AECOM

CANADIAN ROYALTIES INC.

NUNAVIK NICKEL

Addendum to the Environmental and Social Impact Assessment

Phase 2b : Mining of the Delta Deposit

Volume 1 – Main Report

Certificate of Authorization nº 3215-14-007 : Nunavik Nickel Mining Project

Project number : 60635966

January 2023

Delivering a better world

Addendum to the Environmental and Social Impact Assessment

Phase 2b: Mining of the Delta Deposit

Volume 1 – Main Report

Certificate of Authorization nº 3215-14-007: Nunavik Nickel Mining Project

Project number 60635966

January 2023

*This document is a translation of the initial French version. In case of difference, the original text in French prevails.

Delivering a better world

Statement of Qualifications and Limitations

The attached Report (the "Report") has been prepared by AECOM Consultants Inc. ("Consultant") for the benefit of the client ("Client") in accordance with the agreement between Consultant and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations and conclusions contained in the Report (collectively, the "Information"):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations");
- represents Consultant's professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- may be based on information provided to Consultant which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
- must be read as a whole and sections thereof should not be read out of such context;
- was prepared for the specific purposes described in the Report and the Agreement; and
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time.

Consultant shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information. Consultant accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

Consultant agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but Consultant makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

Without in any way limiting the generality of the foregoing, any estimates or opinions regarding probable construction costs or construction schedule provided by Consultant represent Consultant's professional judgement in light of its experience and the knowledge and information available to it at the time of preparation. Since Consultant has no control over market or economic conditions, prices for construction labour, equipment or materials or bidding procedures, Consultant, its directors, officers and employees are not able to, nor do they, make any representations, warranties or guarantees whatsoever, whether express or implied, with respect to such estimates or opinions, or their variance from actual construction costs or schedules, and accept no responsibility for any loss or damage arising therefrom or in any way related thereto. Persons relying on such estimates or opinions do so at their own risk.

Except (1) as agreed to in writing by Consultant and Client; (2) as required by law; or (3) to the extent used by governmental reviewing agencies for the purpose of obtaining permits or approvals, the Report and the Information may be used and relied upon only by Client.

Consultant accepts no responsibility, and denies any liability whatsoever, to parties other than Client who may obtain access to the Report or the Information for any injury, loss or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information ("improper use of the Report"), except to the extent those parties have obtained the prior written consent of Consultant to use and rely upon the Report and the Information. Any injury, loss or damages arising from improper use of the Report shall be borne by the party making such use.

This Statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report is subject to the terms hereof.

Signatures

Report prepared by:	Emmanuelle Cecchi, Ph.D. Earth Sciences - AECOM	January 31, 2023
	Audrey-Anne Grenier, biologist Sc., AECOM	January 31, 2023
	Stéphane Sacotte, biologist M. Sc.- AECOM	January 31, 2023
Report reviewed by:	Claudia Cossette, biologist M.Sc. Project Director - AECOM	January 31, 2023
	Stéphane Lemay, Ing. Discipline Manager- Engineering - AECOM	January 31, 2023
	Judy-Fay Ferron Environmental Analyst Canadian Royalties Inc.	January 31, 2023
	Steve Quessy, ing. Chief Engineer Canadian Royalties Inc.	January 31, 2023
	Nicolas Kuzyk, biol, M.Env. ESG Chief Canadian Royalties Inc.	January 31, 2023
Report approved by:	Stéphane Twigg Environmental Superintendent - Canadian Royalties Inc.	January 31, 2023

Project Team

CANADIAN ROYALTIES INC.

Stéphane Twigg	Environmental Superintendent
Nicolas Kuzyk	ESG Chief
Steve Quessy	Chief Engineer
Marie-Eve Ratthé	Environmental Senior Supervisor
Judy-Fay Ferron	Environmental Analyst

AECOM

Claudia Cossette, Biologist, M. Sc.	Project Director
Stéphane Lemay, Eng.	Discipline Manager
Jacques Langlois, Ph.D.	Scientific Reviewer
Emmanuelle Cecchi, Ph.D. Earth Sciences	Writing
Emmanuel Maltais, Biologist, M.Sc.	Field work, writing
Elisa Mignot, Biologist, B.Sc.	Field work, writing
Sylvain Daraîche, Biologist, Sc.	Analysis and writing
Cynthia Hébert, Biologist, Sc., M. Ing.	Analysis and writing
Patricia Bolduc, Biologist	Writing
Mathieu Lafond, Biologist, M.Sc.	Writing
Cyril Saison, Biologist, M. Sc.	Field work and analysis
Alexandre Joly, Wildlife Technician	Field work
Félix-Antoine Dumontier-Boislard, wildlife technician	Field work
Dominic Savard, Wildlife Technician	Field work
Claire Dubé, Anthropologist	Analysis and writing
Patrick Hébert, Anthropologist	Writing, human environment
Érik Phaneuf, Anthropologist and Archaeologist	Analysis and writing
Cherine Akkari, Biologist Sc., M. Geography	Specialist in resilience and adaptation to climate change, writing
Audrey-Anne Grenier, Biologist	Analysis and writing
Shadnoush Pashaei Farahani, M. Sc. Architecture and M. Sc. Civil Engineer	Analysis and writing
Luc Godin, Biologist, M. Sc.	Analysis and writing
Yves Leblanc, Biologist, M. Sc.	Reviewer
Sonia Labrecque, Biologist, M. Sc.	Reviewer
Ionah Seyfried, Biologist, M. Sc.	Analysis and writing
Amélie Morneault, Bbiologist, M. Sc.	Analysis and writing
Thomas Bergeron, M.Sc. Water Sciences	Analysis and writing

Stéphane Sacotte, Biologist, M. Sc.	Analysis and writing
Charles Gauthier, Ecotoxicologist, Ph. D.	Translation
Maude Thériault-Gauthier, Biologist, M. Sc. Env.	Translation
Josée Dubois, Biologist, M. Sc. ENV.	Cartography and mapping
Chloé Drapeau, Editor	Report editing

Reference to be Cited:

AECOM and Canadian Royalties Inc. 2023. Addendum to the Environmental and Social Impact Assessment – Phase 2b : Mining ot the Delta Deposit – Certificate of Authorization no 3215-14-007 : Nunavik Nickel Mining Project. (Volume 1) 380 pages and appendices (Volumes 2 to 4).

Table of Contents

List of Tables

List of Figures

List of Diagrams

List of Photos

List of Maps

List of Appendices

(Volume 2)

(Volume 3)

(Volume 4)

Abbreviations, symbols and acronyms

BQMA	Database on the quality of the aquatic environment (*Banque de données sur la qualité du milieu aquatique*)
CA	Certificate of Authorization
CCME	Canadian Council of Ministers of the Environment
JBNQA	James Bay and Northern Quebec Agreement
FEL	Frequent Effect Level
OEL	Occasional effect level
PEL	Probable Effect Level
REL	Rare Effect Level
TEL	Threshold Effect Level
DOC	Dissolved Organic Carbon
NNC	Nunavik Nickel Committee
CRI	Canadian Royalties Inc.
CVAA	Protection criteria for aquatic life against acute effects (*Critère de protection pour la vie aquatique contre les effets aigus*)
CVAC	Protection criteria for aquatic life against chronic effects (*Critère de protection pour la vie aquatique contre les effets chroniques*)
KEQC	Kativik Environmental Quality Commission
C_{10}-C_{50}	Petroleum Hydrocarbon C10-C50
ESIA	Environmental and Social Impact Assessment
ECCC	Environment and Climatic Change Canada
ESG	Environmental, Social and Governance
GHG	Greenhouse Gas
PAH	Polycyclic Aromatic Hydrocarbons
RDL	Reported Detection Limit
IAA	Impact Assessment Act
LEMN	Northern Landfills
EQA	Environment Quality Act
KI	Kativik Ilisarniliriniq
MELCCFP	*Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs*
TSS	Total Suspended Solids
NAG	Non Acid Generating
PEIIC	Program for Environmental Improvement in Inuit Communities
PAG	Potentially Acid Generating
NNiP	Nunavik Nickel Project
NNiPRP	Nunavik Nickel Project Restoration Plan
REAFIE	Regulation respecting the supervision of activities based on their environmental impact (*Règlement sur l'encadrement d'activités en fonction de leur impact sur l'environnement*)
TSM	Towards Sustainable Mining

1 Introduction

Canadian Royalties Inc. (CRI) is a mining company with headquarters located in Montreal. CRI undertook the development of the Nunavik Nickel Project (NNiP), an autonomous mining complex in Nunavik, following the environmental and social impact assessment (ESIA) in 2008 (GÉNIVAR, 2007) and issuance on May 20, 2008 of the global authorization certificate n° 3215-14-007 (hereafter named the global CA). The complex is located approximately 80 km west of Kangiqsujuaq and about 140 km south-east of Salluit.

Intensive exploration activities in this area initially brought the discovery of the Mesamax, Expo, Méquillon and Ivakkak deposits, whose open pit mining was included in the global CA issued in 2008. Mining of the first three deposits has started at different times since 2012. Mining of the Expo deposit was completed in 2020 while mining of the Ivakkak deposit will begin in 2023.

Continued exploration efforts have led to the discovery of new deposits as well as extensions of previously discovered deposits. The Allammaq and Puimajuq deposits have each been the subject of an addendum to the ESIA and their development has been added to the overall CA in 2011 and 2020 respectively. Amendments to the global CA were also issued for the underground mining of the Expo and Méquillon deposits, now the Expo West (2020) and Méquillon UG1 (2021) projects, as well as for the modification of the tailings management method (2021). An addendum for the underground mining of the Mesamax deposit (Mesamax UG project), filed in March 2022, is currently being analyzed by the MELCCFP. The most recent addendum, named Phase 2a, was submitted to the MELCCFP in June 2022 and addresses the following:

- The addition of underground mining of the Nanaujaq deposit, located between the Expo complex and the Méquillon deposit.
- The extension of the Ivakkak, Expo West and Méquillon UG1 underground mines, representing the Ivakkak UG, Expo South and Méquillon UG2 projects respectively.
- Related projects to support the extension of the NNiP brought about by the addition of other projects (increase in the capacity of the Expo site and the wastewater treatment system, addition of a landfill cell at the northern landfill site, modification of the tailings management method, etc.)

These exploratory efforts also led to the discovery of the Delta deposit, located 60 km from the Expo deposit. The proximity of the Expo complex, as well as its location are within the legal calving ground for migratory caribou defined by the MELCCFP, which adds technical components and potential impacts that are specific to this project, and are therefore presented in this addendum named Phase 2b, separately from the addendum for Phase 2a. Like the projects listed above, the Delta deposit is located in the study area of the 2007 ESIA and the mining processes and daily ore processing tonnage are not modified. The application for authorization of this new project is therefore presented as an addendum to the 2007 ESIA. Phases 2a and 2b would allow the NNiP to operate beyond 2030. All of the Phase 2 projects, as well as previous projects that have been authorized through amendments to the CA, demonstrate CRI's efforts to optimize existing infrastructure.

This document is the Phase 2b addendum to the NNiP ESIA. It includes :

- Open pit and underground mining of the Delta deposit (hereafter referred to as the Delta OP and Delta UG projects), including the operation of a water treatment plant (WTP)
- The construction of a road linking the Ivakkak and Delta deposits, allowing the Delta deposit to be connected to the Expo industrial complex, as well as the construction of a road linking the Delta deposit to Lake No. 4, in order to build a water withdrawal facility.
- The establishment of a camp with an accommodation capacity of 150 people, including related infrastructure (drinking water treatment, sanitary wastewater treatment and a northern landfill site (LEMN).

Chapters 2 and 3 present the location, context, project justification and regulatory framework for Phase 2b of the NNiP. Chapter 3 also presents the main issues, CRI's sustainable development objectives, as well as the agreements with the Aboriginal communities.

Chapter 4 summarizes the consultation process held with local communities, whether through the Nunavik Nickel Committee (NNC) as part of the Impact and Benefit Agreement (IBA), or as a result of concerns raised since 2006.

Chapter 5 describes the various alternatives for Phase 2b with respect to the method of mining the ore, the location of infrastructure such as the waste rock pile and access portals to the underground deposit, the location of the final discharge point for treated water, the access road, the location of the temporary camp, the water withdrawal methods and finally the closure of the site and its restoration. This comparison determines the best alternative in terms of technical feasibility, economic feasibility, and the magnitude of impacts on the biophysical and social environment. The chapter then describes the complete details of Phase 2b for the selected alternative. This description concerns, among other things, all the mining infrastructures and the activities that will take place there, the implementation schedule, the operating sequence and the costs of the work.

Chapter 6 describes the physical, biological and human environments located in the study area selected for the environmental and social impact assessment. This description includes a synthesis of the information collected in the context of the 2007 ESIA (GENIVAR, 2007), including all relevant information included in the various modification requests to the overall CA, as well as the results of specific inventories conducted during the summers of 2021 and 2022 in the area under study in Phase 2b of the project.

Chapter 7 presents the assessment of the impacts of Phase 2b, the applicable mitigation measures and the residual effects for each component. A summary of the significant residual impacts, after mitigation measures, concludes this section.

Chapter 8 presents a climate change resilience study for the Phase 2a project, as well as the greenhouse gas balance produced under Phase 2b.

Chapter 9 presents the environmental surveillance and monitoring programs. Environmental monitoring is present at each phase of the project. It must be planned as of the plans and specifications preparation phase. The purpose of the established environmental monitoring plan is to evaluate the effectiveness of the proposed mitigation measures and to verify if certain negative impacts are occurring. If necessary, these impacts must be quantified, while ensuring that standards are respected and that the necessary corrective measures are applied to protect the environment.

Chapter 10 describes the general procedures for managing the main accidents that may occur during construction and operation of Phase 2b. These procedures are relative to preventing spills of petroleum products and hazardous materials, in addition to fires and explosions.

Throughout this document, Phase 2b will be referred to as the Delta Project. These two terms are synonymous and refer to the same project.

1.1 Project Initiator and Consultants Involved

The project promoter is Canadian Royalties Inc. - Nunavik Nickel Project. CRI is exclusively owned by the parent company, Jien International Investment Ltd. CRI's headquarters are located in Montreal.

CRI mandated the firm AECOM to complete the impact study in its entirety, in addition to the specific social and environmental studies. AECOM is a firm that specializes in engineering and environmental impact studies who operate in several countries worldwide.

The contact details of the project initiator and the consultant involved in the file are included in Table 1-1.

Table 1-1: Contact Details for the Project Initiator and the Consultant Involved

Project Initiator	
Name:	Canadian Royalties Inc.
Civic address:	800, boul. René-Lévesque O. Locale 410 Montreal (Quebec) H3B 1X9
Phone:	1-877-879-1688
Fax:	1-514-879-1795
Project manager:	Stéphane Twigg
Email of the project manager:	Stephane.Twigg@canadianroyalties.com
Quebec business number (NEQ) from the Registraire des Entreprises du Québec:	1166090366
AECOM	
Name:	AECOM Consultants Inc.
Civic address:	2 rue Fusey, Trois-Rivières, QC, G8T 2T1
Phone:	1-873-387-0306
Fax:	819-373-7573
Project manager:	Claudia Cossette
Email of the project manager:	claudia.cossette@aecom.com
Quebec business number (NEQ) from the Registraire des Entreprises du Québec:	1161553129

2 Project Location

The exploitation of NNiP's deposits will take place in the arctic tundra of Nunavik, located about 80 km west of Kangiqsujuaq and 140 km south-east of Salluit. The land regime established by the James Bay and Northern Quebec Agreement (JBNQA) is divided into three categories: I, II and III category lands. NNiP is located on land of category III where the Inuit of Nunavik have specific rights for that location.

Map 2-1 presents the project's situation; the general location of NNiP in this case. In addition to the project's components and infrastructure (existing and projected), which includes the mining complex in Phase 2a, the following elements are also present:

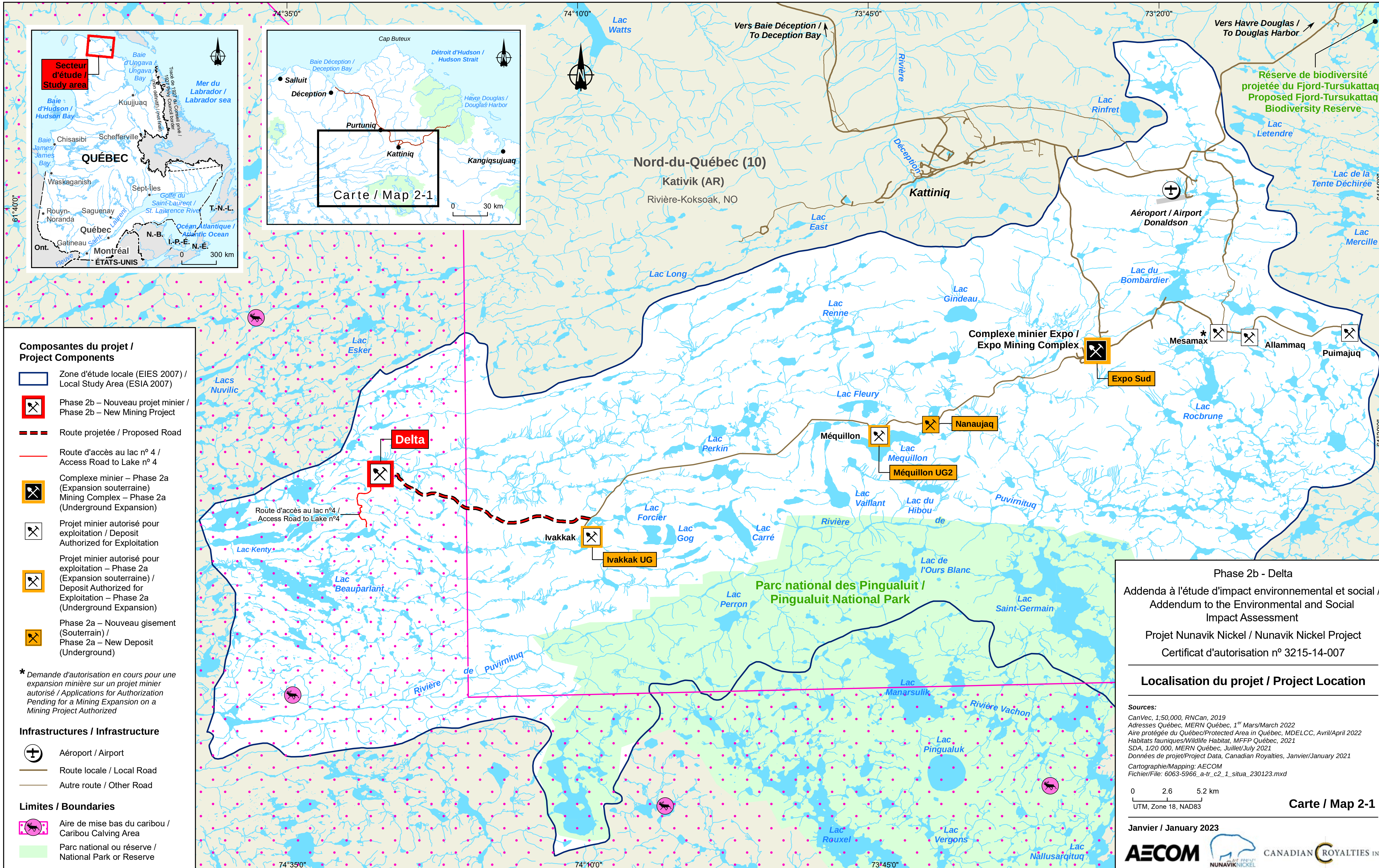
1) Existing and projected roads
2) Hydrography (lakes and waterways)
3) The Donaldson airport to the north-east
4) Limits of the Pingualuit National Park to the south and the *Réserve de Biodiversité Projetée du Fjord-Tursukattaq* to the north-east
5) Roads toward Deception Bay and Douglas Harbour.

Port infrastructure, including a transshipment dock, are located in Deception Bay at about 110 km from the Expo camp. These infrastructures make it possible to receive the goods and transport the ore. A camp also gives the workers a place to rest. The harbour infrastructure and the Deception Bay camp will be present for the entire duration of the NNiP mining operations and for the time required to restore the sites after their operation.

The property on which the Delta deposit is located is currently owned by a sister company of Canadian Royalties whose name and business number is 9405-9292 Québec Inc (SIGEOM, 2022). It consists of 26 mining claims covering a total area of 6.53 km^2 (see Map 2-2). The central geographic coordinates of the Delta site are 61º28" 54.51' N & 74º28" 20.30' W.

The Delta deposit is located:

- 60 km west of the Expo complex;
- 47 km southwest of the Raglan mining operation (Glencore).



Phase 2b - Delta

Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment

Projet Nunavik Nickel / Nunavik Nickel Project

Certificat d'autorisation nº 3215-14-007

Localisation du projet / Project Location

Sources:
CanVec, 1:50,000, RNCan, 2019
Adresses Québec, MERN Québec, 1er Mars/March 2022
Aire protégée du Québec/Protected Area in Québec, MDELCC, Avril/April 2022
Habitats fauniques/Wildlife Habitat, MFFP Québec, 2021
SDA, 1/20 000, MERN Québec, Juillet/July 2021
Données de projet/Project Data, Canadian Royalties, Janvier/January 2021
Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c2_1_situa_230123.mxd

Carte / Map 2-1

Janvier / January 2023

3 Project Context

3.1 Project Justification

CRI began exploration work on the NNiP properties in 2001 and invested a total of 73.6 million dollars in exploration, mineral resource delineation, in addition to technical and economic studies through 2009. Mineral resources reported in 2009 totalled 23.7 million tonnes from six deposits. CRI continued their efforts in the search for new deposits and in the development of known and mined deposits. The investment in exploration and development reached 112 million dollars between 2010 and 2021, including 69.6 million dollars since 2018. Exploration activities led to the discovery of four new deposits and several major mineralized zones during this period. NNiP is the 5th largest nickel mining operation in Canada (Mining Technology, 2022).

This search for ore is based on the growing need for copper and nickel worldwide. Nickel is used in the design of lithium-ion batteries for electric and hybrid vehicles (Gouvernement du Canada, 2022a), whereas nearly 35% of copper is used for electrical purposes (distribution, transmission and building electrical systems) (IRIS, 2019). Thus, the global energy transition taking place in electrified transport and the decarbonization of energy and electrical technologies have become priorities that meet international climate objectives and local pollution issues.

In addition to meeting the needs for the transition to greener energies for vehicle motorization, The Delta project, by combining open pit and underground mining, ensures the installation's performance and profitability in relation to the life of the equipment, as well as maintaining jobs in Nunavik. Open pit mining of the deposit will produce more copper and nickel in a shorter period of time than underground mining alone. Therefore, as a complement to the Phase 2a projects, this new deposit will ensure the viability and profitability of mining and ore processing activities for CRI until at least 2032, as indicated in Table 3-1, without the need for an increase in the maximum authorized ore processing rate of 4,500 tonnes per day.

The Delta deposit will become accessible through the construction of a 16 km access road from the Ivakkak deposit; the road from Ivakkak to the Expo complex was approved as part of the global CA in 2008 and was constructed in 2021 and 2022. The Delta Project is considered economical, particularly because the core facilities (including the industrial complex with ore processing and tailings facility) are already in place and the ore grade of copper and nickel is sufficient to offset the costs of road construction, temporary camp and mining, despite the 60 km distance from the industrial complex. Furthermore, as presented in Table 3-1, which presents the mining schedule for the various Phase 1 and 2 deposits of the NNiP, as well as the tonnages, the Delta Project is able to generate tons of ore crucial to the profitability of the ore processing plant, with an authorized annual processing capacity of 1.6425 kt (4,500 t/day). This table outlines the planned sequence of operations for the entire NNiP, while this addendum only addresses the Delta Project.

Table 3-2 presents the ore production for the open pit and underground operations of the Delta Project.

The new deposits will not be mined simultaneously (see table 3-1). In fact, mining will be spread over time starting in 2023 by overlapping the mining operations with prior authorization. In addition, most deposits have a limited lifespan given their estimated ore reserve.

Table 3-1: Mining schedule of the different deposits of the NNiP

Mine	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Expo														
Allammaq														
Méquillon														
Méquillon UG1														
Méquillon UG2														
Mesamax														
Mesamax UG														
Expo Ouest														
Expo Sud														
Puimajuq														
Ivakkak														
Ivakkak UG														
Nanaujaq														
Delta OP														
Delta UG														
Expo marginal ore														
Total annual tonnage (kt)[1]				1 499	1 674	1 604	1 657	1 710	1 749	1 893	1 572	1 579	1 393	187

	Mining authorized under the global CA 3215-14-007.
	Mining of Phase 2a, for which the request for a modification to the global CA 03215-14-007 is being analyzed
	Mining of Phase 2b targeted by the present request
	Mining targeted by another request for modification of global CA 3215-14-007 and currently under analysis

[1]: This is the annual tonnage extracted from the deposits and not the ore processed at the plant, which will not exceed the authorized processing capacity.

Table 3-2: Ore production for the Delta 1 Project[1]

Mine	Tons/day	Tons	Lifespan
Delta OP	1 100	325 600	2 ans
Delta UG	1 100	1 986 400	7 ans
Total	1 100	2 312 000	7 ans

[1] : Ore production from the underground mine (UG) will start during the open pit (OP) operation. Due to the overlap of the mining phases, the daily production (t/day) and the project duration are not the sum of the OP and UG phases.

Maps 3-1 details mining claims and leases held by Canadian Royalties, including leases on public land and exclusive and non-exclusive leases.

3.1.1 Objectives and Benefits of Phase 2b (Delta Project)

The expansion of the Delta deposit, both underground and open pit, is designed to meet CRI's business objectives while continuing to provide significant benefits to Nunavik communities.

The operational objectives of CRI are as follows:

- Continue underground mining operations until at least 2032 using most of the infrastructure already in place in order to minimize the footprint on the natural environment: Expo complex including a concentrator, a tailings facility, a power plant and a camp; port facilities at Deception Bay including a concentrate storage facility, a wharf and a camp; a road network, etc;
- Maintain the concentrator feed at 4,500 tons of ore per day for the production of nickel and copper concentrates.

Completion of the Delta project will result in the following benefits:

- Maintain existing jobs;
- Create jobs during the construction phase;
- Create economic benefits at the local and regional levels for Inuit communities;
- Create economic partnership opportunities with Inuit partners;
- Create economic benefits within Quebec and across Canada;
- Provide stimulating jobs for residents of regional Inuit communities and elsewhere in Quebec;
- Assist in the training of local workers to ensure the smooth operation of NNiP mining activities.

Thus, given the operational objectives and benefits resulting from the Delta Project, its completion is not only a priority for CRI, but it also provides positive economic and social benefits for Nunavik and its residents, as well as for Quebec.

3.2 Legal and Regulatory Framework

An Environmental and Social Impact Assessment (ESIA) was filed in 2007 as part of the NNiP. The Delta project described in this addendum and the resulting activities are in the NNiP study area and are therefore subject to the same legal and regulatory framework, which is detailed in GENIVAR (2007). In this context, the Delta project is designated as phase 2b of the NNiP and will not require a new impact assessment. However, the implementation of the project requires a modification of the global CA.

Specific environmental assessment procedures are provided for projects located in the territory governed by the James Bay and Northern Québec Agreement (JBNQA). North of the 55th parallel, the Kativik Environmental Quality Commission (KEQC) is responsible for defining the nature and scope of the impact study to be carried out. This addendum to the NNiP ESIA contains all of the knowledge and analysis required for the KEQC's analysis, with the objective of modifying the NNiP's overall implementation plan.

At the federal level, according to the *Physical Activities Regulations* (s. 18c; 19cd; SOR/2019-285[1]) arising from the *Impact Assessment Act*, the completion of this projet is not subject to the federal impact assessment procedure. The production capacity of the metal mine is still below 5,000 tons/day and the expansion is being done without increasing the mining area by 50% or more. A project notice has also been filed for review with the Impact Assessment Agency of Canada (the Agency) to ensure that the project is not subject to the *Impact Assessment Act* at the federal level. The Agency's response indicates that the project is indeed not subject to this law (Appendix A).

The new *Règlement sur l'encadrement d'activités en fonction de leur impact sur l'environnement* (Q-2, r. 17.1; REAFIE is to specify the supervision of activities subject to ministerial authorization, under section 22 and those subject to a modification of such an authorization under section 30 of the Environment Quality Act (EQA), will also apply for certain activities. Chapter 3 of this regulation deals exclusively with mining activities (art. 78 to 80).

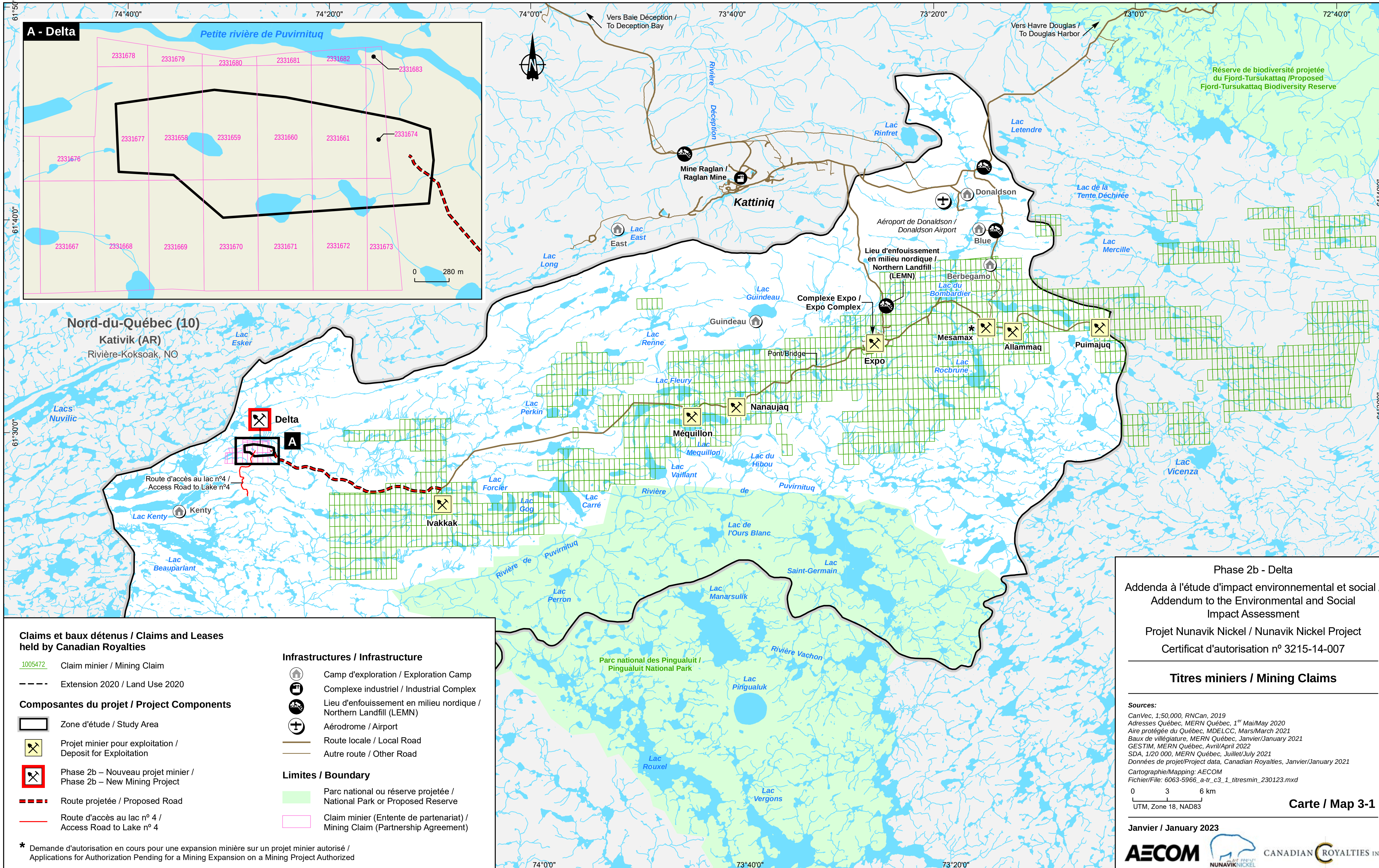
Even if the Delta projet does not require a new impact study, all of the project's effects have been documented as to comply with the guidelines of the *Directive pour la réalisation d'une étude d'impact sur l'environnement d'un projet minier* (MDDELCC, 2016), in accordance with the *Regulation respecting the environmental and social impact assessment and review procedure applicable to the territory of James Bay and Northern Québec,* the document *Les changements climatiques et l'évaluation environnementale : Guide à l'intention de l'initiateur de projet* (MELCC, 2021[2] and Chapter 23 of Appendix 3 of the JBNQA. Appendix I "*Autres renseignements requis pour un projet minier*"[3] was also consulted since it records the specific information necessary when carrying out an impact study for mining projects subject to the assessment and review of environmental impacts.

Mining projects may be subject to several other laws and regulations, in addition to the laws and regulations governing environmental assessment processes. Among those applicable to some of the NNiP activities are:

At the Provincial level

- Regulation respecting hazardous materials (RLRQ, chapter Q-2, r. 32)
- Land Protection and Rehabilitation Regulation (RLRQ, chapter Q-2, r. 37)
- Soil Protection and Contaminated Sites Rehabilitation Policy
- Politique de protection des rives, du littoral et des plaines inondables (only in French) (ch. Q-2, r. 35)
- Regulation respecting industrial depollution attestations (RLRQ, chapter Q-2, r. 5)
- Regulation respecting sand pits and quarries (RLRQ, chapter Q-2, r. 7)
- Water Withdrawal and Protection Regulation (RLRQ, chapter Q-2, r. 35,2)
- Regulation respecting the quality of drinking water (RLRQ, chapter Q-2, r. 40)
- Regulation respecting the landfilling and incineration of residual materials (RLRQ, chapter Q-2, r. 19)

[1] La Gazette du Canada, Partie 2, volume 153, numéro 17 : Règlement sur les activités concrètes
[2] https://www.environnement.gouv.qc.ca/evaluations/directive-etude-impact/guide-intention-initiateur-projet.pdf
[3] APPENDIX I - OTHER INFORMATION REQUIRED FOR A MINING PROJECT (MINE OR ORE TREATMENT PLANT), available only in French (gouv.qc.ca)


A - Delta
Petite rivière de Puvirnituq
2331678
2331679
2331680
2331681
2331682
2331683
2331677
2331658
2331659
2331660
2331661
2331674
2331676
2331667
2331668
2331669
2331670
2331671
2331672
2331673
0 280 m
Nord-du-Québec (10)
Kativik (AR)
Rivière-Koksoak, NO
Vers Baie Déception / To Deception Bay
Vers Havre Douglas / To Douglas Harbor
Rivière Déception
Mine Raglan / Raglan Mine
Kattiniq
Donaldson
Aéroport de Donaldson / Donaldson Airport
Blue
Lieu d'enfouissement en milieu nordique / Northern Landfill (LEMN)
Berbegamo
Complexe Expo / Expo Complex
Guineaudeau
Expo
Mesamax
Allammaq
Puimajuq
Pont/Bridge
Nanaujaq
Méquillon
Delta
A
Ivakkak
Kenty
East
Route d'accès au lac nº4 / Access Road to Lake nº4
Réserve de biodiversité projetée du Fjord-Tursukattaq /Proposed Fjord-Tursukattaq Biodiversity Reserve
Parc national des Pingualuit / Pingualuit National Park
Lac Rinfret
Lac Letendre
Lac de la Tente Déchirée
Lac Mercille
Lac East
Lac Long
Lac Guineaudeau
Lac du Bombardier
Lac Renne
Lac Esker
Lacs Nuvilic
Lac Fleury
Lac Rocbrune
Lac Perkin
Lac Mequillon
Lac du Hibou
Lac Vaillant
Lac Forcier
Lac Gog
Lac Carré
Rivière de Puvirnituq
Lac Kenty
Lac Beauparlant
Lac de l'Ours Blanc
Lac Saint-Germain
Lac Manarsulik
Lac Perron
Rivière Vachon
Lac Pingualuk
Lac Rouxel
Lac Vergons
Lac Vicenza
74°40'0"
74°20'0"
74°0'0"
73°40'0"
73°20'0"
73°0'0"
72°40'0"
61°50'0"
61°40'0"
61°30'0"
Claims et baux détenus / Claims and Leases held by Canadian Royalties
1005472 Claim minier / Mining Claim
Extension 2020 / Land Use 2020
Composantes du projet / Project Components
Zone d'étude / Study Area
Projet minier pour exploitation / Deposit for Exploitation
Phase 2b – Nouveau projet minier / Phase 2b – New Mining Project
Route projetée / Proposed Road
Route d'accès au lac nº 4 / Access Road to Lake nº 4
Infrastructures / Infrastructure
Camp d'exploration / Exploration Camp
Complexe industriel / Industrial Complex
Lieu d'enfouissement en milieu nordique / Northern Landfill (LEMN)
Aérodrome / Airport
Route locale / Local Road
Autre route / Other Road
Limites / Boundary
Parc national ou réserve projetée / National Park or Proposed Reserve
Claim minier (Entente de partenariat) / Mining Claim (Partnership Agreement)
* Demande d'autorisation en cours pour une expansion minière sur un projet minier autorisé / Applications for Authorization Pending for a Mining Expansion on a Mining Project Authorized
Phase 2b - Delta
Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment
Projet Nunavik Nickel / Nunavik Nickel Project
Certificat d'autorisation nº 3215-14-007
Titres miniers / Mining Claims
Sources:
CanVec, 1:50,000, RNCan, 2019
Adresses Québec, MERN Québec, 1er Mai/May 2020
Aire protégée du Québec, MDELCC, Mars/March 2021
Baux de villégiature, MERN Québec, Janvier/January 2021
GESTIM, MERN Québec, Avril/April 2022
SDA, 1/20 000, MERN Québec, Juillet/July 2021
Données de projet/Project data, Canadian Royalties, Janvier/January 2021
Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c3_1_titresmin_230123.mxd
0 3 6 km
UTM, Zone 18, NAD83
Carte / Map 3-1
Janvier / January 2023
AECOM
NUNAVIK NICKEL
CANADIAN ROYALTIES INC.

- Clean Air Regulation (RLRQ, chapter Q-2, r. 4,1)
- Regulation respecting a cap-and-trade system for greenhouse gas emission allowances (RLRQ, chapter Q2, r. 46.1)
- Regulation respecting mandatory reporting of certain emissions of contaminants into the atmosphere (RLRQ, chapter Q2, r. 15)
- Mining Act (chapter M-13.1)
- Act respecting the conservation of wetlands and bodies of water (2017, chapter 14) and the Regulation respecting compensation for adverse effects on wetlands and bodies of water
- Act respecting the lands in the domain of the State (RLRQ, chapter T-8.1)
- Act respecting threatened or vulnerable species (RLRQ, chapter E-12.01)
- Act respecting the conservation and development of wildlife (RLRQ, chapter C-61.1)
- Regulation respecting wildlife habitats (RLRQ, chapter C-61.1, r. 18)
- Regulation respecting hazardous materials (RLRQ, chapter Q-2, r. 32)
- Transportation of Dangerous Substances Regulation (RLRQ, chapter C-24.2, r. 43) of the Highway Safety Code
- Petroleum Products Regulation (RLRQ, chapter P-30.01) and its rules of application (R.R.Q., C. P-30.01, r. 1)
- Act Respecting Explosives (RLRQ, chapter E-22) and its rules of application
- At the Federal level
- Fisheries Act (R.S.C., 1985, c. F-14)
- Canadian Environmental Protection Act, 1999 (S.C. 1999, c. 33)
- Environmental Emergency Regulations, 2019 (SOR/2003-307)
- Metal and Diamond Mining Effluent Regulations (SOR/2002-222)
- Species at Risk Act (S.C. 2002, c. 29)
- Explosives Act (R.S.C., 1985, c. E-17).

Table 3-3 presents the modifications to the global CA obtained to date by CRI within the NNiP framework. For informational purposes, guidelines have also been issued since 2004, particularly for the *Southern Raglan Mine* mining project (2006-08-29), as to oversee pre-project activities. Certificates of exemption were also received for the operation of a domestic waste landfill site (2006-07-11), the improvement of a basic mining road (2005-05-12), a mining road leading to the Mesamax and Expo deposits (2004-09-24), and from the waste pit to the Expo geological camp (2004-07-12; #3215-16-30). The NNiP project is also known to federal authorities, under the JBNQA projects, which establishes an environmental and social protection regime for both James Bay and Nunavik. The president of the Agency acts as the Federal Administrator of the JBNQA for federal projects and is responsible for authorizing or not authorizing projects, according to the assessment recommendations and review committees. The port infrastructure project and sediment management in Deception Bay are among the projects completed under this federal approach.[4]

[4] https://www.canada.ca/fr/agence-evaluation-impact/organisation/convention-baie-james-et-nord-quebecois/projet-infrastructures-portuaires-et-gestion-sediments-baie-deception.html

Table 3-3: Modifications to the *Nunavik Nickel Mining Project's* Certificate of Authorization Since 2008

Title	Date
Environmental and Social Impact Assessment – Nunavik Nickel Mining Project	
Issuance of a certificate of authorization	2008-05-20
Decision by the KEQC relative to the project	May 2008
Environmental and Social Impact Assessment – Nunavik Nickel Mining Project– Requests for modifications to the CA	
Supply work at Deception Bay and installation of an optical fiber	2022-07-12
Underground mining of the Méquillon UG1 deposit and addition of mining infrastructure to the Ivakkak mining site	2022-04-22
Tailings management at the Expo mine	2022-01-06
Adjustment of the loss of fish habitat required for the Tr-5 crossing and addition of the Ivakkak quarry	2021-04-29
Exploitation of an underground mine at Expo West site	2020-11-04
Development of port infrastructure in Deception Bay	2014-07-11
Modification to the Environmental Monitoring Program	2013-10-31
Development of port facilities and the management of dredged sediment in Deception Bay	2013-07-05
Project to increase permanent accommodation capacity in Deception Bay	2013-03-05
Widening of the road section between Ivakkak and Allammaq	2013-01-15
Relocation of the collection basin and discharge point of the Méquillon satellite mine	2012-11-06
Mining a sand pit at km 34 near Lac François-Malherbe	2012-07-24
Second stage of the modification of terms and conditions and approval of the monitoring program	2012-06-22
Nunavik Nickel Mining – Expo No. 4 Quarry mining project	2012-01-27
Nunavik Nickel Mining – Expo No. 2 Quarry mining project	2012-01-27
Project to increase temporary accommodation capacity at Expo and Deception Bay	2011-11-28
Changes to Terms and Conditions	2011-06-06
Mining of a quarry at Lac du Bombardier	2011-02-16
Allammaq deposit mining and increase to the concentrator's processing capacity	2011-01-25
Waste management of the Chrysler mining exploration camp	2010-08-23
Pre-Project (Exploration for NNiP)	
Construction of a mining exploration road leading to the Expo deposit – addition of a quarry	2008-01-25
Construction of a mining exploration road leading to the Expo deposit	2007-04-12

3.3 Main Challenges

The stakes of a project are related to the risks that it can bring to the study area, by causing a modification, alteration, gain or loss of certain components to which concerns are attributed and whose analysis could influence the decision on the authorization of said project. Challenges in establishing a mining project generally relate to the following elements:

- The conservation and the protection of water resources including wetlands.
- The protection of biodiversity.
- The conservation of air quality.
- A reduction in greenhouse gas (GHG) emissions.
- The adoption and implementation of sustainable and inclusive mining development (relating to climate changes and Inuit communities).

In addition to these main challenges for mining projects, there are site-specific challenges such as constraints related to deadlines, social acceptability, mining project location and technical constraints. These challenges are interrelated.

Since the project is located in arctic tundra and in the permafrost zone, the natural environment is rich in wetlands and bodies of water. Much of the local wildlife is partially dependent on these environments. First and foremost, the installation of mining project infrastructure avoids wetlands as much as possible to reduce the technical complexity during construction and to reduce the project's impact on these environments. The integration of mining activities within the migratory activities of caribou and birds is also an important issue when carrying out the various mining projects.

In particular, the Delta Project will be located in part within the legal calving grounds of caribou, as delineated by the MELCCFP (map 2-1). CRI considers caribou as a distinct component for which several caribou-specific mitigation measures have been developed to minimize the potential impacts of the Delta project on caribou. These measures were developed with the support and expertise of AECOM and are presented in Chapter 7.

The Delta project is located in Nunavik, where the population, mostly made up of Inuit, is small and spread over a vast territory. The Delta project represents a major stake from a socio-economic point of view. In fact, the pursuit of mining activities will make it possible to maintain jobs, hire new resources and perfect the training process for Inuit employees at CRI.

Social acceptability of its activities in Nunavik is an aspect in which CRI has attributed great importance since the project began. Consequently, an impact and benefit agreement, named the Nunavik Nickel Agreement (hereinafter the Agreement) was developed and signed with the Inuit partners following the global CA. CRI has ensured compliance with the clauses of this agreement since 2008 and ensured the satisfaction of the Inuit partners via the Nunavik Nickel Committee, created under this agreement. This committee makes it possible to communicate the changes to come and the information extracted from the environmental monitoring done by CRI to the Inuit communities involved. It also makes it possible to collect the communities' concerns, maintain a dialogue and thus promote the social acceptability of CRI mining projects. The Nunavik Nickel agreement is therefore a fundamental component of the social acceptability of Phase 2a. The Nunavik Nickel Agreement is described in more detail in section 3.5. The members of the committee met thrice in 2021 to outline the development vision to 2034, with input from Phase 2a and the Delta Project, and the planned consultation process. The Delta Project was also presented to the signatories to the Agreement in January 2022.

CRI is subject to a major scheduling challenge for several reasons: 1) the deposits are generally small in size and the maximum daily tonnage is limited to 4,500 tonnes, which requires an almost un-interrupted ore supply. 2) The weather conditions limit when construction is possible. This tight schedule indicates that a delay in ministerial authorizations may lead to layoffs.

Climate change is a challenge for any project. It has been considered according to the mining project's specific situation, while considering the receiving environment in which the NNiP is inserted. They have thus been integrated and assessed as to reduce the sources of (direct, indirect) greenhouse gas (GHG) (section 8.2) according to the directives of the document on *Les changements climatiques et l'évaluation environnementale : Guide à l'intention de l'initiateur de projet* (MELCC, 2021)[5] while adapting the content to the northern territory, which will experience even greater projected effects compared to more southern areas. To this intent, the *Guide de quantification des émissions de gaz à effet de serre*[6], which details the calculation methodologies for quantifying GHG emissions, was also consulted. Measures to prevent and reduce GHG emissions will be implemented, depending on the different project phases.

A climate change resilience and adaptation study has been completed (section 8.1). in terms of climate change adaptation. It includes the identification of the hazards likely to have repercussions on the project, although mining at the site has already taken place for several years. As part of the climate change adaptation process, climate variables important to the project are identified and project-specific adaptation measures are developed if necessary.

By committing to minimizing the negative effects on the natural and social environment as part of its activities according to the various established mitigation measures, CRI thus contributes to respecting the project's challenges and to implementing responsible mining development. The measures will therefore evolve over time, depending on the operations within the framework of NNiP and the Delta project, according to the deposits and the phases (construction, operation, post-operation and restoration, post-restoration).

It is important to mention that the process for determining the challenges could evolve during the modifications made to the project and the environmental and social challenges will therefore be adjusted, if required, according to the evolution of the activities in the framework of the NNiP.

After the exploitation phase, the restoration of the NNiP deposits and the post-restoration phase will take place. During these phases no challenges will persist except for the projected effects of climate change on the northern environment that will follow thereafter.

3.4 Sustainability and Corporate Social Responsibility

3.4.1 Integration of the Sustainable Development Principles

Like the integration of climate change into the project planning and design process, sustainable development remains at the centre of CRI's priorities. In fact, CRI is a metal mining company committed to environmental protection, as well as occupational health and safety.

The principles of the MELCC's *Sustainable Development Act* are found throughout the design and will be implemented during the Delta project. On one hand, all NNiP activities, including the Delta project, are anchored in the Environment, Health and Safety policy (presented in the following section), the Nunavik Nickel Agreement on the impacts and benefits (presented further in section 3.5 and in Chapter 4) and the project's mitigation measures. Table 3-4 illustrates how sustainability principles are intrinsic to the NNiP, without, however, being exhaustive as to the ramifications of applying the principles.

[5] https://www.environnement.gouv.qc.ca/evaluations/directive-etude-impact/guide-intention-initiateur-projet.pdf
[6] https://www.environnement.gouv.qc.ca/changements/ges/guide-quantification/guide-quantification-ges.pdf

On the other hand, the reader will be able to note the integration of principles such as those of precaution and respect for ecosystem support capacity. These principles are upheld by minimizing the environmental footprint of infrastructure and operating methods and by maximizing economic efficiency by extending the life of existing infrastructure. It should be noted that CRI has been implementing a comprehensive environmental monitoring program for over ten years, covering atmospheric, aquatic and biological components. An Environmental Monitoring Program provides a framework for the implementation of and compliance with the commitments set out in the EHS Work Policy (section 3.4.2). It allows for the analysis, control and reduction of the environmental impacts of its activities, notably through compliance inspections aimed at ensuring the application of mitigation measures and their effectiveness. CRI is and will continue to be able to carry out mining development that is sustainable for future generations.

Phase 2b thus allows the mining of new resources and the creation of new wealth by using infrastructure already in place. Added to this is a mechanism for redistributing the wealth created through the Nunavik Nickel Agreement for Inuit communities. Ultimately, Phase 2a moves in the direction of the balance sought between the three objectives of sustainable development which are social equity, environmental integrity and economic efficiency.

Table 3-4: Evaluation of the Project According to the 16 Principles of Sustainable Development

Principe	Application du principe
1. Health and quality of life Protecting health and maintaining or improving the quality of life of the population.	• Application of mitigation measures for potential impacts on the human environment (economy and employment, Inuit occupation and land use, non-Aboriginal occupation and land use, noise climate). • Respect of the regulations concerning the noise climate. • Increased efforts during mining operations to preserve air quality and reduce air emissions.
2. Social equity and solidarity Consider intragenerational and intergenerational equity, ethics and social solidarity.	• Signing of the Nunavik Nickel Agreement. • relation of a sub-committee specific to the Delta project within the Nunavik Nickel Committee. • Realization of an impact study evaluating the potential effects of the project on the human environment. • Creation of jobs. • Hiring new resources locally and in the surrounding communities. • Training process for internal Inuit employees. • Training opportunities for the local and regional community workforce. • Employment opportunities for the local and regional community workforce. • Consultation with the Nunavik Nickel Committee to present Phase 2b project developments and environmental monitoring results. • Policy of favouring local and regional businesses when awarding contracts. Compliance with the environmental standards and processes established by the authorities of Nunavik, Quebec, and when applicable, Canada.
3. Environmental protection Ensure the protection of the environment and the preservation of biodiversity.	• Carrying out an impact study evaluating the potential effects of the project on the physical and biological environment, taking into account the effects on climate change. • Compliance with applicable environmental standards. • Application of mitigation measures for potential impacts on the physical and biological environment (air, soil, water, hydraulic and sedimentary regime, vegetation, avifauna, terrestrial fauna, aquatic fauna). • Consideration of caribou migration and calving during construction and during mining operations. • Participation in a research program with Caribou Ungava concerning the effect of mining on caribou migration. • Application of the environmental monitoring program. • Application of the PEIIC as a compensation measure for wetland losses. • Application of the waste management program.

Table 3-4: Assessment of the Phase 2b project against the 16 principles of sustainable development (continued)

Principle	Application of the principle
4. <u>Economic efficiency</u> Ensuring economic efficiency that leads to innovation, prosperity and social progress, while protecting the environment.	• Contribution to local and regional economic prosperity, notably through the creation of; - business opportunities for local and regional companies. - employment and training opportunities for the local and regional community workforce. • Hiring new resources locally and in the surrounding communities. • Training process for internal Inuit employees. • Business opportunities for local and regional companies, as well as for Quebec companies. • Favouring local and regional businesses in the awarding of contracts. • Employment opportunities for the local and regional community workforce. • Training opportunities for the local and regional community workforce.
5. <u>Participation and commitment</u> Promote citizen participation and engagement and/or groups representing citizens in order to define a concerted vision of development and ensure its environmental, social and economic sustainability.	• The Nunavik Nickel Agreement provides participation and engagement mechanisms, including the incorporation of the summary table of mitigation measures into the Agreement, following its approval by the stakeholders. • Creation of a sub-committee specific to the NNiP's Phase 2
6. <u>Access to knowledge</u> Encourage access to education and training, share information and foster public participation in the implementation of development and stimulate innovation.	• Presentation of the results of the completed field inventories as part of the impact study via the Nunavik Nickel Committee and its subcommittee. • Sharing the results of the environmental monitoring with local communities. • Training processes for internal Inuit employees.
7. <u>Subsidiarity</u> Delegate powers and responsibilities to the appropriate level of authority. Distribute decision-making locations appropriately, with the goal of bringing them as close as possible to the citizens and communities concerned.	• Transparency regarding the distribution of authority and responsibility.
8. <u>Inter-governmental partnership and cooperation</u> Collaboration between governments to make development environmentally, socially and economically sustainable. Actions taken in a territory must take into account their impacts outside the territory.	• The project will be carried out in accordance with the environmental standards and processes established by the authorities of Nunavik, Quebec, and when applicable, Canada. • Participation in discussion tables with government departments and the Caribou Ungava Research Chair on migratory Caribou.

Table 3-4: Assessment of the Phase 2b project against the 16 principles of sustainable development (continued)

Principle	Application of the principle
9. Prevention Based on known risks, planning for prevention and mitigation measures and remediation.	• Assessment of hazards, risks and impacts on the natural, human and social environment. • Carrying out an impact study evaluating the potential effects of the project on the physical, biological and human environments, and taking into account the effects on climate change. • Compliance with applicable environmental standards. • Application of mitigation measures for potential impacts on the physical, biological and human environments. • Integration of climate change into the project design process. • Consideration of climate change according to the specificity of the project and taking into account the characteristics of receiving environment. • Implementation of measures that evolve over time according to mining operations, deposits and various phases. • Application of the environmental monitoring program. • Application of an emergency response plan. • Application of the waste management program.
10. Precaution Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.	• Assessment of hazards, risks and impacts on the natural, human and social environment. • Carrying out an impact study evaluating the potential effects of the project on the physical, biological and human environments, and taking into account the effects on climate change. • Compliance with applicable environmental standards. • Application of mitigation measures for potential impacts on the physical, biological and human environments. • Conducting a climate change resilience and adaptation study for the entirety of the NNiP projects, including Phase 2a and 2b projects. • Identification of climatic hazards that may affect the project. • Consultation with the Nunavik Nickel Committee and its sub-committee to discuss the impact study and proposed mitigation measures. • Application of the environmental monitoring program. • Participation in a research program with Caribou Ungava concerning the effect of mining on caribou migration. • Application of the PEIIC as a compensation measure for wetland losses. • Application of an emergency response plan. • Application of the waste management program.
11. Protection of cultural heritage To ensure the identification, protection, transmission and enhancement of cultural heritage while also taking into account its fragility.	• Carrying out an impact study assessing the potential effects of the project on archaeological heritage and the landscape. • Implementation of mitigation measures to protect archaeological resources that may be discovered incidentally during project construction or decommissioning.

Table 3-4: Assessment of the Phase 2b project against the 16 principles of sustainable development (continued)

Principle	Application of the principle
12. Biodiversity preservation Ensure the preservation of species, ecosystems and natural life-supporting processes in order to protect the quality of life of citizens. **13. Respect for ecosystem support capacity** Consider the carrying capacity of ecosystems to ensure their sustainability.	• Carrying out an impact study evaluating the potential effects of the project on the physical, biological and human environments, and taking into account the effects on climate change. • Consideration of caribou migration and calving during construction and during mining operations. • Participation in the restoration of sites impacted by mining activities and ensuring that the restoration will be resilient to climate change. • Compliance with applicable environmental standards. • Application of mitigation measures for potential impacts on the physical and biological environment (air, soil, water, hydraulic and sedimentary regime, vegetation, avifauna, terrestrial fauna, aquatic fauna). • Minimizing the physical footprint of the project. • Avoiding and respecting the integrity of sensitive environments. • Rehabilitation of the Delta site at the end of operations with the topsoil from the site. • Application of the environmental monitoring program. • Application of the waste management program.
14. Responsible production and consumption Adopt more socially and environmentally responsible modes of production and consumption. This can be done by avoiding waste, optimizing the use of resources and promoting energy efficiency.	• Recirculation of mine water. • Energy recovery from used oil. • Retreading of large tires to extend the lifespan of the tires. • Tracking diesel fuel consumption for optimization.
15. Polluter pays In the case that development causes pollution or environmental degradation, assume (in part or entirely) of the costs related to the mitigation and offset measures to be deployed.	• Compliance with applicable environmental standards. • Application of mitigation measures for potential impacts on the physical and biological environment (air, soil, water, hydraulic and sedimentary regime, vegetation, avifauna, terrestrial fauna, aquatic fauna). • Rehabilitation of the Delta site at the end of operations with the topsoil from the site. • Application of the environmental monitoring program. • Participation in a research program with Caribou Ungava concerning the effect of mining on caribou migration. • Application of the PEIIC as a compensation measure for wetland losses. • Application of the waste management program. • Application of an emergency response plan.
16. Internalization of costs Ensure that the value of goods and services reflects the full costs they incur to society throughout their life cycle, from design to consumption and final disposal.	• Application of the waste management program. • Rehabilitation of the Delta site at the end of operations with the topsoil from the site.

3.4.2 Environment, Health and Safety Policy

To implement its commitments, CRI has adopted an environmental policy, approved by senior management, in order to minimize the dangers, risks and impacts on the natural and human environment and thus improve its performance on a continuous basis (see Diagrams 3-1 and 3-2).

CANADIAN ROYALTIES INC.

Environment, Health and Safety Policy

Canadian Royalties Inc. is a metal mining company committed to occupational health & safety and environmental protection. Canadian Royalties Inc. will act in a manner that minimizes dangers, risks and impacts and will continually seek to improve its performance. Canadian Royalties Inc. will engage the commitment and involvement of all of its employees and contractors to ensure that environmental, health and safety performance objectives are met.

Canadian Royalties Inc. is committed to:

- Evaluating the dangers, risks and impacts for the natural, human and social environments with a focus on the goals of prevention and protection.
- Implementing prevention and response programs in order to minimize and mitigate impacts and adverse events.
- Complying with current laws and regulations wherever the company is engaged in mining or mining-related activities.
- Ensuring responsible use of energy, water and consumable goods.
- Informing employees, subcontractors and suppliers of the company's policies and programs and their required involvement to ensure successful implementation.
- Conducting monitoring programs and periodic audits in order to identify opportunities for improvement and implementing corrective actions where required to improve environmental and organizational health and safety performance.
- Identifying stakeholders and undertaking dialog with the inclusion of governmental authorities and the public in order to improve Canadian Royalties Inc.'s practices and performance.
- Reclaiming the impacted environment to a condition as near to its original state as is reasonably possible, upon the termination of mining and mining-related activities.
- Ensuring that sufficient human, material and financial resources are available to implement this policy.

James Xiang
Chief Executive Officer
Canadian Royalties Inc.
May 08, 2020

Diagram 3-1: CRI's Environment, Health and Safety Policy

CANADIAN ROYALTIES INC.

ᓯ2ᒥᓕᕆᓂᖅ, ᐊᒪ ᓴᕈ/ ᒍᒃ ᓯᖅᕿ ᖅᑐHᒡᒍᒥᒡᒎ ᓴᔾᐋ

Canadian Royalties Inc. ᓴᙱᕋᔭᕐᓂᒃ ᐅᔭᕋᕐᓂᐊᙱᐅᑦᓯᓂ ᑲᒃᐸᓂᐅᕗᖅ ᑐᓂᒪᑦᓯᓂ ᐱᓇᓯᖕᙱᒥ ᐃᓗᓯᓕᕆᓂᕐᒧᑦ ᕐᑲᓄᐃᖕᖏᓯᐊᕐᓂᒧᑦ ᐊᕙᑎᒥᒡᒍ ᐅᖅᑐᒪᑦᓯᓂᕐᒧᑦ. Canadian Royalties Inc. ᐱᓇᓯᐊᓚᖅᑲᖅ ᐊᑦᑕᓇᕐᑐᒥᑦᑎᓯᑦᑌᓕᓂᕐᒥᒃ, ᓇᖅᑭᐊᕐᓇᑐᓂ ᐊᒻᒪᓗ ᑲᔪᓯᔪᒥᒃ ᐱᐅᓯᐅᒥᑎᑦᓯᒪᓯᐊᓚᖅᒪᑦᓯᓂ ᐱᓇᓯᑦᑕᒥᓂᒃ. Canadian Royalties Inc. ᐃᓚᒥᔭᐅᑎᑦᓯᓯᐊᓚᖅᒐᖅ ᑐᓂᒪᓂᖅᒥᓐᓄᑦ ᐃᓚᐅᓂᖅᒥᓐᓄᓗ ᐱᓇᓯᑦᑎᓕᒫᑦ ᐊᒻᒪᓗ ᐱᓇᓯᒍᑦᔨᓂᕐᒧᑦ ᐊᖅᒥᕐᑲᑎᒌᒍᑎᓖᑦ ᓯᕐᑯᐃᓯᐊᕐᑯᓗᒥᑦ ᐊᕙᑎᓕᕆᓂᖅ. ᐃᓗᓯᓕᕆᓂᖅ ᕐᑲᓄᐃᖕᖏᓯᐊᕐᓂᓗ ᐱᓇᓯᑦᑕᐅᓲᑦ ᑐᕌᒐᖅᒥᑦ ᑎᑭᐅᑎᔭᐅᑦᓯᐊᕐᑯᓗᒥᑦ.

Canadian Royalties Inc. ᑐᓂᒪᕗᖅ ᐅᑯᓂᖓ:

- ᕐᑲᐅᔮᓴᕐᑲᑦᑕᓗᓂ ᐊᑦᑕᓇᕐᑐᓂᒃ, ᓯᒃᑯᐊᕐᑭᒍᑕᐅᒍᓐᓇᑐᓂᒃ, ᓯᕐᕓᒍᓐᓇᑐᓂᒃ ᓄᓇᓂᒃ, ᐃᓄᓐᓂᒃ ᐃᓅᕐᑲᑎᒌᓐᓗ ᐊᕙᑎᖓ ᑐᕌᒐᖅᑲᕐᓗᓂᒃ ᐃᑯᓪᓚᑎᑦᓯᒪᔭᐊᕐᓂᒥᒃ ᐅᖅᑐᒪᓂᕐᒥᓗ.
- ᑳᔨᑎᑦᓯᓗᓂ ᓯᒃᑯᐊᕐᑭᑦᑎᓯᑦᑌᓕᒍᑎᓂᒃ ᐊᒻᒪᓗ ᐃᑳᕐᓯᐅᑎᐅᒪᔭᕐᑐᓂᒃ ᐱᓇᓯᓐᓂᓂᒃ ᐃᑭᓕᐅᒥᕐᑯᓗᒥᑦ ᓯᕐᕓᔩᑦ ᓇᒻᒪᓇᖅᑭᑐᐃᓐᓗ ᐱᔦᕐᑲᕐᓂᑦ.
- ᒪᓕᒡᓗᑎᒃ ᑕᒐᑕᒐ ᐱᕐᑯᔭᕆᔭᐅᔦᓂᒃ ᒪᓕᒐᓕᐊᑐᓯᒪᔦᓂᒡᓗ ᕐᑲᖅᒐᑐᐃᓐᓇᖅ ᑳᐸᓂ ᐅᔭᕋᓂᐊᓕᕐᐸᑦ ᐅᕙᓗᒃᓂᑦ ᐅᔭᕋᓂᐊᓂᕐᔫᓕᖅᒐᔦᓂᒃ ᐱᓇᓯᐊᓕᕈᓂ.
- ᕐᑲᐅᔮᒪᑎᑦᓯᕐᑲᑦᑕᓗᓂ ᐱᓇᓯᑦᑎᓂᒃ. ᐱᓇᓯᒍᑦᔨᓂᕐᒧᑦ ᐊᖅᒥᕐᑲᑎᒌᒍᑎᑎᒍᑦ ᐱᓇᓯᑦᑐᓂᒃ ᑎᑭᓴᙱᓂᓗ ᑳᐸᓂᐅᑉ ᒪᓕᒐᖅᒥᓂᒃ ᐱᓇᓯᑦᑕᖅᒥᓂᓗ ᐊᒻᒪᓗ ᐃᓚᐅᒥᐊᕐᑲᕐᓂᖅᒥᓂᒃ ᓯᕐᑯᐃᕐᑯᓗᒥᑦ ᐱᑦᓯᐊᑐᒥᒃ ᑳᔨᕐᑯᓗᒥᑦ.
- ᑳᔨᑎᑦᓯᕐᑲᑦᑕᓗᑎᒃ ᐃᑉᐱᒍᓯᑦᑐᓂᒃ ᓇᒡᓕᐅᑎᑦᑐᓂᒡᓗ ᑕᒃᒪᓯᒪᔦᕐᓯᐅᑕᐅᓂᕐᒥᒃ ᓇᓗᓀᕐᓯᕐᑯᓗᒥᑦ ᐱᐅᓯᐅᒥᑎᑦᓯᒪᔭᕐᑐᓂᒃ ᑳᔨᑎᑦᓯᓗᑎᒡᓗ ᐋᕐᕿᒥᐊᕈᑎᓂᒃ ᐊᐅᓚᑦᔭᓇᐊᕈᑕᐅᒥᐊᓕᖅᓂᒃ ᒥᐊᕐᑲᓕᕈᑎᒃ ᐱᐅᓯᐅᒥᑎᑦᓯᒪᔭᐊᕐᓗᑎᒃ ᐊᕙᑎᓕᕆᓂᕐᒥ. ᐱᓇᓯᖕᙱᓂ ᐃᓗᓯᓕᕆᓂᕐᒥ ᕐᑲᓄᐃᖕᖏᓯᐊᕐᓂᒥᒡᓗ ᐊᑑᑎᔭᐅᓂᕐᒥᒃ.
- ᓇᓗᓀᕐᑎᓯᓗᑎᒃ ᑲᖅᑮᓯᑦᑐᓂᒃ ᑳᔨᑎᑦᓯᓗᑎᒡᓗ ᐅᕐᑲᕐᑲᑎᒦᓂᒥᒃ ᐃᓚᐅᑎᒡᓗᑦ ᑲᕆᒪᒃᑯᓂ ᐱᓇᓯᑦᑏᑦ ᐊᒻᒪᓗ ᓇᐅᓕᒫᑦ ᐱᐅᓯᐅᒥᕐᑯᓗᑦ Canadian Royalties Inc. ᐱᐅᓯᓐᓃᖅᑭᑦ ᐊᑑᑎᓃᖅᑭᒡᒎ.
- ᓴᑐᐃᒥᐊᓗᓂ ᓯᕐᓴᑕᐅᓯᒪᔦᑦ ᐊᕙᑎᒥᒃ ᐱᒍᓐᓇᙱᓕᒫᖅᒐᓄᑦ ᐱᐅᓯᙱᓂᖅᒐᓄᑦ ᐃᓂᓪᓚᓴᓯᐊᓚᖅᒐᓗᒍ. ᐃᓯᓕᑐᐊᕐᐸᑦ ᐅᔭᕋᓂᐊᓂᖅ ᐅᔭᕋᓂᐊᓂᕐᒥᓗ ᐊᐅᓚᑕᐅᔦᑦ.
- ᓯᕐᑯᐃᔨᓗᑎᒃ ᓇᒻᒪᓂᖅᒥᓂᒃ ᐱᓇᓯᑏᑦ, ᐱᒃᑐᑏᑦ, ᑮᓇᐅᔭᓪᓗ ᐊᑐᐃᓐᓇᐅᓯᐊᕋᓗᐊᕐᒪᖅᑖᑕ ᑳᔨᑎᑕᐅᕐᑯᓗᒍ ᑖᓐᓇ ᒪᓕᒐᖅ.

James Xiang
President/Chief Operating Officer
Canadian Royalties Inc.

May 30, 2022

Diagram 3-2 : CRI's Environment, Health and Safety Policy in Inuktitut

Furthermore, when mining and mine-related activities cease on the territory occupied by the NNiP, CRI is committed to respect the *Guidelines for preparing mine closure plans in Québec*[7] with respect to the restoration of mining sites in northern environments, all while respecting the surrounding environment.

3.4.3 Environmental, Social and Governance Initiatives

CRI integrates the general principles of sustainable development into its business management strategies.

3.4.3.1 Past and Present Initiatives

Technological breakthrough for the recirculation of mine water

CRI reduced the withdrawal of fresh water from Lac Bombardier by more than 50% in 2019 and 2020. More specifically, while the amount of water withdrawn was 764,629 m^3 in 2018, it was reduced to 314,831 m^3 and 338,292 m^3 in 2019 and 2020.

This decrease in consumption was largely attributable to the acquisition and start-up of a nanofiltration water treatment unit, which makes it possible to reuse a greater portion of the process water and thus limit the withdrawal of fresh water from the lake. This has also had the benefit of reducing the contaminated water generated that must be stored at the tailings disposal facility. To this intent, the water from the tailings disposal facility was returned to the concentrator and filtered by the nanofiltration units, allowing it to be used once again in the ore concentration process.

Great logistical efforts have been made for its installation and optimization, including employee training, considering that the transformation process of ore, in addition to copper and nickel, is very sensitive to variations in water quality.

In parallel, CRI has been conducting pilot tests to treat the free water from the tailings with sodium carbonate to precipitate metals and other ions for reuse in the process without using nanofiltration. This technique, which will generate less secondary waste, such as used filters, than nanofiltration, is expected to be applied by the end of 2023 to recirculate free water from the tailings to the ore treatment process. This treatment technique will also consume less energy.

CRI has thus respected one of the commitments of the global CA regarding the mine water recirculation and will continue these efforts in the years to come, in addition to those for good water management from a global perspective.

Energy efficiency and reduction of fossil fuel consumption

As the NNiP is located outside the Hydro-Québec network, the energy required for all of its activities is based on diesel, which is transported by sea to the port facilities in Deception Bay.

For the sake of responsible consumption of this non-renewable resource, CRI has carried out rigorous monitoring of diesel consumption over the past few years, specifically with regards to the use of power generators. In fact, the latter represents the largest proportion of diesel consumption, mainly used to produce electricity. Efforts to reduce consumption can be summarized in two parts.

On one hand, the generator consumption trends study of the satellite sites made it possible to combine the consumption of certain sites with fewer generators, specifically via electrical cables. Since 2017, it's been estimated that 4,339,000 L, or 13.5% of the annual consumption, was saved.

[7] https://mern.gouv.qc.ca/english/mines/reclamation/documents/guidelines-mine-closure.pdf

On the other hand, CRI commissioned the firm BBA in 2019 to optimize the central group of generators, which supplies the ore concentrate plant and a section of the Expo camp. This made it possible to maintain diesel consumption at a relatively stable level, despite more sustained occupation of the camp.

Through its projects to reduce its carbon footprint, CRI confirms its commitment to be a constructive partner in the fight against climate change.

Complete carbon footprint

CRI understands the importance of considering GHG emissions throughout its value chain and product portfolio as to comprehensively manage GHG risks and opportunities. To this intent, the company plans to begin voluntary reporting its indirect GHG emissions other than those related to energy (*scope 3*) starting in 2022. The *scope 3* emissions include, among others, upstream and downstream emissions from administration, materials, and travel. This comprehensive exercise will enable CRI to better assess the carbon footprint of its products, nickel and copper concentrates and to identify new opportunities for reducing its GHG emissions, to involve its partners in the GHG management, in addition to improving stakeholder information and corporate reputation through public reporting.

Participation in the "Towards Sustainable Mining" initiative

CRI has been a member of the Towards Sustainable Mining (TSM) initiative of the Mining Association of Canada since 2017. CRI is committed to respecting the guiding principles of the program, as well as their implementation by integrating the seven performance protocols of the program into its activities and management systems. CRI is also committed to ensuring that its actions are consistent with each of the protocols' strategic frameworks.

This world-renowned program enables CRI to better identify and manage its primary environmental and social risks. CRI aims to demonstrate leadership through its community commitments, the health and safety of employees and communities, in addition to energy efficiency. To this end, in 2023, CRI commissioned a consulting firm to advise it on how to improve its performance on TSM protocol indicators.

PEIIC - giving back to communities

The program for environmental improvement in Inuit communities (PEIIC), created by CRI, consists of the implementation of projects completed as a replacement for compensation plans, relative to the loss of wetlands and bodies of water established for projects in southern Quebec. Although this does result from obligation, this innovative program remains an excellent example of the partnership between CRI, the regional government (the Kativik Regional Government - KRG), and the local communities that are members of the Nunavik Nickel Agreement. This partnership allows the KRG and the communities to suggest environmental improvement projects, which will benefit the inhabitants of the Inuit villages. These projects will be primarily financed by CRI. Through its involvement in the PEIIC, CRI demonstrates that its development in Nunavik can harmoniously contribute to the sustainable development of Inuit communities.

Rehabilitation of Orphaned Mining Sites

CRI participates in initiatives to clean up abandoned mining exploration sites in Nunavik and this support is highlighted by the Kativik Regional Government in its annual activity reports. Notably, in 2019, CRI proceeded with the clean-up of the Vinceza Lake and Guindeau Lake sites. In 2023, CRI will make a financial contribution to the rehabilitation of the Chrysler site and will continue to participate in these initiatives.

3.4.3.2 Future Initiatives

Wind turbines project

CRI, in partnership with Tugliq Energy, is taking steps to create a small wind farm near the Expo industrial complex. The project consists of the installation of two wind turbines of 3 MW each, near the Expo mining site, coupled with a battery energy storage system. The wind turbines selected for this project are adapted to northern climates as they are equipped with ice detection technology on the surface of the blades and a de-icing system included in each of the three blades. The turbines will reach a total height of 120 m (Figure 3-1). The renewable energy produced by the wind farm will avoid the annual emission of 14,096 tonnes of CO2 equivalent, which represents a 10.5% annual reduction of the current GHG emissions of the Nunavik Nickel mining complex. This project requires a new environmental and social impact assessment and will constitute Phase 2c of the NNiP.

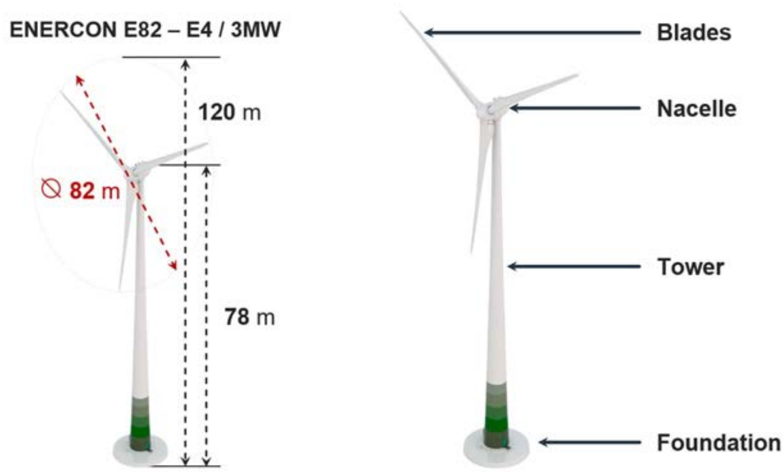


Figure 3-1: Diagram of the Enercon E82 E4 Wind Turbine (from AECOM et TUGLIQ Energy, 2022)

Life Cycle Analysis (LCA)

In 2023, CRI will conduct a life cycle analysis (LCA) to quantify the environmental footprint of copper and nickel production in the NNiP. In conjunction with the complete carbon footprint project, CRI wishes to identify the elements of the NNiP with a high environmental footprint and the elements on which significant reduction actions can realistically be taken. This analysis will provide an understanding of the NNiP footprint that will support the production of meaningful ESG reports (see description below).

Environmental, social and governance (ESG) management strategy

CRI is working to refine its sustainability strategy by implementing goals and practices to demonstrate progress and accountability on the issues that matter most to stakeholders, which will better help CRI to understand and manage its social and environmental risks and opportunities.

Specifically, CRI intends to produce a consistent ESG report according to recognized international standards, as to increase transparency and accountability regarding important questions. This study will strengthen our ability to manage risk, better define our sustainability goals, and meet the highest international environmental standards.

3.5 Agreements With Aboriginal Communities

The basis of the collaboration between CRI and the Inuit people is an impact and benefit agreement called the Nunavik Nickel Agreement ("the Agreement"). The Agreement was established in 2008 between CRI, the land corporations of Salluit and Kangiqsujuaq, the municipality of Puvirnituq and the Makivik Corporation. It states the foundations of CRI's commitment to work fairly with its Inuit partners in writing. The Agreement is intended to:

- Facilitate equitable and meaningful participation of Inuit beneficiaries regarding the NNiP
- Promote the development and operation of the NNiP in an efficient and environmentally friendly manner

- Ensure that the Inuit people benefit from direct and indirect socioeconomic benefits during the development and operation phases of the NNiP
- Integrate the anticipated impacts, mitigation measures and monitoring programs as presented in the environmental and social impact study
- Ensure that the monitoring of environmental impacts is implemented and that unanticipated impacts, in addition to those whose scope or significance is greater than what was anticipated, are addressed appropriately
- Ensure the support of Makivik Corporation for the development and operation of the NNiP
- Allow a dynamic, continuous, and effective relationship between the Parties. Prior to the development phase, during subsequent phases of the development and operation phases of the NNiP.

The Agreement provides the means to achieve these objectives. Specifically:

1) Environmental Component

The Agreement includes, in its appendices, the anticipated impacts and mitigation measures identified during the impact study conducted by Genivar in 2007. It specifies that the environmental monitoring described in the impact study must be carried out in such a way, as to validate the effectiveness of the mitigation measures and assess the level of residual impacts after mitigation. These monitoring results must be sent to the Nunavik Nickel Committee (see below). If unanticipated impacts are identified, additional mitigation measures must be implemented to reduce them to a level deemed acceptable by the Inuit parties. Compensatory measures will be negotiated if the level of residual impact is not deemed acceptable.

The Agreement also recognizes that it is possible that CRI may wish to develop deposits other than those included in the Agreement, in the years following the Agreement's signing. It is then expected that a consultation process and an impact study will be carried out. The apprehended impacts, mitigation measures and planned environmental monitoring must be presented to the Inuit parties. Compensatory measures will be negotiated if the mitigation of impacts is not satisfactory to the Inuit parties.

This clause of the Agreement was applied by CRI during the development of the new Puimajuq deposit and the presentation of this addendum to the initial ESIA.

2) Social and Economic Component

CRI is committed to creating jobs for Inuit peoples and to implementing special training programs in various professions during the Agreement. CRI's objective is to offer and grant as many jobs as possible to qualified Inuit peoples for available positions, throughout the mine's lifespan.

CRI has implemented an apprenticeship vocational training program, working in partnership with the Kativik Regional Government (KRG) and the Kativik Ilisarniliriniq School Board (KI), in addition to provincial employment and training organizations. Additional development phases are scheduled in the program. In addition, various strategies are used (pairing with other employees, learning through virtual glasses, etc.) to arouse the interest of the Inuit peoples in occupying different positions as part of NNiP.

The Agreement provides for prioritizing the hiring of Inuit workers, in addition to the payment by CRI of free transportation from the northern villages to the NNiP site.

CRI has also created the position of "*Inuit Hiring and Training Advisors*" as to be more attentive to the concerns of Inuit employees and respond to the needs expressed when required.

As planned in the Agreement, an Inuit employability support system has been implemented. This system includes the promotion of respect for Inuit culture, by and among CRI employees, in addition to specific training for management personnel. Other measures have also been implemented, including flexible working hours, adaptations for the language spoken at work and a kitchen dedicated to Inuit employees.

CRI is committed to using Inuit companies when certain subcontracted work is required, with the perspective of generating positive benefits for the Inuit parties as much as possible. A list of goods and services, in addition to designated companies, have been specified in the Agreement.

Lastly, the Agreement defines the terms of payments and royalties to the Inuit parties. Since NNiP began operations, CRI has made annual transfers of several million dollars and will continue do so throughout the life of the project.

3) Inuit Liaison Officer

The Agreement provides for the hiring, by CRI, of an Inuit liaison officer, who will ensure compliance with the Agreement and who will report directly to the VP of Operations. This officer will also act as a Nunavik Nickel Committee representative.

4) Nunavik Nickel Committee (NNC)

The Agreement provides for the implementation of a committee with decision-making powers, named the Nunavik Nickel Committee (NNC). The committee is designed to:

Serve as a communication forum between CRI and Inuit parties

Provide an effective framework for cooperation regarding the NNiP and the implementation of the Agreement

To carry out the functions specified in the Agreement

Specifically, the results of the planned environmental, social and economic measures will be reported and discussed during NNC meetings. Section 4.1 lists the actions of this committee in detail and specifies the elements relative to this addendum.

In light of this, the Agreement will continue to be a basis for the pursuit of NNiP activities and will provide the mechanisms required so that the community's concerns are heard and taken care of.

4 Consultation with the Community

4.1 Consultation Process

Under the NNiP framework, the consultation process led by CRI with the local communities, gave way to the establishment of an impact and benefit agreement, called the Nunavik Nickel Agreement (hereafter named "The Agreement") The Agreement was established in 2008 between CRI, the land corporations of Salluit and Kangiqsujuaq, the Municipality of Puvirnituq and the Makivik Corporation, under the framework of the Global CA and is written in detail in Section 3.5 (Agreement with Native Communities). The presence of the Makivik Corporation among the signatories also ensures representation of all Nunavimmiuts.

The Agreement provides for a dynamic consultation process, specifically through the implementation of a committee with decision-making powers, named the *Nunavik Nickel Committee*. It's composed of representatives from each of the following partners, specifically the president of Qaqqalik (Land Corporation of Salluit), the president of Nunaturlik (Land Corporation of Kangiqsujuaq), a representative from the mayor of NV Puvirnituq, the mining coordinator of the Makivik Corporation, in addition to four representatives from CRI. These meetings allow for the exchange of information on various aspects, e.g., planning mining activities, certain issues and challenges, in addition to anticipated developments. The committee therefore met on several occasions since the Agreement was signed.

The Agreement provides for the possible integration of new deposit exploitation, in addition to weighing their relative benefits and repercussions. Points 3.2.1 to 3.2.3, applicable to the Delta project, are presented below.

Extracted from the Agreement :

> *“3.2.1 The Parties acknowledge that Canadian Royalties has identified a number of mineral deposits within the Claims Area, but only the deposits referred to as the Expo, Ivakkak, Mequillon, and Mesamax deposits have been specifically designated for development and extraction, as described in Chapter 4 of the Environmental Impact Study.*
>
> *3.2.2 In the event that Canadian Royalties intends to extract mineral deposits from the Claims Area, other than at the Expo, Ivakkak, Mequillon, and Mesamax deposits, Canadian Royalties shall, at its expense, prior to proceeding with such New Development cause to have performed an Environmental Assessment regarding such New Development, the results of which shall be reported to the Inuit Parties.*
>
> *3.2.3 Based on the Environmental Assessment referred to in sub-subsection 3.2.2, Canadian Royalties shall prepare, in consultation with the Inuit Parties, a summary in the format of Annex 7, of the impacts, mitigation measures, monitoring programs and significance of residual impacts after mitigation of each impact resulting from such New Development based on the four (4) criteria referred to in subsection 4.3. By noting, where applicable, those impacts, mitigation measures, monitoring programs and significance, after mitigation that are different than those identified in Annex 7; which summary, once agreed to by the Parties and following its execution by the Parties, shall become an annex to and form part of this Agreement as a New Development Annex.*
>
> *3.2.4 In the event that there is no appropriate mitigating work or works that would eliminate or diminish certain of the identified impacts resulting from such New Development, to a level of significance that is mutually acceptable to the Parties, considering the level of significance presently foreseen in Annex 7 related to such impact, the Parties shall negotiate other mutually satisfactory measures, including compensatory measures."*

In regard to the clauses of the Agreement, it has been established that an appendix summarizing the impacts and mitigation measures of Phase 2b (projet Delta[8]) must be added thereto, adjoining Annex 7 of the Agreement (Table 7-47 (Annex B) of this document), which applies to the activities of the current NNiP.

An ad hoc meeting was held on March 22, 2021 to communicate CRI's long-term mine development plan and new mining projects to the NNC, in addition to establishing the planned consultation process, based on the creation of a specific sub-committee for Phases 2a and 2b.

The sub-committee provides for the participation of two representatives designated by the Inuit stakeholders, plus two CRI representatives. Thereafter, the representatives following Mr. Willie Keatainak, and Mr. Lukasi Pilurtuut) were appointed to represent the Inuit stakeholders and Mr. Stéphane Twigg and Mr. Andy Pirti) were appointed to represent CRI. Mr. Jean-Marc-Séguin, of the Makivik Corporation, was designated as a facilitator for the sub-committee.

The objective and mandate of this sub-committee is to conduct a review of the Phase 2a and 2b and develop an additional phase-specific mitigation measures appendix, which will be included in the Agreement. Pertaining to Phase 2b. This appendix will become Annex 7.3 of the Agreement, like Annex 7.1, added in 2021 to include the mitigation measures relating to the Allammaq and Puimajuq deposits exploitation projects, and Annex 7.2, which will cover Phase 2a. The sub-committee will conduct the ESIA review, will relay communications for and by the communities and report to the NNC to provide a summary, recommendations and develop a summary of impacts and mitigation measures (Annex 7) agreed between the parties.

The consultation process to be followed by the sub-committee is as follows:

1. Review all relevant documentation and create a summary presentation of new impacts and associated mitigation measures;
2. Sub-committee meetings to discuss the reports produced on the projects under study, their impacts and the mitigation measures suggested;
3. Validate the results with the communities via presentations and communications;
4. Make a summary presentation to the attention of the NNC, as to lead toward the integration of the new mitigation measures in the form of a summary table (Annex 7)
5. Signature of the stakeholders for the official integration of the new Annex 7 (mitigation measures) into the Agreement. This takes place at a signatory meeting of the Agreement.

Thereafter, the sub-committee will conduct the ESIA review and report the summary and recommendations to the NNC.

In addition, one regular NNC meeting also took place on August 17, 2021. This focused on, among other points, the social, environmental and technical aspects relative to the operations and the administration of the Agreement.

During this meeting it was mentioned that CRI would like access to the data from a recent study completed by the Inuit on territory use, as to integrate this data into this addendum. To this intent, Makivik responded to this request in part. The results are presented in Chapter 6, along with those of certain monitoring programs on the human environment, specifically the statistics regarding the number of Inuit workers employed by CRI or certain contractors, in addition to the challenges in terms of training and success stories.

[8] The terms “Phase 2b“ and “Delta project“ are used interchangeably in this document.

A meeting of the signatories of the Agreement was held on January 26, 2022. Various clauses of the Agreement were discussed (employability, profit sharing, 2021 environmental monitoring report, characterization work carried out for the addendum to the ESIA for phases 2a and 2b). The Delta project and the preliminary infrastructure plan were also presented.

4.2 Sub-Committee Meetings for Phase 2

The first meeting of the sub-committee relating to Phase 2 was held on November 10, 2021. The sub-committee's terms of reference have been reviewed and operating rules have been established.

The specific projects for Phases 2a (Expo South, Nanaujaq, Méquillon UG2 and Ivakkak UG) and 2b (Delta) were presented along with a work schedule. The anticipated impacts were also presented in summary. The characterization work on the environment completed in the summer of 2021 by professionals from the firm, Aecom, in terms of the ESIA, has been detailed. The next steps were presented, including the process leading to the production and transmission of this addendum to the ESIA (mid-2022), in addition to presenting the results to the sub-committee. The results will be presented specifically in the form of an addition to Annex 7 of the Agreement, to facilitate the understanding of the impacts identified, the mitigation measures, the associated environmental monitoring and the significance of the residual impacts after mitigation. It is therefore planned to hold additional meetings in 2022, to ensure the consultation process leading to the approval of Annex 7 by all the stakeholders continues its due course. However, the meetings had to be postponed to later dates in 2023, due to logistical difficulties regarding the availability of stakeholders.

4.3 Community Concerns Raised

During the NNiP's environmental and social impact assessment, consultations were carried out in 2006 with the Inuit communities to consider their concerns in regard to the NNiP development and the resulting direct and indirect mining activities.

Concerns were raised regarding the following: Hiring, high school training to work in the mines, student summer jobs, labour relations, Inuit employee turnover rate, effects of job creation (negative concerns in the face of increased cash on hand for those with substance abuse problems), business opportunities and the local economy (companies other than those in Abitibi – involvement and investments, profits and royalties), the effect the mine has on the environment (destruction of fox dens, archaeological sites, etc.), modification of water quality (contaminated water and dust discharge activities), potential contamination of fish, change in air quality, contamination of caribou meat, changes in the population's hunting and fishing activities and post-closure effects.

Many of the jobs generated by the new projects should be filled by Inuit beneficiaries under the JBNQA according to the Agreement. It should be noted that the Agreement initially promotes the hiring of Inuit from Salluit, Kangiqsujuaq and Puvirnituq, with the goal to reduce concerns associated with Inuit employability. Moreover, Annex 7 (Appendix B of this document), produced in collaboration with Inuit partners and the global environmental monitoring program, is also to respond to the concerns raised during the consultations completed during the initial impact assessment.

CRI will continue to consider these concerns raised during the initial impact assessment as part of Phase 2b. No new concerns, specific to the Delta project, were raised following the first sub-committee meeting held on November 10, 2021, as well as the January 2022 meeting of the signatories. However, interest was expressed in the aspects of employability, infrastructure and a mining effluent and information was exchanged.

CRI, via the NNC and the monitoring on the planned social environment (Monitoring 35 and 36[9] of the Environmental Monitoring Program), has remained and will remain attentive to the concerns expressed by the communities in terms of NNiP activities. For example, additional environmental monitoring, consisting of surface water sampling at three stations located along the Puvirnituq River, was implemented following certain concerns and questions raised

[9] Monitoring 35 involves the information program for the Inuit communities and program 36, the plan for evaluating NNiP perceptions.

by members of the northern village of Puvirnituq during a visit by the Environmental Department in January, 2020 as part of Monitoring 35. Also, the establishment of a NNC sub-committee will be created in 2023 and dedicated specifically to the question of the NNiP restoration. The creation of this sub-committee was already a commitment by CRI and piqued interest expressed by the communities during the NNC *ad hoc* meeting on March 22, 2021. The mining restoration aspect of our sites is a major issue that has been raised many times by our partners.

CRI will continue to respond to the concerns expressed by the communities before and during the Delta project and modifications may be made to Annex 7 of the Agreement as required.

5 Description of the Project and Development Alternatives

This section of the study includes the determination of the development alternatives, selection, with discriminating parameters, of the alternative or alternatives on which the detailed impact assessment will be based and, finally the description of the selected alternative or alternatives.

5.1 Comparative Analysis of Alternatives

Several components of the project were the object of a technical, environmental, social and economic comparative analysis process with the goal of selecting the best alternatives for the Delta Mine project. These components are:

- Mine site operational mode;
- Location of the main infrastructures;
- Number of pits in operation;
- Positioning of the access portals to the underground deposits;
- Location of the waste rock crushing plant;
- Location of the final treated water discharge point;
- Access road alternatives;
- Location of the satellite camp and related infrastructures;
- Supply mode and location of the drinking water withdrawal site;
- Waste management.

The analysis of alternatives aims to allow the moist suitable response to CRI's requirements, considering the economic, technical, environmental and social issues. For environmental purposes, the comparative analysis also accounts for the GHG emission potential and the impact climate change could have, including the achievable adaptation strategies. For this purpose, this analysis of alternatives is based on six criteria divided into several tiers:

- Meets CRI's requirement (yes or no);
- Contributes to the economic viability of operation of the deposit (negative, low, medium, high);
- Technically achievable (difficult, achievable, uncertain);
- Produces impacts on the physical environment (none, low, medium, high);
- Produces impacts on the biological environment (none, low, medium, high);
- Produces impacts on the social environment (none, low, medium, high).

It should be noted that the presence of several infrastructures at the site of the Expo industrial complex provides the possibility of using these infrastructures for the Delta mine's requirements. However, the distance between the two sites, about 60 km, involves major transportation of materials which ultimately may render this approach environmentally and economically inappropriate.

5.1.1 Mine Site Operating Mode

5.1.1.1 Description of the Deposits

The characteristics of the deposits present on the Delta site allowing operation according to two modes, open pit and/or underground drifts. Thus, two operational alternatives of the deposits were studied for technical feasibility, economic viability, and the impacts on the physical, biological and human environments (see Maps 5-1 and 5-2).

According to the latest reports presenting the site's resources and reserves, the following total tonnage of ore is estimated for operation:

- Alternative 1 (OP + 2 UG): this alternative includes an open pit (OP) for tonnage of 325,628 t and underground mining for the deposit via two portals (UG) for 1,986,400 t of ore. This alternative allows total extraction of 2,312,000 tonnes;
- Alternative 2: this alternative involves an exclusively underground mining operation, also via two portals (UG), and would allow extraction of 2,094,500 tonnes of ore.

For these two alternatives, the extracted ore will be transported, by CAT775 trucks for the pit and by CATAD30 or AD40 truck for the underground mine, to one of the ore piles of the Delta site for temporary stockpiling before its transport to the Expo industrial complex. The ore pile located east of the site has a capacity of 59,100 m^3 while the ore pile located west of the site has a capacity of 62,640 m^3.

Let us note that a third option had been reviewed by CRI, namely operation in two pits (west and east) and two underground operations. This option was not analyzed in more depth, because it was considered that the impacts on the environmental and social components would have been too great with the addition of a second pit (encroachment of 3.27 ha on the environment), the permanence of the waste rock pile, and the visual and noise impacts (landscape altered more materially, louder noise).

5.1.1.2 Surface Infrastructures

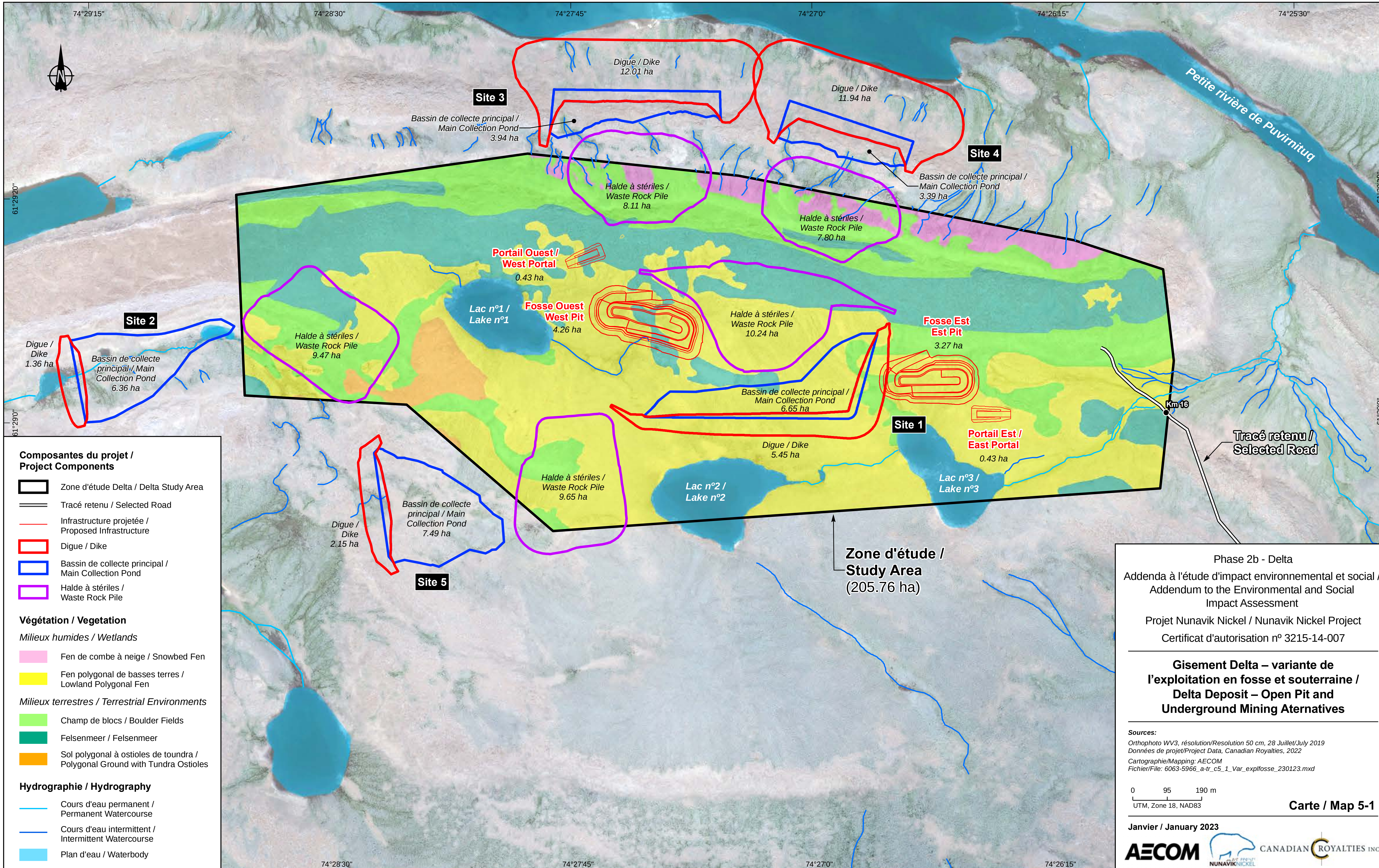
The surface infrastructures required for mining for each alternative analyzed and described in section 5.1.1.1 are similar to each other, except for the components identified in red in Table 5-1. The main differences are the absence of an open pit for Alternative 2 and the smaller area of the waste rock pile for Alternative 2 (Table 5-1 and Maps 5-1 and 5-2). Moreover, the overall footprint of the project on the natural environment is reduced for Alternative 2. We should mention that for the two alternatives, there are several possible locations for the following infrastructures: Main Collection Pond, waste rock pile and camp.

For the two alternatives, the waste rock volumes to be stockpiled (Table 5-2) include the quantities of waste rock and overburden coming from the underground portals, the excavations for the development of the Main Collection Pond and the underground development, and for all the surface infrastructures necessary on the site for operation. In the case of Alternative 1, an additional quantity of overburden is added from the west pit that will be mined.

Thus, the waste rock and overburden volumes to be stockpiled on the Delta site are three times greater for Alternative 1 because operation requires a pit, contrary to Alternative 2. Consequently, the footprint and the height of the waste rock pile are greater for Alternative 1.

The social effect landscape of an open pit is generally perceived negatively by the local Inuit communities and by the non-Native users of the territory.

It should be noted that the waste rock stockpiled on the pile will eventually be reused for backfilling of the underground drifts, for the two alternatives. They will also be used to fill the pit of the open pit mine (Alternative 1) once its operation is completed. The non-acid-generating waste rock may also be used for construction of dikes, roads and/or stockpile pads. At the end of operation, both for Alternative 1 and Alternative 2, the waste rock pile will no longer be present on the site.



74°29'15"
74°28'30"
74°27'45"
74°27'0"
74°26'15"
74°25'30"
61°29'20"
61°29'0"
Petite rivière de Puvirnituq
Site 1
Site 2
Site 3
Site 4
Site 5
Digue / Dike 12.01 ha
Digue / Dike 11.94 ha
Bassin de collecte principal / Main Collection Pond 3.94 ha
Bassin de collecte principal / Main Collection Pond 3.39 ha
Halde à stériles / Waste Rock Pile 8.11 ha
Halde à stériles / Waste Rock Pile 7.80 ha
Portail Ouest / West Portal 0.43 ha
Fosse Ouest / West Pit 4.26 ha
Lac nº1 / Lake nº1
Halde à stériles / Waste Rock Pile 9.47 ha
Halde à stériles / Waste Rock Pile 10.24 ha
Fosse Est / Est Pit 3.27 ha
Bassin de collecte principal / Main Collection Pond 6.65 ha
Digue / Dike 5.45 ha
Portail Est / East Portal 0.43 ha
Km 16
Tracé retenu / Selected Road
Digue / Dike 1.36 ha
Bassin de collecte principal / Main Collection Pond 6.36 ha
Halde à stériles / Waste Rock Pile 9.65 ha
Lac nº2 / Lake nº2
Lac nº3 / Lake nº3
Digue / Dike 2.15 ha
Bassin de collecte principal / Main Collection Pond 7.49 ha
Zone d'étude / Study Area (205.76 ha)
Composantes du projet / Project Components
Zone d'étude Delta / Delta Study Area
Tracé retenu / Selected Road
Infrastructure projetée / Proposed Infrastructure
Digue / Dike
Bassin de collecte principal / Main Collection Pond
Halde à stériles / Waste Rock Pile
Végétation / Vegetation
Milieux humides / Wetlands
Fen de combe à neige / Snowbed Fen
Fen polygonal de basses terres / Lowland Polygonal Fen
Milieux terrestres / Terrestrial Environments
Champ de blocs / Boulder Fields
Felsenmeer / Felsenmeer
Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles
Hydrographie / Hydrography
Cours d'eau permanent / Permanent Watercourse
Cours d'eau intermittent / Intermittent Watercourse
Plan d'eau / Waterbody
Phase 2b - Delta
Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment
Projet Nunavik Nickel / Nunavik Nickel Project
Certificat d'autorisation nº 3215-14-007
Gisement Delta – variante de l'exploitation en fosse et souterraine / Delta Deposit – Open Pit and Underground Mining Aternatives
Sources:
Orthophoto WV3, résolution/Resolution 50 cm, 28 Juillet/July 2019
Données de projet/Project Data, Canadian Royalties, 2022
Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c5_1_Var_explfosse_230123.mxd
0 95 190 m
UTM, Zone 18, NAD83
Carte / Map 5-1
Janvier / January 2023
AECOM
NUNAVIK NICKEL
CANADIAN ROYALTIES INC.

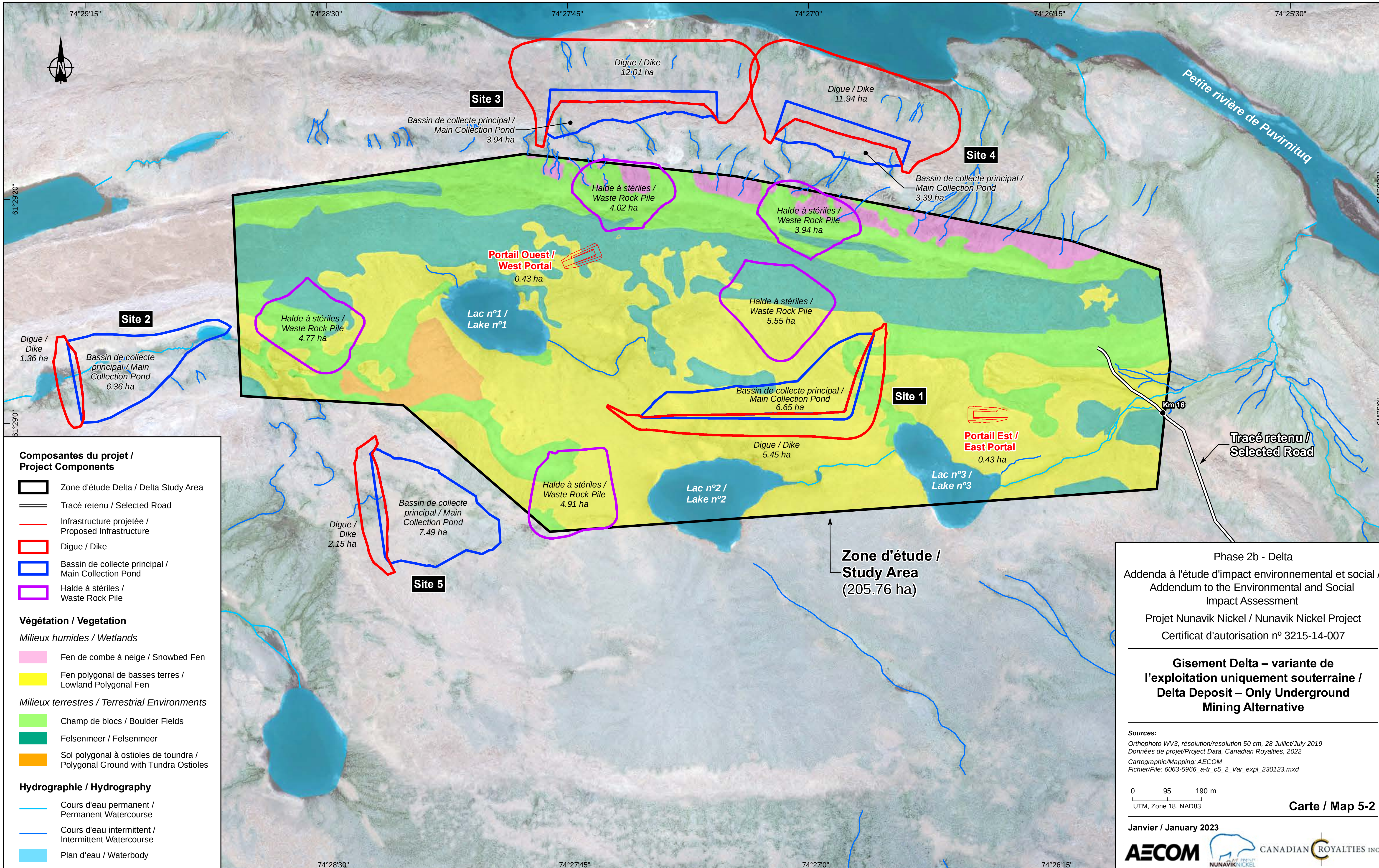

74°29'15"
74°28'30"
74°27'45"
74°27'0"
74°26'15"
74°25'30"
61°29'20"
61°29'0"
N
Petite rivière de Puvirnituq
Site 3
Digue / Dike
12.01 ha
Bassin de collecte principal /
Main Collection Pond
3.94 ha
Digue / Dike
11.94 ha
Site 4
Bassin de collecte principal /
Main Collection Pond
3.39 ha
Halde à stériles /
Waste Rock Pile
4.02 ha
Halde à stériles /
Waste Rock Pile
3.94 ha
Portail Ouest /
West Portal
0.43 ha
Halde à stériles /
Waste Rock Pile
5.55 ha
Site 2
Digue /
Dike
1.36 ha
Bassin de collecte
principal / Main
Collection Pond
6.36 ha
Halde à stériles /
Waste Rock Pile
4.77 ha
Lac nº1 /
Lake nº1
Bassin de collecte principal /
Main Collection Pond
6.65 ha
Site 1
Km 16
Tracé retenu /
Selected Road
Portail Est /
East Portal
0.43 ha
Digue / Dike
5.45 ha
Lac nº3 /
Lake nº3
Lac nº2 /
Lake nº2
Halde à stériles /
Waste Rock Pile
4.91 ha
Digue /
Dike
2.15 ha
Bassin de collecte
principal / Main
Collection Pond
7.49 ha
Site 5
Zone d'étude /
Study Area
(205.76 ha)
Composantes du projet /
Project Components
Zone d'étude Delta / Delta Study Area
Tracé retenu / Selected Road
Infrastructure projetée /
Proposed Infrastructure
Digue / Dike
Bassin de collecte principal /
Main Collection Pond
Halde à stériles /
Waste Rock Pile
Végétation / Vegetation
Milieux humides / Wetlands
Fen de combe à neige / Snowbed Fen
Fen polygonal de basses terres /
Lowland Polygonal Fen
Milieux terrestres / Terrestrial Environments
Champ de blocs / Boulder Fields
Felsenmeer / Felsenmeer
Sol polygonal à ostioles de toundra /
Polygonal Ground with Tundra Ostioles
Hydrographie / Hydrography
Cours d'eau permanent /
Permanent Watercourse
Cours d'eau intermittent /
Intermittent Watercourse
Plan d'eau / Waterbody
Phase 2b - Delta
Addenda à l'étude d'impact environnemental et social /
Addendum to the Environmental and Social
Impact Assessment
Projet Nunavik Nickel / Nunavik Nickel Project
Certificat d'autorisation nº 3215-14-007
Gisement Delta – variante de
l'exploitation uniquement souterraine /
Delta Deposit – Only Underground
Mining Alternative
Sources:
Orthophoto WV3, résolution/resolution 50 cm, 28 Juillet/July 2019
Données de projet/Project Data, Canadian Royalties, 2022
Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c5_2_Var_expl_230123.mxd
0 95 190 m
UTM, Zone 18, NAD83
Carte / Map 5-2
Janvier / January 2023
AECOM
NUNAVIK NICKEL
CANADIAN ROYALTIES INC.

Table 5-1: Surface Infrastructures Required for the Alternatives Analyzed

Alternative 1 – Open pit (OP) and underground (UG) mining	Alternative 2 – Underground mining (UG)
• Access road to the site from Ivakkak • Access roads to the various infrastructures on the Delta site • **An open pit of 4.26 ha** • Two access portals to the underground mines • **Temporary waste rock pile of 1.3 Mm^3 (for the OP mine) and 10.24 ha for the surface** • Two ore piles (one per underground mine) • Ventilation chimneys and emergency exit • Clean and contaminated water catchment ditches • Contaminated minewater, sanitary wastewater and drinking water treatment plants • Main Collection Pond (MCP) • Retention dike of the Main Collection Pond + spillway (12.1 ha) • Lower Collection Pond (LCP) • Two magazines (explosives + detonators) • Pad and sifting and crushing equipment (to crush waste rock) • Domed cement slurry plant • Delta camp for a maximum of 150 workers (two possible alternatives for the location, see point 5.1.8)	• Access road to the site from Ivakkak • Access roads to the various infrastructures on the Delta site • **No open pit** • Two access portals to the underground mines • **Temporary waste rock pile reduced to 0.5 Mm^3 and 5.55 ha for the surface** • Two ore piles (one per underground mine) • Ventilation chimney and emergency exit • Clean and contaminated water catchment ditches • Contaminated minewater, sanitary wastewater and drinking water treatment plants • Main Collection Pond (MCP) • Retention dike of the Main Collection Pond + spillway (12.1 ha) • Lower Collection Pond (LCP) • Two magazines (explosives + detonators) • Pad and sifting and crushing equipment (to crush waste rock) • Domed cement slurry plant • Delta camp for a maximum of 150 workers (two possible alternatives for the location, see point 5.1.8)

Table 5-2: Quantity of Waste Rock from the Operational Alternatives Studied

Alternative studied	Maximum volume of waste rock to be stockpiled (m^3)	Estimated volume that will be returned to the drifts (m^3)	Estimated volume that will be used to fill the pit (m^3)	Estimated volume that will remain on site after restoration (m^3)
Alternative 1: open pit and underground mining (Delta OP)	1,299,149	616,000	683,149	0
Alternative 2: underground mining (Delta UG)	499,372	499,372	Not applicable	0

5.1.1.3 Workforce

For the two alternatives, the workers will be divided into two shifts, from 06:00 to 18:00 and from 18:00 to 06:00.

The workers' camp has a maximum capacity of 150 people. Thus, the number of employees required is estimated at a maximum of 137 or 138 starting in 2029 for the two operational alternatives (Table 5-3). The employees include those dedicated to mine operations, those assigned to exploration and those responsible for maintenance and repair of infrastructures and equipment. Added to this, for the two alternatives, are the CRI employees assigned to supervision and engineering of the work, the people responsible for building maintenance and the healthcare staff, who will divide their time among the different operational sites. However, for Alternative 2, the operational work will begin one year later and will end one year earlier than for Alternative 1. Thus, a greater number of workers is required and for a longer time than for Alternative 1.

Table 5-3: Numbers of Employees Forecast by Alternative

	2025	2026	2027	2028	2029	2030	2031	2032
Alternative 1	40	111	111	133	138	138	138	138
Alternative 2		37	111	133	137	138	138	

5.1.1.4 Mining Equipment

In operation, the mining equipment required for the two alternatives analyzed are detailed in Table 5-4. Alternative 1 requires more mining equipment for the operational period due to the presence of an open pit. This additional equipment represents an additional contribution of greenhouse gas emissions associated with the project's activities and an ambient noise increase for wildlife and users the land west of the site.

Table 5-4: Mining Equipment Required for Mining of Deposits Depending on the Operational Alternative

UG equipment	Number of equipment units required Alternative 1 - Operation	Number of equipment units required Alternative 2 - Operation
Electric boom truck/Hydraulic Jumbo	2	2
Power bolter	4	4
CAT R1700 shuttle loader/scoop	3	3
Service truck	1	1
Haul truck (30 t capacity)	5	5
Gas/oil truck	1	1
ANFO loader	1	1
Tanker truck - 20,000 L	1	1
Forklift truck	1	1
Longhole drill	2	2
Grader	1	1
Emulsion pump	1	1
Scissor lift	1	1
Underground van	6	6
Loading equipment (990 loader, CAT 390 excavator)	2	-
Tractor	1	-
70 t haul truck (CAT775)	4	-
Hydraulic shovel	2	-
Emulsion loading truck	1	-
Drill	3	-
Service truck (mechanical)	2	-
Pickup	5	-
Grand total	**50**	**30**

5.1.1.5 Use of Explosives

Explosives will be used both in the open pit and in the underground mines. In the pit, emulsion will be used and delivered directly to the drill holes by the Dyno Nobel emulsion trucks.

For the underground mines, the workings will be loaded from the emulsion that will be delivered with an emulsion pump designed for this purpose.

Thus, Alternative 1 requires open-area use of explosives and thus increases the noise impacts on the neighbouring environment. Because the work zone is located in a legal caribou calving area, sudden noises generated by the explosions could have a certain effect on the females who are calving or who already have their young calves with them. The impacts thus are greater in the case of Alternative 1 (OP+ 2 UG) due to the open pit, which propagates noise more loudly. The impacts of the selected alternative and its mitigation measures will be described in more detailed in Chapter 7.

5.1.1.6 Operational Periods

The operational periods of the deposits vary somewhat between Alternatives 1 and 2. For Alternative 1, the operational period of the open pit (OP) mine would be only one year, starting in the first year, while the underground mines would be operated over a period of 5.2 years. For Alternative 2, operation of the underground mines is scheduled over a period of 5.6 years.

5.1.1.7 Construction Costs, Operating Costs and Net Earnings

The construction costs of the mining facilities are similar for the two alternatives and amount to an investment of about $107.8 million dollars, with possibly an additional $1 million to $2 million for Alternative 1 (OP + 2 UG).

The operating costs during operation represent the following total amounts for each of the alternatives analyzed:

- Alternative 1 (OP+ 2 UG): $627.8 million;
- Alternative 2 (2 UG): $552.8 million.

The restoration costs will include at least the following amounts for each of the alternatives analyzed:

- Alternative 1 (OP+ 2 UG): $117 million only for the waste rock pile and the pit, considering that the waste rock will be returned to the underground drifts and to the pit;
- Alternative 2 (2 UG): about $4.5 million only for the waste rock piles.

However, for all of the restoration work, little difference in costs between the two alternatives is calculated in this planning stage, considering variant n02, where it becomes necessary toimport waste rock from the Ivakkak site, to complete the backfilling of the underground drifts which will result in additional costs.

5.1.1.8 Comparative Analysis of Operational Alternatives

Table 5-5 summarizes the main economic, technical, environmental and social issues according to the criteria established in section 5.1 for each of the operational alternatives analyzed.

According to the comparative analysis, Alternative 2 generates fewer impacts on the biological, physical and human environments, mainly due to the permanent footprint of the developments, which is smaller due to the absence of an open pit and the reduction of the size of the waste rock pile. This reduction diminishes the footprint by about 10 ha. This more reduced footprint in the case of Alternative 2 thus limits the disturbances to the physical and biological environments, but also to the landscape, given the absence of residual structures after closure. Moreover, this alternative eliminates the use of explosives on the surface, which would avoid restriction of blasting activities during the caribou calving period and the period when these animals are present near the site.

Table 5-5: Comparison of Operational Alternatives of the Delta Project

Criteria	Alternative 1 Operation of the Delta deposit (OP + 2UG)	Alternative 2 Operation of the Delta deposit (2 UG)
Meets CRI's requirements	Yes	Medium: access to the ore is delayed by 1 year
Economic viability	Yes	Yes, but high risk of shutdown of operations on the Expo site due to an ore shortage
Technical feasibility	Achievable, no constraint	Achievable, no constraint
Impacts on the biological environment	Major: • Permanent destruction of wetlands over a surface of 4.26 ha for the pit. • Area of 9.83 ha of wetlands affected by MCP and retention dike. • Temporary waste rock pile on an area affecting 6.25 ha of wetlands. • Potential total destruction of a large Sulphur Buttercup colony (species at-risk). • Greater disturbance of caribou during calving due to high-intensity noise (explosion) on the surface in the operational period of the pit. • Disturbance of water quality and fish habitat. • Long-term destruction, but zone then totally restored at the end of the work.	Medium: • Area of 9.83 ha of wetlands affected by MCP and retention dike. • Waste rock pile affecting 2.90 ha of wetlands. • Reduced destruction of the large Sulphur Buttercup colony due to the reduction of the footprint of the work (absence of an open pit and reduction of the size of the waste rock pile). • More limited disturbance of caribou during calving due to the reduction of high-intensity noise (explosion) on the surface in the operational period. • Disturbance of water quality and fish habitat. • Long-term destruction, but zone then totally restored at the end of the work.
Impacts on the physical environment	Medium: • Major change in soil drainage and water and sedimentary regimes due to the presence of a pit. • Impacts of air quality, the noise environment and greater GHG emissions	Minor: • Long-term reduction of the risks of climate change (permafrost), because few environmental liabilities compared to a pit. • Reduction of changes in soil drainage and the water and sedimentary regimes • Reduction of the impacts on air quality, the noise environment and GHG emissions.
Impacts on the human environment	Medium: • Greater impact on the landscape during operation due to the presence of the pit and the waste rock pile. • Disturbance of activities on the trapline • Opening of the territory (positive impact).	Medium: • Reduced impact on the landscape during operation and eliminated at the end of the project. • Disturbance of activities on the trapline. • Opening of the territory. • Potential job losses for workers at the Expo mill due to the ore shortage between 2025 and 2027
Alternative selected	**Alternative 1 is selected**	

Despite the fact that Alternative 2 may represent a slight economic advantage, due to investments that are slightly lower because of the absence of a pit, CRI wishes to implement Alternative 1. This is more advantageous than Alternative 2, because it meets CRI's operational needs better. More specifically, the operation of a pit will allow the ore to be obtained more quickly. This contribution is crucial for the operation of the ore processing mill of the Expo site, which otherwise would have to slow and even shut down its production between 2025 and 2027. The operation of an open pit mine is much quicker, which is a major advantage for keeping the Expo mill's operations afloat (see Figure 5-1). On the one hand, CRI has commitments to the smelters that purchase its ore concentrate. On the other hand, the current labour shortage very present in Québec could compromise CRI's future operations if temporary shutdowns lead to layoffs of personnel, at the risk they will not return to work. Alternative 1 also represents an advantage in terms of employability.

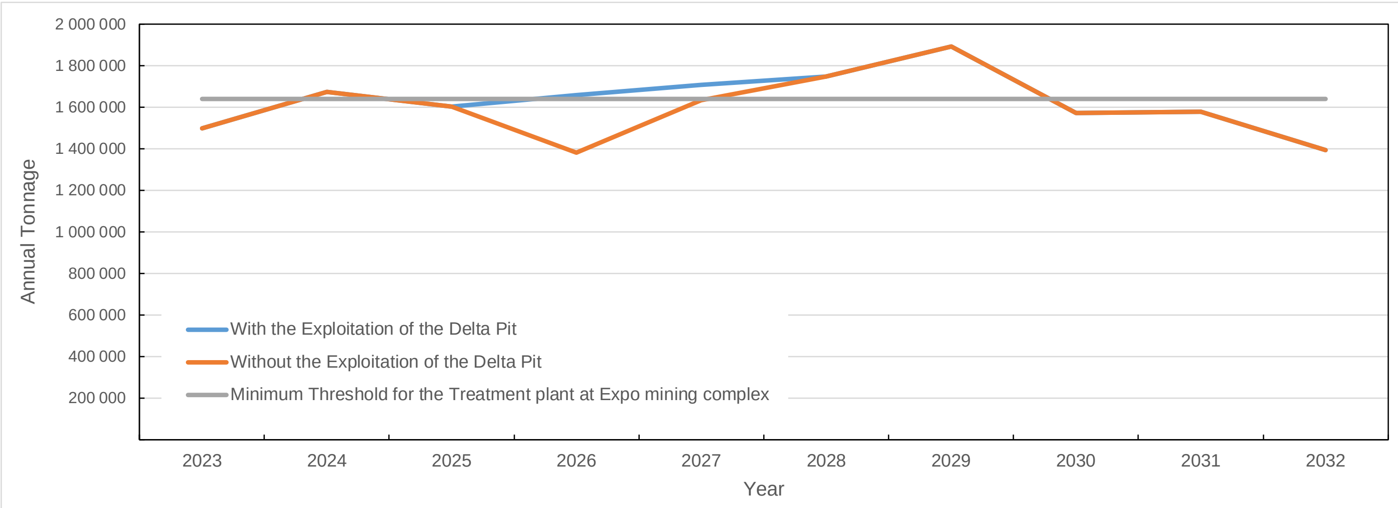


Figure 5-1: Annual Tonnage Sent for Processing at the Expo Complex with Operation of the Pit

For the above reasons, operation of the open pit is necessary (Alternative 1) to allow the uninterrupted pursuit of CRI's operations in the years ahead. The impacts and mitigation measures for this alternative will be presented in Chapter 7.

5.1.2 Location of the Main Infrastructures

The infrastructures are composed of a management pond for water in contact with the waste rock pile and the ore piles. The location of the water management pond is related to the topography of the terrain and the location of the waste rock pile. No alternative is present for the ore piles.

5.1.2.1 Water Management

All the mine sites require a water management infrastructure that includes construction of collection ponds, ditches for collection of contact water, i.e. runoff water on the mine site, particularly on the waste rock pile, on the ore piles and in the portals sector.

For the two operational alternatives presented in point 5.1.1, five location sites for the waste rock piles and the surface water management infrastructure were reviewed and assessed. The five sites studied aim to limit the impact of these works on the sensitive environments present in the footprint and around the Delta site, i.e. wetlands (snowbed fen and lowland polygonal fen) and environments with the presence of plant species at risk. The potential locations are presented in Maps 5-1 for Alternative 1 and 5-2 for Alternative 2.

5.1.2.2 Location Sites of Waste Rock Piles and Water Management Infrastructures

Five different locations of the main mining infrastructures were analyzed to favour the best possible location to respond to the main economic technical, environmental and social issues. For each site considered for the location of the waste rock piles and the water management infrastructure, the technical specifications are given in Table 5-6.

Table 5-6: Location Sites of Waste Rock Piles and Surface Water Management Infrastructure – Technical Specifications

Infrastructures		Alternative 1					Alternative 2				
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 1	Site 2	Site 3	Site 4	Site 5
Waste rock pile	Elevation (m)	523.0	501.0	506.3	504.0	504.0	512.0	492.0	507.0	512.0	495.0
	Area (ha)	10.24	9.47	8.11	7.80	9.65	5.55	4.77	4.02	3.94	4.92
	Volume (Mm^3)	1.16					0.37				
Retention dike	Elevation (m)	493.1	463.5	464.5	466.0	477.0	493.1	463.5	464.5	466.0	477.0
	Area (ha)	5.45	1.36	12.01	11.94	2.15	5.45	1.36	12.01	11.94	2.15
	Volume (Km^3)	234	56	1,569	1,735	84	234	52	1,569	1,735	84
MCP	Elevation (m)	491.6	462.0	463.0	464.5	475.5	491.6	462.0	463.0	464.5	475.5
	Area (ha)	5.65	6.05	2.32	1.91	7.05	5.65	6.05	2.32	1.91	7.05
	Volume (Km^3)	170					170				
Diversion ditch to the natural environment	Length (m)	1,016.0	732.0	780.0	834.7	1,456.4	814.5	564.0	858.0	903.6	1,463.0
Contact water ditch to the MCP	Length (m)	524.0	565.2	301.0	304.7	290.5	300.0	479.2	337.1	368.7	382.0

The dike construction materials will come from various sources, including quarries located along the access road to the Delta site from the Ivakkak Mine, for which operation will have to be authorized, non-acid-generating waste rock from the Ivakkak Mine and overburden and waste rock excavated at the Delta site (if non-acid-generating and according to the geochemical characterizations).

Both for Alternatives 1 and 2, Sites 3 and 4 require large volumes of materials for construction of the retention dike of the Main Collection Pond, respectively 1.5 and 1.7 million m^3. With a density of 1.9 tonnes per m^3, this is respectively 3.0 and 3.3 million tonnes, which is double the total tonnage of waste rock from the Delta pit. There is major importing of materials from the local quarries locales and the construction time is much too long to allow mining of ore starting in 2026 as desired. The costs associated with the construction of these dikes are significant and considered to have little economic viability. The footprint of the retention dike for these two sites (3 and 4) is also larger than on the other sites (1, 2 and 5). Construction of the dike, for Sites 3 and 4, also involves a certain technical challenge due to the topography of the sites, including a fairly steep natural slope in this sector of the site, which involves a high waste rock pile. Moreover, the dike encroaches on the bank and the shore of the Little Puvirnituq River. Due to the proximity of the river, technical construction difficulties, the large volumes of materials required for development of the retention dike and high construction costs, Sites 3 and 4 were eliminated at the outset for the next stage of assessment of the alternatives.

Sites 2 and 5 are those for which the volume of materials required for development of the retention dike is the lowest, between 52,000 and 84,000 m^3. Therefore, the footprint of the retention dike for these sites is the most reduced, for the two alternatives. The volume of materials required for the retention dike of Site 1 is between 3 and 5 times greater than for Sites 2 and 5, for the two alternatives. Nonetheless, Site 2 is located much too far from the mining operations and would require construction of 1.5 to 2.0 km of additional access roads. The same is true for Site 5, which is also farther from the mining facilities, although to a lesser extent than Site 2. Site 1 offers the advantage of being near the mining facilities and therefore contributes to limit transport of waste rock.

In environmental terms, the terrestrial environments and wetlands affected by the waste rock pile, the retention dike and the Main Collection Pond differ among Sites 1, 2 and 5 considered (Table 5-7). It should be noted that the environmental characterization is nonetheless incomplete for a certain portion of Sites 2 and 5. The smallest footprint is observed on Site 2 for Alternative 2 (12.18 ha), while the largest footprint is observed for Alternative 1 and Site 1 (25.60 ha). The dike, the pond and the waste rock pile of Alternative 1 and Site 1 also destroy nearly the entire Sulphur Buttercup colony. The largest destroyed wetland area is also observed for Alternative 1 and Site 1.

For CRI, Site 1 nonetheless remains the best option due to the proximity of the mine works (MCP and waste rock pile), which allows minimization of construction of access roads and trips, both in the operational period (stockpiling of waste rock) and in the restoration periods (backfilling of the underground drifts and the pit with waste rock).

Table 5-7: Area Affected for Wetlands and Terrestrial Environment According to the Alternative and the Site

Site	Wetlands in ha (uninventoried area)		Terrestrial environments in ha (uninventoried area)			Water environment (ha)	Total destroyed area in ha (uninventoried area)	Plant species at risk
	Snowbed fen	Lowland polygonal fen	Felsenmeer	Boulder field	Tundra ostiole polygonal soil			
Alternative 1 [A]								
1	-	19.63	4.85	1.11	-	-	25.60	Great abundance of *Ranunculus sulphureus*
2	-	8.20 (1.78)	2.78	6.24 (1.96)	0.35	0.21 (0.21)	21.13 (6.05)	Incomplete inventory
5	-	6.23 (1.23)	0.716	4.88 (3.06)	3.22 (3.19)	-	23.11 (10.49)	Incomplete inventory
Alternative 2 [B]								
1	-	12.74	2.80	1.11	-	-	16.64	Great abundance of *Ranunculus sulphureus*
2	-	2.82 (1.78)	1.31	4.38 (1.96)	-	0.21 (0.21)	12.18 (7.41)	Incomplete inventory
5	-	7.34 (3.64)	-	3.60 (2.38)	3.18 (3.18)	-	14.11 (9.19)	Incomplete inventory

[A] The areas include those of the pit, the collection pond and its dike, and the waste rock pile.
[B] The areas include those of the collection pond and its dike, and the waste rock pile.

5.1.2.3 Comparative Analysis of the Sites Considered for the Main Infrastructures

The comparative analysis of the alternatives indicates that for the infrastructure development sites, Site 2 is favoured due to the smaller footprint on the wetlands for this alternative (Table 5-8). However, additional inventories should confirm the absence of plant species at risk.

Considering the quantity of ore to be extracted with Alternative 1 and the proximity of the infrastructures, Site 1 is selected.

Table 5-8: Comparison of the Alternatives and the Sites Considered for the Main Infrastructures of the Delta Project (Waste Rock Pile and Main Collection Pond)

Criteria	**Alternative 1** Operation of the Delta deposit (OP + 2 UG)	**Alternative 2** Operation of the Delta deposit (2 UG)
Meets CRI's requirements	Yes	Medium: access to the ore is delayed by 1 year
Economic viability	Site 1: Yes Sites 2 and 5, less viable than Site 1 due to the distance between the different infrastructures.	Site 1: Yes Sites 2 and 5, less viable than Site 1 due to the distance between the different infrastructures.
Technical feasibility	Achievable	Achievable
Impacts on the biological environment	Site 1: Major: almost complete encroachment on the Sulphur Buttercup colony (species likely to be designated threatened or vulnerable).	Site 1: Major: reduced encroachment on the Sulphur Buttercup colony compared to Alternative 1.
	Sites 2 and 5: Medium for the waste rock pile: no sensitive component affected apart from wetlands. **Unknown** for the dike and the Main Collection Pond and one part of the waste rock pile of Site 5, because no inventory has been produced to date in these sectors.	Sites 2 and 5: Medium for the waste rock pile: no sensitive component affected apart from wetlands. **Unknown** for the dike and the Main Collection Pond and one part of the waste rock pile of Site 5 (no inventory to date), but the occupied area is smaller than for Alternative 1.
Impacts on the physical environment	Site 1: Minor: no permanent watercourse present in the footprint; the upper portion of an intermittent watercourse not considered as fish habitat will be filled.	Site 1: Minor: no permanent watercourse present in the footprint; the upper portion of an intermittent watercourse not considered as fish habitat will be filled.
	Site 2: Medium: minor encroachment on an intermittent and permanent watercourse.	Site 2: Medium: minor encroachment on an intermittent and permanent watercourse.
	Site 5: Medium: minor encroachment on intermittent watercourses.	Site 5: Medium: minor encroachment on intermittent watercourses.
Impacts on the human environment	Site 1 Medium: presence of a more massive dike and a temporary waste rock pile. The landscape will be altered more materially during operation. Site 2 Medium: reduced footprint compared to Site 1. More trucking necessary, so increase in GHG Site 3 Medium: highest environmental footprint. More trucking necessary, so increase in GHG	All sites: Minor: reduced footprint during operation.
Alternative selected	**Site 1 is selected**	

5.1.3 Number of Pits in Operation

Because the alternative selected one that includes operation of an open pit mine, the positioning of the pit was determined in consideration of the topographical and geotechnical constraints and the deposit present. The Delta site offered the potential of two pits to be operated, the "East" pit (3.27 ha) and the "West" pit (4.26 ha) (Map 5-1). The "East" pit was not selected due to the excessively small quantity of ore and its low profitability. Indeed, the "East" pit would have produced only 75,000 t of ore to generate between 800,000 and 900,000 tonnes of waste rock. Moreover, after production of the plant inventories, Sulphur Buttercups were also detected at the location of the "East" pit. Considering this pit's low economic contribution for CRI's activities and the additional destruction of wetlands and individual Sulphur Buttercups, it was determined that the "East" pit will not be operated to reduce the project's footprint on the natural environment.

The selected alternative therefore includes a single pit, the "West" pit.

5.1.4 Positioning of the Access Portals to the Underground Deposits

The deposits may be operated via an open pit or via underground drifts accessible through entrance portals. They are necessary for access to the underground drifts both for Alternatives 1 and 2. Ideally they must be developed to minimize the environment footprint while considering the topographic and geotechnical constraints.

The access portals to the underground deposits, including the surface infrastructures, as shown on Maps 5-1 and 5-2, are located northeast of Lake 1 in a mixed environment (terrestrial and wetland) and northeast of Lake 3, in a wetland (lowland polygonal fen). For this second portal, its position results in the destruction of a small Sulphur Buttercup colony. These two portals will destroy a total of about 1 ha of wetlands, depending on the overburden thickness removed, which will have to be offset according to the measures established with the MELCCFP. The portals may not be positioned at another location due to the topographical constraints of the site and the location of the other infrastructures.

5.1.5 Location of the Waste Rock Crushing Plant

It is estimated that an average of about 180,000 tonnes of waste rock will have to be crushed annually to meet the cemented rock fill requirements of the Delta UG mine. In this context, a waste rock crushing area will be located east of the waste rock pile (Map 5-1). This waste rock then will be returned underground for backfilling of the mined workings of the Delta Mine according to the requirements of the operational and closure phases.

5.1.5.1 Alternative 1: Backfilling the Workings Without Crushing

The first alternative involves backfilling the workings with rock from the waste rock pile, but without crushing it in advance. This option has the advantage of not requiring a crushing plant and avoids the need for space for its location and the related development costs.

However, backfilling the underground workings with uncrushed waste rock is less technically recommendable and non-viable. The blasted rock contains plenty of big stones with large diameters, which prevent good cohesion with concrete and results in poor-quality backfilling (Table 5-9).

5.1.5.2 Alternative 2: Underground Waste Rock Crushing Plant

The second alternative for the location of the crushing plant is to build an underground plant. This alternative offers the advantage of minimizing the encroachments in the terrestrial environment outside the mine. However, underground crushing presents several technical challenges, including the space available, and challenges for the workers' health and safety, including management of air quality and dust in a closed environment. Despite the presence of a dust removal system, this location poses a significant risk of redistribution of dust in the underground ventilation system. Given the confinement of the underground crushing plant, total respiratory protection would be required for all workers. The underground location also presents a higher risk for the maintenance team, who will have to work in a confined environment. This location also increases the underground fire risk due to heat, friction and hot work. It is important to remember that management of underground fires is much more laborious than on the surface. Moreover, the heavier truck traffic on the access ramp and in the crushing sector increases the collision risks. Due to these major challenges and the additional costs required to implement this alternative safety, it was not selected by CRI (Table 5-9).

5.1.5.3 Alternative 3: Crushing Plant on the Surface

The last alternative involves installing the waste rock crushing plant on the surface on a crushing area with stockpiling juxtaposed to the temporary piling area for waste rock from the portals and the pit. To limit the release of airborne dust a sprinkler dust suppression system will be deployed during the crushing activities. Crushing will be done over a shortened period and the production required for the year will be produced in a few months. Crushing would begin in August to October, when sprinkling is possible to limit dust. Although this alternative encroaches on the terrestrial environment, it presents the best advantages in terms of technical feasibility, workers' health and safety and economic viability. The natural environment impacted also does not contain sensitive elements in the waste rock crushing area; moreover, the period would coincide with the time when caribou are less present on the site.

5.1.5.4 Comparative Analysis of the Alternatives

The different alternatives presented above are compared in Table 5-9 based on the main economic, technical, environmental and social issues according to the criteria established in section 5.1 for each of the alternatives analyzed for the waste rock crushing plant.

Due to the major impacts on ambient air quality for workers in the underground mines, the surface alternative is recommended where the crusher will be installed on a crushing area.

Table 5-9: Comparison of Delta Project Alternatives – Waste Rock Crushing Plant

Criteria	Backfilling the workings without crushing	Underground waste rock crushing plant	Crushing plant on the surface
Meets CRI's requirements	No	Yes	Yes
Economic viability	High	Low	High
Technical feasibility	Difficult	Difficult	Achievable
Impacts on the biological environment	None: absence of site development for crushing.	None: no surface natural environment affected	Minor: small land area affected and dust accumulation on the adjacent ambient environment. Caribou calving avoided. Shortened crushing period.
Impacts on the physical environment	None: absence of site development for crushing.	Medium: no land area affected, but air quality degradation due to the increase in dust inside the mine.	Minor: dust emissions controlled by sprinkling
Impacts on the human environment	Minor: no impact on noise and the landscape, except for stockpiling of waste rock before underground backfilling.	Major: management of ambient air quality and dust for workers in confined spaces	Medium: noise and dust emissions, but in open area, rock stored before backfilling. Shortened crushing period.
Alternative selected			**Crushing plant the surface on a crushing area**

5.1.6 Location of the Final Discharge Point

The projected discharges present on the Delta complex site will be composed of mine effluent combined with sanitary effluent (pipes adjacent to each other).

In the case of mine effluent, it will come from a mobile treatment unit, for which the flow will range between 180 m^3/h (0.04 m^3/s) and 300 m^3/h (0.13 m^3/s) distributed over a maximum period of 110 days for a maximum average volume of 230,000 m^3 (capacity of the MCP and the LCP). Sanitary effluent is estimated at 2.1 m^3/h. For sanitary effluent combined with mine effluent, the flow is estimated between 182.1 m^3/h (0.051 m^3/s) and 302,1 m^3/h (0.084 m^3/s).

Two solutions were considered for the location of the mine effluent and sanitary effluent discharge point, i.e. Tributary CE-D13 (flows into the Little Puvirnituq River) and the Little Puvirnituq River. These two watercourses were subjected in the past few years to water quality sampling and analysis, as well as an ecological characterization, to find out the initial state in the portions that could be affected by the discharge, an upstream of the various potential discharge points. The Little Puvirnituq River was considered the best site based on its dilution capacity (mean summer flow of about 9.2 m^3/s compared to about 0.06 m^3/s for Tributary CE-D13). However, the Little Puvirnituq River is a watercourse accommodating a fish population including Arctic Char, Lake Trout and Sculpins. This watercourse presents a potential spawning area downstream from the projected discharge point. Currently, no fish were caught in Tributary CE-D13. This does not offer attractive conditions for breeding of species that may be present, due to overly shallow depths between 0.03 and 0.05 in the rapid zones, despite the presence of a large pool about 0.60 m deep. The watercourse could be suitable, in certain periods of the year, for rearing and feeding of fish from upstream. The fish from The Little Puvirnituq River encounter an obstacle passable under high water level conditions in Tributary CE-D13, about 180 m from its mouth, which could also explain the absence of fish in this watercourse during fishing. The first lake upstream of the watercourse would contain few or no fish, according to the fishing done. Only the second lake upstream seems to contain an Arctic Char population. Tributary CE-D13 thus currently could be an environment mainly used for downstream migration of fish in the lakes after snowmelt or during floods.

Given the risk that the increased flow in the tributary will create an inrush of water for fish and induce them to use a tributary that offers weak dilution, and thus would expose fish to excessive organic enrichment and higher metal contents in this environment, it is proposed to discharge the double effluent (mine and sanitary) into the Little Puvirnituq River. The discharge point would be positioned immediately downstream from the mouth of Tributary CE-D13 (see Map 5-3).

Due to the location on the left bank, on the side opposite the potential salmonid spawning area identified, and nearly 650 m upstream of this spawning area, few impacts are anticipated on potential silting of the spawning area.

Let us remember that mine effluent will be discharged a maximum of 110 days per year during the thaw period, between the end of June and the beginning of October.

5.1.7 Access Roads Alternatives

Two major access roads will have to be developed for operations at the Delta site to run smoothly: 1) a road from the road leading to Ivakkak, and 2) an access road to the fresh water pumping station located on the edge of a lake about 3.5 km from the periphery of the Delta site as the crow flies (see Map 5-4).

Thus, the first road to be developed will be the one that must connect the Ivakkak site to the Delta site, located 16 km to the southeast. The quantity of ore that will be transported on this road is estimated between 400 and 1,100 tonnes per day. Considering that the ore will be transported by 120 t bi-train trucks, the estimate road transportation volume will range between 4 and 9 transport trips per day. Several alternatives for roads were assessed for construction and each alternatives should account for the following factors:

- The topography, which may be a major technical constraint for bi-train manoeuvres;
- The area and the presence of wetlands and the length of road affected in the wetlands;

- The road must limit encroachment on the wetlands;
- The proximity of material usable for construction of the road;
- Avoid wide sections of watercourses that must be crossed;
- Make sure to have the shortest road to limit the quantity of air pollutants emitted related to construction and to road transport during operation;
- Limit the impacts on plant species at risk;
- Technical feasibility for road construction.

The second road to be developed will aim to connect the Delta site to the fresh water pumping station. The development constraints for this road are more limited, given that the bi-trains will not use this road. The constraints to be considered for selection of the road will depend mainly on the following:

- The topography must have slopes less than 12%;
- Avoid wide sections of watercourses that must be crossed;
- Limit the impacts on plant species at risk;
- Technical feasibility for road construction.

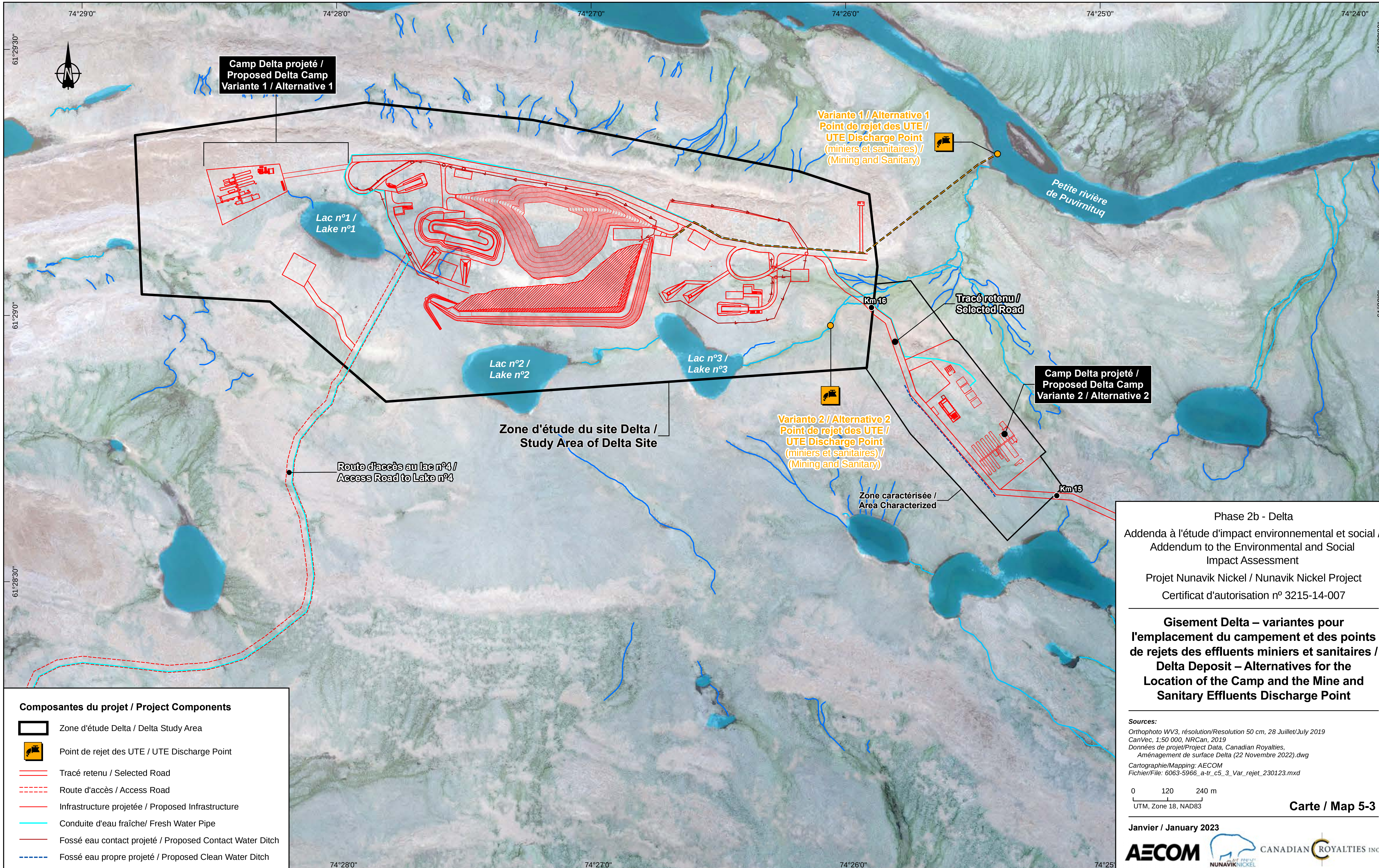
5.1.7.1 Alternatives for the Access Road Connecting the Delta Site to the Road Leading to the Ivakkak Site

Alternative 1 of the Delta-Ivakkak road had been determined by CIMA in 2019 during a helicopter flight before conducting field inventory surveys for delineation of the wetlands (Map 5-4). The portion of the road farthest west is located in wetlands with several intermittent watercourses (length of 4.01 km) and steep slope problems were noted along the alternative for technical feasibility and bi-train manoeuvres (total length of 16.68 km). Thus, this total alternative would have a length of 20.69 km.

Alternative 2 was produced to establish the shortest road to reach the Delta site (Map 5-4). The length of this alternative was 16.43 km. However, this alternative includes several crossings of permanent watercourses and many crossings of intermittent watercourses. The slopes are also too problematic to allow development of a practicable road for bi-trains.

Alternatives 3 and 3a were produced after photointerpretation and validation of the topography to select a road that avoids crossings of permanent watercourses and intermittent runoff zones whenever possible. Optimization of the road distance to be developed was also at the centre of production of the alternative by selecting the best slopes for feasibility of bi-train traffic. When the slopes allow this, the alternative of the road passes on the crest to avoid wetlands whenever possible. For Alternative 3, the length of road to be constructed would be 16.33 km and Alternative 3a of 16.63 km. Thus, this road alternative includes a section of 14,91 ha on boulder fields, 9,05 ha on tundra ostiole polygonal soils, 4,94 ha on felsenmeer soils and 4,99 ha in wetlands. Thus, 85 % of the road passes through terrestrial environments. Five small permanent watercourses (less than 2 m at modulated flow) will be crossed, as well as two intermittent watercourses (runoff). The watercourse located west of the selected Delta camp (see point 5.1.8) has different widths along its course. Thus, Alternative 3a would require a crossing of about 7 m at modulated flow, while for Alternative 3, the crossing to be developed at modulated flow would have a width of less than 1 m.

Alternative 4 includes a road of 16.38 km that begins near the Delta site. However, this site begins with an increase in elevation of the boulder fields, with a slope too steep for bi-trains. This alternative would prefer a passage only on the crest, with as few wetlands as possible on the road. Therefore, all the slopes generally were not adapted for bi-trains. The wetlands thus cannot be avoided to develop an access road between the different mine sites operated.



Phase 2b - Delta

Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment

Projet Nunavik Nickel / Nunavik Nickel Project

Certificat d'autorisation nº 3215-14-007

Gisement Delta – variantes pour l'emplacement du campement et des points de rejets des effluents miniers et sanitaires / Delta Deposit – Alternatives for the Location of the Camp and the Mine and Sanitary Effluents Discharge Point

Sources:

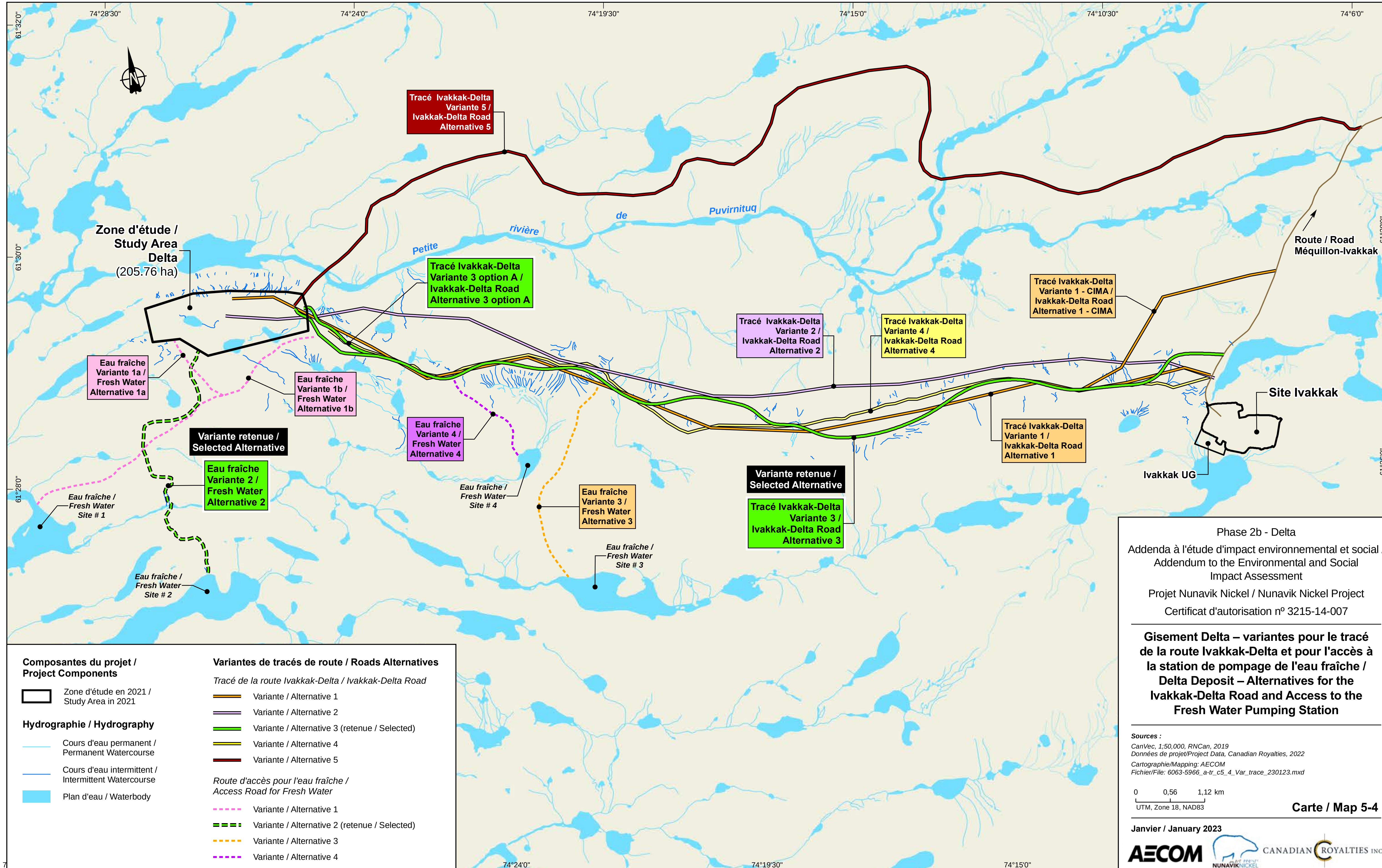
Orthophoto WV3, résolution/Resolution 50 cm, 28 Juillet/July 2019
CanVec, 1;50 000, NRCan, 2019
Données de projet/Project Data, Canadian Royalties, Aménagement de surface Delta (22 Novembre 2022).dwg

Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c5_3_Var_rejet_230123.mxd

Carte / Map 5-3

Janvier / January 2023

AECOM NUNAVIK NICKEL CANADIAN ROYALTIES INC.



74°28'30"
74°24'0"
74°19'30"
74°15'0"
74°10'30"
74°6'0"
61°32'0"
61°30'0"
61°28'0"
61°26'0"
Tracé Ivakkak-Delta Variante 5 / Ivakkak-Delta Road Alternative 5
Petite rivière de Puvirnituq
Zone d'étude / Study Area Delta (205.76 ha)
Tracé Ivakkak-Delta Variante 3 option A / Ivakkak-Delta Road Alternative 3 option A
Tracé Ivakkak-Delta Variante 2 / Ivakkak-Delta Road Alternative 2
Tracé Ivakkak-Delta Variante 4 / Ivakkak-Delta Road Alternative 4
Tracé Ivakkak-Delta Variante 1 - CIMA / Ivakkak-Delta Road Alternative 1 - CIMA
Route / Road Méquillon-Ivakkak
Site Ivakkak
Ivakkak UG
Tracé Ivakkak-Delta Variante 1 / Ivakkak-Delta Road Alternative 1
Eau fraîche Variante 1a / Fresh Water Alternative 1a
Eau fraîche Variante 1b / Fresh Water Alternative 1b
Eau fraîche Variante 4 / Fresh Water Alternative 4
Variante retenue / Selected Alternative
Eau fraîche Variante 2 / Fresh Water Alternative 2
Eau fraîche / Fresh Water Site # 1
Eau fraîche / Fresh Water Site # 2
Eau fraîche / Fresh Water Site # 3
Eau fraîche / Fresh Water Site # 4
Eau fraîche Variante 3 / Fresh Water Alternative 3
Variante retenue / Selected Alternative
Tracé Ivakkak-Delta Variante 3 / Ivakkak-Delta Road Alternative 3
Composantes du projet / Project Components
Zone d'étude en 2021 / Study Area in 2021
Hydrographie / Hydrography
Cours d'eau permanent / Permanent Watercourse
Cours d'eau intermittent / Intermittent Watercourse
Plan d'eau / Waterbody
Variantes de tracés de route / Roads Alternatives
Tracé de la route Ivakkak-Delta / Ivakkak-Delta Road
Variante / Alternative 1
Variante / Alternative 2
Variante / Alternative 3 (retenue / Selected)
Variante / Alternative 4
Variante / Alternative 5
Route d'accès pour l'eau fraîche / Access Road for Fresh Water
Variante / Alternative 1
Variante / Alternative 2 (retenue / Selected)
Variante / Alternative 3
Variante / Alternative 4
Phase 2b - Delta
Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment
Projet Nunavik Nickel / Nunavik Nickel Project
Certificat d'autorisation nº 3215-14-007
Gisement Delta – variantes pour le tracé de la route Ivakkak-Delta et pour l'accès à la station de pompage de l'eau fraîche / Delta Deposit – Alternatives for the Ivakkak-Delta Road and Access to the Fresh Water Pumping Station
Sources :
CanVec, 1:50,000, RNCan, 2019
Données de projet/Project Data, Canadian Royalties, 2022
Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c5_4_Var_trace_230123.mxd
0 0,56 1,12 km
UTM, Zone 18, NAD83
Carte / Map 5-4
Janvier / January 2023
AECOM
NUNAVIK NICKEL
CANADIAN ROYALTIES INC.

Alternative 5 was established only on the basis of satellite images presenting the gentlest slopes, passing on the north side and crossing the Little Puvirnituq River twice. The road thus would be about 21.70 km long, which makes it the longest alternative. However, this sector would be located in a flatter environment, and thus easier for bi-train traffic, but very rich in wetlands. The number of important crossings would be greater, i.e. two that probably would require a bridge or multiple arches.

5.1.7.1.1 Comparative Analysis of the Ivakkak-Delta Access Road

Based on the shortest length of road to be constructed, a smaller number of road crossings to be constructed, on a smaller scale, technical feasible, viable and with fewer impacts on the biological and physical environments, Alternative 3 is selected (Table 5-10).

Table 5-10: Comparison of the Delta Project Alternatives – Road Between the Delta Site and the Ivakkak Road

Criteria	Alternative 1	Alternative 2	Alternative 3 and 3a	Alternative 4	Alternative 5
Meets CRI's requirements	Yes	Yes	Yes	Yes	Yes
Economic viability	No	No	Yes	No	No, very long road
Technical feasibility	No, limit due to bi-train traffic	No, limit due to bi-train traffic	Yes, shorter road length to develop	No	Yes, but many major crossings to develop
Impacts on the biological environment	Impacts not assessed due to rejection of alternatives for technical unfeasibility		Medium: wetland losses, fragmentation of the caribou migration road, disturbance of nesting of migratory birds, disturbance of fish habitat for 2 small watercourses	Impacts not assessed due to rejection of alternatives for technical unfeasibility	Major: several large watercourses disturbed for development of crossings (fish habitat), greater wetland losses due to a longer road, fragmentation of the caribou migration road, disturbance of nesting of migratory birds
Impacts on the physical environment			Medium: disturbance of the surface flow and soil quality, disturbance of water quality.		Major: greater disturbance of surface water flow due to the presence of several intermittent watercourses over a longer distance, alteration of soil and water quality
Impacts on the human environment			Medium: noise and dust emissions during construction, alteration of the landscape, opening of the territory for use		Medium: noise and dust emissions during construction, alteration of the landscape, opening of the territory for use
Alternative selected			**Alternative 3**		

5.1.7.2 Alternatives for the Access Road Connecting the Delta Site to the Pumping Station for Withdrawal of Fresh Water

A total of four bodies of water were assessed for the fresh water supply, which led to the development of four different alternatives for access roads (Map 5-4).

Alternatives 1a and 1b are composed of an access road connecting either the Delta site (Alternative 1a – 5.2 km) or the camp (Alternative 1b – 5.48 km) to the pumping station located at Site 1 (Little Puvirnituq River). These two alternatives circulate within several wetlands and terrestrial environments and no watercourse crossing would have to be developed. The pumping site would be located about 11 km downstream from the sanitary and mine wastewater discharge point. It is therefore not desirable to install a water inlet for the drinking water requirements downstream from the projected discharge, considering that quality is not yet known for the two discharge sources.

Alternative 2 presents a winding access road through various hills that will reach a deep isolated lake (Lake No. 4). The lake is able to meet CRI's daily fresh water requirements, without a significant impact on fish habitat. The road nonetheless will be more difficult to develop over these 5.18 km from the Delta site, due to very steep slopes (over 20%) at several locations. Also, a watercourse 18 m wide at modulated flow is present on this alternative. The crossing to be developed will therefore be important.

Alternatives 3 and 4 are the access roads that lead to two other potential sites for fresh water withdrawals. These roads respectively are 3.60 km and 1.79 km from the Ivakkak – Delta Road. Those alternatives are therefore interesting, because the distance to be developed is short compared to Alternative 2 and no culvert needs to be installed. However, during the summary assessment of bathymetry, Sites 3 and 4 proved to be too shallow to meet the CRI requirements during the winter period (ice anticipated on these bodies of water). Then, those alternatives were not selected.

5.1.7.2.1 Comparative Analysis of the Alternative of the Access Road to Fresh Water Pumping Station

Despite the fact that Alternatives 1a and 1b present a simpler road to develop for operations, they were not selected as a safety measure for the fresh water quality available at Site 1 (see point 5.1.9). Given the daily water requirements, only Site 2 was selected for fresh water withdrawal and therefore the road of Alternative 2 (Table 5-11). No other site close enough to Delta and not requiring a long fresh water pipe to the treatment plant is available.

Table 5-11: Comparison of the Delta Project Alternatives – Road Between the Delta Site and the Pumping Station for Access to Fresh Water

Criteria	Alternative 1a and 1b	Alternative 2	Alternative 3	Alternative 4
Meets CRI's requirements	Yes	Yes	No, risk of freezing	No, risk of freezing
Economic viability	Yes	Yes, but major crossing to be developed	No	No
Technical feasibility	Yes	Yes, but major crossing to be developed and slopes of the terrestrial environment to be softened	No	No
Impacts on the biological environment	Minor: disturbance of fish habitat, no loss of area	Minor: disturbance of fish habitat, no loss of area	Unassessed impacts due to the discharge of these two sites for the contribution of drinking water not guaranteed during the winter.	
Impacts on the physical environment	Minor: increase in water mixing during pumping	Minor: increase in water mixing during pumping		

Table 5-11: Comparison of the Delta Project Alternatives – Road Between the Delta Site and the Pumping Station for Access to Fresh Water (cont'd)

Criteria	Alternative 1a and 1b	Alternative 2	Alternative 3	Alternative 4
Impacts on the human environment	Major: This site is located downstream from the mine and sanitary effluent discharge point. Water consumed by workers would potentially contain slightly higher levels of copper, nickel, nitrates and selenium. Infrastructures present on the edge of the Little Puvirnituq River	Minor: Infrastructures present on the edge of the lake, opening of the territory due to creation of an access road to the lake		
Alternative selected		**Alternative 2 is selected.**		

5.1.8 Location of the Satellite Camp and Related Infrastructures

The satellite camp at the Delta site will serve the workers both in the construction period and in the operational period. The camp planned for 150 workers will be equipped with all the infrastructures required to be autonomous. The main infrastructures in the Delta camp site sector include:

- Rooms;
- Kitchen, cafeteria and refrigerated containers;
- Laundry;
- Dryhouse and locker rooms for workers;
- Offices, meeting and training rooms;
- Infirmary;
- Computer server rooms;
- Gym and recreation space;
- Warehouses;
- Core bank and other facilities related to exploration activities (helipad, maintenance shop, etc.);
- Maintenance shop with washing bay and water-oil separator;
- Sharpening and carpentry shops;
- Used oil reclamation equipment;
- Fire station;
- Waste Management (WM) storage area;
- Drinking water treatment plant and domestic wastewater treatment plant;
- Generators, diesel tanks and service station.

Two sites were assessed to position the infrastructures associated with the camp. One is located completely on the west side of the mine and Lake 1 (encroachment of 4.12 ha on the environment), while the other is located completely on the east of the mining operation (encroachment of 26.80 ha on the environment), along the access road to the mine from the Ivakkak deposit, as illustrated on Map 5-3. The location on the west includes a little under

50% wetland area (lowland polygonal fen) and no colony of plant species at risk. The location on the east is also located on about 50% of the area in lowland polygonal fen wetlands and a Sulphur Buttercup specimen was inventoried.

However, the west location requires additional development of access roads in terrestrial environments on an additional surface of 0.36 ha, because the camp is located west of the Delta deposit. Moreover, the West camp requires that the workers circulate through the site in operation, which leads to certain risks in occupational safety.

Other infrastructures will be added to the Delta site, such as a mobile cement slurry plant, which will be moved on two different work areas, a mobile wastewater treatment unit, a pumping station for the drinking water supply, and magazines. These infrastructures will be located outside the camp area. No alternative is associated with these components.

5.1.8.1 Comparative Analysis of the Temporary Camp and Related Infrastructures

Given the higher construction costs for the west site and the issue of the safety of workers circulating in the operational area the West camp alternative was rejected. Table 5-12 summarizes the main economic, technical, environmental and social issues according to the criteria established in section 5.1 for each of the alternatives analyzed for the location of the camp and the related service buildings.

Table 5-12: Comparison of the Delta Project Alternatives – Camp and Related Service Buildings

Criteria	Camp and related service buildings on the west	Camp and related service buildings on the east
Meets CRI's requirements	Yes	Yes
Economic viability	Medium: additional development of a road section of about 500 m west of the site in operation	High, because no other additional access road is to be developed.
Technical feasibility	Easy, but in a potential gold	Easy, but largely on wetlands
Impacts on the biological environment	Minor: no encroachment on wetlands or on species at risk	Medium: encroachment on lowland polygonal fen wetlands. A Sulphur Buttercup specimen inventoried in the work area.
Impacts on the physical environment	Minor: only a disturbance of the soil	Minor: only a disturbance of the soil, with presence of water. The impact is greater for the wet alternative.
Impacts on the human environment	Medium: fairly far from the mine's operations (about 750 m), but the workers must pass through the site in operation to get to the camp.	Minor: fairly far from the mine's operations (about 750 m) and access directly from the road from Ivakkak, without crossing the sit in operation.
Alternative selected		**East camp**

5.1.9 Water Supply Mode and Location of the Withdrawal Site

The operation at the Delta site and the presence of a temporary camp will require a water source for the requirements of mining operations and human consumption. Two fresh water supply alternatives were analyzed:

- Supply from the Expo site (treated water from the drinking water treatment plant of the Expo site for human consumption and fresh water from Lac du Bombardier for operations);
- Local supply from a water inlet in a body of water near the operations and treatment of part of this water in a drinking water plant at the Delta camp, for the camp's requirements (Map 5-4).

The two alternatives are described below.

5.1.9.1 Supply from the Expo Site

The first drinking water supply alternative comes from the Expo water treatment system. This involves transport of this water in 20 L bottles only for consumption. Fresh water from Lac du Bombardier would also be transported by tanker truck and would be stored in 10,000 L tanks, which would be located near the service building. This fresh water covers the requirements other than those of consumption, including sanitary uses, such as toilets, washbasins, laundry, etc.

5.1.9.2 Local Supply

To reduce trucking in the Delta sector, it was envisioned to draw water from the natural environment for treatment in a drinking water treatment plant at the Delta site. The second supply alternative thus includes the development of a pumping station and a water inlet near the Delta Mine and a drinking water treatment plant.

The consumption requirements are estimated at about 48,750 L/day estimated based on average consumption of 325 L/person/day at peak occupancy (150 workers). The pumped water is piped to a building accommodating the drinking water treatment system. The drinking water tank will contain the equivalent of one day of consumption.

Four potential fresh water withdrawal sites were visited in summer 2022 to perform a summary bathymetry. This bathymetry was performed to decide on the capacity of the body of water to supply CRI's annual drinking water and raw water requirements (Map 5-4). Among the four bodies of water visited, only Sites 1 and 2 had a sufficient average depth and an adequate watershed to guarantee an adequate water supply during the winter, without significantly affecting the area of the body of water and thus the habitat available for fish (Table 5-13). The bodies of water at Sites 3 and 4 thus will not be included in point 5.1.9.3 in the analysis of the alternatives.

Table 5-13: Average and Maximum Depths of Potential Bodies of Water for Drinking Water Withdrawals

Line labels	Average depth (m)	Maximum depth (m)
Site 1 for drinking water	5.79	10
Site 2 for drinking water	8.62	11
Site 3 for drinking water	3.54	6
Site 4 for drinking water	6.62	9.3

The first site is located in a pool of the Little Puvirnituq River and is positioned southwest of the Delta Mine. According to the bathymetric surveys, the average depth of the pool is 5 m. According to the assessment of the water requirements, the available quantities of water and the winter freeze of water 2 m thick, the capacity of this site is sufficient for the drinking water requirements. However, this pool is located downstream from the projected discharge point of treated water from the collection ponds and sanitary effluent. This body of water thus was eliminated and will not be included in point 5.1.9.3 in the analysis of the alternatives.

The second site considered for the water inlet is located in Lake No. 4 south of the mine and has an average depth between 8 and 9 m. No problem concerning the quantity of water available is therefore encountered. Moreover, the water level will not be affected significantly. The water depth and the volume of the lake thus would be sufficient in winter, despite the thickness of the ice, for the water supply requirements of the operations and the camp, and to protect the fish habitat.

5.1.9.3 Comparative Analysis of the Fresh Water Supply Alternatives

The comparative analysis of the alternatives between the water supply from the Expo site and the lake at Site 2 allowed local supply to be chosen as the fresh water supply (Table 5-14). This choice will require the development of a pumping station and a water inlet in Lake No.4 located near the Delta site. This water then must be transported by pumping and treated at the Delta site before its consumption, but will also be stored in a reservoir for the raw water requirements on the site. This alternative thus avoids the nuisances associated with trucking from the Expo site, including noise, dust emissions, greenhouse gas emissions and the road accident risks between the two sites about 60 km apart. The reduction of trucking due to the local supply alternative also allows mitigation of the impacts of road traffic on caribou in their calving area.

Table 5-14: Comparison of Delta Project Alternatives – Fresh Water Supply

Criteria	Supply from the Expo site	Local supply (Site 2)
Meets CRI's requirements	Yes	Yes
Economic viability	Medium	Medium
Technical feasibility	Achievable, but requires constant daily transport	Achievable, but complex from a technical point of view (development of a water inlet, pumping, treatment).
Impacts on the biological environment	Medium: trucking on the road generating noise and dust that may affect the adjacent plant life and wildlife	Medium on wetlands and water environments due to the development of the water inlet and the access road to the lake
Impacts on the physical environment	Medium: increase in dust and GHG associated with trucking	Low: encroachments on water environments (water inlet) and wetlands (access road to the water inlet).
Impacts on the human environment	Medium: trucking on the road increasing the road accident risks	None
Alternative selected		**Local supply**

5.1.10 Waste Management

In the context of the NNiP, many efforts are made to limit production of waste. Measures to encourage collection and separation at source of waste and recycling are set out in CRI's management plan, which consistent with the 4R principle (reduction, recovery, reuse, reclamation). Nonetheless, construction and operation or the Delta mine will generate waste that must be managed suitably. A storage area for hazardous waste (HW) is planned to manage them appropriately and their management is described in more detail in section 5.2.9. Non-hazardous waste must be managed in a northern landfill (LEMN), and explosives packaging will be managed in a separate burning zone. The main sources of waste at the Delta site will be household waste, construction scraps and shop scrap (scrap wood and plastic, etc.).

The alternatives to the disposal method considered are:

- Routing and management at the Expo site at the existing northern landfill (LEMN);
- Development of a northern landfill (LEMN) near the Delta site.

5.1.10.1 Disposal at the Expo Industrial Complex Site

In the context of disposal at the Expo LEMN, the waste resulting from construction and operation will be collected by convoy trucks for transport to the Expo LEMN. Due to the many sources of production of waste, the activities and infrastructures of waste management are centralized southeast of the Expo Industrial complex.

A storage space for reclaimable materials was developed at the Expo complex to encourage their collection and separation at source, and thus favour recycling. Waste are sent there and sorted according to the different materials presenting potential for reuse and recycling, i.e. wood, metals, plastic, rubber, etc. Combustible non-recyclable are burned. Non-recyclable and non-combustible materials are sent to the authorized LEMN near the Expo site. If this alternative were selected, an expansion of the Expo LEMN would therefore have to be planned and authorized. This expansion would require the development of one or more additional cells, for a total area of 2,6 ha.

5.1.10.2 Disposal in a New LEMN at the Delta Site

To reduce road transportation, the second alternative for management of waste produced at the Delta site involves development of a second LEMN. The Delta LEMN will be designed similarly to the LEMN of the Expo site. It will be composed for temporary stockpiling area, incineration cells and landfill cells. Two sludge cells and a geotube pad will also be present for management of sanitary wastewater treatment sludge. The design will be produced in accordance with the MELCCFP *Regulation respecting the landfilling and incineration of residual materials*. The explosives packaging and products will be burned in a sector near the Delta LEMN, in accordance with the *Explosives* Act (R.S.Q., c. E-22) and the ashes will be buried in the LEMN.

The total area would be about 2,6 ha. The LEMN will be located about 2 km southeast of the Delta site south of the access road to the mine (see Map 5-5). It is described in section 5.2.9.

5.1.10.3 Comparative Analysis of Waste Management Alternatives

The comparative analysis made it possible to select waste management based on the alternative of development of an LEMN on the Delta site (Table 5-15). This alternative avoids the nuisances associated with trucking from the Expo site, including noise, dust emissions, greenhouse gas (GHG) emissions and the road accident risks between the two sites a little over 60 km from each other.

Table 5-15: Comparison of Delta Project Alternatives – Waste Management

Criteria	Disposal at the site of the Expo Industrial Complex	Disposal at a new LEMN at the Delta site
Meets CRI's requirements	Yes	Yes
Economic viability	High	Moderate
Technical feasibility	Easy	Achievable, but more complex (development of an LEMN)
Impacts on the biological environment	Medium: trucking on the road generating noise and dust that could affect the adjacent plant life and wildlife	Low: temporary destruction of terrestrial environments. No plant species at risk present.
Impacts on the physical environment	Medium: increase in dust and GHG associated with trucking.	Low: temporary soil disturbance during stripping. The site will be restored at the end of the project.
Impacts on the human environment	Medium: trucking on the road increasing the road accident risks	Low: small-scale site, far from the communities and generating few odours. The site will be completely restored at the end of the project.
Alternative selected		**New LEMN near the Delta satellite camp**

5.2 Description of the Selected Alternatives

5.2.1 Delta Deposit Mining Project

The nickel and copper deposit of the Delta project will be mined from an open pit and two underground mines with a total lifecycle of about 7 years. During this period, it is planned to extract a total of about 2.312 million tonnes of ore, for average annual production of 320 kilotonnes of ore.

The development of the mine is divided into three main periods:

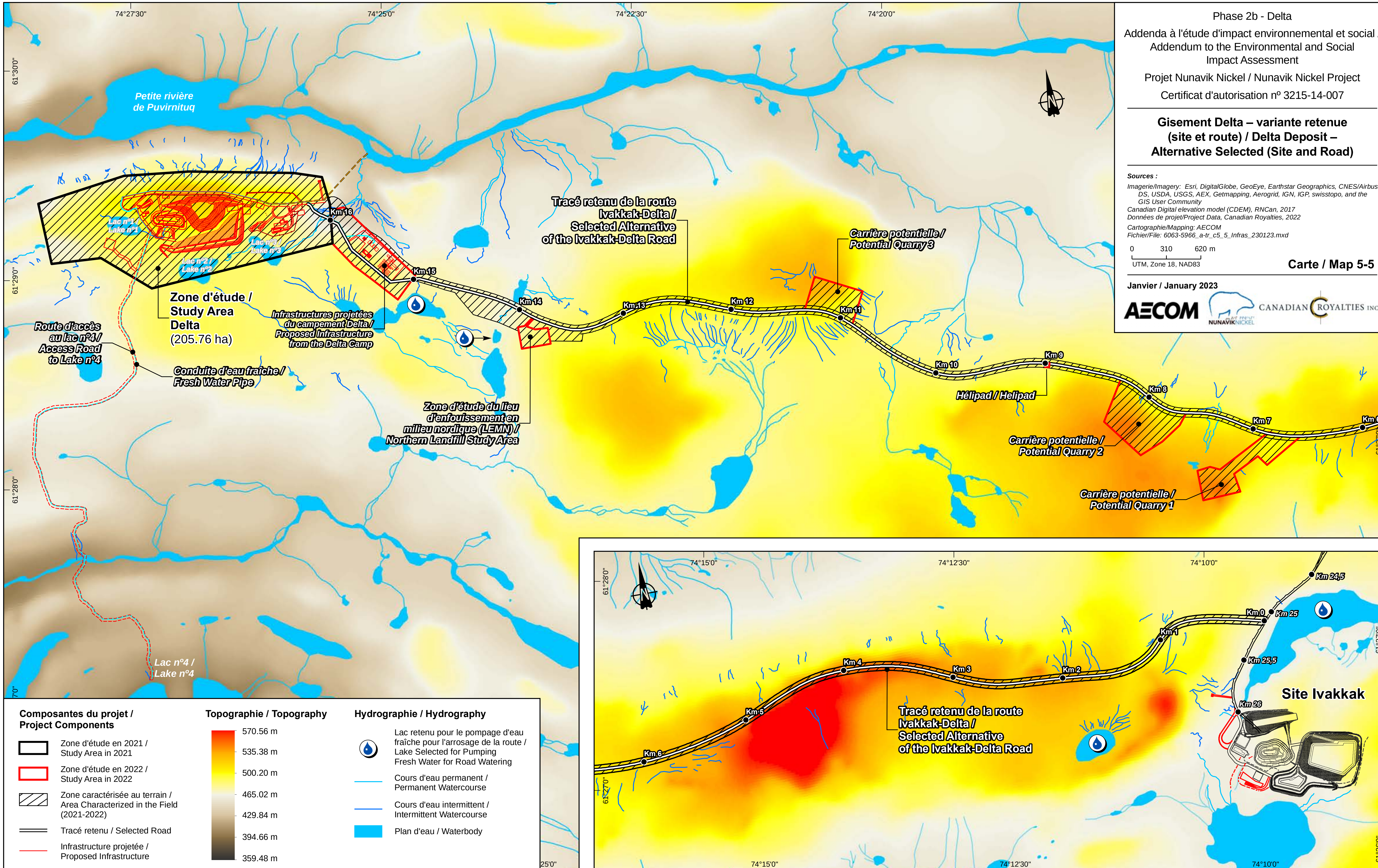
- The construction period: corresponds to a duration of about 18 to 24 months during which the mine site will be developed;
- The operational period: corresponds to Years 1 to 7, during which ore will be extracted from the pit and the underground drifts;
- The closure period: corresponds to an initial period of 18 months for dismantling of the main equipment, redevelopment and restoration of the mine site. The catchment equipment for runoff water from the mine site will remain in place until the analyses show that the water is compliant with all the environmental rules of Directive 019.

5.2.1.1 Surface infrastructures

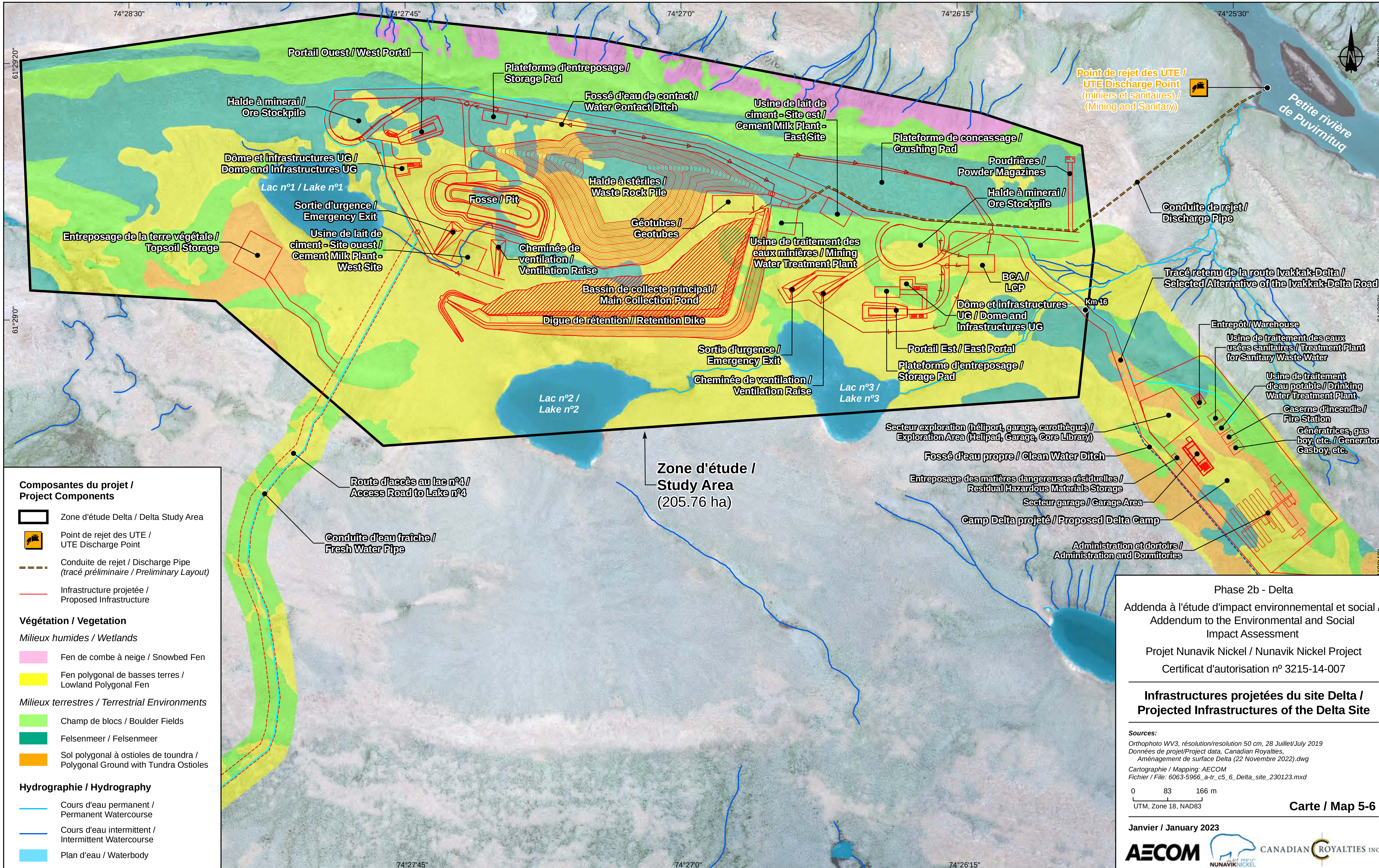
Because of the distance of the Delta deposit from the Expo mining complex, several surface infrastructures will be necessary for the smooth operation of this site (Table 5-16). They are illustrated on Maps 5-5 and 5-6 and are described in the following sections.

Table 5-16: Surface Infrastructures Required

Surface infrastructures
• Access road to the site about 16 km from Ivakkak, with a right of way of 22 m on the ground, and crossing 5 permanent watercourses (WC), 3 of which are fish habitats, and 2 intermittent WC
• Access roads to the various infrastructures on the Delta site
• Access road about 5.18 km long to the lake intended for drinking water withdrawal, with a right of way of 22 m on the ground, and crossing 1 permanent WC, which is a fish habitat, and 3 intermittent WC.
• Mine infrastructures o One open pit o Two access portals to the underground mines o Ventilation chimneys and emergency exit o Temporary waste rock pile of 9.65 ha o Two ore piles (one per underground mine) o Clean and contaminated water catchment ditches o MCP, retention dike and spillway o LCP o Minewater treatment plant (WTP) o Double effluent (sanitary + mine) in the Little Puvirnituq River. o Pad and sifting and crushing equipment (for waste rock backfill) o Two magazines (explosives + detonators) o Domed cement slurry plant
• Related infrastructures o Three quarries along the Delta-Ivakkak road o Camp for a maximum of 150 workers o Fresh water pumping station (at the lake) o Potable water treatment plant o Domestic wastewater treatment plant o Maintenance shop and warehouses o Other infrastructures related to the camp: core bank, maintenance shop, workshop, HW storage area, generators, electric cables, oil tanks and service station. o One or two telecommunication towers. o Northern landfill (LEMN)



Phase 2b - Delta
Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment
Projet Nunavik Nickel / Nunavik Nickel Project
Certificat d'autorisation nº 3215-14-007
Gisement Delta – variante retenue (site et route) / Delta Deposit – Alternative Selected (Site and Road)
Sources :
Imagerie/Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Canadian Digital elevation model (CDEM), RNCan, 2017
Données de projet/Project Data, Canadian Royalties, 2022
Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c5_5_Infras_230123.mxd
0 310 620 m
UTM, Zone 18, NAD83
Carte / Map 5-5
Janvier / January 2023
AECOM
NUNAVIK NICKEL
CANADIAN ROYALTIES INC.
74°27'30"
74°25'0"
74°22'30"
74°20'0"
61°30'0"
61°29'0"
61°28'0"
61°27'0"
Petite rivière de Puvirnituq
Lac nº1 / Lake nº1
Lac nº2 / Lake nº2
Lac nº3 / Lake nº3
Lac nº4 / Lake nº4
Zone d'étude / Study Area Delta (205.76 ha)
Route d'accès au lac nº4 / Access Road to Lake nº4
Conduite d'eau fraîche / Fresh Water Pipe
Infrastructures projetées du campement Delta / Proposed Infrastructure from the Delta Camp
Zone d'étude du lieu d'enfouissement en milieu nordique (LEMN) / Northern Landfill Study Area
Tracé retenu de la route Ivakkak-Delta / Selected Alternative of the Ivakkak-Delta Road
Carrière potentielle / Potential Quarry 3
Carrière potentielle / Potential Quarry 2
Carrière potentielle / Potential Quarry 1
Hélipad / Helipad
Km 16
Km 15
Km 14
Km 13
Km 12
Km 11
Km 10
Km 9
Km 8
Km 7
Km 6
74°15'0"
74°12'30"
74°10'0"
61°26'0"
Km 24,5
Km 0
Km 25
Km 1
Km 25,5
Km 26
Km 2
Km 3
Km 4
Km 5
Km 6
Site Ivakkak
Composantes du projet / Project Components
Zone d'étude en 2021 / Study Area in 2021
Zone d'étude en 2022 / Study Area in 2022
Zone caractérisée au terrain / Area Characterized in the Field (2021-2022)
Tracé retenu / Selected Road
Infrastructure projetée / Proposed Infrastructure
Topographie / Topography
570.56 m
535.38 m
500.20 m
465.02 m
429.84 m
394.66 m
359.48 m
Hydrographie / Hydrography
Lac retenu pour le pompage d'eau fraîche pour l'arrosage de la route / Lake Selected for Pumping Fresh Water for Road Watering
Cours d'eau permanent / Permanent Watercourse
Cours d'eau intermittent / Intermittent Watercourse
Plan d'eau / Waterbody



74°28'30"
74°27'45"
74°27'0"
74°26'15"
74°25'30"
61°29'20"
61°29'0"
61°28'40"
Portail Ouest / West Portal
Plateforme d'entreposage / Storage Pad
Halde à minerai / Ore Stockpile
Fossé d'eau de contact / Water Contact Ditch
Usine de lait de ciment - Site est / Cement Milk Plant - East Site
Point de rejet des UTE / UTE Discharge Point (miniers et sanitaires) / (Mining and Sanitary)
Petite rivière de Puvimituq
Plateforme de concassage / Crushing Pad
Poudrières / Powder Magazines
Dôme et infrastructures UG / Dome and Infrastructures UG
Lac nº1 / Lake nº1
Halde à stériles / Waste Rock Pile
Fosse / Pit
Halde à minerai / Ore Stockpile
Conduite de rejet / Discharge Pipe
Sortie d'urgence / Emergency Exit
Géotubes / Geotubes
Entreposage de la terre végétale / Topsoil Storage
Usine de lait de ciment - Site ouest / Cement Milk Plant - West Site
Cheminée de ventilation / Ventilation Raise
Usine de traitement des eaux minières / Mining Water Treatment Plant
BCA / LCP
Tracé retenu de la route Ivakkak-Delta / Selected Alternative of the Ivakkak-Delta Road
Bassin de collecte principal / Main Collection Pond
Dôme et infrastructures UG / Dome and Infrastructures UG
Km 16
Digue de rétention / Retention Dike
Entrepôt / Warehouse
Usine de traitement des eaux usées sanitaires / Treatment Plant for Sanitary Waste Water
Portail Est / East Portal
Sortie d'urgence / Emergency Exit
Plateforme d'entreposage / Storage Pad
Cheminée de ventilation / Ventilation Raise
Lac nº3 / Lake nº3
Usine de traitement d'eau potable / Drinking Water Treatment Plant
Lac nº2 / Lake nº2
Caserne d'incendie / Fire Station
Génératrices, gas boy, etc. / Generators, Gasboy, etc.
Secteur exploration (héliport, garage, carothèque) / Exploration Area (Helipad, Garage, Core Library)
Fossé d'eau propre / Clean Water Ditch
Zone d'étude / Study Area (205.76 ha)
Route d'accès au lac nº4 / Access Road to Lake nº4
Entreposage des matières dangereuses résiduelles / Residual Hazardous Materials Storage
Secteur garage / Garage Area
Camp Delta projeté / Proposed Delta Camp
Conduite d'eau fraîche / Fresh Water Pipe
Administration et dortoirs / Administration and Dormitories
Composantes du projet / Project Components
Zone d'étude Delta / Delta Study Area
Point de rejet des UTE / UTE Discharge Point
Conduite de rejet / Discharge Pipe (tracé préliminaire / Preliminary Layout)
Infrastructure projetée / Proposed Infrastructure
Végétation / Vegetation
Milieux humides / Wetlands
Fen de combe à neige / Snowbed Fen
Fen polygonal de basses terres / Lowland Polygonal Fen
Milieux terrestres / Terrestrial Environments
Champ de blocs / Boulder Fields
Felsenmeer / Felsenmeer
Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles
Hydrographie / Hydrography
Cours d'eau permanent / Permanent Watercourse
Cours d'eau intermittent / Intermittent Watercourse
Plan d'eau / Waterbody
Phase 2b - Delta
Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment
Projet Nunavik Nickel / Nunavik Nickel Project
Certificat d'autorisation nº 3215-14-007
Infrastructures projetées du site Delta / Projected Infrastructures of the Delta Site
Sources:
Orthophoto WV3, résolution/resolution 50 cm, 28 Juillet/July 2019
Données de projet/Project data, Canadian Royalties, Aménagement de surface Delta (22 Novembre 2022).dwg
Cartographie / Mapping: AECOM
Fichier / File: 6063-5966_a-tr_c5_6_Delta_site_230123.mxd
0 83 166 m
UTM, Zone 18, NAD83
Carte / Map 5-6
Janvier / January 2023
AECOM
NUNAVIK NICKEL
CANADIAN ROYALTIES INC.

5.2.2 Description of the Deposit and its Operation

5.2.2.1 Mineralogy

The various deposits of the Nunavik Nickel Project are found in the Ungava Orogen of the Paleoproterozoic Age, more specifically in the tectonostratigraphic unit of the South Domain (Lamothe and Simard, 2010). This orogen is intersected by an overlapping fault, with a northern inclination, which extends more than 350 km from Hudson Bay (Wolfe, 1975). All of the Ni-Cu sulphide deposits are located north of this major fault. The lithologies most commonly found are mafic volcanic rocks (meta-basalts, volcanic tuffs and breccias), metasedimentary rocks (graphitic argilites, schist), intrusive ultramafic rocks.

The Delta is located 16 kilometres northwest of the Ivakkak site. Its lithology, and associated mineralogy, is very similar to that of the other deposits of the Nunavik Nickel Project. This deposit is divided into two mineralized zones: D8 and D9. Zone D8 is subdivided into D8 North (D8N) and D8 South (D8S).

Zone D8 North

This mineralization zone would be a tabular horizon that may present some local thickenings. It is located about 4 km east-northeast (ENE) of Lac Cécilia (eastern extension of Lac Qikirtalik), 600 m southwest (SW) of Lac Dorothy (expansion of the Little Puvirnituq River) and 600 m northwest (NW) of Zone D8S (SIÉGOM, 2022). The mineralization is contained in a pegmatitic gabbro and composed 20% or less of disseminated sulphides. The main sulphide is chalcopyrite, accompanied by pyrrhotite, pentlandite, pyrite and covellite.

Zone D8 South

This mineralization zone corresponds to a lens of massive sulphides to be disseminated, measuring 130 m from east to east and 10 m thick. Zone D-8 disappears 150 m from the surface. It is located at the summit of the crest, 4.5 km ENE of Lac Cécilia. This zone is at the contact between a gabbroic intrusion and a peridotite and is encased in siltstones. The mineralization is mainly composed of pentlandite, chalcopyrite and pyrrhotite with traces of pyrite, violarite and other minerals rich in platinum group elements (PGE).

Zone D-9

This zone is lens-shaped and located 5.5 km ENE of Lac Cécilia and 620 m south of Lac Dorothy (expansion of the Little Puvirnituq River). The mineralization is associated with a shear zone that puts gabbros, peridotites, pyroxenites and sedimentary rocks in contact. It contains chalcopyrite, pyrrhotite and pentlandite, accompanied by smaller quantities of pyrite, violarite, sphalerite and arsenopyrite. Traces of PGE minerals were also identified.

The lithological proportions of the Delta deposit are presented in Table 5-17.

Table 5-17: Proportions of the Main Lithologies Extrapolated from the Drill Core Database of the Delta Deposit (Golder, 2022).

Main lithologies	Type	Approximate tonnage	Approximate proportions
Peridotite	Waste rock	879,000	31%
Sediments (graphitic and non-graphitic)	Waste rock	825,000	29%
Gabbro	Waste rock	694,000	25%
Pyroxenite	Waste rock	402,000	14%
Total		2,800,000	100%

5.2.2.1.1 Geochemical Characterization

The acid generation and leaching potential of the site was classified in the report *Caractérisation géochimique du minerai and des roches stériles du projet Delta – Essais statiques. Mémorandum technique préliminaire 1021-20138922-12000-MTF-RevB* (Golder Associés Ltée, 2022 – Geochemical characterization of ore and waste rock of the Delta project. Preliminary technical memorandum *1021-20138922-12000-MTF-RevB*). This report is provided in Appendix C.

The Delta deposit is a massive sulphide zone, like most of the deposits of the NNiP project. Due to this fact and accounting for the knowledge acquired previously on the other projects, the Delta geochemical characterization program concentrated on the potentially problematic units regarding their acid generation potential, i.e. sulphides.

The ore and waste rock were classified according to the recommendations of *Guide de caractérisation des résidus miniers and du minerai* (MELCC, 2020a – Tailing and ore characterization guide), the soil criteria and the water quality of the *Guide d'intervention – Protection des sols and réhabilitation des terrains contaminés* (Beaulieu, 2021 – Intervention guide – Soil protection and rehabilitation of contaminated sites), and according to the results of the static tests conducted. Based on the results obtained, the materials then were classified according to the categories applicable to the site: low-risk, acid-generating, leachable and high-risk materials.

The results of the static tests led to the following conclusions (Golder, 2022):

- The ore is classified as acid-generating. Most of the samples also showed leaching potential at neutral pH (Cu, Ni), while the SPLP static tests (iron) and SPLP/CTEU static tests (nickel) showed contents that exceed the final effluent criteria of Directive 019 for these two metals.
- The waste rock from sedimentary (graphitic and non-graphitic) and volcanic mafic rock is classified as potentially acid-generating. This waste rock shows copper leaching potential (Table 5-19). The CTEU 9 leaching tests indicate that the sediments (graphitic and non-graphitic) leach higher iron concentrations than the final effluent criterion of Directive 019.
- Gabbro, peridotite and pyroxenite were classified as non-acidogenic after performing NAG tests (Table 5-18). These tests demonstrated that the silicate minerals present have sufficient neutralization potential to prevent acid generation. However, the gabbros were identified as having a copper leaching potential.
- The current anticipated management plan (tailings stored in the tailings storage facility, the Expo pit, and then covered) is adequate for the tailings that will be managed during operation of the Delta site.

<u>Additional analyses of the ore and acid-generating waste rock could be performed</u>:

- Mineralogy by X-ray diffraction for assemblages of sulphides and carbonate minerals (reactivity of mineral assemblies, self-heating potential).
- Kinetic tests to assess the reactivity over time and 1) evaluate the delay before the development of acidogenic conditions, 2) evaluate the leachability of gabbro waste rock under conditions closest in the field.

Table 5-18: Summary of Analytical Results and Classification of the Acid Generation Potential of the Lithologies of the Delta Deposit (Golder, 2022)

Type	Lithology	Potentiel acidogène
Ore	Sulphides[A]	Acid generating
Waste rock	Gabbro	Non-acidogenic
	Volcanic mafic	Acid generating
	Peridotite	Non-acidogenic
	Pyroxenite	Non-acidogenic
	Sediments	Acid generating
	Graphitic sediments	Acid generating

[A] The sulphides contain ore and its host rock.

Table 5-19: Summary of Exceedances of the Applicable Criteria According to the Results of the Static Tests and the Sample Classifications of the Delta Deposit (Golder, 2022)

Tests	Classification criterion (number of exceedances)	Ore	Waste rock				
Lithology		Sulphides[A]	Gabbro	Peridotite	Pyroxenite	Sediments	Graphitic sediments
Number of samples		13	7	7	8	6	4
Metal content (MA.200)	Criteria de sols A	Co(13), Cu(13), Ni(13), Se(13), Cr(10), Ag(9), Cd(4), Hg(3), As(2), Sn(2), Pb(1), Zn(1)	Cu(7), Ni(7), Cr(3), As(1), Co(1)	Co(7), Ni(7), Cr(6), Cu(5)	Cu(8), Ni(8), Co(7), Cr(7), As(3), Ag(1), Se(1)	Cu(6), Se(6), Ni(5), Mo(1)	Cu(3), Ni(3), Se(2), Ag(1)
TCLP leaching test	RES[C]	Cu(13), Ni(13), Cd(6), Zn(5), Co(3),Hg(3), Pb(1)	Cu(3), Ni(3)	Ni(3), Cu(1)	Cu(5), Ni(3)	Pb(1), Zn(1)	Cu(1)
SPLP leaching test	RES[C]	Ni(7), Cd(1), Hg(1)	-[D]	-[D]	-[D]	-[D]	-[D]
CTEU-9 leaching test	RES[C]	Cu(4), Hg(3), Ni(3)	Cu(4), Hg(2), Ag(1)	Hg(3), Cu(1)	Hg(4), Cu(1)	Cu(3), Hg(2)	Cu(4), Hg(3), Ag(1)
Leachable parameters (Exceedance of Criterion A and SPLP or CTEU-9)[B]		**Ni(8), Cu(4), Cd(1), Hg(1)**	**Cu(4)**	**Cu(1)**	**Cu(1)**	**Cu(3)**	**Cu(3), Ag(1)**
Number of samples classified as leachable		**11/13**	**4/7**	**1/7**	**1/8**	**3/6**	**3/4**

Notes: The elements with an analytical detection limit higher than the applicable criteria are not considered exceedances if the analyses showed that the content of this element is not above the detection limit. The exceedances are presented as follows: parameters accompanied by the number of samples presenting an exceedance in parentheses.
[A]: Sulphides include ore and its host rock.
[B]: Leachable parameters: parameters for which the metal content of an analyzed sample exceeds soil criterion A and the RES parameters for the SPLP and/or CTEU-9 tests.
[C]: RES = Québec groundwater quality criterion, resurgence in surface water (MELCC, 2021)
[D]: - indicates that no parameter exceeds the classification criteria.

5.2.2.2 Resources and Reserves

The data of the last report showing the resources and reserves of the Delta are presented in Tables 5-20 and 5-21. The reserves amount to 325.6 kt of ore for open pit mining and 1,986.4 kt for underground mining, for a total of 2,312 kt of ore projected for extraction.

Table 5-20: Estimate of Mineral Resources of the Delta-Kenty Property

Type	Class	Tonnes (kt)	Ni (%)	Cu (%)	Pd (g/t)	Pt (g/t)	Au (g/t)	Co (%)
Pit	Indicated	496	1.40	0.68	1.39	0.58	0.07	0.04
	Inferred	10	1.59	0.47	1.20	0.53	0.06	0.05
Underground	Indicated	2,163	1.96	1.12	2.14	0.97	0.25	0.05
	Inferred	283	2.26	1.36	3.54	1.76	0.75	0.05
Total	Indicated	2,659	1.85	1.03	2.00	0.90	0.22	0.05
	Inferred	293	2.23	1.32	3.45	1.71	0.22	0.05

Table 5-21: Mineral Reserves[1] of the Delta Deposit

Type	Tonnes (kt)	Ni (%)	Cu (%)	Co (%)	Au (g/t)	Pt (g/t)	Pd (g/t)
Pit	325.6	1.84	1.07	0.05	0.28	1.01	2.14
Underground	1,986.4						
Total	2,312.0						

1: Sum of probable and inferred reserves

5.2.2.3 Ore Extraction

The ore extraction rate for the Delta property will vary between 400 and 1100 t per day. The pit should produce a total of 325.6 kt of ore for a 2-year lifecycle (Table 5-22). The underground mine should produce a total of 1,986.4 kt of ore over a 7-year lifecycle (Table 5-22). Annual production will be nearly 320 kt per year once full production is reached.

The Delta project should generate a total of 2,278 kt tonnes of waste rock and 2,312 kt of ore during operation of the pit and the underground mine (Table 5-23). A summary of the quantities of waste rock, ore, concentrate and tailings estimated for the lifecycle of the project is presented in Table 5-23.

Table 5-22: Annual Operation Schedule of the Delta Site

Delta site		2026	2027	2028	2029	2030	2031	2032	2033	Total
Pit	Ore (t)	276,678	48,922							325,600
	Waste rock (t)	1,221,165	200,000							1 421,165
Underground mine	Ore (t)		77,797	320,596	378, 352	384,766	376,292	349,749	98,848	1,986,400
	Development (m eq)	2,551	4,291	5,860	4,245					-
	Waste rock (t)	157,705	187,196	313,549	198,379					856,829

Table 5-23: Tonnage (t) of Waste Rock, Ore, Concentrate and Tailings Produced During Operation of the Delta Deposit

Operation	Tonnage (t)			
	Waste rock	Ore	Concentrate	Tailings
Pit + underground	2,277,994	2,312,000	431,188	1,880,812

5.2.2.3.1 Characteristics of the Open Pit Mine

The Esker Lake ultramafic suite contains potentially economic mineralizations of Ni-Cu-Pt-Pd. Specifically, these mineralizations are concentrated in three thin subvertical lenses named D8N, D8S and D9. The proposed Delta pit encompasses the upper part of D8N and a small part of D8S. These high-content mineralized lenses generally are composed of a core of sulphides with a thread-like texture and massive sulphides a few tens of metres wide, followed in depth by more extensive zones, but thinner veins and veinlets (2 to 3 m wide). The approximate dimensions of the pit are 150 m wide, 320 m long and 42 m deep. The waste rock/ore ratio forecast is 4.4:1. The main ramp, which begins on the north side of the pit and circles the pit as it descends, will have a maximum slope of about 10% and will connect elevations 470 m to 430 m. Figure 5-2 show a typical cross-section of the Delta West pit.

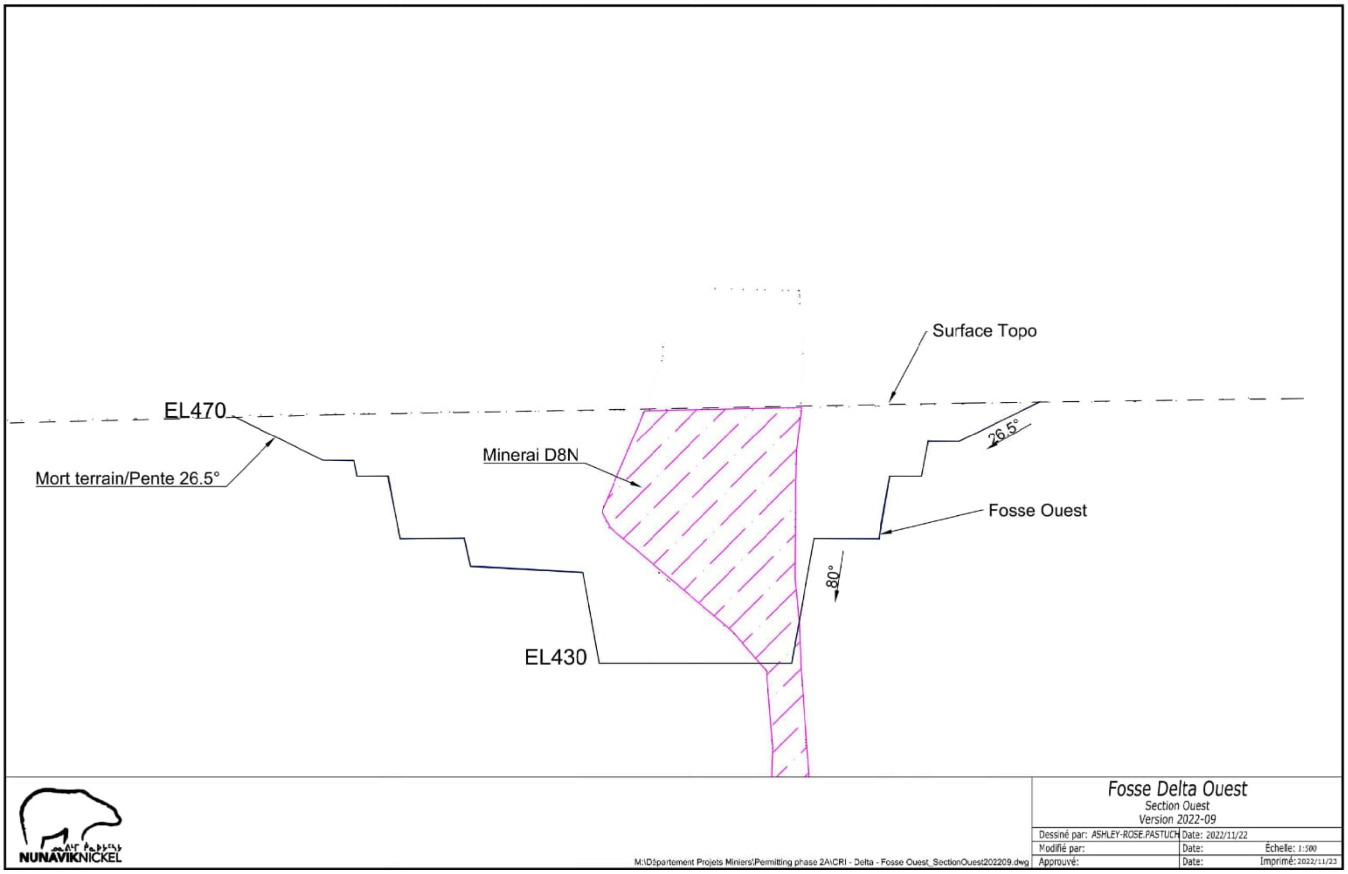


Figure 5-2: Typical Cross-Section of the Delta Pit

5.2.2.3.2 Characteristics of the Underground Mines

The underground operation of the Delta deposit is divided into two mines, West and East, for which the dimensions are given in Table 5-24 and the longitudinal profile in Figure 5-3.

Table 5-24: Dimensions of the Underground Mines of the Delta Deposit

Structures	Dimension (linear m)	Dimensions of the drifts (m)	Volume (m^3)
West Mine:			
Lateral waste rock:	4,920	5.3 x 5.5	143,425.7
Vertical waste rock:	253.2	3 x 3	2,281.7
East Mine			
Lateral waste rock:	3,653	5.3 x 5.5	106,479.8
Vertical waste rock:	229.1	3 x 3	2,062.1
Total volume in bank			**254,249.3**

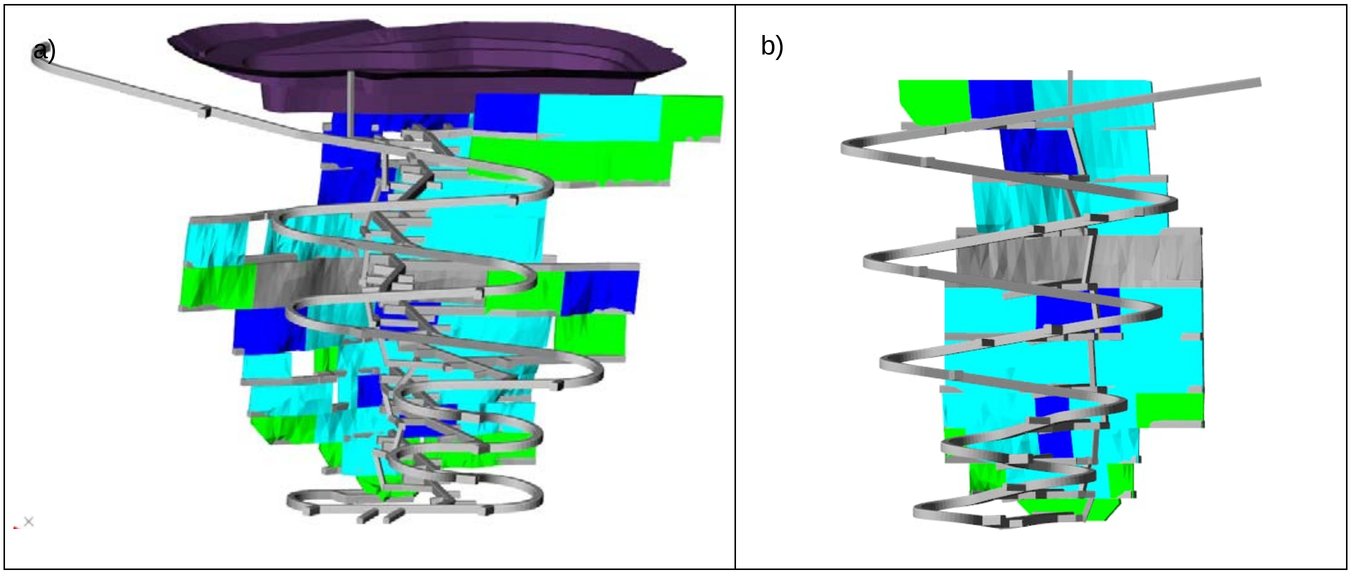


Figure 5-3: Underground Mine (a) West and (b) East

Each underground mine will be accessible via its own portal and a ramp. The access to the upper level of each mine will be used for drilling and blasting operations, and eventually backfilling, while the access to the lower level will be used for mucking the ore. A secondary exit will be provided by ladders, and a ventilation chimney will ensure the fresh air supply.

The projected depth of the East underground mine will be 285 m up to elevation 175 m. In the case of the West mine, the projected depth is 263 m up to elevation 192 m. The height of the chambers between the levels will vary according to the depth in relation to the surface. It will be 30 m for the first 200 metres of depth, and then 20 m after 200 m, due to geotechnical considerations. The chambers will have a width of 40 m. Given the presence of continuous permafrost, calcium chloride (115 g/l) will be used as a dense fluid during drilling to maintain the water used in the liquid state.

The thermistors that will be installed effective in 2023 will allow adjustment of certain elements of the configuration of the chambers and the workings, if required, as well as the extensometers that will be installed in the following years.

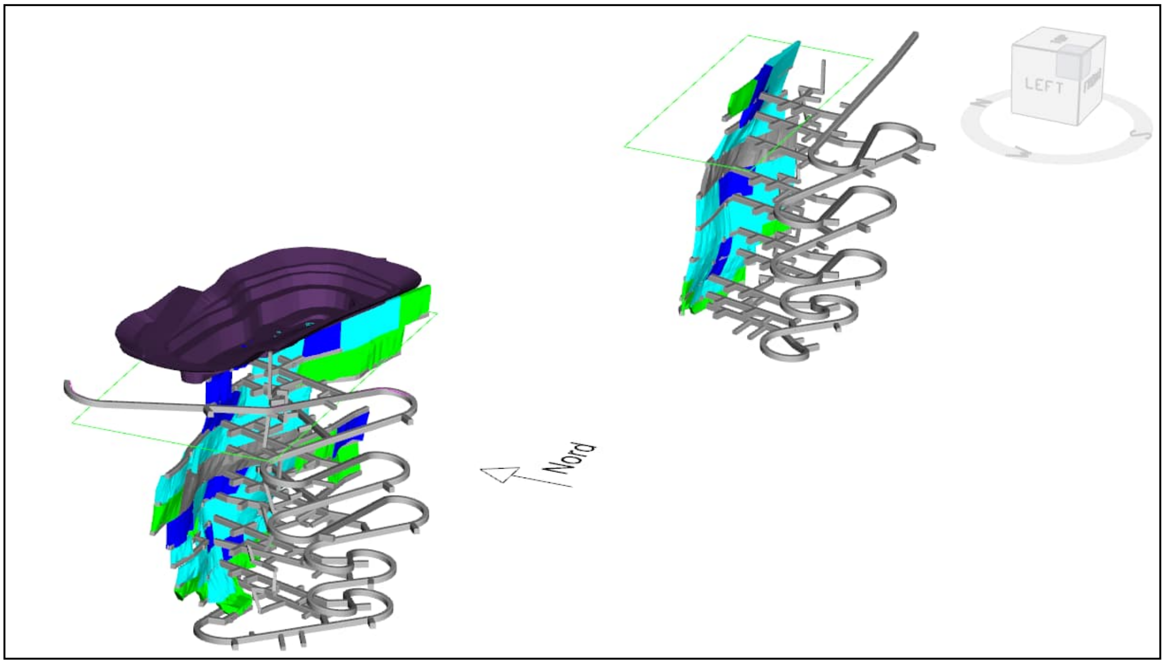


Figure 5-4: 3D View of the Delta Project

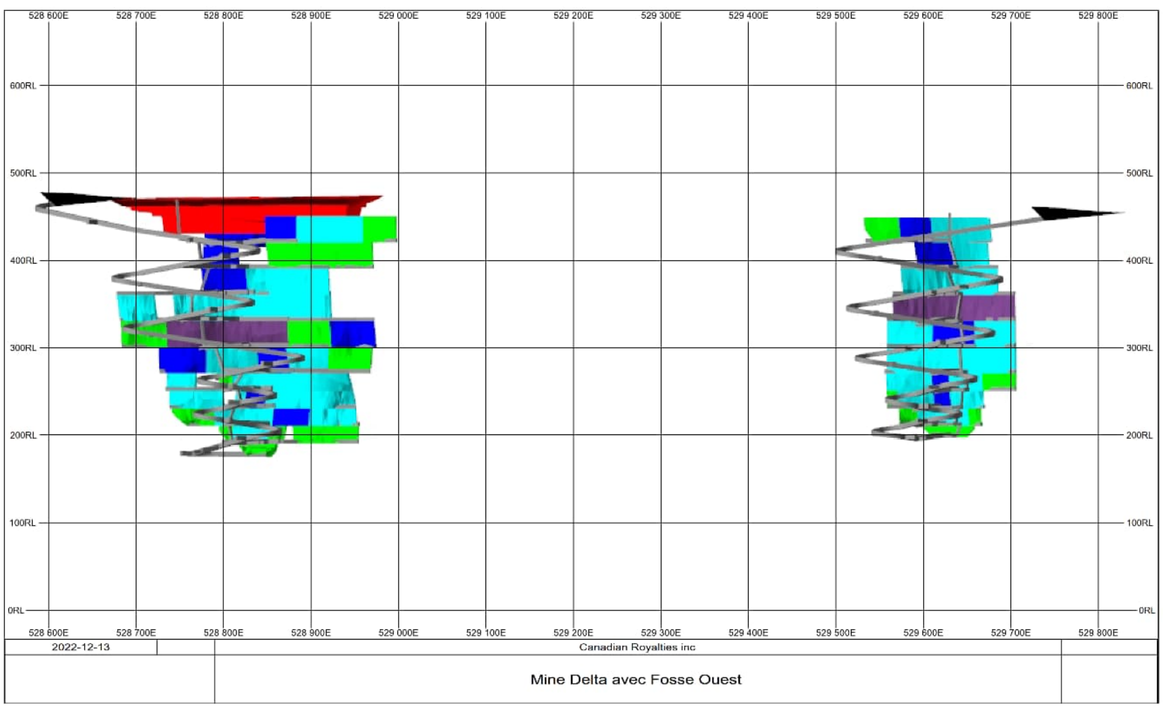


Figure 5-5: Project Delta, View in North Direction

5.2.2.3.3 Preparation, Transport and Use of Explosives

Emulsion will be used as the main explosive for ore production to optimize fragmentation, both for open pit mining and for the underground mines. Electronic detonators will be used to reduce the occurrences of undetonated explosives. ANFO and standard detonators will be used for the development phases of the underground mines. Emulsion and ANFO will be transported from the Dyno Nobel plant, located about 8 km east of the Expo complex, to the Delta site. These choices are based on the characteristics of the ore, the type of operation and the manufacturing and transportation costs.

In the pit, the emulsion will be used upon delivery. A transfer from the emulsion transport truck to the emulsion truck loading the holes.

For the underground mines, the workings will be loaded with emulsion, which will be delivered by an emulsion pump designed for this purpose. Management of the explosives and detonators will be managed in accordance with the requirements of the *Regulation respecting occupational health and safety in mines* (R.S.Q., c. S-2,1, r. 19.1. For the development phases of the underground mines, an ANFO loader will be used.

Explosives and detonators will be stored temporarily in two separate magazines with about one week of production capacity each. When development of the underground mine will be advanced, two magazines will also be developed underground.

The explosives requirements are estimated at: 750,000 kg of emulsion for the underground mine workings, 1,300,000 kg of ANFO for development of the underground mines, 75.000 kg of emulsion for the portals, 600,000 kg of emulsion for the pit and 1,000,000 kg of emulsion for the roads and infrastructures. In the case of operation of the pit, blasting is scheduled every 10 days, throughout the production period.

The plastic packaging of the explosives will be managed independently of the other types of packaging. Similarly to the management at the Expo site, it will be burned in a sector near the LEMN of the Delta site, in accordance with the *Explosives Act* (R.S.Q., c. E-22) and the ashes will be buried at this LEMN.

5.2.2.3.4 Mining Equipment

The equipment used on the Delta site is detailed in Table 5-25.

Table 5-25: Mining Equipment Require for Operation of the Delta Deposit

UG equipment	Number of equipment units required	OP equipment	Number of equipment units required
Electric boom truck/Hydraulic Jumbo	2	Loading equipment (990 loader, CAT 390 excavator)	2
Power bolter	4	Tractor	1
CAT R1700 shuttle loader/scoop	3	70 t haul truck (CAT775)	4
Service truck	1	Hydraulic shovel	2
Haul truck (30 t capacity)	5	Emulsion loading truck	1
Gas/oil truck	1	Drill	3
ANFO loader	1	Service truck (mechanical)	2
Tanker truck - 20,000 L	1	Pickup	5
Forklift truck	1		
Longhole drill	2		
Grader	1		
Emulsion pump	1		
Scissor lift	1		
Grand total	**50**		

Arctic diesel will be used for the mining equipment, pumps and generators.

Table 5-26 indicates the anticipated maximum trucking frequencies.

Table 5-26: Anticipated Maximum Trucking Frequencies

Ore (reserves) (tonnes)	Time in operation (years)	Tonnage transported at full production (tonnes/day)	Capacity of the bi-trains (tonnes)	Number of trips per day
2,312,000 (pit + underground)	7 (pit + underground)	1,100 t/day	120	5 to 9

5.2.2.4 Ore, Tailings, Waste Rock and Overburden Management

5.2.2.4.1 Tailings Management

All the tailings generated in the context of the mining project will be generated at the tailings storage facility of the Expo mining complex. Consequently, no tailings will be accumulated on the Delta site.

Air emissions will be in line with loading of the trucks and transport of the tailings to the tailings storage facility located at the Expo site. The quantities of CO_2 emitted annually by transport are presented in Chapter 8.2.

5.2.2.4.2 Waste Rock Management

The planned waste rock pile has a capacity of 1.3 Mm^3 and rises to an elevation of 500 m. From its lowest point, its height is 30 metres. It occupies a space of 9.65 ha and was positioned just north of the MCP. Thanks to the favourable topography, all water that will be contaminated by the rock of this pile will go directly into the MCP by gravity and via a water collection ditch. Its dimensions were planned on the basis of having enough space to stockpile the waste rock and the overburden, mainly coming from excavation of the collection pods, until operation of the underground mines is advanced enough to require backfilling with waste rock (Table 5-27). From that point, the waste rock pile will start to be emptied to begin the operations of backfilling the workings. The waste rock pile filling schedule is presented in Table 5-27. Although the geochemical characterization report (Golder, 2022) indicates that some of these lithologies are potentially acid-generating, it is considered conservatively in the design of the waste rock pile that all of the waste rock has AGP.

The waste rock geochemistry report (Golder, 2022) indicates that non-graphitic and graphitic sediments may not be used for surface construction, because of their relatively high sulphur content. However, this waste rock could be used as backfill in a mine void on condition that oxidation and leaching are controlled in the long term (e.g. pit covered with a low-permeability layer). Similarly, the gabbro, peridotite and pyroxenite waste rock will be reclaimable on the site, even during the mining lease, if the complementary results confirm that it is non-leachable. Different waste rock use scenarios will be assessed and the required analyses will be performed. In the event that all of the MELCCFP criteria are met, including those of the *Guide de valorisation des matières résiduelles inorganiques non dangereuses de source industrielle comme matériau de construction* (Reclamation guide of industrial-sourced residual non-hazardous inorganic materials as construction material) and that reclamation of certain lithologies is considered, a space will be circumscribed in the footprints already established, in order to stockpile this material. In all cases, the waste rock pile will no longer be present at the end of operation of the Delta site and all the waste rock will have been returned to the pit in the event that no reclamation could be done.

The associated air emissions will be in relation to loading, transport and deposit of waste rock on the pile. When waste rock is used for backfilling of the workings, the associated emissions will be in relation to loading and transport. However, because the deposit site of these rocks is near the extraction site, the emissions will be reduced in view of the short distances to travel.

Table 5-27: Waste Rock Pile Backfilling Schedule

		Size of the waste rock pile at the Delta site (m^3)									
Type	**Contingency**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**
MCP[1]	5%		38,684	38,684							
East Portal	0%			42,105							
West Portal	0%			42,105							
Pit	5%			642,718	157,058						
Underground Mine											
Waste rock sent to the pile	0%			51,534	61,161						
Waste rock sent to UG backfill	0%					102,465	64,828				
Waste rock from the pile sent to UG backfill	0%					14,268	90,106	191,147	171,021	75,633	35,013
Total UG backfill	0%					116,733	154,934	191,147	171,021	75,633	35,013
Pit backfill							248430	248430			
Annual variation of the pile			38,684	817,146	218,219	-14,268	-338 536	-439 577	-171,021	-75,633	-35,013
Delta pile		0	38,684	855,830	1,074,049	1,059,781	721 254	281 938	110 647	35 013	0

[1] The dimensions of the LCP are still under study; the excavated volume was not entered in the table, but it will have little significance in relation to all the volumes of the table.

5.2.2.4.3 Ore Management

The ore will be stockpiled on two piles, one located on the east near the underground mine with a capacity of 59,100 m^3 and one with a capacity of 62,640 m^3 for the pit and the underground mine on the west of the site. The capacity in tonnes for each pile is about 135,930 and 144,072 tonnes (2.3 t/m^3), the equivalent of about 12 to 16 weeks of production per pile during peak production. Because the Delta site is far from the Expo mining complex by nearly 60 km of roads to be maintained, it is preferable to wait for a site to be filled with ore and to apply all efforts to the same location. In this way, the bi-trains are concentrated in one road sector, which will greatly improve the safety of operations.

Once the ore is on the Expo site, it is stored on an ore pile before treatment at the mill.

The potential air emissions will be associated with loading of the ore in the trucks, transport and deposit on the ore piles on the Delta site and then with loading, transport and deposit on the Expo site.

5.2.2.4.4 Overburden Management

Due to the presence of a Sulphur Buttercup colony (*Ranonculus sulphideus*), and with the goal of favouring the speedy restoration of the environment at the end of the project, it was decided to conserve part of the overburden or topsoil located at the centre of the study area, in the wetland where the Sulphur Buttercup colony is located, to conserve the seed bank of this species. For the other stripped sectors, the overburden will not be stockpiled for reuse during restoration. The quantities of topsoil present in the other sector is too insufficient due to the nature of the rocky soils, and the value of this topsoil is not interesting for reuse during restoration in a revegetation context.

Topsoil Conservation Methods

The soil will be stripped to a depth of 15 cm or less, depending on the available thickness on a surface of about 5 ha. The soils will be swathed to a maximum height of about 1 m, with the goal of keeping this soil active and avoiding deterioration of the seeds by heating.

Depending on the volumes to be stockpiled and the space available for stockpiling, the topsoil may be stockpiled directly on the natural soil by forming swaths to cover a continuous surface or may be deposited in strips over a width and length to be determined according to the space available and the configuration of the site.

After formation of swaths, the surface will be sowed with a mix of indigenous herbaceous species, if available, or a mix adapted to the local climate conditions. The objectives of sowing are to keep the soil active and reduce water and wind erosion.

For an area of 5 ha to be stripped to a depth of 15 cm, the volume of soil to be stockpiled will be 7,500 m^3. Because the swaths are 1 m high, a surface of about 87 m x 87 m was reserved for this purpose far from the usual activities (Map 5-6), to prevent workers from using this material for roads. A barrier and a sign will also be installed to avoid any incident regarding unauthorized use of this soil.

At the end of the lifecycle of the waste rock pile, the soil will be returned to the initial location and will serve to reseed the area and thus limit the environmental impacts.

5.2.3 Waste Rock Crushing Infrastructure

The drifts and workings of the underground mine will be backfilled with a cemented rock fill throughout its operation. It is estimated that about 180,000 tonnes of waste rock will have to be crushed annually to meet the cemented rock fill requirements of the Delta UG mine. As indicated in the waste rock filling schedule (Table 5-28), the duration of backfilling activities, and thus of crushing, is estimated at 6 years. The quantity to be crushed annually is detailed in Table 5-28.

The crusher will be installed in an area specifically developed on the north of the site. The final product of the crusher will be composed 80% of waste rock with a diameter of less than 300 mm. The crushed material will be mixed with cement slurry, which will be manufactured at the cement slurry plant described in the next section. It will be mixed with the cement slurry on the surface or underground, depending on whether a semi-mobile or mobile plant will be selected. The mix of rock and cement slurry will be poured in the underground drifts by a shuttle loader until complete backfilling.

With the crushing equipment projected for deployment, the probable hourly tonnage is estimated at about 400 tonnes per hour. Depending on maintenance and mechanical contingencies, the crushing period thus should be 2 to 3 months a year in the summer and fall period (August, September and beginning of October). To limit the release of airborne dust, a sprinkler dust suppression system will be used during crushing activities.

For the secondary workings that will be backfilled only with uncemented rock fill, no crushing will be necessary. Only a sorting operation will be performed with a power shovel to remove the oversized rocks.

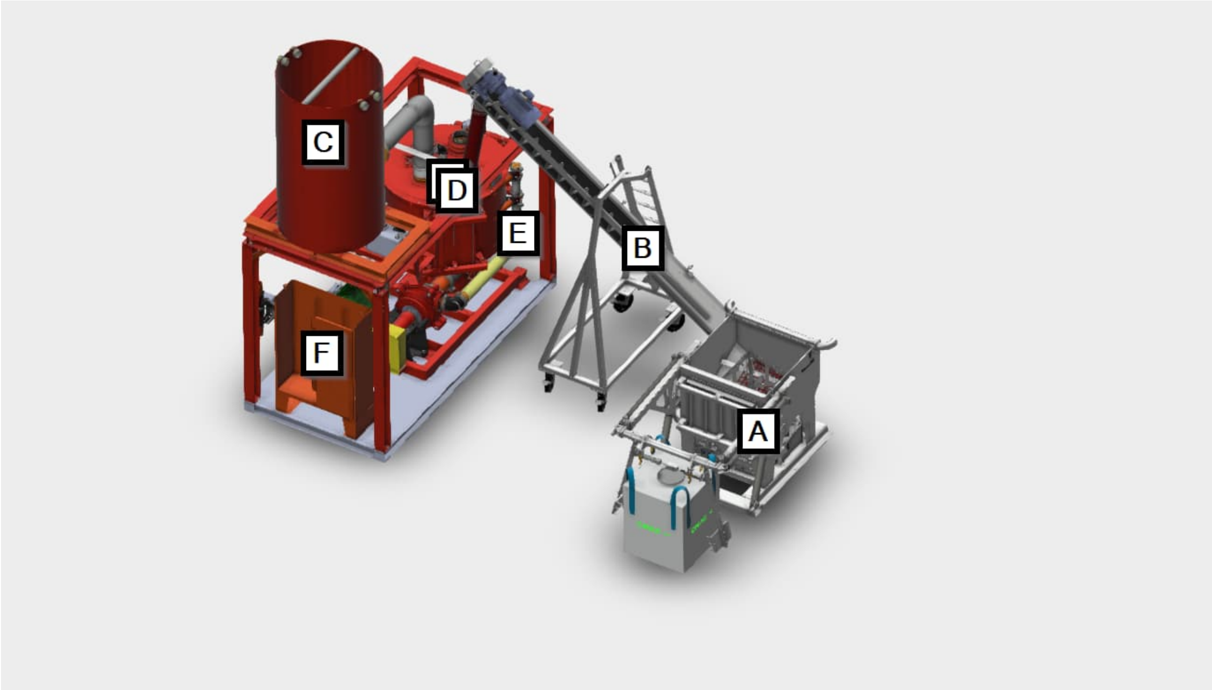
Table 5-28: Tonnage of Waste Rock Crushed Annually for Delta

Year	Tonnage
1	155,922
2	280,948
3	314,460
4	179,433
5	73,118
6	76,679

5.2.4 Cement Slurry Plant

The main parts of the cement slurry plant are identified in Figure 5-6. The design foreseen is currently in the conceptual stage. Two options are being considered: 1) semi-mobile plant that would be moved to the workings 1 to 3 times a year, and 2) mobile plant to go directly to the underground workings throughout the year of activity.

The cement slurry will be produced in a semi-automatic plant located near the mine portal entrance and installed under a closed dome about 24 m X 30 m; the necessity for a concrete floor is under review. The design must ensure storage and handling of 1,000 kg cement bags at a maximum daily rhythm of 70 bags. The cement slurry will be obtained by adding a predetermined quantity of cement powder to a certain quantity of saltwater 4% to 6% by volume heated to 60 degrees Celsius.



A) Storage and opening of bags to a dry cement silo
B) Conveyor to a preparation silo
C) Saltwater silos
D) Dry cement and water mixing bin to create a cement slurry & dust removal system
E) Pump to send the product to a transport truck
F) Electrical installation and control panel

Figure 5-6: Cement Slurry Plant of the Delta Site

5.2.5 Camp and Related Buildings

An autonomous camp will be necessary to house the at the Delta site, considering the distance of about 60 km from the Expo site. The maximum accommodation capacity will be 150 workers. The services present will be similar to those of the Expo camp:

- Bedrooms with adjoining bathroom;
- Kitchen, cafeteria and refrigerated containers for food storage;
- Laundry;
- Administration offices, meeting and training room, computer server room;
- Dryhouses and locker rooms for surface operations and underground mines;
- Infirmary;
- Gym and recreation space.

The buildings will be supplied with cold and hot water and equipped with bathroom accessories, heating, ventilation, a fire protection system and electricity. Some portions possibly will be constructed on two or three storeys. The buildings will be constructed similarly to the Expo complex, in modular complexes. The foundations will be on stilts, concrete foundations and/or piles, with the goal of ensuring the stability of the buildings.

The drinking water plant and the domestic wastewater treatment plant, present in the camp sector, are described in section 5.2.6 on water management. The storage area for hazardous waste, reclamation of used oils and LEMN are discussed in more detail in section 5.2.9 on waste.

Other buildings and infrastructures will be present near the camp, such as:

- Warehouses;
- Generators, power cables, boilers, diesel tanks and a service station;
- A fire station;
- Sharpening and carpentry workshops;
- A maintenance shop dedicated to mobile equipment maintenance, including a washing bay and a water-oil separator;
- A core bank and other facilities related to mineral exploration activities (helipad, maintenance shop for exploration drills, etc.);
- One or two telecommunication towers
- An HW stockpiling area (described in a subsequent section);
- Waste oil reclamation equipment.

The buildings will have a foundation of fill or a concrete floor, depending on the nature of the activities carried on there, with a goal of preventing soil contamination. The mobile maintenance shop will be equipped with concrete floor and gutters to collect the contaminated water resulting from repairs and the washing bay. Piles or thermosiphons possibly will be installed to ensure the stability of its concrete foundation.

The water from the gutters of the maintenance shop will be treated by an oil-water separator. The water treated by the separator will be directed to the MCP; the sludge and soil collected by the separator will be disposed of with the residual hazardous materials and returned to an authorized treatment centre in southern Québec. The sludge from the washing bay gutters will be characterized and disposed of in accordance with the regulations applicable to it. The oil-water separator will be subject to environmental monitoring, described in Chapter 9.

Electricity will be produced from generators running on diesel and heating will come from stationary combustion equipment, such as boilers. They will be supplied by diesel tanks. The power distribution configuration is in development. The electricity possibly will be distributed to the mining facilities (cement slurry plant, underground fans, etc.) and the water withdrawal station at Lake No. 4 by means of power cables. They will run along the fresh water supply pipe and their right of way will be less than 50 cm (not illustrated on the map for resolution reasons). The cable will be deposited on the ground. Auxiliary generator nonetheless will be present on the mine site and at the fresh water withdrawal station, in support of power distribution by cable.

One or two telecommunication towers, the precise location of which at the Delta site will be determined at a later date, will be required to relay the radio signals. They will be located within the planned impacted areas described in Chapter 7.

5.2.6 Water Management

5.2.6.1 Industrial Water

The runoff water coming into contact with the waste rock pile, the ore piles, the waste rock crushing area, the portals and the entire area dedicated to operation of the pit and the underground mines, will be directed to the MCP, via the topography and the collection ditches. This runoff water is rainwater and snowmelt. A LCP will collect the contact water from the East mine and its ore pile, because the topography of the site does not allow its direction by gravity to the MCP. The LCP water will be pumped to the MCP in the summer period. In the winter period, the waste snow will be transported and stockpiled in the MCP footprint.

The minewater from the pit and the underground mines will be pumped to the MCP. The minewater production from the underground mines will be negligible, because it will be not heated and the water required for drilling will be recirculated via water supply sumps, once the development of the mine will be advanced enough. The contribution of fresh water for the beginning of operations was taken into account for an estimate of the water requirements.

An oil-water separator, installed in the maintenance shop sector, will ensure pretreatment of water from the washing bay and other oily water that could be generated at the Delta site, before directing it to the MCP. The volume of this water will be considered in the capacity of the MCP (about 2,000 to 3,000 m^3/year), although negligible in comparison with the volume of all the runoff water from the site.

Because the mine site is elevated in relation to the neighboring environment, the clean water will already be diverted from the site by the natural topography. The clean water and snow that will be outside the berms of the contaminated water ditches will reach the natural water system without pretreatment. The runoff water in the camp sector will reach the natural water system. A non-contact water diversion ditch will be developed south of this sector.

The ditches will be constructed according to the typical cross-sections presented in Figure 5-7 (Golder, 2021). The width of the footprint of the contact ditches (including the berm) is 10 m and is 11 m for non-contact ditches (including the berm). The calculation of the impacts on the natural environment thus will include a footprint 10 m wide from the centre of the ditch so as not to underestimate the changes that may occur in the natural environment due to the presence of the ditches. The visual appearance of the ditches is represented in Photo 5-1, which illustrates a contact ditch surrounding the waste rock pile of the Expo site.

Photo 5-1: Examples of Non-Contact Water Diversion Ditch

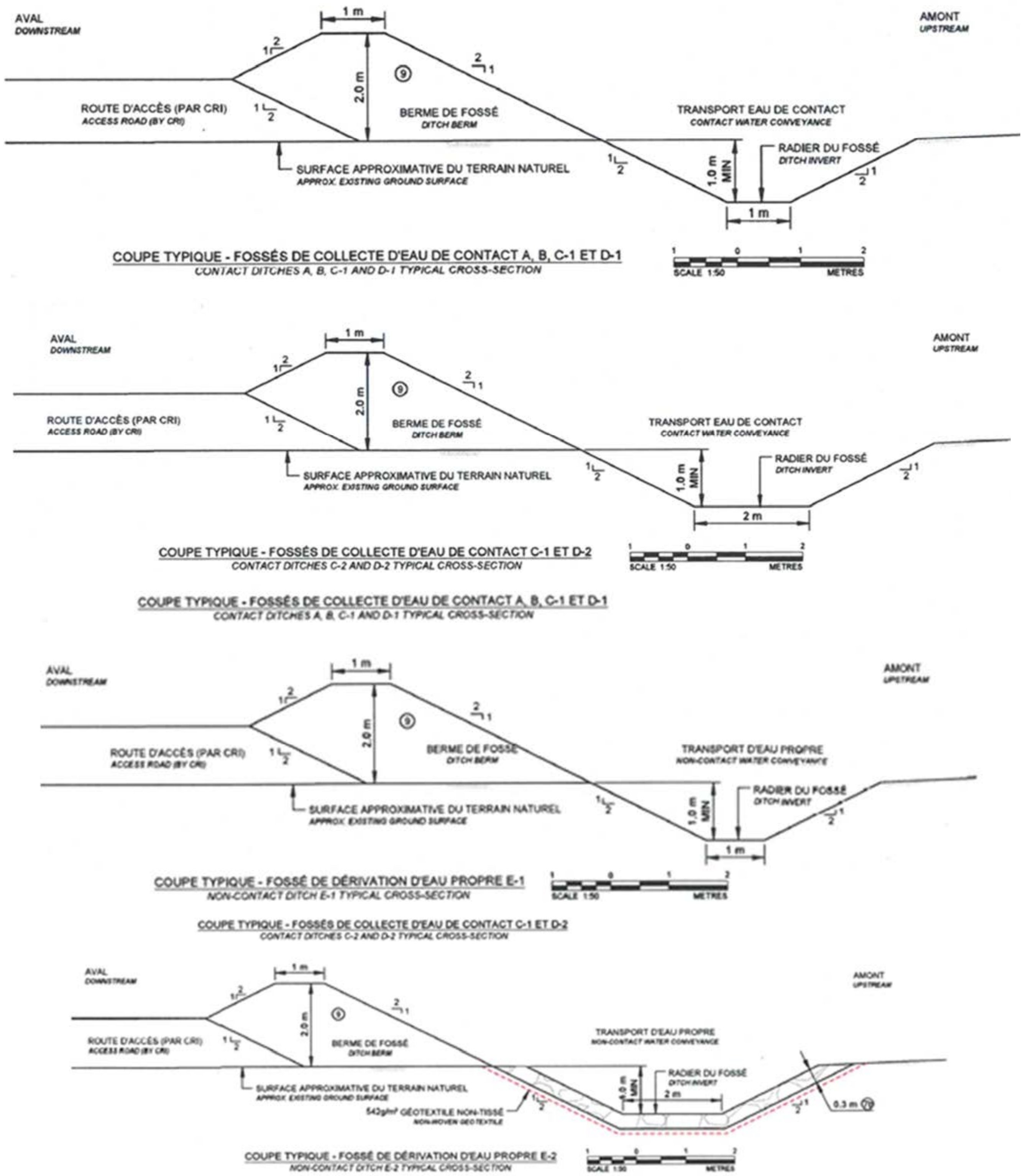


Figure 5-7: Typical Cross-Sections of Non-Contact Water Diversion and Contact (Contaminated Water) Collection Ditches

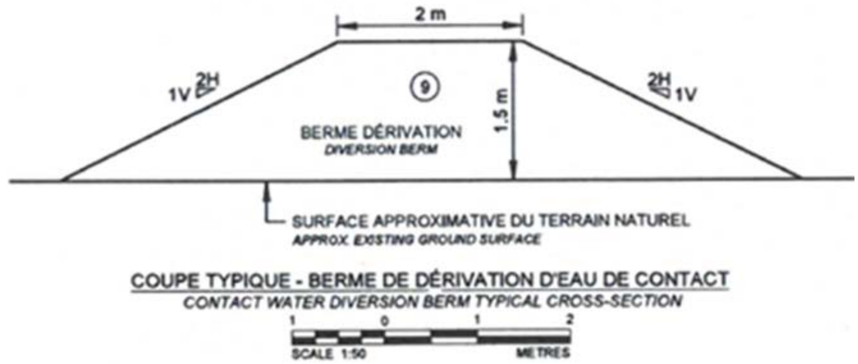


Figure 5-7: Typical Cross-Sections of Non-Contact Water Diversion and Contact (Contaminated Water) Collection Ditches (continued)

The MCP and LCP are in the conceptual stage at this stage of the project. It is projected that their respective capacities are 170,000 m^3 and 60,000 m^3. The dimensions of the LCP will be confirmed later. The MCP will include a retention dike and a spillway. The design of the work will meet the requirements of Directive 019 and will integrate safety factors that account for the possible alteration of the water regime by climate change. The time the water stays in the MCP will also allow a certain decantation of suspended solids. The ponds will be located over 60 linear metres from any lake or watercourse.

It should be specified that thermistors will be installed in summer 2023. They will allow precision to be added, particularly to the water balance.

The MCP water will be pumped, in the summer period, to theWTP, for treatment before rejection into the environment, in the Little Puvirnituq River. The maximum mean annual volume for treatment considered is the total capacity of the MCP and the LCP (230,000 m^3).

5.2.6.1.1 Mine Wastewater Treatment

A mobile WTP is planned and will be installed on the Delta site effective 2025, to be able to ensure treatment of the water from the MCP in summer 2026. The WTP will be in the form of heated containers and may be in operation from the end of June to the beginning of October, for availability of about 110 days of treatment. The treatment chain will be similar to that of the Ivakkak WTP, for which the ministerial authorization was issued in June 2022 (Y/Ref.: 7610-10-01-70080-85). More specifically, this will involve physicochemical treatment sequencing the steps of metal precipitation by addition of alkali to increase the pH to about 10.3, coagulation-flocculation, ballasted flocculation and decantation in an Actiflo decanter and pH readjustment from about 7.5 to 8.5 by addition of acid. The chemicals provided are:

- Caustic soda (NaOH);
- Ferric chloride ($FeCl_3$) as coagulant and anionic polymer (e.g. Hydrex 354) as flocculant;
- Carbamate for the precipitation of heavy metals (ex: Hydrex 6909);
- Metalsorb (potentially will be used to facilitate removal of copper);
- Microsand for ballasted decantation;
- Sulphuric acid (H_2SO_4) for pH readjustment.
- Cationic polymer (ex: Hydrex 6508) for sludge dewatering

Certain chemical substitutions could be done for the purposes of improving the performance of the WTP. Management of these products is presented in more detail in section 5.2.8 – Management of Petroleum and Chemical Products.

Part of the sludge from the decanter will be recirculated to facilitate precipitation-decantation. The sludge extracted from the decanter will be directed to geotubes for dehydration. The geotubes will be installed in the footprint of the MCP and their runoff water will be captured by the MCP. The final disposal site of the sludge will be the Expo tailings storage facility.

The equipment provided will include, in particular:

- Influent and effluent pumps;
- Chemical dosing pumps;
- Agitators, mixing tanks, a polymer preparation unit;
- Actiflo decanter(s);
- Treatment measuring and control equipment, including the equipment required in Directive 019 (flowmeter and continuous effluent pH metre);
- Automated recirculation mechanism in case of non-compliance of effluent for certain parameters, including pH;
- A discharge pipe into the Little Puvirnituq River with a diffuser similar to that of the other NNiP discharge points. Depending on the site conditions and the need, a rock arrangement could be produced to prevent erosion and ensure that the effluent mixes well with the receiving watercourse. The pipe will be HDPE with a diameter between 8 and 16 inches and the diffuser will be installed to limit erosion. The layout of the pipe, illustrated on Map 5-6, is preliminary and could be adjusted slightly depending on the topographic details of the site.

The treatment capacity and the discharge flow will be between 180 and 300 m^3/h; these flows will be established more precisely according to the MCP detailed design report. The chosen treatment chain will allow compliance with the effluent discharge requirements of Directive 019 and tend to values representative of the environmental discharge objectives (EDO) in force on the NNiP's other sites. The expected effluent loads, their dilution and their potential impact on the receiving environment are detailed in Chapter 7. Environmental monitoring of mine effluent will be performed, in accordance with the requirements of Directive 019 and the *Metal and Diamond Mining Effluent Regulations* (MDMER). This monitoring, and the monitoring of the receiving watercourse, are addressed in Chapter 9.

A request for environmental discharge objectives will be submitted to the MELCCFP following the analysis of this addendum.

5.2.6.2 Domestic Wastewater

The domestic wastewater will come mainly from the camp and certain related buildings (kitchen, laundry, washbasins, toilets, etc.). It will be routed by gravity and pumping to the domestic wastewater treatment plant (DWTP), located in the camp sector. In the event the sanitary facilities (toilets, washbasins) are installed near the work areas on the mine site, this wastewater would be directed to the DWTP by vacuum truck or by gravity and pumping.

Wastewater production will be proportional to drinking water consumption. Considering that the drinking water requirements are estimated in the next section at 0.325 m^3/person/day and the drinking water plant will have a capacity of 50 m^3/day, it is anticipated that the DWTP will have a similar capacity. The water will be treated and discharged continuously, 365 days a year, thus resulting in mean maximum effluent of 2.1 m^3/h. Discharge into the environment will be done through an pipe independent of mine effluent to the Little Puvirnituq River. The discharge points will be at the same location.

The treatment technology selected is a Moving Bed Biofilm Reactor (RGBS), which is a technology included in the MELCCFP *Guide pour l'étude des technologies conventionnelles de traitement des eaux usées d'origine domestique* (Guide for the study of convention domestic wastewater treatment technologies). The treatment chain will include, in particular:

- Pretreatment: grease trap/screen and buffer tank
- Pumping station(s), if required
- Primary treatment: dissolved air flotation (DAF)
- Secondary treatment: RGBS and DAF
- Disinfection: UV reactors

The reactor will be divided into two stages, allowing successive suppression of biological oxygen demand (BOD_5) and ammoniacal nitrogen ($N\text{-}NH_3$). The entire chain will allow removal of oil and grease, phosphorus, suspended solids, BOD_5 and $N\text{-}NH_3$. The process sludge will be directed to a sludge pond located at the DWTP, then thickened by a screw press or other technology. It will be disposed of in the sludge cells provided for this purpose in the LEMN.

The expected effluent loads, their dilution and their potential impact on the receiving environment are detailed in Chapter 7. The effluent will be routed to the same discharge point as the mine effluent, in the Little Puvirnituq River, via a parallel pipe.

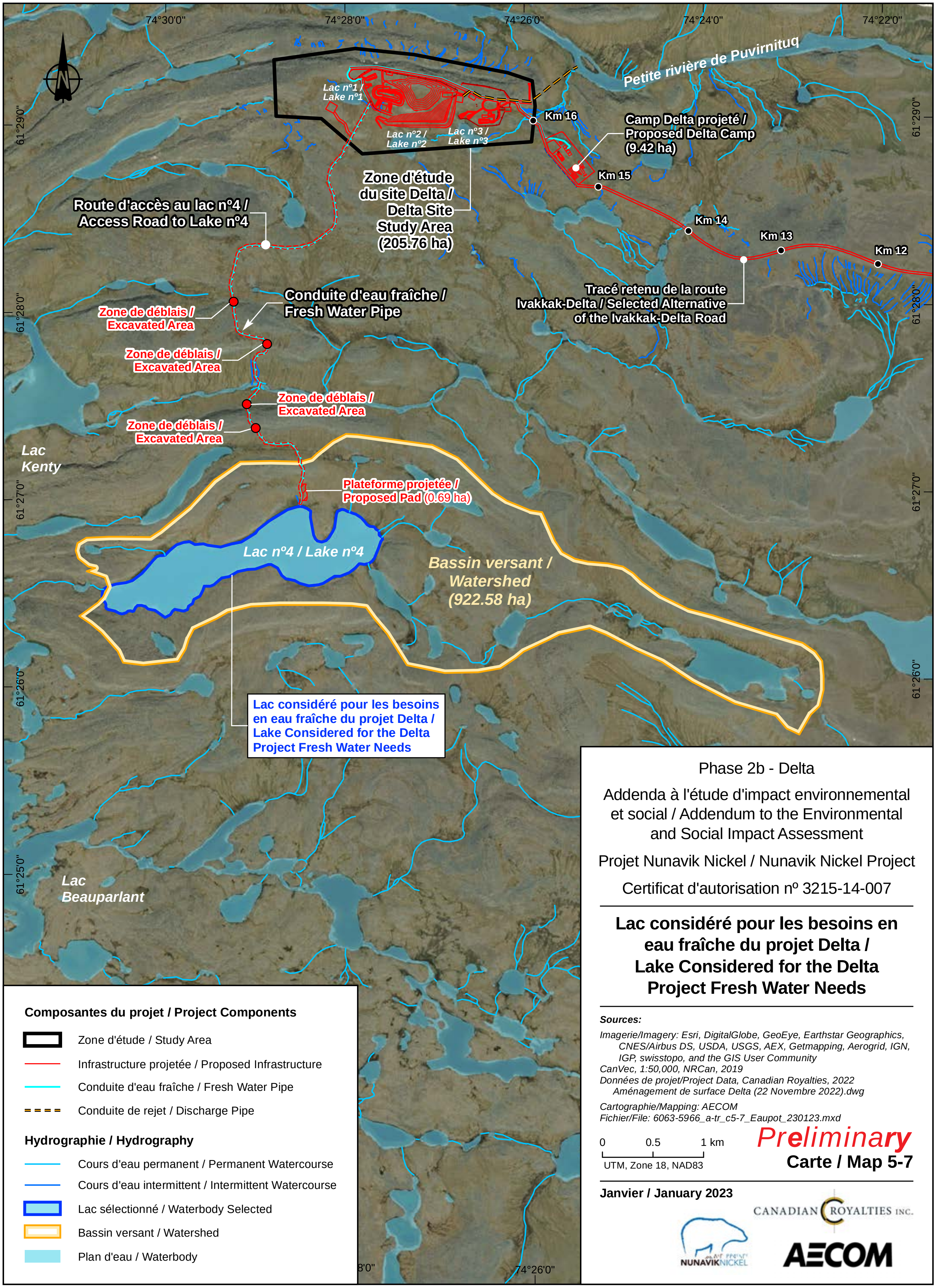
A request for environmental discharge objectives (EDO) will be submitted to the MELCCFP following analysis of this addendum. Environmental monitoring of the effluent will be done to validate compliance with the EDOs that will be issued; it is addressed in more detail in Chapter 9. The treatment capacity of the DWTP equipment will provide for redundancy in the treatment chain, to maintain compliance with the EDOs in case of maintenance or repair of this equipment.

5.2.6.3 Fresh water Withdrawal and Potable Water Treatment

Infrastructures

The lake located at the coordinates -74.48°, 61.44° (Lake No. 4; Map 5-7) was selected as the site for installation of the Delta site water inlet. The pumping station will be developed on a barge or on the shore of Lake No. 4. The pumping station will be insulated and sheltered to protect the facilities from cold and bad weather and facilitate maintenance work. A pad will be developed near the pumping station to install the generators (which will be the main or emergency power supply, depending on whether the station is powered by electrical cabling). The pad will also allow traffic vehicles that must go into the sector (tanker truck, mechanical repair truck, etc.). Each submersible pump will have a capacity of 225 and 375 m^3/day, will be equipped with a water or air circulation system to avoid freezing and mesh to prevent fish from being sucked in.

The pumps will push the water into a pipeline 8,62 km long. The pipeline that will channel the water will be composed of HDPE pipes six to ten inches in diameter and will be insulated with heating cables. The uses planned for fresh water are detailed in Table 5-29; the requirements for the potable water treatment plant (PWTP) will represent less than 25% of the total requirements, on the average. One or more connection points will be developed between the fresh water inlet and the drinking water treatment plant, to allow the supply of fresh water for the different requirements (cement slurry plant, drilling, etc.).



Phase 2b - Delta

Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment

Projet Nunavik Nickel / Nunavik Nickel Project

Certificat d'autorisation nº 3215-14-007

Lac considéré pour les besoins en eau fraîche du projet Delta / Lake Considered for the Delta Project Fresh Water Needs

Sources:

Imagerie/Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
CanVec, 1:50,000, NRCan, 2019
Données de projet/Project Data, Canadian Royalties, 2022
Aménagement de surface Delta (22 Novembre 2022).dwg

Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c5-7_Eaupot_230123.mxd

0 0.5 1 km
UTM, Zone 18, NAD83

Preliminary

Carte / Map 5-7

Janvier / January 2023

CANADIAN ROYALTIES INC.

NUNAVIK NICKEL

AECOM

Composantes du projet / Project Components

- Zone d'étude / Study Area
- Infrastructure projetée / Proposed Infrastructure
- Conduite d'eau fraîche / Fresh Water Pipe
- Conduite de rejet / Discharge Pipe

Hydrographie / Hydrography

- Cours d'eau permanent / Permanent Watercourse
- Cours d'eau intermittent / Intermittent Watercourse
- Lac sélectionné / Waterbody Selected
- Bassin versant / Watershed
- Plan d'eau / Waterbody

A fresh water tank near the PWTP, with a capacity of about 1500 m^3, will ensure a water reserve in case of fire and serve as a raw water tank for the PWTP. The PWTP treatment chain will include, in particular:

- A membrane microfiltration unit
- Anionic resin units, for removal of the dissolved organic matter
- Disinfection with UV rays
- Disinfection with sodium hypochlorite
- Mineralization by addition of sodium bicarbonate (to be determined)
- Drinking water reserve
- Distribution to the buildings by pumping

The treatment chain will be designed in compliance with the requirement of the *Regulation respecting the quality of drinking water.* The microfiltration unit will minimally allow achievement of the elimination rate of 3 log *Cryptosporidium* and 3 log *Giardia*. The UV lamps will allow addition of 4 log of virus elimination. The microfiltration operation is planned without coagulation regarding the current knowledge of the fresh water characteristics at this stage; this step may be added if it proves necessary for the production of quality drinking water. The drinking water reserve will be composed of one or more tanks ensuring between 8 and 24 hours of autonomy.

The treatment capacity of the chain will allow coverage of a requirement estimated at 325 L/day/person. The requirement was estimated according to the observations of consumption at the Expo camp, including a contingency, considering that the presence of a laundry and a cafeteria results in certain consumption independent of the number of workers.

Quantities Pumped

The water withdrawal requirement at Lake No. 4 is assessed at a maximum of 374.5 m^3/day in summer and 224.5 m^3/day in winter. The withdrawals are detailed by need and by season in Table 5-29.

The use of fresh water as a dust suppressant on the roads is part of the NNiP mitigation measures. Thus, the need was established at 54,000 m^3/year (450 m^3/day), considering the daily sprinkling scenario, over the entire summer period (120 days). To cover this requirement of 450 m^3/day, it is planned to withdraw 150 m^3 from Lake No. 4 and withdraw 300 m^3/day from 4 other lakes near the Ivakkak-Delta road, identified on Map 5-5. The withdrawals will be less than 75 m^3/day for each lake. This strategy will allow reduction of routing and the associated emissions to draw water and perform sprinkling. However, it is possible that the entire watering requirement, estimated at 450 m^3/day, could be taken from Lake No. 4, depending on the operational context, resulting in a potential maximum daily water withdrawal of 675 m^3/day.

The characteristics of Lake No. 4 are addressed in Chapter 6 (section 6.2.5.3), the water balance of the withdrawals and their impacts are addressed in Chapter 7 (section 7.2.3.2.1). A contingency doubling the quantity of water withdrawn will be considered.

Table 5-29: Water Requirements Considered for Modelling

Category	Daily withdrawal (m^3)	Annual withdrawal (m^3)
Drinking water		
325 L/day at 150 persons	48.8	17,794
Non-potable water		
Sprinkling of roads	150.0 (summer)	18,000 (condensed in summer over 120 days.)
Mine drilling	1.4	500
Cement slurry plant	41.1	15,000
Maintenance shop washing bay	6.7	2,433
Drilling for exploration activities	126.6	46,200
Total (winter – 245 days/year)	**224.5**	**82,133**
Total (summer - 120 days/year)	**374.5**	

5.2.7 Access Roads

The materials that will be used for construction of main road (Ivakkak-Delta) and other access roads may come from various sources, depending on the desired characteristics. They may come from:

- Quarries and eskers already authorized under the NNiP
- Potential quarries, near the Delta site, presented in this addendum
- NAG (non-acid generating) waste rock from the Ivakkak site or the Delta site
- Material from road construction, particularly during excavations potentially required for the development of certain crossings

The reclaimed material will be characterized in accordance with the MELCCFP *Guide de valorisation des matières résiduelles inorganiques non dangereuses de source industrielle comme matériau de construction* (Guide to reclamation of residual non-hazardous inorganic materials as construction material).

5.2.7.1 Ivakkak –Delta Road

The driving surface, 16 m wide, will be composed of a subbase of MG-56 granular material about 300 mm thick and a base of MG-20 granular material about 150 mm thick. The road base will be composed of run material a maximum of 1.5 m thick, while the infrastructure thickness will vary according to the topography of the terrain. Figure 5-8 illustrates a typical road cross-section, but a narrower driving surface. The embankments are developed with a 1:1.5 slope and drainage ditches will be excavated on at least one side of the road. The total road right of way will be around 22 m wide and the profile of the slopes will not exceed 10%.

This road section will be maintained with the surface equipment in place. When required, this will be done by addition and spreading of granular material.

The development of this road will include the development of seven watercourse crossings, i.e. five for permanent watercourses and two for intermittent watercourses (Table 5-31) (Map 5-5) (Photos 5-2 to 10).

Among the permanent watercourses, only two constitute a potential fish habitat. The other three watercourses were not considered as potential fish habitats, due to the observation of an impassable obstacle downstream, combined with an absence of fish at the time of the characterizations, indicating the absence of a resident population in these watercourses (no winter shelters available due to complete freezing of the watercourse). For the seven crossings, a development with a circular culvert will be produced. The design of the crossings will integrate the passability measures for fish in the watercourses constituting a potential habitat and will be submitted for review to Fisheries and Oceans Canada (DFO).

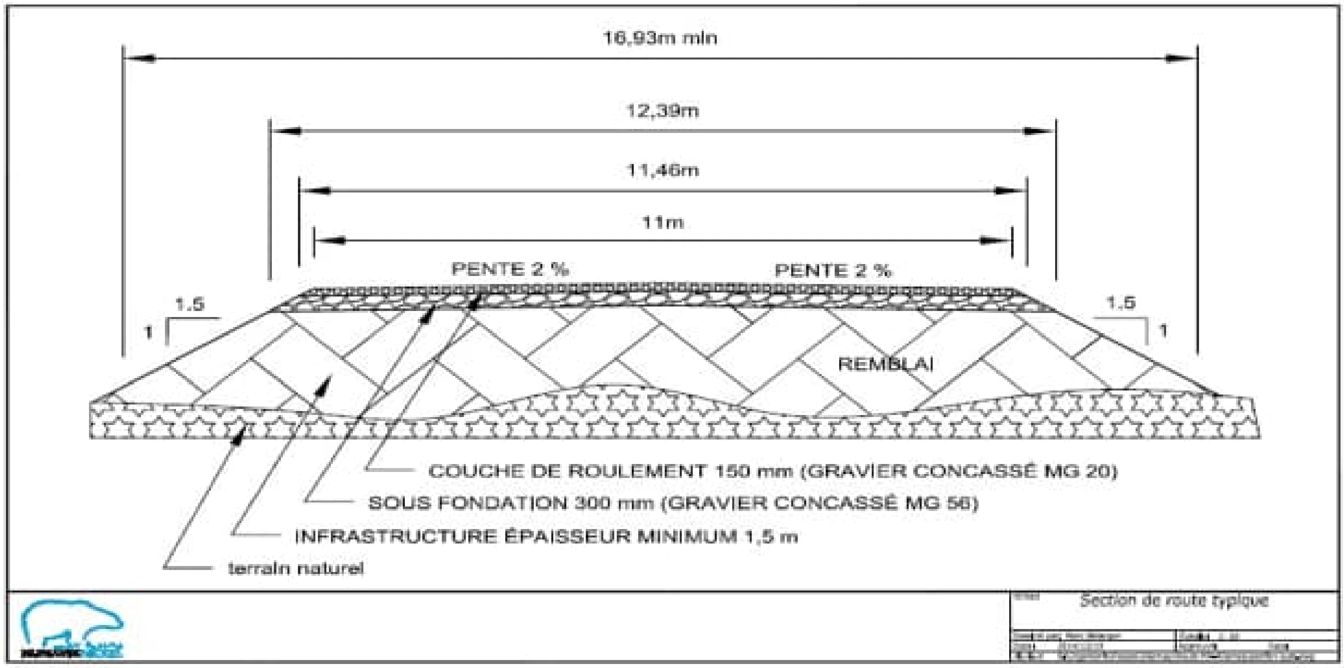


Figure 5-8: **Typical Road Cross-Section**


Photo 5-2: Watercourse CE-D13 Upstream and Downstream Views (Site of Crossing TR-D7)


Photo 5-3: Watercourse CE-D10 Upstream and Downstream Views (Site of Crossing TR-D6)


Photo 5-4: Watercourse CE-D8 Upstream and Downstream Views (Site of Crossing TR-D5)


Photo 5-5: Watercourse CE-D2 Upstream and Downstream Views (Site of Crossing TR-D2)


Photo 5-6: Watercourse CE-D1 Upstream and Downstream Views (Site of Crossing TR-D1)

Photo 5-7: Watercourse CEI-D7 (Site of Crossing TRI-D4)

Photo 5-8: Watercourse CEI-D3 (Site of Crossing TRI-D3)

5.2.7.2 Delta-Lake No. 4 Road

The drinking water access road will have a right of way on the ground of 22 m and a driving surface of 16 m. The slopes of the road right of way are 1:1.5. Due to the steeper grade separations on the selected road, certain sections will be drilled and possibly blasted so that the slopes allow safe vehicular traffic. The cut areas are illustrated on Map 5-7. This strategy allows minimization of the area of the road encroaching on the wetlands and conservation of this section in the terrestrial environment. The material from this drilling/blasting will be characterized and may be used as construction material if the analyses establish that it is NAG. In the event that its characteristics do not allow it to be used as material, it will be transported to the waste rock pile of the Delta site.

This road will include a single crossing (TR-D10) for a permanent watercourse (CE-D38) before accessing Lake No. 4. This watercourse has a width of 18 m at inbank capacity. In the summer, its average depth is 30 cm and its flow speed is less than 0.05 m/s (see Photo 5-9). The heaviest truck to circulate on this crossing will have a maximum load of 180 tonnes. There will also be a crossing for an intermittent watercourse (TRI-D9), which will required installation of a circular culvert (Photo 5-10). This environment is not a fish habitat, because there is too little presence and diffusion of water in the vegetation. At the time of the inventories, the site was completely dried up.

The design alternatives for Crossing TR-D10 are illustrated in Table 5-31. The concept of multiple arches was selected, with reconstitution of the natural bed for certain arches, depending on what will have been determined during the authorization process with Fisheries and Oceans Canada (DFO).

CE-D38 (upstream view at the site of Crossing TR-D10)

CE-D38 (downstream view at the site of Crossing TR-D10)

CE-D38 (downstream view, right bank at the site of Crossing TR-D10)

CE-D38 (downstream view, left bank at the site of Crossing TR-D10)

Photo 5-9: Watercourse CE-D38 Requiring Installation of a Major Crossing (TR-D10)

CEI-D37 (upstream view at the site of Crossing TRI-D9)

CEI-D37 (downstream view at the site of Crossing TRI-D9)

Photo 5-10: Watercourse CEI-D37 Upstream and Downstream Views (Site of Crossing TRI-D9)

5.2.7.3 Access Road Network on the Delta site

The Delta site will require the development of a network of access roads for trips by the various vehicles necessary for operations. The width of the roads, including the right of way, will range between 22 and 16 m. Only one culvert (TRI-D8) will be required for watercourse CEI-D20 (Photo 5-11).

Photo 5-11: Watercourse CEI-D20

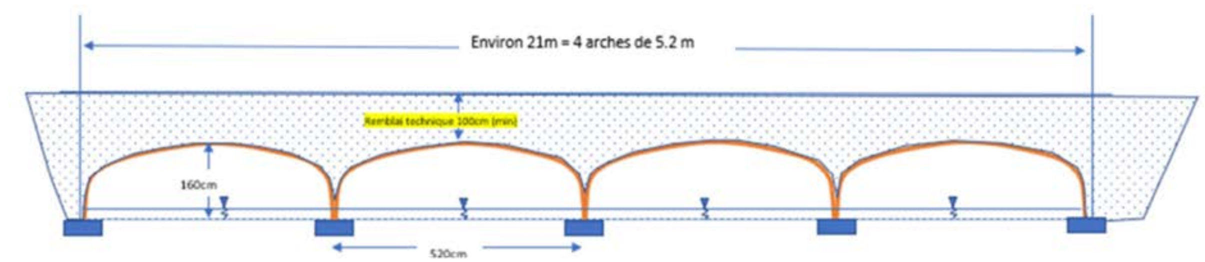
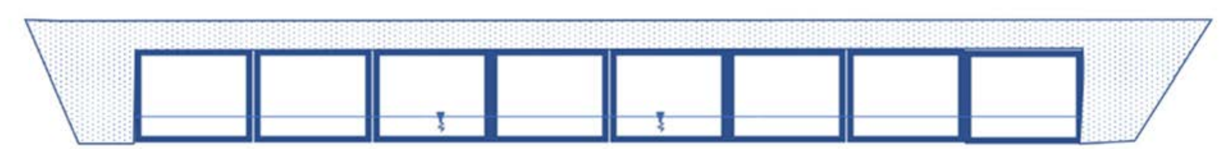
5.2.7.4 Estimate of the Required Quantity of Materials

An estimate of the quantity of materials required for construction of all the roads of the Delta project is presented in Table 5-30. This quantity may vary according to the topography, and a contingency will be anticipated. The development of caribou crossings will require an addition of run material and MG-20 at the locations that will be selected along the Ivakkak-Delta road and along the road leading to Lake No. 4.

Table 5-30: Estimate of the Volume of Materials Required

Materials	Volume required (m^3)
Construction of roads and access roads	
Run material	838,350
MG-20	46,575
MG-56	46,575
Total	**931,500**
Construction of caribou crossings (12 passages of 100 linear metres on each side of the roads)	
Run material	64,800
MG-20	3,600
Total	**68,400**

Table 5-31: Proposed Crossing Types Depending on the Watercourses Encountered on the Delta-Ivakkak Road and the Access Road to Drinking Water

Crossing	Type	Width at full flow (m)	Presence of fish	Fish habitat potential	Downstream migration obstacle	Structure type recommendation	
Delta-Ivakkak road							
TR-D7	Permanent	0.55	Was fishing; no fish, but fish habitat	Low to medium	Yes (passable with restriction)	1) Circular culvert	
TR-D6	Permanent	0.75			No		
TR-D5	Permanent	1.2	Permanent tributaries have been fished; no fish, but they are not fish habitat like intermittent tributaries.	None	Yes (impassable)		
TR-D2	Permanent	0.5			Yes (impassable)		
TR-D1	Permanent	2.3			Yes (impassable)		
TRI-D3	Intermittent	Diffuse			Yes (impassable)		
TRI-D4	Intermittent	0.30			Yes (impassable)		
Access road to Lake No. 4 for drinking water withdrawals							
TR-D10	Permanent	18.0	No fish caught, but fish were observed. This tributary is a fish habitat confirmed.	High	No	2) Multiple arches (about four would be necessary) or a series of eight prefabricated reinforced concrete culverts	 Or series of prefabricated culverts 
TRI-D9	Intermittent	0.5	No fishing possible; too little water; this is not a fish habitat.	None	Yes (impassable)	1) Circular culver	See above
Access road to Lake No. 4 for drinking water withdrawals							
TRI-D8	Intermittent	3,0 (near Lake No. 1)	No fishing possible; too little water; this is not a fish habitat.	None	Yes (impassable)	1) Circular culver	See above

5.2.8 Management of Petroleum and Chemical Products Other Than Explosives

5.2.8.1 Chemicals

The chemicals present on the site will be used for treatment of the mine wastewater coming from the Main Collection Pond. They will be stored at the mobile mine wastewater treatment plant or in the other sectors intended for storage on the mine site. Their Safety Data Sheets are found in the available Appendix D of this document. Chemical consumption was estimated according to laboratory tests conducted with the treatment chain described in the section describing the Delta WTP (Table 5-32); however, annual consumption may fluctuate according to the dosages and the volumes of water that will really be treated. As mentioned in this section, some chemicals could be substituted for the purposes of obtaining better WTP performance.

Table 5-32: Estimate of Annual Consumption of Reagents (ASDR, 2021)[1]

Chemical	Chemical formula	Density (g/L)	Grade	Consumption (kg/year)	Note
Sodium hydroxide	NaOH	1,260	25% p/p	27,000	Solution
Ferric chloride	$FeCl_3$	1,200	40% p/p	90,000	Solution
Metalsorb	N.A.	1,150	HCO	3,600	Solution
Magnafloc 155	N.A.	N.A.	Anionic	900	Dry
Sulphuric acid	H_2SO_4	1,820	93% p/p	4,680	Solution

1 Estimates adapted from the 2021 ASDR report, considering the similar dosages, but a greater volume of water to be treated for the Delta site.

5.2.8.2 Petroleum Products

A fuel storage area will be developed near the generators on the surface infrastructure pad (office area, camps and maintenance shops). The fuel stored will be used for refuelling of the vehicles, heavy machinery, pumps, heating and generators. The fuel used, Arctic diesel, will be delivered by tanker truck. It will be stored in five to ten 50,000 L tanks.

These mobile tanks with built-in dikes will be installed in accordance with requirements of the *Building Act* and al the applicable regulation, codes and standards. CRI will ensure it obtains all the permits required prior to installation of this petroleum equipment.

The Safety Data Sheet for the Arctic diesel used is attached to Appendix D of this study.

5.2.9 Waste Management

The waste that will be generated at the Delta site will be managed according to the NNiP waste management plan currently in force, which was submitted to the MELCCFP in the context of the various authorizations of the NNiP. Non-hazardous waste and Hazardous waste management are each governed by a procedure, which provides for application of the 4R principle. They are presented in Appendix E and integrate the requirements of the regulations in effect. It is estimated that each worker will produce about two tonnes of residual materials per year (GENIVAR, 2007), both for the construction and operational periods. It is therefore forecast that 300 tonnes/year of residual materials will be generated on the Delta site, considering occupancy by 150 workers.

5.2.9.1 Waste Types

The main waste that will be produced are household waste, cafeteria fats, and construction and shop scrap. A space will be developed to facilitate the grouping of materials with a potential for reuse on the NNiP sites (e.g. wood, rubber, plastic). Another space will be developed in the LEMN to store scrap iron or other materials with recycling potential in the south which will be returned to southern Québec.

Waste without reuse or recycling potential will be burned in the LEMN, except for certain non-combustible materials (e.g. glass, gypsum, concrete). These materials will be buried directly, with the ashes of the combustible materials. The explosive packaging will be burned in a sector near the LEMN of the Delta site, in accordance with the *Explosives Act* (R.S.Q., c. E-22) and the ashes will be buried in the LEMN.

The sludge from household wastewater treatment will also be disposed of in the LEMN. Table 5-33 presents the waste management summary.

Table 5-33: Summary of Residual Non-Hazardous Materials Management

Waste	Stockpiling	Disposal method
Waste with reuse or recycling potential	Disposal at the recyclable materials stockpiling site at Expo	Recycling at a site in southern Québec
Combustible non-recyclable waste	N/A	Burning in a cell assigned for this purpose at the Expo LEMN
Non-recyclable and non-combustible waste, sludge and ashes	N/A	Permanent burial in the LEMN

5.2.9.2 Northern Landfill (LEMN)

The LEMN will be located about 2 km southeast of the Delta site south of the mine access road. It will be developed and operated in accordance with the *Regulation respecting the landfilling and incineration of residual materials (RLIRM)*. It will contain incineration and landfill cells and stockpiling areas. Two sludge cells and a pad for geotubes will also be present for management sludge from sanitary wastewater treatment. It is not planned to install a lining or a membrane inside the cells.

The LEMN will be surrounded to limit windborne dispersion of waste and access to waste by wildlife.

The non-contact water will be diverted, and the contaminated water will be collected and routed to the MCP. More detailed development is in preparation. The total area will be 2,6 ha.

5.2.9.3 Hazardous Waste (HW) and Special Waste

The HW produced will be similar to the HW produced on the other NNiP sites: oils, oil filters, lead batteries, paint, domestic batteries, electronic waste, etc. It will be managed in accordance with the HW management procedure in force, which provides for the disposal mode of each material.

An HW storage area will be developed in the camp sector and will be developed in accordance with the *Regulation respecting hazardous materials*. The HW will be returned to southern Québec for disposal at authorized treatment centres. However, it is planned to reclaim used oils, as described in the following subsection

Other special waste, also governed by CRI's waste management procedure, will be produced, such as:

- Biomedical waste: this will be sent for disposal to a specialized disposal centre
- End-of-life tires: the tires that can be recovered will be placed in the maintenance shop parking area. They will be retreaded for reuse on the site. Those that cannot be recovered will be sent to southern du Québec
- End-of-life vehicles: they will be managed in accordance with the MELCCFP *Guide des bonnes pratiques pour la gestion des véhicules hors d'usage* (Good practices guide for end-of-life vehicles). The fluids will be recovered from the vehicles and the vehicles will be returned to the south with the scrap iron. They will be stored near the scrap iron stockpiling area in the LEMN.
- Contaminated soil: in case of an environmental incident, the site will be cleaned as soon as possible, and the soil will be managed in accordance with the response procedure in effect in case of an environmental incident (*PRO-NENV-1211-01_F*). The procedure is available in Appendix F. The soil will be stockpiled temporarily in the HW stockpiling area and sent to the south for treatment at an authorized centre.

5.2.9.3.1 Used Oils

A ministerial authorization was issued in 2008 for use for energy purposes of the waste oils produced by the mechanical maintenance activities on the heavy equipment and generators in 5 furnaces located on the Expo site (Y/Ref.: 7610-10-01-70080-26). It is desirable to reclaim waste oils for energy purposes also at the Delta site, from the Delta site or other NNiP sites. The equipment will be selected subsequently and an application for authorization will be submitted to the MELCCFP.

5.2.10 Workforce

From 2025 to 2032, the number of employees will range from 40 to 138, as presented in Table 5-34. OP corresponds to the open pit mine and UG to the underground mines. The camp itself will account for about fifteen employees from the second year of operation of the site. The workers will be divided into two shifts, 06:00 to 18:00 and 18:00 to 06:00.

It is also necessary to consider the CRI employees assigned to supervision and engineering of the work, the building maintenance personnel, and the healthcare staff, who will divide their time among the different operational sites.

Table 5-34: Workforce Required for Construction and Operation of the Delta Deposit

Operation	OP	OP / UG	UG	UG	UG	UG	UG	UG
Year	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Exploration	**-**	**20**	**20**	**20**	**20**	**20**	**20**	**20**
Diamond driller		10	10	10	10	10	10	10
Geology		4	4	4	4	4	4	4
Geophysical		6	6	6	6	6	6	6
Services	**6**	**10**	**10**	**10**	**10**	**10**	**10**	**10**
Water treatment plant operator	4	4	4	4	4	4	4	4
Electromechanical		1	1	1	1	1	1	1
Pump operator	2	2	2	2	2	2	2	2
Substitutes (2 days)		2	2	2	2	2	2	2
Supervisor (shared)		1	1	1	1	1	1	1
Surfaces	**7**	**7**	**2**	**2**	**2**	**2**	**2**	**2**
Grader	1	1	1	1	1	1	1	1
Sander	1	1	1	1	1	1	1	1
Loader	1	1						
Labourer	4	4						
Technical Services	**6**	**7**	**7**	**7**	**7**	**7**	**7**	**7**
Surveying	2	2	2	2	2	2	2	2
Mining engineer	1	1	1	1	1	1	1	1
Geotechnical	1	1	1	1	1	1	1	1
Geology	2	3	3	3	3	3	3	3
Camp	**-**	**15**	**15**	**15**	**16**	**16**	**16**	**16**
OP	**21**	**21**	**-**	**-**	**-**	**-**	**-**	**-**
Power shovel	2	2						
Truck	8	8						
Supervisor	2	2						
Driller	6	6						
Blaster	3	3						
UG	**-**	**23**	**49**	**71**	**75**	**75**	**75**	**75**
Longhole drill		2	4	8	10	8	8	8
Truck		2	4	10	12	14	14	14
Jumbo		2	6	6	6	6	6	6
Blaster		2	6	8	8	8	8	8
Power bolter		4	8	8	8	8	8	8
Service		2	4	6	6	6	6	6
Longhole driller		-	2	6	6	6	6	6
Mechanic		4	8	10	10	10	10	10
Electrician		2	2	2	2	2	2	2
Supervisor		2	4	4	4	4	4	4
Captain		1	1	1	1	1	1	1
Fill plant operator				2	2	2	2	2
Other	**-**	**8**	**8**	**8**	**8**	**8**	**8**	**8**
Clerk		1	1	1	1	1	1	1
IT technician		1	1	1	1	1	1	1
OHS		1	1	1	1	1	1	1
Environment		2	2	2	2	2	2	2
Surface Service		3	3	3	3	3	3	3
TOTAL	**40**	**111**	**111**	**133**	**138**	**138**	**138**	**138**

5.2.11 Mine Restoration

Under the *Mining Act*, the project is subject to restoration of the land affected by mining activities. A Delta site restoration plan will be produced in accordance with the particularities and the general requirements contained in the MERN *Guide de préparation du plan de réaménagement and de restaturation de sites miniers au Québec* (Guide to preparation of the redevelopment and restoration of mine sites in Québec), in which the applicable measures will be found. This plan will be deposited with the MRNF and its approval will be required to obtain the mining lease. It will be accompanied by a financial guarantee in accordance with section 232.2 of the *Mining Act*. In particular, it will include a detailed description of the restoration and redevelopment work planned during the operational phase and once the mining activity is completed.

The following interventions are generally planned:

- Securing of the sites and the mined areas
- Dismantling and disposal of buildings and infrastructures
- Restoration of the area occupied by the temporary waste rock and ore piles
- Surface and contaminated water management, if applicable;
- Scarification of secondary access roads to hinder access to vestiges of mine infrastructures
- Follow-up of the integrity of the works and complete environmental monitoring.

In accordance with the regulations in effect, CRI will proceed with a follow-up of mine restoration to ensure compliance with the discharge objectives for protection of the receiving environment. The restoration activities specific to the Delta project that will be deployed during closure are described summarily in the following sections. All of the measures will also be carried out to restore, as much as possible, the natural flow of water to the lakes near the Delta site.

5.2.11.1 Restoration of the Pit

At the end of operation of the mine, all the waste rock present on the pile will be returned to the pit. Partial or complete filling of the pit will be determined subsequently, based on thermal and water quality modelling, while accounting for climate change, as well as covering with a thermal cap or a geomembrane. Because the volume of waste rock that will remain on the pit will be insufficient for complete backfilling, waste rock from the Ivakkak site possibly will be used.

In the event that the complete pit filling scenario is not selected, access to the pit will be blocked with an NAG rock levee of 1.5 to 2 m to ensure the safety of the site. Trilingual signs indicating the danger will be installed on the levees.

5.2.11.2 Restoration of Underground Mines

The waste rock produced during development of the Delta underground mines will be managed on the surface and then returned gradually to the depleted drifts to ensure safety during operation.

The physical stability of the surface pillars will be assessed by a qualified engineer. Any risk of collapse of the pillars will be reduced in advance by backfilling of the sections at risk. Because the underground mine is located in the permafrost and will not be heated, production of minewater will be negligible. It is possible that the water level will reach static conditions in the very long term.

To eliminate the needs for maintenance of a fence after operation of the underground deposit, the access portal to the ramp of the underground mine will also be secured with NAG rock. To ensure the safety of the site, the daylight openings from the ventilation chimneys and emergency exit will be blocked with concrete caps. Trilingual signs (Inuktitut, French and English) indicating the danger will be installed at the entrance of the portal and the condemned chimneys.

5.2.11.3 Restoration of the Piles

The waste rock pile and the ore piles will be restored quickly after the end of operation of the site. The soil from their footprint will then be characterized to manage it adequately in case of presence of contamination. These accumulation areas will be graded according to the requirements to counter erosion and restore their natural appearance. During restoration, a final characterization will be done to validate the surface soil quality and in accordance with Division IV of the EQA.

The overburden stockpiled during stripping will be spread according to the directives indicated in section 7.3.1.3 at the end of restoration to assist vegetation recovery and favour colonization by the species at risk identified in the work sector.

5.2.11.4 Restoration of the Water Collection Ponds and Ditches

Once the environmental monitoring related to minewater has been completed as described in the restoration plan, the ditches will be backfilled with NAG material and surfaces will be graded to limit erosion and facilitate the natural flow of water. The sediments of the MCP and the LCP will be removed and disposed of at a suitable site, such as one of the NNiP’s AGP waste rock piles. The MCP dike will be breached in two places and the spillway will be left in place. A NAG rock levee 1.5 to 2 m high will secure the daylight opening of the LCP by blocking access.

5.2.11.5 Surface Infrastructure and Heavy Machinery

All the buildings and all the surface infrastructures that will not be useful for post-closure monitoring of the underground mine will be removed and recovered for reuse in the context of the NNiP. When it will have been shown that the follow-up is compliant with the applicable requirements, the remaining buildings and infrastructures will also be recovered. Whatever cannot be returned to the south for recycling will be disposed of in the LEMN of the Delta site or of the Expo site.

Whenever possible, all the equipment and heavy machinery may be reused for operation of other NNiP deposits. Otherwise, they will be sold as used equipment or sold for scrap metal. Any other debris or non-reusable part will be disposed of in the LEMN of the Delta site or of the Expo site.

The surfaces will be graded according to the requirements to control erosion and restore their natural appearance as such as possible.

5.2.11.6 Restoration of the LEMN

During the final closure of mining activity and at the complete end of restoration of the Delta site, the LEMN will be closed, and the site will be restored. The different cells will be covered with an esker layer, coming from an authorized site, at least 30 cm thick. The fence surrounding the site will be dismantled and the metal will be directed to the Expo site. The surface will be graded to limit wind erosion, favour the natural flow of water and give the site a natural appearance.

5.2.11.7 Reusable Products, Petroleum Product and Waste Management

Petroleum products, diesel, oils and greases will be returned to the Expo mining complex where they will be stockpiled temporarily and safely before use in the context of the NNiP's activities.

The chemicals that will not have been used for water treatment will be returned to the Expo mining complex where they will be where they will be stockpiled temporarily and safely before use in the context of the NNiP's activities.

The residual non-hazardous and hazardous materials will be disposed of in accordance with the waste management procedure of CRI, which is based on the regulations in effect.

5.2.11.8 Potentially Contaminated Soil and Materials

Upon cessation of mining activities, a soil characterization study will be produced, as prescribed by section 31.51 of the EQA. CRI will take the necessary measures in compliance with the provisions of the EQA and the *Land Protection and Rehabilitation Regulation* (c. Q-2, r.18.1.01) in the case this characterization reveals the presence of contaminants beyond the criteria established by the regulation. The contaminated soil, if applicable, will be transported to southern Québec for treatment at an authorized site.

5.2.12 Implementation Schedule

The activities of the Delta deposit mining project will be conducted in three main phases, construction, operation and restoration. The schedules of each of its are presented in Tables 5-35 to 5-37, in which the caribou calving period is framed in red. Currently, road construction is scheduled starting in 2025 over a period of 6 to 9 months. Construction of the infrastructures necessary for operation of the Delta deposit is scheduled to begin at the end of 2025 and end in 2026. The access portals to the underground mines would be constructed in 2027. Operation and production will begin in 2026 and end in 2032. The restoration thus would begin in 2033, even if the material of the waste rock piles would be refused starting in 2028. The MCP will be constructed when the analyses of the water samples that will have been collected post-operations will meet the criteria. The restoration schedule presented in Table 5-37 is preliminary and will be adjusted according to the restoration plan that will have been approved by the MRNF.

Table 5-35: Implementation Schedule of the Construction Activities of the Delta Project

Construction Activities	Period
Engineering Studies	2023
Road Construction	2025 - Q3
Construction of Site Access	2025 - Q4
Construction of Crossings	2025 - Q4
MCP Construction	2025 - Q4
LCP Construction	2025 - Q4
Water Management Trenches	2025 - Q4
East Portal	2026 - Q1
West Portal	2026 - Q1
East Portal Dome	2026 - Q2
West Portal Dome	2026 - Q2
Ventilation	2026 - Q1
Emergency Exit	2027
Ventilation Raise	2027
Infrastructure Pad	2026 - Q3
Material Storage Pad	2026 - Q1
Cement Slurry Plant for Backfilling	2026 - Q4
Pad for Cement Slurry Plant	2026 - Q3
Dome for Cement Slurry Plant	2026 - Q3
Pump Station and Water Lines (Drinking and Services)	2025 - Q4
Pump Station and Water Lines (MCP and Mine)	2025 - Q4
Pad for Water Treatment Plant	2025 - Q4
Water Treatment Plant (Mines)	2025 - Q4
Generators	2025 - Q4
Electrical Substations	2025 - Q4
Gas Boy	2025 - Q4
Fuel Reservoirs	2025 - Q4
Communication	2025 - Q4
Garage	2025 - Q4
Warehouse	2025 - Q4
Drinking Water Treatment Plant	2026 - Q2
Wastewater Treatment Plant	2026 - Q2
Firehouse	2026 - Q2
Core Shack	2026 - Q2
Camp (Rooms, Kitchen, Offices, etc.)	2026 - Q2
Nordic Environment Disposal Site (LEMN)	2026 - Q2
UG Shelters	2026 - Q2
Surface Powder Keg	2025 - Q4
UG Powder Keg	2025 - Q4
Main Ramps	2026 - Q2

Note: The construction activities in red occur during the caribou calving period.

Table 5-36: Implementation Schedule of the Operational Activities of the Delta Project Deposit (OP+UG)

Activities	2026	2027	2028	2029	2030	2031	2032	2033
OP	X	X						
UG		X	X	X	X	X	X	X

Table 5-37: Implementation Schedule of the Restoration Activities of the Delta Project

Activities	OP post-operation period 2028 – 2034	UG post-operation period 2034 - 2039	Restoration period 2040-2041	2042 - 2047
	Transfer of waste rock to the Delta pit and addition of waste rock from Ivakkak if required	Dismantling of infrastructures not useful for the restoration work Securing of the portals, daylight operating. Restoration of the piles Environmental monitoring	Restoration of the water collection ponds and ditches Restoration of the remaining infrastructures (including the camp and the maintenance shop) Restoration of the LEMN Environmental monitoring	Post-restoration environmental monitoring

5.2.13 Cost of the Project

The preliminary costs of the Delta project are detailed in Tables 5-38 to 5-40. The restoration costs are estimated on a preliminary basis at $21,700,000 and would be distributed as follows:

- $7,000,000 for moving all the remaining waste rock on the waste rock pile of the Delta site to the Delta pit (backfilling of the pit)
- $500,000 to secure the site
- $2,000,000 for restoration of the MCP and LCP
- $1,200,000 for dismantling of the underground infrastructures
- $6,000,000 for dismantling of the surface infrastructures
- $5,000,000 contingency

Table 5-38: Details of the Capital Costs of the Delta Project (Construction and Operation)

Project stages	Costs ($CAD 2022)
Engineering studies	$800,000
Construction of the road	$12,800,000
Construction of accesses to the site	$3,200,000
Construction of crossings	$1,000,000
Construction of the MCP	$7,000,000
Construction of the LCP	$1,000,000
Water management ditches	$800,000
Pumping station + water lines (drinking + services)	$1,500,000
Pumping station + water lines (MCP + mine)	$1,000,000
Water treatment plant pad	$600,000
Water treatment plant (mines)	$2,000,000
Generators	$16,000,000
Electrical substations	$2,875,000
Service stations	$375,000
Diesel tanks	$375,000
Communication	$100,000
Maintenance shop	$800,000
Warehouse	$800,000
Surface magazines	$160,000
UG magazines	$350,000
East Portal	$1,500,000
West Portal	$1,500,000
Ventilation	$700,000
Material stockpiling pad	$800,000
Dome facing the East Portal	$600,000
Dome facing the West Portal	$600,000
Drinking water treatment plant	$1,200,000
Wastewater treatment plant	$2,000,000
Fire station	$2,000,000
Core bank	$2,000,000
Camp (bedrooms, kitchen, offices, etc.)	$30,000,000
Northern landfill	$400,000
UG refuges	$400,000
Main ramps	$57,600,000
Infrastructure pad	$3,000,000
Cement slurry plant pad	$600,000
Cement slurry plant dome	$600,000
Cement slurry plant for backfilling	$1,500,000
Emergency exit	$750,000
Ventilation chimney	$750,000
Total	**$162,035,000**

Table 5-39: Details of the Capital Costs of the Delta Project According to the Two Types of Operation

Item	Costs ($M CAD 2022)
Open pit (OP) operation	
OP mining	12.0
Mill	13.0
Ore transport to Expo	2.4
Energy maintenance	0.9
General services	12.6
Geology	0.4
Technical services	1.4
Environment	1.0
HR and health/safety	2.8
Procurement	9.8
Logistics	6.0
Administration and IT	1.4
Infrastructures and other	2.5
Subtotal – operating costs	66.0
Total operating costs – open pit (OP) operation with 15% contingency	**75.9**
Underground (UG) operation	
UG mining cost	137.5
Mill	79.0
Ore transport to Expo	14.4
Maintenance	3.4
General services	81.5
Geology	2.3
Technical services	8.9
Environment	3.9
HR and health/safety	13.6
Procurement	61.7
Logistics	33.3
Administration and IT	8.9
Infrastructures and other	31.7
Subtotal – operating costs	479.9
Total operating costs – underground (UG) operation with 15% contingency	**551.9**
Total cost of operations – OP + 2 UG	**627.8**

Table 5-40: Capital Expenditures (CAPEX) and Operating Expenses (OPEX) Per Year

Type	Period	Preproduction cost ($ M)	Production cost per year ($ M)							Total costs ($M)
	Item	Year 1	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	
OPEX	Open pit operation		66.0	-	-	-	-	-	-	66.0
	Underground operation		13.8	62.7	81.0	110.5	103.4	90.6	17.9	479.9
CAPEX	Site preparation	60.4	-	-	-	-	-	-	-	60.4
	Open pit operation	18.3	-	-	-	-	-	-	-	18.3
	Underground operation	19.9	28.7	48.5	38.4	-	-	-	-	135.4
Total	Subtotal OPEX		79.9	62.7	81.0	110.5	103.4	90.6	17.9	546.0
	Subtotal CAPEX	98.6	28.7	48.5	38.4	-	-	-	-	214.1
	Subtotal OPEX+ CAPEX without contingency		108.5	111.2	119.4	110.5	103.4	90.6	17.9	760.0
	OPEX + CAPEX including contingency	118.3	126.2	130.3	139.2	127.1	118.9	104.2	20.5	884.8

6 Description of the Receiving Environment

This chapter presents the description of the inventories carried out in addition to the initial ESIA, and thereby allows for certain components to be updated. It is therefore not a new impact study on its own, but rather an addendum to an existing ESIA. Thus, the study areas covered by the description of the environment and the description of the impacts in chapter 7 are linked to the footprint of the project (limited area) since the whole description of the environment and the impacts at the local and regional scales were documented in the initial ESIA.

6.1 Study Areas of Inventories

The study area selected for the Phase 2b inventories covers 475.21 ha and includes three major sectors within the NNiP study area, namely:

- Delta site sector: this new deposit is located at the western end of the NNiP study area and northwest of the Ivakkak site (Maps 6-1 and 6-2). The area covered by the inventories is 205.76 ha. The water in this site drains in several directions due to the presence of several water bodies and streams around the perimeter. The new infrastructures are located within the areas inventoried in 2021 and 2022. This study area includes two portals, a pit, a waste rock pile, two ore pits, infrastructure platforms (e.g. crushing unit), a MCB and a LCP, a mobile mine wastewater treatment unit, fresh water and wastewater pipes, ditches, ventilation stacks and emergency exits, as well as an area intended for the conservation of vegetal soil harvested during the stripping of certain areas. Only a small portion of the natural environment was not characterized in the field (approximately 600 m²), namely the portion located under the effluent pipes of the mine water and domestic wastewater treatment plant, between the study area and the discharge point. As described in Chapter 5, this area consists of 2 adjacent pipes, which are laid down on the ground without further disturbance. This portion will be characterized in the summer of 2023.
- Ivakkak-Delta road sector: this sector is located between the road leading to the Ivakkak site and the Delta site. The inventoried area covers 133.77 ha. The maps associated with this sector include the selected alternative of the road, the three potential quarries (53.41 ha), the study area for the future Delta LEMN (4.64 ha), a helipad (0.09 ha) along the road, and the alternative location of the satellite camp (26.85 ha) (Map 6-3; Sheet 1 to 3).
- Fresh water lake and its access road: The project will require a potable water supply. Lake No. 4 has been selected to provide drinking water for the Delta Camp and is located just under 5 km from the southern boundary of the Delta Site (Map 6-4). This lake is 129 ha in size. The study area for this sector includes the water body and its access road. The selected road area covers an inventory area of 51.67 ha.

The study areas for the various sectors cover all of the natural and human environments that will be affected by the expansion works and their associated projects, with the exception of a section of the double effluent pipe. Appendix G presents the methodology used for the various inventories conducted in 2021 and 2022.

6.2 Physical Environment

6.2.1 Climate

The climate in the study area is Arctic. According to data collected at the Bélanger camp weather station located in the Puvirnituq Mountains (latitude: 61º21'16" and longitude -75º2'32"), the average temperature recorded in 2022 between January 1 and November 23 is -6.91ºC, while from January 1 to December 31, 2021 it was -6.41ºC. The thickness of accumulated precipitation over the course of the year 2021 is 364 mm, while the thickness of snowfall between September 1, 2021 and June 30, 2022 is 100 cm. The minimum and maximum air temperatures recorded from January 1, 2021 to November 23, 2022 were -43.5°C and 22.4°C respectively. The growing season for vegetation is thus very short and falls between late June and early September.

Note that in 2011, it was reported that the average air temperature for the NNiP study area was approximately -9.5°C, while precipitation averaged 520 mm per year, of which approximately 50% fell as snow (ARK, 2011 in WSP, 2015), which does not appear to be representative of the Belanger Camp station. A specific component on the effect of climate change on the project is presented in Section 8.1.

The first snow is expected as early as September (Ciesielski, 2020). In winter, temperatures can drop to -50°C with 2 m of ice on the lakes. Weather conditions can change rapidly, with strong winds or fog. It is not uncommon for north-facing escarpments to remain covered with snow throughout the year.

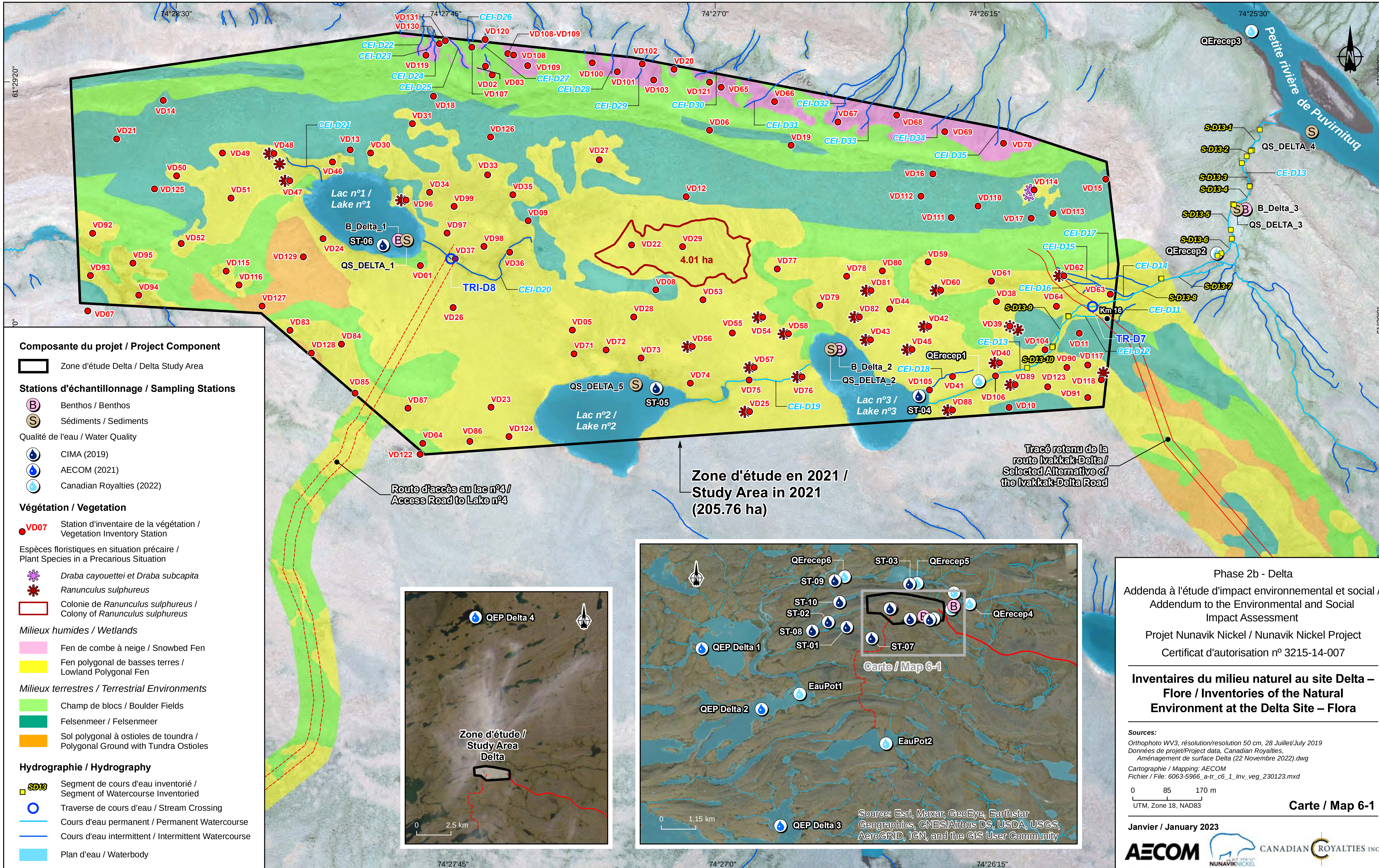
According to the Canadian Wind Atlas, winds are somewhat weaker in the Delta site area with an annual average of 6.65 m/s compared to the areas near Expo where the annual average wind speed is 7.27 m/s (Table 6-1). For the NNiP sector, the strongest winds are observed in the fall. However, the Belanger Camp has lower mean annual wind speeds of 4.29 m/s with a maximum wind speed of 26.44 m/s. The prevailing winds are from the southwest or northeast (Figure 6-1). In summer, when the weather is drier and dust can travel more easily, the prevailing winds are predominantly from the west, with some presence of northeast winds. This will have an impact on the long-range transport of airborne mining particles.

Daylight hours range from a maximum of 20 hours in summer to only 5 hours in winter.

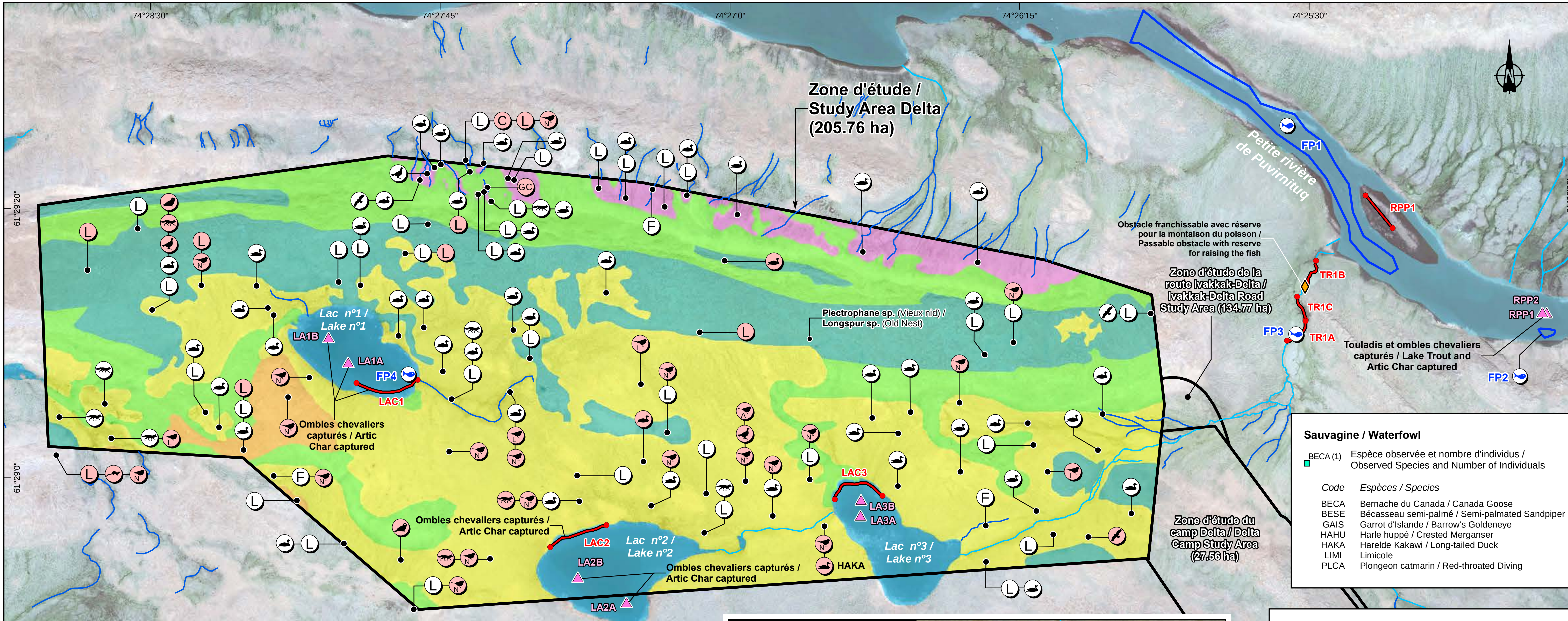
Figures 6-2 and 6-3 show the average, minimum, and maximum monthly temperatures between November 27, 2020 and November 23, 2022 in relation to snowpack amounts and total precipitation. Therefore, climate has an effect that can amplify or reduce the impacts of the Delta project.

Table 6-1: Average Wind Speeds from the Government of Canada Wind Atlas

Period	Average speed at Delta (m/s) (coordinates : Lat. : 61.476, Long. : -74.468)	Average speed at Expo (m/s) (coordinates: Lat. : 61.541, Long. : -73.451)
Annual	6.65	7.27
Winter (DJF)	6.82	7.43
Spring (MAM)	6.39	7.02
Summer (JJA)	6.13	6.77
Fall	7.22	7.78



Composante du projet / Project Component
Zone d'étude Delta / Delta Study Area
Stations d'échantillonnage / Sampling Stations
Benthos / Benthos
Sédiments / Sediments
Qualité de l'eau / Water Quality
CIMA (2019)
AECOM (2021)
Canadian Royalties (2022)
Végétation / Vegetation
Station d'inventaire de la végétation / Vegetation Inventory Station
Espèces floristiques en situation précaire / Plant Species in a Precarious Situation
Draba cayouettei et Draba subcapita
Ranunculus sulphureus
Colonie de Ranunculus sulphureus / Colony of Ranunculus sulphureus
Milieux humides / Wetlands
Fen de combe à neige / Snowbed Fen
Fen polygonal de basses terres / Lowland Polygonal Fen
Milieux terrestres / Terrestrial Environments
Champ de blocs / Boulder Fields
Felsenmeer / Felsenmeer
Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles
Hydrographie / Hydrography
Segment de cours d'eau inventorié / Segment of Watercourse Inventoried
Traverse de cours d'eau / Stream Crossing
Cours d'eau permanent / Permanent Watercourse
Cours d'eau intermittent / Intermittent Watercourse
Plan d'eau / Waterbody
Lac nº1 / Lake nº1
Lac nº2 / Lake nº2
Lac nº3 / Lake nº3
Petite rivière de Puvirnituq
4.01 ha
Zone d'étude en 2021 / Study Area in 2021 (205.76 ha)
Route d'accès au lac nº4 / Access Road to Lake nº4
Tracé retenu de la route Ivakkak-Delta / Selected Alternative of the Ivakkak-Delta Road
Zone d'étude / Study Area Delta
Carte / Map 6-1
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Phase 2b - Delta
Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment
Projet Nunavik Nickel / Nunavik Nickel Project
Certificat d'autorisation nº 3215-14-007
Inventaires du milieu naturel au site Delta – Flore / Inventories of the Natural Environment at the Delta Site – Flora
Sources:
Orthophoto WV3, résolution/resolution 50 cm, 28 Juillet/July 2019
Données de projet/Project data, Canadian Royalties, Aménagement de surface Delta (22 Novembre 2022).dwg
Cartographie / Mapping: AECOM
Fichier / File: 6063-5966_a-tr_c6_1_Inv_veg_230123.mxd
0 85 170 m
UTM, Zone 18, NAD83
Carte / Map 6-1
Janvier / January 2023
AECOM
NUNAVIK NICKEL
CANADIAN ROYALTIES INC.



Sauvagine / Waterfowl

BECA (1) Espèce observée et nombre d'individus / Observed Species and Number of Individuals

Code	Espèces / Species
BECA	Bernache du Canada / Canada Goose
BESE	Bécasseau semi-palmé / Semi-palmated Sandpiper
GAIS	Garrot d'Islande / Barrow's Goldeneye
HAHU	Harle huppé / Crested Merganser
HAKA	Harelde Kakawi / Long-tailed Duck
LIMI	Limicole
PLCA	Plongeon catmarin / Red-throated Diving

Composante du projet / Project Component

Zone d'étude Delta / Study Area Delta

Végétation / Vegetation

Milieux humides / Wetlands

- Fen de combe à neige / Snowbed Fen
- Fen polygonal de basses terres / Lowland Polygonal Fen

Milieux terrestres / Terrestrial Environments

- Champ de blocs / Boulder Fields
- Felsenmeer / Felsenmeer
- Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles

Hydrographie / Hydrography

- Cours d'eau permanent / Permanent Watercourse
- Cours d'eau intermittent / Intermittent Watercourse
- Plan d'eau / Waterbody

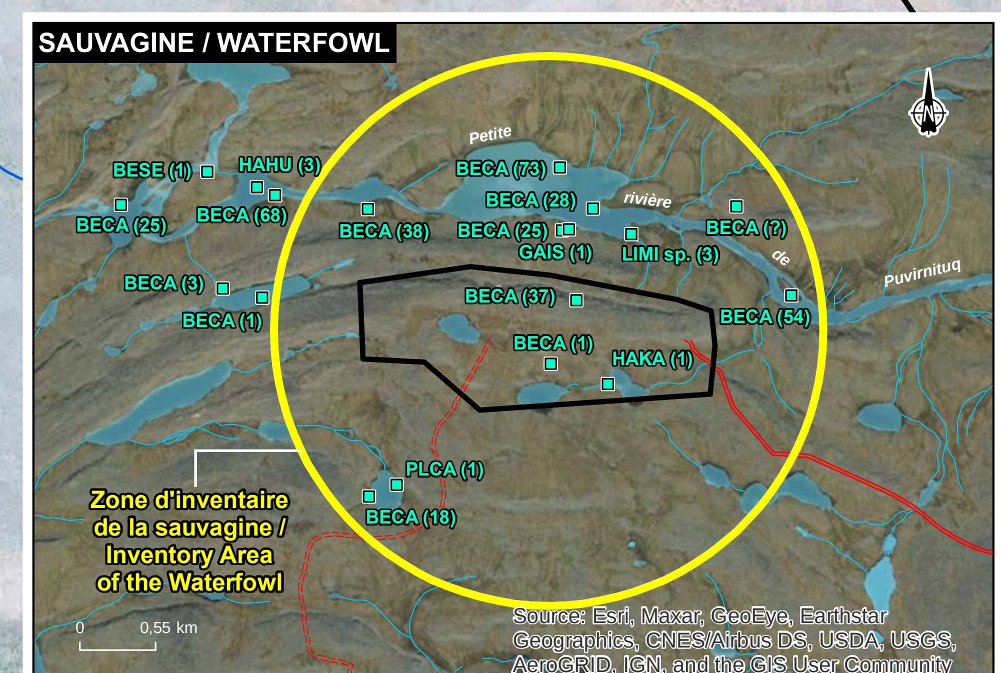
Faune / Wildlife

Poissons / Fish

- LA1A Station de pêche à la ligne et trappe Alaska / Angling and alaska Trap Station
- LAC1 Transect de pêche à l'électricité / Electrofishing Transect
- Frayère potentielle / Potential Spawning Ground

Observations directes ou indirectes / Direct or indirect observations

- Observation directe / Direct Observation
- Observation indirecte ou signe de présence ou passage / Indirect observation and/or sign of presence or passage
- Bernache du Canada / Canada Goose
- Harfang des neiges / Snowy Owl
- Plectrophane lapon / Lapland Longspur
- Alouette / Lark
- L Lemming / Lemming
- C Campagnol des champs / Meadow Vole
- F Espèce indéterminée / Undetermined species
- HAKA Harelde kakawi / Long-tailed Duck
- Plectrophane des neiges / Snow Longspur
- GC Grand corbeau / Big Raven
- Lagopède / Ptarmigan
- Renard / Fox
- Hermine / Ermine
- Buse pattue ou pelote de déjection / Rough-legged Nozzle or Ball of Dejection



Phase 2b - Delta

Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment

Projet Nunavik Nickel / Nunavik Nickel Project

Certificat d'autorisation nº 3215-14-007

Inventaires du milieu naturel au site Delta – Faune / Inventories of the Natural Environment at the Delta Site – Wildlife

Les observations de caribous se retrouvent sur la carte 6-6. Caribous Sightings on Map 6-6.

Sources:

Orthophoto WV3, résolution/resolution 50 cm, 28 Juillet/July 2019
Données de projet/Project data, Canadian Royalties, Aménagement de surface Delta (10 Octobre 2022).dwg

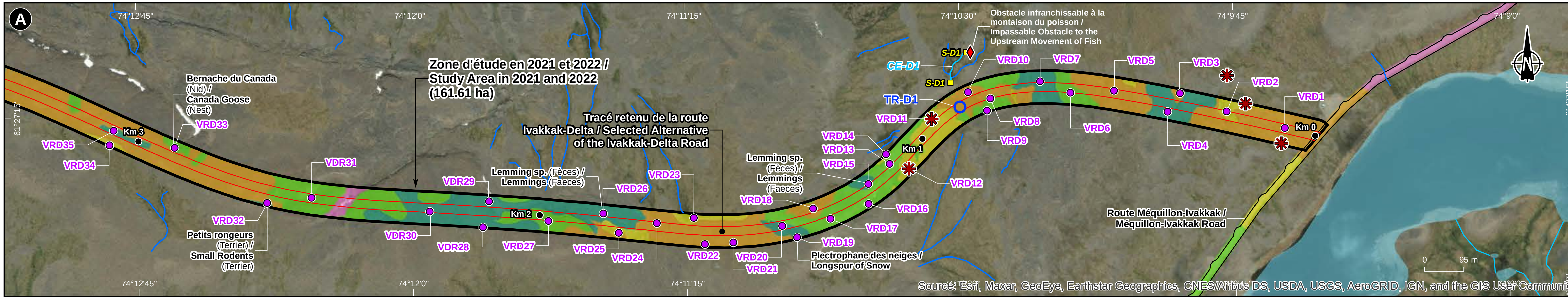
Cartographie / Mapping: AECOM
Fichier / File: 6063-5966_a-tr_c6_2_Delta_faune_230123.mxd

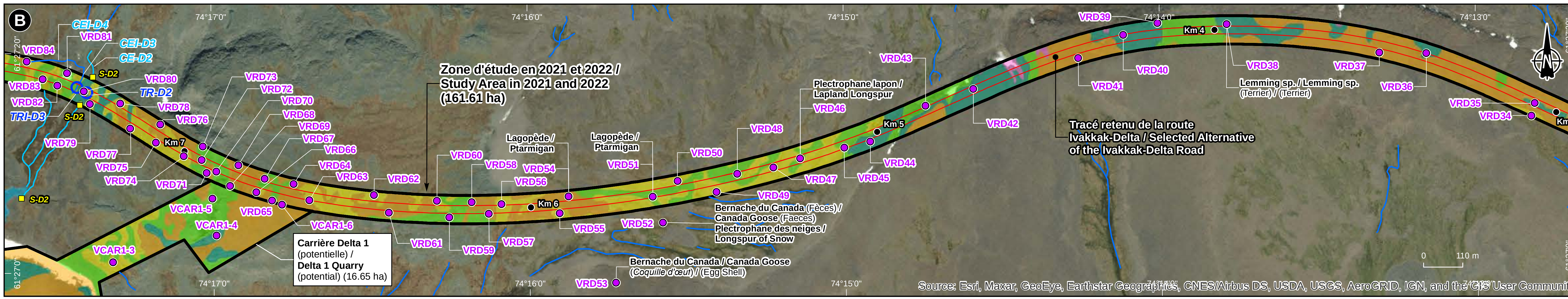
0 90 180 m
UTM, fuseau 18, NAD83

Carte / Map 6-2

Janvier / January 2023

AECOM NUNAVIK NICKEL CANADIAN ROYALTIES INC.





Composante du projet / Project Component

Zones d'étude / Study Areas

Végétation / Vegetation

VRD1 Station d'inventaire de la végétation / Vegetation Inventory Station

Espèce floristique en situation précaire / Plant Species in a Precarious Situation

Ranunculus sulphureus

Milieux humides / Wetlands

Fen de combe à neige / Snowbed Fen

Fen polygonal de basses terres / Lowland Polygonal Fen

Milieux terrestres / Terrestrial Environments

Champ de blocs / Boulder Fields

Felsenmeer / Felsenmeer

Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles

Faune / Wildlife

Oiseaux / Birds

Faucon pèlerin / Peregrine Falcon

Goéland argenté / Herring Gull

GC Grand corbeau / Big Raven

Sauvagine / Waterfowl

BECA (1) Espèce observée et nombre d'individus / Observed Species and Number of Individuals

Code	*Espèces / Species*
BECA	Bernache du Canada / Canada Goose
HAKA	Harelde Kakawi / Long-tailed Duck
LIMI	Limicole
OINE	Oie des neiges / Snow Goose
PLCA	Plongeon catmarin / Red-throated Diving

Hydrographie / Hydrography

SD1 Segment de cours d'eau inventorié / Segment of Watercourse Inventoried

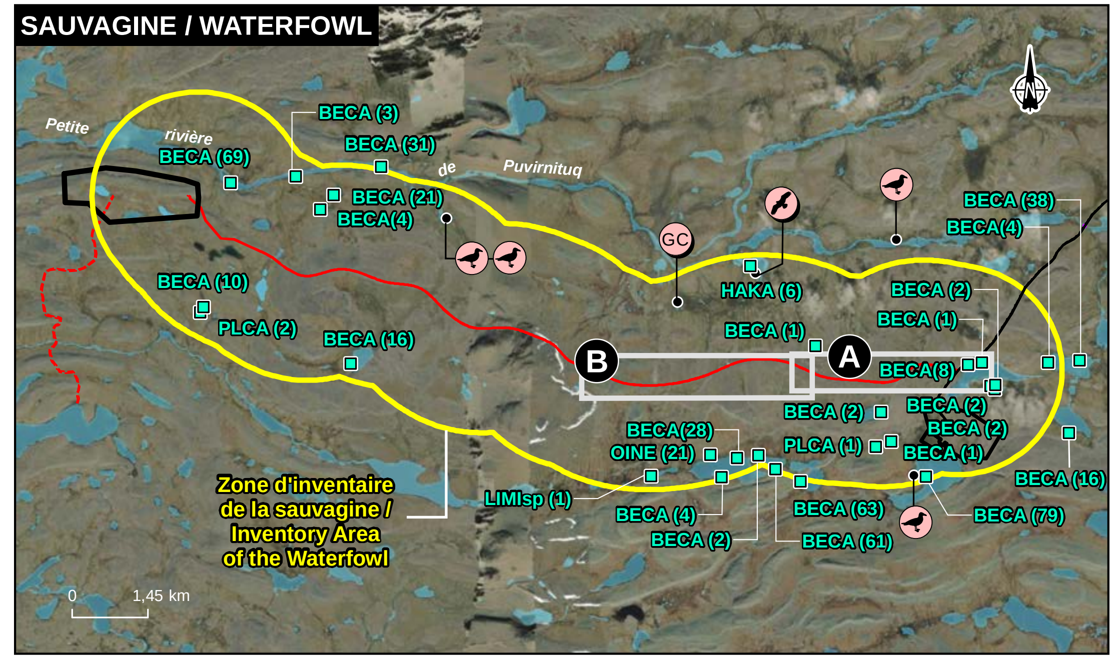
Traverse de cours d'eau / Stream Crossing

Cours d'eau permanent / Permanent Watercourse

Cours d'eau intermittent / Intermittent Watercourse

Plan d'eau / Waterbody

SAUVAGINE / WATERFOWL



Les observations de caribous se retrouvent sur la carte 6-6. / Caribous Sightings on Map 6-6.

Phase 2b - Delta

Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment

Projet Nunavik Nickel / Nunavik Nickel Project

Certificat d'autorisation nº 3215-14-007

Inventaires du milieu naturel pour la route Ivakkak-Delta / Inventories of the Natural Environment for Ivakkak-Delta Road

Sources:

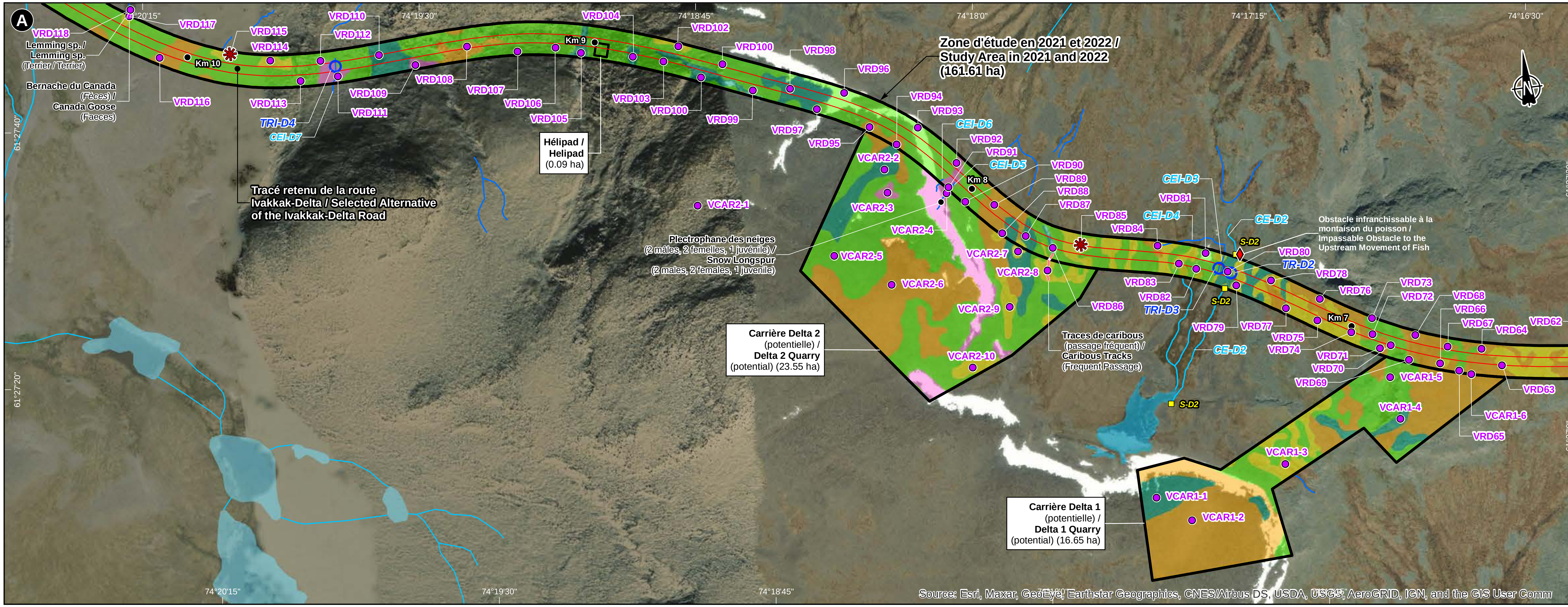
Imagerie/Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
CanVec, 1:50, 000, NRCan, 2019
Données de projet/Project Data, Canadian Royalties, 2022

Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c6_3_1_Rte_Delta_230123.mxd

Carte / Map 6-3.1

Janvier / January 2023

AECOM NUNAVIK NICKEL CANADIAN ROYALTIES INC.



Composante du projet / Project Component

Zones d'étude / Study Areas

Végétation / Vegetation

VRD1 Station d'inventaire de la végétation / Vegetation Inventory Station

Espèce floristique en situation précaire / Plant Species in a Precarious Situation

Ranunculus sulphureus

Milieux humides / Wetlands

Fen de combe à neige / Snowbed Fen

Fen polygonal de basses terres / Lowland Polygonal Fen

Milieux terrestres / Terrestrial Environments

Champ de blocs / Boulder Fields

Felsenmeer / Felsenmeer

Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles

Faune / Wildlife

Traces de caribous / Caribou Tracks

Oiseaux / Birds

Faucon pèlerin / Peregrine Falcon

Goéland argenté / Herring Gull

GC Grand corbeau / Big Raven

Sauvagine / Waterfowl

BECA (1) Espèce observée et nombre d'individus / Observed Species and Number of Individuals

Code	*Espèces / Species*
BECA	Bernache du Canada / Canada Goose
HAKA	Harelde Kakawi / Long-tailed Duck
LIMI	Limicole
OINE	Oie des neiges / Snow Goose
PLCA	Plongeon catmarin / Red-throated Diving

Hydrographie / Hydrography

SD2 Segment de cours d'eau inventorié / Segment of Watercourse Inventoried

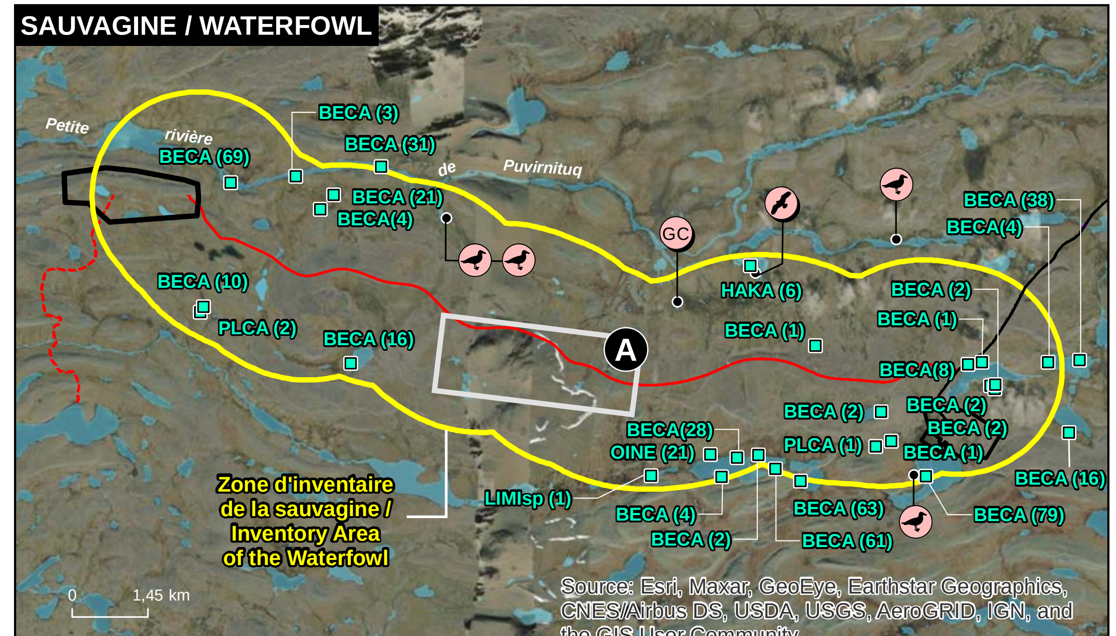
Traverse de cours d'eau / Stream Crossing

Cours d'eau permanent / Permanent Watercourse

Cours d'eau intermittent / Intermittent Watercourse

Plan d'eau / Waterbody

SAUVAGINE / WATERFOWL



Les observations de caribous se retrouvent sur la carte 6-6. / Caribous Sightings on Map 6-6.

Phase 2b - Delta

Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment

Projet Nunavik Nickel / Nunavik Nickel Project

Certificat d'autorisation nº 3215-14-007

Inventaires du milieu naturel pour la route Ivakkak-Delta / Inventories of the Natural Environment for Ivakkak-Delta Road

Sources:

Imagerie/Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

CanVec, 1:50, 000, NRCan, 2019

Données de projet/Project data, Canadian Royalties, 2022

Cartographie/Mapping: AECOM

Fichier/File: 6063-5966_a-tr_c6_3_2_Rte_Delta_230123.mxd

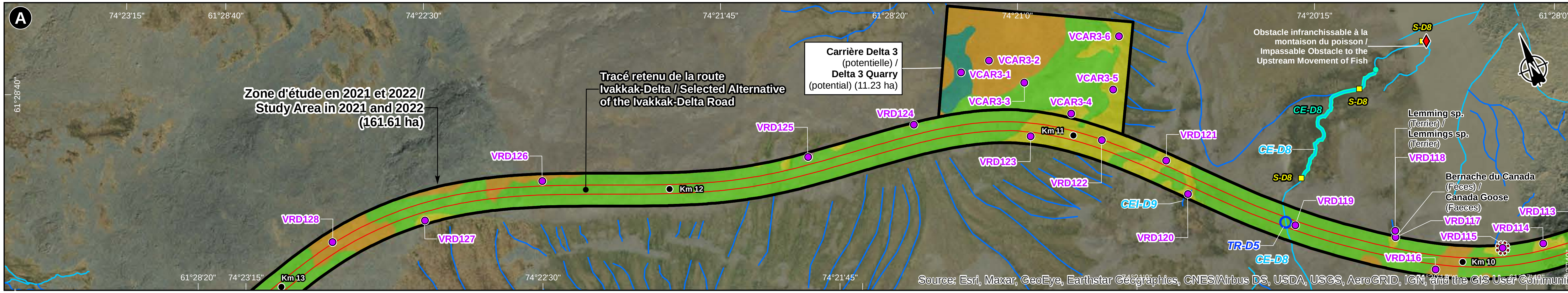
0 95 190 m

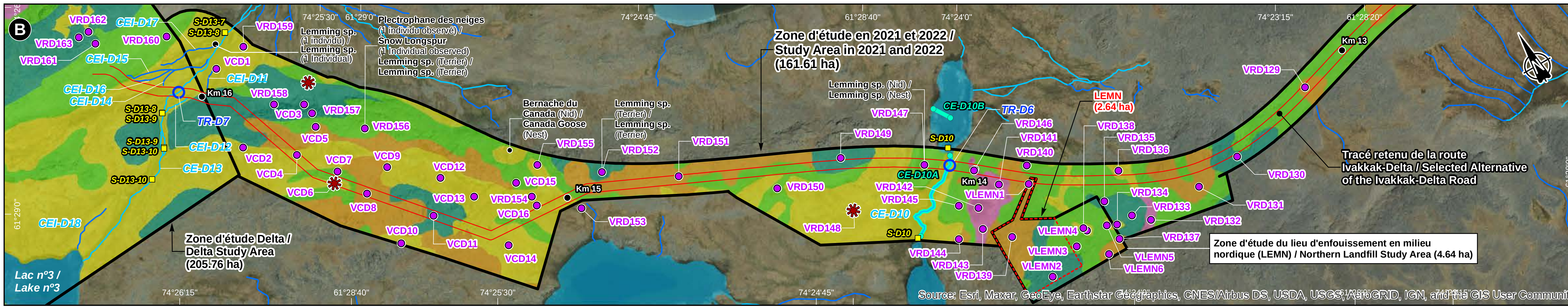
UTM, Zone 18, NAD83

Carte / Map 6-3.2

Janvier / January 2023

AECOM · NUNAVIK NICKEL · CANADIAN ROYALTIES INC.





Composante du projet / Project Component

Zones d'étude / Study Areas

Végétation / Vegetation

VRD1 — Station d'inventaire de la végétation / Vegetation Inventory Station

Espèce floristique en situation précaire / Plant Species in a Precarious Situation

Ranunculus sulphureus

Milieux humides / Wetlands

- Fen de combe à neige / Snowbed Fen
- Fen polygonal de basses terres / Lowland Polygonal Fen

Milieux terrestres / Terrestrial Environments

- Champ de blocs / Boulder Fields
- Felsenmeer / Felsenmeer
- Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles

Faune / Wildlife

Oiseaux / Birds

- Faucon pèlerin / Peregrine Falcon
- Goéland argenté / Herring Gull
- GC — Grand corbeau / Big Raven

Poissons / Fish

- CE — Transect de pêche à l'électricité / Electrofishing Transect

Sauvagine / Waterfowl

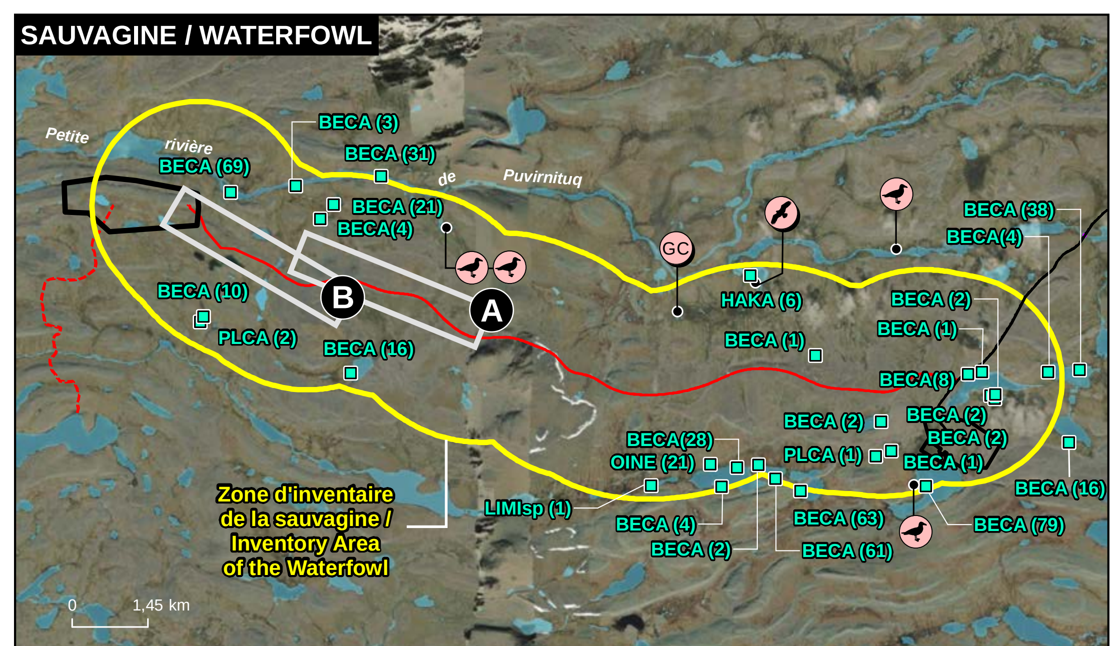
BECA (1) — Espèce observée et nombre d'individus / Observed Species and Number of Individuals

Code	Espèces / Species
BECA	Bernache du Canada / Canada Goose
HAKA	Harelde Kakawi / Long-tailed Duck
LIMI	Limicole
OINE	Oie des neiges / Snow Goose
PLCA	Plongeon catmarin / Red-throated Diving

Hydrographie / Hydrography

- SD8 — Segment de cours d'eau inventorié / Segment of Watercourse Inventoried
- Traverse de cours d'eau / Stream Crossing
- Cours d'eau permanent / Permanent Watercourse
- Cours d'eau intermittent / Intermittent Watercourse
- Plan d'eau / Waterbody

SAUVAGINE / WATERFOWL



Les observations de caribous se retrouvent sur la carte 6-6. / Caribous Sightings on Map 6-6.

Phase 2b - Delta

Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment

Projet Nunavik Nickel / Nunavik Nickel Project

Certificat d'autorisation nº 3215-14-007

Inventaires du milieu naturel pour la route Ivakkak-Delta / Inventories of the Natural Environment for Ivakkak-Delta Road

Sources:

Imagerie/Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
CanVec, 1:50, 000, NRCan, 2019
Données de projet/Project Data, Canadian Royalties, 2022

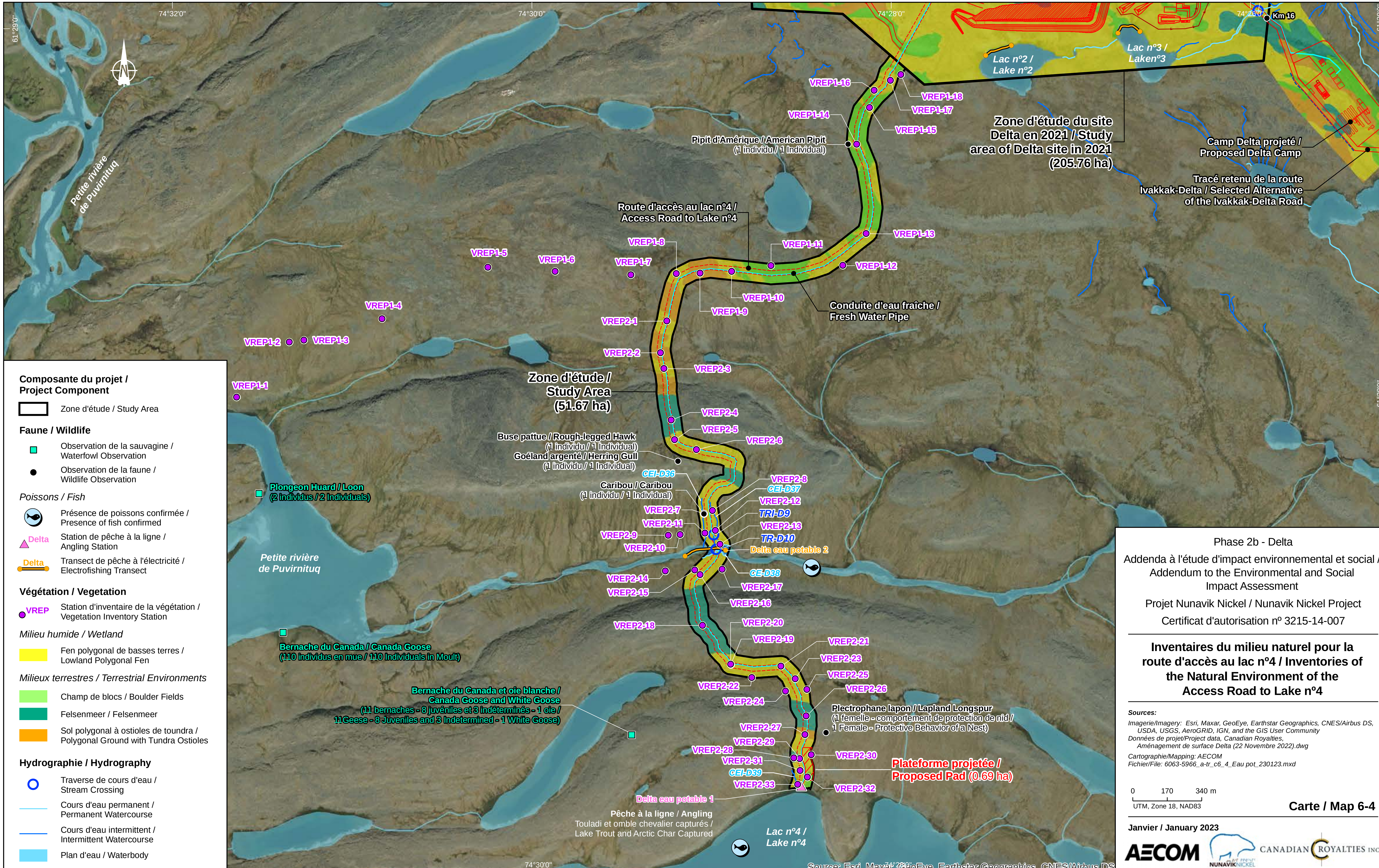
Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c6_3_3_Rte_Delta_230123.mxd

0 95 190 m
UTM, Zone 18, NAD83

Carte / Map 6-3.3

Janvier / January 2023

AECOM — Nunavik Nickel — Canadian Royalties Inc.



Composante du projet / Project Component
Zone d'étude / Study Area
Faune / Wildlife
Observation de la sauvagine / Waterfowl Observation
Observation de la faune / Wildlife Observation
Poissons / Fish
Présence de poissons confirmée / Presence of fish confirmed
Delta Station de pêche à la ligne / Angling Station
Delta Transect de pêche à l'électricité / Electrofishing Transect
Végétation / Vegetation
VREP Station d'inventaire de la végétation / Vegetation Inventory Station
Milieu humide / Wetland
Fen polygonal de basses terres / Lowland Polygonal Fen
Milieux terrestres / Terrestrial Environments
Champ de blocs / Boulder Fields
Felsenmeer / Felsenmeer
Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles
Hydrographie / Hydrography
Traverse de cours d'eau / Stream Crossing
Cours d'eau permanent / Permanent Watercourse
Cours d'eau intermittent / Intermittent Watercourse
Plan d'eau / Waterbody
74°32'0"
74°30'0"
74°28'0"
74°26'0"
61°29'0"
61°28'0"
Km 16
Lac nº2 / Lake nº2
Lac nº3 / Lakenº3
Lac nº4 / Lake nº4
Petite rivière de Puvirnituq
Zone d'étude du site Delta en 2021 / Study area of Delta site in 2021 (205.76 ha)
Camp Delta projeté / Proposed Delta Camp
Tracé retenu de la route Ivakkak-Delta / Selected Alternative of the Ivakkak-Delta Road
Pipit d'Amérique / American Pipit (1 individu / 1 Individual)
Route d'accès au lac nº4 / Access Road to Lake nº4
Conduite d'eau fraîche / Fresh Water Pipe
Zone d'étude / Study Area (51.67 ha)
Buse pattue / Rough-legged Hawk (1 individu / 1 Individual)
Goéland argenté / Herring Gull (1 individu / 1 Individual)
Caribou / Caribou (1 individu / 1 Individual)
Plongeon Huard / Loon (2 individus / 2 Individuals)
Bernache du Canada / Canada Goose (110 individus en mue / 110 Individuals in Moult)
Bernache du Canada et oie blanche / Canada Goose and White Goose (11 bernaches - 8 juvéniles et 3 indéterminés - 1 oie / 11Geese - 8 Juveniles and 3 Indetermined - 1 White Goose)
Plectrophane lapon / Lapland Longspur (1 femelle - comportement de protection de nid / 1 Female - Protective Behavior of a Nest)
Plateforme projetée / Proposed Pad (0.69 ha)
Delta eau potable 1
Delta eau potable 2
Pêche à la ligne / Angling
Touladi et omble chevalier capturés / Lake Trout and Arctic Char Captured
CEI-D36
CEI-D37
CEI-D38
CEI-D39
TRI-D9
TR-D10
VREP1-1
VREP1-2
VREP1-3
VREP1-4
VREP1-5
VREP1-6
VREP1-7
VREP1-8
VREP1-9
VREP1-10
VREP1-11
VREP1-12
VREP1-13
VREP1-14
VREP1-15
VREP1-16
VREP1-17
VREP1-18
VREP2-1
VREP2-2
VREP2-3
VREP2-4
VREP2-5
VREP2-6
VREP2-7
VREP2-8
VREP2-9
VREP2-10
VREP2-11
VREP2-12
VREP2-13
VREP2-14
VREP2-15
VREP2-16
VREP2-17
VREP2-18
VREP2-19
VREP2-20
VREP2-21
VREP2-22
VREP2-23
VREP2-24
VREP2-25
VREP2-26
VREP2-27
VREP2-28
VREP2-29
VREP2-30
VREP2-31
VREP2-32
VREP2-33
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS
Phase 2b - Delta
Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment
Projet Nunavik Nickel / Nunavik Nickel Project
Certificat d'autorisation nº 3215-14-007
Inventaires du milieu naturel pour la route d'accès au lac nº4 / Inventories of the Natural Environment of the Access Road to Lake nº4
Sources:
Imagerie/Imagery: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Données de projet/Project data, Canadian Royalties, Aménagement de surface Delta (22 Novembre 2022).dwg
Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c6_4_Eau pot_230123.mxd
0 170 340 m
UTM, Zone 18, NAD83
Carte / Map 6-4
Janvier / January 2023
AECOM
NUNAVIK NICKEL
CANADIAN ROYALTIES INC.

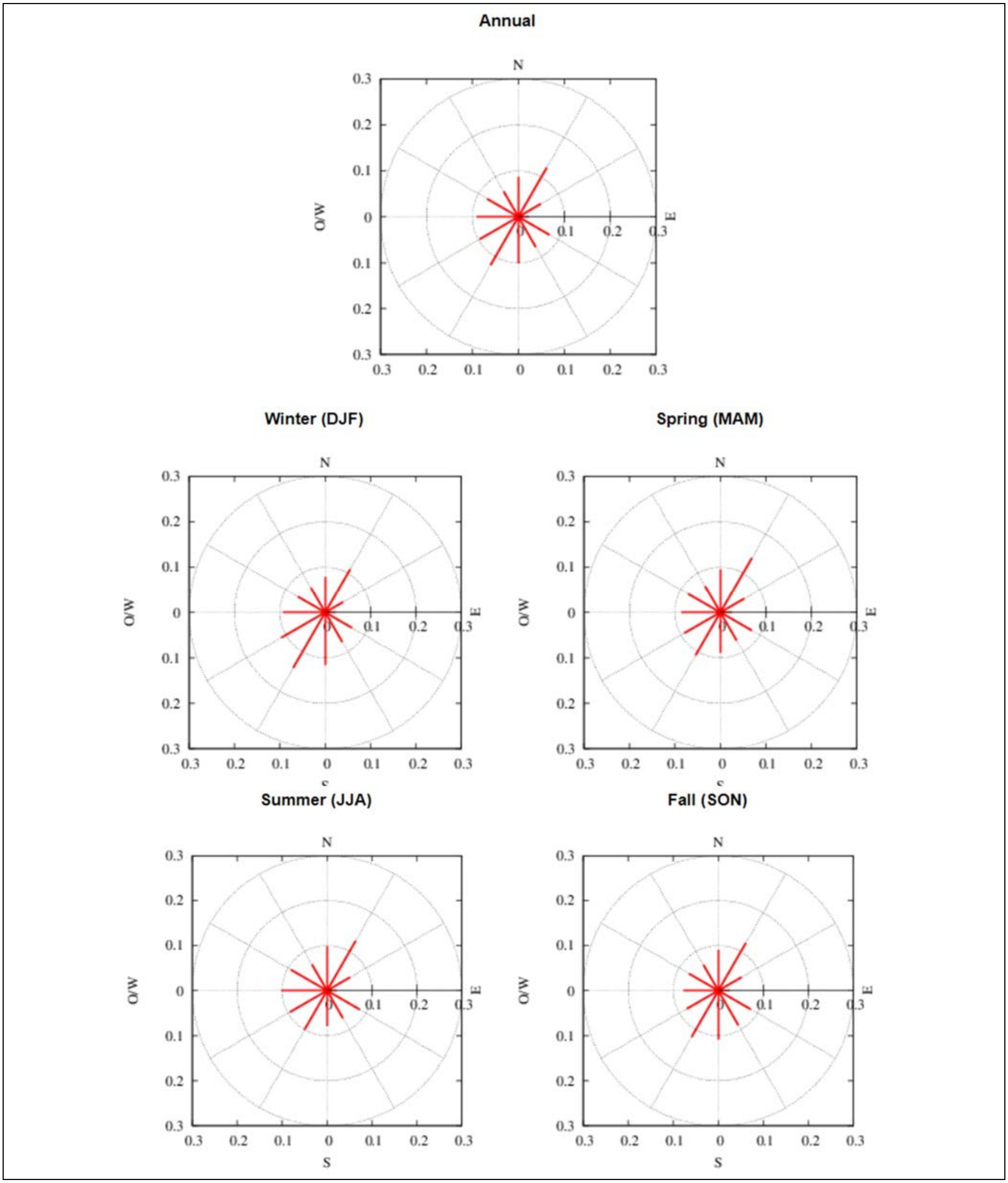
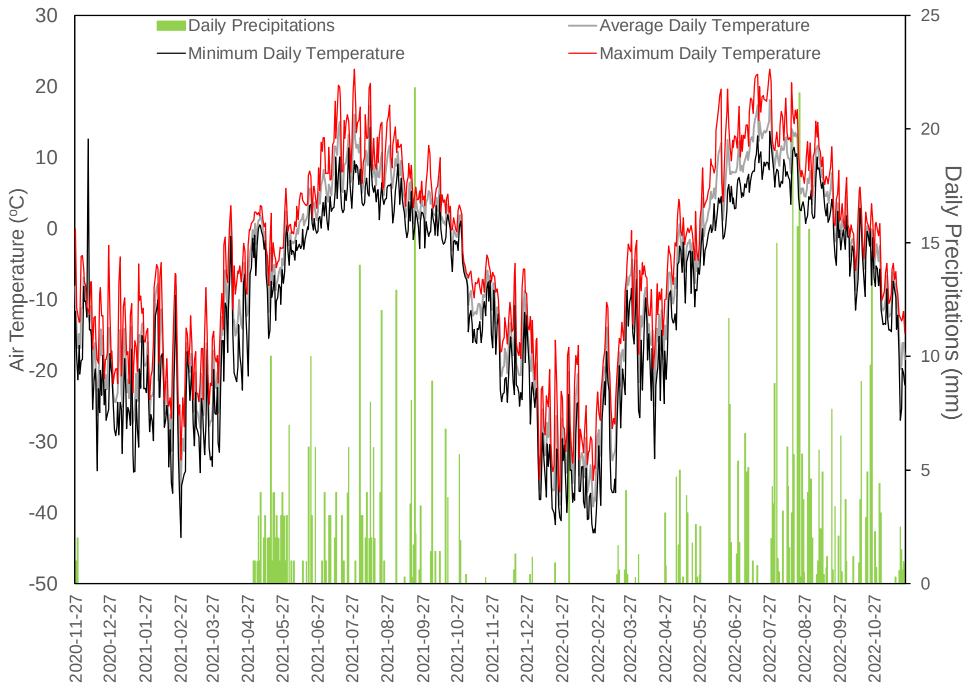


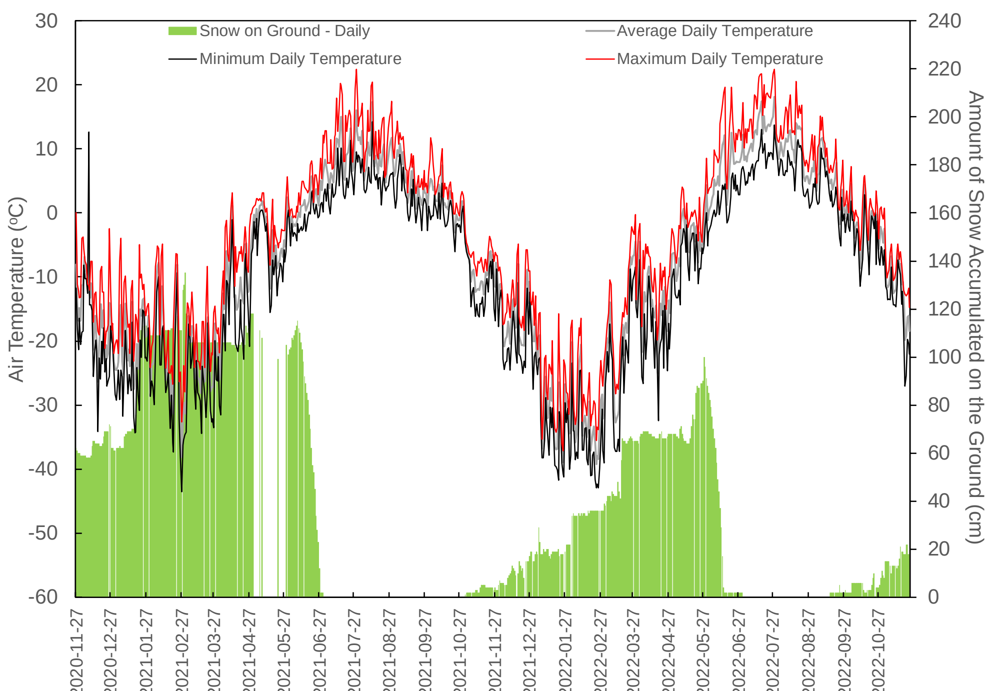
Figure 6-1: **Wind Rose at the Delta Site**

Source: Gouvernement du Canada, 2022b; for the coordinates Latitude = 61.476, longitude = -74.468



Source: Graph from **https://www.environnement.gouv.qc.ca/climat/donnees/OQcarte.asp**

Figure 6-2: Monitoring of Air Temperature and Daily Precipitation at the Bélanger Camp Weather Station in the Puvirnituq Mountains.



Source: Graph from https://www.environnement.gouv.qc.ca/climat/donnees/OQcarte.asp

Figure 6-3: Monitoring of Air Temperature and Annual Snowfall at the Bélanger Camp Weather Station in the Puvirnituq Mountains.

6.2.2 Air Quality

In 2006, the first air quality measurements in the vicinity of the exploration camps during the initial impact study showed that ambient concentrations of atmospheric contaminants were low, and that air quality was therefore rated "good" (Table 6-2). In fact, only one exceedance was noted for the maximum recorded levels of fine particles in the air.

Table 6-2: Atmospheric Contaminant Concentrations in Ambient Air During the Initial Impact Study (from GENIVAR, 2007)

Parameters	Number	Average (µg/m³)	Standard deviation (µg/m³)	Min (µg/m³)	Max (µg/m³)	2022 Standard (µg/m³)	Duration (average/unit of time)
Arsenic	6	0.0005	0.0005	0.0002	0.0011	**0.003**	1 an
Beryllium	6	<0.0002	-	<0.0002	<0.0002	**0.0004**	1 an
Cadmium	6	<0.0002	-	<0.0002	<0.0002	**0.0036**	1 an
Chrome	6	0.0037	0.0017	<0.0005	0.004	**0.004**	1 an
Nickel	6	0.0015	0.0009	<0.0002	0.003	**0.014**[A]	1 an
Lead	6	0.0018	0.0013	<0.001	0.005	**0.1**	1 an
Vanadium	6	<0.007	<0.007	<0.001	<0.007	**1.00**	1 an
Zinc	6	0.115	0.086	<0.06	0.137	**2.50**	1 an
Fine particles (<2,5 **µm**)	2500	2.5 (24 h)	2.4	0	11.3	**30**	24 h
		3.7 (1 h)	5	0	**50.9**		
Total suspended particulates (TSP)	6	3.5	1.5	<1	4	**120**	24 h

Note : A **grey background and bold characters** indicates an exceedance of the standard/criterion under the Clean Air Regulation (CAR).
[A] As of April 28, 2022, the new daily standard is 0.0700 µg/m ^{3}.

Since the initial implementation of NNiP activities, annual air quality monitoring has been conducted to analyze the influence of construction and operational activities on ambient air. Table 6-3 presents the results obtained for the period 2019 to 2021.

Since the start of operations for NNiP, air quality has changed slightly in the vicinity of the mining infrastructures. In fact, from the data collected for fine particles, the results obtained based on the calculation of the air quality index (AQI), according to the formula defined by Environment Canada, indicate that 97% of the time the air quality is rated as "good". However, for 3% of the time, the air is rated as "acceptable", mainly due to dust generation during periods of high winds.

Monitoring of total suspended particulates (TSP) is conducted between May and September using a high-volume air sampler. Due to extreme weather conditions during the rest of the year, this monitoring cannot be conducted from October through April. On all samples taken from 2019 to 2021 no exceedance of the RAA standard (120 µg/m3) was detected. For fine particulate matter, samples are collected continuously from a BAM-1020 instrument. Like TSP, no exceedance of the CAR standard (30 µg/m ^{3}) was measured from 2019 to 2021. The results for the year 2022 are currently being analyzed and will be presented to the MELCC and the communities in the annual environmental monitoring report.

Table 6-3: Atmospheric Contaminant Concentrations in Ambient Air - Period: 2019/2021

Contaminant	Period	Limit value	Unit	2019		2020		2021	
				Mean	Maximum	Mean	Maximum	Mean	Maximum
PST	24 h	**120**	µg/m³	16.5	81.6	13.8	36.0	8.70	42.9
$PM_{2.5}$	24 h	**30**	µg/m³	4.35	17.6	3.60	10.9	3.70	14.9
Arsenic	1 an	**0,003**	µg/m³	0.000262	0.000571	0.000207	0.000233	0.000223	0.000355
Beryllium	1 an	**0,0004**	µg/m³	0.000168	0.000177	0.000155	0.000175	0.000165	0.000267
Cadmium	1 an	**0,0036**	µg/m³	0.000112	0.000118	0.000103	0.000116	0.000110	0.000178
Chromium	1 an	**0,004**	µg/m³	**0.00461**	0.0194	**0.00517**	0.0269	0.00339	0.0967
Copper	24 h	**2,50**	µg/m³	0.0899	0.462	0.0419	0.103	0.0460	0.264
Nickel	24 h	**0,014**[A]	µg/m³	**0.0395**	0.228	**0.0249**	0.0713	0.0112	0.0497
Lead	1 an	**0,1**	µg/m³	0.000650	0.00655	0.000210	0.000273	0.000289	0.000510
Vanadium	1 an	**1,00**	µg/m³	0.00151	0.00417	0.00114	0.00184	0.00107	0.00215
Zinc	24 h	**2,50**	µg/m³	0.00738	0.0165	0.00514	0.0120	0.00658	0.0204

Note : A **grey background and bold characters** indicates an exceedance of the standard/criterion according to CAR.

[A] As of April 28, 2022, the new daily standard is 0.0700 µg/m ³.

For metals, exceedances are measured for chromium and nickel. For chromium, the annual average of concentrations measured in the samples taken is higher than the standard in 2019 and 2020. However, it is important to note that the limit value used as a standard is that of hexavalent chromium (0.004 µg/m³) and not that of trivalent chromium (0.1 µg/m³). However, the concentration obtained during the laboratory analysis is that of total chromium, which may lead to an overestimation of the result. For nickel, the results of the sampling show an exceedance of the daily standard.

With respect to air emissions that could affect air quality at the Delta site, activities such as ore loading, waste rock crushing and stockpiling, and transportation to the various stockpiles would potentially be the main sources of dust emissions that could contain contaminants.

Condition 6.7 of the global CA issued by the *ministère du Développement durable, de l'Environnement et des Parcs* (MDDEP) in 2008 stipulates that CRI must carry out dust dispersion monitoring around the Expo mine complex. The purpose of this monitoring is to assess the extent and magnitude of the dispersion of dust, fine particles of mine tailings or atmospheric metal concentrations, to prevent contamination of the surrounding water bodies, including Lake Pingualuk, and to minimize nuisances. There are 25 winter stations and 20 summer stations distributed in 5 sectors, namely the periphery of the Expo mining complex, Deception Bay, the Pingualuit National Park, the surroundings of the village of Kangiqsujuaq and the periphery of the Puimajuq mine. The results obtained in 2021 are consistent with those obtained in 2020, when the Expo camp sector had the highest overall dust and metal deposition rates in both summer and winter. In this area, about half of the parameters show a decrease in winter deposition rates compared to 2020 and the majority of the summer parameters show an increase in summer deposition rates, due to weather conditions and the presence of natural debris in some samples.

In order to include the Delta site in the dust monitoring program as described in CRI's environmental monitoring program, additional sampling stations have been planned and are detailed in section 9.

Considering similar weather conditions at the Delta site compared to the Expo site and that the activities at the Delta site will be smaller than those at the Expo site, air quality modeling, in addition to what was presented in the 2007 ESIA, was not conducted as part of this addendum. However, atmospheric modelling, in compliance with the requirements of the Clean Air Regulation (CAR), is currently being carried out and will be submitted to the MELCCFP during the ministerial authorization process.

6.2.3 Geology and lithology

The 26 claims delineating the Delta project are located in the Ungava pit (Li and Ducruc, 1999), which is of Paleoproterozoic age. The pit is composed of several formations of varying lithologies that trend from south to north as follows: The Lamarche Group (psammite, pelite, basalt), the Beauparlant Formation (basalt, rhyolite, sediment), the ultramafic-mafic suite of Lac Esker which is intrusive of the Cecilia Formation (basanite, phonolite, sediment) and the Nuvilic Formation (psammite, carbonate, pyroclastic, basalt) (SIGEOM 2022). All of these formations are separated by intersecting faults or thrusts. Also, rocks of Proterozoic age of the Chukotat Group, consisting mainly of basalt and mafic volcaniclastic rocks, outcrop locally at the site (SIGEOM, 2019). The local geology is characterized by mafic volcanic-type rocks, detrital rocks, as well as sedimentary carbonate rocks of the Beauparlant Formation and Cecilia Formation that is intersected by the ultramafic-mafic Esker Lake suite. The latter underlies most of the Delta property and hosts most of the Ni-Cu mineralization (Ciesielski, 2020; CIMA+, 2019).

The most common lithologies on the property are mainly ultramafic magmatic rocks of the gabbro and peridotite type, which often contain large minerals. These rocks are in contact and/or intersected by pyroxenite and quartzites. Further north, the lithology is dominated by sedimentary rocks such as siltstones and limestones, while in the southern part of the project, volcaniclastite rocks (breccias, tuffs, etc.) are the most common. Sulphides can represent between 5 and 25% of the mineralization present on the property. The most common are pentlandite ($(Ni,Fe)_9S_8$) and chalcopyrite ($CuFeS_2$), followed by pyrrhotite ($Fe_{1-x}S$). Other sulphides are also present, but in smaller quantities, such as marcasite (FeS_2), violarite (Fe_2+Ni_3+$2S_4$), pyrite (FeS_2) and covellite (CuS). Finally, traces of PGE minerals were also detected such as sudburyite (PdSb), merenskyite ($PdTe_2$), testiobiopalladinite (PdTe(Sb,Te)), sperrylite ($PtAs_2$) and kotulskite ($Pd(Te,Bi)_{2-x}$) (SIGEOM, 2022). Figure 6-4 shows the lithologies related to the boundaries of the Delta property.

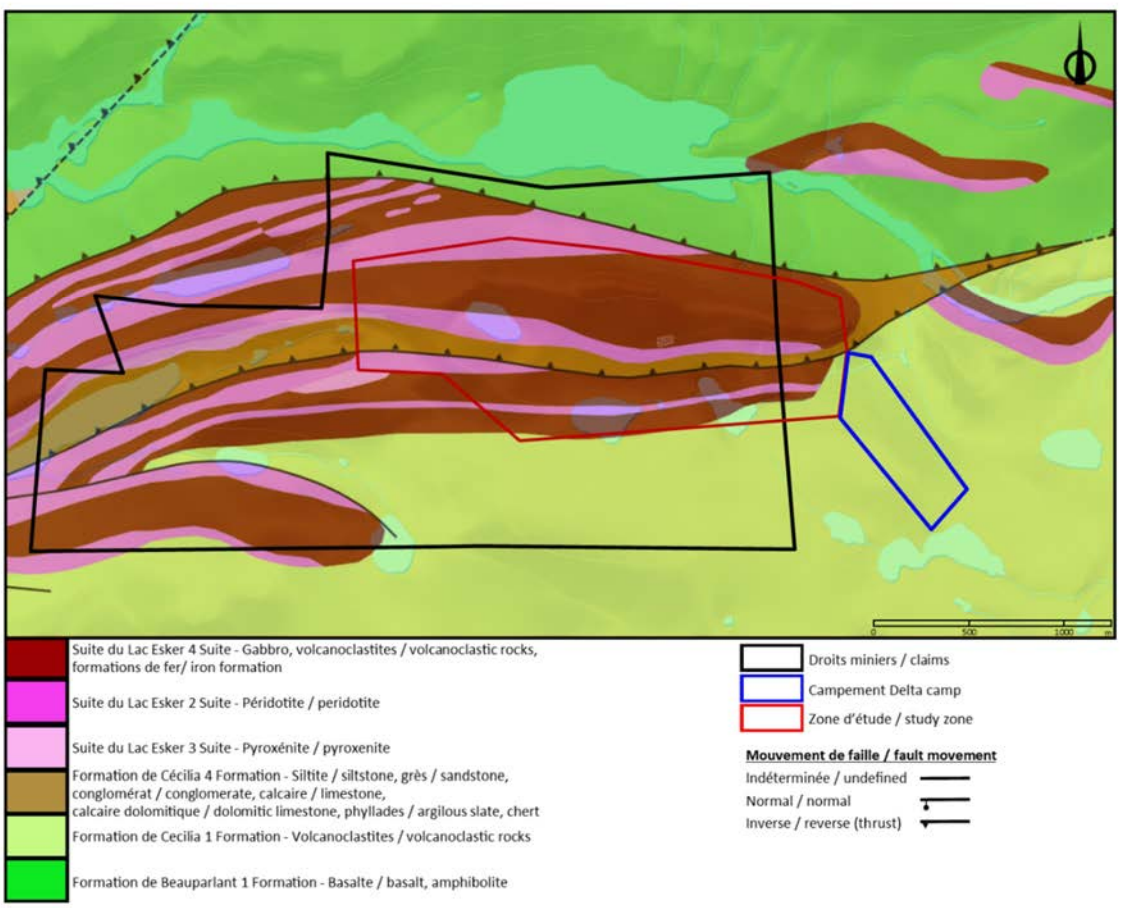


Figure 6-4: Lithologies of the Delta Site and Study Area of Satellite Camp

6.2.4 Topography and Watersheds

6.2.4.1 Topography

The overall area of the NNiP is part of the Puvirnituq Hills physiographic subunit, which is composed of four relatively long and wide rocky ridges (GENIVAR, 2007). The terrain in the Delta project-specific study area is generally flat, with elevations ranging from 406 to 525 m in the Delta site study area, whereas over a larger area (including access roads), elevations range from 387 to 575 m, and are therefore somewhat more rugged (based on the Canadian Digital Elevation Model, NAD83-CSRS-EPSG:4617).

The Delta Project is located on a broad plateau 500 km north of the tree line. The physiography of the terrain is characterized by rolling terrain with some scattered steep hills and a few cliffs. The average elevation is about 465 m (relative to sea level) and the relief is fairly moderate (see Map 5-5 in Section 5.2.1). The elevation at the Puvirnituq River is 350 m and 525 m for the highest hill. Gently sloping valleys predominate around the rivers. Rocky outcrops represent 10 to 15% of the study area (Fisher et al, 1998). The general topography is characterized by rocky ridges and valleys, oriented east-west, with moderate to steep slopes. Observed topographic eminences are generally either rock outcrops or frost heave, while low areas are most often peatland (Simard, 2019), represented by fens. To the north of the Delta site, there is the presence of the deep valley of the Little Puvirnituq River (Ciesielski, 2020; Odewande, 2020).

The outcrops have all been affected by freezing and have been reduced to clusters of angular boulders, small fragments and rock debris (felsenmeer) (Ciesielski, 2020). The study site consists mainly of a ground moraine and the presence of continuous permafrost. Polygonal networks, formed by the presence of ice wedges and ostioles have also been observed on the property (Lauriol et al., 1984; CIMA+, 2019). Overburden thicknesses generally do not exceed 20 m, with values between 1.50 m and 10.30 m (based on drilling; Odewande, 2020). Valleys are typically covered by grassy and/or fens, raised rock/mud rings ("frost boils"; see Photo 6-1), and boulder fields (Ciesielski, 2020).

Source : Wikipédia; https://en.wikipedia.org/wiki/Frost_boil

Photo 6-1: Frost Boil

Analyses of nickel and copper in soils, carried out during previous exploration campaigns (Wolfe, 1974), have shown that several soil samples contained high levels of copper and nickel (Ciesielski, 2020), as shown in Figure 6-5.

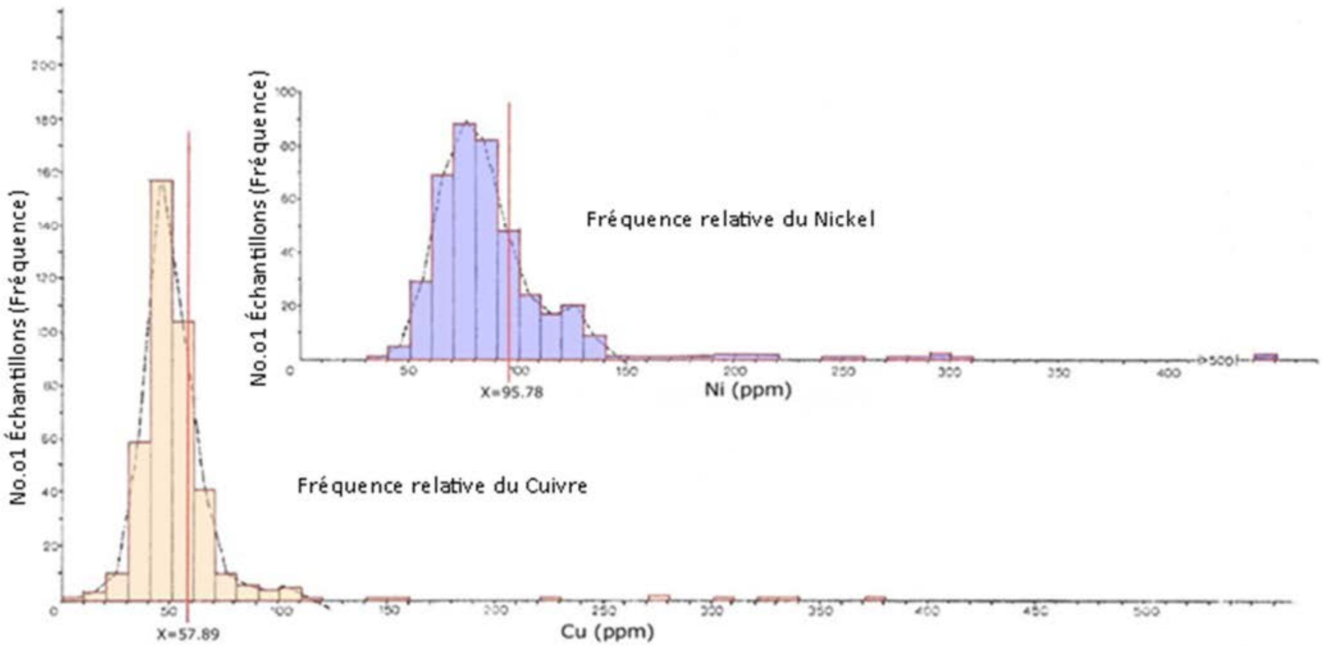


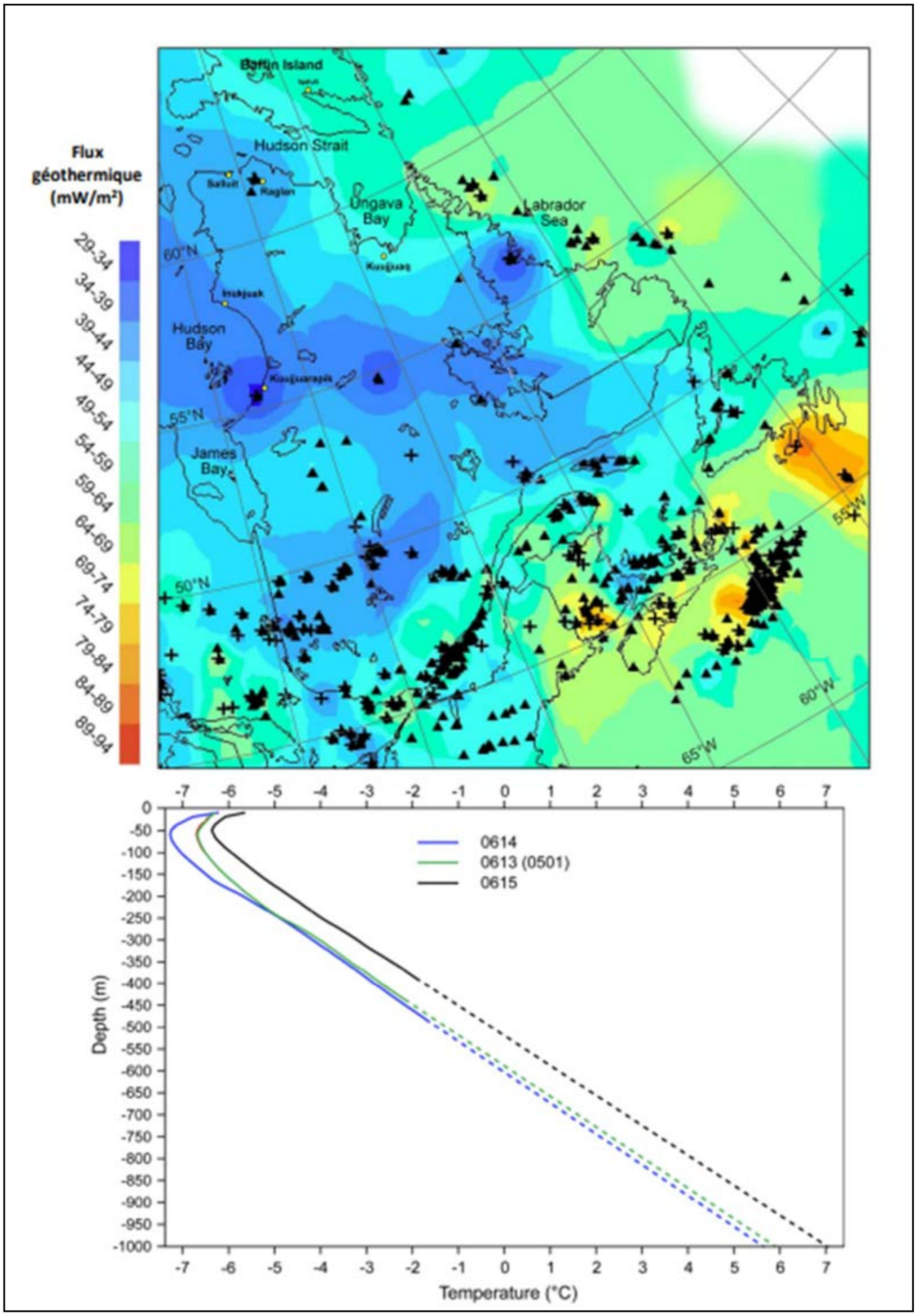
Figure 6-5: Distribution of Copper and Nickel in Sampled Soils Around Delta Lake (Ciesielski, 2020, Wolfe, 1974)

The study area lies within a zone of continuous permafrost, which extends several hundred meters below the surface (Fisher et al, 1998). The area is characterized by permafrost with a depth of at least 300 m (Ciesielski, 2020).

The study area at the Delta site is surrounded by 3 lakes (Lakes 1, 2, and 3 - Map 6-1) that are greater than 200m in diameter. In addition, the presence of confirmed fish populations in two of these three lakes indicates that the lower part of the water column does not freeze during the winter.

As indicated in the initial impact study, the NNiP territory is located in an area of continuous permafrost with an average temperature of less than -5°C and reaching depths of about 500 m in places (GENIVAR, 2007). A more recent study of permafrost in Nunavik, attributes thicknesses of up to 630 m in the Raglan mine area (L'Hérault and Allard, 2018), a mine located in the same soil type as those of NNiP (see Figure 6-6). The drainage capacity of the soils is limited to the layer that is thawed during the summer. And thus, no groundwater is located near the surface given the frozen soil.

No areas of soil erosion were observed in the natural study areas surveyed in 2021 and 2022.



Source: Figure from L'Hérault et Allard (2018)

Figure 6-6: Example for the Raglan Mine of High Precision Geothermal Fluxes (Crosses) Determined From Temperature Records and Estimated (Triangles) from Downhole Temperatures and an Average Thermal Conductivity of Rocks of 2.5 W/m K.

6.2.4.2 Watersheds

The Ungava Peninsula has a highly developed river system (Map 6-5). Within the claim boundaries of the Delta-Kenty property, several lakes are present, some of which are interconnected such as lakes No. 2 and No. 3 (see Map 6-1 at the beginning of this chapter). The water regime observed in this area will be very similar to other northern regions. Spring flooding generally occurs from mid-June to mid-July in conjunction with melting snow cover, with break-up occurring in late June. The lakes have thawed by the end of June or early July. This type of water regime is directly related to the local rainfall in summer and the lack of water flow in winter. It is therefore common for many of the streams located on the property to be intermittent (CIMA+, 2019b; Simard, 2019).

The property is located in the watershed of the Little Puvirnituq River (980.8 km²), which lies at the northern boundary of the site and is thus fed by the lakes and streams on the site (Map 6-5). The Little Puvirnituq River has a permanent flow towards the west-southwest, joining the Puvirnituq River, to flow into Hudson Bay, not far from the village of Puvirnituq. Based on satellite imagery and field visits, several streams are present at the study site in addition to small surface gullies indicative of the impermeability of the underlying permafrost (CIMA+, 2019). The stream connecting Lake No. 2 to Lake No. 3 is intermittent, as is the stream flowing in Lake No. 1 (CIMA+, 2019). The outflow from Lake No. 3 flows into the Little Puvirnituq River. The three lakes surrounding the study site, as well as the watercourses, are part of the same sub-basin (13.5 km²) in the Little Puvirnituq River watershed, with a easterly flow direction (Map 6-5).

6.2.5 Hydrography, Water and Sediment Quality

The Inuit village of Puvirnituq, located over 200 km west of the study area, gets its drinking water from the Puvirnituq River. As previously mentioned, the study site is located in the watershed of this river. The final mining effluent from the NNiP Expo industrial complex is discharged into a tributary of this river. However, the mining effluent from the Delta project will be discharged a maximum of 110 days per year, during the thaw period, from late June to early October. To this end, a study on the quality of surface water was conducted at the mouth of the Puvirnituq River near this village in 2007 (GENIVAR, 2007). In relation to the Monitoring 5 of the Environmental Monitoring Program (EMP) of CRI, an annual water sampling was carried out at the village's drinking water intake from 2011 to 2017. An agreement in principle was reached under the Nunavik Nickel agreement on May 16, 2017 to remove this sampling from the program. An additional monitoring of three surface water stations of the Puvirnituq River has been carried out since 2020, downstream of the stations planned for Monitoring 4 (Surface water - watercourse receiving mining effluents) and has been added to Monitoring 4 of the EMP.

With respect to groundwater, the study area lies within the zone of continuous permafrost. In general, groundwater flow is limited to a few meters in depth, where soils are unfrozen and therefore permeable. This involves the mollisol and talik zones. Mollisol is the surface portion of the soil that is subject to alternating freeze/thaw conditions. The thickness of the mollisol depends on the thermal characteristics of the soil, the geomorphological characteristics and the types of deposits present. Thus, the thickness of the mollisol reaches 2.2 m in Salluit and can reach up to 5 m in Kangiqsualujjuaq. In general, mollisol thicknesses are greater in areas where the grain size is coarser (sand, gravel). The taliks zones correspond to unfrozen zones that may be present under rivers or lakes where the lower water column does not freeze.

During rapid melt of the mollisol or following heavy rainfall, the flow will be more important. This will be mainly on the surface and in the form of water. The topography of the ground and the trails used by wildlife (caribou) will influence the flow of the water, which can lead to the formation of intermittent watercourses between several wetlands. However, these do not constitute fish habitat (GENIVAR, 2007). It should be noted that the limited study area does not contain any aquifers that could be considered as a source of drinking water for Nunavik Inuit communities, according to exploratory drilling performed in the area (Golder, 2022).

The flow of the Little Puvirnituq River was evaluated since this watercourse will receive the mining and sanitary effluents. The values obtained are presented in Table 6-4.

Table 6-4: Assessed Flows in the Tributary

			Summer flow in L/s (m³/s in brackets)				Winter flow in L/s (m³/s in brackets)		
Watercourse	**Location**	**Drained area (km^2)**	**Q avg**	$Q_{2,7}$	$Q_{10,7}$	$Q_{5,30}$	$Q_{2,7}$	$Q_{10,7}$	$Q_{5,30}$
Little Puvirnituq River	Downstream of the tributary CE-D13	543.01	9231.17 (9.23)	760.21 (0.76)	271.51 (0.27)	434.41 (0.43)	54.30 (0.054)	27.15 (0.027)	32.58 (0.033)

The values obtained from the analysis in 2021 for water quality and presented in the following sections were compared with the *Surface water quality criteria* from MELCCFP (2022a), more specifically with the *Quality criteria for the protection of aquatic life*. Two criteria for chemical water quality are used to protect all forms of aquatic life on the short (CVAA – criteria that protect against acute effect) and long-term (CVAC – criteria that protect against chronical effect). The CVAC is the highest concentration of a substance at which no negative effects are produced on the aquatic organisms (and their offspring) while they are exposed daily during their entire life. The CVAA is the maximum concentration of a substance at which aquatic organisms can be exposed for a short period of time without being seriously harmed.

Sediment samples were also collected during the 2021 field inventories. The criteria for assessing the sediment quality in Quebec (EC and MDDEP, 2007) were used to interpret the chemical analysis results of freshwater sediment. There are five reference values required for sediment management in Quebec:

REL: **Rare Effect Level**. This criterion is used to monitor changes in sediment quality. When the concentration of all the substances analyzed is less than, or equal to the REL, no measure is considered, since the sediment is deemed to have no effect on the environment.

TEL: **Threshold Effect Level**. When the concentrations are equal to, or less than the TELs and > RELs, the probability that the sediment will have an impact on the environment is considered low.

OEL: **Occasional Effect Level**. Threshold above which the probability of observing adverse biological effects is relatively high.

PEL: **Probable Effect Level**. Threshold above which the probability of observing adverse biological effects is high.

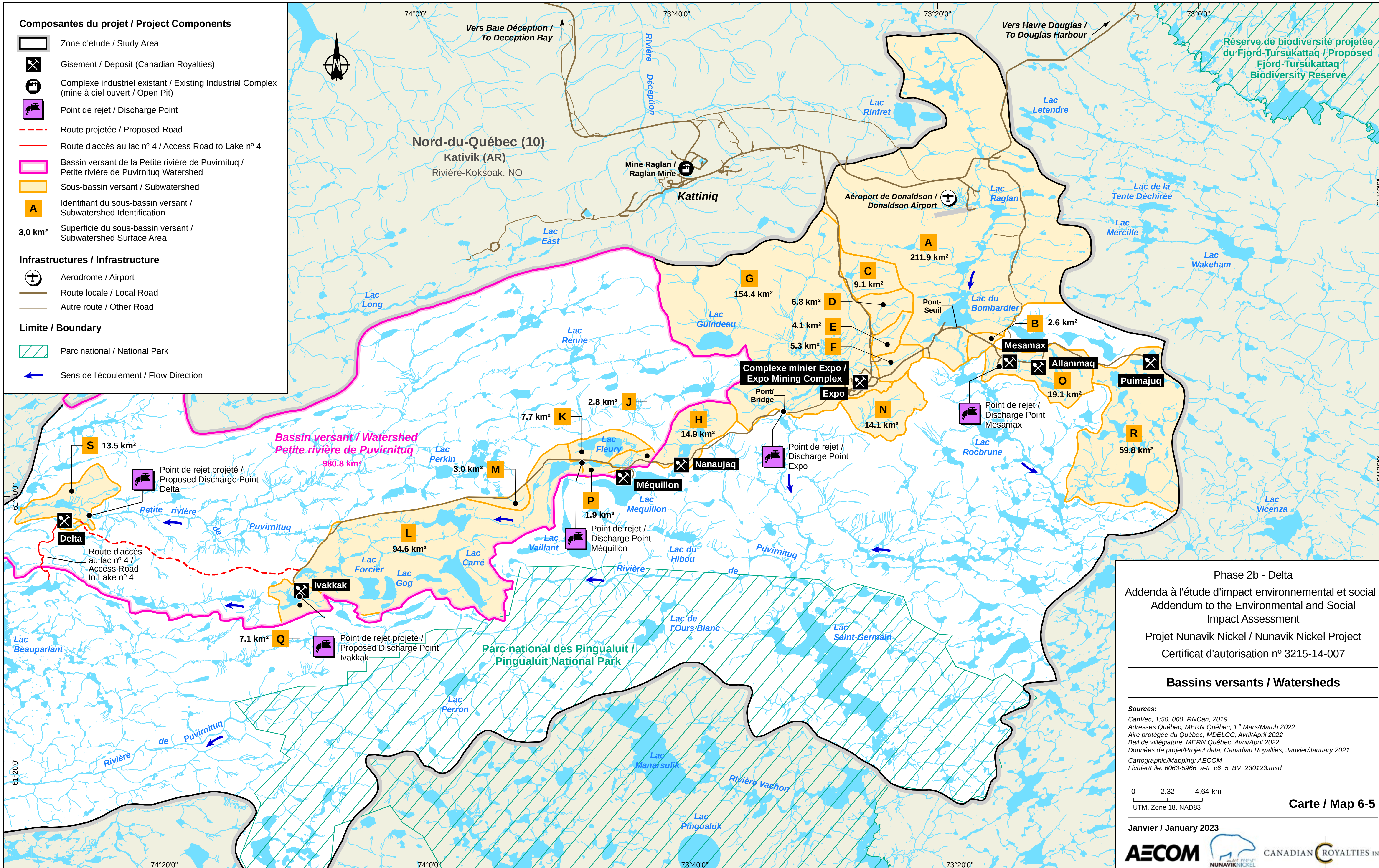
FEL: **Frequent Effect Level**. Threshold above which the probability of observing adverse biological effects is very high.

Although there are five reference values, they are never used simultaneously during sediment management. In fact, only two are used for each of the following three sediment management contexts:

- Prevention of sediment contamination due to industrial discharges;
- Sediment management resulting from dredging activities;
- Restoration of contaminated sites.

Therefore, the occasional effect level (OEL) and the frequent effect level (FEL) constitute the two threshold values that govern the disposal of sediment in aquatic environments (table 6-5).

Furthermore in cases where sediment must be removed from a body of water or a watercourse, it should then be considered as soil if it is found on its banks. Consequently, the sediment quality is also established on the basis of the generic criteria for the soils of Quebec. The latter makes it possible to assess the extent of contamination and to set decontamination objectives for a specific use in the event that the sediment is deposited on land environment (Beaulieu, 2021).


Composantes du projet / Project Components
Zone d'étude / Study Area
Gisement / Deposit (Canadian Royalties)
Complexe industriel existant / Existing Industrial Complex (mine à ciel ouvert / Open Pit)
Point de rejet / Discharge Point
Route projetée / Proposed Road
Route d'accès au lac nº 4 / Access Road to Lake nº 4
Bassin versant de la Petite rivière de Puvirnituq / Petite rivière de Puvirnituq Watershed
Sous-bassin versant / Subwatershed
Identifiant du sous-bassin versant / Subwatershed Identification
3,0 km² Superficie du sous-bassin versant / Subwatershed Surface Area
Infrastructures / Infrastructure
Aerodrome / Airport
Route locale / Local Road
Autre route / Other Road
Limite / Boundary
Parc national / National Park
Sens de l'écoulement / Flow Direction
Vers Baie Déception / To Deception Bay
Vers Havre Douglas / To Douglas Harbour
Réserve de biodiversité projetée du Fjord-Tursukattaq / Proposed Fjord-Tursukattaq Biodiversity Reserve
Nord-du-Québec (10)
Kativik (AR)
Rivière-Koksoak, NO
Mine Raglan / Raglan Mine
Kattiniq
Aéroport de Donaldson / Donaldson Airport
A 211.9 km²
B 2.6 km²
C 9.1 km²
D 6.8 km²
E 4.1 km²
F 5.3 km²
G 154.4 km²
H 14.9 km²
J 2.8 km²
K 7.7 km²
L 94.6 km²
M 3.0 km²
N 14.1 km²
O 19.1 km²
P 1.9 km²
Q 7.1 km²
R 59.8 km²
S 13.5 km²
Complexe minier Expo / Expo Mining Complex
Expo
Pont/ Bridge
Pont-Seuil
Mesamax
Allammaq
Puimajuq
Nanaujaq
Méquillon
Delta
Ivakkak
Point de rejet / Discharge Point Mesamax
Point de rejet / Discharge Point Expo
Point de rejet / Discharge Point Méquillon
Point de rejet projeté / Proposed Discharge Point Delta
Point de rejet projeté / Proposed Discharge Point Ivakkak
Route d'accès au lac nº 4 / Access Road to Lake nº 4
Bassin versant / Watershed Petite rivière de Puvirnituq
980.8 km²
Parc national des Pingualuit / Pingualuit National Park
Rivière Déception
Lac Rinfret
Lac Letendre
Lac Raglan
Lac de la Tente Déchirée
Lac Mercille
Lac Wakeham
Lac du Bombardier
Lac East
Lac Long
Lac Renne
Lac Guindeau
Lac Perkin
Lac Fleury
Lac Mequillon
Lac Rocbrune
Lac Vicenza
Lac Vaillant
Lac du Hibou
Lac Carré
Lac Forcier
Lac Gog
Lac Beauparlant
Lac de l'Ours Blanc
Lac Saint-Germain
Lac Perron
Lac Manarsulik
Lac Pingualuk
Rivière Vachon
Petite rivière de Puvirnituq
Rivière de Puvirnituq
74°0'0"
73°40'0"
73°20'0"
73°0'0"
74°20'0"
61°40'0"
61°30'0"
61°20'0"
Phase 2b - Delta
Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment
Projet Nunavik Nickel / Nunavik Nickel Project
Certificat d'autorisation nº 3215-14-007
Bassins versants / Watersheds
Sources:
CanVec, 1;50, 000, RNCan, 2019
Adresses Québec, MERN Québec, 1er Mars/March 2022
Aire protégée du Québec, MDELCC, Avril/April 2022
Bail de villégiature, MERN Québec, Avril/April 2022
Données de projet/Project data, Canadian Royalties, Janvier/January 2021
Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c6_5_BV_230123.mxd
0 2.32 4.64 km
UTM, Zone 18, NAD83
Carte / Map 6-5
Janvier / January 2023
AECOM
NUNAVIK NICKEL
CANADIAN ROYALTIES INC.

In fact, soil management implies compliance with the standards and provisions stated in the *Regulation respecting contaminated soil storage and contaminated soil transfer stations (RESC)*[10] and the *Guide d'intervention – Protection des sols et réhabilitation des terrains contaminés (Intervention Guide – Soil Protection and Rehabilitation of Contaminated Sites)* (Beaulieu, 2021*)*. The basic principle stipulates that contaminated soil (or sediment) cannot be disposed on soil with contaminant concentrations lower than these contaminated soils (or sediment.

Table 6-5: Context of Application of Quality Criteria for Dredged Sediments in Quebec

	Level (- → +)				
Expected impact	The probability of measuring adverse biological effects is relatively low.	Threshold OEL[A]	The probability of measuring adverse biological effects is relatively high and increases with concentration.	Threshold FEL[B]	The probability of measuring adverse biological effects is very high.
Dredged sediment management	Sediment can be discharged into open water or be used for other purposes as long as the deposit does not contribute to the deterioration of the receiving environment.		Disposal in open water can only be considered as a valid option if the toxicity tests indicate that the sediments is harmless for the receiving environment and if the deposit does not contribute to the deterioration of the receiving environment.		Discharging into open water is prohibited. Sediment must be treated or safely contained according to the *Guide d'intervention – Protection des sols et réhabilitation des terrains contaminés (Intervention Guide – Soil Protection and Rehabilitation of Contaminated Sites)* (Beaulieu, 2021).

Source: Environment Canada and MDDEP, 2007.
[A]: Occasional effect level.
[B]: Frequent effect level.

The criteria (A, B, C) are defined as follows:

- Criteria A: Background levels for inorganic parameters and quantification limit[11] for organic parameters. For the latter, this criterion corresponds to the quantification limit since these are contaminants that are not found naturally in the soil.
- Criteria B: Maximum acceptable limit for residential lands or lands where certain institutional uses take place such as:
  - Primary or secondary schools;
  - Childcare centres;
  - Daycare centres;
  - Hospitals;
  - Long-term and homecare centres;
  - Rehabilitation centres;
  - Child and youth protection centres;
  - Detention facilities;
  - The first meter of the playgrounds in municipal parks.

[10] https://www.legisquebec.gouv.qc.ca/en/document/cr/Q-2,%20r.%2046
[11] The quantification limit is defined as the minimum concentration that can be quantified using an analytical method with a defined reliability.

- Criteria C: Maximum acceptable limit for industrial, commercial, non-sensitive institutional and recreational lands (bike paths and municipal parks, except for the first meter of playgrounds), in addition to those intended to form the base of a roadway or bordering sidewalk.

6.2.5.1 Hydrography of the study area

As presented previously, the study area is located in the Little Puvirnituq River watershed. Within the limits of this property, the characterization revealed the presence of several lakes that feed this river. In addition to these lakes, several watercourses are present. One major watercourse is present in the study area, the Little Puvirnituq River, which has a mean summer flow of approximately 9.2 m^3/s (see Table 5-33 in section 5.2.5).

During the 2021 and 2022 inventories, a total of seven permanent streams were identified throughout the Delta Site study area and roads to be developed. Of these streams, only one is located on the selected alternative road to Lake No. 4 for drinking water (CE-D38) (Map 6-4), one is located between the Delta camp and the site (CE-D13) (Map 6-3; Sheet 3), four are located on the selected alternative of the Ivakkak-Delta road (Map 6-3; Sheets 1 to 3), and one is located to the north of the Delta site (Little Puvirnituq River) (Map 6-3). Concerning intermittent streams, these are very numerous and as mentioned above, they serve as drainage during snowmelt and mainly connect wetlands/bogs. They are not considered to be fish habitat by any means. Within the study area of the proposed Ivakkak-Delta road, four intermittent streams have been identified in 2021, two of which pass under the proposed road. Within the Delta study area, 23 intermittent streams have been identified, most of which are located in the northern part of the study area. However, one of these streams will require a culvert (CEI-D20). Finally, three intermittent streams were identified within the study area of the proposed road between the Delta site and Lake No.4, none of which pass under the road, and two were identified within the study area of the potential Delta 2 quarry.

Table 6-6 reports the main characteristics of each of the permanent streams present in the Ivakkak-Delta road study area (CE-D1, CE-D2, CEC-D8, CE-D10 and CE-D13), the Delta site study area (Little Puvirnituq River) and along the future drinking water access road (CE-D38). This table also presents their fish habitat potential in terms of spawning, rearing and feeding, while Appendix H presents the detailed results of the physical characterization of all streams (intermittent and permanent).

6.2.5.2 Surface Water Quality

The quality of surface water, streams and water bodies at the study site, was assessed by CIMA+ in August 2019 via in situ physico-chemical water measurements as well as by taking surface water samples ($n = 10$) for laboratory analysis. Sampling was conducted at wading stations for each of the streams, and water bodies, present within the property boundaries for laboratory analysis of metals, nutrients, and various water quality parameters (Map 6-1). In 2022, six new stations were sampled for surface water quality analyses to further characterize the ambient environment that may receive treated (mining and sanitary) wastewater (Map 6-1).

The criteria used for comparison are those related to the protection of aquatic life (MELCCFP and CCME) and preventing the contamination of aquatic organisms that may be harmful for human consumption (MELCCFP). Details on the methodology and processing of the results are provided in Appendix G.

Table 6-6: Characteristics of Permanent Streams in the Delta Project Study Area

Characteristics	CE-D1	CE-D2	CE-D8	CE-D10	CE-D13	CE-D38	Little Puvirnituq River
Average width at bankfull (m)	2.3	0.5	1.2	0.75	3.5	18	101
Average width (m)	2.3	0.3	1.2	0.75	3.2	10	91.7
Flow type	Lentic	Lotic	Lotic	Lotic	Lotic-Lentic	Lotic	Lotic-Lentic
Facies type	Meander	Cascades	Channel	Channel	Various	Channel	Pools and runs
Substrate (R=rock, B=boulder; CO=cobble; P=pebble; GR=gravel; S=sand; C=clay; SI=silt, MO=organic matter)	40%SI 25%CO 20%OM 10%P 5%R	20% P-SI-OM 15%GR 10%S 5% CO	60%P 15% CO - GR 5%B-S	35%SI 15%CO-P-GR 10%B 5%S- OM	30%Ga 20%P 15%B-SI 10% OM 5%R-GR	70%P 20%GR 10%CO Deposits of OM on the substrate	50 %CO 20%B-P 5%S-GR
Average current speed (m/s)	0.09	0.09	0.08	0.08	0.08	<0.05	Between 0 and 0.43 depending on the section
Average depth (m)	0.16	0.03	0.15	0.11	0.16	0.3	Between 0.24 et 2.0 m depending on the section
Max. depth (m)	0.35	0.05	0.38	0.45	0.65	0.5	Between 0.45 et 2.5 m depending on the section
Passability P=passable, PR = passable with reserve, IR= impassable with reserve, I=Impassable;	I	I	I	P	PR	P	P
Potential fish habitat (salmonids and cottids) Spawning Rearing Feeding adults	Null	Null	Null	Limited Null Low Null	Limited Null Low-medium	High High High High	High High High High

Results of 2019

Table 6-7 reports the water quality results obtained in 2019 (stations ST1 through ST10) and presented in the CIMA+ study (2019).

In the absence of industrial activity at the site, only copper shows exceedances of the quality criterion for all stations, i.e. the MELCCFP CVAC. This criterion is also exceeded for nickel at one station (ST8 - lake not affected by future activities). In the case of exceedances of the MELCCFP CVAA criterion, they are observed for copper at six of the stations, including one in the Little Puvirnituq River (ST9). These exceedances are explained by naturally high copper levels in the study area (CIMA+, 2019). Thus, copper concentrations are naturally higher than the MELCCFP criteria.

The criterion for the prevention of contamination of aquatic organisms that may be harmful for human consumption is not exceeded for any of the parameters measured.

For the CCME aquatic life guidelines, they are exceeded for long-term exposure for aluminum at two stations (one in the Little Puvirnituq River), copper at four stations and iron at three stations (one in the Little Puvirnituq River).

Very few guidelines for the protection of aquatic life for short-term exposure exist for the parameters measured. None of these guidelines are exceeded.

Among the general findings, it is noted that C10-C50 hydrocarbons are not detected (<0.1 mg/l), as well as total phosphorus (<0.02 mg/l) and nitrates and nitrites (<0.04 mg/l). The total Kjeldahl nitrogen ranges from <0.3 to 0.5 mg/l. For the three lakes surrounding the future Delta site in operation, no criteria exceedances are observed except for the CVAC for copper.

In terms of in situ measurements (August 2019), the water temperature ranges from 7.7 to 12.4 °C. The pH is relatively neutral (6.56 to 7.44) and the conductivity varies from 18.8 to 43.0 µS/cm, showing that the water has a low ionic charge. With respect to turbidity, it remains low, with a few values exceeding 1.0 NTU for only three stations, for which it is argued that the values were influenced by turbulence generated by strong winds at the time of sampling (CIMA+, 2019).

It is reported by CIMA+(2019) that the presence of an old camp and dump site nearby could be potential sources of contamination. Numerous debris were observed there, including metals, fuel drums, batteries, etc. However, water quality results do not indicate any transport of contaminants into the aquatic environment.

Table 6-7: Surface Water Quality by Sampling Station - August 9, 2019 (CIMA+, 2019)

Parameter	Unit	ST1	ST2	ST3	ST4	ST5	ST6	ST7	ST8	ST9	ST10	MELCCFP – PCO	MELCCFP–CVAC	CCME – Long term	MELCCFP– CVAA	CCME – Short term
Conventional and other elements																
Conductivity (*in-situ*)	µS/cm	30.7	30.6	22.6	30.6	18.8	26.9	31.1	32.2	22.9	43					
pH (*in-situ*	-	7.1	7.2	6.6	7.4	7.1	6.8	6.8	6.8	6.6	7.1		6.5 to 9.0	**6.5 to 9.0**	5.0 to 9.0	
Temperature (*in-situ)*	º C	11.7	12.4	10.2	9.8	11.2	10.8	12	12.3	7.7	8.5					
Turbidity (*in-situ)*	mg/L	0.65	0.29	0.82	0.29	0.66	0.30	0.68	1.37	2.79	5.31					
Nutrients																
Total Kjeldahl nitrogen	mg/L	0.40	<0.3	0.50	0.50	0.40	0.30	0.30	<0.3	0.40	0.30					
Nitrates and Nitrites	mg/L - N	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04					
Phosphorous (total)	mg/L - P	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		0.03			
Total Metals																
Aluminium	mg/L	0.012	<0.010	0.030	<0.010	<0.012	<0.010	0.037	0.066	**0.116**	**0.187**			0.10		
Antimony	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.64	0.240		1.100	
Silver	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	11	0.0001	0.00025	0.0001	
Arsenic	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.021	0.150	0.005	0.340	
Barium	mg/L	0.0030	0.0020	0.0010	0.0080	0.0080	0.0030	0.0020	0.0020	0.0020	0.0020	160	0.038		0.108	
Boron	mg/L	<0.04	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	160	5	1.5	28	29
Beryllium	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	1.2	0.0001		0.0012	
Cadmium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.13	0.000049	0.000040	0.000205	0.000202
Chrome	mg/L	<0.0005	<0.0005	0.0006	<0.0005	0.001	<0.0005	0.0007	<0.0005	0.001	0.0017					
Cobalt	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00070		0.10		0.37	
Copper	mg/L	0.0019	**0.0023**	0.0015	0.0014	0.0014	0.0015	**0.0021**	**0.0029**	0.0017	**0.0039**	38	0.0013	0.0020	0.0016	
Tin	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005					
Iron	mg/L	0.11	0.05	0.18	0.14	0.15	0.16	0.19	**0.33**	**0.35**	**0.54**			0.30	3.4	
Manganese	mg/L	0.002	0.002	0.016	0.009	0.012	0.020	0.005	0.013	0.011	0.027	59	0.255	0.25	0.551	
Molybdenum	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	10	3.2	0.073	29	
Nickel	mg/L	0.0030	0.0070	0.0020	0.0030	0.0040	0.0030	0.0040	0.0090	0.0030	0.0070	4.6	0.0074	0.0250	0.0669	
Selenium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	21	0.005	0.001	0.062	
Strontium	mg/L	0.0180	0.009	0.003	0.034	0.029	0.011	0.011	0.01	0.003	0.003		21		40	
Thallium	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00047	0.0072	0.0008	0.047	
Titanium	mg/L	<0.002	<0.002	<0.002	<0.002	<0.004	<0.002	<0.002	<0.003	<0.006	0.01					
Vanadium	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0008	0.001	2.2	0.012		0.11	
Zinc	mg/L	0.0080	<0.003	0.004	0.004	0.004	<0.003	0.006	0.005	<0.003	0.004	26	0.0170		0.0170	
Major Ions																
Calcium	mg/L	5.08	3.05	2.02	7.05	5.73	3.18	3.39	3.42	2.15	1.18					
Lithium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	58	0.44		0.91	
Magnesium	mg/L	2.29	1.73	1.59	2.47	1.46	1.38	1.69	1.89	1.64	4.40					
Lead	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.19	0.00017	0.0010	0.00435	
Potassium	mg/L	0.57	<0.005	<0.005	0.60	0.53	0.50	0.51	<0.005	<0.005	<0.005					
Sodium	mg/L	0.69	0.514	0.507	0.875	0.58	0.516	0.644	0.549	0.478	0.441					

Table 6-7: Surface Water Quality by Sampling Station - August 9, 2019 (CIMA+, 2019) (Continued)

Parameter	Unit	ST1	ST2	ST3	ST4	ST5	ST6	ST7	ST8	ST9	ST10	MELCCFP – PCO	MELCCFP–CVAC	CCME – Long term	MELCCFP– CVAA	CCME – Short term
Hydrocarbons																
Hydrocarbons C_{10}-C_{50}	mg/L	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		0.011 to 0.2		0.11 to 2.8	
Rare minerals																
Uranium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		0.014	0.015	0.032	0.033

Note : Water quality criteria/recommendations for some metals were based on a water hardness value of 10 mg/l CaCO3 (CIMA+, 2019);

Note 2 : An empty field indicates that no criteria are available or applicable.

abc : Concentration above the contamination prevention criteria (PCO) (aquatic organisms only); MELCCFP (2022a));

abc : Concentration above the aquatic life protection criterion - chronic effect (CVAC); MELCCFP (2022a);

abc : Concentration above the guideline for the protection of aquatic life (long-term exposure); CCME (2022);

abc : Concentration above the aquatic life protection criterion - acute effects (CVAA); MELCCFP (2022a);

abc : Concentration above the guideline for the protection of aquatic life (short-term exposure); CCME (2022).

Results from 2022

Tables 6-8 and 6-9 report the water quality results for 2022 (QErecep1 to QErecep6).

As noted in 2019, only copper demonstrates exceedances (or else equivalent values) of water quality criteria/guidelines for most stations:

- The chronic effect level is exceeded for stations EQrecep4 to 6.
- The acute effect level is exceeded at QErecep4 and QErecep5. Station QErecep6 is equal to, but does not exceed, the criterion.
- The long-term effect level is not exceeded at any of the stations, but values equal to this guideline are observed for stations QErecep1 and QErecep3 at 6.

No short-term concentration criteria exist for copper and no values are above the contamination prevention criterion for aquatic organisms. These results confirm that the observed exceedances are the result of naturally high levels of copper in watershed soils and sediments.

None of the other measured parameters show any exceedance of water quality criteria/recommendations.

Among the general findings, it is noted that C_{10}-C_{50} hydrocarbons are not detected (< 0.1 mg/l) and that nutrient (nitrogen compounds and total phosphorus) and total metal concentrations are generally measured in low quantities (often below the detection limit). The water is low in alkalinity (< 30 mg/l $CaCO_3$), low in hardness (< 50 mg/l $CaCO_3$), and well oxygenated (> 9 mg/l).

In terms of in situ measurements, the water temperature ranged from 9.7 to 12.0 °C at the time of the inventories. The pH is relatively neutral (6.8 to 7.3) and the conductivity varies from 21.8 to 91.1 µS/cm, showing that the water has an ionic charge. Turbidity remains low, with values below 1.0 NTU for all stations.

Quality control from 2022

The field blanks show values that are for the vast majority of the data below the detection limit (Appendix I), demonstrating that any biases that could be attributable to field manipulations are negligible.

Note that since the hardness values were documented for each sample, it was possible to evaluate the specific criteria according to the hardness for the parameters where necessary.

Table 6-8: Surface water quality by sampling station for QErecep1 to 3 - August 21, 2022

Parameter (mg/L)	QErecep 1	MELCCFP PCO	MELCCFP CVAC	CCME Long term	MELCCFP CVAA	CCME Short term	QErecep 2	MELCCFP PCO	MELCCFP CVAC	CCME Long term	MELCCFP CVAA	CCME Short term	QErecep 3	MELCCFP PCO	MELCCFP CVAC.	CCME Long term	MELCCFP CVAA	CCME Short term
Conventional and other elements																		
Alkalinity	24.7						25.6						12.9					
Conductivity in situ (µS/cm)	80.4						91.1						44.5					
Conductivity (at 25 °C) (µS/cm)	92						105						41					
BOD5	3.0		3.0				2.0		3.0				<2		3.0			
COD	8						<5						7					
Hardness	37.9						40.9						17.6					
Dissolved oxygen in situ (%)	91.1						89.4		6.0	5.5			94.5		5.0	5.5		
Dissolved oxygen in situ (mg/L)	9		6.0	5.5			10		6.0	5.5			10		5.0	5.5		
pH in situ	6.9		6.5 to 9.0	6.5 to 9.0	5.0 to 9.0		7.3		6.5 to 9.0	6.5 to 9.0	5.0 to 9.0		6.8		6.5 to 9.0	6.5 to 9.0	5.0 to 9.0	
pH	6.93		6.5 to 9.0	6.5 to 9.0	5.0 to 9.0		7.16		6.5 to 9.0	6.5 to 9.0	5.0 to 9.0		7.14		6.5 to 9.0	6.5 to 9.0	5.0 to 9.0	
Temperature in situ (o C)	9.7						9.9						10					
Turbidity	0.40						0.20						0.50					
TSS	<2						<2						<2					
Dissolved solids	64						80						34					
Total solids	74						82						36					
Nutrients																		
Ammoniacal nitrogen	<0.02		3.00	8.47	3.00		0.02		2.90	8.47	2.90		<0.02		4.00	26.65	4.00	
Total Kjeldahl nitrogen	0.50						0.40						0.40					
Ionized ammonia	<0.02						0.02						<0.02					
Non-ionized Ammonia	<0.02			0.019			<0.02			0.019			<0.02			0.019		
Nitrates	<0.02		3.0	13.00		*550*	0.020		3.0	13.00		*550*	<0.02		3.0	13.00		*550*
Nitrites	<0.02		0.10	0.06	0.300		<0.02		0.20	0.06	0.600		<0.02		0.02	0.06	0.060	
Nitrates+Nitrites	<0.04						<0.04						<0.04					
Total Phosphorus	<0.02		0.03				<0.02		0.03				<0.02		0.03			
Total metals																		
Aluminium	0.010		0.52	0.10	1.30		0.006		0.57	0.10	1.40		0.013		0.34	0.10	0.68	
Silver	<0.0005	11	0.0001	0.00025	0.0008		<0.0005	11	0.0001	0.00025	0.0009		<0.0005	11	0.0001	0.00025	0.0002	
Arsenic	<0.001	0.021	0.150	0.005	0.340		<0.001	0.021	0.150	0.005	0.340		<0.001	0.021	0.150	0.005	0.340	
Barium	<0.01	160	0.156		0.445		0.0100	160	0.169		0.483		<0.01	160	0.069		0.197	
Beryllium	<0.0001	1.2	0.0013		0.0117		<0.0001	1.2	0.0015		0.0133		<0.0001	1.2	0.0004		0.0032	
Cadmium	<0.000045	0.13	0.000132	0.000071	0.000796	0.000783	<0.000045	0.13	0.000140	0.000075	0.000860	0.000846	<0.000045	0.13	0.000075	0.000037	0.000365	0.000359
Chrome	<0.001						<0.001						<0.001					
Cobalt	<0.00125		0.10		0.37		<0.00125		0.10		0.37		<0.00125		0.10		0.37	
Copper	0.0020	38	0.0041	0.0020	0.0056		0.0010	38	0.0043	0.0020	0.0060		0.0020	38	0.0021	0.0020	0.0027	

Table 6-8: Surface water quality by sampling station for QErecep1 to 3 - August 21, 2022 (Continued)

Parameter (mg/L)	QErecep 1	MELCCFP PCO	MELCCFP CVAC	CCME Long term	MELCCFP CVAA	CCME Short term	QErecep 2	MELCCFP PCO	MELCCFP CVAC	CCME Long term	MELCCFP CVAA	CCME Short term	QErecep 3	MELCCFP PCO	MELCCFP CVAC.	CCME Long term	MELCCFP CVAA	CCME Short term
Total metals																		
Iron	**0.36**		See Fct[b]	0.30	3.4		<0.05		See Fct[b]	0.30	3.4		0.10		See Fct[b]	0.30	3.4	
B-Correction Factor (Iron)	0.12		1.30				-		1.30				0.03		1.30			
Manganese	0.019	59	0.823	0.25	1.776		<0.002	59	0.880	0.26	1.898		0.004	59	0.419	0.21	0.905	
Mercury	0.0000021	0.0000018	0.00091	0.000026	0.00160		0.0000015	0.0000018	0.00091	0.000026	0.00160		0.000002	0.0000018	0.00091	0.000026	0.00160	
Molybdenum	<0.001	10	3.2	0.073	29		<0.001	10	3.2	0.073	29		<0.001	10	3.2	0.073	29	
Nickel	0.0040	4.6	0.0230	0.0250	0.2065		0.0020	4.6	0.0245	0.0250	0.2202		0.0030	4.6	0.0120	0.0250	0.1079	
Lead	<0.0005	0.19	0.00093	0.0010	0.02374		<0.0005	0.19	0.00102	0.0010	0.02616		<0.0005	0.19	0.00035	0.0010	0.00894	
Selenium	<0.0005	21	0.005	0.001	0.062		<0.0005	21	0.005	0.001	0.062		<0.0005	21	0.005	0.001	0.062	
Thallium	<0.0004	0.00047	0.0072	0.0008	0.047		<0.0004	0.00047	0.0072	0.0008	0.047		<0.0004	0.00047	0.0072	0.0008	0.047	
Zinc	0.0050	26	0.0527		0.0527		0.026	26	0.0562		0.0562		<0.004	26	0.0275		0.0275	
Rare minerals																		
Uranium	<0.0075		0.014	0.015	0.032	0.033	<0.0075		0.014	0.015	0.032	0.033	<0.0075			0.015		0.033
Major Ions																		
Calcium	8.30						10.00						3.50					
Chlorides	9		230	120	860	640	12.9		230	120	230	120	1.6		230	120	230	120
Fluoride	<0.05		0.200	0.12	4.00		<0.05		0.200	0.12	4.00		<0.05		0.200	0.12	4.00	
Magnesium	4.17						3.88						2.15					
Potassium	<0.5						<0.5						<0.5					
Sodium	1						0.9						0.5					
Sulphates	4.7						5.1						1.9		500		500	
Hydrocarbons and oils																		
Hydrocarbons C10-C50	<0.1		0.011 to 0.2		0.11 to 2.8		<0.1		0.011 to 0.2		0.11 to 2.8		<0.1		0.011 to 0.2		0.11 to 2.8	
Radioactive isotopes																		
Radium 226 (Bq/L)	<0.01						<0.01						<0.01					

Note : An empty field indicates that no criteria are available or applicable.

abc : Concentration above contamination prevention criteria (PCO) (aquatic organisms only); MELCCFP (2022a);

abc : Concentration above the criterion for the protection of aquatic life (chronic effect)); MELCCFP (2022a);

abc : Concentration above the guideline for the protection of aquatic life (long-term exposure); CCME (2022);

abc : Concentration above the criterion for the protection of aquatic life (acute effect)MELCCFP (2022a);

abc : Concentration above the guideline for the protection of aquatic life (short-term exposure); CCME (2022).

Table 6-9: Surface Water Quality by Sampling Station for QErecept4 to 6 – August 21, 2022

Parameter (mg/L)	Qrecep 4	MELCCFP PCO	MELCCFP CVAC	CCME Long term	MELCCFP CVAA	CCME Short term	Qrecep 5	MELCFPC PCO	MELCCFP CVAC	CCME Long term	MELCCFP CVAA	CCME Short term	Qrecep 6	MELCCFP PCO	MELCCFP CVAC	CCME Long term	MELCCFP CVAA	CCME Short term
Conventional and other elements																		
Alkalinity	8,9						9,4						10,7					
Conductivity *in situ* (µS/cm)	31,8						34,3						35,5					
Conductivity (at 25 °C) (µS/cm)	24						27						28					
BOD_5	<2		3				<2		3				<2		3			
COD	7						8						10					
Hardness	12,2						12,1						12,9					
Dissolved oxygen *in situ* (%)	92,2		5	5,5			93,3		5	5,5			88		5	5,5		
Dissolved oxygen in situ (mg/L)	10		5	5,5			10		5	5,5			10		5	5,5		
pH *in situ*	7,1		6,5 to 9,0		5,0 to 9,0		6,9		6,5 to 9,0		5,0 to 9,0		6,9		6,5 to 9,0	6,5 to 9,0	5,0 to 9,0	
pH	6,98		6,5 to 9,0		5,0 to 9,0		6,96		6,5 to 9,0		5,0 to 9,0		7,03		6,5 to 9,0	6,5 to 9,0	5,0 to 9,0	
Temperature *in situ* (º C)	10,1						10,9						12					
Turbidity	0,6						0,7						0,6					
SS	2						<2						<2					
Dissolved solids	14						32						36					
Total solids	<25						38						36					
Nutrients																		
Ammoniacal nitrogen	<0,02		2,9	2,68	2,9		<0,02		3,2	8,47	3,2		<0,02		3,6	26,65	3,6	
Total Kjeldahl nitrogen	0,4						0,5						0,4					
Ionized ammonia	<0,02						<0,02						<0,02					
Non-ionized Ammonia	<0,02			0,019			<0,02			0,019			<0,02			0,019		
Nitrates	<0,02		3	13		550	<0,02		3	13		550	<0,02		3	13		550
Nitrites	<0,02		0,02	0,06	0,06		<0,02		0,02	0,06	0,06		<0,02		0,02	0,06	0,06	
Nitrates+Nitrites	<0,04						<0,04						<0,04					
Total Phosphorus	<0,02		0,03				0,02		0,03				<0,02		0,03			
Total metals																		
Aluminum	0,024		0,7	0,1	1,7		0,033		0,52	0,1	1,3		0,021		0,41	0,1	0,9	
Silver	<0,0005	11	0,0001	0,00025	0,0001		<0,0005	11	0,0001	0,00025	0,0001		<0,0005	11	0,0001	0,00025	0,0001	
Arsenic	<0,001	0,021	0,15	0,005	0,34		<0,001	0,021	0,15	0,005	0,34		<0,001	0,021	0,15	0,005	0,34	
Barium	<0,01	160	0,047		0,134		<0,01	160	0,046		0,132		<0,01	160	0,05		0,142	

Table 6-9: Surface Water Quality by Sampling Station for QErecept4 to 6 – August 21, 2022 (Continued)

Parameter (mg/L)	Qrecep 4	MELCCFP PCO	MELCCFP CVAC	CCME Long term	MELCCFP CVAA	CCME Short term	Qrecep 5	MELCFPC PCO	MELCCFP CVAC	CCME Long term	MELCCFP CVAA	CCME Short term	Qrecep 6	MELCCFP PCO	MELCCFP CVAC	CCME	MELCCFP	CCME
Total metals																		
Beryllium	<0,0001	1,2	0,0002		0,0017		<0,0001	1,2	0,0002		0,0017		<0,0001	1,2	0,0002		0,0019	
Cadmium	<0,000045	0,13	0,000057	0,00004	0,000251	0,000248	<0,000045	0,13	0,000057	0,00004	0,000249	0,000246	<0,000045	0,13	0,000059	0,00004	0,000266	0,000262
Chrome	<0,001						<0,001						<0,001					
Cobalt	<0,00125		0,1		0,37		<0,00125		0,1		0,37		<0,00125		0,1		0,37	
Copper	0,002	38	0,0015	0,002	0,0019		0,002	38	0,0015	0,002	0,0019		0,002	38	0,0016	0,002	0,002	
Iron	0,11		See Fct[b]	0,3	3,4		0,17		See Fct[b]	0,3	3,4		0,11		See Fct[b]	0,3	3,4	
B-Correction Factor (Iron	0,06		1,3				0,06		1,3				0,04		1,3			
Manganese	0,002	59	0,304	0,26	0,656		0,01	59	0,302	0,25	0,651		0,004	59	0,319	0,23	0,689	
Mercury	0,0000021	0,0000018	0,00091	0,000026	0,0016		0,0000026	0,0000018	0,00091	0,000026	0,0016		0,0000022	0,0000018	0,00091	0,000026	0,0016	
Molybdenum	<0,001	10	3,2	0,073	29		<0,001	10	3,2	0,073	29		<0,001	10	3,2	0,073	29	
Nickel	0,003	4,6	0,0088	0,025	0,0791		0,004	4,6	0,0087	0,025	0,0786		0,003	4,6	0,0092	0,025	0,083	
Lead	<0,0005	0,19	0,00022	0,001	0,00561		<0,0005	0,19	0,00022	0,001	0,00555		<0,0005	0,19	0,00023	0,001	0,00602	
Selenium	<0,0005	21	0,005	0,001	0,062		<0,0005	21	0,005	0,001	0,062		<0,0005	21	0,005	0,001	0,062	
Thallium	<0,0004	0,00047	0,0072	0,0008	0,047		<0,0004	0,00047	0,0072	0,0008	0,047		<0,0004	0,00047	0,0072	0,0008	0,047	
Zinc	<0,004	26	0,0202		0,0202		<0,004	26	0,02		0,02		<0,004	26	0,0211		0,0211	
Calcium	1,74						1,97						2,06					
Chlorides	0,7		230	120	230	120	0,9		230	120	230	120	0,8		230	120	230	120
Fluoride	<0,05		0,2	0,12	4		<0,05		0,2	0,12	4		<0,05		0,2	0,12	4	
Magnesium	1,91						1,74						1,89					
Potassium	<0,5						<0,5						<0,5					
Sodium	0,6						<0,5						<0,5					
Sulphates	0,9		500		500		1,2		500		500		1,5		500		500	
Uranium	<0,0075			0,015		0,033	<0,0075			0,015		0,033	<0,0075			0,015		0,033
Hydrocarbons and oils																		
Hydrocarbons C_{10}-C_{50}	<0,1		0,011 to 0,2		0,11 to 2,8		<0,1		0,011 to 0,2		0,11 to 2,8		<0,1		0,011 to 0,2		0,11 to 2,8	
Radioactive isotopes																		
Radium 226 (Bq/L)	<0,01						<0,01						<0,01					

Note : An empty field indicates that no criteria are available or applicable.
abc : Concentration above contamination prevention criteria (PCO) (aquatic organisms only); MELCCFP (2022a);
abc : Concentration above the criterion for the protection of aquatic life (chronic effect)); MELCCFP (2022a);
abc : Concentration above the guideline for the protection of aquatic life (long-term exposure); CCME (2022);
abc : Concentration above the criterion for the protection of aquatic life (acute effect)MELCCFP (2022a);
abc : Concentration above the guideline for the protection of aquatic life (short-term exposure); CCME (2022).

6.2.5.3 Drinking Water Quality

Drinking water quality sampling was conducted in the vicinity of the future Delta site. This sampling was conducted on different dates, July 18, 2021, August 19, 2021, and July 26, 2022. Four sampling stations were scheduled in 2021, for which water quality was assessed in situ as well as in the laboratory for metals, nutrients, and various water quality parameters (Map 6-1). In 2022, two stations were sampled for essentially the same measurements and analyses.

The concentrations measured during the sampling campaign were compared (when applicable) to the maximum concentration mentioned in the *Regulation respecting the quality of drinking water* (RQEP) of the MELCCFP (2022b).

Lake No. 4 was selected as the source of fresh water following the assessment of alternatives presented in section 5.1, a portion of which will be treated and used for the camp's drinking water supply, and it is the EauPot2 station that will be used for this purpose. This water will be treated at a drinking water treatment plant, as described in section 5.2 and according to the current requirements of the RQEP. The results of the other sampling are still presented to further document the quality of the ambient water. Appendix J presents the certificates of analysis from the laboratories.

Results of 2021

Table 6-10 reports the water quality results for 2021 (stations QEP Delta1 to QEP Delta4).

None of the measured parameters exceed the maximum RQEP limit.

The water quality of the sampled lakes had low alkalinity (6.9 to 21.5 mg/L CaCO3), low conductivity (33.8 to 70.8 µS/cm), low to moderate turbidity depending on the presence of precipitation (0.07 to 7.0 NTU), saturated with dissolved oxygen (10.6 to 11.4 mg/L), and neutral pH (6.8 to 7.7).

No organic substances, phenolic compounds, and cyanotoxins are measured at concentrations above the detection limit. The only exception is benzo(a)pyrene at QEP station DELTA 1 on August 19, 2021. However, this parameter is measured at a concentration equal to the detection limit (0.00001 mg/L).

As for metals, they occupy values that are often below the detection limit, except for aluminum, copper, iron and manganese, which are often detected, revealing a high natural concentration in the water bodies.

Notable concentrations included total coliforms for August samples (83-310 CFU/100 ml), whereas they were lower in July (<2-40 CFU/100 ml).

Quality Control 2021

The field blanks show values that are all below the detection limit (Appendix J), demonstrating that no bias can be attributed to field manipulations.

The results of the quality control on the duplicate sample are presented in Table 6-11. Only the parameters that showed a concentration above the detection limit for at least one of the two samples are presented.

With regard to the results, it appears that the most important differences are noted for coliforms, which may be the result of a certain heterogeneity in the water concerning this parameter.

The important difference noted on nitrates and nitrites in August (175%) is essentially due to the fact that the occupied values are low, which amplifies the percentage difference, without it being really significant.

Apart from the results noted on coliforms, the results are therefore considered reproducible.

Results of 2022

Table 6-12 reports the water quality results for 2022 (EauPot1 and EauPot 2).

None of the measured parameters exceed the maximum RQEP limit.

Water bodies have low alkalinity (<15 mg/L $CaCO_3$), low conductivity (<45 µS/cm), low turbidity (<1 NTU), saturated dissolved oxygen (>9 mg/L) and neutral pH (≈ 7,0).

No organic substances, phenolic compounds and cyanotoxins are measured at a concentration above the detection limit.

As for metals, they often occupy values that are below the detection limit, except for aluminum, copper and manganese, which are detected at both stations, as well as arsenic and iron, which are detected only at the station EauPot1.

Total coliforms occupy values of 600 and 350 CFU/100 ml for each of the two stations (EauPot 1 and EauPot2 respectively). Atypical bacteria are measured at concentrations of 600 and 240 CFU/100 ml respectively for these same stations.

Quality Control 2022

Field blanks show all values below the detection limit (Appendix I), demonstrating that biases that could be attributable to field manipulations are negligible.

Table 6-10: Drinking Water Quality by Sampling Station - July 18 and August 19, 2021

Parameter	Unit	QEP DELTA 1		QEP DELTA 2		QEP DELTA 3		QEP DELTA 4		RQEP
		July 18 [A]	August 19	July 18	August 19	July 18	August 19	July 18	August 19	
Conventional elements and nutrients										
Alkalinity	mg/L - $CaCO_3$	10.0	21.5	9.0	10.8	7.8	6.9	12	15.6	n. d.
Conductivity *in situ*	µS/cm	48.8	70.8	33.8	40.2	36	38	43.3	50.6	n. d.
True color	UCV	6	<5	5	<5	7	<5	<5	<5	n. d.
Dissolved oxygen *in situ*	mg/L	11.23	11.06	10.65	10.75	10.70	10.6	11.43	11.33	n. d.
	%	95.4	99.1	96.1	99.6	94.3	98.4	90.3	101.2	n. d.
Hardness	mg/L - $CaCO_3$	21.3	31	15.4	15	14.6	13	19.2	20	n. d.
pH *in situ*	-	7.09	6.79	7.1	6.8	7.06	7.73	7.19	6.99	n. d.
Temperature *in situ*	° C	6.48	7.05	8.91	8.44	7.95	8.52	3.69	6.92	n. d.
Total coliforms	UFC/100 ml	13	83	<2	310	<2	110	40	178	n. d.
Thermotolerant coliforms	UFC/100 ml	80	<2	<2	<2	<2	<2	160	<2	n. d.
Enterococci	UFC/100 ml	<2	8	<2	<2	<2	<2	<2	<2	n. d.
Turbidity	UTN	4.39	3.74	7.00	0.92	4.25	1.20	0.07	0.88	0.2 to 5*
Total organic carbon	mg/L	1.34	2.43	1.93	2.08	2.5	1.37	1.88	0.98	n. d.
Nitrates	mg/L - N	<0.02	-	<0.02	-	<0.02	-	<0.02	-	1.0
Nitrites	mg/L - N	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	1.0
Nitrites+Nitrates	mg/L - N	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.08	10.0
Fluorides	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1.5
Sodium	mg/L	0.50	0.556	<0.5	0.412	0.60	0.585	<0.50	0.50	n. d.
Sulphides	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	n. d.
Radium 226	Bq/L	<0.01		<0.01		<0.01		<0.01		0.0005
Nitrilotriacetic acid	mg/L	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.28
Total metals										
Aluminum	mg/L	0.028	-	0.14	-	0.039	-	0.008	-	n. d.
Antimony	mg/L	-	<0.001	-	<0.001	-	<0.001	-	<0.001	0.006
Arsenic	mg/L	<0.001	0.0003	<0.001	<0.0003	<0.001	<0.0003	<0.0010	<0.0003	0.010
Barium	mg/L	<0.010	<0.002	<0.010	<0.002	<0.01	0.002	<0.010	<0.002	1.00
Boron	mg/L	<0.04	0.040	<0.04	0.040	<0.04	0.040	<0.04	0.040	5.0
Cadmium	mg/L	<0.000045	<0.00010	<0.000045	<0.00010	<0.000045	<0.00010	<0.000045	<0.00010	0.005
Chrome	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.05
Copper	mg/L	0.003	0.002	0.002	0.002	0.002	0.001	<0.001	<0.001	1.00
Total cyanides		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.2
Iron	mg/L	0.28	0.10	0.46	0.09	0.19	0.11	<0.05	<0.06	n. d.
Manganese	mg/L	0.005	0.003	0.027	0.004	0.036	0.01	0.006	0.001	n. d.
Lead	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.005
Selenium	mg/L	<0.0005	<0.0010	<0.0005	<0.0010	<0.0005	<0.0010	<0.0005	<0.0010	0.01
Uranium	mg/L	<0.0075	<0.0005	<0.0075	<0.0005	<0.0075	<0.0005	<0.0075	<0.0005	0.020
Hydrocarbons and oils										
Benzo(a) pyrene	mg/L	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001
Benzene	mg/L	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.0005
Bromodichloromethane	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.08**
Bromoform	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.08**
Chlorobenzene	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.06
Chloroform	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.08**
Vinyl chloride (chloroethene)	mg/L	<0.0007	<0.0007	<0.0007	<0.0007	<0.0007	<0.0007	<0.0007	<0.0007	0.002
Dibromochloromethane	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.08**
1,2-Dichlorobenzene	mg/L	<0.0007	<0.0007	<0.0007	<0.0007	<0.0007	<0.0007	<0.0007	<0.0007	0.15
1,4-Dichlorobenzene	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.005
1,2-Dichloroethane	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.005
1,1-Dichloroethene	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01
Dichloromethane	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.05
Tetrachloroethene	mg/L	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.025
Carbon tetrachloride	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.005
Trichloroethene	mg/L	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.005
Total THMs	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n. d.
Total VOCs	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n. d.
Phenols										
2,4+2.5-Dichlorophenol	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.7
Pentachlorophenoll	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.042
2,3,4,6-Tetrachlorophenol	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.07
2,4,6-Trichlorophenol	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.005

Table 6-10: Drinking Water Quality by Sampling Station - July 18 and August 19, 2021 (Continued)

Parameter	Units	QEP DELTA 1		QEP DELTA 2		QEP DELTA 3		QEP DELTA 4		RQEP
		July 18 A	August 19	July 18	August 19	July 18	August 19	July 18	August 19 A	
Cyanotoxins										
Anatoxine-a	mg/L	<0.00001	-	-	-	-	-	-	<0.00001	n. d.
(D-Asp3) et/ou (Asp3;Dhb7) microcystine-RR	mg/L	<0.00001	-	-	-	-	-	-	<0.00001	n. d.
Microcystine-RR	mg/L	<0.00001	-	-	-	-	-	-	<0.00001	n. d.
Microcystine-YR	mg/L	<0.00001	-	-	-	-	-	-	<0.00001	n. d.
Microcystine-HtyR	mg/L	<0.00001	-	-	-	-	-	-	<0.00001	n. d.
(D-Asp3) microcystine-LR	mg/L	<0.00001	-	-	-	-	-	-	<0.00001	0.0015
Microcystine-LR	mg/L	<0.00001	-	-	-	-	-	-	<0.00001	0.0015
Microcystine-HilR	mg/L	<0.00001	-	-	-	-	-	-	<0.00001	n. d.
Microcystine-WR	mg/L	<0.00001	-	-	-	-	-	-	<0.00001	n. d.
Microcystine-LA	mg/L	<0.00002	-	-	-	-	-	-	<0.00002	n. d.
Microcystine-LY	mg/L	<0.00001	-	-	-	-	-	-	<0.00001	n. d.
Microcystine-LW	mg/L	<0.00001	-	-	-	-	-	-	<0.00001	n. d.
Microcystine-LF	mg/L	<0.00001	-	-	-	-	-	-	<0.00001	n. d.

RQEP : Règlement sur la qualité de l'eau potable (Regulation respecting the quality of drinking water) (MELCC, 2022b).
n.d.: Not determined
* The maximum turbidity limit value depends on the type of treatment. See MELCC (2022b); Appendix 1, Section 5.
** Maximum average concentration to be calculated over 4 trimesters. See MELCC (2022b); Appendix 1, Section 3.
A : Average value from an analysis and its duplicate.

Table 6-11: Quality Control Results on Water Samples Taken in 2021

Parameter	Sample A	Sample B	Average	Relative difference (%)
July	(QEP DELTA 1)	(duplicate)		
Total coliforms	18.0	8.0	13.0	55.6 %
Thermotolerant coliforms	110.0	50.0	80.0	54.5 %
Alkalinity	9.20	10.80	10.0	17.4 %
Total organic carbon	1.20	1.47	1.3	22.5 %
True color	<5	6.0	5.5	20.0 %
Aluminum	0.029	0.027	0.028	6.9 %
Copper	0.003	0.003	0.003	0.0 %
Total hardness	21.30	21.20	21.3	0.5 %
Iron	0.28	0.27	0.28	3.6 %
Manganese	0.005	0.005	0.005	0.0 %
Sodium	0.50	0.50	0.50	0.0 %
August	(QEP DELTA 4)	(duplicate)		
Total coliforms	350	6	178	98.3 %
Alkalinity	15.5	15.6	15.55	0.6 %
Total organic carbon	0.98	0.98	0.98	0.0 %
Nitrites - Nitrates	<0.04	0.11	0.08	175.0 %
Manganese	0.001	0.001	0.001	0.0 %
Sodium	0.50	0.52	0.51	2.6 %
Total hardness	20	20	20	0.0 %

Table 6-12: Drinking Water Quality by Sampling Station - July 26 2022

Parameters	Units	EauPot1 July 26	EauPot2[A] July 26	RQEP
Conventional elements, nutrients and major ions				
Alkalinity	mg/L - $CaCO_3$	12	8.1	n. d.
Conductivity *in situ*	µS/cm	42.5	31.4	n. d.
True color	UCV			n. d.
Dissolved oxygen *in situ*	mg/L	9.87	10.05	n. d.
	%	103.5	107.5	n. d.
Hardness	mg/L - $CaCO_3$	21	13	n. d.
pH *in situ*	-	7.06	7.06	n. d.
Temperature *in situ*	^{o} C	14.5	15.4	n. d.
Total coliforms	UFC/100 ml	600	350	n. d.
Atypical bacteria	UFC/100 ml	600	240	n. d.
Thermotolerant coliforms	UFC/100 ml	<2	<2	n. d.
Enterococci	UFC/100 ml	<2	<2	n. d.
Turbidity	UTN	0.4	0.2	0.2 to 5*
Total organic carbon	mg/L	2.02	1.34	n. d.
Nitrates	mg/L - N	0.03	<0.02	1.0
Nitrites	mg/L - N	<0.02	<0.02	n. d.
Nitrites+Nitrates	mg/L - N	<0.04	0.04	10.0
Fluorides	mg/L	<0.10	<0.10	1.50
Sodium	mg/L	0.471	0.483	n. d.
Sulphides	mg/L	<0.02	<0.02	n. d.
Bromates	mg/L	<0.006	<0.006	0.010
Chlorites	mg/L	<0.01	<0.01	n. d.
Chlorates	mg/L	<0.01	<0.01	0.8
Radium 226	Bq/L	<0.01	<0.01	0.0005
Nitrilotriacetic acid	mg/L	<0.01	-	0.28
Cyanotoxines				
Anatoxin-a	mg/L	<0.00001	<0.00001	n. d.
(D-Asp3) and/or (Asp3;Dhb7) microcystine-RR	mg/L	<0.00001	<0.00001	n. d.
Microcystine-RR	mg/L	<0.00001	<0.00001	n. d.
Microcystine-YR	mg/L	<0.00001	<0.00001	n. d.
Microcystine-HtyR	mg/L	<0.00001	<0.00001	n. d.
(D-Asp3) microcystine-LR	mg/L	<0.00001	<0.00001	0.0015
Microcystine-LR	mg/L	<0.00001	<0.00001	0.0015
Microcystine-HilR	mg/L	<0.00001	<0.00001	n. d.
Microcystine-WR	mg/L	<0.00001	<0.00001	n. d.
Microcystine-LA	mg/L	<0.00002	<0.00002	n. d.
Microcystine-LY	mg/L	<0.00001	<0.00001	n. d.
Microcystine-LW	mg/L	<0.00001	<0.00001	n. d.
Microcystine-LF	mg/L	<0.00001	<0.00001	n. d.
Total metals				
Aluminum	mg/L	0.009	0.006	n. d.
Arsenic	mg/L	0.0004	<0.0003	0.010
Barium	mg/L	<0.002	<0.002	1.00
Boron	mg/L	<0.040	<0.040	5.0
Cadmium	mg/L	<0.0001	<0.0001	0.0050
Chrome	mg/L	<0.001	<0.001	0.050
Copper	mg/L	0.005	0.001	1.00
Total Cyanide	mg/L	<0.005	<0.005	0.20
Iron	mg/L	0.09	<0.060	n. d.
Manganese	mg/L	0.003	0.002	n. d.
Mercury	mg/L	<0.00004	<0.00004	0.001
Lead	mg/L	<0.0005	<0.0005	0.005
Selenium	mg/L	<0.001	<0.001	0.010
Uranium	mg/L	<0.0005	<0.0005	0.020

Table 6-12: Drinking Water Quality by Sampling Station – July 26 2022 (Continued)

Parameters	Units	EauPot1 July 26	EauPot2A July 26	RQEP
MAH and CAH				
Acrylonitrile	mg/L	<0.001	<0.001	n. d.
Benzene	mg/L	<0.0003	<0.0003	0.0005
Chlorobenzene	mg/L	<0.001	<0.001	0.06
1,2-Dichlorobenzene	mg/L	<0.0007	<0.0007	0.15
1,3-Dichlorobenzene	mg/L	<0.001	<0.001	n. d.
1,4-Dichlorobenzene	mg/L	<0.001	<0.001	0.005
Ethylbenzene	mg/L	<0.0003	<0.0003	n. d.
Styrene	mg/L	<0.001	<0.001	n. d.
Toluene	mg/L	<0.001	<0.001	n. d.
Xylenes	mg/L	<0.001	<0.001	n. d.
MAH and CAH				
Chloroform	mg/L	<0.001	<0.001	0.080**
Chloride	mg/L	<0.0007	<0.0007	n. d.
1,2-Dichloroethane	mg/L	<0.001	<0.001	0.005
1,1-Dichloroethene	mg/L	<0.001	<0.001	0.010
1,2-Dichloroethene (cis)	mg/L	<0.001	<0.001	n. d.
1,2-Dichloroethene (trans)	mg/L	<0.001	<0.001	n. d.
1,2-Dichloroethene (cis and trans)	mg/L	<0.001	<0.001	n. d.
Dichloromethane	mg/L	<0.001	<0.001	0.05
1,2-Dichloropropane	mg/L	<0.001	<0.001	n. d.
1,3-Dichloropropane	mg/L	<0.001	<0.001	n. d.
1,3-Dichloropropene (cis)	mg/L	<0.001	<0.001	n. d.
1,3-Dichloropropene (trans)	mg/L	<0.001	<0.001	n. d.
1,3-Dichloropropene (cis and trans)	mg/L	<0.001	<0.001	n. d.
1,1,2,2-Tetrachloroethane	mg/L	<0.0002	<0.0002	n. d.
Tetrachloroethene	mg/L	<0.0003	<0.0003	0.025
Carbon tetrachloride	mg/L	<0.001	<0.001	0.005
1,1,1-Trichloroethane	mg/L	<0.001	<0.001	5
1,1,2-Trichloroethane	mg/L	<0.0003	<0.0003	n. d.
Trichloroethene	mg/L	<0.0003	<0.0003	0.005
PAH				
Acenaphthenes	mg/L	<0.0001	<0.0001	n. d.
Acenaphthylene	mg/L	<0.0001	<0.0001	n. d.
Anthracene	mg/L	<0.0001	<0.0001	n. d.
Benzo(a)anthracene	mg/L	<0.0001	<0.0001	n. d.
Benzo(a) pyrene	mg/L	<0.00001	<0.00001	0.00001
Benzo(b) fluoranthene	mg/L	<0.0001	<0.0001	n. d.
Benzo(j) fluoranthene	mg/L	<0.0001	<0.0001	n. d.
Benzo(k) fluoranthene	mg/L	<0.0001	<0.0001	n. d.
Benzo(c) phenanthrene	mg/L	<0.0001	<0.0001	n. d.
Benzo(g,h,i) perylene	mg/L	<0.0001	<0.0001	n. d.
Chrysene	mg/L	<0.0001	<0.0001	n. d.
Dibenzo(a,h) anthracene	mg/L	<0.0001	<0.0001	n. d.
Dibenzo(a,i) pyrene	mg/L	<0.0001	<0.0001	n. d.
Dibenzo(a,h) pyrene	mg/L	<0.0001	<0.0001	n. d.
Dibenzo(a,l) pyrene	mg/L	<0.0001	<0.0001	n. d.
Fluoranthene	mg/L	<0.0001	<0.0001	n. d.
7,12-dimethylbenzo(a)anthracene	mg/L	<0.0001	<0.0001	n. d.
Fluorene	mg/L	<0.0001	<0.0001	n. d.
Indeno (1,2,3-cd) pyrene	mg/L	<0.0001	<0.0001	n. d.
Naphthalene	mg/L	<0.0001	<0.0001	n. d.
Phenanthrene	mg/L	<0.0001	<0.0001	n. d.
Pyrene	mg/L	<0.0001	<0.0001	n. d.
3-Methylcholanthrene	mg/L	<0.0001	<0.0001	n. d.

Table 6-12: Drinking Water Quality by Sampling Station – July 26 2022 (Continued)

Parameters	Units	EauPot1 July 26	EauPot2A July 26	RQEP
1-Methylnaphthalene	mg/L	<0.0001	<0.0001	n. d.
2-Methylnaphthalene	mg/L	<0.0001	<0.0001	n. d.
1,3-Dimethylnaphthalene	mg/L	<0.0001	<0.0001	n. d.
2,3,5-Trimethylnapthalene	mg/L	<0.0001	<0.0001	n. d.
Total PAHs	mg/L	<0.0001	<0.0001	n. d.
Phenols				
o-Cresol	mg/L	<0.001	<0.001	n. d.
p-Cresol	mg/L	<0.001	<0.001	n. d.
m-Crésol	mg/L	<0.001	<0.001	n. d.
2,4-dimethylphenol	mg/L	<0.001	<0.001	n. d.
2,4-Dinitrophenol	mg/L	<0.001	<0.001	n. d.
4-nitrophenol	mg/L	<0.001	<0.001	n. d.
Phenol	mg/L	<0.001	<0.001	n. d.
2-chlorophenol	mg/L	<0.001	<0.001	n. d.
3-chlorophenol	mg/L	<0.001	<0.001	n. d.
4-chlorophenol	mg/L	<0.001	<0.001	n. d.
2,3-dichlorophenol	mg/L	<0.001	<0.001	n. d.
2,4+2,5-dichlorophenol	mg/L	<0.001	<0.001	0.7
2,6-dichlorophenol	mg/L	<0.001	<0.001	n. d.
Phenols				
3,4-dichlorophenol	mg/L	<0.001	<0.001	n. d.
3,5-dichlorophenol	mg/L	<0.001	<0.001	n. d.
2-Methyl-4,6-dinitrophenol	mg/L	<0.001	<0.001	n. d.
Pentachlorophenol	mg/L	<0.001	<0.001	0.042
2,3,4,6-tetrachlorophenol	mg/L	<0.001	<0.001	0.070
2,3,5,6-tetrachlorophenol	mg/L	<0.001	<0.001	n. d.
2,4,5-trichlorophenol	mg/L	<0.001	<0.001	n. d.
2,4,6-trichlorophenol	mg/L	<0.001	<0.001	0.005
Total chlorinated phenolic compounds	mg/L	<0.001	<0.001	n. d.

RQEP : Règlement sur la qualité de l'eau potable (Regulation respecting the quality of drinking water) (MELCC, 2022b).
n.d.: Not determined
[A] Lake retained for fresh water withdrawals for Delta satellite operations and camp.
* The maximum turbidity limit value depends on the type of treatment. See MELCC (2022b); Appendix 1, Section 5.
** Maximum average concentration to be calculated over 4 trimesters. See MELCC (2022b); Appendix 1, Section 3.

6.2.5.4 Quality of sediments

Sediment samples were collected at various stations using a Ponar Standard grab (0.052 m²) in 2021.

The concentrations of various parameters measured in the sediments are reported in Table 6-13 (stations QS Delta 1 to QS Delta 3 and QS Delta 5). The criteria for assessing sediment quality in Quebec (EC and MDDEP, 2007) were used to interpret the results of the chemical analysis of the sediments.

The occasional effects level (OEL) and the frequent effects level (FEL) are the two threshold values that guide sediment management in the current context.

For illustrative purposes, concentrations were also compared to generic soil criteria (Beaulieu, 2021), if land management is required.

The results indicate that chromium and nickel are present at OEL concentrations for all four inventory stations, which can be explained by the rock composition of the soil underlying the water bodies. All other measured parameters, metals as well as hydrocarbons and oils, show values below their respective detection limit or below their respective OEL (when an OEL value exists).

Comparison of the sediment concentrations with the generic soil criteria indicates no concentrations at or above the B-C level. There are therefore no soil management constraints in effect within the Churchill Geological Province, in which the sampling stations are located. The measured values are considered representative of the natural state of the sediments. Thus, for parameters such as copper and nickel, a concentration varying respectively between 32 and 52 mg/kg and 60 to 76 mg/kg could be considered as being below criterion A.

For reference, in situ water quality measurements were taken at the sediment sampling stations (15 cm below the surface) and are presented at the end of Table 6-13. The results indicate that the water is well oxygenated (> 9.0 mg/L), has a neutral pH, and that QS Delta1 is the most conductive station (176.2 µS/cm) compared to the other stations (≈ 70 µS/cm).

Table 6-13: Sediment Quality by Sampling Station – August 15, 2021

No. station	QS Delta 1	QS Delta 2	QS Delta 3	QS Delta 5	Criteria for freshwater sediment quality[a]		Generic soil criteria[b]		
Parameter (mg/kg)					OEL	FEL	A	**B**	**C**
Total organic carbon (%)	0,47	0,25	1,27	0,21	-	-	-	-	-
Aluminum	10500	8640	11000	12100	-	-	-	-	-
Antimony	<7	<7	<7	<7	-	-	-	-	-
Silver	<0,5	<0,5	<0,5	<0,5	-	-	n. d.	20	40
Arsenic	2,3	2,1	1,8	3,4	7,6	23	n. d.	30	50
Barium	45	46	91	79	-	-	n. d.	500	2000
Bismuth	<5	<5	<5	<5	-	-	-	-	-
Boron	<10	<10	<10	<10	-	-	-	-	-
Beryllium	<1	<1	<1	<1	-	-	-	-	-
Cadmium	<0,3	<0,3	<0,3	<0,3	1,7	12	n. d.	5	20
Calcium	2050	2140	3710	2890	-	-	-	-	-
Chrome	71	82	87	86	57	120	n. d.	250	800
Cobalt	17	20	21	20	-	-	n. d.	50	300
Copper	32	32	52	40	63	700	n. d.	100	500
Tin	5	<5	<5	<5	-	-	n. d.	50	300
Iron	28900	26300	32500	34900	-	-	-	-	-
Lithium	12	10	16	16	-	-	-	-	-
Magnesium	9250	8760	10500	11400	-	-	-	-	-
Manganese	412	650	493	414	-	-	n. d.	1000	2200
Mercury	0,03	0,03	0,04	0,03	0,25	0,87	n. d.	2	10
Molybdenum	<2	<2	<2	<2	-	-	n. d.	10	40
Nickel	60	76	69	70	47	-	n. d.	100	500
Lead	5	5	9	6	52	150	n. d.	500	1000
Potassium	907	717	1130	1710	-	-	-	-	-
Sodium	36	31	<30	38	-	-	-	-	-
Strontium	<10	<10	24	15	-	-	-	-	-
Selenium	<1	<1	<1	<1	-	-	n. d.	3	10
Silicon	491	383	369	524	-	-	-	-	-
Thallium	<15	<15	<15	<15	-	-	-	-	-
Titanium	812	776	1040	994	-	-	-	-	-
Uranium	<20	<20	<20	<20	-	-	-	-	-
Vanadium	47	41	49	58	-	-	-	-	-
Zinc	44	40	49	47	170	770	n. d.	500	1500
Total oils and greases	<300	<300	<300	<300	-	-	-	-	-
P.H. C_{10}-C_{50}	<50	<50	<50	<50	-	-	n. d.	500	3500
Acenaphthenes	<0,003	<0,003	<0,003	<0,003	0,021	0,94	n. d.	10	100
Acenaphthylene	<0,003	<0,003	<0,003	<0,003	0,03	0,34	n. d.	10	100
Anthracene	<0,01	<0,01	<0,01	<0,01	0,11	1,1	n. d.	10	100
Benzo(a)anthracene	<0,01	<0,01	<0,01	<0,01	0,12	0,76	n. d.	10	10
Benzo(a)pyrene	<0,01	<0,01	<0,01	<0,01	0,15	3,2	n. d.	1	10
Benzo(b)fluoranthene	<0,01	<0,01	<0,01	<0,01	-	-	n. d.	1	10
Benzo(j)fluoranthene	<0,01	<0,01	<0,01	<0,01	-	-	n. d.	1	10
Benzo(k)fluoranthene	<0,01	<0,01	<0,01	<0,01	-	-	n. d.	1	10
Benzo (b+j+k) fluoranthene	<0,01	<0,01	<0,01	<0,01	-	-	n. d.	1	10
Benzo(c)phenanthrene	<0,01	<0,01	<0,01	<0,01	-	-	n. d.	1	10
Benzo(g,h,i)perylene	<0,01	<0,01	<0,01	<0,01	-	-	n. d.	1	10
Chrysene	<0,01	<0,01	<0,01	<0,01	0,24	1,6	n. d.	1	10

Table 6-13: Sediment Quality by Sampling Station – August 15, 2021 (Continued)

No. station	QS Delta 1	QS Delta 2	QS Delta 3	QS Delta 5	Criteria for freshwater sediment quality[a]		Generic soil criteria[b]		
Parameter (mg/kg)					OEL	FEL	A	**B**	**C**
Dibenzo(a,h)anthracene	<0,003	<0,003	<0,003	<0,003	0,043	0,2	n. d.	1	10
Dibenzo(a,i)pyrene	<0,01	<0,01	<0,01	<0,01	-	-	n. d.	1	10
Dibenzo(a,h)pyrene	<0,01	<0,01	<0,01	<0,01	-	-	n. d.	1	10
Dibenzo(a,l)pyrene	<0,01	<0,01	<0,01	<0,01	-	-	n. d.	1	10
7,12-Dimethylbenzo(a)anthracene	<0,01	<0,01	<0,01	<0,01	-	-	n. d.	1	10
Fluoranthene	<0,01	<0,01	<0,01	<0,01	0,45	4,9	n. d.	10	100
Fluorene	<0,01	<0,01	<0,01	<0,01	0,061	1,2	n. d.	10	100
Indeno(1,2,3-cd)pyrene	<0,01	<0,01	<0,01	<0,01	-	-	n. d.	1	10
3-Methylcholanthrene	<0,01	<0,01	<0,01	<0,01	-	-	n. d.	1	10
1-Methylnaphthalene	<0,01	<0,01	<0,01	<0,01	-	-	n. d.	1	10
2-Methylnaphthalene	<0,01	<0,01	<0,01	<0,01	0,063	0,38	n. d.	1	10
Naphthalene	<0,01	<0,01	<0,01	<0,01	0,12	1,2	n. d.	5	50
Phenanthrene	<0,01	<0,01	<0,01	<0,01	0,13	1,1	n. d.	5	50
Pyrene	<0,01	<0,01	<0,01	<0,01	0,23	1,5	n. d.	10	100
1, 3-Dimethylnaphthalene	<0,01	<0,01	<0,01	<0,01	-	-	n. d.	1	10
2,3,5-Trimethylnaphthalene	<0,01	<0,01	<0,01	<0,01	-	-	n. d.	1	10
Lower molecular weight PAHs	<0,01	<0,01	<0,01	<0,01			-	-	-
High molecular weight PAHs	<0,01	<0,01	<0,01	<0,01	-	-	-	-	-
Water quality (*in situ*)									
Dissolved oxygen (mg/L ; %)	9,84; 92,3	11,12 ; 103,9	10,98 ; 100,9	10,84 ; 101,3					
pH	6,47	6,97	6,94	6,82					
Conductivity (µS/cm)	176,2	70,3	79,0	66,5					
Temperature (°C)	8,90	8,76	8,07	8,73					

: Occasional effect level;
: Frequent effect level;
Abc : B-C level concentration;
Abc : >C level concentration;
a : Environnement Canada and MDDEP, 2007
b : Beaulieu, 2021
n. d. : Not determined; no Criterion A values are available for the Churchill Geological Province.

6.3 Biological environment

6.3.1 Wetlands and terrestrial environment

Plant and wetlands surveys were carried out in the environments likely to be affected by the project according to the detailed method described in Appendix G. Surveys were carried out in 2021 from July 7 to 22, as well as August 8, and between 13 and 17. In 2022, surveys took place from July 22 to 31.

The plant species identified are listed in tables according to the site and the type of environment in which they were observed. The species indicated in the following paragraphs contribute at least 5% to the absolute mean cover of a site. At-risk species were also found, although their absolute cover is often less than 5%. All the species observed for each site can be found in Appendix K. The photographic appendix of terrestrial and wetland environments is presented in Appendix M, while the characterization sheets are available in Appendix N.

6.3.1.1 Delta site

Delta site was characterized between July 7 and July 22 in 2021 over a period of 8 days in order to delimit the different wetlands and carry out vegetation surveys. A second field visit was carried out on August 8, 13 and 17, 2021 to validate the identification of late growing vegetation, especially for sedges and grasses which were not yet grown, or which were overgrazed during the first visit of the study area. This second visit also increased the chances of observing at-risk species. Photos 6-2 and 6-3 are representative of the wetlands and terrestrial environments present on site. A total of 90 different species were identified at the Delta site.

The Delta site study area consists of 97.11 ha of wetlands, specifically lowland polygon fen. Lowland polygon fen occupies 90.03 ha of the wetlands, or approximately 44% of the study area (Table 6-14). Most of the polygonal lowland fens are located around the periphery of the three lakes in the study area and consist mostly of fragile sedge (*Carex membranacea*), sphagnum, mosses, and other bryophytes[12], and water sedge (*Carex aquatilis*) (cover between 23% and 43%). Fragile sedge and snowbed willow (*Salix herbacea*) occur at nearly all lowland polygonal fen sites (97% occurrence) (Table 6-15). A total of 77 plant species were inventoried at lowland fen stations.

Photo 6-2: Terrestrial environments of the Delta site

Photo 6-3: Delta Site Wetlands

[12] Bryophytes, including mosses but excluding sphagnum mosses, were not identified in the field at the genus level considering the general need for a laboratory for identification. A sub-sampling, according to the different types of environment, was done in order to make an identification in laboratory on return from the field to identify the presence of species with precarious status. The identification revealed the absence of genus with at-risk status that can be found in the study area (see Appendix G).

Table 6-14: Surface Area for Each Type of Environment Found on the Delta Site

Environment	Environment category	Total surface area (ha)	Total number of characterization stations
Terrestrial	Felsenmeer	45.67	17
	Boulder field	46.18	4
	Polygonal ground with tundra ostioles	4.16	4
Wetland	Lowland polygonal fens	90.03	86
	Snowbed fen	7.08	21
Total		**193.12**	**132**
Water environments		12.64	**-**
Total surface study area		**205.76**	

The Delta site is also characterized of snowbed fen. This wetland type was characterized to the north of the study area, at the bottom of the hill, and running east-west through the area. The accumulated snow on the north faces of this hill gradually melts during the summer. This creates water flows that end up under rocks or accumulate to create wetlands. Fragile sedge, water sedge, bryophytes, including sphagnum, occupy between 23 and 38% of the vegetation cover of snowbed fens. The species found in more than 80% of the stations are fragile sedge, arctic bluegrass (*Poa arctica*), four-angled mountain heather (*Cassiope tetragona*) and snow buttercup (*Ranunculus nivalis*). A total of 50 plant species were inventoried in the snowbed fen stations.

During wetlands plant surveys, sulfur buttercups (likely to be designated as threatened or vulnerable in Quebec) were identified on the Delta site. Sulfur buttercups were observed on 22 lowland polygonal fen stations occupying between 1 and 5% of the vegetation cover. An area of high abundance of sulfur buttercup was also observed in the center of the study area and represents a 4.01 ha colony. Two other species likely to be designated threatened or vulnerable in Quebec were found on a polygonal lowland fen station. In fact, the Cayouette's draba (*Draba cayouettei*) and the ellesmere Island draba (*Draba subcapitata*) were identified northeast of the study area on a flat area surrounded by felsenmeer (Table 6-15 and Map 6-1).

Terrestrial environments occupy 96.01 ha and represent approximately 50% of the study area. Three types of environments were characterized: boulder fields, felsenmeer and polygonal ground with tundra ostioles. On the 4 boulder field stations, 27 different species were inventoried, including *Racomitrium sp*. (a genus belonging to the mosses) and alpine bistort (*Bistorta vivipara*), which covered an average of 25% and 11% of the stations respectively. In addition, fragile sedge was found at all stations inventoried in boulder fields (Table 6-15). Boulder fields are most notably found on the hill slopes north of the study area. As for the felsenmeer, a zone was characterized on the entire crest of the hill crossing the study area from east to west. In this type of environment, the most frequent species were Arctic bluegrass (94% occurrence), northern woodrush (*Luzula confusa*) (88% occurrence), *Racomitrium sp.* (88% occurrence), and four-angled mountain heather (76% occurrence). A total of 49 different species were recorded at the 17 felsenmeer stations. To the southwest of the Delta site, an area of polygonal ground with tundra ostioles was characterized. This terrestrial environment includes 30 different species at 3 survey stations. Of these species, four-angled mountain heather is very common, with 100% occurrence. Bryophytes, racomitrium, were observed on more than half of the stations with a coverage of 67%.

Table 6-15: Plant Species Present on the Delta Site According to the Environment Types

Environment	Plant species	Scientific Name	Number of stations with occurrence	Absolute average cover (%)	Occurrence (%)
Boulder Field	Racomitrium sp.	*Racomitrium sp.*	3	25	75
	Alpine bistort	*Bistorta vivipara*	2	11	50
	Fragile sedge	*Carex membranacea*	4	9	100
	Bryophytes	-	2	8	50
	Wide-leaved polargrass	*Arctagrostis latifolia*	3	6	75
	Arctic cinquefoil	*Potentilla hyparctica*	3	6	75
	Snowbed willow	*Salix herbacea*	3	6	75
	Alpine draba	*Draba alpina*	1	5	25
		Total survey stations	**4**		
Felsenmeer	Bryophytes	-	1	30	6
	Racomitrium sp.	*Racomitrium sp.*	15	27	88
	Rour-angled mountain heather	*Cassiope tetragona*	13	15	76
	Arctic bluegrass	*Poa arctica*	16	9	94
	Arctic pyrola	*Pyrola grandiflora*	3	9	18
	Short-leaved sedge	*Carex fuliginosa*	3	7	18
	Entire-leaved mountain avens	*Dryas integrifolia*	2	7	12
	Northern woodrush	*Luzula confusa*	15	6	88
	Snowbed willow	*Salix herbacea*	7	6	41
	Short-leaved hairgrass	*Deschampsia cespitosa subsp. Septentrionalis*	2	6	12
	Fragile sedge	*Carex membranacea*	9	5	53
	Wide-leaved polargrass	*Arctagrostis latifolia*	5	5	29
		Total survey stations	**17**		
Polygonal ground with tundra ostioles	Bryophytes	-	2	85	67
	Racomitrium sp.	*Racomitrium sp.*	2	43	67
	Rour-angled mountain heather	*Cassiope tetragona*	3	18	100
	Arctic willow	*Salix arctica*	1	10	33
	Alpine sweetgrass	*Anthoxanthum monticola*	2	6	67
	Tufted hairgrass	*Deschampsia cespitosa*	2	5	67
	Alpine chickweed	*Cerastium alpinum*	1	5	33
	Purple mountain saxifrage	*Saxifraga oppositifolia*	1	5	33
		Total survey stations	**3**		
Snowbed fen	Sphagum sp.	*Sphagnum sp.*	10	38	48
	Fragile sedge	*Carex membranacea*	20	26	95
	Water sedge	*Carex aquatilis*	4	26	19
	Bryophytes	-	9	23	43
	Fisher's tundra grass	*Dupontia fisheri*	6	20	29
	Arctic bluegrass	*Poa arctica*	19	19	90
	Short-leaved hairgrass	*Deschampsia cespitosa subsp. Septentrionalis*	9	16	43
	Tufted hairgrass	*Deschampsia cespitosa*	9	14	43

Table 6-15: Plant Species Present on the Delta Site According to the Environment Types (Continued)

Environment	Plant species	Scientific Name	Number of stations with occurrence	Absolute average cover (%)	Occurrence (%)
Snowbed fen	Rour-angled mountain heather	*Cassiope tetragona*	17	11	81
	Snowbed willow	*Salix herbacea*	13	9	62
	Racomitrium sp.	*Racomitrium sp.*	9	9	43
	Hairy willow	*Salix vestita*	2	8	10
	Arctic pyrola	*Pyrola grandiflora*	11	6	52
	Two-glumed rush	*Juncus biglumis*	7	6	33
	Entire-leaved mountain avens	*Dryas integrifolia*	5	6	24
	Snow buttercup	*Ranunculus nivalis*	17	5	81
	Wide-leaved polargrass	*Arctagrostis latifolia*	15	5	71
		Total survey stations	**21**		
Lowland polygonal fen	Fragile sedge	*Carex membranacea*	83	43	97
	Bryophytes	-	56	41	65
	Water sedge	*Carex aquatilis*	24	39	28
	Sphagnum sp.	*Sphagnum sp.*	43	23	50
	Fisher's tundra grass	*Dupontia fisheri*	30	20	35
	Racomitrium sp.	*Racomitrium sp.*	38	18	44
	Loose-flowered alpine sedge	*Carex rariflora*	2	13	2
	Snowbed willow	*Salix herbacea*	83	12	97
	Tufted hairgrass	*Deschampsia cespitosa*	33	10	38
	Net-veined willow	*Salix reticulata*	7	10	8
	Arctic bluegrass	*Poa arctica*	66	9	77
	Short-leaved hairgrass	*Deschampsia cespitosa subsp. Septentrionalis*	28	9	33
	Alpine bistort	*Bistorta vivipara*	79	7	92
	Wide-leaved polargrass	*Arctagrostis latifolia*	77	7	90
	Tussock cottongrass	*Eriophorum vaginatum*	19	7	22
	Bigelow's sedge	Carex bigelowii	30	6	35
	Beautiful cottongrass	Eriophorum callitrix	61	6	71
	Entire-leaved mountain avens	Dryas integrifolia	56	6	65
	Short-leaved sedge	Carex fuliginosa	50	5	58
	Wahlenberg's woodrush	Luzula wahlenbergii	13	5	15
	Lichens	-	4	5	5
	Richardson's anemone	Anemonastrum richardsonii	1	5	1
	Sulphur buttercup	Ranunculus sulphureus	22	2	26
	Cayouette's draba	Draba cayouettei	1	1	1
	Ellesmere Island draba	Draba subcapitata	1	1	1
		Total survey stations	**86**		

6.3.1.2 Delta road

The characterization of the future road Ivakkak-Delta, was carried out from 21 to 27 July 2021. A second field visit on August 14, 15, 16 and 20, 2021 validated the vegetation later, or overgrazed during the first visit. The inventories established that the road is composed mostly of terrestrial environments. Indeed, 76% (123.34 ha out of 161.61 ha) of the study area is occupied by boulder fields, felsenmeer, and polygonal ground with tundra ostioles (Table 6-16). Wetlands occupy 38.23 ha or 24% of the Ivakkak-Delta Road study area. Photos 6-4 and 6-5 are representative of the wetlands and terrestrial environments present in that area. A total of 74 different species were identified on the study area of the Ivakkak-Delta road.

Photo 6-4: Terrestrial Environments on Ivakkak-Delta Road

Photo 6-5: Wetlands on Ivakkak-Delta road

Table 6-16: Area for Each Type of Environment Found of the Ivakkak-Delta Road Study Area

Environment	Environment category	Total surface area[A] (ha)	Total number of characterization stations
Terrestrial	Felsenmeer	22.06	38
	Boulder field	62.08	35
	Polygonal ground with tundra ostioles	39.20	35
Subtotal		**123.34**	
Wetland	Lowland polygonal fens	34.46	43
	Snowbed fen	2.77	12
Subtotal		**38.23**	**55**
Water environments		0.04	-
Total		**161.61**	**163**

[A] The area also includes the satellite camp study area.

During the wetland characterization, 43 stations were conducted within the lowland polygon fens and a total of 59 plant species were inventoried. Bryophytes (including the genera Racomitrium and Sphagnum), water sedge and fragile sedge have the highest absolute cover (Table 6-17). It is also observed that the species and genera present at the majority of sites are snowbed willow, fragile sedge, and sphagnum (Table 6-17). Note that snowbed willow is present at all lowland polygonal fen stations inventoried. Sulfur ranunculus (a species likely to be designated threatened or vulnerable) was inventoried at 6 lowland polygonal fen sites (14% occurrence). They have an average absolute cover of 3%.

A total of twelve snowbed fen stations were also characterized. This characterization resulted in the identification of 37 different plant species. Snowbed fens are predominantly composed of bryophytes (43% cover), fragile sedge (35% cover), and Fisher's tundra grass (*Dupontia fisheri*) (30% cover). Snowbed willow is also present at all stations while fragile sedge, alpine bistort, wide-leaved polargrass, rour-angled mountain heather, Arctic bluegrass, snow buttercup, and narrow-leaved cottongrass are present at the majority of stations.

Terrestrial environments present on the road are predominantly boulder fields followed by polygonal ground with tundra ostioles and felsenmeer. Boulder fields and polygonal ground with tundra ostioles have similar species richness (49 and 48 different plant species, respectively) while 38 plant species are found in felsenmeer. One genus and one species dominate the terrestrial vegetation, racomitrium and rour-angled mountain heather. Racomitrium was inventoried within all terrestrial environments (66-97% occurrence) and covers 22-33% of characterized stations (Table 6-17). Rour-angled mountain heather was also present at all terrestrial environment stations (77% to 94% occurrence). It averages between 14% and 17% of stations. Arctic bluegrass is also a species found at the majority of terrestrial stations, between 51% and 66%. However, it has a lower average absolute cover of 7% for all types of environments.

Note that a helipad will be installed along the Ivakkak-Delta road at km 9. This surface infrastructure will cover 0.09 ha in the terrestrial environment only (block field). No species at risk have been inventoried in this site.

Table 6-17: Plant Species Present on the Ivakkak-Delta Road Area According to the Environment Types

Environment	Plant species	Scientific Name	Number of stations with occurrence	Absolute average cover (%)	Occurrence (%)
Boulder field	Bryophytes	-	6	23	17
	Racomitrium sp.	*Racomitrium sp.*	23	22	66
	Two-glumed rush	*Juncus biglumis*	1	15	3
	Alpine pussytoes	*Antennaria alpina*	1	15	3
	Four-angled mountain heather	*Cassiope tetragona*	27	14	77
	Bluebell of Scotland	*Campanula rotundifolia*	1	10	3
	Snowbed willow	*Salix herbacea*	10	9	29
	Sea thrift	*Armeria maritima*	2	8	6
	Arctic bluegrass	*Poa arctica*	18	7	51
	Tufted hairgrass	*Deschampsia cespitosa*	15	7	43
	Wide-leaved polargrass	*Arctagrostis latifolia*	6	13	17
	Moss campion	*Silene acaulis*	5	7	14
	Arctic pyrola	*Pyrola grandiflora*	2	7	6
	Northern woodrush	*Luzula confusa*	23	6	66
	Arctic willow	*Salix arctica*	4	6	11
	Narrow-leaved cottongrass	*Eriophorum angustifolium*	2	6	6
	Fragile sedge	*Carex membranacea*	7	5	20
	Entire-leaved mountain avens	*Dryas integrifolia*	1	5	3
	Beautiful cottongrass	*Eriophorum callitrix*	1	5	3
	Short-leaved fescue	*Festuca brachyphylla*	1	5	3
Total survey stations			**35**		

Table 6-17: Plant Species Present on the Ivakkak-Delta Road Area According to the Environment Types (Continued)

Environment	Plant species	Scientific Name	Number of stations with occurrence	Absolute average cover (%)	Occurrence (%)
Felsenmeer	Racomitrium sp.	*Racomitrium sp.*	31	24	82
	Four-angled mountain heather	*Cassiope tetragona*	30	15	79
	Wahlenberg's woodrush	*Luzula wahlenbergii*	1	15	3
	Mountain cranberry	*Vaccinium vitis-idaea*	3	14	8
	Snowbed willow	*Salix herbacea*	6	10	16
	Lichens	-	13	8	34
	Arctic bluegrass	*Poa arctica*	23	7	61
	Short-leaved hairgrass	*Deschampsia cespitosa subsp. Septentrionalis*	5	7	13
	Northern woodrush	*Luzula confusa*	25	6	66
	Short-leaved fescue	*Festuca brachyphylla*	4	6	11
	Alpine sweetgrass	*Anthoxanthum monticola*	2	6	5
	Tufted hairgrass	*Deschampsia cespitosa*	16	5	42
	Wide-leaved polargrass	*Arctagrostis latifolia*	8	5	21
	Two-glumed rush	*Juncus biglumis*	2	5	5
	Arctic pyrola	*Pyrola grandiflora*	1	5	3
Total survey stations			**38**		
Polygonal ground with tundra ostioles	Bryophytes	-	1	75	3
	Racomitrium sp.	*Racomitrium sp.*	34	33	97
	Four-angled mountain heather	*Cassiope tetragona*	33	17	94
	Fragile sedge	*Carex membranacea*	14	16	40
	Snowbed willow	*Salix herbacea*	13	12	37
	Beautiful cottongrass	*Eriophorum callitrix*	4	11	11
	Tufted hairgrass	*Deschampsia cespitosa*	21	10	60
	Water sedge	*Carex aquatilis*	1	8	3
	Arctic bluegrass	*Poa arctica*	23	7	66
	Wide-leaved polargrass	*Arctagrostis latifolia*	15	7	43
	Arctic willow	*Salix arctica*	12	7	34
	Entire-leaved mountain avens	*Dryas integrifolia*	3	7	9
	Narrow-leaved cottongrass	*Eriophorum angustifolium*	4	6	11
	Alpine foxtail	*Alopecurus magellanicus*	1	5	3
	Northern woodrush	*Luzula confusa*	23	5	66
	Alpine bistort	*Bistorta vivipara*	14	5	40
	Mountain cranberry	*Vaccinium vitis-idaea*	9	5	26
	Short-leaved hairgrass	*Deschampsia cespitosa subsp. Septentrionalis*	9	5	26
	Arctic pyrola	*Pyrola grandiflora*	7	5	20
	Lichens	-	3	5	9
Total survey stations			**35**		
Snowbed fen	Bryophytes	-	2	43	17
	Fragile sedge	*Carex membranacea*	10	35	83
	Fisher's toundra grass	*Dupontia fisheri*	2	30	17
	Tufted hairgrass	*Deschampsia cespitosa*	4	23	33
	Sphagnum sp.	*Sphagnum sp.*		21	0

Table 6-17: Plant Species Present on the Ivakkak-Delta Road Area According to the Environment Types (Continued)

Environment	Plant species	Scientific Name	Number of stations with occurrence	Absolute average cover (%)	Occurrence (%)
Snowbed fen	Water sedge	*Carex aquatilis*	4	18	33
	Short-leaved hairgrass	*Deschampsia cespitosa subsp. Septentrionalis*	2	18	17
	Snowbed willow	*Salix herbacea*	12	17	100
	Two-glumed rush	*Juncus biglumis*	3	16	25
	Four-angled mountain heather	*Cassiope tetragona*	7	15	58
	Alpine bistort	*Bistorta vivipara*	10	13	83
	Arctic bluegrass	*Poa arctica*	6	11	50
	Laiche de Lachenal	*Carex lachenalii*	3	10	25
	Far-northern buttercup	*Ranunculus hyperboreus*	2	10	17
	Northern woodrush	*Luzula confusa*	1	10	8
	Wide-leaved polargrass	*Arctagrostis latifolia*	8	9	67
	Wahlenberg's woodrush	*Luzula wahlenbergii*	5	9	42
	Racomitrium sp.	*Racomitrium sp.*	2	9	17
	Snow buttercup	*Ranunculus nivalis*	6	8	50
	Scheuchzer's cottongrass	*Eriophorum sceuchzeri*	4	8	33
	Leafy-stemmed saxifrage	*Micranthes foliolosa*	2	8	17
	Mountain-sorrel	*Oxyria digyna*	2	6	17
	Narrow-leaved cottongrass	*Eriophorum angustifolium*	6	5	50
	Beautiful cottongrass	*Eriophorum callitrix*	3	5	25
	White beakrush	*Rhynchospora alba*	1	5	8
	Moss campion	*Silene acaulis*	1	5	8
Total survey stations			**12**		
Lowland polygonal fen	Bryophytes	-	24	50	28
	Water sedge	Carex aquatilis	11	47	26
	Fragile sedge	Carex membranacea	38	34	88
	Sphagnum sp.	Sphagnum sp.	33	27	77
	Fisher's toundra grass	Dupontia fisheri	10	26	23
	Snowbed willow	Salix herbacea	43	14	100
	Racomitrium sp.	Racomitrium sp.	20	13	47
	Short-leaved hairgrass	Deschampsia cespitosa subsp. Septentrionalis	17	11	40
	Tufted hairgrass	Deschampsia cespitosa	17	10	40
	Alpine sweetgrass	Anthoxanthum monticola	1	10	2
	Alpine bistort	Bistorta vivipara	33	9	77
	Four-angled mountain heather	Cassiope tetragona	24	9	56
	Bigelow's sedge	Carex bigelowii	11	9	26
	Laiche de Lachenal	Carex lachenalii	6	8	14
	Entire-leaved mountain avens	Dryas integrifolia	6	8	14
	Scheuchzer's cottongrass	Eriophorum sceuchzeri	6	7	14
	Far-northern buttercup	Ranunculus hyperboreus	5	7	12
	Wide-leaved polargrass	Arctagrostis latifolia	33	6	77
	Arctic bluegrass	Poa arctica	30	6	70
	Two-glumed rush	Juncus biglumis	20	6	47
	Net-veined willow	Salix reticulata	3	6	7
	Field horsetail	Equisetum arvense	1	5	2
	Sulphur buttercup	Ranunculus sulphureus	6	3	14
Total survey stations			**43**		

6.3.1.3 Potential site location for satellite camp

The potential site location for the satellite camp was characterized on July 22, 2022 in order to delimit the wetlands and terrestrial environments, as well as to identify the vegetation. The site consists of 40% wetlands and 60% terrestrial environments, for a total area of 27.56 ha (Table 6-18). The results from the 16 survey stations indicate an identification of 54 plant species. Photos 6-6 and 6-7 are representative of the wetlands and terrestrial environments present on the site.

No snowbed fen have been identified on this site and therefore the wetlands consist of the polygonal lowland fen, covering 11.08 ha in the satellite camp study area. The latter are composed mainly of water sedge, bryophytes, fragile sedge and Bigelow's sedge (*Carex bigelowii*) (Table 6-19). Although water sedge has the highest absolute cover (58%), bryophytes and fragile sedge are found on almost all stations with an occurrence of 90% each, against 30% for water sedge. In addition, narrow-leaved cottongrass (*Eriophorum angustifolium*) is present on many stations (70% occurrence), but in low quantity (5% absolute cover). It is important to mention that the sulfur buttercup was observed at one station, (VCD6). A total of 42 species were identified in the 10 wetland survey stations.

Terrestrial environments occupy an area of 16.48 ha in the study area. Three types of environments were characterized: boulder fields, felsenmeer and polygonal grounds with tundra ostioles. Although several species are present in the felsenmeer, none has an absolute cover of more than 5%. *Racomitrium* is mainly present in boulder fields (100% occurrence) and polygonal grounds with tundra ostioles (50% occurrence) in addition to having the highest cover for each of the sites (35% and 7% respectively). A total of 38 species were identified in the 6 terrestrial environment stations.

Photo 6-6: Terrestrial environments of the potential camp site

Photo 6-7: Wetlands of the potential camp site

Table 6-18: Surface area for each type of environment found on the potential site location of the satellite camp

Environment	Environment category	Total surface area (ha)	Total number of characterization stations
Terrestrial	Felsenmeer	4.79	2
	Boulder field	5.45	2
	Polygonal ground with tundra ostioles	6.24	2
Subtotal		**16.48**	**6**
Humide	Lowland polygonal fens	11.08	10
Total		**27.56**	**16**

Table 6-19: Plant Species Present on the Potential Site Location for the Satellite Camp According to the Environment Types

Environment	Plant species	Scientific Name	Number of stations with occurrence	Absolute average cover (%)	Occurrence (%)
Boulder field	Racomitrium sp.	*Racomitrium sp.*	2	7	100
	Wide-leaved polargrass	*Arctagrostis latifolia*	1	7	50
	Entire-leaved mountain avens	*Dryas integrifolia*	1	5	50
		Total survey stations	**2**		
Polygonal ground with tundra ostioles	Racomitrium sp.	*Racomitrium sp.*	1	35	50
	Fragile sedge	*Carex membranacea*	1	15	50
	Four-angled mountain heather	*Cassiope tetragona*	1	10	50
		Total survey stations	**2**		
Polygonal lowland fen	Water sedge	*Carex aquatilis*	3	58	30
	Bryophytes	-	9	48	90
	Fragile sedge	*Carex membranacea*	9	20	90
	Bigelow's sedge	*Carex bigelowii*	3	12	30
	Hairgrass sp.	*Deschampsia sp.*	1	7	10
	Racomitrium sp.	*Racomitrium sp.*	3	6	30
	Narrow-leaved cottongrass	*Eriophorum angustifolium*	7	5	70
	Sphagnum sp.	*Sphagnum sp.*	3	5	30
	Sulphur buttercup	*Ranunculus sulphureus*	1	1	10
		Total survey stations	**10**		

6.3.1.4 Location of future quarries

Currently, three potential sites that could be used as quarries have been identified near the future Ivakkak-Delta road.

The three future quarries were characterized on July 23, 2022 in order to delimit wetlands and carry out vegetation field surveys. The study areas of the sites are mainly composed of terrestrial environments (93, 85 and 84% respectively for quarries 1, 2 and 3), which represents 44,79 ha in total out of 51.43 ha surveyed (Table 6-20). The field surveys indicate the presence 49 different species among the 22 survey stations. Photo 6-8 is representative of the terrestrial environments present on the site, while photo 6-9 represents a wetland.

Only Delta 2 quarry has both types of wetlands: a snowbed fen and a lowland fen. For the three quarries (1, 2 and 3 respectively), wetlands occupy 1.17 ha, 3.65 ha and 1.82 ha (Table 6-20). Thus, wetlands occupy only 6.64 ha, or 13% of the entire quarry study area. The species identified are similar between the two types of wetlands. Indeed, bryophytes (mosses including the *Sphagnum* genus) and fragile sedge are the dominant species and present on all survey stations (Table 6-21). Bryophytes have the greatest cover in both environments followed by fragile sedge. In addition, although it does not have a significant cover (4%; see Appendix K), snowbed willow is present on all survey stations in the lowland fens. A total of 34 species were identified in the 10 wetland survey stations.

Photo 6-8: Terrestrial Environments of Future Quarries Site

Photo 6-9 : Wetlands in the Future Quarries Site

Terrestrial environments occupy 44.79 ha and represent 87% of the study area. Three types of environments were characterized: boulder fields, felsenmeer and polygonal grounds with tundra ostioles. Although several species are present in the boulder fields as well as in the felsenmeer, none indicates an absolute cover of more than 5% when the three quarries are considered. The *Racomitrium* is mainly present in polygonal grounds with tundra ostioles (100% occurrence) in addition to having the highest cover (25%). The four-angled mountain heather is also present in all survey stations and has a cover of 20%.

No at-risk species has been identified at the potential quarry sites.

6.3.1.5 Access road to Lake No. 4 for the freshwater supply

The vegetation along the future access path leading to the lake was characterized on July 29 and 30, 2022 in order to delimit wetlands and terrestrial environment and to carry out vegetation field surveys. This survey was conducted for freshwater supply purposes to the Delta site. The study area is made up of 27.41 ha of wetlands (54%) and 23.82 ha of terrestrial environment (46%) (Table 6-22). The presence of water bodies is negligible with 0.44 ha on the course of this path. In total, 71 plant species were observed leading for a total of 42 surveyed stations (see map 6-4). Photos 6-10 and 6-11 are representative of the terrestrial and wetland environments present on the site.

Table 6-20: Surface Area of Each Environment Type Found on the Future Quarries Site

Environment	Environment category	Total surface area (ha)	Total number of characterization stations
Delta quarry 1		**16.65**	**6**
Terrestrial	Boulder field	3.72	1
	Felsenmeer	1.91	2
	Polygonal ground with tundra ostioles	9.85	2
	Total	**15.48**	**5**
Wetland	Polygonal lowland fen	**1.17**	**1**
Delta quarry 2		**23.55**	**12**
Terrestrial	Boulder field	11.83	1
	Felsenmeer	1.89	1
	Polygonal ground with tundra ostioles	6.18	2
	Total	**19.90**	**4**
Wetland	Snowbed fen	2.33	3
	Polygonal lowland fen	1.32	5
	Total	**3.65**	**8**
Delta quarry 3		**11.23**	**6**
Terrestrial	Boulder field	4.01	1
	Felsenmeer	1.03	1
	Polygonal ground with tundra ostioles	4.37	1
	Total	**9.41**	**3**
Wetland	Polygonal lowland fen	**1.82**	3
All quarries		**51.43**	**24**
Terrestrial	Boulder field	19.59	3
	Felsenmeer	4.83	4
	Polygonal ground with tundra ostioles	20.40	5
	Total	**44.79**	**12**
Wetland	Polygonal lowland fen	4.31	9
	Snowbed fen	2.33	3
	Total	**6.64**	**12**

Table 6-21: Plant Species Present on the Future Quarries Site

Environment	Plant species	Scientific Name	Number of stations with occurrence	Absolute average cover (%)	Occurrence (%)
Polygonal ground with tundra ostioles	Racomitrium sp.	*Racomitrium sp.*	5	25	100
	Four-angled mountain heather	*Cassiope tetragona*	5	20	100
	Fragile sedge	*Carex membranacea*	3	8	75
	Arctic pyrola	*Pyrola grandiflora*	1	5	25
		Total survey stations	**5**		
Snowbed fen	Bryophyte	*Bryophyta sp.*	2	90	100
	Fragile sedge	*Carex membranacea*	2	38	100
	Sphagnum	*Sphagnum sp.*	2	9	100
	Lachenal's sedge	*Carex lachenalii*	1	5	50
		Total survey stations	**2**		
Polygonal lowland fen	Bryophyte	*Bryophyta sp.*	7	60	88
	Fragile sedge	*Carex membranacea*	7	51	88
	Sphagnum	*Sphagnum sp.*	8	8	100
	Lachenal's sedge	*Carex lachenalii*	3	6	38
		Total survey stations	**8**		

Photo 6-10: Terrestrial Environments on the Fresh Water Access Road

Photo 6-11: Wetlands on the Fresh Water Access Road

Wetlands are represented only by polygonal lowland fen along the road path (27.41 ha; Table 6-22). The latter are composed mainly of bryophytes with an absolute cover of 77%, followed by water sedge (48%) and fragile sedge (35%) (Table 6-23). Bryophytes, including *Sphagnum genus*, and fragile sedge were found on the majority of survey stations with an occurrence of at least 75% for the three species. Although the absolute cover of Lachenal's sedge is low (7%), this species was found in 56% of the survey stations. A total of 51 species were identified on the 33 wetland stations.

Terrestrial environments occupy a surface area of 23.82 ha and represent 46% of the study area. Three types of environments were characterized: boulder fields, felsenmeer and polygonal grounds with tundra ostioles. The *Racomitrium* is present on all types of terrestrial environments and in more than half of the survey stations of felsenmeer and polygonal grounds with tundra ostioles. In the felsenmeer, entire-leaved mountain avens (*Dryas integrifolia*) has the same absolute cover rate as *Racomitrium* (10%), but has a lower occurrence of 25%. In polygonal ground tundra ostioles, Bigelow's sedge and *Racomitrium* have an absolute cover of 20%. Although arctic bluegrass has a lower absolute cover (6%), it is found on all survey stations (100% occurrence). A total of 37 species were identified in the 10 terrestrial environment survey stations. No at-risk specie has been found on the road path between the Delta site and the selected lake for freshwater supply.

Table 6-22: Surface Area for Each Type of Environment Found on the Access Road Leading to the Lake No. 4 for Fresh Water Supply

Environment	Environment category	Total surface area (ha)	Total number of characterization stations
Terrestrial	Felsenmeer	8,12	4
	Boulder field	9,86	3
	Polygonal ground with tundra ostioles	5,84	2
	Total	**23,82**	**8**
Wetland	Lowland polygonal fens	27,41	33
Total survey stations			**42**
Water environments		0,44	-
Total		51,67	42

Table 6-23: Plant Species Present on the Access Road Leading to lake No. 4 for Fresh Water Supply According to the Types of Environment

Environment	Plant species	Scientific Name	Number of stations with occurrence	Absolute average cover (%)	Occurrence (%)
Boulder field	Racomitrium sp.	*Racomitrium sp.*	1	6%	33%
		Total survey stations	**3**		
Felsenmeer	Racomitrium sp.	*Racomitrium sp.*	3	10%	75%
	Entire-leaved mountain avens	*Dryas integrifolia*	1	10%	25%
	Arctic willow	*Salix arctica*	1	5%	25%
	Spike trisetum	*Trisetum spicatum*	1	5%	25%
		Total survey stations	**4**		
Polygonal ground with tundra ostioles	Racomitrium sp.	*Racomitrium sp.*	2	20%	67%
	Bigelow's sedge	*Carex bigelowii*	1	20%	33%
	Arctic bluegrass	*Poa arctica*	3	6%	100%
		Total survey stations	**3**		
Polygonal lowland fen	Bryophytes	-	27	78%	82%
	Water sedge	*Carex aquatilis*	17	48%	53%
	Fragile sedge	*Carex membranacea*	25	38%	76%
	Sphagnum sp.	*Sphagnum sp.*	25	18%	78%
	Fisher's tundra grass	*Dupontia fisheri*	15	15%	47%
	Lachenal's sedge	*Carex lachenalii*	18	7%	56%
	Racomitrium sp.	*Racomitrium sp.*	5	6%	15%
	Marsh willowherb	*Epilobium palustre*	1	5%	3%
		Total survey stations	**33**		

6.3.1.6 Northern landfill (LEMN)

The study area for the location of the LEMN was characterized on July 29 and 30, 2022 in order to delimit wetlands and carry out vegetation surveys. The site study area is mainly composed of terrestrial environments (4.49 ha), which represents 98% of the total surface area of 4.64 ha (Table 6-24). On the 6 survey stations, 31 species were observed. Photos 6-12 and 6-13 are representative of the terrestrial and wetland environments present on the LEMN site. However, it is expected that the LEMN will occupy a smaller surface area (2.7 ha).

Photo 6-12: Terrestrial Environments at the Future LEMN Site

Photo 6-13: Wetlands in the Study Area of the Future LEMN Site

Wetlands consist of a polygonal lowland fen of 0.15 ha, or 3% of the study area (Table 6-24). It is mainly composed of fragile sedge (63% absolute cover) which is present at all the survey stations (Table 6-25). A total of 18 species

Terrestrial environments occupy a surface area of 4.49 ha and dominate the LEMN study area (97%). Three types of environments were characterized: boulder fields, felsenmeer and polygonal grounds with tundra ostioles. The *Racomitrium* is present on all terrestrial survey stations and has the highest absolute cover for each (Table 6-25). The four-angled mountain heather is also found on all boulder fields and polygonal grounds with tundra ostioles with a 15% cover in both cases. In total, 20 plant species were identified at the 4 stations of the terrestrial environment survey.

No at-risk specie has been found in the study area of the future landfill site.

Table 6-24: Surface Area for Each Type of Environment Found in the Future LEMN Study Area

Environment	Environment category	Total surface area (ha)	Total number of characterization stations
Terrestrial	Felsenmeer	1.53	1
	Boulder field	1.61	1
	Polygonal ground with tundra ostioles	1.35	2
Total		**4.49**	**4**
Wetland	Lowland polygonal fens	0.15	2
Total		**4.64**	**6**

Table 6-25: Plant Species Present on the Future LEMN Study Area According to the Type of Environment

Environment	Plant species	Scientific Name	Number of stations with occurrence	Absolute average cover (%)	Occurrence (%)
Boulder field	Racomitrium sp.	*Racomitrium sp.*	1	30	100
	Four-angled mountain heather	*Cassiope tetragona*	1	15	100
		Total survey stations	**1**		
Felsenmeer	Racomitrium sp.	*Racomitrium sp.*	1	15	100
		Total survey stations	**1**		
Polygonal ground with tundra ostioles	Racomitrium sp.	*Racomitrium sp.*	2	23	100
	Four-angled mountain heather	*Cassiope tetragona*	2	15	100
	Snowbed willow	*Salix herbacea*	1	5	50
		Total survey stations	**2**	2	
Polygonal lowland fen	Fragile sedge	*Carex membranacea*	2	58	100
	Bryophytes	-	1	30	50
	Sphagnum sp.	*Sphagnum sp.*	1	10	50
	Wide-leaved polargrass	*Arctagrostis latifolia*	1	5	50
		Total survey stations	**2**	2	

6.3.1.7 Species of interest for Inuit communities

During the 2007 ESIA, several plant species were identified as having a traditional interest for the Inuit (15 taxa). The 2021 and 2022 field surveys identified several of them in different areas (Table 6-26).

Table 6-26: List of Plant Species of Traditional Inuit Interest in the Delta Project Area

Plant Scientific name	Plant english name	Absolute average cover (%)
Delta site		
Racomitrium sp.	Racomitrium	19,69
Cassiope tetragona	Four-angled mountain heather	11,71
Bistorta vivipara	Alpine bistort	6,50
Salix arctica	Arctic willow	4,09
Silene acaulis	Moss campion	3,48
Pedicularis hirsuta	Hairy lousewort	3,18
Oxyria digyna	Mountain-sorrel	2,13
Delta camp		
Cassiope tetragona	Four-angled mountain heather	10.00
Racomitrium sp.	Racomitrium	9.86
Bistorta vivipara	Alpine bistort	3.08
Salix arctica	Arctic willow	1.64
Oxyria digyna	Mountain-sorrel	1.00
Pedicularis hirsuta	Hairy lousewort	1.00
Silene acaulis	Moss campion	1.00
LMN		
Racomitrium sp.	Racomitrium	22.50
Cassiope tetragona	Four-angled mountain heather	10.20
Bistorta vivipara	Alpine bistort	1.00
Oxyria digyna	Mountain-sorrel	1.00
Vaccinium vitis-idaea	Mountain cranberry	1.00
Road leading to the fresh water lake		
Racomitrium sp.	Racomitrium	11.33
Cassiope tetragona	Four-angled mountain heather	3.00
Vaccinium vitis-idaea	Mountain cranberry	2.50
Salix arctica	Arctic willow	2.48
Bistorta vivipara	Alpine bistort	1.80
Oxyria digyna	Mountain-sorrel	1.67
Pedicularis hirsuta	Hairy lousewort	1.00
Silene acaulis	Moss campion	1.00
Quarries		
Racomitrium sp.	Racomitrium	15.80
Cassiope tetragona	Four-angled mountain heather	9.69
Vaccinium vitis-idaea	Mountain cranberry	3.00
Silene acaulis	Moss campion	2.25
Bistorta vivipara	Alpine bistort	2.14
Salix arctica	Arctic willow	2.00
Oxyria digyna	Mountain-sorrel	1.33
Pedicularis hirsuta	Hairy lousewort	1.00
Ivakkak-Delta road		
Racomitrium sp.	Racomitrium	23.27
Cassiope tetragona	Four-angled mountain heather	14.31
Vaccinium vitis-idaea	Mountain cranberry	5.22
Umbilicaria sp.	Rock polybody	5.00
Oxyria digyna	Mountain-sorrel	3.27
Bistorta vivipara	Alpine bistort	7.92
Salix arctica	Arctic willow	4.77
Silene acaulis	Moss campion	3.57
Pedicularis hirsuta	Hairy lousewort	2.00

In the Delta project area, nine species of traditional Inuit interest are present (Table 6-26). The two species with the greatest average absolute cover on all sites are the *Racomitrium* and the four-angled mountain heather. Their average covers vary between 3 and 23.5%. Other species are present on almost all the sites, but with lower average cover, varying between 6.5 and 1%. These species are alpine bistort, arctic willow (*Salix arctica*), moss campion (*Silene acaulis*), hairy lousewort (*Pedicularis hirsuta*), mountain-sorrel (*Oxyria digyna*), mountain cranberry (*Vaccinium vitis-idaea*) and rock polybody (*Umbilicaria sp*.). The area where the greatest number of these species are found is along the road between Ivakkak and Delta, where nine species have been identified.

6.3.1.8 Ecological Functions of Wetlands and Water Environments in the Study Areas

Wetlands and waterways play essential roles for the proper functioning of the ecosystems in which they are embedded. These particular functions are also beneficial for humans (Varin, 2013). Section 13.1 of the *Act to affirm the collective nature of water resources and to promote better governance of water and associated environments* (RLRQ, c. C-6.2) lists the main functions associated with wetlands and water environments: filtration and retention of sediment, water level regulation, conservation of biological diversity, survival of the environment, carbon sequestration and mitigation of the impacts of climate change, in addition to the contribution to the landscape's quality (LegisQuébec, 2020). The wetlands' ecological functions will be modified following the construction and underground mining of the Delta deposit, including the development of roads and the necessary infrastructures. Several wetlands and bodies of water will be affected by the planned work.

Sediment filtration and retention

Wetlands have a good water retention capacity, which slows down the runoff of water towards the water network. In the northern context, the flow of water is mainly on the surface (<3 m depth) given the presence of continuous permafrost beyond this depth (Smith *et al.*, 2004). The direction of the slope will indicate the direction of water flow. Wetlands are therefore mainly found in depressions or in environments where the relief is flat.

Lowland polygonal fens delimited during field surveys sustains lake or watercourse. Therefore, they contribute to sediment retention and water filtration. The destruction of this type of environment, by the construction of mining infrastructures, can therefore alter these functions in addition to being a supplementary contribution of sediment and pollutants. Since the wetlands surround the three lakes surrounding the Delta mine site, sediments or deposits caused by the activities of the NNiP could reach them during the infrastructures' construction. The destruction of associated wetlands can reduce their filtration and sediment retention functions, thereby increasing the risk of sedimentation towards the body of water south of the study area. However, implementing mitigation measures can counter these effects and these are addressed in the chapter on impacts (Chapter 7).

Regulation

In northern Quebec, the presence of continuous permafrost affects water flow, which occurs primarily on the surface. This flow can therefore be more or less rapid depending on the slope. The fens presented in the study area are on flat or mid-slope terrain, thus allowing better water retention.

The excellent retention capacity of wetlands allows them to play a role in water regulation, especially in the spring (flood periods) and at the end of summer (severe low water period). The fens present in the study area could therefore play a role in regulating the rate at which water reaches the lakes located near the study area. Stripping a portion of these wetlands in the Delta site will therefore cause a local modification of the regulatory function.

Conservation of Biodiversity

Wetlands are known to harbour a great diversity of flora and fauna. However, this diversity is less than what is found in southern Quebec when compared to the northern environment. However, some at-risk species in Quebec can be found in this type of environment. In the case of the Delta site, a large 4.01 ha colony of sulfur buttercup (likely to be designated as threatened or vulnerable) will be completely removed during construction. The colony has an average density of 1.71 individuals/100 m². However, stripped soil containing the seed reserves of this species will be retained. No damage to biological diversity is therefore anticipated at the end of the project.

Survival of the Environment

In wetlands, the environment is normally maintained by the root system of plants, which contributes to soil conservation. Riparian vegetation is therefore a key factor in protecting banks against erosion. The flat relief surrounding the watercourses does not encourage erosion in the study area. In the study area, the flat relief surrounding watercourses helps to reduce erosion. Since there will be surface stripping in the study area, the environment cannot be maintained in its original state. However, stripping in a wetland environment will be done at more than 60 m from watercourses, allowing this function to be preserved.

Carbon Sequestration and Mitigation of Climate Change Impacts

Wetland vegetation uses carbon dioxide, water and light (photosynthesis) in the air to create its tissue. These carbon compounds are then sequestered in the biomass. Wetlands are among the most efficient in carbon sequestration.

The wetlands that will be destroyed represent a small area of the scale of landscape. This destruction will therefore have minimal impact on the reduction of carbon sequestration.

Landscape Quality

The presence of wetlands makes it possible to preserve an environment's natural aspect. Although this function is crucial in southern Quebec, northern ecosystems are made up of a large portion of wetlands. The extension of the NNiP by open-pit and underground mining of the Delta deposit in a new unused sector will therefore have a temporary visual impact in the northern wetlands landscape in the northern wetlands landscape.

6.3.2 Fauna

During the 2006 initial impact study, specific field surveys and characterization of wildlife habitats took place in the area encompassing the Ivakkak, Méquillon, Expo and Mesamax sites. Larger-scale field surveys highlighted the use of the area by terrestrial mammals and avifauna. These are two components likely to be affected by the projects covered by this addendum. Since the 2b Phase project could affect avian, terrestrial and fish fauna, as well as their habitat, specific field surveys for these components were carried out in 2021 and 2022.

Specific field surveys of avifauna and ichthyofauna (including benthic invertebrates) were conducted, while more extensive data on terrestrial fauna were sampled during vegetation field surveys (incidental observations). The detailed protocol is provided in Appendix G.

Herpetofauna was not considered since the study area is well beyond the northern distribution limit of the various species of amphibians and reptiles in Quebec.

6.3.2.1 Terrestrial mammals

According to data from the 2007 impact study, a dozen species of terrestrial mammals live in the arctic tundra and are likely to use the study area at one time or another during the year (table 6-27). The homogeneity of the Arctic territory and the harsh winter conditions contribute to the environment's low faunal diversity. In regard to at-risk species, note that there is no population estimate for the wolverine in Quebec due to its rarity. In addition, the Inuit of Salluit and Kangiqsujuaq interviewed during the initial impact study mentioned having never observed a wolverine (GENIVAR, 2007). The least weasel has never been observed and polar bears are very rarely present in the NNiP area.

In 2021 and 2022, no specific field survey was carried out on terrestrial mammals. Only incidental observations of individuals and indications of land use were reported. Locations of incidental sightings other than those associated with caribou can be viewed on Maps 6-2, 6-3 and 6-4. Section 6.3.2.2 is dedicated to caribou.

Only a few species of mammals were observed during the various field surveys: lemming (*Dicrostonyx hudsonius*), arctic fox (*Alopex lagopus*), vole (not identified to the species because it was observed too quickly) and ermine (*Mustela erminea*). Because of its small size and stealthiness, the lemming has not often been sighted directly. However, several clues were noted such as burrows, bones and feces. Most observations were made in wetlands with a few occurrences in terrestrial environments. The arctic fox was directly observed on a few occasions only in wetlands and feces were also noted. Ermine and vole were directly observed only once, each in terrestrial environments.

Table 6-27: Terrestrial Mammals Likely to Use the NNiP Local Study Area

French name	English name	Scientific name	Relative abondance
Belette pygmée[A]	Least weasel	*Mustela nivalis*	Low
Campagnol des champs	Meadow vole	*Microtus pennsylvanicus*	Low to high[B]
Carcajou[A]	Wolverine	*Gulo*	Rare
Caribou des bois	Caribou	*Rangifer tarandus*	Low to high[C]
Bœuf musqué	Muskox	*Ovibos moschatus*	Low
Hermine	Ermine	*Mustela erminea*	Average
Lemming d'Ungava	Ungava lemming	*Dicrostonyx hudsonius*	Low to high[B]
Lièvre arctique	Arctic hare	*Lepus arcticus*	Low to average
Loup[E]	Wolf	*Canis lupus*	Low
Loutre de rivière	River otter	*Lutra canadensis*	Low
Ours blanc[A]	Polar bear	*Ursus maritimus*	Low
Renard arctique	Arctic fox	*Alopex lagopus*	Low to average[B]
Renard roux[D]	Red fox	*Vulpes*	Low

Source: GENIVAR, 2007.
A At-risk species, see Section 6.3.3.
B The abundance of these species varies according to an approximate 3 to 5 year cycle.
C The abundance of caribou varies throughout the seasons.
D This species has considerably extended its range north due to global warming.
E Lone wolf or in a pack.

6.3.2.2 Caribou

The woodland caribou (*Rangifer tarandus*) is a terrestrial mammal found in the study area. Woodland caribou is of great importance for the Inuit community because of its abundance and its nutritional value (ECCC, 2005). In relation to the use of particular ecosystems, three caribou ecotypes are present on Quebec territory: 1) the migratory ecotype (the status of this ecotype is currently being analyzed), 2) the mountain ecotype (species designated threatened in Quebec and endangered by the Species at Risk Act or SARA at the federal level) and 3) forest ecotype (designated vulnerable species in Quebec and threatened according to SARA).

The migratory ecotype is found in the study area. Two distinct populations are part of this ecotype in Quebec: Rivière Georges herd and the Leaf River Herd (LRH), which occupies the study area. The LRH one would have approximately 199,000 ± 15,920 caribou according to the most recent estimate made in 2016 (COSEWIC, 2017). In recent years, signs of decline have become increasingly noticeable, including the poor physical condition of lactating females (Taillon et al. 2011 in COSEWIC 2017). In 2014, the fall recruitment rate was estimated at 14 calves/100 females, which is considered very low. According to Inuit and Cree hunters, the Rivière-aux-Feuilles subpopulation has declined since 2011 (COSEWIC, 2017). The mitigation measures to be put in place will therefore be of great importance, so as not to disturb the good breeding years.

The study area is used by the caribou population, but represents a tiny part of its territory, approximately 502 ha (5.02 km²) out of 153,400 km² for the legal calving area and 663,810 km² for its used area according to COSEWIC (2017) and as shown in Figure 6-7. This area therefore represents around 0.003% of the territory known for the calving area. The area concerned by the projected path of the road linking the Ivakkak and Delta mine sites is used by the migratory caribou of the LRH during calving and during the summer for feeding. These two seasonal habitats are considered sensitive because their quality influences the population growth potential. The caribou calving ground, north of the 52nd parallel, constitutes a legal wildlife habitat under the Act respecting the conservation and development of wildlife (LCMVF; RLRQ, c. C 61.1, r. 18). It should be noted that the LRH has suffered a significant reduction since the 2000s (nearly 75%) and is still in decline according to the latest studies (Plante, 2020). Although this woodland caribou population has no legal status in Quebec or Canada, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed the species as endangered in 2017.

Source: Taillon et coll., 2016

Figure 6-7: Seasonal Migrations Made by the Caribou of Leaf River Herd (LRH)

Thus, the entire study area for Delta site exploitation project and the Ivakkak-Delta road is located on a territory frequently used by caribou (photos 6-14 to 6-16 and figures 6-8 to 6-11). It should be noted that photo 6-15 highlights a trail used by several hundred individuals during a single day (July 28, 2021). The use of the area by the caribou is explained by the fact that it is covered with wetlands and terrestrial environments with vegetation that are used as a food source by the caribou (maps 6-6). Observations made in the field have shown that the area where the Delta site is located is intensely grazed in its southern part, unlike its northern part which is a little more rocky and elevated. However, grazing is not only caused by caribou, but also by Canada geese (*Branta canadensis*). Caribous are mainly observed in groups varying from 2 to 60 individuals. Caribous were seen at the future Delta site, in the northeast-southwest axis of an area of frequent passage (map 6-6). A group of approximately 200 individuals was observed at the northeast end of the study area. Nevertheless, signs of the presence or passage of caribou were seen throughout the study area of the Delta site, but mainly in the wetlands. They correspond to a large portion of the study area to the south as well as to the northern end where several snowbed fens are found. A few sightings and tracks were noted along the path of the road, but these were more sporadic. It should be noted that the road is perpendicular to three areas of frequent caribou passage and that sporadic caribou sightings are concentrated near those. Finally, a caribou was observed along the access path leading to the fresh water supply lake.

Caribou are not present for long periods in the study area since they go through it during their migration and during calving. AECOM teams were present on the field from July 12 to August 23, 2021, a period during which several caribou sightings were noted. During this period, the largest sightings in terms of numbers occurred in late July and early August. This observation corroborates the telemetric monitoring carried out by the *ministère de la faune et des Parcs* (MFFP) in 2021 (V. Brodeau, pers. comm., 2021) and which indicated that caribou were present in the Delta study area mainly in July 2021 (see Figure 6-11). According to data collected from previous telemetry surveys, caribous are generally present from June to July in the Delta study area but are known to use the south and southwest of the study area as early as May. The presence of the caribou at the site is related to the biological needs of the specie regarding its life cycle, which consists of (1) moving from the south to the north for calving due to the lower abundance of predators, and (2) to then return to the south for the winter period which is less rigorous. During its migration, the caribou uses rich shrubs sites (*Salix sp*. and *Betula sp*.), grasses, herbaceous plants and terrestrial lichen (Plante, 2020). According to field survey data, the areas identified in yellow and orange on Map 6-6 are especially rich in sedges and grasses with a ground cover of nearly 100%.

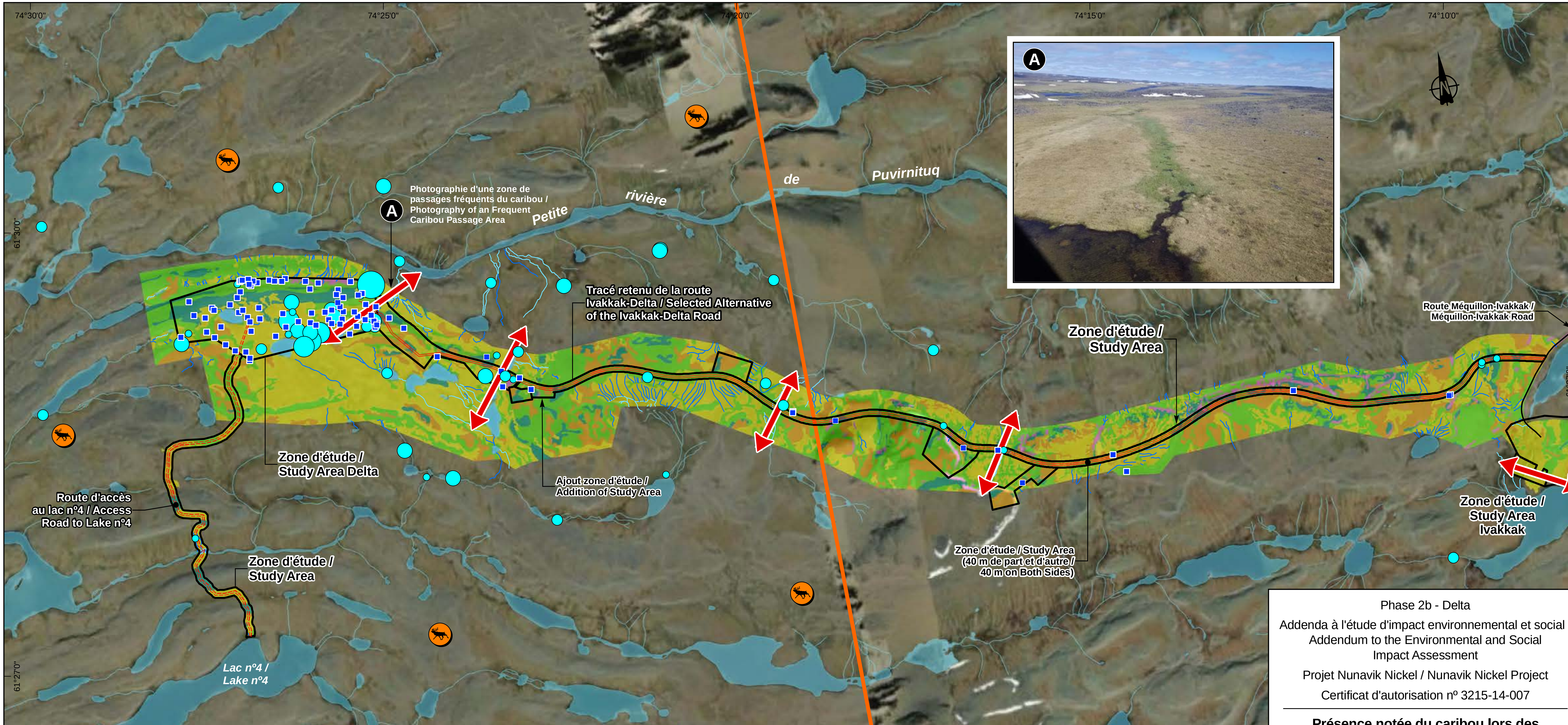
Finally, part of the LRH seems to migrate along a North-South axis in the study area according to the trampled trails and the topography of the land. Map 6-6 shows the caribou's crossing sites of the study area as well as the various incidental observations. These observations also corroborate the observations made by the telemetric monitoring of the MFFP (Figures 6-8 to 6-11; V. Brodeau, pers. comm., 2021).

All of these observations corroborate the fact that the study area of the future Delta site is in a caribou calving area, that it is used for feeding purposes and for the seasonal migration of the specie.

Photo 6-14: Herd of Caribou Accompanied by Calves on July 22, 2022 Near the Future Delta Camp Site

Photo 6-15: Trail Widely Used by Caribou at the Ivakkak Site

Photo 6-16: Large Male Wandering in the Future Ivakkak-Delta Road Area



Composantes du projet / Project Components

- Zone d'étude / Study Area
- Tracé retenu / Selected Road
- Route d'accès au lac nº4 / Access Road to Lake nº4

Faune / Wildlife

Abondance / Plenty

- 1 individu / Individual
- Entre 2 et 5 individus / Individuals
- Entre 6 et 20 individus / Individuals
- Entre 21 et 60 individus / Individuals
- 200 individus / Individuals
- Signe de présence ou passage du caribou / Sign of Presence or Passage of Caribou
- Aire de mise bas du caribou légale / Legal Caribou Calving Area
- Zone de passages fréquents du caribou / Frequent Caribou Passage Area

Végétation / Vegetation

Milieux humides / Wetland

- Fen de combe à neige / Snowbed Fen
- Fen polygonal de basses terres / * Lowland Polygonal Fen*

Milieux terrestres / Terrestrial Environments

- Champ de blocs / Boulder Fields
- Felsenmeer / Felsenmeer
- Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles

Hydrographie / Hydrography

- Cours d'eau permanent / Permanent Watercourse
- Cours d'eau intermittent / Intermittent Watercourse
- Cours d'eau (CanVec) / Watercourse (CanVec)
- Plan d'eau / Waterbody

* *Brouté intensément par l'oie des neiges et le caribou / Heavily Grazed by Snow Geese and Caribou*

Phase 2b - Delta

Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment

Projet Nunavik Nickel / Nunavik Nickel Project

Certificat d'autorisation nº 3215-14-007

Présence notée du caribou lors des inventaires de 2021 et 2022 / Noted Presence of Caribou During the 2021 and 2022 Inventories

Sources:

Imagerie/Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
CanVec, 1:50, 000, NRCan, 2019
Habitats fauniques / Wildlife habitat, MFFP Québec, 2021
Données de projet/Project data, Canadian Royalties, 2022

Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c6_6_Caribous_230123.mxd

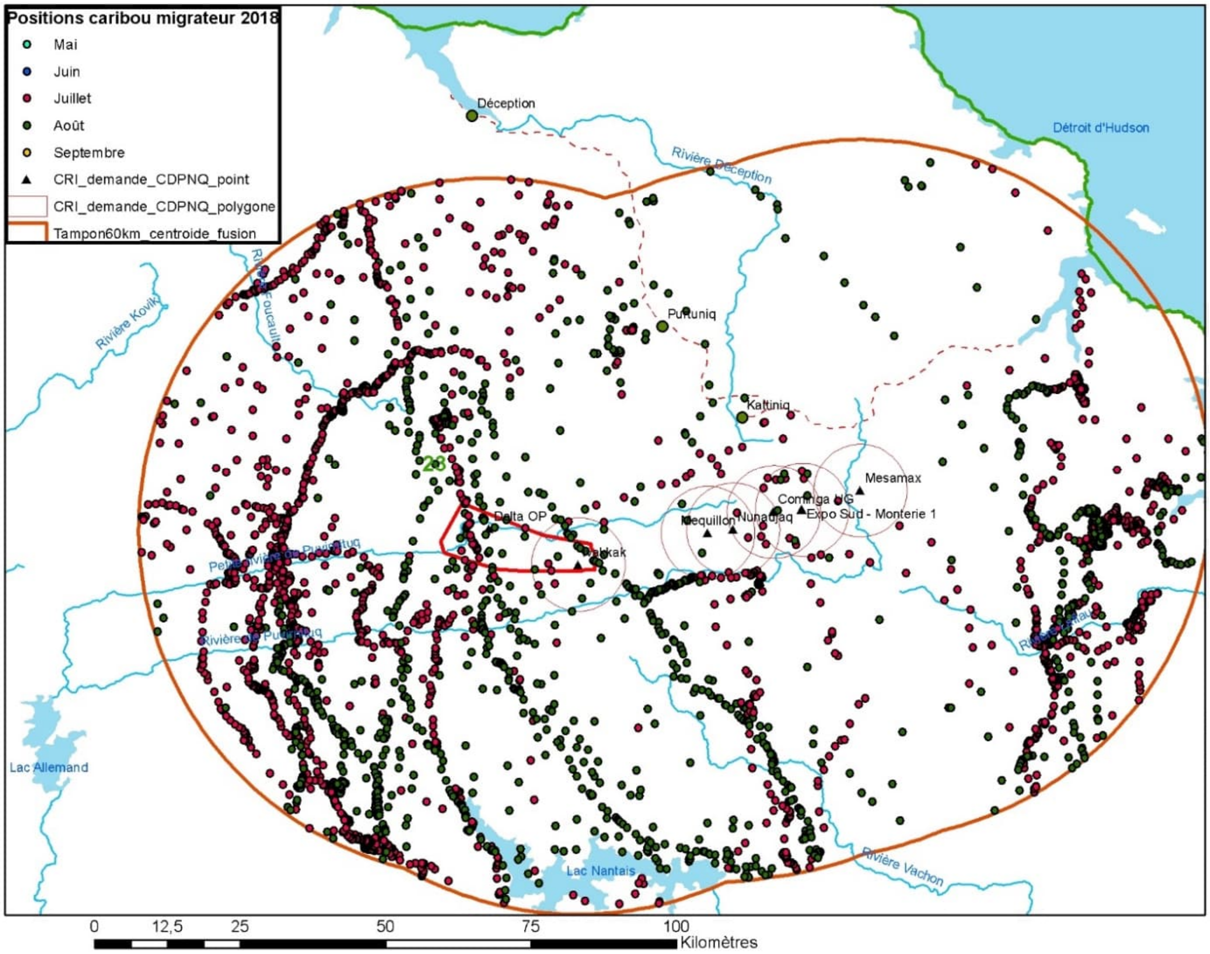
0 500 1 000 m

UTM, Zone 18, NAD83

Carte / Map 6-6

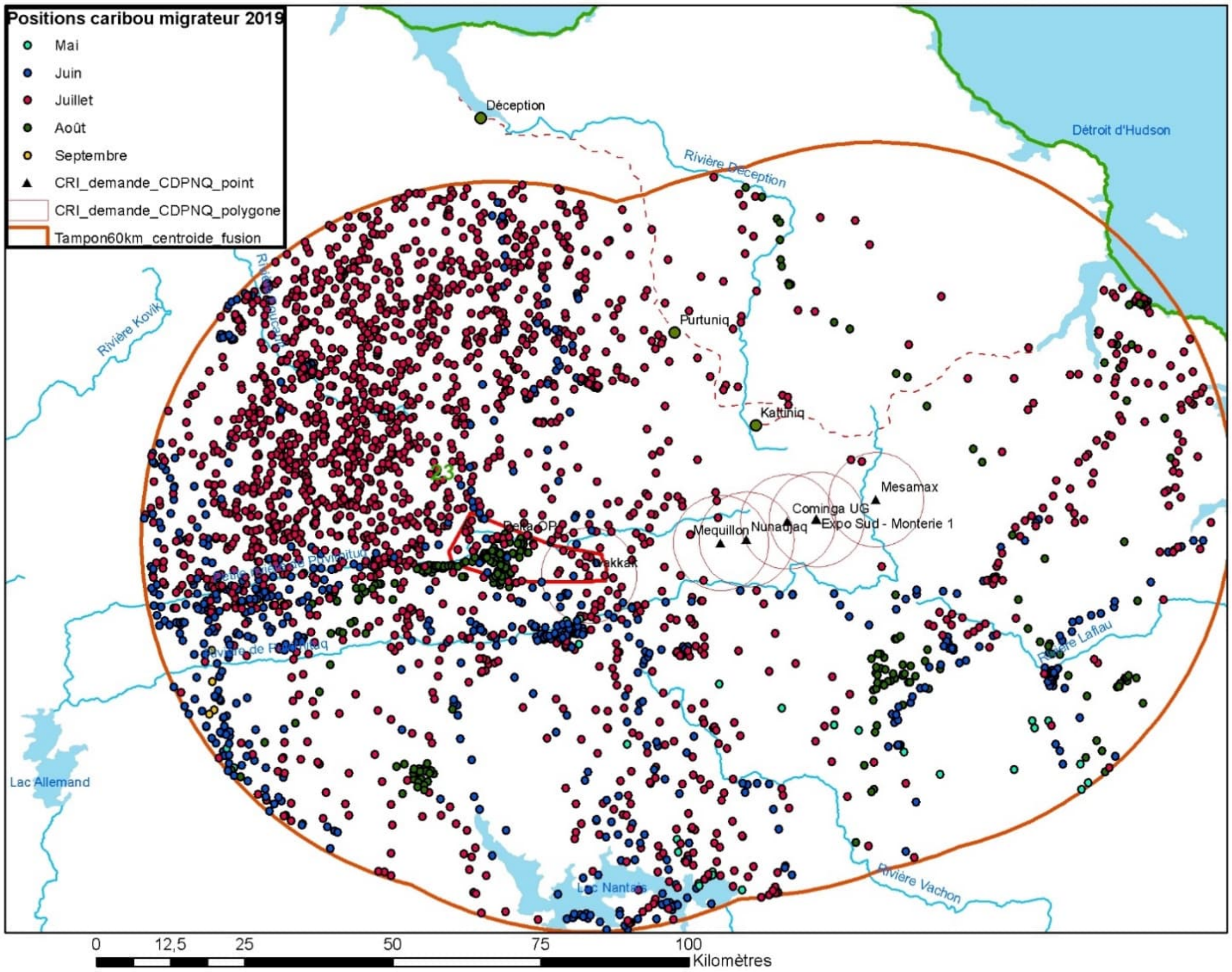
Janvier / January 2023

AECOM NUNAVIK NICKEL CANADIAN ROYALTIES INC.



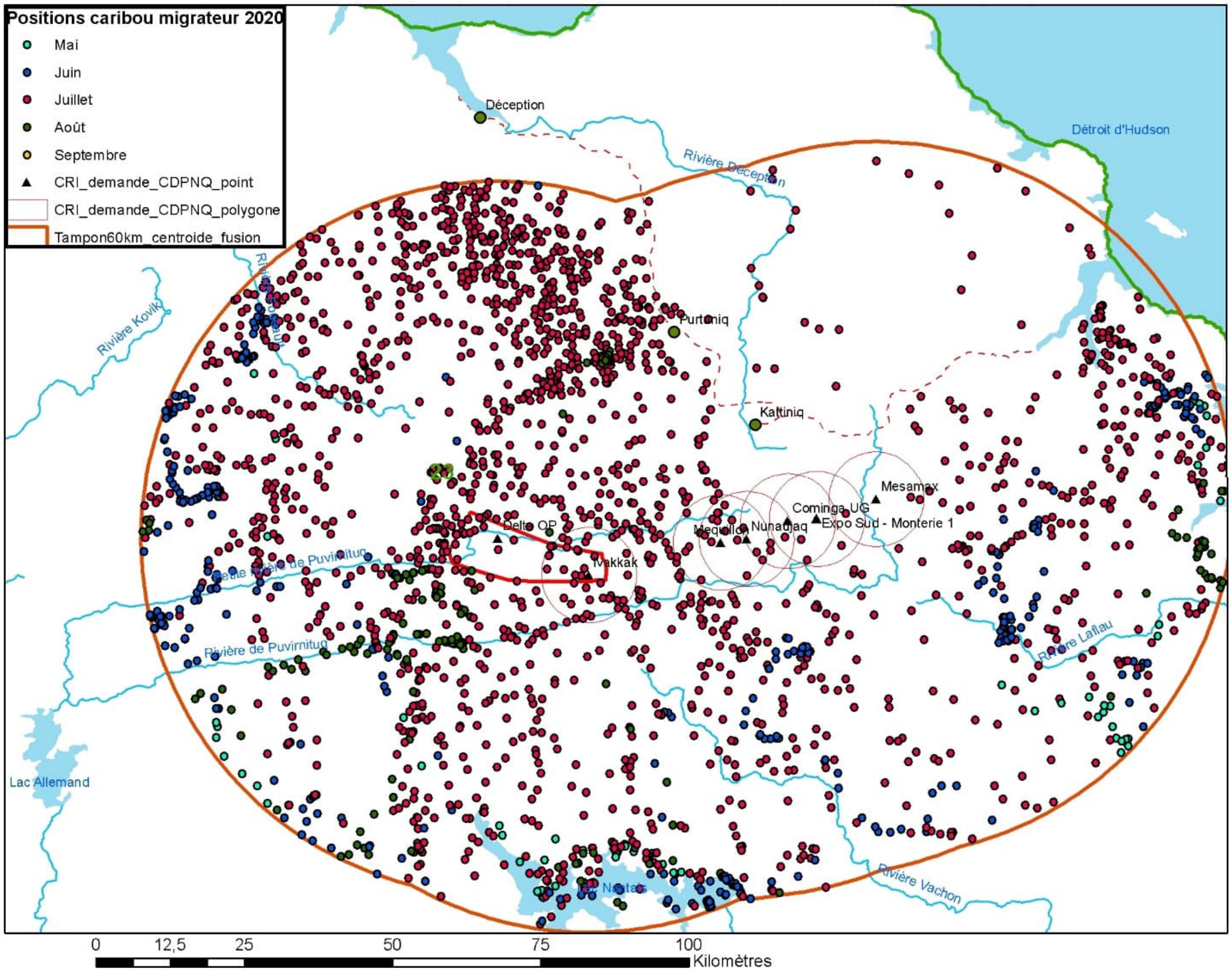
(Source: S. Boudreault for the Direction de la gestion de la faune du Nord-du-Québec, pers. comm. October 19, 2021)

Figure 6-8: Migratory Caribou Position in 2018



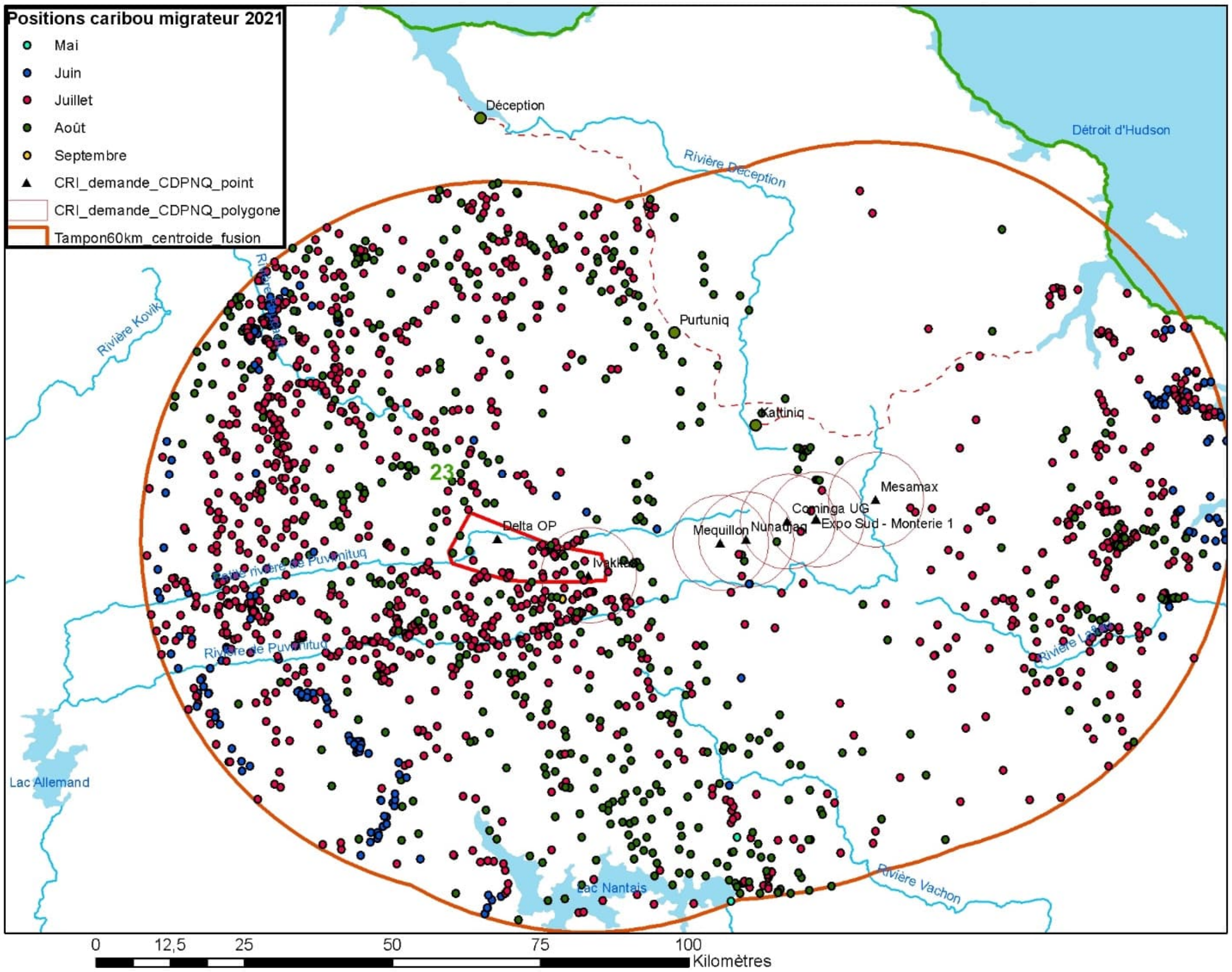
(Source: S. Boudreault for the Direction de la gestion de la faune du Nord-du-Québec, pers. comm. October 19, 2021)

Figure 6-9: Migratory Caribou Position in 2019



(Source: S. Boudreault for the Direction de la gestion de la faune du Nord-du-Québec, pers. Comm. October 19, 2021)

Figure 6-10: Migratory Caribou Position in 2020



(Source: S. Boudreault for the Direction de la gestion de la faune du Nord-du-Québec, pers. Comm. October 19, 2021)

Figure 6-11: Migratory Caribou Position in 2021

6.3.2.3 Avifauna

Appendix L indicates the list of species as well as the observations map made during the 2007 initial impact study. Among the previously listed species, 23 were considered "nesting" ones, including 8 species who were confirmed breeders, 3 who were probable breeders and 12 who were possible breeders. The breeding period of these species extends from May/June to September, while the migration period generally extends from mid-September to mid-October. However, increased climate change could alter these periods over the lifetime of mining operations. Field surveys confirmed the presence of the golden eagle (*Aquila chrysaetos*) and the peregrine falcon (*Falco peregrinus*) in the study area, i.e. two at-risk species (section 6.3.3.).

No field survey was conducted during the initial impact study in the Delta project area. An exhaustive field survey on avifauna was then conducted from July 17 to 22, 2021 for this area. Results indicates it is possible to list 30 species, including several species of waterfowl (n=7), aquatic birds other than waterfowl (n=9), birds of prey (n=5) and passerines (n=7). In addition to these groups, common raven and rock ptarmigan were observed.

The following sections indicate field surveys results conducted in 2021 on avifauna. The protocol used is similar to the one that was carried out and approved by the MELCC as part of the impact study for the exploitation of the Puimajuq deposit (WSP, 2015).

During field surveys, 68 plots of 10 ha (35 for the Ivakkak-Delta road sector and 33 in the study area of the Delta site) were surveyed (see map in appendix G for plots and maps 6-2 and 6-3 for observation results). The different plots were grouped according to the types of habitat observed in the field. A total of eight types of habitats were identified:

- **Boulder field** – terrestrial habitat (9 plots along the Ivakkak-Delta road and 10 plots at the Delta site; photo 6-17);
- **Felsenmeer** – terrestrial habitat (1 plot along the Ivakkak-Delta road path and 5 plots at the Delta site; photo 6-18);
- **Snowbed fen** – wetland habitat (3 plots along the Ivakkak-Delta road and 1 plot at the Delta site; Photo 6-19);
- **Lowland polygonal fen** – wetland habitat (7 plots along the Ivakkak-Delta road path and 11 plots at the Delta site; Photo 6-20);
- **Wet heterogeneous habitat** – (fragmented habitat located within a lowland fen and different terrestrial environments fragmentations - 9 plots along the Ivakkak-Delta road and 4 plots at the Delta site; photo 6 - 21);
- **Terrestrial heterogeneous habitat** – (fragmented habitat located within different types of terrestrial habitats fragmentations - 4 plots along the Ivakkak-Delta road and 1 plot at the Delta site; photo 6-22) ;
- **Polygonal ground with tundra ostioles** – (2 plots along the Ivakkak-Delta road path; photo 6-23);
- **Lake** – (1 plot at the Delta site; photo 6-24).

Detailed results of the plot field surveys are shown in Appendix O.

Photo 6-17: Boulder Fields (Delta Site)

Photo 6-18 : Felsenmeer (Delta Site)

Photo 6-19: Snowbed Fen (Selected Alternative of the Ivakkak-Delta Road)

Photo 6-20: Lowland Polygonal Fen (Selected Alternative of the Ivakkak-Delta Road)

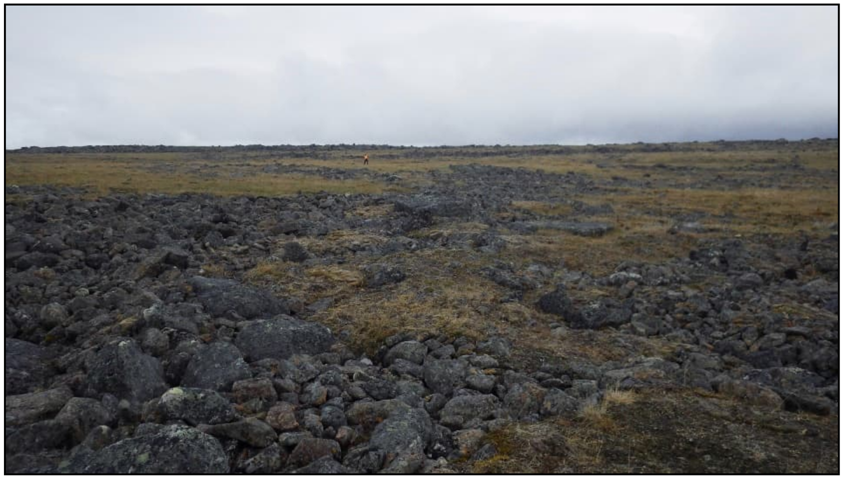


Photo 6-21: Wetlands Heterogeneous Habitat (Delta Site)

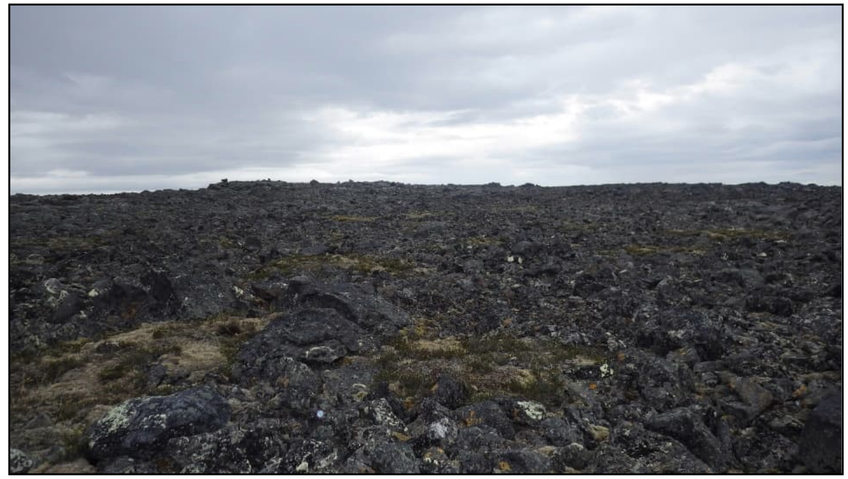


Photo 6-22: Terrestrial Heterogeneous Habitat (Selected Alternative of the Ivakkak-Delta Road)

Photo 6-23: Polygonal Grounds with Tundra Ostioles (Selected Alternative of the Ivakkak-Delta Road)

Photo 6-24: Lake (Delta Site)

6.3.2.3.1 Waterfowl and other aquatic birds

A total of 8 waterfowl and other aquatic birds species were identified during the aerial and ground field surveys on the combined delta site and Ivakkak-Delta road site. Seven species were identified on the Delta site: five species of waterfowl (Canada goose, Barrow's goldeneye, long-tailed duck, red-breasted Merganser, snow goose) and three species of aquatic birds (herring gull, Red-throated Loon and Common Loon) (Map 6-2). The Canada goose is the only specie that has been confirmed to be breeding in the Delta site area, since eggs were seen in a nest during the aerial field survey. The nesting status is "possible" for all the other observed species.

The Quebec Barrow's goldeneye, which is part of the Eastern Canada population (nearly 6,000 individuals), is defined as vulnerable in Quebec under the *Act respecting threatened or vulnerable species* (MFFP, 2021). At the federal level, the Barrow's goldeneye was listed as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2011 and is listed in the Special Concern column under the *Species at Risk Ac*t (Gouvernement du Canada, 2015). Of all the observed species, only one individual was seen in the Delta site area, but outside the planned work area. The individual was moulting near the Puvirnituq river.

For the Ivakkak-Delta road area, five different species were identified (Map 6-3). For waterfowl, these are the Canada goose, the greater snow goose and the long-tailed duck. For other aquatic species, the herring gull and the red-throated loon have been listed. A female Canada goose was identified during the ground field survey outside the observation transects while she was incubating four eggs. The male, meanwhile, stood nearby. All other observations are from the helicopter survey. Canada goose and greater snow goose have been confirmed breeding in the Ivakkak-Delta road area. The nesting status is established as "possible" for all the other observed species.

The full list of species and the numbers of individuals observed are presented in Appendix O along with their breeding status.

6.3.2.3.2 Landbirds

Biodiversity in a given environment can be expressed in different ways. Specific richness corresponds to the number of species present in an environment, while relative abundance represents the percentage of individuals of one specie on the total number of individuals identified in a specific area. Other indexes were calculated to obtain estimates of the abundance of landbirds in the study areas, i.e. the pair numbers in each 10-ha plot, the number of pair-equivalent, constancy and density. Detailed calculations for these indexes are provided in Appendix G.

A total of seven species of landbirds were observed within the two study areas. These are the horned lark, rock ptarmigan, snow ptarmigan, American pipit, lapland longspur, snow bunting and also a sparrow not identified at the species level.

<u>Delta site area</u>

The Delta site area has seven habitats (three terrestrial habitats, three wetland habitats and one lake) and 56 landbirds were counted there. Habitats made up of lowland polygonal fen (11 field survey plots) and boulder fields (10 field survey plots) are the most frequented habitats by birds. In these habitats, the specific richness is proved to be the greatest in terms of individuals of landbirds, with respectively 35 and 19 individuals of six different species (horned lark, lapland longspur, snow bunting, rock ptarmigan, willow ptarmigan and American pipit).

For **lowland polygonal fen** habitat, the horned lark has the highest constancy with 0.36, while the snow bunting appears second with a constancy of 0.27 (Table 6-28). The ptarmigan (not identified to the species level) is the most observed genus in this habitat with an average of 0.82 pairs per field survey plot (relative abundance of 51%) while the horned lark has an average of 0.41 pairs per field plot (relative abundance of 26%).

Finally, ptarmigan has the greatest density with 0.16 individuals/ha, which corresponds to half the total density for this type of habitat. Other species have a density that varies between 0.01 and 0.08 individuals/ha.

Table 6-28: Constancy and density of landbird species in lowland polygonal fen

English name	French name	Scientific name	Density	Constancy	Couples number		Field survey plot (numbers of indicated pairs)										
					Mean	Standard deviation	o_delt_1	o_delt_2	o_delt_4	o_delt_5	o_delt_6	o_delt_7	o_delt_8	o_delt_9	o_delt_11	o_delt_12	o_delt_13
Horned Lark	Alouette hausse-col	*Eremophila alpestris*	0.08	0.36	0.41	0.63	1.5	0.5	0	0	1	1.5	0	0	0	0	0
Rock Ptarmigan	Lagopède alpin	*Lagopus muta*	0.01	0.09	0.09	0.3	0	1	0	0	0	0	0	0	0	0	0
Willow Ptarmigan	Lagopède des saules	*Lagopus lagopus*	0.03	0.09	0.27	0.9	0	0	0	0	3	0	0	0	0	0	0
Ptarmigan	Lagopède sp.	Lagopus sp.	0.16	0.09	0.82	2.71	0	0	0	0	9	0	0	0	0	0	0
Snow Bunting	Plectrophane des neiges	*Plectrophenax nivalis*	0.03	0.27	0.18	0.34	0	0	1	0	0	0	0	0.5	0	0	0.5
Lapland Longspur	Plectrophane lapon	*Calcarius lapponicus*	0.01	0.09	0.05	0.15	0	0	0	0	0	0	0	0	0.5	0	0
Total	-	-	0.32	0.73	1.82	2.49	1.5	1.5	1	0	13	1.5	0	0.5	0.5	0	0.5

In the **boulder fields**, the snow bunting is the most observed species with a presence noted in five out of the ten field survey plots (constancy of 0.50; Table 6-29). The average of 0.95 pairs per field survey plot (relative abundance of 68%) is the highest on the Delta site. The density is also the highest with 0.13 individuals/ha, i.e. more than half the density for this habitat (0.19 individuals/ha). Other species observed have a density that varies between 0.01 and 0.02 individuals/ha.

Table 6-29: Constancy and density of landbird species in boulder fields

English name	Scientific name	Density	Constancy	Couples number		Field survey plot (numbers of indicated pairs)									
				Mean	Standard deviation	o_delt_1	o_delt_2	o_delt_5	o_delt_6	o_delt_7	o_delt_8	o_delt_9	o_delt_11	o_delt_12	o_delt_13
Horned Lark	*Eremophila alpestris*	0.02	0.1	0.1	0.32	0	0	1	0	0	0	0	0	0	0
Ptarmigan	*Lagopus sp.*	0.01	0.1	0.05	0.16	0.5	0	0	0	0	0	0	0	0	0
American Pipit	*Anthus rubescens*	0.02	0.1	0.1	0.32	1	0	0	0	0	0	0	0	0	0
Snow Bunting	*Plectrophenax nivalis*	0.13	0.5	0.95	1.17	0	0	1	3	1	2.5	2	0	0	0
Lapland Longspur	*Calcarius lapponicus*	0.01	0.1	0.1	0.32	0	0	1	0	0	0	0	0	0	0
Total	-	0.19	1	1.3	0.85	1.5	0.5	3	3	1	2.5	2.5	0.5	0.5	0.5

Of the five field survey plots located in **felsenmeer**, only one snow bunting male was noted in plot 0_delt_1 (Table 6-30). Results indicate an average of 0.20 pairs per field survey plot for this terrestrial habitat with a density of 0.02 individuals/ha.

Table 6-30: Constancy and density of landbird species in felsenmeer

English name	Scientific name	Density	Constancy	Couples number		Field survey plot (numbers of indicated pairs)				
				Mean	Standard deviation	o_delt_1	o_delt_2	o_delt_4	o_delt_5	o_delt_12
Snow Bunting	*Plectrophenax nivalis*	0.02	0.20	0.20	0.45	1	0	0	0	0

Finally, a Sparrow (*sp.*) of undetermined sex was seen in a mixed **heterogeneous habitat** (terrestrial and wetland; Table 6-31). A total of four field survey plots were completed in this habitat for an average of 0.13 pairs per field survey plot and a density of 0.03 individuals/ha.

Table 6-31: Constancy and density of landbird species in heterogneous habitats

English name	Scientific name	Density	Constancy	Couples number		Field survey plot (numbers of indicated pairs)			
				Mean	Standard deviation	o_delt_8	o_delt_9	o_delt_11	o_delt_12
Sparrow	-	0.03	0.25	0.13	0.25	0.5	0	0	0

The total density for landbirds in **lowland polygonal fen** habitat is the highest in the entire study area with 0.32 individuals/ha, while boulder fields habitat appears second with 0,19 individuals/ha. Only two other landbirds were observed elsewhere in the Delta site area which are a snow bunting in a Felsenmeer-type habitat and a sparrow (not identified to the species level) in an heterogeneous habitat (terrestrial and wetland). Male, female or indeterminate individuals of four different species (horned lark, willow ptarmigan, American pipit and snow bunting) were observed at a same station but no nesting of landbirds could be confirmed for this area.

<u>Ivakkak-Delta road area</u>

For the Ivakkak-Delta road area, seven different habitats (four terrestrials and three wetlands) were surveyed, for a total of 18 birds observed. No observations were made on the ground in **lowland fens** and **felsenmeer**. The majority of observed bird occurs in boulder fields, with a small presence in felsenmeer. The observation locations can be consulted in appendix O.

Boulder fields, with nine field survey plots, are the most used terrestrial habitat with 17 birds across five species (i.e., hHorned lark, lapland longspur, snow longspur, ptarmigan and American pipit; Table 6-32). The snow bunting (11 individuals) is the most common species with a constancy of 0.67. It is also the most abundant with a mean of 0.75 pairs per field survey plot (relative abundance of 65%) and a density of 0.12 individuals/ha. The total density for landbirds in this habitat is the highest with 0.19 individuals/ha, compared to densities that vary between 0 and 0.03 individual/ha for the six other surveyed habitats. An old longspur nest was observed not too far from the satellite camp area (map 6-3, sheet 3).

Table 6-32: Constancy and density of landbird species in boulder fields (9 stations)

English name	Scientific name	Density	Constancy	Couples number		Field survey plot (numbers of indicated pairs)								
				Mean	Standard deviation	OR2	OR3	OR5	OR6	OR7	OR9	OR10	OR11	OR21
Horned Lark	*Eremophila alpestris*	0.01	0.11	0.05	0.17	0	0.5	0	0	0	0	0	0	0
Ptarmigan	*Lagopus*	0.02	0.11	0.1	0.33	1	0	0	0	0	0	0	0	0
American Pipit	*Anthus rubescens*	0.01	0.11	0.05	0.17	0	0	0	0	0	0	0	0	0.5
Snow Bunting	*Plectrophe nax nivalis*	0.12	0.67	0.75	0.83	1	2	0.5	0	0	0	0.5	2	1.5
Lapland Longspur	*Calcarius lapponicus*	0.02	0.11	0.15	0.5	0	0	1.5	0	0	0	0	0	0
Total	-	0.19	0.67	1.1	0.6	1	2.5	2	0	0	0	0.5	2	2

Only one other landbird (horned lark) was observed for the Ivakkak-Delta road area in a **snowbed fen** (wetland; Table 6-33).

Table 6-33: Constancy and density of landbird species in snowbed fen

English name	Scientific name	Density	Constancy	Couples number		Field survey plot (numbers of indicated pairs)		
				Mean	Standard deviation	OR2	OR7	OR21
Horned Lark	*Eremophila alpestris*	0.03	0.33	0.17	0.29	0	0.5	0

In the **lowland fens**, a Canada goose and a common raven were heard, while a rough-legged buzzard was observed in flight (Appendix O).

6.3.2.3.3 Shorebirds

During the helicopter field survey for waterfowl, only one shorebird specie was identified for the Delta site area: semipalmated sandpiper (Table 6-34). At about 15 cm in length, it is one of the smallest shorebirds in Canada and the most common of the sandpipers in eastern Canada (Godfrey 1989). A single individual of undetermined sex was seen on the shore of a lake. In this same area, three wader birds (not identified to the species level) were also observed on land. For the Ivakkak-Delta road area, only one shorebird was seen on land (not identified to the species level).

No shorebird was observed within the study area during terrestrial surveys in the field survey plots.

Table 6-34: Shorebird species observed by helicopter field survey in the study area

English name	French name	Scientific name	Individual number	
			Site Delta	Ivakkak-Delta rpad
Semipalmated sandpiper	Bécasseau semipalmé	*Calidris pusilla*	1	0
-	Limicole sp.	-	3	1
Total			**4**	**1**

6.3.2.3.4 Birds of prey and common raven

<u>Delta site area</u>

During terrestrial field surveys, four birds of prey of two different species were observed in the Delta site area. First, two rough-legged hawks of undetermined sex were spotted in the boulder field habitat. The first individual was seen in flight in the third transect of plot 0_delt_12, while the other was observed in the third transect of plot 0_delt_9 while lying in wait. A third rough-legged hawk was seen in flight in the second transect of plot 0_delt_13, in an habitat corresponding to a lowland polygonal fen. The Rough-legged Buzzard is a bird that nests in the Arctic on cliff ledges or on top of rocks. The species is not at risk in Canada and the population appears to be stable since the 1970s (Gouvernement du Canada 2015).

The second specie of bird of prey seen in the area was a male snowy owl. The observation took place outside the limits of the transects, on the edge of a lake located 1.5 km west of plot 0_delt_1, near the driller's camp. The snowy owl is widespread in Canada and there is no evidence of its decline or any obvious limiting factors (Gouvernement du Canada, 2021). The nesting area is located further north (Godfrey 1989).

For the common raven, three individuals were observed within the limits of the Delta site area. The three records come from the second transect of the field survey plot 0_delt_2. At first, an individual was seen in flight, emitting calls above an habitat corresponding to boulder fields. The other two ravens, flying together north of the lake, were seen outside the observation transect above a polygonal lowland fen. Boulder fields and polygonal lowland fens are the only habitats where birds of prey and common ravens have been sighted.

<u>Ivakkak-Delta road area</u>

In the Delta road area, only one mention of birds of prey was noted during the terrestrial field surveys. It was a rough-legged hawk of undetermined sex seen in the third transect of plot OR2, an habitat corresponding to a lowland polygonal fen. The bird was flying and uttering calls to signal its presence when it was observed.

A second specie of bird of prey was seen during the helicopter field survey for waterfowl: a peregrine falcon of undetermined sex whose presence was noticed on a rock north of km 12 of the future projected road. There are two subspecies of peregrine falcon that are present in Quebec: *Falco peregrinus anatum* and *Falco peregrinus tundrius*. However, the geographical boundaries between these two species are not clearly defined. Despite the success of the repopulation program put in place, the *anatum* subspecies has been designated as vulnerable in Quebec under the *Act respecting threatened or vulnerable species* (MELCCFP, 2022c). The *tundrius* subspecies is qualified as likely to be designated threatened or vulnerable. In Canada, both subspecies are classified as special concern under the *Species at Risk Act* (SARA) and deemed not at risk by COSEWIC in November 2017 (Gouvernement du Canada, 2022c).

For the common raven, five individuals of undetermined sex were observed in three different habitats within the limits of the Delta road area. Two records come from the first transect of survey plot OR21 (polygonal ground with tundra ostioles), with the observation of individuals emitting calls. Another individual was seen croaking in the second transect of plot OR3 (lowland polygonal fen). The last two common ravens were seen off-transect calling near plot OR20, in mixed terrestrial habitat.

6.3.2.4 Fish fauna and their habitat

6.3.2.4.1 Characterization of fish habitat

Intermittent and permanent watercourses were characterized according to their presence in the study area of the Delta site, the quarries, the northern landfill or the campsite. For this type of characterization, the watercourse is completely characterized by homogeneous section of habitat and is noted CE for a permanent watercourse and CEI for an intermittent watercourse. In order to distinguish all the watercourses identified on the territory of the NNiP, the title -Dx is added at the end of CE or CEI where x identifies the number of the watercourse. Number 1 is the one closest to the Ivakkak site. In the case where the watercourses are located on a road path, the crossing points are indicated, and the characterization of the environment is presented only for the area surrounding the road crossing sites. The nomenclature used is then TR-Dx and the numbering starts at 1 from the point closest to the Ivakkak site and increases by one unit with each new crossing.

6.3.2.4.1.1 Watercourses along the Ivakkak-Delta road

<u>Permanent watercourses</u>

Photo-interpretation of the planned road between Ivakkak and Delta sites revealed the potential presence of 10 permanent streams. Each of these potential watercourses were visited in the summer of 2021. Only five of those could be characterized as two of them were intermittent watercourses (characterized and presented in section 3.1.2) and the other presumed watercourses were only depressions or crevices draining water with no hydrological connection to a body of water (Map 6-3).

Tables 6-35 and 6-36 respectively present the main characteristics of permanent streams at road crossings; and the habitat potential for fish in terms of spawning, rearing and feeding.

The characteristics of streams in northern regions depend exclusively on the lateral surface flow occurring following the thawning and the summer precipitations. Some characteristics in Table 6-35 may therefore vary from year to year. A few "ponds" formed by the snowmelt in depressions are also present on the road path, but these "ponds" are not connected to watercourses and therefore do not present a favorable fish habitat. They have then been documented alongside wetlands.

No fish was caught during the experimental fishing carried out in the five permanent streams surveyed on the planned road path. Apart from the TR-D6 (CE-D10) crossing, the four others have obstacles to fish migration (OMP) downstream of the crossing point. The most diversified stream regarding facies and flow types on the characterized section is the CE-D13 stream. Habitat is diverse in depth, flow velocity and substrate. This watercourse has average habitat potential for the three essential components for fish (Table 6-35). However, a potential spawning ground of about 5 m^2 has been identified in stream CE-D13 (map 6-2 and 6-3 sheet 3). The latter has a depth that varies between 0.35 and 0.60 m, an average speed of 0.10 m/s and a rock and gravel substrate.

Finally, the site where the CE-D1 crosses the road (TR-D1) does not represent an aquatic habitat for fish. It has its source underground, immediately upstream of the crossing point. It becomes underground again a hundred meters downstream from the crossing point. This watercourse is therefore considered impassable for fish.

Despite the absence of fish, streams CE-D13 and CE-D10 have low to medium potential for salmonidae and cottidae regarding spawning, feeding and rearing habitat. The CE-D10 stream has a low potential for cottidae according to their habitat needs. Stream CE-D13 is connected to Puvirnituq river, but an OMP is located between the crossing point and the river. However, this OMP has been classified as passable with reservations and could potentially be passable during a significant water supply, such as snowmelt. The CE-D8 stream is located between two small lakes. No OMP was spotted on this watercourse. The other watercourses have zero habitat potential given their rather diffuse nature and being not hydrologically connected to a larger lake or river.

In the case of tributaries CE-D2 (TR-D2) and CE-D8 (TR-D5), the latter do not constitute a usable habitat for a population of fish located downstream due to the presence of obstacles to upstream migration (respectively at 30 and 500 m downstream from the sampling sites). In addition, in the case of CE-D2, the very shallow mean water in summer represents a serious limitation for fish with a 3 cm mean depth (Table 6-35) and a 5 cm maximum depth.

Table 6-35: Main characteristics of permanent watercourses crossing the planned road between Ivakkak and Delta sites

Crossing point	Flow facies	Dominant substrate	Codominant substrate	Flow type	Wet width of the stream	Full edge flow width	Width at high water mark	Mean depth	Mean velocity	Aquatic vegetation cover	Presence of fish	Obstacle to fish migration downstream
					(m)	(m)	(m)	(m)	(m/s)	(%)		
TR-D1[A] (CE-D1)	Meander	Silt	Cobble and organic matter	Lentic	2.30	2.30	17.00	0.16	0.09	2	No	Yes (impassable)
TR-D2[A] (CE-D2)	Cascade	Coarse gravel	Silt and organic matter	Lotic	0.30	0.50	1.00	0.03	0.09	50	No	Yes (impassable)
TR-D5[A] (CE-D8)	Channel	Coarse gravel	Cobble and coarse gravel	Lotic	1.20	1.20	13.00	0.15	0.08	2	No	Yes (impassable)
TR-D6 (CE-D10)	Channel	Silt	Cobble, coarse gravel, fine gravel and large boulder	Lotic	0.75	0.75	7.00	0.11	0.08	95	No	No
TR-D7 (CE-D13)	Cascades	Large boulder and cobble	Coarse gravel and fine gravel	Lotic	0.50	0.55	6.50	0.07	0.05	0	No	Yes (passable with reserve)

[A] : This watercourse does not represent a fish habitat.

Table 6-36: Assessment of habitat potential in permanent watercourses considered as fish habitat crossing the planned road between Ivakkak and Delta sites

Watercourses and crossings	Family	Rearing	Feeding	Spawning
TR-D7 in CE-D13	Salmonidae	Medium	Medium	Low
TR-D7 in CE-D13	Cottidae	Medium	Medium	Medium
TR-D6 in CE- D10	Cottidae	Low	Low	Low

Intermittent streams

Along the the future road between Ivakkak and Delta sites, four intermittent streams have been counted and located, but only two will be affected by road construction (Map 6-3). In the case of the CEI-D3 and CEI-D7 watercourses located on the planed road between the two sites, they do not constitute a fish habitat due to their shallow depth and the fact that they aren't hydrovconnected to a so-called fish habitat.

Table 6-37 presents the characteristics associated with all these watercourses. The dominant substrate of most of the streams consists of organic matter and, to a lesser extent, cobble. This substrate is associated with rock, pebble, silt or organic matter. The average depth of these rivers does not exceed 15 cm. They all have an OMP downstream of the crossing point. Photographs of these watercourses are presented in Appendix P.

Table 6-37: Main characteristics of intermittent watercourses crossing the planned road between Ivakkak and Delta sites

Watercourse	Dominant substrate	Codominant substrate	Flow type	Wet width of the stream (m)	Mean depth (m)	Obstacle to fish migration downstream
CEI-D3 [A,B] (TRI-D3)	Organic matter	Cobble	Lentic	Diffuse	0.05	Yes
CEI-D4[B]	Organic matter	Cobble	Lentic	0.30	0.05	Yes
CEI-D7[A,B] (TRI-D4)	Organic matter	Cobble	Lentic	0.50	0.15	Yes
CEI-D9[B]	Organic matter	-	Lotic	1.00	0.15	Yes

[A] Intermittent stream crossing the planed road between the Ivakkak and Delta sites
[B] This watercourse is not a fish habitat.

6.3.2.4.1.2 Watercourses on the Delta mine site

Permanents watercourses

The Puvirnituq river is connected to the Delta mine site by the CE-D13 watercourse. The characterization of this watercourse is presented in the previous section on the Delta road path. Regarding Puvirnituq river, a search for sensitive habitats over 1 km upstream and 500 m downstream from the mouth of CE-D13 and a general characterization of the habitat by homogeneous segments was carried out. Electrofishing and angling plots were also carried out.

Table 6-38 indicates the results of the characterization carried out in this river. Two types of flow facies were identified in the characterized sections. Stations 2 and 3 have lotic-type flow facies with rapids, while station 1 has a lentic-type flow with a pool. The substrate in the three stations is dominated by cobbles and granular materials of varying sizes. However, the coarse gravel was found in significant quantities at two stations. The substrate is generally clean and free of fine matter such as silt or organic matter. Moreover, the habitat potential for fish that has been determined in these sectors shows that the characterized stations are an important environment for fish fauna. In fact, this habitat had a high potential for rearing, feeding and spawning of salmonidae (Arctic char and lake trout) in several stations (Table 6-39). During the field surveys, a potential spawning area (FP2) was identified at the foot of the rapids (10 m²), in the upstream part of the station 1 pit (map 6-2). Station 2 allowed to characterized a large potential spawning area covering approximately 1,800 m² (FP1) and containaing several smaller areas suitable for spawning. These potential spawning grounds can be used by both Arctic char and lake trout since they are at the limit of a current zone as well as a pool (photo 1, appendix P) and that the substrate is suitable for both of their spawning habitat.

In the case of the Cottidae, the substrate, depths and current speeds encountered help to establish this area as a potential rearing, feeding and spawning habitat.

Table 6-38: Habitat Potential For Fish in the Sections of the Little Puvirnituq River Characterized in 2021

Species	Station	Rearing	Feeding	Spawning
Arctic char	1	High	Medium	Null
	2	High	High	High
	3	High	High	High
Lake trout	1	High	Medium	Null
	2	High	Medium	High
	3	Low	Low	Null
Cottidae	1	Medium	Medium	Medium
	2	Medium	Medium	Medium
	3	Medium	Medium	Medium

Intermittents streams

All watercourses on the Delta site are classified as intermittent. A total of 24 intermittent watercourses have been documented and located (Map 6-1). Table 6-40 presents the characteristics of these watercourses. The majority of them have a dominant substrate of organic matter. Depending on the watercourse, the silt substrate is accompanied by cobble, silt or rock. However, since many of these streams are created by melting snow and cracks in the mollisol of the slopes located upstream, the water can also flow over a rocky substrate (large boulder, cobble or coarse gravel). The average depth of these streams does not exceed 15 cm. They all have an obstacle to fish migration downstream. Photographs of these watercourses are presented in Appendix P.

For intermittent streams, an assessment should be made to determine if drainage culverts are required. Since these diffuse watercourses are in major wetlands, an accumulation of water would be expected in the event that the hydrological link is broken.

An intermittent watercourse connects lakes No.2 and No.3 (CEI-D19). The latter offers some portions with residual water, but without a permanent link between the two lakes. The width of the watercourse during high water is therefore variable (a few meters to less than one meter) and so is the depth. A residual pit is present in summer downstream of lake No. 2 in CEI-D19, the average depth of which is 0.20 m. The watercourse was dry in several places during the field surveys, thus constituting an obstacle to free fish movement in the summer period. The stream has not been fished considering the actual drying up (photo 6-25).

Table 6-39: Main characteristics of the stations of the Little Puvirnituq River, as well as of the lakes on the Delta site

Lake / river	Station	Flow facies	Dominant substrate	Codominant substrate	Flow type	Wet width of the stream (m)	Full edge flow width (m)	Width at high water mark (m)	Mean depth (m)	Mean velocity (m/s)	Aquatic vegetation (%)	Presence of fish	Obstacle to fish migration downstream
Lake No.1	PE1	Pond	Large boulder	Cobble / Coarse gravel	Lentic	Na[A]	Na	Na	0.35	0	0	Yes	No
	T01	Pit	Large boulder	Cobble	Lentic	Na	Na	Na	3.00	0	0	Yes	No
	T02	Pit	Cobble	Large boulder / Coarse gravel	Lentic	Na	Na	Na	3.50	0	0	Yes	No
Lake No.2	PE1	Pond	Cobble	Large boulder / Coarse gravel/Rock	Lentic	Na	Na	Na	0.30	0	0	Yes	No
	T01	Pit	Large boulder	Cobble / Coarse gravel	Lentic	Na	Na	Na	3.00	0	0	Yes	No
	T02	Pit	Large boulder	Cobble/ Coarse gravel	Lentic	Na	Na	Na	2.80	0	0	Yes	No
Lake No.3	PE1	Pond	Large boulder	Rock / Cobble / Coarse gravel	Lentic	Na	Na	Na	0.30	0	0	No	No
	T01	Pit	Cobble	Coarse gravel /Large boulder	Lentic	Na	Na	Na	2.20	0	0	No	No
	T02	Pit	Large boulder	Cobble /Coarse gravel	Lentic	Na	Na	Na	2.00	0	0	No	No
Little Puvirnituq River	Station 1	Pit	Cobble	Coarse gravel / Sand / Large boulder	Lentic	118	118	128	2.00	0	0	Yes	No
	Station 2	Current	Cobble	Large boulder/Coarse gravel/Fine gravel	Lotic	65	93	126	0.24	0.43	0	Yes	No
	Station 3	Current	Cobble	Coarse gravel / Large boulder / Fine gravel / Sand	Lotic	92	92	179	0.32	0.29	0	Yes	No

[A] Na : Not applicable.

Table 6-40: Main characteristics of intermittent watercourses on the Delta site characterized in 2021

Intermittent watercourses	Dominant substrate	Codominant substrate	Flow type	Wet width of the stream (m)	Mean depth (m)	Obstacle to fish migration downstream
CEI-D11	Organic matter	-	Lentic	Diffuse under rock	0.05	Yes
CEI-D12	Cobble	Coarse gravel	Lotic	Diffuse under rock	0.10	Yes
CEI-D14	Organic matter	-	Lentic	0.2	0.05	Yes
CEI-D15	Organic matter	-	Lentic	0.8	0.03	Yes
CEI-D16	Organic matter	Silt	Lotic	0.4	0.05	Yes
CEI-D17	Organic matter	Silt	Lotic	0.3	0.03	Yes
CEI-D18	Coarse gravel	Cobble	Diffuse under substrate	1.2	ND	Yes
CEI-D19 – between the two lakes	Coarse gravel	Organic matter	Lentic	Variable	Dried	Yes
CEI-D20	Organic matter	Cobble	Lentic	3	0.05	Yes
CEI-D21	Organic matter	-	Lentic	5	0.05	Yes
CEI-D22	Organic matter	Coarse gravel	Lentic	Diffuse	0.05	Yes
CEI-D23	Organic matter	Cobble	Lotic	0.5	0.05	Yes
CEI-D24	Organic matter	Cobble	Lentic	4	0.05	Yes
CEI-D25	Boulder	Cobble	Lentic	Diffuse under rock	ND	Yes
CEI-D26	Coarse gravel	Cobble	Lentic	0.35	0.07	Yes
CEI-D27	Organic matter	Cobble	Lentic	1	0.05	Yes
CEI-D28	Organic matter	Coarse gravel	Lotic	Diffuse	0.15	Yes
CEI-D29	Organic matter	-	Lentic	Diffuse	0.05	Yes
CEI-D30	Organic matter	Boulder	Lentic	Diffuse	0.05	Yes
CEI-D31	Large Boulder	Organic matter	Lentic	Diffuse under rock	0.15	Yes
CEI-D32	Organic matter	Cobble	Lentic	Diffus	0.05	Yes
CEI-D33	Cobble	Organic matter	Lotic	Diffuse under rock	0.05	Yes
CEI-D34	Organic matter	Cobble	Lentic	Diffuse	0.05	Yes
CEI-D35	Organic matter	Cobble	Lotic	ND	0.05	Yes

ND : not determined

Photo 6-25: Watercourse CEI-D19 Dried Up for the Most Part and Linking Lakes No.2 and No.3.

Lakes

The lakes characterization was done mainly at the fishing stations and the various data collected for each fishing gear are presented in Table 6-38 (previously indicated). Overall, the three lakes surrounding the Delta project are not very deep. The maximum depth recorded was 3.5 m, 3.0 m and 2.2 m in lakes No. 1, No. 2 and No. 3 respectively. Two out of three lakes (Nos. 1 and 2) have a fish population.

The physico-chemistry of the water was measured in 2021, below 0.5 m from the surface, using a Manta +35 multiprobe. The results indicate good oxygenation of the water (percentage of saturation > 100%) and an adequate pH for aquatic fauna (close to neutrality), as well as a fairly high conductivity (see Table 6-41), probably related the high presence of sodium, potassium and magnesium naturally present in the lake waters (see table 6-7 in section 6.2.5.2, stations ST4 to ST6).

Arctic char were caught in lakes No. 1 and No. 2. The depth of these two bodies of water is adequate for the fish fauna. Arctic char can complete their entire life cycle (feeding, spawning and rearing) in these environments and survive the winter. Moreover, a potential spawning site of 10 m² was noted in shallow water of Lake No. 1, between 0.25 and 1.0 m (Map 6-2). Although this site has interesting features, it is unlikely to be used due to the depth of winter frost on the lakes (about 2 m). It is therefore reasonable to think that the spawning grounds are located at least at two meters deep.

It is not impossible, in high water conditions, that the fish can circulate to Lake No. 3. However, this lake has a much shallower depth, which offers very little refuge fro winter. It should be noted that no water link connects lake No. 1 to other water bodies, unlike lakes No. 2 and No. 3 which are linked together by an intermittent watercourse (CEI-D19) and which has a permanent link with Little Puvirnituq River by the stream CE-D13. It is then estimated that even if fish are reaching Lake No. 3 via the upstream lakes and reproduced, the adults, the fry and the spawn would not survive the winter. In fact, the entire water column is likely to freeze in lake No. 3.

Table 6-41: Water chemistry in the lakes and the Little Puvirnituq River

Lake/river	Water physico-chemistry				
	Temp. (°C)	pH	O_2 (%)	O_2 (mg/l)	Cond. (µS/cm)
Lake No. 1	9.68	6.97	103.1	11.58	154.2
Lake No. 2	10.16	7.27	102.8	11.42	56.6
Lake No. 3	11.15	7.37	103.0	11.18	72.4
Little Puvirnituq River	14.14	7.62	103.9	10.54	17.0

6.3.2.4.2 Watercourse along the road path between Delta site and Lake No. 4

The watercourses located on the path of the future road linking the Delta site to Lake No. 4 were surveyed on July 29 and 30. In total, four watercourses have been listed on the path of the road leading to the drinking water supply point. The only permanent watercourse present (CE-D38) has a width at mean annual flow of 18 m (table 6-42). In addition to its larger dimensions, this watercourse also stands out from the others by its type of substrate, which is dominated by coarse gravel and fine gravel to a lesser extent, as well as by its high potential for fish habitat.

The three other watercourses listed were dry at the time of the field surveys. However, their full edge flow width varies between 0.5 and 1.5 m (table 6-42). In all cases, the dominant substrate consists of organic matter, with fine gravel as the codominant substrate in the case of CEI-D37. Unlike watercourse CE-D38, these three intermittent watercourses offer no potential interest for fish fauna.

6.3.2.4.3 Watercourses in potential quarry sites

In total, two intermittent watercourses have been identified in the Delta 2 quarry area. The flow facies encountered consist of narrow and shallow channels, whose substrate is dominated by organic matter and by cobbles to a lesser extend (Table 6-43).

At the time of the field surveys, the wet width was 1.5 m and 0.6 m for the CEI-5 and CEI-6 respectively, with a mean depth estimated at 0.05 m for both. It should be noted, however, that these two streams can become bigger during the snowmelt period. Indeed, their width at the high water mark varies from 4 to 4.5 m. Finally, the habitat potential for these two watercourses is considered null since they are not hydrologically linked to any major watercourse that could support a fish population.

Table 6-42: Main characteristics of watercourses crossing the freshwater supply access road path from camp Delta to lake No. 4

Watercourse	Permanence	Flow facies	Dominant substrate	Codominant substrate	Flow type	Wet width (m)	Full edge flow width (m)	Width at high water mark (m)	Mean depth (m)	Flow velocity (m/s)	Aquatic vegetation (%)	Potential fish habitat	Obstacle to fish migration
CEI-D36	Intermittent	Channel	Organic matter	-	Lotic	Dried	1.5	2	0	Null to slow (<0.05)	0	Null	Na
CE-D38 (TR-D8)	Permanent	Channel	Coarse gravel	Fine gravel	Lotic	10	18	24	0.3	Null to slow (<0.05)	0	High	No
CEI-D37	Intermittent	Channel	Organic matter	Fine gravel	Lotic	Dried	0.5	1.5	0	Null to slow (<0.05)	0	Null	Na
CEI-D39	Intermittent	Channel	Organic matter	-	Lotic	Dried	0.5	2	0	Null to slow (<0.05)	0	Null	Na

[A] Na : Not applicable.

Table 6-43: Main characteristics of intermittent watercourses at Delta 2 quarry

Intermittent watercourse	Flow facies	Dominant substrate	Codominant substrate	Flow type	Wet width (m)	Full edge flow width (m)	Width at high water mark (m)	Mean depth (m)	Flow velocity (m/s)	Aquatic vegetation (%)	Potential fish habitat	Obstacle to fish migration
CEI-D5	Channel	Organic matter	Cobble	Lotic	1.5	2	4.5	0.05	Medium	0	Null	No water connection
CEI-D6	Channel	Organic matter	Cobble	Lotic	0.6	0.85	4.0	0.05	Medium	0	Null	No water connection

[A] Na : Not applicable.

6.3.2.4.4 Fish populations

No fish were caught in the characterized watercourses along the future road path. In this context, it is unlikely that the fish fauna of this area will be affected by the construction of the road or by its use. However, two sectors seem to have fish habitat potential: CE-D4, which connects two small lakes on either side of the future road path, and CE-D5, which communicates directly with the Little Puvirnituq River. In addition, lakes No. 2 and No. 3 are linked to the watercourse CE-D5. However, the fish population of the Little Puvirnituq River is isolated from this tributary due to the presence of an obstacle to fish migration upstream of about 180 m from its mouth.

With the aim of improving knowledge on fish populations of the three lakes of the Delta site, each of them fished during the 2021 field surveys. For each lake, Alaska traps were deployed in the deep parts while electrofishing stations took place on the shore, in shallow areas. For the Little Puvirnituq River sector, the fishing effort was carried out using electrofishing and angling. Table 6-44 indicates all the average lengths of fish caught for each lake and in the Little Puvirnituq River.

<u>Fresh water supply lake for Delta Camp</u>

Angling was carried out on July 30, 2022 in the chosen lake for the freshwater supply for Delta Camp. Fishing took place between 11:44 a.m. and 12:05 p.m. for a total of 19 minutes. Two lake trouts, each 450 mm long, were caught as well as a 150 mm Arctic char. It should be noted that the objective was not to make an exhaustive fishing, but to determine the presence or not of a fish population. On the same day, electrofishing was carried out at the crossing in the permanent watercourse on the access road to the lake No.4. No fish was caught but some were observed in the watercourse CE-D38.

<u>Lake No. 1</u>

A 5 net-day effort was deployed in Lake No. 1 from July 28 to 29, 2021, allowing to capture 147 Arctic chars between 74 and 170 mm long (Table 6-44). During the site field survey, the low water period was already well under way and there was no linking water with Lake No. 1. Two hypotheses can be put forward to explain the presence of this allopatric population. First, it is possible that the population of Arctic chars in this lake has been isolated since the retreat of the ice cap several thousand years ago. Since then, it has lived in complete autonomy, breeding and feeds without any external input or exchange. It is also possible that on different occasions a water link will be temporarily established between the different lakes in this area, following, for example, a melting of snow and a more significant flooding of water. At this time, fish take advantage to move from isolated lakes to permanently flowing rivers, such as the Little Puvirnituq River in this case.

Table 6-44: Summary of Fish Captures in Lakes and in the Little Puvirnituq River at the Delta site

Lake / River	Species	n	Total length (mm)		
			Mean	Min	Max
Lake No. 1	Arctic char	147	132	74	170
Lake No.2	Arctic char	88	133	52	465
Lake No.3	No captures				
Little Puvirnituq River	Arctic char	6	523	440	610
	Lake trout	3	493	480	510

At the time of the field surveys, it was still too early to determine sexual maturity of the Arctic char by applying abdominal pressure. To obtain this information, two specimens were sacrificed to determine the developmental stage of the gonads. The first fish from Lake No. 1 was 153 mm long and was a male. The gonads were well developed and filled 2/3 of the abdominal cavity (photo 9, Appendix P). The second specimen from Lake No. 2 was 150 mm long and was a female with well developed but still attached eggs (photo 10, Appendix P). These observations demonstrate the possibility that these fish spawn directly in the lakes even though the specimens are small in size. Scott & Crossman (1974) report that in certain populations of Arctic char the females can reach sexual maturity at lengths from 152 to 178 mm or less.

Lake No. 2

In Lake No. 2, the same fishing effort was deployed, namely 5 net-days. A total of 88 Arctic char were captured (Table 6-44). The mean length (133 mm) of the fish was essentially the same as in Lake No. 1. However, the range of sizes was much broader (52 to 465 mm). Like Lake No. 1, no hydraulic connection linked this lake to other waterbodies at the time of sampling.

The field surveys did identify an intermittent watercourse linking lakes No.2 and No. 3 during periods of snowmelt (CEI-D19).

Lake No. 3

Different from the two other lakes, no fish was captured in Lake No. 3, despite an equivalent fishing effort.

This lake is peculiar because of a separation in its center caused by a rocky shoal (photo 11, Appendix P). This shoal creates two small trenches that complicates the establishment of a fish population. Once again, no hydraulic connections linked this lake to other waterbodies at the time of the field surveys. Photointerpretation work and characterization of the CE-D5 tributary did however identify the presence of a hydraulic link during snowmelt between Lake No.3 and the Little Puvirnituq River. Topography between the river and Lake No. 3 does however puts into doubt the ability of fish to migrate to spawn in the lake. As a matter of fact, an obstacle determined as conditionally traversable was identified in the CE-D5 tributary.

Little Puvirnituq River

Fish sampling in this area confirmed the presence of two species of salmonidae. Six Arctic chars and three lake trouts were captured using hook and line in the trench at the fishing stations PL1 and PL2 (Table 6-44). All specimens were considered adults since the lengths varied from 440 mm to 610 mm. Details of the fish metrics are presented in Appendix Q. Maturity could not be evaluated using abdominal pressure since the theoretical spawning period for these fish is later than the time of the field surveys. It should be noted that the water temperature at the time of the field surveys was 14 °C. Given the short summer in Nunavik, these fish were likely in a period of intensive feeding. However, given the observations collected during the characterizations (section 6.3.2.4.1), it is probable that the fish also use this sector to spawn.

6.3.2.4.5 Benthic invertebrates

Benthic samples were taken on August 19 2021 at three stations of the Delta site (Map 6-1). The Delta 1 (Lake No. 1) and Delta 2 (Lake No. 3) sites were sampled in riparian environments. Delta 1 is located in an isolated lake with no important hydraulic connections while Delta 2 is located on the most upstream lake of the CE-D5 tributary of the Little Puvirnituq River. Delta 3 was sampled in the CE-D5 tributary approximately 330 m from the mouth of the river. Delta 2 had the highest mean density and specific richness with 28 750 organisms/m^2 from 28 taxa, followed by Delta 3 with 7 423 organisms/m^2 from 17 taxa (Appendix R). Delta 1 has the lowest density with 2 308 organisms/m^2 from 15 taxa. Despite these differences, macroinvertebrate communities were dominated by arthropods representing 72% of organisms from Delta 1 and more than 90% from Delta 2 and 3 (Figure 6-12). Only one genus was present above 5% and common to all three stations, namely *Cladotanytarsus* from the Chironomidae family. Their density varied from 15% to 48.5%.

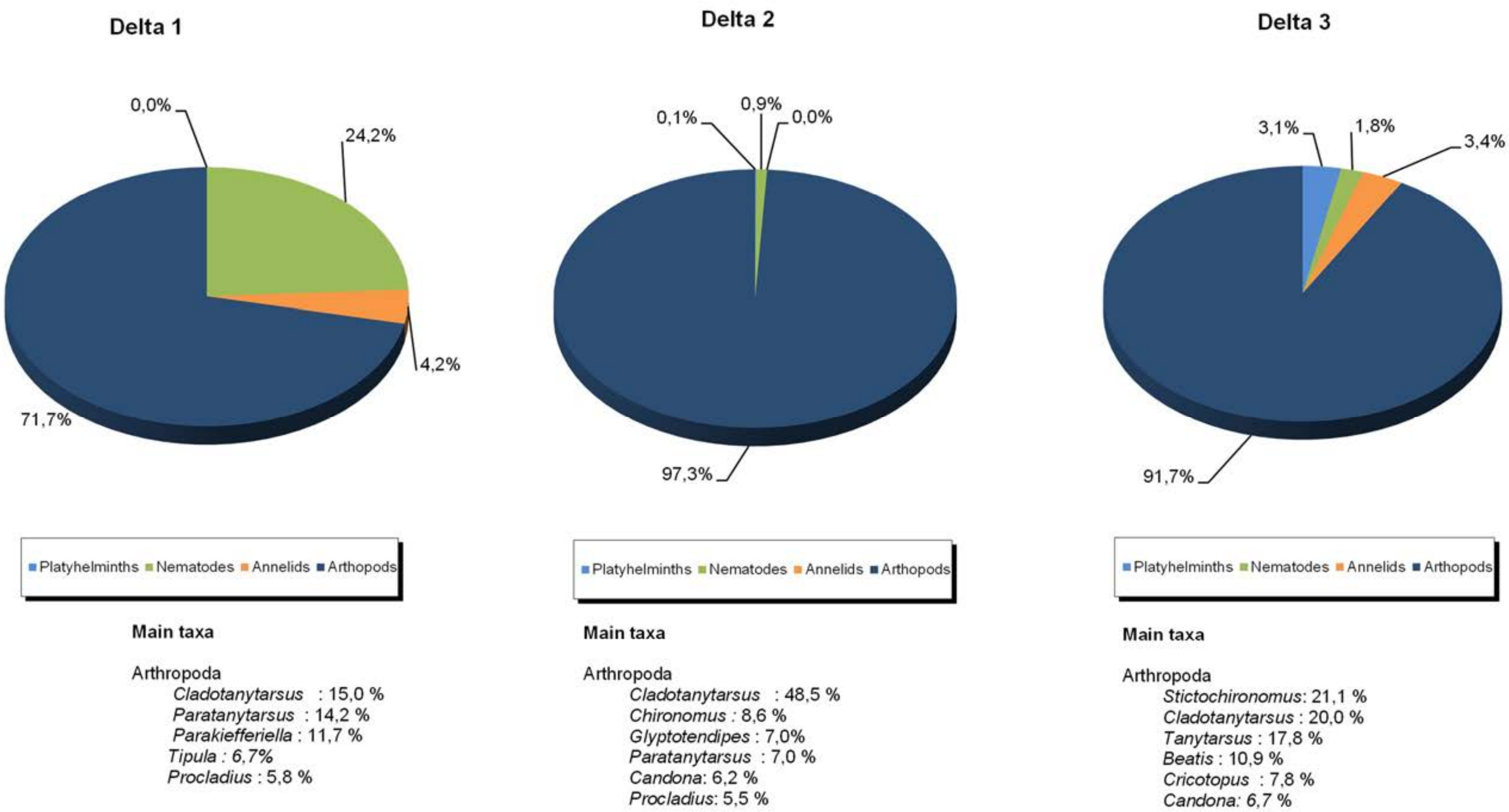


Figure 6-12: Relative Abundance of Benthic Macroinvertebrates Sampled in 2021 at the Delta Site

The genus *Beatis* represented 10.9% of the organisms at the Delta 3 site and belongs to Ephemeroptera. These are typically associated with streams with warmer temperatures (Elliot, 1972). This Order was not observed in the watercourses examined during the reference studies in 2006 and its presence in 2021 could be explained by the increase in temperatures observed in the far north because of climate change. The genus *Beatis* was only captured in the CE-D5 tributary where no fish are present and where water can warm more easily because of the shallow depth. These arthropods use watercourses as habitat and are an excellent food source for fish (Jacobus et al., 2019).

Also, the communities in Lake No. 1 (Delta 1 station) are composed of 24% nematodes while in the other two stations have less than 2%. It is possible that this waterbody is enriched in nutrients.

6.3.3 Species at Risk

6.3.3.1 Flora

The study by Tremblay (2006) mentions 84 species of vascular plants in different zones around the NNiP, particularly in the Ivakkak, Méquillon and Expo sites. This study did not cover the zones for Delta. Among the species at risk identified in the study by Tremblay, there was the sulphur buttercup and the Ellesmere Island draba that have a status at the provincial level (species susceptible of being designated at risk or vulnerable). The inventories in 2021 and 2022 indicated that these species were present at the Delta site. Cayouette's draba, another species likely to be granted a particular status, was also identified at the Delta site at one station. Also, the sulphur buttercup was found at one station in a wetland along the proposed Ivakkak-Delta Road and at one station in the study area for the Delta Camp.

For flora, the CDPNQ mention other species susceptible of being designated on the territory of the NNiP (Appendix S), namely the hooked threadwort (*Cephaloziella uncinate*) and the alpine grimmia moss (*Grimmis sessitana*), two species of moss, the flat-top draba (*Draba corymbosa*), the small-flowered draba (*Draba micropetala*) and Ross' stitchwort (*Sabulina rossii*). None of these species were encountered during the inventories for 2021 and 2022. For mosses, the identifications made in the laboratory did not match the genera with at-risk status for subsampling (absence of *Grimmia* sp. and *Cephaloziella* sp.),

Table 6-45 presents the distances travelled to search for the flora species at-risk.

6.3.3.2 Fauna

Quebec's CDPNQ has identified four occurrences of fauna at risk near the Delta site (Appendix S), notably the golden eagle and the peregrine falcon. The CDPNQ mentions a golden eagle nest and a peregrine falcon nest 10 km east of the Ivakkak site, therefore 25 km from the Delta site. Since the distance between the nests and the site is relatively large, few impacts are expected for these species. These two species are nevertheless susceptible of being found in proximity to the future Ivakkak-Delta Road and the Delta site. The golden eagle and the *anatum* sub-species of the peregrine falcon have a vulnerable status according to the LEMV, while the *tundrius* sub-species of peregrine falcon is susceptible of being classified at risg. At the federal level, the peregrine falcon is a species of special concern according to the *Species at Risk Act* (SARA) and not threatened according to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) while the golden eagle does not have a status according to the SARA and is designated as not in peril according to COSEWIC.

During the inventories of waterfowl, Barrow's goldeneye was observed north of the Delta site, probably a moulting male. This species is considered vulnerable in Quebec under the LEMV and a species of special concern under the SARA. The peregrine falcon was also observed in the sector of the Ivakkak-Delta Road.

The environment seems to be little utilized by species at risk and no nesting sites were observed around the Delta site. These sites seem concentrated in proximity to the Little Puvirnituq River south of the study zone.

Table 6-45: Distances Travelled During the Search for Floral Species At-Risk in the Study Zones

Study Zone	Distance travelled (km)
Delta Site	391,3
Ivakkak-Delta Road	
Delta Camp	6,92
Potential Quarries #1, #2 and #3	8,32
Fresh water access road	23,23
LEMN Delta	1,86

6.4 Human Environment

The description of the human environment presents the main social and cultural characteristics of the local communities affected by the project, including the Inuit communities, the relationship between these communities and the natural environment, in addition to how they make use of the environment's different elements. This use takes into account the social, cultural and economic values that the Inuit communities attribute to them, their perceptions of the project, in addition to relevant information in regard to the local population's health.

6.4.1 Nunavik and its Communities

Nunavik is composed of 14 Inuit villages that are several hundred kilometers apart. They are scattered along the coasts of Hudson Bay, Hudson Strait and Ungava Bay. An Inuit community is also established in the Cree village of Chisasibi. Kangiqsujuaq, Salluit and Puvirnituq are the villages closest to the study area. Kangiqsujuaq and Salluit are located approximately one hundred kilometers from the NNiP study area, while the village of Puvirnituq is located over 200 km to the west.

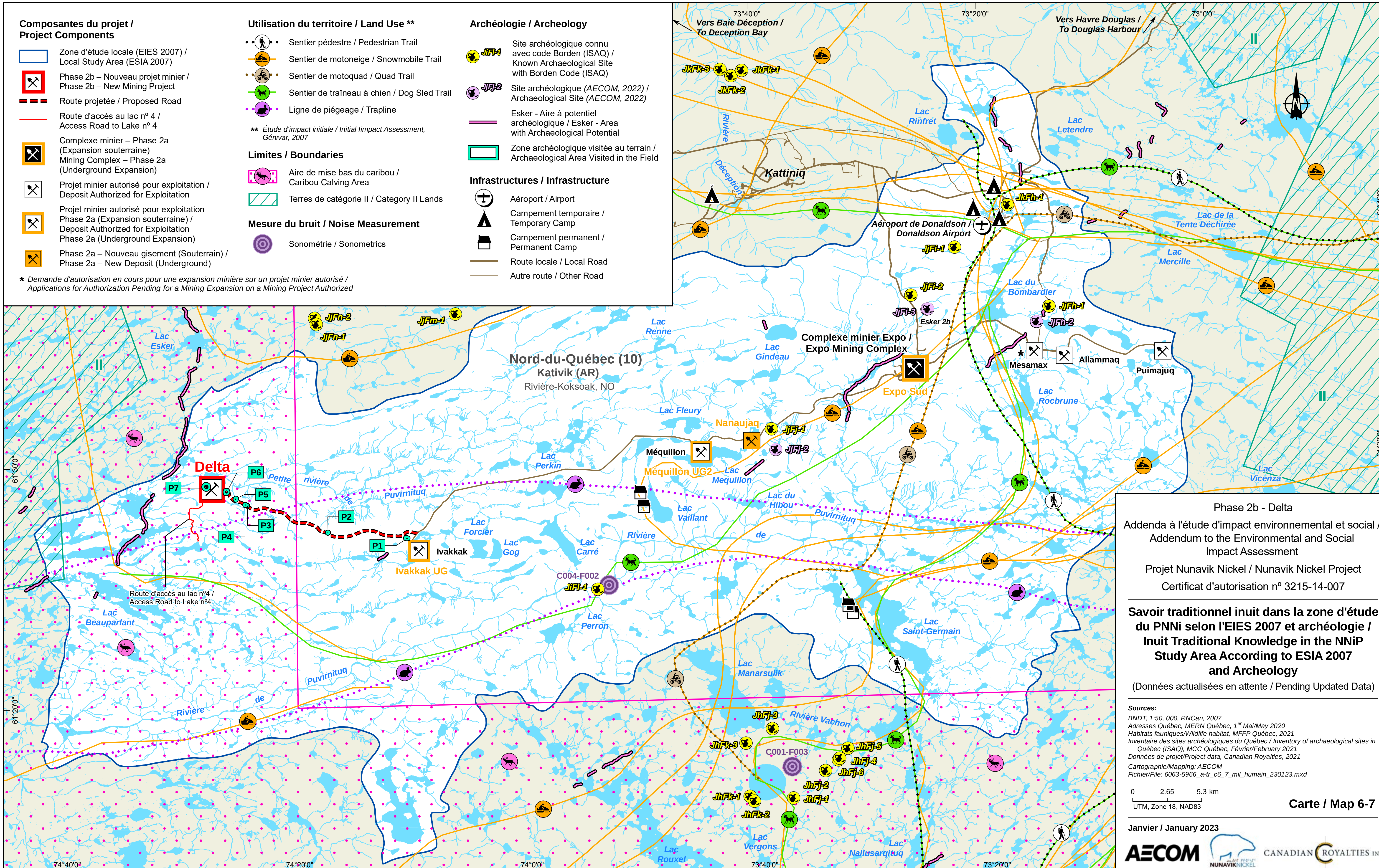
6.4.1.1 The James Bay and Northern Quebec Agreement (JBNQA)

The territory of Nunavik is governed by the James Bay and Northern Quebec Agreement (JBNQA) signed in 1975. This Convention, described as the first "modern treaty," redefined the relationships between the province of Quebec, Canada and the Inuit populations of northern Quebec, within the context of the hydroelectric development in James Bay. The terms of this Convention primarily cover land management. The lands of categories I on which the Inuit villages (and Cree) are located, and the surrounding areas are managed exclusively by the latter. The lands of category II are reserved exclusively for hunting, fishing and trapping, while the lands of category III can be the subject of a development, all while maintaining exclusive hunting and gathering rights to the profit of the Inuit (Turcotte, 2019).

The NNiP deposit sites are located on lands of category III (WSP, 2015) (Map 6-7). The entire site is located north of the Puvirnituq River and the Pingualuit National Park established in 2004 (Proulx et al., 2019).

Under the JBNQA, the Inuit of Nunavik hold title to 8,152 km^2 of land and exercise their rights of several hundred thousand square kilometers (Crown-Aboriginal Relations and Northern Affairs Canada, 2020).

The JBNQA agreement signed in 1975 solved land claims requests, provided financial compensation and defined Nunavik Inuit’s rights. Another agreement was signed in 2007 in regard to offshore rights. These agreements now form the basis of the relationship between the Inuit and their neighbors and the various levels of the federal and provincial governments. As for the Cree and Naskapi, the JBNQA defined harvesting rights, established a resource management system and created I, II and III land categories. The signing of this agreement also led to the creation of entities such as the KRG, the Kativik School Board (KSB) and the Nunavik Regional Board of Health and Social Services (NRBHSS) in order to promote the *Nunavimmiut's* development.


Composantes du projet / Project Components
Zone d'étude locale (EIES 2007) / Local Study Area (ESIA 2007)
Phase 2b – Nouveau projet minier / Phase 2b – New Mining Project
Route projetée / Proposed Road
Route d'accès au lac nº 4 / Access Road to Lake nº 4
Complexe minier – Phase 2a (Expansion souterraine) Mining Complex – Phase 2a (Underground Expansion)
Projet minier autorisé pour exploitation / Deposit Authorized for Exploitation
Projet minier autorisé pour exploitation Phase 2a (Expansion souterraine) / Deposit Authorized for Exploitation Phase 2a (Underground Expansion)
Phase 2a – Nouveau gisement (Souterrain) / Phase 2a – New Deposit (Underground)
* Demande d'autorisation en cours pour une expansion minière sur un projet minier autorisé / Applications for Authorization Pending for a Mining Expansion on a Mining Project Authorized
Utilisation du territoire / Land Use **
Sentier pédestre / Pedestrian Trail
Sentier de motoneige / Snowmobile Trail
Sentier de motoquad / Quad Trail
Sentier de traîneau à chien / Dog Sled Trail
Ligne de piégeage / Trapline
** Étude d'impact initiale / Initial Iimpact Assessment, Génivar, 2007
Limites / Boundaries
Aire de mise bas du caribou / Caribou Calving Area
Terres de catégorie II / Category II Lands
Mesure du bruit / Noise Measurement
Sonométrie / Sonometrics
Archéologie / Archeology
Site archéologique connu avec code Borden (ISAQ) / Known Archaeological Site with Borden Code (ISAQ)
Site archéologique (AECOM, 2022) / Archaeological Site (AECOM, 2022)
Esker - Aire à potentiel archéologique / Esker - Area with Archaeological Potential
Zone archéologique visitée au terrain / Archaeological Area Visited in the Field
Infrastructures / Infrastructure
Aéroport / Airport
Campement temporaire / Temporary Camp
Campement permanent / Permanent Camp
Route locale / Local Road
Autre route / Other Road
Vers Baie Déception / To Deception Bay
Vers Havre Douglas / To Douglas Harbour
Kattiniq
Aéroport de Donaldson / Donaldson Airport
Complexe minier Expo / Expo Mining Complex
Expo Sud
Mesamax
Allammaq
Puimajuq
Nord-du-Québec (10)
Kativik (AR)
Rivière-Koksoak, NO
Nanaujaq
Méquillon
Méquillon UG2
Delta
Ivakkak
Ivakkak UG
P1
P2
P3
P4
P5
P6
P7
C004-F002
C001-F003
Route d'accès au lac nº4 / Access Road to Lake nº4
Lac Rinfret
Lac Letendre
Lac de la Tente Déchirée
Lac Mercille
Lac du Bombardier
Lac Renne
Lac Gindeau
Lac Rocbrune
Lac Fleury
Lac Perkin
Lac Mequillon
Lac du Hibou
Lac Vaillant
Lac Forcier
Lac Gog
Lac Carré
Lac Perron
Lac Saint-Germain
Lac Manarsulik
Lac Vergons
Lac Rouxel
Lac Nallusarqituq
Lac Vicenza
Lac Esker
Lac Beauparlant
Petite rivière de Puvirnituq
Rivière de Puvirnituq
Rivière Vachon
Rivière Déception
JkFk-3
JkFk-1
JkFk-2
JkFh-1
JjFi-1
JjFi-2
JjFi-3
Esker 2b
JjFh-1
JjFh-2
JjFn-2
JjFn-1
JjFm-1
JiFj-1
JiFj-2
JiFl-1
JhFj-3
JhFk-3
JhFj-5
JhFj-4
JhFj-6
JhFj-2
JhFj-1
JhFk-1
JhFk-2
73°40'0"
73°20'0"
73°0'0"
74°40'0"
74°20'0"
74°0'0"
61°40'0"
61°30'0"
61°20'0"
Phase 2b - Delta
Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment
Projet Nunavik Nickel / Nunavik Nickel Project
Certificat d'autorisation nº 3215-14-007
Savoir traditionnel inuit dans la zone d'étude du PNNi selon l'EIES 2007 et archéologie / Inuit Traditional Knowledge in the NNiP Study Area According to ESIA 2007 and Archeology
(Données actualisées en attente / Pending Updated Data)
Sources:
BNDT, 1:50, 000, RNCan, 2007
Adresses Québec, MERN Québec, 1er Mai/May 2020
Habitats fauniques/Wildlife habitat, MFFP Québec, 2021
Inventaire des sites archéologiques du Québec / Inventory of archaeological sites in Québec (ISAQ), MCC Québec, Février/February 2021
Données de projet/Project data, Canadian Royalties, 2021
Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c6_7_mil_humain_230123.mxd
0 2.65 5.3 km
UTM, Zone 18, NAD83
Carte / Map 6-7
Janvier / January 2023
AECOM
NUNAVIK NICKEL
CANADIAN ROYALTIES INC.

The Makivik Corporation, created during the signing of the JBNQA, has a diversified mandate, including to ensure overall compliance with the Agreement, managing financial compensation, creating jobs for Inuit, promoting socio-economic development, improving housing conditions, supporting language and culture, etc. (Canadian Geographic, 2021; Makivik Corporation, 2021a).

Under the JBNQA, the Inuit have opted for a municipal system run on a non-ethnic basis. This governance is structured around two levels. The first level is local and is composed of northern villages. The second level, supra-local, is composed of the KRG. Northern villages are governed by councils which consist of a mayor and up to six councillors. Elections are held every 3 years. Northern villages essentially have the same powers and jurisdictions as other municipalities in Quebec, e.g., the supply of certain services, including drinking water, waste collection, wastewater treatment, recreation, etc. The KRG is managed by a board of 17 members and an administrative committee of 5 members. The council includes representatives from each of the fourteen northern villages and the Naskapi village of Kawawachikamach (*Ministère des Affaires municipales et de l'Habitation du Québec*, 2010)(Ministry of Municipal Affairs and Housing).

6.4.2 Socio-Economic and Demographic Situation

6.4.2.1 Demographic

Nunavik is a vast region that extends from northern James Bay to the Hudson Strait and includes the eastern part of Hudson Bay and all the lands bordering Ungava Bay. It is bounded to the South by the 55th parallel and to the East by Labrador to form a territory of approximately 507 000 km^2. Today, Nunavik has a population of approximately 12,000 permanent residents. They live mainly in one of the 14 Inuit villages spread along the coasts of the Hudson and Ungava Bay.

The Nunavik population is very young. Usually, more than 60% of the population is under 30 years of age, which is double to the corresponding proportion in southern Quebec. The population is growing at a rate of 3 to 4 times higher than the Quebec average (Société Makivik, 2022a).

The closest Inuit villages of Kangiqsujuaq and Salluit are respectively located approximately 75 km east and 140 km northwest to the proposed wind turbine site. In 2021, the villages of Kangiqsujuaq had 837while Salluit had 1,580 inhabitants (Statistiques Canada, 2022). The population of both villages was relatively young, with the 0-14 age group accounting for nearly 30% of the population in Kangiqsujuaq and 37% in Salluit (Table 6-46). In comparison, the same age group accounted for 16% of the total population of the province of Quebec during the same year, which is half as large as in the two Inuit villages.

Table 6-46: Age Distribution of the Population of Kangiqsujuaq and Salluit Villages and the Province of Quebec in 2021

Territory	Ages 0-14	Ages 15-64	Ages 65 and above	Average age (years)
Province of Quebec	16 %	63 %	21 %	42,8
Kangiqsujuaq	29 %	66 %	5 %	28,0
Salluit	37 %	59 %	4 %	25,9

Source: Statistiques Canada, 2022.

The 15-64 age group, or working population, was also quite large in both Inuit villages, representing more than 65% of the total population in Kangiqsujuaq and close to 60% in Salluit. These proportions are comparable to province of Quebec.

The average age of the two Inuit villages was much lower (28 in Kangiqsujuaq and close to 26 in Salluit) than of the province of Quebec. This can be explained by the large number of people aged 14 and under, as well as by the low proportion of people aged 65 and over in Salluit and Kangiqsujuaq.

6.4.2.2 Economy and Employment

The Inuit society has changed significantly over the past fifty years. The *Nunavimmiut* have gone from a way of life in close relationship with the territory and its resources, toward a more sedentary way of life focused on paid work. The Nunavik now lives under a mixed economic regime based on employment income and traditional means of subsistence (Nunavik Regional Board of Health and Social Services, 2015).

In 2015, in Kangiqsujuaq, the employment rate for the population aged 15 and over was 57.4%, while it was 56.3% for the population of Salluit (Statistiques Canada, 2022). However, the unemployment rate was higher in Kangiqsujuaq (23.7%) than in Salluit (15.1%). The unemployment rate is higher for men than for women in both villages.

In general, Nunavik's economy is much less diversified than Quebec's. In 2012, the public administration, mining and construction sectors accounted for 85% of all activity in the region. The mining sector alone accounted for 40% of economic activity. According to a 2012 analysis, although the region's economic activity combined with its small population resulted in a GDP (which is established on a territorial basis) per capita that was significantly higher than that of the province as a whole, the disposable income of Nunavik's residents was lower than that of the province. This disparity was explained by the fact that a large part of the wages in the mining (exploitation and exploration) and construction sectors were paid to workers who did not live in the region. This gap would also tend to narrow over time (Robichaud and Duhaime, 2015).

In addition, some data from Statistics Canada's 2017 Aboriginal Peoples Survey (Statistiques Canada, 2019) provide insight into Inuit participation in the wage economy and the resource-based economy (hunting, fishing, trapping, gathering). For example, in 2017, 27% of Inuit in Nunavik between the ages of 25 and 54 were inactive and not participating in the wage economy. Compared to the other regions of Inuit Nunangat, people living in Nunavik were among those most likely to participate in resource-related activities (hunting, fishing, trapping) to supplement their income (35%). The results of this analysis indicated that conventional measures of labour market activity, combined with participation in resource-related activities such as hunting, fishing and gathering, provided a more accurate insight of the complex reality of work in these communities. Public administration, health care and social assistance, educational services, and retail trade were among the main sectors of paid employment.

CRI has committed, as part of the Nunavik Nickel Agreement presented in section 3.5, to hire as many Inuit employees as possible, according to the positions available and skills required, in order to promote socio-economic benefits in the Inuit communities. The average number of Inuit employees between 2019 and 2020 is shown in Table 6-47. Employees carry out functions within the various departments, according to the interests in which they've expressed. Restrictions related to the Covid-19 pandemic to limit Inuit employee hiring, explain the declines in 2020 and 2021, which still have repercussions to this day in 2022. However, recruitment efforts will continue.

We also note that most of the Inuit employees at the Expo site are male. The same situation is also noted for all employees, since less than 10% of the total number of employees at the Expo site were female between 2020 and 2022. However, the number of female Inuit employees has been increasing since 2020, since their average annual number has increased from 4 to 14.

Table 6-47: Average Number of Inuit Employees in the NNiP 2019-2022

Number of Inuit employees	2019	2020	2021	2022*
Average number during the year	54	23	41	48
Average proportion of total employees	8 %	5 %	7 %	8 %
Average number of women	10	4	9	14
Average number of men	44	19	31	34

* Calculated from January to April.

Source: Data provided by CRI.

6.4.2.3 Language

Inuktitut is the predominant language spoken in Nunavik. However, English is commonly used due to the historical presence of the federal government in the administration.

6.4.2.4 Governance

Although it is part of the province of Quebec, Nunavik enjoys a certain degree of autonomy and is administered by a regional government, the KRG. The KRG was formed in 1978, following the signing of the James Bay and Northern Quebec Agreement. It has the same powers and responsibilities as the Regional County Municipalities (RCMs), but is also responsible for the management of other areas, such as local and regional economic development, wildlife management, development and management of national parks, social housing and childcare (MAMH, 2022). The KRG exercises its jurisdiction over the entire territory of Nunavik. It is governed by a 17-member council made up of representatives from each of the fourteen Inuit villages of Nunavik and the Naskapi village of Kawawachikamach.

Makivik Corporation was also created following the signing of the James Bay and Northern Quebec Agreement to administer the funds resulting from this agreement (Makivik Corporation, 2022b). Its mission is to promote and foster the economic, social and cultural development of Nunavik. It also represents the Inuit villages and Nunavik in their relations with other levels of government.

Like the other Inuit villages in Nunavik, the villages of Kangiqsujaq and Salluit are northern villages as defined in the James Bay and Northern Quebec Agreement. These villages have essentially the same powers and jurisdictions as other Quebec municipalities and are governed by councils consisting of a mayor and councillors (MAMH, 2022).

6.4.3 Land Use by the Inuit

As part of the Addendum to the Environmental and Social Impact Assessment for Phase 2a of the Nunavik Nickel Project (NNiP) (AECOM and Canadian Royalties Inc., 2022), maps presenting information in regard to the Inuit's use of territory under study were transmitted by the Makivik Corporation (Figures 6-13 to 6-18). These maps are the result of interviews conducted by the Corporation in the communities of Salluit and Kangiqsujuaq during the winter of 2017. They illustrate elements of Inuit land use within the Nunavik Nickel project area and therefore do not cover the entire study area. Nevertheless, they provide information on the use of the area planned for the installation of the proposed wind farm and part of the access roads leading to the port facilities at Deception Bay.

The Makivik Corporation's maps illustrate more specifically the routes taken on the territory (mainly by snowmobile), the camps that were used during these routes, as well as the harvesting sites. For those locations, the resources exploited and the periods of exploitation are not mentioned. Furthermore, for each of the elements identified on the maps (routes, camps, harvesting sites), it is not possible to know if they were mentioned by more than one person, or if they were visited on more than once between 2007 and 2017. Therefore, it is not possible to know the intensity of their use. It is also not possible to know whether the elements shown on the maps have been used since 2017.

The maps provided by the Makivik Corporation identify two routes (probably made by snowmobile) passing about 5 km west of the future Delta site (Figure 6-13). These routes were made by people from Salluit during outings lasting several days in the territory. The maps also identify a route taken by people from Kangiqsujuaq that passes slightly to the west and then branches off to the east, passing 8 km south of the proposed mine site. A trapping route used by the people of Kangiqsujuaq passing about 3 km south of the future Delta site is also identified on the maps provided by the Makivik Corporation (Figure 6-14).

The maps provided by the Makivik Corporation identify only one camp in the vicinity of the future Delta site. It is associated with the community of Salluit and is located on the north shore of Kenty Lake, about 10 km southwest of the proposed mine site (Figure 6-15). The camps mentioned by the people of Kangiqsujuaq in the territory covered by Phase 2a of the NNiP are located much further east, the closest being just to the west of Lake Méquillon, i.e., a little more than 30 km east of the future Delta site (Figure 6-16).

A dozen harvesting sites appearing on the maps provided by the Makivik Corporation are located not far from the future Delta site. These sites were mentioned by the people of Salluit. They are located near the Kenty and Qikirtalik lakes, and a little further east. The closest one is located about 4 km west of the future Delta site (Figure 6-17). The sites mentioned by the people of Kangiqsujuaq are located at a good distance from the proposed mine site, the closest being just over 15 km south and 20 km southwest of the future mine site (Figure 6-18). As in the case of the camps, the harvesting sites shown on the Makivik Corporation's maps were likely visited during the trips made in the area.

It should be noted that all of the land use elements shown on the Makivik Corporation maps were mentioned during interviews conducted in 2017 and correspond to land use between 2007 and 2017. Thus, certain sectors, particularly those closest to the mining sites currently in operation, are no longer used today. In fact, Inuit users cannot approach within 5 km of the mining sites currently operating on the territory covered by the NNiP.

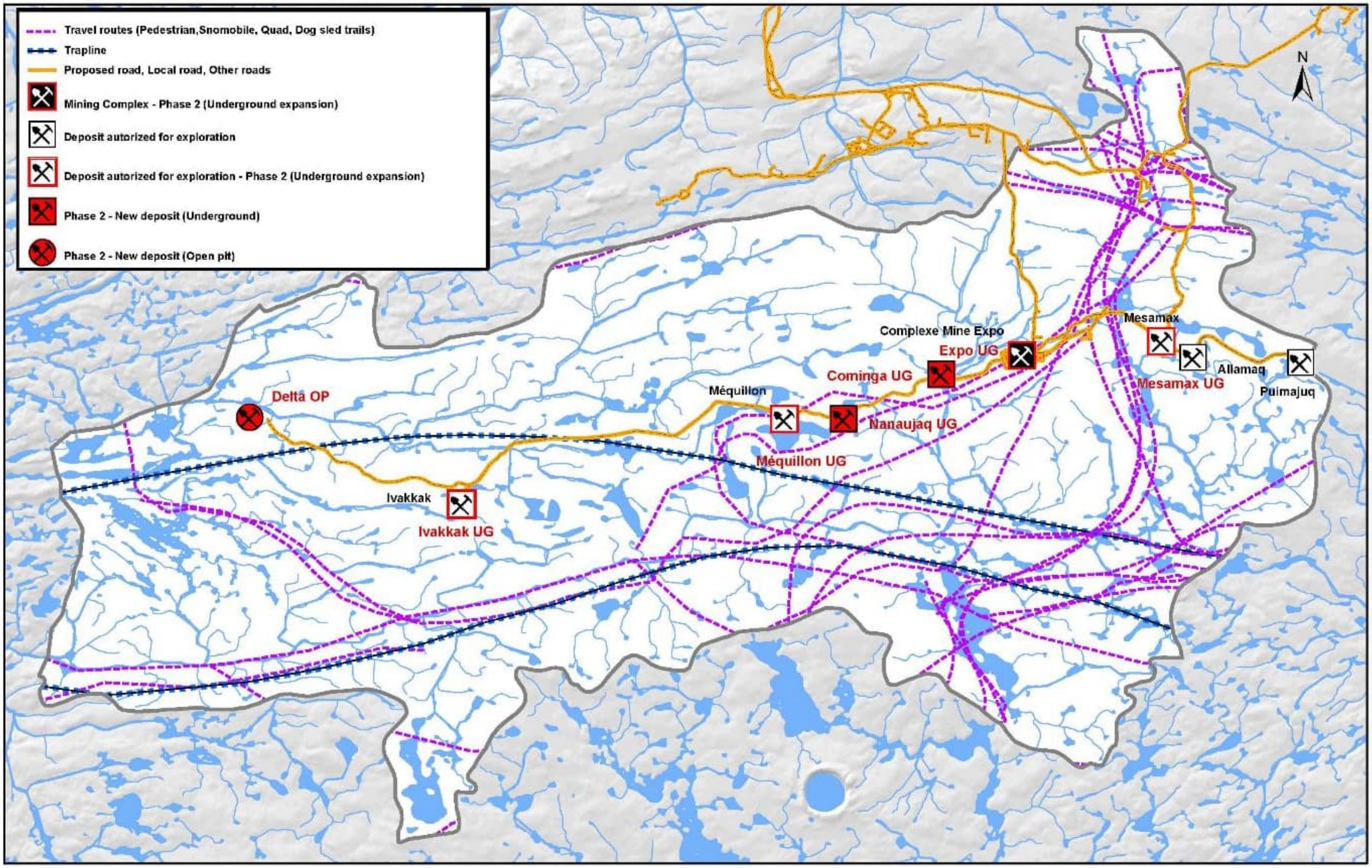


Figure 6-13: Routes Taken by Inuit Users of Kangiqsujuaq on the Territory Affected by NNiP's Phase 2a, 2007-2017

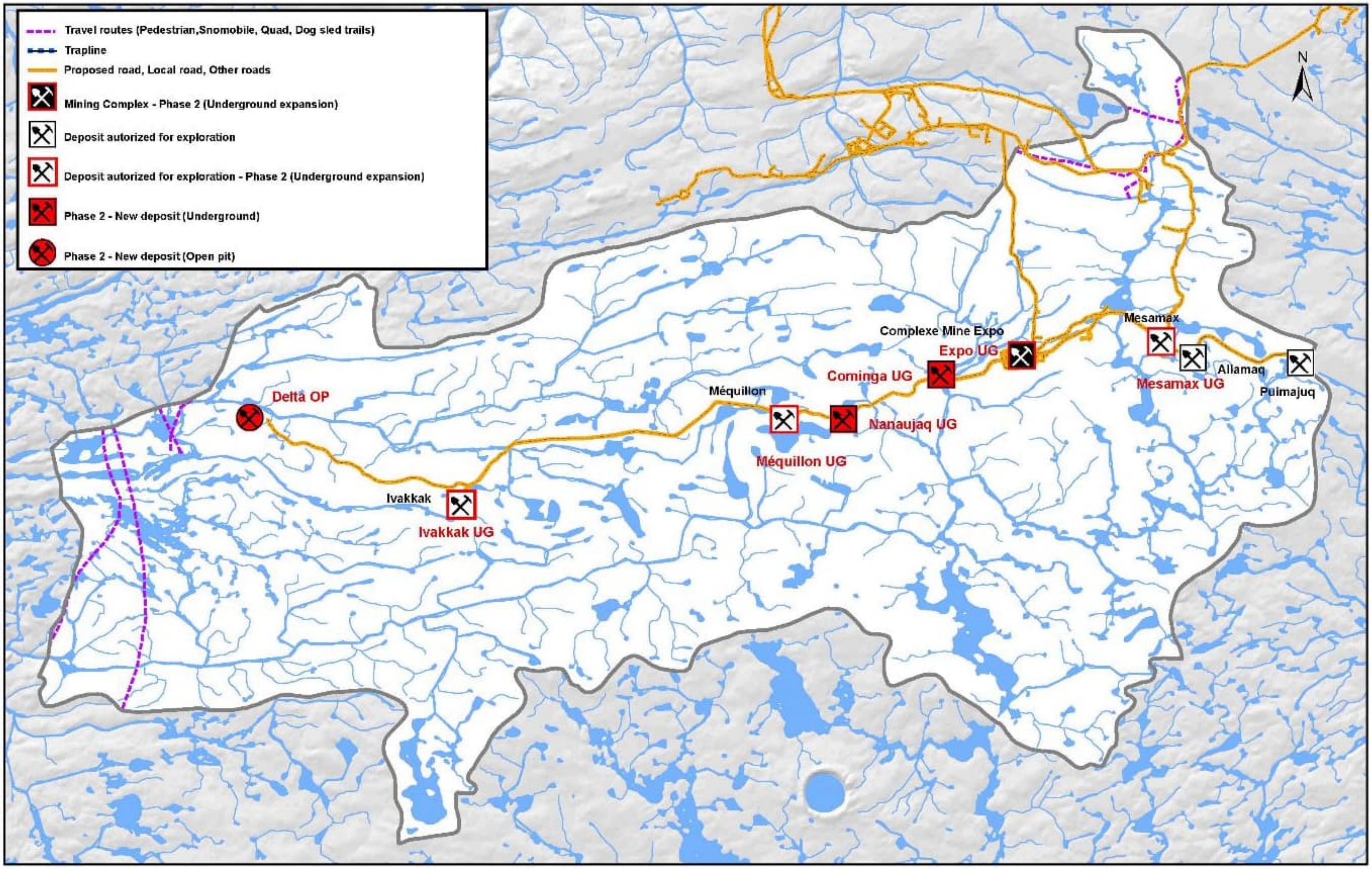


Figure 6-14: Routes Taken by Inuit Users of Salluit on the Territory Affected by NNiP's Phase 2a, 2007-2017

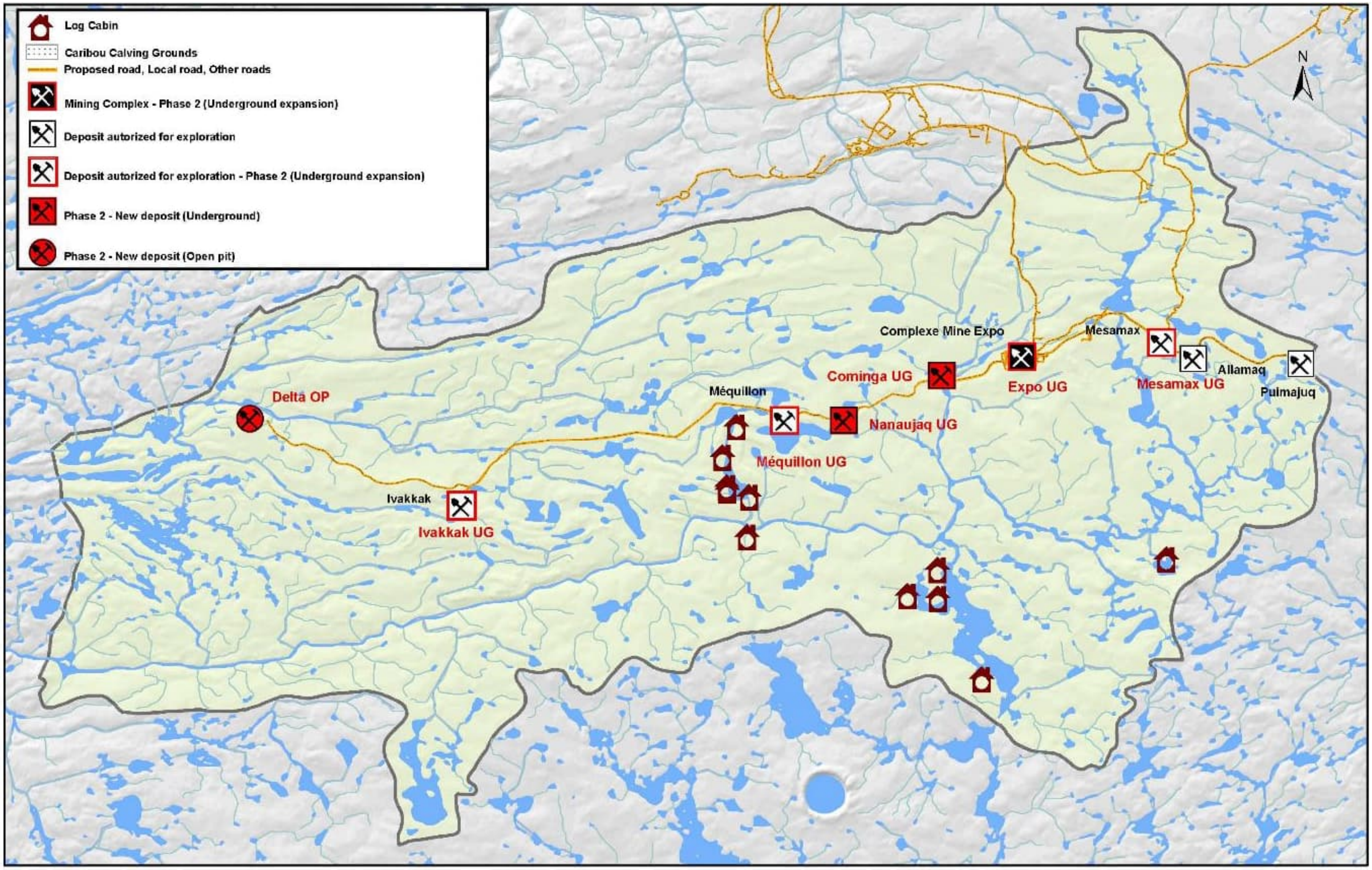


Figure 6-15: Camps Used by Inuit Users of Kangiqsujuaq on the Territory affected by NNiP's Phase 2a, 2007-2017

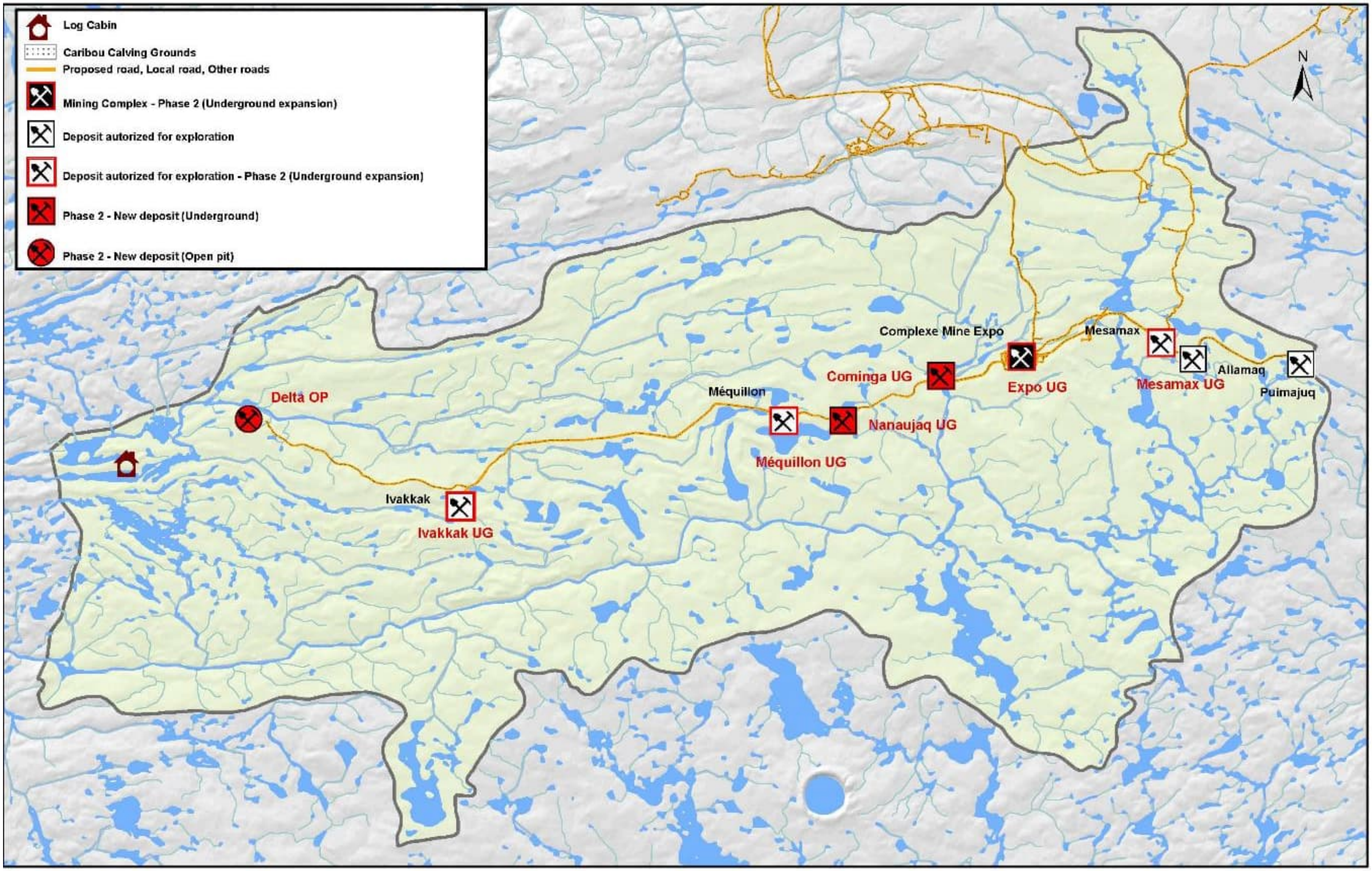


Figure 6-16: Camps Used by Inuit Users of Salluit on the Territory Affected by NNiP's Phase 2a, 2007-2017

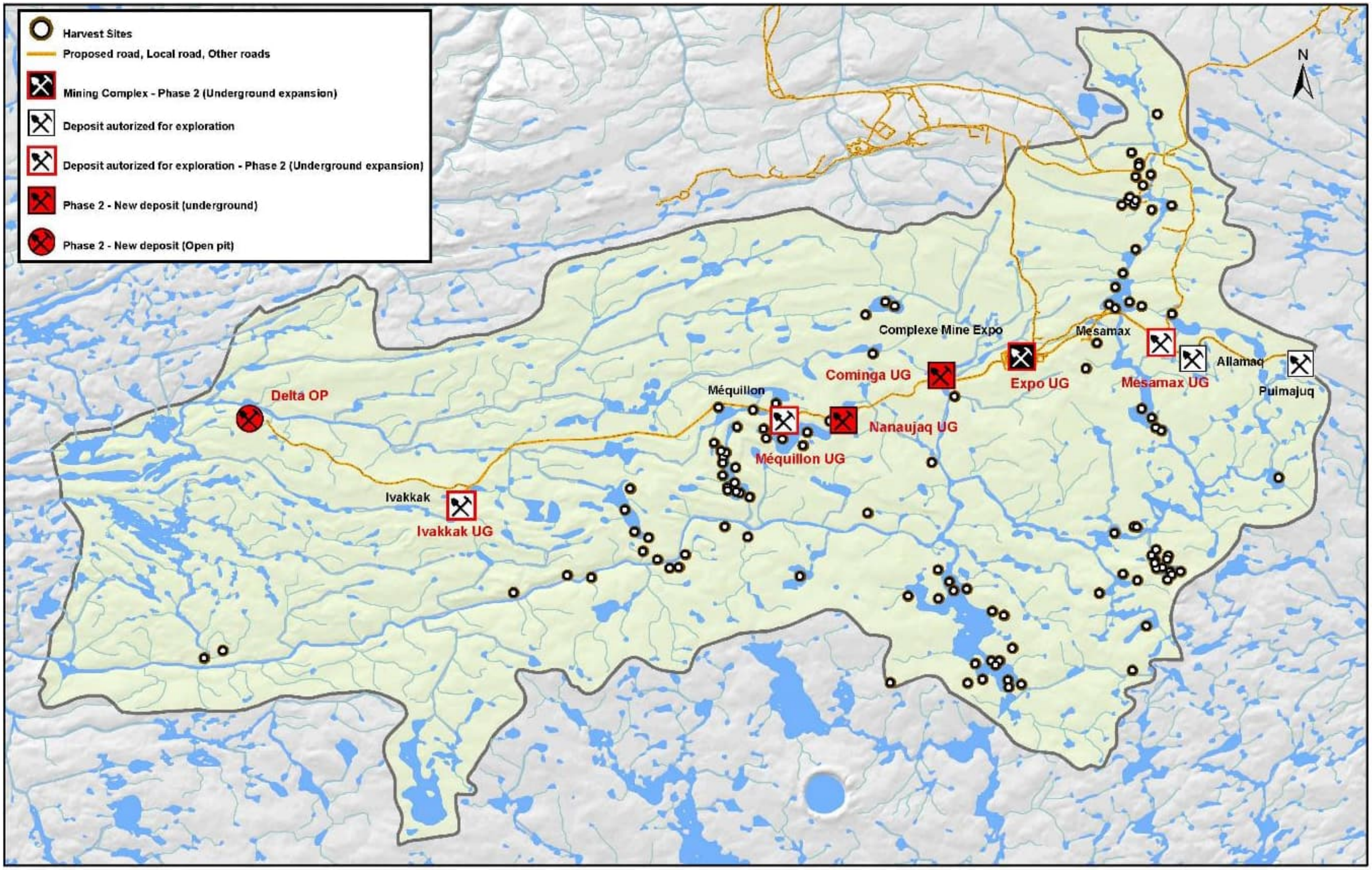


Figure 6-17 : Harvesting Sites Mentioned by Inuit Users of Salluit and Kangiqsujuaq on the Territory Affected by NNiP's Phase 2a and 2b, 2007-2017

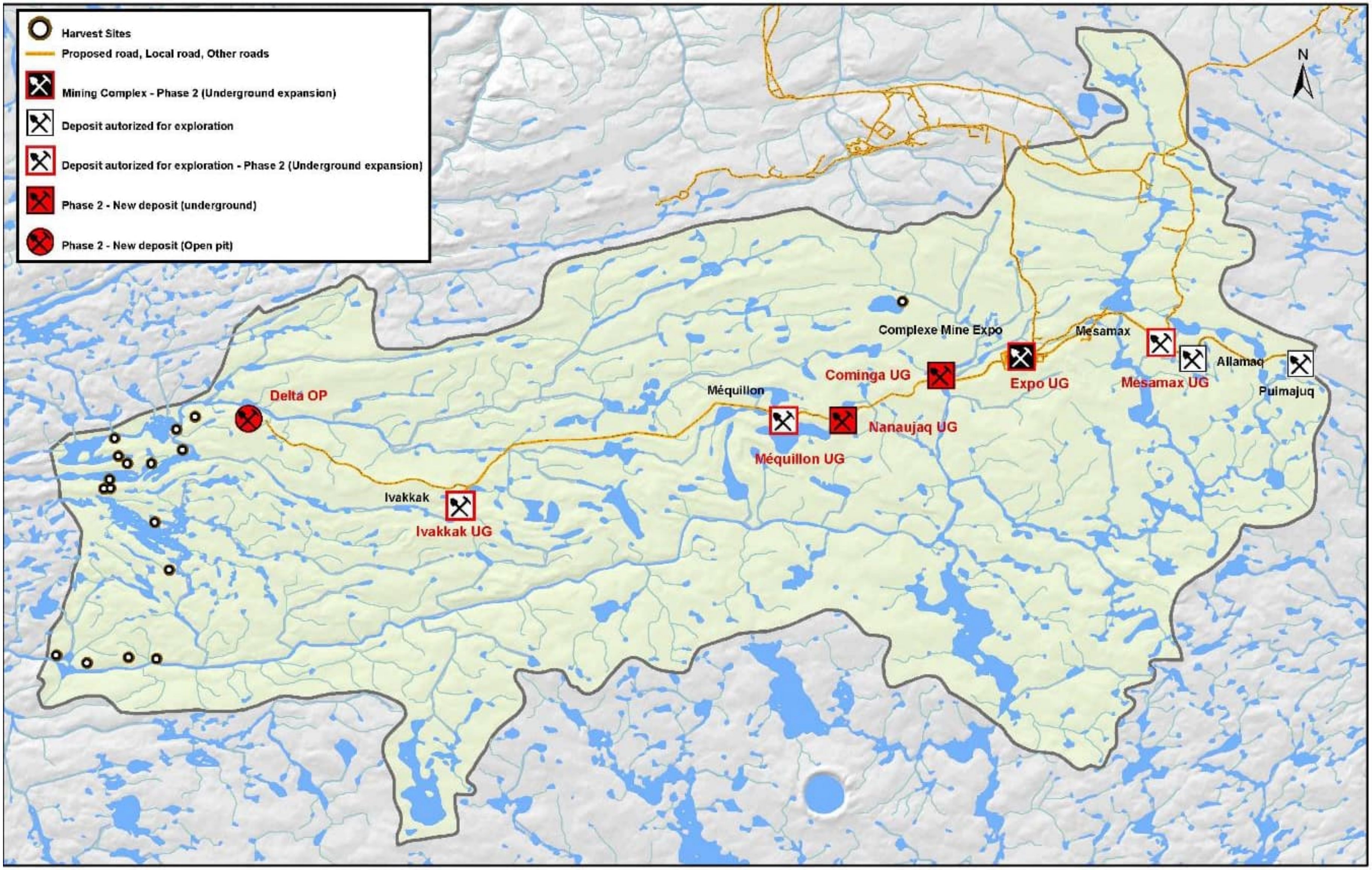


Figure 6-18 : Harvesting Sites Mentioned by Inuit Users of Salluit on the Territory Affected by NNiP's Phase 2a and 2b, 2007-2017

6.4.4 Landscape

The study area is an integral part of the Ungava Peninsula Natural Province, a MELCCFP Level 1 Ecological Reference Classification (ERC). It is surrounded by Hudson Bay (to the west), Hudson Strait (to the north) and Ungava Bay (to the east). This arctic zone, more precisely the bioclimatic domain "Arctic Herbaceous Tundra", is the most northerly in Quebec. The proposed site for the Delta site and all related infrastructure and roads is located in the Puvirnituq Mountains (level 2 ERC).

The landscape of the study area is typical of the "Puvirnituq Hills" sub-unit, which is part of the "Ungava Plateau" natural region. It is made up of a vast undulating plateau formed by low hills surrounded by lakes s (specifically Beauparlant lake, Mequillon lake, Saint-Germain lake, Bombardier lake and Rocbrune lake) and watersheds that are covered with snow for most of the year. The village of Salluit represents the most significant concentration of observers and the closest to the study area compared to the village of Kangiqsujuaq. The Delta site is bordered to the north by the Little Puvirnituq River (see Photo 6-26), to the south by the Puvirnituq River and to the west by lake Kenty and lake Beauparlant (map 6-7).

The Pingualuit Crater, recognized worldwide as an exceptional geological phenomenon in this northern landscape, is located approximately 48 km away from the future Delta site, which is further than the Expo industrial complex site for which very little impact on the landscape has been noted from the crater. However, the landscape in the areas affected by this addendum may be frequented by some Inuit who have permanent camps or some Inuit who may set up temporary camps nearby to practice traditional activities as reported in Figure 6-16.

The landscape of the study area can only be accessed by Inuit trails since no developed road is yet present between the Ivakkak site and the Delta site. However, a road to the the Ivakkak site was built in 2022. The existing landscape has been modified by the exploratory drilling, but no permanent infrastructure has been erected to date. The landscape of the proposed road and the Delta site can therefore be considered entirely natural. Photo 6-26 shows the current visual environment from an aerial view during the summer. A visual representation during operations is presented in the Impacts section in section 7.4.5.

6.4.5 Study of Archaeological Potential

A theoretical archaeological potential study was carried out by AECOM in 2021 for the area of the future Ivakkak-Delta road and the Delta deposit (see Appendix T for the complete study, which is appended to the archaeological inventory study).

The archaeological potential study uncovered the location of archaeological sites on a regional scale and identifies areas with potential for the presence of cultural resources that are archaeological in nature. Within the territory under study, it was possible to observe a distribution of archaeological sites around the shores of the main lakes, along the navigable waterways, more specifically at the Little Puvirnituq River and in proximity to the caribou crossing areas, caribou being the primary resource sought by the occupants of the inner territory. The archaeological potential study concluded that no archaeological sites were present within the territory under study and proposed six areas of archaeological potential along the proposed Ivakkak-Delta road (photos 6-27 to 6-31) and one area within the boundaries of the Delta site study area (photo 6-32). All of these areas were associated with caribou movement areas, which were identified as significant resources for Inuit populations. The archaeological potential study recommended a field survey of the potential areas and a helicopter survey of the entire proposed Ivakkak-Delta road and of the Delta study area. This archaeological field survey was conducted from July 20 to 26, 2022 inclusively with the archaeological research permit 22-AECO-03 issued by the Ministry of Culture and Communications (*Ministère de la Culture et des Communications)* (MCC). It should be noted that at the time of the archaeological inventory, the access road to Lake No. 4 had not yet been determined. However, no archaeological potential had been identified in this sector during the archaeological potential study. Therefore, no additional field examinations would be required in this case.

Photo 6-26: Aerial View of the Future Delta Site (July 20, 2021; Looking Northwest).

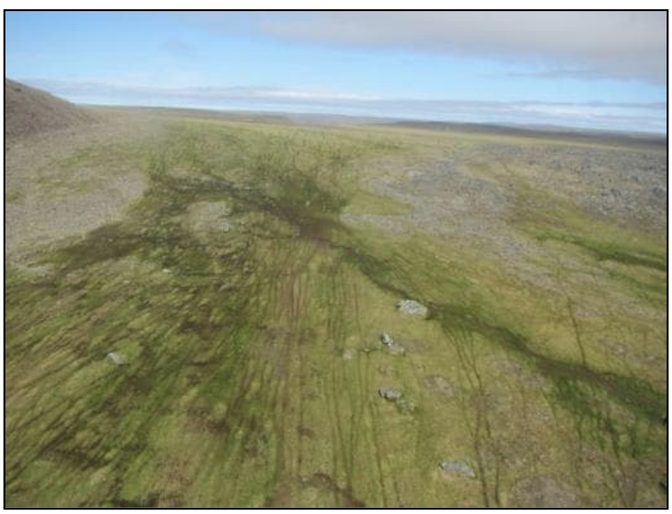


Photo 6-27: Caribou Crossing not far from the Ivakkak Site (CRI22-EP-105)

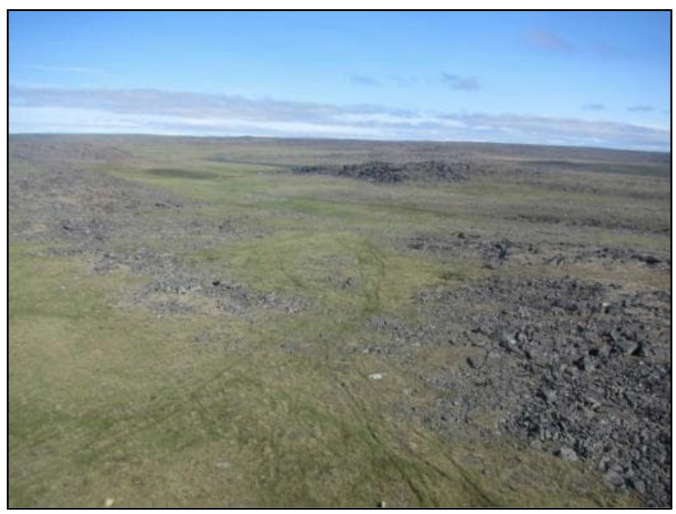


Photo 6-28: Zone P2 Caribou Crossing Between km 7 and 8 (CRI22-EP-98)

Photo 6-29: Zone P3 Caribou Crossing Near Km 1 (CRI22-EP-14)

Photo 6-30: Zone P5 Caribou Passageway near Projected Infrastructures of the Delta Camp not far from Km 15 (CRI22-EP-11)

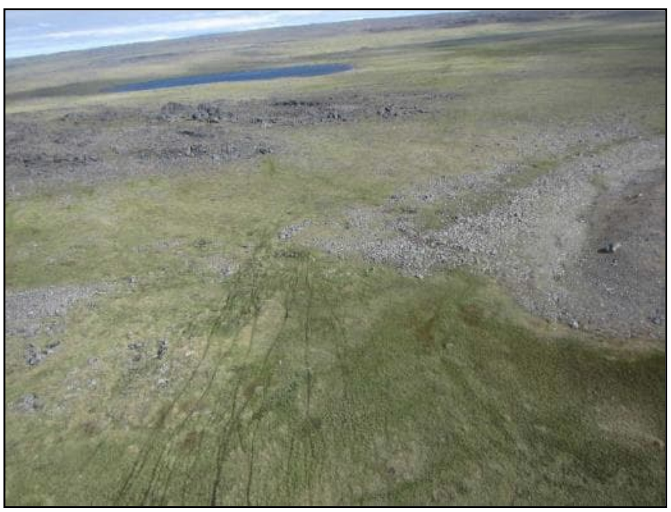


Photo 6-31: Zone P6 Located at the Eastern Boundary of the Delta Study Area (CRI22-EP-93)

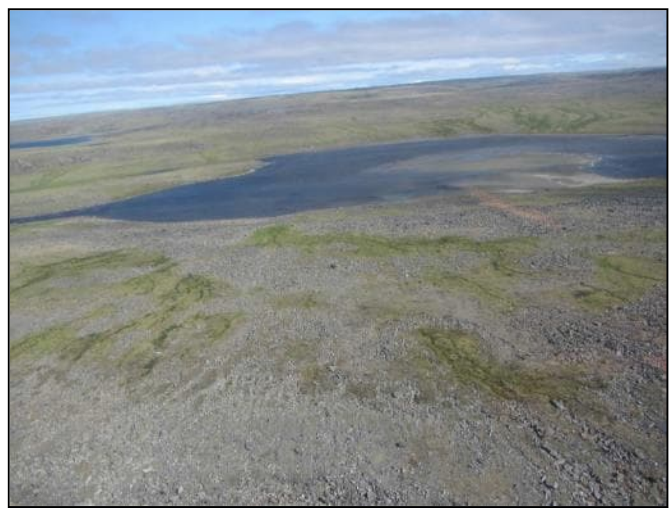


Photo 6-32: Zone P7 within the Delta Study Area (CRI22-EP-90)

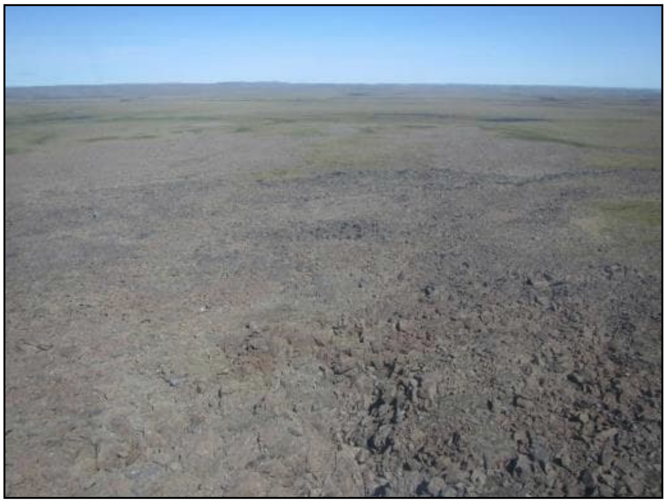


Photo 6-33: View of the Proposed Site for the LEMN (CRI22-EP-99)

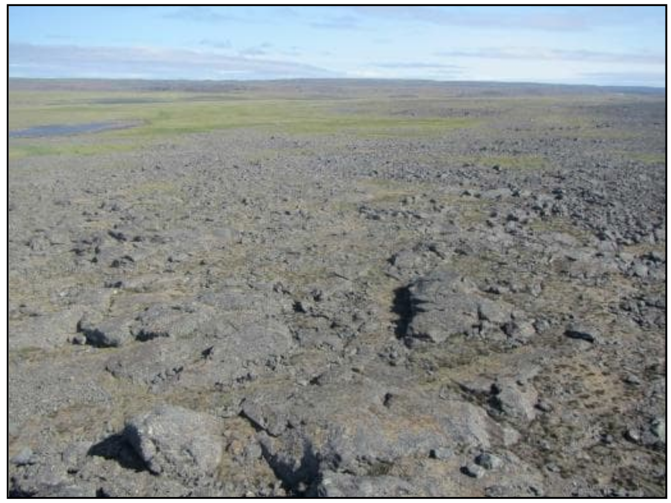


Photo 6-34: General View of the Helipad (CRI22-EP-24)

A helicopter survey was conducted in the area of the new Delta mine, as well as in the corridor encompassing the selected road linking Ivakkak and Delta study areas. This initial flyover of the road was conducted by following the layout on a handheld GPS, as no ground surveys were available to locate the selected route. For the purposes of the road inventory, a 100 m right-of-way was considered and the inspection was done only from the helicopter, which was moving at a speed of slightly less than 30 km/h and at an altitude of approximately 200 feet. This first flight also allowed for the photographing of the study areas and the seven areas of archaeological potential. As a result, the Delta study area, the proposed infrastructures of the Delta camp, the LEMN (photo 6-33), helipad (photo 6-34) and potential quarries 1 to 3 (photos 6-34 to 6-36) were more closely inspected by helicopter. The areas with archaeological potential were also subjected to a detailed visual inspection from the helicopter, with an additional field visit to areas deemed suitable for caribou hunting.The environment of the quarries under study consists mainly of felsenmeer and boulder fields. For all the Delta quarries, the archaeological inventory was conducted only from the helicopter. No ground inventory was conducted for the quarries because no elements of cultural interest were observed from the flyover that would have deserved a closer observation. Therefore, each of the quarries was flown at low altitude and at a reduced speed in order to maximize the chances of seeing anthropogenic disturbances (see photos 6-35 to 6-37).

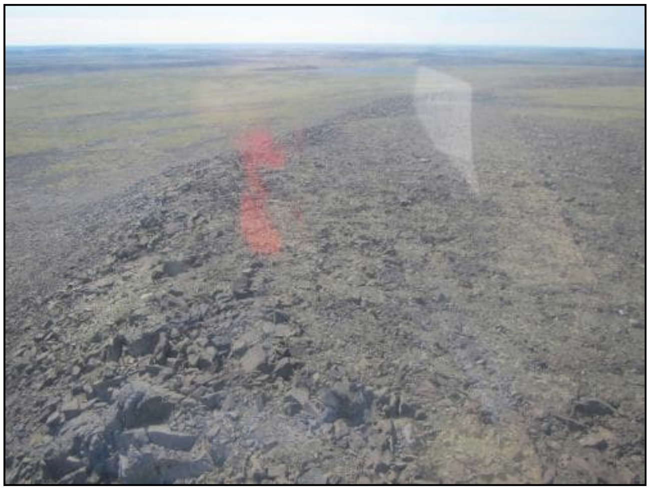


Photo 6-35: General View of Part of the Delta Quarry 1 (CRI22-EP-36)

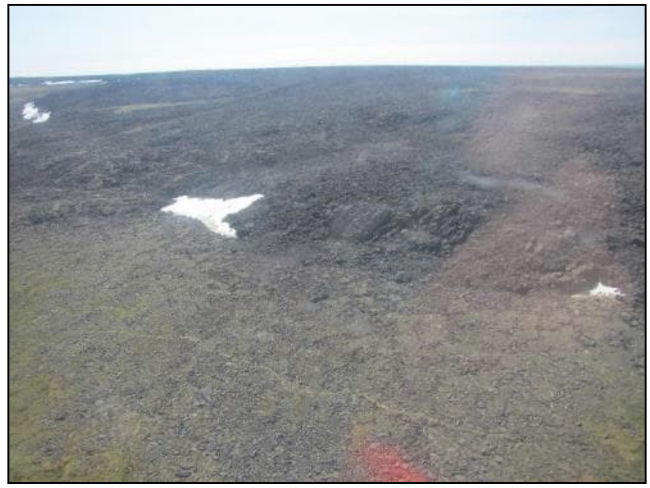


Photo 6-36: General View of Part of the Delta Quarry 2 (CRI22-EP-25)

Photo 6-37: General View of Part of the Delta Quarry 3 (CRI22-EP-19)

Following the inventory carried out in the field, it is possible to affirm that the project components that have been the subject of archaeological research do not present any evidence of cultural activities that could be associated with a so-called traditional Inuit occupation. Consequently, the construction and operation of the infrastructures planned for the exploitation of the Delta deposit for the variants retained in October 2022 for Phase 2b should not have any impact on archaeological heritage.

However, as archaeological resources can be elusive and sometimes end up buried or unsuspected, if during the course of the work archaeological resources are discovered, the mitigation measures outlined in section 7.4.3 should be applied.

6.4.6 Soundscape

Pursuant to condition 6.11 of the global CA, monitoring of NNiP's noise impacts was implemented. The objective of this monitoring is to assess the sound levels from the Pingualuit National Park's mining complex. Environmental monitoring details can be found in the 2021 EMP report (Canadian Royalties, 2022). The data from this monitoring makes it possible to document ambient noise in the natural environment outside the NNiP study area's limits.

A Larson Davis Model 831 sound level meter was used to record noise peaks and ambient noise. When the noise measurements were recorded, wind direction and speed are logged, in addition to noting the unnatural noises not originating from the mining facilities.

The results of the equivalent minimum, maximum and continuous noise levels recorded in 2021 are comparable to those of 2019. It should be noted that the values measured in 2021 for ambient noise do not include the noise of helicopter take-offs and landings, as to be representative of the actual conditions observed in the natural environment. The average noise levels (LAeq) recorded in 2021 varied between 32.8 dB and 55.3 dB depending on the times and locations where the measurements were taken (Table 6-48). The environmental technicians remained at the canyon and at Pingualuk lake for some time, as to complete a qualitative assessment of noise that could come from the Méquillon site's installations, which was and is still under exploitation. No noise was perceived, besides those from the natural environment (river current, wind, etc.).

No other specific sound anomaly was reported during the other samplings in the Pingualuit National Park in 2021.

The addition of construction and operation activities at the Delta site could have an additional effect on the noise measured at Pingualuit Park, since the same types of noise as those at Expo and Méquillon will be generated there. However, the distance from the Pingualuit National Park is greater at the Delta site (about 48 km) than at Expo (about 33 km) and Méquillon (about 26 km). The anticipated additive effect could therefore be low.

Table 6-48: Maximum and Minimum Sound Levels, Peak and Equivalent Continuous Noise Levels Recorded in the Summer of 2021 in the Pingualuit National Park

Station	Date	Time	Wind[A]			Relative humidity (%)	LAS min (dB)	LAS max (dB)	LApeak max (dB)	LAeq (dB)	Commentaries
			Speed[A] (m/s)	Average direction	Calm/ moderate						
Pingualuk lake (Crater)	2021-07-22	11 :30	5.1	Northwest	Moderate	75.5	27.5	70.54	83.4	55.3	It was a cloudy and windy day. No noise from Méquillon while listening for 15 minutes.
Pingualuk lake (Crater)	2021-07-22	14 :30	10.3	Northwest	Moderate with gusts	75.5	27.5	70.54	83.4	55.3	It was a cloudy and windy day. No noise from Méquillon while listening for 15 minutes.
Pingualuk lake (Crater)	2021-08-15	14 :15	3.9	Northwest	Moderate	82.5	16.9	68.9	77.8	49.5	Constant moderate breeze but almost inaudible. No gusts while present. Cloudy with no precipitation.
Pingualuk lake (Crater)	2021-08-15	17:30	5.7	Northwest	Moderate	82.5	16.9	68.9	77.8	49.5	Constant moderate breeze but almost inaudible. No gusts while present. Cloudy with no precipitation.
Canyon	2021-07-21	11 :40	2.8	Sud	Moderate	85.5	36.7	73.2	80.3	46.6	Constant light breeze, but nothing audible to the human ear, no gusts. Only the river next to the canyon was slightly audible
Canyon	2021-07-21	14 :40	2.5	Est	Moderate	85.5	36.7	73.2	80.3	46.6	Constant light breeze, but nothing audible to the human ear, no gusts. Only the river next to the canyon was slightly audible
Canyon	2021-08-15	08 :05	1.2	West	Very light breeze	91.2	24.7	59.9	72.9	32.8	No audible wind, no gusts. Light drizzle, cloudy. No one occupies the Park's camp. Increased wind towards the end of the recording.
Canyon	2021-08-15	11:35	1.9	West	Light breeze	91.2	24.7	59.9	72.9	32.8	No audible wind, no gusts. Light drizzle, cloudy. No one occupies the Park's camp. Increased wind towards the end of the recording.

[A] Average speed measured on-site with an anemometer.

6.4.7 Inuit Communities Information Program

A community information program was implemented in 2011, following condition 7.1 of the global CA. This program is included in CRI's environmental monitoring program (Monitoring 35). This monitoring is to reach the Inuit community populations of Puvirnituq, Salluit and Kangiqsujuaq, to explain the operation and nature of mining activities, the measures implemented to protect the environment and the corrective measures taken to provide solutions to the problems experienced by land users.

Two representatives from the Environmental Department met with the Puvirnituq elected officials on January 22, 2020. They presented the activities and actions taken by CRI to protect the environment and improve its environmental performance. The presentation was given in English and Inuktitut. The results of certain environmental monitoring completed in response to concerns expressed by elected officials were presented. They explained that surface water samples were taken from various locations along the river during helicopter campaigns, between the NNiP study area and the intake for the community drinking water. The results show a metal content below or around the detection limits. The meeting was positive overall and appreciated by the participants (Canadian Royalties, 2021 and 2022).

Three Nunavik Nickel agreement meetings took place via a virtual platform in 2021. An *ad hoc* meeting was held on March 22nd with the goal of presenting CRI's long-term plans and to implement a sub-committee dedicated to the discussions surrounding Phase II. A regular meeting took place on August 17th to discuss the social, environmental and technical aspects relative to the operations and the administration of the Nunavik Nickel agreement. A presentation addressed, among other things, Inuit employability, specific environmental monitoring, the ESST recognition program and the evolution of NNiP's Phase II. Lastly, the sub-committee's first meeting relating to NNiP's Phase II implemented in March, was held on November 10th. The presentations completed by CRI during these meetings are included in Appendix U.

The employment and training counsellors (EFI) are in regular and frequent contact with local employment officers in northern villages, town hall, landholding corporations and other Inuit organizations. Moreover, they were the spokespeople for the Inuit employees for CRI's operations manager. Several communities were visited to inform and promote the hiring and training opportunities with Canadian Royalties. EFI advisors also participate in the Kautapikkuut and ESUMA committees on a regular basis. Interviews are periodically conducted with EFI advisors by the Environmental Department, to collect any concerns and questions that Inuit employees may have shared with them in terms of NNiP's environmental impacts. The advisers are instructed on how to respond to the concerns and questions raised, when required. The results of these interviews are presented in CRI's annual environmental monitoring report, sent to the MELCC and the Inuit partners.

The information program was impacted by the restrictions related to Covid-19 prevention for most of 2021. After March, 2020, planned visits to the villages had to be cancelled and postponed to a later date due to health risks and conditions decreed by public health. Efforts to organize the visits were resumed in late 2022 with the goal of conducting them in early 2023.

6.4.8 NNiP Perception and Assessment Plan

The global CA provides, under condition 7.2, for the keeping of a plan for developing the perceptions of the project by the users of the territory. It aims to specifically evaluate the effectiveness of the communication methods for the monitoring results carried out and to receive, if applicable, complaints and comments from the territory's users in connection with the project's activities. This monitoring must be completed every five years according to the established calendar. The results must also be presented in the 2020 environmental monitoring report. The project schedule has been disrupted by the restrictions in connection with Covid-19.

A liaison officer position has been created within the CRI organization to promote constructive dialogue with partners. In 2021, the liaison officer visited certain Inuit communities as to maintain an ongoing dialogue with them. They collected comments relative to CRI's planned developments during these visits. The main concerns related to the water quality in the Puvirnituq River and its tributaries, potential contamination in the event of a spill, poisoning of caribou grazing near the exploited sites, the choice of subcontractors, the number of Inuit employees hired and the origin of the employees (see chapters 35 and 36 from Canadian Royalties, 2022). The liaison officer left in May 2022 and the position could not be filled until October, the new liaison officer has completed some community visits and will continue these in 2023.

CRI plans to distribute a perception survey based on previous editions to support the development of a perception plan. However, it has been evaluated that it would be wiser to combine the survey's distribution with the community visits, as to ensure the maximum number of people are reached. This distribution will therefore take place when visits to the villages are once again possible in terms of Covid-19 transmission restrictions.

7 Impact Identification and Assessment

7.1 Methodology

The method used for the identification and assessment of impacts is in accordance with the Quebec government's general directive on the execution of impact studies (MDDELCC, 2016). This approach is based on a detailed project description (Chapter 5) and the receiving environment (Chapter 6). The approach is presented in detail in Appendix G and Table 7-1 summarizes the quantification of residual impact after mitigation measures have been applied. The generic mitigation measures established in Annex 7 following the Nunavik Nickel Agreement are monitored by CRI. These measures are added to the specific measures for new projects under study in Phase 2a. These mitigation measures will be the subject of discussions during meetings hosted by the Nunavik Nickel Committee's subcommittee.

The project description makes it possible to identify the impact sources based on the technical characteristics of the structures to be built, as well as the activities, methods and construction and operation schedules. The description of the receiving environment makes it possible to understand the environmental and social context in which the project takes place, to identify the issues to be considered and determine the project's most sensitive environmental components. The Inuit's concerns and expectations expressed when the 2007 ESIA was filed and in Monitoring report 35 to the project are taken into consideration.

Note that the environmental assessment is simplified from the project development phase by the integration, from the project development phase, of various environmental optimizations of the project concept, so as to immediately reduce the number and significance of the impacts that could manifest. The various issues targeted when the analysis began are also taken into account for project optimization to increase its environmental and social acceptability.

Lastly, the lessons learned from the implementation of already authorized NNiP projects and the results of certain NNiP environmental monitoring activities provide relevant data which allow to determine the nature and magnitude of certain impacts associated with this project type, as well as the effectiveness of some mitigation and compensation measures.

Sources of impact and project-sensitive components of the environment are discussed in more detail in the following sections (7.1.1 and 7.1.2). An interrelation grid connects the links between the impact sources and the environmental valued components (section 7.1.3), which makes it possible to predict the project's probable impacts.

An impact can be positive or negative. A positive impact leads to improvement in the environmental component affected by the project, while a negative impact contributes to its deterioration. An impact's significance is assessed using the specific criteria presented in Appendix G. The impact's significance is the result of an overall judgement that affects a project activity regarding a component from the receiving environment, which is based on three main criteria, specifically the impact's magnitude, extent and duration. A residual impact assessment is presented for each of the impacts developed. The residual impact is defined as the impacts remaining after the mitigation measures have been implemented. Three classes of significance are used for this purpose: **Minor**, **moderate** or **major**. Mitigation measures for reducing or eliminating the identified impacts' significance will be developed for each environmental component. Integrating these measures at this stage requires a commitment from CRI to apply them during the construction, operation, closure and restoration phases.

Table 7-1: Grid for Determining the Significance of the Overall Impact

Magnitude[a]	Extent[b]	Duration	Significance of the residual impact		
			Major	Moderate	Minor
Strong	Regional	Long	×		
		Moderate	×		
		Short	×		
	Local	Long	×		
		Moderate	×		
		Short		×	
	Specific	Long	×		
		Moderate		×	
		Short		×	
Moderate	Regional	Long	×		
		Moderate	×		
		Short		×	
	Local	Long	×		
		Moderate		×	
		Short			×
	Specific	Long		×	
		Moderate			×
		Short			×
Low	Regional	Long		×	
		Moderate		×	
		Short			×
	Local	Long		×	
		Moderate			×
		Short			×
	Specific	Long			×
		Moderate			×
		Short			×

a: Magnitude is assessed based on whether or not the component has a cumulative effect. For example, impacts on air and soil quality have a cumulative impact on water quality, since these two components have a potential impact on water quality.
b: A specific extent designed an impact limited to the project footprint or limited to a few individuals (animals, plants or human)

7.1.1 Impact Sources

The detailed project description (chapter 5) provides an overview of all project components that could have an impact on the environment. The impact sources are associated with the project's construction, operation and closure and restoration phases (Table 7-2).

Table 7-2: Impact Sources associated with the exploitation of the Delta deposit

Impact source	Description
New infrastructure related to operation, the camp, associated projects and the construction of the access road	
Land preparation	Land preparation activities (stripping overburden, excavation, dynamiting, backfilling and grading) for implementing the surface structures (access roads, gates, ventilation raises, emergency exits, construction site areas, waste rock pile, ore stockpile, main collection pond).
Construction of access road	Construction activities, blasting, unloading of material, installation of culverts or crossings
Construction of structures	All construction work
Circulation of machinery	Circulation of the workers, the machinery required for the works, as well as the trucks for material supply and refuelling.
Atmospheric emissions	Atmospheric emissions include exhaust gases emitted by machinery, burning waste and dust emissions.
Tank farm and hazardous material warehouse	Areas destined for storage of fuel and hazardous materials (explosives, solvents, reagents and other hazardous waste), including reservoirs and their contents and spill retention walls. Includes their use, handling and management (recovery, recycling etc.)
Production and management of waste and hazardous waste	The main sources of waste at mine sites are domestic waste, oils, explosives packaging, and mechanical and welding shop waste.
Workforce	Canadian Royalties employees and subcontractors associated with the construction phase.
Deposit exploitation	
New infrastructure presence, maintenance and operation	Includes all extraction and maintenance activities carried out on the sites.
Water management and use	Industrial water (drainage ditch network, collection ponds, pumps and berms) and wastewater management.
Atmospheric emissions	Atmospheric emissions include exhaust gases emitted by machinery, burning waste and dust emissions.
Storage and handling of ore and waste rock	Includes all ore and waste rock handling and storage areas (ore stockpiles and waste rock piles).
Machinery traffic	Circulation of the workers, the machinery required for the works, ore transportation trucks, as well as the trucks for material supply and refuelling.
Production and management of waste and hazardous waste	The main sources of waste at mine sites are domestic waste, oils, explosives packaging, and mechanical and welding shop waste.
Workforce	Canadian Royalties employees and subcontractors associated with the deposit exploitation phase.
Site closure and restoration	
Water management	Managing surface water and contaminated water, if any.
Restoration works	Excavation, backfilling and earthwork to restore the site.
Workforce	Canadian Royalties employees and subcontractors associated with the site closure and restoration phase.

7.1.2 Environmental Components

The receiving environment's detailed description (Chapter 6) identifies the components of the physical, biological and human environments that are likely to be affected by one or more potential project impact sources and by the potential interactions between the different sources. The impact evaluation relates to the environmental components presented in Table 7-3.

Table 7-3: Environmental Components Likely to be Modified by the Exploitation of the Delta Site (Open Pit and Underground Deposits) and Subject to Impact Assessment

Components	Description
Physical Environment	
Air Quality	Physicochemical characteristics of the air, including dust concentrations and emission of GHGs
Soil Quality	Physicochemical characteristics of the soil, structure of the soil and effects on permafrost
Water and Sediment Quality	Physicochemical characteristics of water and sediments
Hydraulic and sedimentary regime	Surface water runoff, water pumping in the lake, release of two effluents into the Puvirnituq River
Biological Environment	
Terrestrial Environments	Terrestrial habitats (felsenmeer, polygonal ground with tundra ostioles, eskers and boulder fields) and the plant species which inhabit these environments.
Wetlands	Wetlands (lowland fens, snowbed fens), plant species which inhabit these environments and ecological functions.
Aquatic fauna and their habitats	Fish populations, benthic organisms and their habitats in waterbodies adjacent to the Delta site, the Puvirnituq River and watercourses crossed by the new access roads
Avian fauna and their habitats	All bird species using the future impacted environment for their migration, moulting, nesting and feeding
Caribou and other land mammals	Caribou using the study zone for migration and calving and other species of mammals using the zone for shelter (burrows) or feeding.
At-risk wildlife and plant species	All at-risk wildlife, plant species and their habitats
Human Environment	
Economy and employment	Economic benefits associated with new deposit construction and operation.
Land use by the Inuit	Land appropriation, occupation, use and development by the Inuit.
Archeology and heritage	Known occupation sites and areas with potential archaeological sites. .
Soundscape	Noise emissions for workers, the Inuit and the ambient environment in zones adjacent to the Delta site
Landscape	View of operation sites from Pingualuit National Park and from sites potentially used by the Inuit.

Several other environmental components were subject to an impact assessment in the context of the NNiP (GENIVAR, 2007), but were not retained in the present impact assessment, since they do not apply to the activities planned within exploitation of the Delta deposit.

7.1.3 Interrelation Between the Impact Sources and Environmental Components

The potential impact sources and environmental components likely to be affected by the project are presented in an interrelation grid (Table 7-4). This matrix makes it possible to determine which project phase (construction, operation and closure and restoration Duration) and which specific activities are likely to cause impacts on the various components of the physical, biological and human environments.

A priori, the impact sources likely to affect the greatest number of environmental components are the site preparation (overburden stripping, excavation, blasting, backfilling and grading) and the construction of structures. Indeed, these activities will have a lasting impact on the physical, biological, and human environments. Other activities such as maintenance, deposit exploitation or trucking are likely to have a more targeted impact on certain environmental components.

Table 7-4: Interrelation Grid Between the Impact Sources and Environmental Components

Environmental Component / Impact Sources	Physical Environment				Biological Environment					Human Environment				
	Air quality	Soil quality	Water and sediment quality	Hydraulic and sedimentary regime	Wetlands and terrestrial	Aquatic fauna and their	Avian fauna and their	Caribou and other land mammals	At-risk wildlife and plant species	Economy and employment	Land use by the Inuit	Archeology and heritage	Soundscape	Landscape
Construction phase – Development of new infrastructure at the Delta site, access roads and adjacent infrastructure														
Land preparation	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Construction of the structures (collection basins, trenches, roads, etc.)	■	■	■	■	■	■	■	■	■	■	■		■	■
Machinery traffic	■	■	■		■		■	■	■	■	■		■	■
Atmospheric emissions	■	■	■		■	■	■	■	■		■			■
Production and management of waste and hazardous waste	■	■	■		■	■	■	■	■					■
Workforce										■				
Operation phase - Exploitation of the open pit and underground deposits														
New infrastructure presence, maintenance and operation	■	■	■	■	■		■	■	■	■	■		■	■
Water management and use			■	■		■	■				■		■	■
Atmospheric emissions	■	■	■		■	■	■	■	■		■			■
Storage and handling of ore and waste rock	■	■	■		■	■	■	■	■		■		■	■
Machinery traffic	■	■	■				■	■		■	■		■	■
Production and management of waste and hazardous waste	■	■	■		■	■	■	■	■		■		■	■
Workforce										■				
Site closure and restoration phase														
Water management			■	■	■	■							■	
Restoration activities	■	■	■	■	■	■	■	■	■	■	■		■	■
Workforce										■				

7.1.4 Cumulative Impacts

Cumulative impacts are defined generally as changes affecting the environment caused by an action combined with the effect of past, present or future activities. Cumulative impacts therefore result from the combined effect of the present project and those stemming from other activities (past, actual or future) taking place on the territory in question. These cumulative effects can occur over a certain temporal period and at a certain distance from the project. The current section evaluates how exploitation of the Delta deposit can exert cumulative impacts on Valued Components of the Environment (VCE) of the territory in question.

The assessment of the cumulative effects therefore involves:

1. Identifying the VCEs to be considered in the analysis of the cumulative effects
2. Identifying and justifying the spatial and temporal limits of the analysis, based on the intrinsic characteristics of the VCEs and their distribution
3. Identifying the other past, present or future activities in the territory considered that may affect these same VCEs
4. Determining whether the effects of the project concerned on another VCE accrue with the effects of the other activities
5. Determining whether the combined effects of the project concerned and the other activities risk causing a current or future material change to the VCEs and whether additional mitigation measures should be deployed

Cumulative impacts will therefore be presented after the residual impact assessment, taking into account attenuation measures, so that the reader can clearly distinguish them from the direct or indirect impacts of the main project.

7.1.1 Identification of the VCEs Considered

7.1.2 Identification of the VCEs Considered

The VCEs considered for the assessment of the cumulative impacts arise from the six environmental and social issues identified in section 3.3 of this report. These VCEs are as follows:

1. Air quality (Reduction of dusts and greenhouse gas emission)
2. Conservation and protection of wetlands and water environments
3. Protection of biodiversity
4. Economy and employment
5. Land use by the Inuit communities
6. The landscape

In the case of **biodiversity**, the species or groups of species considered as VCEs for the analysis of cumulative effects in the present study are those with an increased risk of being disturbed by the mining activities and collisions with road vehicles (**caribou**) and those having a particular importance for the subsistence activities of the Inuit (**waterfowl**).

7.1.2.1 Identification and Justification of the Spatial and Temporal Limits of the Analysis

The spatial limits considered for this analysis are those of the extended study area, because all this territory is visited and used by the Inuit communities of the neighboring villages (Salluit, Kangiqsujuaq and Puvirnituq). This territory is also visited by the Leaf River Herd (LRH) caribou and by several migratory bird species, such as snow goose and Canada goose, in different periods of the year.

Concerning the temporal limits of the analysis, given that the mining activities on the NNiPs territory began in 2001 for exploration and 2013 for production and that this territory was previously very little developed, a period of 25 years is therefore considered for past activities. Concerning future activities, the anticipated period of operation of the CRI mineral deposit extends at least to 2032, according to the current information, but the mining activities eventually could extend beyond this period if the operation of the new mineral deposits were to be authorized in the territory in the future. For the purposes of this analysis, the lifecycle of the projected mine operation (2032) on the NNiPs territory will be considered as the temporal limit for future activities, namely a maximum operation period of 10 years.

7.1.2.2 Identification of past, present and future activities potentially affecting VCEs

The main activity occurring on the territory is mining. Mining activities imply the installation of infrastructure (industrial and mining sites, access roads, telecommunication towers, etc.) mineral extraction and preliminary treatment, energy production (diesel generators, future windmills at the Expo site), heavy transport on the territories access roads, aerial transport (via the Kattiniq-Donaldson airport) and maritime transport (via port infrastructure of the two companies at Deception Bay). All these elements have the potential to cause cumulative impacts on the different VCEs considered in the present analysis.

Other activities that could affect VCEs are industrial development activities taking place outside of the NNiP, but that could impact VCEs like air quality (ex: atmospheric pollution coming from industries south of the site), land use by the Inuit (ex: road development by other mining companies), caribou, terrestrial fauna and waterfowl (ex: fragmentation of the territory, creation of dams), etc.

7.1.3 Maps of the Affected Areas

Maps illustrating the impacts on the areas affected by the construction, operation, closure and restoration activities of the Delta deposit and associated infrastructure are presented at the end of this chapter. The reader is invited to open them now for future reference while reading. The map order is listed below:

- Map 7-1: Impacts on surface drainage at the Delta site
- Map 7-2: Impacts on the natural environment – Delta site
- Map 7-3: Impacts on the natural environment – Ivakkak-Delta road
- Map 7-4: Impacts on the natural environment – Satellite camp and LEMN;
- Map 7-5: Impacts on the natural environment – Road between Delta site and Lake No.4
- Map 7-6: Impacts on the natural environment – Sector for potential quarries

7.2 Impacts on the Physical Environment

7.2.1 Air Quality

7.2.1.1 Construction Phase - New Infrastructures and Related Project Development

During the development phase of new infrastructures and related project development, the main impacts on air quality will come from dust rising during overburden stripping, excavation, blasting, backfilling and grading as well as from the operation of quarries. All machinery used on the site for construction or for transporting people and materials will emit dust and exhaust gases, which contain air contaminants such as nitrogen oxides (NOx), sulphur dioxide (SO2), carbon monoxide (CO), volatile organic carbons (VOCs) and particulate matter.

The increase in road traffic during the construction of the various infrastructures can lead to an increase in dust in the air as vehicles pass by repeatedly. In fact, on the NNiP site, the lifting and dispersion of dust is more significant during dry and windy weather, conditions observed mainly during the summer period (June-September at the latest). These temporary dust clouds can affect the risk of accidents due to poor visibility. Snow cover and frozen ground in winter do not favor dust lifting and dispersion.

Construction machinery will also be a source of air contaminant and greenhouse gas (GHG) emissions. Emissions calculations are presented in Chapter 8.2.

Impacts assessed without mitigation measures during the construction period on air quality are considered to be of moderate magnitude (high probability of occurrence), local extent (considerable particle dispersion) and short duration, leading to a minor impact significance. However, several mitigation measures will reduce dust and atmospheric emissions.

7.2.1.2 Operation Phase

Just like the construction phase, dust and exhaust gases will be emitted by the machinery circulating and working on-site, in addition to waste management, which involves the burning and burial of combustible materials. Fumes are also likely to be emitted during the new infrastructure maintenance, but to a lesser extent. An increase in mining dust is also likely to occur during the handling and storage of overburden, ore and waste rock.

For ore, potential air emissions will be associated with loading into trucks, transportation and storage on temporary stockpiles at the Delta site, and loading, transportation and storage at the Expo site.

For waste rock, emissions will be related to the loading, transport and disposal of waste rock on the waste rock pile. When waste rock is used to backfill the construction sites during operation, the associated emissions will be related to loading/unloading and transportation. However, since the disposal site for this rock is close to the extraction site, emissions will be reduced due to the short distances to be travelled. The waste rock crushing stage at the Delta site has the potential to emit particulates. This activity aims to break down 80% of the waste rock to a size less than 300 mm in diameter. An output of 400 tonnes per hour is planned for crushing. Depending on maintenance and mechanical contingencies, the crushing period is expected to be 2 to 3 months per year in the summer and fall (August, September and early October), using water as a dust suppressant to limit dust dispersion.

Quarry operations (blasting, drilling, crushing) and open pit operations (blasting/drilling) will produce dust. However, this type of dust dispersion will be punctual, when blasting and drilling, and generally does not result in a dust cloud that spreads over a long distance. Furthermore, most of the activities that generate dust from the operation will be at the bottom of the mine and therefore sheltered from the wind.

The operation of the Delta site will emit atmospheric contaminants through the burning of diesel fuel for electricity (generators) and heating, as well as the use of explosives for pit mining (approximately one blast per week for the duration of operations) and quarrying. Calculations of GHG emissions produced by the operation are presented in Chapter 8.2.

The impacts assessed without mitigation measures, during the operational period, on air quality are of moderate magnitude (high probability of occurrence), local extent (extensive airborne contamination) and medium duration, leading to a medium impact significance. However, several mitigation measures will reduce dust and air emissions and are presented below.

7.2.1.3 Site Closure and Restoration Phases

The primary sources of atmospheric emissions during the site closure and restoration phases are:

- Infrastructure dismantlement;
- Reworking of soils and overburden;
- The use of waste rock for backfilling;
- The machinery circulating and working on-site.

When waste rock is used for backfilling the pit, the associated emissions will be related to loading and transportation. However, since the waste rock pile is close to the pit, emissions will be reduced due to the short travel distances.

Therefore, the impacts present are of low magnitude (reduced probability of occurrence), of local extent (reduced dispersion of atmospheric emissions due to site closure) and of short duration, resulting in a minor impact. However, some mitigation measures are applicable and will have an effect on certain impact components.

7.2.1.4 Mitigation Measures

The mitigation measures stated in Annex 7 of the Nunavik Nickel Agreement, applicable to the present project, as well as the new proposed mitigation measures are presented in Table 7-5.

Table 7-5: Mitigation Measures to Reduce the Impacts on Air Quality

Nº [A]	Mitigation Measures
AIR1	Vehicles, to the extent possible, shall not be left running when not in use.
AIR2a	In dry, windy weather, dust reducers (calcium chloride or water) will be sprayed on certain areas. The humidification frequency will be adjusted according to the meteorological conditions and the dust emissions observed. Dust control agents will comply with the BNQ 410-300 standard or will be approved by the *Ministère des Transports du Québec* (MTQ). The choice of dust reducers must take account of the proximity of wetlands or bodies of water.
AIR3	Machinery used must meet Environment and Climate Change Canada's emission standards for on- and off-road vehicles.
AIR4a	Equip the crushers and grinders with dust control agent equipment. See also AIR4b.
AIR4b	The waste rock crusher will be equipped with a dust control system, which will be checked daily and cleaned regularly.
AIR4c	At the Expo ore stockpile, limit handling to the waste rock crushing area during periods of high winds to reduce dust emissions.
AIR5	Use generators with low contaminant emission rates.
AIR6	Prior and regular inspection of machinery will be performed to ensure that it is in good condition and working properly. See also AIR6a
AIR6a	Apply the mechanical service preventive maintenance program to ensure optimal operation of machinery and that equipment vibrations are reduced to a minimum, as to reduce emissions to a minimum.
AIR11	Addition of three stations around the Delta site for dust monitoring.

[A] The mitigation measure number refers to Annex 7 established by the Nunavik Nickel Committee (see Appendix B).

Note : A grey background indicates a new mitigation measure n the Phase 2a impact study and a yellow background ndicates mitigation measures specific to Phase 2b.

7.2.1.5 Residual Impact Significance

Air quality in Nunavik is considered good because the territory is not significantly affected by anthropogenic activities. There are no large cities, the road and air traffic and is low and there are no sources of industrial pollution other than the mining activities. It is therefore unlikely that the work of the Delta project will cause a significant deterioration in air quality. Moreover, the low relief and absence of arborescent vegetation in the study area, combined with very frequent strong winds, contribute to the movement of air, the diffusion of exhaust gases and the dispersion of dust and other atmospheric pollutants.

Increasing the application of mitigation measures for airborne dust management over the years should have beneficial effects on air quality. In addition, applying mitigation measures makes it possible to reduce periods of low visibility attributed to dust, thus minimizing, among other things, the risks of accidents related to poor visibility and therefore ensures worker safety (AIR1 to AIR4cThe application of measures AIR5 to AIR6a will make it possible to control emissions of atmospheric contaminants during all phases of the project. Finally, three monitoring stations for summer and winter dust dispersion will be added to CRI's environmental monitoring program (Monitoring 23).

The most significant impacts on air quality are observed during construction and operation (impact magnitude assessed as minor and moderate in 7.2.1.1 and 7.2.1.2 respectively). Application of the mitigation measures presented in Table 7-5 reduces the residual impact significance to minor rather than moderate (Table 7-6).

Therefore, the air quality residual impact magnitude is described as minor for all project stages (table 7-6).

Table 7-6 : Description of the Project's Residual Impact on Air Quality

Project phase	Impact description	Mitigation measures[A]	Magnitude	Scope	Duration	Residual impact significance
Construction, exploitation, closure and restoration	Increase in airborne dust and exhaust emissions.	AIR1 to AIR3	Low	Specific	Moderate	Minor
	Atmospheric particles and greenhouse gas emissions	AIR5 to AIR6a	Low	Local	Moderate	Minor
Exploitation	Increase in airborne mining dust	AIR4a to AIR4c, AIR11	Low	Local	Moderate	Minor

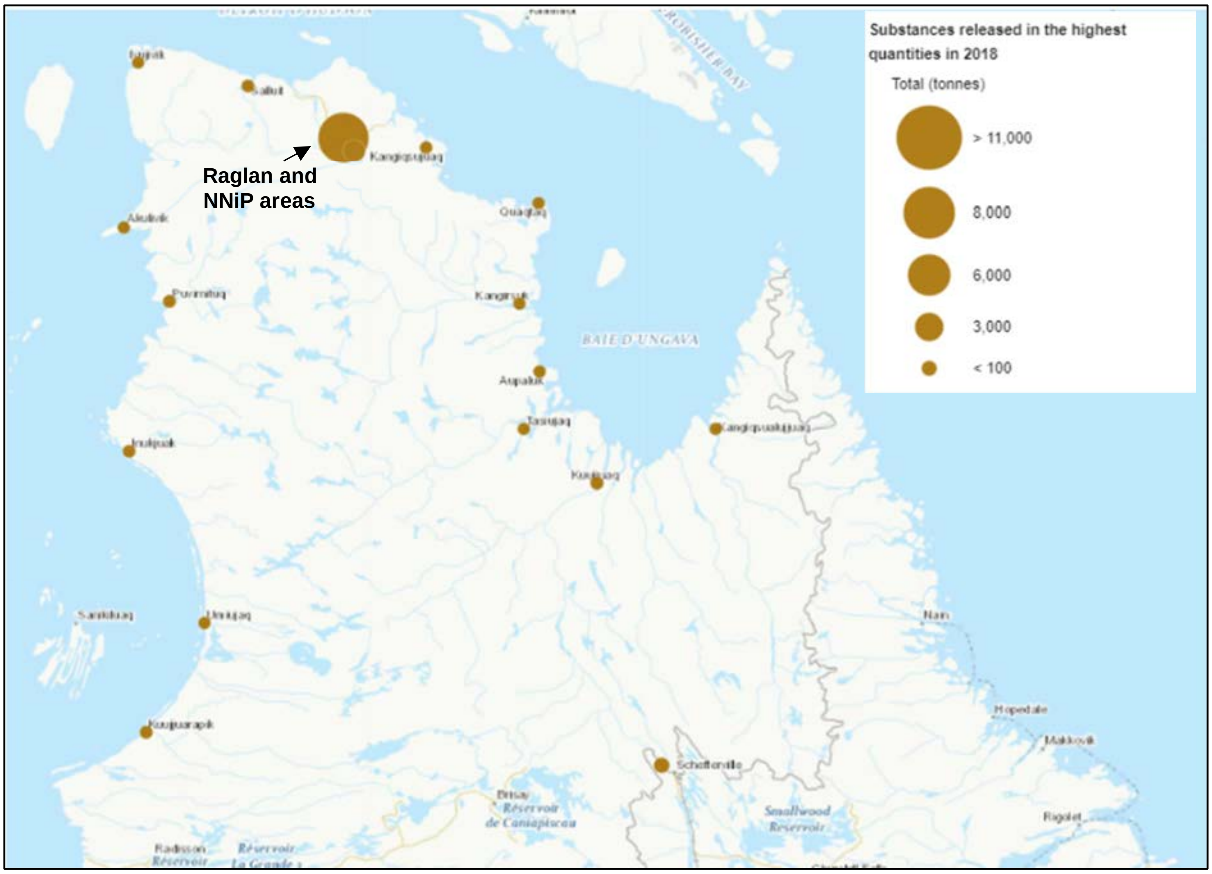
7.2.1.1 Cumulative Effects

Climate change is likely to have the greatest impact on air quality in terms of increased extreme weather events. For example, drier weather and stronger winds in the summer (usually observed simultaneously) could have a significant impact on the travel distance of fine particles and mining dust. Watering of roads and access roads would then have to be more frequent. Therefore, dust control mitigation measures will need to be adapted to the summer weather to avoid the transport of mining dust and fine particles over very long distances. The frequency of occurrence of these extreme weather events is unknown at this time, but will likely be occasional.

Air quality can also be affected by industrial activity in southern Quebec. In order to address the concerns of Inuit communities, the Northern Contaminants Program (NCP) has been established by the Government of Canada. This program was established in 1991 to address concerns about exposure of Inuit consumers to wildlife species that are an integral part of their diet. Early studies indicated that many of the contaminants found in the species did not originate in the Arctic or Canada. Since controlling emissions outside of Canada is not necessarily possible, it is all the more important to be able to limit air emissions from new projects. It should be noted, however, that the mining and milling of metals in the NNiP does not result in significant emissions of atmospheric pollutants such as sulphur dioxide and nitrogen oxides, which are typical pollutants from copper and nickel smelters (GENIVAR, 2007).

The change in air quality may also come from an additive effect of the operation of the Raglan mine, located immediately north of the NNiP area. In fact, according to the data compiled by the two mines, the emissions were quite significant for the Raglan and PNNi sectors (Figure 7-1). This impact would then become regional in scope.

Thus, given the mitigation measures and regulations in place, the cumulative effects on air quality are considered **minor** for the NNiP site and the local and regional environment.



Source : Adapted from "Aboriginal Component of the National Pollutant Release Inventory: Nunavik (Gouvernement du Canada, 2022d) ».

Figure 7-1 : Total amount of substances released in large quantities in 2018

7.2.2 Soil Quality

7.2.2.1 Construction Phase - New Infrastructures and Related Project Development

New infrastructure and related project developments require soil stripping and removing overburden. The preparation and leveling of the soil will allow the implementation of infrastructures such as the Delta site and road. Stripping will be required for the operation of some of the sites intended for use by potential quarry equipment. The pit site will also need to be stripped, blasted and excavated prior to the start of operations. The area of land that will be disturbed during construction will cover 171,41 ha.

These works also require the use of machinery and a fuel depot on-site during the construction phase, which can lead to accidentally contaminating the soil with polluting substances. Trucks and heavy machinery contain many hydrocarbon-based systems. Hydrocarbon leaks could occur as a result of machinery or storage tank failure. Lastly, the increase in road transportation to carry out construction work increases the risk of accidental spills during, e.g., a wrong maneuver during machinery maintenance or refuelling.

Without mitigation measures, these impacts are considered to be of moderate magnitude (moderate probability of occurrence), of specific extent (reduced contamination at a specific site) and of long duration (if no decontamination), meaning a moderate impact significance.

7.2.2.2 Operation Phase

As mentioned for the construction phase, accidental hydrocarbon spills could occur as a result of machinery or storage tank failure, the increase in road transport and maneuvers on-site increases the risk of accidental hydrocarbon spills from machinery and the fuel depot and could also cause soil contamination. In addition, the operation of quarries for the construction of roads or other infrastructure prevents the use of these soils for other purposes.

The storage of waste rock in the waste rock piles may alter the quality of the soils due to localized increases in metal concentrations from airborne dust or particles. These impacts are directly related to air quality.

Le potentiel de présence de taliks, ainsi que les risques et impacts associés le cas échéant, sera évalué suivant l'analyse des données qui seront collectées par des thermistances. Ces données seront collectées et présentées dans la demande d'autorisation régionale au MELCCFP, afin que la construction du site soit adaptée conséquemment le cas échéant.

The addition of new infrastructure to the ground for new operations and related projects brings with it a risk of increased soil subsidence due to increased active layer following the thawing of permafrost. This can be attributed to the presence of the infrastructure itself or to climate change. The construction of road embankments could accelerate the thawing of permafrost in conjunction with snow accumulation (GENIVAR, 2007). This thawing could lead to greater instability of the roads and thus increase the need for grading and granular materials. Buildings would be at greater risk of subsidence.

Considering these various impacts during the operation phase, and without application of mitigation measures, the magnitude is moderate (moderate probability of occurrence), the local extent (contamination that may extend outside the sites) and long duration (if no decontamination), leading to a major impact.

7.2.2.3 Closure and Restoration Phases

As for the construction and operation phases, the main anticipated impact on soil quality during site restoration and closure is the risk of hydrocarbon contamination following an accidental spill from vehicle circulation and machinery. However, these will be less prevalent than in the operation phase.

The restoration phase is a mitigation measure in itself. Ground that may have been contaminated during the construction, operation and closure phases will be excavated and decontaminated during mine site restoration activities. It should be noted that prompt, effective and comprehensive spill management is governed by the Environmental Incident Management Procedure (see mitigation measure SOL2a below), which will limit the amount of contaminated soil that remains to be excavated during the closure phase. Mining dust emissions will cease following the reclamation of the waste rock and ore stockpiles. As mentioned in Chapter 5, all waste rock on the waste rock pile will be returned to the pit.

The site closure work will likely require some material for capping (e.g., northern landfill) or grading of some areas, which will come from permitted eskers and quarries. The remediation phase will be carried out in accordance with the provisions of the remediation plan to be approved by the MRNF.

Since the restoration phase represents mitigation measures to compensate for spills that would occur during the restoration phase, impacts are considered minor due to the use of the esker or quarry.

7.2.2.4 Mitigation Measures

The mitigation measures stated in Annex 7 of the Nunavik Nickel Agreement and applicable to this project will be implemented, in addition to new measures (Table 7-7). It should be noted that mitigation measure VEG 6 stipulates the conservation of topsoil in a wetland environment in order to promote vegetation recovery, which also reduces the impact on soils.

Table 7-7 : Mitigation Measures to Reduce the Impacts on Soil Quality

N° [A]	Mitigation measures
SOL1	Prior and regular inspection of machinery shall be performed to ensure that it is in good condition and working properly (not leaking hydrocarbons).
SOL1a	Apply the mechanical service preventive maintenance program to ensure optimal operation of machinery (verify there are no hydrocarbon leaks).
SOL2	An emergency kit for recovering petroleum products and hazardous materials shall be readily accessible at all times, construction site machinery shall have absorbent material in order to respond quickly, and polluted soil and wastes shall be disposed of in accordance with applicable legislation and regulations. See also SOL2a.
SOL2a	Apply the spill management procedure "PRO-NENV-1211-01 Response to an Environmental Incident" which ensures the safe, fast, efficient and comprehensive management of a spill as to minimize the environmental impact.
SOL3	Non-acid-generating waste rock shall be used as granular material during the operational phase in order to minimize encroachment upon eskers.
SOL5	To prevent subsidence due to the soil heating, major buildings shall rest on piles and lighter buildings shall be on ventilated foundations.
SOL9	The final cover shall include an impervious membrane and an erosion protection layer.
SOL10	Measures shall be taken when building major civil structures to prevent permafrost from thawing.
SOL12	Remove and dispose of contaminated soils in an authorized location and perform a characterization according to the terms in the *Politique de Protection des Sols et de Réhabilitation des Terrains Contaminés: Plan d'Action 2017-2021* (MDDELCC, 2017) and the *Guide d'intervention – Protection des Sols et Réhabilitation des terrains Contaminés* (Intervention Guide – Soil Protection and Restoration of Contaminated Sites) (Beaulieu, 2021). Apply the procedures presented in the ERP for spills.
SOL13	The PAG waste rock generated by the new exploitations will be returned to the underground mine tunnels.
SOL14	Apply the AIR4a, AIR4b, AIR4c, AIR4d mitigation measures air quality protection relating to mining dust..
SOL15	Use double-walled tanks for storing fuel, compliant with the requirements of the *Building Act*.

[A] The mitigation measure number refers to Annex 7 established by the Nunavik Nickel Committee. (See annex B).

Note : A grey background indicates the new mitigation measures presented in the Phase 2a impact study and a yellow background indicates mitigation measures specific to Phase 2b.

7.2.2.5 Residual Impact Significance

Applying the SOL3 mitigation measure for soil loss allows for reducing the magnitude of the impact to low, the extent stays local and the duration long. These changes make it possible to obtain minor residual impact significance.

The impact risk of soil contamination by hydrocarbons is considered to be low magnitude due to the mitigation measures (SOL1, SOL1a, SOL2, SOL2a and SOL15) and a work management and surveillance plan. The contamination is site specific and of moderate duration since CRI is responsible for the sites' total decontamination. The residual impact's significance is therefore considered minor (Table 7-8).

The risk of soil collapse can be reduced by applying the SOL5 and SOL10 mitigation measures, which decrease the magnitude, extent and duration, thus contributing to the residual impact significance being classified as minor.

The increase in mineral concentrations on the soil's surface is a low magnitude impact taking into account the mitigation measures that will be put in place (SOL9 and SOL14). The extent is site specific since the transport of airborne particles with mitigation measures remains localized near the infrastructures. Lastly, the duration is moderate since the soil that would have been contaminated during the construction and operation phases, will be excavated and decontaminated during the mining site's closure and restoration. The residual impact's significance is therefore considered minor (Table 7-8).

Finally, by applying the SOL12 and SOL13 mitigation measures, site restoration reduces the impact magnitude to low in terms of the environmental liability left over from the modified land rights. With mitigation measures, the extent becomes site specific, however, the duration remains long, leading to a minor significance of the residual impact.

Overall, the mitigation measures make it possible to maintain a minor significance of residual impact to soil quality for all phases of the projects in this addendum.

Table 7-8: Description of the Project's Residual Impact on Soil Quality

Project phase	Impact description	Mitigation measures	Magnitude	Extent	Duration	Residual impact significance
Construction	Loss of soil usable for other purposes	SOL3	Low	Specific	Moderate	Minor
Construction, operation	Risk of soil contamination by hydrocarbons	SOL1, SOL1a, SOL2, SOL2a, SOL15	Low	Specific	Moderate	Minor
Operation	Risk of subsidence	SOL5, SOL10	Low	Specific	Moderate	Minor
Operation, closure and restoration	Localized increase in metal concentrations on the soil surface	SOL9 and SOL14	Low	Specific	Moderate	Minor
Operation, closure and restoration	Environmental liability that may affect long-term soil use	SOL12 and SOL13	Low	Specific	Long	Minor

7.2.3 Hydraulic and Sediment Regimes

7.2.3.1 Construction and Operation Phases

The open pit and underground mining of the new Delta deposit will require infrastructure for the construction of contact water collection ditches to the collection ponds for water collection and treatment. The work will lead to a change in surface runoff pattern of some intermittent streams flowing to Lake 1, which cannot be used by fish due to the limited amount of water percolating through the wet vegetation and rock bed. The impact created during the construction phase will continue into the operation phase.

Natural surface runoff from the Delta site, which is elevated above the surrounding topography, flows to lakes No.1, No.2 and No.3, which surround the future pit and waste rock pile. Capture of contact water from the Delta site will deprive these lakes of this water supply. However, clean runoff from the periphery of the Delta site will be naturally diverted from the site by its topography and will retain its natural direction in the watershed. An analysis was conducted to quantify the potential impacts of surface development at the Delta site on water bodies in the vicinity of the site. To do this, the drainage areas of each of the lakes were delineated (Map 7-1). The projected surface-area of the new developments were then overlaid on the drainage areas to observe the losses due to development within each drainage area. On average, about 45% of the drainage areas are lost (Table 7-9). It is therefore anticipated that the surface area of the lakes will decrease after the construction of all ditches and infrastructure. Lake No. 2 would be the most affected by the construction and operation phases. It is possible that the outflow from this lake would no longer be able to feed Lake #3 during the open water period, which could result in greater impacts than those noted in Table 7-9. A detailed bathymetric survey of the three lakes will be carried out in the summer of 2023 (and therefore before the start of any construction) in order to assess the impacts more precisely and specify the appropriate mitigation measures, if necessary. The bathymetric analysis, as well as a complete water balance of these lakes, will be the subject of a complementary report, which will be added to this addendum and transmitted to the MELCCFP.

Note that the intermittent watercourse CEI-D20 is the only one that will be partially filled as part of the overall work area of approximately 600m².

Table 7-9: Drainage areas before and after implementation of surface infrastructures

Lake Name	Pre-project drainage area (ha)	Post-project drainage area (ha)	Loss (%)
Lake #1 (confirmed presence of Arctic char)	29,84	17,26	42,16%
Lake #2 (confirmed presence of Arctic charr)	30,42	14,10	53,65%
Lake #3 (no fish caught)	67,73	39,54	41,62%
Total	**128,01**	**70,90**	**44,61%**

As mentioned in the initial 2007 impact study and confirmed during the characterization of the permanent and temporary watercourses, the bed of the majority of the watercourses is predominantly composed of boulders, cobbles and pebbles. However, in the case of the TR-D1 and TR-D2 crossings, the streams have a deposit of organic material due to their passage through the lowland fens. Therefore, during road construction and stream crossing development (culverts and other infrastructure), there could be an increase in sediment transport into the streams, despite the presence of coarse substrate, as well as some susceptibility to bank erosion. However, a significant change in the sediment regime is not anticipated during construction.

The potential quarries in the Delta sector are located near a few intermittent watercourses that are not linked to any permanent water body; their operation therefore poses no risk of transporting TSS into the aquatic environment.

Thus, during construction, the most significant impact will be on the water regime of the lakes surrounding the Delta site due to the collection and diversion of contact water to the MCP. The impact of construction is therefore considered moderate due to the moderate magnitude, specific extent and moderate duration. Mitigation measures are to be defined according to the evaluation of the water level decrease calculated following the bathymetric survey planned for 2023.

7.2.3.2 Operation Phase

The operation phase may affect the water and sediment regime in the following ways:

- withdrawal of water from lake #4 for potable and fresh water needs;
- surface water collection;
- mining and sanitary discharges in the Petite rivière de Puvirnituq;
- presence of water crossings (culverts and arches).

7.2.3.2.1 Freshwater withdrawal

The satellite camp at the Delta site will include sanitary facilities (showers and toilets), a dormitory and a cafeteria. This implies water needs which will have to be met by drawing from a lake located near the camp. The water withdrawal from the selected lake (lake n04) also involves fresh water requirements for operations as presented in Table 5-29 in section 5.2.6.3. The water withdrawal may therefore have an impact on the water level of the impounded lake and thus on fish habitat if the water inflow from the watershed is not sufficient. Water withdrawals that result in the drawdown of the lake, which supports fish habitat, in an excess of 15cm are prohibited under section 17 of the *Règlement sur les habitats fauniques* of the *LCMVF*

Summary bathymetric surveys were conducted using an echo sounder to estimate the average depth of the lake on July 25, 2022. This site was selected due to the significant depth of several pools, the size of the water body, as well as the average depth that allows for significant volume storage (Table 7-10).

Table 7-10: Morphometric characteristics of the lake

Watershed area (ha)	Average lake area (ha)	Maximum depth (m)	Average depth (m)	Average volume (ML)
933	129	11,01	8,62	11 464

In order to assess whether the amount of water pumped each day will significantly alter the water level of the lake, a methodology, based on Nantel (2006), was used. It consists of applying a drinking water and gross water vulnerability index based on the ratio between the inflows and the maximum daily pumping demand.

When the pumping fraction approaches the value of 1, the vulnerability on the intake increases and when the index is below a value of 1 the water withdrawal is greater than the inflow. If this situation occurs, a water balance will be performed to analyze the hydrological conditions during this period and observe if the lake is able to support the water demand. The equation below presents the terms generally found in a lake water balance:

$$Q + P = Q' + I + E \pm \Delta V$$

Where :
Q = Runoff including subsurface inputs;
P = Precipitation at the surface of the lake;
Q' = Loss to outflowing stream;
I = Infiltration loss (neglected in this case)
E = Evapotranspiration from the lake surface;
ΔV = Variation in volume.

The following sections of the methodology identify the climatic and hydrological variables required to calculate the lake water balance. They also identify the different assumptions used to calculate the summer and winter water balance.

In terms of the climate variables considered, the climatology of the study site is harsh, based on analysis of weather data from Camp Belanger where average temperatures are above 0°C only about five months of the year. In 2018, only four months had average temperatures above 0°C (Figure 7-2).

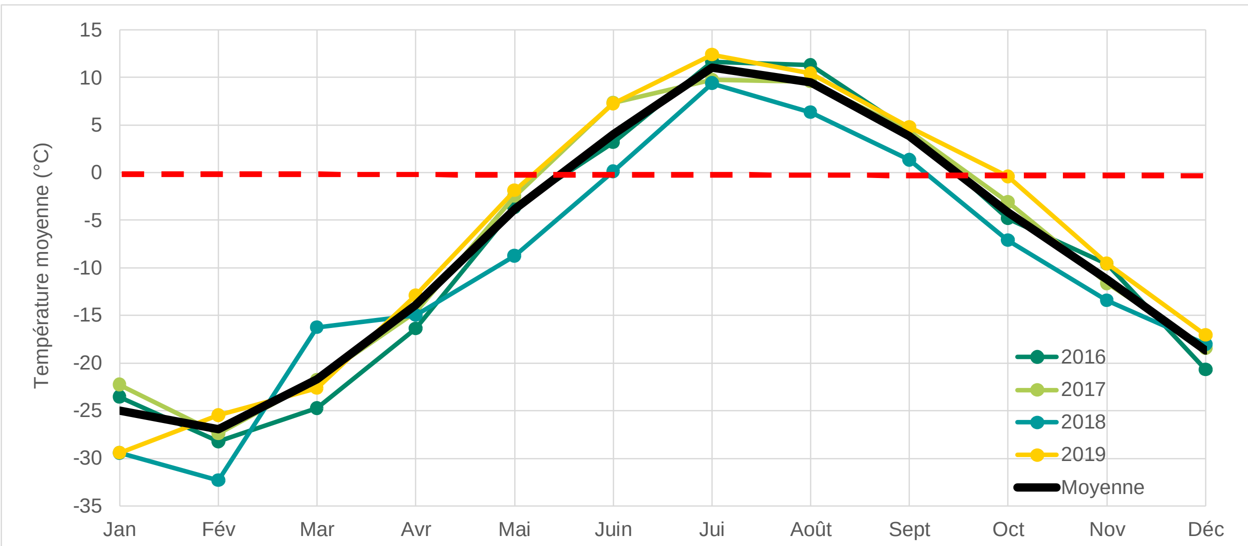


Figure 7-2 : Average temperature recorded at the Camp Bélanger station

Total precipitation is approximately 520 mm per year, 50% of which falls as snow according to Renaud and Plourde (2007). Annual evapotranspiration is 100 mm per year condensed between the months of April and September when daylight hours exceed 12 hours.

The maximum vertical extent of the winter ice cover was estimated to be 2 m in the Bombardier Lake study. The vertical ice accretion of the lake ice cover was confirmed using Stefan's law as illustrated in the following equation:

$$h_i = k * Df^{0.5}$$

Where:

h_i = Thickness of ice cover;

k = The value of k is a constant that illustrates the exposure and insolation conditions of the surface. The constant was set at 2.4 which is the value for lakes with a light snow cover;

Df = Degree days below freesing.

Ice cover modeling for the year 2018, which was the coldest year among the years measured at Camp Belanger with 4,268 degree days below freezing, gives an ice thickness of 1.76 m. The assumption of 2 m of ice that was used at Bombardier Lake therefore seems to be an acceptable assumption to use for winter water balance modeling. Furthermore, this assumption is conservative in the context of climate change since it reduces the amount of water available under the ice cover.

For the hydrological variables, flow data is required to determine the water supply of the selected lake. The proposed approach uses flows that were calculated by Renaud and Plourde (2007). An analysis was performed to update the flows calculated in 2007, but no new hydrometric stations were found in the vicinity with small watersheds gauged by the Quebec government over a period of at least 10 years. For example, Renaud and Plourde's (2007) flow calculations used the Highfall Creek hydrometric station (#103501; MELCCFP, 2022d), in operation from 1963 to 1972. The watershed area of this stream is 736 km^2 and the mean discharge is 11 m3/s. This watercourse is a tributary of the Koksoak River, which empties into Ungava Bay near the village of Kuujjuaq.

Although these flows were calculated at a station located 500 km from the study area in the 1970s, the data were corrected locally by Renaud and Plourde (2007), which increases the confidence of the calculated flows. In their methodologies, several summertime correction factors were applied using about 20 gages. A correction factor was developed for watersheds larger than 100 km^2, while another factor was applied for watersheds smaller than 30 km^2.

Table 7-11 shows the calculated flows for the summer mean as well as for the annual and summer low flows. The calculated unit flows for stream Q^2 (small watershed <30 km^2) are greater than those for Q^1 (large watershed >100 km^2). Stream Q^2, which was used as a reference, has no lake that could be used to regulate flows, but is quite steep. The watershed of the study lake has 23% of its total area covered by lakes (see Map 5-7 in Section 5.2.6.3). Thus, observed flows in the basin are likely to be less than those transferred from Q^2. For these reasons, it was determined to use the water transfers from Q^1, which will provide more conservative estimates of water inflows. For the winter period, Renaud and Plourde (2007) assume that most small streams are frozen to the bottom of the bed. This assumption is retained as it will provide the most conservative estimates for winter water availability and that the streams flowing into the lake are all characterized as intermittent, as are the outflowing streams.

Table 7-11: Flows considered for the water withdrawal study

Variables	Q^1 per unit (l/s/ha)	Q^2 per unit (l/s/ha)	Q^1 Lake water (l/s)	Q^2 Lake water (l/s)
Q_{moy} Summer	0,17	0,31	158,61	289,23
$Q_{2,7}$ Summer	0,014	0,038	13,06	35,45
$Q_{10,7}$ Summer	0,005	0,014	4,67	13,06
$Q_{5,30}$ Summer	0,008	0,024	7,46	22,39
$Q_{2,7}$ Annual	0,001	0,003	0,93	2,80
$Q_{10,7}$ Annual	0,0005	0,001	0,47	0,93
$Q_{5,30}$ Annual	0,0006	0,002	0,56	1,87
Q_{moy} Summer	0,17	0,31	158,61	289,23

Q^1 : Flow calculation for watersheds >100 km^2
Q^2 : Flow calculation for watersheds <30 km^2

Summer water balance in Lake No.4 in the operation phase

For the calculation of the summer water balance, the fraction of water withdrawal was calculated from the average water inflow and the inflow during severe low water conditions. During the summer season, the average water inflow is 36.60 times greater than the water withdrawal. During average low water levels (variable Q2.7), the inflow is 3.01 times greater than the outflow, while during severe low water levels (variable Q10.7), the inflow is 1.08 times greater than the outflow. Evapotranspiration during the summer period was estimated at 100 mm, and would subtract 133 megalitres, or 1.16% of the lake volume. Evapotranspiration would remove 5.67% of the average inflow during the summer period. In all situations, there is still more than enough water to supply the lake during pumping.

In addition, in order to reduce the impact on the water level of Lake No.4, four water bodies located near the Ivakkak-Delta road (see Map 5-5 in Chapter 5.2.1) may be used for watering this road in summer, as long as the withdrawals comply with the *Règlement sur les habitats fauniques* of the LCMVF. It is also expected that these withdrawals will be less than 75 m^3/day.

Winter water balance in Lake No.4 in the operation phase

During the winter period, the flow in the tributaries and the outfall will be zero. The vulnerability on water inflow becomes high while the ratio between inflow and pumping becomes nil. Furthermore, the lake is left to itself during this period. Little data exists to quantify what is happening under the ice. The most conservative assumption was adopted, which was to isolate the lake for a period of eight months.

A simple water balance was performed under the assumption that lake volume variations are solely related to lake pumping. The lake volume was calculated by subtracting 2 m of ice. The initial lake volume available for drinking water in winter is estimated at 8,804 megalitres. The water withdrawal during the eight-month winter period corresponds to 53.86 megalitres. Thus, the winter water withdrawal corresponds to 0.61% of the lake's water volume.

Conclusion on the water balance in Lake No.4

Pumping water poses no constraints for the lake selected for the summer season and the winter period. The winter period was deemed to be the most critical for water supply. A water balance performed with very conservative assumptions showed that winter water withdrawal represents only 0.61% of the available winter volume. The impact on the lake level at the end of the winter period would be approximately 4 cm. This loss will be filled very quickly during the following spring freshet.

In the event of additional water needs, the maximum winter drawdown could reach 540 m³/day over eight months (currently projected at 220 m³/day), representing an additional 145% drawdown and a 10 cm drop in the water level. For the summer period, the pumping is currently 3 times higher than Q2.7 and 1.08 times higher than Q10.7. In order to remain conservative (using Q5.30 flows), the summer lake level should not vary by more than 5 cm, in case the lake cannot return to its initial level in the fall. The maximum summer drawdown would therefore be 2230 m³/day, whereas this was simulated at 375 m³/day for the current water needs, which is 500% higher than the scenario of the present study. Also, by applying a contingency that doubles the need and includes the scenario where water is withdrawn from other lakes in the sector for dust suppression, the total maximum withdrawal would be 1,050 m³/day, which is below the maximum withdrawal established at 2,230 m³/day. The lake is therefore able to support increased needs compared to the initial scenario. However, before additional water is withdrawn for mine operations, the water quality of the main collection pond will be characterized. This will allow the identification of possible uses at the site in order to reduce the amount of fresh water to be withdrawn from the lake.

7.2.3.2.2 Surface water drainage

As mentioned in Section 7.2.3.1, contact water runoff from the Delta Mine site must be collected and directed to the MCP for treatment prior to discharge to the environment. This water will be diverted from the lakes to which it is directed, as it will flow through the mine site.

The impact of construction and operation on the residual water level of the lakes cannot currently be established as the detailed bathymetry of the affected water bodies is not known. Additional information will be provided in 2023 by conducting bathymetric surveys and a complete water balance will then be established. This will make it possible to specify the impacts on the water regime of the affected lakes. If a significant impact is identified on the water level of the lake, i.e. if the change in water level limits or prevents fish from completing their life cycle, then additional mitigation measures will be put in place to reduce the impact of the drainage modification on the site.

Given the considerable thickness of continuous permafrost under the Delta site (over 300 m at a minimum), there will be no impact on groundwater as a result of changes to site drainage, and the contact water collection system will be designed to direct all contact water to the MCP to prevent contamination of the surrounding natural waters.

7.2.3.2.3 Mining and sanitary effluents

The satellite camp at the Delta site will require the use of potable water for day-to-day needs (showers, meals, bathrooms, etc.) and therefore the installation of a domestic wastewater treatment plant. Also, as indicated above, drainage from the mine site will gravitate to the LCP or MCP. Subsequently, the MCP water will be directed to the mobile treatment plant. All sanitary and mine water will then be discharged to the natural environment after treatment and will therefore increase the flow of the receiving stream. As indicated in section 5.2.6, sanitary waters will be discharged into the receiving environment every day through a discharge pipe, whereas for mining waters, the discharge period is limited to the summer season, i.e., a maximum of approximately 110 days of discharge.

The dilution calculations based on the flow of the receiving environment (Table 7-12) are presented for the sanitary effluent (see Table 7-13), the mining effluent (Table 7-14) and the combination of the two effluents (situation present only during the summer period; see Table 7-14). The results indicate that the greatest impact will occur in the summer during periods of severe low flow (Q10.7), when the combined flow will add a maximum of 0.084 m^3/s to the calculated flow of 0.27 m^3/s in the Petite rivière de Puvirnituq. This addition represents a 31% local increase in flow during the period of lowest river flow. However, at the peak of the summer flow (Qmean), this new water supply represents an increase of only 0.91%. The water input for the sanitary effluent alone is also very small (0.0006 m^3/s) compared to the winter river flows (between 0.027 and 0.054 m^3/s), representing an increase of only 1 to 2% of the winter flow. These additional water inflows may reduce some of the effects of severe summer low flow locally by raising the water level slightly. However, the changes will be minor considering the low flow rates of the effluents versus the one present in the receiving environment (Petite rivière de Puvirnituq).

Table 7-12: Flows assessed in the Petite rivière de Puvirnituq (receiving environment)

Watercourse	Location	Drained area (km^2)	Summer flow (m^3/s)				Winter flow (m^3/s)		
			Q_{moy}	$Q_{2,7}$	$Q_{10,7}$	$Q_{5,30}$	$Q_{2,7}$	$Q_{10,7}$	$Q_{5,30}$
Petite rivière de Puvirnituq	Downstream of tributary CE-D13	543,01	9,23	0,76	0,27	0,43	0,054	0,027	0,033

Table 7-13: Dilution factor of the sanitary effluent

Watercourse	Location	Summer dilution (sanitary effluent flow at 2.03 m^3/h) [A]				Winter dilution (sanitary effluent flow at 2.03 m^3/h) [A]		
		Q_{moy}	$Q_{2,7}$	$Q_{10,7}$	$Q_{5,30}$	$Q_{2,7}$	$Q_{10,7}$	$Q_{5,30}$
Petite rivière de Puvirnituq	Downstream of tributary CE-D13	0,00006	0,0007	0,0021	0,0013	0,010	0,021	0,017

[A] The flow rate is 0.0006 m^3/s. The dilution factor is the effluent flow rate relative to the stream flow.

Table 7-14: Summer dilution factor of combined mining and sanitary effluents

Watercourse	Location	Dilution of the mining effluent (variation between 180 m^3/h and 300 m^3/h)[A]				Dilution of mining effluent + sanitary effluent (variation between 182.03 m^3/h and 302.03 m^3/h)[B]			
		Q_{moy} Summer	$Q_{2,7}$	$Q_{10,7}$	$Q_{5,30}$	Q_{Moy} Summer	$Q_{2,7}$	$Q_{10,7}$	$Q_{5,30}$
Petite Rivière de Puvirnituq	Downstream of the tributary CE-D13	0,005 / 0,009	0,07 / 0,11	0,184 / 0,31	0,11 / 0,19	0,006/ 0,009	0,07/ 0,11	0,189/ 0,311	0,119/ 0,195

[A] The flows correspond to 0.05 m^3/s and 0.08 m^3/s. The dilution factor is the effluent flow rate relative to the stream flow.
[B] The flows correspond to 0.051 m^3/s and 0.084 m^3/s. The dilution factor is the effluent flow in relation to the stream flow.

7.2.3.2.4 Presence of Culverts and Other Water Crossings

As mentioned during construction, the presence of roads, culverts and other water crossings can cause erosion and sediment transport in watercourses, thus impacting their sediment regime. With the exception of the watercourse crossing on the road leading to Lake No.4 (which could impact 800 m² of the watercourse), the five other crossings on permanent watercourses are small (less than 2 m) and located on gentle slopes. Thus, these five other crossings could impact the watercourses over an area of approximately 200 m². In all cases, flow velocities are low (<0.1 m/s) and the risk of increased erosion and sediment transport is considered low. Impacts will therefore be minor on the sediment regime in the study area.

7.2.3.2.5 Conclusion for the Operation Phase

In the absence of mitigation measures, all of these impacts are considered moderate given the modifications of the flow patterns and the presence of two effluents, the local extent and the average duration, which leads to a moderate impact significance.

7.2.3.3 Closure and Restoration Phases

For the closure and restoration phases, the dismantling of the infrastructures and the re-profiling of the site will allow the runoff to once again reach lakes No.1, No.2 and No.3. The backfilling of the collection ditches and the restoration of the LCP and MCP will only be carried out after the environmental monitoring that will be included in the restoration plan indicating that the water quality meets the criteria of Directive 019. As indicated in section 5.2.11, the plan is to remove the sediment from the ponds and dispose of it in a suitable location (such as one of the PAG waste rock piles at the NNiP) and to make two breaches in the MCP retention dike to allow water flow. It is possible that the maintenance of the dike, despite the presence of these two openings, could continue to impact Lakes No.2 and No.3 due to the change in water regime (impoundment). If this is the case, the openings will be adjusted accordingly to eliminate the residual effects. Lake No. 1 will regain its original drainage, considering that the road preventing the drainage of water towards this lake will also be removed.

It should be noted that the rapid re-establishment of the water regime of lakes No.1, No.2 and No.3 will be considered a priority during the development of the restoration plan that will be submitted for approval to the MRNF.

No change in the sediment regime is expected during these two phases. On the one hand, there are no plans to remove the stream crossings in the perspective that the road will be offered to the communities. On the other hand, the sediments will have been removed from the MCP and LCP and will therefore not contaminate the surrounding lakes.

Finally, the effluent will be removed from the Petite rivière de Puvirnituq, which will reduce the flow to this watercourse.

The closure and restoration phase is considered to have a strong magnitude due to the re-establishment of lake drainage, the local extent and the short duration. The impact significance is then rated as moderate, but **positive.**

7.2.3.4 Mitigation Measures

Since the impact is considered moderate in significance, mitigation measures will be implemented to limit the magnitude, extent and duration of the impact (Table 7-15). The table presents the mitigation measures set out in Annex 7 of the Nunavik Nickel Agreement, applicable to the present project, as well as the new mitigation measures proposed.

In order to reduce the risk of sediment transport to adjacent streams and water bodies and thereby alter the sediment regime, Measures RHS1, RHS2a, RHS4, RHS6, RHS8, RHS9, RHS10 and RHS13 will be implemented. Measures RHS2a and RHS11 are intended to minimize effects on drainage and adjacent stream regime. Measure RHS15 will quantify the extent to which the water regime of the three lakes surrounding the Delta site is altered. At the time of restoration, breaches will be made in the dike in the MCP (RHS16).

Table 7-15: Mitigation Measures to Minimize Impacts on the Hydraulic and Sedimentary Regime

Nº [A]	Mitigation measures
RHS1	Install culverts during the summer low flow period (July to September).
RHS2a	Interrupt drainage ditches 10 m from the natural high-water mark when watercourses or bodies of water are present nearby.
RHS4	A geomembrane will be installed downstream of crossings and around work areas in order to catch particles that are stirred up.
RHS4a	Prevent the transport of fine particles during construction by installing sediment barriers at the edge of aquatic environments
RHS6	Road banks at stream crossings shall be covered with a geomembrane and riprap.
RHS8	Stones removed during grading earthwork shall be reused to stabilize banks and hollows.
RHS9	Resuspension of material shall be minimized when adding or removing material in water.
RHS10	Earth removed and fill shall be stored outside the buffer strip.
RHS11	Culverts shall be large enough to not significantly reduce the flow cross-section at stream crossings.
RHS13	During earthwork on steep slopes, the bottom of ditches shall be progressively stabilized with a cover of well-drained granular material and riprap.
RHS15	The results of the detailed bathymetric survey of Lakes No. 1, No. 2 and No. 3 and the water balance will determine if additional mitigation measures need to be applied to preserve water levels for these lake environments.
RHS16	Breaching the MCP dike during its restoration.

[A] The number of the mitigation measures refers to Annex 7 established by the Nunavik Nickel Committee (see Appendix B).

Note : A gray background indicates the new mitigation measures presented in the Phase 2a impact study and A yellow background indicates mitigation measures specific to Phase 2b.

7.2.3.5 Residual Impact Significance

The implementation of mitigation measures reduces the magnitude, extent, and duration of the impact (Table 7-16). The significance of the residual impact thus becomes minor with the mitigation measures during construction and operation. However, during the closure and reclamation phase, the magnitude of the impact will be strong, as the hydrologic regime of the site will be restored, the extent will be local, and the duration will be short, resulting in a **positive** moderate residual impact significance.

Table 7-16: Description of the Project's Residual Impact on the Water and Sediment Regime

Project phase	Impact description	Mitigation measures	Magnitude	Extent	Duration	Residual impact significance
Construction and operation	Modification of the surface water flow and hydraulic regime of the three lakes surrounding the Delta site.	RHS2a, 11 and 15	Moderate	Specific	Moderate	Minor
	Possible increase in erosion and sediment transport in streams (change in sedimentary regime)	RHS1, 4, 6, 8, 9, 10 and 13	Low	Specific	Short	Minor
Closure and Restoration	Restoration of the hydrological regime	RHS16	Strong	Local	Short	Moderate **(positive)**

7.2.4 Water and Sediment Quality

7.2.4.1 Construction Phase: Development of New Infrastructure and Related Projects

The study site is surrounded by several lakes and wetlands, while the road alignments to be constructed must pass over six permanent and three intermittent streams. Construction will require the stripping of wetlands, but not entirely. The construction phase may therefore affect these areas in different ways. However, the water quality of the lakes will not be directly affected by the construction work on the Delta site since a 60 m buffer zone will be respected.

Construction activities (excavation, stripping) on the site as well as the deposition of materials can increase suspended solids (TSS) in nearby aquatic environments. The transport of these particles by water erosion can also cause sedimentation in streams and lakes downstream. Work carried out during dry periods in the summer could also emit dust that could fall directly into the water environments in the vicinity of the work sites.

The use of explosives for road construction could pose a risk of dispersing ammonium nitrate during the loading of explosives and if not completely consumed during the explosion. Surface water generated by rainfall or snowmelt can carry this contaminant into water bodies and be deposited in sediments.

Finally, the increase in road transport and machinery traffic for all sites could modify the quality of water and sediments due to the increased risk of hydrocarbon contamination. These risks are present during the refuelling of vehicles and machinery, during breakdowns or road accidents that could occur near a watercourse, a water body or a hydraulically connected wetland.

In the absence of mitigation measures, all of these impacts have a moderate magnitude due to the moderate probability for hydrocarbon and ammonium nitrate contamination, local extent (potential to extend beyond the site due to contamination in water) and long duration (if no decontamination), leading to a major impact significance.

7.2.4.2 Operation Phase

As with the construction phase, increased road transport and machinery traffic for all sites could alter water and sediment quality due to the increased risk of hydrocarbon contamination.

In addition, the need for road maintenance will result in a possible increase in TSS in streams downstream of the crossing points. No increase in chloride is anticipated, as calcium chloride will not be used as a dust suppressant near water bodies, fresh water will be prioritized, and finally, de-icing is not generally applied in winter on the roads of the NNiP, except under dangerous or exceptional conditions (icy roads, bends or dangerous slopes). Inputs are therefore considered negligible for the receiving environment.

New quarries will be developed for the construction and operation phase of the Delta site. Two intermittent streams have been inventoried in Quarry No. 2. However, these streams are not associated with any permanent water body or fish habitat. Therefore, the water quality that may be altered does not affect any aquatic biota.

7.2.4.2.1 Presence of Mining and sanitary effluents

Sanitary effluents and wastewater will be collected and directed to a treatment plant (DWTP) located in the satellite camp area. Mine water will be collected and ultimately directed to the MCP via the collection ditches and the LCP, then treated at the mobile plant (WTP), located near the MCP. These two effluents will be directed in two separate pipes, parallel along part of their route, to a common discharge point in the Petite Rivière de Puvirnituq (Map 7-2). The treated domestic wastewater will be discharged continuously, 365 days a year, while the mining water will be discharged over a maximum of about 110 days during the summer, which is limited by the season’s short duration.

The production of sanitary effluents will be proportional to the consumption of drinking water. Considering that the drinking water needs are estimated at 0.325 m³/pers/day and that the drinking water plant will have a capacity of 50 m³/day, it is expected that the DWTP will have a similar capacity, resulting in maximum average effluents of 2.1 m³/h. The dilution capacity of the receiving environment was calculated and presented in Tables 7-13 and 7-14 (see Section 7.2.3.2.3) based on the assessed flows in the Petite rivière de Puvirnituq (Table 7-12).

The dilution capacity of the river is therefore important for the sanitation effluents, whether being considered in summer flow or severe winter flow conditions (Q10.7) with a dilution factor of 0.0021 and 0.021 respectively. It should be noted that the treatment technology selected is a Moving bed biofilm reactor (RGBS), which is a technology included in the MELCCFP's *Guide pour l'étude des technologies conventionnelles de traitement des eaux usées d'origine domestique* (2022e) and that the treatment process will include pretreatment, primary and secondary treatment, as well as disinfection using a UV reactor. The technology used will aim to meet the standards for a very small facility indicated in Table 30 of the *Guide pour l'établissement des normes de rejet d'une installation de traitement des eaux usées d'origine domestique* (MELCC, 2020). Therefore, no impact is anticipated in terms of enrichment of the receiving environment due to the dilution capacity of the Petite rivière de Puvirnituq. In addition, measures at the satellite camp will aim to limit phosphate inputs into the water to be treated.

The treatment capacity and discharge rate for the mine effluent will vary between 180 and 300 m³/h; these rates will be determined more precisely following the detailed design report for the MCP. Considering the characteristics of the waste rock from the Delta site, it is anticipated that the characteristics of the water to be treated will be similar to those of the other NNiP sites and that these characteristics could be variable over time depending on the different inputs to the LCP (quantities of waste rock and ore stored, input from the LCP, etc.). The selected treatment process will meet the effluent discharge requirements of Directive 019 and will be representative of the Environmental Discharge Objectives (OERs) in effect at the other NNiP sites. This process is described in section 5.2.6.1 and consists essentially of a physical-chemical treatment using coagulation, flocculation and ballasted settling with microsand (Actiflo). The firm Veolia, designer and supplier of the treatment process, conducted laboratory tests with water from the Mesamax and Méquillon collection basins, thus providing an overview of the expected performance. Depending on the characteristics of the raw water, the tests show levels between 0.0062 mg/L and 0.012 mg/L for copper (97 and 99% removal) and between 0.083 and 0.117 mg/L for nickel (98 and >99% removal). The final version of the Veolia technical report is being edited and will be submitted to the MELCCFP as part of the applications for regional ministerial authorizations.

Simulations of the maximum expected concentrations in the receiving environment were performed using the following mass balance equation, with the C_m value representing the desired value:

$$Q_eC_e + Q_rC_r = (Q_e+Q_r)C_m$$

Where:
Qe = final effluent flow rate;
C_e = concentration of a contaminant in the final effluent;
Q_r = flow in the river;
C_r = natural concentration of a contaminant in the river;
C_m = concentration of the contaminant obtained following the perfect mixing of the effluent and the river water.

Four scenarios are presented in the tables below (Table 7-17 through 7-20). These four scenarios are conservative and assume a discharge with the limits of the monthly average concentrations allowed in Directive 019 and a discharge with similar levels to the Mesamax WTP effluent in 2021. The effluent from the Méquillon WTP had similar concentrations, so an additional simulation with these values was not performed.

Table 7-17 : Estimated concentrations in the receiving environment for an effluent flow of 180 m³/h (0.05 m³/s) based on the average monthly values authorized by Directive 019

Parameters	Natural environment before discharge (mg/L)	Mine effluent (mg/L)	Maximum expected river concentrations (mg/L)				CVAA (mg/L)	CVAC (mg/L)
	Average of the stations in the Petite rivière de Puvirnituq (n between 4 & 6)	Assuming similar levels at the limits of the D019	Summer	Average low-water period	Low-water period	Severe low-water period		
			Average flow (9,23 m³/s)	Q2,7 0,76 m³/s)	Q5,30 (0,43 m³/s)	Q10,7 (0,27 m³/s)		
TSS	1,25	15	1,25	1,3	2,1	2,7	25	5
Arsenic	0,0005	0,2	0,0005	0,0016	0,0128	0,0213	0,3400	0,1500
Copper	0,00019	0,3	0,00019	0,0018	**0,0187**	**0,0314**	0,0021	0,0016
Iron	0,17	3	0,17	0,2	0,3	0,5	3,4	1,3
Nickel	0,003	0,5	0,003	0,0057	0,0337	0,0548	0,0804	0,0089
Lead	0,00025	0,2	0,00025	0,00133	**0,01258**	**0,02106**	0,00653	0,00026
Zinc	0,00225	0,5	0,00225	0,00493	0,03298	**0,05410**	0,03375	0,01385

Note : A gray background indicates an exceedance of CVACs and a **bold and underlined number** indicates an exceedance of the CVAA (except for the tributary representing the Directive 019 limits since the exceedance is implied).

Table 7-18: Estimated concentrations in the receiving environment for an effluent flow of 180 m³/h (0.05 m³/s) based on monthly average values obtained at the Mesamax effluent in 2021

Parameters	Natural environment before discharge (mg/L)	Mine effluent (mg/L)	Maximum expected river concentrations (mg/L)				CVAA (mg/L)	CVAC (mg/L)
	Average of the stations in the Petite rivière de Puvirnituq (n between 4 & 6)	Assuming similar levels to Mesamax effluent	Summer	Average low-water period	Low-water period	Severe low-water period		
			Average flow (9,23 m³/s)	Q2,7 0,76 m³/s)	Q5,30 (0,43 m³/s)	Q10,7 (0,27 m³/s)		
TSS	1,25	3,6	1,3	1,4	1,5	1,6	25	5
Arsenic	0,0005	0,0005	0,0005	0,0005	0,0005	0,0005	0,3400	0,1500
Copper	0,00019	**0,038**	0,0004	**0,0025**	**0,0041**	**0,0061**	0,0021	0,0016
Iron	0,17	0,28	0,2	0,2	0,2	0,2	3,4	1,3
Nickel	0,003	**0,246**	0,0043	0,0180	0,0283	0,0410	0,0804	0,0089
Lead	0,00025	0,00025	0,00025	0,00025	0,00025	0,00025	0,00653	0,00026
Zinc	0,00225	0,009	0,00229	0,00267	0,00295	0,00330	0,03375	0,01385

Note: A gray background indicates an exceedance of CVACs and a **bold and underlined number** indicates an exceedance of the CVAA.

Table 7-19: Estimated concentrations in the receiving environment for an effluent flow of 300 m³/h (0.08 m^3/s) based on the average monthly values authorized by Directive 019

Parameters	Natural environment before discharge (mg/L)	Mine effluent (mg/L)	Maximum expected river concentrations (mg/L)				CVAA (mg/L)	CVAC (mg/L)
	Average of the stations in the Petite rivière de Puvirnituq (n between 4 & 6)	Assuming similar levels at the limits of the D019	Summer	Average low-water period	Low-water period	Severe low-water period		
			Average flow (9,23 m^3/s)	Q2,7 0,76 m^3/s)	Q5,30 (0,43 m^3/s)	Q10,7 (0,27 m^3/s)		
TSS	1,25	15	1,4	2,6	3,4	4,4	25	5
Arsenic	0,0005	0,2	0,0022	0,0195	0,0318	0,0461	0,3400	0,1500
Copper	0,00019	0,3	**0,0028**	**0,0287**	**0,0472**	**0,0687**	0,0021	0,0016
Iron	0,17	3	0,2	0,4	0,6	0,8	3,4	1,3
Nickel	0,003	0,5	0,0073	0,0503	**0,0810**	**0,1166**	0,0804	0,0089
Lead	0,00025	0,2	0,00197	**0,01927**	**0,03158**	**0,04591**	0,00653	0,00026
Zinc	0,00225	0,5	0,00653	**0,04965**	**0,08033**	**0,11602**	0,03375	0,01385

Note: A gray background indicates an exceedance of CVACs and a **bold and underlined number** indicates an exceedance of the CVAA (except for the tributary representing the Directive 019 limits since the exceedance is implied).

Table 7-20: Estimated concentrations in the receiving environment for an effluent flow of 300 m³/h based on monthly average values obtained at the Mesamax effluent in 2021

Parameters	Natural environment before discharge (mg/L)	Mine effluent (mg/L)	Maximum expected river concentrations (mg/L)				CVAA (mg/L)	CVAC (mg/L)
	Average of the stations in the Petite rivière de Puvirnituq (n between 4 & 6)	Assuming similar levels to Mesamax effluent	Summer	Average low-water period	Low-water period	Severe low-water period		
			Average flow (9,23 m^3/s)	Q2,7 0,76 m^3/s)	Q5,30 (0,43 m^3/s)	Q10,7 (0,27 m^3/s)		
TSS	1,25	3,6	1,3	1,5	1,6	1,8	25	5
Arsenic	0,0005	0,0005	0,0005	0,0005	0,0005	0,0005	0,3400	0,1500
Copper	0,00019	**0,038**	0,0005	**0,0038**	**0,0061**	**0,0088**	0,0021	0,0016
Iron	0,17	0,28	0,2	0,2	0,2	0,2	3,4	1,3
Nickel	0,003	**0,246**	0,0051	0,0261	0,0411	0,0585	0,0804	0,0089
Lead	0,00025	0,00025	0,00025	0,00025	0,00025	0,00025	0,00653	0,00026
Zinc	0,00225	0,009	0,00231	0,00289	0,00331	0,00379	0,03375	0,01385

Note: A gray background indicates an exceedance of CVACs and a **bold and underlined number** indicates an exceedance of the CVAA.

This shows that:

- The effluent, diluted with the mean flow of the Petite rivière de Puvirnituq, leads to an exceedance of the CVAC or CVAA for copper only (and of the CVAA for only one of the scenarios). However, the river already has a baseline value, in the absence of mine discharge, exceeding the CVAC for copper.
- A representative effluent from the Mesamax WTP, at a maximum flow rate of 300 m^3/h, would exceed the CVAA only for copper during baseflow periods.
- Exceedances of the CVAC, during low-flow periods, are expected for copper and nickel.

It is important to note, however, that these exceedances are localized at the discharge site itself and that due to the dilution factor, the values are expected to be lower a few hundred meters further away. A more precise evaluation of plume diffusion will be carried out by taking measurements in the summer of 2023. However, more refined modeling will only be possible during the discharge period because of the atypical configuration of the river in the downstream sector of the discharge.

In addition, a higher performance is expected at the WTP Delta, notably by the higher efficiency of the chosen technology (ballasted settling rather than sludge recirculation settling).

Also, as mentioned in Chapter 5.1.6, at this stage of the design, it is anticipated that a volume of approximately 230,000 m^3/year will need to be treated, based on the sum of the projected capacities of the MCP and the LCP. This volume, with a discharge rate of 180 m^3/h, will require 54 days of continuous treatment. The expected concentrations in the receiving environment for a 300 m^3/h flow are presented for contingency purposes. A discharge rate of 300 m^3/h will not result in a proportional increase in the annual contaminant load (kg of Ni and kg of Cu per year). Such treatment flexibility also opens the possibility of limiting the number of days of severe low water discharge.

The concentration of nitrogen compounds (NH3, $NO3^-$, $NO2^-$) in the mine effluent cannot be assessed at this time. On the one hand, the selected treatment process is not designed to remove it from the influent, so the effluent will have similar values to the influent for these compounds. On the other hand, the management of explosives at the Delta Site, which are a significant source of these compounds, will benefit from the continuous improvement efforts made by CRI in recent years. Therefore, it is possible that the Delta WTP influent will have lower levels of nitrogen compounds than other WTPs in the NNiP.

In conclusion, the mine discharge could affect the receiving environment over a few hundred meters, with respect to the total concentration of dissolved metals and an enrichment in nitrogenous compounds.

7.2.4.2.2 Surface water drainage and runoff to adjacent water bodies

The mining operations at the Delta site pose a risk of hydrocarbon contamination of water and sediments, as documented for the construction phase due to vehicle traffic on the roads.

Also, surface water draining from the site could be laden with PAG mineral-bearing particles, NAG particles and other particles from roads, access roads and areas of reworked soil. Surface runoff consists primarily of rain and meltwater that will run off the mine site, particularly on the temporary waste rock and ore stockpiles. This water will be captured by a network of collection ditches and directed to the LCP and/or MCP for treatment before being discharged to the receiving environment. It should be noted that it is estimated that the production of mine water from the underground mines will be negligible since the mines will not be heated. If water were to be pumped, it would be directed to the MCP and treated with the drainage water. The water quality of the water bodies adjacent to the site will not be affected by drainage due to the presence of collection ditches. In addition, several mitigation measures will be put in place to manage the risk associated with hydrocarbon spills during the handling of these products.

The potential for the presence of taliks and the associated risks and impacts, if any, will be assessed based on the analysis of data collected by thermistors, which are scheduled to be installed in 2023. Should adaptations be required to prevent potential groundwater contamination, these will be submitted to the MELCCFP prior to implementation.

7.2.4.2.3 Conclusion for the Operation Phase

Collectively, these impacts have a strong magnitude (high probability of occurrence and potential to exceed the CVAC and CVAA criteria), local in scope (affecting several components) and of moderate duration. The impact significance would therefore be major without mitigation measures.

7.2.4.3 Closure and Restoration Phase

During site closure and restoration phase, activities that may affect water and sediment quality are the same as those identified during construction with respect to the use of vehicles on roads and machinery at sites.

Without mitigation measures, the impact is considered moderate in magnitude (high probability of occurrence), local in extent and moderate in duration, leading to a moderate impact significance.

7.2.4.4 Mitigation Measures

The mitigation measures set out in Annex 7 of the Nunavik Nickel Agreement, applicable to the present project, as well as the proposed new mitigation measures are presented in Table 7-21. The other proposed mitigation measures are aimed at the overall protection of water quality for runoff, water bodies, watercourses and wetlands.

Table 7-21: Mitigation Measures to Reduce the Impacts on Water and Sediment Quality

Nº A	Mitigation Measures
QES2a	Carry out inspections to ensure that the temporary hydrocarbon storage tanks are in good condition.
QES2b	Conduct inspections to ensure the proper condition of land and water-based machinery at the Lake No.4 water withdrawal facility.
QES3	Any machinery that must cross a stream outside the winter period shall be inspected and cleaned.
QES4	Heavy machinery will only be used within the road right-of-way and borrow pit access roads.
QES5	Excavated material will be disposed of in a way that minimizes the spread of suspended solids.
QES6	Stones removed during grading earthwork will be reused to stabilize banks and hollows.
QES7	Interrupt the drainage ditches of the proposed roadway a few meters above the natural high-water mark of the traversed watercourses.
QES8	Machinery parking, washing and maintenance areas shall be at least 60 m from any watercourse, and machinery shall be refuelled under constant supervision at least 30 m from any watercourse.
QES9	Install culverts during the summer low flow period (July to September).
QES16	Install a geomembrane downstream of crossing points and around work areas to intercept suspended particles.
QES17	Road banks at stream crossing will be covered with a geomembrane and riprap.
QES18	A turbidity curtain will be installed in the water if granular material is taken less than 75 m from a lake.
QES19	The top of mine tailings and waste rock piles shall be kept at a 1% to 3% gradient to minimize infiltration.
QES21	Solids will be removed from domestic sewage using a mobile biodisc treatment unit and the waste water will be disinfected using ultraviolet treatment.
QES22	Temporary ore storage sites would rest on a compacted gravel base surrounded by a collecting ditch to channel drainage water to the sedimentation pond, from which it shall be pumped into the process water tank.
QES23	The kitchen will be equipped with oil and grease traps.
QES24	Only phosphate-free soaps and detergents will be used.
QES25	Special care shall be taken to avoid spilling ammonium nitrate beside blast holes when loading them, an operation always done using equipment to inject the explosives directly into the blast holes.
QES26	Abrasives and de-icing chemicals will only be spread on dangerous locations or during ice-storms.

Table 7-21: Mitigation Measures to Reduce the Impacts on Water and Sediment Quality (continued)

N° A	Mitigation Measures
QES27	Fuel tanks will be surrounded by a berm high enough to contain a spill equal to the largest capacity tank plus 10%.
QES29	Geomembranes shall be placed beneath mine tailings cells, on dike walls and on the top of tailings and waste rock piles.
QES30	During earthwork on steep slopes, the bottom of ditches shall be progressively stabilized with a cover of well-drained granular material and riprap.
QES34	Apply the mitigation measures SOL1, SOL1a, SOL2, SOL2a and SOL3 to limit the risk of water and sediment contamination.
QES35a	Treat water in the Delta MCP using the mobile WTP prior to discharge to the Petite rivière de Puvirnituq.

A The mitigation measure number refers to Annex 7 established by the Nunavik Nickel Committee (see Appendix B).

Note : A grey background indicates a new mitigation measure since Annex 7 or a modification to an existing mitigation measure and a yellow background indicates mitigation measures specific to Phase 2b.

7.2.4.5 Residual Impact Significance

In order to reduce the risks associated with explosives use during construction and operation, efficient handling of explosives (QES25) will minimize the amount of ammonia entering the surface runoff. Capture of site runoff through the collection ditch system will minimize the amount of contaminants potentially released to the environment (QES7). Mitigation measures on air emissions will also reduce the amounts of particulate matter that may be deposited in the surrounding environment (QES34).

During the construction and operation phase, dust suppressants (fresh water or calcium chloride) will be used from June to September to limit dust emissions. The dust suppressants used will comply with the BNQ 410-300 standard or will be approved by the *Ministère des Transports et de la mobilité durable du Québec* (MTMDQ). The choice of dust suppressant will take into account the proximity of a wet or hydrous environment (AIR2a).

The Domestic Water Treatment Units (DWTP) and Mining Water Treatment Units (WTP) will be installed at the beginning of the construction phases to avoid any untreated water discharge to the environment. The effluent from the DWTP will respect the OERs (Environmental Discharge Objectives) that will have been established during its authorization process. Effluent from the WTP will comply with current regulations, in addition to working towards the OERs that have been established. The environmental monitoring reports of CRI's environmental monitoring program for the sanitation effluents (Monitoring 2) and the mining effluents (Monitoring 3) will be applied to the Delta Project, as well as the monitoring of the receiving watercourses of the mining effluents (Monitoring 4).

The mitigation measures put in place for the construction and operation phase with respect to TSS and hydrocarbons will be applied during the closure of the site (QES 2b, 3 à 9, 16, 17, 18, 27 et 30).

As a result, following the implementation of mitigation measures, the impact significance is now minor for all stages involving construction, operation, closure and restoration (see Table 7-22). The magnitude of the impact has changed from moderate or strong to low for all impacts due to a decrease in the likelihood of occurrence. The extent of the impact remains local, but the duration of the impact varies from short to moderate.

Table 7-22: Description of the Project's Residual Impact on Water and Sediment Quality

Project phase	Impact description	Mitigation measures	Magnitude	Extent	Duration	Residual impact significance
Construction	Potential for increased suspended solids in adjacent streams and watercourses.	QES5, 6, 7, 9, 16, 17, 18 et 30	Low	Local	Short	Minor
	Risk of dispersal of ammonium nitrate in water and sediments when loading explosives.	QES25	Low	Local	Short	Minor
Construction, operation, closure and restoration	Risk of water and sediment contamination by hydrocarbons during refueling or in the event of a breakage or accident along a watercourse or wetland.	QES 2b, 3, 4, 8, 27, 30 et 34	Low	Local	Moderate	Minor
Operation	Potential degradation of water quality through increased sedimentation downstream of mine drainage outlets and freshwater collection ditches.	QES5,19, 22, 26, 29	Low	Local	Short	Minor
	Potential degradation of water quality downstream of mine and sanitation effluents.	QES, 21, 23, 24, 35a	Low	Specific	Moderate	Minor

7.3 Impacts on the Biological Environment

7.3.1 Wetlands and Terrestrial Environments

7.3.1.1 Construction and Operation Phases

The construction phase for the new Delta site project, the Ivakkak-Delta Road and connected projects (satellite camp, northern landfill, three potential quarries and an access road to take freshwater) will lead to the loss of 110.60 ha of terrestrial environments 60.67 ha of wetlands (table 7-23). The area of wetlands actually impacted and indicated in ministerial authorisations will be added to the PEIIC.

Construction and operations will impact both terrestrial environments and wetlands as well as the vegetation found there. Impacted terrestrial environments are boulder fields, felsenmeers and polygonal ground with tundra ostioles. These environments are typical of the region and the vegetation is very sparse. In fact, the soil of the boulder fields and the felsenmeer is mainly composed of rock or boulders with a few terrestrial plants in the loose deposits between the boulders. For their part, polygonal ground with tundra ostioles is generally found in terrain characterized by fine or very fine granulometry caused by till deposits and a slightly uneven and very smooth topography located at moderate altitudes. The plant diversity found in polygonal tundra with mud circles is relatively high, but there is usually no clear dominance.

Wetlands impacted by the construction of the Delta site and connected projects are mainly composed of lowland polygonal fens and a few snowbed fens. The lowland fens generally have dense and fairly diverse vegetation. The Delta site contains a wetland in its south-central portion (97.11 ha); site infrastructure will for the most part be constructed in this environment. Another portion of the installations are planned along a felsenmeer in the north as well as in the eastern portion where boulder fields mix with lowland polygonal fens (Map 7-2). A total of 43.04 ha of wetlands will be encroached upon during construction of the Delta site. Three floral species at risk (species likely to be designated as threatened or vulnerable) were observed in the study zone at the Delta site, namely the sulphur buttercup, Cayouette's draba (one individual) and the Ellesmere Island draba (one individual). Since the two species of draba were observed outside the work zone, no impact is anticipated. As shown on Map 6-1, a colony of sulphur buttercup of 4.01 ha is located at the centre of the Delta site. This colony will be impacted by the construction of the waste rock pile and the MCP, which implies soil stripping. The colony has a mean density of 1.71 individuals/100 m^2. Photo 7-1 shows and area of this colony where density is high, around 5 specimens/m^2. Other specimens of sulphur buttercup were observed to the east and near lake No.1 to the west. The buttercups to the west will not be impacted since they are outside the work zone.

Photo 7-1: Colony of sulphur buttercup at the Delta site

The 16 km road between Ivakkak and Delta passes through all types of environments. The road is 16 m wide with a footprint of 22 m. Road construction will encroach on 4.99 ha of wetlands and 28.90 ha of terrestrial environments and will affect two individuals of sulphur buttercup (Map 7-3).

The road leading to the fresh water source from the satellite camp will also be 16 m wide with a footprint of 22 m. Its construction will impact 7.73 ha of lowland fens and 5.99 ha of terrestrial environments. An area of 0.68 ha (0.54 ha in wetlands and 0.14 ha in terrestrial environments) for the work pad near Lake No.4 is included in these totals.

The areas impacted by road construction include the twelve crossings that will facilitate the passage of caribou on both sides of the road.

The satellite camp site is located primarily on a lowland fen (4.58 ha), boulder field (3.76 ha) and polygonal ground with tundra ostioles (3.49 ha). A smaller portion is located on felsenmeer (2.27 ha). A specimen of sulphur buttercup was observed in the zone for the satellite camp and the road that will lead to the Delta site and can not be avoided (Map 7-3). This specimen will be destroyed.

The northern landfill (LEMN) will only impact terrestrial environments, namely on polygonal ground with tundra ostioles and felsenmeers (Map 7-3). A total of 2.64 ha of terrestrial environments will be encroached upon for the installation of the LEMN (Table 7-23).

Finally, three quarries are situated along the Ivakkak-Delta Road, or in its vicinity, near kilometers 7, 8 and 11. In total, 30.03 ha of terrestrial environments will be destroyed for the exploitation of these quarries, for the construction of an access road to quarry 1 (490 m long) and a 2.36 ha crushing pad (Table 7-23; Map 7-3). For the potential quarries, no wetlands will be affected during exploitation of the quarries, but 0.33 ha will be encroached upon for the access road to quarry 1 (Table 7-23).

Table 7-23: Surface Area of Terrestrial Environments and Wetlands affected by the Delta Project

Type of environment	Surface area lost (ha)							
	Delta site	Ivakkak-Delta Road	Delta Camp	LEMN	Road to Lake no. 4	Potential quarries (3)[A]	Helipad	Total
Terrestrial environments								
Boulder fields	9.74	14.91	3.76	0.33	2.57	10.78	0.09	42.09
Felsenmeer	22.21	4.94	2.27	1.19	1.95	3.78	-	36.34
Polygonal soil with tundra ostioles	1.57	9.05	3.49	1.12	1.47	15.47	-	32.17
Sub-total	**33.52**	**28.90**	**9.52**	**2.64**	**5.99**	**30.03**	**0.09**	**110.60**
Wetlands								
Lowland fens	43.04	4.59	11.08	-	7.73	0.33	-	60.27
Snowbed fens	-	0.40	-	-	-	-	-	0.14
Sub-total	**43.04**	**4.99**	**11.08**	**-**	**7.73**	**0.33**	**-**	**60.67**
Total	**76.56**	**33.89**	**27.56**	**2.64**	**13.72**	**30.36**	**0.09**	**171.41**

[A] The surface area of wetland impacted is not for exploitation of the quarries, but for the construction of an access road and a crushing pad only for quarry 1.

It should be noted that despite the presence of plant species of interest to the Inuit communities in the zones of soil stripping for construction and operations, no land use for plant harvesting was reported to CRI to this date. The impacted zones do not appear in the data provided by the Makivik Corporation (see Section 6.4.3) as harvesting sites. These species are not specific to the Delta site and are found elsewhere on the territory covered by the NNiP. The impact on this component is judged to be negligeable.

The terrestrial environments and wetlands around the work zone could be negatively impacted by dust deposition and/or contaminants emitted during differing work phases for construction and operations. Dust could reduce productivity in these environments since it could potentially modify certain phytological processes such as photosynthesis, flowering or pollen dissemination. Contamination risks by hydrocarbons are increased in terrestrial environments and wetlands because of an increase in traffic on the site and the storage of fuel.

Contrary to terrestrial environments that have variable specific diversity (low to high) accompanied by a low vegetation cover density, vegetation in wetlands is generally both dense and diverse. Wetlands plan an essential role in the proper functioning of ecosystems in which they are found. The main functions associated with wetlands are identified in Article 13.1 of the *Loi affirmant le caractère collectif des ressources en eau et favorisant une meilleure gouvernance de l'eau et des milieux associés* (RLRQ, c. C-6.2) and are described in more detail in Section 6.3.1.8 of the present document. A loss of the ecological function in wetlands will be observed following the destruction of 60.67 ha. Furthermore, wetlands in Nunavik are important for mammal, such as caribou, as well as birds and small mammals. The loss is however small at the scale of the NNiP's study area, evaluated at approximately 110 893 ha according to the initial impact assessment. The losses represent 0.05 % of the wetlands in the study zone for the NNiP.

All of the vegetated surfaces encroached upon during the construction phase will remain during operations (loss of 60,67 ha of wetlands and 110,60 ha of terrestrial environments). Given the important role of wetlands in the ecosystem, the magnitude of the impact is considered moderate (very small area lost compared to the unaffected territory), the extent site specific and the duration long. This impact's significance is therefore major without mitigation measures.

7.3.1.2 Closure and Restoration Phases

During closure and restoration, almost all of the site infrastructure will be removed (see section 7.4.5 for a visual simulation post-restoration). Restoration work will aim to restore similar topography and surface drainage to what was present before the project. Spreading of topsoil coming from wetlands rich in seeds, including those from the sulphur buttercup colony, could allow a faster revegetation of the site post-restoration.

The impact of closure and restoration has a moderate magnitude, a specific extent and a long duration, for a residual impact significance of moderate positive impact.

7.3.1.3 Mitigation Measures

The mitigation measures stated in Annexe 7 of the Nunavik Nickel Agreement applicable to the present project, as well as new mitigation measures are presented in Table 7-24.

These measures aim to limit the footprint of the construction work to a strict minimum, i.e., to the perimeter planned for the construction of the surface facilities (VEG1). Furthermore, species of draba at risk found in the study zone for the Delta site were excluded from the work site or their influence (VEG5; Map 7-2). In the case of the sulphur buttercup, the colony will be destroyed during construction of the waste rock pile and the collection basin. However, the surface layer of the soil (15 cm) where the colony is found will be conserved inside the study zone (Map 5-6), to be re-used during restoration (VEG6). It is expected that the soil will contain sulphur buttercup seeds allowing a recovery of the colony. A few specimens of sulphur buttercup will be preserved in the south portion of the Delta study zone and clearly identified to ensure their protection (VEG5).

Traffic throughout the project's operating life will be confined to the mine site work area (VEG2). Another measure aimed at limiting dust and the risk of habitat contamination by accidental spills will be implemented (VEG4). Lastly, since the loss of wetlands will not be preventable, financial compensation will be paid into the PEIIC fund, a program approved by the MELCCFP and intended for environmental improvement in Inuit communities.

Table 7-24: Mitigation Measures to Reduce the Impacts on Terrestrial Environments and Wetlands

Nº A	Mitigation Measures
VEG1	Machinery must not circulate outside work area boundaries (unless otherwise authorized).
VEG2	Habitats next to jobsites must be protected (particularly close to stream banks).
VEG3	Compensation for wetland areas lost through contributions to the PEIIC (Program for Environmental Improvement in Inuit Communities).
VEG4	Apply the mitigation measures AIR2a, AIR3, SOL1, SOL1a, SOL2, SOL2a, SOL3, and SOL14.
VEG5	Apply the fauna and flora protection plan.
VEG6	Conserve the topsoil from the sulphur buttercup colony to favour the recovery of vegetation during restoration and preserve the seeds.

A The mitigation measure number refers to Annex 7 established by the Nunavik Nickel Committee (see Annexe B).

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

7.3.1.4 Residual Impact Significance

Infrastructure development will result in the destruction of 110.60 ha of natural terrestrial environments and 60.67 ha of wetlands, as well as the functions associated with the affected wetlands. Since the surface area of wetlands that will be destroyed is negligible in the northern landscape, the destruction of these environments will not affect the functioning of wetlands at the local extent but be site specific. Although CRI is responsible for restoring the site when the deposit is depleted, it will not regain the exact same functions as it had in its original state. Moreover, this restoration will take place in a few years, which attributes a long duration to this impact. Considering the different mitigation measures, the impact's magnitude is therefore low, the extent is local and long duration. The significance of this residual impact is considered moderate (Table 7-25).

The risk of trampling on the natural vegetation around the sites by personnel or machinery is minimal since the habitats bordering the work sites will be protected and traffic will be prohibited there. These activities increase the risks of hydrocarbon contamination of the surrounding terrestrial and wetland environments, but low in relation to the mitigation measures applied. Therefore, these impacts are considered to have a low magnitude, a specific extent, a moderate duration leading to a residual impact of minor significance.

Avoiding plant species at risk at the Delta site and along the Ivakkak-Delta Road is impossible, only a portion of the individuals will be protected from the construction work. However, conservation of the topsoil, expected to contain seeds, will favour the recovery of vegetation post-restoration. Therefore, the impacts are considered to have a low magnitude, a local extent and a long duration, leading to a residual impact of moderate significance.

Table 7-25: Description of the Project's Residual Impact Significance on Terrestrial Environments and Wetlands

Project phase	Impact description	Mitigation measures	Magnitude	Extent	Duration	Residual impact significance
Construction and operation	Loss of surface area in terrestrial environments (110,60 ha) and wetlands (60,67 ha) for projects associated with the Delta site, the Ivakkak-Delta Road, the satellite camp, the freshwater access road, the LEMN, the three potential quarries and loss of ecological function for the impacted wetlands.	VEG1 to VEG3	Low	Local	Long	Moderate
	Loss of plant species at risk at the satellite camp and Delta site.	VEG1, 5 and 6	Low	Local	Long	Moderate
	Risk of trampling vegetation by personnel or machinery, dust deposition and risk of contaminating the natural environment.	VEG 4 and 5.	Low	Specific	Moderate	Minor

7.3.1.5 Cumulative Impacts

Wetland and aquatic environments in Nunavik are of considerable importance for birds, notably waterfowl, and for mammals, including caribou. During the design phase of the project, the placement of the Ivakkak-Delta Road and the access road to Lake no. 4 were optimized, when topography permitted, to minimize their encroachment into wetlands. Furthermore, water crossings were always placed in locations where watercourses were narrowest both for technical feasibility and to limit perturbations to fish habitat. Concerning infrastructure at the Delta site, their locations are constrained by the topography and must be placed in wetlands. All infrastructure at the Delta site and satellite camp that could be, were placed in terrestrial environments (ex: crushing site). The same can be said for other work sites.

The anticipated encroachment into wetlands is 60.67 ha. Encroachment into watercourses is considered minimal at around 600 m^2 in an intermittent stream that is not considered fish habitat. Furthermore, seven permanent watercourses, four among them potentially used by fish (fish capture was not done in the Puvirnituq River), will be directly affected during project realization. For six watercourses a crossing will be constructed while for the Puvirnituq River mine and sanitary effluents will be present during operations. Finally, three lakes will see their surface drainage reduced by nearly 45 %, which could affect certain habitats used to complete the life cycles of fish in the lakes.

In comparison, the development and operation of mineral deposits by CRI in the NNiP's study zone is actually 76.88 ha with an anticipated wetland loss for Phase 2a between 28.37 and 29.98 ha, depending on which variant is chosen (AECOM and CRI, 2022). Theses losses are in addition to losses caused by the development of the Raglan mining complex in the Kattiniq region.

Cumulatively, the impact of the Delta project on the loss of wetlands (60.67 ha) can be considered negligeable next to those still intact in the NNiP's study zone (around 110 810 ha) and considering the site restoration that will take place in the mid term. For aquatic environments, the most important impact will be a reduction of the surface drainage for three lakes around the Delta site. This impact, in addition to extreme heat events and droughts that could occur in the following years, or extreme rainfall events associated with climate change, could be more important or attenuated during operations.

Therefore, considering the small surface area lost at the regional scale, the cumulative impact of the new project exploiting the Delta deposit is considered negligeable on wetlands and aquatic environments in the study zone.

7.3.2 Aquatic Fauna and their Habitats

7.3.2.1 Construction and Operation Phases

During the construction phase, many activities could impact aquatic fauna and their habitats. Many waterbodies are inside the study zone for the Delta site and it's connected projects. Moreover, three lakes border the Delta site peripheral to future infrastructure. In 2021, fishing confirmed the presence of fish in two of these lakes. The Puvirnituq River will also be affected during exploitation of the Delta deposit because of the release of sanitary and mine effluents into its waters. According to data collected in the summer of 2021, this permanent river offers potential habitat for arctic char, lake trout and sculpins, including a probable spawning bed for arctic char of 1 804 m^2 downstream of the effluent releases. Furthermore, 23 intermittent watercourses were inventoried on the Delta site. However, except for the stream connecting lakes No.2 and No.3, all of these watercourses are located in wetlands or are not considered fish habitat because of impassable barriers. One of these watercourses (CEI-D20) will be partially backfilled for around 600 m^2 as a part of the construction of the Delta site. As shown on Photo 7-2, the shallow depth after the melt (± 5 cm) and the diffuse flow through the vegetation do not make this intermittent stream a habitat favourable for fish. It should be noted that this watercourse is easily accessible from Lake No.1. It is also considered impassable for arctic char, the only species captured in this lake.

Photo 7-2: Intermittent tributary CEI-D20

Along the proposed Ivakkak-Delta Road, 5 permanent watercourses and 4 intermittent watercourses were inventoried. Only two watercourses are passable by fish, though no fish were captured during fishing efforts in 2021. Only two intermittent watercourses will be crossed by the road and they are also not favourable fish habitat. The road that will be constructed between the Delta site and Lake No.4 will require the construction of a crossing over a permanent watercourse. This crossing will be the widest of the present project at 18 m for the bankfull discharge. Also, all intermittent watercourses have a barrier to fish movement downstream or are only present in wetlands without hydraulic connection to other permanent waterbodies. The impacts on fish will therefore be absent in these types of watercourses during the construction of the roads or their use during operations.

Thus, for all watercourses and lakes considered fish habitat, the construction and operation activities in the water (construction of crossings and effluents) or in periphery (construction of access roads, mine water drainage, mine and sanitary effluents) could have an impact on the quality on fish habitat by introducing suspended solids and other contaminants into the aquatic environments. This modification could cause fish to avoid the impacted habitats. Work is however unlikely to increase erosion of watercourses since the sites modified by the project are not considered at high risk of erosion because of the granular substrate and the shallow slopes of the shores.

More specifically, during operations the presence of a waste rock pile, two ore stockpiles and a crushing area will produce water contaminated with metals and other products used during operations when rainfall occurs. This water will be treated on site with a mobile WTP and released into the Puvirnituq River. This will also be the case for the sanitary effluent which will be released at the same place. In addition to intermittently increasing flow rates and locally modifying flow speed, these releases will be more loaded than the natural environment in metals (copper, nickel, selenium, mercury), nutrients (nitrogen compounds) and suspended solids. This could impact the use of the small spawning beds spread throughout the 1 804 m^2 zone downstream of the effluent releases. No validation of the use of this sector by arctic char was done in 2021 and 2022. Should they be used, sediment deposition on eggs after spawning could impact their survival during incubation. An additional evaluation of the potential use of the spawning zone will be done in the summer of 2023. Depending on the conclusion of this evaluation, the spawning bed could be added to the environmental monitoring for arctic char spawning beds (Monitoring 14) of CRI's monitoring program.

The sanitary effluent could also cause a localized enrichment in nitrogen compounds, which could increase the density of benthic invertebrates and consequently food for fish. However, an increase in metal concentrations in the water caused by the mine effluent could slow this increase in density. There could then be no effect on the benthic invertebrate community and the food available for fish with the presence of both effluents.

Construction of watercourse crossings generally leads to a loss of aquatic habitat at the crossing compared to the natural shoreline (previously the high-water mark) because crossings are built with respect to the bankfull flow. This loss of surface area will need to be compensated. It is generally impossible to construct crossings with respect to the shorelines since the width is much too large and this width after snowmelt is only present for a short period of time. Currently, construction of crossings could temporarily disturb around 1 400 m^2 of aquatic habitat. This area will be validated during the design step.

One of the potentially important impacts during construction and operations will be the elimination of part of the surface drainage to the three lakes peripheral to the Delta site. This will reduce surface water drainage to the lakes by 42 to 54 %. The presence of arctic char has been confirmed in two of the three lakes. This reduction in surface drainage could impact access to reproductive habitat, including a potential spawning bed on the periphery of Lake no. 1. Since detailed bathymetry of these lakes in not known, nor is the location of spawning beds confirmed, anticipated impacts on fish habitat are hypothetical.

Operations at Delta site require drawing freshwater from Lake no. 4 for both the drinking water needs of the satellite camp and for operations. The anticipated removal will not have a large impact on fish habitat since the water level will never vary by more than 15 cm in a year. The removal of water was calculated to allow water levels in the lake to return to current levels after the snow melt.

As a consequence, the anticipated impacts of the project on aquatic fauna and habitat include risks for the health of fish and other aquatic organisms following a possible deterioration of the water quality in waterbodies and watercourses on the Delta site, along the Ivakkak-Delta Road and the access road to Lake No.4. Furthermore, crossings on watercourses could hinder free movement of fish if the installation is inadequate. Access to spawning beds could also be compromised by a lowering of the water levels in the three lakes peripheral to the Delta site. However, without detailed bathymetry of the lakes and knowledge of the used spawning beds, the impacts remain hypothetical.

Without mitigation measures the impact is judged to be high (high probability of occurrence and potential effects on aquatic fauna), the extent local (affecting many components and outside of the immediate site) and of long duration. The importance of the impact would therefore be major without mitigation measures.

7.3.2.2 Closure and Restoration Phase

Anticipated work for closure and restoration does not currently include the dismantling of crossings.

Dismantling of infrastructure and the re-profiling of the site will allow surface runoff to return to lakes No.1, No.2, and No.3. Backfilling of the collection ditches and restoration of the LCP and MCP will not be undertaken until planned environmental monitoring indicates that water quality satisfies criteria from *Directive 019*. As indicated in Section 5.2.11, removal of the sediments from the basins and disposal in an adequate site (PAG waste rock piles of NNiP) is planned. Two breaches will also be created in the dike surrounding the MCP to allow water drainage. It is possible that the presence of the dike, despite the breaches, could continue to have an impact on lakes No.2 and No.3 by modifying the hydraulic regime. If this should be the case, the breaches will be corrected to eliminate this residual effect. Drainage for Lake No.1 will return to normal since the road preventing drainage to this lake will be removed.

The closure and restorations phases are themselves mitigation measures. As such, the importance of the impact is judged to be minor (Table 7-27). Some mitigation measures will nevertheless be added to reduce the potential input of suspended solids in watercourses and waterbodies adjacent to the work, for example adding sediment barriers (measure FAQ24 in Table 7-26).

7.3.2.3 Mitigation Measures

The mitigation measures stated in Annexe 7 of the Nunavik Nickel Agreement applicable to the present project, as well as new mitigation measures are presented in Table 7-26. They aim to preserve water quality and thereby reduce the potential impacts of the project on the health of aquatic communities.

Table 7-26: Mitigation Measures to Reduce the Impacts on Aquatic Fauna and their Habitats

Nº A	Mitigation measures
FAQ1	Culverts will be installed during the summer low-flow period (July to September).
FAQ2	Vehicle and construction machinery traffic shall be avoided within 20 m of a perennial stream or within 5 m of an intermittent stream and, if such traffic is unavoidable, any water flowing into ruts shall be diverted to an area of vegetation located at least 20 m from a stream.
FAQ12	Culverts will be installed so as not to impede the flow of water (base of culverts set beneath the natural stream bed, riprap used for stabilization, etc.).
FAQ13a	Installation of a mobile water treatment system for mine drainage water collected by the downstream collection basin and the main collection basin for operations of the Delta deposit.
FAQ14	Remove solid matter from sanitary wastewater with a mobile biodisc treatment unit and disinfect the water with a UV treatment.
FAQ16	Culverts will be laid at the same slope as the natural stream bed and baffles shall be installed if flow exceeds 1.2 m/s.
FAQ17	Culverts will be laid in steps to concentrate flow during the low-water period
FAQ19	A fishing program will be established to provide guidelines for fishing in a number of bodies of water.
FAQ20	The free movement of fish shall be ensured at all times when a stream is temporarily diverted
FAQ22	Clean granular material shall be used to cofferdams (imperviousness preferably being achieved using non-granular material).
FAQ23	Temporary structures shall be stabilized using a geomembrane or riprap.
FAQ24	Fine particle transport shall be prevented in the aquatic environment beyond the immediate work area.
FAQ25	Areas disturbed by earthwork (ex: slopes and banks) shall be stabilized progressively as work is completed.
FAQ26	Surplus material shall be disposed of at a specially designated site.
FAQ27a	Perform maintenance and refuelling of vehicles, handle and store hydrocarbons at a distance more than 30 m from the shorelines.
FAQ28	Machinery shall be prohibited from fording streams.
FAQ29	Vehicle traffic shall be restricted to designated and clearly identified roadways.
FAQ30	Hydrocarbon-absorbing floating booms shall be installed downstream of work in streams, as well as in lakes and areas with low flow.
FAQ31	Machinery shall be moved away from streams as soon as possible.
FAQ32	Machinery shall be clean and in good condition.
FAQ33	Waste oil from machinery shall be taken to a specially designated site.
FAQ34	Emergency gear shall be on hand in case of spills and workers shall know how to use it.
FAQ36	Areas of streams affected by construction shall be restored to their initial characteristics (substrate, width, depth and vegetation).
FAQ54a	The water intake at Lake No.4 will have a grate installed that respects the DFO requirements concerning fish grates for freshwaters. The design of the grate will prevent aspiration of fish and their capture on the grate (ACÉE2).
FAQ59	Apply mitigation measures for air, soil, water and sediment quality.
FAQ60	Following inventories aiming to produce detailed bathymetry of lakes No.1, No.2 and No.3 and a water balance, it will be determined is changes in water level are important or not. The results will inform the necessity to do fall inventories to identify the depth of spawning beds used by arctic char. Identification of an impact on aquatic fauna will results in the application of specific mitigation measures.
FAQ61	Perform water quality testing before creating breaches in the MCP dike and remove the road blocking drainage towards Lake No.1.

A The mitigation measure number refers to Annex 7 established by the Nunavik Nickel Committee (see Annexe B).

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

7.3.2.4 Residual Impact Significance

The impact magnitude of possible harm to the health of aquatic communities in the project's watersheds is assessed as low, given the application of mitigation measures aimed at ensuring good water and sediment quality (such as FAQ1, 2, 13a, 14, 24 and 59), the free movement of fish (such as FAQ12, 16 and 17), access to required habitats so that fish can complete their entire lifecycle (FAQ 16 and 60) and protection of the resource (FAQ 19 and 54a).

It should be noted that the environmental monitoring program that monitors free passage of fish through crossings (monitoring #12) will be applied to the Delta project, more precisely to crossings situated on watercourses identified as potential fish habitat, in addition to monitoring of water quality mentioned in Section 7.2.4.5.

The magnitude of the impact is considered to be low, the extent of the impact specific and the duration varies from short to moderate since the drainage will be affected for a minimum of 7 years. The significance of the residual impact is therefore judged to be minor for all identified impacts (Table 7-27).

Table 7-27: Description of the Project's Residual Impact Significance on Aquatic Fauna and their Habitats

Project phase	Impact description	Mitigation measures	Magnitude	Extent	Duration	Residual impact significance
Construction	Avoidance of zones near to work sites by fish when installing crossings.	FAQ1, 2, 20 and 29	Low	Specific	Short	Minor
Construction	Temporary loss of aquatic habitat (during installation of crossings and after reduction in the surface drainage to lakes No.1, No.2 and No.3).	FAQ25, 26 and 36	Low	Specific	Short	Minor
Construction and operation	Possible damage to aquatic organisms in watercourses and waterbodies in proximity to the different activities by modifying water quality (increase in SS and contaminants).	FAQ14, 22, 23, 24, 27a, 28, 29, 30, 31, 32, 33, 34, and 59	Low	Specific	Short	Minor
	Reduction in surface drainage of water to lakes No.1, No.2 and No.3.	FAQ60	Low	Local	Moderate	Minor
Operation	Possible modification of aquatic communities (fish and benthic invertebrates) downstream of effluent releases.	FAQ13a and FAQ14	Moderate	Local	Moderate	Minor
Operation	Obstacles to the free movement of fish in watercourses.	FAQ12, 16, 17, and 36	Low	Specific	Short	Minor
Operation	Fish mortality due to sport fishing and capture by the water intake.	FAQ19 and FAQ54a	Low	Specific	Short	Minor
Closure and restoration	Transport of fine particles towards adjacent waterbodies and water contamination associated with surface drainage.	FAQ24 and FAQ61	Low	Specific	Short	Minor

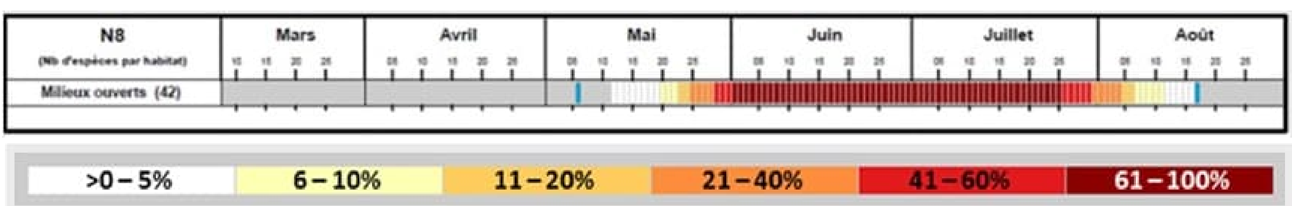
7.3.3 Avian Fauna and their Habitats

7.3.3.1 Construction Phase - New Infrastructure Development and Related Project Development

As mentioned in Section 7.3.1.1, the construction phase for the project will cause a loss of 110.60 ha of natural terrestrial environments and 60.67 ha of wetlands. Observations have demonstrated that waterfowl and terrestrial birds only sparingly use the environments in the study zone for reproduction since few nests were inventoried. However, the observations of grazing by Canada and snow geese are frequent. These two observations indicate that the reduction of terrestrial and wetland habitats will constitute a loss of nesting and feeding grounds for birds, but the overall importance is still negligeable compared to the availability of similar habitats at the local and regional level. Terrestrial environments like boulder fields can be used by certain birds such as the Lapland longspur, but wetlands are generally favoured by a wider range of species. It should be mentioned that the Canada Goose is very abundant in the fens throughout the NNiP's sites. As a matter of fact, individuals, feces and traces of grazing by Canada Goose are regularly observed at the characterization stations inventoried in the fens.

Since numerous species of birds were observed during inventories, including a Canada Goose nest at the Delta site and another along the future Ivakkak-Delta Road and broods of ptarmigan were sighted at a few locations (see Section 6.3.2.3), it is possible that construction work could lead to the abandonment and destruction of nests in the work sites.

Except for the cormorants and pelicans, all marine and aquatic birds usually present in Canada are protected under the terms of the *Migratory Birds Convention Act*. This law prohibits killing, injuring or possessing migratory birds, their nests or their eggs. The area under study is located in the N8 nesting area. For this sector, the general nesting period (which covers egg laying and the presence of chicks in the nest) extends from May 12th to August 17th (ECCC, 2022; Figure 7-3). However, the intensive nesting period is over at the end of July. Carrying out the work after August 17th would therefore have no perceptible impact on the breeding period and young being born throughout the year. The complete stoppage of work during this period could however prove to be impossible in order to maintain the smooth functioning of the operations.



Note: The number of species in percentage. The blue indicators show the extreme dates predicted.

Figure 7-3: Migratory Birds Nesting Period in the Arctic Plains Zone in Quebec (taken from ECCC, 2022)

The noise, movement and dust from all construction activities may disturb nesting pairs, moulting birds and migrating birds present near construction sites and along the Ivakkak-Delta Road and the access road to Lake No.4. The dust that would settle on the surrounding wetlands could have a small-scale impact on waterfowl's food source.

Without mitigation measures, the impact magnitude is deemed to be high (high probability of occurrence), of specific extent (at disrupted sites) and of moderate duration (7 years). The impact's significance is therefore deemed major.

7.3.3.2 Operation Phase

The anticipated impacts on birds from the deposits' mining phase implicate the disturbance of birds present near the Delta site and along roads, mainly the Ivakkak-Delta Road, due to the increase in activities and traffic. Even in the absence of mitigation measures, the impact during operation will have a moderate magnitude since the birds will not be disturbed during their nesting, as the site is already under operation. Birds will nest in the least disturbed areas where noise is reduced. The extent of the impact is site specific, as it is limited to the disturbed areas and the impact duration is long (7 years). This impact's significance is therefore moderate before the mitigation measures are applied.

7.3.3.3 Closure and Restoration Phases

As for the two previous phases, the restoration and closure activities of the sites may disturb nesting pairs, moulting birds and migrating birds present near construction sites and along the Ivakkak-Delta Road. However, the natural environments will be partly restored during the site closure phase, and this could restore some of the lost habitats.

In the restoration phase, the impact significance, before mitigation measures, is considered low, of specific extent and of short duration, for a minor impact significance.

7.3.3.4 Mitigation Measures

The mitigation measures that will be applied to minimize the impacts on birds and their habitats are presented in Table 7-28. Some of the measures applied during the construction phase (FAV1 to FAV3) are the same as those in section 7.3.1.3 for terrestrial and wetland environments. The goal is to limit the destruction of natural habitats as much as possible.

Since migratory birds are present in the study area, special attention must be paid to their nesting period during the construction phase. Measures will be taken to ensure that no migratory bird nests are destroyed during construction work (FAV5; Table 7-28). CRI's fauna and flora protection plan includes inventories of active nests before construction begins, when such work is to be done during the nesting period, and mitigation measures according to the context (active nest, bird behaviour, etc.; AECOM and CRI 2023).

Concerning birds of prey that nest in cliffs (peregrine falcon and rough-legged buzzard), no mitigation measures are planned since only occasional observations of birds at rest or that were hunting (perched on rocky mounds with shallow slopes in boulder fields and lowland fens) were made. No habitat ideal for nesting (cliffs) were inventoried in proximity to the Delta site or along the Ivakkak-Delta Road since the slopes are generally shallow in the study zone. The same case can be made for ravens that use the same type of habitat for nesting.

Table 7-28: Mitigation Measures to Reduce the Impacts on Birds and their Habitats

N°[A]	Mitigation measures
FAV1	Traffic must be limited to work areas
FAV2	Habitats next to jobsites will be protected
FAV3	The extent of stripping and levelling shall be limited
FAV 5	Apply the fauna and flora protection plan.

[A] The mitigation measure number refers to Annex 7 established by the Nunavik Nickel Committee (see Annexe B).

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

7.3.3.5 Residual Impact Significance

The loss of nesting and foraging habitats during construction for birds is an impact of low magnitude and specific extent given the very small areas involved (destruction of 60.67 ha of wetlands and 110.60 ha of terrestrial habitats) at the local (110 810 ha of intact wetlands, and as much terrestrial habitats, in the NNiP's study zone) and regional level. Birds will easily be able to use the nearby untouched habitats, which makes up the majority in the Nunavik regional landscape. Although CRI is responsible for restoring the site when the deposit is exhausted, it will not regain the exact same functions as it had in its original state. Moreover, this restoration will take place in a few years, which attributes a long duration to this impact. The significance of this residual impact is considered minor (Table 7-29).

Given the mitigation measures aimed at limiting disturbance during the construction phase (Table 7-28), including the implementation of a fauna and flora protection plan[13], it is unlikely that a migratory bird's nest will be destroyed during construction. The magnitude of this impact is considered to be low, its extent is site specific and its duration short. Therefore, the residual impact's significance for nest abandonment or destruction during the construction phase is minor (Table 7-29).

Birds are mobile animals capable of temporarily avoiding the disrupted areas. They can move as soon as disturbing elements are nearby the areas in which they frequent. They then return soon after the disturbance and are usually unaffected. Considering these facts and the mitigation measures, the impact's magnitude for disrupting birds around the infrastructure during the operation, closure and restoration phases is considered low. The extent is site specific, the duration is long, and the significance of the residual impact is considered minor (Table 7-29).

Table 7-29: Description of the Project's Residual Impact Significance on Birds and their Habitats

Project phase	Impact description	Mitigation measures	Magnitude	Extent	Duration	Residual impact significance
Construction	Loss of accessible habitat for birds (loss of 110.60 ha in terrestrial habitats and 60.67 ha in wetlands).	FAV1 and FAV3	Low	Specific	Long	Minor
	Disturbance of breeding pairs and migrating birds near construction sites and along roads leads to a risk of nest abandonment. Potential destruction of nests.	FAV2 to FAV5	Low	Specific	Short	Minor
Operation, closure and restoration	Disturbance of nesting pairs and migrating birds present on the outskirts of infrastructures.	FAV1, FAV2 and FAV5	Low	Specific	Long	Minor

7.3.3.6 Cumulative Impacts

As mentioned previously, the cumulative impact analysis for birds examines groups of species at elevated risk of disturbance by mining activities and/or having a particular importance for the subsistence activities of the Inuit (waterfowl and birds of prey).

An authorization request to establish a windfarm in proximity to the Expo site is currently being studied by the MELCCFP and the KEQC. This windfarm could cause additional disturbance during the migration of large groups of snow geese, Canada Geese and birds of prey over the NNiP's territory (AECOM and Tugliq, 2022). Also, mining operations and site restoration by the NNiP east of the Delta site will have cause an additive disturbance on migration and nesting of waterfowl since many of these activities will take place in proximity to nesting sites. Furthermore, a windfarm with two windmills is located around 20 km northwest of the Expo site and has been in operation since 2014 and 2018 by Glencore. The also operate four underground mines. All of these activities therefore cause a cumulative effect at the local and regional level.

Truck and machinery traffic is also very present on the NNiP's territory, and this situation will be continued for the next ten years with the anticipated development and exploitation of new deposits by CRI in the local study zone (Ivakkak UG, Méquillon UG2, Nanaujaq UG and Expo South projects). However, the residual impact on birds associated with the development of these new deposits is considered minor since birds are mobile animals capable of avoiding temporary perturbations (AECOM and CRI, 2022). Furthermore, birds can easily use untouched habitats in proximity to the sites impacted by mining activities (large availability immediately west of the Delta site) because of the low bird density observed and the high availability of similar habitats in the regional landscape of Nunavik (AECOM and CRI, 2022 and the present study). Figure 7-4 shows potential nesting sites in a 10 km radius around the Delta site. Therefore, habitat for waterfowl to substitute those destroyed at the Delta site and satellite camp, as well as those disturbed by noise in proximity to them, does not seem limited at the regional scale.

[13] The fauna and flora protection plans was submitted to the MELCCFP at the beginning of year 2023.

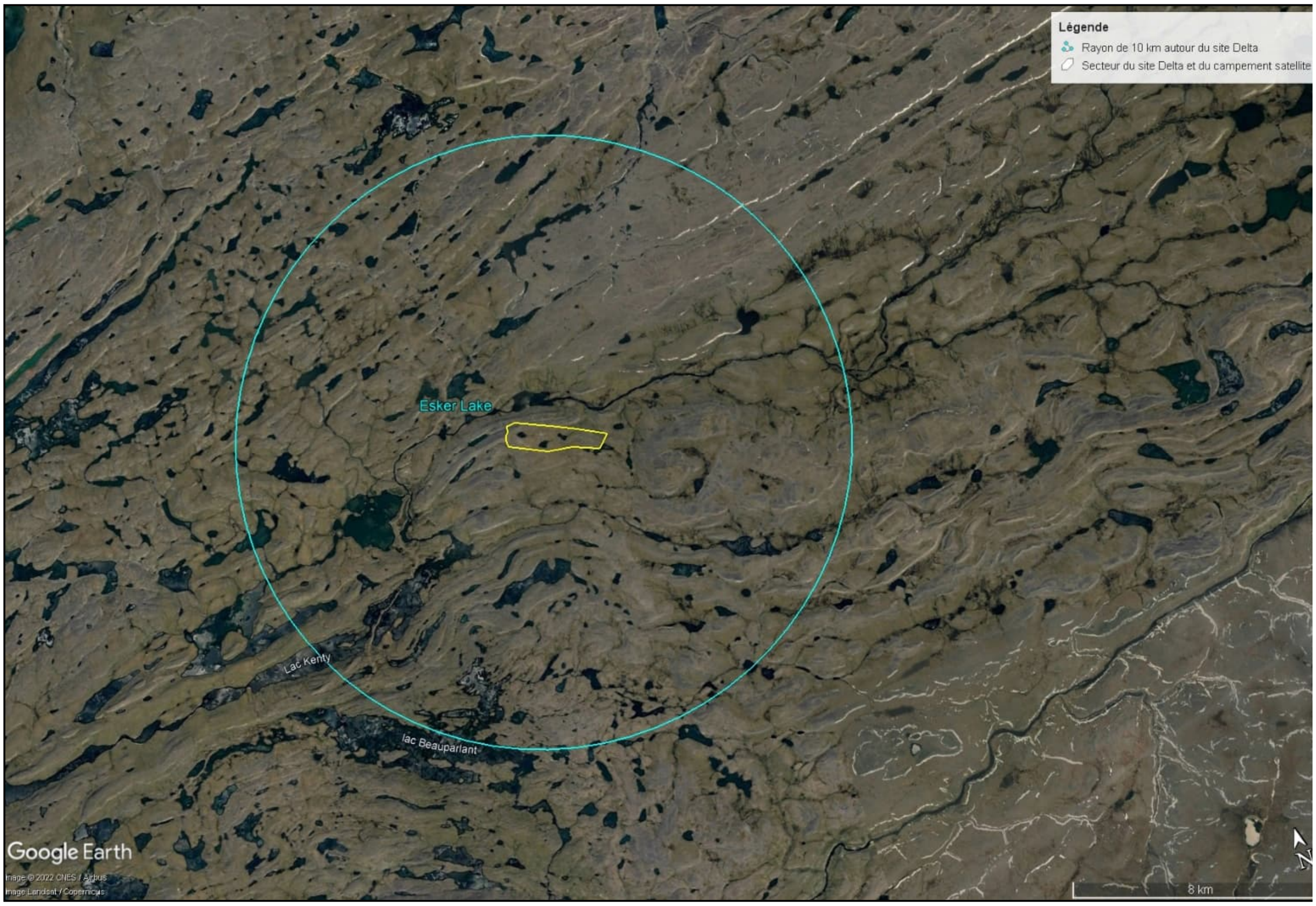


Figure 7-4: Riparian habitats in a 10 km radius around the Delta site and satellite camp

Indigenous knowledge and land use by the Inuit also provides important information about the impacts observed on birds in the NNiP's study zone. The president of Nunaturlik (Land Corporation of Kangiqsujuaq), Mr. Lukasi Pilurtuut, has mentioned that he has not seen notable changes in the size of the populations, their behaviour or the nesting sites of birds of prey and waterfowl over the last decade, except for a higher abundance of snow geese and snowy owls in the Kattiniq region, a situation that has been observed for 7 to 10 years (AECOM and Tugliq, 2022). These observations tend to demonstrate that mining activities and windfarms operated on the territory of Kattiniq don't seem to have a negative impact on birds and that certain species like snow geese and snowy owls could even be more abundant, an observation that was made before.

This traditional knowledge supports the impact assessments made in this study for the exploitation of the Delta site, namely that the residual impacts of the different mining projects and windfarms on birds is of low magnitude and of minor significance. Cumulatively, even when adding the effects of all of the mining projects and windfarms in the region, the impacts remain of low magnitude and of minor significance since these projects do not affect the integrity of the concerned bird populations and do not affect the abundance and distribution of the birds of interest. As such, the cumulative impact of the exploitation of the Delta deposit is judged to be **minor** for birds in the study zone.

7.3.4 Caribou

The caribou is a species that is subjected to the effects of many environmental factors. It should be noted that in natural environments without anthropic presence, the migration and calving of caribou are closely linked to the climate, snow and ice melt, vegetation, harassment by insects and the quantity of predators (Sharma et al. 2009 *in* Blangy and Deffner, 2014). It should be noted that the Delta project is partially located within the legal calving grounds of the caribou. Additional effect of projected mining activities are presented below.

7.3.4.1 Construction Phase for the Access Roads and Installations at the Delta Site

During the construction of infrastructure at the Delta site, the road between the Ivakkak and Delta sites, as well as the construction of the access road between the Delta site and the pump station on Lake No.4, many impacts are anticipated for caribou. The main construction impacts on the LRH (Leaf River Herd) caribou are linked to traffic for the transport of materials and the noise associated with construction of the roads and infrastructure. Further, these works could use explosives at certain moments to prepare the soil before construction. All of this construction work will be a source of noise and the disturbance caused to the caribou will be important if the work occurs during the calving season (recognized as being from the 15th of May to the 15th of July). These impacts will however be short in duration.

Road and infrastructure construction will not require helicopter flights, unlike exploration activities that will continue in parallel. To this end, a helicopter landing pad (heliport) will be installed along the Ivakkak-Delta Road to allow the continuation of exploration activities in the NNiP's territory. A second heliport will be installed at the satellite camp. Therefore, during exploration work, helicopter flights will occur over the calving grounds, and it recognized that these flights are especially stressful when done at low altitudes during the calving period. These flights will however be intermittent and of short duration.

The construction work will temporarily lead to a disruption of the access to summer feeding grounds during the migration of the LRH by creating a certain fragmentation of the habitat. However, the surface area lost or disturbed is quite minimal with 171.27 ha, compared to the global territory used by the LRH caribou of 663 810 km² (a loss of less than 0.001 %) (COSEPAC, 2017) and the calving grounds covering 153 400 km² (a loss of 0.001 %).

Finally, the increase in traffic for the transport of machinery and construction materials will increase the risk of collisions with caribou on the existing road network.

7.3.4.2 Operation Phase of the Delta Mine and Use of the New Road Section

During the initial impact study, it was mentioned that 9 mine exploration camps, 60 active mine exploration sites and 29 airports, landing strips, heliports or water airports were present in the distribution range of the LRH caribou. Since the beginning of Phase 1 for the NNiP, many dozens of exploration sites were established in the study zone for the Ivakkak-Delta Road and the Delta site (information found on the Government of Quebec's SIGEOM site, 2022). Operations at the Delta site and use of the road section will considerably reduce helicopter flights in the sector. Except for required exploration flights and environmental monitoring studies, no other helicopter flights are expected in this sector. As such, this will reduce the stress associated with the flights in the zone for caribou and during calving. Furthermore, helicopter flights will be subjected to specific mitigation measures, as established in the fauna and flora protection plan (see 7-32 for avoidance distances), which should contribute to reducing the stress on the caribou.

Mining operations require many activities, some of which occur on the surface, others underground. Surface activities are a source of disturbance for fauna because of the noise and vibrations they create. These activities can cause non-negligeable impacts on the LRH caribou that currently use the site as a summer feeding ground during it's north-south migration and as a calving ground. Notable activities likely to have an impact on caribou are open pit mine operations, blasting in the pit and quarries, road transport, vehicle traffic on the site, crushing of the waste rock and the usual operations on the mine site. These activities, typical of operations at the Delta site, can disturb caribou that frequent the study zone, especially during calving. Sources of noise and the presence of humans can limit the use of sectors peripheral to the mine site, as indicated in the impact review done by COSEPAC (2017). According to observations collected between 2020 and 2022 by CRI for the Méquillon site, caribou remain in proximity to operational sites. Some of the observations are estimations since a very large number of caribou can be observed at a same location. These observations are done between June and September, during the migration (see Annexe V for details of the observations). In 2020 1 704 caribou observations were reported, the majority in July. For 2021, only 585 observations were reported with a peak in August. For 2022, 4 200 observations of caribou were compiled peaking in mid July.

Certain studies have however reported that caribou tended to avoid active mine sites (COSEPAC, 2017). In certain cases, avoidance could go as far as 6 km from mining activities, which would reduce noise exposure and associated stress. This avoidance could however increase energy expenditure for migration by the caribou that cross the sector (see Figures 6-6 to 6-10 of the telemetry monitoring of the LRH caribou). Indeed, according to the above-mentioned figures, this herd comprises hundreds of thousands of individuals, only a small portion of which circulate inside the NNiP's territory. However, the caribou present in the study area seem to present signs of having adapted to the presence of humans and to a certain noise level, as evidenced by photos 7-3 and 7-4 below. This phenomenon was also observed in Alaska where it was noted that caribou become habituated to roads associated with hydrocarbon development, outside of the calving period (Haskell and collab., 2006 in St-Laurent et al., 2012). For these reasons, no additional loss of habitat outside of the study zone for the Delta site will be compiled.

During the initial impact study, it was mentioned that the caribou migration routes had changed since the beginning of mining activities in Nunavik (GENIVAR, 2007). As indicated in the study, the activities at the new Delta mine, such as ore transport, the presence of roads and blasting could lead to changes in the caribou migration routes. These changes could continue for the entire duration of the road's presence if no mitigation measures are put into place. Among these elements, the caribou could be particularly sensitive to habitat fragmentation caused by the construction of linear infrastructure. A recent study seems to indicate that the road associated with the Raglan Mine (between the mine and Deception Bay) acted as a semi-permeable barrier to the movements of the LRH caribou by limiting access to the northernmost portion of their range (Plante, 2020). This road is frequently used by heavy machinery. The linear fragmentation phenomenon was observed for the construction of the 100 km road for the Meadowbank site in Nunavut. In this study the caribou mainly avoided the road because of the large volume of traffic (Blangy and Deffner, 2014). Considering the low density of roads in northern Quebec and Labrador, the consequences for the caribou are likely to be considered low (Plante, 2020). According to field inventories, a few routes frequently used by the caribou in their north-south migrations are present in the sector of the future Ivakkak-Delta Road (see Map 6-6). The presence and use of the access road to the Delta site could somewhat modify the migration pattern of the LRH. Specific mitigation measures will be put into place during the construction of the road and during operations.

Photo 7-3: Caribous feeding in proximity to the Expo site

Photo 7-4: Caribous on a road in proximity to a site exploiting an esker (Esker 2 site)

The presence of roads implies road traffic. Since these activities occur inside the caribou migration zone, an increase in collisions with caribou could be observed during operations. This could lead to the death of caribou, material damages and injuries to people. The presence of an autonomous satellite camp, thanks to connected infrastructure (production of drinking water, treatment of wastewater, LEMN) will limit traffic on the new road segment. In this context, nothing indicates that occasional collisions will be an issue for the survival of the caribou as a whole. Also, CRI's environmental monitoring program for collisions with caribou (monitoring #18) indicates that no collisions have occurred on the roads of the mining complex, but that collisions have occurred on Glencore's road leading to Deception Bay (Table 7-30). Between 2011 and 2022 five collusions have occurred implicating vehicles these roads and none within NNiP site operations area. All collisions occurred in July at the height of the migration. It was also noted that the collisions typically occurred either in the evening or at night when visibility was reduced. One collision in 2014 occurred during very foggy conditions that reduced visibility nearly to zero. As such, collisions on the new Ivakkak-Delta segment will not be an issue for the survival of caribou.

Table 7-30: Collisions with Caribou having Occurred on the NNiP's Roads Between 2011 and 2020.

Date	Hour	Km	Road	Type of vehicle	# of deceased caribou
07-07-2014	Night	24	Katinniq – Déception Bay[A]	Truck	1
30-07-2018	00h15	6	Katinniq – Déception Bay	Truck and trailer	2
11-07-2019	20h00	56	Katinniq – Déception Bay	Truck with load	1
10-07-2020	1h30	14	Katinniq – Déception Bay	Truck with load	1
Total					**5**

[A]: This road is under the responsibility of Glencore.

It was also observed that for large roads, traffic lifted appreciable quantities of dust and, mainly during the summer, this dust fell on the vegetation that caribou feed upon (Blangy and Deffner, 2014). The Ivakkak-Delta Road will cross 4.99 ha of densely vegetated wetlands and 28.90 ha of sparsely vegetated terrestrial environments. The road between the Delta site and Lake No.4 will cross 7.73ha of wetlands and 5.99 ha of terrestrial environments. This second road will not have much traffic, only required for maintenance of the pump station. It will therefore generate less dust.

It is expected that a very small quantity of dust will be deposited on vegetation bordering roads for the Delta project. For caribou, literature examining the contamination of caribou meat by dust is rather rare. According to Mr. Vincent Brodeur, biologist at the MELCCFP, no such research has been conducted in Nunavik over the last 10 to 20 years. In fact, the nutritional quality of caribou meat is mainly linked to the availability of its primary food source, lichen. Between 1988 and 2001, based on the carcass weights of lactating females (a loss of 9.3 kg), it would seem that the physical condition of caribou from the LRH has deteriorated (Couturier and collab., 2004). Other indicators such as percentage of adipose reserves and protein content confirm this trend. This deterioration of the physical condition of caribou seems attributable to the degradation of lichens caused by intensive grazing from a herd that has seen its population increase considerably since the 1970's. As such, the most important impact on the nutritional quality of caribou seems to be the density of available lichens to graze upon. Mitigation measures will nevertheless be implemented to ensure that the effect of dust on the LRH is as low as possible.

The loss of calving habitat (approximately 0.001 %) and overall range (less than 0.001 %) is very low, as such the project will not significantly reduce the availability of these habitats, especially considering that the site will be restored at the end of operations. As such, the most important impacts will be a disturbance of migration routes (fragmentation by linear infrastructure) and during calving by mining activities. Mitigation measures will therefore be put into place to reduce these effects.

7.3.4.3 Closure and Restoration Phases

The anticipated impacts during the closure and restoration phases will mainly be a reduction of the residual effects linked to mining activities during calving and on migratory behaviour of caribou with the cessation of activities.

Depending on the agreement established with Inuit communities, the Ivakkak-Delta Road will either be preserved or removed. If it is removed, the barrier effect it represents will no longer exist. If the road is preserved, the presence of mitigation measures presented below will allow for the passage of caribou along their migration routes, without a detour.

7.3.4.4 Mitigation Measures

Though the LRH does not have a legal status in Quebec or Canada, CRI considers caribou as a distinct component, and they have are considered independently of other components in its protection plan.

It should also be noted that in 2017 a round-table discussion was formed by seven indigenous nations from Quebec and Newfoundland and Labrador to manage populations of migratory caribou. This was done in response to the drop in the population of the herds over the last 25 years and the slowness of government actions (Radio-Canada, 2017). During this round table, it was mentioned by the vice-president of the Makivik Corporation that caribou must be protected to ensure the continuation of traditional indigenous activities.

It was in this context that CRI elaborated the mitigation measures presented below to integrate as best as possible mining operations at the Delta site while enabling the LRH caribou to complete their life cycles. It was also in this context that CRI partnered with Laval University's Caribou Ungava research group to participate in research to better identify mitigation measures to reduce the impact of mining operations on the LRH caribou.

The mitigation measures are presented in Table 7-31. On the whole, the will limit as much as possible disturbance and stress on caribou and collisions with them. MTR5 (Store domestic waste in closed containers before their incineration.) aims, among other objectives, to avoid attracting predators of caribou, such as bears, to the site.

Table 7-31: Mitigation measures to minimize the impacts on caribou

N^{oA}	Mitigation measures
MTR1	Prior and regular inspection of machinery will be performed to ensure that it is in good condition and working properly (minimizing noise).
MTR2	Machine circulation will be limited to work areas.
MTR5	Store domestic waste in closed containers before their incineration.
MTR6a	Apply the fauna and flora protection plan.
MTR7	Avoid the direct movement of equipment and personnel towards caribou observed within 100 m of a work site or access road. Do not use vehicle horns or adopt behaviours that could stress caribou.
MTR8	Mobile equipment and vehicles must yield and allow passage of fauna such as caribou.
MTR9	If a caribou is observed near an access road, follow Diagram 7-1 included in the fauna and flora protection plan.
MTR10	Make workers aware, especially before calving, of the risks of disturbing caribou and of appropriate behaviour.
MTR11	Make aircraft and helicopter pilots aware of the susceptibility of caribou to disturbance during the calving period (May 15th to July 15th) and ask that, upon returning to base, they transmit the locations and number of caribou observed during their trips so that sectors with their presence can be identified. Avoidance distances, as identified in Table 7-28, can then be applied and reported in the fauna and flora protection plan, except in the case of emergencies.

Table 7-31: Mitigation measures to minimize the impacts on caribou (continued)

NºA	Mitigation measures
MTR12	Limit helicopter transport between the Ivakkak and Delta sites between May 15th and July 15th, favouring road transport for material and personnel.
MTR13	Elaborate and apply a surveillance protocol for caribou (between mid May and mid July) for the Ivakkak-Delta sector that will trigger the application of MTR14 and MTR17. This surveillance will be done a minimum of three times per day with an observation interval of 4 hours.
MTR14	In the Delta sector and its access roads: • Suspend activities causing a sudden noise (ex: surface blasting) when caribou are observed in a 1 km radius. • Suspend other types of activities when caribou are observed in a 1 km radius and show signs of nervousness. • Suspend activities causing a non sudden noise that could disturb caribou (ex: drilling, crushing, loading and unloading on the surface) when a female accompanied by a calf is observed in a radius of 1km (between mid May and mid July). • When caribou have left the 1 km radius, wait 30 minutes before restarting suspended activities to ensure that the individuals have not returned inside the perimeter.
MTR15	Install crossings for caribou on both sides of the Ivakkak-Delta Road and the Delta-Lake No.4 Road to facilitate their crossing of the road.
MTR16	Apply mitigation measure AIR2a.
MTR17	Plan and group vehicle traffic on the Ivakkak-Delta Road using convoys when observations of a herd of more than 50 individuals are made near the road.
MTR18	Support research projects with Caribou Ungava on caribou behaviour.

A The mitigation measure number refers to Annex 7 established by the Nunavik Nickel Committee (see Annexe B).

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

With regards to measure MTR11, that determines avoidance distances during helicopter flights, the distances are detailed in Table 7-32 below.

Table 7-32: Avoidance Distances for Caribou According to Time of the Year and Number of Individuals for Helicopter Transport (Based on the Fauna Protection Plan of Blue Star Gold Corp., 2021)

Season	Number of caribou	Avoidance distance for helicopter transport
Early summer (calving period) (May 15th to July 31st)	Group > 250	610 m vertical 4 km horizontal
Early summer (calving period) (May 15th to July 31st)	Group > 50	610 m vertical 2 km horizontal
All other seasons (August 1st to July 14th)	Group > 50	300 m vertical 1 km horizontal

The decision tree for measure MTR9 for the observation of caribou in proximity to an access road is presented in Diagram 7-1.

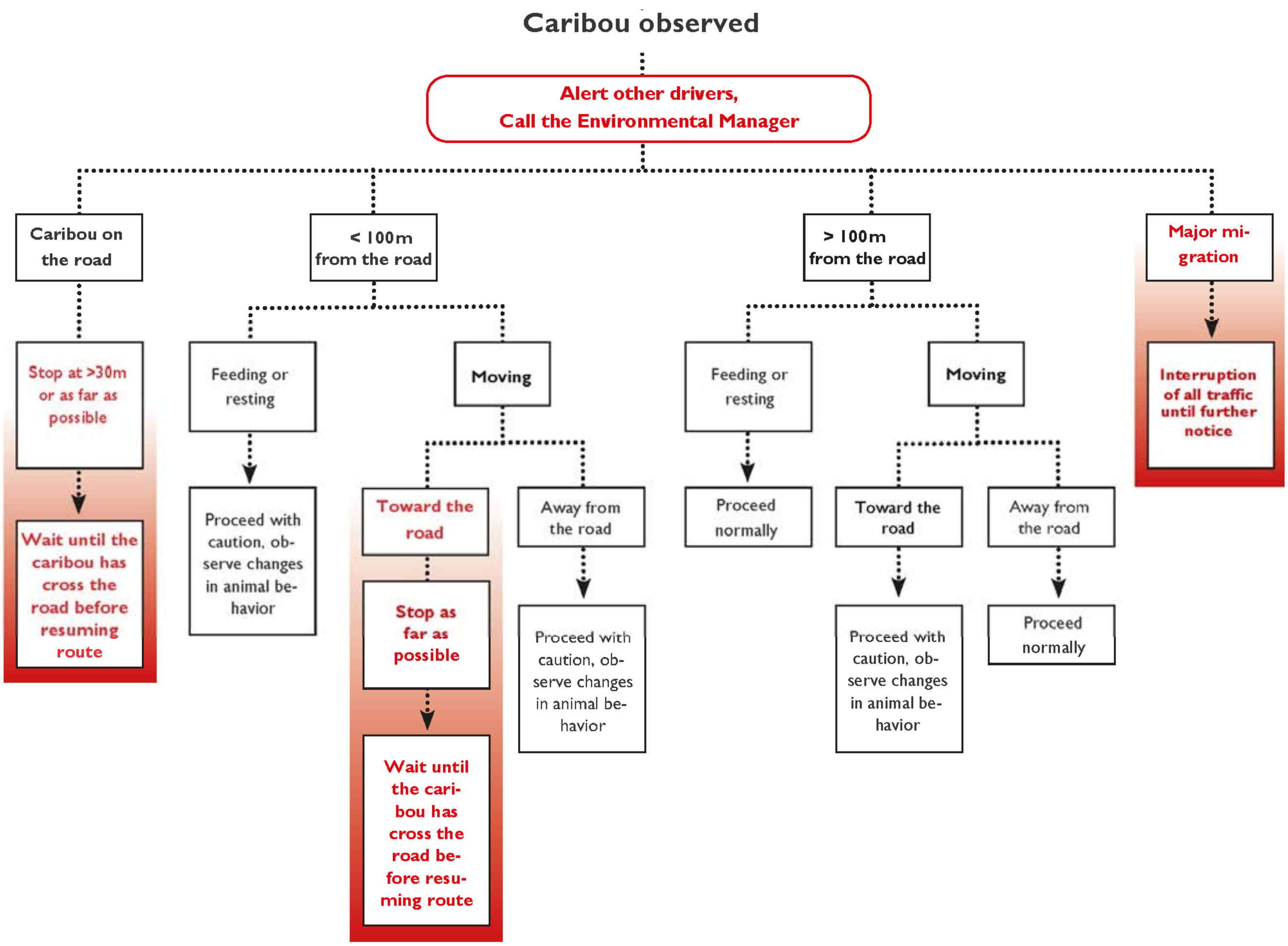


Diagram 7-1: Decision tree for the presence of a caribou at less than 100 m of a road

Noisy work and road traffic cannot be totally stopped during the calving season, or when migrating caribou are present, because of critical construction phases and the need for ore. Therefore, a caribou surveillance protocol for the Delta site and access roads will be used to initiate the appropriate application of MTR14 (suspension of certain activities) and MTR17 (use of road convoys). The protocol is being elaborated, particularly for certain logistical aspects (use of drones, mobile observation stations, etc.). It is expected that surveillance will be done at least three times per day with an interval between observations of 4 hours and that it will target sectors with activities that could produce sudden noises (surface blasting) or potential disturbances (drilling, crushing, surface loading and unloading).

Surveillance will be initiated when telemetry from the MELCCFP indicates that caribou are located in proximity to the work zones, usually in May. All observations will be documented with as much detail as possible (male, female with or without calves, number of individuals, etc.).

A radius of 1 km for direct observations was established because topography limits observation distances. Permanent and effective markers will be installed to correctly evaluate the distance for observers (Diagram 7-2). The selected observation stations will ensure the best visibility possible inside the work zone while respecting the exclusion zone around the caribou. The surveillance protocol will be integrated into the Fauna and Flora Protection Plan (FFPP). They will be presented to the MELCCFP during the process for ministerial authorizations (road, quarry operation, mining operation).

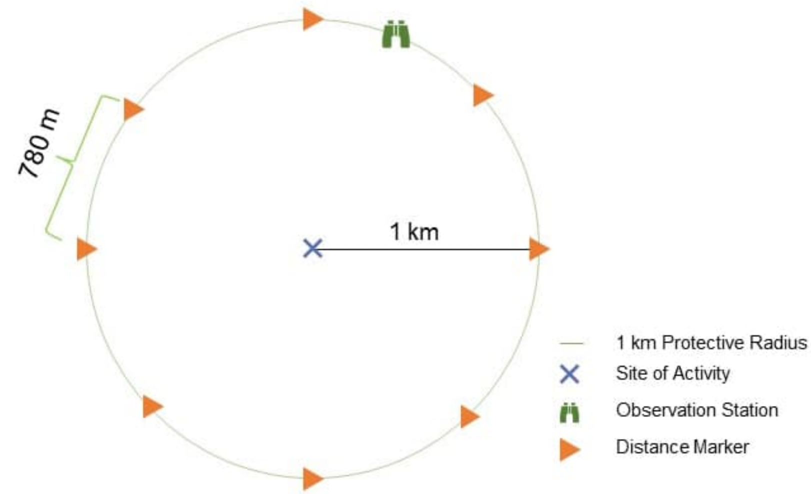


Diagram 7-2: 1 km protection perimeter for caribou and observation station

As such, the surveillance protocol provides for the suspension of certain activities (described in MTR 14) in the Delta sector and its access roads to limit disturbance to caribou, according to the decision tree presented in Diagram 7-3.

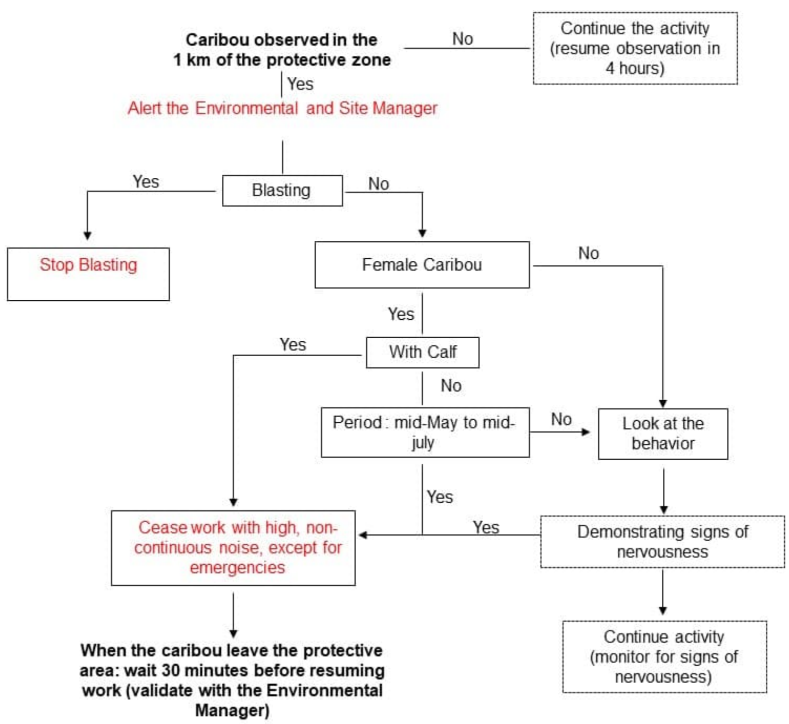


Diagram 7-3: Decision tree to stop work in the 1 km protection zone

Also, as a function of the observations made during surveillance activities, the grouping of vehicles into a convoy on the Ivakkak-Delta Road will be done when a herd of more than 50 individuals is seen along the road (MTR17). This will reduce the duration of periods during which heavy machinery traffic will be present on the Ivakkak-Delta Road. The best moments for the transit of these convoys will also be determined based on observations and will limit the risk of collisions and disturbance. The convoys could happen 3 to 5 times per day.

To reduce the barrier effect of the road on caribou migration, certain specific mitigation measures will be applied. Four important migration routes seem to be present on the future Ivakkak-Delta Road. These sites are all located near permanent watercourses, three of which will require installation of crossings. For these four sites, the proposal is to landscape the crossings with a shallow slope (1 : 3) on both sides of the road and for 50 m on each side of the crossing using fine material to facilitate the passage of caribou. Figures 7-5 and 7-6 present simulated images of the road in the natural environment after the application of the mitigation measure. Indeed, ungulates like caribou do not favour rocky substrates or environments for their movements (Stantec Consulting Ltd, 2010). The substrate covering these gentle slopes should resemble that used on the top portion o the roads actually constructed (Photo 7-5). For the passage without a crossing, the footprint of the road will be landscaped with a gentle slope over a distance of 100 m. Five other such passage will be constructed along the Ivakkak-Delta Road with a spacing of at least 1 km between passages. For the access road to Lake No.4 for drinking water, three passages will be landscaped in the same way. Furthermore, to reduce dust on the roads, they will regularly be wetted (MTR16). The frequency of the wetting will depend on meteorological conditions and observed dust emissions.

Photo 7-5: Adequate surface cover only present on the upper part of the slope. This substrate will need to cover the slope for approximately 100 m on either side of the road for each caribou crossing site.

Relative to MTR19, on the 8th of November 2021, Caribou Ungava presented its projects for phase III of the caribou research. In total, 12 projects touch caribou and their habitat. Table 7-33 presents the first research project to which CRI will contribute financially, in addition to an in-kind contribution in the form of transport, lodging and meals. Furthermore, CRI will actively participate since certain operational changes will be made for the needs of the project.

Figure 7-5: Visual simulation (profile view) of the Ivakkak-Delta road in the migration corridor of the caribou with the application of the mitigation measure to flatten the slopes

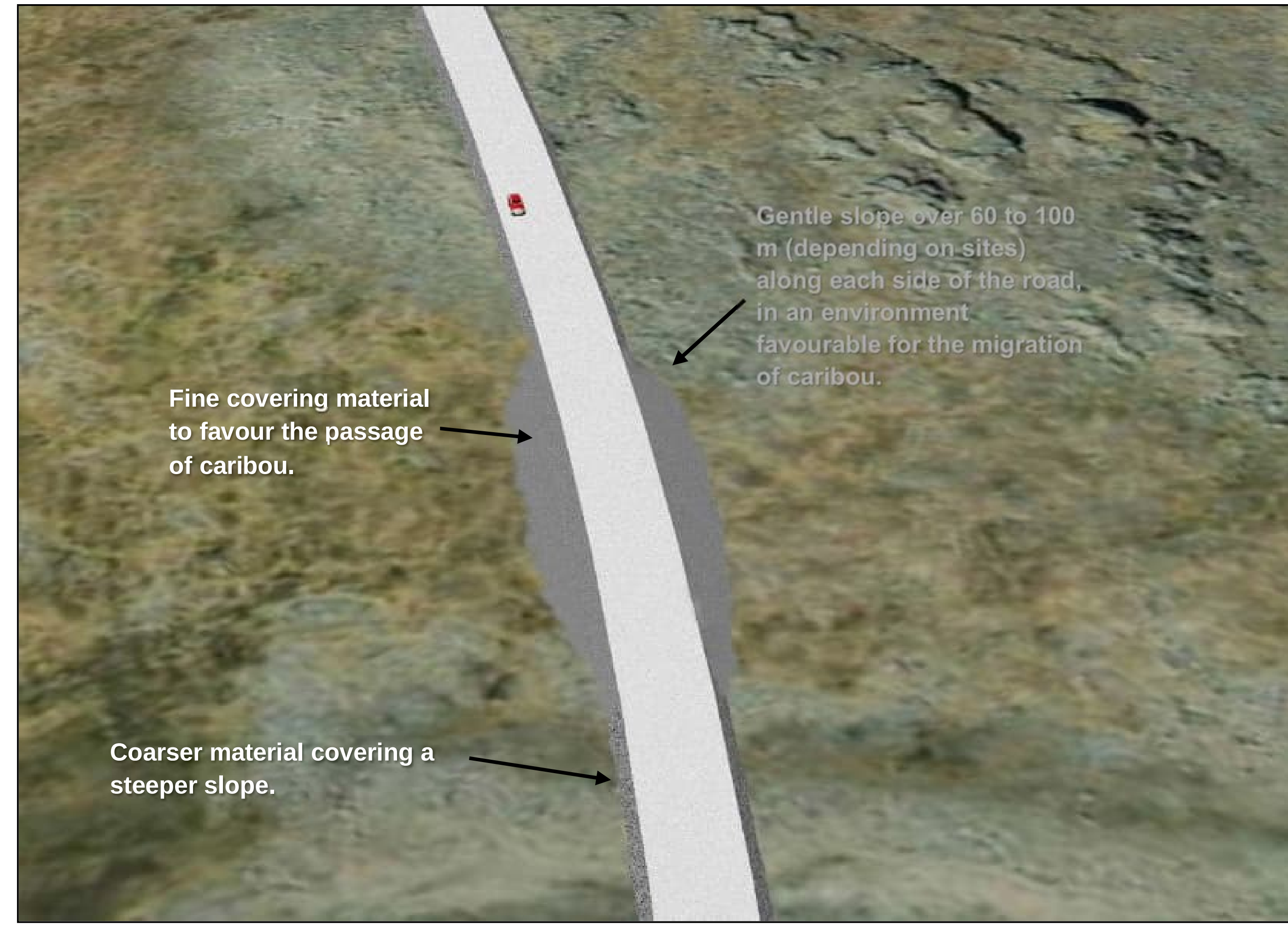


Figure 7-6: Overhead view of the proposed landscaping to make the road's slopes gentler and use of a finer substrate on the caribou crossing perpendicular to the road

Table 7-33: Research Projects on Caribou Undertaken by Caribou Ungava and Being of Interest to Canadian Royalties.

Name of the research project	General objective	Specialized objectives
Impact of linear structures on the behaviour of caribou.	The main objective of the project is to quantify and identify the measure that will mitigate the negative effects of mining transport on the behaviour of caribou.	1. Identify the effects associated with mining transport in the Ungava trough on the fine scale movement rate, activity budget and probability to cross a road by migrating caribou. 2. Evaluate the impact of the type and number of vehicles, and their speed, on the behaviour and probability that caribou will cross a road. 3. Propose mitigation methods for road disturbance (modulate speed and stop traffic) and measure their efficacy. 4. Evaluate the impact of road design (ex: height of the road, slope) on the probability that caribou will cross it.

7.3.4.5 Residual Impact Significance

When the Delta mine will begin its operation, approximately 171 ha will have been impacted by the Delta project within the caribou calving grounds and range. This represents less than 0.001% of the available caribou habitat. With the application of mitigation measures MTR6a, the impact will be limited to the construction and operation areas.

As indicated by Plante (2020) in her Master's thesis, migratory caribou face other threats such as climate change, the effects of which may be more difficult to mitigate than those of human infrastructure and activities, for example at a mine site. It is currently hypothesized that climate change could significantly reduce the ecological niche of migratory caribou, including the LRH in the coming decades (Yannic et al. 2014 in Plante, 2020), and thus lead to an additive effect of habitat loss associated with anthropogenic development (see section 7.3.4.6). Thus, this demonstrates the importance of implementing the above mitigation measures, as these measures could lead to greater herd resilience to climate change (Bauduin et al. 2018 in Plante, 2020).

The implementation of the FFPP aims to reduce as much as possible the stress and injuries to caribou that use the territory in which the NNiP is located. Limiting traffic to work areas and inspecting machinery to avoid excessive noise and stopping work during certain critical periods when females are accompanied by a calf, all contribute to reducing impacts on caribou.

Thus, the proposed mitigation measures contribute to reducing the intensity of the impact and its extent. The significance of the impact is therefore considered minor for all components (Table 7-34).

Table 7-34: Description of the Project's Residual Impact Significance on Caribou

Project phase	Impact description	Mitigation measures	Magnitude	Extent	Duration	Residual impact significance
Construction, operation, closure and restoration	Disturbance of caribou caused by noise, human presence or increased predators.	MTR1, 2, 5 to 12	Low	Local	Moderate	Minor
Construction and operation	Loss of feeding and calving habitat (less than 0.001 %)	MTR6a	Low	Specific	Moderate	Minor
	Stress on caribou and disturbance of calving due to the presence of sudden (blasting) or loud (crushing, loading and unloading) noise.	MTR13 and 14	Low	Local	Moderate	Minor
	Barrier effect on caribou migration due to road construction.	MTR15	Low	Local	Moderate	Minor
Operation	Deposit of dust on vegetation along the mine site and roads.	MTR16 and MTR17	Low	Local	Moderate	Minor
Closure and restoration	Rehabilitation of the site.	MTR18 and MTR19	Low	Specific	Short	Minor (positive)

Although a tiny portion of the recognized caribou calving ground is affected by the Phase 2b Project (approximately 0.001%) as well as its summer feeding grounds (less than 0.001%), the LRH is subject to several other disturbance elements during its migration such as the following (COSEWIC, 2017):

- Hydroelectric development;
- Development of road networks;
- Increased predator numbers;
- Climate change;
- Disease;
- Availability of food;
- Increased mineral exploration in the North by several companies;
- Hunting (prohibited to non-aboriginals since 2018)

With respect to climate change, several studies point out that it may alter caribou distribution patterns in northern environments and affect their survival due to increased predation pressure that may occur. Currently, the main predator of caribou remains the wolf, as well as the black bear (COSEWIC, 2017). It is currently hypothesized that climate change could significantly reduce the ecological niche of migratory caribou, including the LRH, in the coming decades (Yannic et al. 2014 in Plante, 2020), and thus lead to an additive effect of habitat loss associated with anthropogenic development. This further justifies the need to implement the mitigation measures mentioned in section 7.3.4.4.3, as they could lead to greater resilience of the herd to climate change (Bauduin et al. 2018 in Plante, 2020).

Increased mining and resource development in northern regions are contributing to the increasing fragmentation of caribou migration routes, which could result in longer trips during migration and greater energy expenditure to access food resources. COSEWIC has pointed out that the current overall impact of threats is considered high to very high in the case of the eastern migratory population of which the LRH is a part, due to the addition of factors negatively affecting caribou, the main negative factors being mining, and the roads associated with this activity (increasing access to hunting grounds), the increase in fires and the modification of vegetation associated with climate change.

Parasites are common in caribou and may even affect their fecundity. Climate change is predicted to alter some host-parasite relationships (COSEWIC 2017), which may result in additive effects on the caribou population of the LRH.

For hunting by Inuit, no issues are envisaged since as of 2018 hunting is now prohibited for non-aboriginals. Thus, since 2018, hunting is carried out only for subsistence food among the Inuit, which should therefore not constitute a significant cumulative effect on the survival of the LRH.

These different effects taken separately have minor impacts on caribou but added together they can cause more significant impacts on the size of the LRH population. Thus, even though only a small part of the LRH population will be affected by Phase 2b and the overall extension of mining operations in the NNiP, according to telemetric monitoring carried out by the MELCCFP, the mitigation measures proposed in section 7.3.4.3 are aimed at reducing the disturbance caused by the planned activities as much as possible in the short term, but also in the moderate term. In the long term, the restoration activities aim to return the environment to a state that is as natural as possible, in order to remove almost all the effects of the project on the caribou population.

Therefore, the cumulative impact of this Delta deposit development project is considered **minor** on LRH caribou in the NNiP study area due to the mitigation and compensation measures implemented for this project.

7.3.5 Other Land Mammals

7.3.5.1 All Activities

Construction and operation activities have the potential to disturb terrestrial mammals and to attract scavengers and predators to the LEMN site. Indeed, the natural environment in the study area is used by lemmings, ermines, and Arctic foxes, among others, according to various observations made in 2021 and 2022. In addition, caribou carcasses were found in the Delta study area in 2021, suggesting the presence of predators such as wolves and black bears. The Delta site appears to be more heavily used by lemmings (over 30 occurrences) than by foxes (9 occurrences).

Restoration of the environment at the end of the operation will allow terrestrial mammals to regain almost complete availability of the study area.

Considering the small area affected for mammals in relation to local availability and the non-intensive use of the area by terrestrial wildlife other than caribou, the intensity of the impact is considered minor, the extent local and the duration moderate. The significance of the impact before mitigation measures is therefore low.

7.3.5.2 Mitigation Measures

The mitigation measures set out in Appendix 7 of the Nunavik Nickel Agreement, applicable to the present project, as well as the proposed new mitigation measures are presented in Table 7-35.

Table 7-35: Mitigation Measures to Reduce the Impacts on Other Land Mammals

N°[A]	Mitigation measures
MTR1	Prior and regular inspection of machinery shall be performed to ensure that it is in good condition and working properly (minimizing noise).
MTR2	Machine circulation will be limited to work areas.
MTR3a	Undertake an inventory of arctic fox dens in eskers likely to be exploited for the Delta project.
MTR4	Forbid workers from feeding arctic foxes and inform them of the consequences this could have.
MTR5	Store domestic waste in closed containers before its incineration.
MTR6a	Apply the fauna and flora protection plan.

A The number of the mitigation measure refers to Appendix 7 established by the Nunavik Nickel Committee (see Appendix B).

Note : A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

7.3.5.3 Residual Impact Significance

The FFPP includes provisions for bears, wolves and foxes in various contexts (aggressive animals, injured animals, etc.), thus allowing for their protection and reducing the stress that could be caused to them by the activities of the PNNi. Limiting traffic to the work areas and inspecting machinery to avoid excessive noise will also help reduce impacts on terrestrial wildlife.

Thus, the proposed mitigation measures contribute to reducing the magnitude of the impact and its extent. The significance of the impact is therefore considered minor (Table 7-36).

Table 7-36: Description of the Importance of the Residual Impact of the Project on Small Mammals

Project phase	Impact description	Mitigation Measures	Magnitude	Extent	Duration	Residual impact significance
Construction, operation, closure and restoration	Disrupting several species by noise. Possibility of hurting or killing an animal during road transport.	MTR1 to MTR6a	Low	Specific	Moderate	Minor

7.3.6 At-risk Wildlife and Plant Species

7.3.6.1 All Activities

Two observations of wildlife species of precarious status were made. First, a peregrine falcon (species likely to be designated threatened or vulnerable for the subspecies *tundrius* and vulnerable for the subspecies *anatum* according to the *LEMV*) of undetermined sex was noticed on a rock north of km 12 of the future proposed road. Secondly, a Barrow's goldeneye (vulnerable status in Quebec under the *LEMV* and status of special concern in Canada according to SARA) was observed north of the Delta.

Peregrine falcons nest on cliffs, which are not present in the study area. No specific mitigation measures are envisaged as these were occasional observations of resting or hunting birds on low rocky mounds in habitats such as rocky fields or polygonal lowland fens. Barrow’s Goldeneye was a moulting bird, as this is the only possible habitat use for this species, as its breeding range is mainly located north of the estuary and the Gulf of St. Lawrence, in the boreal forest (MELCCFP, 2022f). This is the only observation that has been made of this bird since inventories have been conducted in the territory of NNiP. Thus, only noise and traffic are likely to disturb these two species during construction, operation, closure and restoration.

In terms of plant species of special concern, the species most likely to occur in or near the work area are sulphur buttercup, Ellesmere Island draba, Cayouette's draba, flat-top drab and small-flowered draba. Several individuals of sulphur buttercup were observed at the Delta site, in the satellite camp study area, and along the future road between Ivakkak and Delta. Also, one specimen of Cayouette's draba and one specimen of Ellesmere Island draba were inventoried northeast of the Delta site study area on a flat surrounded by felsenmeer. In the case of the drabas, the specimens were not found in a planned construction area. However, buttercup individuals, including a 4.01 ha colony, are located in areas to be stripped for road and infrastructure construction and development. An impact will thus be produced on this species.

During the construction and operation phases, the dust produced by road transport and traffic could be deposited in the natural environments around the work sites. It could then lead to a decrease in the productivity of these environments since it could potentially modify certain phytological processes, such as photosynthesis, flowering, or pollen dissemination.

Without mitigation measures, the intensity of the impact on species of special concern is high due to the loss of the buttercup colony, the specific extent, and the long duration. The significance of the impact is considered major.

7.3.6.2 Mitigation Measures

Prior to construction work at the Delta site, on the road between Ivakkak and Delta, and at the camp site areas where individuals of Cayouette's draba, Ellesmere Island draba and sulphur buttercup have been seen, will be revisited. An appropriately trained biologist or technician will check to see if individuals are still present and, if so, the location will be marked with visual markers and protected (ESP1; Table 7-37).

The other measures (ESP2a and ESP3) are intended to limit the impact of the project on the habitat of plant species of precarious status, which are the same measures as those in section 7.3.1.3 for terrestrial and wetland environments. Measure ESP4 is intended to conserve the vegetated soil for the preservation of the sulphur buttercup colony.

Finally, considering the low anticipated impact on sensitive habitats for the two species of birds in precarious situation observed during the inventories, no additional mitigation measures will be applied, with the exception of ESP3.

Table 7-37: Mitigation Measures to Reduce the Impacts on Flora and Fauna with At-risk Status

Nº[A]	Mitigation Measures
ESP1	Appliquer VEG1 et VEG1a.
ESP2	Appliquer VEG4
ESP3	Appliquer le plan de protection de la faune et de la flore
ESP4	Appliquer VEG6

[A] The number of the mitigation measure refers to Appendix 7 established by the Nunavik Nickel Committee (see Appendix B).

Note : A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

7.3.6.3 Importance de l'impact résiduel

A colony of sulphur buttercup of 4.01 ha will be destroyed, with an average density of 1.71/100 m^2. However, the conservation of the vegetal soil in front of this colony, probably including its seeds, will help the recolonization of the species during the restoration of the site (ESP2). In the case of the drabas, the risk is rather low since only one individual of each species was observed during the field surveys on the Delta site. These individuals are outside the construction area. The position of these specimens was noted and they will be protected during the development work (mitigation measure ESP1 and 3).

Overall, the intensity of the impact is considered low on this component since the destruction of the colony will only occur over a certain period of time. The extent is local since it would affect a large colony of 4.01 ha and the duration is long, since the destruction of a plant is considered permanent and no data for the time of vegetation restoration is available. Therefore, the significance of this residual impact is considered moderate (Table 7-38).

The impact of degraded habitat for sensitive plant species in the vicinity of the mine sites is low intensity because the terrestrial environments preferred by the drabas are exposed and windswept and therefore less sensitive to dust, and several mitigation measures will be applied to limit the impact on the sulphur buttercup (Table 7-38). The extent is local and the duration is moderate. The project's impact on the habitat of status plants is of minor significance (Table 7-38).

For bird species at risk, the intensity of the impact is low, the local extent and the duration medium, making the significance of the residual impact minor.

Table 7-38: Description of the Project's Residual Impact Significance for At-risk Flora and Fauna Species

Phase de réalisation	Description de l'impact	Mesures d'atténuation	Intensité	Étendue	Durée	Importance de l'impact résiduel
Construction, operation, closure and restoration	Loss of a 4.01 ha colony of sulphur buttercup, additional potential loss of plants of special status species at the Delta site and on the road between Ivakkak and Delta.	ESP1 to 4	Low	Local	Long	Moderate
	Risk of degradation of the habitat of plant species of precarious status due to dust or trampling.	ESP2	Low	Specific	Moderate	Minor
	Disturbance of birds in precarious situations while foraging or moulting.	ESP3	Low	Specific	Moderate	Minor

7.4 Impacts on the Human Environment

7.4.1 Economy and Employment

7.4.1.1 All Activities

The two variants of the Delta project anticipate hiring and/or maintaining roughly a hundred workers over a period of 5-7 years. CRI expects that some of these jobs will be occupied by Inuit employees from Nunavik. Therefore, the project will maintain or create new local and regional jobs. This impact will be positive, of moderate magnitude, with a regional extent (jobs will be available to all Nunavik residents, not just for those from the local communities of Salluit and Kangiqsujuaq) and of moderate duration (5 to 7 years). Furthermore, companies based in Nunavik will be able to obtain contracts as a part of the different phases of the project which will also have a positive effect on the regional economy.

Moreover, although it is beneficial from a monetary point of view, job creation within the Inuit communities will also lead to changes in Inuit lifestyles who work on the various mining sites of Delta project. Mitigation measures are therefore required to limit this impact.

7.4.1.2 Mitigation Measures

Implementation of improvement measures will favour the hiring of Inuit workers from Nunavik during the different phases of the Delta project and prioritize companies based in Nunavik during bidding for work linked to construction, operation and closure phases of the project. In parallel mitigation measures will ne put into place to minimize the impact of the lifestyle of Inuit workers (Table 7-39).

Table 7-39: Mitigation Measures Aimed at Fostering Economic Benefits and Employment Within the Nunavik Inuit Communities

Nº[A]	Mitigation measures
ECO1	Hiring will give preference to Inuit workers.
ECO2	Maintain the information and recruitment program in the Inuit villages.
ECO3	Maintain the training program intended and adapted for future Inuit workers.
ECO4	Encourage Nunavik-based companies with the skills for the tasks requested in the call for bids procedure, before undertaking requests to companies based in Abitibi, elsewhere in Quebec or abroad.
ECO7	Promote the integration of Inuit workers hired for construction into the operation phase.
ECO9	Respect the updated Nunavik Nickel Agreement policies related to the hiring of Inuit workers as well as royalties.
MOE1 to MOE10	Integrate new workers by explaining the different living conditions and regulations on the NNiP site, as well as the different programs available. All of these measures can be found in Annex 7 of the Nunavik Nickel Agreement.

[A] The mitigation measure number refers to Annex 7 established by the Nunavik Nickel Committee (see Annexe B).

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

7.4.1.3 Residual Impact Significance

The project will allow continuation and creation of jobs within local and regional communities and present business opportunities for regional companies. These positive impacts on local and regional economies and employment will be felt during the construction, operation, and closure of the project. The duration will be long (7 to 10 years). The extent of the impact will be regional since many communities will be affected. The magnitude will be moderate. The impact of job creation and the local and regional economic benefits is therefore judged to be major and positive (Table 7-40).

In terms of the changes of the Inuit workers' lifestyles, the extent will remain long, due to the work's duration (several years). Fewer people will be affected since this impact will only affect the workers directly involved and not for all communities. In addition, mitigation measures will be implemented to facilitate worker integration into their new work environment. The extent will therefore be site specific (impacts only on workers) and the magnitude low. The impact's significance is therefore considered minor.

Table 7-40: Description of the Project's Residual Impact on the Economy and Employment

Component	Project phase	Impact description	Mitigation measures	Magnitude	Extent	Duration	Residual impact significance
Social environment - Economy and employment	Construction, operation, closure and restoration	Job creation and local and regional economic benefits.	ECO1 to ECO7, ECO9	Moderate	Regional	Long	Major (positive)
		Labor mobility and change in the Inuit employees' lifestyle.	MOE1 to MOE10	Low	Specific	Long	Minor

7.4.1.4 Cumulative Impacts

Mining activity over the last 25 years have generated many jobs in local and regional communities and has created business opportunities for certain companies, namely Transport Padlayat and Nunavik Construction. Furthermore, Glencore Canada and CRI pay royalties to the northern villages of Salluit and Kangiqsujuaq. In parallel, the Pingualuit National Park employs members of the Kangiqsujuaq community on a permanent, temporary and punctual basis.

The current project will offer new business opportunities for local and regional companies, will create or consolidate jobs for these companies, particularly during the construction phase. It will also permit the training and employment of new personnel from the local communities during the operation phase.

Therefore, the cumulative impact on local and regional employment and the economy is considered **major** and **positive**.

7.4.2 Land Use by the Inuit

7.4.2.1 All Activities

Data obtained from the Makivik Corporation shows that activities were practiced between 2007 and 2017 by people from Salluit and Kangiqsujuaq in proximity to the proposed Delta project sites. As noted in section 6.4.3, they indicated that members of the community travelled in proximity to the anticipated Delta mine site, possibly using a snowmobile. Information from the Makivik Corporation also identified a camp frequented by people from Salluit on the north shore of Kenty Lake, approximately 10 km southwest of the anticipated mine site (Figure 6-16). Furthermore, the same information located a dozen harvesting sites (associated with Salluit) near Kenty and Qikirtalik lakes, some found less than 4 km west of the future Delta mine site and less than 2 km from the freshwater pump station planned for Lake No.4.

Although partial, the information available regarding the current use of the territory concerned by Phase 2b shows that Inuit visited there between 2007 and 2017. Certain places are less than 5 km from the anticipated mine site and even closer to certain elements of the Delta project, such as the drinking water treatment plant. The noise, dust and vibrations caused by the construction of new mining infrastructures, their operation and possibly their closure could therefore be seen by Inuit users visiting the area, contributing to a disturbance of the site's tranquillity, as well as a possible decrease in the quality of hunting, fishing, trapping, and gathering in the sectors affected. The construction and operation of the Delta project sites could also cause a temporary or permanent access interruption to certain sites frequented by the Inuit, or even lead to the partial or total loss of certain sites used. As a matter of face, from the start of construction to the end of the closure phase, Inuit will not be allowed closer than 5 km to CRIs infrastructure which will not allow use of the sector northeast of Kenty Lake.

The construction, operation and closure of the sites proposed for NNiP's Phase 2b could also temporarily or permanently hinder travel routes used by the Inuit in the territory affected. To this intent, the safety of Inuit users travelling there could be affected by the circulation of vehicles or machinery used during operations carried out by CRI (construction, operation and closure), particularly along roads or access roads, snowmobile crossings, ATV or other means of land travel routes found in the territory affected by Phase 2b.

Also, activities undertaken during the construction, operation, and closures phases of the mine site could affect fauna prized by Inuit users, namely caribou. Perturbations to these species could cause them to move to other locations and leave usual hunting grounds. This could affect the hunting habits of Inuit users who could possibly have to deploy more effort to find game successfully.

Lastly, the creation of new jobs in the Nunavik Inuit communities in connection with NNiP's Phase 2b could indirectly lead to a decrease in the practice of activities on the territory among Inuit workers. It is in fact possible that Inuit employees working on the construction, operation and closure of the sites proposed for the Delta project will have less time to devote to their land use activities due to their presence at the CRI operated sites, rather than in their community.

7.4.2.2 Mitigation Measures

The implementation of mitigation measures will reduce the impacts of NNiP's Phase 2b on the use of the territory by the Inuit, specifically:

- By informing the people of the Salluit and Kangiqsujuaq communities of the work carried out on the territory affected by NNiP's Phase 2b
- By maintaining access and circulation as much as possible on the territory affected
- By ensuring the safety of Inuit users frequenting the territory affected

Table 7-41 describes all suggested mitigation measures.

Table 7-41: Mitigation Measures to Reduce the Impacts on Land Use by the Inuit

Nº[A]	Mitigation measure
ORS1a	Possibility for Inuit workers to do a shorter work rotation (two weeks on, followed by two weeks off), so they can spend more time in their community.
TRC1	Mark new access roads and post traffic signs where snowmobile and all-terrain vehicle trails intersect these roads or the main road when required.
TRC11	Install signs mentioning the presence of traffic lanes or work/operation areas in proximity to inform Inuit users who may travel through or practice activities in the sector.
URT1	No measures will be taken to facilitate sports fishing by the workers (e.g., transportation by helicopter).
URT2a	Prohibit the possession of firearms at CRI sites (except with special authorization for protection against polar bears), as to limit sport hunting activities practiced by employees.
URT3	Prior and regular inspection of machinery will be performed to ensure that it is in good condition and working properly (to avoid producing excessive noise).
URT4	Lakes used by the residents of Salluit and Kangiqsujuaq will remain accessible.
URT6	Continue to set up fishing programs governing this activity in the targeted bodies of water.
URT10	In the event that traffic must be temporarily or permanently impeded on trails used by Inuit users, provide bypasses or new safe travel routes together with the Salluit and Kangiqsujuaq communities. Inform the population of the Salluit and Kangiqsujuaq communities of the bypassing routes or new travel routes.
URT11	Regularly inform the Salluit and Kangiqsujuaq communities of the work carried out on the NNiP territory affected (nature of the work/operations, location of the work/operations, schedule, potential dangers for Inuit users).
URT12	Regularly inform CRI workers of the potential presence of Inuit users in the territory concerned by NNiP's Phase 2a.
SON2	Machine circulation will be limited to work areas.
SON3	If possible, isolate the main sources of noise with a sound-absorbing material, when possible.

[A] The mitigation measure number refers to Annex 7 established by the Nunavik Nickel Committee (see Annexe B).

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

7.4.2.3 Residual Impact Significance

Implementing mitigation measures will reduce the impacts of NNiP's Phase 2b on the use of the territory by the Inuit. These measures will make it possible to inform the communities affected, to maintain - as much as possible - the continuity of traffic and access to the territory affected by the NNiP, to ensure the safety of users moving there and to limit the pressure on resources that could be induced by allochthonous CRI workers.

However, the NNiP's Phase 2b construction, operation, and closure will still lead to a partial or total loss of territories likely to be frequented by the Inuit. This loss will be permanent, or at least continue for the duration of the various phases of the project (a minimum of 7 – 10 years). Furthermore, the noise and vibrations caused by the construction, operation and closure of the proposed sites could also be seen by Inuit users, moving, staying, or practicing activities not far from the proposed Delta project or near the access road that connects them territory covered by the NNiP. Noise and vibrations, but also the dust produced (construction, operation, and closure of the proposed Delta project), could also affect the resources present in the surrounding territory (wildlife species, plant species, water), which would result in a decrease in the quality of activities for Inuit users. Once again, these impacts will be felt for the entire duration of the construction, operation, and closure of the proposed project. The impact on Inuit land use will therefore be long in duration (minimum of 7 to 10 years).

Although it is difficult to decide on the magnitude of the impact after mitigation measures regarding the Inuit use of the territory covered by NNiP's Phase 2b, it is evident that activities do take place. This territory's extent is vast. It is therefore possible that, despite mitigation measures being implemented, certain activities carried out by the Inuit will be affected at one time or another during construction, operation, or closure of the Delta project. The extent of this impact will therefore be local. However, the Inuit will have the option of moving their activities to other locations if they feel that the territory covered by NNiP's Phase 2b no longer meets their needs. Note that measures will be taken to maintain access and circulation of users on the territory as much as possible, as well as to ensure their safety. The magnitude of this impact is considered to be low. Therefore, the residual impact's significance on the use of the territory is considered moderate (Table 7-42).

Table 7-42: Description of the Project's Residual Impact Significance on Land Use by Inuit

Component	Project phase	Impact description	Mitigation measures	Magnitude	Extent	Period	Residual impact significance
Human environment - Land use by the Inuit	Construction, operation, closure and restoration	Disruption of traditional Inuit activities within the NNiP territory.	ORS1a TRC1 and TRC11 URT1 to URT6 URT10 to URT12 SON 2 and SON3	Low	Local	Long	Moderate

7.4.2.4 Cumulative Impacts

Mining activities have limited the land use by people from Salluit and Kangiqsujuaq[14], and have led to inconveniences for users travelling near mine sites (noise, odour of diesel fumes, alterations of the landscape). These limitations to land use could increase with the projected expansion of CRIs mining activities over the next 10 years. Territory covered by the NNiP could increase with the current Delta project and the, as yet unevaluated, Nanaujaq project.

[14] Use of most roads constructed by mining companies is not authorized and it is not authorized to approach within a certain distance of mining installations.

On the other hand, mining activities have indirectly facilitated access to certain portions of the territory for people from Salluit who can now take advantage of an access road to travel between Deception Bay and areas around Duquet and François-Malherbe lakes (AECOM and TUGLIQ Energy, 2022). For its part, tourism activities have facilitated land use by users from Kangiqsujuaq. Notably, this is achieved by the creation of a winter access corridor between the northern village of Kangiqsujuaq and the Pingualuit National Park, but also because of the construction and regular upkeep of camps used by both visitors to the park and people from Kangiqsujuaq.

The present project will open new access to Kenty and Beauparlant lakes, which seem to be frequented sectors according do information transmitted by Makivik. However, these sites could be disturbed by noise coming from the mining activities.

Therefore, the cumulative impact of the present project on land use by Inuit is judged to be **major** in the study zone.

7.4.3 Archeology and Heritage

7.4.3.1 Construction Phase

Soil stripping and disturbance can destroy archaeological sites.

Since field inventories didn't find cultural indicators associated with what could be considered a traditional Inuit occupation site, the construction phase shouldn't have an impact on archeological heritage. Only the sector for the access road for drinking water was not subjected to a meticulous field inspection, but no archeological potential was identified. No additional archeological inventories are deemed necessary.

However, since archeological resources are elusive and sometimes buried and unsuspected, if during work archeological objects are discovered the site foreman must avoid these vestiges and CRI must absolutely ensure the cultural resource's protection. Subsequently, the *Ministère de la Culture et des Communications du Québec* (MCC) must be informed under the terms of article 74 of the Cultural Heritage Act (L.R.Q., P-9.002, 2011, chap. B 4) which states that *"A person who discovers an archaeological property or site must inform the Minister of it without delay."* Work may continue only if the archaeological resource is not affected and is protected.

7.4.3.2 Mitigation Measures

In the event that remains of interest are discovered during the work and they have not been listed during the 2022 inventories, the ARC1 mitigation measure would be applied (table 7-43).

Table 7-43: Mitigation Measures to Reduce the Impacts on Archeology and Heritage

Nº[A]	Mitigation measures
ARC1	If remains of importance are discovered, the site supervisor shall be informed immediately, and measures taken to protect the site.

[A] The mitigation measure number refers to Annex 7 established by the Nunavik Nickel Committee (see Annexe B).

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

7.4.3.3 Residual Impact Significance

The application of the mitigation measure and survey completion prior to the work, aim to protect and conserve archaeological sites of interest. These actions contribute to reducing and completely eliminating the impact on this component (table 7-44).

Table 7-44: Description of the Project's Residual Impact on Archaeology and Heritage

Component	Project phase	Impact description	Mitigation measures	Magnitude	Extent	Period	Residual impact significance
Human environment - Archaeology and heritage	Construction	Discovery of archaeological or historic remains during construction	ARC1	Impact eliminated			

7.4.4 Soundscape

7.4.4.1 All Activities

Construction, operation, closure, and restoration activities will produce an increase in noise at the local level due to the use of noisy machinery, industrial activities, and road traffic. Table 7-45 shows an example of the type of mobile machinery that can be used on site or on the road. The level of noise produced by the machinery is very high in close proximity, which can cause damage to workers' hearing (Table 7-45). Blasting must not generate linear decibel levels exceeding 128 dBL according to *Directive 019*. It is possible that noise levels will increase in proximity to Lake No.4 because of the operation of the pump station.

The sound monitoring carried out in Pingualuit National Park seems to indicate the absence of noise impact in this area’s natural environment, which was the sensitive component identified during the initial impact assessment. Thus, the increase in noise at the local level will be felt mainly in the disturbance of land animals. So far, no report of noise disturbance in nearby natural sites used for hunting or fishing or in temporary camps has been brought to CRI's attention. Furthermore, the nearest village to the Delta site is Kangiqsujuaq which is more than 80 km away. Residents will not be inconvenienced by the noise emanating from the construction site.

Further, a noise study was done during the impact study for the installation of a wind farm in proximity to the Expo mining complex (AECOM and TUGLIQ Energy, 2022). According to an instructional note by the MELCC (2006), noise levels for sensitive receptors, like Bombardier Lake (having a pump station) and Rocbrune Lake (almost 8km from the Expo site), must not exceed 45 dBA during the day and 40 dBA at night, limits associated with residential zones. Activities currently present at the Expo site, which are noisier than Delta, are not perceptible, except for blasting which generates ambient noise levels of 57.4 dBA in proximity to the Expo camp. For the work camp at the Expo site, the noise levels must not exceed 55 dBA during the day and 50 dBA at night, since the camp is in an industrial zone.

When mitigation measures are absent, the impact's magnitude will be high for the workers and medium for the surrounding fauna and the environment's users, the extent site specific and the duration long if there are aftereffects for workers and short for animals (can move quickly to escape the noise) and users (move to a quieter place if an effect is felt). The impact's significance is therefore major for workers and minor for wildlife and users, when no mitigation measures are applied.

Table 7-45: Sound Level Produced by Machinery Regularly Used Outdoors on the NNiP Site (GENIVAR, 2007)

Mobile equipment	Sound level (dB (A))	Equipment distance
Drilling machine air compressor	110-115	1 m
	98	15 m
Jaw crusher	90-100	Operator’s position
Rotary drill	72-100	Operator's position
Diesel truck	74-109	Driver’s cabin
	88	15 m
Loader	84-107	Driver's cabin
	87	15 m
Grader	76-104	Driver's cabin
Pneumatic hammer	104-112	Operator's position
Excavator	78-101	Driver's cabin

7.4.4.2 Mitigation Measures

To ensure that the workers' physical integrity is protected, it is essential that they apply the SON4 measure (Table 7-46), as well as site visitors if they travel into environments where the decibels require hearing protection devices to be worn. The SON 1, SON 2 and SON3 mitigation measures aim to restrict the extent and range of noise outside the local sites where the machinery is being used.

Table 7-46: Mitigation Measures to Reduce the Impacts of the Soundscape

Nº[A]	Mitigation measures
SON1	Preliminary and regular inspections of the machinery to ensure it is in good condition and working properly (so no excess noise is generated)
SON2	Machine circulation will be limited to work areas.
SON3	If possible, isolate the primary sound sources with absorbent material
SON4	It shall be mandatory for workers to wear hearing protection devices when inside noisy buildings (e.g., crushing and grinding unit)

[A] The mitigation measure number refers to Annex 7 established by the Nunavik Nickel Committee (See Annexe B).

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

7.4.4.3 Residual Impact Significance

The mitigation measures set out above lead to a low impact magnitude, a specific extent and moderate duration. The residual impact's significance is then minor for all the components affected by noise (table 7-47).

Table 7-47: Description of the Project's Residual Impact on the Soundscape

Component	Project phase	Impact description	Mitigation measures	Magnitude	Extent	Duration	Residual impact significance
Human Environment - Soundscape	Construction, operation, closure, and restoration	Increase in the noise level around the site.	SON1 to SON4	Low	Specific	Moderate	Minor

7.4.5 Landscape

During the construction phase, no activities will take place in proximity to the Pingualuit National Park. Given the distance from the Delta site work zone, about 45 km from the crater, they will not be very visible from the Pingualuit National Park. However, the construction work for the road will begin near the Ivakkak site and this road is situated a little more than 30 km from the crater and around 8 km from the park limits.

All of the construction, operation and closure activities will lead to the landscape's occasional modification with the insertion of anthropogenic structures. Indeed, the natural topography of the area will be modified by the mine extraction work because of the accumulation of waste rock and by buildings. No mining infrastructure will affect the integrity of the landscape of the Pingualuit National Park since no activity will take place inside of, or in proximity to, the limits of the park.

All of the construction, operation and closure activities will lead to the landscape's occasional modification with the insertion of anthropogenic structures. However, this impact is part of an environment that seems little frequented by the population of the surrounding Inuit villages. During the initial impact assessment, the issue identified was mainly a change in the natural landscape's appearance for users of Pingualuit National Park. Situated around 45 km from the Pingualuit crater, the Delta site is unlikely to be visible from the crater, considering that the Expo and Méquillon sites, located 33 and 25 km away respectively, are not very visible from different locations inside the park (see photo 7-6). Further, Pingualuit National Park is currently in the process of becoming a dark sky preserve (AECOM and TUGLIQ Energy, 2022). One of their preoccupations is therefore to not have new sources of light pollution that will interfere with its development plan. As seen on photo 7-7, it is unlikely that the addition of the Delta site operation will emit light sources that will interfere with the development plan of the Park, given the distance of the mine installations compared to Expo and Méquillon.

Diagrams 7-4 to 7-11 show a visual simulation of the Delta site before and during operation, as well as during the site restoration phase. Diagrams 7-12 to 7-15 show the natural environment before, during and after installation of the Delta satellite camp. Note that the road will remain after the dismantling of the installations.

In addition, the environments are completely restored, and all buildings or other traces of mining use are removed when the various projects are complete. As shown in the visual simulations of Diagrams 7-7, 7-11, and 7-15, some structure will remain, but the impact on the landscape will be minimal. It will still take some time after the restoration for the vegetation to regain its place in the areas where it can grow.

The importance of the impact on the landscape for the construction, operation, and closure phases will be moderate without mitigation measures because of its low magnitude, local extent and long duration.

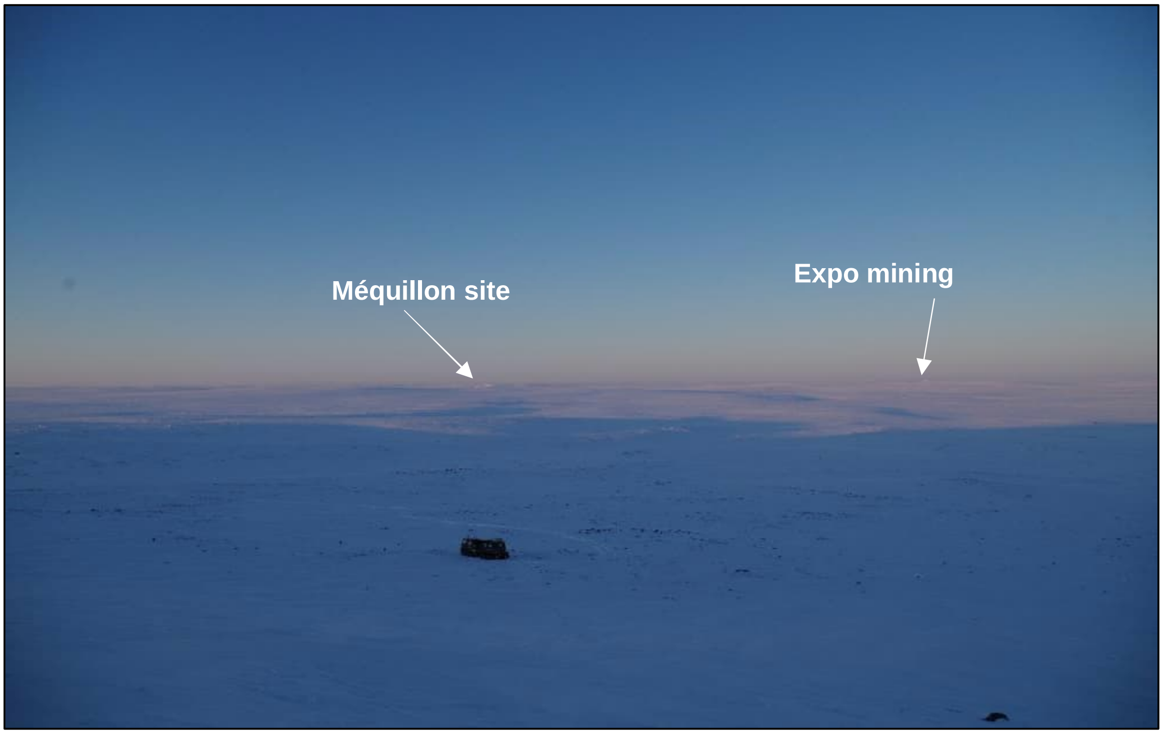


Photo 7-6: View of the Expo Mining Complex and the Méquillon Site Facilities from Pingualuit National Park.

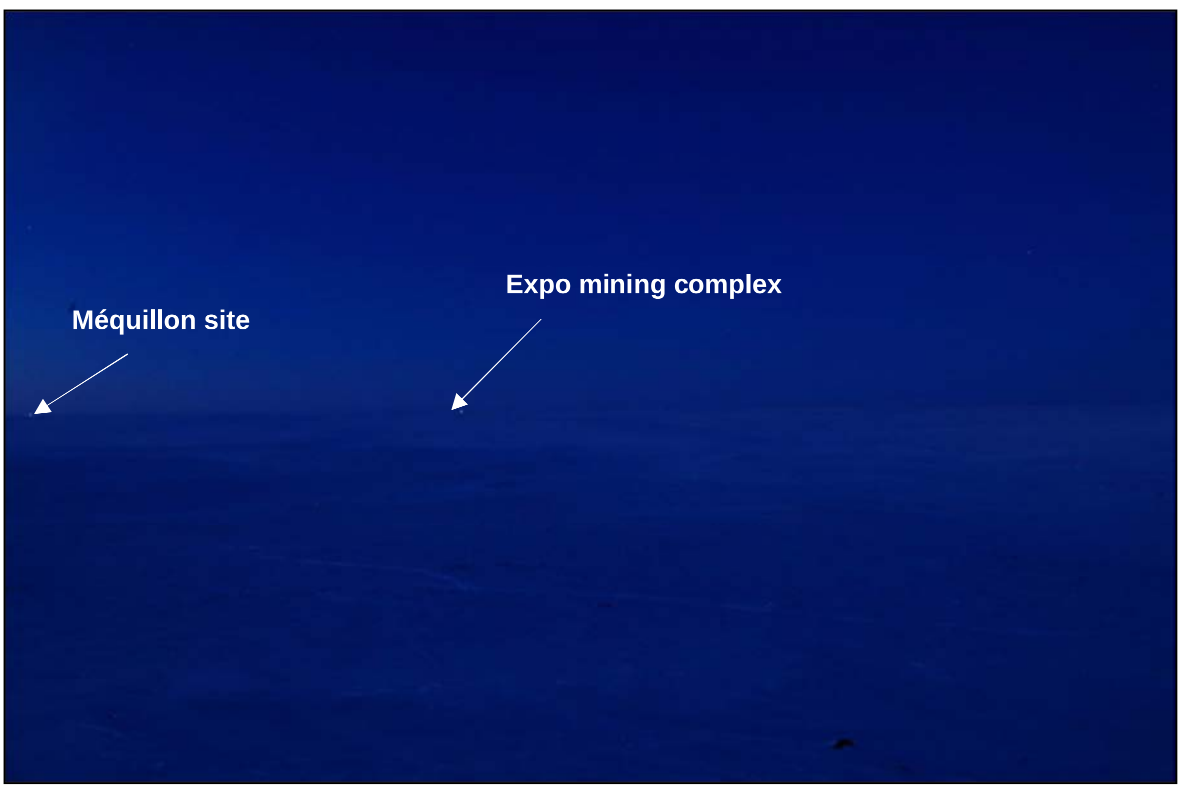


Photo 7-7: View of the Expo Mining Complex and the Méquillon Site Facilities from Pingualuit National Park in the darkness.

Diagram 7-4: Aerial view of the natural environment at the future Delta site, view to the east.

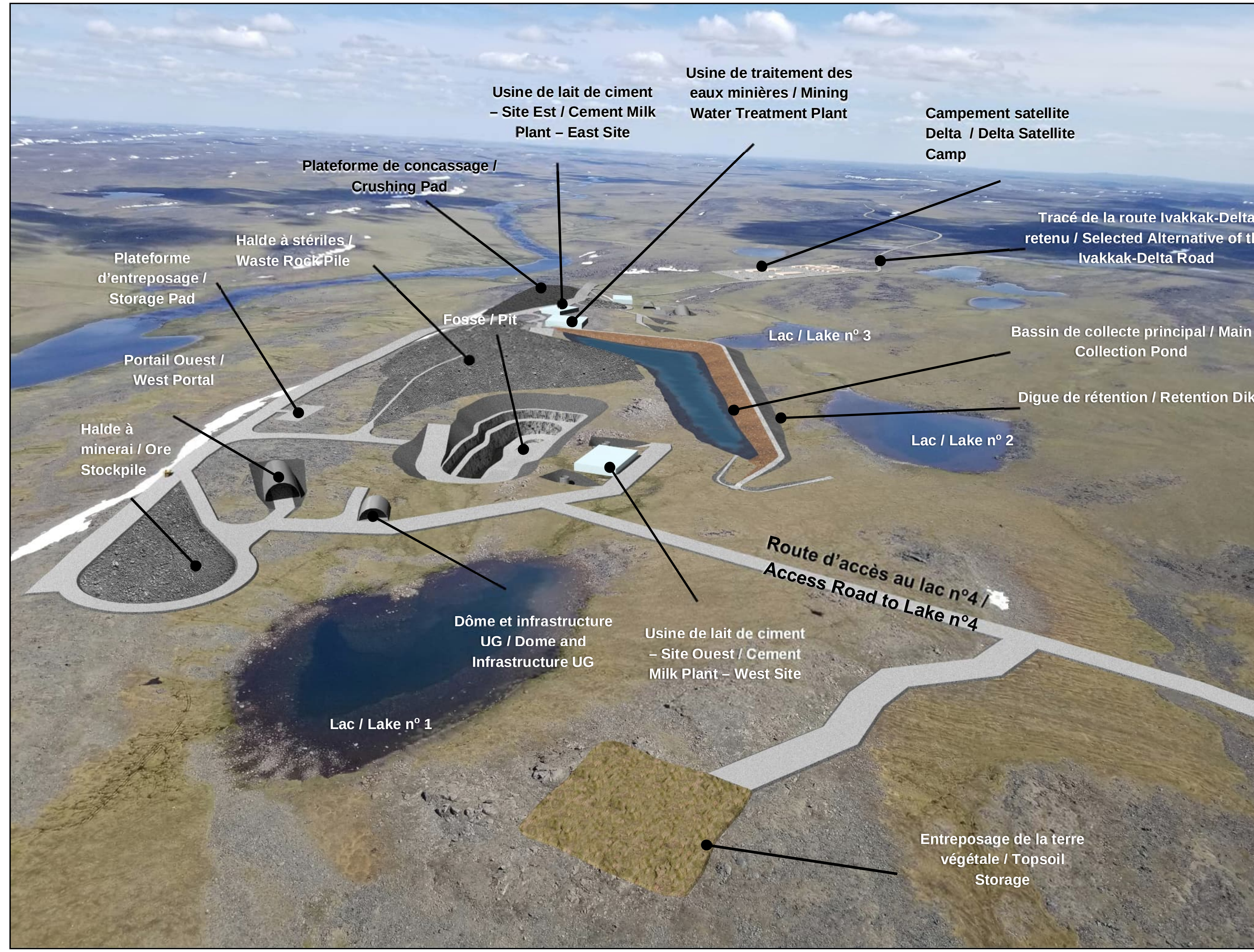


Diagram 7-5: Visual simulation of the installations at the Delta site, view to the east.

Diagram 7-6: Aerial view of the natural environment at the future Delta site, view to the east.

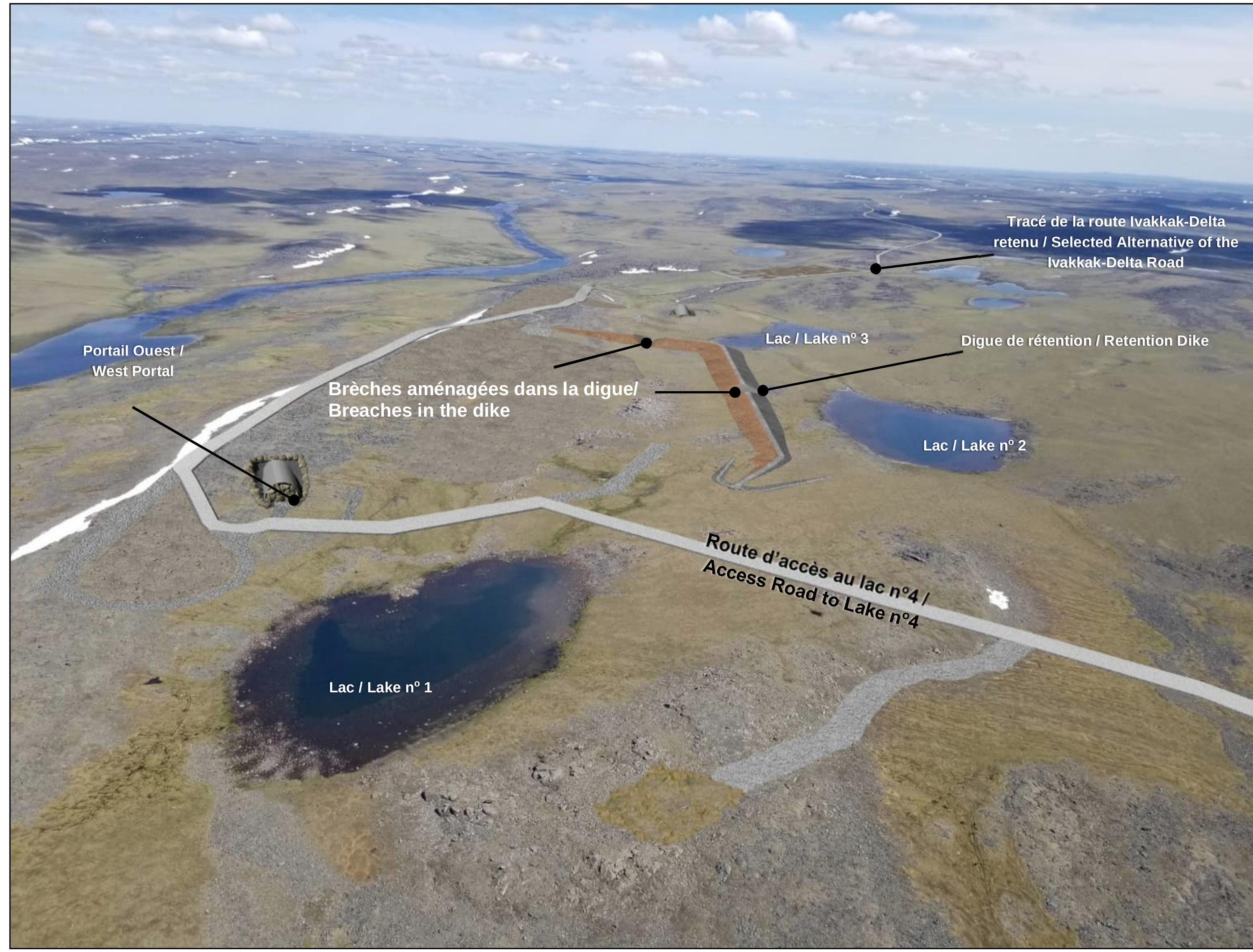


Diagram 7-7: Visual simulation of the Delta site post-restoration, view to the east.

Diagram 7-8: Aerial view of the natural environment at the future Delta site, view to the west.

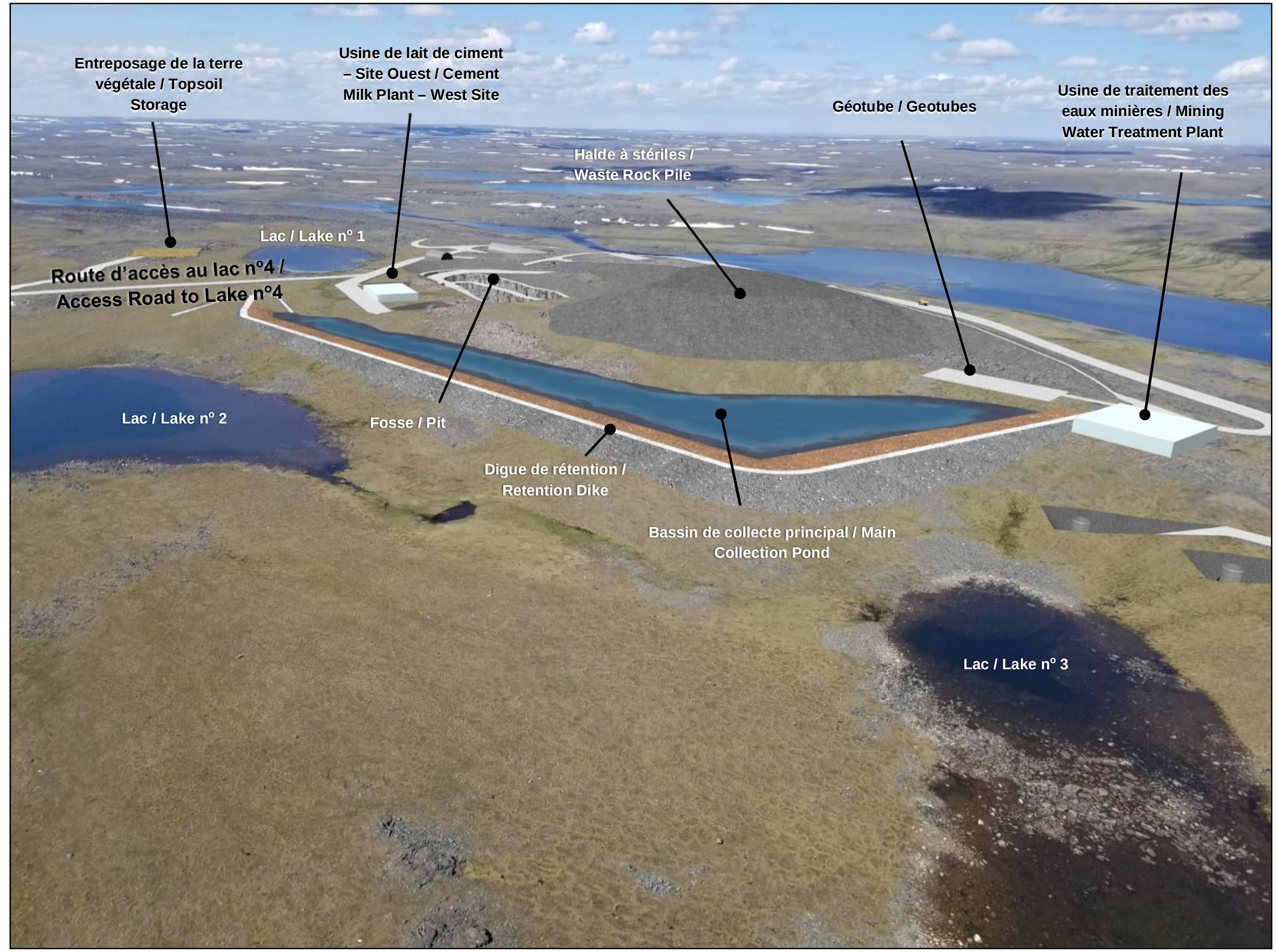


Diagram 7-9: Visual simulation of the installations at the Delta site, view to the west.

Diagram 7-10: Aerial view of the natural environment at the future Delta site, view to the west.

Diagram 7-11: Visual simulation of the Delta site post-restoration, view to the west.

Diagram 7-12: Aerial view of the natural environment at the future Delta satellite camp, view to the north.

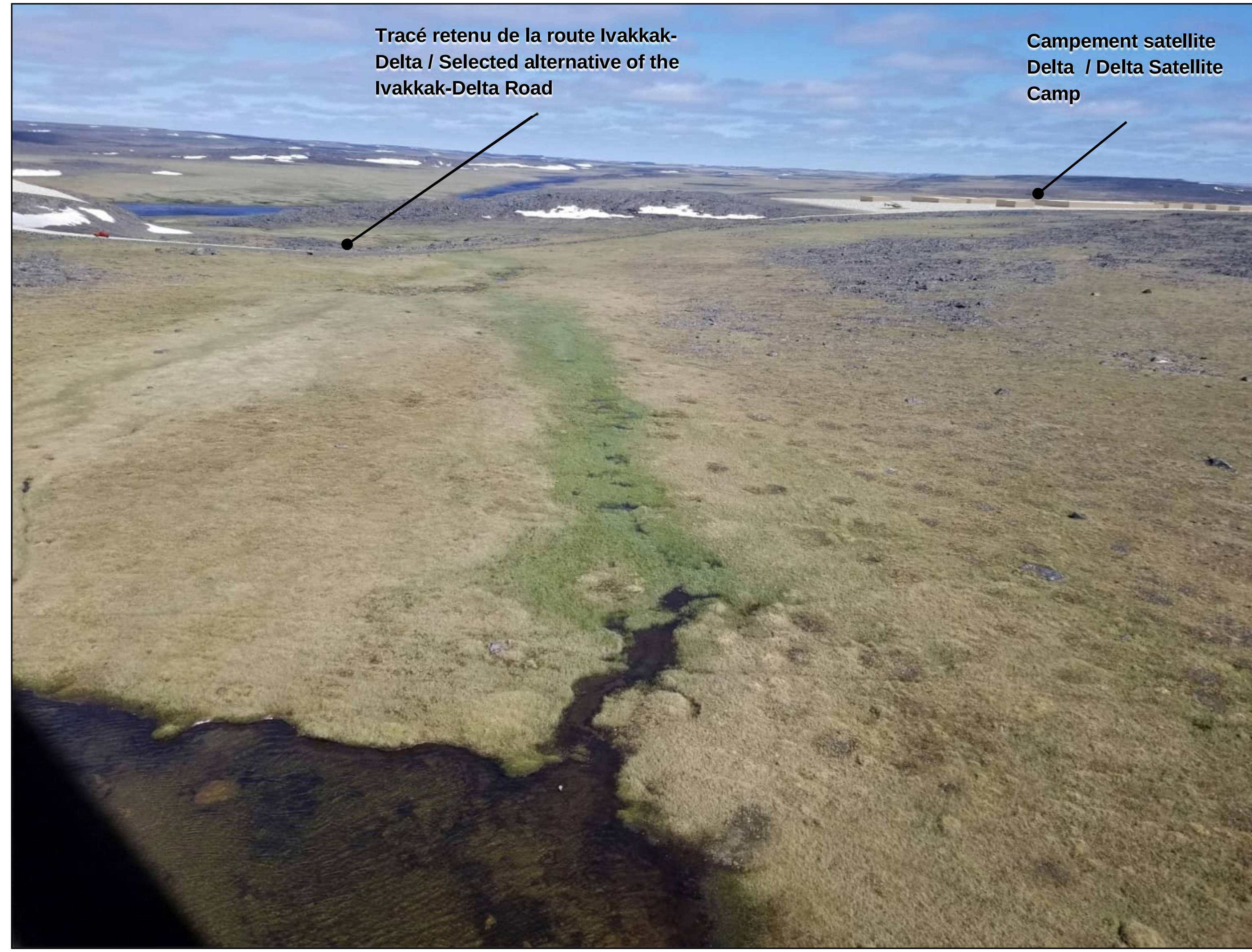


Diagram 7-13: Visual simulation of the Delta satellite camp, view to the north.

Diagram 7-14: Aerial view of the natural environment at the future Delta satellite camp, view to the north.

Diagram 7-15: Visual simulation of the Delta satellite camp post-restoration, view to the north.

Nevertheless, some mitigation measures will be implemented to limit the effects on the landscape and are presented in Table 7-48. The mitigation measures make it possible to reduce the impact's extent, but the residual impact's significance remains minor for the construction, operation and closure phases. An impact will remain after restoration since not all of the infrastructure will be totally removed (Table 7-49).

Table 7-48: Mitigation measures to minimize impacts on the landscape

N°[A]	Mitigation measures
PAY1	Minimize stripping, clearing, excavation, backfilling and grading to maintain the natural topography as much as possible.
PAY2	When construction is completed, work areas shall be rehabilitated and restored so that they blend in as much as possible with the natural landscape (regrowth of vegetation).
PAY3	Build the waste rock and ore stockpiles in such a way to round its shape to better integrate it into the landscape.
PAY4	After the mine closes, disturbed sites will be rehabilitated and restored by encouraging plant growth so they blend in with the natural landscape as much as possible, and mine facilities will be dismantled and taken back south.
PAY5	Installation of directional sodium lighting to limit the light dispersion around the mining complex.
PAY6	Add photos looking towards the Delta complex to monitor light pollution.

A The mitigation measure number refers to Annex 7 established by the Nunavik Nickel Committee (see Annexe B).

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

Table 7-49: Description of the Project's Residual Impact Significance on the Landscape

Component	Project phase	Impact description	Mitigation measures	Magnitude	Extent	Duration	Residual impact significance
Human Environment – Landscape	Construction, operation, closure	Deterioration of surrounding scenery.	PAY1, PAY3, PAY5, and PAY6	Low	Specific	Long	Minor
	Restoration	Site restoration	PAY2 and PAY4	Low	Specific	Long	Minor

7.4.5.1 Cumulative impacts

Mining activities have already had an important impact on the landscape of the region through construction and operation of different mine sites and the construction of roads, port infrastructure, an airport, various buildings, telecommunication towers and windmills (windfarm exploited at the Raglan mine and a future windfarm at the Expo mining complex). These impacts on the landscape could become more important with the projected expansion of CRI's mining activities over the next 10 years on territory covered by the NNiP, mainly for the Ivakkak project currently under construction and the potential new Nanaujaq project, in addition to the present project. Site restoration will however reduce the effect on the landscape and at certain sites (Allammaq, Puimajuq, Nanaujaq, Delta) the waste rock piles will be completely removed.

For its part, tourism has had a minor impact on the landscape. It is essentially linked to the creation of hiking trails, camp construction, temporary refuges and arrival buildings within the Pingualuit National Park, as well as the establishment of a winter access corridor between the park and the northern village of Kangiqsujuaq (AECOM and TUGLIQ Energy, 2022).

The present project will contribute to amplify the impact on the landscape since the waste rock piles could be seen from Pingualuit National Park and the project will be inserted into an environment not used by CRI for mine operation (new road and site). However, no additional light pollution for the users of Pingualuit National Park is anticipated, in particular at night, because of the distance from the park (about 45 km from the crater) and the generally white colour of the light source. The disturbance on the landscape will be long since, even after restoration, certain small infrastructure will remain in place.

As a consequence, the cumulative impact of the present project on the landscape is considered **minor** in the study zone.

7.5 Assessment of the Impacts, Mitigation Measures and the Residual Effect

Table 7-50 presents the impact assessments associated with Phase 2b for the construction, operation, closure, and restoration of the Delta site and associated projects.

Table 7-50: Assessment of Potential Impacts and Mitigation Measures for the Operation of the Delta Deposit (open pit and underground mine).

Component	Project phase[A]	Impact source (additional compared to the 2007 ESIA)	Impact description	Source	Mitigation measures		Residual impact significance	Monitoring
					Nº	Description		
Air Quality	Construction, operation, closure and restoration	Increase in road transport and machinery traffic on the sites, presence of soil stripping, extraction of materials in authorized quarries, removal of specific structures during closure, soil reworking during restoration.	Increase in airborne dust and exhaust fumes.	IA: p. 324, 327	AIR1	Vehicles, to the extent possible, shall not be left running when not in use.	Minor	General surveillance and monitoring during construction, operation, closure and restoration, dust emissions monitoring at three stations
				AECOM and CRI, 2022	AIR2a	In dry, windy weather, dust reducers (calcium chloride or water) will be sprayed on certain areas. The humidification frequency will be adjusted according to the meteorological conditions and the dust emissions observed. Dust control agents will comply with the BNQ 410-300 standard or will be approved by the *Ministère des Transports du Québec* (MTQ). The choice of dust reducers must take account of the proximity of wetlands or bodies of water.		
				IA: p. 324	AIR3	Machinery used must meet Environment and Climate Change Canada's emission standards for on- and off-road vehicles.		
		Increased energy production through satellite generators, increased burning of waste materials.	Atmospheric particles and greenhouse gas emissions	IA: p. 327	AIR5	Use generators with low contaminant emission rates.	Minor	
					AIR6	Prior and regular inspection of machinery will be performed to ensure that it is in good condition and working properly. See also AIR6a.		
				AECOM and CRI, 2022	AIR6a	Apply the mechanical service preventive maintenance program to ensure optimal operation of machinery and that equipment vibrations are reduced to a minimum, as to reduce emissions to a minimum.		
	Operation	Expansion of ore and waste rock storage areas resulting in waste rock and ore stockpiling activities. Crushing waste rock for backfilling underground.	Increase in airborne mining dust.	AECOM and CRI, 2022	AIR4a	Equip the crushers and grinders with dust control agent equipment. See also AIR4b.	Minor	General surveillance and monitoring during operations, dust emissions monitoring at three stations
					AIR4b	At the Expo ore stockpile, application of dust reducers or watering the road and the machinery operation area (active zone) of the ore storage area (loading zone, up to the concentrator). Watering the loading areas before unloading ore.		
					AIR4c	Limit handling the Expo ore stockpile during periods of high wind.		
					AIR11	Addition of three stations around the Delta site to monitor dust.		
Soil Quality	Construction	Soil stripping and using quarries and eskers.	Localized soil loss for other uses	IA: p. 340-341	SOL3	Non-acid-generating waste rock shall be used as granular material during the operational phase in order to minimize encroachment upon eskers.	Minor	General surveillance and monitoring during construction, operation, closure and restoration, dust emissions monitoring.
	Construction and operation	Increase in road transport, machinery traffic, underground mining activities, number of fuel storage pad on the ground and increase in waste incineration.	Risk of soil contamination by hydrocarbons.	IA: p.340-341	SOL1	Prior and regular inspection of machinery shall be performed to ensure that it is in good condition and working properly (not leaking hydrocarbons).	Minor	
				AECOM and CRI, 2022	SOL1a	Apply the mechanical service preventive maintenance program to ensure optimal operation of machinery (verify there are no hydrocarbon leaks).		
				IA: p.340-341	SOL2	An emergency kit for recovering petroleum products and hazardous materials shall be readily accessible at all times, construction site machinery shall have absorbent material in order to respond quickly, and polluted soil and wastes shall be disposed of in accordance with applicable legislation and regulations. See also SOL2a.		
				AECOM and CRI, 2022	SOL2a	Apply the spill management procedure "PRO-NENV-1211-01 Response to an Environmental Incident" which ensures the safe, fast, efficient and comprehensive management of a spill as to minimize the environmental impact.		
					SOL15	Use double-walled tanks for storing fuel, compliant with the requirements of the *Building Act*.		
	Operation	Addition of new surface infrastructure and connected projects.	Risk of subsidence.	IA: p.343-344	SOL5	To prevent subsidence due to the soil heating, major buildings shall rest on piles and lighter buildings shall be on ventilated foundations.	Minor	
					SOL10	Measures shall be taken when building major civil structures to prevent permafrost from thawing.		
	Operation, closure and restoration	Transport of the ore and storing of the waste rock in piles.	Local increase of metal concentrations at the soil surface.	IA: p.343-344	SOL9	The final cover shall include an impervious membrane and an erosion protection layer.	Minor	
				AECOM and CRI, 2022	SOL14	Apply the AIR4a, AIR4b, AIR4c, AIR4d mitigation measures air quality protection relating to mining dust.		
			Environmental liability that may affect long-term soil use	AECOM and CRI, 2022	SOL 12	Remove and dispose of contaminated soils in an authorized location and perform a characterization according to the terms in the *Politique de Protection des Sols et de Réhabilitation des Terrains Contaminés: Plan d'Action 2017-2021* (MDDELCC, 2017) and the *Guide d'intervention – Protection des Sols et Réhabilitation des terrains Contaminés* (Intervention Guide – Soil Protection and Restoration of Contaminated Sites) (Beaulieu, 2021). Apply the procedures presented in the ERP for spills.		
					SOL 13	The PAG waste rock generated by the new operations will be returned to the underground mine tunnels.		

[A] The operation phase includes the closure and restoration phases when applicable.

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

Source: IA = Impact assessment (GENIVAR, 2007).

Table 7-50: Assessment of Potential Impacts and Mitigation Measures for the Operation of the Delta Deposit (open pit and underground mine). (continued)

Component	Project phase[A]	Impact source (additional compared to the 2007 ESIA)	Impact description	Source	Mitigation measures		Residual impact significance	Monitoring
					Nº	Description		
Water and sediment regime	Construction and operation	Construction of a collection basin, waste rock pile, two ore stockpiles, ditches to collect drainage and clean water, road construction, installation of two effluents.	Modification of the surface water flow pattern and hydraulic regime of the three lakes surrounding the Delta site and the Puvirnituq River.	AECOM and CRI, 2022	RHS2a	Interrupt drainage ditches 10 m from the natural high-water mark when watercourses or bodies of water are present nearby.	Moyenne	General monitoring and surveillance during construction and operations.
				IA: p. 351-352	RHS11	Culverts shall be large enough to not significantly reduce the flow cross-section at stream crossings.		
					RHS15	Results of detailed bathymetry for lakes No.1, No.2 and No.3 and the hydraulic assessment will determine if addition mitigation measures must be applied to preserve water levels in the lakes.		
		Installation of watercourse crossings and infrastructure near water sources	Possible increase of erosion and sediment transport in a watercourse (modification to the sediment regime)	IA: p. 347	RHS1	Install culverts during the summer low flow period (July to September).	Minor	General monitoring and surveillance during construction and operations.
					RHS4	A geomembrane will be installed downstream of crossings and around work areas in order to catch particles that are stirred up.		
					RHS4a	Prevent the transport of fine particles during work by installing sediment barriers in periphery of aquatic environments.		
				IA: p. 347	RHS6	Road banks at stream crossings shall be covered with a geomembrane and riprap.		
					RHS8	Stones removed during grading earthwork shall be reused to stabilize banks and hollows.		
					RHS9	Resuspension of material shall be minimized when adding or removing material in water.		
					RHS10	Earth removed and fill shall be stored outside the buffer strip.		
					RHS13	During earthwork on steep slopes, the bottom of ditches shall be progressively stabilized with a cover of well-drained granular material and riprap.		
		Dismantling of infrastructure.	Sediment transport during opening of the breaches in the MCP		RHS16	Create breaches in the MCP dike during restoration		
Sediment and water quality	Construction	Soil stripping and installation of water crossings.	Risk of an increase in suspended solids in the water of adjacent watercourses and bodies of water.	IA: p. 363-365 IA: p. 369-371	QES5	Excavated material will be disposed of in a way that minimizes the spread of suspended solids.	Minor	General monitoring and surveillance during construction.
					QES6	Stones removed during grading earthwork will be reused to stabilize banks and hollows.		
					QES7	Interrupt drainage ditches a few meters from the natural high-water mark when at water crossings.		
					QES9	Installation of culverts during the summer low-water period (July to September)		
					QES16	Install a geomembrane downstream of culverts and around work zones to intercept suspended particles.		
					QES17	Road banks at stream crossing will be covered with a geomembrane and riprap.		
					QES18	A turbidity curtain will be installed in the water if granular material is taken less than 75 m from a lake.		
					QES30	During earthwork on steep slopes, the bottom of ditches will be progressively stabilized with a cover of well-drained granular material and riprap.		
		Use surface explosives if required.	Risk of ammonium nitrate dispersal when explosives are loaded in surface water and sediment.	IA: p.369-371	QES25	Special care shall be taken to avoid spilling ammonium nitrate beside blast holes when loading them, an operation always done using equipment to inject the explosives directly into the blast holes.	Minor	General monitoring and surveillance during construction.

[A] The operation phase includes the closure and restoration phases when applicable.

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

Source: IA = Impact assessment (GENIVAR, 2007).

Table 7-50: Assessment of Potential Impacts and Mitigation Measures for the Operation of the Delta Deposit (open pit and underground mine). (continued)

Component	Project phase[A]	Impact source (additional compared to the 2007 ESIA)	Impact description	Source	Mitigation measures		Residual impact significance	Monitoring
					N°	Description		
Sediment and water quality	Construction and operation	Increase in road transport, machinery traffic, underground mining activities and refuelling.	Risk of water and sediment contamination by hydrocarbons during refuelling, or in the event of damage and an accident along a watercourse or wetland.	AECOM et CRI, 2022	QES2a	Carry out inspections to ensure that the temporary hydrocarbon storage tanks are in good condition.	Minor	General surveillance and monitoring during construction, operation, closure, and restoration.
					QES2b	Carry out inspection to ensure the good condition of terrestrial and aquatic machinery at the pump station on Lake No.4.		
				IA: p.369-371	QES3	Inspect and clean all machinery that will cross a watercourse outside of the winter period.		
					QES4	Heavy machinery will only be used within the road right-of-way and borrow pit access roads.		
					QES8	Machinery parking, washing and maintenance areas shall be at least 60 m from any watercourse, and machinery shall be refuelled under constant supervision at least 30 m from any watercourse.		
					QES27	Fuel tanks will be surrounded by a berm high enough to contain a spill equal to the largest capacity tank plus 10%.		
					QES30	During earthwork on steep slopes, the bottom of ditches shall be progressively stabilized with a cover of well-drained granular material and riprap.		
				AECOM et CRI, 2022	QES34	Apply the mitigation measures SOL1, SOL1a, SOL2, SOL2a and SOL3 to limit the risk of water and sediment contamination.		
	Operation	Water from drainage ditches, tailings disposal site, waste rock and ore piles.	Possible degradation of water quality by increased sediment downstream of mine drainage discharge points and clean water ditches.	IA: p. 363-365	QES5	Excavated material will be disposed of in a way that minimizes the spread of suspended solids.	Minor	Comprehensive environmental monitoring program affecting discharged water, surface water, runoff and ditches.
				IA: p.369-371	QES19	The top of mine tailings and waste rock piles shall be kept at a 1% to 3% gradient to minimize infiltration.		
					QES22	Temporary ore storage sites would rest on a compacted gravel base surrounded by a collecting ditch to channel drainage water to the sedimentation pond, from which it shall be pumped into the process water tank.		
					QES26	Abrasives and de-icing chemicals will only be spread on dangerous locations or during ice-storms.		
					QES29	Geomembranes shall be placed beneath mine tailings cells, on dike walls and on the top of tailings and waste rock piles.		
		Installation of two effluents in the Puvirnituq River, one mine effluent and one sanitary effluent.	Possible degradation of the water quality downstream of the mine and sanitary effluents.	IA: p.369-371	QES21	Remove solid matter from sanitary wastewater with a mobile biodisc treatment unit and disinfect the water with a UV treatment.	Minor	
					QES23	Install oil and grease traps in the kitchen.		
					QES24	Use of only phosphate free soaps and detergents.		
					QES35a	Treat water contained in the MCP at the Delta site using a mobile WTP before releasing then into the Puvirnituq River		
Vegetation	Construction and operation	Presence of surface infrastructure (access road, cement slurry plant, portal, ditches, storage pad, ventilation raise, collection pond, waste rock and ore piles, administrative infrastructure, powder magazines, etc.).	Loss of surface area in terrestrial environments (110.60 ha) and wetlands (60.67 ha) for projects linked to the Delta site, to the Ivakkak-Delta Road, the satellite camp, the access road for freshwater, the northern landfill (LEMN) and the three potential quarries and loss of ecological functions for wetlands	IA: p.401	VEG1	Machinery must not circulate outside work area boundaries (unless otherwise authorized).	Moderate	General surveillance and monitoring during construction and operation.
					VEG2	Habitats next to jobsites must be protected (particularly close to stream banks).		
				AECOM and CRI, 2022	VEG3	Compensation for wetland areas lost through contributions to PEIIC (Program for Environmental Improvement in Inuit Communities).		
			Potential loss of at-risk plants species at the site of the satellite camp and at Delta	IA: p.401	VEG1	Machinery must not circulate outside work area boundaries (unless otherwise authorized).	Moderate	
					VEG5	Apply the fauna and flora protection plan.		
					VEG6	Conserve the soil from the sulphur buttercup colony to favour vegetation recovery during restoration and allow the preservation of seeds.		
		Circulation of machinery and employees.	Risk of trampling of vegetation by personnel or machinery, deposit of dust and risk of contamination to natural environments.	AECOM and CRI, 2022	VEG4	Apply the mitigation measures AIR2a, AIR3, SOL1, SOL1a, SOL2, SOL2a, SOL3, and SOL14.	Minor	
					VEG5	Apply the fauna and flora protection plan.		

[A] The operation phase includes the closure and restoration phases when applicable.

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

Source: IA = Impact assessment (GENIVAR, 2007).

Table 7-50: Assessment of Potential Impacts and Mitigation Measures for the Operation of the Delta Deposit (open pit and underground mine). (continued)

Component	Project phase[A]	Impact source (additional compared to the 2007 ESIA)	Impact description	Source	Mitigation measures		Residual impact significance	Monitoring
					Nº	Description		
Aquatic wildlife and their habitats	Construction	Construction activities for roads, access roads, surface infrastructure and installation of water crossings in fish habitat.	Avoidance by fish of areas around work in water	IA: p405-406, 430-431 ACÉE: Qu. MPO42 ACÉE2	FAQ1	Installation of culverts during the summer low-water period (July to September)	Minor	General surveillance and monitoring during construction
					FAQ2	Vehicle and construction machinery traffic shall be avoided within 20 m of a perennial stream or within 5 m of an intermittent stream and, if such traffic is unavoidable, any water flowing into ruts shall be diverted to an area of vegetation located at least 20 m from a stream.		
					FAQ20	The free movement of fish shall be ensured at all times when a stream is temporarily diverted.		
					FAQ29	Vehicle traffic shall be restricted to designated and clearly identified roadways.		
			Temporary loss of aquatic habitat (during installation of crossings and following reduction of surface drainage for lakes No.1, No.2 and No.3)	ACÉE: Qu. MPO42 ACÉE2	FAQ25	Areas disturbed by earthwork (ex: slopes and banks) shall be stabilized progressively as work is completed.	Moderate	
					FAQ26	Surplus material shall be disposed of at a specially designated site.		
					FAQ36	Areas of streams affected by construction shall be restored to their initial characteristics (substrate, width, depth and vegetation).		
	Construction and operation	All construction and operation activities at the Delta site and connected projects.	Possible modification of aquatic communities (fish and benthic invertebrates) downstream of effluent releases.		FAQ13a	Installation of a mobile water treatment system for mine drainage water collected by the downstream collection basin and the main collection basin for operations of the Delta deposit.	Minor	General surveillance and monitoring during construction and operation; monitoring of crossings and the free movement of fish.
				IA: p. 411	FAQ14	Remove solid matter from sanitary wastewater with a mobile biodisc treatment unit and disinfect the water with a UV treatment.		
			Possible damage to aquatic organisms located in watercourses and bodies of water near the various activities by modifying water quality (input of SS and contaminants).	IA: p. 411-412, 430-431 ACÉE2	FAQ14	Remove solid matter from sanitary wastewater with a mobile biodisc treatment unit and disinfect the water with a UV treatment.		
				ACÉE: Qu. MPO42 ACÉE2	FAQ22	Clean granular material shall be used to cofferdams (imperviousness preferably being achieved using non-granular material).		
					FAQ23	Temporary structures shall be stabilized using a geomembrane or riprap.		
					FAQ24	Fine particle transport shall be prevented in the aquatic environment beyond the immediate work area.		
					FAQ27a	Perform maintenance and refuelling of vehicles, handle and store hydrocarbons at a distance more than 30 m from the shorelines.		
				ACÉE: Qu. MPO42 ACÉE2	FAQ28	Machinery shall be prohibited from fording streams.		
					FAQ29	Vehicle traffic shall be restricted to designated and clearly identified roadways.		
					FAQ30	Hydrocarbon-absorbing floating booms shall be installed downstream of work in streams, as well as in lakes and areas with low flow.		
					FAQ31	Machinery shall be moved away from streams as soon as possible.		
					FAQ32	Machinery shall be clean and in good condition.		
					FAQ33	Waste oil from machinery shall be taken to a specially designated site.		
					FAQ34	Emergency gear shall be on hand in case of spills and workers shall know how to use it.		
				AECOM and CRI, 2022	FAQ59	Apply mitigation measures for air, soil, water and sediment quality.		
			Elimination of a part of the surface water draining to lakes No.1, No.2 and No.3		FAQ60	Following inventories aiming to produce detailed bathymetry of lakes No.1, No.2 and No.3 and a water balance, it will be determined is changes in water level are important or not. The results will inform the necessity to do fall inventories to identify the depth of spawning beds used by arctic char. Identification of an impact on aquatic fauna will results in the application of specific mitigation measures.		

[A] The operation phase includes the closure and restoration phases when applicable.

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

Source: IA = Impact assessment (GENIVAR, 2007).

Table 7-50: Assessment of Potential Impacts and Mitigation Measures for the Operation of the Delta Deposit (open pit and underground mine). (continued)

Component	Project phase[A]	Impact source (additional compared to the 2007 ESIA)	Impact description	Source	Mitigation measures		Residual impact significance	Monitoring
					N°	Description		
Aquatic wildlife and their habitats	Operation	All operation activities at the Delta site and connected projects	Barriers to free movement of fish in watercourses.	IA: p. 411-412, 430-431 ACÉE2	FAQ12	Culverts shall be installed so as not to impede the flow of water (base of culverts set beneath the natural stream bed, riprap used for stabilization, etc.).	Minor	General surveillance and monitoring during construction and operation; Monitoring of culverts and the free movement of fish
					FAQ16	Culverts shall be laid at the same slope as the natural stream bed and baffles shall be installed if flow exceeds 1.2 m/s.		
					FAQ17	Culverts shall be laid in steps to concentrate flow during the low-water period.		
					FAQ36	Areas of streams affected by construction shall be restored to their initial characteristics (substrate, width, depth and vegetation).		
			Fish mortality caused by sport fishing and capture at water intake.	IA: p. 411	FAQ19	A fishing program shall be established to provide guidelines for fishing in a number of bodies of water.	Minor	
					FAQ54a	The water intake at Lake No.4 will have a grate installed that respects the DFO requirements concerning fish grates for freshwaters. The design of the grate will prevent aspiration of fish and their capture on the grate (ACÉE2).		
		All closure and restoration activities at the Delta site and connected projects	Transport of fine particles to adjacent water bodies and water contamination associated with surface drainage.	ACÉE: Qu. MPO42 ACÉE2	FAQ24	Fine particle transport shall be prevented in the aquatic environment beyond the immediate work area.	Minor	General surveillance and monitoring during closure and restoration
					FAQ61	Perform water quality testing before creating breaches in the BCP dike and remove the road blocking drainage towards Lake No.1.		
Birds and their habitats	Construction	All construction activities for the exploitation of the Delta mine site and connected projects.	Loss of accessible habitat for birds (loss of 110.60 ha in terrestrial environment and 60.67 ha in wetlands).	IA: p.441 ACÉ.E2	FAV1	Traffic must be limited to work areas	Minor	General surveillance and monitoring during construction, operation, closure and restoration.
					FAV3	Limit the extent of soil stripping and levelling.		
			Disturbance of breeding pairs and migrating birds near infrastructure leading to a risk of nest abandonment. Potential destruction of nests.	IA: p.441 ACÉ.E2	FAV2	Habitats next to jobsites will be protected.	Minor	
				AECOM and CRI, 2022	FAV5	Apply the fauna and flora protection plan.		
	Operation	All operational activities for the closure and restoration of the Delta site and connected projects	Disturbance of breeding pairs and migrating birds near facilities.	IA: p.443-444	FAV1	Traffic must be limited to work areas.	Minor	
					FAV2	Habitats next to jobsites will be protected.		
				AECOM and CRI, 2022	FAV5	Apply the fauna and flora protection plan.		

[A] The operation phase includes the closure and restoration phases when applicable.

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

Source: IA = Impact assessment (GENIVAR, 2007).

Table 7-50: Assessment of Potential Impacts and Mitigation Measures for the Operation of the Delta Deposit (open pit and underground mine). (continued)

Component	Project phase[A]	Impact source (additional compared to the 2007 ESIA)	Impact description	Source	Mitigation measures		Residual impact significance	Monitoring
					Nº	Description		
Caribou	Construction and operation	All construction and operation activities	Loss of around 171 ha of feeding habitat and calving grounds.	AECOM and CRI, 2022	MTR6a	Apply the fauna and flora protection plan.	Minor	General surveillance and monitoring during construction and operation.
	Construction and operation	All construction, operation, closure and restoration activities at the Delta site and connected projects.	Disruption of caribou by noise, human presence, or an increase in the number of predators.	IA: p. 436-437	MTR1	Prior and regular inspection of machinery shall be performed to ensure that it is in good condition and working properly (minimizing noise).	Minor	General surveillance and monitoring during construction, operation, closure, and restoration Application of a protocol for the surveillance of caribou.
					MTR2	Machine circulation will be limited to work areas.		
					MTR5	Store domestic waste in closed containers before their incineration.		
				AECOM and CRI, 2022	MTR6a	Apply the fauna and flora protection plan.		
					MTR7	Avoid the direct movement of equipment and personnel towards caribou observed within 100 m of a work site or access road. Do not use vehicle horns or adopt behaviours that could stress caribou.		
					MTR8	Mobile equipment and vehicles must yield and allow passage of fauna such as caribou.		
					MTR9	If a caribou is observed near an access road, follow Diagram 7-1 included in the fauna and flora protection plan.		
					MTR10	Make workers aware, especially before calving, of the risks of disturbing caribou and of appropriate behaviour.		
					MTR11	Make aircraft and helicopter pilots aware of the susceptibility of caribou to disturbance during the calving period (May 15th to July 15th) and ask that, upon returning to base, they transmit the locations and number of caribou observed during their trips so that sectors with their presence can be identified. Avoidance distances, as identified in Table 7-28, can then be applied and reported in the fauna and flora protection plan, except in the case of emergencies.		
					MTR12	Limit helicopter transport between the Ivakkak and Delta sites between May 15th and July 15th, favouring road transport for material and personnel.		
	Construction and operation	Construction and operation activities emitting loud and sudden noises.	Stress to the caribou and disturbance of calving caused by the presence of sudden (blasting, loading, unloading) or very loud (crushing) noises.		MTR13	Elaborate and apply a surveillance protocol for caribou (between mid May and mid July) for the Ivakkak-Delta sector that will trigger the application of MTR14 and MTR17. This surveillance will be done a minimum of three times per day with an observation interval of 4 hours.		
					MTR14	In the Delta sector and its access roads: • Suspend activities causing a sudden noise (ex: surface blasting) when caribou are observed in a 1 km radius. • Suspend other types of activities when caribou are observed in a 1 km radius and show signs of nervousness. • Suspend activities causing a non sudden noise that could disturb caribou (ex: drilling, crushing, loading and unloading on the surface) when a female accompanied by a calf is observed in a radius of 1km (between mid May and mid July). • When caribou have left the 1 km radius, wait 30 minutes before restarting suspended activities to ensure that the individuals have not returned inside the perimeter.		
	Construction and operation	Construction and operation activities emitting loud and sudden noises.	Barrier to migration of caribou because of road construction		MTR15	Install crossings for caribou on both sides of the Ivakkak-Delta Road and the Delta-Lake No.4 Road to facilitate their crossing of the road.	Minor	

[A] The operation phase includes the closure and restoration phases when applicable.

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

Source: IA = Impact assessment (GENIVAR, 2007).

Table 7-50: Assessment of Potential Impacts and Mitigation Measures for the Operation of the Delta Deposit (open pit and underground mine). (continued)

Component	Project phase[A]	Impact source (additional compared to the 2007 ESIA)	Impact description	Source	Mitigation measures		Residual impact significance	Monitoring
					Nº	Description		
Caribou	Operation	Crushing activities, road transport, presence of stockpiles, presence of bare excavated soil	Dust deposition on vegetation bordering the mine site and roads.		MTR16	Apply mitigation measure AIR2a.	Minor	General surveillance and monitoring during construction, operation, closure, and restoration.
					MTR17	Plan and group vehicle traffic on the Ivakkak-Delta Road using convoys when observations of a herd of more than 50 individuals are made near the road.		
		Closure and restoration activities	Site restoration.		MTR 18	Support research projects with Caribou Ungava on caribou behaviour.	Minor	
Terrestrial mammals	Construction and operation	All activities.	Noise disturbance for many species. Possibility of wounding or killing an animal during road transport.	IA: 436-437	MTR1	Prior and regular inspection of machinery shall be performed to ensure that it is in good condition and working properly.	Minor	General surveillance and monitoring during construction, and operation.
					MTR2	Limit the circulation of machinery on work sites.		
					MTR3a	Undertake an inventory of arctic fox dens in eskers likely to be exploited for the Delta project.		
				IA: 436-437	MTR4	Forbid workers from feeding arctic foxes and inform them of the consequences this could have.		
					MTR5	Store domestic waste in closed containers before their incineration.		
				AECOM and CRI, 2022	MTR6a	Apply the fauna and flora protection plan.		
Species at risk	Construction and operation	Presence of surface infrastructure (access road, cement milk plant, portals, ditches, storage platforms, chimneys, collection basins, waste rock and ore piles, administrative infrastructure, satellite camp, roads, powder magazines, etc.).	Loss of a 4.01 ha colony of sulphur yellow buttercup, potential additional loss of flora at risk at the Delta site and on the Ivakkak-Delta Road.	AECOM and CRI, 2022	ESP1	Apply VEG1 and VEG1a.	Moderate	General surveillance and monitoring during construction, and operation. Add to monitoring 20 for draba
					ESP2	Apply VEG4.		
					ESP3	Apply the fauna and flora protection plan.		
					ESP4	Apply VEG6.		
			Risk of degrading habitat for flora at risk caused by dust or trampling.	AECOM and CRI, 2022	ESP2	Apply VEG4.	Minor	General surveillance and monitoring during construction, and operation.
		All activities.	Disturbance of birds at risk during their search for food or moulting.		ESP3	Apply the fauna and flora protection plan.		

[A] The operation phase includes the closure and restoration phases when applicable.

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

Source: IA = Impact assessment (GENIVAR, 2007).

Table 7-50: Assessment of Potential Impacts and Mitigation Measures for the Operation of the Delta Deposit (open pit and underground mine). (continued)

Component	Project phase[A]	Impact source (additional compared to the 2007 ESIA)	Impact description	Source	Mitigation measures		Residual impact significance	Monitoring
					Nº	Description		
Human environment - Economy and employment	Construction and operation	All construction, operation and closure activities for the Delta project	Job creation and local and regional economic benefits.	IA: p. 448-449	ECO1	Hiring will give preference to Inuit workers.	Major (positive impact)	Continue the monitoring regarding the Inuit communities information program.
					ECO2	Maintain the information and recruitment program in the Inuit villages		
					ECO3	Maintain the training program intended and adapted for future Inuit workers.		
					ECO4	Encourage Nunavik-based companies with the skills for the tasks requested in the call for bids procedure, before undertaking requests to companies based in Abitibi, elsewhere in Quebec or abroad.		
				IA: p.452	ECO7	Promote the integration of Inuit workers hired for construction into the operation phase.		
				AECOM and CRI, 2022	ECO9	Respect the updated Nunavik Nickel Agreement policies related to the hiring of Inuit workers as well as royalties.		
			Substantial workforce mobility and lifestyle changes at the Delta satellite camp.	IA: p. 454-455	MOE1 à MOE10	Integrate new workers by explaining the different living conditions and regulations on the NNiP site, as well as the different programs available.	Minor	
Human environment - Land use by the Inuit	Construction, operation, closure and restoration	All construction, operation and closure activities for the Delta project	Disruption of traditional Inuit activities within the NNiP territory.	IA: p.470	ORS1a	Possibility for Inuit workers to do a shorter work rotation (two weeks on, followed by two weeks off), so they can spend more time in their community.	Moderate	General monitoring and surveillance during operation.
				IA: p.473	TRC1	Mark new access roads and post traffic signs where snowmobile and all-terrain vehicle trails intersect these roads or the main road when required.		General monitoring and surveillance during operation.
					TRC11	Install signs mentioning the presence of traffic lanes or work/operation areas in proximity to inform Inuit users who may travel through or practice activities in the sector.		
				IA: p.487-488	URT1	No measures will be taken to facilitate sports fishing by the workers (e.g., transportation by helicopter).		General surveillance and monitoring during construction, operation, closure and restoration. Monitoring continuation regarding the plan for evaluating NNiP perceptions and sport fishing monitoring.
				AECOM and CRI, 2022	URT2a	Prohibit the possession of firearms at CRI sites (except with special authorization for protection against polar bears), as to limit sport hunting activities practiced by employees.		
				IA: p.487-488	URT3	Prior and regular inspection of machinery will be performed to ensure that it is in good condition and working properly (to avoid producing excessive noise).		
					URT4	Lakes used by the residents of Salluit and Kangiqsujuaq will remain accessible.		
					URT6	Continue to set up fishing programs governing this activity in the targeted bodies of water.		
				AECOM and CRI, 2022	URT10	In the event that traffic must be temporarily or permanently impeded on trails used by Inuit users, provide bypasses or new safe travel routes together with the Salluit and Kangiqsujuaq communities. Inform the population of the Salluit and Kangiqsujuaq communities of the bypassing routes or new travel routes.		
					URT11	Regularly inform the Salluit and Kangiqsujuaq communities of the work carried out on the NNiP territory affected (nature of the work/operations, location of the work/operations, schedule, potential dangers for Inuit users).		
					URT12	Regularly inform CRI workers of the potential presence of Inuit users in the territory concerned by NNiP's Phase 2a.		
				IA: p.494-495	SON2	Machine circulation will be limited to work areas.		Continue the sound monitoring in the Pingualuit National Park
					SON3	If possible, isolate the main sources of noise with a sound-absorbing material, when possible.		

[A] The operation phase includes the closure and restoration phases when applicable.

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

Source: IA = Impact assessment (GENIVAR, 2007).

Table 7-50: Assessment of Potential Impacts and Mitigation Measures for the Operation of the Delta Deposit (open pit and underground mine). (continued)

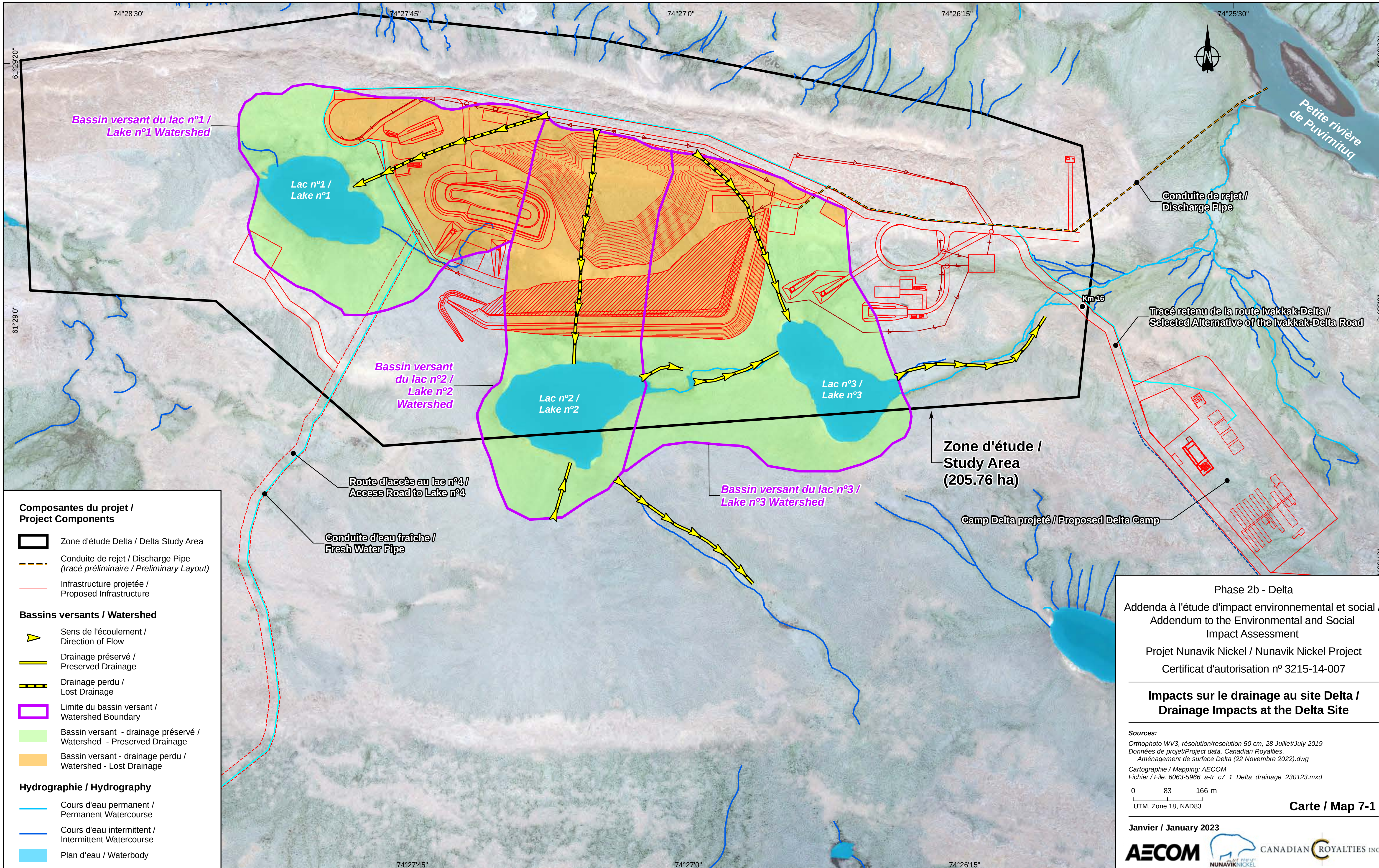
Component	Project phase[A]	Impact source (additional compared to the 2007 ESIA)	Impact description	Source	Mitigation measures		Residual impact significance	Monitoring
					Nº	Description		
Human environment - Archaeology and heritage	Construction	All construction activities for the Delta project	Discovery of archeological or historical vestiges during construction work.	IA: p.492	ARC1	If remains of importance are discovered, the site supervisor shall be informed immediately and measures taken to protect the site.	Minor	General monitoring and surveillance during construction.
Human Environment - Soundscape	Construction and operation	All construction, operation and closure activities for the Delta project	Increase noise level around the construction site and mining activities.	IA: p.494-495	SON1	Preliminary and regular inspections of the machinery to ensure it is in good condition and working properly (so no excess noise is generated)	Minor	Continue the sound monitoring in the Pingualuit National Park.
					SON2	Machine circulation will be limited to work areas.		
					SON3	If possible, isolate the primary sound sources with absorbent material		
					SON4	It shall be mandatory for workers to wear hearing protection devices when inside noisy buildings (e.g., crushing and grinding unit)		
Human Environment - Landscape	Construction, operation and closure	All construction, operation and closure activities for the Delta project	Deterioration of surrounding scenery.	IA: p.499	PAY1	Minimize stripping, clearing, excavation, backfilling and grading to maintain the natural topography as much as possible.	Minor	Monitoring continuation regarding the plan for evaluating NNiP perceptions and general monitoring during activities. Add to monitoring 33.
				IA: p. 501 ARK	PAY3	The waste rock and tailings piles shall be rounded so that they blend in better with the surrounding landscape.		
					PAY5	Installation of directional sodium lighting to limit the light dispersion around the mining complex.		
	Restoration	Activities related to site restoration after closure.	Site restoration	IA: p.499	PAY2	When construction is completed, work areas shall be rehabilitated and restored so that they blend in as much as possible with the natural landscape (regrowth of vegetation).	None	
				IA: p. 501 ARK	PAY4	After the mine closes, disturbed sites will be rehabilitated and restored by encouraging plant growth so they blend in with the natural landscape as much as possible, and mine facilities shall be dismantled and taken back south.		

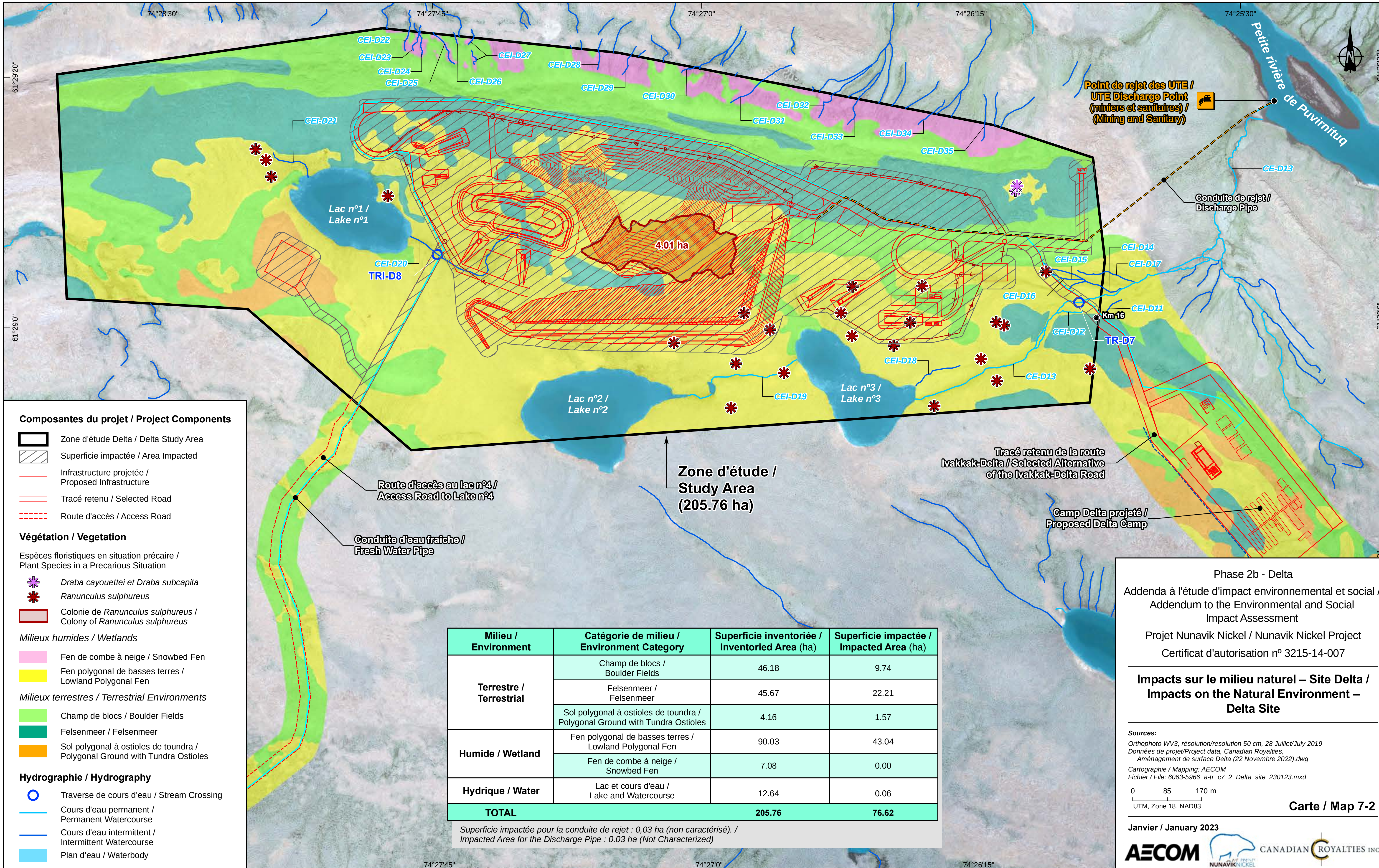
[A] The operation phase includes the closure and restoration phases when applicable.

Note: A grey background indicates new mitigation measures presented in the impact study for Phase 2a and a yellow background indicates mitigation measures specific to Phase 2b.

Source: IA = Impact assessment (GENIVAR, 2007).

ARK = Response document of the Kativik Regional Administration (March 2008).


74°28'30"
74°27'45"
74°27'0"
74°26'15"
74°25'30"
61°29'20"
61°29'0"
61°28'40"
Bassin versant du lac nº1 / Lake nº1 Watershed
Lac nº1 / Lake nº1
Bassin versant du lac nº2 / Lake nº2 Watershed
Lac nº2 / Lake nº2
Lac nº3 / Lake nº3
Bassin versant du lac nº3 / Lake nº3 Watershed
Petite rivière de Puvirnituq
Conduite de rejet / Discharge Pipe
Km 16
Tracé retenu de la route Ivakkak-Delta / Selected Alternative of the Ivakkak-Delta Road
Zone d'étude / Study Area (205.76 ha)
Route d'accès au lac nº4 / Access Road to Lake nº4
Conduite d'eau fraîche / Fresh Water Pipe
Camp Delta projeté / Proposed Delta Camp
Composantes du projet / Project Components
Zone d'étude Delta / Delta Study Area
Conduite de rejet / Discharge Pipe (tracé préliminaire / Preliminary Layout)
Infrastructure projetée / Proposed Infrastructure
Bassins versants / Watershed
Sens de l'écoulement / Direction of Flow
Drainage préservé / Preserved Drainage
Drainage perdu / Lost Drainage
Limite du bassin versant / Watershed Boundary
Bassin versant - drainage préservé / Watershed - Preserved Drainage
Bassin versant - drainage perdu / Watershed - Lost Drainage
Hydrographie / Hydrography
Cours d'eau permanent / Permanent Watercourse
Cours d'eau intermittent / Intermittent Watercourse
Plan d'eau / Waterbody
Phase 2b - Delta
Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment
Projet Nunavik Nickel / Nunavik Nickel Project
Certificat d'autorisation nº 3215-14-007
Impacts sur le drainage au site Delta / Drainage Impacts at the Delta Site
Sources:
Orthophoto WV3, résolution/resolution 50 cm, 28 Juillet/July 2019
Données de projet/Project data, Canadian Royalties, Aménagement de surface Delta (22 Novembre 2022).dwg
Cartographie / Mapping: AECOM
Fichier / File: 6063-5966_a-tr_c7_1_Delta_drainage_230123.mxd
0 83 166 m
UTM, Zone 18, NAD83
Carte / Map 7-1
Janvier / January 2023
AECOM
NUNAVIK NICKEL
CANADIAN ROYALTIES INC.



Milieu / Environment	Catégorie de milieu / Environment Category	Superficie inventoriée / Inventoried Area (ha)	Superficie impactée / Impacted Area (ha)
Terrestre / Terrestrial	Champ de blocs / Boulder Fields	46.18	9.74
	Felsenmeer / Felsenmeer	45.67	22.21
	Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles	4.16	1.57
Humide / Wetland	Fen polygonal de basses terres / Lowland Polygonal Fen	90.03	43.04
	Fen de combe à neige / Snowbed Fen	7.08	0.00
Hydrique / Water	Lac et cours d'eau / Lake and Watercourse	12.64	0.06
TOTAL		**205.76**	**76.62**

Superficie impactée pour la conduite de rejet : 0,03 ha (non caractérisé). / Impacted Area for the Discharge Pipe : 0.03 ha (Not Characterized)

Phase 2b - Delta

Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment

Projet Nunavik Nickel / Nunavik Nickel Project

Certificat d'autorisation nº 3215-14-007

Impacts sur le milieu naturel – Site Delta / Impacts on the Natural Environment – Delta Site

Sources:

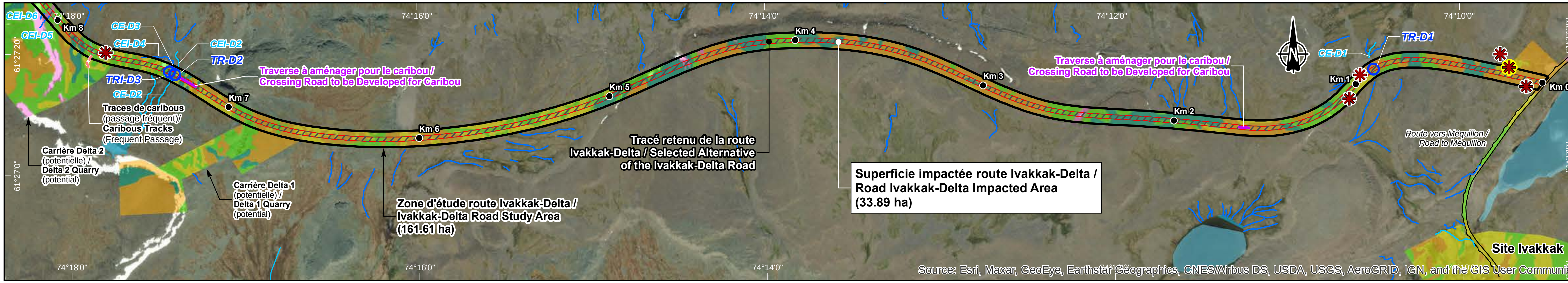
Orthophoto WV3, résolution/resolution 50 cm, 28 Juillet/July 2019
Données de projet/Project data, Canadian Royalties, Aménagement de surface Delta (22 Novembre 2022).dwg

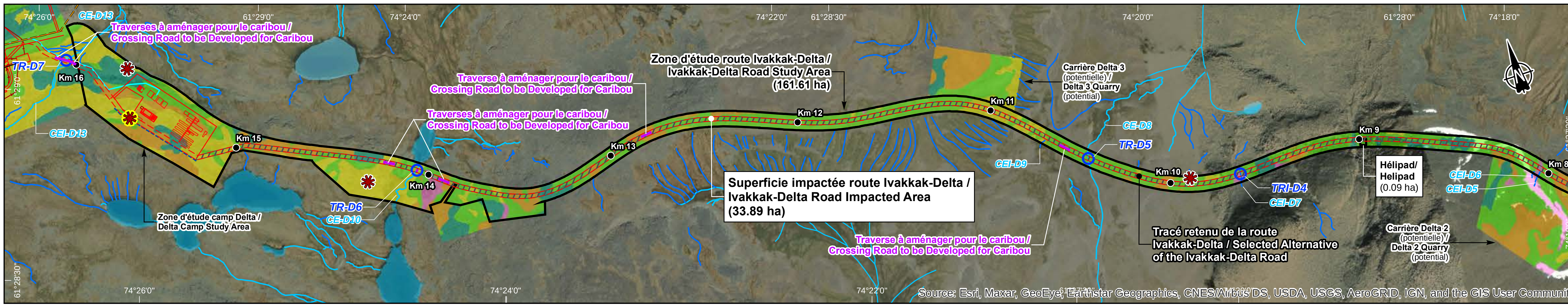
Cartographie / Mapping: AECOM
Fichier / File: 6063-5966_a-tr_c7_2_Delta_site_230123.mxd

Carte / Map 7-2

Janvier / January 2023

AECOM NUNAVIK NICKEL CANADIAN ROYALTIES INC.





Composantes du projet / Project Components

- Zone d'étude / Study Area
- Superficie impactée / Impacted Area
- Tracé retenu / Selected Road

Végétation / Vegetation

Espèce floristique en situation précaire / Plant Species in a Precarious Situation

- *Ranunculus sulphureus (impactée / Impacted)*
- *Ranunculus sulphureus*

Milieux humides / Wetlands

- Fen de combe à neige / Snowbed Fen
- Fen polygonal de basses terres / Lowland Polygonal Fen

Milieux terrestres / Terrestrial Environments

- Champ de blocs / Boulder Fields
- Felsenmeer / Felsenmeer
- Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles

Faune / Wildlife

- Traverse à aménager pour le caribou / Crossing Road to be Developed for Caribou
- Traces de caribous / Caribou Tracks

Hydrographie / Hydrography

- Traverse de cours d'eau / Stream Crossing
- Cours d'eau permanent / Permanent Watercourse
- Cours d'eau intermittent / Intermittent Watercourse
- Plan d'eau / Waterbody

Milieu / Environment	Catégorie de milieu / Environment Category	Superficie inventoriée / Inventoried Area (ha)	Superficie impactée / Impacted Area (ha)
Terrestre / Terrestrial	Champ de blocs / Boulder Fields	62.08	14.91
	Felsenmeer / Felsenmeer	22.06	4.94
	Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles	39.20	9.05
Humide / Wetland	Fen polygonal de basses terres / Lowland Polygonal Fen	35.46	4.59
	Fen de combe à neige / Snowbed Fen	2.77	0.40
Hydrique / Water	Lac et cours d'eau / Lake and Watercourse	0.04	0.00
TOTAL		161.61	33.89

Une portion de la route est comptabilisée dans la zone d'étude du campement mais pas la superficie impactée. / A Portion of the Road is Counted in the Study Area of the Camp but not the Impacted Area

Phase 2b - Delta

Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment

Projet Nunavik Nickel / Nunavik Nickel Project

Certificat d'autorisation nº 3215-14-007

Impacts sur le milieu naturel – Secteur de la route Ivakkak-Delta / Impacts on the Natural Environment – Sector of the Ivakkak-Delta Road

Sources:

Imagerie/Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
CanVec, 1:50, 000, NRCan, 2019
Données de projet/Project Data, Canadian Royalties, 2022

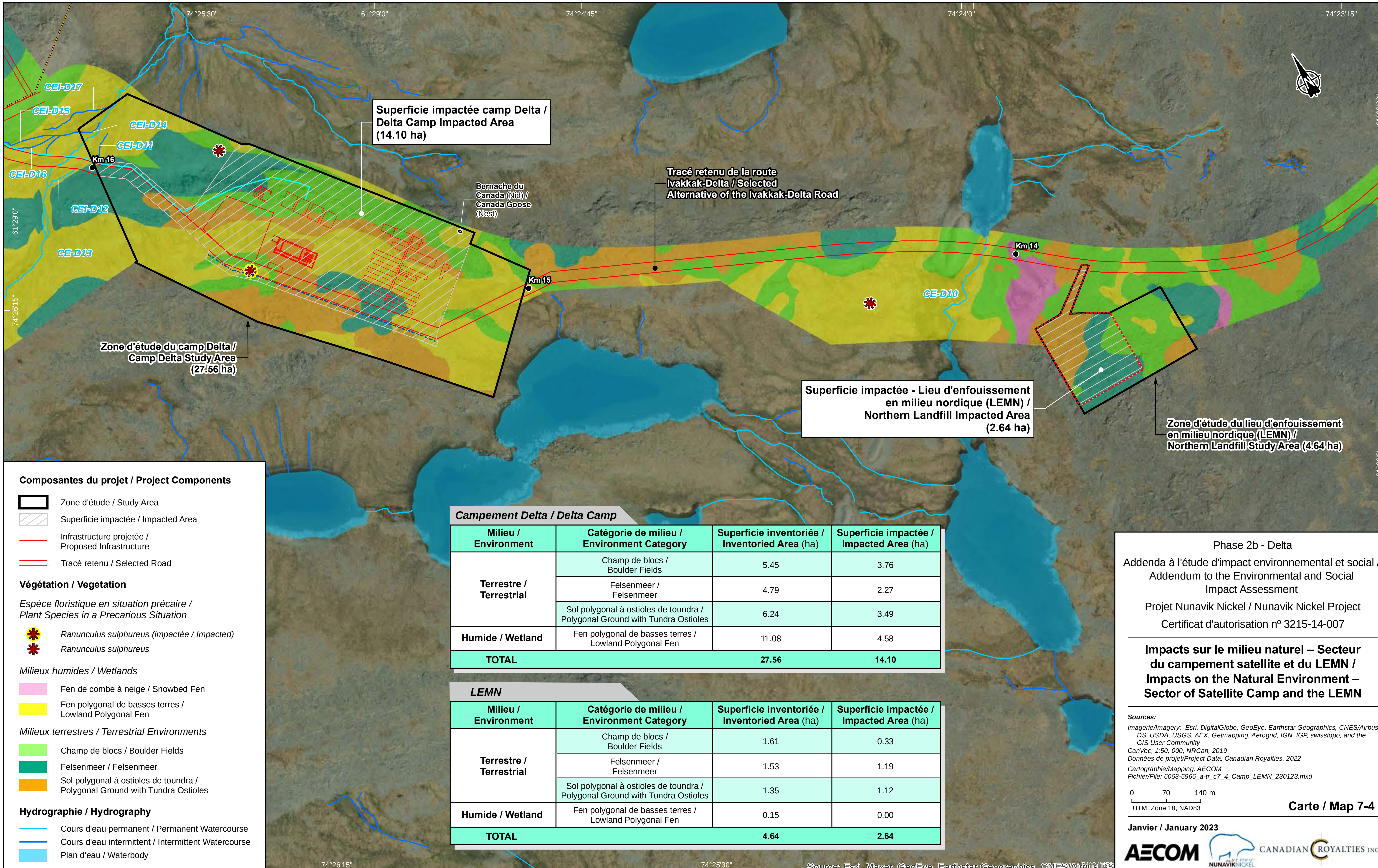
Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c7_3_Rte_Delta_230123.mxd

0 200 400 m
UTM, Zone 18, NAD83

Carte / Map 7-3

Janvier / January 2023

AECOM NUNAVIK NICKEL CANADIAN ROYALTIES INC.



Campement Delta / Delta Camp

Milieu / Environment	Catégorie de milieu / Environment Category	Superficie inventoriée / Inventoried Area (ha)	Superficie impactée / Impacted Area (ha)
Terrestre / Terrestrial	Champ de blocs / Boulder Fields	5.45	3.76
	Felsenmeer / Felsenmeer	4.79	2.27
	Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles	6.24	3.49
Humide / Wetland	Fen polygonal de basses terres / Lowland Polygonal Fen	11.08	4.58
TOTAL		27.56	14.10

LEMN

Milieu / Environment	Catégorie de milieu / Environment Category	Superficie inventoriée / Inventoried Area (ha)	Superficie impactée / Impacted Area (ha)
Terrestre / Terrestrial	Champ de blocs / Boulder Fields	1.61	0.33
	Felsenmeer / Felsenmeer	1.53	1.19
	Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles	1.35	1.12
Humide / Wetland	Fen polygonal de basses terres / Lowland Polygonal Fen	0.15	0.00
TOTAL		4.64	2.64

Phase 2b - Delta

Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment

Projet Nunavik Nickel / Nunavik Nickel Project

Certificat d'autorisation nº 3215-14-007

Impacts sur le milieu naturel – Secteur du campement satellite et du LEMN / Impacts on the Natural Environment – Sector of Satellite Camp and the LEMN

Sources:

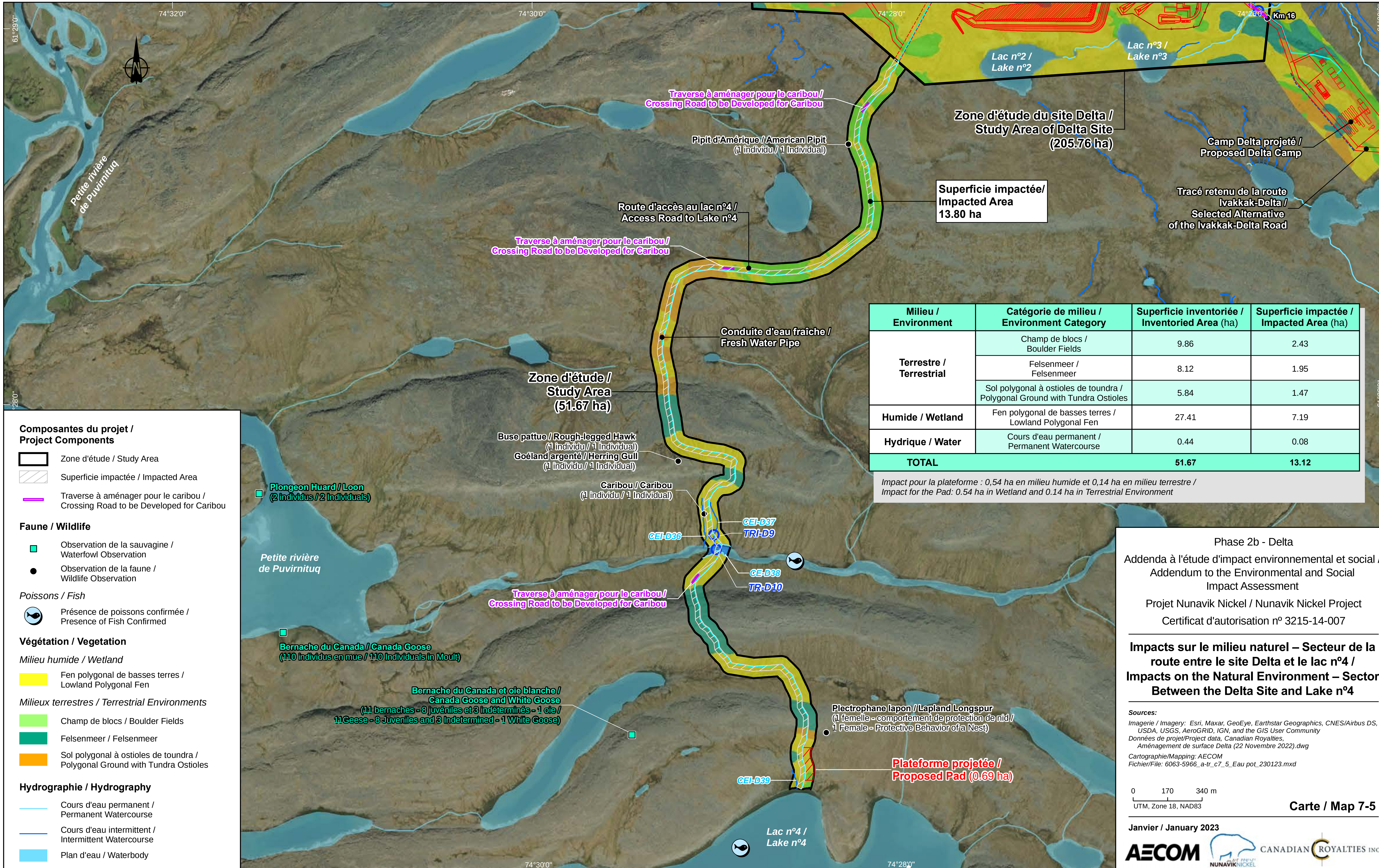
Imagerie/Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
CanVec, 1:50, 000, NRCan, 2019
Données de projet/Project Data, Canadian Royalties, 2022

Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c7_4_Camp_LEMN_230123.mxd

Carte / Map 7-4

Janvier / January 2023

AECOM NUNAVIK NICKEL CANADIAN ROYALTIES INC.



Milieu / Environment	Catégorie de milieu / Environment Category	Superficie inventoriée / Inventoried Area (ha)	Superficie impactée / Impacted Area (ha)
Terrestre / Terrestrial	Champ de blocs / Boulder Fields	9.86	2.43
	Felsenmeer / Felsenmeer	8.12	1.95
	Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles	5.84	1.47
Humide / Wetland	Fen polygonal de basses terres / Lowland Polygonal Fen	27.41	7.19
Hydrique / Water	Cours d'eau permanent / Permanent Watercourse	0.44	0.08
TOTAL		51.67	13.12

Impact pour la plateforme : 0,54 ha en milieu humide et 0,14 ha en milieu terrestre /
Impact for the Pad: 0.54 ha in Wetland and 0.14 ha in Terrestrial Environment

Composantes du projet / Project Components

- Zone d'étude / Study Area
- Superficie impactée / Impacted Area
- Traverse à aménager pour le caribou / Crossing Road to be Developed for Caribou

Faune / Wildlife

- Observation de la sauvagine / Waterfowl Observation
- Observation de la faune / Wildlife Observation

Poissons / Fish

- Présence de poissons confirmée / Presence of Fish Confirmed

Végétation / Vegetation

Milieu humide / Wetland

- Fen polygonal de basses terres / Lowland Polygonal Fen

Milieux terrestres / Terrestrial Environments

- Champ de blocs / Boulder Fields
- Felsenmeer / Felsenmeer
- Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles

Hydrographie / Hydrography

- Cours d'eau permanent / Permanent Watercourse
- Cours d'eau intermittent / Intermittent Watercourse
- Plan d'eau / Waterbody

Phase 2b - Delta

Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment

Projet Nunavik Nickel / Nunavik Nickel Project

Certificat d'autorisation nº 3215-14-007

Impacts sur le milieu naturel – Secteur de la route entre le site Delta et le lac nº4 / Impacts on the Natural Environment – Sector Between the Delta Site and Lake nº4

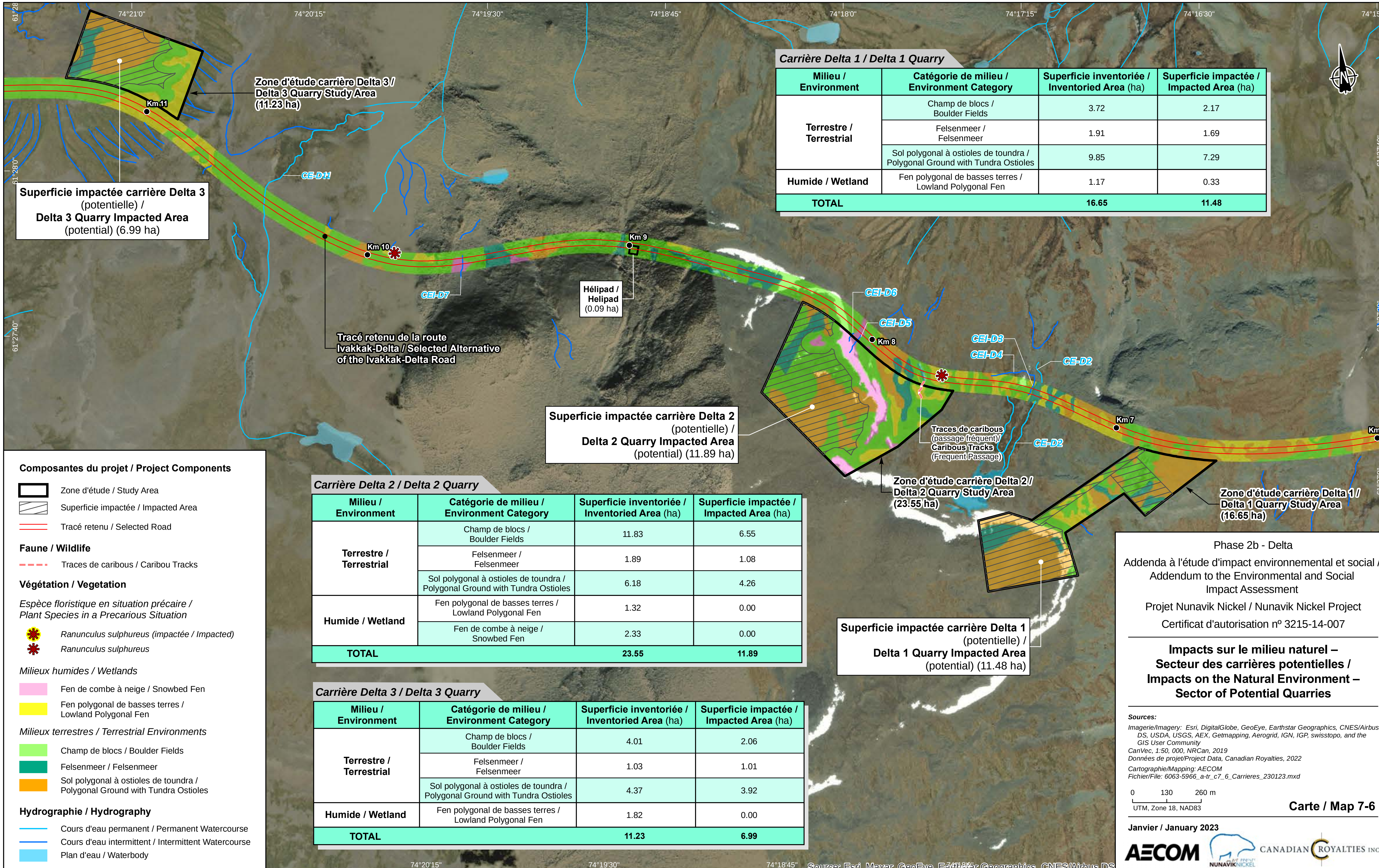
Sources:
Imagerie / Imagery: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Données de projet/Project data, Canadian Royalties, Aménagement de surface Delta (22 Novembre 2022).dwg
Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c7_5_Eau pot_230123.mxd

0 170 340 m
UTM, Zone 18, NAD83

Carte / Map 7-5

Janvier / January 2023

AECOM · NUNAVIK NICKEL · CANADIAN ROYALTIES INC.



Carrière Delta 1 / Delta 1 Quarry

Milieu / Environment	Catégorie de milieu / Environment Category	Superficie inventoriée / Inventoried Area (ha)	Superficie impactée / Impacted Area (ha)
Terrestre / Terrestrial	Champ de blocs / Boulder Fields	3.72	2.17
	Felsenmeer / Felsenmeer	1.91	1.69
	Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles	9.85	7.29
Humide / Wetland	Fen polygonal de basses terres / Lowland Polygonal Fen	1.17	0.33
TOTAL		16.65	11.48

Carrière Delta 2 / Delta 2 Quarry

Milieu / Environment	Catégorie de milieu / Environment Category	Superficie inventoriée / Inventoried Area (ha)	Superficie impactée / Impacted Area (ha)
Terrestre / Terrestrial	Champ de blocs / Boulder Fields	11.83	6.55
	Felsenmeer / Felsenmeer	1.89	1.08
	Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles	6.18	4.26
Humide / Wetland	Fen polygonal de basses terres / Lowland Polygonal Fen	1.32	0.00
	Fen de combe à neige / Snowbed Fen	2.33	0.00
TOTAL		23.55	11.89

Carrière Delta 3 / Delta 3 Quarry

Milieu / Environment	Catégorie de milieu / Environment Category	Superficie inventoriée / Inventoried Area (ha)	Superficie impactée / Impacted Area (ha)
Terrestre / Terrestrial	Champ de blocs / Boulder Fields	4.01	2.06
	Felsenmeer / Felsenmeer	1.03	1.01
	Sol polygonal à ostioles de toundra / Polygonal Ground with Tundra Ostioles	4.37	3.92
Humide / Wetland	Fen polygonal de basses terres / Lowland Polygonal Fen	1.82	0.00
TOTAL		11.23	6.99

Phase 2b - Delta

Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment

Projet Nunavik Nickel / Nunavik Nickel Project

Certificat d'autorisation nº 3215-14-007

Impacts sur le milieu naturel – Secteur des carrières potentielles / Impacts on the Natural Environment – Sector of Potential Quarries

Sources:

Imagerie/Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
CanVec, 1:50, 000, NRCan, 2019
Données de projet/Project Data, Canadian Royalties, 2022

Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c7_6_Carrieres_230123.mxd

Carte / Map 7-6

Janvier / January 2023

AECOM NUNAVIK NICKEL CANADIAN ROYALTIES INC.

8 Climate change and Greenhouse Gases

8.1 Evaluation of the Resiliency and Adaptations to Climate Change for Phase 2b

8.1.1 Project Context

The present study only examines the expansion of the open pit and underground exploitation of the Delta project and the infrastructure required to operate the site.

It should be noted that the articles 24, 25, 31.1.1 and 31.9 of the *Loi sur la qualité de l'environnement* (chapter Q-2) (LQE) and articles 1, 3 and 5 of the *Règlement relatif à l'évaluation et l'examen des impacts sur l'environnement de certains projets* (REEIE) (chapter Q-2, r. 23.1) require that climate change must be considered in the environmental authorization scheme of projects in Quebec. As a result, projects and their components must be localized, conceived, and operated is such a way as to take into account the risks associated with actual and anticipated changes in climate. If these steps are not taken, the integrity or efficiency of the studied infrastructure could be affected, environmental risks could be amplified and new environmental risks could occur.

It is in this context that this study identifies and evaluates the possible risks and makes recommendations for the various components, activities and operations with regards to changing climate and extreme weather conditions. The scope of this analysis covers all infrastructure that will be needed for the exploitation of the Delta deposit as well as new access routes required for operations.

8.1.2 Objectives

The mandate consists of evaluating the risks and vulnerabilities associated with climate change for the new exploitation project of the Delta deposit (open pit and underground) and the access routes (project constituents) with the aim of deriving recommendations. This evaluation will need to meet requirements relating to climate change adaptation described in the guide for project initiators of the MELCCFP (MELCC, 2021).

Specifically, this study aims to:

- Establish the context and identify hazards that could potentially lead to repercussions on the project or modify it's impacts on the environment
- Identify the project components susceptible of being affected by hazards
- Identify the consequences of these hazards for the project and its surrounding environment
- Identify and evaluate the risks associated with climate changes on all components of the project for the entire lifespan of the project
- Propose adaptation measures to be put into place to reduce the identified hazards

8.1.3 Methods

In order to conceive and adequately evaluate a projects' impacts, it is essential to take into account effects attributable to changes in climate. Hazards can be amplified by the effects of climate change and increase the impact of the project on natural and man-made components of the environment during the projects' life. The hazards are identified using an Evaluation of Risks and Vulnerabilities to Climate Change (ERVCC) so that adequate adaptation measures can be proposed following the analysis. An ERVCC generally implies the adoption of a risk management approach for:

- Anticipation of the risks associated with climate change that could impact the studied assets or activities

- Identification of design characteristics or potential actions to aid in preventing, resisting, responding to, restoring and adapting to these risks.

The ERVCC was realized following the five steps described in the guide for project initiators of the MELCCFP (MELCC, 2021). The steps are described below.

Step 1: Establish the context and identify the hazards likely to cause repercussions on the project and modify it's impacts on the environment.

Step 1 of the ERVCC consists of the following activities:

- Describe the environment in which the project will take place and identify the hazards associated with climate phenomena susceptible of affecting the project during its lifespan
- Describe historical and recent climate, a review of extreme events and hazards that have recently affected the realization of similar projects located in the same region, namely Nunavik
- Examine climate projections for the 2040-2064 period for scenarios RCP 4.5 and 8.5
- Determine the zones in the natural and man-made environments that could be affected by actual and projected climatic conditions, and which could also produce or amplify a hazard

Step 2: Identification of the project components likely to be affected by hazards

Step 2 of the ERVCC consists of the following activities:

- Identify the components vulnerable to the effects of the hazards identified in the previous step
- Identify the potential for amplified environmental impacts of the project components associated with identified hazards

Step 3: ***Identification of the consequences for the project or it's operational environment***

- Create a list of possible interactions between the hazards identified in step 1 and the project components identified in step 2
- Determine the potential consequences of these interactions for the project
- Describe the potential consequences of these interactions for the environment

Step 4: Evaluation of the impacts and risks for the project and its operational environment

The fourth step of the ERVCC consists of only the following step:

- Evaluate and describe the impacts and risks caused by the effects of climate change for the project and the surrounding environment

Step 5: Adaptation measures to climate change

The final step of the ERVCC consists of the following activities:

- Identify the risk management and adaptation measures
- Recommend a suite of adaptation measures for each project component

8.1.4 Description of the Projects Operational Environment and Hazard Identification

8.1.4.1 Climate

Climate data analysis was performed using temperature and precipitation data collected from the Canadian Center for Climate Services (CCCS) at weather stations[15] in the territory of Nunavik, which also includes the climatic averages during the period 1981 to 2010. Figure 8-1 presents climate averages for temperature (mean, minimum and maximum) and global precipitation for this period.

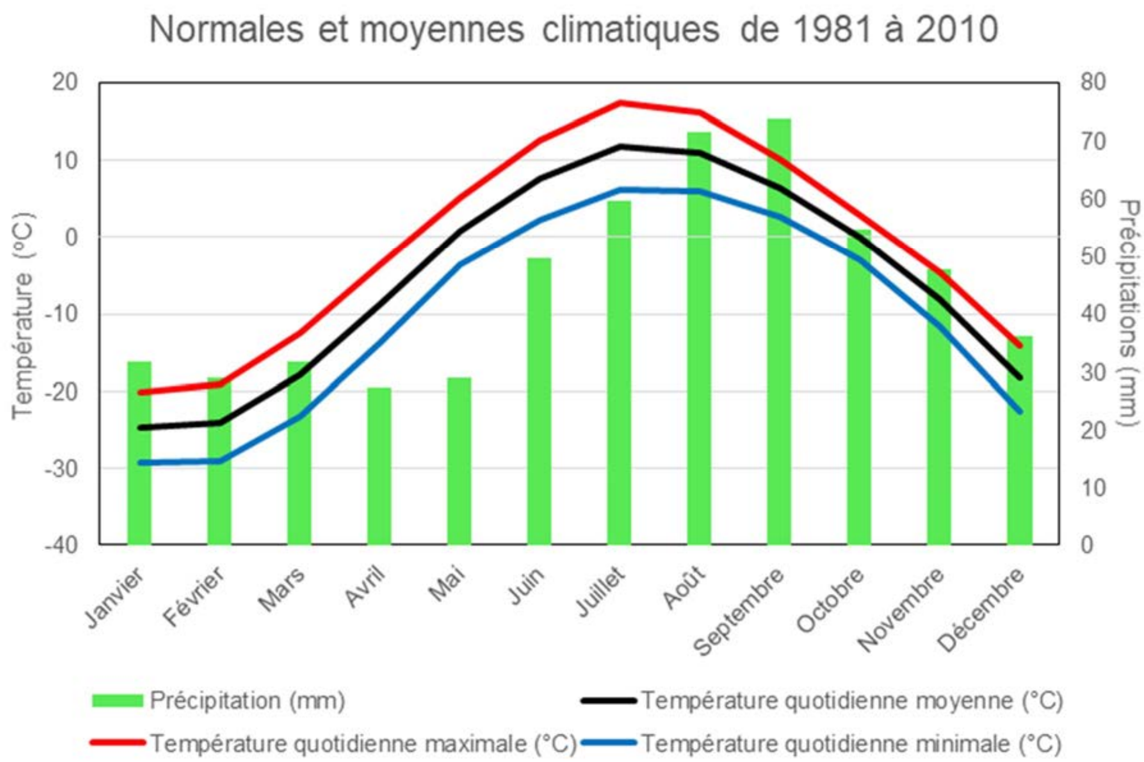


Figure 8-1 : Climate Normals and Means for 1981 to 2010

The climate averages represent the expected climate for a given region. They are defined as the average of the different recorded climate parameters such as temperature or precipitation for a given period at a specific place (Gouvernement du Canada, 2022e). Generally, the averages are based on data collected over a 30-year period and are revised at the end of each decade (Données climatiques, 2022).

The study zone for the project is characterized by a climate belonging to the polar temperature category where annual mean temperatures range from -9.4°C to -6.0°C, annual precipitation varies from 470 mm to 799 mm and the growth season is from 90 to 119 days per year.

[15] 22 sites have been identified by project collaborators based on issues for impact studies and adaptation to climate change. The majority of these sites correspond to villages (Kuujjuaq, Salluit), the others correspond to mine sites (Raglan / Nunavik Nickel), roads, parcs and hunting or fishing sites

Daily mean temperatures range from -24.11°C in January to 11.78°C in July. The mean daily minimum occurs in January (-29.26°C) and the mean daily maximum occurs in July (17.42°C).

Maximal daily temperatures above 20 °C occur 21.7 days per year while occurrences of temperatures above 30 °C occur only rarely with an occurrence of 0.34 days per year. Daily minimums below or equal to 0 °C occur on average 244 days per year, including 45.2 days per year where daily minimums are below -30 °C.

September is the month with the highest precipitations at 73.78 mm while April is the month with the least precipitation at 27.29 mm.

8.1.4.2 Permafrost

The study area is situated in a known permafrost zone. In this zone, the drainage capacity of the soil is limited to the thawed active layer during the summer. The amount of energy transmitted in the soil and the thermal diffusivity of the soil (capacity to conduct and store heat) depends on the thickness of this layer which is determined by the maximum depth of the summer defrost (GENIVAR, 2007). The thickness of the active layer ranges from 0.25 to 5 m depending on thermal characteristics of the soil (thermal conductivity and diffusivity, specific heat), the geomorphology of the site (exposure, drainage, thickness of the surface organic matter layer) and the latitude of the site. For example, on bedrock the active layer reaches 2.2 m in Salluit but can be up to 5 m thick in Kangiqsualujjuaq. Gray et al. (1988) demonstrated that the depth of the active layer is proportional to the thermal diffusivity of the soil. Based on temperatures measured in Salluit in different surface deposits the active layer reaches depths of approximately 1 m in fine marine sediments while soils with coarser granulometry such as sand and gravel have surface layers between 1.5 to 2 m.

Effect of Warming

With the increasing temperatures observed in northern Quebec since the 1990’s, the permafrost layer has also warmed. Observations from 1993 to 2007 showed an increase in temperature of 1.8 to 2.7 °C at 4 m depth in Salluit while in Kangiqsualujjuaq the temperature increase at the same depth reached 3.4 °C. Even at shallow depths (20 m), the soil warmed by 1 to 1.3 °C in Salluit and up to 1.2 °C in Kangiqsualujjuaq (Allard et al. 2012). This increase in temperature increases the thickness of the active layer. For example, in Salluit for the period from 1987 to 2004, the thickness of the active layer went from 2.2 m to around 3.05 m in the rock and from 1.30 m to more than 1.40 m in till (L’Hérault, 2005). More recent observations of the depth of the active layer in the Narsajuaq river valley near Salluit have shown that it has increased considerably between 1991 and 2017 (Gagnon and Allard, 2020). In another study, Gagnon and Allard (2020) show that the increase in the depth of the active layer will continue with ongoing climate change. Depending on the emission scenario and soil type, the depth of the active layer could be 2 to 3.4 times deeper by the end of the century compared to 1992.

Thawing of the permafrost and transformation of the continuous permafrost zone into a discontinuous zone in several areas could lead to the following risks:

- The structural integrity and stability of earthworks
- Difficulty to find suitable locations for construction
- Increased costs to maintain road infrastructure
- Road closures (landslides and subsidence of terrain) and site isolation

8.1.4.3 Climate Extremes

The Nunavik territory is an environment affected by natural and catastrophic event such as river floods, coastal flooding, ice jams, ice break-ups, floods, slope movements (landslides, gelifluction, avalanche, etc.), periglacial phenomena and extreme meteorological phenomena (windstorms, blizzards, droughts, etc.). Many events have occurred since 1935, including avalanches in Kangiqsualujjuaq (in 1981, 1982, 1986, 1993 and 1999), the avalanche of wet snow in Deception Bay (L'Hérault, 2005) and landslides in Salluit (Herault, 2005). In 2003 a blizzard with violent winds and important snowfall affected the community of Salluit. This caused breaks in telephone and electrical service and flights were suspended (Allard et al., 2010; L'Hérault et al., 2016). The next year, two other violent winter storms paralysed the region (Allard et al., 2020).

8.1.4.4 Hazards that have Affected Similar Projects in Nunavik

Slope Movements

Detachment of the active layer is likely to happen on banks characterized by surface deposits rich in ice and which have slopes as low as 4° (L'Hérault, 2009). Uncommon meteorological conditions (several consecutive hot days) that occurred in 1998, 2005 and 2010 increased the instability of the slopes and triggered the detachment of the active layer in the Salluit valley (L'Hérault, 2005).

The Deception Bay site saw three episodes of avalanches of wet snow in the last fifty years. The first occurred between June 6th and 7th 1970 and was likely caused by the rapid melting of the snow provoking the detachment of the saturated snow layer (L'Hérault, 2005),

Hydrological Hazards

On Mai 23rd 1979 a major ice jam occurred in the Kuujjuaq region. Twelve hours before the event large quantities of freezing rain and wet snow fell (19 cm; L'Hérault, 2005).

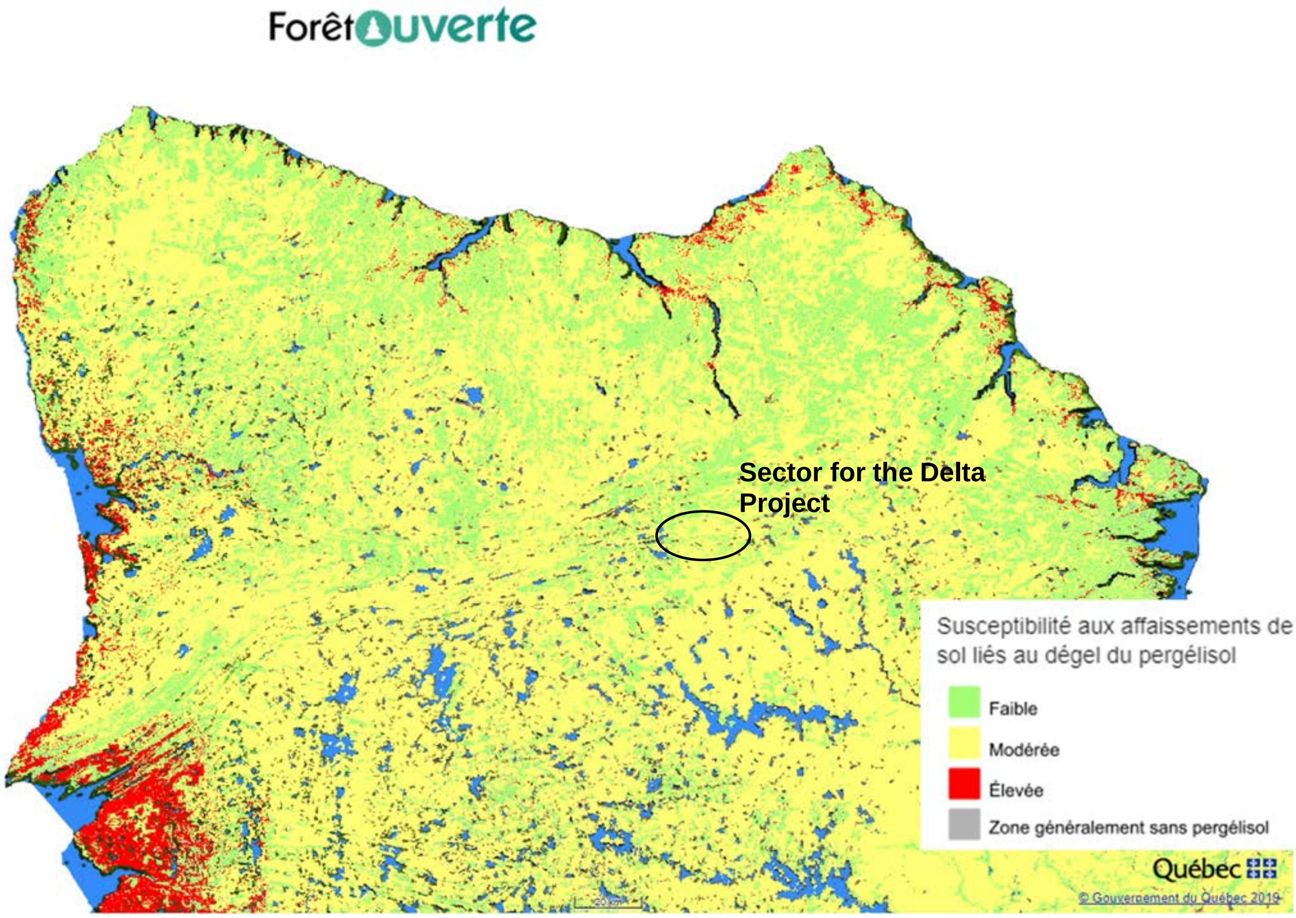
Between the 8th and 11th of October 2010, a storm surge was present along Hudson Strait and the north coast of Ungava. An atmospheric depression coincidental with high seas and tides caused an exceptional increase in the water level (L'Hérault, 2005).

On November 19th, 2015, particular meteorological conditions (abnormally high temperatures combined with a long period of precipitations and strong winds) led to the Innuksuak river bursting its banks at Inukjuak (L'Hérault, 2009).

Hazards associated with Permafrost

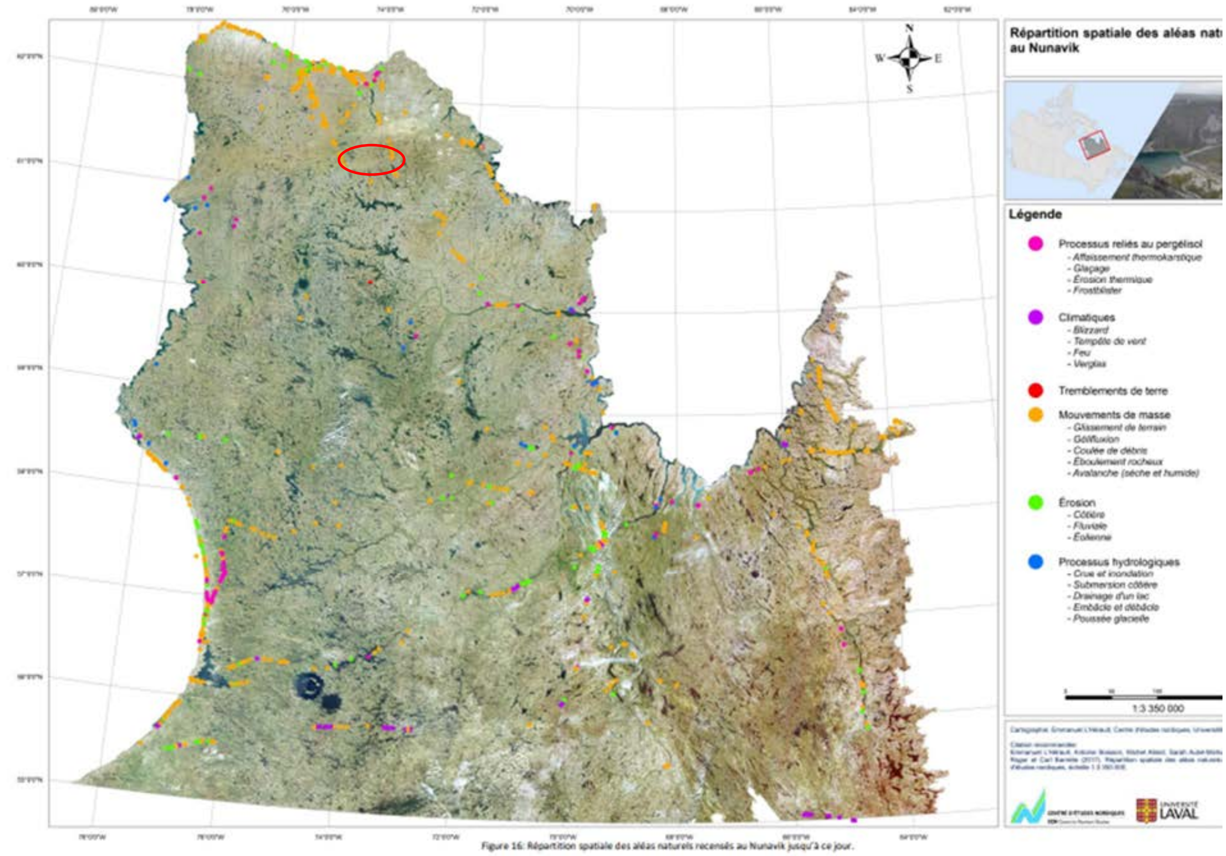
Many cases of thermokarsic subsidence (settling associated with thawing of permafrost) were noted in the Nunavik territory. A few sectors affected by coastal or fluvial erosion were observed using photointerpretation with geolocalized images obtained during littoral flights for coastal classification. As a consequence, new wetlands are appearing with the thawing of permafrost caused by the rapid warming of the region. This radically changes the landscape and function of the Nordic ecosystems on which the lifestyle and culture of Nunavik's Inuit communities depend. As a matter of fact, a large portion of the infrastructure at the Delta site and many access roads are built on wetlands. Figure 8-2 presents the vulnerability soils to settling caused by thawing permafrost. The sector is mainly located in a zone where the risks of settling are determined to be mild to moderate if the thawing of permafrost is accentuated.

Figure 8-3 illustrates the recorded events of climatic hazards having happened from 1970 to 2015 in the Nunavik territory (L'Hérault *et al.*, 2016).



Source: https://www.foretouverte.gouv.qc.ca/

Figure 8-2: Susceptibility to soil settling caused by thawing of the permafrost (The sector for the Delta project is circled in black).



Source: Figure reproduced from L'Hérault *et al*., 2016

Figure 8-3 : Spatial distribution of natural hazards recorded in Nunavik until 2015. The zone circled in red represent the approximate study area.

8.1.4.5 Climate Projections

To understand the exposure of infrastructure to climate change and evaluate the associated risks, it is essential to establish the potential changes at the location and the lifespan of the infrastructure. This is based on regional climate projections obtained from a combination of reduced scale multi-models built from multiple Global Climate Models (GCM) taken from the *Coupled Model Intercomparison Project Phase 5* (CMIP5) (Mailhot et Chaumont, 2017).

The climate projections are based on hypotheses about the evolution of greenhouse gas (GHG) emissions. These hypotheses are called "*Representative Concentration Pathways"* (RCP) and their names come from their associated level of radiative forcing, which is to say the difference between the solar radiation absorbed by the Earth and that returned to space. For example, the RCP 2.6, RCP 4.5, RCP 6 and RCP 8.5 correspond to a radiative forcing of 2.6, 4.5, 6 et 8.5 W/m² respectively for each scenario. The carbon dioxide (CO_2) concentrations are projected based on anticipated growth of the population and energy demand (type of energy is an important factor), as well as anticipated changes in the coverage and type of vegetation. Detailed descriptions of the RCPs are presented below in Table 8-1.

Table 8-1: Different carbon concentration scenarios (RCP)

RCP	Description
RCP 2.6	**Rigorous attenuation scenario:** Represents a scenario that aims to maintain global warming below a 2 °C increase compared to preindustrial temperatures. Ambitious reduction of GHG emissions, peaking around 2020, then reducing and becoming markedly negative before 2100.
RCP 4.5	**Intermediate attenuation scenario:** Compatible with somewhat ambitious emission reductions causing a slight increase peaking in 2040 followed by reductions. This scenario is below the 2 °C limit agreed to in the Paris Agreement.
RCP 6.0	**Intermediate to elevated emission scenario:** Emissions peaking in 2060 and reducing for the rest of the century
RCP 8.5	**Very high GHG emissions:** Corresponds to the absence of policy changes to reduce emissions (actual policies or maintaining the status quo)

Source: IPCC, 2014.

The scenarios with very high carbon concentrations (RCP 8.5) and intermediate carbon concentrations (RCP 4.5) were chosen for the analysis of the concerned mining projects in this document. The projections for changes to the climate come from the *Portrait Bioclimatique du Nunavik* (GENIVAR, 2007).

The climate scenarios are based on a combination of projections established using global climate models taken from the *Coupled Model Intercomparison Project Phase 5* (CMIP5) (CCCS, 2021). The historical simulations and emission scenarios (RCP 8.5 and 4.5) are realized using a 1° x 1° grid resolution (CCCS, 2021). The changes projected by the CCCS are expressed as anomalies compared to a reference period spanning 1986 to 2005. In the context of the *Portrait Bioclimatique du Nunavik* (Mailhot et Chaumont, 2017), the 1980 to 2004 period is used as a historical reference to analyse the climate data. The climate projections were analyzed for a period of 2040 to 2064 to integrate climate data found in the *Portrait Bioclimatique du Nunavik* and to respect the lifespan of the project.

8.1.4.6 Natural and Man-made Zones Potentially Affected by Actual and Projected Climatic Conditions

Ecosystems depend on the precise equilibrium of environmental factors. Precipitation and the availability of water is integral to the equilibrium of flora and fauna from terrestrial and aquatic habitats. Furthermore, plants and animals depend on seasonal cycles of temperature. The rapid pace of anthropogenic climate change threatens this equilibrium and puts into peril flora and fauna since they cannot adapt quickly enough. For example, deep thawing of the soil can lead to drying of peat and transform wetlands into terrestrial habitats (Woo et al., 2006).

It is also possible that in an environment dominated by permafrost, there is an increased risk of flooding in wetlands and near waterbodies since water does not penetrate deeply, though the active layer seems to have increased in thickness over the last 15 years. Therefore, there might be little impact on soil water levels if the increase in liquid precipitation happens at the same rate as thawing of the permafrost. As a result, there may be little to no drying of wetlands observed as a result of climate warming.

In natural environments, without anthropogenic influences, the migration and calving season of the caribou is closely linked to the climate, snow and ice melt, the vegetation, harassment by insects and the quantity of predators (Sharma et al. 2009 *dans* Blangy et Deffner, 2014). Climate change is therefore likely to disturb these phases in the caribou life cycle, even without the presence of mining activities.

Surface infrastructure and roads are vulnerable to climate change and an improper integration of it's impacts to plans could lead to damaging consequences in the natural environment. For example, a ruptured dyke on the collection basin could lead to important environmental consequences on aquatic habitats such as lakes and wetlands downstream of the leak. The engineering consultant responsible for the design of the infrastructure at the Delta site, namely Golder Associates, will ensure the integration of climate change in order to avoid damaging environmental consequences.

Among other activities that regularly take place in mining operations, which could affect natural environments, and which are likely to be influenced by climate change, are crushing operations. Instances of extreme drought could increase the amount of dust in the air and lead to consequences on workers, animals, and vegetation in proximity to the work. As such, the crushing plant should be on the surface and should use a water sprayer dust reduction system during operations to limit the liberation of dust into the air. This sprayer system has been planned for the crushing plant which will operate principally during frost free periods to allow spraying.

8.1.5 Project components likely to be affected by hazards

Reports and scientific studies were consulted to determine which components were potentially susceptible to extreme meteorological events. Based on these documents, several components were identified for the open pit mining projects at CRI and must be examined during the climate change resiliency evaluation (Table 8-2).

Concerning underground exploitation, few risks are associated with regards to climate change. One of the only problems would be an intense period of winter rainfall that could lead to an increase in the water levels in the galleries if the pumps are insufficient. Since the pump systems in the galleries allow easy addition of more pumps, therefore rapidly increasing the evacuation capacity, there are no problem anticipated for underground exploitation. This aspect will therefore not be treated in Table 8-2.

The restoration plan will need to take into account climate change regarding surface drainage and erosion of bare surfaces post-restoration so as to reduce impacts on aquatic environments and local vegetation. These components are frequently affected by climate hazards.

Table 8-2: List of components and project elements

Components	Elements
Access infrastructure and transport	• Roads and access routes • Access ramps to underground galleries • A total of six permanent water crossings and five intermittent water crossings to be constructed • A total of five to nine daily transits on the Delta route towards the Expo site
Water management	• Water collection basins (primary and downstream) defined by a water retention dyke and an emergency spillway • Contaminated and clean water ditches • Drinking water pipes and a drinking water treatment plant • Mobile wastewater treatment plant • Sanitary water treatment plant • Discharge for mine water • Discharge for sanitary water
Storage areas	• Ore stockpile • Waste rock pile • Open pit trench • Landfill site • Crushing site and geotube storage
Buildings	• Surface buildings (garage, office, fire station, computer server room, gym, laundry, etc.) • Drinking water pump station in a lake • Dormitory and cafeteria for workers (150) • Cement slurry plant • Powder magazines (explosives and detonators)
People	• Employees

8.1.6 Project Components whose Environmental Impact could be Amplified by Identified Hazards

The results demonstrate vulnerabilities to climate change during a mine's exploitation phase. They depend greatly on elements seen at the design and construction phases of the different structures with regards to their performance when faced with a changing climate. Many documents and technical guides exist to help in the design and construction of infrastructure on permafrost that are resilient during a mine's exploitation phase in northern latitudes (Andersland et Ladanyi, 2004; Doré et Zubeck, 2008; Gouvernement du Québec, 2012; MEND, 2012). The elements most vulnerable to climate change are the management of residues (only at the Expo site) and water management in collection basins and ditches. Water management must consider the potential for increased water volumes. During exploitation it is not necessarily the evolution of the climate that poses a problem, but the variability of the extremes that is most preoccupying. In this context the capacity of spillways and the structural integrity of retaining walls must take into account extreme weather events associated with climate change. Furthermore, a precautionary approach must be taken when designing infrastructure in a region with permafrost to prevent grave consequences such as settling of buildings during the thaw and the release or movement of soil caused by a ruptured dyke associated with collection basins. It must be underscored that water management infrastructure will be designed according to the best modern standards to limit climate risks.

Identification of Climate Indicators

A climate indicator is a climatic condition or type of event (for example, the number of warm days) whose variability exceeds a defined threshold. Above this threshold infrastructure could be subject to impacts such as a loss of productivity, damage to the infrastructure or implementation of a more intensive maintenance plan. The probability associated with a climate indicator is calculated by extracting the trend of a regression for the reference period and for a given climate variable.

To determine the risks linked to climate for the project, the climate indicators and their probability of occurrence were analysed both for the historical reference period (1980-2004) and in a climate change context as described in the document *Élaboration du portrait bioclimatique du Nunavik* (Mailhot and Chaumont, 2017).

Using the information and data from Mailhot et Chaumont (2017), three categories of climate hazards were considered pertinent for the region. Namely, ambient temperatures, precipitations and solid precipitations. Within these hazards, certain indicators were identified and selected for the pertinence to the project. In total, 8 climate indicators were kept for the ERVCC (Table 8-3).

Table 8-3: Description of climate indicators according to Mailhot and Chaumont (2017)

Climate indicators	Definition
Average annual temperature (º C)	Annual average of daily mean temperatures.
Hot days (days)	Annual number of days with a maximum daily temperature above 15 º C (Mailhot and Chaumont, 2017).
Length of frost-free season (days)	Number of days between the end and start date of the frost-free season.
Freeze-Thaw (days)	Annual number of days on which, for the same day, the daily minimum temperature is below 0 °C and the daily maximum temperature above 0 °C.
Total annual precipitation (mm)	Annual total precipitation.
Days with very heavy precipitation (days)	Annual number of days with precipitation more intense than the 95th percentile of the wet day precipitation distribution (more than 1 mm) over the reference period.
Annual solid precipitation (mm)	Annual total precipitation in solid form.
Duration of snow cover (days)	Number of days in a year between the beginning and the end of the snow cover (first day when the thickness of the snow accumulated on the ground is below a given threshold after March 1) where the thickness of the accumulated snow on the ground is greater than or equal to 2 cm.

Table 8-4 presents the variation of the climate indicators between the historical data and the 2040-2064 period for the RCP4.5 and RCP8.5 and shows the percentage change in the climate indicators.

Climate projections taken from Mailhot and Chaumont (2017) indicate that there will be an increase in the average annual temperature of 57% for the RCP 4.5 scenario and of 78% for the RCP 8.5 scenario. There will also be a 43% and 71% increase in the number of hot days for the RCP 4.5 and RCP 8.5 scenarios respectively. Increased temperatures will influence the frost-free season which will become progressively longer.

With regards to precipitations, they will increase by 19% for the RCP 4.5 scenario and 23% for the RCP 8.5 scenario. There will also be an increase in the number of days with heavy precipitations. Annual solid precipitation will decrease by 1% for the RCP 8.5 scenario. Finally, because of the increased temperatures the duration of snow cover will be reduced by 9% for the RCP 4.5 scenario and by 13% for the RCP 8.5 scenario, indicating that snow will not remain on the ground as long in the future.

Table 8-4: Variation and rate of change for the eight climate indicators and future projections

Climate indicators	History (1980-2004)	Future RCP 4.5	Future RCP 8.5	Future RCP 4.5	Future RCP 8.5
		Variation (2040-2064)		Rate of change	
Average annual temperature (°C)	-5.8	+3.3	+4.5	+57%	+78%
Hot days (days)	42	+18	+30	+43%	+71%
Length of frost-free season (days)	111	+22	+32	+20%	+29%
Freeze-Thaw (days)	63	-2	-5	-3%	-8%
Total annual precipitation (mm)	616	+120	+140	+19%	+23%
Very heavy precipitation days (days)	5.5	+2.3	+3.4	42%	+62%
Annual solid precipitation (mm)	350	+1	-5	0%	-1%
Duration of snow cover (days)	244	-21	-31	-9%	-13%

8.1.6.1 Vulnerabilities to Climate Change

The analysis of climate vulnerabilities evaluates the exposure, sensitivity and adaptability of a resource, a community, an ecosystem or a region to a particular climate hazards or extreme weather event. The assets and operations that are sensitive and with a limited adaptation capacity go on to the next step in the risk analysis. The present study examined the climate vulnerability to determine exposure, sensitivity and adaptation capacity for each component (Diagram 8-1) to the eight climate indicators detailed above (see Table 8-4).

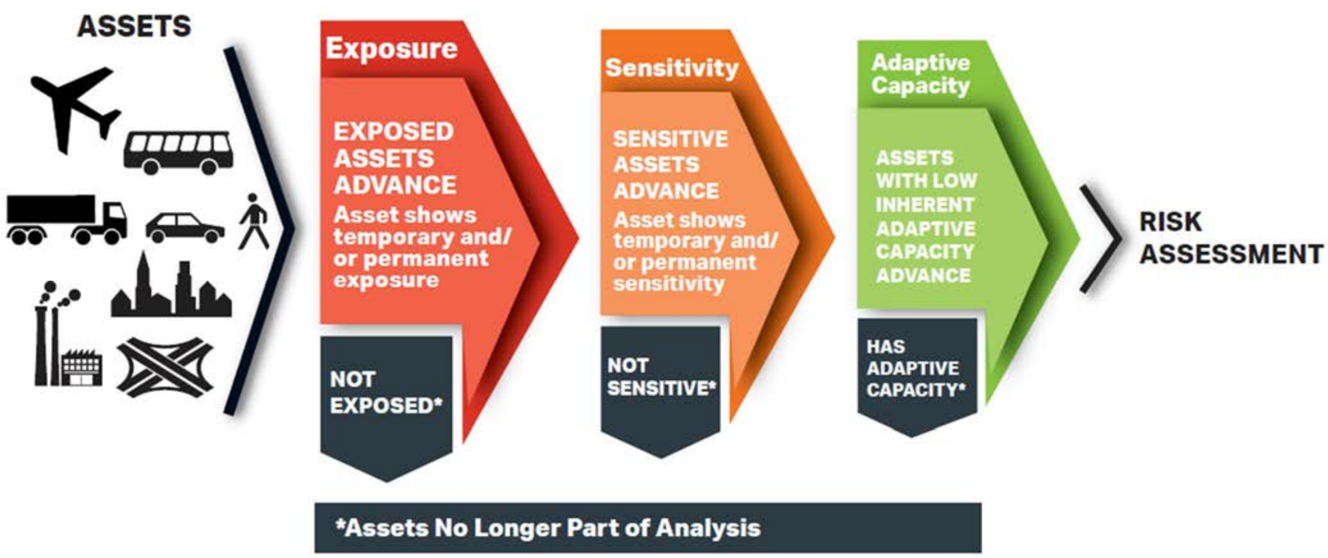


Diagram 8-1: Strategy to evaluate climate vulnerability

8.1.6.2 Description of the Potential Consequences of Interaction for the Environment

Table 8-10 (see section 8.1.8.3) and section 8.1.8 describe the consequences for the environment of interactions between climate hazards and the project components.

8.1.6.3 Identification of Risks Susceptible of Causing Repercussions to the Project

The identification of risks susceptible of having an impact on the project are detailed in Table 8-10 (see section 8.1.8.3) and in section 8.1.8.

8.1.7 Risk Analysis (estimation of the consequences for the project)

Thus, a risk is defined as a probability of occurrence of a dangerous event combined with the severity of the harm to an asset (for example a road or building) if the event occurs. A risk evaluation was performed to estimate the impacts of the eight climate indicators on each of the project components identified above (see Table 8-4) using and impact classification matrix. The matrix classifies the level of consequences of a severity index from very weak to very high.

8.1.7.1 Estimation of the Probability that an Event Occurs

With the goal of determining climate risks for the project, pertinent climate indicators were examined for the reference period (1980-2004) and, in the context of climate change, the period of 2040-2064. The probability rating is described in Table 8-5 below.

First, using the variability, the rate of change for each climate indicator was calculated for the RCP 4.5 and RCP 8.5 scenarios as described in Table 8-4. The rate of change was then used to determine a probability rating of occurrence ranging from 1 to 5 with the help of Table 8-5. These ratings are on a scale of 1 to 5 where 3 represents baseline climate conditions and a stable rate of occurrence compared to baseline conditions. For example, mean temperature shows an increase of 57% for RCP 4.5 (Table 8-4). Using Table 8-5, a probability rating of 5 is attributed to this climate indicator since the increase is situated between 50% and 100%. This approach is applied to all climate indicators for both time horizons (1980-2004 and 2040-2064) and for both RCP scenarios (4.5 and 8.5).

Table 8-6 presents the probability of occurrence rating attributed for each climate indicator for the base conditions and the climate scenarios RCP 4.5 and 8.5 for the 2040-2064 time horizon.

Table 8-5: Description of the probability of occurrence ratings

Probability of occurrence rating	Tendency	Occurrence	Definition
1	↑	Likely to occur less frequently than current climate	50-100% reduction in frequency or intensity with reference to baseline mean
2			10-50% reduction in frequency or intensity with reference to baseline mean
3	Current climate reference by parameter	Likely to occur as frequently as in current climate	Baseline average conditions or +/- 10% change in frequency or intensity with reference to baseline mean
4	↓		10-50% increase in frequency or intensity with reference to baseline mean
5		Likely to occur more frequently than in current climate	50-100% increase in frequency or intensity with reference to baseline mean

Table 8-6: Probability of occurrence rating for the climate indicators

Climate hazard	Climate indicator	Definition	Probability of occurrence: Current baseline conditions	RCP 4.5	RCP 8.5
Ambient temperature	Average annual temperature (°C)	Annual average of daily mean temperatures.	3	5	5
	Length of frost-free season (days)	Number of days between the end and start date of the frost-free season.	3	4	4
	Freeze-Thaw (days)	Annual number of days on which, for the same day, the daily minimum temperature is below 0 °C and the daily maximum temperature is above 0 °C.	3	3	3
	Hot days (days)	Annual number of days with maximum daily temperature above 15 ºC.	3	4	5
Precipitation	Annual total precipitation	Annual total precipitation.	3	4	4
	Very heavy precipitation days (days)	Annual number of days with precipitation more intense than the 95th percentile of the wet day precipitation distribution (more than 1 mm) over the reference period.	3	4	5
Solid Precipitation	Annual solid precipitation	Annual total precipitation in solid form.	3	3	3
	Duration of snow cover (days)	Number of days in a year centered on winter (August-July) when the depth of snow accumulated on the ground is greater than or equal to 2 cm.	3	3	2

8.1.7.2 Estimation of the Severity of the Consequences

The severity of the consequences was defined on a scale of 1 (very weak) to 5 (very high) for the four impacted components according to Table 3 of Appendix G of the general guidelines « Climate Lens – General Guidance » of the Government of Canada (2019) (Table 8-7).

8.1.8 Risk Assessment and Impacts for the Project and Receiving Environment

8.1.8.1 Risk Assessment

According to the CAN/CSA-31000 standard, a risk (R) is defined as being the product of the probability of occurrence (P) and the severity of the consequences (G). Table 8-8 below presents the scoring of the risk assessment matrix.

Table 8-7: Impact Severity Index and Impact Categories

		Impact category			
Impact Severity Index	**Consequences**	**Health and Security**	**Infrastructure Health**	**Operational Impact**	**Costs**
1	**Very weak**	First aid in case of injury	Very low damage; immediately repairable maintenance cost	Operation closed for less than 24 hours (loss of service)	Minor cost increase
2	**Weak**	Medical treatment for a minor injury	Slight increase in infrastructure construction efforts, low investments required preventively	Operation closed for 24 hours to 72 hours (loss of service)	Investments required to adapt facilities
3	**Moderate**	Bodily injury / Illness with work restrictions	Moderate damage to the materials making up the structure; slow deterioration of the materials of certain essential components; investments required to maintain infrastructure stability	Closure from 72 hours to 1 week (loss of service); disruptions of operations; interruption of certain works for short periods	Minor investments required for corrective work and possible work interruption
4	**High**	Permanent disabling injury or accident affecting several people	Causes additional costs and high logistical difficulties leading to difficulties in finding suitable sites for construction	Closure of the mining site for 1 week to 1 month (loss of service); disruptions to operations; temporary interruption of work; significant cost increase	Major investments required for corrective work and possible work interruption
5	**Very high**	Death or significant irreversible disability	Significant increase in construction and maintenance costs; risks to infrastructure stability.	Closure of the mining site for more than 1 month (loss of service); frequent interruptions of work which can go as far as the impossibility of carrying them out during the summer, major increase in costs	Additional costs significant enough to consider abandoning the project

Table 8-8: Risk Matrix

			Severity of consequences (G)				
			Very Weak	Weak	Moderate	High	Very High
		Rating	1	2	3	4	5
Probability of occurrence (P)	Very high	5	5	10	15	20	25
	High	4	4	8	12	16	20
	Moderate	3	3	6	9	12	15
	Weak	2	2	4	6	8	10
	Very Weak	1	1	2	3	4	5

To quickly identify the elements to be managed on a priority basis, the risks have been grouped into four categories (Table 8-9).

Table 8-9: Risk Assessment Scale

Risque (R) = Probability (P) x Gravity (G)	Risk Treatment
Low risk: <6	Controls probably not required.
Moderate risk: 7 < R 16	Some controls required to reduce risk to lower levels.
High risk: R > 20	High priority control measures required.
Risk = 5 (Special case)	Interactions giving rise to a risk rated "5" are considered special cases and are considered in the risk evaluation, as these can either be interactions with very low likelihood but very high severity or interactions with high likelihood and very low severity. While the former case may have very severe impacts, the latter case can trigger a slow deterioration of project components due to the high likelihood of the climate condition.

8.1.8.2 List of Possible Interactions Between Hazards and Project Components

The final risk assessment revealed 40 interactions between the eight climate indicators (hazards) and the five project components.

For the 2040 to 2064 period and the RCP 4.5 scenario, the risks were assessed for 40 interactions in the following way:

- 8 interactions with a low risk
- 30 interactions with a moderate risk
- 1 interaction with a high risk (mean annual temperature for transport infrastructure and road transport)
- 1 special case

For the 2040 to 2064 period and the RCP 8.5 scenario, the risks were assessed for 40 interactions in the following way:

- 9 interactions with a low risk
- 27 interactions with a moderate risk
- 2 interactions with a high risk (mean annual temperature and number of hot days for transport infrastructure and road transport)
- 2 special cases

Table 8-10 presents a summary of the risk assessment for each climate indicator (hazard) and for project components for each RCP (4.5 and 8.5) for the forecasted future period (2040-2064).

8.1.8.3 Presence of Potential Impacts

The potential impacts of climate hazards for each project component were described, when present, in Table 8-10. Adaptation measures for these impacts are presented in point 8.1.10.

Table 8-10: Summary of risk assessment for climate indicators and project components for each RCP scenario for the forecasted future period and the potential impacts

Project component	Climate hazard	Climate indicator	RCP 4.5			RCP 8.5			Potential impact
			Probability of occurrence	Gravity of consequences	RISK	Probability of occurrence	Gravity of consequences	RISK	
Access infrastructure and transport	Temperature	Mean annual temperature (°C)	5	4	20	5	4	20	The increase in temperature can create dry conditions and increase dusty conditions coming from roads and access routes during transport. Transport and access roads are among the usual sources of dust on the mine site, as well as crushing activities. This has a negative impact on air quality and can potentially impact nearby vegetation. Further, the carrying capacity of helicopters is reduced with increasing air temperature. This phenomenon could lead to increased costs for mining companies. It should be noted that exploitation of the Delta mine and the use of a transport corridor will reduce helicopter flights in the sector. However, the use of the road could lead to potentially important consequences since increased temperatures could increase global costs for road transport (increase in fuel consumption from air conditioning use for example) which could be considerable over time.
		Hot days (Days)	4		16	5		20	
		Frost-free season (days)	4		16	4		16	
		Freeze-thaw (days)	3	4	12	3	4	12	Increased mean winter temperatures could augment the frequency of freeze-thaw cycles which could impact road infrastructure and, consequently, increase maintenance costs. Given the remote locations and that mining companies are responsible for the maintenance of the on-site road networks, the impacts could be important. In extreme cases, increased damage caused by freeze-thaw cycles (for example on river crossings) and melting of the permafrost could result in road closures and, in certain cases, the temporary isolation of mine sites.
	Precipitation	Total annual Precipitations (mm)	4	2	8	4	2	8	The main problems linked to transport are permafrost thawing or maintenance attributed to abundant precipitations. Increased precipitation and a higher number of days with intense precipitation could increase the risks of water accumulation on access roads and increase runoff. Swelling of watercourses could affect the integrity of infrastructure and increase erosion close to the water crossing. Increased precipitation could also reduce the frequency of aerial transport. Damages could cause temporary closures of roads and landing strips, which could perturb the supply chain or provoke punctual work stoppages. In certain extreme cases, road closures causing a temporary isolation could lead to a shutdown of the new Delta site by preventing work teams from doing shift changes. However, watercourses on the Ivakkak-Delta road are small, reducing the risk of road collapse and service interruptions. Increase precipitation could provoke higher erosion on the right-of-way and lead to clogging of culverts. However, considering the technics and materials used, the increase in the risk of erosion is fairly low.
		Very heavy precipitation days (days)	4			5		10	
	Solid Precipitation	Annual solid precipitation	3	3	9	3	3	9	A slight reduction in solid precipitation and of the duration of snow cover is currently forecast. However, it is still important to consider the impacts of solid precipitation since they will continue to occur and an increase in extreme event is anticipated. Road infrastructure could be impacted by snow since it could block access to the mine by making roads impassable.
		Duration of snow cover (days)	3		9	2		6	
Water management (collection basin, retention dyke, ditches, drinking water supply, mining and sanitary effluent)	Temperature	Mean annual temperature (°C)	5	3	15	5	3	15	A progressive increase in temperatures in the region could provoke the thawing of the permafrost and increase discontinuous permafrost zones. This increase in the active permafrost zones could lead to subsidence. These consequences could affect the structural integrity and stability of retention walls on the collection basin and dykes as well as ditches for clean and contaminated water. However, technologies exist that allow construction on permafrost and these guidelines are well known. Increased temperatures will increase evapotranspiration during the summer. This could cause problems with water recirculation by increasing contaminant loading in the water and reducing the dilution of the final effluent because of the reduced receiving watercourse. These impacts are considered low because of the restricted summer season and the high summer flow of the receiving watercourse. Increased evapotranspiration could also cause the drying of the water supply. In this case, this cannot happen since the water intake is in a zone with a water depth of 11 m. No risk is therefore associated with the water intake.
		Hot days (Days)	4		12	5		15	
		Frost-free season (days)	4		12	4		12	
		Freeze-thaw (days)	3		9	3		9	
	Precipitation	Total annual Precipitations (mm)	4	3	12	4	3	12	An increase in the frequency and intensity of extreme precipitation events is forecast for all mining regions, as well as for mean annual precipitations. The risks associated with instability of retention walls and the maintenance of their integrity is therefore increased. However, the exploitation period is short, and the works are often modified during exploitation to adapt to the changing operational conditions. The increased precipitations could lead to an insufficiency of the collection basin and increase the amount of water to be managed and treated, especially during the period of snowmelt. This could increase the risk of releasing contaminated water into the environment. However, design criteria have considered an 18% increase in the occurrence of century level precipitations and millennial floods as recommended by Directive 019 (Golder, 2021)
		Very heavy precipitation days (days)	4			5		15	

Table 8-10: Summary of risk assessment for climate indicators and project components for each RCP scenario for the forecasted future period and the potential impacts (continued)

Project component	Climate hazard	Climate indicator	RCP 4.5			RCP 8.5			Potential impacts
			Probability of occurrence	Gravity of consequences	RISK	Probability of occurrence	Gravity of consequences	RISK	
Water management (collection basin, retention dyke, ditches, drinking water supply, mining and sanitary effluent)	**Solid precipitation**	Annual solid precipitation	3	4	12	3	4	12	Snowmelt can create a large quantity of water to manage. This increase can potentially create an insufficiency in capacity of the collection basins and increase the volume of contaminated water to be managed and treated. This can increase the risk of releasing contaminated water into the environment. However, since the forecasted snow quantity is reduced and the dykes and basins are designed to contain more than the maximum likely water quantities (24-hour rainfall with a return period of 1000 years combined with snowmelt over 30 days with a return period of 100 years) the risk is considered moderate.
		Duration of snow cover (days)	3			2		8	
Storage areas (ore and waste rock piles, open pit and waste rock storage pit, LEMN)	**Temperature**	Mean annual temperature (°C)	5	3	15	5	3	15	An increase in temperature can cause a thickening of the active layer which can favour oxidation of the sulphurs contained in the waste rock by bringing water and oxygen. An increase in the active layer of permafrost can also cause subsidence which can affect the structural integrity of the landfill and the walls of its trench. An increase in temperature can cause an increase in the quantity of dust coming from the stockpiles and the open pit, potentially affecting air quality and vegetation in proximity to the site.
		Hot days (Days)	4		12	5			
		Frost-free season (days)	4			4		12	
		Freeze-thaw (days)	3		9	3		9	
	Precipitation	Total annual Precipitations (mm)	4	3	12	4	3	12	An increase in precipitations and the number of days with intense precipitation can increase the quantity of water in the stockpiles and runoff from the ore and waste rock piles. This increased runoff can transport contaminants from the piles and carry it to the natural environment. This increase in precipitation can also affect the structure of the walls of the open pit where runoff could weaken their stability. For the LEMN, an increase in precipitation could be problematic if the drainage is not contained on the site and makes its way into the natural environment. Currently, no impacts are associated with water coming from the LEMN because of its design and the management of runoff.
		Very heavy precipitation days (days)	4			5		15	
	Solid precipitation	Annual solid precipitation	3	3	9	3	3	9	A quicker melt of the snow cover will increase the quantity of water in the ore and waste rock stockpiles as well as in the open pit, via an increase in the risk of runoff.
		Duration of snow cover (days)	3			2		6	
Surface buildings (Dormitories, warehouses, garage, etc.).	**Temperature**	Mean annual temperature (°C)	5	3	15	5	3	15	A progressive increase in temperatures in the region can cause a thawing of the permafrost and a more important discontinuous permafrost zone. Further, the mere presence of buildings can increase the thawing of permafrost. The combination of these impacts can create risks for the structural integrity of buildings. However, the foundations of the buildings are adapted to avert increased thawing of permafrost, which reduces the impacts of this hazard.
		Hot days (Days)	4		12	5			
		Frost-free season (days)	4			4		12	
		Freeze-thaw (days)	3		9	3		9	
	Precipitation	Total annual Precipitations (mm)	4	3	12	4	3	8	Increase in total and intense precipitations can cause infiltrations in different surface buildings (habitation, warehouses, workshops, etc.). Drainage systems could be overloaded creating the possibility of flooding in buildings.
		Very heavy precipitation days (days)	4			5		15	
	Solid precipitation	Annual solid precipitation	3	2	6	3	2	6	The presence of snow requires management of snow removal and clearing of entryways and roofs of buildings.
		Duration of snow cover (days)	3			2		4	
Employees	**Temperature**	Mean annual temperature (°C)	5	1	5	5	1	5	Climate simulations forecast a lengthening of the maximum consecutive days without precipitations for the summer season. In extreme cases this could limit collection of freshwater and temporarily expose employees to natural uplifting of dust.
		Hot days (Days)	4		4	5		5	
		Frost-free season (days)	4		4	4		4	
		Freeze-thaw (days)	3	2	6	3	2	6	Freeze-thaw cycles could create slippery conditions and lead to falls by personnel and employees circulating outside.
	Precipitation	Total annual Precipitations (mm)	4	1	4	4	1	4	Intense precipitations can increase the risk of water accumulation and flooding, leading to difficulties accessing infrastructure. Very intense rainfall can cause a greater risk of water accumulation and flooding, creating more difficult access to infrastructure.
		Very heavy precipitation days (days)	4	2	8	5	2	10	
	Solid precipitation	Annual solid precipitation	3	2	6	3	2	6	Snowy conditions could create slippery conditions and lead to falls by personnel and employees circulating outside.
		Duration of snow cover (days)	3			2		4	

8.1.9 Adaptation Measures to Climate Change

Different types of adaptation measures to climate change exist: Project location, design measures, operation and maintenance as well as internal policies of the company. For the NNiP mining projects, the location cannot be changed. Therefore, no adaptation measures of this type will be discussed in the following sections.

Adaptation measures aim to reduce the impacts and risks associated with climate for project components or the environment in which it is located. With the help of these measures, the vulnerability of the project and its components to climate hazards is reduced, so is the sensitivity of the environments to the projects impacts.

8.1.9.1 Identified risk treatment and adaptation measures

Risk treatments and adaptation measures were identified for the 2 interactions leading to an elevated risk, the 28 interactions leading to a moderate risk and the 2 special cases for the RCP 8.5 scenario (most pessimistic scenario) between the 8 climate indicators and the 5 project components. According to the literature and the guide CSA PLUS 4011:19 (CSA Groupe, 2019), adaptation measures were identified on the basis of the three following measures:

- **Design**: Measures to be incorporated during the design phase of assets (for example buildings or collection basins) for these to be resilient to future climate risks and to prevent costly revamps.
- **Operation and maintenance (O&M)**: Measures to be incorporated over the lifespan of the assets during operation and maintenance to ensure resiliency.
- **Policy**: Measures to ensure and maintain safe and healthy working conditions.

8.1.9.2 Recommendations for adaptation measures for each project component

The principal recommendations of the evaluation to the **resilience to climate change** of the new Delta mining project and its components are presented below.

Design Measures:

- Impose speed limits sufficiently low to minimize the uplifting of dust by vehicles and frequently applying dust reducers (ex: spraying) on the access roads to the Delta site. The vegetation and the health of workers nearby the infrastructures would be less subjected to dust transport – Measure already applied as a part of the NNiP.
- Waterproofing the surface of stockpiles to prevent inputs of water and oxygen in the contact soil (measure also protecting surface and groundwater) – Measure already applied, will also be applied in the context of Phase 2b for the new stockpiles and the main collection basin.
- Restoring vegetation in certain sectors of the mine site that will no longer be disturbed (during restoration) and using native species appropriate to the territory.
- Study and analyze the relationship between air temperature and its effects on the behaviour of the mine residues
- Study and analyze the relationship between soil temperature and its effects on the behaviour of the mine residues – Installation of thermistors at the Expo site
- Construct building foundations taking into account thawing of permafrost and design so as to reduce the risk of collapse of the infrastructure. – Measure already applied to works at NNiP since Phase 1.
- Carrying out capacity studies for drainage systems to install systems with adequate capacity – Measure already in place in installations since Phase 1
- Document the design and construction process for the infrastructure foundations since they are complex in regions where permafrost is present. – Measure included in constructions done in the context of NNiP.

Measures Related to Operations and Maintenance (O&M) :

- Increased monitoring and inspection following precipitation events and heavy precipitation days to ensure road and access route integrity is not compromised. – Measure already applied by CRI in the context of NNiP
- Undertake necessary repairs in a timely manner - Measure already applied by CRI
- Ensure snow clearance and de-icing of routes and access roads following instances of solid precipitation - Measure already applied by CRI in the context of NNiP
- Regularly verify the performance, state and security of water management installations and make a report - Measure already applied by CRI in the context of NNiP
- Inspect pipelines to verify flow rate and hydraulic integrity - Measure already applied by CRI in the context of NNiP
- Survey water quality and levels in retention installations such as stockpiles and retention basins - Measure already applied by CRI in the context of NNiP
- Inspection of facilities such as collection ponds, ditches and dykes to check for sediment accumulation and possible damage to the embankments, in particular by erosion - Measure already applied by CRI in the context of NNiP
- Install an emergency spillway so that an eventual maximal flood can be evacuated in a safe manner - Measure already applied by CRI in the context of NNiP
- Regular inspection of buildings to validate their condition and thus identify areas affected by ground subsidence - Measure already applied by CRI in the context of NNiP
- Regular inspection of buildings to validate their condition and repair of cracks where water could infiltrate - Measure already applied by CRI in the context of NNiP
- An annual examination by a geotechnical engineer is recommended with more frequent examinations if problems appear - Measure already applied by CRI in the context of NNiP
- Undertake a site study respecting Chapter 8 of the CAN/BNQ 2501-500 standard[16]
- Follow the details of the CAN/CSA-S500-14[17] guide for foundations dependent on thermosyphons to maintain permafrost.
- Put into place a surveillance program to take into account the main characteristics to be measured: soil temperature, air temperature and soil deformation.

Policy-related measures:

- Implementation of an emergency warning system when the basins approach their capacity. – Measure already applied for collection basins

8.1.10 Conclusion and recommendations

The study was carried out in accordance with the requirements concerning adaptation to climate change described in the guide for project initiators (MELCC, 2021) and to generate a portrait of the potential impacts of climate change on the NNiP for all project components for the lifespan of the exploitation (20-30 years). Two greenhouse gas (GHG) emission scenarios were chosen (RCP 4.5 and 8.5) and the projections for climate change were also extracted from CCSC.

Risk analysis linked to climate for the historical (1980-2004) and future (2040-2064) periods permitted the retention of eight climate indicators based on past meteorological extremes, future tendencies and a significant probability of increases during the study period. The pertinence of these meteorological events with regards to the local reality was also taken into account.

The risk analysis was done on 5 distinct project components of NNiPs mine exploitation, namely water management, storage areas, surface buildings, access infrastructure and transport, as well as workers on the mine sites.

[16] NORME NATIONALE DU CANADA – BUREAU DE NORMALISATION DU QUÉBEC. 2017. CAN/BNQ 2501-500/2017. Études géotechniques pour les fondations de bâtiments construites dans les zones de pergélisols. 85 p.
[17] CSA GROUP. 2014. CSA S500:14 (R2019). Thermosyphon foundations for buildings in permafrost regions. 44 p.

For each RCP, final risk assessment revealed 40 possible interactions between the eight climate indicators and the five project components. For the 2040-2064 period, the 40 interactions led to the following risk levels:

RCP 4.5:

- 8 interactions with a low risk
- 30 interactions with moderate risk
- 1 interaction with high risk
- 1 special case

RCP 8.5:

- 9 interactions with low risk
- 27 interactions with moderate risk
- 2 interactions with high risk
- 2 special cases

The most problematic interactions (high and moderate risk and special cases) were analyzed in detail to recommend appropriate treatments and adaptation measures.

With regards to moderate and high risks identified during the analysis, the main recommendations of the evaluation of the **resilience to climate change** of NNiP and all of the components are the following:

- Integration of the eight measures during project design so that the components are resilient to future climate risks
- Implementation of fourteen measure during operation and maintenance of the different mine sites
- Establishment of one policy measure to the mine sites to ensure and maintain safe and secure working conditions for employees

It should be noted that CRI intends to elaborate in 2023 a plan to adapt to climate change for the entirety of the NNiP, including the Delta project. This plan will improve measures already put into place by CRI and rigorously address all the moderate risks encountered in this study.

8.2 Greenhouse Gas Emissions

This section presents the assessment of greenhouse gases (GHG) emissions related to Phase 2b of the NNiP. It should be noted that since the NNiP is located outside the Hydro-Québec network, the energy required for all of its activities relies on diesel. The section 5.1.1 shows the analysis of the environmental, economical, and social elements of variants of the Project. These variants have been examined based on six criteria investigated by different level of impacts such as none, low, medium and high (Table 5-5). The chosen variant is Variant 1, which includes an Open Pit (OP) and Underground (UG) mining of the deposit via 2 portals. The assessment below represents the GHG emissions of the chosen variant operated in different phases of construction, exploitation and closure.

8.2.1 Methodology

The GHGs emitted during the Phase 2b of the NNiP has been evaluated based on the method and emission factors presented in National Inventory Report (NIR)[18]. The settings and different factors considered during this study are detailed in the following sections.

Table 8-38 at Section 8.2.2 shows the GHG emissions from Delta site, Phase 2b in detail and it will be explained in the next sections.

8.2.1.1 GHG Emissions

The global warming potentials (GWPs) of the GHGs which is the heat absorbed by any greenhouse gas in the atmosphere, as a multiple of the heat that would be absorbed by the same mass of carbon dioxide (CO_2), considered in this assessment are presented in Table 8-11.

Table 8-11: Global Warming Potential

Greenhouse gases	Global warming potentials
Carbon dioxide (CO_2)	1
Methane (CH_4)	27,9
Oxide nitrous (N_2O)	273

Source: *Climate Change 2022: Impacts, Adaptions and Vulnerability, Working Group II contribution to the Sixth Assessment Report (UN IPCC AR6)*

These GHGs are generally emitted during the combustion of fossil fuels that are used by heavy equipment and transport trucks, generators present on industrial and port complexes, residential camp and Delta LEMN (northern landfill) as well as mining sites.

In accordance with the *Guide for the quantification of greenhouse gas emissions* from the MELCC, the potentials considered are those of the AR6 report of the Intergovernmental Group of Experts on the evolution of the climate (IPCC). These potentials make it possible to convert GHG emissions into tonnes of CO_2-equivalent (CO_2 eq). In the current study, the GHG emissions from different phases are presented in CO_2, CH_4 and N_2O, however, according to the Global Warming Potentials (GWP) the main unit is CO_2 eq. Note that the total GHG emissions presented in the current section is attributed into the whole period of each phase.

8.2.1.2 Scope of Analysis

The operational limits of this assessment are limited to the construction, exploitation and closure activities of the sites used during Phase 2b of the NNiP. They include direct GHG emissions by:

- Fixed equipment and mobile equipment used on the Delta deposit based on variant 1.
- Heavy trucks transporting the ore from Delta site to the Expo Complex and then the concentrated ore will be transferred to the port of Deception Bay.
- Generators supplying electricity to the Delta site.

[18] National inventory report: greenhouse gas sources and sinks in Canada.: En81-4E-PDF - Government of Canada Publications - Canada.ca

However, other sources have been excluded:

- Based on the GHG emissions report published by CRI in 2020 under the *Regulation respecting mandatory reporting of certain emissions of contaminants into the atmosphere* (RDOCECA), explosives represent less than 1% of total GHG emissions during one year of operation. Considering that Phase 2b should not lead to a significant increase in the use of explosives, it is considered that this source of GHG emissions is negligible.
- As the Project takes place in the Canadian Far North, emissions related to deforestation were not considered.
- Indirect emissions related to the consumption of electricity from an electrical network were also excluded, since the sites are only supplied with electricity by generators.

8.2.1.3 Sources of GHG Emissions

To precise results of GHG emissions assessment construction, exploitation and closure phases are divided into two sectors of Mining sites including Delta OP and Delta UG, and Operation Sites including Delta Camp, Delta Road and Delta LEMN. The list of the sectors and the GHG emissions sources considered in each category involved in this assessment is presented in Table 8-12 for the construction, exploitation and closure phases. It is noted that there are no stationary sources used in Delta Road and Delta LEMN.

Table 8-12 : GHG Sources

Categories	Sites	Source	CO_2	CH_4	N_2O
Mining Sites	Delta OP	Mobility sources	✓	✓	✓
		Stationary sources	✓	✓	✓
	Delta UG	Mobility sources	✓	✓	✓
		Stationary sources	✓	✓	✓
Operation Sites	Delta Camp	Mobility sources	✓	✓	✓
		Stationary sources	✓	✓	✓
	Delta Road	Mobility sources	✓	✓	✓
	Delta LEMN	Mobility sources	✓	✓	✓

8.2.1.4 Construction Phase

The mobility and stationary sources of both sectors:

The mining sites which include the following, among others:

- Open pit preparation, UG portals and ventilation/emergency shaft, waste rock pad, ore pad, MCP.

The operation/services sites include the following, among others.

- Delta road (Ivakkak-Delta), LEMN Delta camp wastewater treatment, potable water treatment.

The construction period varies based on different sites and equipment. However according to the activity data provided by CRI, it is assumed that the construction period is 6 months for Delta Camp, and 9 months for Delta Road, Delta OP and UG. The construction period of Delta LEMN is uncertain at this stage; however, the available data show the exact operation hours of the equipment used to construct the Delta LEMN.

8.2.1.4.1 Construction of Mining Sites

Mobility Sources

In order to consider the northern climate of the Project, the fuel consumption rates are estimated from data collected by CRI on heavy equipment in service during Phase 2b. Where the rate of equipment is not available, an average value is estimated from the equipment handbooks[19] and fuel consumption Guide from Canada Government[20].

The list of heavy equipment used in Delta and the total operation hours and diesel consumption, and the rate of fuel consumption required are presented in Table 8-13 and Table 8-14 and respectively for UG and OP. The mobile equipment that consumes the most diesel for Delta UG is the 30 t production trucks (302 220 litres) for 13 140 hours of operation. Total diesel consumption is just over 1 million litres. However, it is the construction phase of Delta OP that consumes the most diesel fuel, at just over 5 800 000 litres. The surface drill is the most diesel-consuming equipment (just under 2 million litres) for 27 624 hours of operation.

Table 8-13 : Consumption of Mobile Equipment During the Construction Phase of Delta UG

Equipment	Fuel Consumption Rate (L/h)	Operation Hours (h)	Fuel Consumption (L)
Nutrunner	4,1	4 380	18 030
30 t production truck	23	13 140	302 220
70 t production truck	31	7 296	226 176
Charger of ANFO	10	48	480
Charger on road	25	600	15 000
Loader-commuter	27	6 570	177 390
Elevator	3,2	1 460	4 672
Surface drill	70	2 544	178 080
Jumbo drill	2	4 380	8 760
Crawler tractor	43,5	2 400	104 400
Total		**42 818**	**1 035 208**

Table 8-14: Consumption of Mobile Equipment During the Construction Phase of Delta OP

Equipment	Fuel Consumption Rate (L/h)	Operation Hours (h)	Fuel Consumption (L)
Nutrunner	4,1	4 380	18 030
Bulldozer	25	13 140	328 500
Diesel tanker truck	10	6 570	65 700
30 t production truck	23	13 140	302 220
40 t production truck	28	1 875	52 501
70 t production truck	31	32 946	1 021 326
Maintenance truck	5	918	4 593
Dump truck	5	528	2 643
Sander/snow plow truck	10	262	2 625
Pick-up	6	32 850	197 102
Mini loader	6	525	3 150
Charger of ANFO	10	48	480

[19] Heavy Equipment / Heavy Machinery | Cat | Caterpillar
[20] 2022 Fuel Consumption Guide (nrcan.gc.ca)

Table 8-14: Consumption of Mobile Equipment During the Construction Phase of Delta OP (continued)

Equipment	Fuel Consumption Rate (L/h)	Operation Hours (h)	Fuel Consumption (L)
Wheel loader	25	6 570	164 250
Wheel loader (for ore)	60	6 570	394 200
Wheel Loader - Crushing	22	92	2 029
Loader-commuter	27	6 570	177 390
Mobile crusher	52	3	158
Elevator	3,2	1 460	4 672
Excavator	51	15 540	792 540
Excavator-crushing	40	92	3 692
Flatbed	24	847	20 340
Surface drill	70	27 624	1 933 680
Jumbo drill	2	4 380	8 760
Grader	18	6 570	118 260
Shovel	29	4 800	139 200
Mobile screener	23	4 051	93 600
Total		**192 356**	**5 851 646**

GHG emissions from mobile combustion systems are estimated based on the fossil fuel consumption of heavy equipment and transport vehicles used during the construction phase of Phase 2b of the NNiP. All of the equipment considered consumes diesel fuel.

This consumption is then combined with the GHG emission factors presented in Table 8-15, according to the following equation.

$$GHG\ Emission = \sum_{i=1}^{i=n} Amount\ of\ fuel\ i\ used\ \times Emission\ factor_i$$

Table 8-15: Emission Factors Associated with Mobile Combustion Systems

Combustible	gCO_2/L	gCH_4/L	gN_2O/L	gCO_2 eq/L
Diesel fuel	2 681	0,11	0,151	2 729
Diesel off-road vehicle	2 681	0,073	0,022	2 689

Source : National Inventory Report (RIN) 1990-2019 (ECCC, 2021)

Table 8-16 represents the GHG emissions by mobility sources from Construction phase of Mining sites including Delta UG and Delta OP. Mobility sources of Delta OP construction phase emit 15 764 t CO_2eq and the same source of diesel in Delta UG construction phase produces 2 784 t CO_2eq throughout the construction phase.

Table 8-16: GHG Emissions from Mobility Sources of Mining Sites Construction Phase

Sites	Fuel Consumption (Litre)	CO_2 (t)	CH_4 (t)	N_2O (t)	CO_2eq (t)
Delta OP	5 851 646	15 688	0,45	0,22	15 764
Delta UG	1 035 208	2 775	0,08	0,02	2 784
Total	**6 886 853**	**18 464**	**0,53**	**0,24**	**18 547**

Stationary Sources

The list of stationary equipment used in the construction phase of Delta UG and Delta OP is presented in table 8-17. The table shows the total diesel consumption by stationary sources operated in Delta OP construction would be 214 522 litres and 1 394 760 litres would be consumed during the Delta UG construction.

Table 8-17: Consumption of Stationary Equipment During the Construction Phase of Delta OP and Delta UG

Equipment	Fuel Consumption Rate (L/h)	Operation Hours (h)	Fuel Consumption (Litre)
Delta OP			
Compressor	6	1 460	8 760
Generator	30	4 380	131 400
Heating unit	12	6 197	74 362
Total Delta OP		**12 037**	**214 522**
Delta UG			
Compressor	6	1 460	8 760
Generator	100	13 140	1 314 000
Heating unit	12	6 000	72 000
Total Delta UG		**14 030**	**1 394 760**

Table 8-18 shows the emission factors associated with the stationary combustion system.

Table 8-18: Emission Factors Associated with Stationary Combustion Systems

Combustible	gCO_2/L	gCH_4/L	gN_2O/L	gCO_2 eq/L
Diesel	2 663	0,133	0,4	2 786

Source: National Inventory Report (RIN) 1990-2019 (ECCC, 2021)

Table 8-19 shows the GHG emissions from stationary sources during the construction phase of Mining sites including Delta UG and Delta OP. Table 8-9 also represents the GHG emissions from stationary equipment during the construction phase of Delta UG and Delta OP either 3 877 t CO_2eq and 598 t CO_2eq respectively.

Table 8-19: Emission Factors Associated with Stationary Combustion Systems

Site	Fuel Consumption (L)	CO_2 (t)	CH_4 (t)	N_2O (t)	CO_2eq (t)
Delta OP	214 522	571	0,03	0,09	598
Delta UG	1 394 760	3 716	0,18	0,53	3 877
Total	**1 609 282**	**4 286**	**0,21**	**0,61**	**4 475**

8.2.1.4.2 Construction of Operation/services Sites

Mobility Sources

The Operation Sites include the construction of Delta Camp, Delta LEMN and Delta Road. This section also includes mobility sources and stationary sources. The list of mobile equipment that participated in the construction of the operation sites with the operation hours, the number of equipment and diesel consumption represent in table 8-20 and table 8-21.

As shown in table 8-20, the diesel consumption of mobile equipment during the construction phase of Delta camp is 2 752 535 litres.

Table 8-20: Consumption of Mobile Equipment During the Construction Phase of Delta Camp

Equipment	Fuel Consumption Rate (L/h)	Operation Hours (h)	Fuel Consumption (L)
Bulldozer	25	6 570	164 250
Vacuum truck	10	912	9 125
Diesel tanker truck	10	3 285	32 850
40 t production truck	28	3 285	91 980
70 t production truck	31	22 740	704 940
Maintenance truck	5	1 225	6 125
Tractor trailer	20	3 285	65 700
Sander/snow plow truck	10	350	3 500
Roll Off Truck	10	912	9 125
Water tank truck	10	912	9 125
crane Truck	10	912	9 125
Van	6	9 855	59 130
Mini loader	6	700	4 200
Wheel loader	25	5 685	142 125
wheel loader-crushing	22	9 472	208 379
Telehandler	7	912	6 387
Mobile crusher	52	9 472	492 533
Excavator	51	3 285	167 535
Excavator-crushing	40	9 472	378 871
Flatbed	24	1 000	24 000
Grader	18	3 285	59 130
Crawler tractor	43,5	2 400	104 400
Total		**99 928**	**2 752 535**

Table 8-21shows that the diesel consumption by mobility sources in Delta Road is 4 540 578 litres and the same sources will consume 6 577 litres in the construction phase of Delta LEMN.

Table 8-21: Consumption of Mobile Equipment During the Construction Phase of Delta Road and Delta LEMN

Equipment	Fuel Consumption Rate (L/h)	Operation Hours (h)	Fuel Consumption (L)
Delta Road			
Bulldozer	25	13 140	328 500
Diesel tanker truck	10	6 570	65 700
70 t production truck	31	58 680	1 819 080
Van	6	13 140	78 840
Wheel loader	25	7 770	194 250
Wheel loader-crushing	22	9 093	200 041
Mobile crushing	52	9 093	472 825
Excavator	51	6 570	335 070
Excavator-crushing	40	9 093	363 712
Surface drill	70	6 570	459 900
Grader	18	6 570	118 260
Crawler tractor	43,5	2 400	104 400
Total Delta Road		**148 688**	**4 540 578**
Delta LEMN			
70 t production truck	31	168	5 208
Excavator 390	10	84	874
Tractor D6	5,9	84	496
Total Delta LEMN		**336**	**6 577**

In the operation sites the highest GHG emissions is attributed to Delta Road with 12 211 t CO_2eq and the GHG emissions from mobility sources during the construction phase of Delta Camp and Delta LEMN are 7 403 t CO_2eq and 18 t CO_2eq respectively (table 8-22).

Table 8-22: GHG Emissions from Mobility Sources of Operation Sites Construction Phase

Site	Fuel Consumption (L)	CO_2 (t)	CH_4 (t)	N_2O (t)	CO_2eq (t)
Delta Camp	2 752 534	7 379	0,20	0,06	7 402
Delta Road	4 540 578	12 173	0,33	0,10	12 211
Delta LEMN	6 577	17,63	0,0005	0,0001	18
Total	**7 299 690**	**19 570**	**0,53**	**0,16**	**19 632**

Stationary Sources

The stationary sources of the construction operation sites only belong to Delta Camp and there are no stationary sources in the construction phase of Delta LEMN and Delta Road. The list of the stationary equipment showed in table 8-23. The diesel consumption of stationary sources in Delta is 269 114 litres and this diesel consumption will emit 750 t CO_2eq during the construction phase.

Table 8-23: Consumption of Stationary Equipment During the Construction Phase of Delta Camp

Equipment	Fuel Consumption Rate (L/h)	Operation Hours (h)	Fuel Consumption (L)
Generator	45	4 380	197 100
Heating unit	12	2 000	72 014
Total		**6 380**	**269 114**

8.2.1.5 Exploitation Phase

The operation period of the variant 1 for Delta OP is one year and the UG is 5,2 years. To achieve the accurate assessment of GHG emissions the operation hours of each equipment is represented in months, therefore the operation period of OP in the GHG calculation is 12 and UG is 62 months. The same sectors as construction phase have been considered in the exploitation phase and each of the sectors includes mobility and stationary sources.

8.2.1.5.1 Exploitation of Mining Sites

This section presents the fuel consumption and GHG emissions from mobility and stationary sources in the exploitation phase of Delta OP and Delta UG. It is noted that the exploitation period of Delta UG is between 2026 to 2032 for a duration of 62 months and Delta OP is between 2026 t0 2027 for a duration of 12 months.

Based on the ore deposits estimated for Delta UG, the list of mobile equipment and the overall consumption of diesel during the operating phase is estimated and presented in table 8o-24. Diesel fuel consumption by mobile equipment during the 62 months of the operating phase is thus estimated at 25 497 978 litres.

Table 8-24: Consumption of Mobile Equipment During the Exploitation Phase of Delta UG

Equipment	Fuel Consumption Rate (L/h)	Operation Hours (h)	Fuel Consumption (L)
Nutrunner	4,1	68 448	281 759
30 t production truck	23	623 875	14 349 125
Emulsion truck	10	1 338	13 380
Boom truck	25	28 520	713 000
UG fuel truck	25	14 260	356 500
Charger ANFO	10	21 390	213 900
Loader-commuter	27	256 680	6 930 360
Elevator	3,2	28 520	91 264
Jumbo drill	2	17 112	34 224
Long hole drilling rig	43	11 408	490 544
Jeep	8,5	114 080	965 117
Grader	18	1 783	32 085
Backhoe	36	28 520	1 026 720
Total		**1 215 933**	**25 497 978**

As shown in table 8-25, the diesel fuel consumption in the Exploitation phase of Delta OP is 10 046 607 liters.

Table 8-25: Consumption of Mobile Equipment During the Exploitation Phase of Delta OP

Equipment	Fuel Consumption Rate (L/h)	Operation Hours (h)	Fuel Consumption (L)
Nutrunner	25	17 520	438 000
Diesel tank truck	10	8 760	87 600
40 t production truck	28	2 500	70 002
70 t production truck	31	71 400	2 213 400
Emulsion truck	10	1 971	19 710
Maintenance truck	5	6 745	33 725
Dump truck	5	705	3 525
Sander/snow plow truck	10	350	3 500
Van	6	43 800	262 803
Mini loader	6	700	4 200
Wheel loader	25	8 760	219 000
Wheel loader (for Mineral activities)	60	13 935	836 100
Excavator (CAT 395)	51	22 695	1 157 445
Flatbed	24	1 130	27 121
Surface drill	70	48 840	3 418 800
Fuel truck	34	1 725	58 650
Grader	18	12 900	232 200
Shovel	29	6 900	200 100
Pick up	13,35	34 500	460 575
Crawler tractor	43,5	6 900	300 150
Total		**312 737**	**10 046 607**

Table 8-26 shows that the mobility sources of Delta UG and OP during the exploitation phase emit 68 574 t CO_2eq and 27 019 t CO_2eq respectively.

Table 8-26: GHG Emissions from Mobility Sources of Mining Sites Exploitation Phase

Site	Fuel Consumption (L)	CO_2 (t)	CH_4 (t)	N_2O (t)	CO_2eq (t)
Delta OP	10 046 607	26 935	0,73	0,22	27 019
Delta UG	25 497 978	68 360	1,86	0,56	68 574
Total	**35 544 585**	**95 295**	**2,59**	**0,78**	**95 593**

Stationary Sources

There are few numbers of stationary equipment for exploitation phase of the mining sites.Table 8-27 shows the list of stationary equipment with diesel consumption during the exploitation phase. The total fuel consumption during Delta OP is 265 966 litres and during Delta UG, it is 9 221 632 litres.

Table 8-27: Consumption of Stationary Equipment During the Exploitation Phase of Delta OP and Delta UG

Equipment	Fuel Consumption Rate (L/h)	Operation Hours (h)	Fuel Consumption (L)
Delta OP			
Generator	30	8 760	262 800
Heating unit	12	263	3 156
Total Delta OP		**9 023**	**265 956**
Delta UG			
Compressor	6	28 272	169 632
Generator	100	90 520	9 052 000
Total Delta UG		**118 792**	**9 221 632**

Table 8-28 represents the GHG emissions from stationary sources during the exploitation phase. Stationary sources in Delta UG over the 5,2 years produce 25 687 t CO_2eq and in Delta OP over a year produce 741 t CO_2eq.

Table 8-28: GHG Emissions from Stationary Sources of Mining Sites Exploitation Phase

Site	Fuel Consumption (L)	CO_2 (t)	CH_4 (t)	N_2O (t)	CO_2eq (t)
Delta OP	265 956	708	0,04	0,11	741
Delta UG	9 221 632	24 557	1,23	3,69	25 687
Total	**9 487 588**	**25 265**	**1,27**	**3,80**	**26 428**

8.2.1.5.2 Exploitation of Operation/ Site Services

This section presents the equipment, fuel consumption and the GHG emission from Delta Camp, Delta Road and Delta LEMN sites during the exploitation phase. Since the sites mentioned above will be operated during the operation of Delta UG, the exploitation period is 62 months. There is a lack of data on operation hours of each equipment used for Delta camp exploitation phase. According to the history data from Camp Expo, it is assumed the total fuel consumption during the exploitation period of Delta Camp would be 1 265 233 litres and there is also a bus during the period for offering the services to the camp which will consume 224 595 litres. Therefore, in total the mobile equipment in Delta Camp will consume 1 489 828 litres over 62 months.

Table 8-29 shows the fuel consumption rate, operation hours and diesel consumption of the mobile equipment used in Delta Road and Delta LEMN in the exploitation phase. The Delta Road exploitation phase will consume nearly seven times more fuel than the Delta LEMN.

Table 8-29: Consumption of Mobile Equipment During the Exploitation Phase of Delta Road and Delta LEMN

Equipment	Fuel Consumption Rate (L/h)	Operation Hours (h)	Fuel Consumption (L)
Delta Road			
Bulldozer	25	12 808	320 199
Wheel Loader - Crushing	22	459	10 107
Mobile crusher	52	459	23 890
Excavator-crushing	40	459	18 377
Grader	18	12 808	230 543
Sandblaster-snow plow	10	12 808	128 080
Total Delta Road		**39 802**	**731 196**
Delta LEMN			
Roll off	10	8 329	83 299
Pelle 390	10,4	1 344	13 973
Tractor D6	5,9	1 344	7 927
Total Delta LEMN		**5 374**	**105 199**

The GHG emissions from mobility sources during exploitation phase in operation sites including Delta Camp, Delta Road and Delta LEMN are 4 007 t CO_2eq, 1 966 t CO_2eq and 283 t CO_2eq respectively (table 8-30).

Table 8-30: GHG Emissions from Mobility Sources of Mining Sites Exploitation Phase

Site	Fuel Consumption (L)	CO_2 (t)	CH_4 (t)	N_2O (t)	CO_2eq (t)
Delta Camp	1 489 828	3 994	0,11	0,03	4 007
Delta Road	731 196	1 960	0,05	0,02	1 966
Delta LEMN	105 199	282	0,008	0,002	283
Total	**2 326 223**	**6 237**	**0,17**	**0,05**	**6 256**

Stationary Sources

Between the operation sites, Delta Camp is the one where few stationary equipment gets involved during the exploitation phase. The list of the stationary equipment and the fuel consumption is represented in table 8-31. The total diesel consumption from stationary sources during the exploitation phase of the operation site is 3 524 707 litres and the relative GHG emissions would be 9 818 t CO_2eq during the exploitation period of Delta Camp which is 5,2 years.

Table 8-31: Consumption of Stationary Equipment During the Exploitation Phase of Delta Camp

Equipment	Fuel Consumption Rate (L/h)	Operation Hours (h)	Fuel Consumption (L)
Generator	45	45 260	2 036 700
Heating unit	12	124 001	1 488 007
Total		**169 261**	**3 524 707**

Transportation of Ore and Concentrate

The extracted ore is transported to the concentrator located at the Expo Complex, then the concentrated product is again transported for export to the port located at Deception Bay.

GHG emissions from the transportation of ore and concentration are calculated based on the estimated diesel consumption of heavy trucks travelled between the above destinations. This assessment is obtained from the distance travelled by the trucks and the diesel consumption rate calculated from the fleet of heavy trucks currently used by CRI. Western Star B-Train model 6900XD[21] is the equipment that has been considered by CRI to deliver the ore and concentrate from Delta site to the port. There is a lack of data on the fuel consumption of that truck, therefore a similar model of the same company has been considered to find the fuel economy of the truck. The fuel economy of this off-road vehicle is assumed to be 2,4[22] litre per kilometer and the capacity of the vehicle is 120 Tonnes. It is also assumed that the same truck is used for all transportation.

Based on variant 1 chosen to operate one OP and two UG deposits the tonnes of the ore during the exploitation of the UG over the 5,2 years between 2026 to 2033 would be 1 986 400 tonnes and OP over the year of 2026-2027 would exploit 325 628 tonnes ore.

Different variants also have been analysed for the Delta Road and finally, variant 3 which is a 16,33 km road distance, has been chosen.

To determine the total distance travelled by heavy trucks during the exploitation phase of Phase 2b of the NNiP, the following assumptions were made:

- Distance Delta site – Ivakkak site: 16 km;
- Distance Ivakkak– Expo Complex: 46 km;
- Distance Expo Complex – Port to Deception Bay: 120 km.

Total travel distance for ore is 62 km, at the Expo Complex the ore is transmitted into concentration and then it would travel over 120 km to the port.

Table 8-32 presents the GHG emissions estimated from transportation of ore and concentrate. The GHG emissions from Delta OP over the one-year of exploitation period is 6 388 tonne CO_2eq and Delta UG over 5,2 years of exploitation produces 38 968 t CO_2eq.

Table 8-32: GHG Emissions from Transportation

Site	Total Fuel Consumption (L)	CO_2 (t)	CH_4 (t)	N_2O (t)	CO_2eq (t)
Delta OP	2 375 249	6 368	0,17	0,05	6 388
Delta UG	14 489 546	38 846	1,06	0,32	38 968
Total	**16 864 796**	**45 215**	**1,23**	**0,37**	**45 356**

[21] wst-15476-57x-tech-sheet_eng_dc-60-72_3-0-final.pdf (windows.net)
[22] Western Star 4900EX km/L - Actual km/L from 3 Western Star 4900EX owners (fuelly.com)

8.2.1.6 Closing Phase

8.2.1.6.1 Closure Phase of Mining Sites

Mobility Sources

Based on the available data 2033 is considered the closure year of Delta sites and different sites will take different closure period. The following assumptions were considered for the closure period of different sites by CRI:

Delta OP, 1 month

Delta UG, 6 months

Delta LEMN, 2 months

Delta Camp, 5 months and,

Delta Road, 4 months.

The list of mobile equipment used during the closure phase of the mining sites is presented in table 8-33. The consumption of mobile equipment during the closure phase of the Project is thus estimated at 31 466 litre and 521 136 litres of diesel fuel for Delta OP and Delta UG.

Table 8-33: Consumption of Mobile Equipment During the Closing Phase of Mining Sites

Equipment	Fuel Consumption Rate (L/h)	Operation Hours (h)	Fuel Consumption (L)
Delta OP			
70 t production truck	31	330	10 230
Excavator	51	330	16 830
Pick up	13,4	330	4 406
Total Delta OP		**990**	**31 466**
Delta UG			
Diesel tanker truck	10	1 980	19 800
70 t production truck	31	3 960	122 760
Mechanical truck	5	1 980	9 900
Telehandler	7	1 980	13 860
Excavator	51	1 980	100 980
Shovel	29	3 960	114 840
Pick up	13,4	3 960	52 866
Crawler tractor	43,5	1 980	86 130
Total Delta UG		**21 780**	**521 136**

Table 8-34 shows the GHG emissions from mobile equipment involved in the closure phase of Delta OP is 85 t CO_2eq and Delta UG for 1 402 t CO_2eq. The total GHG emissions from mobile equipment of closure phase of the mining sites is 1 486 t CO_2eq.

Table 8-34: GHG emissions of Mobile Equipment During the Closing Phase of Mining Sites

Site	Fuel Consumption (L)	CO_2 (t)	CH_4 (t)	N_2O (t)	CO_2eq (t)
Delta OP	31 466	84	0,002	0,001	85
Delta UG	521 136	1 397	0,04	0,01	1 402
Total	**552 602**	**1 482**	**0,04**	**0,01**	**1 486**

Stationary Sources

During the closure phase, it is assumed that the generators present on each of the mining sites will be used for the entire duration of the work. For each site, table 8-35 presents the diesel fuel consumption by these generators. The generator consumption is estimated to produce 28 t CO_2eq at Delta OP and 1 103 t CO_2eq at Delta UG.

Table 8-35: Consumption of Generators During the Closing Phase of the Mining Site

Equipment	Fuel Consumption Rate (L/h)	Operation Hours (h)	Fuel Consumption (L)
Generator-Delta OP	30	330	9 900
Generator-Delta UG	100	3 960	396 000

8.2.1.6.2 Closure Phase of Operation Sites

Mobility Sources

Table 8-36 shows the list of mobile equipment involved in the closure phase of the operation sites. The Delta Camp closure phase will consume the most fuel at just over 400 000 litres, followed by the Delta Road at 235 620 litres and finally the Delta LEMN at 116 721 litres.

Table 8-36: Consumption of Mobile Equipment During the Closing Phase of Operation Sites

Equipment	Fuel Consumption Rate (L/h)	Operation Hours (h)	Fuel Consumption (L)
Delta Camp			
Diesel tank truck	10	1 650	16 500
Mechanical truck	5	1 650	8 250
Tractor trailer	20	1 650	33 000
Roll Off Truck	10	1 650	16 500
Water tank truck	10	1 650	16 500
Truck crane	10	3 300	33 000
Telescopic loader	25,4	3 300	83 820
Forklift	9	1 650	14 850
Shovel	29	3 300	95 700
Pick up	13,35	6 600	88 110
Total Delta Camp		**26 400**	**406 230**
Delta Road			
40 t production truck	28	3 960	110 880
Excavator	51	1 320	67 320
Crawler tractor	43,5	1 320	57 420
Total Delta Road		**6 600**	**235 620**
Delta LEMN			
70 t production truck	31	1 320	40 920
Telehandler	7	660	4 620
Excavator	51	660	33 660
Pick up	13,35	660	8 811
Crawler tractor	43,5	660	28 710
Total Delta LEMN		**3 960**	**116 721**

Table 8-37 shows the GHG emissions form closure phase of operation sites which is evaluated at 2 040 t CO_2eq, in total.

Table 8-37: GHG emissions of Mobile Equipment During the Closing Phase of Operation Sites

Site	Fuel Consumption (L)	CO_2 (t)	CH_4 (t)	N_2O (t)	CO_2eq (t)
Delta Camp	406 230	1 089	0,03	0,009	1 093
Delta Road	235 620	632	0,02	0,005	634
Delta LEMN	116 721	313	0,01	0,003	314
Total	**758 571**	**2 034**	**0,06**	**0,017**	**2 040**

Stationary Sources

The only stationary source used in the closure phase of the operation site is the generator which is used on Delta Camp. The generator will consume 74 250 litres over the 5 months of the closure phase in the site and it results to emit 207 t CO_2eq.

8.2.2 GHG Emissions Report

Table 8-38 below outlines the total GHG emissions emitted for all of Phase 2b and its related projects.

8.2.3 Conclusion

The evaluation of GHG emissions from Phase 2b of the NNiP has established that emissions related to the construction phase of the Project are estimated at 43 404 tonnes of CO_2 equivalent. For the exploitation phase, planned between 2026 and 2033 for UG and one year between 2026-2027 for OP emits a total of 183 451 tonnes of CO_2 equivalent, it is noted that the total GHG emissions from the exploitation phase also includes the emissions from transportation of mineral products. Finally, GHG emissions during the closure phase are estimated at 4 864 tonnes of CO_2 equivalent.

In total, it is estimated that Phase 2b of the NNiP will be responsible for the emissions of 231 kilotonnes of CO_2 equivalent, approximately.

The followings show the measures that could help to reduce the GHG emissions during the different phases:

- Avoid leaving vehicles running unnecessarily.
- Use machinery that meets Environment and Climate Change Canada emission standards for on-road and off-road vehicles.
- Use generators with low contaminant emission rates.
- Inspect the machinery beforehand and regularly to ensure its good condition and proper functioning.
- Apply the mechanical service preventive maintenance program to ensure optimal operation of the machinery.

Table 8-38: GHG Emissions Associated with the Different Phases

Construction Phase		Fuel Consumption (L)	CO_2 (t)	CH_4 (t)	N_2O (t)	CO_2eq (t)
Construction Phase						
Delta Camp	Mobility	2 752 535	7 380	0,20	0,06	7 403
	Stationary	269 114	717	0,04	0,11	750
Total Delta Camp		**3 021 649**	**8 096**	**0,24**	**0,17**	**8 152**
Delta OP	Mobility	5 851 646	15 688	0,45	0,22	15 764
	Stationary	214 522	571	0,03	0,09	598
Total Delta OP		**6 066 168**	**16 260**	**0,48**	**0,30**	**16 361**
Delta Road	Mobility	4 540 578	12 173	0,33	0,10	12 211
Delta UG	Mobility	1 035 208	2 775	0,08	0,02	2 784
	Stationary	1 394 760	3 716	0,18	0,53	3 877
Total Delta UG		**2 429 968**	**6 491**	**0,26**	**0,55**	**6 661**
Delta LEMN	Mobility	6 577	18	0,0005	0,0001	18
Total Construction Phase		**16 064 940**	**43 038**	**1,31**	**1,12**	**43 404**
Exploitation Phase						
Delta Camp	Mobility	1 489 828	3 994	0,11	0,03	4 007
	Stationary	3 524 707	9 386	0,47	1,41	9 818
Total Delta Camp		**5 014 535**	**13 381**	**0,58**	**1,44**	**13 825**
Delta OP	Mobility	10 046 607	26 935	0,7	0,2	27 019
	Stationary	265 956	708	0,04	0,1	741
Total Delta OP		**10 312 563**	**27 643**	**0,77**	**0,33**	**27 760**
Delta Road	Mobility	731 196	1 960	0,05	0,02	1 966
Delta UG	Mobility	25 497 978	68 360	1,86	0,56	68 574
	Stationary	9 221 632	24 557	1,23	3,69	25 687
Total Delta UG		**34 719 610**	**92 917**	**3,09**	**4,25**	**94 261**
Delta LEMN	Mobility	105 199	282	0,008	0,002	283
Total Exploitation		**50 883 103**	**136 183**	**4,50**	**6,04**	**138 095**
Transport						
Delta OP		2 375 249	6 368	0,17	0,05	6 388
Delta UG		14 489 546	38 846	1,06	0,32	38 968
Total Transportation		**16 864 796**	**45 215**	**1,23**	**0,37**	**45 356**
Grand Total Exploitation		**67 747 898**	**181 398**	**5,73**	**6,41**	**183 451**

Table 8-38: GHG Emissions Associated with the Different Phases (continued)

Construction Phase		Fuel Consumption (L)	CO_2 (t)	CH_4 (t)	N_2O (t)	CO_2eq (t)
Closure Phase						
Delta Camp	Mobility	406 230	1 089	0,03	0,009	1 093
	Stationary	74 250	198	0,01	0,03	207
Total Delta Camp		**480 480**	**1 287**	**0,04**	**0,04**	**1 299**
Delta OP	Mobility	31 466	84	0,002	0,001	85
	Stationary	9 900	26	0,001	0,004	28
Total Delta OP		**41 366**	**111**	**0,004**	**0,005**	**112**
Delta Road	Mobility	235 620	632	0,02	0,005	634
Delta UG	Mobility	521 136	1 397	0,04	0,01	1 402
	Stationary	396 000	1 055	0,05	0,16	1 103
Total Delta UG		**917 136**	**2 452**	**0,09**	**0,17**	**2 505**
Delta LEMN	Mobility	116 721	313	0,01	0,003	314
Total Closure Phase		**1 791 323**	**4 794**	**0,16**	**0,22**	**4 864**
Gran Total Phase 2b		**85 604 161**	**229 230**	**7,19**	**7,75**	**231 719**

9 Monitoring and Surveillance Program

9.1 Surveillance

The environmental surveillance completed during the project will consist of ensuring compliance with environmental commitments and obligations. It also aims to verify the integration of the project's proposed mitigation measures and CRI's commitments, in addition to ensuring compliance with the laws, regulations and other environmental considerations enacted in the various government permits for the plans, specifications and subcontracts.

One of the monitoring program's activities will consist of ensuring that all authorization and permit applications required for the project have been completed and that the authorizations and permits have been received.

Construction site meetings will take place before the start of each of the projects presented above, jointly organized by the heads of the environmental department and site managers. A copy of the authorization documents will be given to the site managers, so as to define the work in accordance with the authorizations' provisions. These meetings will also inform and sensitize the staff assigned to the environmental and safety provision on site, which will be observed throughout the work periods and to explain the monitoring activities' general operation. Also, a weekly meeting during the construction period will be held to target potential problems and identify applicable solutions.

The CRI Environmental Department will be responsible for the environmental monitoring. The mitigation measures must be rigorously applied during work periods. Generally speaking, the person in charge of environmental surveillance must perform regular visits to the work areas, take note of the rigorous respect of the commitments, obligations, measures and other requirements from the parties involved. They must also assess the quality and effectiveness of the measures applied and note any non-compliance observed. The supervisor must ensure the effectiveness of these measures, inform those in charge and propose alternative protective measures if required. Site monitoring forms (Appendix Y) will allow the site supervisor to monitor the application of mitigation measures. Any incidents will be noted in the last column of the form entitled "Comments/Corrective Actions. The supervisor will take note of the following information:

- The nature of the event
- The applied intervention measures
- The effectiveness of the intervention. A follow-up will also be performed in the days following the application of the corrective intervention

Environmental monitoring will also include the application of the caribou monitoring protocol, both during the construction and operation phases. The monitoring protocol will be submitted to the MELCCFP after submission of this impact study following the comments received on the proposed mitigation measures.

A weekly report will be prepared during the infrastructure development phase, which will include photos to facilitate understanding of the non-compliance events observed and the corrective actions taken. The environmental monitoring sheets will be given to the site supervisor on a weekly basis, or when required in the event of non-compliance.

The "as-built" (AB) plans will be prepared and sent to regional, provincial and federal authorities as required once the work is completed.

9.2 Monitoring

The NNiP Environmental Monitoring Program (EMP) includes all of CRI's commitments, their obligations, conditions and requirements created by the appropriate authorities, in addition to the current applicable directives and regulations.

The EMP's 5th version was revised in 2022 and includes the latest authorizations issued since the previous version was published in 2015, specifically regarding the Puimajuq deposit and the PEIIC (CRI, 2022a). It will also be updated to integrate dispositions to the Fauna and Flora Protection Plan (FFPP), transmitted to the MELCCFP in December of 2022. The FFPP integrates in a single document the protection measures, surveillance and monitoring that must be applied to avoid and reduce the negative effects of the NNiP on the faunal and floral environmental components of interest identified in the ESIA and its appendixes.

The EMP will be continued throughout the period of mining activities by CRI. It was established that the extension of existing monitoring to the Delta project, when applicable, will allow an adequate monitoring of the efficacy of attenuation measures and the residual impacts where applicable. As such, we do not anticipate adding monitoring activities, but many will be improved. These are presented in Table 9-1. When sampling stations are added, monitoring will be done according to the same parameters and frequencies as equivalent stations actually monitored in the EMP. For example, Delta's sanitary effluent will be sampled monthly, like Expo's sanitary effluent. The FFPP will also be improved to integrate attenuation measures applicable to fauna and flora elaborated in the context of the authorisation process for the Delta project.

The results will be presented in the annual environmental monitoring report.

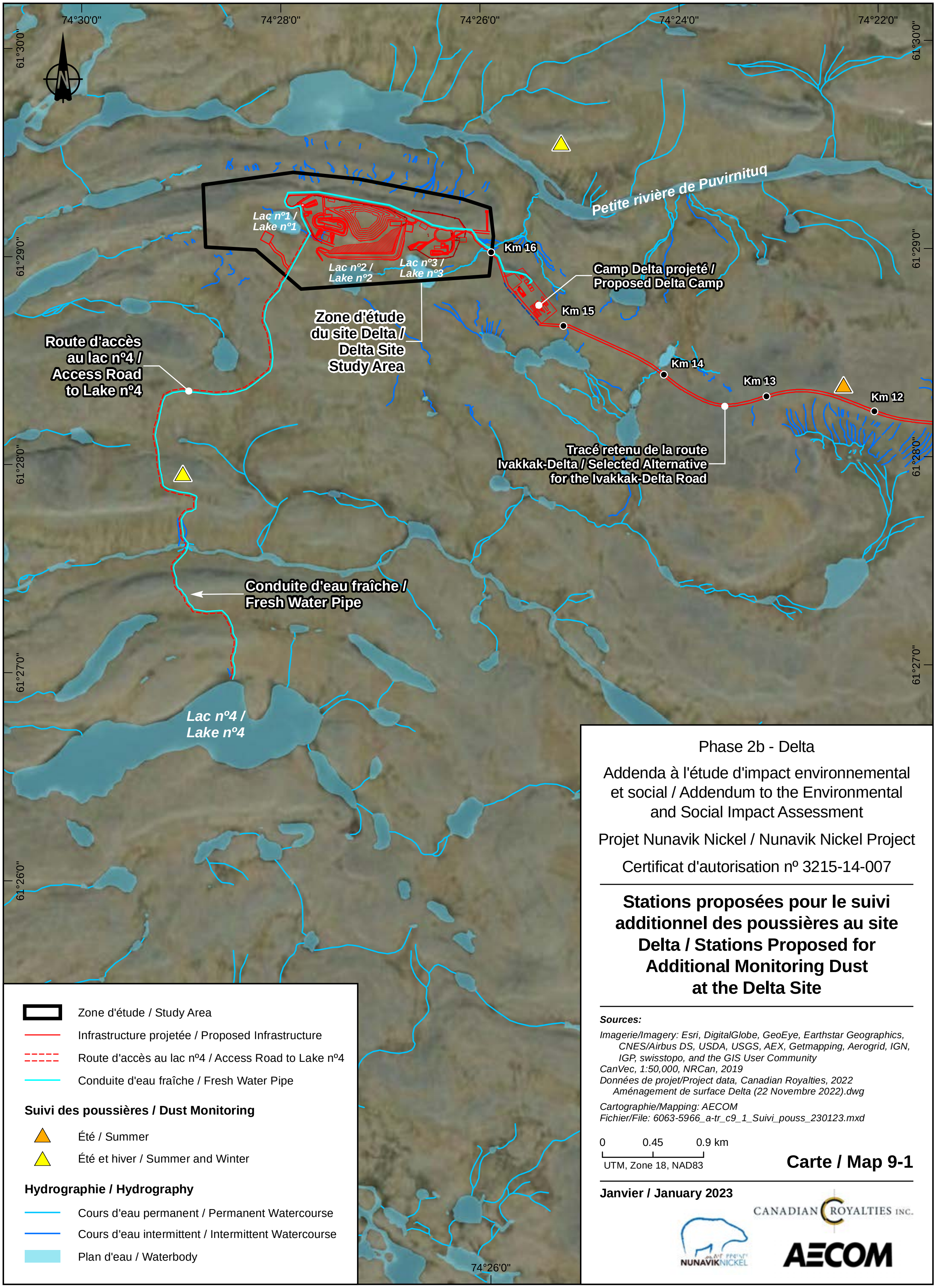
Table 9-1: Environmental Monitoring

Monitoring number	Monitoring title	Improvement to monitoring
1	Drinking water for the Expo complex and satellite camps	Monitoring of drinking water at the Delta camp with the addition of a sampling point at the beginning and the end of the network.
2	Effluent of treated sanitary wastewater	Monitoring of sanitary water at the Delta camp with the addition of a sampling point at the effluent and sampling points upstream and downstream of the discharge point
3	Mining effluent	Monitoring of the mining effluent for the Delta WTP with the addition of a sampling point at the effluent
4	Surface water - Mine effluent receiving water	Monitoring of the receiving water of the Delta WTP with addition of a sampling point in the reference and exposed zones.
12	Culvert stability and fish movement	Monitor the passage of fish in the culverts located in potential fish habitat, addition of two culverts on the Ivakkak-Delta route and one on the Delta-Lake No. 4 route
15	Sport fishing	Monitoring of sport fishing in Lake No. 4, the addition of this lake for sport fishing will be evaluated and approval will be sought from the proper authorities where required
17	Polar bear sightings	Addition of the observations done at the Delta site
18	Collisions with caribou	Addition of the observations done at the Delta site

Table 9-1: Environmental monitoring (continued)

Monitoring number	Monitoring title	Improvement to monitoring
23	Dust Dispersion	Monitoring dust dispersion in Delta sector; addition of three monitoring stations for the summer and winter monitoring. Preliminary locations are shown on Map 9-1. They were selected according to dominant winds and the representativeness for dust deposition. Notably, the station north of the site was moved away hundreds of meters to find a more appropriate elevation for dust deposition; a station closer to the site would have been too low and would have potentially been under exposed to dust. Their location could be slightly changed to accommodate accessibility constraints, especially in winter.
24	Waste	Weekly inspections at the LEMN to monitor waste generated at the Delta site and compilation of the quantities received.
25	Hazardous and special waste	Monitoring of HW generated at the Delta site with addition of a sampling point for the intermediate effluent of the water-oil separator, a trimestral sampling of burned oil and keeping a register equivalent to that of the Expo site (separator maintenance, storage of HW, biomedical waste).
26	Acid generating potential of waste rock	Monitoring of the acid generating potential of the waste rock at Delta site; addition of a sampling point at the MCP and LCP, addition of a sampling point in the ditches collecting contact water and clean water diversion ditches at the Delta camp
33	Visual impacts	Monitoring of the visual impact of the Delta site at Pingualuit National Parc; addition of a photo angle that includes Delta site.
34	Noise impacts	Monitoring of the noise impacts of the Delta Site at the Pingualuit National Parc; the monitoring stations as defined in the EMP will also capture potential impacts of the Delta site.
Fauna and Flora Protection Plan (FFPP)		Compilation of the flora and fauna observations as described in the FFPP for the Delta site including those linked to the caribou surveillance protocol. Observations will be integrated into the existing EMP, namely monitorings 17 and 18.

The EMP will be updated with the evolution of mining activities at CRI to include the required monitoring of the post-exploitation and post-restoration phases. Modification propositions will be submitted to the Administrator for information.



Phase 2b - Delta

Addenda à l'étude d'impact environnemental et social / Addendum to the Environmental and Social Impact Assessment

Projet Nunavik Nickel / Nunavik Nickel Project

Certificat d'autorisation nº 3215-14-007

Stations proposées pour le suivi additionnel des poussières au site Delta / Stations Proposed for Additional Monitoring Dust at the Delta Site

Sources:

Imagerie/Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
CanVec, 1:50,000, NRCan, 2019
Données de projet/Project data, Canadian Royalties, 2022
Aménagement de surface Delta (22 Novembre 2022).dwg

Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_c9_1_Suivi_pouss_230123.mxd

0 0.45 0.9 km

UTM, Zone 18, NAD83

Carte / Map 9-1

Janvier / January 2023

CANADIAN ROYALTIES INC.

NUNAVIK NICKEL

AECOM

10 Accident Risk Management

CRI advocates risk reduction through prevention and taking said risks into account during the designation of various infrastructures, through the use of safe technologies, in addition to the implementation of NNiP risk-specific measures, which includes the new deposits and new structures covered by this addendum.

As part of the NNiP, CRI has developed an Emergency Response Plan (ERP) due to the inherent risks of all industrial activities and the remoteness and the fragility of Arctic ecosystems. The prevention and contingency measures associated with each of these risks identified in the NNiP are integrated into the CRI's EMP. Accident risk management that could be specific to the four projects presented in this addendum is therefore included in this ERP.

The ERP is based on good practices in the field of emergency management and aims to ensure the protection of people, the environment and CRI's assets. More specifically, CRI's NNiP is subject to the *Environmental Emergency Regulations* – SOR/2019-51 (EER) resulting from the *Canadian Environmental Protection Act* – S.C. 1999, c. 33. Consequently, the EMP of the NNiP acts as an Environmental Emergency Plan (EEP) in accordance with the provisions set out in the EER.

The objective of the CRI's ERP is to:

- Establish a framework for effective and efficient emergency management at CRI
- Establish a framework for the maintenance and continuous improvement of the contingency management program within CRI
- Establish a framework to ensure employee awareness and responder training in emergency measures
- Ensure periodic testing of established mechanisms and procedures

The ERP is revised annually, and the most recent version is presented in Appendix Z. It can also be modified outside the annual review period to include any new risks or situations reported on-site for the various activities in progress.

11 Bibliography

AECOM et TUGLIQ Énergie. 2022. *Projet de déploiement de deux éoliennes au complexe minier Nunavik Nickel. Parc éolien du Nickel - Expo. Étude d'impact environnemental et social. Volume 1 - Rapport principal et Volume 2 - Annexes.* Étude d'impact déposée au ministère de l'Environnement et de la Lutte contre les changements climatiques. 238 pages et annexes.

AECOM et Canadian Royalties Inc. (AECOM et CRI). 2022. *Addenda à l'étude d'impact environnemental et social – Phase 2a : Exploitation des gisements Expo Sud, Ivakkak UG, Méquillon UG2 et Nanaujaq – Certificat d'autorisation no 3215-14-007 : Projet minier Nunavik Nickel*. 251 pages (Volume 1) et annexes (Volume 2).

Allard, M., E. L'Hérault, J. Doyon & D. Sarrazin. 2010. *L'impact des changements climatiques sur la problématique de la fonte du pergélisol au village de Salluit, Nunavik : Analyse microclimatique adaptée à l'aménagement du village de Salluit.* Québec, Centre for Northern Studies, Université Laval. 43 p.

Allard, M., M. Lemay, D.Sarrazin & C.Barrette. 2012. *Permafrost and climate change in Nunavik and Nunatsiavut: Importance for municipal and transportation infrastructure, Chapter 6 in Nunavik and Nunatsiavut: From science to policy.* An Integrated Regional Impact Study (IRIS) of climate change and modernization (pp.171-197)

Allard., M. R. Fortier et O. Gagnon. 2002. *Problématique du développement du village de Salluit, Nunavik. Inventaire et compilation de l'ensemble des sondages et études géotechniques; compte rendu de la campagne de terrain 2002. Rapport d'étape 2*. Québec, Centre d'études nordiques, Université Laval. 145 p.

Allard, M., S. Aubé-Michaud, E. L'Hérault, V. Marhon-Dufour, C. Deslauriers, & A. Chiasson. 2020. *Identification of Current and Potential Risks from Climate Change for Nunavik Community Territory – Phase 2: Summary Document: Salluit.* Report produced on behalf of the Ministère de la Sécurité publique du Québec.

Anctil, F., J. Rousselle, & Lauzon, N. (2012). *Hydrologie: Cheminements de l'eau.* Presses Internationales Polytechnique. 369 p.

Andersland, O., Ladanyi, B., 2004. Frozen ground engineering (2nd ed.) Hoboken, New Jersey, John Wiley & Sons, Inc.

ASDR. 2021. Rapport d'ingénierie pour demande de permis : Traitement des eaux de surface du site Ivakkak, présenté à Canadian Royalties inc., février 2021

Association canadienne des barrages. 2007. R*ecommandations de sécurité des barrages de l'ACB (Édition 2013).* Édition numérique. 82 pp.

Association canadienne de normalisation. 2018. *Norme CSA-ISO 31000-F18. Management du risque – Lignes directrices.* 32 p.

Beaulieu, M. 2021. *Guide d'intervention – Protection des sols et réhabilitation des terrains contaminés.* Ministère de l'Environnement et de la lutte contre les changements climatiques, Québec, mai 2021, 326 p. [http://www.environnement.gouv.qc.ca/sol/terrains/guide-intervention/guide-intervention-protectionrehab.pdf]

Blangy, S. et A. Deffner. 2014. *Impacts du développement minier sur les hommes et les caribous à Qamani'tuaq au Nunavut: approche participative.* Études/Inuit/Studies, 38(1-2), 239–265. https://doi.org/10.7202/1028862a

Blue Star Gold Corp. 2021. *Wildlife Protection Plan Ulu Gold Project*. *Kitikmeot Region, Nunavut.* 32 p.

Canadian Geographic. 2021. I. En ligne : https://atlasdespeuplesautochtonesducanada.ca/article/nunavik-2/ Consulté en mai 2021.

Canadian Royalties Inc. (CRI). 2021. *Projet Nunavik Nickel. Rapport de suivi environnemental 2020*. 465 p.

Canadian Royalties Inc. (CRI). 2022. *Projet Nunavik Nickel – Rapport de suivi environnemental 2021*. 570 p.

Centre canadien des services climatiques (CCSC) : *Documentation technique : Phase 5 du Projet d'intercomparaison de modèles couplés (CMIP5)* (site web consulté le 4 décembre 2021 : En ligne : https://www.canada.ca/fr/environnement-changement-climatique/services/changements-climatiques/centre-canadien-services-climatiques/afficher-telecharger/documentation-technique-phase5-intercomparaison-modeles-couples.html)

Ciesielski, A. 2020. *Delta-Kenty Nickel property – Nunavik Québec*. Technical Report. 75 p.

CIMA+. 2019a. *Delta-Kenty Project – Caractérisation environnementale*. Rapport de mission préparé pour la IR Battery Resources & Processing Inc., dans le cadre du projet Q192678B. 20 p. + annexes.

CIMA+. 2019b. *Desktop Study – Delta Kenty Project.* Report prepared for IR Battery Resources & Processing Inc. 15 p. + annexes.

Conseil canadien des Ministres de l'Environnement (CCME). 2022. *Recommandations canadiennes pour la qualité de l'environnement*. [En ligne] : http://ceqg-rcqe.ccme.ca/?lang=fr

COSEPAC. 2017. *Évaluation et Rapport de situation du COSEPAC sur le caribou (Rangifer tarandus), population migratrice de l'Est et population des monts Torngat, au Canada.* Comité sur la situation des espèces en péril au Canada, Ottawa, xx + XX p.
En ligne : http://www.registrelepsararegistry.gc.ca/default.asp?lang=Fr&n=24F7211B-1.

Couturier, S., D. Jean, R. Otto and S. Rivard. 2004. *Demography of the migratory tundra caribou (Rangifer tarandus) of the Nord-du-Québec region and Labrador.* Direction de l'aménagement de la faune du Nord-du-Québec et Direction de la recherche sur la faune, ministère des Ressources naturelles, de la Faune et des Parcs, Québec City, Québec, 68 p.

CSA Group. 2019. CSA PLUS 4011:F19. *Guide technique : Infrastructure dans le pergélisol : lignes directrices pour l'adaptation au changement climatique*. 103 p.

CVIIP. 2021. *Protocole du CVIIP – Guide d'évaluation préalable de haut niveau.* En ligne : https://cviip.ca

Données climatiques. 2022. En ligne : https://donneesclimatiques.ca/

Doré, G., Zubeck, H., 2008. Cold Regions Pavement Engineering. McGraw-Hill Professionnal.

Eary, L.E. et M.A. Williamson. 2006. *Simulations of the neutralizaing capacity of silicate rocks in acid mine drainage environments.* 7th international conference on acid rock drainage (ICARD), 26-30 Mars, St. Louis, MO.

Elliot, J.M. 1972. "Effect of temperature on the time of hatching in Baetis rhodani *(Ephemeroptera : Baetidae*)". *Oecologia (Berl.)*, 9: 47-51.

Environnement et Changement climatique Canada (ECCC). 2005. Faune et flore du pays – Le caribou. En ligne : https://www.hww.ca/fr/faune/mammiferes/le-caribou.html#:~:text=Le%20caribou%20(Rangifer%20tarandus)%20est,animaux%20%C3%A0%20onglons)%2C%20ruminants.

Environnement Canada et Ministère du Développement durable, de l'Environnement et des Parcs du Québec (MDDEP). 2007. *Critères pour l'évaluation de la qualité des sédiments au Québec et cadres d'application : prévention, dragage et restauration*. 39 p.

Environnement et Changement climatique Canada (ECCC). 2022. *Périodes générales de nidification des oiseaux migrateurs au Canada.*
En ligne : https://www.canada.ca/fr/environnement-changement-climatique/services/prevention-effets-nefastes-oiseaux-migrateurs/periodes-generales-nidification/periodes-nidification.html
(page consultée le 6 avril 2022).

Environnement et Changement climatique Canada (ECCC). (2021). *Rapport d'inventaire national 1990-2019 : Sources et puits de gaz à effet de serre au Canada*.
[En ligne] : https://publications.gc.ca/collections/collection_2021/eccc/En81-4-2019-3-fra.pdf

FCM. 2005. *Dépoussiérage des routes non revêtues. Guide national pour des infrastructures municipales durables*. En ligne : https://fcm.ca/sites/default/files/documents/resources/guide/infraguide-depoussierage-des-routes-non-revetues-pgam.pdf

Fischer, P. and Associates. 1998. *Raglan project, Delta East, Delta West, Sub, Lac Nuvilik, Voisin, Expo West, Expo East and Scoop Properties, P.E. 1052 – 'Delta East' - NovaWest Resources Inc - Summer 1997 - MRN-GÉOINFORMATION 1999.* 632 p.

Gagnon, S. et M. Allard. 2020. "Changes in ice-wedge activity over 25 years of climate change near Salluit, Nunavik (northern Québec, Canada)". *Permafrost and Periglac Process* 31: 69-84.

GENIVAR. 2007. *Projet Nickélifère Raglan Sud – Rapport principal – Étude d'impact sur l'environnement et le milieu social*. Rapport de GENIVAR Société en commandite pour Canadian Royalties inc. 649 p. et annexes.

GIEC. 2014. *Changement climatique 2014 : Rapport de synthèse*. Contribution des groupes de travail I, II et III au cinquième rapport d'évaluation du Groupe d'experts intergouvernemental sur l'évolution du climat [Core Writing Team, R.K. Pachauri et L.A. Meyer (eds.)]. GIEC, Genève, Suisse. 151 p.

Godfrey, E. 1989. *Les oiseaux du Canada.* Éd. Broquet, 650 p.

Golder Associés Ltée. 2021. *Conception du parc à residus du site Expo. Mine Nunavik Nickel, Québec*. Rapport soumis à Canadian Royalties Inc.

Golder Associés Ltée. 2022. *Caractérisation géochimique du minerai et des roches stériles du gisement Delta – Essais statiques*. Memorandum technique préliminaire 1021-20138922-12000-MTF-RevA. Juin 2022. 114 p.

Gouvernement du Canada. 2022a. *Faits sur le Nickel*.
[En ligne] : https://www.rncan.gc.ca/nos-ressources-naturelles/mines-materiaux/faits-mineraux-metaux/faits-sur-le-nickel/20 601

Gouvernement du Canada. 2022 b. *Atlas éolien*. En ligne :
http://www.atlaseolien.ca/nav-fr.php?no=22&field=E1&height=50&season=ANU

Gouvernement du Canada. 2022c. Registre public des espèces en péril. En ligne (consulté le 21 décembre 2022 : https://www.canada.ca/fr/environnement-changement-climatique/services/registre-public-especes-peril.html

Gouvernement du Canada. 2022d. *Volet autochtone de l'Inventaire national des rejets de polluants : Nunavik.* En ligne : https://www.canada.ca/fr/environnement-changement-climatique/services/inventaire-national-rejets-polluants/outils-ressources-donnees/nunavik.html

Gouvernement du Canada. 2022e. Normales climatiques canadiennes. En ligne : https://climat.meteo.gc.ca/climate_normals/index_f.html

Gouvernement du Canada, 2002. *Loi sur les espèces en péril* L.C. 2002, ch. 29.

Gouvernement du Québec. 2019. *Règlement sur la sécurité des barrages, chapitre S-3.1.01, r. 1*.

Gouvernement du Québec. 2022. *Forêt ouverte, carte interactive des données écoforestière*s. En ligne : https://www.foretouverte.gouv.qc.ca

Gray, J. T., J. Pilon & J. Poitevin. 1988. "A method to estimate active-layer thickness on the basis of correlations between terrain and climatic parameters as measured in northern Quebec". *Canadian Geotechnical Journal* 25: 607-616.

Jacobus, L.M, C. R. Macadam et M. Sartori. 2019. "Mayflies *(Ephemeroptera)* and their contribution to ecosystem services". *Insects,* 10 (170): 1-26.

Lamothe, D. et M. Simard. 2010. *Compilation géologique de l'orogène de l'Ungava, version préliminaire*. RP 2010-05 – Carte géologique.

Lauriol, B., A. Champoux et J.T. Gray. 1984. *Répartition estivale des surfaces enneigées en Ungava, Nouveau-Québec.* Géographie physique et Quaternaire 38 : 37-47.

LegisQuebec. 2020. *C-6.2 - Loi affirmant le caractère collectif des ressources en eau et favorisant une meilleure gouvernance de l'eau et des milieux associés.* En ligne : [www.legisquebec.gouv.qc.ca/fr/ShowDoc/cs/C-6.2] Page consultée le 18 juillet 2020.

LegisQuebec. 2022. *Loi sur la qualité de l'environnement. C. Q-2, r. 46.- Règlement sur le stockage et les centres de transferts de sols contaminés*. En ligne : *http://legisquebec.gouv.qc.ca/fr/ShowDoc/cr/Q-2,%20r.%2046/*

LegisQuébec. 2022. C. E-22 – *Loi sur les explosifs*. En ligne : https://www.legisquebec.gouv.qc.ca/fr/document/lc/E-22

Lévesque, R., M. Allard, M.K. Séguin & J. Pilon. 1990. *Données préliminaires sur le régime thermique du pergélisol dans quelques localités du Nunavik, Québec*. Proceedings, 5th Canadian Permafrost Conference. C. d. é. Nordiques. Université Laval, Québec. 54 : 207-213.

L' Hérault, E. 2005. *Application d'une méthode d'estimation de l'épaisseur de la couche active du pergélisol à l'aide de données géothermiques et climatiques mesurées à Salluit, Nunavik*. 70 p.

L'Hérault, E. 2009. *Contexte climatique critique favorable au déclenchement de ruptures de mollisol dans la vallée de Salluit, Nunavik*. Département de Géographie. Québec, Université Laval. Maîtrise en Sciences Géographiques : 149.

L'Hérault, E., M. Allard, S. Aubé-Michaud, A. Boisson, D. Sarrazin, J. Roger & C. Barrette. 2016. *Détermination et analyse des vulnérabilités du Nunavik en fonction des composantes environnementales et des processus physiques naturels liés au climat*. Progress report no. 2. Produced on behalf of the Ministère des Forêts, de la Faune et des Parcs. Centre for Northern Studies, Université Laval, Québec, 68 p.

Li, T. et J.P. Ducruc. 1999. *Les provinces naturelles. Niveau I du cadre écologique de référence du Québec*. Ministère de l'Environnement. 90p.

Mailhot A. & D. Chaumont D. 2017. *Élaboration du portrait bioclimatique futur du Nunavik – Tome I.* Rapport présenté au Ministère des Forêts, de la Faune et des Parcs. Ouranos. 216 p.

Ministère des Affaires municipales et de l'habitation (MAMH). 2022. *Régime municipal nordique*. En ligne : https://www.mamh.gouv.qc.ca/organisation-municipale/organisation-territoriale/organisation-territoriale-municipale/regime-municipal-nordique/
(Consulté en ligne en juillet 2022)

Ministère des Affaires municipales et de l'Habitation du Québec (MAMH). 2010. *Organisation territoriale. Régime municipal nordique.* En ligne :
https://www.mamh.gouv.qc.ca/organisation-municipale/organisation-territoriale/organisation-territoriale-municipale/regime-municipal-nordique/ Consulté en mai 2021.

Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC). 2016. Directive pour la réalisation d'une étude d'impact sur l'environnement d'un projet minier. Direction générale de l'évaluation stratégique. 29 p.

MEND, 2012. *Cold regions cover system design technical guidance document*. Report 1.61.5c. Mine Environmental Neutral Drainage program, Natural Resources Canada. http://mend-nedem.org/wp-content/uploads/2013/01/1.61.5c.pdf

Ministère du Développement durable, de l'Environnement et des Parcs (MDDEP). 2012. *Directive 019 sur l'industrie minière*. ISBN : 978-2-550-64507-8 (PDF). 105 p.

Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC). 2020. *Guide pour l'établissement des normes de rejet d'une installation de traitement des eaux usées d'origine domestique.* 74 p. En ligne : Guide pour l'établissement des normes de rejet d'une installation de traitement des eaux usées d'origine domestique (gouv.qc.ca)

Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC). 2020a*. Guide de caractérisation des résidus miniers et du minerai.* Québec. 52 p. En ligne :
http://www.environnement.gouv.qc.ca/Industriel/secteur-minier/guidecaracterisation-minerai.pdf

Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC). 2021. *Les changements climatiques et l'évaluation environnementale : Guide à l'intention de l'initiateur de projet.* En ligne : www.environnement.gouv. qc.ca/evaluations/directive-etude-impact/guideintention-initiateur-projet.pdf

Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP). 2022a. *Critères de qualité de l'eau de surface au Québec.* En ligne :
https://www.environnement.gouv.qc.ca/eau/criteres_eau/index.asp

Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP). 2022b. *Règlement sur la qualité de l'eau potable.* En ligne :
https://www.environnement.gouv.qc.ca/eau/potable/brochure/parties-1-2-3.htm#:~:text=L'eau%20ne%20doit%20pas,exempts%20de%20bact%C3%A9ries%20coliformes%20totales.

Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP). 2022c. *Loi sur les espèces menacées ou vulnérable.* En ligne : https://www.legisquebec.gouv.qc.ca/fr/document/lc/e-12.01#:~:text=Nul%20ne%20peut%2C%20%C3%A0%20l,celle%20provenant%20de%20la%20reproduction.

Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP). 2022d. Fiche signalétique de la station Highfall. En Ligne : https://www.cehq.gouv.qc.ca/hydrometrie/historique_donnees/fiche_station.asp?NoStation=103501

Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP). 2022e. *Guide pour l'étude des technologies conventionnelles de traitement des eaux usées d'origine domestique*. En ligne : https://www.environnement.gouv.qc.ca/eau/eaux-usees/domestique/index.htm

Ministère de l'Environnement, de la Lutte aux changements climatiques, de la Faune et des Parcs (MELCCFP). 2022f. *Garrot d'Islande, population de l'Est*. En ligne : https://www3.mffp.gouv.qc.ca/faune/especes/menacees/fiche.asp?noEsp=83

Ministère de l'Énergie et des Ressources naturelles (MERN). *Guide de préparation du plan de réaménagement et de restauration des sites miniers au Québec.* ISBN 978-2-550-92682-5 (PDF). 97 p.

Morin, K.A. et N.M. Hutt. 1994.*Observed preferential depletion of neutralization potential over sulfide minerals in kinetic tests: site-specific criteria for safe NP/AP ratios.* International land reclamation and mine drainage conference and the Third international conference on the abatement of acidic drainage, Pittsburgh, PA, USA, 24-29.

Nantel, E. (2006). *Élaboration d'une méthode d'estimation des vulnérabilités historiques des approvisionnements en eau potable au Québec.* Mémoire de maîtrise. Institut National de la Recherche Scientifique. 134 p.

Odewande, A. 2020. *Assessment report on Assessment report on 2020 exploration campaign, diamond drilling program, Kenty lake – Delta zone D8 et D9 - P.Geo*.

Plante, S. 2020. *Effet simples et cumulés des perturbations humaines sur l'habitat et la survie du caribou migrateur*. Thèse. Doctorat en biologie. Université Laval. 203 p.

Proulx, g., Dubé, J. et G. Cloutier. 2019. *Enjeux et bénéfices socioéconomiques : La création du parc national des Pingaluit*. Théoros, 38 (2). En ligne : https://journals.openedition.org/teoros/3815 Consulté en mai 2021.

Radio-Canada. 2017. *Des nations autochtones s'entendes pour protéger le caribou migrateur*. En ligne : Des nations autochtones s'entendent pour protéger le caribou migrateur | Radio-Canada.ca

Régie régionale de la Santé et des Services sociaux Nunavik, 2015. *Portrait de santé Nunavik. Les enfants et leur famille, les jeunes, les adultes et les aînés.* En ligne : https://nrbhss.ca/sites/default/files/Profile%20Youth_Adults_Elders_2015_FR%20.pdf Consulté en mai 2021.

Relations Couronne-Autochtones et Affaires du Nord Canada, 2020. *Inuit.* En ligne : https://www.rcaanc-cirnac.gc.ca/fra/1100100014187/1534785248701#sc1 Consulté en avril 2021.

Renaud, S. et Y. Plourde. 2007. *Projet Nickélifère Raglan Sud – Climatologie et hydrologie*. Rapport sectoriel final – Étude d'impact sur l'environnement. Rapport de GENIVAR pour Canadian Royalties inc. 51 p. et annexes.

Robichaud, V. et G. Duhaime. 2015. *Portrait économique du Nunavik 2012*. Rapport présenté à l'Administration régionale Kativik.
En ligne : https://www.chaireconditionautochtone.fss.ulaval.ca/doc/Publication/Rapport-final-MCS2012-v3-01.pdf Consulté en mai 2021.

Sharma, S., C. Serge & D.C. Steeve. 2009. "Impacts of climate change on the seasonal distribution of migratory caribou". *Global Change Biology*, 15(10): 2549-2562. Dans: Blangy, S. & Deffner, A. (2014). Impacts du développement minier sur les hommes et les caribous à Qamani'tuaq au Nunavut: approche participative. Études/Inuit/Studies, 38(1-2), 239–265. En ligne : https://doi.org/10.7202/1028862ar

Simard, J. 2019. *Geophysical consulting report on a mag-VTEM survey completed on the Delta Kenty project.* Report to IR Battery Resources Inc, June 2019. Ref: 19C-339, 41p.

Smith SL, Burgess MM, Riseborough D, Nixon FM. 2005. *Recent trends from Canadian permafrost thermal monitoring network sites.* Permafrost and Periglacial Processes 16: 19– 30.

Société Makivik. 2021a. La Société Makivik.
En ligne : https://www.makivik.org/fr/la-societe/histoire/la-societe-makivik/ Consulté en septembre 2022.

Société Makivik. 2021b. Histoire récente et démographie. https://www.makivik.org/fr/histoire-recente-et-demographie/ Consulté en septembre 2022.

St-Laurent, M.-H., A.-L. Renaud, M. Leblond et D. Beauchesne. 2012. « Synthèse des connaissances relatives aux impacts des routes sur l'écologie du caribou ». *Le Naturaliste canadien*, 136(2), 42–47.

Stantec Consulting Ltd. 2010. *Wildlife passage engineering design guidelines*. Préparé pour la Ville d'Edmonton. 249 p.

Statistiques Canada 2019. *Participation des Inuits à l'économie basée à la fois sur les salaires et les ressources dans l'Inuit Nunangat par Paula Arriagada et Amanda Bleakney*.
En ligne : https://www150.statcan.gc.ca/n1/pub/89-653-x/89-653-x2019003-fra.htm Consulté en mai 2021.

Statistique Canada. 2022. (tableau). *Profil du recensement, Recensement de la population de 2021*, produit nº 98-316-X2021001 au catalogue de Statistique Canada. Ottawa. Diffusé le 9 février 2022. En ligne : https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/index.cfm?Lang=F (Page consultée en mai 2022).

Système d'information géominière du Québec (SIÉGOM). 2022. *Carte interactive*. Site Internet consulté le 17 octobre 2022. En ligne : http://sigeom.mines.gouv.qc.ca/signet/classes/I1108_afchCarteIntr

Système d'information géominière du Québec (SIÉGOM). 2019. *Carte interactive*. Site Internet consulté le 28 août 2019. En ligne : http://sigeom.mines.gouv.qc.ca/signet/classes/I1108_afchCarteIntr

Taillon, J., V. Brodeur et S. Rivard. 2016. *État de la situation biologique du caribou migrateur, troupeau de la rivière aux Feuilles.* Ministère des forêts, de la Faune et des Parcs, Québec. 69 p.

Tremblay, B. 2006. *Projet Nickélifère Raglan Sud- Inventaire de la flore vasculaire, de la végétation et des plantes rares*. Rapport sectoriel préliminaire – Étude d'impact sur l'environnement. Rapport de GENIVAR pour Canadian Royalties inc. 47 p. et annexes.

Turcotte, Y. 2019. *Convention de la baie James et du Nord québécois*.
En ligne : https://www.thecanadianencyclopedia.ca/fr/article/convention-de-la-baie-james-et-du-nord-quebecois#. Consulté en mai 2021.

Varin, M. 2013. *Cartographie de trois fonctions écologiques des milieux humides à l'aide d'indicateurs spatiaux dans un contexte d'aide à la décision*. Mémoire de maîtrise, Département de géomatique appliquée, Université de Sherbrooke, 95 p. + annexes.

Wan, R. and A. Booshehrian. 2015. *Permafrost Degradation within Continuous Permafrost Zones due to Mining Disturbances in Canadian Northern Regions* – Final report RSP-493.1, Department of Civil Engineering, University of Calgary. 301 p.

Wolfe, W.J. 1974. Year-end Report, Summary of 1974 Exploration program, Ungava Nickel Belt, Kenty Project. 28 p.

Woo, M.K., K.L. Young & L. Brown. 2006. "High Arctic patchy wetlands: hydrologic variability and their sustainability". *Physical Geography* 27:297-307.

WSP. 2015. *Projet Nunavik Nickel – Exploitation du gisement Puimajuq. Étude d'impact sur l'environnement et le milieu social – Addenda au certificat d'autorisation 3215-14-007*. Rapport produit pour Canadian Royalties Inc. 92 p. et annexes.

About **AECOM**

AECOM is the world's trusted infrastructure consulting firm, delivering professional services throughout the project lifecycle – from planning, design and engineering to program and construction management. On projects spanning transportation, buildings, water, new energy and the environment, our public- and private-sector clients trust us to solve their most complex challenges. Our teams are driven by a common purpose to deliver a better world through our unrivaled technical expertise and innovation, a culture of equity, diversity and inclusion, and a commitment to environmental, social and governance priorities. AECOM is a *Fortune 500* firm and its Professional Services business had revenue of $13.3 billion in fiscal year 2021.

See how we are delivering sustainable legacies for generations to come at **aecom.com** and **@AECOM**.

AECOM
2, rue Fusey
Trois-Rivières (Québec) G8T 2T1

Tél. : 819 373-6820
Téléc. : 819 373-7573

aecom.com/aecom.ca/fr

aecom.com

Printed on recycled paper.