases will also be used. These oils are hydrocarbons and come from a fairly heavy petroleum fraction. This means they are viscous and have high flash points.

This section covers the potential risks associated with the transportation, storage and use of petroleum products. Three accident scenarios have been identified:

- spill of petroleum products;
- fire and/or explosion of petroleum products;
- spill of oils and greases.

9.3.4.1 SPILL OF PETROLEUM PRODUCTS

Factors likely to cause an accidental spill of petroleum products include mainly:

- an accident during transport of a petroleum product by truck on the site;
- a collision causing a fuel tank failure (vehicle, machinery or other);
- a leak from a valve, pipe or connection;
- a machinery breakdown;
- corrosion of equipment;
- overflow of a tank or another container during filling;
- human error.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of petroleum product spills.

During the construction phase

- Ensure that a sufficient number of emergency kits for the recovery of petroleum products and chemicals are available in sensitive locations.
- Through frequent inspections, ensure that machinery is in good working order (clean with no contaminant leaks) and that fuel and lubricant tanks are perfectly sealed. Any discovered leaks require immediate repairs to the tank in question.
- The usual precautions should be taken during maintenance (draining, greasing, etc.) and refuelling of machinery on site to avoid any accidental spills. Maintenance is to be permitted only in authorized locations intended for that purpose (garage, mechanical workshop); refuelling is to take place in specifically designated areas.
- Equip all fixed equipment containing oils and/or fuel (e.g. lighting tower, generator, crusher, sifter, etc.) located less than 60 m from a watercourse or body of water with a leakproof recovery system. Equipment must be equipped with absorbents for quick and effective response in the event of an accidental spill.
- Prohibit any vehicle and machinery maintenance outside the designated areas.
- Mark out access, paths and work areas before undertaking work, and prohibit parking and movement of machinery and vehicles outside those areas.
- Machinery fuel will be supplied by ground transportation. All suppliers must comply with the *Transportation of Dangerous Goods Act* and the *Regulation respecting hazardous materials*. They will be required to develop safety and emergency procedures.

- The contractor will be required to hold a permit for the use of high-risk petroleum equipment if installing or using an aboveground tank with a capacity of 10,000 L or more of diesel fuel or a tank with a capacity of 2,500 L or more of gas. This permit comes with inspection and servicing obligations.

During the operation phase

- Transfer, equipment and tank areas will be designed in compliance with regulations, standards, applicable codes and industrial best practices.
- Tanks will be installed on a concrete slab.
- The tanks will be double-walled with a secondary containment tank that can hold 110% of the stored volume.
- A level detection system will be installed in fuel tanks: an instrument panel showing the tank level to prevent overfilling and confirm the integrity of the double wall.
- A petroleum product receiving and distribution procedure will be developed.
- Tanks and related equipment will undergo preventive maintenance against breakage and premature wear.
- Workers responsible for bulk petroleum hydrocarbon transfer and handling will be trained.
- Spill kits containing absorbents will be available near transfer and handling points.
- A regular inspection schedule will be established for petroleum product transfer and storage locations.
- The emergency response plan will include a procedure for responding to spills of petroleum products.

PROBABILITY OF OCCURRENCE

A spill of petroleum products, regardless of the quantity spilled, may occur multiple times during the life of the mine. As a result, the probability is considered **high**.

SEVERITY

A spill of petroleum products in a containment tank or on a waterproof surface, such as a concrete slab, will have no effects once cleaned up.

In the event of an uncontained spill of petroleum products, the product could drain into the ground under the effects of gravity and accumulate in a depression. In a worst-case scenario, which is highly unlikely, the spill could reach a wetland or the creek CE3.

A spill of petroleum products could also cause a fire if the oil slick is ignited. This scenario is explored in the next section.

Although potentially major, this type of spill would be controlled at the site of the incident, given the prevention (double-walled tanks, containment system, etc.) and response (spill kit and means of containment) measures in place. The affected environment may include soil, a wetland or, at worst, a watercourse, depending on the location of the spill. The severity level may vary from low (soil) to **moderate** (wetland or watercourse).

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk of a petroleum products spill to **moderate**. The risk level is based on risks to the environment.

9.3.4.2 FIRE AND/OR EXPLOSION OF PETROLEUM PRODUCTS

Petroleum products may catch fire in the diesel storage area or during transport and distribution.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of fire and/or explosion of petroleum products:

- design of transfer, equipment and tank areas in compliance with regulations, standards, applicable codes and industrial best practices;

- installation of tanks on a concrete slab;
- fuel tank level detection: an instrument panel showing the tank level to prevent overfilling and confirm the integrity of the double wall;
- development of a petroleum product receiving and distribution procedure;
- preventive maintenance of tanks and related equipment against breakage and premature wear;
- training of workers responsible for bulk petroleum hydrocarbon transfer and handling;
- training of a fire brigade;
- assessment of risks and compliance of petroleum product transfer and storage locations as part of internal inspections;
- dedicated water reserve for fire protection;
- update of an emergency response plan comprising a fire response procedure.

PROBABILITY OF OCCURRENCE

A fire or even an explosion involving petroleum products could occur in exceptional circumstances, such as during a fire near petroleum product tanks or if fuel ignites during a spill. As a result, the probability of occurrence is considered **very low**.

SEVERITY

Fire

If petroleum product tanks catch fire, the fire is not very likely to spread to nearby infrastructure given their location. Therefore, the only impacts would be on the people present, on infrastructure and on vegetation due to the heat release.

Explosion

An explosion is a physical phenomenon leading to the significant release of energy in a very short amount of time in the form of high-pressure, high-temperature gas production. It is a wave of excessive pressure accompanied by projection effects (blasts) and/or thermal effects (heat emission). The impact distances are difficult to assess because they depend on the topography, the presence of obstacles and/or buildings and the quantity of explosive substance involved.

An explosion of petroleum products may cause flammable materials to ignite due to the thermal effect or the projection of burning debris. In such a case, the impacts on environmental components as well as the prevention and control measures will be those set forth in the preceding section.

However, this type of incident could lead to permanent disability, or even loss of human life, within the impact radius as well as significant damage to nearby buildings and infrastructure, requiring an interruption in production and causing considerable economic losses.

With respect to environmental impacts, vegetation near the explosion site (petroleum product storage area) could be destroyed by the heat. Further away from the explosion site and in the absence of fire, the potential impacts on vegetation will be related to blast and projection effects. As for the wildlife within the impact perimeter, the potential outcome would be injuries or even death.

The severity level is therefore considered **very high**.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk of a petroleum product fire and/or explosion to **moderate**. The risk level is based on risks to workers and property.

9.3.4.3 SPILL OF OILS AND GREASES

A spill of petroleum products such as lubrication oils and greases could occur. The causes could be an equipment failure, operator error or an equipment spill.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of spills of oils and greases:

- design of transfer, equipment and tank areas in compliance with regulations, standards, applicable codes and industrial best practices;
- containment systems for spills in storage, distribution and usage areas;
- environmental protection and awareness training for workers;
- availability of spill kits containing absorbents near transfer and handling points;
- update of an emergency response plan comprising a petroleum product spill procedure.

PROBABILITY OF OCCURRENCE

An oil and grease spill is not very likely given the prevention measures in place. However, it may occur. The probability of occurrence is considered **low**.

SEVERITY

The severity level for the natural environment is considered **low** given the quantities involved, the fact that these products are used and stored in buildings and the mitigation measures in place. The impact will therefore be highly localized.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk of an oil or grease spill to **low**. The risk level is based on risks to the environment.

9.3.5 PROPANE STORAGE AND USE

This section covers the risks associated with the storage and use of propane.

Propane is planned to be used for the workers' camp heating system and the emergency heating system of buildings in the administrative and industrial sector.

A tank is expected to be installed next to the camp. The tank will have a capacity of 113,562 L. Annual consumption is expected to be 1,250,972 L. Table 9-7 shows the propane characteristics.

Table 9-7 Propane characteristics

Product	State	Flash point (°C)	Self-ignition temperature (°C)	Flammable limits		Reactivity	Classification
				LFL	UFL		
Propane	Liquefied gas	-103	430	2.1	9.5	Strong oxidizers, chlorine dioxides	

Propane is a flammable, explosive liquefied gas. It is a substance that appears on the list of hazardous materials in the MDDELCC guide with potential to cause a major technological accident. It is also an EER-regulated substance. However, since the threshold quantity is 4.5 metric tonnes and the density of propane is approximately 2.01 kg/m³, the threshold will not be exceeded.

Two accident scenarios have been identified:

- propane tank fires;
- propane vapour cloud formation.

9.3.5.1 PROPANE TANK FIRES

Propane leaks caused by a broken flexible hose, broken pipes or a vehicle colliding with the tank could result in a fire or explosion of the tank. A building or forest fire could also cause a propane fire/explosion.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of a propane tank fire:

- facilities in accordance with CSA B149.2-05 (Propane Storage and Handling Code);
- installation of shock protection devices around tanks, aboveground pipes and related equipment;
- area surrounding propane tanks free of combustible materials, vegetation, debris, etc.;
- ground under propane tanks sloped toward the periphery to avoid the accumulation of combustible liquid under the tank in case of accidental leakage;
- qualified propane supplier;
- training of workers responsible for propane transfer and handling operations;
- portable fire extinguishers located near tanks;
- update of emergency response plan including an accident response procedure for incidents involving propane.

PROBABILITY OF OCCURRENCE

A propane tank fire/explosion could occur in an exceptional situation. The probability of occurrence is considered **very low**.

SEVERITY

The exposure of a propane tank to flame leads to a rise in tank pressure, a weakening of the tank walls and rupture resulting in a fireball, a shock wave and projection of fragments. The situation develops very fast. Such an incident could lead to loss of life and significant damage to the surrounding infrastructure, leading to a major operations interruption and economic loss.

The severity level is therefore considered **very high**.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk level for a propane tank fire/explosion to **moderate**. The risk level is based on risks to workers and property.

9.3.5.2 PROPANE VAPOUR CLOUD FORMATION

Propane vapour cloud formation could occur because of a propane leak in a pipe or valve due to equipment failure. The vapours are likely to concentrate to explosive levels. The explosive range for propane is 2.4% v/v to 9.5% v/v.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of propane vapour cloud formation:

- facilities in accordance with CSA B149.2-05 (Propane Storage and Handling Code);
- installation of shock protection devices around tanks, aboveground pipes and related equipment;

- ground under propane tanks sloped toward the periphery to avoid the accumulation of combustible liquid under the tank in case of accidental leakage;
- qualified propane supplier;
- training of workers responsible for propane transfer and handling operations;
- update of emergency response plan including an accident response procedure for incidents involving propane.

PROBABILITY OF OCCURRENCE

Propane vapour cloud formation could occur in an exceptional situation. The probability of occurrence is considered **very low**.

SEVERITY

A flammable propane vapour cloud formation could result in a fire and/or explosion causing loss of life and significant damage to the surrounding infrastructure, leading to major operations interruption and economic loss. The severity level is therefore considered **very high**.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk level for propane vapour cloud formation to **moderate**. The risk level is based on risks to workers and property.

9.3.6 STORAGE AND USE OF NON-PETROLEUM PRODUCTS

Table 9-8 lists the main products used, how they are stored and quantities expected. Table 9-9 shows product characteristics.

This section covers the potential risks associated with the transportation, storage and use of non-petroleum products. An accident scenario was identified, i.e. a chemical spill.

Accidental chemical spills may occur during the transportation, use, handling or storage of these products. Equipment failure or human error can also cause a spill.

Table 9-8 Main products used

Product	Use	Storage method	Annual quantity used (t)	Maximum quantity stored (t)
Ferrosilicon	Added to the DMS process to separate spodumene	One-ton bags, stored outside next to the DMS product warehouse	845	200
Hydrated lime	Added during production stoppages to prevent corrosion in the DMS process	20 Kg bags, stored on pallets in the DMS product warehouse	40	10
Flocculant	Added to the thickeners to precipitate suspended solids before recycling the water back into the DMS system	Inside the DMS product warehouse	2	0.5

Table 9-9 Characteristics of main products used

Product	Characteristics			
	State	Colour	Reactivity	Classification
Ferrosilicon	Solid (granulated)	Grey	Releases flammable gas on contact with water (hydrogen) Oxidizing agent	 
Hydrated lime (calcium hydroxide)	Solid	Colourless or white	Reacts violently in the presence of strong acids, maleic anhydride, nitro-alkanes, phosphorus, ammonium salts, hydrides, nitrides, sulphides and peroxides. It attacks certain metals (aluminum, copper, zinc and certain steels).	
Sulfamic acid	Solid in crystal form	White	Incompatible with acids, chlorine, fuming nitric acid. Becomes corrosive when wet. Reacts quickly with alkalis and metals.	 

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of chemical spills.

Storage

Storage will respect the compatible product classes defined by the Workplace Hazardous Materials Information System (WHMIS) as well as the *National Fire Code (NFC)* and *Regulation respecting hazardous materials*.

Storage areas will be established, and storage conditions will take into account incompatibilities between products.

Secondary containment systems at transfer points will be designed to contain the worst-case spill scenario. Containment volume will be established for each chemical reagent delivered in bulk, based on transfer rates and supplier recommendations.

All used and non-reusable chemicals will be stored for up to one year in accordance with the *Regulation respecting hazardous materials*. Used hazardous materials will be recovered by companies authorized to recover the products concerned. Secure collection areas with specialized waste disposal and hazardous materials containers separated by category will be provided at appropriate locations, depending on the production site. Temporary storage areas will be inspected on a regular basis and all employees will be instructed as to their use to avoid mixing errors or overfilling.

Handling

Chemicals will be employed in accordance with supplier instructions as well as applicable regulations. When handling chemicals, wearing appropriate protective equipment is mandatory (e.g. safety glasses or goggles, chemical resistant gloves [neoprene, butyl rubber, rubber or leather], appropriate protective clothing [e.g. full face mask]). Equipment required in critical areas will be indicated by posters. They will also be defined beforehand in a health and safety program. National Institute for Occupational Safety and Health (NIOSH)-approved respirators may also be required to reduce worker exposure to dust and/or fumes when handling certain chemicals.

Training

Employees responsible for the handling and transportation of hazardous materials will have first undergone specialized handling and related hazards training, such as Transportation of Dangerous Substances, WHMIS or other appropriate instructions. Employees must be informed about the contents of the hazardous products material safety data sheets.

Transport

It is expected that chemicals will be transported to the site by truck. Transportation arrangements will comply with the *Transportation of Dangerous Substances Regulation* and the *Transportation of Dangerous Substances Guide* (MTMDET, 2017). Hazardous products will be placed in compliant, leak-proof containers to minimize the risk of a spill if they are tipped over by the carrier.

Response equipment

Spill response kits, customized to the type and quantity of substance, will be placed at strategic locations on the site (storage and refuelling areas). The contents of the kits will be checked periodically.

Emergency showers and eyewash fountains will also be installed where chemicals are used.

Emergency response plan

An emergency response plan will be developed and updated. It will include response strategies in the event of a chemical spill.

PROBABILITY OF OCCURRENCE

A chemical spill is unlikely due to existing safety measures. However, it could occur as it has on similar sites. The probability of occurrence is considered **low**.

SEVERITY

In the case of a chemical spill, the product, if not contained, could reach the ground by gravity and accumulate in a depression. It's unlikely that it could reach a waterway. The level of severity on the environment is therefore considered low due to the quantities involved, the fact that the products will be used and stored in buildings and the existing mitigation measures. The impact would therefore be very localized.

However, in the case of a spill:

- Ferrosilicon, when in contact with water, emits a flammable, highly explosive and toxic gas: phosphine (or hydrogen phosphide).
- Lime, with its very basic pH, poses a risk to aquatic life if it reaches a watercourse.
- Sulfuric acid's highly acidic pH poses a risk to aquatic life if it reaches a watercourse.

The impact level is considered **high** because of the reactivity of ferrosilicon.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk level for chemical product spills to **moderate**. The risk level is based on risks to workers and the environment.

9.3.7 EXPLOSIVES HANDLING AND STORAGE

Pit blasting will be carried out using an emulsion explosive consisting of ammonium nitrate, fuel oil and surfactant. Storage will be at three sites: the explosives warehouse (ammonium nitrate), the emulsion warehouse and the detonator warehouse.

The expected amounts of explosives used are:

- detonators: 27,000;
- ammonium nitrate: 159 kg;
- emulsion: 76.5 kg.

A specialized supplier will be responsible for the procurement, operation and maintenance of the explosives transfer site.

This section covers the risks associated with explosives. Two hazards that can lead to major accidents have been identified:

- explosion of explosive material;
- theft of explosive material.

9.3.7.1 EXPLOSION OF EXPLOSIVE MATERIAL

An accidental explosion could occur due to an accident involving a transport vehicle, an explosives warehouse fire or a poorly controlled blast.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of aboveground explosions.

Use

- To prevent negligence or error, the handling and use of explosives will be entrusted to an authorized and specialized supplier.
- Workers handling explosives must hold an explosives certificate issued by the Sûreté du Québec.
- Heat sources and open flame and other pyrotechnic or flammable materials will be removed before a spill clean-up, because an explosive can explode when located near a fire source.
- Specific controls will be put in place to check drill hole dimensions, depth and direction as well as the charges.
- Weather conditions (e.g. rain, wind) can influence the effectiveness of an explosion. If water is present in the blast holes, the detonation will not be as effective as in dry weather. Some of the explosives, such as ammonium nitrate, could also be converted into a nitrogen oxide vapour, a toxic gas. Thus, the blasting schedule will be based on weather conditions to reduce the risk of faulty blasting and to protect workers.
- Blasting must comply with the requirements of the *Regulation respecting occupational health and safety in mines* (R.S.Q., c. S-2.1 r.14).
- Signs prohibiting smoking will be posted in the explosives assembly facility and within the blasting zone.
- Particular attention will be paid to emissions when wet explosives are detonated or in the event of faulty blasting in order to not impact worker health and the environment.

Storage

Storage facilities and explosives preparation management will also be the responsibility of a specialized contractor. Contractors must ensure that:

- Storage methods (location, distance, size, etc.) will comply with applicable provincial and federal provisions, including the *Regulation respecting hazardous materials* (R.S.Q., c. Q-2, r.32), Explosives Regulatory Division (ERD) quantity-distance principles and the *Guidelines for Bulk Explosives Facilities* (NRCan, 2014).
- Explosives are stored in warehouses. They will be secured to prevent unauthorized personnel from trespassing and will comply with provincial and federal explosives laws (R.S.Q., c. E-22 and R.S.C., c. E-17) regarding construction standards, safety distances from site facilities, protection measures, well-ventilated areas and areas protected from moisture.
- The products used are clearly identified.
- Emulsions and detonators are stored separately.

Transport

Explosives will also be transported by a specialized supplier as specified in the *Regulation respecting hazardous materials*. Vehicles used to transport explosive agents will be marked, and the people transporting explosives will have the necessary training and skills.

PROBABILITY OF OCCURRENCE

An explosion could occur, but in exceptional circumstances; thus, the probability is considered **very low**.

SEVERITY

Ammonium nitrate is used in explosives and is accompanied by gas emissions, namely carbon dioxide (CO₂), nitrogen (N₂), hydrogen (H₂), nitrogen oxides (NO_x), sulfur dioxide (SO₂) and carbon monoxide (CO). Under normal operating conditions during blasting, none of these gases represent health risks to workers. However, nitrogen oxide vapours from burning ammonium nitrate are extremely toxic.

An explosion is a physical phenomenon leading to the significant release of energy in a very short amount of time in the form of high-pressure, high-temperature gas production. It is a wave of excessive pressure accompanied by projection effects (blasts) and/or thermal effects (heat emission). The impact distances are difficult to assess because they depend on the topography, the presence of obstacles and/or buildings and the quantity of explosive substance involved.

A petroleum product or explosive material explosion may cause flammable materials to ignite due to the thermal effect or the projection of burning debris. In such a case, the impacts on environmental components as well as the prevention and control measures will be the same as a fire situation.

Such a situation would result in serious injury or in a worst-case scenario, loss of life. Depending on the location of the explosion, it could also have a significant impact on property and bring operations to a halt for around a month.

Vegetation near the site of the explosion could be destroyed by the heat. Further away from the explosion site and in the absence of fire, the potential impacts on vegetation will be related to blast and projection effects. As for the wildlife within the impact perimeter, the potential outcome would be injuries or even death. It is expected the number of feeding areas and shelters will decrease when habitats are disturbed. Finally, the water quality could also be affected by the introduction of debris and contaminants.

The severity level is considered **very high**.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk level for an explosion of explosive material to **moderate**. The risk level is based on risks to workers and property.

9.3.7.2 THEFT OF EXPLOSIVE MATERIAL

Stolen explosives could be used for criminal purposes.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of explosive material theft:

- explosives deliveries supervised at all times;
- maintenance of inventory records for explosives and detonators;
- warehouses located in enclosed areas.

PROBABILITY OF OCCURRENCE

Explosive material theft could occur, but in exceptional circumstances, thus, the probability is considered **very low**.

SEVERITY

Misuse of stolen explosives could result in serious injury and/or loss of life. The severity level is therefore considered **high**.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk level for explosive material theft to **moderate**. The risk level is based on risks to workers and property.

The level of severity could also be considered "very high" in the case of human loss. In order to get the risk level, the severity level must be combined with the probability of occurrence. In this case, the likelihood of the theft of explosives by malicious people who succeed in injuring people is obviously very unlikely; the probability of occurrence is therefore considered "very low". Combined with a high or very high severity of consequences, a very low probability of occurrence results in a moderate level of risk. As the estimate of the risk level therefore remains unchanged, the resulting assessment remains unchanged.

9.3.8 USE OF ELECTRIC TRANSFORMERS

An electrical substation will be built in the area of the treatment plant. A 69/4.16-kV, 10-MVA transformer will be installed. In addition, five 4.16/0.6-kV, 2.5-MVA transformers will be installed on the site. These transformers will contain mineral oil.

The transformers will not contain polychlorinated biphenyls (PCBs).

This section covers the risks associated with the presence of electric transformers. Two hazards that can lead to major accidents are:

- dielectric oil spills;
- a fire or explosion involving a transformer.

9.3.8.1 DIELECTRIC OIL SPILL

Dielectric oil spills could be caused by equipment corrosion, breakage or human error.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of dielectric oil spills:

- transformer and related equipment preventive maintenance to prevent breakage and premature wear;
- lightning protection;
- a catch basin for transformers containing dielectric fluid;
- an emergency generator at the treatment plant and at the workers' camp;
- update of an emergency response plan including an incident response procedure in the case of a spill.

PROBABILITY OF OCCURRENCE

A dielectric oil spill could possibly occur, because it has already happened at similar sites. However, the probability of occurrence is considered **low**.

SEVERITY

The impact on the environment is considered to be **low** because of a catch basin confining the spill to the incident site.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk level for dielectric oil spills to **low**. The risk level is based on risks to the environment.

9.3.8.2 TRANSFORMER FIRE/EXPLOSION

Transformer fire is a potential risk. Possible causes are contaminated dielectric oil, a short circuit and overheating.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of transformer fire:

- preventive maintenance of transformers and related equipment to prevent breakdowns and premature wear;
- lightning protection;
- an emergency generator for the workers' camp and drinking water treatment system that will be used in case of a breakdown so as to avoid interruptions in production;
- update of an emergency response plan comprising a fire response procedure.

PROBABILITY OF OCCURRENCE

A transformer fire could occur as this has already happened at similar sites. The probability of occurrence is therefore deemed **low**.

SEVERITY

An explosion could result in the projection of debris causing serious injury and damage to equipment and infrastructure. The risk is therefore deemed **high**.

ESTIMATED RISK LEVEL

The inclusion of the likelihood and severity components brings the level of risk of a transformer fire and/or explosion to **moderate**. The risk level is based on risks to workers.

9.3.9 ACCUMULATION AREAS

Accumulation areas **will be provided to hold organic matter and unconsolidated deposits as well as waste rock and tailings. A stockpile for organic matter and unconsolidated deposits will be set up in the northern part of the project site. Four additional stockpiles for waste rock and tailings will be set up: two to the north of the creek CE3 and two to the south of this watercourse. Runoff will be pumped and redirected to a main water management pond, located to the north of the organic matter and unconsolidated deposit stockpile.**

A runoff collection pond **will also be set up to the east of the east waste rock and tailings stockpile. This intermediate pond will collect part of the runoff before it is pumped into the main pond (Map 9-1).**

This section addresses the risks associated with the accumulation areas. The risks are:

- stockpile collapse;
- failure of a retaining dike.

9.3.9.1 STOCKPILE COLLAPSE

An unstable stockpile slope could cause the materials to collapse (slide) outside the containment area. The instability could be caused by extreme weather or errors and omissions during construction.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of stockpile collapse:

- hydrogeological and geotechnical studies will be carried out;
- a slope stability analysis will be carried out;
- a monitoring program will be implemented.

PROBABILITY OF OCCURRENCE

The stockpile could collapse but this is unlikely. The probability of occurrence is therefore deemed **low**.

SEVERITY

Since there will be dikes around the stockpile containment areas, the collapse of a stockpile would have little or no effect on infrastructure (buildings, power lines, roads, etc.), with the exception of the road between the accumulation areas. The presence of workers at the time of the collapse would, however, increase the severity of the incident. The severity level is therefore deemed **high**.

ESTIMATED RISK LEVEL

The inclusion of the likelihood and severity components brings the level of risk of a stockpile collapse to **moderate**. The risk level is based on risks to workers.

9.3.9.2 FAILURE OF A RETAINING DIKE

A retaining dike could fail as a result of:

- extreme weather (heavy flooding, very heavy rains, strong winds, etc.);
- an earthquake;
- errors or omissions during its construction;
- ageing of the structure.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of dike failure:

- an analysis of dike failure risks and potential consequences will be carried out;
- retention structures will be designed according to the criteria of the Canadian Dam Association and the *Dam Safety Act* and its regulation;
- geological and hydrogeological studies, including dike stability, will be carried out;
- dike design will take into consideration seismic data for the area;
- the dike designer's operating guide will be carefully followed at all times;
- an inspection and maintenance program will be implemented for the retention structures;
- monitoring instrumentation will be used;
- an emergency response plan laying out a response procedure in the event of dike failure will be kept up to date.

PROBABILITY OF OCCURRENCE

Collapse could occur but this is extremely unlikely. The probability of occurrence is therefore deemed **very low**.

SEVERITY

Dike failure could result in heavy property damage and the release of contaminants (suspended solids, leachate, residual reagents, debris, etc.) into the environment, thus violating the MDMER and D019.

A failure in the **main water management pond** retaining dike would affect environmental components north of the site, particularly in the vicinity of the creek CE2 and subsequent watercourses to the north.

An analysis of dike failure risks and potential consequences will be carried out following completion of the project's detailed engineering. This study will make it possible to define areas where human and biological environments would be affected.

However, at this stage, the risk is deemed **very high** for the environmental components.

It should be noted that the runoff collection pond set up to the east of the east waste rock and tailings stockpile will most often be empty, or nearly empty, because this pond will be a transfer point, where a pump will redirect water into the main water pond. So, the risk that this dike will fail is low. If this dike were to fail, it would impact the creek CE4.

ESTIMATED RISK LEVEL

The inclusion of the likelihood and severity components brings the level of risk of a retaining dike failure to **moderate**. The risk level is based on risks to workers, the environment and property.

9.3.10 ROAD TRANSPORT

This section covers the risks associated with road use, particularly Billy-Diamond highway. Two accident scenarios have been identified:

- an accident involving hazardous materials;
- an accident involving a truck carrying spodumene concentrate.

9.3.10.1 ACCIDENT INVOLVING HAZARDOUS MATERIALS

Hazardous materials and other chemicals will be transported by tank trucks and 53-foot closed trucks. An accident involving hazardous materials on Billy-Diamond highway could be the result of a spill from a tank truck carrying petroleum products (diesel, gasoline) or chemicals. The causes can be:

- loss of vehicle control by the driver due to poor weather, **an animal on the road**, human error or a health issue;
- collision with another vehicle.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of hazardous material spills on the road:

- Drivers assigned to transport hazardous materials **will have received training on the transport of hazardous materials (THM). Drivers will also be made aware of the risks related to the use of the Billy-Diamond highway as well as the risks related to winter driving and night driving and must respect the number of hours of transport applicable.**
- A preventive maintenance program will be put in place to prevent vehicle breakdowns and premature wear.
- The emergency response plan will include a procedure for road spills.

Also, Billy-Diamond highway is designed according to the MTQ standards for heavy truck transport.

PROBABILITY OF OCCURRENCE

Hazardous materials could spill on the road as this type of situation has already happened. It is, however, unlikely. The probability of occurrence is therefore deemed **low**. **Indeed, if we consider a driver (regardless of the load), the probability that he loses control of his vehicle (malaise, human error or collision with another vehicle) to the point of releasing his load is considered low. This type of accident happens once or less in the professional life of a driver.**

SEVERITY

The severity of the incident will depend on the product involved and location of the spill. Depending on its location, the spill could reach a watercourse or just contaminate the soil.

Spill in a terrestrial environment

Some of the product will seep into the soil until it encounters an impermeable layer or an area saturated with water such as an aquifer. The proportion of product flowing versus the amount that infiltrates depends on the permeability of the soil and the characteristics of the spilled product. Some compounds of the spilled product may eventually escape into the air. Upon contact with groundwater, some of the product is also likely to dissolve.

The magnitude of the effect in a terrestrial environment will depend, among other things, on the time of year, weather, characteristics of the spilled product, amount spilled and the depth of its penetration into the soil.

Potential impact on vegetation

A hazardous materials spill would probably affect vegetation in the following manner:

- foliage depigmentation, patches on leaves, decrease in density, stem height and number of leaves on the stem;
- alteration of plant reproduction strategy;
- mortality of exposed vegetation;
- loss, over time, of habitat or plant species favourable to the presence of several species of wildlife.

Potential impact on wetlands

In the event of a hazardous material spill in wetlands, the product would come into contact with plants, sediment and the underlying soil. A spill in such an environment would harm the ecosystem, i.e. aquatic fauna and flora, including the loss over time of habitats or plant species favourable to the presence of wildlife. It would also lead to the use of complex rehabilitation techniques and subsequently, wetland replacement. The cost of wetland rehabilitation is high and depends mainly on the volume of product spilled, reaction time and effectiveness of the response strategies. The environmental impact will depend on the ecological value of the affected wetland.

Potential impact on terrestrial fauna and avifauna and their habitats

Hazardous material spills can cause health problems for any animal that comes in direct or indirect contact with the product. Mammals, reptiles and bird species that come into direct physical contact with the spilled product may, depending on the product, suffer skin and eye damage or chemical burns that may result in death.

Animals affected by the spilled product may experience reproductive problems due to disease or interference with normal breeding patterns. Birds may see a reduction in the number of eggs laid and their thickness. In general, mammalian and bird populations can be affected by a land spill if their habitat or prey is affected in terms of reproduction, juvenile rearing, feeding and/or wintering.

However, mammals and birds capable of moving within their habitat and relocating to an environment less exposed to contaminants in the event of a spill are less likely to feel the effects of such an event.

Potential impact on herpetofauna and its habitat

Herpetofauna populations associated with land environments may be affected by this type of spill if their habitat or prey is affected in terms of reproduction, juvenile rearing, feeding and/or wintering.

The herpetofauna group has a limited ability to move and has a harder time relocating to an environment that is less exposed to contaminants in the event of a spill. These animals are therefore more likely to feel the effects of such an event, especially during reproduction, egg incubation and larval stages.

The potential effects on herpetofauna are:

- mortality of individuals that came into contact with the product;
- lower egg and larva production;
- deterioration in the quality of breeding and feeding sites, as well as shelters.

Spill in an aquatic environment

As previously mentioned, if a hazardous material spills on the ground, it will flow under the effect of gravity and could reach a watercourse. The environments likely to be affected would then be the hydrous environment as well as benthic fauna, fish and their habitats.

Potential impact on hydrous environments

Several watercourses and bodies of water are present along the routes to the site.

Petroleum products are mostly insoluble in water. When they are poured in water, they spread to the surface where they form an oily film or fall to the bottom in the case of heavy oil products. Chemicals are mostly soluble in water and are rapidly diluted. In all cases, alteration of water quality is expected, including sediment contamination.

Potential impact on benthic fauna and its habitat

The potential effects on the benthic community would be contamination potentially leading to mortality, decreased benthic abundance and diversity, as well as lower recruitment (eggs and larvae), food consumption and growth rates.

Potential impact on fish and their habitat

Fish and shellfish may ingest toxic substances and transmit them to the predator that eats them. A hazardous material spill in an aquatic environment may have a dire impact on the next generation of fish and shellfish.

Generally speaking, fish populations can be affected by a spill at different times of the year if their habitat or prey is affected in terms of reproduction, hatching, feeding, migration and wintering.

Fish capable of moving within their habitat and potentially relocating to an environment less exposed to contaminants in the event of a spill are less likely to feel the effects of such an event, except during the reproduction and egg incubation period.

Severity level

In light of the foregoing, the severity level is deemed **high**.

ESTIMATED RISK LEVEL

The inclusion of the likelihood and severity components brings the level of risk of a hazardous material spill on the road network to **moderate**. The risk level is based on risks to the environment.

9.3.10.2 ACCIDENT INVOLVING A TRUCK CARRYING ORE CONCENTRATE

The spodumene concentrate will be transported by a closed semi-trailer truck. Moving trucks carrying spodumene could lead to road accidents with spodumene spills.

The causes can be:

- loss of vehicle control by the driver due to poor weather, **an animal on the road**, human error or a health issue;
- collision with another vehicle.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of hazardous material spills on the road:

- drivers assigned to transport hazardous materials will be trained;
- a preventive maintenance program will be put in place to prevent vehicle breakdowns and premature wear;
- the emergency response plan will include a procedure for road spills.

Also, Billy-Diamond highway is designed according to the **MTQ** standards for heavy truck transport.

PROBABILITY OF OCCURRENCE

A spodumene spill on the road network could occur. It is, however, unlikely. The probability of occurrence is therefore deemed **low**.

SEVERITY

Such an incident could lead to injuries that do not cause disability but temporary discomfort through inhalation. The effects on the natural environment will be at the site of the spill. Since it is solid, spodumene will spread only if it reaches a watercourse, in which case it will tend to settle at the bottom. The severity level is therefore deemed **low**.

ESTIMATED RISK LEVEL

The inclusion of the likelihood and severity components brings the level of risk of a spodumene spill on the road network to **low**. The risk level is based on risks to workers and the environment.

9.3.11 RISKS ASSOCIATED WITH EXTERNAL HAZARDS

9.3.11.1 FOREST FIRES

There have been several forest fires near the project site in the past. Forest fires can be the result of human activity but lightning is the main cause.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the consequences of a forest fire:

- the peat will be removed down to the mineral soil over a 35 m radius around the processing facilities, mine water treatment unit and explosives warehouse;
- the site will be cleared;
- a periodic inspection program will be implemented;
- personnel will be educated about forest fires;
- an agreement will be made with SOPFEU;
- SOPFEU will provide periodic advice concerning fire hazards;
- there will be a dedicated water reserve for fire protection;
- a water supply network with a fire hydrant will be installed;
- a fire brigade will be formed and trained in fighting forest fires;
- an emergency response plan comprising a procedure for responding to forest fires will be kept up to date.

PROBABILITY OF OCCURRENCE

Given the history of forest fires in the project area, the probability of occurrence is deemed **high**.

SEVERITY

A forest fire threatening the facilities could result in serious firefighter injury as well as heavy damage to infrastructure if it were to catch fire. However, these risks will be reduced due to the mitigation measures in place.

The effects on the environmental components will vary depending on the magnitude of the fire and its spread.

Potential impact on vegetation

There are several types of fires with different effects on land vegetation:

- crown fires burn trees up their entire length to the top. These are the most intense and dangerous vegetation fires;
- surface fires burn only surface litter and humus. These are the easiest fires to extinguish and those that cause the least forest damage;

- ground fires (sometimes called underground or subsurface fires) occur in deep accumulations of humus, peat and similar dead vegetation that become dry enough to burn. These fires move very slowly but can become difficult to fully put out or suppress. Occasionally, especially during prolonged drought, such fires can smoulder all winter underground and then emerge at the surface again in spring.

In the event of fire, the anticipated impacts are vegetation mortality, disturbance in the evolution of the forest and loss over time of habitats or plant species favourable to the presence of several species of wildlife. In forests, wildfires have an ecological influence at all levels: species, stand and landscape.

Potential impact on terrestrial fauna and avifauna and their habitats

Fires affect populations of terrestrial and avian species, whose need for cover and food forces them to move as the type of forest changes. Highly dependent on the vegetation in its habitat, terrestrial wildlife responds to fire by evacuating and avoiding the area during the fire and following changes in vegetation cover.

In the event of fire, the effects on terrestrial and avifauna are potential mortality during juvenile rearing, a reduction in the availability of foraging areas and shelter when habitats are disturbed and egg destruction during nesting season.

Potential impact on hydrous environments

A fire can alter water quality by adding particulate matter and other contaminants to the water and allowing them to spread.

Potential impact on herpetofauna and its habitat

Fires affect herpetofauna populations, whose need for cover and food forces them to move as the type of forest changes. Highly dependent on the vegetation in its habitat, herpetofauna responds to fire by evacuating and avoiding the area during the fire and following changes in vegetation cover.

In the event of fire, the potential effects on herpetofauna are mortality, egg destruction during the incubation period and a reduction in the availability of foraging areas and shelter when habitats are disturbed.

Severity level

In light of the foregoing, the severity level is deemed **moderate**.

ESTIMATED RISK LEVEL

The inclusion of the likelihood and severity components brings the level of risk of a forest fire threatening the facilities to **high**. The risk level is based on risks to persons, property and the environment.

9.3.11.2 EXTREME WEATHER

Unusual or extreme weather could occur, including strong winds, heavy snowfalls and ice storms, among others.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risks associated with extreme weather:

- infrastructure will be designed in accordance with applicable laws, regulations and codes;
- the camp will be equipped with generators;
- spare electrical equipment will be kept on site;
- an emergency response plan laying out an evacuation procedure for mine personnel will be developed.

PROBABILITY OF OCCURRENCE

Although extreme weather could occur, it is highly unlikely. Consequently, the probability of occurrence is deemed **very low**.

SEVERITY

The consequences of such weather can vary but could go as far as heavy damage to infrastructure and damage to Hydro-Québec's 450-kV line or to the internal line, depriving the site of power for a long time and seriously disrupting activities. Such a situation could require evacuation of workers from the mine to ensure their safety.

The severity level is therefore deemed **high**.

ESTIMATED RISK LEVEL

The inclusion of the likelihood and severity components brings the level of risk for extreme weather to **moderate**. The risk level is based on risks to persons, property and the environment.

9.3.12 RISK SUMMARY

The technological risks identified in the preceding sections are summarized in Table 9-10.

9.4 PRELIMINARY EMERGENCY RESPONSE PLAN

An emergency response plan is an essential tool to ensure a quick and effective response in an emergency.

A preliminary plan has been developed. Presented in Appendix K, it contains:

- a list and description of events considered as high and very high risk;
- the roles and responsibilities of the stakeholders;
- the phone numbers of the main external stakeholders;
- the alert and mobilization procedures;
- the emergency response procedures;
- the evacuation procedures;
- the return to normal process.

The emergency plan will be known to internal stakeholders, updated annually, quickly accessible in an emergency 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.

9.5 CORPORATE POLICY

GLCI is firmly committed to limiting environmental impacts resulting from the development of mineral resources, while building a successful business that fully assumes its responsibilities in the communities where it operates.

This commitment is put into practice daily by integrating the social, economic and environmental dimensions to the company's decision-making process and through the ongoing respect of the interests of other stakeholders in its activities.

In its environmental policy, GLCI plans to conduct its activities in a manner that respects the environment and all applicable regulations and to implement a management system that will ensure that the highest environmental standards possible are applied to its products, services and processes. In its health and safety policies, GLCI wants to take all possible and feasible measures to ensure the health and safety of its employees and other members of its personnel directly or indirectly involved in the project by eliminating all occupational injuries and diseases. GLCI guarantees that no business objectives will compromise safety.

Table 9-10 Summary of risk analysis results

Activity	Scenario	Probability of occurrence	Severity level	Risk level
Extraction pit	Pit flooding	Low	High	Moderate
	Falling rocks and landslides	Low	High	Moderate
Ore processing	Fire	Low	High	Moderate
	Exposure to ionizing radiation	Very low	High	Moderate
	Dust emission	Moderate	Low	Moderate
Storage and use of petroleum products	Spill of petroleum products	High	Moderate	High
	Fire/Explosion of petroleum products	Very low	Very high	Moderate
	Spill of oils and greases	Low	Low	Low
Propane storage and use	Fire	Very low	Very high	Moderate
	Propane vapour cloud formation	Very low	Very high	Moderate
Chemical storage and use	Chemical spill	Low	High	Moderate
Explosives storage and handling	Explosion of explosive material	Very low	Very high	Moderate
	Theft of explosive material	Very low	High	Moderate
Use of electric transformers	Dielectric oil spill	Low	Low	Low
	Fire/explosion	Low	High	Moderate
Mine water treatment	Non-compliant discharge into final effluent	Low	High	Moderate
Accumulation area	Stockpile collapse	Low	High	Moderate
	Failure of a retaining dike	Very low	Very high	Moderate
Road transport	Hazardous material spill	Low	High	Moderate
	Ore concentrate spill	Low	Low	Low
External hazards	Forest fire	High	Moderate	High
	Extreme weather	Very low	High	Moderate

10 SURVEILLANCE AND MONITORING PROGRAM

10.1 ENVIRONMENTAL MANAGEMENT SYSTEM

Through its environmental policy, GLCI commits to implementing and applying a management system that will ensure the highest environmental standards are applied to its products, services and processes.

To facilitate fulfilling this commitment, the Corporate Environmental and Workplace Health and Safety Division has asked its Canadian representatives to implement an ISO-14001:2015-type environmental management system, with a view to subsequent certification.

The ISO-14001-type system puts environmental concerns at the forefront, and is not limited to legal compliance – it also strives to continuously improve environmental performance. All levels, functions, and decisional processes are invested in the company's environmental performance. One of the guiding principles is to establish a corrective action trigger zone between normal conditions and harmful conditions: more inspections and minor corrective actions, and fewer major corrective actions.

The comprehensive system will be developed and implemented for the period **of operation**. During the construction period, the environmental management rules will be integrated in the project execution plan (PEP). Thus, certain system elements planned **for the operation phase** will be implemented **during the construction phase**. Table 10-1 presents all of the elements in a 14001-type system, along with their implementation phase. Setting up an organized system also ensures better use of resources, a reduction in pollution and improved environmental performance, all of which contribute to a decrease in costs.

GLCI will also set up a system for receiving and managing complaints. Generally speaking, the procedure applied will be as follows:

- Any person who feels they have suffered prejudice and would like to file a complaint shall, within a reasonable amount of time after the alleged events, contact the person appointed by GLCI. The complainant may formulate their complaint using one of the following channels: online, by telephone, in person or in writing.
- GLCI will acknowledge receipt of all complaints and date them. GLCI will review the complaint, determine its admissibility in accordance with the procedure criteria to be established and will respond to all complainants. In collaboration with the complainant, GLCI will seek to find a solution and will ensure the complaints are followed up.
- Throughout the process, all documents associated with the complaint shall be kept in a complaint log. Complaints will also be handled confidentially by all stakeholders.

10.2 MONITORING COMMITTEE

As required under *An Act to amend the Mining Act* (section 101.0.3), GLCI will establish a monitoring committee to foster the participation of the communities involved in the project's execution. This committee will be created prior to the mine's construction and will remain active throughout its life, until such time as the works provided for in the mining site rehabilitation plan are fully completed.

The committee's membership will be determined as per the regulations established under the Act, and it will be comprised of at least one representative from the Eastmain Band Council, one from the business community, one from the community of Eastmain and one from the EIJBRG. Furthermore, the RE2 Tallyman or a member of his family will be **invited** to this committee.

Table 10-1 Implementation of the ISO-14001 system

Numbering ISO-14001:2015	System element	Type of document	Construction phase	Operation phase
4.1 – 4.3	Context of the organization	Manual		X
5.1	Leadership and commitment	Manual		X
5.2	Environmental policy	Page signed by upper management	X	X
5.3	Roles and responsibilities	PEP and manual	X	X
6.1.1	Planning – identification of risks and opportunities	Manual		X
6.1.2	Environmental aspects	Register of aspects		X
6.1.3	Compliance requirements	Register of legal requirements	X	X
6.1.4	Planning – actions	Manual		X
6.2	Environmental objectives	Register of objectives		X
7.1	Commitment to supply resources	Manual		X
7.2	Skills	Training matrix		X
7.3	Awareness	Integrated in the contracts Welcome session	X	X
7.4.1	Internal communication	Bulletin board Internal bulletin	X	X
7.4.2	External communication	Register	X	X
7.5	Documented information	System procedures		X
8.1	Operational proficiency	Operational procedures	X ¹	X ²
8.2	Emergency response	EMP	X	X
9.1	Supervision	Documented inspections with references to legal requirements and issued authorizations	X	
9.1.1	Supervision, measure, analysis and assessment	Operational procedures and programs		X
9.1.2	Compliance assessment	Procedure		X
9.2	Internal audit	Procedure		X
9.3	Management review	Procedure		X
10	Improvement	Register of non-compliances and corrective actions	X	X
1	During construction, new and used hazardous materials management, waste materials management and spill management will be documented in procedures; compliance with these procedures will be integrated in inspections.			
2	During operation, all activities with impacts or risks deemed to be significant will be documented in procedures.			

GLCI is committed to preparing and making public an annual report of the monitoring committee's activities. The annual report, the contents of which will be more specifically defined in collaboration with the committee members, will include at least the following elements:

- Nature and number of activities carried out;
- Roles and mandates of the local stakeholders involved;
- Subjects and concerns addressed;
- Actions undertaken;
- Local stakeholders' level of satisfaction;
- Responses to the recommendations, as applicable.

10.3 ENVIRONMENTAL MONITORING

An environmental monitoring program describes the means and mechanisms implemented to ensure compliance with legal and environmental requirements. More specifically, the program targets compliance with the laws, regulations and other environmental considerations set out in the plans and specifications, as well as in the authorizations and permits issued by government authorities.

The environmental monitoring program helps to ensure work is progressing smoothly, and equipment and facilities are operating properly. It also ensures that any environmental disturbance caused by project execution is monitored. Environmental monitoring therefore is intended to ensure mitigation measures, conditions set out in the governmental authorizations, GLCI's commitments, as well as the requirements set out in laws and regulations are all followed.

Environmental monitoring will also be enforced during project implementation. GLCI will ensure this general environmental monitoring. Its responsibilities will include:

- Monitoring and overseeing all tasks that require preventive, mitigation or corrective measures with regards to the environment;
- Updating the environmental management system;
- Ensuring work is carried out in accordance with the laws, regulations and conditions set out in authorization certificates;
- Updating the storage and disposal condition follow-up logs for any hazardous waste materials required for the project;
- Monitoring the petroleum product refuelling procedures for project equipment;
- Managing and following procedures to follow in the event of an accidental spill, including monitoring the conditions for temporary stockpiling of contaminated soils, if applicable.

10.3.1 MONITORING PROGRAM DEVELOPMENT AND CONTENT

The preliminary environmental monitoring program presented hereunder will be completed at a later date, subsequent to receipt of authorization for project implementation. **The detailed monitoring program will be presented at the time of the request for the project's certificate of authorization. All information related to the analysis by the various governmental stakeholders (i.e. MELCC, IAAC, COMEX, CEC) will be known at that time, including all commitments resulting from the environmental assessment.**

Once GLCI has received authorizations for its project, discussions will be held with the RE2, VC33 and VC35 trapline tallymen and /or the Eastmain environmental services to determine their interest and willingness to be actively involved in the monitoring activities.

The final **monitoring** program will include:

- List of elements that require environmental monitoring;
- All measures and means planned to protect the environment;

- Consultation with involved stakeholders;
- Detailed characteristics of the monitoring program, wherever foreseeable (e.g.: location of interventions, planned protocols, list of parameters measured, analysis methods used, completion schedule, human and financial resources allocated to the program);
- An intervention mechanism in the event of non-compliance with legal and environmental requirements;
- Commitments with regards to filing monitoring reports (number, frequency and content);
- GLCI's commitments in terms of distribution of environmental monitoring results to the population affected.

The complete monitoring program will include the following steps:

- **Consolidation of mitigation measures and commitments identified in the EIA;**
- **Consolidation of mitigation measures and commitments added during the ministerial consultation process (provincial and federal);**
- **Development of the monitoring schedule according to the critical construction and operation periods based on the schedule determined during the detailed engineering;**
- **Development of the monitoring schedule according to the type of work and the component to be monitored;**
- **Preparation of the monitoring files;**
- **Determination of the environmental lead's roles and responsibilities and their authority in this regard.**

The monitoring program will indicate the measures and means planned to ensure such monitoring at the time of its implementation. This program may be submitted to the competent authorities at their request. The monitoring program will be developed following the ministerial consultation process and once all the preventive, mitigation and control measures and the various commitments are known.

10.3.2 IMPLEMENTING THE MONITORING PROGRAM

The environmental monitoring program **will be** an activity that is part of the construction site procedures and must be documented like all other activities. The first step will consist in forming an inspection team that has experience with this type of project, so that they can adequately monitor execution of the work. Together with the contractors, the construction and environmental managers will organize numerous construction meetings, the first of which will take place at the very start of the work. One notable goal will be to inform and raise the awareness of personnel assigned to the construction site of the environmental and safety provisions that must be observed throughout the work period, as well as of the general functioning of supervision activities.

Before the start of work, the following activities **will be** performed:

- Verify that all necessary authorizations and permits have been obtained;
- Ensure that all contributors on the construction site have been informed of the environmental concerns and protective measures;
- Establish clear-cut roles and authority for each one, according to a hierarchical system, in preparation for unexpected or non-compliant situations, so that appropriate preventive and corrective measures can be applied;
- Establish measures that contributors will need to apply to protect the environment, according to their respective activities;
- Verify that the spill response plan is available and understood by all;
- Implement the programs and procedures to ensure the businesses' policies are followed;
- Implement the mechanisms to ensure compliance with the procedures in place.

GLCI will ensure regular monitoring during the construction phase. The environmental monitoring program must ensure that all environmental provisions specified in the plans, specifications and authorizations are followed¹.

The program will include regular construction site inspection, documentation control, preparation of reports and compliance with communication channels. Construction site supervision involves direct communication between the person responsible and all other personnel to ensure non-compliant situations are resolved efficiently and immediately, and that action is quickly taken in the event of an environmental emergency.

A process will be established to document and follow-up on construction activities, construction site observations, decisions on how to resolve non-compliant situations, corrective actions taken and results observed as a result of these actions and, lastly, preventive measures implemented to ensure that these non-compliances will not recur.

During the work, mitigation measures must be carefully applied, most particularly during work performed near waterways and bodies of water. Furthermore, throughout the work, GLCI may also identify improvements to make to mitigation measures while complying with environmental requirements, specifications, goals and objectives set out in the environmental impact assessment.

Generally speaking, GLCI will visit the work areas regularly, take note of the contributors' strict compliance with commitments, obligations, measures and other provisions, assess the quality and efficiency of the measures applied and note any non-compliances observed.

Since the specifications will indicate the various protection, prevention and control measures, they will form an integral part of the contract with the contractor responsible for the work. The environmental lead, supported by their team of inspectors, will be responsible for applying all the measures. Any failure to comply will be unacceptable and liable to various penalties.

Just as with the construction phase, an environmental monitoring program will be developed for the mine's site rehabilitation phase. The roles and responsibilities presented above will be the same during site rehabilitation work. Thus, as for the construction phase, the stakeholders involved will be consulted when the environmental monitoring program is developed for the site rehabilitation phase.

The monitoring programs will be integrated into an Environmental and Social Management Plan (ESMP), which specifies monitoring activities for all biophysical and human components related to the project (see section 10.4).

10.4 MONITORING PROGRAMS DURING OPERATIONS

As with the environmental monitoring program during construction, the detailed monitoring programs during operations will be finalized upon completion of the ministerial consultation processes at the provincial and federal levels. At that time, GLCI will consolidate all the monitoring commitments to which it has committed considering all the requirements requested into an Environmental and Social Management Plan (ESMP). The environmental monitor will use the detailed ESMP as an environmental guide. The purpose of this tool will be to integrate all applicable commitments and mitigation measures for each of the work sectors that require monitoring. The overall vision will then allow the efficient consolidation of all monitoring programs. The detailed monitoring programs will be submitted to the competent authorities for approval when applying for an environmental authorization and will be completed to their satisfaction. The elements of the monitoring programs are described below and will be improved as needed.

1 As requested by the Joint Assessment Committee in July 2020, the criteria that will be targeted for SS during construction work, the frequency and locations of sampling as well as the corrective measures that will be applied in the event of an overrun will be presented in the detailed monitoring program that will be developed once the ministerial consultation process is completed and all the preventive, mitigation and control measures and the various commitments are known. Runoff from leachable construction materials, such as waste rock, will be subject to specific monitoring and follow-up of problematic metals. Corrective measures to ensure compliance with the pollution prevention provisions of the Fisheries Act at all times will be presented where appropriate.

Once GLCI has received the project authorizations, discussions will be held with the RE2, VC33 and VC35 trapline tallymen and/or the Eastmain environmental services to determine their interest and willingness to become actively involved in the monitoring activities. RE2, VC33 and VC35 trapline tallymen who will be invited to sit on the monitoring committee, will also be informed of the results of the monitoring reports.

The environmental monitoring results will be presented in a report to the MELCC and the monitoring committee, which will distribute the results to the Eastmain, Waskaganish and Waswanipi communities. Environmental monitoring reports will also be published on the GLCI website.

GLCI is also committed to holding presentation and explanation sessions on the environmental monitoring results once or twice a year for the Eastmain, Waswanipi and Waskaganish Cree community members. The presentations may be in English and in Cree to ensure that everyone attending these sessions has a good understanding of the information presented. The tallymen will be consulted to determine the topics of discussion and the frequency of these meetings.

10.4.1 MONITORING WATER QUALITY

Water quality will be monitored to ensure compliance with the MDMER on the federal level, and D019 at the provincial level. An **effluent discharge objective (EDO)** monitoring program will also be defined.

10.4.1.1 METAL AND DIAMOND MINING EFFLUENT REGULATIONS (MDMER)

The MDMER, under the Fisheries Act, requires mines to conduct **environmental effects monitoring (EEM) for metal mines** as a condition for effluent authorization. The purpose of EEM is to assess the potential effects that effluents would have on fish, fish habitat and use of fish resources.

The study area covered by EEM will include all waterways exposed to the mine effluent (**CE2**), and a reference waterway located outside the mine's area of influence. **To do so, the stations used to determine the reference state will also be used (Map 6-8).** First, the water quality will be monitored (environment and effluent). This process will consist of three distinct activities:

- Characterization of the effluent;
- Sublethal toxicity test on the effluent at the final discharge point;
- Water quality monitoring, sampled from the exposed area near the effluent inlet point and final discharge point, in the reference areas, and in the selected sampling areas, within the context of the biological monitoring study.

Regarding the biological environment, the following activities will be undertaken:

- **Monitoring the fish population:** The purpose of this is to take measurements of the health indicators of the fish population in the exposed area and reference areas, in order to determine whether the mine's effluents have an effect on the fish. This study is required if effluent concentration in the exposed area is greater than 1% at 250 m from the final discharge point.
- **Monitoring the benthic invertebrate community:** The purpose of this is to determine whether the effluent has an effect on the fish habitat by sampling the benthic organisms in the exposed area and reference area.
- **Monitoring fish tissue:** This will assess whether mercury from the effluent is affecting the use of fishery resources. This monitoring is only necessary if total mercury concentration in the effluent is equal to or greater than 0.10 µg/L.

Concerning the water from the overburden and peat storage facility, as opposed to what was planned in the initial project (2018) where the water was managed in a closed system independent of mine water, the water will now be collected and channelled to the main water management pond in compliance with the MELCC comment made in the analysis of the 2018 EIA, which favoured a single final effluent on the mine site. Therefore, the monitoring of the water quality will be ensured by the analysis of water from the main water management pond.

An EEM is conducted as follows: the effluent will be characterized four times per calendar year, with at least one month between characterizations. The first characterization will be done no later than six months following the date when the mine becomes subject to the MDMER. Sublethal toxicity tests are performed twice per calendar year for the first three years, and once per year thereafter. Water quality monitoring will be done no later than six months following the date when the mine becomes subject to the MDMER. It is performed four times per calendar year, with at least one month between tests.

The first EEM study plan will be presented no later than 12 months following the date when the mine becomes subject to the MDMER. The various other studies outlined will be performed in accordance with the terms and conditions of the study plan. Furthermore, the first interpretation report will be presented no later than 30 months following the date when the mine becomes subject to the MDMER.

10.4.1.2 MINING INDUSTRY DIRECTIVE 019

The mine will need to monitor the various parameters on a regular basis, according to the frequency established within the context of this directive, i.e. three times per week for SSeS [Suspended Solids], once per week for the selected metals and once per month for acute toxicity. Furthermore, due to the fact that effluent volume exceeds 1000 m³/day, the pH and flow rate will also need to be continuously recorded.

Each year, the mine will need to analyze or measure effluents during the month of July or August. Measurement and sampling of the parameters outlined for annual monitoring must be done over the course of the same day, and will replace the usual monitoring for that week. All results of the annual monitoring must be sent to the MELCC no later than September 30 of that year. It should be noted that the D019 requirements are usually included in the provincial authorization requirements.

10.4.1.3 EFFLUENT DISCHARGE OBJECTIVES (EDO)

GLCI will monitor the EDOs defined by the **MELCC**. The provisions for this monitoring program will be developed in conjunction with the **MELCC**. This program will include:

- the monitoring of phyco-chemical parameters subject to EDOs as well as chemical toxicity at a quarterly basis during the discharge period. For acute toxicity, the monitoring shall be carried out on a monthly.
- the presentation of exceedings of EDOs where appropriate, the cause of these exceedings, and the means taken by the Proponent to meet the EDOs, or to come as close as possible. This exercise shall help identify contaminants that presents no risk to the environment, possibly reducing the list of contaminants to monitor.

An analysis report on the monitoring of the effluent quality will be delivered to the MELCC after 3 years of exploitation and every 5 years thereafter. This report shall include a comparison between EDOs and the results obtained at the effluent, consistent with the document *Lignes directrices pour l'utilisation des objectifs environnementaux de rejet relatifs aux rejets industriels dans le milieu aquatique* and its addendum *Comparaison entre les concentrations mesurées à l'effluent et les objectifs environnementaux de rejet (OER) pour les entreprises existantes*.

10.4.2 MONITORING GROUNDWATER

OBJECTIVE

The groundwater monitoring program falls within the framework of the project. Under D019, a network of monitoring and collection wells must be set up around any facilities that could possibly affect groundwater quality. This network must include observation wells upstream and downstream of each facility at risk. Furthermore, since dewatering of the pit could affect the surrounding groundwater level, monitoring the changes in water level is also proposed.

STUDY AREA

The monitoring wells will be distributed upstream and downstream of the **mining waste rock stockpiles (16 sites)**, the pit (4 sites), the industrial sector (**4 sites**) **and the explosives warehouse area (3 sites)**. They will be used for monitoring. Depending on the stratigraphic context, the wells will be dug either in the rock or unconsolidated deposits. Information regarding the proposed wells is found in Table 10-2 and their locations are illustrated on Map 10-1.

MONITORING ACTIVITIES

Monitoring activities will include:

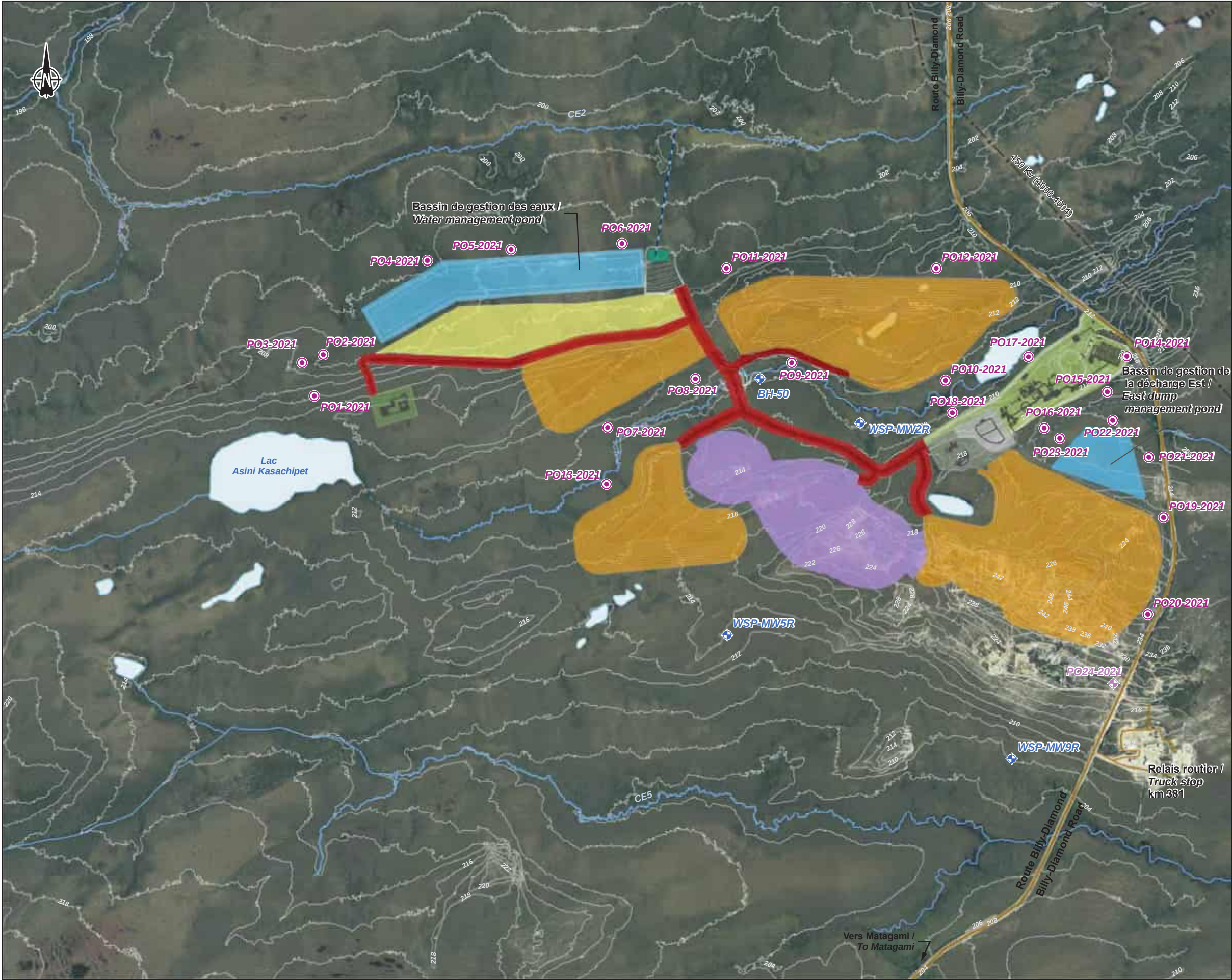
- 1** Monitoring groundwater quality
- 2** Monitoring water levels around the pit

Relevant details are presented hereunder.

Monitoring groundwater quality

The micropurge method with parameter stabilization will be used for sampling. This method allows sampling at a low flow rate, which provides a sample that is representative of the aquifer, while minimizing disturbances in the observation wells. Sampling will be done once the physicochemical parameters are stable. The pH, conductivity, temperature and dissolved oxygen data will be compiled regularly using a multi-parameter sensor each time an observation well is purged and whenever a sample is taken.

Water level readings will be taken during the sampling campaigns (spring and summer) in all wells sampled.



Suivi des niveaux des eaux / Water level monitoring

- Puits existant / Existing well
- Puits proposé / New well

Suivi de la qualité de l'eau / Water quality monitoring

- Puits proposé / New well

Infrastructures / Infrastructure

- Route principale / Main road
- Route d'accès / Access road
- Ligne de transport d'énergie / Transmission line
- Relais routier / Truck stop

Hydrographie / Hydrography

- CE3 Numéro de cours d'eau / Stream number
- Cours d'eau / Stream
- Cours d'eau à écoulement diffus ou intermittent / Intermittent or diffused flow stream
- Plan d'eau / Waterbody

Composantes du projet / Project Component

- Effluent minier / Mine effluent
- Route / Road
- Usine de traitement de l'eau / Water treatment plant
- Secteur administratif et industriel / Administrative and industrial sector
- Fosse / Pit
- Halde à minéral / ROM pad
- Halde à stériles / Waste rock stockpile
- Halde à matières organiques et dépôts meubles / Overburden and peat storage facility
- Entrepôt à explosifs / Explosives magazine
- Cour d'entreposage / Dry storage area



Mine de lithium Baie-James / James Bay Lithium Mine

Carte / Map 10-1
Suivi des eaux souterraines /
Groundwater Monitoring

Sources :
Orthoimage : Galaxy, août / august 2017
Général Arrangement, 2020
Données du projet / Project data : Galaxy 2021

0 200 400 m
UTM, fuseau 18, NAD83

Juillet / July 2021

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c10-1_T160_suivi_eaux_sout_wspit_210702.mxd



Table 10-2 Geographic coordinates of the wells for groundwater monitoring

Sector	ID	X UTM18 (m)	Y UTM18 (m)
Groundwater quality monitoring			
Explosives warehouse area	PO1-2021	355166.839	5790266.63
	PO2-2021	355138.336	5790357.32
	PO3-2021	355244.574	5790367.69
West stockpile pile sector - pond - overburden pile	PO4-2021	355845.726	5790857.42
	PO5-2021	356247.357	5790911.83
	PO6-2021	356781.138	5790940.34
	PO7-2021	356711.176	5790056.75
	PO8-2021	357133.537	5790289.95
North stockpile sector	PO9-2021	357594.765	5790367.69
	PO10-2021	358333.249	5790282.18
	PO11-2021	357281.234	5790821.14
	PO12-2021	358289.199	5790821.14
JB-1 Stockpile sector	PO13-2021	356705.994	5789784.67
industrial sector	PO14-2021	359203.882	5790398.78
	PO15-2021	359110.6	5790227.76
	PO16-2021	358807.433	5790054.16
	PO17-2021	358732.289	5790396.19
East Stockpile sector - temporary pond	PO18-2021	358366.934	5790126.71
	PO19-2021	359380.081	5789624.02
	PO20-2021	359304.937	5789160.2
	PO21-2021	359310.12	5789914.23
	PO22-2021	359136.511	5790090.43
	PO23-2021	358882.577	5790004.92
Water level monitoring			
Pit sector	WSP-MW5R	357283.955	5789061.02
	PO24-2021	359139.102	5788828.53
	WSP-MW9R	358650.813	5788466.24
	WSP-MW2R	357922.004	5790078.77
	BH-50	357442.243	5790292.23

Parameters to analyze were chosen according to site usage and include those required under D019. Sampling frequency will be twice per year, at summer low flow and spring freshet. The analytical program parameters will be:

- Petroleum hydrocarbons C₁₀-C₅₀;
- Major ions (bicarbonates, calcium, carbonates, chlorides, fluoride, magnesium, potassium, sodium and sulfates);
- Dissolved metals (Ag, Al, As, B, Cd, Co, Cr, Cu, Fe, **Hg**, Li, Mn, Mo, Ni, Pb, Se, Sb, Sn, Sr, Ta, Ti, U, V, Zn);
- Nutrients (ammoniacal nitrogen, total Kjeldahl nitrogen, nitrates, nitrites, total phosphorus);
- Other parameters (total cyanides, total dissolved solids, total sulphurs);
- Field measurements (pH, electrical conductivity, temperature, dissolved oxygen, ORP).

A quality control program will be applied to confirm the validity of the various parameter measurement methods. At least 10% of samples will be taken in duplicate and sent to the laboratory for analysis and to verify that their results match the results of the original samples. Field and trip blanks will also be taken with each sampling campaign and sent to the laboratory. Field blanks and trip blanks will also be sampled during each campaign and sent to the laboratory.

Considering the groundwater at the study site could end up in surface water, the chemical analysis results will be compared to the criteria for resurgence in surface water, or RSW (résurgence dans les eaux de surface, or RES) set out in the Guide d'intervention: Protection des sols et réhabilitation des terrains contaminés from the **MELCC** (Beaulieu, 2016).

Moreover, RSW criteria for metals will be adjusted to a hardness of 10 mg/L, which is representative of the water in surrounding streams.

Given certain criteria (Cu, Ba, Mn, Zn) were exceeded when groundwater was sampled, background levels were assessed under D019. The results were presented in the specialized hydrogeology report (WSP, 2018a). In the event that they exceed the RES criterion, background levels assessed will be used as the criteria. Lastly, for parameters with no criteria, results will be compared to the values generally observed in the groundwater and concentrations obtained under the initial conditions.

Monitoring water levels around the pit

Piezometric variation will be continually monitored in certain wells using three levellogger-type sensors. A fourth barologger-type sensor will be used to measure atmospheric pressure. Three probes, installed in the pit sector, will enable temperature and water pressure to be measured. These sensors will monitor how pit dewatering affects the water levels near the surface waterways.

SCHEDULE

As soon as operation begins, sampling campaigns will be conducted twice per year, in the spring and summer. The program may be reassessed while it is in progress, in collaboration with the **MELCC**, according to the results obtained.

Water levels around the pit will be continuously monitored every hour. Sensor data will be able to be collected twice per year during the sampling campaigns.

10.4.3 MONITORING DRINKING WATER

OBJECTIVE

GLCI agrees to conduct water quality tests on the drinking water supply wells at the km 381 truck stop and at the well(s) supplying the administrative and industrial sector of the mine to characterize the water in the wells under initial conditions and during mine construction and operation. GLCI is committed to ensuring that no qualitative or quantitative impacts are observed in the truck stop well water. If there is an impact, GLCI will implement corrective actions to ensure an adequate supply of drinking water at the truck stop. These measures could include drilling a new well, on-site water treatment, or even a temporary supply of transported water.

STUDY AREA

The monitoring will concern the drinking water supply at the truck stop at km 381 and the well(s) supplying the mine's administrative and industrial sectors.

MONITORING ACTIVITIES

Monitoring will be carried out in compliance with the Regulation respecting the quality of drinking water (RRQDW). This Regulation's criteria reflect, for most parameters, the guidelines for drinking water quality in Canada.

Monitoring will also be performed on the well water quantity that could be affected by the possible drawdown of the groundwater table.

SCHEDULE

Monitoring will be conducted continuously during the construction phase but more regularly during the operation phase.

10.4.4 MONITORING SEDIMENT PHYSICOCHEMICAL QUALITY

OBJECTIVE

As an integral part of the fish habitat, GLCI undertakes to carry out sediment physicochemical quality monitoring. This monitoring will comply with procedures described in the *Guide de caractérisation physicochimique de l'état initial du milieu aquatique avant l'implantation d'un projet industriel*.

STUDY AREA

The program will tie into the water quality monitoring, and the same stations sampled for the initial characterization will be used (Section 6.2.9 and Map 6-8). The existing stations have locations that will, or will not, be exposed to the expected effluent.

MONITORING ACTIVITIES

The same parameters as the initial characterization will be analyzed to compare the results before project start-up and during mine operation.

Station results will also be compared between stations that are exposed and not exposed to project activities. Specifics of the program will be proposed to the MELCC during application for a depollution attestation, and the program will be adjusted as required.

SCHEDULE

This sampling will be conducted during the operational phase in different years, the interval of which is to be determined with the MELCC. Sediment monitoring must be included as part of the EEM to meet federal requirements.

10.4.5 MONITORING VEGETATION AND WETLANDS SURROUNDING THE INFRASTRUCTURE

OBJECTIVE

In addition to areas directly affected by work, the development of the site and projected infrastructures will have an indirect impact on preserved plant communities. Construction of the mining infrastructures could modify the terrestrial and wetland plant communities in the vicinity; modification to the drainage patterns could also lead to modification in the hydrology of certain wetland areas.

This monitoring program will allow assessment of the project's indirect impacts on the terrestrial and wetland plant communities, as well as re-assessment, depending on results obtained, of the surface area that will need to be compensated. A monitoring report will be produced and mitigation measures enhanced, as needed.

STUDY AREA

The monitoring method will include the detailed inventory of vegetation in the survey plots located along the transects, in a 25-m band, in order to be able to discern a potential disturbance gradient.

MONITORING ACTIVITIES

Vegetation and hydrology of the plant communities will be monitored in a 25-m band around the mining infrastructures. The purpose of this monitoring program will be to document the following parameters:

- Characterization of vegetation in plant communities adjacent to mining infrastructures;
- Comparison with the composition of original vegetation in the plant community;
- Characterization of the hydrology of wetlands (hydrological and pedological indicators) adjacent to mining infrastructures;
- Comparison with original hydrological and pedological indicators;
- Identification of modifications in terms of composition and/or hydrology.

SCHEDULE

The first inventory will be carried out during the site construction phase, and monitoring will be conducted over a five-year period, on years 1, 3 and 5.

10.4.6 MONITORING TRANSPLANTATION OF *CAREX STERILIS* PLANTS

A population of *Carex sterilis* plants, **previously identified as a plant species “likely to be designated as threatened or vulnerable in Quebec” during the initial impact assessment**, will be **affected** by the mining infrastructure construction work. **However, this species was removed from this list in the most recent ministerial order published in the *Gazette officielle du Québec* on February 12, 2020. Therefore, this population will not be monitored.**

10.4.7 MONITORING OF THE INTRODUCTION AND SPREADING OF INVASIVE ALIEN PLANT SPECIES

OBJECTIVE

Construction work and activities associated with mine operations could contribute to the accidental introduction and spreading of invasive alien plant species (IAPS) on the territory.

STUDY AREA

Work and traffic areas on the mining site.

MONITORING ACTIVITIES

The monitoring program will aim to:

- Survey all areas where work takes place and machinery travels during the plant growth period (July and August) to identify possible IAPS;
- Mark out and characterize any IAPS colonies with a GPS and take photos;
- Identify the most appropriate control method, eradicate and manage the waste and soils contaminated by these plants to prevent subsequent spreading;
- If required, monitor the colony and its eradication for a three-year period.

SCHEDULE

Annual follow-up will take place to detect the presence of IAPS in areas affected by the work. Introduction and spreading of IAPS will be monitored every year during the mine construction, operation and rehabilitation phases. Once rehabilitation is complete, the area will be monitored one more time. An annual report will be produced and mitigation measures enhanced if significant issues associated with IAPS are detected.

10.4.8 MONITORING EFFECTIVENESS OF COMPENSATION PROJECTS FOR LOSS OF WETLANDS

If the compensation program for loss of wetlands includes arrangement, rehabilitation or creation of wetlands, specific monitoring programs will be developed to assess their effectiveness over the medium term. These projects will be subject to pre-approval from the **MELCC**.

10.4.9 MONITORING AIR QUALITY

OBJECTIVE

Air quality will be monitored within the context of the project. The purpose of the monitoring program is to measure the impact that mining activities have on the local air quality. This will be carried out in order to determine whether the mining operations are acceptable and compliant with applicable standards and criteria, i.e. those set out in the **MELCC**'s *Normes et critères québécois de qualité de l'atmosphère* [Quebec's atmospheric quality standards and criteria]. This program will primarily consist of sampling the ambient air.

STUDY AREA

A measuring station will be set up near the km 381 truck stop. **In fact, this receptor is identified as being the sensitive receptor where higher concentrations of dust are expected according to the modelling. These measures will therefore provide a conservative portrait of any other receptor.** The exact location of this measurement station will depend on the direction of prevailing winds and other dust sources. The proposed location will be submitted to the **MELCC** beforehand for validation. A verification will be carried out to ensure that the **ECCC** and **MELCC** location criteria are met, i.e.:

- Minimum distance of 100 m from a waterway or body of water;
- Minimum distance of twice the height of any windbreak obstacles;
- Sampling points located at least 2 m from the ground;
- Measurements taken are representative of the study area's conditions.

The site selected will also need to be far enough from the Billy Diamond Highway and km 381 truck stop to ensure values obtained are representative of operations.

MONITORING ACTIVITIES

GLCI proposes monitoring total particulate matter (TPM), respirable suspended particulate matter (PM₁₀), fine particulate matter (PM_{2.5}) and crystalline silica from the start of operations. The monitoring will be modulated according to the results collected. A high-volume (Hi-Vol) sampler is recommended for the TPM analysis. Hi-Vol sampling will be for a 24-hour period from midnight to midnight the next day, and carried out for TPM once every six days. These samples will also be used to monitor exposure to certain metals. Metals with standards based on smaller average particle sizes will be first measured on total particulate. If standards are exceeded, then the size of the particles will then be measured.

The monitoring of respirable suspended particulate matter (PM₁₀) and fine particulate matter (PM_{2.5}) will be performed using a T640 type instrument or equivalent. This instrument is a nephelometer allowing the continuous measurement of PM₁₀ and PM_{2.5} particles. It is listed on the USEPA's list of designated reference or equivalent methods².

The potential emission of NO₂ generated during blasting will be monitored mainly through the observation of blasting events. This monitoring is presented in the dust management plan and also includes the implementation of additional mitigation measures, if needed, that may lead to better management and reduced NO₂ emissions from blasting.

2 https://www.epa.gov/sites/production/files/2019-08/documents/designated_reference_and-equivalent_methods.pdf (December 15, 2020 version)

Monitoring of crystalline silica will be performed on particulate matter collected on filters by sampling PM4 using a PQ100 sampler. The PM4 fraction will be collected using a sampling flow rate and a selective head equipped with an appropriate cyclone (SCCA, 11.1 LPM). To achieve an adequate detection limit, sampling will be conducted over five days (7,200 minutes). Silica laboratory analyses will be performed in compliance with the NIOSH 7500 protocol.

All analyses will be performed in a MELCC certified laboratory. Methods used will comply with those developed by the CEAEQ [Centre d'expertise en analyse environnementale du Québec], whenever available. Several quality control and quality assurance (QC/QA) measures will be instituted within the framework of the sampling campaign to ensure results are representative and accurate.

SCHEDULE

The measurement station will be installed at the very start of operations and will run continuously throughout the site operation phase.

10.4.10 MONITORING THE SOCIAL ENVIRONMENT

10.4.10.1 MONITORING THE SOCIOECONOMIC ENVIRONMENT

OBJECTIVE

The project will have positive benefits on training, jobs and the Cree communities' economy, most particularly the community of Eastmain. The proposed monitoring program is intended to qualify and quantify the economic benefits, and to evaluate the effectiveness of the measures implemented, and whether or not the community's expectations have been reached.

MONITORING ACTIVITIES

Monitoring the socioeconomic conditions will be based on documentary research and meetings with organizations and workers in the Eastmain community. With regard to documentary research, monitoring will be based on available data and statistics, most notably the following:

- Training programs, school clientele and success rate;
- Number of Cree employees at the mine, type and duration of jobs, and the workers' socioeconomic profile;
- Value of contracts won by Cree businesses;
- Data on the active population, employment rate and unemployment rate (Institut de la statistique du Québec [Quebec Statistics Institute], Statistics Canada, etc.).

Furthermore, meetings with stakeholders from Eastmain will provide an opportunity to obtain information on various aspects associated with training, jobs and contracts. Some of the organizations that could be met are:

- Council of the Cree Nation of Eastmain;
- Cree School Board;
- Wabannutao Eeyou Development Corporation (WEDC).

GLCI will also survey Cree workers at the mine to document their assessment of and experience with their jobs. A monitoring report will be produced each year.

SCHEDULE

The monitoring will be performed annually. The data will also be included in the annual report. The data taken during the monitoring will be analyzed and will be the subject of specific reports every 10 years.

10.4.10.2 MONITORING CURRENT USE OF LAND AND RESOURCES FOR TRADITIONAL PURPOSES

OBJECTIVE

The proposed monitoring program is intended to document and evaluate the effects that the project has on the practice of traditional activities of the RE2, **VC33, VC35 trapline tallymen** and the members of **their families**, as well as the effectiveness of the measures implemented. Frequent and regular contact will also be maintained with the RE2 trapline Tallyman to ensure that the mining activities do not hinder the territory users' activities, and to make any necessary adjustments.

Furthermore, other stakeholders may be consulted on the monitoring of certain specific issues. For example, the RE3 and R08 tallymen and the Waskaganish and Eastmain communities will be involved in monitoring traffic management and access to the camps and trails.

STUDY AREA

The territory in consideration corresponds to the study area illustrated on Map 6-22.

MONITORING ACTIVITIES

This monitoring is based on meetings with the RE2, **VC33, VC35 trapline tallymen** and members of **their families**. These meetings will provide an opportunity to update data and information collected during interviews conducted within the context of the EIA and to gather information regarding the current situation at the time of monitoring. Interviews will address the following subjects:

- Use and frequentation of the study area;
- Traditional hunting, fishing, trapping and other activities;
- Trails for snowmobiles and other modes of transport;
- Frequentation of the camps **and their quietness**;
- Problems using the territory;
- Accessibility to activity areas and travel;
- Assessment of the state of the resources;
- Changes that occurred and perceived effects;
- Assessment of measures implemented to mitigate the effects;
- **Effectiveness of the traffic management plan**;
- **Access to camps during hunting seasons**

SCHEDULE

Monitoring activities will be carried out according to the following schedule:

- Upon completion of construction;
- On the third, seventh, twelfth and last year of operation;
- One year after mine rehabilitation work has been completed.

If, after a few years of monitoring, no significant change is observed at the VC33 and VC35 traplines, monitoring will be limited to RE2 land users. It should be noted that VC33 and VC35 land users will still be able to contact the mine owner, if deemed necessary.

10.4.10.3 MONITORING QUALITY OF LIFE AND WELL-BEING

OBJECTIVE

Consultation activities carried out within the context of this environmental assessment brought to light the significance of the concerns that stakeholders who were interviewed expressed regarding quality of life and well-being in Cree communities. The monitoring program focuses on the population in the community of Eastmain. **GLCI will establish a monitoring committee before the project construction begins. Steps have been taken with the Cree Board of Health and Social Services of James Bay (CBHSSJB) for a representative of the organization to sit on the committee. The various users of the land will also be involved in this monitoring committee. As far as possible, GLCI will undertake to implement solutions to alleviate the social and/or health problems brought to its attention and regular monitoring will be performed. The details associated with the final social impact monitoring program, such as the target stakeholders, proposed activities, and issues to be monitored, will be specified after the project is authorized, before the construction period.**

MONITORING ACTIVITIES

The monitoring program will pertain to:

- Improving the quality of life of the members of this community;
- Tensions between the Cree population and mine workers;
- Social problems most notably associated with alcohol and drug consumption and compulsive gambling;
- **Sexual harassment problems;**
- Managing the enrichment of a portion of the community;
- Sense of loss and damage to cultural identity;
- Billy-Diamond highway users' diminished sense of security;
- Pressure on the health and social services systems.

This aspect will be based on meetings and discussion groups with stakeholders from the Eastmain community, which will allow the population an opportunity to express themselves regarding this aspect of the project.

Some of the organizations that could be met are:

- Council of the Cree Nation of Eastmain;
- Cree Board of Health and Social Services of James Bay;
- **Cree Women of Eeyou Istchee Association.**

Issues related to possible social problems such as sexual harassment, drug or alcohol use or safety issues will be addressed through investigation, discussion and meetings with GLCI employees and the liaison officer. A system for confidentially receiving and processing complaints will be implemented by GLCI before the start of construction, and will continue until mine closure. Complaints related to women's sense of well-being and safety can be addressed through this system. GLCI will ensure that these complaints are dealt with quickly and effectively. The human resources department will include at least one Cree woman who will monitor employee well-being, including that of Cree women.

SCHEDULE

Monitoring activities will be carried out according to the following schedule:

- Upon completion of construction;
- On the second, seventh, twelfth and last year of operation;
- One year after mine rehabilitation work has been completed.

10.4.10.4 **TRADITIONAL FOOD**

OBJECTIVE

Once the authorizations are obtained, GLCI is committed to developing a monitoring program for the quality of plants used by the Cree community as traditional food. The objective of this program will be to record any changes in the chemical composition of the main foods used by the community. The monitoring programs for the physical environment (water, air and sediment quality) will, therefore, complement the traditional food monitoring program and ensure compliance with environmental requirements.

MONITORING ACTIVITIES

This program will be developed in collaboration with the land's users to adequately target the species to be monitored. A preliminary version of the program will be developed and presented to the Eastmain, Waskaganish and Waswanipi communities for discussion.

The 24 metals analyzed in the leaves / needles, fruits, branches of six species sampled in the study area as part of the EIA will also be subjected to analyses for this monitoring. The same plant species will be targeted so that comparisons can be made of chemical element concentrations in plants and to assess the potential for contamination of traditional foods across the project area.

The results of the physical environmental quality will be compared to the human health protection criteria. GLCI will ensure that additional mitigation measures are implemented quickly should they be required to ensure compliance with these criteria.

10.4.10.5 **NOISE**

OBJECTIVE

A noise monitoring program will be designed to ensure compliance with the NI 98-01 noise limits and the Health Canada recommendations in its document entitled "Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise" (January 2017).

The detailed monitoring plan will be developed once the project's detailed engineering is completed.

MONITORING ACTIVITIES

At least two measurements will be taken at measurement points C1 and C2 (workers' camp and truck stop). Depending on the updated modelling results, other measurement points may be added (notably sites used by Indigenous persons).

At each assessment point, a measurement station will be installed, consisting of a sound level meter (including a microphone) and an audio recorder. The measurements will be taken continuously over at least 24 hours during weather conditions suitable for environmental noise measurements. A report will summarize the measurement results, the data processing and analysis, the measured sound indices with or without recording, in third-octave frequency bands and sound indices as required. Mitigation measures will be proposed if noise limits are exceeded.

SCHEDULE

This sampling will be conducted during the operational phase in different years the interval of which is to be determined with the MELCC.

10.4.11 **MONITORING WILDLIFE**

GLCI plans on involving land users in all operations affecting wildlife resources on their territory. The James Bay Eeyou Istchee representatives, the Eastmain, Waswanipi and Waskaganish band councils or designated community members, the RE1, RE2, RE3, VC33, VC35 and R08 trapline tallymen or a representative that they will appoint respectively and Matagami representatives will sit on the monitoring committee, and their participation will be solicited to learn about the monitoring measures and participate in their improvement so that the activities will proceed in compliance with traditional knowledge and community acceptance.

10.4.11.1 MONITORING BEAVER

OBJECTIVE

Beaver is a concern for the Cree users of the territory. The beaver will be the subject of special monitoring. The monitoring objectives are to ensure the safety of the dams and the colony's health while considering the dynamics of the beaver habitat. The monitoring points will be located in the areas most at risk of causing problems to mining infrastructures or access roads.

MONITORING ACTIVITIES

The monitoring will be performed with a habitat inspection. The terrain surrounding the site being hard to navigate, drone inspection may be considered where required. If issues are noted, the condition will be reported to the monitoring committee and the tallyman will be contacted. A solution will then be discussed with an expert and the tallyman of the area in question to have the animals trapped or the problematic structures dismantled. Mitigation measures presented before will, therefore, be applicable for the management of beaver dams in the vicinity (i.e. UTT03: Conduct beaver dam inspections at regular intervals to identify any changes to the CE2 water level and flow and notify the community of these changes. CIR02: Secure sites that pose a risk to land users).

Information on beaver, as well as on other wildlife species of interest to Cree users, will be communicated to the monitoring committee where tallymen will be represented. This information will then be communicated to relevant tallymen.

SCHEDULE

Monitoring the presence of beaver will be carried out in parallel with the regular inspection of mine site facilities and the surrounding areas. Beaver dam inspections will be conducted at monitoring points previously identified during the initial inventory and likely every two weeks during the active season (frequency to be confirmed following the initial inventory). This interval is based on a control objective in cohabitation with the beaver colony.

10.4.11.2 MONITORING BIRD POPULATIONS

The main monitoring and surveillance activities for migratory birds likely to frequent the territory during the mine's construction, operation and restoration phases are presented. Particular attention is given to waterfowl, a species that is highly valued by the local community, and species at risk under the LEMV (Act respecting threatened or vulnerable species), SARA or COSEWIC recommendations.

USE OF PONDS

One of the issues for bird populations during mine operations is their use of the various ponds (retention and sedimentation). As previously mentioned, these ponds are not attractive environments for avian wildlife, as they do not offer a food source, unlike the surrounding lakes and ponds. However, to ensure this, inspection measures will be implemented as soon as the ponds are created, in conjunction with the water quality monitoring that will be conducted in compliance with the federal MDMER and the provincial D 019 (section 10.4.1 of the EIS), to document the possible presence of bird concentrations and, if necessary, quickly implement measures to minimize the use of these ponds by avian fauna (FAU 06).

A monthly inspection program of these ponds, distributed throughout the ice-free period, will allow for the recording and quantification of the possible presence of birds or other wildlife. The competent authorities will be consulted as required and, if necessary, appropriate mitigation measures applied. At first glance, acoustic scaring devices appear to be the best option (WSP, 2007). The program outline is as follows:

- At a minimum, monitor the ponds on a bi-monthly basis during the ice-free period, i.e., approximately from mid-May to mid-November.
- The inspection shall be carried out through visits at the start and end of the day, when the visibility conditions are favourable for the observation and counting of birds that are likely to be found in the ponds.

- The inspection shall be conducted by an individual capable of identifying and counting the specimens present. If such a resource is unavailable, the monitoring manager shall use the camera at his/her disposal to take pictures and forward them to an individual qualified to identify birds. Data will be compiled in a record of which a copy will also be kept by GLCI. The wildlife record will be a part of the global inspection and monitoring reports that will be made available to the monitoring committee.
- Increase the frequency of visits to weekly basis, or more often as required, during the spring and fall migration periods.
- Where applicable, analyze the frequenting data of migratory birds to the sites in relation to the monitoring of pond water quality which will be an integral part of the global monitoring and follow-up program.
- In consultation with the competent authorities, if the use of ponds by birds is deemed as a threat to their health or survival, exclusion measures shall be implemented (e.g. sufficient number of acoustic scaring devices).
- If necessary, install one or more cameras as such that pictures can be viewed remotely, to facilitate site monitoring and control triggering of scaring devices.

USE OF BORROW PITS

An inspection of the use of borrow pits by wildlife will be conducted during bi-monthly rounds or site visits by the environmental monitor. The specific problem with borrow pits is mainly related to their potential use by nesting Bank Swallows. To target this specific issue, inspections would be staggered from mid-May to mid-August inclusively. The monitoring frequency shall be increased to one visit per week if Bank Swallow is observed at any of the sites.

Table 7.5 in Chapter 7 (FAU 07) identifies applicable mitigation measures should the inspected sites be used by Bank Swallows.

The proposed monitoring program to prevent adverse effects on the Bank Swallow from the use of borrow pits is outlined as follows. A final and more detailed program will be created at a later stage:

- The program will be implemented to verify the possible presence of Bank Swallow at the project's borrow pits.
- The inspection part of this program will be assigned to a competent individual (biologist or technician). This individual will be tasked with verifying the presence of birds, informing the machine operators of restrictions and methods to be used to protect the species, and making sure that these measures are implemented. Where necessary, the individual will report any violation to GLCI's management
- Site visits shall be conducted before opening a new borrow pit, and afterwards on a bi-monthly basis from mid-May to mid-August;
- The monitoring frequency shall be increased to one visit per week if Bank Swallow is observed at any of the sites.
- All borrow pits selected for material extraction will be visited from mid-May to mid-August;
- To reduce the appeal of borrow pits for Bank Swallow nesting, the operators will be asked to maintain, at all times, a gradient of maximum 70 degrees at bench slopes that are being exploited. At the end of each day's operation at a borrow pit, the operator shall ensure that the slopes are profiled to a gradient of less than 70 degrees;
- In addition, each spring, before the end of April, the operator shall make sure that the slope gradient of borrow pits to be exploited in the following months is, indeed, less than 70 %. If required, the operator shall reprofile the slopes before the birds are expected to return;
- Wherever possible, the operator will maintain an alternative unexploited Bank Swallow nesting area by developing a slope with a gradient of at least 70 degrees. This compensation measure will be mandatory as soon a site already used by a Bank Swallow colony becomes operational.
- Alternatively, if other sites suitable for operation are not available within a reasonable distance from the project and that development of an alternative nesting site nearby is impossible, an acoustic scaring device may be set up in the early spring to discourage the Bank Swallow colony from settling in an area to be exploited. However, no scaring device shall be used once a colony is established.

OVERALL MONITORING OF BREEDING BIRDS

For the purpose of documenting the actual impact of the mine on the breeding birds, five-year surveys can be carried out at various stages of operation until the follow-up monitoring of restoration work, starting from the fifth year of mine operation until the fifth year after its permanent closure.

Post-closure monitoring could also be conducted in conjunction with other required monitoring (e.g. vegetation recovery monitoring). These surveys will help document the effect of restoration on the natural habitats affected by forest fires on bird populations.

These breeding bird surveys could be conducted at listening stations visited during the 2017 survey, at several stations within the project footprint, and at selected restored sites as the project progresses.

10.4.11.3 MONITORING FISH AND FISH HABITAT

The MDMER, under the Fisheries Act, requires mines to conduct environmental effects monitoring (EEM) for metal mines as a condition for effluent authorization. The purpose of EEM is to assess the potential effects that effluents would have on fish, fish habitat and use of fish resources. Section 10.4.1 presents the specifics of this monitoring.

10.4.11.4 MONITORING OF SPECIES AT RISK

In addition to the monitoring programs presented in section 10.4.10.2 for avian populations, various environmental monitoring programs may be conducted for other major terrestrial animal species of special concern under the LEMV, SARA or COSEWIC recommendations.

BATS

A survey effort of 261 station nights was made to assess the use of the study area by bats, and all of the data collected was analyzed, which significantly exceeds provincial requirements for this (MRNF, 2008). Despite this survey effort, only 68 bat passages were recorded for all the stations, including three calls by bats of the *Myotis* genus, which is explained by the generally poor quality of the environment and the northern nature of the study site (WSP, 2018). Moreover, the project's impact on bats was deemed minor following the completion of the impact assessment.

For the purpose of documenting the impact of the project on bat species at risk, we propose five-year surveys carried out at various stages of mine operation until the monitoring of restoration work, starting from the fifth year of mine operation until the fifth year after its permanent closure. These surveys will also help document the effect of restoration on the natural habitats affected by forest fires on these mammals.

These surveys would be conducted using the same protocol and at the same sites as those examined during the 2017 survey, using six automated stations active during the breeding (early June to late July) and migration (mid-August to mid-October) periods. Locations surveyed in 2017, but rendered unsuitable by mine operations, would be replaced by an adjacent site with similar habitat.

However, although we propose monitoring this wildlife component, it is likely that the data collected would not be sufficient, given the low relative densities recorded, to assess the effectiveness of the mitigation measures implemented as part of the James Bay Lithium Mine project. Consequently, if the first three years of monitoring (years 1, 5 and 10) do not show significant differences in the use of the study area by bats — or suggest an increase in use — this monitoring could be discontinued with the MFFP's agreement.

CARIBOU AND WOLVERINE

Considering the low probability of wolverine presence in the study area, the extent of the territory it occupies, the small size of the area influenced by the mining project and the intensity of current human occupation in the sector, the James Bay Lithium Mine project will not affect this species.

Furthermore, the project is considered to have no significant effect on woodland caribou or their habitat. As previously mentioned, the study area offers poor habitat conditions due to its high disturbance rate and the fact that the species has very rarely occupied the study area over the past decade. Therefore, its actual probability of occurrence in the study area is considered insignificant in the short and medium terms.

However, the Proponent commits to creating a joint work table (GLCI, Eastmain community and Waskaganish community) to discuss the caribou monitoring to perform. This monitoring could provide a more accurate picture of past and projected caribou use on the RE2, RE3, VC33, VC35, R08 traplines (and RE1 if needed). It would also allow for the collection of traditional knowledge concerning caribou habitat fragmentation. This monitoring would allow the development of adequate measures to mitigate the possible effects of the project on the harvesting of woodland and migratory caribou for current and future territory users. It will also help knowledge transfer in the communities about caribou and its “sensitive” status, to promote good Cree practices and the preservation of the resource for future generations, which could include a growing number of young hunters.

Furthermore, a boreal caribou module will be integrated into the mine’s employee and subcontractor training, the objectives of which would be to educate them about the precarious nature of boreal caribou, develop their ability to distinguish potential signs of presence, and inform them of the control system and action plan in case of caribou presence and the importance of reporting any on-site caribou observations. Where applicable, these observations will be compiled in a wildlife record.

The proponent also plans to set up a communication system to inform truck drivers of any observations or signs of caribou presence on the road near the mine’s area of influence and on Billy Diamond Highway.

SPECIES WITH SPECIAL STATUS

In addition to the monitoring program presented in Section 10.4.10.2, the purpose of the monitoring program for bird species at risk is to verify the predictions of the environmental assessment and to determine the effectiveness of the measures implemented to mitigate the project’s adverse effects on these species. Its objectives include verifying the presence and the number of local populations of these birds, establishing trends over time and, if required, modifying the mitigation measures already in place or implementing additional measures to reduce the extent of the residual effects observed.

The monitoring program will mainly focus on species at risk whose habitat is found in the study area, as well as on favourable habitats that will gradually recover from recent forest fires and construction works of the project’s infrastructure. Nine of the forty-one bird species designated as “at risk” in Quebec were identified having a distribution area that either covers or nears the study area. These include the Hudsonian Godwit, Common Nighthawk, Short-eared Owl, Bank Swallow, Olive-sided Flycatcher, Canada Warbler, Red-necked Phalarope, Rusty Blackbird, and Yellow Rail. Particular attention will be paid to these species, without excluding new species that may be assigned a special status during the monitoring period. Listening stations will, therefore, be set up in habitats conducive to each of these species. If necessary, the five-year monitoring plan may evolve over time.

Survey effort, timelines and methods will be similar to those employed in 2017 to establish a baseline condition (WSP 2017, 2018), namely the listening station method (Blondel and al. 1970; Environment Canada, 1997, 2007) for terrestrial breeding birds and ground station surveying for waterfowl and aquatic bird nesting. In addition, protocols will be developed specifically for Nighthawks (Regroupement QuébecOiseaux, 2015) and Short-eared Owls. Previously accessed monitoring stations that are available will be reused for the survey.

For the purpose of documenting the actual impact of the mine project’s infrastructure and operational activities on the breeding birds, we propose that five-year surveys be carried out at various stages of operation until the monitoring of restoration work, starting from the fifth year of mine operation until the fifth year after its permanent closure. In this way, it will be possible to observe the evolution of local populations of bird species at risk and adjust mitigation measures, if needed. These surveys will also help document the effect of the gradual restoration of borrow pits, quarries and stockpiles, as well as natural habitats affected by forest fires on bird populations.

The results of these surveys shall be provided to the Environmental Monitoring Committee as well as to the competent authorities within six months of collecting the data.

If problems with a bird species at risk are identified, the proposed measures shall be described in the follow-up reports and may be discussed and improved upon in consultation with the Environmental Monitoring Committee and the competent authorities.

10.5 POST-RESTORATION MONITORING PROGRAM

A monitoring program will be included in the site rehabilitation plan. The purpose of the monitoring program is to validate whether the measures applied to the site meet expectations. The following elements will be considered.

10.5.1 GEOTECHNICAL MONITORING

Subsequent to rehabilitation activities, a monitoring program must be implemented to validate the stability of the infrastructures left in place. The integrity of the waste rock stockpiles, the ROM pad and civil engineering work will be checked for erosion, movement, settling and cracking. Annual inspections will be conducted by an engineer for the first five years, and then periodically for the next ten years, at the frequency the engineer recommends.

10.5.2 MONITORING OF WATER QUALITY

Surface and groundwater quality monitoring will be required post-rehabilitation. A biannual groundwater monitoring campaign (summer and fall) will be carried out, and compliance criteria will be validated against those set out in D019. Furthermore, surface water effluent will also be the subject of a monitoring program. **Post-operational environmental monitoring will be carried out for three years, from the time operations end until the completion of the restoration work, and comply with requirements of the D019, or equivalent at that time. Thereafter, post-restoration environmental monitoring will be carried out for five years, as recommended by D019. The post-operation environmental monitoring will be carried out on a bi-monthly basis for 6 months, then monthly for 2.5 years, as recommended in D019. Finally, post-restoration monitoring will be carried out six times a year for 5 years.**

The results of the environmental monitoring will be sent to the MERN and the MELCC each year in the form of an annual report. Even if the monitoring committee is disbanded, the results will remain public and accessible to everyone. GLCI may send, upon request, a copy to interested band councils.

10.5.3 MONITORING OF VEGETATION RECOVERY

Monitoring of vegetation recovery on restored surfaces is required. The purpose is to ensure that the site rehabilitation activities helped to establish an adequate vegetation density to protect against erosion, and adequately revegetated areas disturbed by mining activities. The monitoring program will aim to characterize the plant cover and species composition in restored areas, and to identify signs of erosion. Monitoring will continue for five years.

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