CANADIAN ROYALTIES INC.

NUNAVIKNICKEL

Projet Nunavik Nickel
Nunavik Nickel Project

Addenda au certificat d'autorisation 3215-14-007

Exploitation du gisement Puimajuq

Étude d'impact sur l'environnement et le milieu social

Addenda to the Certificate of Authorisation 3215-14-007

Puimajuq Deposit Mining Project

Environmental and Social Impact Assessment

Novembre 2015 / November 2015
101-53046-05

WSP

Canadian Royalties Inc.

NUNAVIK NICKEL PROJECT

PUIMAJUQ DEPOSIT MINING PROJECT

ENVIRONMENTAL AND SOCIAL IMPACT STUDY

ADDENDUM TO CERTIFICATE OF AUTHORIZATION NUMBER 3215-14-007

Study Report

Project number: 101-53046-04
Date: November 2015

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1 INTRODUCTION

This document is an addendum to an environmental and social impact assessment (ESIA) of the Nunavik Nickel Project (NNP; GENIVAR, 2007) containing all the elements of knowledge and analysis required to modify the NNP certificate of authorization (n° 3215-14-007). It addresses the Puimajuq Deposit Mining Project (PDMP), an extension of the NNP because it will extend the lifespan of the existing mining complex. This deposit will be mined for a little over a year using open-pit techniques to supply the ore processing plant in the nearby Expo industrial complex. The nickel concentrates and copper products will be shipped by road to Deception Bay and from there by sea to a smelter.

Chapter 2 presents the background and rationale for the project. It also sets out the regulatory framework of the NNP, since the PDMP is only subject to an addendum to the ESIA in view of obtaining a modification to the existing decree. It focuses on specific characteristics prevalent in Nunavik.

Chapter 3 summarizes past and upcoming consultations with local communities.

Chapter 4 compares options for the project, which are analyzed in terms of the ore mining method, the waste rock management method, the route for the access road, and the location of the waste rock pile and collecting pond. This comparison brings out the optimal environmental and technical-economic options.

Chapter 5 presents a detailed description of the PDMP concept. Without limitation, the description covers mining infrastructures, mine operations, the management method for waste rock and water, mine effluent and related infrastructures. The timetable, operational sequence and the cost of the work are also described.

Chapter 6 describes the biophysical and human environments of the study area selected for the assessment of environmental and social impacts. This description includes and synthesis of information collected in the context of the ESIA of 2007), including all of the relevant addenda (GENIVAR, 2009), and the results of specific inventories completed in the summer of 2015 in the PDMP study area.

The PDMP impact assessment is presented in Chapter 7. It deals only with the impacts of new infrastructures and ore transport between Puimajuq and the Expo industrial complex. A report on significant residual impacts, after mitigation, concludes this section.

Chapter 8 presents the environmental surveillance and monitoring programs. The surveillance mainly concerns the construction phase and should be scheduled in the plans and specifications phase. Monitoring aims to assess the effectiveness of proposed mitigation measures, to check whether any negative impacts appear and to quantify them, to ensure compliance with standards and to implement solutions, as needed, to protect the environment.

Chapter 9 describes general procedures for managing accidents that could occur during the construction and operation of the PDMP. They aim to prevent oil and hazardous material spills, fires and explosions.

Finally, the conclusion brings out the main challenges of the project and any residual impacts.

2 PROJECT CONTEXT AND JUSTIFICATION

2.1 PROJET LOCATION

The PDMP is located in the far north of the province of Quebec in the region of Cape Smith, Nunavik, near latitude 61.56° (Map 2.1). More precisely, it is located 59 km west of the Inuit village of Kangiqsujuaq, 154 km south-east of Salluit and approximately 290 km from Puvirnituq. The deposit is about 24 km south of the Raglan mine in Katinniq, which is operated by the Glencore Company. Puimajuq is also located 23 km north of Parc national des Pingualuitk and 44 km from Lake Pingualuk. PDMP activities will never, under any circumstances, cross park boundaries.

The PDMP is part of NNP operations. The Puimajuq Deposit is 8 km east of the Allammaq Deposit, 10 km east of the Mesamax Deposit and 19 km east of the Expo industrial complex (Map 2.1).

2.2 PROJECT JUSTIFICATION

Mining is an industry whose raw material is non-renewable. It is also an industry that requires major investments to attain profitability for investors. Before being able to market a product with economic value, mining contractors must first find a deposit, ensure that it is physically minable, and create mining infrastructures.

Generally, one exploration target in a thousand is estimated to have economic potential. This target must then be checked to find out whether or not the rock mass can be mined safety and without involving excessive waste rock management during extraction. The ore must be evaluated for its physical-chemical response to separation. The location of the deposit is also evaluated for existing infrastructures, such as access by road, air, sea, energy supply, water supply, proximity to a labour pool or the need for a housing infrastructure.

Once the extraction method is determined, the mining contractor must also check the processing method and the product that will be made to sell on the market. After prior studies have been accepted, facilities must be built. When the area is far from services, these facilities may also include those required for industrial activities, including the construction of camps, workshops, garages, a port, an airport, a water supply system, a sewage treatment system, road infrastructures, a landfill, etc.

Industrial activities require the acquisition of equipment, the construction of a processing plant and many facilities required for the protection of workers and the environment.

Starting up a mining complex is in fact a major project. To ensure good economic performance, contractors continue to investigate deposits to optimize the profitability of their installations in relation to the lifespan of the equipment.

Construction of NNP facilities began following the assessment of four surface deposits, including two near central facilities and two to the west of Puvirnituq River, for which roads are not yet built. Then a fifth deposit was identified and assessed as potentially profitable through underground mining. A concentrator, an autonomous camp, roads, workshops, a water reservoir and a port were built to mine these deposits. The concentrator can process up to 1,750,000 tons of ore per year. The mines currently available supply the concentrator. Authorizations for the construction of the access road to the west are under consideration. The Puimajuq Deposit is a 6th deposit identified. It is considered economically feasible because of the existing facilities; it is easily accessible because it is very close to existing roads. Mining this deposit requires less investment than starting up mining operations on deposits to the west, for which some 40 km of road infrastructures would have to be built. The Puimajuq Deposit is in the same watershed as CRI's other mining operations in Nunavik, it is near the surface, the ore is easily accessible and rich compared to the other NNP deposits already identified. It has average levels of 1.5% Ni, 2.4% Cu, PGE, 1.5 gpt. Mining the Puimajuq Deposit will serve to supply the concentrator during the construction of the road to the deposits to the west, thus maintaining the production rate and avoiding layoffs.

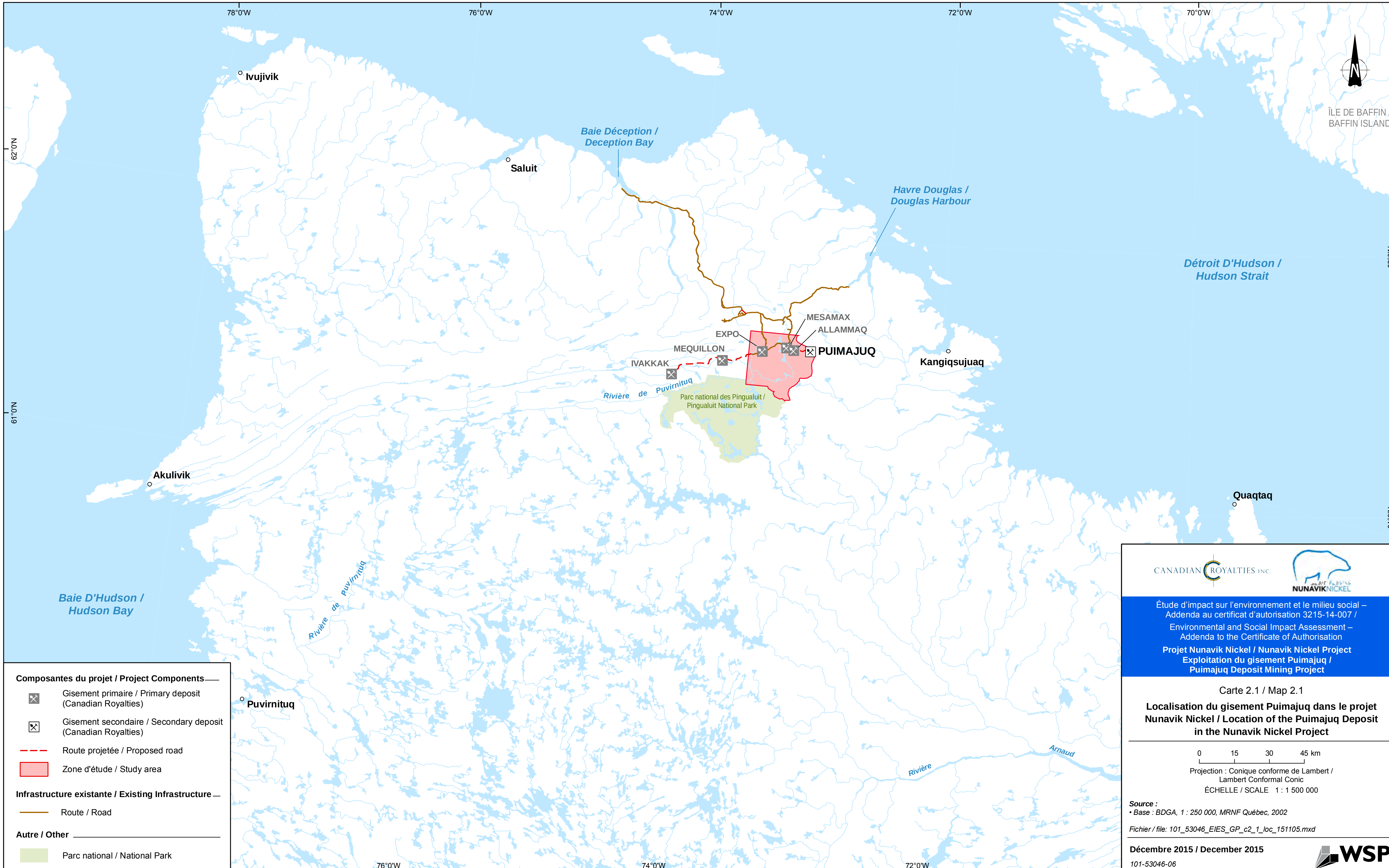
2.3 LEGAL AND REGULATORY FRAMEWORK

Since the PDMP is part of the NNP, it is subject to the same legal and regulatory framework, which is detailed in the ESIA (GENIVAR, 2007). In this context, building the PDMP does not require any modifications to the global certificate of authorization (n° 3215-14-007), issued by the Quebec government for the NNP in 2008.

After the submission of the addendum, the final plans and specifications will be drawn up. In addition to the working methods and mitigation measures described in this addendum, the final design of the PDMP should comply with applicable standards for the proposed equipment and infrastructures. Lastly, the final plans and specifications will need to be assessed and permit applications filed according to the laws and regulations of the governments of Canada and Quebec (Table 2.1).

Table 2.1 Applicable Laws and Regulations in the Context of the PDMP.

LEVEL OF GOVERNMENT	LAWS AND REGULATIONS
Government of Canada	Canadian Environmental Protection Act (CEPA, 1999, ch. 33) and its regulations
	Fisheries Act (R.S.C., 1985, ch. F-14) and its regulations • Metal Mining Effluent Regulations (SOR/2002-222)
	Species at Risk Act (S.C., 2002, ch. 29) and its regulations
Government of Quebec	Bay James and Northern Quebec Agreement (1975) Environment Quality Act (R.S. Q., c. Q-2) and its regulations, including: • Regulation respecting pits and quarries (R.R.Q., c. Q-2, r. 2) • Regulation respecting the quality of drinking water (R.R.Q., c. Q-2, r. 18.1.1)
	Building Act (R.S.Q., c. B-1.1) and its regulations
	Act respecting threatened or vulnerable species (R.S.Q. c. C-61.1) and its regulations, including: • Regulation respecting threatened or vulnerable plant species and their habitats (R.R.Q, E-12-01, r. 0.4)
	Mining Act (R.S.Q., c. M-13.1) and its regulations
	Watercourses Act (R.S.Q, R-13) and its regulations
	Act respecting occupational health and safety (R.S.Q., c. S-2.1) and its regulations


78°0'W
76°0'W
74°0'W
72°0'W
70°0'W
62°0'N
61°0'N
Ivujivik
Saluit
Baie Déception / Deception Bay
Havre Douglas / Douglas Harbour
Détroit D'Hudson / Hudson Strait
ÎLE DE BAFFIN / BAFFIN ISLAND
N
MESAMAX
ALLAMMAQ
EXPO
MEQUILLON
IVAKKAK
PUIMAJUQ
Kangiqsujuaq
Rivière de Puvirnituq
Parc national des Pingualuit / Pingualuit National Park
Akulivik
Quaqtaq
Baie D'Hudson / Hudson Bay
Rivière de Puvirnituq
Puvirnituq
Rivière Arnaud
Composantes du projet / Project Components
Gisement primaire / Primary deposit (Canadian Royalties)
Gisement secondaire / Secondary deposit (Canadian Royalties)
Route projetée / Proposed road
Zone d'étude / Study area
Infrastructure existante / Existing Infrastructure
Route / Road
Autre / Other
Parc national / National Park
CANADIAN ROYALTIES INC.
NUNAVIK NICKEL
Étude d'impact sur l'environnement et le milieu social – Addenda au certificat d'autorisation 3215-14-007 /
Environmental and Social Impact Assessment – Addenda to the Certificate of Authorisation
Projet Nunavik Nickel / Nunavik Nickel Project
Exploitation du gisement Puimajuq / Puimajuq Deposit Mining Project
Carte 2.1 / Map 2.1
Localisation du gisement Puimajuq dans le projet Nunavik Nickel / Location of the Puimajuq Deposit in the Nunavik Nickel Project
0 15 30 45 km
Projection : Conique conforme de Lambert / Lambert Conformal Conic
ÉCHELLE / SCALE 1 : 1 500 000
Source :
• Base : BDGA, 1 : 250 000, MRNF Québec, 2002
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Décembre 2015 / December 2015
101-53046-06
WSP

3 CONSULTATION WITH THE COMMUNITY

3.1 NUNAVIK NICKEL COMMITTEE

Nunavik Nickel Committee includes representatives of each partner who have decision-making powers, such as the President of Qaqqalik (Landholding Corporation of Kangiqsujuaq), a representative of the Mayor of NV Puvirnituk, the coordinator of Makivik Mines, the CRI Vice President of Human Resources, the Chief of Operations, the Environment Specialist and an officer of Inuit communication/training.

During a recent meeting of the Nunavik Nickel Committee on October 13, 2015, the Puimajuq project was presented and it was received with enthusiasm. Following the meeting, on October 25 the members of the committee were given a description of the operations schedule and invited to comment and suggest any avenues of improvement for the project. No comments were submitted to CRI by the Inuit partners other than encouragements at the committee meeting.
For the communities, the fact that the Puimajuq Deposit mining operation will not affect another watershed is a key criterion.

Further to this meeting, a visit to the communities was recommended by the end of 2015. This visit will include an update on CRI activities and a presentation of upcoming activities, including the Puimajuq Deposit mining operation, the installation of one or two wind turbines and the optimization of the concentrator processing rate. These visits will also be an opportunity to explain and demonstrate to the representatives of the communities present how our operations will not affect fish consumption for the community of Kangiqsujuaq or the quality of water for the community of Puvirnituq. CRI representatives will also take the opportunity to address concerns and answer questions these communities may have.

These visits will take the form of a presentation to municipal officials, elected officials from landholding corporations and their guests. A statement will be broadcast on FM radio the week before the meeting so that elected officials can collect the questions and concerns of their fellow citizens and send out invitations.

4 COMPARATIVE ANALYSIS OF OPTIONS

4.1 MINING METHOD

Because of the shallow depth of the deposit and the thickness required for developing the surface pillar, only one mining method option was considered for the Puimajuq deposit, namely the conventional method (open pit).

On the Puimajuq Deposit site, the terrain's natural topography is at elevations between 588 and 592 m. The mineralized area starts at a level of 570 m, about twenty meters below the surface. Since the deposit is near the surface, the surface pillar would only have a thickness of about 20 m, which is not sufficient for safe underground mining.

According to the literature, the minimum thickness of the surface pillar should be at least the width of the sites being mined. For the PDMP, the site will be 25 metres wide. According to this rule, the ore could only be mined starting at an elevation of 563 m. One must also consider that this type of deposit may be partially oxidized on the surface, thus requiring an even thicker surface pillar to compensate for the loss of competence of the rock mass. Also considering the layer of vegetation and fractured rock on the surface, one can assume that to obtain a safe surface pillar of 25 m in thickness, a surface pillar of at least 33 m thick is the minimal requirement. Thus, the ore could only be mined from 555 m and consequently about 100,000 t of ore would be lost in the surface pillar, representing approximately 60% of the deposit, plus additional losses in the various pillars.

4.2 WASTE ROCK MANAGEMENT

Waste rock produced in the context of the PDMP will be stored in a waste rock pile with 900 000 m^3 capacity for the duration of the mining operation. When the operation ends, three waste rock management methods will be possible:

- → Disposal of all of the waste rock in a waste rock pile with impervious cover,
- → Disposal of some of the waste rock in the pit and covering the remaining waste rock pile with an impervious cover,
- → Disposal of some of the waste rock in the pit, collecting pond and some a minimal waste rock pile.

It was also thought to truck some waste rock in Allammaq stopes but cost was considered too high and Allammaq remaining stopes are already anticipated to be stabilized by some Mesamax waste

4.2.1 OPTION 1: DISPOSAL IN A WASTE ROCK PILE WITH IMPERVIOUS COVER

Option 1 is the management method advocated in the context of the NNP for other open-pit mines: the creation of a conventional pile covered by impervious cover. The maximum volume of the waste rock pile could reach 900,000 m^3, which corresponds to a footprint of 8.2 ha with 20m of height. The pile would be located just to the south of the mining pit on the side of the road (Map 4.1).

4.2.2 OPTION 2: WASTE ROCK DISPOSAL IN THE PIT AND A WASTE ROCK PILE

Because of the amounts of waste rock produced, option 2 proposes filling the pit with the leachable waste rock, equivalent to 12 % of the total product, when mining on the deposit is completed. According to this option, the waste rock pile would have a footprint of 7.7 ha with height of 20m. This option involves taking the leachable waste rock stored in the pile back into the pit at the close of mining operations, which would increase truck transport.

4.2.3 OPTION 3: WASTE ROCK DISPOSAL IN THE PIT, COLLECTIONG POND AND WASTE PILE

Option 3 provides for the disposal of leachable waste rock in the pit as some of the non-leachable. Collecting pond would also be filled with non-leachable waste rock and the remaining would stay as pile. This way, the pile is minimized.

4.2.4 COMPARATIVE ANALYSIS OF THE OPTIONS

According to the analysis conducted, the waste rock management method deemed preferable, taking environmental considerations into account, is option 3 (Table 4.1). This option allows the lowest potential impact on the environment and Inuit use of the area. With this option, the footprint of the waste rock pile is reduced to a minimum and industrial holes are filled.

Although this option requires more trucking than options 1 and 2, the additional emissions of air pollutants could be controlled by the mitigation measures described in the context of the NNP, including the occasional use of dust-suppression liquids on some sections of the road (GENIVAR, 2007).

In conclusion, option 3 is the one that generates the fewest technical constraints (limited amount of waste rock to manage on site), even if it results in additional costs.

4.3 ROUTE OF THE ACCESS ROAD

The ore extracted from the Puimajuq Deposit will be trucked to the Expo industrial complex. In this regard, six road layout options were explored to link the Puimajuq mine to the current NNP road network (Map 4.1). An analysis of surface deposits and delineation of the wetlands by photo-interpretation have allowed the optimization of the proposed routes, taking into account constraints related to soil bearing capacity.

4.3.1 OPTION 1A

The option 1a route starts in Allammaq and heads north around two lakes. While following the high points of the terrain, it then turns south to cross between the two lakes. Then it forks north to the Puimajuq mining site (Map 4.1).

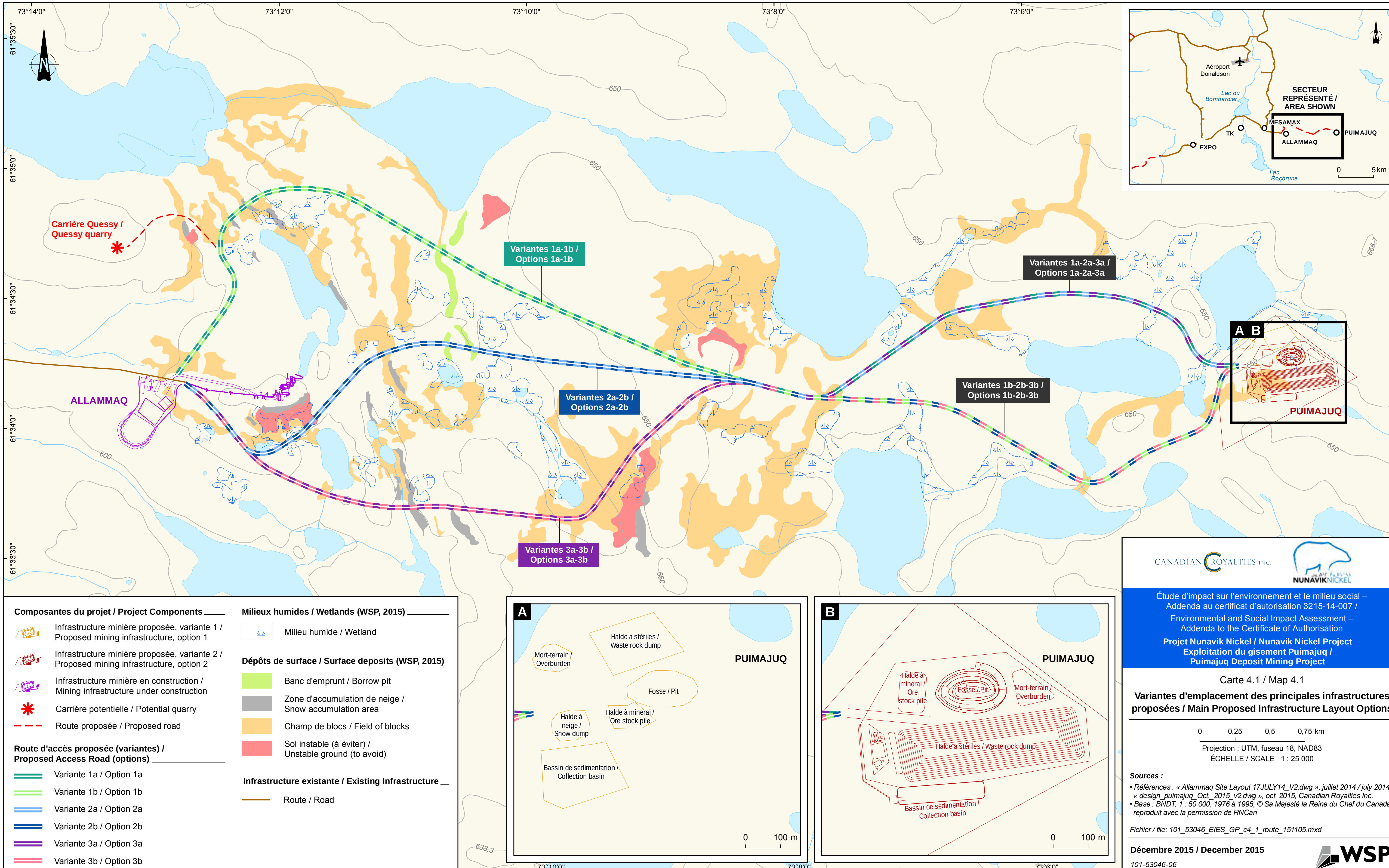

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Table 4.1 Comparison of Waste Rock Management Options

ELEMENT OF COMPARISON	OPTION 1	OPTION 2	OPTION 3
Duration of the impact on Inuit land use	Longer	Medium	Shorter
Extent of the impact on Inuit land use	Greater	Medium	Smaller
Air pollutant emissions	Lower	Medium	Higher
Footprint of the waste rock pile	Greater	Medium	Smaller
Timeline for completion	Shorter	Medium	Shorter
Cost	Lower	Medium	Average

This alternative requires the construction of a 9.3-km stretch of road between the entrance to the Puimajuq mine and the road from Allammaq. This route is suggested because of the relatively good soil bearing capacity. Almost all along the way, it also avoids the wetlands and low-lying areas. An esker that offers a potential borrow pit also crosses the route approximately 3 km from Allammaq. In addition, Quessy quarry, identified as potential fill material is located immediate north of proposed route (Map 4.1).

According to this option, there is only one water-crossing point, which is near the Puimajuq mining site. In fact, this route provides sufficient distances (a minimum of 60 m) from lakes and watercourses, which would significantly reduce impacts on aquatic environments.

Finally, the snow potential for this option does not seem problematic since it follows high points in the terrain, which are continually windswept.

4.3.2 OPTION 1B

The option 1b route leaves Aallamaq's main road heading north and goes around the two lakes. It then turns south following high points in the terrain. Then it goes between two larger lakes before heading south to the Puimajuq mining site (Map 4.1).

This route would be 9.4 km in length between the entrance to the Puimajuq mine and the road from Allammaq. This option takes the same route as option 1a for the first 6 km from Allammaq, which gives it a relatively good bearing capacity on this section.

This route involves crossing only one waterway. However, the construction of semi-stacked culverts in this location could cause an instability problem due to an unconsolidated boulder field (Map 4.1).

The snow potential of this option is low for the first 6 km and increases over the rest of the route, since it crosses more low-lying areas.

4.3.3 OPTION 2A

Starting from Allammaq, option 2a heads south and bypasses the Allammaq dome around the base and then climbs to the existing Allammaq road (Map 4.1). It then continues along a fairly straight line to the two big lakes, which it crosses, and then forks to the north to reach the Puimajuq mining site.

According to option 2a, the road would be 8.5 km long between the Puimajuq and Allammaq mining sites (Map 4.1). However, this route presents many technical challenges, particularly near the Allammaq dome, where surface deposits are not favourable to road building because of their instability. Ongoing maintenance would be required to ensure stability of the road throughout its use. Note that the route crosses two small eskers that could serve as borrow pits for the construction of the road.

The route also passes close to colonies of special status draba, such as *Draba cayouettei*, a new discovery in Nunavik.

Finally, snow potential is high south of the Allammaq dome, since this barrier favours the accumulation of snow and would require ongoing maintenance in the winter.

4.3.4 OPTION 2B

The option 2b route goes around the Allammaq dome to the south and then heads north for approximately 2 km before turning east. After crossing the two big lakes, it connects to the Puimajuq site from the south.

Like option 2a, option 2b presents the same technical challenges south of the Allammaq dome due to the instability of surface deposits. This route also runs alongside new colonies of special status plants discovered in the summer of 2015.

Snow potential is higher to the south of the Allammaq dome, which is a considerable snow bed, and also all along the route, since it follows the lowest-lying points of the landscape.

4.3.5 OPTION 3A

Option 3a heads south around the rocky Allammaq dome and continues east to bypass many watercourses. It then forks north to the Puimajuq mine site (Map 4.1).

The length of option 3a is 8.7 km. This option goes south around the Allammaq rocky dome area. Because of the many constraints due to the presence of lakes and wetlands, for approximately 1 km, the proposed route crosses a field of unconsolidated boulders, which implies additional investments to ensure the road's stability.

This route crosses three watercourses and a snow accumulation area. The construction of semi-stacked culverts could be problematic at the first watercourse crossing because of a field of unconsolidated boulders, which could lead to instability.

Finally, the snow potential is considered medium due to a snow accumulation area near the second watercourse crossing. Additional maintenance would be required during the winter to ensure safety.

4.3.6 OPTION 3B

Option 3b takes the most southerly route. It is 8.8 km in length, and presents the same technical and environmental constraints as option 3a on the section between Allammaq and the two big lakes (snow accumulation area, unstable boulder fields and two watercourse crossings).

It then branches south to head to the Puimajuq mine site. On this part of the route, it crosses a watercourse in an area of unstable boulders, which would result in additional technical challenges.

Finally, the snow potential is considered medium since there are a few snow accumulation areas near the second watercourse crossing and it follows the lowest points in the landscape.

4.3.7 COMPARATIVE ANALYSIS OF ROUTE OPTIONS

First, although options 2a and 2b are shorter in distance, the analysis helps exclude them because they present more environmental and technical-economic constraints (Table 4.2) than the other options.

Table 4.2 Comparison of route options

ELEMENT OF COMPARISON	OPTION					
	1A	1B	2A	2B	3A	3B
Length (km)	9.3	9.4	8.5	8.6	8.7	8.8
Negative impacts related to the construction and maintenance of the road	Fewer	Medium	More	More	Average	Average
Air pollutant emission related to trucking	Higher	Higher	Medium	Medium	Medium	Medium
Potential impact on rare plants	Lower	Lower	Higher	Higher	Higher	Higher
Snow potential	Lower	Lower	Higher	Higher	Average	Average
Technical feasibility	Easier	Intermediate	Harder	Harder	Intermediate	Intermediate
Cost of construction	Intermediate	Intermediate	Higher	Higher	Intermediate	Intermediate
Nb. of watercourse crossing points	1	1	1	1	3	3
Distance of wetlands to cross (m)	89	54	199	163	89	54
Distance of surface deposits to bypass (km)	1.2	1.1	0.9	0.8	1.6	1.5

Options 1b and 3b were not selected because of the technical and environmental constraints related to building semi-stacked culverts in a field of unstable boulders.

Option 1a is preferred to option 3a because of lower snow potential, shorter distances to travel over unstable surface deposits and fewer watercourse crossings. It appears that despite the longer distance of option 1a, construction costs would be comparable. Therefore, route 1a has been selected.

4.4 LOCATION OF THE WASTE ROCK PILE AND COLLECTING POND

Waste rock consists of materials removed from the pit that do not contain enough metal to make processing them economically feasible. Obviously, the disposal site for these rocks must be as close as possible to the pit to minimize transport costs and reduce air pollutant emissions by travelling shorter distances.

In Puimajuq, two locations were considered for the disposal of waste rock, one to the north (option 1) and the other to the south of the pit (option 2). At the site of option 1, part of the natural flow of water comes directly from nearby lakes. Because of the topography, it is essential to create a more complex runoff management system (e.g. ditches, dams). The site selected for option 2 is downstream of the pit on a gentle slope. This configuration facilitates the transportation of waste rock and the management of mine drainage during operations. For these reasons, option 2, south of the pit, was selected for the PDMP waste rock pile.

5 PROJECT DESCRIPTION

5.1 GENERAL DESCRIPTION OF THE NNP

In 2006, CRI initiated the development of an independent stand-alone mining complex in Nunavik. A certificate of authorization was issued on May 20, 2008, under Article 201 of the Environment Quality Act (EQA) (V/Ref.: 3215-14-007). Since then, several addenda have been issued, including one authorizing the mining of the Allammaq deposit. The NNP comprises five deposits and is located approximately 80 km west of Kangiqsujuaq and approximately 140 km southeast of Salluit (Map 2.1).

Separate waste rock piles are set up near each of the extraction sites or underground mines (Allammaq). At the Expo site, a tailings dump is set up to receive waste rock from the Expo pit along with tailings from the concentrator. These disposal areas are sufficient in capacity to receive waste rock and tailings for the ten years of mining still forecast for this project.

Nickel and copper concentrates are transported by road to Deception Bay, where a warehouse and wharf allow for maritime shipping to foundries.

Effluent from the ore concentration plant, located at the Expo site, along with drainage water from waste rock piles, is treated before being discharged into the environment.

Residual materials, other than the waste rock and tailings generated by operations, are burned to the extent possible. Non-combustible materials are recycled or reused if possible or disposed of in the authorized northern-condition landfill site prepared for this purpose. Hazardous waste materials are returned to southern Québec, with the exception of used oils, which are recovered for heating fuel.

The water supply comes from a 1.3-million-m^3 reservoir created by building a berm-bridge at the outlet of Bombardier Lake. Power is supplied by a diesel-fired generating plant. Fuel is received at the Deception Bay port and stored on site. It is then transported to the sites by tanker trucks and stored in tanks on the different mining sites.

Construction of the mining complex began in 2008 but had to be interrupted following the economic slowdown of 2009. Work started up again in the summer of 2010. Three currently active mines (Mesamax, Expo, Allammaq) are operated at a rate of 4,000 t/d, and have an expected mine life of around 10 years.

The project was designed in accordance with modern industrial mining practices, with final restoration constantly in mind. Restoration will be undertaken gradually throughout the mine's life in order to minimize impacts on the environment.

Once mining operations are complete, the pit walls will be stabilized and the pits filled naturally from the input of surface water drainage. The adjacent waste pile areas will also be restored when mining of the deposits is complete. Waste piles characterized as reactive will be covered to prevent acid drainage, and non-reactive ones will be physically stabilized. Surface water will be collected to ensure control to prevent any water that does not comply with regulations from being discharged into the receiving environment.

Upon completion of mining operations, the buildings will be dismantled, the waste area will be closed to prevent mining acid drainage, the entire site will be cleaned and the ground will be left in a state compatible with its surroundings.

5.2 GENERAL DESCRIPTION OF THE PDMP

This project consists of mining the Puimajuq Deposit using open-pit mining. The extracted ore will be temporarily stock-piled near the pit and then hauled by truck (around 50-t capacity) to the Expo industrial complex, for the ore to be processed in the concentrator at a rate that could reach up to 4,500 t/d. Nickel and copper concentrates produced will be transported by road to Deception Bay, and then shipped by sea to different foundries depending on the sales contracts.

Waste rock will be transported to an area set aside for this purpose (waste rock pile) alongside the pit. Waste rock is non-acid generating and non-leachable (Golder, 2015; section 5.4.2). The waste rock pile will be surrounded by ditches and berms designed to capture mining water runoff and steer it downstream from the mining site toward a collection basin.

Waste rock and ore reserves are estimated at 1.715 million tons and 0.171 million tons respectively.

During mining operations, drainage water from the entire mining site will be captured by a network of ditches and directed toward a collecting pond, where it will be monitored. Water accumulated in the pond will be diverted back toward Mesamax where it will be treated, before being returned to a tributary with no name on the Puvirnituq River.

The project also includes restoration of the mine at the end of the mine's life, in accordance with the requirements of the Mining Act (section 5.13).

The following sections describe the PDMP in more detail, including the infrastructures proposed and mining operations planned.

5.3 LOCATION OF THE PUIMAJUQ DEPOSIT

The Puimajuq Deposit comprises over six claims (Map 5.1) covering approximately 41.1 ha:

- 1027688, 1027689, 1027690, 1027691,
- 1027670, 1027671

The geographic coordinates at the centre of the deposit are:

- longitude: 73° 3' 58,767" west
- latitude: 61° 34' 6,072" north

The UTM projection coordinates (datum NAD 83, zone 18 north) for this same location are:

- X = 602 700 m east
- Y = 6 827 620 m north.

5.4 DESCRIPTION OF THE DEPOSIT

5.4.1 MINERALOGY

All NNP deposits are magmatic sulphide deposits. Although the morphology varies among the major deposits, the geology is consistent (Golder, 2012). The Puimajuq Deposit is comprised of mainly net-textured sulphides, with massive sulphides and very few disseminated sulphides (Golder, 2012). The contents measured in the Puimajuq Deposit are higher than those of other property deposits (P & E, 2009). As with the other NNP deposits, the dominant sulphide minerals of the Puimajuq Deposit contain pyrrhotite (FeS), pentlandite [(Fe, Ni)S] and chalcopyrite ($CuFeS_2$) (P & E, 2010).

Waste rock from the Puimajuq Deposit is composed of basalt, intrusive mafic rock (gabbro) and intrusive ultramafic rock (pyroxenite/peridotite). The mineralogical results obtained following an X-ray powder diffraction performed on three waste rock samples (basalt and intrusive mafic) showed the presence of actinolite, plagioclase, clinochlore, clinozoisite, titanite, biotite, muscovite, quartz and calcite. No sulphide mineral was detected in the samples. The quantitative results of the mineralogical analysis are attached in Appendix C of Golder's Characterization Report (2015) (Appendix 1).

5.4.2 GEOCHEMICAL CHARACTERIZATION

Static tests were first performed to evaluate the chemical composition of the ore and mining rock waste, their acid mine drainage (AMD) generating potential and their metal leaching potential into the environment (Golder, 2012). After obtaining the results, kinetic tests and a mineralogical analysis were performed on three representative samples of waste rock (Golder, 2015). In order to classify the risk associated with the waste rock and ore, the results were compared with the criteria of MDDELCC's Directive 019 relating to the mining industry (D019), with the "A" criteria of the Soil Protection and Contaminates Sites Rehabilitation Policy (Policy) and with the Generic Criteria for Soils and Groundwater (RESIE) in the MDDELCC policy.

5.4.2.1 CHEMICAL COMPOSITION

Chemical composition test results on the waste rock and ore show that the major elements are present in similar concentrations for each of the lithologies. All rock types display a similar composition, with the exception of the intrusive ultramafic rock samples, which present a content greater in MgO and less in TiO_2 (Golder, 2012). Table 5.1 shows the major and minor elements in each type of rock found in the Puimajuq deposit.

Table 5.1 Waste Rock and Ore Composition in the Puimajuq Deposit

TYPE OF ROCK IN THE PUIMAJUQ DEPOSIT		ESTIMATED PROPORTIONS OF WASTE ROCK (%)[1]	MAJOR ELEMENTS	MINOR ELEMENTS
Volcanic mafic waste rock	Basalt	88	Si, Fe, Al	Ca, Mg, Na, Ti
Intrusive mafic waste rock	Gabbro	7	Si, Fe, Al	Ca, Na, K, Ti
Intrusive ultramafic waste rock	Pyroxenite/peridotite	5	Si, Fe, Al, Mg	Ca, Na,
Ore	Pyrrhotite, pentlandite, chalcopyrite	0	Si, Fe	Mg, Al, Ca

1 The proportions of waste rock shown were calculated by Golder on a visual basis using transversal sections provided by CRI.
Source: Golder, 2012

Most of the samples tested contain elements that surpass the province's geological background contents for the Labrador Trough, or the "A" criteria of the Policy (MDDEP, 2001; Table 5.2).

5.4.2.2 ACID GENERATING POTENTIAL

The acid generating potential (AGP) was evaluated using the Modified Acid-Base Accounting (MABA) method. Results showed that all the types of waste rock from the Puimajuq Deposit are classified as non-AGP. The sulphide content is low (mean value of 0.18%, 0.10% and 0.015%, respectively, for basalt, intrusive mafic and ultramafic rock). Moreover, the neutralizing potential (NP) is sufficient to generate alkaline pH values (Golder, 2012).

Ore is classified as AGP since all samples tested had a sulphide content greater than 0.3% (mean value of 11%), while the mean NP is low (8.3 t $CaCO_3$/1000 t).

5.4.2.3 LEACHING POTENTIAL

The metal leaching potential was evaluated in accordance with protocols TCLP-1311 (simulation of acid conditions), SPLP-1312 (simulation of acid rain) and CTEU9 (simulation with water).

The TCLP test results show that basalt is non-leachable and is classified as low risk according to D019 (Golder, 2012). As for intrusive mafic and intrusive ultramafic waste rock, they are leachable for chromium, copper and nickel (Golder, 2012). The metal concentrates in the leachate are nevertheless lower than the limits of Table 1 in Appendix 2 of D019, therefore classifying all the types of waste rock as low risk (Golder, 2012).

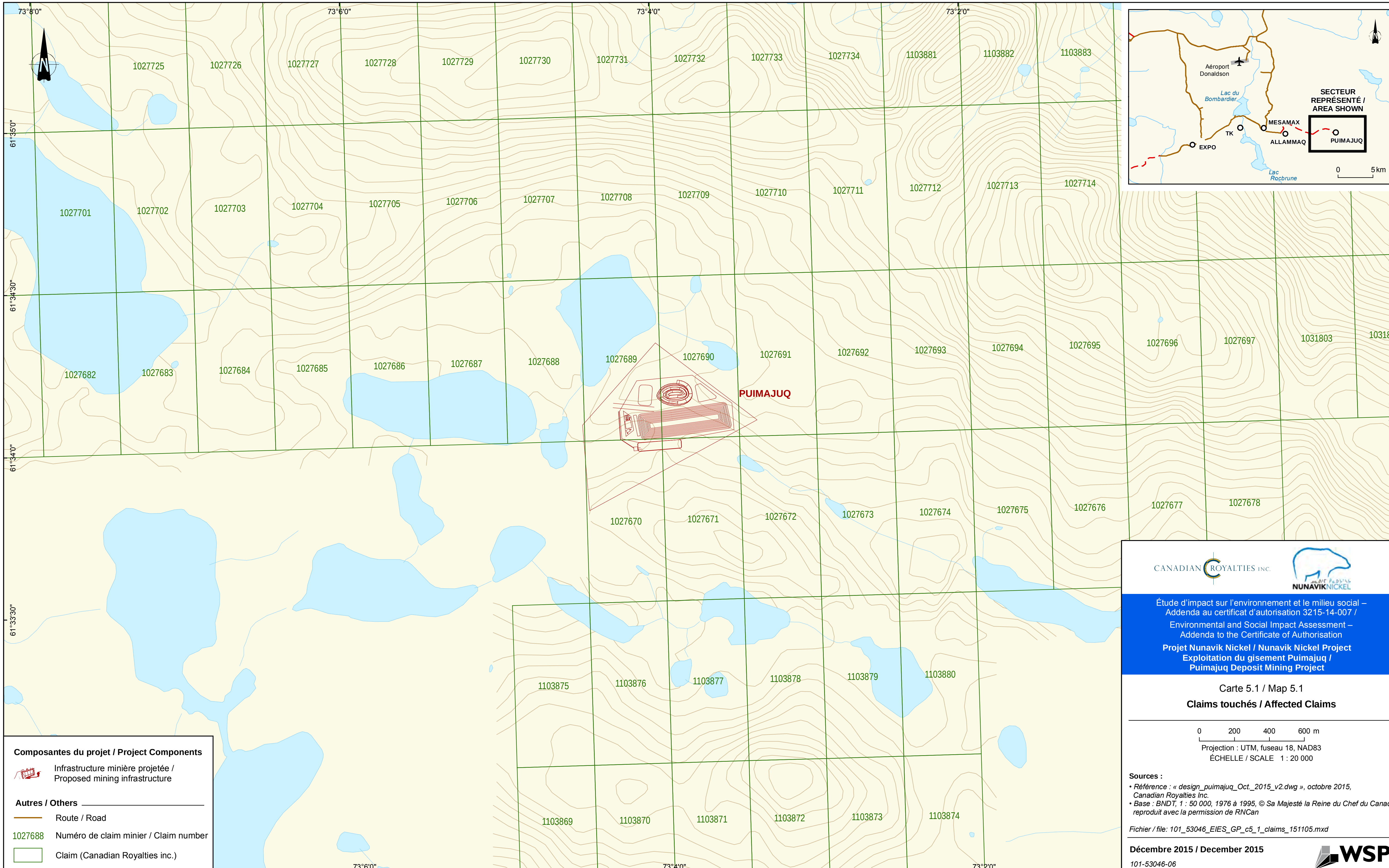

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Table 5.2 Parameters Surpassing the Policy's "A" Criteria in Waste Rock and Ore in the Puimajuq Deposit

TYPE OF ROCK IN THE PUIMAJUQ DEPOSIT	PARAMETERS SURPASSING THE POLICY'S "A" CRITERIA (for one sample or more)
Volcanic mafic rock waste	As, Co, Cu
Intrusive mafic rock waste	As, Cr, Cu, Ni
Intrusive ultramafic rock waste	As, Co, Cr, Cu, Ni
Ore	As, Co, Cr, Cu, Ni, Se

Source: Golder, 2012

For ore, the TCLP test results show that it is leachable for cobalt, chromium, copper and nickel (Golder, 2012). Therefore, according to Directive 019, ore and intrusive mafic and ultramafic waste rock should be managed so as to include leak-proof measures to protect underground waters.

It should be mentioned that the TCLP test is performed in an aggressive acid solution. It is also noteworthy that the SPLP test results performed on the same samples, which simulate acid rain, do not surpass the RESIE criteria.

For the leachates generated by the CTEU9 tests, the results meet the requirements of the RESIE criteria for most parameters, with the exception of the following:

- → Waste rock samples: arsenic;
- → Ore samples: cobalt, iron, manganese, nickel and selenium.

5.4.2.4 KINETIC TEST

Kinetic tests are considered more specific than static tests to predict drainage water quality over the long term. Three kinetic tests were completed in a humidity cell to help characterize the waste rock. Since no waste rock sample was identified as AGP after the static tests were performed, the kinetic test focused only on the metal leaching potential of the basaltic and volcanic mafic lithologies (Golder, 2015).

The volcanic mafic rock sample showed neutral to alkaline pH values (8.8) from the start of the test and stabilized neutral pH values (7.5) as of the third week and up to the end of the test. Generally, the concentration parameters in the leachate remained stable after cycle 5. All metal concentrations were below the RESIE criteria and the D019 criteria, for all cycles. Since the pH values remained neutral throughout the kinetic test, the results support the non-AGP classification for rock making up the intrusive mafic lithology. However, since the metal concentrations remained below the RESIE criteria and the D019 criteria, these results do not support the "leachable" classification attributed from the static test results alone.

For the basaltic rock samples, the pH values obtained varied from neutral to alkaline but stabilized to neutral pH after an initial decline during the first analysis:

- → the pH value reported for the basaltic sample NF-07-03-02 was 8.9 at the start of the test and stabilized to around 7.5 as of the second week and remained stable up to the end of the test;
- → the pH value for the basaltic sample NF-18-08-03 was 7.9 in week zero and oscillated between 7 and 7.6 between week four and the end of the test.

Generally, the parameters were stable after cycle 8. Metal concentrations in the leachate remained below the RESIE criteria and the D019 criteria. The kinetic test results for the basaltic samples therefore support the static test results, and the rock was therefore classified as non-AGP and non-leachable.

In these conditions, as mafic intrusive and ultramafic rocks present a leaching potential, it is recommended to manage the latter to meet level A for protection of groundwater as recommended by D019; for the remaining only physical stabilisation is required.

5.4.2.5 CLASSIFICATION OF WASTE ROCK AND ORE

Table 5.3 summarizes the geochemical results obtained for each of the lithologies of the Puimajuq Deposit and indicate the protection measures required, if any.

5.5 RESERVES

According to the numerical model used for the mine plan, the estimated total tonnages of waste rock and ore reserves for this deposit are 1,715,407 t and 171,221 t respectively. The waste rock/ore ratio is around 10:1. Table 5.4 shows the tonnage for each of the pit's tiers.

5.6 ORE EXTRACTION

5.6.1 PIT CHARACTERISTICS

According to the most recent geological data and reserve evaluation, the planned dimension of the Puimajuq pit is approximately 215 m long by 105 m wide and 50 m deep. The starting elevation is 580 m and the ultimate depth should reach an elevation of 530 m. Very little washing away will be needed to expose the ore to be mined.

The pit will be developed on six separate tiers. It will be excavated by 10-m benches and the mineralized zones will be mined by 5-m trenches. The overall angle of the pit walls will be 45 degrees, while the bench angles will be 90 degrees.

Table 5.3 Summary of Geochemical Results

Type of Rock in the Puimajuq Deposit		Estimated Proportion of Waste Rock[1] (%)	Static Tests				Kinetic Tests	
			AGP Tests	TCLP Tests	SPLP-1312 Tests	CTEU9 Tests	Ph in Leachate	Metals Present in Leachate
Volcanic mafic waste rock	Basaltic	88	Non-AGP	Non-leachable	Non-leachable	Non-leachable	Neutral	None
Intrusive mafic waste rock	Gabbro	7	Non-AGP	Leachable (Cr, Cu, Ni)	Non-leachable	Leachable (As)	Neutral	None
Intrusive ultramafic waste rock	Pyroxenite/ Peridotite	5	Non-AGP	Leachable (Cr, Cu, Ni)	Non-leachable	Leachable (As)	Non-tested	Non-tested
Ore	Pyrrhotite pentlandite chalcopyrite	0	AGP	Leachable (Co, Cr, Cu, Ni)	Non-leachable	Leachable (Co, Fe, Mn, Ni, Se)	Non-tested	Non-tested

1 The proportions of waste rock shown were calculated by Golder on a visual basis using transversal sections provided by CRI.
Source: Golder, 2012; 2015

Table 5.4 Reserves from the Puimajuq Deposit (including a dilution and operational loss factor)

LEVEL (M)	S+M (t)	PRE-CUT LENGTH OF WALL (m)	WASTE ROCK (t)	ORE						
				t	NI (%)	CU (%)	CO (%)	PT (g/t)	PD (g/t)	AU (g/t)
585	335,345	527	335,345							
580	294,517		294,517							
575	239,985	465	235,655	4,330	0.75	0.78	0.03	0.31	1.20	0.03
570	226,464		209,276	17,188	1.04	1.52	0.04	0.47	1.93	0.07
565	189,938	420	164,996	24,942	1.53	2.82	0.06	0.86	3.03	0.09
560	181,782		154,678	27,104	1.74	3.53	0.07	1.09	2.95	0.11
555	117,555	333	90,739	26,816	1.84	2.99	0.07	0.98	2.66	0.09
550	107,241		83,042	24,199	1.59	2.24	0.06	0.78	2.50	0.06
545	77,213	270	58,220	18,993	1.34	1.81	0.05	0.56	2.26	0.05
540	67,451		54,729	12,722	1.12	1.62	0.05	0.45	1.77	0.05
535	28,936	182	20,651	8,285	1.08	1.36	0.04	0.38	1.39	0.05
530	20,201		13,559	6,642	1.00	1.29	0.04	0.29	1.34	0.05
Total	**1,886,628**		**1,715,407**	**171,221**						

The main ramp for truck circulation will have a width varying from 12 to 20 m, or minimally 2.5 times the width of the vehicle if it is a two-way road (Regulation respecting occupational health and safety in mines, chapter S-2.1, r. 14). In this project, the plan is to use CAT 770 type trucks that are 4.75 m wide. The ramp will have a maximum slope of 10%. The safety benches will vary in width from 5 to 9 m.

It is estimated that the pit will have an approximate life of 13 months.

Figure 5.1 illustrates the type of cut in the pit wall, while Figure 5.2 illustrates the final development of the Puimajuq pit in 3D.

5.6.2 PREPARATION AND TRANSPORTATION OF EXPLOSIVES

Emulsion will be the main explosive used in the ore extraction process. This choice is based on the ore's properties, the type of mining operations and the manufacturing and transport costs. The needs in explosives are estimated at 485 t for the life of the Puimajuq deposit.

The supply will come from the emulsion blending plant to be located northeast of the Expo mining complex. Procedures are underway at the provincial and federal levels to obtain the permits and certificate of authorization necessary to manufacture emulsion and possess the emulsions.

Emulsions prepared at the plant will be transported directly to the mine to fill the blast holes. To transport explosives onto the sites, one specialized truck that produce emulsion will be used along with two other trucks reserved for transporting packaged emulsions. The garage will be used to park the trucks and will be heated with the energy produced by the generator, which will also power the site in electricity.

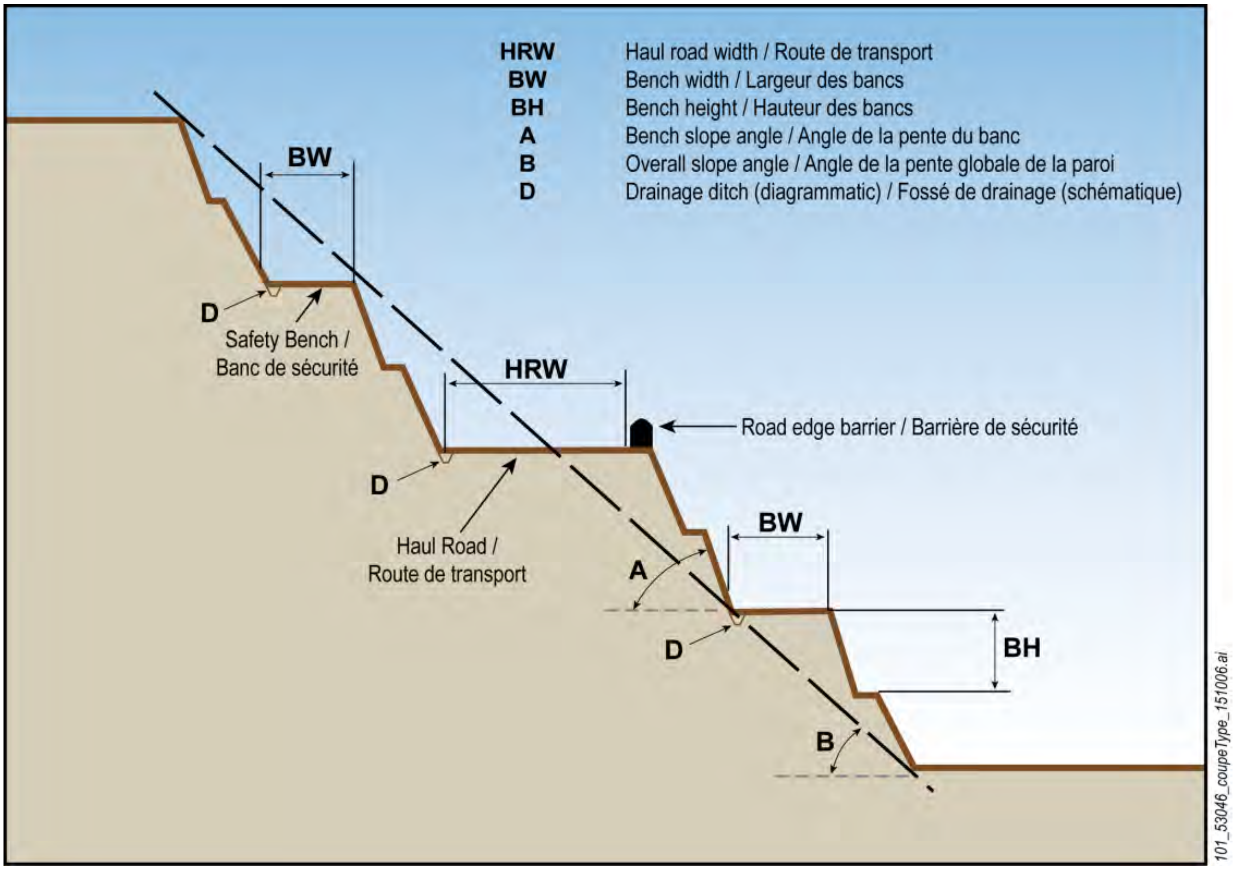


Figure 5.1 Typical Cut in Pit Wall

5.6.3 MINING EQUIPMENT

The pit will be mined using traditional methods for mining open-pit mines. To load the explosives, drilling will be undertaken using a long-hole drill.

A backhoe loader will be used to load the trucks (50-t capacity) to transport the ore. Production and service equipment will also include bulldozers, a leveller and a 20,000-l tanker truck to spray surfaces to keep dust from rising, where required (Table 5.5).

The roads used are those that connect each deposit to the Expo mining complex (Map 5.2). Table 5.6 shows the maximum weekly trucking frequencies expected.

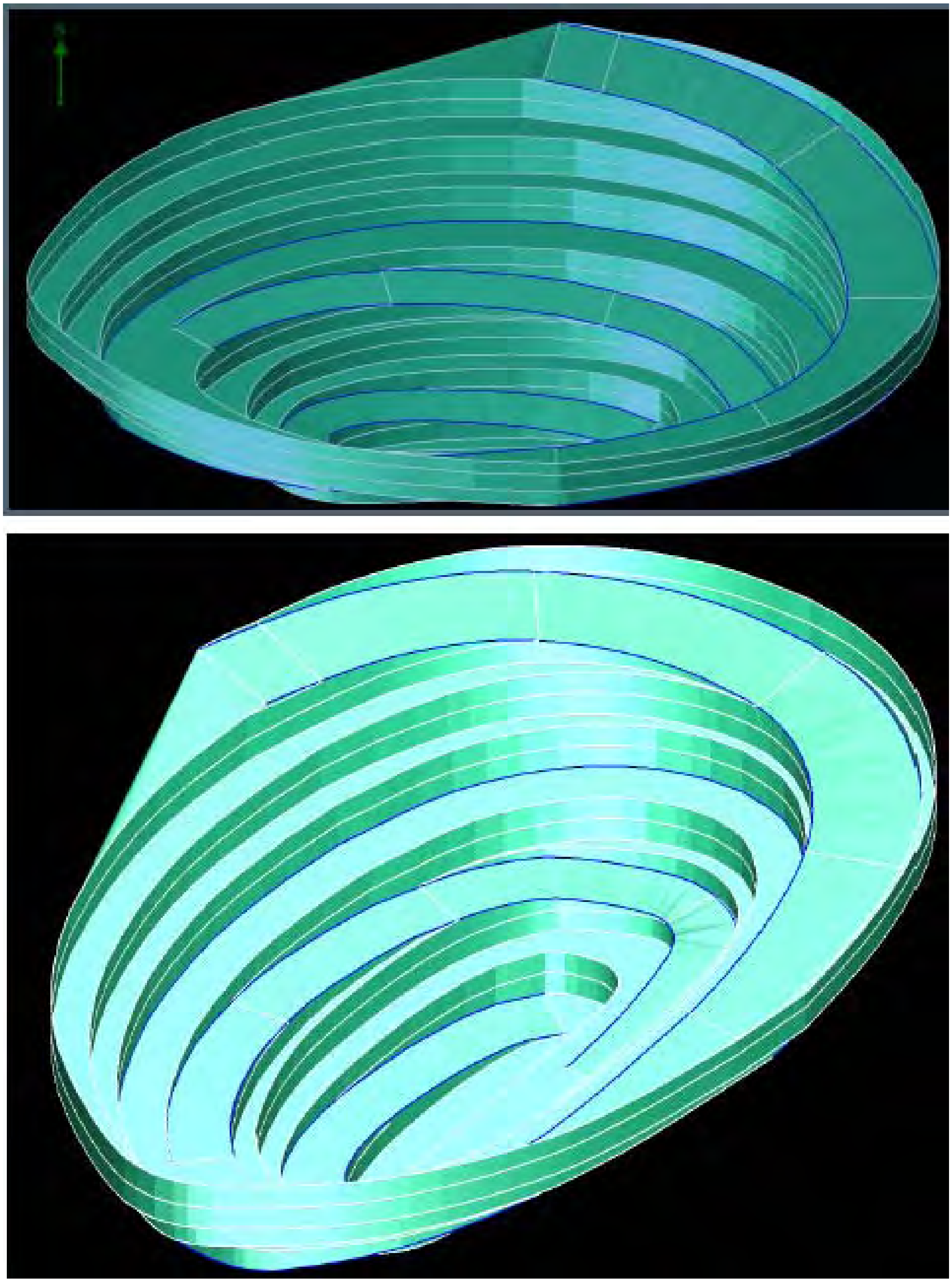


Figure 5.2 Proposed Lay-out of the Puimajuq Pit

Table 5.5 Mobile Equipment Required

EQUIPMENT	QUANTITY
Drill	1-2
Haul truck (50-t capacity)	3
Fuel truck	2
Hydraulic shovel	1-2
Backhoe loader	1
Motor vehicle	1
Bulldozer	1
Leveller	1
Tanker truck	1
Staff vehicle	3

Table 5.6 Maximum Weekly Trucking Frequency.

DEPOSIT	ORE (RESERVE) (M.T.)	NO. MONTHS IN OPERATION	FULL PRODUCTION 13,500 t/MONTH	TRUCK CAPACITY	NUMBER OF TRIPS PER WEEK
Puimajuq	171,221	13	3,375 t/week	50 t	68

5.7 WASTE ROCK AND TAILINGS MANAGEMENT

5.7.1 WASTE ROCK MANAGEMENT

As stipulated in the initial concept, all waste rock generated in the PDMP context will be managed in the waste rock pile set up at the Expo mining complex. As a result, no waste rock will accumulate on the Puimajuq site.

5.7.2 WASTE ROCK PILES

For economic and environmental reasons, waste rock should be disposed of as near as possible to the extraction site. The storage site selected for the mining waste rock is located to the southwest of the pit (Map 5.2). This configuration facilitates waste rock transport and the management of runoff waters during mining operations.

The maximum amount of waste rock produced during the life of the Puimajuq Deposit should reach 1,483,739 t. The average density of the *in situ* waste rock is evaluated at 2.9 t/m³. Considering the swell factor when piled, the density would be closer to 2.0 t/m³. As a result, the maximum volume of the waste rock pile could reach 900,000 m³.

Sorting of waste rock will be performed according to their mineral type and potential for leaching. The reactive waste pile will be lined with and impervious membrane. Volume of potentially leachable waste rock is estimated to 108 000 m³.

In addition, CRI intends to send around 450 000 m³ of non-leachable waste back to the pit and collecting pond at the end of the mine's life. The remaining volume of waste rock will be left in place.

5.7.3 TEMPORARY ORE STORAGE AND TRANSSHIPMENT AREA

Ore will be extracted from the pit using a Cat 770 type truck of 40 t. The ore will be temporarily stockpiled in the ore storage area (Map 5.2) until it is transported by off-road truck to the ore accumulation area at the Expo mining complex.

An ore transshipment area will be built in to facilitate loading. It is not however designed for the storage of large volumes of ore since the supply to the Expo industrial complex must be ensured to maintain a constant production of 4,500 t/d. As a result, if weather conditions do not permit safe transport to the Expo industrial complex, ore will be temporarily stored in the ore storage area (Map 5.2). This area will occupy some 8 500 m^2 and be surrounded by a drainage ditch. Considering an extraction rate of from 3,000 to 4,000 t/d, it is estimated that an area of around 14,000 m³ will be required to temporarily store 28,000 t of ore. This volume corresponds to approximately one week of mining extraction.

5.7.4 OVERBURDEN ACCUMULATION AREA

Should overburden be recovered, it will be secured near the different excavation sites for eventual use at mine closure and for restoration work. It is not currently possible to evaluate the volume. Surveys will be conducted prior to preparing the construction plans and the volume will be estimated at that time.

5.8 WATER MANAGEMENT

5.8.1 INDUSTRIAL WATER

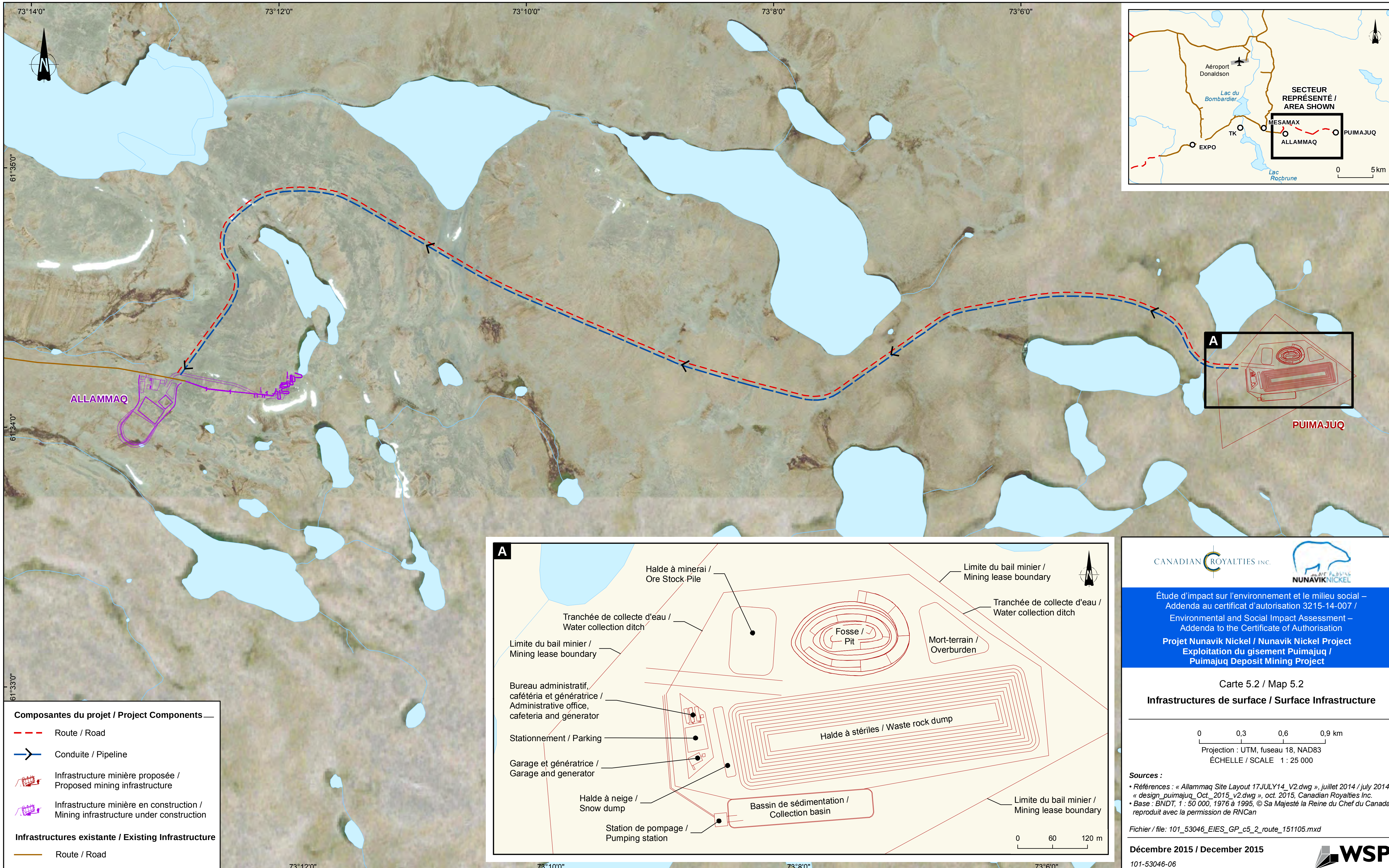
5.8.1.1 SURFACE RUNOFF

Surface drainage water consists mainly of water from precipitation and from snow melt running off the mining site, particularly onto the waste rock pile, the ore storage area and the overburden accumulation area.

To restrain the volume of runoff water and limit the watershed area affected, two berms will be built into each side of the mining site (Map 5.2). This way, any water and clean snow outside the berms will be free from potential contamination and could be directed to the natural receiving hydric network without prior treatment.

5.8.1.2 RUNOFF WATER

Before their discharge in the receiving stream, drainage waters of the mining site will be managed towards a retention pond using ditches and mound (Map 5.2). A system of pumps installed at the low point of the retention pond will allow the continuous pumping of free water during the period of spring thaw and the summer season. The pumped water will be directly forwarded to the Allamaq collecting pond and then towards the mobile treatment unit located at Mesamax.



Étude d'impact sur l'environnement et le milieu social – Addenda au certificat d'autorisation 3215-14-007 /
Environmental and Social Impact Assessment – Addenda to the Certificate of Authorisation

Projet Nunavik Nickel / Nunavik Nickel Project
Exploitation du gisement Puimajuq / Puimajuq Deposit Mining Project

Carte 5.2 / Map 5.2

Infrastructures de surface / Surface Infrastructure

Projection : UTM, fuseau 18, NAD83
ÉCHELLE / SCALE 1 : 25 000

Sources :
- *Références : « Allammaq Site Layout 17JULY14_V2.dwg », juillet 2014 / july 2014 & « design_puimajuq_Oct._2015_v2.dwg », oct. 2015, Canadian Royalties Inc.*
- *Base : BNDT, 1 : 50 000, 1976 à 1995, © Sa Majesté la Reine du Chef du Canada, reproduit avec la permission de RNCan*

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5.8.1.3 MINING PROCESS WATER

Mining process water accumulating inside the pit will be pumped out and forwarded to the collecting pond via the catchment structures.

5.8.1.4 RETENTION POND

The capacity of retention pond and the catchment structures will be of about 60 000 m^3. They are designed to allow containment of potentially contaminated runoff from the mine site, including the waters falling directly in the pond. The pond will be located more than 60 linear meters of any lake or stream.

The objective of retention pond and the catchment works is:

- → Capturing all the runoff waters from the mine site;
- → Contain all water accumulating in the pit, which will be pumped for mining activities;
- → Have the ability to withhold water resulting from a 24 hours recurrence rain 1: 100 years and the average waters from melting snow over a period of 30 days for a recurrence also of 100 years and without any risk of spill;
- → Contain melt water from the snow accumulated during the winter;
- → Ensure that a probable maximum flood (PMF) cannot cause crest overflow and, by extension, jeopardizing the integrity of the infrastructure.

As mentioned above, during the operation of the Puimajuq mine, mine water and drainage water from the entire mine site will be captured and directed to the retention pond where they will undergo monitoring and treatment, if required, before being discharged safely into the environment.

5.8.1.5 TREATMENT OF MINING WASTEWATER

Water accumulated in the retention pond will be treated using the authorized mobile treatment plant installed at the Mesamax mine. Water will then be returned to the Mesamax site storage pond through PeHD piping.

The Mesamax mine's mobile treatment plant has a maximum treatment capacity of 187 m^3/h, or 4,488 m^3/d. The Mesamax retention pond can accumulate up to 150,460 m^3, while the Puimajuq pond has a capacity of 60,000 m^3, which represents 210,460 m^3 to be treated over a period of around 4 months. If the treatment chain operates 24 h/24 h at its maximum flow, it would take 68 days to empty the pond of all water from Mesamax, Allammaq and Puimajuq. Therefore, the mobile treatment chain currently installed at the Mesamax site has the capacity to treat all the water from the Puimajuq site.

Treated water meeting discharge standards will be returned to the natural hydric network. As stipulated in the CA[1], the mobile water treatment plant will be operated in the summer season from June to September, or for a period of around four months a year. When the mobile plant is in operation, it will run 24 h/24 h for a variable duration depending on the volume of water accumulated in the collection basin.

5.8.2 DOMESTIC WATER

5.8.2.1 DRINKING WATER

Drinking water necessary for the employees working at the Puimajuq mine will come from the Expo drinking water treatment system and be brought by tanker truck. It will be stored in a reservoir of 10,000 l to be located near the service building (Map 5.2).

5.8.2.2 WASTEWATER

Domestic wastewater will be temporarily stored in a reservoir of 10,000 l and sent by siphon truck to the Expo industrial complex where it will be treated.

The wastewater treatment system at the Expo site comprises a biological treatment unit using a biodisk system, complete with ultraviolet disinfection.

The biodisk treatment system will meet demand since modifications in the mining sequence do not entail hiring additional employees and thereby increasing the volume of wastewater. Note that this treatment system is currently subject to a preventive maintenance program that will also measure its efficiency.

5.9 SURFACE INFRASTRUCTURES

The temporary service infrastructures required to operate the Puimajuq Deposit include:

- → One mobile trailer for offices (service building);
- → One mobile trailer for the rest area/diner with sanitary services for mine workers;
- → One mechanical workshop;
- → Generators;
- → Mobile tanks for diesel fuel;
- → Reservoirs for drinking water and wastewater (Map 5.2).

1 CA no 7610-10-01-700-80-64/400916012: Operations of a mine wastewater treatment plant issued on September 26, 2012 by the Direction régionale de l'analyse et de l'expertise de l'Abitibi-Témiscamingue et du Nord-du-Québec.

5.9.1 SOIL AND FOUNDATION

Since the NNP is on land characterized by a layer of organic matter that varies in thickness on its surface, there is no plan to remove the material, unless a significant layer of peat creates instability or excessive deformation at the excavation sites.

Minimum preparation will be undertaken before the construction of infrastructures. Large blocks will be removed and the surface levelled. Should inorganic overburden or vegetation be recovered, it will be stored on the site in a secure place near the different extraction sites for eventual use at mine closure and for restoration work. It is not currently possible to evaluate the volume.

Temporary buildings will be built on foundations created by putting down stakes in a rock embankment to ensure the stability of buildings and limit environmental impacts. Due to the presence of strong winds in this sector, the buildings will be solidly anchored to stone blocks to prevent them from being blown away.

The embankment for the infrastructures will be built from non-acid generating waste rock from the Bombardier quarry. Their foundation, around 1.0 m thick, will be built using rough-type material (Table 5.7). A layer of type MG-56 granular finishing material, around 0.3 m, will then be placed on the surface. The area required for the surface infrastructures is around 100 m².

Table 5.7 Estimate of the Volume of Materials Required

MATERIAL	VOLUME REQUIRED (m^3)
Rough material	10,000
MG-56	3,000
Total	**13,000**

5.9.2 SERVICE BUILDING AND REST AREA

An administrative building (prefabricated module) will be installed near the warehouse and the main road (Map 5.2). This building will house a management office with commodities, such as a toilet, phone line, first-aid room, locker room and common room with refrigerator and micro-wave oven. No workers will be lodged in this building on a permanent basis. All workers will be housed at the Expo mining complex. They will transit daily to the Puimajuq mine.

Another building (prefabricated module), housing a locker room, common room with refrigerator and micro-wave oven, sanitary services for mine workers and phone line, will be installed near the service building (Map 5.2).

5.9.3 MECHANICAL WORKSHOP AND WAREHOUSE

A mechanical workshop (garage) will be set up along the main access road (Map 5.2). The shelter used to protect heavy equipment against adverse weather, currently installed at Mesamax, will be transported to the Puimajuq Deposit to be reused as a garage. It is an infrastructure made from containers.

Along with machinery repair and maintenance, this workshop will also act as a collection depot for used oils, which will be stored in containers for this purpose, clearly identified and safely stored. The full containers will be sent to the Expo site to be disposed of in accordance with the regulation in effect.

5.9.4 DIESEL TANKS

A fuel storage area will be set up near the service buildings and power supply area (Map 5.2). The stored fuel will be used for servicing vehicles and heavy machinery, for heating and for the emergency generators. The fuel used, arctic diesel, will be delivered by tanker truck. It will be stored in six tanks, one of 50,000 l for servicing the machinery, two of 10,000 l for heating, two of 50,000 l for electricity supply for the buildings and one of 20,000 l for the emergency generators.

Mobile tanks with built-in dikes will be installed in accordance with the requirements of the Building Act and all applicable regulations, codes and standards. CRI will make certain it obtains all the permits required for oil equipment installation.

5.9.5 EMERGENCY GENERATOR

An emergency generator of 0.5 MW will be installed in a marine container, equipped with a gas exhaust evacuation system. The container will have a leak-proof double floor, resistant to the materials it contains. Generators will only be used during major power failures. It will be installed in the power supply area planned to the south of the service buildings.

5.10 ACCESS ROAD

A stretch of road, approximately 8 km long, will be built to connect the Puimajuq Deposit to the NNP’s existing road network, up to the Allammaq mine (Map 5.2). This stretch of road will be built with non-acid generating waste rock extracted from the Bombardier quarry or Quessy quarry (Map 6.1). The permit application is currently under study.

The road’s running surface, 9 m wide, will be composed of a sub-foundation layer made of type MG-56 granular material, around 300 mm thick, and a foundation comprised of type MG-20 granular material, around 250 mm thick. The road foundation will be made from rough-type material, at least 1.5 m thick. The infrastructure’s thickness will vary depending on the topography of the land.

Figure 5.3 illustrates a typical cut of a section of the road. The banks will be built with a slope of 1.5:1 and drainage ditches will be excavated on at least one side of the road. The road allowance will be around 15 m and the profile of the slopes will not exceed 10%.

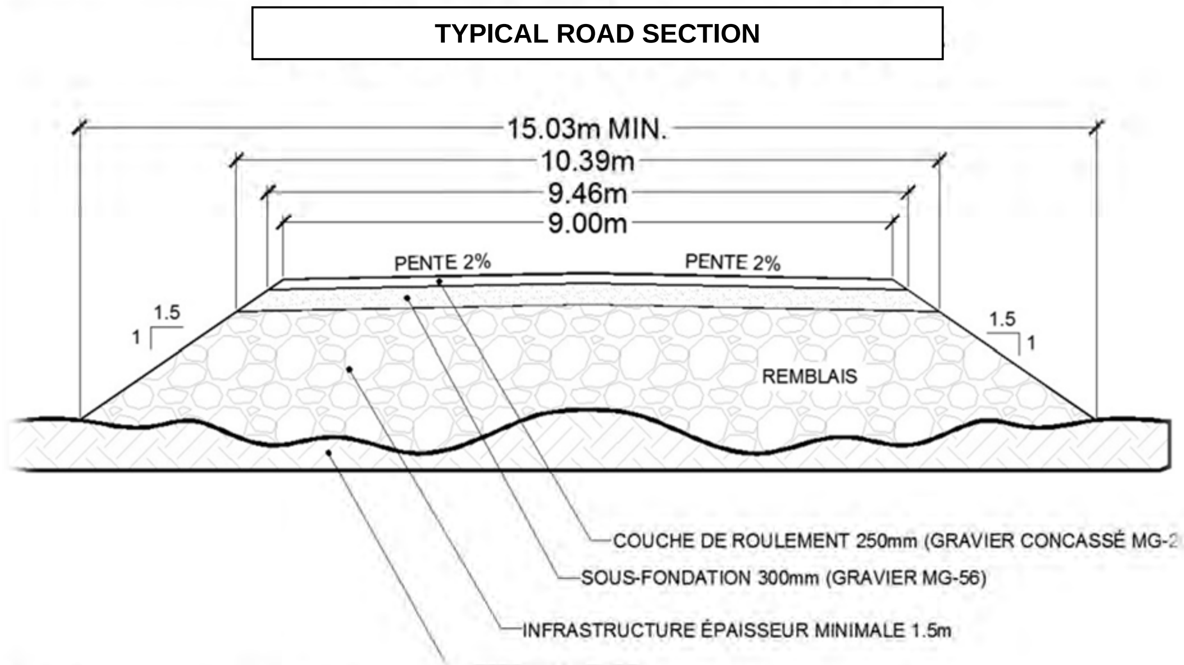


Figure 5.3 Typical Cut of Stretch of Road

The stretch of road will be widened every 150 m to allow trucks from the opposite direction to meet. This stretch of road will be maintained with the surface equipment in place. Where required, maintenance will include additional spreading of granular material.

Only one permanent waterway will be crossed by the road to be built (Map 4.1). At the crossing points, multiple and stacked culverts, each at least 1.2 m in diameter and spaced apart by 1 m, will be built to allow water to flow freely on each side of the road. They will be designed to resist pressure exerted by the embankments and by trucks circulating on the road. They will also allow water to be concentrated into the low-flow culvert to allow fish to circulate freely. Drainage water coming from upstream of the road will be collected in the ditch and directed to the waterway.

5.10.1 ESTIMATE OF THE QUANTITY OF MATERIAL REQUIRED

The quantity of rock required for the construction of a stretch of road 8 km long with a running surface of 9 m wide will vary depending on the topography (Table 5.8).

Table 5.8 Estimate of the Volume of Material Required

MATERIAL	VOLUME REQUIRED (m³)
Rough material	108,000
MG-20	10,800
MG-56	21,600
Total	**140,400**

5.11 MANAGEMENT OF RESIDUAL MATERIALS

Although much effort goes into limiting the production of residual materials, the quantities produced in the PDMP context, in addition to those of the NNP, will nevertheless be too voluminous to be sent back to southern Québec. Residual materials resulting from construction and mining operations at the Puimajuq mine will therefore be transported to the Expo camp. Due to the many sources of production of residual materials, the management operations and infrastructures for residual materials were centralized around 200 m to the southwest of the Expo complex.

Measures to encourage collection and source separation of residual materials, along with recycling, have been incorporated into the CRI management plan, under the 3R-RD principle. Reusable products, such as wood and metal, will therefore be recuperated. Non-recyclable and combustible materials will be burnt in a high-temperature combustion unit, while non-recyclable and non-combustible materials will be disposed of in the landfill site that already exists.

The main sources of residual materials are domestic wastes, oils, and packaging from explosives and scrap from the mechanical workshop. As estimated in the NNP context, each worker will annually produce 2 t of residual materials, which translates into an additional production of around 30 t for the life of the project. All residual materials will be managed according to the procedures provided for in the NNP (Table 5.9).

Table 5.9 Description of Residual Materials Produced and Their Means of Disposal.

RESIDUAL MATERIAL	DISPOSAL
Domestic waste	Northern-condition landfill site (Expo).
Lubricating oil	Hazardous waste storage area, disposal in an approved site in the south.
Hydraulic oil	Hazardous waste storage area, disposal in an approved site in the south.
Transmission oil	Hazardous waste storage area, disposal in an approved site in the south.
Explosives (residues and packaging)	Burner in the explosive depot sector, landfill site (ash).
Batteries	Hazardous waste storage area, disposal in an approved site in the south.
Solvents	Hazardous waste storage area, disposal in an approved site in the south.
Tires not being used	Storage in containers based on tire size and possible use. Firstly, tires will be reused until no longer possible. Then, a certain number of tires will be reused on site. At the end of their useful life, they will be sent south and recovered through the Recyc-Québec program for recycling or transformation.
Metallic scrap	Stock-piled and sent south when possible.

5.12 LABOUR

Some fifteen employees will be assigned to the Puimajuq Deposit during the work period, including:

- One or two drillers;
- Three truck operators;
- One or two backhoe loader operators;
- Fuel truck operator;
- Two or three service operators;
- One surveyor;
- One foreman;
- Two blasters;
- Two site supervisors;
- One labourer.

Other employees involved would include CRI employees assigned to supervision and engineering work, persons in charge of building maintenance and heath care workers, who would share their time among the different sites.

According to the Nunavik Nickel Agreement, several of these jobs could be occupied by Inuit JBNQA beneficiaries. It is noteworthy that the Nunavik Nickel Agreement, signed on May 9, 2008, by CRI, the Makivik Corporation and the three Inuit communities most affected by the project, promote the hiring of Inuit residents from Salluit, Kangiqsujuaq and Puvirnituq.

5.13 MINE RESTORATION

Pursuant to the Mining Act, the PDMP is required to restore the areas affected by its mining activities. A rehabilitation plan will be produced for this site in accordance with the guidelines and general requirements of Québec's Mining Rehabilitation Guide produced by MERN, which contains the applicable measures. The plan will be submitted to MERN prior to the start of mining operations and will be accompanied by a financial guarantee in accordance with Section 232.2 of the Mining Act.

It will specifically include a detailed description of the restoration and rehabilitation work planned during the mining phase and once mining operations are complete. For the infrastructures connected to the mining operations, the following actions are planned:

- Securing the pit and surrounding area;
- Dismantling and disposing of buildings and infrastructures;
- Restoring waste rock pile areas and temporary ore storage areas;
- Managing surface water and contaminated water, if any;
- Scarifying secondary access roads to obstruct access to the remnants of the mining infrastructure;
- Following up the integrity of the excavation site and performing full environmental monitoring.

In accordance with the regulation in effect, CRI will follow up the mining restoration to ensure that the discharge objectives are met for the protection of the receiving environment.

The restoration activities specific to the Puimajuq project to be carried out upon closure of the pit and waste rock pile are briefly described in the following sections.

5.13.1 PIT

The mining site will be comprised of an open-air pit. At the end of the mine's activities, pumping at the bottom of the pit will cease, allowing the pit to gradually fill with water that will stabilize to a naturel level filling in the spaces between the waste rock having been backfilled into the pit. At the end of the mine's life, it is presumed that the water level will stabilize to natural ground elevation, or to an elevation of around 580 m, which will be the threshold of the pit opening.

Boulders will be placed along the banks of the pit filled with waste rock to limit access and a safety warning will be put in place.

5.13.2 WASTE ROCK PILE

The waste rock pile at Puimajuq will be restored upon completion of mining operations, thereby respecting the principle of gradual restoration as applied in the NNP context. It is estimated that around 558 000 m^3 of waste rock can be backfilled into the pit, this is about 60% of all waste rock excavated and it includes the potentially leachable ones.

The residual volume of waste rock will remain on the Puimajuq site. The site will be levelled according to the requirements to control erosion and render it to its natural state to the extent possible.

5.13.3 ORE STORAGE AREA

The ore storage area will be restored at the end of mining operations. No ore will remain on the Puimajuq site upon completion of operations, all ore having been transported to the Expo mining complex. The temporary storage area will be levelled according to the requirements to control erosion and render it to its natural state to the extent possible.

5.13.4 COLLECTING POND

Where the analytical results show that the criteria of D019 and EDOs are met, the collecting pond will be dismantled. Considering that this pond was built by excavation, a portion of the waste rock can be returned to it. The dikes will be dismantled and the ground levelled. As with the pit, stone blocks will be placed all around the pond filled with waste rock, to limit access and a warning sign will be put in place.

5.13.5 SURFACE INFRASTRUCTURES AND HEAVY MACHINERY

All buildings and all surface infrastructures not useful for post-closure follow-up will be removed from the Puimajuq site, and recovered to be reused in the NNP context. Once it is shown that the follow-up complies with the applicable requirements, the remaining buildings and infrastructures will also be recovered. Surfaces will be levelled according to the requirements to control erosion and render them to their natural state to the extent possible.

5.13.6 POTENTIALLY CONTAMINATED SOILS AND MINERALS

Although measures are planned by CRI to reduce risks, the occurrence of incidents associated with the handling of oil and chemical products is probable, especially near oil depots and the mechanical workshop.

Soil characterization will be necessary in places that could be contaminated. In the presence of soil contaminated by hydrocarbons, corrective actions will be taken based on available decontamination techniques and in accordance with the requirements of regulations in effect.

No contaminated soil or contaminated material will remain on site upon completion of mining operations or after decontamination, if need be.

5.14 WORK CALENDAR

The first stage of the construction project will consist of connecting the future Puimajuq mine site to the NNP road network by a new stretch of road. The work will be followed by landscaping work for the construction of surface infrastructures, preparation of the collecting pond and mining of the pit.

Construction work will be spread over one year and be completed by September 2016. Based on this calendar, mining should begin by September 2016.

The project’s activities will be carried out according to the following schedule:

- Road construction: May to September 2016;
- Construction of service areas: September 2016;
- Construction of the pond: September 2016;
- Mining of the pit: September 2016 to the end of 2017;
- Restoration: 2018.

The PDMP modifies the mining sequence planned in the context of the PNNI (Appendix 2). Puimajuq is actually the fourth deposit to be exploited, although it is in conjunction with Expo and Alammaq. According to mining sequence, from December 2014, the PNNI may be completed by 2022, if no other deposit is discovered.

5.15 PROJECT COST

The cost of the construction project is estimated at 3.5 million Canadian dollars. This amount includes the development of site-related areas, the two trailers, the moving of the garage, the generator, the pumping station including the discharge line, the environmental studies and the permits along with restoration costs). An additional amount of $2.2 million shall be added for road construction.

The operating costs are estimated at $34 million.

6 DESCRIPTION OF THE RECEIVING ENVIRONMENT

Since the PDMP is an addendum to the NNP's ESIA, the description of the receiving environment is a synthesis of information taken from this same report (GENIVAR, 2007), from addendum no. 4 regarding the Allammaq deposit mining project (GENIVAR, 2009) and of all relevant documents available. In order to complete the PDMP's reference condition, inventories of flora, avian fauna and the archeological potential were made in the summer of 2015.

6.1 STUDY AREA

The study area chosen for the PDMP covers a surface of approximately 600 m^2 and lies close to latitude 61.56 (Map 6.1). Its outline is irregular because it follows the eastern section of the Puvirnituq River watershed and the northern boundary of the parc national des Pingualuit. On one hand, this delimitation results from the fact that the primary impacts of a mining project on the natural environment mainly concern components of the aquatic environment, such as water quality and sediment, as well as the benthic communities and fish. On the other hand, the PDMP's impacts will be felt in a more limited fashion, by the fact that it is an extension of the NNP, whose impacts were detailed in GENIVAR (2007).

The study area includes the Puimajuq Deposit and all of the localized and linear infrastructures required for its operation. The study area was truncated to the west and north of the Expo complex in order to include the confluence of the Puvirnituq River and the Expo's final effluent, as well as Bombardier Lake, which serves as a water supply for the mining complex.

6.2 PHYSICAL ENVIRONMENT

The climate of the study area is Arctic. The average annual temperature is around -9.5°C and precipitation is approximately 520 mm/a, 50% of which falls in the form of snow (KRG, 2011). According to Ouranos (2004), a probable increase in summer temperatures of 2 to 3°C and winter temperatures of 4 to 5°C for the 2080-2100 period compared to 1960-1990 is expected due to global climate change. The vegetation growing season is short, from the end of June to the beginning of September.

According to measurements taken in 2006 near Expo and Mesamax, ambient air quality is good most of the time (97%; GENIVAR, 2007). This finding reflects the isolation of the study area and the very low number of air pollution emission points. There is however a natural airborne dust problem in the study area, due to strong winds, dry weather, ground sometimes bare of vegetation and the absence of trees and shrubs.

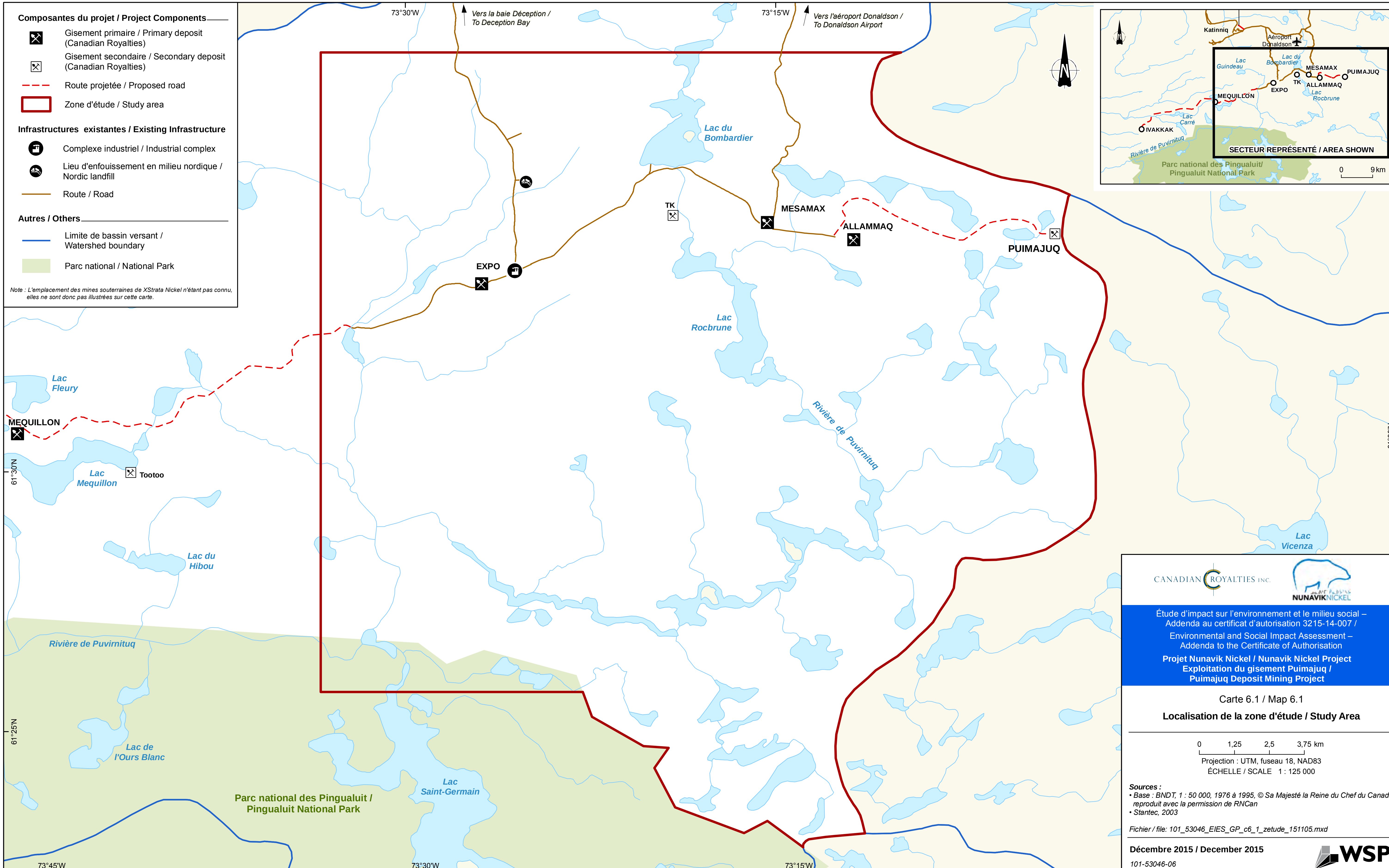
The study area is located in the physiographical sub-unit of the Puvirnituq hills. These hills form a pleated terrain dominated by the presence of rocky ridges facing east-west that are relatively long (0.5 to 7 km) and wide (0.3 to 1 km). Their height ranges from 20 to 60 m and their southern slopes are often marked by a steep change in slope. The altitude of the study area is fairly high—between 400 and 700 m—and the Puimajuq Deposit is located at approximately 600 m elevation (Map 6.2). The slopes are generally low, i.e. less than 5% of 91% of the study area. Due to strong winds, significant snowfall accumulates where there are slope changes and natural or man-made obstacles.

Till is the main surface deposit associated with the last glaciation. The materials are a mix of rocky debris of varying size from fine particles (clay) to coarse ones (metric blocks). In the study area, including the Puimajug deposit site, the till layer is generally continuous and an average thickness greater than 1 m. An area of uneven moraine—a grouping of small flared mounds—is also found near the deposit. Note that landscapes may be modified by aeolian processes.

The study area is located in a sector of continuous permafrost with an average temperature below -5°C (Smith *et al*., 2004), which is approximately 500 m deep (Daigneault, 1997; Smith et al., 2004). The surface layer of permafrost subject to seasonal freezing and thawing is called the *active layer*. Drainage capacity is limited to this unfrozen layer during the summer. Soil temperatures taken in summer 2006 in the Expo and Mesamax sectors ranged from -5 and -7°C and indicated active layer thickness of between 1.7 and 2.2 m. Global warming could cause permafrost deterioration and reduce its weight-bearing capacity, which could present risks for mining and road infrastructure stability.

Groundwater flow in permafrost differs from that observed in environments that are not permanently frozen. Permafrost is a water-resistant layer that restricts the flow of groundwater to *taliks*, i.e. layers of unfrozen soil, and to the active layer during the summer. Flow in the active layer occurs in summer in the direction of the slope, hence the micro-topology associated with the progression of the thaw in the soil. This phenomenon increases during a rapid thaw in the active layer or following precipitation. Water flow occurs mainly on the surface as a wedge of water, according to soil topology. Groundwater flow is limited to two or three metres higher, where the soil is permeable (because it is unfrozen) through a network of sand and gravel seams and pods. The study area includes no aquifer that could be considered a source of drinking water for the Nunavik Inuit communities.

The study area is located at the head of the Puvirnituq River watershed and consists of large shallow streams and shallow lakes. This configuration favours their expansion rather than their rise during an increase in water flow.



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Hydrological conditions of the study area (GENIVAR, 2007) are as follows:

- The average unitary summer flow of the Puvirnituq River is estimated at 3.6 m^3/s at the Bombardier Lake outlet (GENIVAR, 2007a).
- Melting of snow cover generally occurs between the beginning of June and mid-July.
- The presence of permafrost and the lack of tree and shrub vegetation favour the runoff of surface water rather than infiltration, causing accentuated flood peaks that quickly dry up in the absence of rain.
- Given the flat terrain, an increase in water flow results in widening of the flow section rather than rising of the water level.
- Winter low flow is extreme, and water flow becomes practically nil given the severity of winter and the absence of groundwater intake (permafrost).
- Summer low flow, occurring in August, is also extreme.

Due to the harsh winters and little snow cover on the ground, ice can thicken to two metres or more. Given that winter water flow is not maintained by groundwater intake, small tributaries dry up quickly at the beginning of winter. Even in summer, many small streams dry up almost completely, a phenomenon observed during previous inventories.

In the context of the NNP (GENIVAR, 2007), sample-taking campaigns for water quality were conducted for numerous lakes and streams in the study area between 2003 and 2008. Based on average values obtained at the stations included in the local study area, water quality is as follows:

- It is not turbid (4.4 UTN), which is reflected by the low concentration of suspended matter (2 mg/l).
- It remains cold in summer; surface water temperature generally stays below 12°C.
- It is unproductive, as indicated by the elevated saturation of dissolved oxygen (93.2%), the low chemical oxygen demand (COD; 11 mg/l) and the low concentrations of dissolved organic carbon (DOC; 0.5 to 3.6 mg/l). In fact, unproductive lakes (oligotrophic) generally have DOC concentrations of approximately 1 mg/l, while productive lakes (eutrophic) can reach 30 mg/l.
- It ranks among ultra-oligotrophic waters given the low concentrations in nitrogen, total phosphorus and DOC (Wetzel, 1975).
- It pH is close to neutral (6.2), but is nonetheless sensitive to acidification due to its low buffering (alkalinity of 3 mg $CaCO_3$/l).
- It is low in minerals and very fresh, as shown by its low conductivity (13 µS/cm). This parameter incorporates all the variables of mineralization such as alkalinity, hardness (4 mg $CaCO_3$/l), calcium (0.99 mg/l), chlorides (1.4 mg/l), potassium (0.2 mg/l), sodium (0.7 mg/l), sulfates (1.0 mg/l), iron (0.1 mg/l), magnesium (0.51 mg/l) and other metals.

- → It contains very few metals, most of which were not detected. Only certain metals exceed quality criteria (CCME, 2001; MDDELCC, 2015), including aluminum and copper.
- → It is only slightly contaminated by organic compounds and hydrocarbons, as measured concentrations are generally below the threshold of detection. Monocyclic aromatic hydrocarbons (e.g. toluene, ethylbenzene and total xylenes) detected at certain stations are of human origin (probably from combustion of hydrocarbons transported by wind).

Based on inventory results from 2004 to 2008 (GENIVAR, 2009; 2007; 2007a; Roche 2005; 2006), average values of variables analyzed for sediment quality are lower than the Interim Sediment Quality Guidelines (ISQG). Therefore they rarely cause adverse effects on aquatic life. For chromium (60 mg/kg) and copper (44 mg/kg), average values exceed the threshold effect concentration, at which adverse effects can sometimes be observed.

Finally, the Inuit village of Puvirnituq, located more than 250 km west of the study area, draws its drinking water from the river of the same name. As the NNP's final mine effluent was rejected there, CRI will continue to typify the quality of water used for consumption since 2007. In general, few criteria exceedances have been observed there.

6.3 BIOLOGICAL ENVIRONMENT

The vegetation in the study area is typically Arctic. Its composition varies according to the six terrestrial environments present in the study: block fields, polygonal soils with tundra ostioles, wet tundra with sedges, riparian boulder pavement, esker ridges and escarpments. Overall, a certain toposequence can be observed in the distribution of the three main types of environments that dominate the landscape: the block fields and the polygonal soils with tundra ostioles are found mainly on the tops of rocky ridges and slopes, while the wet tundra covers lowlands, especially on the plains separating the rocky ridges. As for eskers, riparian boulder pavement and escarpments, they are far more rare, covering small square areas and not representative of the general vegetation toposequence. The vegetation at the Puimajuq Deposit site is representative of the study area and consists mainly of wet tundra with sedges and polygonal soils with tundra ostioles (Map 6.2).

Phytosociological surveys were conducted between August 1 and 5, 2015, near the Puimajuq Deposit in order to delineate the wetlands and to characterize the flora, including species with special status. Three wetlands were delineated, which are respectively located in the centre, at the northern border of the projected Puimajuq mine site and along the shore of a lake situated to the northwest of the mine site (Map 6.2). Wetland MH1 is a wet herbaceous meadow with an area of 0.3 ha. It consists mainly of mosses and herbaceous plants, the most abundant of which are *Carex membranacea*, *Deschampsia brevifolia* and *Ranunculus nivalis* (Appendix 3). The second wetland (MH2) is a vast, continuous herbaceous meadow measuring 2.9 ha, dominated by moss and herbaceous strata. A continuous wet herbaceous meadow (MH3) dominated by mossy strata covers an area of 0.4 ha on the western shore of a lake found to the northwest of the mine site. Of the 40 floral species catalogued within the limits of the Puimajuq mine site, only northern fescue is likely to be classified as threatened or vulnerable in Quebec (Government of Quebec, 2013). Some of these plants were counted in the tundra ostioles. Conservation of this species is not problematic because of its relatively high frequency in Nunavik. Other floristic species with special status were catalogued near the Allammaq rocky dome (Map 6.2). They are the *Draba subcapitata*, *D. micropetala* and *D. cayouettei*, three species likely to be designated threatened or vulnerable in Quebec. These species colonize a diversity of environments and have high tolerance to strong winds.

Fishing done as part of the ESIA and environmental monitoring conducted since 2010 in several streams in the study zone are deemed sufficient to typify the fish fauna. Consequently, no inventory was done in streams located close to the planned Puimajuq mining facilities. Previous fishing results highlight the low diversity of the fish community in streams located at the head of the Puvirnituq River watershed. In fact, English char (*Salvelinus alpinus*) and lake trout (*Salvelinus namaycush*) are the main catches and are widely distributed in most bodies of water. Some forage species (e. g. sand smelt) were also caught in small streams. The low productivity of aquatic environments and extreme winter conditions in the tundra are such that very few species can survive there. The English char spawn every two or three years in September, on gravel shoals or rocks, usually in lakes, but also in rivers. Lake trout reproduction occurs in September, in lakes on blends of blocks, stones and pebbles. At these latitudes, sexual maturity of the lake trout is late stage (5 to 8 years).

Avian fauna in the study area is neither very diverse nor very abundant for most species, particularly due to the lack of diverse habitats. In total, at various periods of the year, the study area is likely to harbour 43 species of birds (Appendix 4). During inventories conducted between July 21 and 26 2015, the presence of eight of these species was confirmed close to the Puimajuq deposit, including horned larks, semipalmated sandpipers, Canada geese, common ravens, long-tailed ducks, snow buntings, Lapland larkspurs and red-throated loons. Gyrfalcons, American pipits, rock ptarmigans, semipalmated plovers and common loons were also observed near the NNP mine facilities. The most abundant species are Lapland longspurs (29 individuals), snow buntings (16 individuals) and Canada geese (one group of 16 individuals). For other species, only isolated individuals were observed. Among these species, breeding was confirmed for horned larks, Lapland buntings and snow buntings. Breeding is probable for the American pipit and the semipalmated plover, and is possible for semipalmated sandpipers, red-throated loons, rock ptarmigans and common loons. Other species were considered as non-breeding, because they did not display reproductive behaviour at the time of the inventories. Details of avian inventories are found in Appendix 5.

A dozen species of land mammals live in the Arctic tundra and are likely to use the study area at some point during the year. Among these species, caribou (Feuilles River herd) and Arctic foxes are of interest to the Inuit. The only species with endangered status likely to frequent the study area are wolverines, least weasels and polar bears. The homogeneity of the Arctic territory and harsh winter conditions contribute to low animal diversity in the environment.

As reported by the CDPNQ, there is no mention of threatened or vulnerable animal species likely to be designated within the study area (GENIVAR, 2007; 2011). According to their known geographic range, six species with special status are likely to frequent the study area: golden eagles, tundrius peregrine falcons, short-eared owls, wolverines, least weasels and polar bears (MFFP, 2006). Of these species, some individual polar bears or tracks of polar bears and three species of birds have been seen near the NNP facilities since 2006.

6.4 HUMAN ENVIRONMENT

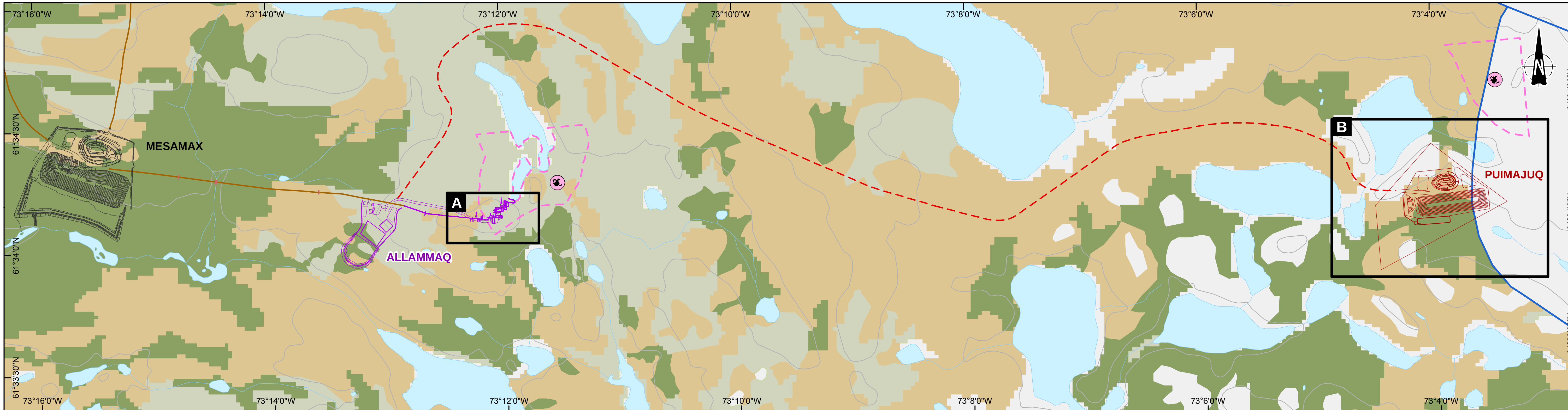
Nunavik consists of 14 villages at distances of several hundred kilometres located on the shores of the Hudson Bay, Hudson Strait and Ungava Bay. The villages closest to the PDMP study area are Kangiqsujuaq (59 km) and Salluit (154 km). In 2011, the populations of Kangiqsujuaq, Salluit and Puvirnituq respectively totaled 696, 1,347 and 1,692 inhabitants. From 2006 to 2011, the growth rate of the populations of Kangiqsujuaq, Salluit and Puvirnituq were respectively 15.0%, 8.5% and 16.1% (Statistics Canada, 2012a; 2012b; 2012c).

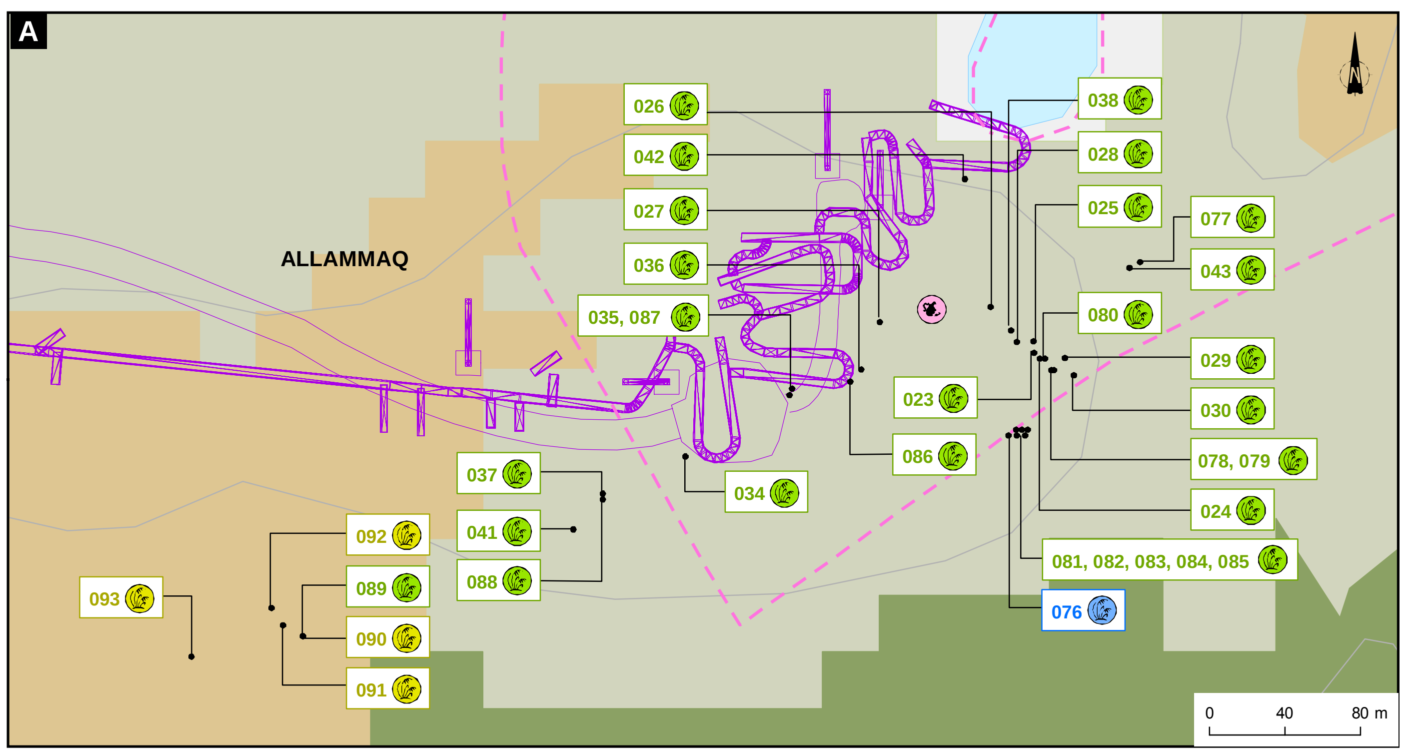
The Nunavik economy revolves mainly around the primary and tertiary sectors. Jobs in the primary sector are mostly linked to wildlife resource utilization and to mining exploration and operations. In Nunavik, the regional government is the primary source of employment for the service sector. Retail business, air and maritime transport and tourism make up the jobs in the service sector. Regardless of the economic sector, businesses face many challenges, including difficult access to resources, high transport costs, scarce and unskilled labour and low population density.

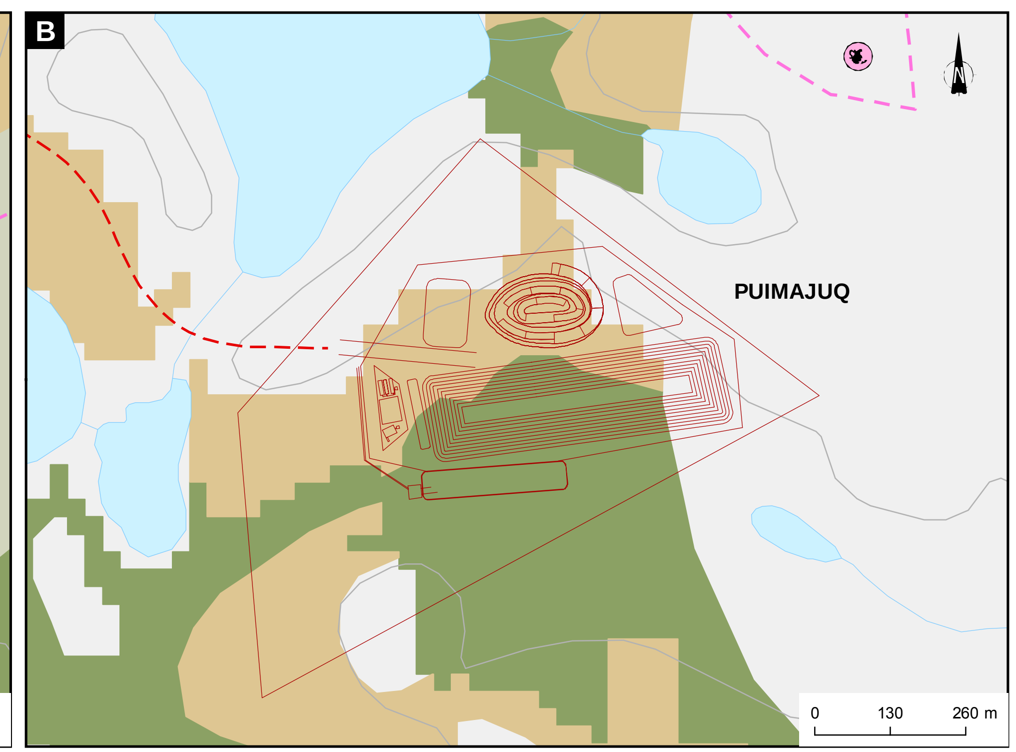
The Nunavik territory is governed by the James Bay and Northern Quebec Agreement (JBNQA), signed in 1975. Signing of this agreement helped to reinforce and extend jurisdiction of the provincial government in Nunavik. It also helped to create independent institutions, including the Kativik Regional Government (KRG), the Kativik School Board (KSB) and the Nunavik Regional Board of Health and Social Services (NRBHSS), which are all managed by the Inuit. Creation of an Inuit corporation, the Makivik Corporation, was planned for under the JBNQA. This company has the responsibility of collecting taxes and managing compensation, ensuring respect of the Agreement and ensuring its integrity (Makivik Corporation, 2015).

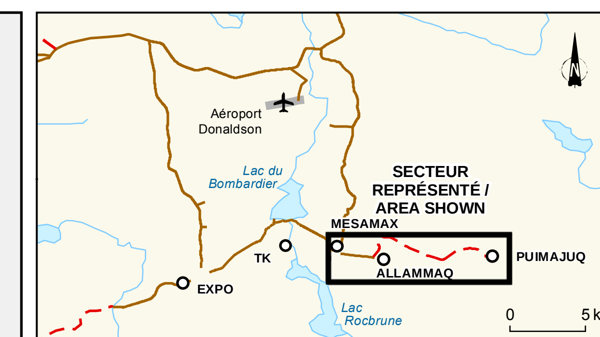
The road network is limited in the Nunavik territory. No road connects the villages or Nunavik to the south of the province. Only air transport serves the villages throughout the year. Consequently, they are all equipped with port infrastructures. Maritime transport allows shipping of heavy or bulky merchandise at reasonable cost. However, it is only possible from July to November, and the lack of adequate facilities causes certain difficulties in supply.

Located on category III lands subject to the JBNQA, the NNP deposit sites, including that of Puimajuq, are only occasionally frequented by the Inuit. Hunting, fishing and trapping are conducted there; two trapping corridors cross the study area from east to west, south of the NNP infrastructures (Map 6.2). Fishing takes place mainly in the spring, summer and early fall and targets anadromous and confined Arctic char in fresh water in the study area. Hunting and trapping target caribou, wolves, polar bears and Arctic foxes.









Stations d'échantillonnage des plantes rares / Rare Plants Sampling Stations (WSP, 2015)

043 — Station d'échantillonnage / Sampling station
Espèce / Species
Numéro de la station / Station number

Espèces / Species

- *Draba cayouettei*
- *Draba micropetala*
- *Draba subcapitata*

Habitats terrestres / Terrestrial Habitats

- Felsenmeer ou champ de blocs / Block field
- Sol polygonaux à ostioles de toundra / Polygonal soil
- Toundra humide à cypéracées / Moist sedge tundra
- Non classifié / Unclassified

Archéologie / Archaeology

- Zone de potentiel archéologique théorique / Area of theoretical archaeological potential

Composantes du projet / Project Components

- Route / Road
- Infrastructure minière proposée / Proposed mining infrastructure
- Infrastructure minière en construction / Mining infrastructure under construction

Infrastructures existantes / Existing Infrastructure

- Route / Road
- Infrastructure minière / Mining infrastructure

Autre / Other

- Limite de bassin versant / Watershed boundary

Format : Tabloid (11 x 17)

CANADIAN ROYALTIES INC. — NUNAVIK NICKEL

Étude d'impact sur l'environnement et le milieu social – Addenda au certificat d'autorisation 3215-14-007 / Environmental and Social Impact Assessment – Addenda to the Certificate of Authorisation

Projet Nunavik Nickel / Nunavik Nickel Project
Exploitation du gisement Puimajuq / Puimajuq Deposit Mining Project

Carte 6.2 / Map 6.2

Milieux biophysique et humain / Biophysical and Human Environment

0 0,3 0,6 0,9 km
Projection : UTM, fuseau 18, NAD83
ÉCHELLE / SCALE 1 : 30 000

Sources :

- *Référence : « Overall_Mesamax.dwg », février 2014 / february 2014 & « Allammaq Site Layout 17JULY14_V2.dwg », juillet 2014 / july 2014 & « design_puimajuq_Oct_2015_v2.dwg », oct. 2015, Canadian Royalties Inc.*
- *Archéologie / Archaeology : Artéfactuel, 2015*
- *Base : BNDT, 1 : 50 000, 1976 à 1995, © Sa Majesté la Reine du Chef du Canada, reproduit avec la permission de RNCan*
- *Inventaires / Surveys WSP, 1 août 2015, August 1st 2015*

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WSP

Current knowledge on colonization of the Arctic over the past 4,000 years shows a potential for discovery of archeological sites in the study area. A study of theoretical potential archeological was completed in the summer of 2015, which covers the mine site and the proposed road route (Artefactuel, 2015; Appendix 6). It shows that two areas are considered to have a theoretical potential for archeological artefacts. Those are located just north of the rocky dome of Allammaq and northeast of the Puimajuq mine site (Map 6.2). Note thet the area north of Allammaq was the subject of inventories during 2008 survey and no archeological remains were found (Artefactuel, 2008, Genivar 2009). Overall, the potential of archeological discovery in the interior is low compared to coastal areas. In addition, the territory covered by the PDMP appears to have generally low potential compared to other surroundings areas.

The landscape in the study area is typical of the sub-unit of Puvirnituq hills that are part of the natural region of the Ungava Plateau. It consists of a vast undulated plateau formed by low hills encircled by lakes and streams, which are covered by snow most of the year. The village of Kangiqsujuaq represents the highest concentration of observers close to the study area. The Pingualuk crater, known worldwide as an outstanding geological phenomenon of Nordic landscapes, is situated about 40 km southwest of the study area.

7 IDENTIFICATION AND ASSESSMENT OF IMPACTS

7.1 METHODOLOGY

The general approach used to identify and assess the level of PDMP impacts on the environment is based on the detailed description of the project (Chapter 5) and of the receiving environment, on consultations with Inuit, on findings from follow up on the NNP since 2010 and on what has been learned from similar projects. The general approach can be summarized as follows:

- → The project description identifies the sources of impact from the technical aspects of the works to be built as well as the construction and operations activities, methods and schedule;
- → The general description of the environment clarifies the environmental and social context of the project, identifies key issues and determines the most sensitive components of the environment relative to the project;
- → Past consultations with Inuit have identified their concerns and their expectations relative to the project.

Taking into consideration these various elements, we can identify those components of the environment to be included in a subsequent PDMP impact evaluation. It should be noted that the integration, from the project's planning stage, of environmental optimizations designed to reduce the number and extent of possible impacts simplifies the environmental assessment process. Issues targeted at the outset are also taken into account in the optimization of the project in order to increase its environmental and social acceptability.

Finally, the lessons learned from previous similar projects (e.g. the Raglan mine) and the findings from environmental follow up on the NNP provide pertinent data needed to determine the nature and the intensity of some of the impacts associated with this kind of project, as well as the efficacy of the mitigation and compensation measures.

For each component of the environment targeted, assessment proceeds as follows:

- → A description of the baseline condition when pertinent: a brief overview of the properties of sensitive components of the physical, biological and human environments;
- → A description of the impact on the environment: the changes anticipated from each of the project's sources of impact;
- → Mitigation measures aimed at reducing and even eliminating identified impacts. Integration of these measures at this stage demonstrates CRI's commitment to applying them during construction, operations and closing;
- → Assessment of the extent of residual impact, that is, the impact that continues after the application of mitigation measures.

The assessment method for the probable impacts of the PDMP is detailed in Appendix 7.

7.1.1 SOURCES OF IMPACT

Identification of PDMP sources of impacts aims to determine all the components of the project that could have an impact on the environment. These include the work and related activities involved in building, operating and maintaining the planned infrastructures and in reclaiming the site at the end of operations (Table 7.1).

Table 7.1 PDMP Sources of Impact

SOURCE OF IMPACT	DESCRIPTION
Construction phase	
Soil stripping	Level and prepare the site for the road, accesses to infrastructures, buildings and other installations.
Building main road and access roads	Build main road connecting Puimajuq to the existing road network and all of the access roads on the mine site. Includes their construction and the consequent truck and heavy equipment traffic.
Building and operating borrow pits	Build borrow pits in the eskers and remove granular material for the construction of the main road and access roads or for any other construction. Could involve dynamiting, crushing and screening.
Manpower	Company employees and those of subcontractors working on the construction phase of the PDMP.
Operations phase	
Transportation and traffic	Movement of vehicles (trucks and equipment) on the mine site and on the road network between Puimajuq and Expo. Includes the transportation of ore, personnel and goods as well as the maintenance of road infrastructures.
Building and services	Installation and maintenance of the services building on the mine site.
Fuel tanks and storage site for hazardous materials	Sites designated for the storage of fuel and hazardous materials (explosives, solvents and other hazardous products), including tanks and their contents as well as retaining structures in case of accidental spills. Includes their use, handling and management (recovery, recycling, etc.).
Open-pit mine	Site intended for the removal of ore from an open pit. Includes all mining operations.
Storing and handling ore	Temporary ore storage area. Includes all ore-handling operations.
Operating borrow pits	Removal of granular material during the operations phase (e.g. maintenance of main and access roads). Could involve dynamiting, crushing and screening.
Waste rock pile	Area intended for the temporary accumulation of waste rock.
Mine effluent	Mine drainage and pit seepage water. Includes activities related to the sedimentation and, as needed, treatment of water from the Mesamax mine.
Manpower	Company employees and those of subcontractors working on the operations phase of the PDMP.
Closing phase	
Mine effluent	Mine effluent
Mine reclamation	Mine reclamation

7.1.2 COMPONENTS OF THE ENVIRONMENT

This section lists the components of the physical, biological and human environments likely to be affected by one or several sources of impact of the PDMP and that will be subject to the impact assessment (Table 7.2).

Table 7.2 Components of the Physical, Biological and Human Environment Likely to be Significantly Affected by the PDMP and Subject to an Impact Assessment

COMPONENTS	DESCRIPTION
Physical Environment	
Air quality	Physical-chemical properties of the air, including dust concentrations.
Water and sediment quality	Physical-chemical properties of the water and sediments.
Biological Environment	
Terrestrial environment	All of the plant species that comprise the boulder fields, polygonal soils with tundra ostioles, eskers and escarpments.
Wetlands	All of the plant species that comprise the tundra sedge wetlands and the border paving.
Rare plants	All of the species of whitlow grasses that have special status and their habitats.
Aquatic fauna	All of the species of fish and other aquatic organisms.
Human Environment	
Use of the territory by the Inuit	Appropriation, occupation, use and development of the territory by the Inuit.
Economy and jobs	All of the direct (e.g. job creation) and indirect (e.g. purchase of goods and services) spinoffs associated with the construction and operation of the open-pit mine.

It should be noted that several other components of the environment were subject to an impact assessment under the NNP (GENIVAR, 2007). However, they were not retained for this impact assessment for the following reasons:

→ Ice cover (modification): even though shipping in Deception Bay will increase somewhat due to the increased processing capacity of the Expo industrial facility, the impact is low and is attributable to the NNP rather than to specific PDMP activities. Furthermore, increased maritime traffic mainly occurs during the ice-free period;

→ The thermal regime of rivers (modification): unlike the NNP, no dam or other retaining structure is planned for the PDMP. Therefore, mining the Puimajuq Deposit will have no impact on this component;

→ Terrestrial fauna and habitats (disturbance, loss of habitat, modification of migration patterns): the disturbance and loss of habitat for terrestrial fauna (40 ha) as well as the modification of caribou migration patterns could occur during the construction and operations phases of the PDMP. These potential impacts are already considered low in the NNP environmental impact study (GENIVAR, 2007), and since the surface area of PDMP operations is smaller than that of the NNP, the level of impact will not change;

- → Avian fauna and habitat (disturbance and loss of nesting and feeding habitat): due to the small surface area needed for PDMP operations (40 ha) and the absence of special status species or specific breeding habitats (Appendix 5), there will be limited disturbance and loss of nesting and feeding habitat for birds. Therefore, this impact, already considered low for the NNP, will remain unchanged and the proposed mitigation measures will also apply for the PDMP (GENIVAR, 2007). Moreover, no significant impact is expected on the three special status species likely to be found in the study area (golden eagle, peregrine falcon and short-eared owl), since they won't be affected by the PDMP;
- → Manpower, health and safety, social organization: workforce mobility, changes to the Inuit's way of life and the workers' risk of accidents and illness are impacts linked more to NNP activities than to those of the PDMP;
- → Transportation and communications: the construction of an additional 9 km of roads for the PDMP will not greatly increase opening of the territory. In this respect, the main impacts and the mitigation measures set out in the NNP environmental impact study (GENIVAR, 2007) will be equally valid for the PDMP and therefore there will be very little impact;
- → Recreational and tourism activities (disturbance): no new disturbance for people using Parc national des Pingualuit beyond those caused by NNP activities (GENIVAR, 2007) is likely to occur because of the PDMP. The greater distance of the Puimajuq mine from the northern boundary of the park (23 km) and from Pingualuk Lake (44 km), along with the mitigation measures set out in the ESIA (GENIVAR, 2007), mean that the residual impact on this component remains low. Dust follow-up programs (Condition 6.7 of the overall CA) and the visual, audible and environmental impacts of NNP activities on Parc national des Pingualuit (Condition 6.11) indicate that operations at the Puimajuq site will not have any significant impacts;
- → Archaeology and heritage (discovery of archaeological or historical remains): according to the Artefactuel study (2015) supplemented by the inventories conducted in the context of the Allammaq assessment (GENIVAR, 2009), it is unlikely that the territory covered by the PDMP presents archeological artefacts. However, if some remains were discovered, same mitigation measures as in the ESIA of PNNI (GENIVAR, 2007) would be applied;
- → Noise levels: while lower than the NNP, somewhat higher noise levels in the area surrounding the mine site could be caused by the construction and operations of the PDMP. Therefore, the main impacts and mitigation measures set out in the NNP environmental impact study (GENIVAR, 2007) will be equally valid for the PDMP and there will be very little impact;
- → Landscape (visual degradation): visual degradation of the surrounding area caused by the presence of PDMP infrastructures will be limited, and permanent changes to the natural landscape will be noticeable to only a few observers. The restoration of degraded areas, height restrictions to the waste rock pile, and its configuration mean that these structures will be better integrated with their surroundings. Consequently, this impact will remain low.

7.2 IMPACTS ON THE PHYSICAL ENVIRONMENT

7.2.1 AIR QUALITY

During construction of the PDMP mine infrastructures, soil stripping and borrow pit operations along with equipment transportation and traffic are likely to temporarily raise concentrations of airborne dust and constitute sources of particle, smoke and exhaust emissions that could locally alter ambient air quality. During operations, the storage and handling of ore, overburden and waste rock will also contribute to an occasional increase in airborne dust. Finally, a temporary one-time degradation in air quality due to increased dust levels could occur during the mine closing operations.

Raising and dispersion of dust is greater under dry and windy conditions. These conditions occur primarily during the summer, which corresponds to just a few weeks. In the winter, the frozen, snow-covered ground is not likely to cause airborne dust.

The stretch of road from Puimajuq to Allammaq will be gravelled and the use of dust suppressants will be restricted to mine sites, where poor visibility could compromise worker safety. Consequently, constant truck and heavy equipment traffic on most of the remaining road network will raise dust over these roads.

With no sources of industrial pollution and little road or air traffic, air quality in Nunavik is considered good, and this was confirmed by analyses conducted in the study area in the summer and fall of 2006 (GENIVAR, 2007). There has been annual follow up on dust dispersion at various NNP facilities since 2010. Results show no significant impact. Therefore, it is considered unlikely that the airborne dust that could be produced during operations would cause significant degradation to air quality (e.g. smog episode). This will rather be a temporary nuisance. Finally, the relatively flat terrain and lack of woody vegetation in the study area, along with very frequent high winds, help displace air, diffuse exhaust emissions and disperse dust and other airborne pollutants.

To minimize impacts on air quality during PDMP construction and operations, authorized vehicles on the mine site must be equipped with exhaust systems approved by Environment Canada for road vehicles. Compliancy with current emission standards, along with the fact that vehicles will be in motion most of the time, will keep emissions below air quality standard levels. Furthermore, the fuel used will meet regulations in effect under the Canadian Environment Protection Act (CEPA) for concentrations of lead, sulphur, phosphorus and benzene.

Taking into account the mitigation measures (Table 7.3) used to restrict dust (e.g. dust suppressants), the good overall ambient air quality, the short summer period favourable to creating dust, and the free circulation of air, the intensity of this impact is considered low. It is local in scope as is mainly restricted to the outskirts of the mine site and to the road network, and its duration is medium.

The probability of occurrence is high, because road traffic and open-pit mining will inevitably result in temporary and localized degradation of air quality. Overall, the extent of this impact is considered to be low during the construction, operations and closing phases of the PDMP, and in this respect, remain low for the NNP.

Table 7.3 Measures Used to Reduce the Impacts of the PDMP on Air Quality

	MITIGATION MEASURES
1.	Make sure that the equipment used meets Environment Canada emission standards for on-road and off-road vehicles.
2.	Avoid leaving vehicles running while not in use for a certain time.
3.	Spread dust suppressants (sodium chloride and water) on surfaces from which traffic could raise dust during dry, windy weather. The dust suppressant used must be NQ 410-300 compliant or be approved by the Ministère des Transports du Québec (MTQ).
4.	Make regular preliminary equipment inspections to make sure it is in good working order, clean and free of any fuel leaks.
5.	Inspect and, as needed, repair exhaust and antipollution systems in order to cut air pollution.

7.2.2 SOIL QUALITY

Trucking and heavy equipment traffic, along with the fuel storage tanks, could cause accidental soil contamination from pollutants during the construction, operations and closing phases.

Trucks and heavy equipment have a number of hydrocarbon-based systems that can break down at any phase of the project. Spills can also occur due to a mishap while refilling on the mine site or from a leak in a tank. Such accidents could lead to soil contamination.

A number of mitigation measures will be in place to prevent and contain accidental spills. For example, equipment will be regularly inspected to make sure it is in good working order. Workers will also have emergency spill kits to be used in the event of an accident.

Furthermore, double-wall tanks will be used for fuel storage, in compliance with Building Code requirements. Finally, PDMP operations are covered by the NNP risk management plan (GENIVAR, 2007).

With the application of several mitigation measures (Table 7.4) and a work monitoring and management plan in place, the impact level on soil quality is considered low. Any soil that was contaminated during the construction and operations phase will be excavated and decontaminated during the closing work on the mine site. Restricted to the location of mine infrastructures and the proposed road, this impact of medium duration will be local. Consequently, the residual impact is considered to be low and will not significantly alter the extent of NNP residual impact.

Table 7.4 Measures Used to Reduce the Impacts of the PDMP on Soil Quality

	MITIGATION MEASURES
1.	Make regular preliminary equipment inspections to make sure it is in good working order, clean and free of any fuel leaks.
2.	Make sure that there is enough absorbent material and clearly marked containers to hold petroleum products and wastes.
3.	Immediately report any accidental spill to the head of the emergency plan for the project. The affected area will be immediately contained and cleaned without delay.
4.	Remove and eliminate contaminated soils in an authorized area and carry out a characterization as prescribed by the Soil Protection and Contaminated Sites Rehabilitation Policy of the Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC).

7.2.3 QUALITY OF WATER AND SEDIMENTS

The impacts on the quality of water and sediments from the PDMP concern:

- → Runoff water along the access road;
- → Mine effluent treated during operations and closing;
- → Post-closure management of contact water.

7.2.3.1 RUNOFF WATER ALONG THE ACCESS ROAD

During construction of the road from Allammaq to Puimajuq, remodelling of the banks and shores of the only watercourse crossed and the installation of multiple stacked culverts to cross it constitute a risk of erosion and of fine sediment input into the aquatic environment. During operations, drainage of runoff water along the road, especially during spring thaw or heavy rains, could also lead to erosion and sediment transport. No special sediment transport problems are foreseen at the proposed crossing point of the watercourse. Moreover, the planned mitigation measures (Table 7.5) will minimize erosion and sediment input, in particular due to the construction of culverts during the low-water period (July to mid-August), when the currants tend to be weak.

Road and culvert maintenance along with truck and equipment traffic during very windy conditions will raise fine particles that could settle on the watercourse that the Allammaq-Puimajuq road crosses. Occasional and localized increased turbidity could occur immediately upstream, but especially downstream from the proposed crossing point of the watercourse. The mitigation measures applied (Table 7.5), including the stabilization of the banks to the right of the crossing with a geomembrane, will restrict the scope of this localized increased turbidity, which will occur primarily during the first years following the road construction.

The use of de-icing salt to melt road ice is known to cause seasonal increases in concentrations of chloride, sodium and calcium in waterways, especially in small watersheds. During the spring thaw, salts dissolve and enter waterways through runoff at the crossing point of the road. No de-icing salt will be used on the NNP road network. Abrasives (sand and fine gravel), which are more effective under low temperatures, will be used in winter. Because abrasives will be used instead of de-icing salt, and there is only one intersection, a single curve located 7.3 km from the crossing point, and low slopes, no impact is expected on the only watercourse to be crossed.

Truck and equipment traffic could also lead to a risk of contamination of water and sediments in the event of an accidental fuel spill. A number of mitigation measures will be taken (Table 7.5) to prevent and contain accidental spills. For example, equipment will be regularly inspected and emergency spill kits will be provided to help prevent, contain and recover any accidental spills before they reach the aquatic environment. Moreover, PDMP operations are covered by the NNP risk management plan (Chapter 9).

7.2.3.2 TREATED MINE EFFLUENT

The discharge of drainage water from the mine site, in particular from the waste rock and ore storage areas, is likely to degrade water and sediment quality downstream from the discharge point. This degradation can be caused by potential acidification of the aquatic environment along with a possible increase in concentrations of some metals and suspended matter (SM). As concerns the PDMP, mine effluent will be carried by a system of ditches and berms to a settling pond, piped first to Allammaq and then to Mesamax for treatment. Therefore, impacts from the discharge of mine effluent from the PDMP will be felt in the Mesamax receiving watercourse rather than those in the PDMP area, into which will no mine effluent will be discharged during operations. Although the addition of PDMP contact water will not alter the composition of the mine effluent treated at Mesamax.

There has been annual follow up by CRI on Mesamax mine effluent since 2013, in compliance with current regulations. These results show that the mine effluent met discharge objectives (EDO) in 2014, with the exception of copper and nickel, for which excesses were observed (WSP, 2015). Nevertheless, the results for these two metals meet acceptable average annual concentrations under Directive 019 on the mining industry. Likewise, the mine effluent has produced no sub lethal effect on the fathead minnow or on *Pseudokirchneriella subcapitata*, an algae. Therefore, the treatment of Mesamax mine effluent limits the intensity and extent of impacts on water and sediment quality in the receiving watercourse.

Analyses of PDMP waste rock and ore (Section 5.4.2) show high concentrations of metals such as arsenic, cobalt, copper and nickel. According to tests by Golder (2015), only the ore is acid-forming and thus likely to acidify drainage water from the mine held in the collecting pond. Some metals could also leach from the ore that is temporarily held in the storage area. To prevent any acid or metal-laden runoff into the environment, the mine site will be encircled by a runoff water management system that sends drainage water to the collecting pond before it is pumped to the Mesamax treatment plant.

In light of the residual outflow along the Puvirnituq River and the very short duration of discharge, concentrations of these metals should quickly diminish downstream from the discharge point, as is currently the case according to follow-up findings. Since the start of mine effluent discharge from Expo and Mesamax, no water quality criteria have been exceeded for the Puvirnituq River within the boundaries of Parc des Pingualuit. Follow up on the 1st EEM cycle show that mine effluent in the Puvirnituq River is 99% diluted a little more than 17 km downstream from the discharge point (WSP, 2015).

During operations, the fine fraction of granular material from the waste rock will be exposed to rain and melt water. This runoff could carry sediments into the drainage system around the waste rock pile and to the collecting pond, where most of it will settle. The collecting pond will be backfilled during site restoration to isolate these sediments from the surrounding environment.

7.2.3.3 POST-CLOSURE CONTACT WATER MANAGEMENT

During closure, a portion of the waste rock accumulated on the surface will be returned to the pit and graded including all the potentially leachable rocks. The remaining waste rock will stay in place with no additional measure. The runoff water during and following the reclamation of this waste rock pile will continue to flow into the drainage ditches around the site and passively, through gravity, into the environment. CRI will conduct follow up on water quality here for a minimum of five years. If the water meets quality criteria, it will be pumped into the pit to accelerate filling, otherwise, it will continue to be sent to the Mesamax treatment plant.

This surface water management strategy ensures that potential acidification of the aquatic environment or increase in concentrations of metals in bodies of water in the vicinity of the PDMP mine site is unlikely.

The level of disturbance and the intensity of impact on water and sediment quality during the construction, operations and closing of the PDMP are considered low, because the road plan was optimized to reduce the number of watercourse crossings to a minimum, the risk of erosion and sediment transport is low, the mine effluent discharged at Mesamax will be treated and followed up on, and a number of mitigation measures will be applied (Table 7.5), namely the disposal of leachable waste in the pit. At the most, slight localized degradation of water and sediment quality could be measured a few kilometres downstream from the discharge point of mine effluent at Mesamax and for ten metres or so from the crossing point of the access road. The duration of this impact is medium. Finally, the probability of its occurrence is high because changes in the quality of water and sediment downstream from the discharge point are inevitable, even following treatment. Overall, impact on water and sediment quality is considered to be low.

Table 7.5 Measures Used to Reduce the Impacts of the PDMP on Water and Sediment Quality

	MITIGATION MEASURES
1.	Limit to a minimum the dispersion of SM into watercourses crossed, paying special attention to the placement of excavated matter nearby.
2.	Make sure that the surface of the road at the crossing point is free of fine sediments (fine sand, silt and clay).
3.	Reuse the rocks excavated during landscaping to stabilize the banks around the culverts and to fill and stabilize depressions.
4.	Prohibit equipment from fording water.
5.	Move equipment away from water when not in use.
6.	Keep the drainage ditches for the proposed road about twenty metres above the natural high-water line (NHWL) of the watercourse to be crossed to slow the flow of drainage and retain SM.
7.	Construct culverts during the summer low-water season from July to mid-August to keep SM levels and the disturbance of spawning in the watercourse crossed to a minimum.
8.	Locate parking and equipment maintenance areas at least 60 m from any watercourse. Refuelling will be done under constant surveillance and at a minimum of 30 m from any watercourse.
9.	Dispose waste oil from equipment and trash at a designated waste disposal site.
10.	Make regular preliminary equipment inspections to make sure it is in good working order, clean and free of any fuel leaks.
11.	Make sure that there is enough absorbent material and clearly marked containers to hold petroleum products and wastes.
12.	Immediately report any accidental spill to the head of the emergency plan for the project. The affected area will be immediately contained and cleaned without delay.
13.	Restrict the use of abrasives and de-icers on the roads to times when there is sleet and in sectors where there is a high risk of accidents (curves, hills and intersections).
14.	Encircle the mining site with a drainage ditch to send runoff water to the settling pond.
15.	Maintain a slope of 1 to 3% on the surface of the waste rock stack so that rainwater will quickly drain into the settling pond to minimize infiltration.
16.	Make sure that the capacity of the settling pond is adequate to hold water over a 100-year period to reduce the risks of overflow that could lead to acid shock.

7.3 IMPACTS TO THE BIOLOGICAL ENVIRONMENT

7.3.1 TERRESTRIAL VEGETATION AND WETLANDS

The mine operations, including installations (e.g. buildings, roads, storage areas, etc.) and ore extraction will result in the loss of 40.0 ha of vegetation groups, comprising 26.2 ha of terrestrial vegetation, 7.7 ha wetlands and 6.1 ha of non-rated environments (Table 7.6).

The terrestrial vegetation affected are polygonal soils with tundra ostioles (20.1 ha) and boulder fields (6.1 ha), which are characteristic of the study area. Losses of terrestrial vegetation are primarily associated with the access road (68%), which is 9.3 km long.

Table 7.6 Surface of the Affected Terrestrial Vegetation and Wetlands

TYPE OF ENVIRONMENT AFFECTED	SURFACE AREA LOST (ha)		
	MINE SITE	ACCESS ROAD	TOTAL
Terrestrial Vegetation			
Boulder field	0	6.1	6.1
Polygonal soils with tundra ostioles	8.5	11.6	20.1
Subtotal	8.5	17.7	26.2
Wetlands			
Wet sedge tundra	7.7	< 0.1	7.7
Subtotal	7.7	< 0.1	7.7
Non-rated environment	5.3	0.8	6.1
Total	**21.5**	**18.5**	**40.0**

The totality of the wetlands is comprised of wet sedge tundra sedge tundra. Practically all of these wetlands are found on the mine site (Table 7.6). The road plan was optimized to avoid them as much as possible. Such wetlands are widespread in Nunavik as well as in the study area.

Taking into account the small loss of habitat surface areas, the fact that the vegetation groups are typical of the Ungava Peninsula and the numerous efforts to design installations so as to avoid them, the impact is considered to be low. Its scope is local and covers all of the PDMP mine infrastructures. Its duration is medium, because the vegetation will recolonize the environment only upon complete reclamation of the mine, planned for 2018. Therefore, impact on terrestrial vegetation and wetlands is considered to be low.

Table 7.7 Measures Used to Reduce the Impacts of the PDMP on Terrestrial Vegetation and Wetlands

MITIGATION MEASURES	
1.	Habitats bordering the worksites will be protected, particularly along the banks of watercourses.
2.	The access road close to the Allammaq mine was redesigned to bypass the rock dome, home to several colonies of special status whitlow grasses.

7.3.2 SPECIAL STATUS PLANTS

Construction activities (soil stripping, main and access road building) along with transportation and equipment traffic, the presence of PDMP mine infrastructures, the open-pit mine and workers, are likely to alter the quality of terrestrial vegetation where special status whitlow grasses are found and cause the loss of some plants.

Note that no mine or road infrastructure will directly encroach on the colonies of special status whitlow grasses identified in the study area, since none of these areas will be touched by the proposed location for these infrastructures. However, the loss of a few specimens of hyperboreal fescue found in the outskirts of the PDMP mine site (Map 6.2) will occur during construction. Although this is a special status plant, it does not represent a conservation issue in Nunavik due to its relatively high frequency of observation, as evidenced by the fifteen or so colonies identified throughout the study area in the 2008 floristic inventories (GENIVAR, 2009).

Dust produced by truck and equipment traffic could settle on terrestrial vegetation on either side of the road from Expo to Puimajuq and on the outskirts of the PDMP mine site. This could lead to reduced productivity in these terrestrial vegetation because it could potentially modify certain phytological processes, such as photosynthesis, flowering or the dispersal of pollen.

The potential loss of special status whitlow grass plants is also possible, though not likely because these plants colonize exposed constantly windswept areas (e.g. rocky escarpments). The use of dust suppressants in the vicinity of the Allammaq rocky dome at the start of the access road to the Puimajuq mine site will help conserve habitat integrity and special status whitlow grasses found there.

As mentioned above, inventories of special status whitlow grasses taken in a 2015 environmental follow up identified three species, *Draba subcapitata*, *D. micropetala* and *D. cayouettei*. Of these, *D. cayouettei* would be the most likely to be affected by PDMP activities, because the specimens inventoried are found in the Allammaq sector, close to the PDMP access road.

In order to protect these colonies, they will be clearly marked off to prohibit access and prevent trampling by workers and equipment. Moreover, dust suppressants will be used as needed on the main and access roads around the mine site. Note that the route planned for the access road will run north of the Allammaq rocky dome to avoid traffic in the vicinity of the colonies.

Finally, follow up on the colonies of special status whitlow grasses (Section 8.2) is currently underway to accurately measure the potential and real effects of mining activities on these plants. The *D. cayouetti* colonies will be included in this follow up, and if it is shown that that PDMP activities cause the degradation of whitlow grass colonies, CRI will institute mitigation or compensation measures to correct the situation.

The extent of impact on special status plants, particularly whitlow grass, is considered to be low for several reasons: no whitlow grass colony will be directly touched by PDMP infrastructures, these plants are found in exposed, constantly windswept areas and are therefore less vulnerable to dust, and a number of mitigation measures will be applied (Table 7.8) to conserve the colonies found in the study area. Due to the high ecosystemic value assigned to this component of the biological environment, the intensity of impact is considered medium. The extent of medium duration impact is localized, as it is limited to the Expo-Puimajuq road and the PDMP mine site. Finally, the probability of occurrence is considered to be medium due to the degree of uncertainty concerning the potential impacts of mine activities on the outskirts of the colonies of special status plants in the vicinity of the mine infrastructures. Consequently, the impact on special status plants is medium.

Table 7.8 Measures Used to Reduce the Impacts of the PDMP on Special Status Plants

MITIGATION MEASURES	
1.	Restrict heavy equipment use and traffic within the work areas and to the roadway and accesses to the borrow pits to maintain the integrity of the tundra.
2.	Protect terrestrial vegetation bordering on the construction site, particularly close to the banks of watercourses.
3.	Spread dust suppressants (sodium chloride and water) on surfaces from which traffic could raise dust during dry, windy weather.
4.	Clearly mark off the area around the Allammaq rocky dome and the *Draba cayouetti* colonies to the southwest of the dome to prohibit access.

7.3.3 AQUATIC FAUNA

7.3.3.1 CONSTRUCTION OF THE ACCESS ROAD

During construction of the road from Allammaq to Puimajuq, remodelling of the banks and shores of the watercourses crossed and the installation of multiple stacked culverts could cause the suspension of sediments and increased turbidity primarily downstream from the crossing point. This situation will cause fish to temporarily avoid the construction area.

In addition to avoidance, lower feeding efficiency (reduced growth rate), reduced ability to locate and avoid predators, gill damage and lower natural disease resistance could also occur if there are high concentrations of SM over a long period. Depending on the level of exposure, lethal effects could also be observed, particularly at vulnerable stages (alevins and eggs). The tolerance threshold for prolonged exposure, where the first effects are seen, is 25 mg/l for adult salmon. Lethal thresholds of SM for salmon are much higher, on the order of 270 mg/l for a few weeks exposure and up to 2,000 mg/l for a few days (SIGMA, 1983 in Morin, 2006).

For salmon farming, an 80 mg/l tolerance threshold is reported by several authors (Morin, 2006). According to the MDDELCC, the acute toxicity criteria for the protection of aquatic life are set at a concentration of SM exceeding that of the aquatic environment by 25 mg/l.

Note that the watercourses sampled in the study area between 2003 and 2008 are not very turbid and show very low concentrations of SM, on the order of 2 mg/l. Moreover, it must be mentioned that given the low proportion of fine particles (silt and clay) in the study area substrates and the appropriate mitigation measures (Table 7.9) to be applied, increased turbidity of the water during road construction will be limited.

7.3.3.2 TREATED MINE EFFLUENT

The aquatic communities colonizing habitats downstream of the mine effluent discharge point in the receiving watercourse at Mesamax could be affected should the quality of water become degraded, either by the possible acidification of the aquatic environment or a limited increase in concentrations of metals and SM.

Table 7.9 Measures Used to Reduce the Impacts of the PDMP on Aquatic Fauna

MITIGATION MEASURES	
1.	Construct culverts during the summer low-water season from July to mid-August to keep SM levels and the disturbance of spawning in the watercourse crossed to a minimum.
2.	Make regular preliminary equipment inspections to make sure it is in good working order, clean and free of any fuel leaks.
3.	Locate parking and equipment maintenance areas at least 60 m from any watercourse. Refuelling will be done under constant surveillance and at a minimum of 30 m from any watercourse.
4.	Prohibit equipment from fording water.
5.	Move equipment away from water when not in use.
6.	Dispose waste oil from equipment and trash at a designated waste disposal site.
7.	Make sure that there is enough absorbent material and clearly marked containers to hold petroleum products and wastes.
8.	Make sure that the surface of the road at the crossing point is free of fine sediments (fine sand, silt and clay).
9.	Install multiple stacked culverts so that water drainage is not restricted. The base of the lower culvert will be beneath in the natural stream bed, at least 20% (not more than 30 cm) of the structure. The extremities of the structure will exceed the base of the fill by at least 30 cm and will be adequately stabilized by rock fill.
10.	Install stacked culverts so that during the summer low-water season drainage will be concentrated in the lower culvert so fish can freely circulate.
11.	Keep the slope of the culverts the same as the natural slope of the watercourse.
12.	Make sure that the capacity of the collecting pond is adequate to hold water over a 100-year period to reduce the risks of overflow that could lead to acid shock.

As described above concerning the water and sediment quality (section 7.2.3.2), acidification of the aquatic environment is very unlikely. In addition to the adjustment of the pH by adding lime, the risks are very low because the capacity of the collecting pond (60 000 m^3) will be sufficient to contain floodwaters over a period of 100 years. Consequently, no impact due to the deterioration of aquatic habitat quality downstream of the mine effluent discharge point is expected. This is true for the post-closure period of the PDMP site. The waste rock will be confined to the pit and covered with an impermeable layer to prevent the leaching of metals during recovery work to prevent any contamination of the nearby aquatic ecosystem.

Furthermore, increased concentrations of metals and SM are also unlikely, because the treatment of Mesamax mine effluent discharge involves the use of lime and flocculants to aid in precipitation. Findings from follow up on Mesamax effluent from 2014 show that no effluent discharge criteria were exceeded under mining industry Directive 019 (WSP, 2015).

Given that there is a single crossing point, that the treatment of Mesamax mine effluent meets discharge criteria and that several mitigation measures will be applied, the impact on aquatic fauna is considered to be low. Although this component has a high socio-economic value, Arctic char fishing being an integral part of the Inuit way of life, the intensity of this impact of medium duration is low. It will only slightly alter the quality, use or environmental integrity of aquatic communities and their habitats. The extent of the impact is circumscribed and limited to the mine infrastructures that encroach on fish habitat in a short stretch of the receiving tributary downstream from the Mesamax mine effluent discharge point. The probability of occurrence is considered to be high due to the fact that disturbances to aquatic fauna are inevitable whenever mine effluent is discharged into the aquatic environment. Overall, the residual impact on aquatic fauna will be low during the PDMP construction and operations phases, and will also remain low for the NNP.

7.4 IMPACTS ON THE HUMAN ENVIRONMENT

7.4.1 INUIT LAND USE

Though practiced much less inland, traditional Inuit fishing, hunting and trapping activities, occurring especially during the winter in the local study area, could be disturbed by PDMP construction and operations.

Fishing could continue in the vicinity of the mine site because the mining activities will not block access to lakes generally used by Inuit. No fishing area site was identified near the Puimajuq Deposit by Inuit consulted and by the Nunaturlik Landholding Corporation in Kangiqsujuaq (brief tabled at the February 2008 public hearings; Lucassie Pilurtuut, pers. corr., 2008).

Furthermore, CRI will set up a fishing program to regulate sport fishing aimed at preventing the lakes near the mine site from being overfished. Under this program, non-beneficiary employees will have the right to fish only in those lakes designated by CRI. The program will also establish quotas and fishing periods.

For the NNP, follow up will be conducted on sport fishing by employees to ensure that fish populations in the lakes near the mine site are maintained. This follow up will also cover the PDMP site.

Noise could also disturb hunting and trapping for the duration of activities on the mine site. It could disturb wildlife species of interest, especially caribou, which are found in the vicinity of the mine site and road infrastructures. Hunters and trappers will have to travel further, essentially from Salluit and

Kangiqsujuaq, to reach species of interest. According to information received from the Makivik Corporation in 2006, the corridor of interest for the practice of traditional Inuit activities that is found in the Puimajuq area is in line with lakes Bombardier and Rocbrune, but is seldom used. Interference from mining operations on traditional Inuit activities and movements will be limited.

There will be no added hunting pressure from CRI employees because the possession of firearms is prohibited on the NNP site. No direct interference with traditional Inuit hunting activities, particularly caribou hunting, is anticipated.

Moreover, no significant impact is expected on the quality of water and sediments or aquatic fauna in the main stem of the Puvirnituq River; environmental monitoring is currently underway to document this. Therefore, the PDMP will not significantly alter traditional Inuit activities that could take place in the PDMP sector.

Finally, no impact is foreseen on the two sites of interest (*Pingualujait* -small hills where people trap foxes- and *Misa tammaavitsatua* -place where people take shelter in a blizzard-) for hunting and trapping by Inuit of Kangiqsujuaq, as their accessibility is not compromised by PDMP operations. These two sites are located outside the study area (Lucassie Pilurtuut, pers. corr., 2008).

The degree of disturbance to use of the territory by Inuit is considered low, because traditional Inuit activities are practiced less in inland areas and the two sites of interest for Inuit of Kangiqsujuaq are located outside the local study area. Moreover, appropriate mitigation measures will be applied during the construction and operations phases (Table 7.10), including a program to regulate sport fishing by mine employees. The intensity of impact is also low, because the project does not greatly alter the quality, use or integrity of this component of the human environment. Its scope is local and is concentrated along PDMP roads and on the outskirts of the Puimajuq mine site. Its duration is long and extends from the construction of surface infrastructures until the complete closure of the mine (about three years). Given that Inuit of Kangiqsujuaq currently use the NNP mine infrastructures sector and therefore will likely use that of the PDMP, the probability of occurrence is considered high. This is why the degree of residual impact is considered low, and will not alter that of the NNP.

Table 7.10 Measures Used to Reduce the Impacts of the PDMP on Inuit Land Use

	MITIGATION MEASURES
1.	Prohibit firearm possession on the mine site, with the exception of special authorization for protection against polar bears.
2.	Make sure that construction equipment is in good working order to prevent excessive noise.
3.	Maintain access to the lakes used by the residents of Kangiqsujuaq and Salluit for fishing.
4.	Set up a program to limit fishing pressure by restricting fishing to a few lakes in the vicinity of the mine infrastructures.

7.4.2 ECONOMY AND JOBS

The PDMP will extend NNP's lifespan. There will be positive repercussions in the form of increased local and regional economic spinoffs as well as retention of the jobs created under NNP.

Economic spinoffs from the PDMP, which will be added to those of NNP, will be shared among the Inuit villages of Kangiqsujuaq, Salluit and Puvirnituq under the provisions of the Nunavik Nickel Agreement signed on May 9, 2008. The Makivik Corporation will also receive the proportion of its share of the economic spinoffs agreed upon under the Agreement.

The continued application of proposed NNP compensation measures (Table 7.11) and compliance with the Nunavik Nickel Agreement, particularly the tendering procedure, will help support the economy in the villages of Kangiqsujuaq, Salluit and Puvirnituq. CRI is careful to give first consideration to Inuit firms in the attribution of mandates for the construction, operation and maintenance of its infrastructures.

Moreover, because of the nature of the project, a number of companies from Abitibi and elsewhere in Québec will also benefit from the extension of NNP's lifespan or from the attribution of contracts and, consequently, from PDMP economic spinoffs.

Some fifteen people will work for two years on PDMP construction and operations. The hiring terms for Inuit workers are set out in the Nunavik Nickel Agreement.

The impact on the economy and on jobs during the construction, operations and closing phases is positive, with economic spinoffs and local and regional jobs being extended.

Table 7.11 Measures Used to Reduce the Impacts of the PDMP on the Economy and Jobs

MITIGATION MEASURES	
1.	Comply with the hiring policies giving precedence to Inuit workers in the Nunavik Nickel Agreement.
2.	Set up an adapted training program to be used in Inuit villages for recruiting personnel right from the construction phase.
3.	Give precedence to Inuit companies for subcontract work during the construction and operations phases. Companies offering air transport, marine cargo shipping and diamond drilling services will be especially in demand. When possible, service offers will be split to give Inuit companies a share of the contracts.
4.	Pay royalties, based on the price of nickel, to the Makivik Corporation and to the communities of Salluit, Kangiqsujuaq and Puvirnituq to compensate for the environmental and human impacts of the project.

7.5 SUMMARY OF IMPACTS

Overall, the impacts of PEGP on the components of natural and human environments are of minor importance (Table 7.12). Special status plants have a residual impact of moderate importance (Table 7.12). The optimization of various elements of PEGP (road layout, management of waste rock, etc.) has allowed a significant reduction of environmental and human residual impacts.

The realization of PEGP however, generates inevitable some residual manifestation of impacts and, consequently, an environmental monitoring program (Chapter 9) is developed for some of the affected components.

Finally, following the rehabilitation of the mine site Puimajuq, only few residual impacts will persist on natural and human environments. The rehabilitation program will aim full compatibility with surroundings.

Table 7.12 Potential Impact Assessment and Mitigation Measures.

ENVIRONMENTAL COMPONENT	SOURCE OF IMPACT	POTENTIAL IMPACT	MITIGATION MEASURES	IMPORTANCE OF RESIDUAL IMPACT
Physical Environment				
Air Quality	• Stripping of soils • Development and exploitation of borrow pits • Transport and traffic • Storage ans handling of ore, overburden and waste rocks	• Increase of dust • Emission of particles fumes and exhaust.	• Ensure working equipment comply with Environment Canada standards for exhaust emissions from off-road machinery. • Stop machinery engine when possible between work periods. • Spread dust suppressant (sodium chloride and water) during dry and windy weather period. Dust suppressant will comply with NQ-410-300 standard or be approved by Quebec Ministry of Transport (MTQ). • Conduct preventive and regular inspections of machinery in order to ensure good conditions, cleaness and exempt of leakage. • Inspect and if necessary, repair exhaust and emission control systems in order to minimize contaminated emissions.	Low
Soil Quality	• Transport and traffic • Fuel Farm	• Risk of soil contamination in case of accidental spill.	• Inspect and if necessary, repair exhaust and emission control systems in order to minimize contaminated emissions • Provide absorbents, complete spill kits and containing pails for cleaning in case of accidental events. • Immediate reporting of any accidental spill in order to allow immediate cleaning. • Store and dispose contaminated soil according to Regulation.	Low
Water and Sediments Quality	• Construction, exploitation and road maintenance • Transport and traffic • Mine effluent • Fuel Farm	• Decrease in water and sediments quality • Risk of water and sediments contamination in case of accidental spill • Potential increase of suspended matters and chlorides downstream of watercourse crossing.	• Minimize spreading of suspended matters in stream at crossing with particular attention to disposal of excavated material in surroundings. • Ensure coating of road section above stream crossing is exempt of fine particles. • Reuse rock removed during workings to stabilize slopes around culverts and as fill material where necessary. • Forbid machinery fording in stream • Keep machinery off stream as soon as its no longer used. • Interrupt drainage ditches of the road section at about twenty meters above the natural high water mark (NHWM) crossed the stream to slow drainage water and allow retention of suspended solids. • Complete the installation of culverts in summer low flow, from July to mid-August, so as to minimize the increase of suspended solids and disruption of spawning in the crossed watercourse • Locate machinery parking and maintenance areas at least 60 meters from any watercourse. Refuelling of machinery will be carried out under constant surveillance and a minimum distance of 30 meters of a watercourse. • Dispose of used oil and waste according to regulations. • Conduct preventive and regular inspections of machinery in order to ensure good conditions, cleaness and exempt of leakage. • Provide absorbents, complete spill kits and containing pails for cleaning in case of accidental events • Immediate reporting of any accidental spill in order to allow immediate cleaning. • Limit the use of abrasives and melting products on roads to periods and areas at risk of accident (curves, slopes and intersection). • Construct a collecting ditch to direct site into to the retention pond. • Maintain a slope of 1 to 3% on surface waste rock pile in order to facilitate rapid flow of rain water to the retention pond and minimize infiltration. • Ensure that the capacity of the retention pond is sufficient to collect precipitation of 100 year return period in order to reduce risk of overflow that could potentially lead to an acid shock.	Low
Biological Environment				
Lands and Wetlands	• Stripping of soils • Presence of infrastructure • Road and access	• Loss of 40,0 ha of plant groups, 26,2 ha on lands, 7,7 ha on wetlands and 6,1 ha unclassified.	• Protect plant habitats along worksite, particularly near the watercourse. • Optimize road layout of the access road near the Allammaq mine to avoid the rocky dome, an area hosting several colonies of draba with special status.	Low

Table 7.12 (cont'd.) Potential Impact Assessment and Mitigation Measures.

ENVIRONMENTAL COMPONENT	SOURCE OF IMPACT	POTENTIAL IMPACT	MITIGATION MEASURES	IMPORTANCE OF RESIDUAL IMPACT
Biological Environment (cont'd.)				
Special Status Plants	• Stripping of soils • Road and access • Transport and traffic • Presence of infrastructure • Manpower	• Potential decrease of lands and wetlands quality. • Potential loss of draba with special status.	• Limit the use and circulation of heavy machinery within the work areas, road right of way and access to borrow pits in order to preserve the integrity of the tundra.Protect land habitat on border of working site, especially near watercourse. • Apply offal-dust (calcium chloride and water) in dry and windy, where traffic is more likely to raise dust. • Apply dust suppressant (calcium chloride and water) during dry and windy period, where traffic is more likely to raise dust. • Install visual cues around the edge of the rocky dome of Allammaq and around colonies Draba cayouettei located southeast of the rocky dome to avoid access.	Moderate
Aquatic Fauna	• Stripping of soils • Construction and exploitation of road and access • Transport and traffic • Mine effluent	• Avoidance by fishes of habitat located around stream crossing. • Modification and habitat loss at stream crossing. • Potential modifications of fish habitat and fish communities downstream of water discharge	• Complete the installation of culverts in summer low flow, from July to mid-August, so as to minimize the increase of suspended solids and disruption of spawning in the crossed watercourse • Conduct preventive and regular inspections of machinery in order to ensure good conditions, cleaness and exempt of leakage. • Locate machinery parking and maintenance areas at least 60 meters from any watercourse. Refuelling of machinery will be carried out under constant surveillance and a minimum distance of 30 meters of a watercourse • Forbid machinery fording in stream • Keep machinery off stream as soon as its no longer used. • Dispose of used oil and waste according to regulations. • Provide absorbents, complete spill kits and containing pails for cleaning in case of accidental events • Ensure coating of road section above stream crossing is exempt of fine particles. • Install multiple staggered culverts so as not to impede the flow of water. The base of the culvert will be below the natural bed of the water at a depth of at least 20% (but not exceeding 30 cm) height of the structure. The base ends of the structure will exceed backfill of maximum 30 cm and will be properly stabilized with clean rock. • Install culverts staggered so that during low flow, the flow is concentrated within the lower culvert, which will promote the free movement of fish. • Respect the natural slope of the bed of the water to the slope culverts. • Ensure that the capacity of the retention pond is sufficient to collect precipitation of 100 year return period in order to reduce risk of overflow that could potentially lead to an acid shock.	Low
Human Environment				
Land use by inuit	Construction and exploitation acitivities	• Disturbance of traditional inuit acitvities inland	• Forbid firearms on site except for specific use and according to Sûreté du Québec permit. • Verify good conditions of machinery to minimize noise • Maintain accessibility to lakes used by Kangiqsujuaq and Salluit for fishing. • Limit fishing pressure by the introduction of fishing program that will provide rules for fishing in lakes close to mine complex.	
Economy and workforce	Construction and exploitation activities	• Revenues and continuation of employment.	• Comply with Nunavik Nickel Agreement namely sections regarding inuit training and employment. • Favor inuit entreprises when offered services meet requests.	

8 SURVEILLANCE AND MONITORING

8.1 SURVEILLANCE

Environmental surveillance work will be completed by the CRI Environment team. During the work, the site supervisor is responsible for ensuring that all environmental measures are met. The team will also verify incorporation of proposed mitigation measures and commitments into the project, and ensure compliance with laws and regulations. Finally, the surveillance team will ensure that all requests for authorization and necessary permits for completion of the project have been completed and that the authorization certificates and permits have been delivered.

Persons in charge of the project and the environment will organize a worksite meeting which will be held at the beginning of the work. The meeting will inform and educate managers and personnel assigned to the site of environmental and safety provisions to be observed during the entire period of work, as well as the general functioning of monitoring activities.

During the work, mitigation measures must be strictly applied. In general, the head of environmental monitoring must make regular visits to worksites and note the strict observance of commitments, obligations, measures and other requirements from stakeholders. He must also assess the quality and effectiveness of measures applied and note any non-compliance that has been observed.

The supervisor must ensure the effectiveness of these measures and, where appropriate, inform managers and propose alternative measures of protection. A site monitoring form (Appendix 8) allows the supervisor to monitor the application of mitigation measures. Any incident will be noted in the last column on the form entitled Remark/Corrective Measure. The supervisor will indicate the following information:

- → nature of the event
- → intervention measures applied
- → effectiveness of the intervention; follow up will be done in the following days

During the infrastructure development phase, a weekly report will be prepared, which will include photographs to aid understanding of non-compliance observed and corrective measures taken. The “as built” (AB) plans will be sent to regional, provincial and federal authorities once the work is completed. Weekly monitoring sheets will be available for consultation upon request.

8.2 MONITORING

The environmental monitoring program implemented in the context of the NNP aims to monitor the evolution of sensitive environmental components in accordance with federal and provincial requirements.

The PDMP will prolong the duration of certain environmental follow up that already exists:

- → quality of the mine effluent and the water in the receiving body of water at Mesamax
- → monitoring of rare plant colonies

Follow up for runoff water quality in Puimajuq in the post-closure phase will also be put in place.

According to the Nunavik Nickel Agreement, CRI will annually invite two representatives from the Inuit party to participate in the monitoring and follow up program. The promoter also agrees to make follow up results available to the Nunavik Nickel Committee, and if an Inuit representative makes a request, to the Nunavik Research Centre in Kuujjuaq for their validation.

8.2.1 MONITORING THE QUALITY OF MINE EFFLUENT IN THE RECEIVING STREAM AT MESAMAX

Monitoring of the mine effluent at Mesamax, which is currently underway (WSP, 2014), will be extended to the end of the mine effluent discharge from Puimajuq in the receiving stream at Mesamax. Data collected during monitoring is used to:

- → monitor the effects of possible changes in mining operation procedures and the evolution of environmental conditions in the receiving waters
- → provide information on the variability of effluent quality and on seasonal and temporal trends
- → obtain measurements of environmental support variables likely to facilitate the interpretation of data from other monitoring projects (studies of fish, communities of benthic invertebrates, etc.)
- → adjust treatment of the mine effluent if the expected performance is occasionally not obtained

8.2.2 MONITORING RARE PLANT COLONIES

During field work conducted in the context of addendum no. 4 for the Allammaq deposit mine project (GENIVAR, 2009), three plants with special status in Quebec, belonging to the Draba genus (*Draba subcapitata*, *D. micropetala* and *D. corymbosa*), were identified. The plants were found in various locations near the planned mining facilities, especially near the underground mine site for the first two species. To ensure sustainability of these colonies, CRI is monitoring to measure the actual effects of mining activities on the distribution, abundance and state of health of the plants in several colonies on the periphery of infrastructures. The monitoring began in 2014, before construction began on the Allammaq mine. It should continue during its development and end one year after its closure.The monitoring includes an assessment of the abundance and quality of colonies within five distinct sectors: 1) the rocky dome on the Allammaq mine site, 2) colonies northwest of the road between the Bombardier Lake bridge and the Expo industrial complex, 3) colonies south of the same road, close to the Bombardier Lake outlet, 4) three colonies west of the road between Katinniq and Mesamax, and 5) the *D. micropetala* colony, southwest of Lake Rocbrune (GENIVAR, 2009)

In each colony, the draba plants are located by GPS and counted, and their phenology is noted (vegetative plant, in bloom, with fruit). Any abnormal state of plant structure is also noted (e. g. yellow leaves, absence of flowers or fruits, etc.) Inventories take place during the fruit-producing period in August. Data is compiled and is the subject of an annual report.

After floristic inventories conducted in the summer of 2015, the four colonies of *Draba cayouettei* observed to the southwest of the Allammaq rocky dome (Map 6.2) will be included in the follow up. Monitoring will be extended for a year, or until closure of the Puimajuq mine.

8.2.3 MONITORING WATER QUALITY AT PUIMAJUQ AFTER CLOSURE

According to Directive 019 on the mining industry, monitoring of low-risk runoff water should be done six times a year for five years in the collecting pond. Given the short time in which there could be runoff water on the site (from about June to September), it is proposed to conduct this follow up once a month during the flow period.

9 MANAGEMENT OF ACCIDENT RISKS

Developed in the context of the NNP, the policy on health, safety and environmental protection applies equally to the PDMP.

Due to risks inherent in any industrial activity, the remoteness and isolation of the NNP and the fragility of Arctic ecosystems, CRI committed to implementing a policy that goes beyond the standards in effect. Developed at the beginning of the NNP construction work, this policy includes statements of principle related to the supply of adequate equipment, preventive measures to be adopted by everyone, respectful practices for the environment and the Inuit way of life, a customized training program, a process of continuous improvement, and follow up and control measures. Inherent to this plan, an emergency response plan was also developed.

The main accident risks identified are those that could have consequences during the phases of construction and operating the PDMP, i.e. the health and safety of the workers, and the environment. Among risks identified for the PDMP, the most likely to occur were the following:

- overturning of a truck
- spilling of petroleum products
- spilling of dangerous products
- fires
- poorly-controlled explosives
- overflowing of the retention basin for mining waters

CRI advocates reduction of these risks by taking them into account during the design of various infrastructures, by using proven technologies for security and planning and by implementing measures adapted to each risk. Prevention and emergency measures associated with each of these risks are incorporated into the CRI management program (procedures and programs). No impact is expected on the health and safety of the Inuit village residents or on public infrastructures due to the distance separating them from the mines.

The emergency response plan covers training, roles and responsibilities of various parties, communications and emergency actions for various scenarios (major injury, surface fires, environmental accidents, road accidents, aircraft accidents, etc.).

BIBLIOGRAPHY

KATIVIK REGIONAL GOVERNMENT (KRG). 2011. *Projet de parc national des Monts-Pyramides. État des connaissances.* Administration régionale Kativik, Service des ressources renouvelables, de l'environnement, du territoire et des parcs, Section des parcs, Kuujjuaq, Québec.

CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME). 2001. *Canadian Water Quality Guidelines for the Protection of Aquatic Life.* [Online] [http://ceqg-rcqe.ccme.ca/en/index.html]

DAIGNEAULT, R.-A. 1997. *Géologie et géomorphologie de la région du cratère du Nouveau-Québec, Nunavik.* Report prepared for the ministère de l'Environnement et de la Faune, Direction des parcs québécois. 117 p. and appendices.

GENIVAR. 2007. *Projet Nickélifère Raglan Sud – Rapport principal – Étude d'impact sur l'environnement et le milieu social.* GENIVAR report to Canadian Royalties Inc. 649 p. and appendices.

GENIVAR. 2007a. *Nunavik Nickel Project. Environmental and Social Impact Assessment – Addendum No. 2. Construction of a Berm-Bridge at Bombardier Lake Outlet.* Environmental Assessment. Final Report. GENIVAR report to Canadian Royalties Inc. 27 p. and appendices.

GENIVAR. 2009. *Projet Nunavik Nickel. Étude d'impact sur l'environnement et le milieu social – addenda n° 4. Projet d'exploitation du gisement Allammaq et augmentation de la capacité de traitement du concentrateur. Évaluation environnementale.* GENIVAR report to Canadian Royalties Inc. 221 p. and appendices.

GOVERNMENT OF QUEBEC. 2013. *Liste des plantes vasculaires susceptibles d'être désignées menacées ou vulnérables (314 espèces).* Last modification: June 2013. 8 p.

GOVERNMENT OF QUEBEC. 2006. *Liste des espèces fauniques désignées menacées ou vulnérables au Québec.* [Online] [http://www3.mffp.gouv.qc.ca/faune/especes/menacees/liste.asp]

MINISTÈRE DES FORÊTS, DE LA FAUNE ET DES PARCS (MFFP). 2006. *Liste des espèces désignées menacées ou vulnérables au Québec.* [Online] [http://www3.mffp.gouv.qc.ca/faune/especes/menacees/liste.asp]

MINISTÈRE DU DÉVELOPPEMENT DURABLE, DE L'ENVIRONNEMENT ET DE LA LUTTE CONTRE LES CHANGEMENTS CLIMATIQUES (MDDELCC). 2015. *Critères de qualité de l'eau de surface.* [Online] [http://www.mddelcc.gouv.qc.ca/Eau/criteres_eau/index.asp]

ROCHE. 2006. *Raglan South Nickel Project – 2005 Environmental Baseline Study. June 2006 – v.0.* Roche report to Canadian Royalties Inc. 47 p. and appendices.

ROCHE. 2005. *Expo and Phoenix Project. Preliminary Environmental Baseline Study*. Final report to Canadian Royalties Inc. Sainte-Foy, Quebec. April 2005. 51 p. and appendices.

SMITH, S.L., M. M. BURGESS and COMMISSION GÉOLOGIQUE DU CANADA. 2004. *Sensitivity of permafrost to climate warming in Canada.* Ottawa. Geological Survey of Canada. Viii. 24.

MAKIVIK CORPORATION. 2015. *Makivik Mandate.* [Online] [http://www.makivik.org/corporate/makivik-mandate/] (Site accessed on September 23, 2015).

STATISTICS CANADA. 2012a. *Kangiqsujuaq, Québec (Code 2499130) et Nord-du-Québec, Québec (Code 2499) (tableau).* Census profile, 2011 census, no. 98-316-XWF in the Statistics Canada Catalogue. Ottawa. Posted on October 24, 2012. [Online] [http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=F] (Site accessed September 23, 2015).

STATISTICS CANADA. 2012b. *Salluit, Québec (Code 2499135) et Nord-du-Québec, Québec (Code 2499) (tableau).* Census profile, 2011 census, no. 98-316-XWF in the Statistics Canada Catalogue. Ottawa. Posted on October 24, 2012. [Online] [http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=F] (Site accessed September 23, 2015).

STATISTICS CANADA. 2012c. *Puvirnituq, Québec (Code 2499120) et Nord-du-Québec, Québec (Code 2499) (tableau).* Census profile, 2011 census, no. 98-316-XWF in the Statistics Canada Cataloque. Ottawa. Posted on October 24, 2012. [Online] [http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=F] (Site accessed September 23, 2015).

WETZEL, R.G. 1975. *Limnology.* W.B. Saunders Company.

WSP. 2015. *Projet Nunavik Nickel – Études de suivi des effets sur l'environnement (ÉSEE) – Rapport d'interprétation du cycle 1.* WSP Canada Inc. report to Canadian Royalties Inc. 95 p. and appendix.

Appendix 1

ASSESSMENT REPORT ON POTENTIAL ACID GENERATION AND LEACHING FROM PUIMAJUQ WASTE ROCK (GOLDER, 2015)

REPORT

October 2015

NUNAVIK NICKEL MINE

Waste Rock Kinetic Testing Results from the Puimajuq Deposit. Rev1. Doc No. 094

Submitted to:
Canadian Royalties Inc.
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Report Number: 10-1118-0066/9102

Distribution:

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Golder Associates

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1.0 INTRODUCTION

Canadian Royalties Inc. (CRI), a subsidiary of Jilin Jien Nickel Industry Company Ltd. (Jien Nickel), is developing the Nunavik Nickel Project (NNP), a nickel-copper mine with platinum group elements (PGE). The NNP is located on the Ungava Peninsula, approximately 1800 kilometres (km) north of Montreal, 90 km west of the coastal village of Kangiqsujuaq and 20 km south of the Xstrata Nickel Raglan Mine (Map 1).

Four deposits, Mesamax, Expo, Mequillon and Ivakkak, were originally included in a feasibility study completed in 2007 and further updated in a Golder 2010 report. The Allamaq and Puimajuq deposits, which are located southeast of the Mesamax deposit, were discovered in 2007 (Map 2). While the Allamaq deposit has been included in the mine plan, studies are currently underway to incorporate the Puimajuq deposit into the overall project (Map 2).

Geochemical characterization of waste rock that will be exposed and handled during mining is required to formulate a mine waste management plan that is protective of the environment. CRI requested Golder Associates Ltd. (Golder) to conduct a geochemical sampling and analysis program of mine waste materials that may be generated from the exploitation of the Puimajuq deposit, including waste rock and ore.

This program was conducted over two stages. The first phase of testing included static testing methods to assess the chemical composition of mine waste (Golder, 2012), it's potential to generate acid rock drainage (ARD) and its potential to leach metals (ML) to the receiving environment upon exposure to ambient conditions.

The second phase of testing included kinetic and mineralogical testing on 3 representative samples, which were chosen based on the static results. This report discusses the results of kinetic tests completed on 3 samples of waste rock. It describes the methods utilized as part of the kinetic testing program, presents the interpreted test results, and provides recommendations on mine waste management planning.

The geochemical characterization program for Puimajuq waste is based on the recommendations of the following documents:

- "Directive 019 sur l'Industrie Minière. Gouvernement du Québec, Ministère du Développement durable, de l'Environnement et des Parcs, Direction des politiques de l'eau, Service des eaux industrielles. Envirodoq: ENV/2005/0120. Avril 2005" (MDDEP, March 2009 update, preliminary);
- "Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials" (MEND, 2009); and,
- "Global Acid Rock Drainage Guide" (GARD, 2009).

The reader is referred to previous Golder reports for results from testing programs on the other deposits at NNP (2007).

1.1 Information Reviewed

Background information on the mine plan, geology, mineralogy, and chemistry of rock types present at the site was extracted from the following documentation:

- Technical Report for the Puimajuq Deposit (NI43-101 report) (P&E 2009);
- Technical Report for the NNP (NI43-101 report) (P&E 2010);
- Geochemical Characterization of Waste Rock from the Puimajuq Deposit (Golder,2012) and,
- Geological cross-sections and maps provided by CRI.

PLOT DATE: March 27, 2013
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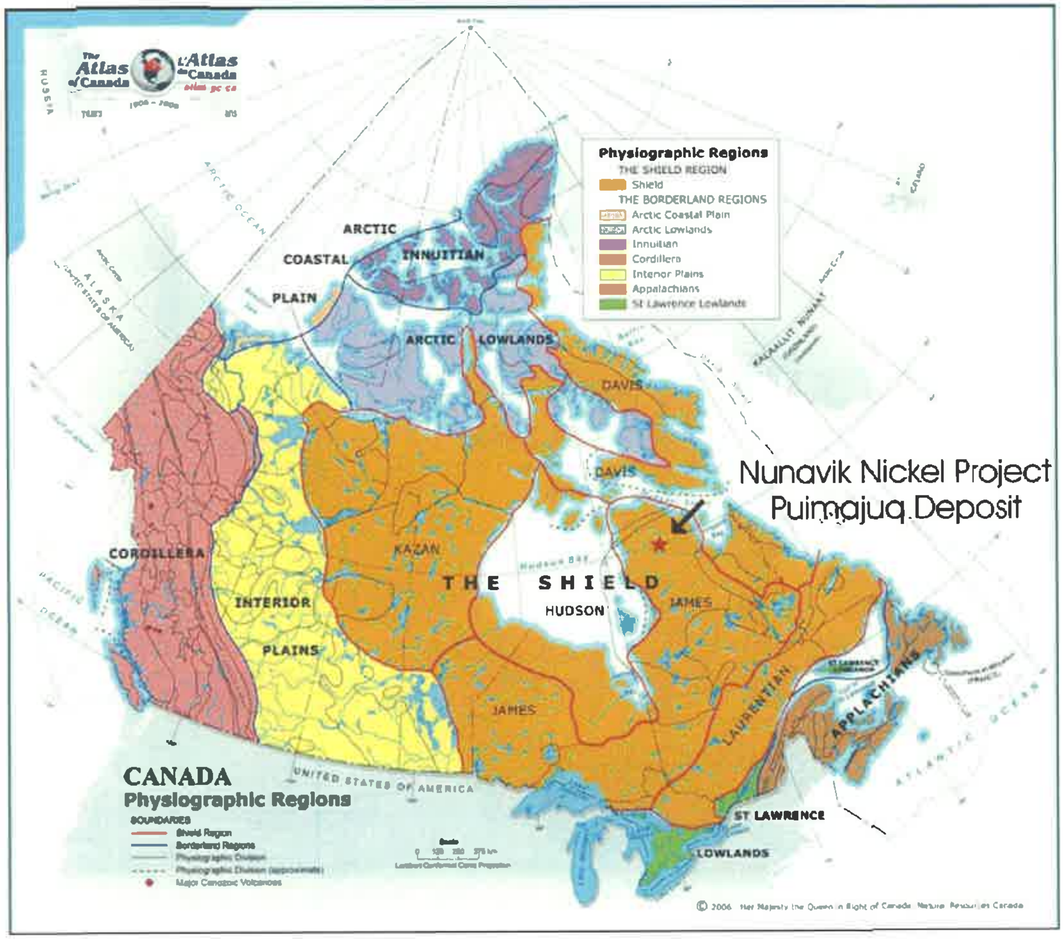

REFERENCE

IMAGE PROVIDED IN ELECTRONIC FORMAT BY P&E CONSULTANTS INC.
CRI-PUIMAJUQ REPORT No. 174

NOTE

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 10-1118-0066

Golder Associates
Ottawa, Ontario

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DATE	24 Feb. 2012
DESIGN	
CAD	P.L.G.
CHECK	A.J.S.
REVIEW	V.J.B.

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TITLE

SITE LOCATION MAP

CRI NUNAVIK NICKEL PROJECT / PUIMAJUQ DEPOSIT

MAP 1

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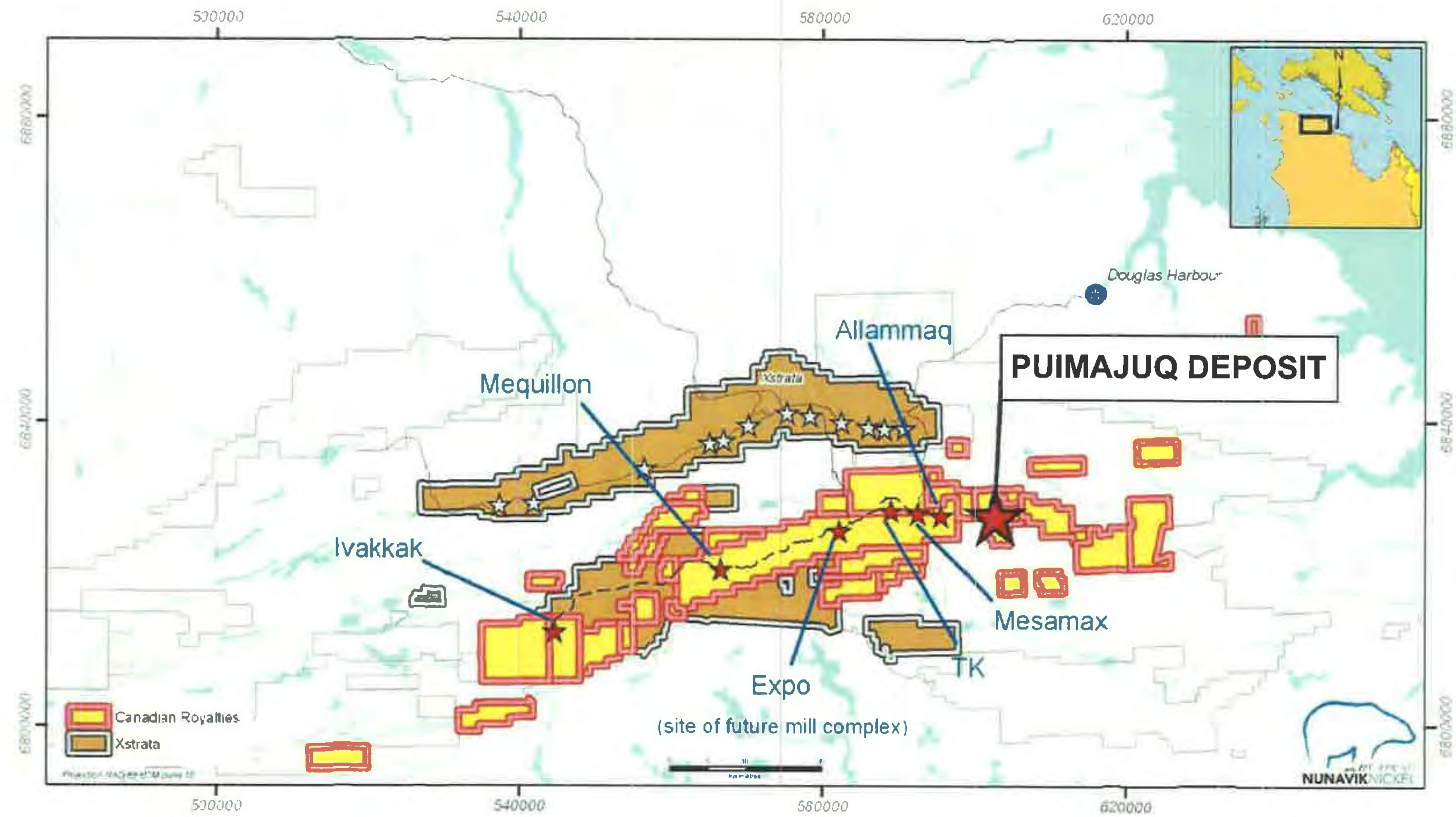

REFERENCE
IMAGE PROVIDED IN ELECTRONIC FORMAT BY P&E CONSULTANTS INC.
CRI-PUIMAJUQ Doc. No. 094

NOTE
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Golder Associates
Ottawa, Ontario

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REVIEW	V.J.B.

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PROJECT No. 10-1118-0066/9000/9102 REV. 0

TITLE
REGIONAL SITE LOCATION MAP
CRI NUNAVIK NICKEL PROJECT / PUIMAJUQ DEPOSIT
MAP 2

1.2 Study Area Description

The five main deposits of the NNP follow an east-west trend spanning approximately 50 km from east to west as follows: Allamaq, Mesamax, Expo, Mequillon and Ivakkak deposits (Map 2). Puimajuq, the focus of this report, is located east of the Allamaq deposit. This section describes the regional and site geology following the NI43-101 report (P&E, 2010) and summarizes the mine plan and waste management plans as understood to date.

1.3 Puimajuq Deposit Geology

Below is a summary of the regional geology of the NNP, which is presented in more detail in the Golder (2010) report.

All deposits of the NNP are magmatic sulphide deposits. The geology of the NNP is consistent between the major deposits, although their morphology is variable. The ultramafic rocks are the dominant rock type in most deposits, with pyroxenites and peridotites co-existing and often grading into each other, and are the main host rock for sulphide mineralization. Gabbros are present at each deposit with the exception of Expo, and are associated directly with the ultramafic rocks, as they often grade into an ultramafic rock and vice versa.

The overall form of the intrusion hosting the Puimajuq mineralization is dyke-like (P&E, 2010). Based on data from diamond drill holes, the intrusion is a near vertical pyroxenite dyke with little structural deformation. The Puimajuq deposit comprises primarily net-textured sulphides, with massive sulphides and very little disseminated sulphides. Grades are higher at the Puimajuq deposit than all other deposits on the Property (P&E, 2009). Like the other deposits, the dominant sulphide minerals include pyrrhotite (FeS), pentlandite [(Fe,Ni)S], and chalcopyrite ($CuFeS_2$) (P&E, 2010).

1.4 Summary of Mining Plan and Mine Waste Management Plans

Due to its shallow nature, the Puimajuq deposit will likely be mined through open pit techniques (P&E, 2009). Ore will be processed at the Expo mill facility and tailings will be deposited in the existing Expo Tailings and Waste Rock Disposal Facility. It is expected that the waste rock will be returned into the Puimajuq open pit.

2.0 SAMPLING AND ANALYTICAL PROGRAM

2.1 Kinetic Sample Selection

As part of the approved geochemical testing program for the Puimajuq deposit, 3 waste rock samples were submitted for kinetic testing. Samples were selected for kinetic testing on the basis of static test results (Golder, 2012) which were used to identify materials having a representative quantity of the elements of interest, namely, copper, chromium, nickel and sulfur. The Puimajuq waste rock is classified as having no ARD potential but having a metal leaching potential. Metals that were found to be leachable according to Quebec Directive 019, include chromium, copper and nickel (Table 1).

Table 1: Static Test Results and Waste Rock Proportions

Waste Rock Type[1]		Leachable Parameters[2]	ARD Designation[2]	Estimated Proportion of Waste[3] (%)
Puimajuq Nomenclature	Rock Type Nomenclature for other deposits (Golder 2010)			
Basalt	Mafic volcanic	Cu	Non-PAG	88%
Mafic Intrusive	Gabbro	Cu, Cr, Ni	Non-PAG	7%
Ultramafic Intrusive	Ultramafic (pyroxenite/peridotite)	Cu, Cr, Ni	Non-PAG	5%
Total				100%

Notes:

[1] Rock type names will be reported consistently with CRI nomenclature for the Puimajuq deposit. Equivalent rock type names reported for other deposits is provided here as reference.

[2] As per Directive 019.

[3] Tonnage estimates are currently not available. Waste rock proportions presented were calculated based on visual estimation by Golder using cross sections provided by CRI.

Ore material will report to tailings

Because there were no PAG samples identified in the static testing program, the focus of the kinetic testing was on the metal leaching potential of the mafic volcanic and basalt lithologies. Sample selection focused on characterizing lithologies that have the largest representation in the waste rock pile for each deposit. Factors considered in sample selection include compositional and spatial representativeness. Sample selection for kinetic testing focused on representing the average and high-end (upper quartile) concentration ranges for the constituents of interest to afford a level of conservatism in kinetic test results. Table 2 summarizes the kinetic selection rationale for each sample by showing the concentration of both the total metals (ICP) and leachate chemistry (SFE) for each parameter as concern. The percentile ranking for each sample is also provided, which is based on the overall results of the lithologies for each parameter of interest.

Table 2: Kinetic Selection Rational Percentile Ranking

Sample No.	Lithology	Total Cr (ug/g)		Leachable Cr* (mg/L)		Total Cu (ug/g)		Leachable Cu* (mg/L)		Total Ni (ug/g)		Leachable Ni* (mg/L)	
NF-08-18-03	Basalt	44	50th percentile	0.0074	100th percentile	51	50th percentile	0.0043	40th percentile	25	50th percentile	0.027	50th percentile
NF-07-03-02	Basalt	54	77th percentile	0.0056	75th percentile	61	67th percentile	0.0094	80th percentile	28	74th percentile	0.022	40th percentile
NF-08-14-01	Mafic Intrusive	250	100th percentile	0.020	75th percentile	61	65th percentile	0.031	73rd percentile	99	80th percentile	0.047	55th percentile

Note: * Leachable criteria based on TCLP results as SPLP results are mostly <method detection limits.

2.2 Kinetic Test Method

Kinetic tests are used to evaluate long-term weathering characteristics of the waste rock. The test apparatus used in the current study consists of a humidity cell, (ASTM method D5744-96, 2001) which simulates weathering under surface (subaerial) conditions by subjecting sample of waste rock to alternate periods of moist and dry air, for a minimum of twenty 1-week cycles or until ARD conditions develop and/or stable leaching rates are obtained. The test method is designed to accelerate the rate of weathering of geologic materials in order to quantify potential consequences of weathering on the receiving environment within a reasonable amount of time. Actual weathering rates under ambient conditions are highly dependent on site-specific characteristics such as, for example, the amount of water coming in contact with the rock, the range of particle sizes in the pile and site climate.

2.2.1 Humidity Cell Operation

Each humidity cell contained a 1-kg sample (dry equivalent) of waste rock that has previously been crushed to <6.3 mm. The test charge (the rock sample) was pre-leached (Cycle 0) with 1 L of deionized water, following which weekly leaching cycles were initiated. The weekly cycles include a 3-day period where dry air is circulated in the cell followed by a 3-day period where humid air is circulated in the cell and a final leach day when the cell is flooded with 1 L of distilled water (1:1 liquid to solid ratio by weight). After 1 hour of retention, the leach water is drained from the bottom of the cell, filtered (0.45 µm filter) and collected for analysis. Approximately 1 L of leachate was collected for analysis of short- and long-suite groups as follows:

- Short suite parameter group with weekly analysis from Cycle 0 to 23, including:
  - volume recovered, pH, conductivity, alkalinity, acidity, sulphate, and calcium; and,
- Long suite parameter group with analysis at Cycle 0, 1, 2, 3, 4, 5, 8, 12, 16 and 20:
  - chloride, dissolved aluminum, antimony, arsenic, barium, bismuth, boron, cadmium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, sodium, strontium, thallium, tin, titanium, uranium, vanadium, and zinc.

Kinetic testing was conducted at SGS Canada Inc. (SGS). Table 3 summarizes the duration of testing for each sample.

Table 3: Kinetic Test Cell Duration

Deposit	Rock Type	Sample ID	Final Reported Week
Puimajuq	Mafic Intrusive	NF-08-14-01	23
	Basalt	NF-07-03-02	23
	Basalt	NF-08-18-03	23

2.2.2 Time Equivalency of Kinetic Test

The ASTM method represents accelerated weathering compared to actual site conditions, with humidity cell weathering rates estimated to be at least one order of magnitude greater than actual weathering rates (ASTM D 5744-96). At NNP, leaching of mine wastes at site will occur only during times when the ground and waste is frost-free, which is assumed to be six months of each year (26 weekly cycles per year). Furthermore, site climate is such that the proportion of water (as precipitation) to rock is much lower on site compared to the amount of water added to humidity cells on a weekly basis. The lower amount of water at site will result in a slower rate of dissolution of neutralizing minerals. Additionally, the lower site temperature (during summer months) than laboratory test temperature is expected to decrease the sulphide mineral oxidation rate. The influence of temperature on chemical reaction rates is described by the Arrhenius equation. Case studies of leaching tests performed at different temperatures document the slower rates of sulphide oxidation in cold temperature relative to room temperature (Meldrum *et al.*, 2001; Davé and Clulow, 1996). In general, the effect on leaching rates of major ions is a two-fold decrease for every 10°C decrease in laboratory temperature (Davé and Blanchette, 1999; DDM, 1998).

Not considering the potential for future warming of site climate, a reasonable time equivalency bracket is estimated at 1 laboratory cycle for 10 to 20 weeks of weathering under site conditions. Twenty weeks of leaching at the laboratory therefore is anticipated to be equivalent to approximately 4 to 8 years of weathering under site conditions.

2.3 Comparative Criteria

HCT leachate chemistry results are compared to Directive 019 effluent criteria (Directive 019, March 2012). Quebec groundwater quality criteria reporting to surface water (RESIE) are also considered for comparative purposes only since waste will be stored in or on permafrost with no exploitable groundwater present. The RESIE hardness-dependant parameters (Ag, Ba, Cd, Cu, Mn, Ni, Pb and Zn) assume a water hardness of 50 mg/L.

3.0 KINETIC TESTING RESULTS

The results of kinetic testing for all samples are presented in Appendix A as figures that illustrate key parameter concentrations versus time for all test cells. Results are tabulated in Appendix B.

Three Puimajuq samples were submitted for kinetic testing in 2012 as described in Table 4. The three samples were terminated as they achieved steady state conditions and were used to determine the long term potential for acid generation and steady state pH conditions.

Table 4: Summary of Puimajuq Humidity Cell Tests

Rock Type	Sample ID	Test Year	Test Cycle	Test Status	Rationale
Mafic Intrusive	NF-08-14-01	2012	23	terminated	steady state conditions achieved
Basalt	NF-07-03-02	2012	23	terminated	steady state conditions achieved
Basalt	NF-08-18-03	2012	23	terminated	steady state conditions achieved

3.1 Puimajuq Mafic Intrusive (sample NF-08-14-01)

Based on the results of static analysis, the mafic intrusive lithology is non-acid generating (non-PAG), but is classified as leachable for chromium, copper and nickel. Rainwater leach static test results (SPLP) report no parameters exceeding the Quebec Groundwater or Quebec Effluent Criteria (Golder, 2012).

This sample reported neutral to alkaline pH values (pH 8.8 in week zero) that stabilized to neutral (pH 7.5) from week three through to the remainder of testing.

Generally, the concentration of parameters in the leachate was stable after cycle 5. All metal concentrations were below both the Groundwater Criteria (RESIE) and the Effluent Criteria for all elements and all cycles.

3.1.1 Mineralogy

The mafic intrusive sample consisted primarily of actinolite (39 weight percent or wt. %), plagioclase feldspar (29 wt. %), clinochlore (11 wt. %), clinozoisite (8.3 wt. %) and titanite (6.7 wt. %) with lesser biotite (2.9 wt. %) and quartz (2.0 wt. %). This sample contains calcite at a low concentration of 0.50 wt. %. No sulphide minerals were detected in any samples. Tabulated results are provided in Appendix C.

3.2 Puimajuq Basalt Samples (NF-07-03-02 and NF-08-18-03)

Based on the results of static analysis, the basalt rocks are classified as non-PAG and non-leachable. Rainwater leach static test results (SPLP) report no parameters exceeding the Groundwater or Effluent Criteria (Golder, 2012).

These samples reported neutral to alkaline pH values that stabilized to a neutral pH after an initial decrease during the first flush. The pH value reported for NF-07-03-02 was 8.9 in week zero, and stabilized to near 7.5 at week two through the remainder of testing. The pH value reported for NF-08-18-03 was 7.9 in week zero, and fluctuated between 7.0 and 7.6 from week four through to the remainder of testing.

Generally, parameters were stable after cycle 8. Metals reported concentrations in leachates that were below both Groundwater (RESIE) and Effluent Criteria.

3.2.1 Mineralogy

The two basalt samples consisted primarily of actinolite (40 to 45 weight percent or wt. %), plagioclase feldspar (8.7 to 23 wt. %), clinochlore (11 to 14 wt. %), clinozoisite (9.9 to 14 wt. %) and titanite (2.9 to 6.9 wt. %) with lesser amounts of quartz (1.0 to 2.1 wt. %). Sample NF-07-03-02 had 2.7 wt. % of biotite, while NF-08-14-01 contained 8.5 wt. % of muscovite. Both samples contain calcite at low concentrations (0.40 to 0.70 wt. %). No sulphide minerals were detected in either sample. Tabulated results are presented in Appendix C.

4.0 INTERPRETATION OF RESULTS

This section provides observations with regard to environmental risk of the Puimajuq waste rock types based on the scope of testing conducted to date, including static and kinetic test results.

The classification of materials under Quebec Directive 019 utilizes static test methods. However, kinetic testing is considered to be better suited to represent the likely site drainage quality over the long term than static leach tests because of the following:

- The nature of the contact between the infiltrating water and the waste in kinetic tests more closely simulate the infiltration of water through a rock pile as opposed to agitated mixing of rock and water in a short-term leach test;
- The lower solution-to-solid ratio used in the kinetic tests which more closely represents the climate conditions at site; and,
- The long-term testing allows for the evaluation of transient chemical processes such as sulphide oxidation and other weathering reactions.

Thus, kinetic weathering test results are also used in the evaluation of risk to the receiving environment rather than the exclusive use of static test results.

Table 5 summarizes rock classification my lithology and presents mine waste management requirements per Directive 019.

Table 5: Summary of Mine Waste Rock Classification and Management

Rock Type	Estimated Proportion of Waste[1]	Bulk Waste Classification (Static Testing)		Bulk Waste Classification (Kinetic Testing)	
		ARD Potential[2]	TCLP Leachability[3]	Leachate pH[4]	Metal Leaching[5]
Ore	to tailings	PAG	Leachable	Not Tested	Not Tested
Mafic intrusive	7%	non PAG	Leachable	neutral	none
Ultramafic intrusive	5%	non PAG	Leachable	Not Tested	Not Tested
Basalt	88%	non PAG	Non-leachable	neutral	none

Notes:

[1] Approximate proportion of waste calculated for each deposit determined by Golder through visual observation of cross-sections

[2] Per Quebec Directive 019, March 2012

[3] Leachability classification under Directive 019 (March, 2012), where TCLP concentrations exceed Quebec Groundwater Criteria and solid chemical concentrations exceed Soil Criteria A

[4] Leachate pH of long-term kinetic testing relative to Quebec Effluent Criteria (pH<6.0 considered acidic)

[5] Metal leaching potential based on humidity cell concentrations exceeding Quebec Groundwater or Effluent criteria

PAG: potentially acid-generating

ARD: acid rock drainage

The kinetic test results support the non-PAG classification of the mafic intrusive lithology, as pH values were neutral throughout kinetic testing. In addition, metal concentrations remained below Quebec Groundwater (RESIE) and Effluent criteria throughout testing. This does not support the "leachable" classification of waste rock assigned from static test results alone.

The kinetic test results on basalt samples support the static result classification of non-PAG and non-leachable, as pH values were neutral and metal concentrations in leachates remained below the Quebec Groundwater and Effluent Criteria throughout testing.

5.0 MINE WASTE ROCK MANAGEMENT CONSIDERATIONS

Based on the results to date of the static and kinetic test programs, basalts which make up approximately 88% of the waste rock is non-acid generating and non-leachable and therefore low risk. The remaining mafic and ultramafic intrusive rocks are also non PAG but are classified as leachable according to Directive 019, although the mafic intrusive rock tested released very low concentrations of chemicals during testing. The risk of contact water quality exceeding the RESIE criteria are considered low.

6.0 RECOMMENDATIONS

At the time of reporting, no waste rock or ore tonnages were available. In order to better define the geochemical properties of the waste rock lithologies, confirmed tonnages produced during mining operations are necessary. It is also recommended that:

- Sampling and analysis of all mine wastes removed during mining be conducted to verify the results of the geochemical characterisation program; and,
- Any drainage water contacting mine wastes during operation be captured and monitored for quality prior to discharge to the receiving environment.

7.0 LIMITATIONS AND USE OF REPORT

This report was prepared for the use of Canadian Royalties Inc. The report, which specifically includes all tables, figures and appendices, is based on data and information collected during the subsurface environmental investigation conducted by Golder Associates Ltd. and from samples provided to Golder Associates Ltd. for analysis, and is based solely on the conditions of the properties and samples at the time of the investigation, supplemented by historical information and data obtained by Golder Associates Ltd. as described in this report.

Except where specifically stated to the contrary, the information contained in this report (such as geology data, mine plans, metallurgical process information amongst other data) was provided to Golder Associates Ltd. by others and has not been independently verified or otherwise examined by Golder Associates Ltd. to determine its accuracy or completeness. Golder Associates Ltd. has relied in good faith on this information and does not accept responsibility for any deficiency, misstatements, or inaccuracies contained in the information as a result of omissions, misinterpretation, fraudulent acts or the persons interviewed or contacted or errors or omissions in the reviewed documentation.

The assessment of the geochemical characteristics of mining wastes for this project has been made using the results of chemical analysis of discrete samples from a limited number of locations. The geochemical characteristics between sampling locations or during operation have been inferred based on conditions observed at these specific locations. Subsurface conditions may vary between sample locations. Additional study, including further subsurface investigation, can reduce the inherent uncertainties associated with this type of study. However, it is never possible, even with exhaustive sampling and testing, to dismiss the possibility that part of a site may have considerably different characteristics.

The services performed as described in this report were conducted in a manner consistent with that level of care and skill normally exercised by other members of the geoscience profession currently practising under similar conditions, subject to the time limits and financial and physical constraints applicable to the services. Any use which a third party makes of this report, or any reliance on, or decisions to be made based of it, are the responsibilities of such third parties. Golder Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The content of this report is based on information collected during our investigation, our present understanding of the site conditions, and our professional judgement in light of such information at the time of this report. This report provides a professional opinion and therefore no warranty is either expressed, implied, or made as to the conclusions, advice and recommendations offered in this report. This report does not provide a legal opinion regarding compliance with applicable laws; regulatory statutes and the interpretation of regulatory statutes are subject to change.

The findings and conclusions of this report are valid as of the date of this report. If new information is discovered in future work, including excavations, borings, samples collected during mine operation or other studies, Golder Associates Ltd. should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

8.0 CLOSURE

We trust this report satisfies your current needs. If you have any questions regarding this report, please contact the undersigned.

GOLDER ASSOCIATES LTD.

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9.0 REFERENCES

ASTM D 5744 – 96. 2001. Standard Test Method for Accelerated Weathering of Solid Materials Using a Modified Humidity Cell.

Davé, N.K. and Blanchette, M. 1999. Role of Cold Climatic Conditions in Management of Reactive Mining Waste in Northern Canada. Mining in the Arctic. Udd & Keen Editors. Balkema. Rotterdam. pp. 115-124.

Davé, N.K. and Clulow, V. 1996. Column Leaching Characteristics of Cullaton Lake B and Shear(S)-Zone Tailings, Phase 2: Cold Temperature Leaching Final Report. Mine Environment Neutral Drainage (MEND) Project 1.61.3. Natural Resources Canada.

Environment Canada, 2010. Canadian Climate Normals 1971-2000 for Kuujuqa, Québec. http://www.climate.weatheroffice.gc.ca/climate_normals/results_e.html?Province=ALL&StationName=Kuujjuaq&SearchType=BeginsWith&LocateBy=Province&Proximity=25&ProximityFrom=City&StationNumber=&IDType=MSC&CityName=&ParkName=&LatitudeDegrees=&LatitudeMinutes=&LongitudeDegrees=&LongitudeMinutes=&NormalsClass=A&SelNormals=&StnId=6095&&autofwd=1 (accessed on November 4, 2010).

Golder Associates Ltd., 2010, Static Testing of Waste Rock from Allamaq, Mesamax, Expo, Mequillon and Ivakkak Deposits, November 2010. 10-1118-0088

Golder Associates Ltd. 2012. Geochemical Characterization of Waste Rock from the Puimajuq Deposit, Canadian Royalties Inc. Nunavik Quebec, February 2012. 10-1118-0066.

Meldrum, J.L., H.E Jamieson, and L.D. Dyke. 2001. Oxidation of Mine Tailing from Rankin Inlet, Nunavut, at Subzero Temperatures. Canadian Geotechnical Journal. Vol. 38. pp. 957-966.

MEND, 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report 1.20.1. Mining Environment Neutral Drainage Program, Natural Resources Canada. December 2009.Lawrence, R.W. and Y. Wang. (1996), Determination of Neutralization Potential for Acid Rock Drainage Prediction, MEND Report 1.16.3, Ottawa, ON, 149 p.

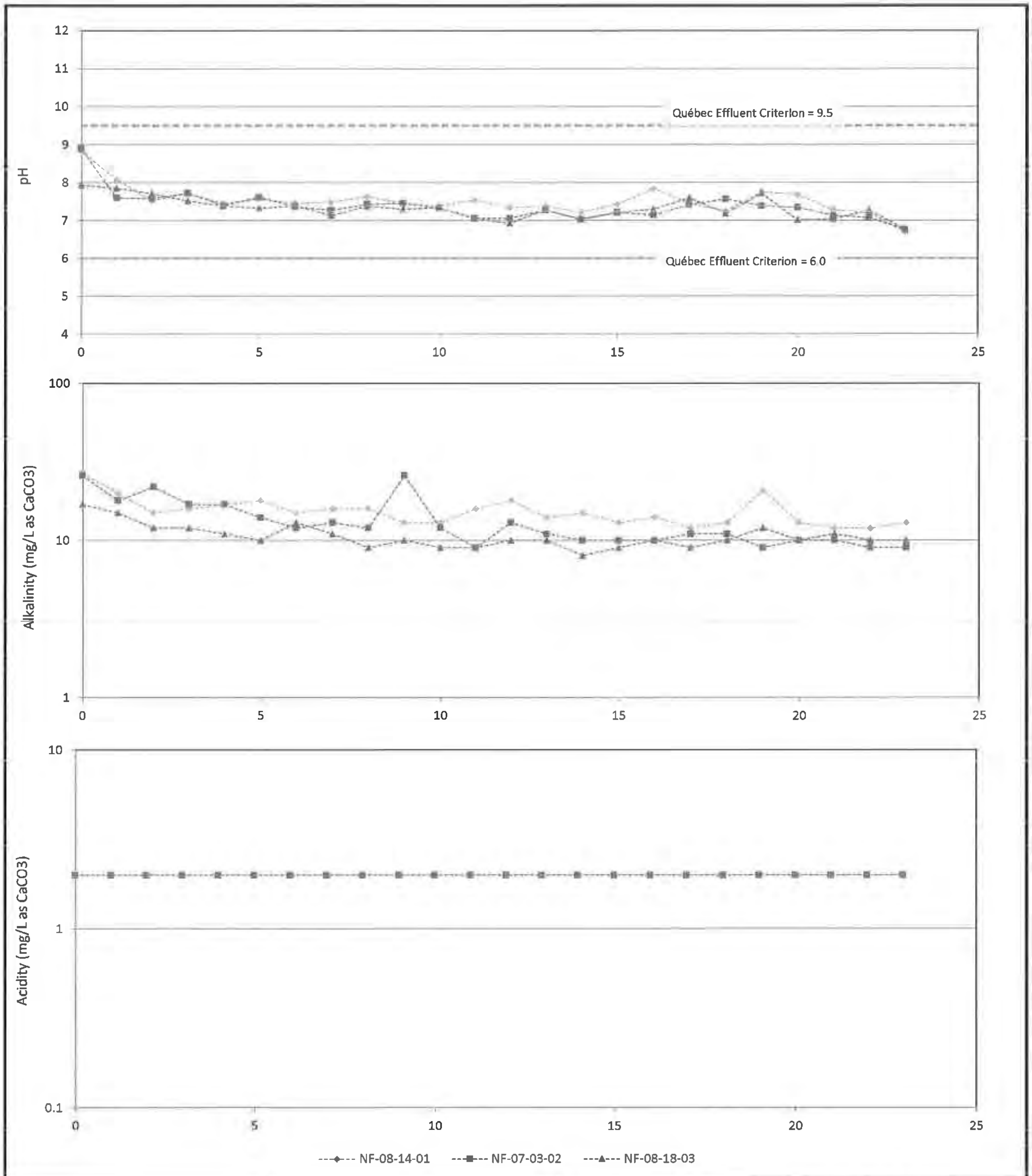
P&E 2010. Technical Report on the Allamaq, Expo, Ivakkak, Mequillon, Mesamax, and Puimajuq Ni-Cu-PGE Deposits of the Nunavik Nickel Project. Nunavik, Québec. Prepared for Canadian Royalties Inc. by P&E Mining Consultants Inc. NI43-101 and 43-101F1 Technical Report.

P&E 2009. Technical Report on the Puimajuq Ni-Cu-PGE Deposit, Nunavik Nickel Project. Nunavik, Québec. Prepared for Goldbrook Ventures Inc. by P&E Mining Consultants Inc. NI43-101 and 43-101F1 Technical Report.

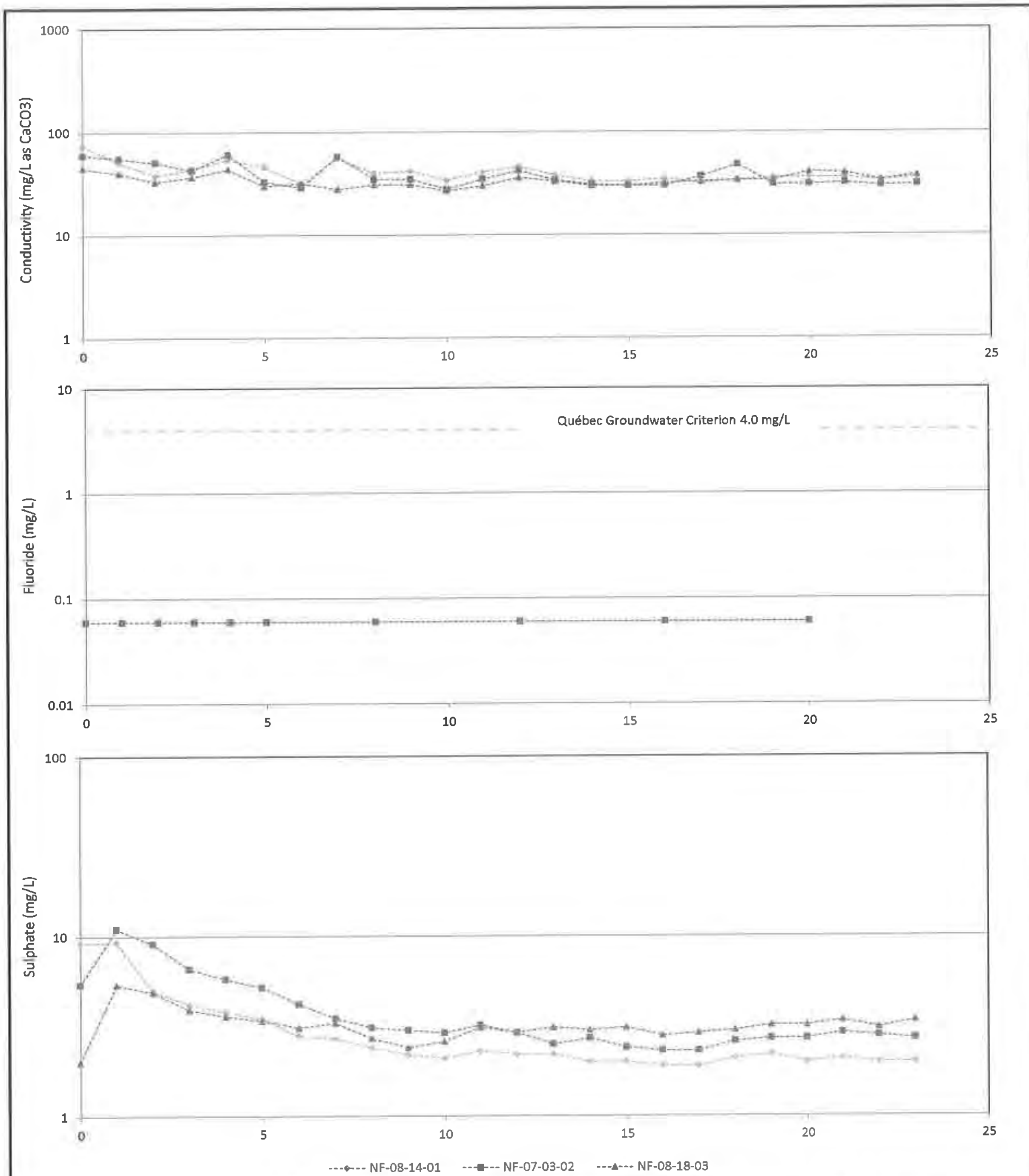
Québec, 2012. Directive 019 Sur L'Industrie Minière. Gouvernement du Québec, Ministère du Développement durable, de l'Environnement et des Parcs, Direction des politiques de l'eau, Service des eaux industrielles. Version mars 2012.

APPENDIX A

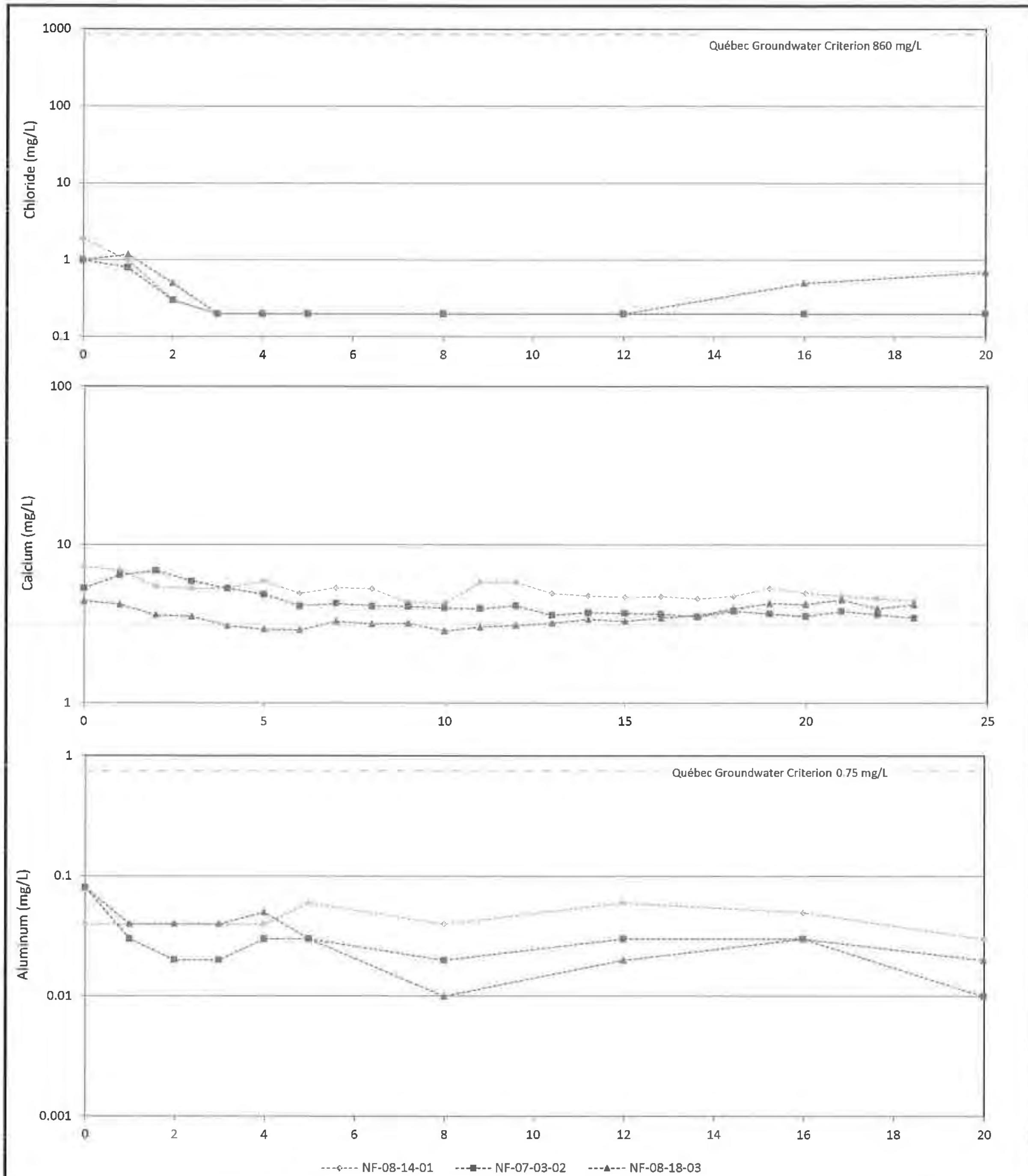
Kinetic Results – Figures



Notes:	Rock Type:	pH Alkalinity Acidity	Kinetic Test Data Puimajuq Waste Rock
Values < MDL are plotted as MDL value	Mafic Intrusive Basalt	DRAWN: LMC; DATE: Apr-13; CHECKED: DH / AJS; JOB NO: 10-1118-0066; REVIEWED: VJB; PHASE/TASK: 9102	Canadian Royalties Inc. Golder Associates; Appendix A.1



Notes:	Rock Type:	Conductivity Fluoride Sulphate	Kinetic Test Data Puimajuq Waste Rock
Values < MDL are plotted as MDL value	Mafic Intrusive Basalt	DRAWN LMC; DATE Apr-13 CHECKED DH / AJS; JOB NO 10-1118-0066 REVIEWED VJB; PHASE/TASK 9102	Canadian Royalties Inc. — Golder Associates Appendix A.2



Notes:	Rock Type:	Chloride Calcium Aluminum	Kinetic Test Data Puimajuq Waste Rock
Values < MDL are plotted as MDL value	Mafic Intrusive Basalt	DRAWN LMC / DATE Apr-13 CHECKED DH / AJS / JOB NO 10-1118-0066 REVIEWED VJB / PHASE/TASK 9102	Canadian Royalties Inc. Golder Associates Appendix A.3

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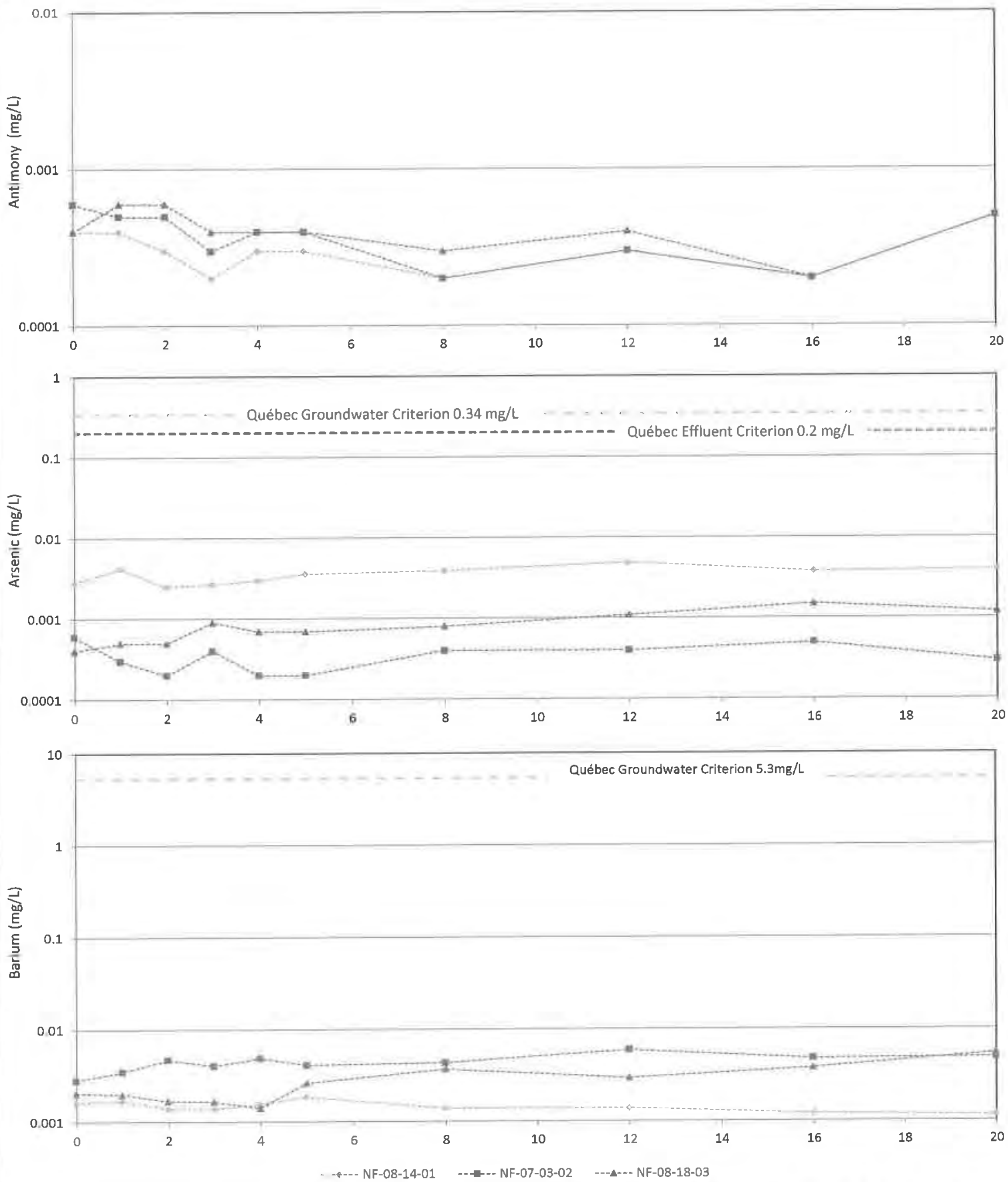
Puimajuq_kinetic_tables and figures_26Mar13.xlsx



Notes: Values < MDL are plotted as MDL value	**Rock Type:** Mafic Intrusive Basalt	**Antimony Arsenic Barium**				**Kinetic Test Data Puimajuq Waste Rock**
		DRAWN	LMC	DATE	Apr-13	Canadian Royalties Inc. Golder Associates
		CHECKED	DH / AJS	JOB NO	10-1118-0066	
		REVIEWED	VJB	PHASE/TASK	9102	Appendix A.4

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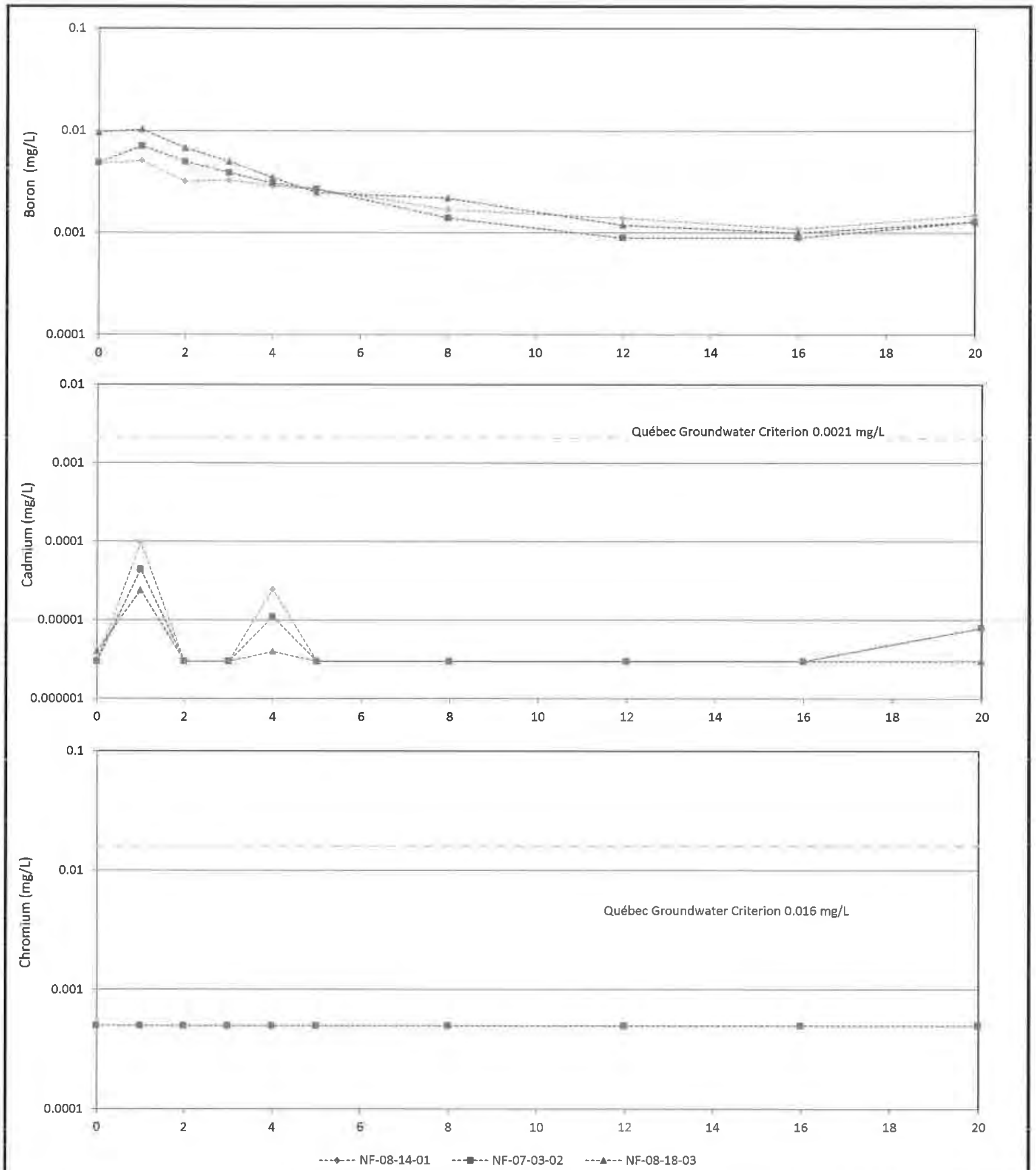
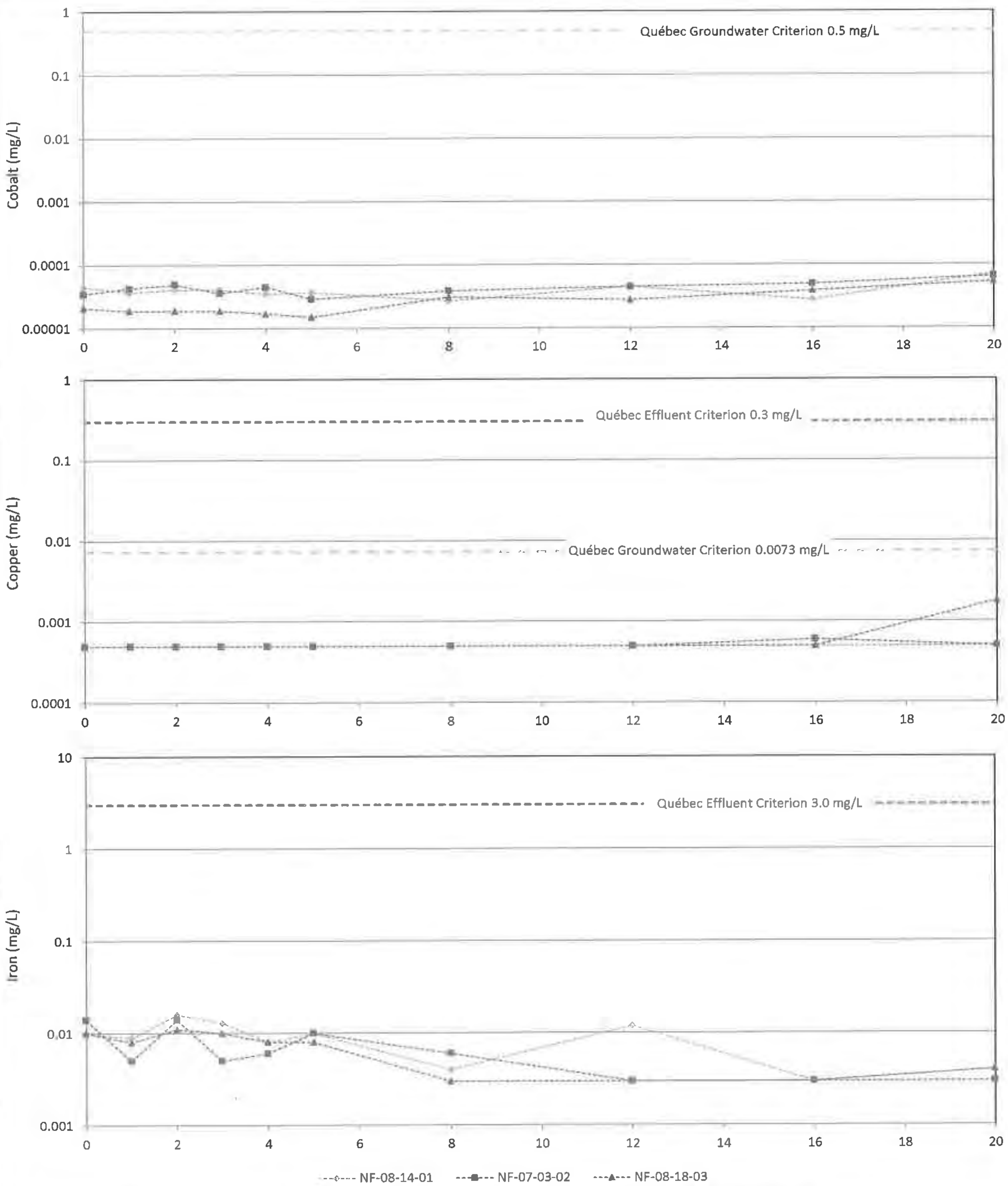
Puimajuq_kinetic_tables and figures_26Mar13.xlsx



Notes: Values < MDL are plotted as MDL value	Rock Type: Mafic Intrusive Basalt	Boron Cadmium Chromium DRAWN LMC · DATE Apr-13 CHECKED DH / AJS · JOB NO 10-1118-0066 REVIEWED VJB · PHASE/TASK 9102	**Kinetic Test Data** **Puimajuq Waste Rock** **Canadian Royalties Inc.** Golder Associates **Appendix A.5**



Notes:	Rock Type:	Cobalt Copper Iron	Kinetic Test Data Puimajuq Waste Rock
Values < MDL are plotted as MDL value	Mafic Intrusive Basalt	DRAWN LMC; DATE Apr-13; CHECKED DH / AJS; JOB NO 10-1118-0066; REVIEWED VJB; PHASE/TASK 9102	Canadian Royalties Inc. Golder Associates
			Appendix A.6

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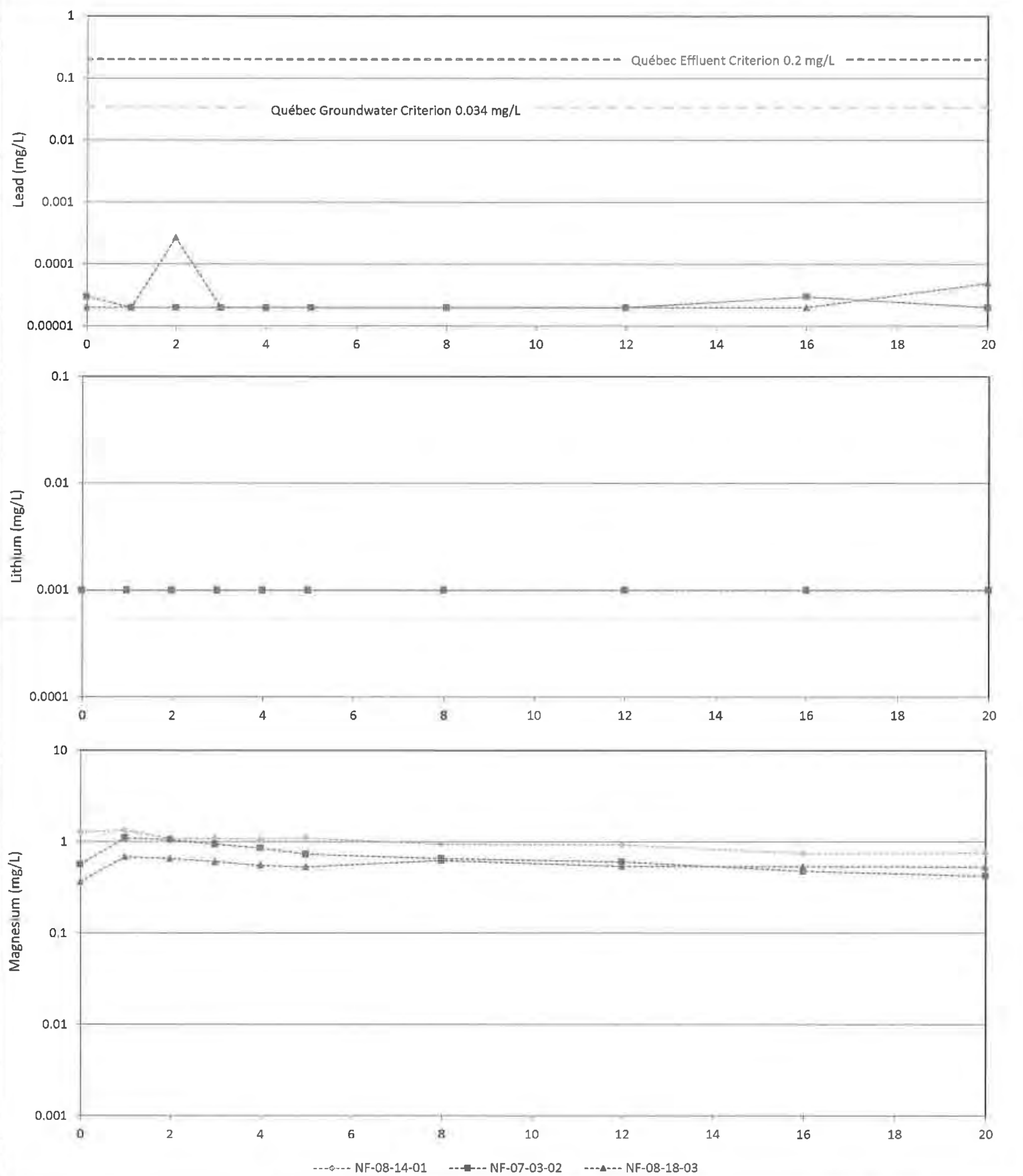
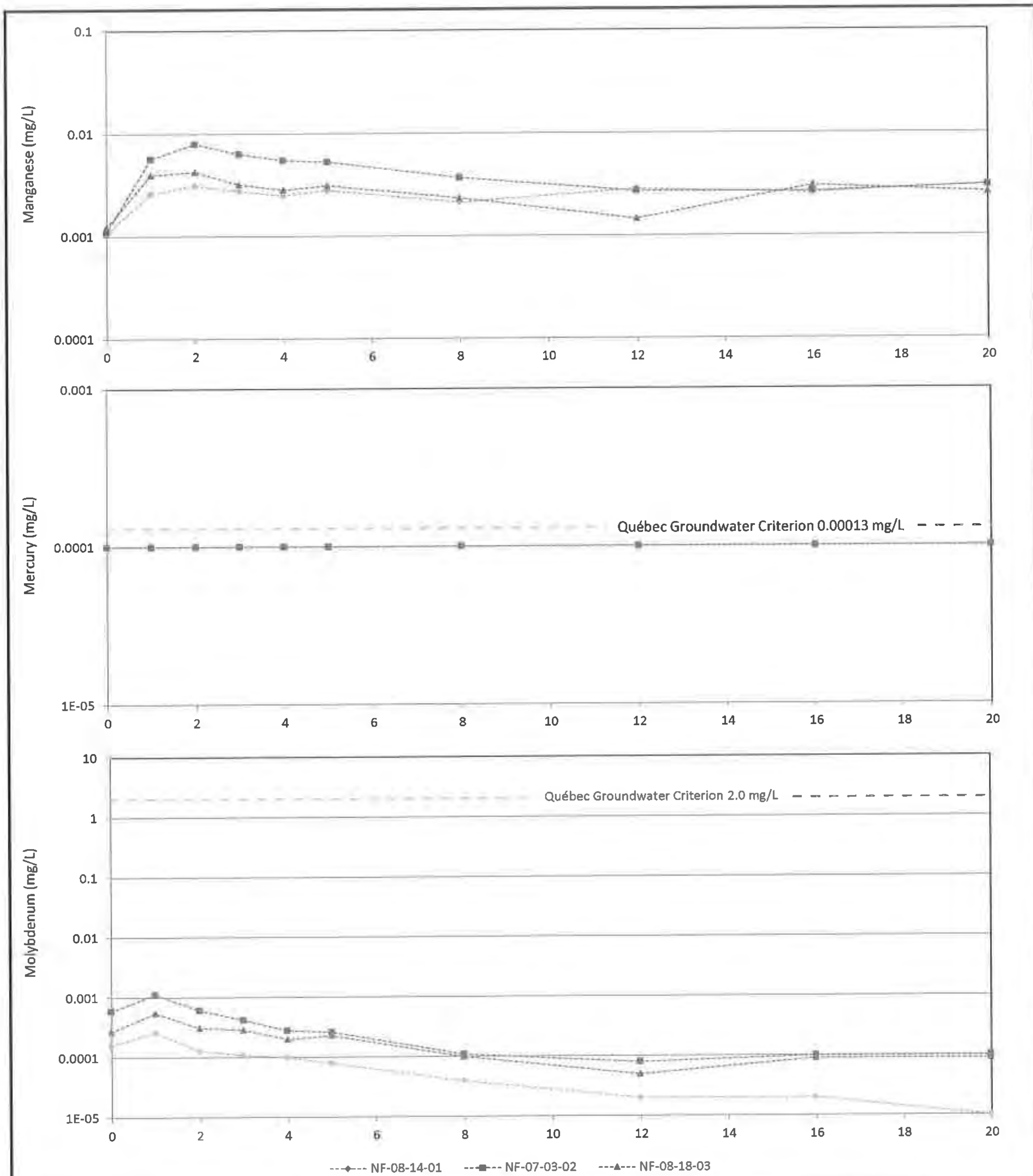
Pumajiuq_kinetic_tables and figures_26Mar13.xlsx



Notes:	Rock Type:	Lead Lithium Magnesium	Kinetic Test Data Puimajuq Waste Rock
Values < MDL are plotted as MDL value	Mafic Intrusive Basalt	DRAWN LMC; DATE Apr-13; CHECKED DH / AJS; JOB NO 10-1118-0066; REVIEWED VJB; PHASE/TASK 9102	Canadian Royalties Inc. Golder Associates
			Appendix A.7



Notes:	Rock Type:	Manganese Mercury Molybdenum	Kinetic Test Data Puimajuq Waste Rock
Values < MDL are plotted as MDL value	Mafic Intrusive Basalt	DRAWN: LMC; DATE: Apr-13 CHECKED: DH / AJS; JOB NO: 10-1118-0066 REVIEWED: VJB; PHASE/TASK: 9102	Canadian Royalties Inc. Golder Associates Appendix A.8

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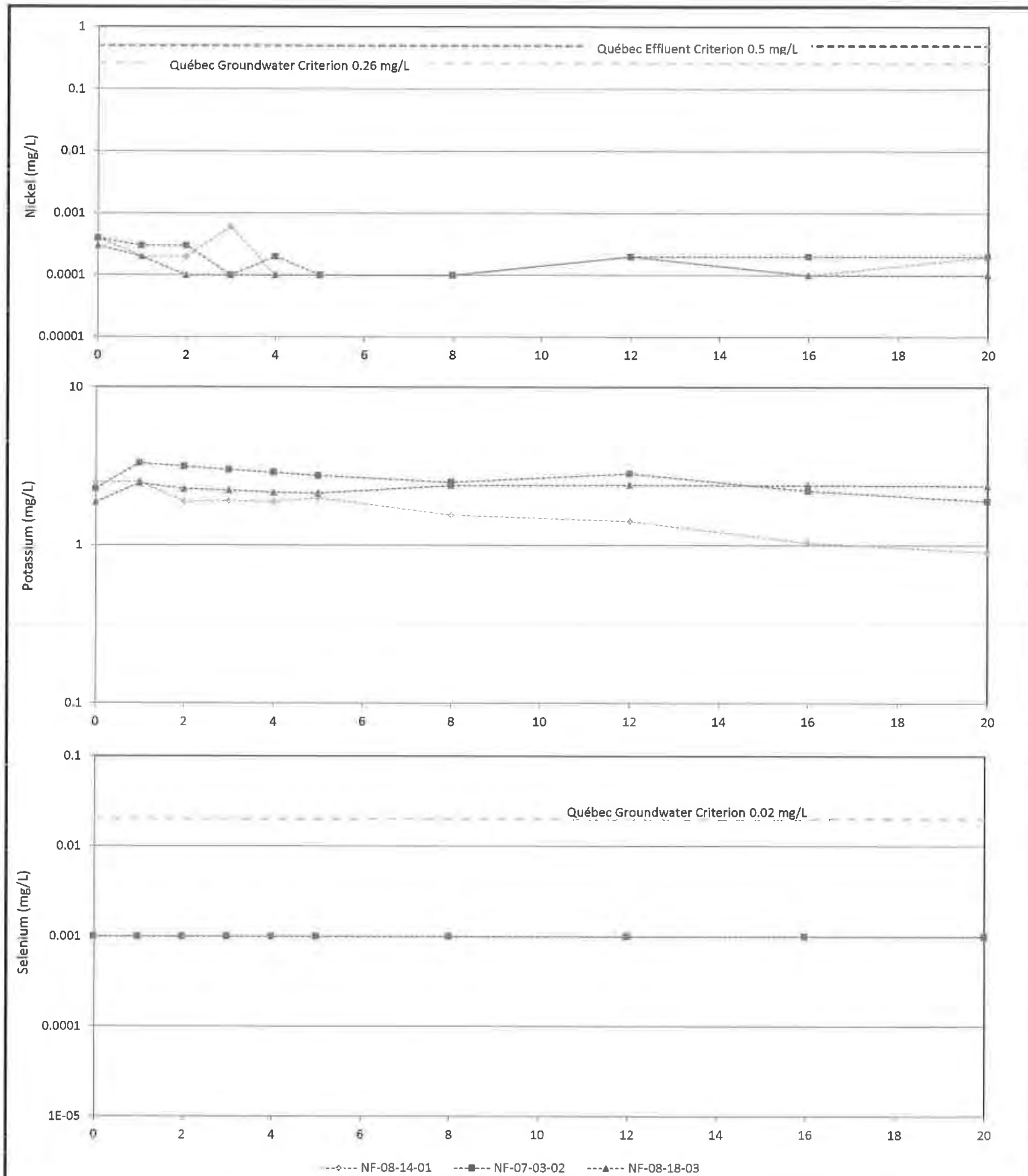

Notes:	Rock Type:		Kinetic Test Data Puimajuq Waste Rock
Values < MDL are plotted as MDL value	Mafic Intrusive Basalt	Nickel Potassium Selenium	Canadian Royalties Inc.

DRAWN	LMC	DATE	Apr-13
CHECKED	DH / AJS	JOB NO	10-1118-0066
REVIEWED	VJB	PHASE/TASK	9102

Golder Associates

Appendix A.9

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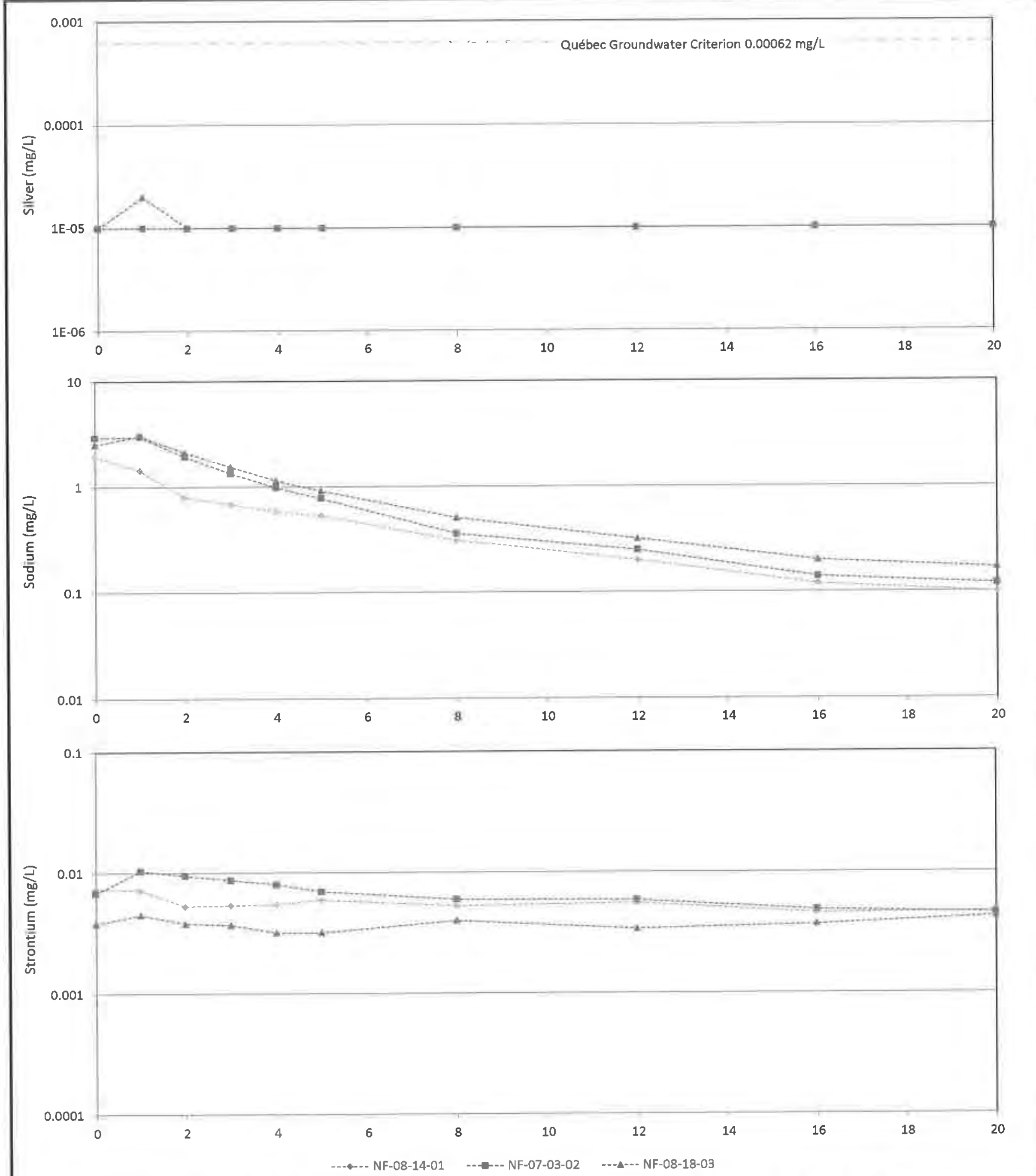

Notes:

Values < MDL are plotted as MDL value

Rock Type:
Mafic Intrusive
Basalt

Silver
Sodium
Strontium

DRAWN	LMC	DATE	Apr-13
CHECKED	DH / AJS	JOB NO	10-1118-0066
REVIEWED	VJB	PHASE/TASK	9102

Kinetic Test Data
Puimajuq Waste Rock

Canadian Royalties Inc.

Golder Associates

Appendix A.10

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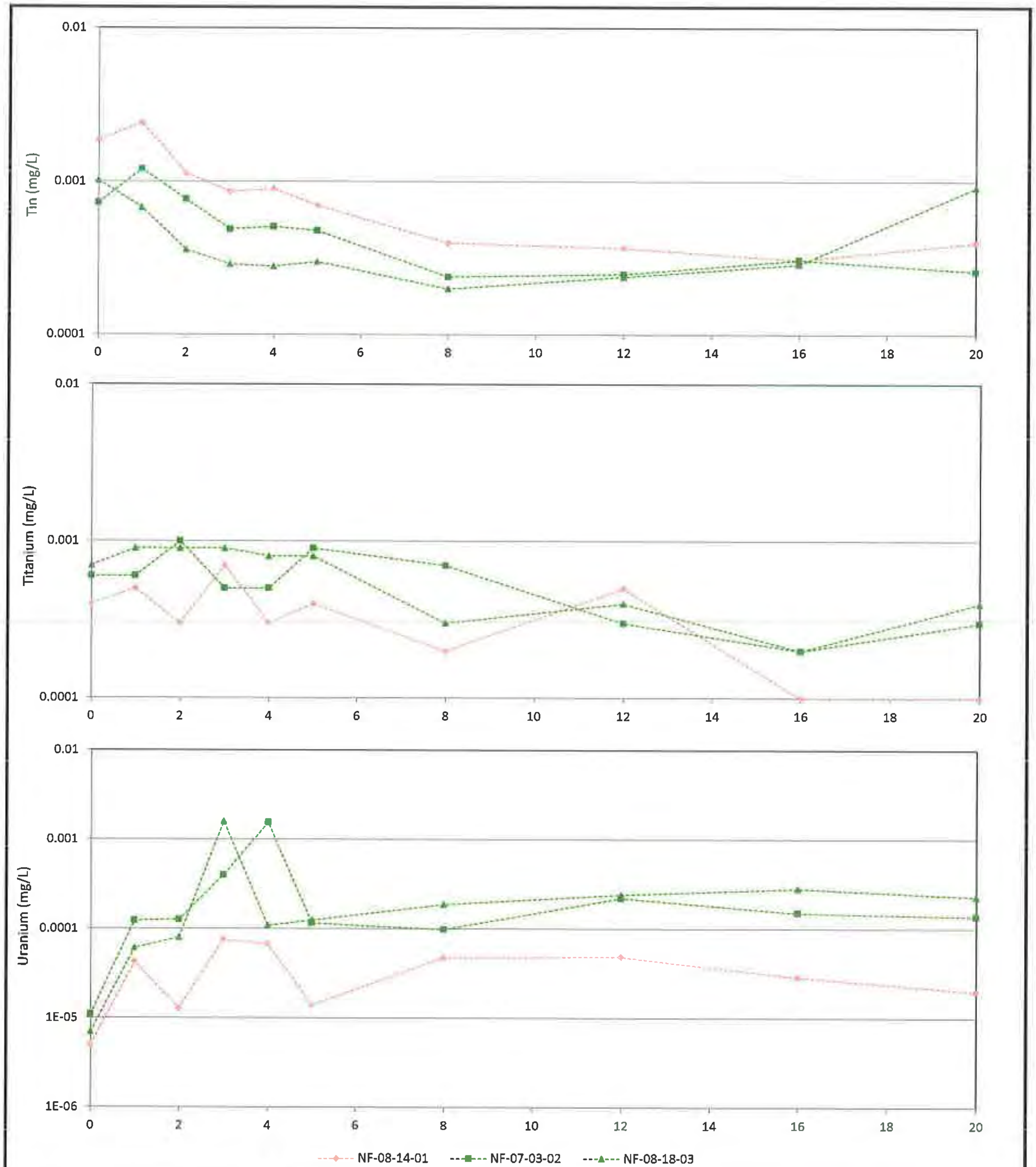
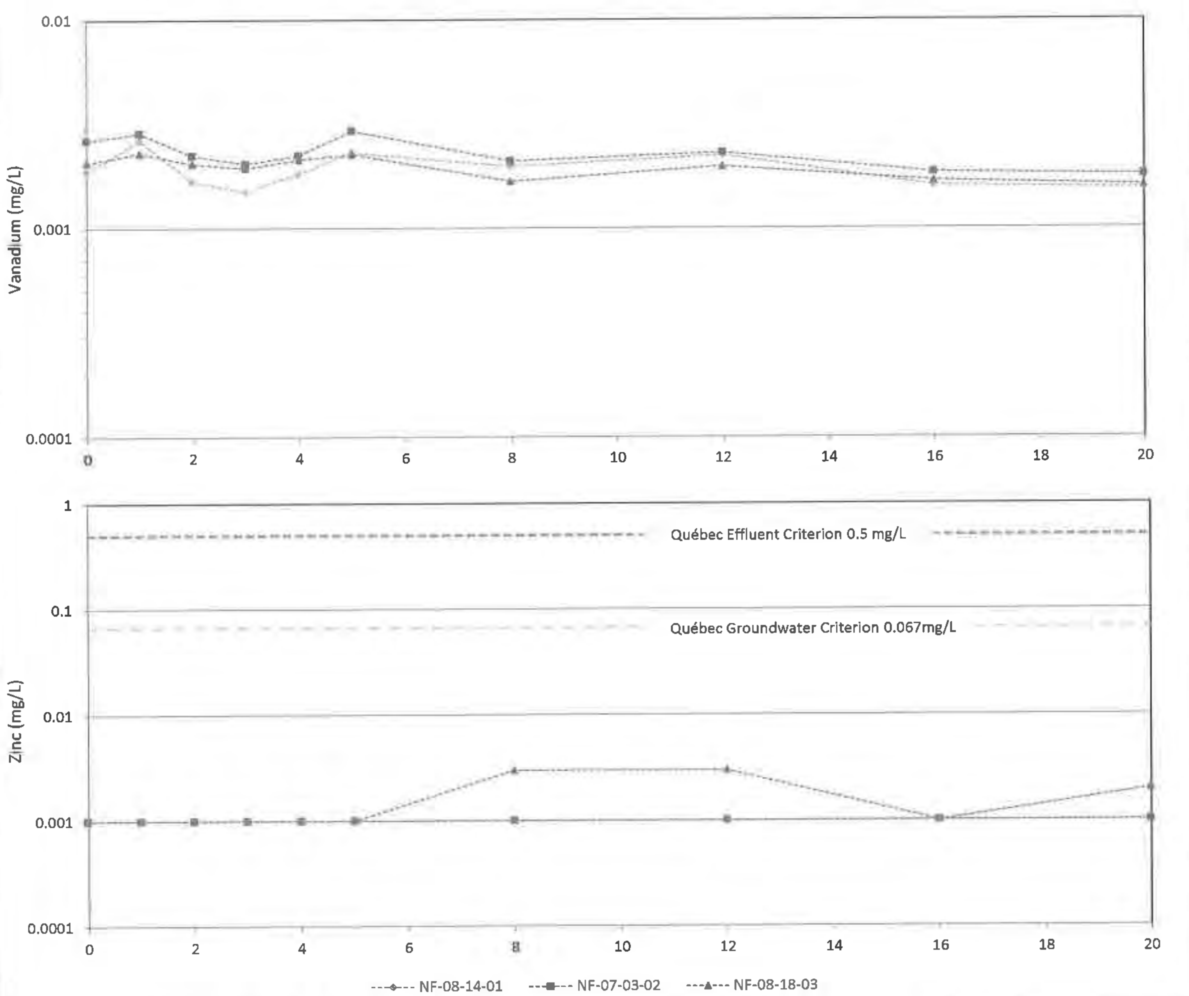
Puimajuq_kinetic_tables and figures_28Mar13.xlsx



Notes:	**Rock Type:**	Tin Titanium Uranium	Kinetic Test Data Puimajuq Waste Rock
Values < MDL are plotted as MDL value	Mafic Intrusive Basalt	DRAWN: LMC; DATE: Apr-13 CHECKED: DH / AJS; JOB NO: 10-1118-0066 REVIEWED: VJB; PHASE/TASK: 9102	Canadian Royalties Inc. — Golder Associates Appendix A.11



Notes: Values < MDL are plotted as MDL value	**Rock Type:** Mafic Intrusive Basalt	Vanadium Zinc				Kinetic Test Data Puimajuq Waste Rock
		DRAWN	LMC	DATE	Apr-13	Canadian Royalties Inc. Golder Associates
		CHECKED	DH / AJS	JOB NO	10-1118-0066	
		REVIEWED	VJB	PHASE/TASK	9102	Appendix A.12

APPENDIX B

Kinetic Results – Tables

Appendix B
Sample NF-08-14-01 - Mafic Intrusive
Kinetic Test Results - Puimajuq Deposit
Nunavik Nickel Project
Canadian Royalties Inc.

Parameter	Symbol	Unit	Quebec Groundwater Criteria	Quebec Effluent Criteria	Humidity Cell Test Cycle - NF-08-14-01 (Mafic Intrusive)										
					Wk#0	Wk#1	Wk#2	Wk#3	Wk#4	Wk#5	Wk#6	Wk#7	Wk#8	Wk# 9	Wk#10
PHYSICAL TESTS															
Leachate Volume Added	-	mL			1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Leachate Volume Recovered	-	mL			805	989	978	982	992	988	998	976	980	1000	992
pH	pH	units		6.0-9.5	8.8	8.1	7.5	7.7	7.5	7.6	7.5	7.5	7.6	7.5	7.4
Conductivity	Conductivity	mg/L as CaCO3			74	51	38	44	54	46	32	56	40	42	34
ANIONS & NUTRIENTS															
Alkalinity, Total	as CaCO3	mg/L			27	20	15	16	17	18	15	16	16	13	13
Chloride	Cl	mg/L	860		1.9	1.0	0.30	< 0.2	< 0.2	< 0.2	—	—	< 0.2	—	—
Fluoride	F	mg/L	4		< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	—	—	< 0.06	—	—
Sulphate	SO4	mg/L			9.2	9.3	5.0	4.2	3.8	3.5	2.8	2.7	2.4	2.2	2.1
METALS:															
Aluminum	Al	mg/L	0.75		0.040	0.040	0.040	0.040	0.040	0.060	—	—	0.040	—	—
Antimony (III)	Sb	mg/L	0.088		0.000400	0.000400	0.000300	< 0.0002	0.000300	0.000300	—	—	< 0.0002	—	—
Arsenic	As	mg/L	0.34	0.2	0.00280	0.00420	0.00250	0.00270	0.00300	0.00360	—	—	0.00390	—	—
Barium	Ba	mg/L	5.3		0.00162	0.00169	0.00139	0.00138	0.00156	0.00187	—	—	0.00139	—	—
Boron	B	mg/L			0.00480	0.00510	0.00320	0.00330	0.00290	0.00270	—	—	0.00170	—	—
Cadmium	Cd	mg/L	0.0021		< 0.000003	0.00	< 0.000003	< 0.000003	0.00	< 0.000003	—	—	< 0.000003	—	—
Calcium	Ca	mg/L			7.3	6.9	5.5	5.3	5.3	5.9	4.9	5.4	5.3	4.3	4.3
Chromium (IV)	Cr	mg/L	0.016		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	—	—	< 0.0005	—	—
Cobalt	Co	mg/L	0.50		0.00	0.00	0.00	0.00	0.00	0.00	—	—	0.00	—	—
Copper	Cu	mg/L	0.0073	0.3	0.000500	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	—	—	< 0.0005	—	—
Iron	Fe	mg/L		3	0.010	0.00900	0.016	0.013	0.00800	0.010	—	—	0.00400	—	—
Lead	Pb	mg/L	0.034	0.2	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	—	—	< 0.00002	—	—
Lithium	Li	mg/L			< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	—	—	< 0.001	—	—
Magnesium	Mg	mg/L			1.3	1.4	1.1	1.1	1.1	1.1	—	—	0.95	—	—
Manganese	Mn	mg/L			0.0011	0.0026	0.0031	0.0028	0.0025	0.0028	—	—	0.0021	—	—
Molybdenum	Mo	mg/L	2.0		0.000160	0.000260	0.000130	0.000110	0.000100	0.00	—	—	0.00	—	—
Mercury	Hg	mg/L	0.00013		< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	—	—	< 0.0001	—	—
Nickel	Ni	mg/L	0.260	0.5	0.000400	0.000200	0.000200	0.000600	0.000100	< 0.0001	—	—	0.000100	—	—
Potassium	K	mg/L			2.5	2.5	1.9	1.9	1.9	2.0	—	—	1.6	—	—
Selenium	Se	mg/L	0.02		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	—	—	< 0.001	—	—
Silver	Ag	mg/L	0.00062		< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	—	—	< 0.00001	—	—
Sodium	Na	mg/L			1.9	1.4	0.80	0.69	0.59	0.54	—	—	0.31	—	—
Strontium	Sr	mg/L			0.00740	0.00720	0.00530	0.00540	0.00550	0.00600	—	—	0.00530	—	—
Tin	Sn	mg/L			0.00188	0.00242	0.00114	0.000860	0.000900	0.000700	—	—	0.000400	—	—
Titanium	Ti	mg/L			0.000400	0.000500	0.000300	0.000700	0.000300	0.000400	—	—	0.000200	—	—
Uranium	U	mg/L			0.00	0.00	0.00	0.00	0.00	0.00	—	—	0.00	—	—
Vanadium	V	mg/L			0.00187	0.00264	0.00168	0.00150	0.00183	0.00230	—	—	0.00198	—	—
Zinc	Zn	mg/L	0.067	0.5	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	—	—	< 0.001	—	—

Note: "—" not analyzed

Appendix B
Sample NF-08-14-01 - Mafic Intrusive
Kinetic Test Results - Puimajuq Deposit
Nunavik Nickel Project
Canadian Royalties Inc.

Parameter	Symbol	Unit	Quebec Groundwater Criteria	Quebec Effluent Criteria	Humidity Cell Test Cycle - NF-08-14-01 (Mafic Intrusive)												
					Wk#11	Wk#12	Wk#13	Wk#14	Wk#15	Wk#16	Wk#17	Wk#18	Wk#19	Wk#20	Wk#21	Wk#22	Wk#23
PHYSICAL TESTS																	
Leachate Volume Added	-	mL			1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Leachate Volume Recovered	-	mL			982	987	989	988	986	990	993	980	983	983	985	983	996
pH	pH	units		6.0-9.5	7.5	7.3	7.4	7.2	7.4	7.8	7.5	7.3	7.8	7.7	7.3	7.2	6.7
Conductivity	Conductivity	mg/L as CaCO3			41	46	38	33	33	35	32	34	36	36	36	34	36
ANIONS & NUTRIENTS																	
Alkalinity, Total	as CaCO3	mg/L			16	18	14	15	13	14	12	13	21	13	12	12	13
Chloride	Cl	mg/L	860		—	< 0.2	—	—	—	< 0.2	—	—	—	< 0.2	—	—	—
Fluoride	F	mg/L	4		—	< 0.06	—	—	—	< 0.06	—	—	—	< 0.06	—	—	—
Sulphate	SO4	mg/L			2.3	2.2	2.2	2.0	2.0	1.9	1.9	2.1	2.2	2.0	2.1	2.0	2.0
METALS:																	
Aluminum	Al	mg/L	0.75		—	0.060	—	—	—	0.050	—	—	—	0.030	—	—	—
Antimony (III)	Sb	mg/L	0.088		—	0.000300	—	—	—	< 0.0002	—	—	—	0.000500	—	—	—
Arsenic	As	mg/L	0.34	0.2	—	0.00490	—	—	—	0.00380	—	—	—	0.00400	—	—	—
Barium	Ba	mg/L	5.3		—	0.00139	—	—	—	0.00121	—	—	—	0.00115	—	—	—
Boron	B	mg/L			—	0.00140	—	—	—	0.00110	—	—	—	0.00150	—	—	—
Cadmium	Cd	mg/L	0.0021		—	< 0.000003	—	—	—	< 0.000003	—	—	—	0.00	—	—	—
Calcium	Ca	mg/L			5.8	5.8	4.9	4.8	4.7	4.7	4.6	4.7	5.3	5.0	4.8	4.6	4.4
Chromium (IV)	Cr	mg/L	0.016		—	< 0.0005	—	—	—	< 0.0005	—	—	—	< 0.0005	—	—	—
Cobalt	Co	mg/L	0.50		—	0.00	—	—	—	0.00	—	—	—	0.00	—	—	—
Copper	Cu	mg/L	0.0073	0.3	—	< 0.0005	—	—	—	< 0.0005	—	—	—	< 0.0005	—	—	—
Iron	Fe	mg/L		3	—	0.012	—	—	—	< 0.003	—	—	—	0.00400	—	—	—
Lead	Pb	mg/L	0.034	0.2	—	< 0.00002	—	—	—	0.00003	—	—	—	0.00002	—	—	—
Lithium	Li	mg/L			—	< 0.001	—	—	—	< 0.001	—	—	—	< 0.001	—	—	—
Magnesium	Mg	mg/L			—	0.93	—	—	—	0.75	—	—	—	0.77	—	—	—
Manganese	Mn	mg/L			—	0.0029	—	—	—	0.0026	—	—	—	0.0031	—	—	—
Molybdenum	Mo	mg/L	2.0		—	0.00	—	—	—	0.00	—	—	—	0.00	—	—	—
Mercury	Hg	mg/L	0.00013		—	< 0.0001	—	—	—	< 0.0001	—	—	—	< 0.0001	—	—	—
Nickel	Ni	mg/L	0.260	0.5	—	0.000200	—	—	—	0.000100	—	—	—	0.000200	—	—	—
Potassium	K	mg/L			—	1.4	—	—	—	1.0	—	—	—	0.91	—	—	—
Selenium	Se	mg/L	0.02		—	< 0.001	—	—	—	< 0.001	—	—	—	< 0.001	—	—	—
Silver	Ag	mg/L	0.00062		—	< 0.00001	—	—	—	< 0.00001	—	—	—	< 0.00001	—	—	—
Sodium	Na	mg/L			—	0.20	—	—	—	0.12	—	—	—	0.10	—	—	—
Strontium	Sr	mg/L			—	0.00560	—	—	—	0.00460	—	—	—	0.00470	—	—	—
Tin	Sn	mg/L			—	0.000370	—	—	—	0.000310	—	—	—	0.000400	—	—	—
Titanium	Ti	mg/L			—	0.000500	—	—	—	0.000100	—	—	—	0.000100	—	—	—
Uranium	U	mg/L			—	0.00	—	—	—	0.00	—	—	—	0.00	—	—	—
Vanadium	V	mg/L			—	0.00224	—	—	—	0.00160	—	—	—	0.00155	—	—	—
Zinc	Zn	mg/L	0.067	0.5	—	< 0.001	—	—	—	< 0.001	—	—	—	0.00200	—	—	—

Note: "—" not analyzed

Appendix B
Sample NF-07-03-02 - Basalt
Kinetic Test Results - Puimajuq Deposit
Nunavik Nickel Project
Canadian Royalties Inc.

Parameter	Symbol	Unit	Quebec Groundwater Criteria	Quebec Effluent Criteria	Humidity Cell Test Cycle - NF-07-03-02 (Basalt)										
					Wk#0	Wk#1	Wk#2	Wk#3	Wk#4	Wk#5	Wk#6	Wk#7	Wk#8	Wk# 9	Wk#10
PHYSICAL TESTS															
Volume Added	-	mL			1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Volume	-	mL			825	980	992	986	990	989	991	987	985	996	993
pH	pH	units		6.0-9.5	8.9	7.6	7.6	7.7	7.4	7.6	7.4	7.3	7.4	7.5	7.3
Conductivity	Conductivity	mg/L as CaCO3			60	56	51	43	61	33	29	58	35	35	28
ANIONS & NUTRIENTS															
Alkalinity, Total	as CaCO3	mg/L			26	18	22	17	17	14	12	13	12	26	12
Chloride	Cl	mg/L	860		1.0	0.80	0.30	< 0.2	< 0.2	< 0.2	—	—	< 0.2	—	—
Fluoride	F	mg/L	4		< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	—	—	< 0.06	—	—
Sulphate	SO4	mg/L			5.4	11	9.1	6.6	5.8	5.2	4.2	3.5	3.1	3.0	2.9
METALS:															
Aluminum	Al	mg/L	0.75		0.080	0.030	0.020	0.020	0.030	0.030	—	—	0.020	—	—
Antimony (III)	Sb	mg/L	0.088		0.000600	0.000500	0.000500	0.000300	0.000400	0.000400	—	—	0.000200	—	—
Arsenic	As	mg/L	0.34	0.2	0.000600	0.000300	0.000200	0.000400	< 0.0002	0.000200	—	—	0.000400	—	—
Barium	Ba	mg/L	5.3		0.00281	0.00348	0.00471	0.00406	0.00488	0.00411	—	—	0.00433	—	—
Boron	B	mg/L			0.00490	0.00710	0.00500	0.00390	0.00310	0.00270	—	—	0.00140	—	—
Cadmium	Cd	mg/L	0.0021		< 0.000003	0.00	< 0.000003	< 0.000003	0.00	< 0.000003	—	—	< 0.000003	—	—
Calcium	Ca	mg/L			5.3	6.4	6.9	5.9	5.3	4.9	4.1	4.3	4.1	4.1	4.0
Chromium (IV)	Cr	mg/L	0.016		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	—	—	< 0.0005	—	—
Cobalt	Co	mg/L	0.50		0.00	0.00	0.00	0.00	0.00	0.00	—	—	0.00	—	—
Copper	Cu	mg/L	0.0073	0.3	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	—	—	< 0.0005	—	—
Iron	Fe	mg/L		3	0.014	0.00500	0.014	0.00500	0.00600	0.010	—	—	0.00600	—	—
Lead	Pb	mg/L	0.034	0.2	0.00	< 0.00002	0.00	< 0.00002	< 0.00002	< 0.00002	—	—	< 0.00002	—	—
Lithium	Li	mg/L			< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	—	—	< 0.001	—	—
Magnesium	Mg	mg/L			0.57	1.1	1.1	0.95	0.86	0.74	—	—	0.66	—	—
Manganese	Mn	mg/L			0.0011	0.0057	0.0080	0.0064	0.0055	0.0053	—	—	0.0037	—	—
Molybdenum	Mo	mg/L	2.0		0.000590	0.00112	0.000610	0.000420	0.000280	0.000260	—	—	0.000110	—	—
Mercury	Hg	mg/L	0.00013		< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	—	—	< 0.0001	—	—
Nickel	Ni	mg/L	0.260	0.5	0.000400	0.000300	0.000300	0.000100	0.000200	< 0.0001	—	—	0.000100	—	—
Potassium	K	mg/L			2.3	3.3	3.2	3.0	2.9	2.8	—	—	2.5	—	—
Selenium	Se	mg/L	0.02		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	—	—	< 0.001	—	—
Silver	Ag	mg/L	0.00062		< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	—	—	< 0.00001	—	—
Sodium	Na	mg/L			2.9	3.0	1.9	1.3	0.99	0.78	—	—	0.36	—	—
Strontium	Sr	mg/L			0.00680	0.010	0.00950	0.00870	0.00800	0.00700	—	—	0.00600	—	—
Tin	Sn	mg/L			0.000730	0.00121	0.000770	0.000490	0.000510	0.000480	—	—	0.000240	—	—
Titanium	Ti	mg/L			0.000600	0.000600	0.00100	0.000500	0.000500	0.000900	—	—	0.000700	—	—
Uranium	U	mg/L			0.00	0.000124	0.000127	0.000401	0.00156	0.000116	—	—	0.000099	—	—
Vanadium	V	mg/L			0.00264	0.00287	0.00224	0.00205	0.00224	0.00294	—	—	0.00210	—	—
Zinc	Zn	mg/L	0.067	0.5	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	—	—	< 0.001	—	—

Note: "—" not analyzed

Appendix B
Sample NF-07-03-02 - Basalt
Kinetic Test Results - Puimajuq Deposit
Nunavik Nickel Project
Canadian Royalties Inc.

Parameter	Symbol	Unit	Quebec Groundwater Criteria	Quebec Effluent Criteria	Humidity Cell Test Cycle - NF-07-03-02 (Basalt)												
					Wk#11	Wk#12	Wk#13	Wk#14	Wk#15	Wk#16	Wk#17	Wk#18	Wk#19	Wk#20	Wk#21	Wk#22	Wk#23
PHYSICAL TESTS																	
Volume Added	-	mL			1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Volume	-	mL			991	1003	991	986	994	1000	997	1001	997	994	989	995	990
pH	pH	units		6.0-9.5	7.1	7.1	7.3	7.0	7.2	7.2	7.4	7.6	7.4	7.4	7.1	7.1	6.8
Conductivity	Conductivity	mg/L as CaCO3			35	42	34	31	30	30	37	48	31	31	32	30	31
ANIONS & NUTRIENTS																	
Alkalinity, Total	as CaCO3	mg/L			9.0	13	11	10	10	10	11	11	9.0	10	10	9.0	9.0
Chloride	Cl	mg/L	860		—	< 0.2	—	—	—	< 0.2	—	—	—	< 0.2	—	—	—
Fluoride	F	mg/L	4		—	< 0.06	—	—	—	< 0.06	—	—	—	< 0.06	—	—	—
Sulphate	SO4	mg/L			3.2	2.9	2.5	2.7	2.4	2.3	2.3	2.6	2.7	2.7	2.9	2.8	2.7
METALS:																	
Aluminum	Al	mg/L	0.75		—	0.030	—	—	—	0.030	—	—	—	< 0.01	—	—	—
Antimony (III)	Sb	mg/L	0.088		—	0.000300	—	—	—	< 0.0002	—	—	—	0.000500	—	—	—
Arsenic	As	mg/L	0.34	0.2	—	0.000400	—	—	—	0.000500	—	—	—	0.000300	—	—	—
Barium	Ba	mg/L	5.3		—	0.00595	—	—	—	0.00478	—	—	—	0.00488	—	—	—
Boron	B	mg/L			—	0.000900	—	—	—	0.000900	—	—	—	0.00130	—	—	—
Cadmium	Cd	mg/L	0.0021		—	< 0.000003	—	—	—	< 0.000003	—	—	—	0.00	—	—	—
Calcium	Ca	mg/L			4.0	4.1	3.6	3.7	3.7	3.7	3.5	3.8	3.7	3.5	3.8	3.6	3.5
Chromium (IV)	Cr	mg/L	0.016		—	< 0.0005	—	—	—	< 0.0005	—	—	—	< 0.0005	—	—	—
Cobalt	Co	mg/L	0.50		—	0.00	—	—	—	0.00	—	—	—	0.00	—	—	—
Copper	Cu	mg/L	0.0073	0.3	—	< 0.0005	—	—	—	0.000600	—	—	—	< 0.0005	—	—	—
Iron	Fe	mg/L		3	—	< 0.003	—	—	—	< 0.003	—	—	—	0.00300	—	—	—
Lead	Pb	mg/L	0.034	0.2	—	< 0.00002	—	—	—	0.00003	—	—	—	< 0.00002	—	—	—
Lithium	Li	mg/L			—	< 0.001	—	—	—	< 0.001	—	—	—	< 0.001	—	—	—
Magnesium	Mg	mg/L			—	0.61	—	—	—	0.48	—	—	—	0.43	—	—	—
Manganese	Mn	mg/L			—	0.0027	—	—	—	0.0027	—	—	—	0.0031	—	—	—
Molybdenum	Mo	mg/L	2.0		—	0.00	—	—	—	0.000100	—	—	—	0.000100	—	—	—
Mercury	Hg	mg/L	0.00013		—	< 0.0001	—	—	—	< 0.0001	—	—	—	< 0.0001	—	—	—
Nickel	Ni	mg/L	0.260	0.5	—	0.000200	—	—	—	0.000200	—	—	—	0.000200	—	—	—
Potassium	K	mg/L			—	2.8	—	—	—	2.2	—	—	—	1.9	—	—	—
Selenium	Se	mg/L	0.02		—	< 0.001	—	—	—	< 0.001	—	—	—	< 0.001	—	—	—
Silver	Ag	mg/L	0.00062		—	< 0.00001	—	—	—	< 0.00001	—	—	—	< 0.00001	—	—	—
Sodium	Na	mg/L			—	0.25	—	—	—	0.14	—	—	—	0.12	—	—	—
Strontium	Sr	mg/L			—	0.00590	—	—	—	0.00490	—	—	—	0.00460	—	—	—
Tin	Sn	mg/L			—	0.000250	—	—	—	0.000310	—	—	—	0.000260	—	—	—
Titanium	Ti	mg/L			—	0.000300	—	—	—	0.000200	—	—	—	0.000300	—	—	—
Uranium	U	mg/L			—	0.000221	—	—	—	0.000152	—	—	—	0.000138	—	—	—
Vanadium	V	mg/L			—	0.00230	—	—	—	0.00185	—	—	—	0.00180	—	—	—
Zinc	Zn	mg/L	0.067	0.5	—	< 0.001	—	—	—	< 0.001	—	—	—	< 0.001	—	—	—

Note: "—" not analyzed

Appendix B
Sample NF-08-18-03 - Basalt
Kinetic Test Results - Puimajuq Deposit
Nunavik Nickel Project
Canadian Royalties Inc.

Parameter	Symbol	Unit	Quebec Groundwater Criteria	Quebec Effluent Criteria	Humidity Cell Test Cycle - NF-08-18-03 (Basalt)										
					Wk#0	Wk#1	Wk#2	Wk#3	Wk#4	Wk#5	Wk#6	Wk#7	Wk#8	Wk# 9	Wk#10
PHYSICAL TESTS															
Added	-	mL			1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Recovered	-	mL			826	962	952	953	941	953	987	983	978	992	990
pH	pH	units		6.0-9.5	7.9	7.9	7.7	7.5	7.4	7.3	7.4	7.1	7.4	7.3	7.3
Conductivity	Conductivity	mg/L as CaCO3			45	40	33	37	44	30	32	28	31	31	27
ANIONS & NUTRIENTS															
Alkalinity, Total	as CaCO3	mg/L			17	15	12	12	11	10	13	11	9.0	10	9.0
Chloride	Cl	mg/L	860		1.0	1.2	0.50	0.20	< 0.2	< 0.2	—	—	< 0.2	—	—
Fluoride	F	mg/L	4		< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	—	—	< 0.06	—	—
Sulphate	SO4	mg/L			2.0	5.4	4.9	3.9	3.6	3.4	3.1	3.3	2.7	2.4	2.6
METALS:															
Aluminum	Al	mg/L	0.75		0.080	0.040	0.040	0.040	0.050	0.030	—	—	0.010	—	—
Antimony (III)	Sb	mg/L	0.088		0.000400	0.000600	0.000600	0.000400	0.000400	0.000400	—	—	0.000300	—	—
Arsenic	As	mg/L	0.34	0.2	0.000400	0.000500	0.000500	0.000900	0.000700	0.000700	—	—	0.000800	—	—
Barium	Ba	mg/L	5.3		0.00205	0.00199	0.00169	0.00166	0.00141	0.00264	—	—	0.00368	—	—
Boron	B	mg/L			0.00970	0.010	0.00680	0.00500	0.00350	0.00250	—	—	0.00220	—	—
Cadmium	Cd	mg/L	0.0021		0.00	0.00	< 0.000003	< 0.000003	0.00	< 0.000003	—	—	< 0.000003	—	—
Calcium	Ca	mg/L			4.4	4.2	3.6	3.5	3.1	2.9	2.9	3.3	3.2	3.2	2.9
Chromium (IV)	Cr	mg/L	0.016		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	—	—	< 0.0005	—	—
Cobalt	Co	mg/L	0.50		0.00	0.00	0.00	0.00	0.00	0.00	—	—	0.00	—	—
Copper	Cu	mg/L	0.0073	0.3	< 0.0005	< 0.0005	< 0.0005	0.000500	< 0.0005	< 0.0005	—	—	< 0.0005	—	—
Iron	Fe	mg/L		3	0.010	0.00800	0.011	0.010	0.00800	0.00800	—	—	< 0.003	—	—
Lead	Pb	mg/L	0.034	0.2	< 0.00002	< 0.00002	0.000270	< 0.00002	< 0.00002	< 0.00002	—	—	< 0.00002	—	—
Lithium	Li	mg/L			< 0.001	< 0.001	< 0.001	0.00100	< 0.001	< 0.001	—	—	< 0.001	—	—
Magnesium	Mg	mg/L			0.37	0.69	0.66	0.61	0.56	0.53	—	—	0.63	—	—
Manganese	Mn	mg/L			0.0012	0.0040	0.0043	0.0032	0.0028	0.0031	—	—	0.0024	—	—
Molybdenum	Mo	mg/L	2.0		0.000270	0.000550	0.000310	0.000290	0.000200	0.000230	—	—	0.000100	—	—
Mercury	Hg	mg/L	0.00013		< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	—	—	< 0.0001	—	—
Nickel	Ni	mg/L	0.260	0.5	0.000300	0.000200	0.000100	< 0.0001	< 0.0001	< 0.0001	—	—	< 0.0001	—	—
Potassium	K	mg/L			1.9	2.5	2.3	2.2	2.2	2.1	—	—	2.4	—	—
Selenium	Se	mg/L	0.02		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	—	—	< 0.001	—	—
Silver	Ag	mg/L	0.00062		< 0.00001	0.00	< 0.00001	< 0.00001	< 0.00001	< 0.00001	—	—	< 0.00001	—	—
Sodium	Na	mg/L			2.5	3.0	2.1	1.6	1.2	0.92	—	—	0.51	—	—
Strontium	Sr	mg/L			0.00380	0.00450	0.00380	0.00370	0.00320	0.00320	—	—	0.00400	—	—
Tin	Sn	mg/L			0.00102	0.000680	0.000360	0.000290	0.000280	0.000300	—	—	0.000200	—	—
Titanium	Ti	mg/L			0.000700	0.000900	0.000900	0.000900	0.000800	0.000800	—	—	0.000300	—	—
Uranium	U	mg/L			0.00	0.00	0.00	0.00160	0.000109	0.000125	—	—	0.000188	—	—
Vanadium	V	mg/L			0.00207	0.00230	0.00205	0.00195	0.00214	0.00227	—	—	0.00168	—	—
Zinc	Zn	mg/L	0.067	0.5	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	—	—	0.00300	—	—

Note: "—" not analyzed

Appendix B
Sample NF-08-18-03 - Basalt
Kinetic Test Results - Puimajuq Deposit
Nunavik Nickel Project
Canadian Royalties Inc.

Parameter	Symbol	Unit	Quebec Groundwater Criteria	Quebec Effluent Criteria	Humidity Cell Test Cycle - NF-08-18-03 (Basalt)												
					Wk#11	Wk#12	Wk#13	Wk#14	Wk#15	Wk#16	Wk#17	Wk#18	Wk#19	Wk#20	Wk#21	Wk#22	Wk#23
PHYSICAL TESTS																	
Added	-	mL			1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Recovered	-	mL			991	995	993	994	993	999	999	995	997	990	988	987	996
pH	pH	units		6.0-9.5	7.1	6.9	7.3	7.0	7.2	7.3	7.6	7.2	7.7	7.0	7.0	7.3	6.8
Conductivity	Conductivity	mg/L as CaCO3			30	36	33	30	30	32	33	34	34	41	40	34	38
ANIONS & NUTRIENTS																	
Alkalinity, Total	as CaCO3	mg/L			9.0	10	10	8.0	9.0	10	9.0	10	12	10	11	10	10
Chloride	Cl	mg/L	860		—	< 0.2	—	—	—	0.50	—	—	—	0.70	—	—	—
Fluoride	F	mg/L	4		—	< 0.06	—	—	—	< 0.06	—	—	—	< 0.06	—	—	—
Sulphate	SO4	mg/L			3.1	2.9	3.1	3.0	3.1	2.8	2.9	3.0	3.2	3.2	3.4	3.1	3.4
METALS:																	
Aluminum	Al	mg/L	0.75		—	0.020	—	—	—	0.030	—	—	—	0.020	—	—	—
Antimony (III)	Sb	mg/L	0.088		—	0.000400	—	—	—	< 0.0002	—	—	—	0.000500	—	—	—
Arsenic	As	mg/L	0.34	0.2	—	0.00110	—	—	—	0.00150	—	—	—	0.00120	—	—	—
Barium	Ba	mg/L	5.3		—	0.00296	—	—	—	0.00378	—	—	—	0.00545	—	—	—
Boron	B	mg/L			—	0.00120	—	—	—	0.00100	—	—	—	0.00130	—	—	—
Cadmium	Cd	mg/L	0.0021		—	< 0.000003	—	—	—	< 0.000003	—	—	—	< 0.000003	—	—	—
Calcium	Ca	mg/L			3.0	3.1	3.2	3.4	3.3	3.5	3.6	3.9	4.3	4.2	4.5	4.0	4.2
Chromium (IV)	Cr	mg/L	0.016		—	< 0.0005	—	—	—	< 0.0005	—	—	—	< 0.0005	—	—	—
Cobalt	Co	mg/L	0.50		—	0.00	—	—	—	0.00	—	—	—	0.00	—	—	—
Copper	Cu	mg/L	0.0073	0.3	—	< 0.0005	—	—	—	< 0.0005	—	—	—	0.00180	—	—	—
Iron	Fe	mg/L		3	—	< 0.003	—	—	—	< 0.003	—	—	—	0.00400	—	—	—
Lead	Pb	mg/L	0.034	0.2	—	< 0.00002	—	—	—	< 0.00002	—	—	—	0.00	—	—	—
Lithium	Li	mg/L			—	< 0.001	—	—	—	< 0.001	—	—	—	< 0.001	—	—	—
Magnesium	Mg	mg/L			—	0.54	—	—	—	0.54	—	—	—	0.53	—	—	—
Manganese	Mn	mg/L			—	0.0015	—	—	—	0.0031	—	—	—	0.0026	—	—	—
Molybdenum	Mo	mg/L	2.0		—	0.00	—	—	—	0.00	—	—	—	0.00	—	—	—
Mercury	Hg	mg/L	0.00013		—	< 0.0001	—	—	—	< 0.0001	—	—	—	< 0.0001	—	—	—
Nickel	Ni	mg/L	0.260	0.5	—	0.000200	—	—	—	0.000100	—	—	—	0.000100	—	—	—
Potassium	K	mg/L			—	2.4	—	—	—	2.4	—	—	—	2.4	—	—	—
Selenium	Se	mg/L	0.02		—	< 0.001	—	—	—	< 0.001	—	—	—	< 0.001	—	—	—
Silver	Ag	mg/L	0.00062		—	< 0.00001	—	—	—	< 0.00001	—	—	—	< 0.00001	—	—	—
Sodium	Na	mg/L			—	0.32	—	—	—	0.20	—	—	—	0.17	—	—	—
Strontium	Sr	mg/L			—	0.00340	—	—	—	0.00370	—	—	—	0.00430	—	—	—
Tin	Sn	mg/L			—	0.000240	—	—	—	0.000290	—	—	—	0.000920	—	—	—
Titanium	Ti	mg/L			—	0.000400	—	—	—	0.000200	—	—	—	0.000400	—	—	—
Uranium	U	mg/L			—	0.000243	—	—	—	0.000283	—	—	—	0.000230	—	—	—
Vanadium	V	mg/L			—	0.00198	—	—	—	0.00169	—	—	—	0.00160	—	—	—
Zinc	Zn	mg/L	0.067	0.5	—	0.00300	—	—	—	0.00100	—	—	—	0.00200	—	—	—

Note: "—" not analyzed

APPENDIX C

Mineralogical Results

QUANTITATIVE PHASE ANALYSIS OF THREE POWDER SAMPLES USING THE RIETVELD METHOD AND X-RAY POWDER DIFFRACTION DATA.

Project: Pumajiuq deposit 10-1118-0066

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March 27, 2012

EXPERIMENTAL METHOD

The three samples of **Project Pumajiuq deposit** were reduced to the optimum grain-size range for quantitative X-ray analysis (<10 μm) by grinding under ethanol in a vibratory McCrone Micronising Mill for 7 minutes. Fine grain-size is an important factor in reducing micro-absorption contrast between phases. Step-scan X-ray powder-diffraction data were collected over a range 3-80°2θ with CoKa radiation on a Bruker D8 Focus Bragg-Brentano diffractometer equipped with an Fe monochromator foil, 0.6 mm (0.3°) divergence slit, incident- and diffracted-beam Soller slits and a LynxEye detector. The long fine-focus Co X-ray tube was operated at 35 kV and 40 mA, using a take-off angle of 6°.

RESULTS

The X-ray diffractograms were analyzed using the International Centre for Diffraction Database PDF-4 and Search-Match software by Siemens (Bruker). X-ray powder-diffraction data of the samples were refined with Rietveld program Topas 4.2 (Bruker AXS). The results of quantitative phase analysis by Rietveld refinements are given in Table 1. These amounts represent the relative amounts of crystalline phases normalized to 100%. The Rietveld refinement plots are shown in Figures 1 – 3.

Table 1. Results of quantitative phase analysis (wt.%)

Mineral	**Ideal Formula**	**NF-08-18-03**	**NF-07-03-02**	**NF-08-14-01**
Quartz	SiO_2	2.0	2.1	1.0
Clinochlore	$(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$	11.2	10.5	14.0
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	2.9	2.7	
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$			8.5
Actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$	39.4	39.5	55.0
Plagioclase	$NaAlSi_3O_8 - CaAl_2Si_2O_8$	29.1	23.3	8.7
Clinozoisite	$Ca_2Al_3(SiO_4)_3(OH)$	8.3	14.3	9.9
Titanite	$CaTiSiO_5$	6.7	6.9	2.4
Calcite	$CaCO_3$	0.5	0.7	0.4
Total		100.0	100.0	100.0

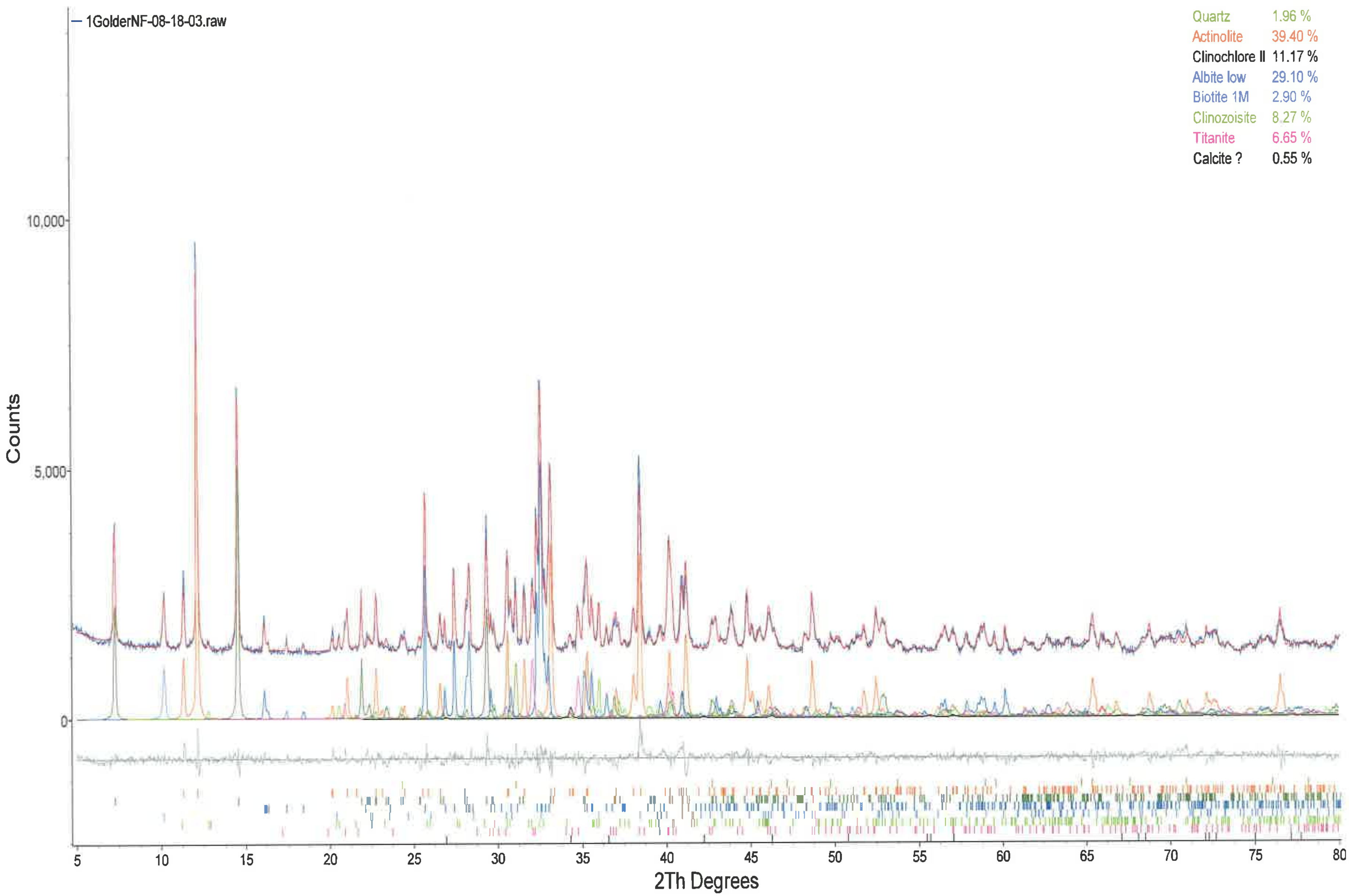

Figure 1. Rietveld refinement plot of sample **Golder Associates** **"NF-08-18-03"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars, positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

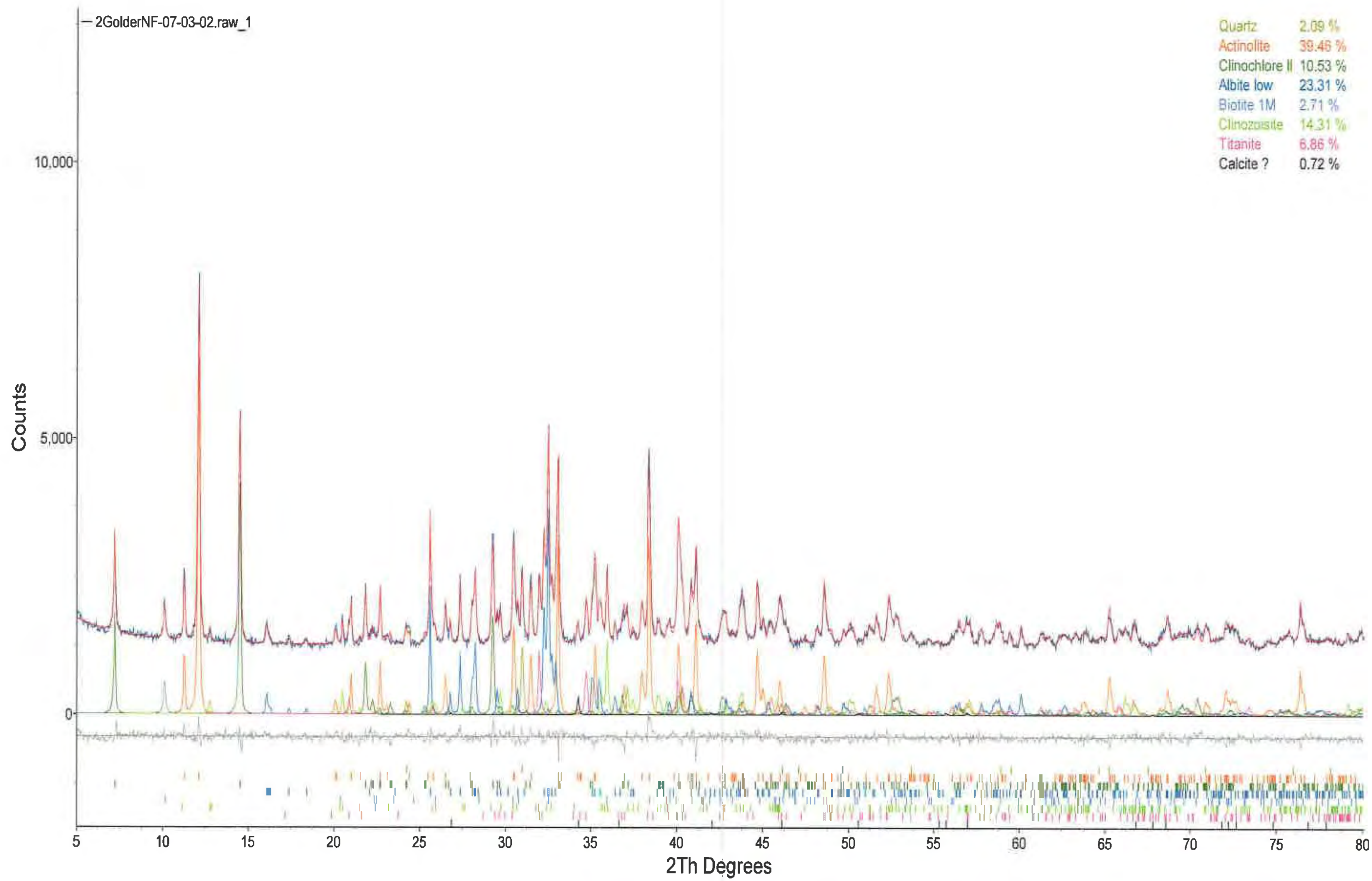

Figure 2. Rietveld refinement plot of sample **Golder Associates "NF-07-03-02"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars, positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

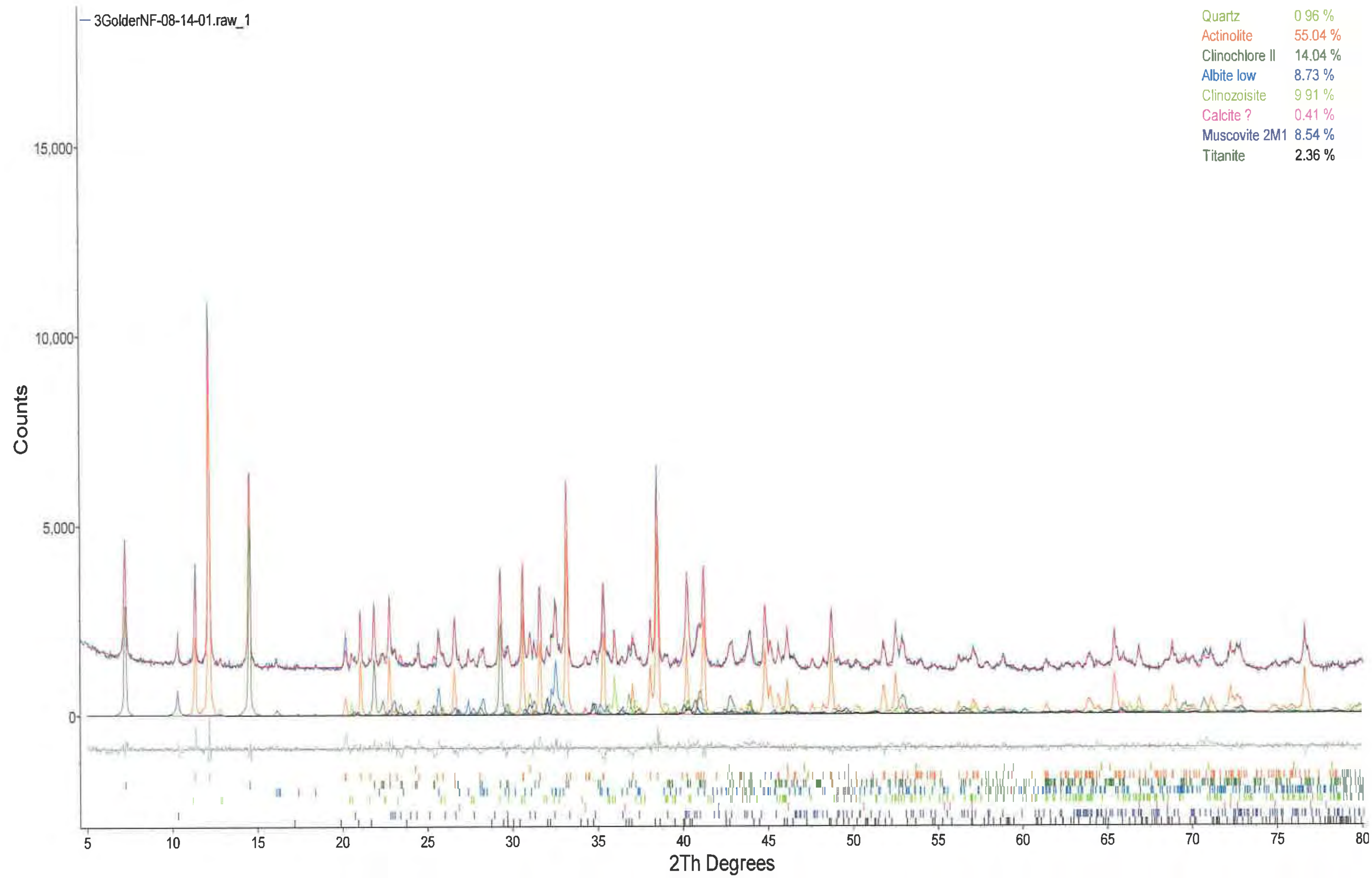

Figure 3. Rietveld refinement plot of sample **Golder Associates "NF-08-14-01"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars, positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

APPENDIX D

Lab Certificates of Analysis

SGS

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April-01-13

Golder Associates Limited
Attn : Valerie Bertrand

32 Steacie Drive, Kanata
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Phone: 613-592-9600, Fax:613-592-9601

Date Rec. : 15 February 2012
LR Report: **CA11090-FEB12**
Reference: NNP Puimajuq WK# 0

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CERTIFICATE OF ANALYSIS

Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: NF-08-18-03 Wk # 0**	**6: NF-07-03-02 Wk # 0**	**7: NF-08-14-01 Wk # 0**
Sample Date & Time			15-Feb-12	15-Feb-12	15-Feb-12
Hum Cell Leachate Volume [mLs]	----	----	826	825	805
pH [no unit]	16-Feb-12	21:07	7.94	8.91	8.84
Alkalinity [mg/L as CaCO3]	16-Feb-12	21:07	17	26	27
Acidity [mg/L as CaCO3]	16-Feb-12	21:07	< 2	< 2	< 2
Conductivity [µS/cm]	16-Feb-12	21:07	45	60	74
Fluoride [mg/L]	17-Feb-12	08:36	< 0.06	< 0.06	< 0.06
Sulphate [mg/L]	24-Feb-12	21:36	2.0	5.4	9.2
Chloride [mg/L]	24-Feb-12	21:36	1.0	1.0	1.9
Calcium [mg/L]	12-Mar-12	14:02	4.41	5.31	7.27
Mercury [mg/L]	20-Feb-12	10:38	< 0.0001	< 0.0001	< 0.0001
Silver [mg/L]	20-Feb-12	18:58	< 0.00001	< 0.00001	< 0.00001
Aluminum [mg/L]	20-Feb-12	11:16	0.08	0.08	0.04
Arsenic [mg/L]	20-Feb-12	18:58	0.0004	0.0006	0.0028
Barium [mg/L]	20-Feb-12	18:58	0.00205	0.00281	0.00162
Boron [mg/L]	20-Feb-12	18:58	0.0097	0.0049	0.0048
Cadmium [mg/L]	20-Feb-12	18:58	0.000004	< 0.000003	< 0.000003
Cobalt [mg/L]	20-Feb-12	18:58	0.000021	0.000035	0.000045
Chromium [mg/L]	20-Feb-12	18:58	< 0.0005	< 0.0005	< 0.0005
Copper [mg/L]	20-Feb-12	18:58	< 0.0005	< 0.0005	0.0005
Iron [mg/L]	20-Feb-12	11:16	0.010	0.014	0.010
Potassium [mg/L]	20-Feb-12	11:16	1.87	2.28	2.51
Lithium [mg/L]	20-Feb-12	18:58	< 0.001	< 0.001	< 0.001
Magnesium [mg/L]	20-Feb-12	11:16	0.366	0.568	1.29
Manganese [mg/L]	20-Feb-12	18:58	0.00123	0.00110	0.00107
Molybdenum [mg/L]	20-Feb-12	18:58	0.00027	0.00059	0.00016
Sodium [mg/L]	20-Feb-12	11:16	2.53	2.94	1.94
Nickel [mg/L]	20-Feb-12	18:58	0.0003	0.0004	0.0004
Lead [mg/L]	20-Feb-12	18:58	< 0.00002	0.00003	< 0.00002

OnLine LIMS

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LR Report : CA11090-FEB12

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk # 0	6: NF-07-03-02 Wk # 0	7: NF-08-14-01 Wk # 0
Antimony [mg/L]	20-Feb-12	18:58	0.0004	0.0006	0.0004
Selenium [mg/L]	20-Feb-12	18:58	< 0.001	< 0.001	< 0.001
Tin [mg/L]	20-Feb-12	18:58	0.00102	0.00073	0.00188
Strontium [mg/L]	20-Feb-12	11:16	0.0038	0.0068	0.0074
Titanium [mg/L]	20-Feb-12	18:58	0.0007	0.0006	0.0004
Uranium [mg/L]	20-Feb-12	18:58	0.000007	0.000011	0.000005
Vanadium [mg/L]	20-Feb-12	18:58	0.00207	0.00264	0.00187
Zinc [mg/L]	20-Feb-12	18:58	< 0.001	< 0.001	< 0.001

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April-01-13

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Date Rec. : 22 February 2012
LR Report: **CA11091-FEB12**
Reference: NNP Puimajuq Wk# 1

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk # 1	6: NF-07-03-02 Wk # 1	7: NF-08-14-01 Wk # 1
Sample Date & Time			22-Feb-12	22-Feb-12	22-Feb-12
Hum Cell Leachate Volume [mLs]	---	---	962	980	989
pH [no unit]	28-Feb-12	14:26	7.85	7.60	8.07
Alkalinity [mg/L as CaCO3]	28-Feb-12	14:26	15	18	20
Acidity [mg/L as CaCO3]	28-Feb-12	14:26	< 2	< 2	< 2
Conductivity [µS/cm]	28-Feb-12	14:26	40	56	51
Fluoride [mg/L]	24-Feb-12	08:00	< 0.06	< 0.06	< 0.06
Sulphate [mg/L]	02-Mar-12	09:45	5.4	11	9.3
Chloride [mg/L]	02-Mar-12	15:01	1.2	0.8	1.0
Calcium [mg/L]	12-Mar-12	14:03	4.19	6.42	6.91
Mercury [mg/L]	24-Feb-12	12:17	< 0.0001	< 0.0001	< 0.0001
Silver [mg/L]	01-Mar-12	08:46	0.00002	< 0.00001	< 0.00001
Aluminum [mg/L]	28-Feb-12	14:35	0.04	0.03	0.04
Arsenic [mg/L]	01-Mar-12	08:46	0.0005	0.0003	0.0042
Barium [mg/L]	01-Mar-12	08:46	0.00199	0.00348	0.00169
Boron [mg/L]	01-Mar-12	08:46	0.0103	0.0071	0.0051
Cadmium [mg/L]	01-Mar-12	08:46	0.000024	0.000044	0.000097
Cobalt [mg/L]	01-Mar-12	08:46	0.000019	0.000043	0.000037
Chromium [mg/L]	01-Mar-12	08:46	< 0.0005	< 0.0005	< 0.0005
Copper [mg/L]	01-Mar-12	08:46	< 0.0005	< 0.0005	< 0.0005
Iron [mg/L]	28-Feb-12	14:35	0.008	0.005	0.009
Potassium [mg/L]	28-Feb-12	14:35	2.48	3.32	2.54
Lithium [mg/L]	01-Mar-12	08:46	< 0.001	< 0.001	< 0.001
Magnesium [mg/L]	28-Feb-12	14:35	0.687	1.11	1.35
Manganese [mg/L]	01-Mar-12	08:46	0.00398	0.00571	0.00261
Molybdenum [mg/L]	01-Mar-12	08:46	0.00055	0.00112	0.00026
Sodium [mg/L]	28-Feb-12	14:35	3.04	3.00	1.44
Nickel [mg/L]	01-Mar-12	08:46	0.0002	0.0003	0.0002
Lead [mg/L]	01-Mar-12	08:46	< 0.00002	< 0.00002	< 0.00002

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LR Report : **CA11091-FEB12**

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk # 1	6: NF-07-03-02 Wk # 1	7: NF-08-14-01 Wk # 1
Antimony [mg/L]	01-Mar-12	08:46	0.0006	0.0005	0.0004
Selenium [mg/L]	01-Mar-12	08:46	< 0.001	< 0.001	< 0.001
Tin [mg/L]	01-Mar-12	08:46	0.00068	0.00121	0.00242
Strontium [mg/L]	28-Feb-12	14:36	0.0045	0.0104	0.0072
Titanium [mg/L]	01-Mar-12	08:46	0.0009	0.0006	0.0005
Uranium [mg/L]	01-Mar-12	08:46	0.000061	0.000124	0.000043
Vanadium [mg/L]	01-Mar-12	08:46	0.00230	0.00287	0.00264
Zinc [mg/L]	01-Mar-12	08:46	< 0.001	< 0.001	< 0.001

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April-01-13

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Date Rec. : 29 February 2012
LR Report: **CA11092-FEB12**
Reference: NNP Puimajuq Wk# 2

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CERTIFICATE OF ANALYSIS

Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: NF-08-18-03 Wk # 2**	**6: NF-07-03-02 Wk # 2**	**7: NF-08-14-01 Wk # 2**
Sample Date & Time			29-Feb-12	29-Feb-12	29-Feb-12
Hum Cell Leachate Volume [mLs]	---	---	952	992	978
pH [no unit]	06-Mar-12	10:24	7.72	7.59	7.53
Alkalinity [mg/L as CaCO3]	06-Mar-12	10:24	12	22	15
Acidity [mg/L as CaCO3]	06-Mar-12	10:24	< 2	< 2	< 2
Conductivity [µS/cm]	06-Mar-12	10:24	33	51	38
Fluoride [mg/L]	05-Mar-12	08:49	< 0.06	< 0.06	< 0.06
Sulphate [mg/L]	08-Mar-12	09:14	4.9	9.1	5.0
Chloride [mg/L]	08-Mar-12	09:14	0.5	0.3	0.3
Calcium [mg/L]	12-Mar-12	14:03	3.60	6.85	5.45
Mercury [mg/L]	05-Mar-12	14:55	< 0.0001	< 0.0001	< 0.0001
Silver [mg/L]	06-Mar-12	17:33	< 0.00001	< 0.00001	< 0.00001
Aluminum [mg/L]	05-Mar-12	12:37	0.04	0.02	0.04
Arsenic [mg/L]	06-Mar-12	17:33	0.0005	0.0002	0.0025
Barium [mg/L]	06-Mar-12	17:33	0.00169	0.00471	0.00139
Boron [mg/L]	06-Mar-12	17:33	0.0068	0.0050	0.0032
Cadmium [mg/L]	06-Mar-12	17:33	< 0.000003	< 0.000003	< 0.000003
Cobalt [mg/L]	06-Mar-12	17:33	0.000019	0.000050	0.000041
Chromium [mg/L]	06-Mar-12	17:33	< 0.0005	< 0.0005	< 0.0005
Copper [mg/L]	06-Mar-12	17:33	< 0.0005	< 0.0005	< 0.0005
Iron [mg/L]	05-Mar-12	12:37	0.011	0.014	0.016
Potassium [mg/L]	05-Mar-12	12:37	2.27	3.16	1.89
Lithium [mg/L]	06-Mar-12	17:33	< 0.001	< 0.001	< 0.001
Magnesium [mg/L]	05-Mar-12	12:37	0.657	1.06	1.09
Manganese [mg/L]	06-Mar-12	17:33	0.00426	0.00798	0.00314
Molybdenum [mg/L]	06-Mar-12	17:33	0.00031	0.00061	0.00013
Sodium [mg/L]	05-Mar-12	12:37	2.13	1.94	0.80
Nickel [mg/L]	06-Mar-12	17:33	0.0001	0.0003	0.0002
Lead [mg/L]	06-Mar-12	17:33	0.00027	0.00002	< 0.00002

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LR Report : CA11092-FEB12

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk # 2	6: NF-07-03-02 Wk # 2	7: NF-08-14-01 Wk # 2
Antimony [mg/L]	06-Mar-12	17:33	0.0006	0.0005	0.0003
Selenium [mg/L]	06-Mar-12	17:33	< 0.001	< 0.001	< 0.001
Tin [mg/L]	06-Mar-12	17:33	0.00036	0.00077	0.00114
Strontium [mg/L]	05-Mar-12	12:37	0.0038	0.0095	0.0053
Titanium [mg/L]	06-Mar-12	17:33	0.0009	0.0010	0.0003
Uranium [mg/L]	06-Mar-12	17:33	0.000080	0.000127	0.000013
Vanadium [mg/L]	06-Mar-12	17:33	0.00205	0.00224	0.00168
Zinc [mg/L]	06-Mar-12	17:33	< 0.001	< 0.001	< 0.001

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Date Rec. : 07 March 2012
LR Report: **CA10063-MAR12**
Reference: NNP Puimajuq Wk# 3

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CERTIFICATE OF ANALYSIS
Final Report

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk # 3	6: NF-07-03-02 Wk # 3	7: NF-08-14-01 Wk # 3
Sample Date & Time			07-Mar-12	07-Mar-12	07-Mar-12
Hum Cell Leachate Volume [mLs]	---	---	953	986	982
pH [no unit]	12-Mar-12	12:11	7.52	7.73	7.72
Alkalinity [mg/L as CaCO3]	12-Mar-12	12:11	12	17	16
Acidity [mg/L as CaCO3]	12-Mar-12	12:11	< 2	< 2	< 2
Conductivity [µS/cm]	12-Mar-12	12:11	37	43	44
Fluoride [mg/L]	09-Mar-12	10:36	< 0.06	< 0.06	< 0.06
Sulphate [mg/L]	15-Mar-12	11:05	3.9	6.6	4.2
Chloride [mg/L]	15-Mar-12	11:05	0.2	< 0.2	< 0.2
Calcium [mg/L]	08-Mar-12	18:18	3.52	5.88	5.28
Mercury [mg/L]	12-Mar-12	14:59	< 0.0001	< 0.0001	< 0.0001
Silver [mg/L]	12-Mar-12	16:19	< 0.00001	< 0.00001	< 0.00001
Aluminum [mg/L]	08-Mar-12	18:18	0.04	0.02	0.04
Arsenic [mg/L]	12-Mar-12	16:19	0.0009	0.0004	0.0027
Barium [mg/L]	12-Mar-12	16:19	0.00166	0.00406	0.00138
Boron [mg/L]	12-Mar-12	16:19	0.0050	0.0039	0.0033
Cadmium [mg/L]	12-Mar-12	16:19	< 0.000003	< 0.000003	< 0.000003
Cobalt [mg/L]	12-Mar-12	16:19	0.000019	0.000036	0.000041
Chromium [mg/L]	12-Mar-12	16:19	< 0.0005	< 0.0005	< 0.0005
Copper [mg/L]	12-Mar-12	16:19	0.0005	< 0.0005	< 0.0005
Iron [mg/L]	08-Mar-12	18:19	0.010	0.005	0.013
Potassium [mg/L]	08-Mar-12	18:19	2.23	3.01	1.92
Lithium [mg/L]	12-Mar-12	16:19	0.001	< 0.001	< 0.001
Magnesium [mg/L]	08-Mar-12	18:19	0.610	0.945	1.10
Manganese [mg/L]	12-Mar-12	16:19	0.00321	0.00636	0.00277
Molybdenum [mg/L]	12-Mar-12	16:19	0.00029	0.00042	0.00011
Sodium [mg/L]	08-Mar-12	18:19	1.55	1.34	0.69
Nickel [mg/L]	12-Mar-12	16:19	< 0.0001	0.0001	0.0006
Lead [mg/L]	12-Mar-12	16:19	< 0.00002	< 0.00002	< 0.00002

SGS

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LR Report : CA10063-MAR12

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk # 3	6: NF-07-03-02 Wk # 3	7: NF-08-14-01 Wk # 3
Antimony [mg/L]	12-Mar-12	16:19	0.0004	0.0003	< 0.0002
Selenium [mg/L]	12-Mar-12	16:19	< 0.001	< 0.001	< 0.001
Tin [mg/L]	12-Mar-12	16:19	0.00029	0.00049	0.00086
Strontium [mg/L]	08-Mar-12	18:19	0.0037	0.0087	0.0054
Titanium [mg/L]	12-Mar-12	16:19	0.0009	0.0005	0.0007
Uranium [mg/L]	12-Mar-12	16:19	0.00160	0.000401	0.000076
Vanadium [mg/L]	12-Mar-12	16:19	0.00195	0.00205	0.00150
Zinc [mg/L]	12-Mar-12	16:19	< 0.001	< 0.001	< 0.001

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Date Rec. : 14 March 2012
LR Report: **CA10064-MAR12**
Reference: NNP Puimajuq Wk#4

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CERTIFICATE OF ANALYSIS
Final Report

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk #4	6: NF-07-03-02 Wk #4	7: NF-08-14-01 Wk #4
Sample Date & Time			14-Mar-12	14-Mar-12	14-Mar-12
Hum Cell Leachate Volume [mLs]	---	---	941	990	992
pH [no unit]	20-Mar-12	10:25	7.39	7.40	7.45
Alkalinity [mg/L as CaCO3]	20-Mar-12	10:25	11	17	17
Acidity [mg/L as CaCO3]	20-Mar-12	10:25	< 2	< 2	< 2
Conductivity [µS/cm]	20-Mar-12	10:25	44	61	54
Fluoride [mg/L]	16-Mar-12	11:30	< 0.06	< 0.06	< 0.06
Sulphate [mg/L]	21-Mar-12	13:04	3.6	5.8	3.8
Chloride [mg/L]	21-Mar-12	13:04	< 0.2	< 0.2	< 0.2
Calcium [mg/L]	19-Mar-12	08:31	3.08	5.29	5.33
Mercury [mg/L]	16-Mar-12	09:14	< 0.0001	< 0.0001	< 0.0001
Silver [mg/L]	21-Mar-12	17:29	< 0.00001	< 0.00001	< 0.00001
Aluminum [mg/L]	19-Mar-12	08:31	0.05	0.03	0.04
Arsenic [mg/L]	21-Mar-12	17:29	0.0007	< 0.0002	0.0030
Barium [mg/L]	21-Mar-12	17:29	0.00141	0.00488	0.00156
Boron [mg/L]	21-Mar-12	17:29	0.0035	0.0031	0.0029
Cadmium [mg/L]	21-Mar-12	17:29	0.000004	0.000011	0.000025
Cobalt [mg/L]	21-Mar-12	17:29	0.000017	0.000045	0.000035
Chromium [mg/L]	21-Mar-12	17:29	< 0.0005	< 0.0005	< 0.0005
Copper [mg/L]	21-Mar-12	17:29	< 0.0005	< 0.0005	< 0.0005
Iron [mg/L]	19-Mar-12	08:31	0.008	0.006	0.008
Potassium [mg/L]	19-Mar-12	08:31	2.16	2.89	1.89
Lithium [mg/L]	21-Mar-12	17:29	< 0.001	< 0.001	< 0.001
Magnesium [mg/L]	19-Mar-12	08:31	0.556	0.862	1.07
Manganese [mg/L]	21-Mar-12	17:29	0.00284	0.00550	0.00250
Molybdenum [mg/L]	21-Mar-12	17:29	0.00020	0.00028	0.00010
Sodium [mg/L]	19-Mar-12	08:31	1.15	0.99	0.59
Nickel [mg/L]	21-Mar-12	17:29	< 0.0001	0.0002	0.0001
Lead [mg/L]	21-Mar-12	17:29	< 0.00002	< 0.00002	< 0.00002

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LR Report : CA10064-MAR12

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk #4	6: NF-07-03-02 Wk #4	7: NF-08-14-01 Wk #4
Antimony [mg/L]	21-Mar-12	17:29	0.0004	0.0004	0.0003
Selenium [mg/L]	21-Mar-12	17:29	< 0.001	< 0.001	< 0.001
Tin [mg/L]	21-Mar-12	17:29	0.00028	0.00051	0.00090
Strontium [mg/L]	19-Mar-12	08:31	0.0032	0.0080	0.0055
Titanium [mg/L]	21-Mar-12	17:29	0.0008	0.0005	0.0003
Uranium [mg/L]	21-Mar-12	17:29	0.000109	0.00156	0.000068
Vanadium [mg/L]	21-Mar-12	17:29	0.00214	0.00224	0.00183
Zinc [mg/L]	21-Mar-12	17:29	< 0.001	< 0.001	< 0.001

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April-01-13

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Phone: 613-592-9600, Fax:613-592-9601

Date Rec. : 21 March 2012
LR Report: **CA10149-MAR12**
Reference: NNP Puimajuq Wk#5

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk #5	6: NF-07-03-02 Wk #5	7: NF-08-14-01 Wk #5
Sample Date & Time			21-Mar-12	21-Mar-12	21-Mar-12
Hum Cell Leachate Volume [mLs]	---	---	953	989	988
pH [no unit]	26-Mar-12	15:25	7.33	7.62	7.57
Alkalinity [mg/L as CaCO3]	26-Mar-12	15:25	10	14	18
Acidity [mg/L as CaCO3]	26-Mar-12	15:25	< 2	< 2	< 2
Conductivity [µS/cm]	26-Mar-12	15:25	30	33	46
Fluoride [mg/L]	23-Mar-12	09:06	< 0.06	< 0.06	< 0.06
Sulphate [mg/L]	29-Mar-12	15:56	3.4	5.2	3.5
Chloride [mg/L]	29-Mar-12	15:56	< 0.2	< 0.2	< 0.2
Calcium [mg/L]	23-Mar-12	12:59	2.92	4.86	5.90
Mercury [mg/L]	23-Mar-12	15:50	< 0.0001	< 0.0001	< 0.0001
Silver [mg/L]	23-Mar-12	13:57	< 0.00001	< 0.00001	< 0.00001
Aluminum [mg/L]	23-Mar-12	12:59	0.03	0.03	0.06
Arsenic [mg/L]	23-Mar-12	13:57	0.0007	0.0002	0.0036
Barium [mg/L]	23-Mar-12	13:57	0.00264	0.00411	0.00187
Boron [mg/L]	23-Mar-12	13:57	0.0025	0.0027	0.0027
Cadmium [mg/L]	23-Mar-12	13:57	< 0.000003	< 0.000003	< 0.000003
Cobalt [mg/L]	23-Mar-12	13:57	0.000015	0.000029	0.000037
Chromium [mg/L]	23-Mar-12	13:57	< 0.0005	< 0.0005	< 0.0005
Copper [mg/L]	23-Mar-12	13:57	< 0.0005	< 0.0005	< 0.0005
Iron [mg/L]	23-Mar-12	12:59	0.008	0.010	0.010
Potassium [mg/L]	23-Mar-12	12:59	2.14	2.76	2.00
Lithium [mg/L]	23-Mar-12	13:57	< 0.001	< 0.001	< 0.001
Magnesium [mg/L]	23-Mar-12	12:59	0.534	0.737	1.11
Manganese [mg/L]	23-Mar-12	13:57	0.00314	0.00531	0.00282
Molybdenum [mg/L]	23-Mar-12	13:57	0.00023	0.00026	0.00008
Sodium [mg/L]	23-Mar-12	12:59	0.92	0.78	0.54
Nickel [mg/L]	23-Mar-12	13:57	< 0.0001	< 0.0001	< 0.0001
Lead [mg/L]	23-Mar-12	13:57	< 0.00002	< 0.00002	< 0.00002

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LR Report : **CA10149-MAR12**

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk #5	6: NF-07-03-02 Wk #5	7: NF-08-14-01 Wk #5
Antimony [mg/L]	23-Mar-12	13:57	0.0004	0.0004	0.0003
Selenium [mg/L]	23-Mar-12	13:57	< 0.001	< 0.001	< 0.001
Tin [mg/L]	23-Mar-12	13:57	0.00030	0.00048	0.00070
Strontium [mg/L]	23-Mar-12	12:59	0.0032	0.0070	0.0060
Titanium [mg/L]	23-Mar-12	13:57	0.0008	0.0009	0.0004
Uranium [mg/L]	23-Mar-12	13:57	0.000125	0.000116	0.000014
Vanadium [mg/L]	23-Mar-12	13:57	0.00227	0.00294	0.00230
Zinc [mg/L]	23-Mar-12	13:57	< 0.001	< 0.001	< 0.001

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Date Rec. : 28 March 2012
LR Report: **CA10203-MAR12**
Reference: NNP Puimajuq Wk# 6

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CERTIFICATE OF ANALYSIS

Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: NF-08-18-03 Wk # 6**	**6: NF-07-03-02 Wk # 6**	**7: NF-08-14-01 WK # 6**
Sample Date & Time			28-Mar-12	28-Mar-12	28-Mar-12
Hum Cell Leachate Volume [mLs]	---	---	987	991	998
pH [no unit]	30-Mar-12	15:03	7.39	7.37	7.46
Alkalinity [mg/L as CaCO3]	30-Mar-12	15:03	13	12	15
Acidity [mg/L as CaCO3]	30-Mar-12	15:03	< 2	< 2	< 2
Conductivity [µS/cm]	30-Mar-12	15:03	32	29	32
Sulphate [mg/L]	03-Apr-12	09:23	3.1	4.2	2.8
Calcium [mg/L]	02-Apr-12	10:01	2.90	4.10	4.94

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Date Rec. : 04 April 2012
LR Report: **CA10029-APR12**
Reference: NNP Puimajuq Wk# 7

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CERTIFICATE OF ANALYSIS

Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: NF-08-18-03 Wk # 7**	**6: NF-07-03-02 Wk # 7**	**7: NF-08-14-01 WK# 7**
Sample Date & Time			04-Apr-12	04-Apr-12	04-Apr-12
Hum Cell Leachate Volume [mLs]	---	---	983	987	976
pH [no unit]	16-Apr-12	12:11	7.14	7.27	7.49
Alkalinity [mg/L as CaCO3]	16-Apr-12	12:11	11	13	16
Acidity [mg/L as CaCO3]	16-Apr-12	12:11	< 2	< 2	< 2
Conductivity [µS/cm]	16-Apr-12	12:11	28	58	56
Sulphate [mg/L]	10-Apr-12	16:20	3.3	3.5	2.7
Calcium [mg/L]	11-Apr-12	14:53	3.27	4.27	5.35

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Date Rec. : 11 April 2012
LR Report: **CA10092-APR12**
Reference: NNP Puimajuq Wk#8

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CERTIFICATE OF ANALYSIS

Final Report

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk #8	6: NF-07-03-02 Wk #8	7: NF-08-14-01 Wk #8
Sample Date & Time			11-Apr-12	11-Apr-12	11-Apr-12
Hum Cell Leachate Volume [mLs]	---	---	978	985	980
pH [no unit]	17-Apr-12	11:56	7.38	7.44	7.63
Alkalinity [mg/L as CaCO3]	17-Apr-12	11:56	9	12	16
Acidity [mg/L as CaCO3]	17-Apr-12	11:56	< 2	< 2	< 2
Conductivity [µS/cm]	17-Apr-12	11:56	31	35	40
Fluoride [mg/L]	12-Apr-12	14:15	< 0.06	< 0.06	< 0.06
Sulphate [mg/L]	16-Apr-12	13:26	2.7	3.1	2.4
Chloride [mg/L]	16-Apr-12	13:26	< 0.2	< 0.2	< 0.2
Calcium [mg/L]	13-Apr-12	14:35	3.16	4.10	5.28
Mercury [mg/L]	15-Apr-12	16:15	< 0.0001	< 0.0001	< 0.0001
Silver [mg/L]	16-Apr-12	17:04	< 0.00001	< 0.00001	< 0.00001
Aluminum [mg/L]	13-Apr-12	14:35	0.01	0.02	0.04
Arsenic [mg/L]	16-Apr-12	17:04	0.0008	0.0004	0.0039
Barium [mg/L]	16-Apr-12	17:04	0.00368	0.00433	0.00139
Boron [mg/L]	16-Apr-12	17:04	0.0022	0.0014	0.0017
Cadmium [mg/L]	16-Apr-12	17:04	< 0.000003	< 0.000003	< 0.000003
Cobalt [mg/L]	16-Apr-12	17:04	0.000031	0.000039	0.000027
Chromium [mg/L]	16-Apr-12	17:04	< 0.0005	< 0.0005	< 0.0005
Copper [mg/L]	16-Apr-12	17:04	< 0.0005	< 0.0005	< 0.0005
Iron [mg/L]	13-Apr-12	14:35	< 0.003	0.006	0.004
Potassium [mg/L]	13-Apr-12	14:35	2.39	2.51	1.56
Lithium [mg/L]	16-Apr-12	17:04	< 0.001	< 0.001	< 0.001
Magnesium [mg/L]	13-Apr-12	14:35	0.630	0.658	0.952
Manganese [mg/L]	16-Apr-12	17:04	0.00235	0.00371	0.00214
Molybdenum [mg/L]	16-Apr-12	17:04	0.00010	0.00011	0.00004
Sodium [mg/L]	13-Apr-12	14:35	0.51	0.36	0.31
Nickel [mg/L]	16-Apr-12	17:04	< 0.0001	0.0001	0.0001
Lead [mg/L]	16-Apr-12	17:04	< 0.00002	< 0.00002	< 0.00002

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LR Report : **CA10092-APR12**

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: NF-08-18-03 Wk #8**	**6: NF-07-03-02 Wk #8**	**7: NF-08-14-01 Wk #8**
Antimony [mg/L]	16-Apr-12	17:04	0.0003	0.0002	< 0.0002
Selenium [mg/L]	16-Apr-12	17:04	< 0.001	< 0.001	< 0.001
Tin [mg/L]	16-Apr-12	17:04	0.00020	0.00024	0.00040
Strontium [mg/L]	13-Apr-12	14:35	0.0040	0.0060	0.0053
Titanium [mg/L]	16-Apr-12	17:04	0.0003	0.0007	0.0002
Uranium [mg/L]	16-Apr-12	17:04	0.000188	0.000099	0.000048
Vanadium [mg/L]	16-Apr-12	17:04	0.00168	0.00210	0.00198
Zinc [mg/L]	16-Apr-12	17:04	0.003	< 0.001	< 0.001

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Date Rec. : 18 April 2012
LR Report: **CA10124-APR12**
Reference: NNP Puimajuq Wk#9

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CERTIFICATE OF ANALYSIS

Final Report

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk #9	6: NF-07-03-02 Wk #9	7: NF-08-14-01 WK#9
Sample Date & Time			18-Apr-12	18-Apr-12	18-Apr-12
Hum Cell Leachate Volume [mLs]	---	---	992	996	1000
pH [no unit]	20-Apr-12	11:12	7.30	7.46	7.46
Alkalinity [mg/L as CaCO3]	20-Apr-12	11:12	10	26	13
Acidity [mg/L as CaCO3]	20-Apr-12	11:12	< 2	< 2	< 2
Conductivity [µS/cm]	20-Apr-12	11:12	31	35	42
Sulphate [mg/L]	25-Apr-12	16:38	2.4	3.0	2.2
Calcium [mg/L]	23-Apr-12	16:22	3.20	4.08	4.32

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Date Rec. : 25 April 2012
LR Report: **CA10192-APR12**
Reference: NNP Puimajuq Wk# 10

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CERTIFICATE OF ANALYSIS

Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: NF-08-18-03 Wk # 10**	**6: NF-07-03-02 Wk # 10**	**7: NF-08-14-01 WK# 10**
Sample Date & Time			25-Apr-12	25-Apr-12	25-Apr-12
Hum Cell Leachate Volume [mLs]	---	---	990	993	992
pH [no unit]	27-Apr-12	10:56	7.34	7.33	7.38
Alkalinity [mg/L as CaCO3]	27-Apr-12	10:56	9	12	13
Acidity [mg/L as CaCO3]	27-Apr-12	10:56	< 2	< 2	< 2
Conductivity [µS/cm]	27-Apr-12	10:56	27	28	34
Sulphate [mg/L]	01-May-12	15:57	2.6	2.9	2.1
Calcium [mg/L]	27-Apr-12	10:27	2.85	3.99	4.28

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Date Rec. : 02 May 2012
LR Report: **CA10043-MAY12**
Reference: NNP Puimajuq Wk# 11

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CERTIFICATE OF ANALYSIS

Final Report

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk # 11	6: NF-07-03-02 Wk # 11	7: NF-08-14-01 WK# 11
Sample Date & Time			02-May-12	02-May-12	02-May-12
Hum Cell Leachate Volume [mLs]	---	---	991	991	982
pH [no unit]	09-May-12	13:13	7.06	7.06	7.54
Alkalinity [mg/L as CaCO3]	09-May-12	13:13	9	9	16
Acidity [mg/L as CaCO3]	09-May-12	13:13	< 2	< 2	< 2
Conductivity [µS/cm]	09-May-12	13:13	30	35	41
Sulphate [mg/L]	09-May-12	14:22	3.1	3.2	2.3
Calcium [mg/L]	03-May-12	15:02	3.02	3.96	5.81

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Date Rec. : 09 May 2012
LR Report: **CA10100-MAY12**
Reference: NNP Puimajuq Wk# 12

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CERTIFICATE OF ANALYSIS

Final Report

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk # 12	6: NF-07-03-02 Wk # 12	7: NF-08-14-01 Wk # 12
Sample Date & Time			09-May-12	09-May-12	09-May-12
Hum Cell Leachate Volume [mLs]	---	---	995	1003	987
pH [no unit]	14-May-12	12:11	6.93	7.06	7.34
Alkalinity [mg/L as CaCO3]	14-May-12	12:11	10	13	18
Acidity [mg/L as CaCO3]	14-May-12	12:11	< 2	< 2	< 2
Conductivity [µS/cm]	14-May-12	12:11	36	42	46
Fluoride [mg/L]	14-May-12	09:34	< 0.06	< 0.06	< 0.06
Sulphate [mg/L]	14-May-12	20:51	2.9	2.9	2.2
Chloride [mg/L]	14-May-12	20:51	< 0.2	< 0.2	< 0.2
Calcium [mg/L]	14-May-12	11:27	3.10	4.13	5.80
Mercury [mg/L]	11-May-12	13:01	< 0.0001	< 0.0001	< 0.0001
Silver [mg/L]	14-May-12	11:27	< 0.00001	< 0.00001	< 0.00001
Aluminum [mg/L]	11-May-12	15:49	0.02	0.03	0.06
Arsenic [mg/L]	14-May-12	11:27	0.0011	0.0004	0.0049
Barium [mg/L]	14-May-12	11:27	0.00296	0.00595	0.00139
Boron [mg/L]	14-May-12	11:27	0.0012	0.0009	0.0014
Cadmium [mg/L]	14-May-12	11:27	< 0.000003	< 0.000003	< 0.000003
Cobalt [mg/L]	14-May-12	11:27	0.000028	0.000045	0.000045
Chromium [mg/L]	14-May-12	11:27	< 0.0005	< 0.0005	< 0.0005
Copper [mg/L]	14-May-12	11:27	< 0.0005	< 0.0005	< 0.0005
Iron [mg/L]	11-May-12	15:49	< 0.003	< 0.003	0.012
Potassium [mg/L]	11-May-12	15:49	2.41	2.84	1.43
Lithium [mg/L]	14-May-12	11:27	< 0.001	< 0.001	< 0.001
Magnesium [mg/L]	11-May-12	15:49	0.544	0.606	0.934
Manganese [mg/L]	14-May-12	11:27	0.00146	0.00273	0.00286
Molybdenum [mg/L]	14-May-12	11:27	0.00005	0.00008	0.00002
Sodium [mg/L]	11-May-12	15:49	0.32	0.25	0.20
Nickel [mg/L]	14-May-12	11:28	0.0002	0.0002	0.0002
Lead [mg/L]	14-May-12	11:28	< 0.00002	< 0.00002	< 0.00002

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LR Report : **CA10100-MAY12**

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: NF-08-18-03 Wk # 12**	**6: NF-07-03-02 Wk # 12**	**7: NF-08-14-01 Wk # 12**
Antimony [mg/L]	14-May-12	11:28	0.0004	0.0003	0.0003
Selenium [mg/L]	14-May-12	11:28	< 0.001	< 0.001	< 0.001
Tin [mg/L]	14-May-12	11:28	0.00024	0.00025	0.00037
Strontium [mg/L]	11-May-12	15:49	0.0034	0.0059	0.0056
Titanium [mg/L]	14-May-12	11:28	0.0004	0.0003	0.0005
Uranium [mg/L]	14-May-12	11:28	0.000243	0.000221	0.000049
Vanadium [mg/L]	14-May-12	11:28	0.00198	0.00230	0.00224
Zinc [mg/L]	14-May-12	11:28	0.003	< 0.001	< 0.001

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Date Rec. : 16 May 2012
LR Report: **CA10155-MAY12**
Reference: NNP Puimajuq Wk# 13

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CERTIFICATE OF ANALYSIS

Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: NF-08-18-03 Wk # 13**	**6: NF-07-03-02 Wk # 13**	**7: NF-08-14-01 WK# 13**
Sample Date & Time			16-May-12	16-May-12	16-May-12
Hum Cell Leachate Volume [mLs]	---	---	993	991	989
pH [no unit]	22-May-12	12:09	7.29	7.28	7.38
Alkalinity [mg/L as CaCO3]	22-May-12	12:09	10	11	14
Acidity [mg/L as CaCO3]	22-May-12	12:09	< 2	< 2	< 2
Conductivity [µS/cm]	22-May-12	12:09	33	34	38
Sulphate [mg/L]	24-May-12	12:08	3.1	2.5	2.2
Calcium [mg/L]	18-May-12	12:54	3.20	3.60	4.94

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Date Rec. : 23 May 2012
LR Report: **CA11145-MAY12**
Reference: NNP Puimajuq Wk#14

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Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: NF-08-18-03 Wk # 14**	**6: NF-07-03-02 Wk # 14**	**7: NF-08-14-01 WK# 14**
Sample Date & Time			23-May-12	23-May-12	23-May-12
Hum Cell Leachate Volume [mLs]	---	---	994	986	988
pH [no unit]	24-May-12	14:07	7.03	7.04	7.22
Alkalinity [mg/L as CaCO3]	24-May-12	14:07	8	10	15
Acidity [mg/L as CaCO3]	24-May-12	14:07	< 2	< 2	< 2
Conductivity [µS/cm]	24-May-12	14:07	30	31	33
Sulphate [mg/L]	29-May-12	16:35	3.0	2.7	2.0
Calcium [mg/L]	25-May-12	15:30	3.39	3.73	4.77

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Date Rec. : 30 May 2012
LR Report: **CA10356-MAY12**
Reference: NNP Puimajuq Wk# 15

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CERTIFICATE OF ANALYSIS

Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: NF-08-18-03 Wk # 15**	**6: NF-07-03-02 Wk # 15**	**7: NF-08-14-01 WK# 15**
Sample Date & Time			30-May-12	30-May-12	30-May-12
Hum Cell Leachate Volume [mLs]	---	---	993	994	986
pH [no unit]	01-Jun-12	14:28	7.21	7.22	7.43
Alkalinity [mg/L as CaCO3]	01-Jun-12	14:28	9	10	13
Acidity [mg/L as CaCO3]	01-Jun-12	14:28	< 2	< 2	< 2
Conductivity [µS/cm]	01-Jun-12	14:28	30	30	33
Sulphate [mg/L]	05-Jun-12	15:41	3.1	2.4	2.0
Calcium [mg/L]	04-Jun-12	09:02	3.28	3.69	4.68

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Date Rec. : 05 June 2012
LR Report: **CA10027-JUN12**
Reference: NNP Puimajuq Wk# 16

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CERTIFICATE OF ANALYSIS
Final Report

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk # 16	6: NF-07-03-02 Wk # 16	7: NF-08-14-01 Wk # 16
Sample Date & Time			06-Jun-12	06-Jun-12	06-Jun-12
Hum Cell Leachate Volume [mLs]	---	---	999	1000	990
pH [no unit]	12-Jun-12	14:35	7.30	7.15	7.84
Alkalinity [mg/L as CaCO3]	12-Jun-12	14:35	10	10	14
Acidity [mg/L as CaCO3]	12-Jun-12	14:35	< 2	< 2	< 2
Conductivity [µS/cm]	12-Jun-12	14:35	32	30	35
Fluoride [mg/L]	12-Jun-12	10:23	< 0.06	< 0.06	< 0.06
Sulphate [mg/L]	12-Jun-12	14:55	2.8	2.3	1.9
Chloride [mg/L]	12-Jun-12	14:55	0.5	< 0.2	< 0.2
Calcium [mg/L]	13-Jun-12	16:39	3.45	3.65	4.72
Mercury [mg/L]	08-Jun-12	15:42	< 0.0001	< 0.0001	< 0.0001
Silver [mg/L]	13-Jun-12	10:51	< 0.00001	< 0.00001	< 0.00001
Aluminum [mg/L]	13-Jun-12	16:39	0.03	0.03	0.05
Arsenic [mg/L]	13-Jun-12	10:51	0.0015	0.0005	0.0038
Barium [mg/L]	13-Jun-12	10:51	0.00378	0.00478	0.00121
Boron [mg/L]	13-Jun-12	10:51	0.0010	0.0009	0.0011
Cadmium [mg/L]	13-Jun-12	10:51	< 0.000003	< 0.000003	< 0.000003
Cobalt [mg/L]	13-Jun-12	10:51	0.000039	0.000050	0.000028
Chromium [mg/L]	13-Jun-12	10:51	< 0.0005	< 0.0005	< 0.0005
Copper [mg/L]	13-Jun-12	10:51	< 0.0005	0.0006	< 0.0005
Iron [mg/L]	13-Jun-12	16:39	< 0.003	< 0.003	< 0.003
Potassium [mg/L]	13-Jun-12	16:39	2.40	2.21	1.04
Lithium [mg/L]	13-Jun-12	10:51	< 0.001	< 0.001	< 0.001
Magnesium [mg/L]	13-Jun-12	16:39	0.538	0.481	0.752
Manganese [mg/L]	13-Jun-12	10:51	0.00308	0.00269	0.00261
Molybdenum [mg/L]	13-Jun-12	10:51	0.00009	0.00010	0.00002
Sodium [mg/L]	13-Jun-12	16:39	0.20	0.14	0.12
Nickel [mg/L]	13-Jun-12	10:51	0.0001	0.0002	0.0001
Lead [mg/L]	13-Jun-12	10:51	< 0.00002	0.00003	0.00003

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LR Report : CA10027-JUN12

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk # 16	6: NF-07-03-02 Wk # 16	7: NF-08-14-01 Wk # 16
Antimony [mg/L]	13-Jun-12	10:51	< 0.0002	< 0.0002	< 0.0002
Selenium [mg/L]	13-Jun-12	10:51	< 0.001	< 0.001	< 0.001
Tin [mg/L]	13-Jun-12	10:51	0.00029	0.00031	0.00031
Strontium [mg/L]	13-Jun-12	16:39	0.0037	0.0049	0.0046
Titanium [mg/L]	13-Jun-12	10:51	0.0002	0.0002	0.0001
Uranium [mg/L]	13-Jun-12	10:51	0.000283	0.000152	0.000029
Vanadium [mg/L]	13-Jun-12	10:51	0.00169	0.00185	0.00160
Zinc [mg/L]	13-Jun-12	10:51	0.001	< 0.001	< 0.001

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Date Rec. : 13 June 2012
LR Report: **CA10081-JUN12**
Reference: NNP Puimajuq Wk# 17

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Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: NF-08-18-03 Wk # 17**	**6: NF-07-03-02 Wk # 17**	**7: NF-08-14-01 WK# 17**
Sample Date & Time			13-Jun-12	13-Jun-12	13-Jun-12
Hum Cell Leachate Volume [mLs]	---	---	999	997	993
pH [no unit]	18-Jun-12	12:10	7.60	7.42	7.46
Alkalinity [mg/L as CaCO3]	18-Jun-12	12:10	9	11	12
Acidity [mg/L as CaCO3]	18-Jun-12	12:10	< 2	< 2	< 2
Conductivity [µS/cm]	18-Jun-12	12:10	33	37	32
Sulphate [mg/L]	20-Jun-12	15:49	2.9	2.3	1.9
Calcium [mg/L]	18-Jun-12	09:37	3.58	3.50	4.56

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Date Rec. : 20 June 2012
LR Report: **CA10124-JUN12**
Reference: NNP Puimajuq Wk# 18

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CERTIFICATE OF ANALYSIS

Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: NF-08-18-03 Wk # 18**	**6: NF-07-03-02 Wk # 18**	**7: NF-08-14-01 WK# 18**
Sample Date & Time			20-Jun-12	20-Jun-12	20-Jun-12
Hum Cell Leachate Volume [mLs]	---	---	995	1001	980
pH [no unit]	26-Jun-12	11:58	7.19	7.57	7.25
Alkalinity [mg/L as CaCO3]	26-Jun-12	11:58	10	11	13
Acidity [mg/L as CaCO3]	26-Jun-12	11:58	< 2	< 2	< 2
Conductivity [µS/cm]	26-Jun-12	11:58	34	48	34
Sulphate [mg/L]	22-Jun-12	15:57	3.0	2.6	2.1
Calcium [mg/L]	27-Jun-12	13:22	3.94	3.81	4.74

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Date Rec. : 27 June 2012
LR Report: **CA10171-JUN12**
Reference: NNP Puimajuq Wk#19

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Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: NF-08-18-03 Wk # 19**	**6: NF-07-03-02 Wk # 19**	**7: NF-08-14-01 WK# 19**
Sample Date & Time			27-Jun-12	27-Jun-12	27-Jun-12
Hum Cell Leachate Volume [mLs]	---	---	997	997	983
pH [no unit]	06-Jul-12	06:56	7.72	7.39	7.76
Alkalinity [mg/L as CaCO3]	06-Jul-12	06:56	12	9	21
Acidity [mg/L as CaCO3]	06-Jul-12	06:56	< 2	< 2	< 2
Conductivity [µS/cm]	06-Jul-12	06:56	34	31	36
Sulphate [mg/L]	05-Jul-12	15:33	3.2	2.7	2.2
Calcium [mg/L]	28-Jun-12	14:12	4.27	3.66	5.30

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Date Rec. : 04 July 2012
LR Report: **CA10037-JUL12**
Reference: NNP Puimajuq Wk#20

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CERTIFICATE OF ANALYSIS
Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: NF-08-18-03 Wk #20**	**6: NF-07-03-02 Wk #20**	**7: NF-08-14-01 Wk #20**
Sample Date & Time			04-Jul-12	04-Jul-12	04-Jul-12
Hum Cell Leachate Volume [mLs]	---	---	990	994	983
pH [no unit]	17-Jul-12	12:04	7.02	7.35	7.68
Alkalinity [mg/L as CaCO3]	17-Jul-12	12:04	10	10	13
Acidity [mg/L as CaCO3]	17-Jul-12	12:04	< 2	< 2	< 2
Conductivity [µS/cm]	17-Jul-12	12:04	41	31	36
Fluoride [mg/L]	10-Jul-12	16:09	< 0.06	< 0.06	< 0.06
Sulphate [mg/L]	11-Jul-12	15:34	3.2	2.7	2.0
Chloride [mg/L]	11-Jul-12	15:34	0.7	< 0.2	< 0.2
Calcium [mg/L]	06-Jul-12	14:51	4.22	3.53	4.96
Mercury [mg/L]	09-Jul-12	15:59	< 0.0001	< 0.0001	< 0.0001
Silver [mg/L]	11-Jul-12	15:13	< 0.00001	< 0.00001	< 0.00001
Aluminum [mg/L]	06-Jul-12	14:51	0.02	< 0.01	0.03
Arsenic [mg/L]	11-Jul-12	15:13	0.0012	0.0003	0.0040
Barium [mg/L]	11-Jul-12	15:13	0.00545	0.00488	0.00115
Boron [mg/L]	11-Jul-12	15:13	0.0013	0.0013	0.0015
Cadmium [mg/L]	11-Jul-12	15:13	< 0.000003	0.000008	0.000008
Cobalt [mg/L]	11-Jul-12	15:13	0.000054	0.000065	0.000072
Chromium [mg/L]	11-Jul-12	15:13	< 0.0005	< 0.0005	< 0.0005
Copper [mg/L]	11-Jul-12	15:13	0.0018	< 0.0005	< 0.0005
Iron [mg/L]	06-Jul-12	14:51	0.004	0.003	0.004
Potassium [mg/L]	06-Jul-12	14:51	2.38	1.90	0.908
Lithium [mg/L]	11-Jul-12	15:13	< 0.001	< 0.001	< 0.001
Magnesium [mg/L]	06-Jul-12	14:51	0.532	0.425	0.765
Manganese [mg/L]	11-Jul-12	15:13	0.00263	0.00309	0.00313
Molybdenum [mg/L]	11-Jul-12	15:13	0.00009	0.00010	0.00001
Sodium [mg/L]	06-Jul-12	14:51	0.17	0.12	0.10
Nickel [mg/L]	11-Jul-12	15:14	0.0001	0.0002	0.0002
Lead [mg/L]	11-Jul-12	15:14	0.00005	< 0.00002	0.00002

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LR Report : CA10037-JUL12

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk #20	6: NF-07-03-02 Wk #20	7: NF-08-14-01 Wk #20
Antimony [mg/L]	11-Jul-12	15:14	0.0005	0.0005	0.0005
Selenium [mg/L]	11-Jul-12	15:14	< 0.001	< 0.001	< 0.001
Tin [mg/L]	11-Jul-12	15:14	0.00092	0.00026	0.00040
Strontium [mg/L]	06-Jul-12	14:51	0.0043	0.0046	0.0047
Titanium [mg/L]	11-Jul-12	15:14	0.0004	0.0003	0.0001
Uranium [mg/L]	11-Jul-12	15:14	0.000230	0.000138	0.000020
Vanadium [mg/L]	11-Jul-12	15:14	0.00160	0.00180	0.00155
Zinc [mg/L]	11-Jul-12	15:14	0.002	< 0.001	0.002

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Date Rec. : 11 July 2012
LR Report: **CA10076-JUL12**
Reference: NNP Puimajuq Wk#21

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Final Report

Analysis	3: Analysis Approval Date	4: Analysis Approval Time	5: NF-08-18-03 Wk #21	6: NF-07-03-02 Wk #21	7: NF-08-14-01 WK#21
Sample Date & Time			11-Jul-12	11-Jul-12	11-Jul-12
Hum Cell Leachate Volume [mLs]	---	---	988	989	985
pH [no unit]	20-Jul-12	08:57	7.04	7.13	7.29
Alkalinity [mg/L as CaCO3]	20-Jul-12	08:58	11	10	12
Acidity [mg/L as CaCO3]	20-Jul-12	08:58	< 2	< 2	< 2
Conductivity [µS/cm]	20-Jul-12	08:58	40	32	36
Sulphate [mg/L]	17-Jul-12	16:19	3.4	2.9	2.1
Calcium [mg/L]	17-Jul-12	13:21	4.49	3.80	4.76

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Date Rec. : 18 July 2012
LR Report: **CA10115-JUL12**
Reference: NNP Puimajuq Wk#22

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Final Report

Analysis	**3: Analysis Approval Date**	**4: Analysis Approval Time**	**5: NF-08-18-03 Wk #22**	**6: NF-07-03-02 Wk #22**	**7: NF-08-14-01 WK#22**
Sample Date & Time			18-Jul-12	18-Jul-12	18-Jul-12
Hum Cell Leachate Volume [mLs]	---	---	987	995	983
pH [no unit]	25-Jul-12	14:00	7.28	7.08	7.20
Alkalinity [mg/L as CaCO3]	25-Jul-12	14:00	10	9	12
Acidity [mg/L as CaCO3]	25-Jul-12	14:00	< 2	< 2	< 2
Conductivity [µS/cm]	25-Jul-12	14:00	34	30	34
Sulphate [mg/L]	25-Jul-12	15:07	3.1	2.8	2.0
Calcium [mg/L]	20-Jul-12	15:33	3.96	3.63	4.61

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Appendix 2

PNNI MINING SEQUENCE (DECEMBER 2014)

Table 1.5- CRI production schedules for the underground, open pits, and stockpiles, from 2015.

Description	Unit	2015				2016	2017	2018	2019	2020	2021	2022	Total
		Q1	Q2	Q3	Q4								
# of days		90	91	92	92	366	365	365	365	366	365	365	
Ore processed / day		1 262	2 482	3 873	4 443	3 930	4 500	4 500	4 315	4 500	4 500	906	
Material moved / day		11 892	18 002	22 906	23 227	15 913	12 097	23 174	26 400	28 407	26 418	12 984	
Ore Mined - **Expo**	tonnes	47 909	109 267	262 026	331 800	744 100	1 001 300	1 102 500	1 102 500	665 923			**5 367 325**
Grades - Ni	(%)	0,61	0,63	0,61	0,63	0,81	0,81	0,81	0,81	0,81			
Cu	(%)	0,63	0,61	0,63	0,61	0,85	0,85	0,85	0,85	0,85			
Co	(%)	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04			
Pt	(g/t)	0,27	0,28	0,27	0,28	0,35	0,35	0,35	0,35	0,35			
Pd	(g/t)	1,20	1,16	1,20	1,16	1,73	1,73	1,73	1,73	1,73			
Au	(g/t)	0,08	0,08	0,08	0,08	0,09	0,09	0,09	0,09	0,09			
Waste Mined	tonnes	930 807	1 252 197	1 706 161	1 664 235	3 165 878	2 495 878	3 556 081	2 556 081	2 305 948			**19 633 266**
Ore Mined - **Mesamax**	tonnes	65 647	70 000	60 000	40 212	329 909							**565 768**
Grades - Ni	(%)	1,21	2,17	2,59	2,51	2,34							
Cu	(%)	1,52	2,82	3,80	3,00	3,06							
Co	(%)	0,11	0,11	0,11	0,11	0,10							
Pt	(g/t)	0,95	1,06	0,95	1,06	0,99							
Pd	(g/t)	4,68	5,84	4,68	5,84	4,90							
Au	(g/t)	0,30	0,22	0,30	0,22	0,27							
Waste Mined	tonnes	25 879	206 718	79 172	100 613	666 116							**1 078 498**
Ore Mined - **Mequillon**	tonnes	0	0	0	0	0	0	0	0	981 000	1 234 500		**2 215 500**
Grades - Ni	(%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,56	0,56		
Cu	(%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,90	0,90		
Co	(%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,03	0,03		
Pt	(g/t)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,54	0,54		
Pd	(g/t)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,84	1,84		
Au	(g/t)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,17	0,17		
Waste Mined	tonnes	0	0	0	0	0	0	3 800 000	5 977 345	6 443 918	5 000 000		**21 221 263**
Ore Mined - **Allammaq**	tonnes	0	0	0	0	280 000	557 000	540 000	472 555				**1 849 555**
Grades - Ni	(%)	0,00	0,00	0,00	0,00	0,92	0,93	0,93	0,93				
Cu	(%)	0,00	0,00	0,00	0,00	1,11	1,13	1,13	1,13				
Co	(%)	0,00	0,00	0,00	0,00	0,04	0,04	0,04	0,04				
Pt	(g/t)	0,00	0,00	0,00	0,00	0,54	0,55	0,55	0,55				
Pd	(g/t)	0,00	0,00	0,00	0,00	2,45	2,50	2,50	2,50				
Au	(g/t)	0,00	0,00	0,00	0,00	0,10	0,10	0,10	0,10				
Waste Mined	tonnes	0	0	60 000	100 170	93 308	19 699	0	0				**273 177**
Ore Mined - **Ivakkak**	tonnes	0	0	0	0	0	0	0	0	0	408 000	330 600	**738 600**
Grades - Ni	(%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,11	1,11	
Cu	(%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,61	1,61	
Co	(%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,05	0,05	
Pt	(g/t)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,66	0,66	
Pd	(g/t)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	3,26	3,26	
Au	(g/t)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,18	0,18	
Waste Mined	tonnes	0	0	0	0	0	0	0	0	0	3 000 000	4 408 719	**7 408 719**
Ore Mined - **Puimajuq**	tonnes	0	0	0	0	84 200	84 200						**168 400**
Grades - Ni	(%)	0,00	0,00	0,00	0,00	1,47	1,47						
Cu	(%)	0,00	0,00	0,00	0,00	2,39	2,39						
Co	(%)	0,00	0,00	0,00	0,00	0,06	0,06						
Pt	(g/t)	0,00	0,00	0,00	0,00	0,75	0,75						
Pd	(g/t)	0,00	0,00	0,00	0,00	2,42	2,42						
Au	(g/t)	0,00	0,00	0,00	0,00	0,07	0,07						
Waste Mined	tonnes	0	0	0	0	834 122	834 122						**1 668 244**

Appendix 3

RECORDS OF IDENTIFIED WETLANDS

	Puimajuq	**Milieux humides**			MH2-2	MH2-1	MH3	MH1
				Polygone (délimitation)	Oui	Oui	Non	Oui
				Lat. N (d,d)	61,5714	61,5714	61,5697	61,5686
				Long. O (d,d)	-73,0633	-73,0633	-73,0569	-73,0647
			Date		2015-08-01	2015-08-01	2015-08-01	2015-08-01
			Observateurs	Jean Deshaye	JD/AMS	JD/AMS	JD/AMS	JD/AMS
				Audrey-Maude Schmidt				
		Milieu humide caractérisé			Herbaçaie humide continue	Herbaçaie humide continue	Herbaçaie humide ouverte	Herbaçaie humide ouverte
		Superficie (ha)						
		Drainage			Imparfait/mauvais	Imparfait/mauvais	Mauvais	Imparfait/Mauvais
		Substrat			Till+MO/Till	Till+MO/Till	Till+MO/Till	Till+MO/Till
		Matière organique (MO)		Épaisseur (cm)	< 10	< 10	< 5	< 10
		Lien hydrologique			Oui	Oui	Oui	Non
		Photos (#)			30-34	30-34	28-29	25-27
		Recouvrement		strate arbustive rampante (ar)	1	1	2	1
				strate herbacée (h)	4	4	2	5
				strate muscinale (m)	5	5	5	4
				litière	2	2		3
				sol nu	1	2	3	2
				eau	2	+	2	1
	Espèces							
Strate	Genre	espèce	ssp	var				
ar	*Salix*	*arctica*			+		+	
ar	*Salix*	*arctophila*			+			
ar	*Salix*	*herbacea*			1	1	2	1
h	*Alopecurus*	*magellanicus*				+	+	1
h	*Arctagrostis*	*latifolia*	ssp *latifolia*		2	1	+	1
h	*Cardamine*	*bellidifolia*			+	+		
h	*Carex*	*lachenalii*				1	2	+
h	*Carex*	*membranacea*				2	1	3
h	*Cerastium*	*alpinum s.l.*						+
h	*Deschampsia*	*brevifolia*					+	2
h	*Draba*	*alpina*						+
h	*Dupontia*	*fisheri*			3	3		
h	*Eriophorum*	*angustifolium*	ssp *angustifolium*		+			
h	*Eriophorum*	*scheuchzeri*	ssp *scheuchzeri*		1	+	1	
h	*Luzula*	*confusa*				+		+
h	*Luzula*	*nivalis*			+			+
h	*Micranthes*	*foliolosa*			+	+	+	+
h	*Oxyria*	*digyna*						1
h	*Pleuropogon*	*sabinei*				+		+
h	*Potentilla*	*hyparctica*	ssp *elatior*			+		
h	*Ranunculus*	*hyperboreus*			1		1	
h	*Ranunculus*	*nivalis*				+		2
h	*Ranunculus*	*pygmaeus*				+	+	1
h	*Saxifraga*	*cernua*			+	+	+	+
h	*Saxifraga*	*rivularis*	ssp *rivularis*					+
h	*Stellaria*	*longipes*	ssp *longipes*		+			1
m	Lichens						+	1
m	Mousses				5	5	5	4
m	Sphaignes				2			
	Litière				2	2		3
	Sol nu				1	2	3	2
	Eau libre				2	+	2	1

Recouvrement (%)
+ : < 1
1 : 1-5
2 : 5-25
3 : 25-50
4 : 50-75
5 : > 75

Strate	Genre	espèce	ssp	var	MT2	MT1
	Puimajuq	**Milieux terrestres**			MT2	MT1
				Polygone (délimitation)	Non	Non
				Lat. N (d,d)	61,5697	61,5694
				Long. O (d,d)	-73,0667	-73,0783
			Date		2015-08-01	2015-08-01
			Observateurs	Jean Deshaye / Audrey-Maude Schmidt	JD/AMS	JD/AMS
		Milieu caractérisé			Ostioles de toundra	Ostioles de toundra
		Superficie (ha)				
		Drainage			Bon	Bon
		Substrat			Till	Till
		Lien hydrologique			Non	Non
		Photos (#)			35-38	21-24
		Recouvrement		strate arbustive rampante (ar)	1	1
				strate herbacée (h)	3	4
				strate muscinale (m)	4	5
				litière	2	2
				sol nu	4	3
				eau		
	Espèces					
Strate	Genre	espèce	ssp	var		
ar	*Salix*	*arctica*				+
ar	*Salix*	*herbacea*			1	1
ar	*Salix*	*reticulata*				+
h	*Alopecurus*	*magellanicus*			1	1
h	*Arctagrostis*	*latifolia*	ssp *latifolia*		1	2
h	*Cardamine*	*bellidifolia*			+	+
h	*Carex*	*bigelowii*	ssp *bigelowii*			1
h	*Cerastium*	*alpinum s.l.*			+	+
h	*Deschampsia*	*brevifolia*			1	1
h	*Draba*	*alpina*			+	+
h	*Eutrema*	*edwardsii*			+	
h	*Festuca*	*brachyphylla*	ssp *brachyphylla*			+
h	*Festuca*	*hyperborea*			+	
h	*Luzula*	*confusa*				+
h	*Luzula*	*nivalis*			1	2
h	*Micranthes*	*foliolosa*			+	+
h	*Micranthes*	*nivalis*			+	+
h	*Oxyria*	*digyna*			+	+
h	*Poa*	*arctica*	ssp *arctica*		2	2
h	*Potentilla*	*hyparctica*	ssp *elatior*		+	+
h	*Ranunculus*	*nivalis*			+	+
h	*Ranunculus*	*pygmaeus*			+	+
h	*Stellaria*	*longipes*	ssp *longipes*			+
m	Lichens				2	2
m	Mousses				3	4
m	Sphaignes					
	Litière				2	2
	Sol nu				4	3
	Eau libre					

Recouvrement (%)
+ : < 1
1 : 1-5
2 : 5-25
3 : 25-50
4 : 50-75
5 : > 75

Appendix 4

LIST OF BIRD SPECIES PRESENT OR LIKELY TO BE PRESENT IN THE STUDY AREA

APPENDIX 4 LIST OF BIRD SPECIES PRESENT OR LIKELY TO BE PRESENT IN THE STUDY AREA

FRENCH NAME[1]	LATIN NAME[1]	ENGLISH NAME[1]	STATUS FOR THE STUDY AREA[2]	SOURCE					SPECIAL STATUS	
				This study	GENIVAR (2009)	GENIVAR (2007)	Roche (2005)	Jacques Withford (2003)	Quebec[3]	Canada[4]
Species present in the study area										
Plongeon catmarin	*Gavia stellata*	Red-throated Loon	CB	X	X	X	X	X		
Bernache du Canada	*Branta canadensis*	Canada Goose	CB	X	X	X	X	X		
Alouette hausse-col	*Eremophila alpestris*	Horned Lark	PoB	X	X	X		X		
Grand Corbeau	*Corvus corax*	Common Raven	PoB	X	X	X	X	X		
Plectrophane lapon	*Calcarius lapponicus*	Lapland Longspur	CB	X	X	X	X	X		
Plectrophane des neiges	*Plectrophenax nivalis*	Snow Bunting	CB	X	X	X	X	X		
Harelde kakawi	*Clangula hyemalis*	Long-tailed Duck	PrB	X		X	X	X		
Bécasseau semipalmé	*Calidris pusilla*	Semipalmated Sandpiper	PoB	X				X		
Espèces susceptibles d'être présentes dans la zone d'étude										
Plongeon huard	*Gavia immer*	Common Loon	PrB		X	X	X	X		
Oie des neiges	*Chen caerulescens*	Snow Goose	PoB		X	X	X			
Bernache cravant	*Branta bernicla*	Brant	Mig					X		
Canard noir	*Anas rubripes*	American Black Duck	Obs			X				
Canard colvert	*Anas platyrhynchos*	Mallard	Obs			X				
Canard pilet	*Anas acuta*	Northern Pintail	PoB				X			
Eider à tête grise	*Somateria spectabilis*	King Eider	Mig					X		
Grand Harle	*Mergus merganser*	Common Merganser	PrB			X				
Harle huppé	*Mergus serrator*	Red-breasted Merganser	PoB					X		
Buse pattue	*Buteo lagopus*	Rough-legged Hack	PoB			X		X		
Aigle royal	*Aquila chrysaetos*	Golden Eagle	PoB			X		X	Vulnerable	
Faucon gerfaut	*Falco rusticolus*	Gyrfalcon	PoB			X		X		
Faucon pèlerin tundrius	*Falco peregrinus tundrius*	Peregrine Falcon	CB		X	X	X			Special concern
Lagopède des saules	*Lagopus lagopus*	Willow Ptarmigan	PoB					X		
Lagopède alpin	*Lagopus muta*	Rock Ptarmigan	CB			X	X	X		
Pluvier semipalmé	*Charadrius semipalmatus*	Semipalmated Plover	PoB			X	X	X		
Bécasseau à croupion blanc	*Calidris fuscicollis*	White-rumped Sandpiper	Mig			X				
Bécasseau à poitrine cendrée	*Calidris melanotos*	Pectoral Sandpiper	Mig			X				
Bécassine de Wilson	*Gallinago delicata*	Wilson's Snipe	Obs			X				
Phalarope à bec étroit	*Phalaropus lobatus*	Red-necked Phalarope	PoB			X		X		
Phalarope à bec large	*Phalaropus fulicarius*	Red Phalarope	PoB					X		
Labbe pomarin	*Stercorarius pomarinus*	Pomarine Jaeger	Mig					X		
Labbe parasite	*Stercorarius parasiticus*	Parasitic Jaeger	PoB					X		
Labbe à longue queue	*Stercorarius longicaudus*	Long-tailed Jaeger	Mig					X		
Goéland argenté	*Larus argentatus*	Herring Gull	CB		X	X	X	X		
Goéland arctique	*Larus glaucoides*	Iceland Gull	Mig					X		
Goéland bourgmestre	*Larus hyperboreus*	Glaucous Gull	Mig					X		

FRENCH NAME[1]	LATIN NAME[1]	ENGLISH NAME[1]	STATUS FOR THE STUDY AREA[2]	SOURCE					SPECIAL STATUS	
				This study	GENIVAR (2009)	GENIVAR (2007)	Roche (2005)	Jacques Withford (2003)	Quebec[3]	Canada[4]
Sterne arctique	*Sterna paradisaea*	Arctic Tern	PoB					X		
Harfang des neiges	*Bubo scandiacus*	Snowy Owl	PoB			X		X		
Hibou des marais	*Asio flammeus*	Short-eared Owl	Obs/PoB					X	ESDMV	Special Concern
Pipit d'Amérique	*Anthus rubescens*	American Pipit	PoB		X	X				
Traquet motteux	*Oenanthe oenanthe*	Northern Wheatear	Mig					X		
Bruant des prés	*Passerculus sandwichensis*	Savannha Sparrow	PoB			X		X		
Junco ardoisé	*Junco hyemalis*	Dark-eyed Junco	Obs			X				
Sizerin flammé	*Acanthis flammea*	Common Redpoll	PoB		X			X		
Sizerin *sp.*	*Acanthis sp.*	Redpoll *sp.*	PoB			X				

1 Source: The American Ornithologists' Union, 2015

2 PoB: Possible Breeding; PrB: Probable Breeding; CB: Confirmed Breeding; Obs: Observed species (codes taken from *The Breeding Birds of Quebec Atlas* (Gauthier and Aubry, 1995)); Mig: Migratory.

3 *SLDTVQ*: Species likely to be designated threatened or vulnerable in Quebec (Government of Quebec, 2006).

4 Source: COSEWIC, 2006

Appendix 5

SECTOR REPORT ON AVIFAUNA INVENTORIES COMPLETED IN SUMMER 2015

CANADIAN ROYALTIES INC.

PROJET NUNAVIK NICKEL
EXPLOITATION DU GISEMENT PUIMAJUQ

ÉTUDE D'IMPACT SUR L'ENVIRONNEMENT ET LE MILIEU SOCIAL – ADDENDA AU CERTIFICAT D'AUTORISATION N° 3215-14-007

RAPPORT SECTORIEL – FAUNE AVIAIRE

OCTOBRE 2015

WSP

PROJET NUNAVIK NICKEL

EXPLOITATION DU GISEMENT PUIMAJUQ

ÉTUDE D'IMPACT SUR L'ENVIRONNEMENT ET LE MILIEU SOCIAL – ADDENDA AU CERTIFICAT D'AUTORISATION N° 3215-14-007

RAPPORT SECTORIEL - FAUNE AVIAIRE

Canadian Royalties Inc.

Projet nº : 101-53046-06
Date : Octobre 2015

–

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Responsable de la faune aviaire

L'original du document technologique que nous vous transmettons a été authentifié et sera conservé par WSP pour une période minimale de dix ans. Étant donné que le fichier transmis n'est plus sous le contrôle de WSP et que son intégrité n'est pas assurée, aucune garantie n'est donnée sur les modifications ultérieures qui peuvent y être apportées.

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Linette Poulin	Édition

Référence à citer :

WSP 2015. *Projet Nunavik Nickel – Exploitation du gisement Puimajuq. Étude d'impact sur l'environnement et le milieu social - Addenda au certificat d'autorisation n° 3215-14-007, Rapport sectoriel – Faune aviaire.* Rapport produit pour Canadian Royalties Inc. 22 pages et annexes.

TABLE DES MATIÈRES

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1 INTRODUCTION

Dans le contexte du Projet Nunavik Nickel (PNNi), Canadian Royalties Inc. (CRI) a découvert deux nouveaux gisements, soit Puimajuq et TK. WSP Canada Inc. (WSP) a été mandatée par CRI pour effectuer les relevés de terrain nécessaires à la description de la communauté aviaire qui fréquente ces lieux. Ce rapport s'inscrit dans l'addenda à l'étude d'impact sur l'environnement et le milieu social (ÉIES) du PNNi (GENIVAR, 2007) visant l'exploitation du gisement Puimajuq.

La présente étude comprend les relevés d'oiseaux nicheurs qui ont été effectués à Puimajuq en juillet 2015. Pour des raisons de logistique, des inventaires ont également été réalisés pour le gisement TK.

Les chapitres suivants présentent la zone d'inventaire associée à cette étude, la méthodologie employée pour caractériser l'avifaune, ainsi que les résultats obtenus.

2 MÉTHODOLOGIE

2.1 ZONE D’ÉTUDE

La zone d’étude considérée pour le gisement TK est située au sud du lac du Bombardier, alors que celle retenue pour le gisement Puimajuq est situé à 19 km à l’est de ce dernier (carte 1). Afin d’inventorier les oiseaux terrestres et les oiseaux de rivage, 12 parcelles ont été disposées au site TK et 27 autres au site Puimajuq (carte 1). Ces parcelles ont été réparties en fonction des installations projetées, incluant la route d’accès. Pour la sauvagine et les autres oiseaux aquatiques, l’inventaire héliporté a été effectué de façon à couvrir la zone occupée par les baux miniers.

2.2 GÉNÉRALITÉS

Les inventaires de la faune aviaire ont été effectués entre le 21 et le 26 juillet 2015. Les relevés ont été réalisés par voie terrestre (21 au 25 juillet) et par hélicoptère (26 juillet). Aucun inventaire spécifique aux oiseaux de proie et au grand corbeau n’a été effectué, puisque les zones d’étude ne comportaient pas de site de nidification propice pour ces espèces. Toutefois, tous les individus observés ont été pris en note. Les sections suivantes présentent la méthodologie employée pour ces inventaires. Les données brutes des inventaires d’oiseaux terrestres et de limicoles sont présentées à l’annexe A.

2.3 SAUVAGINE ET AUTRES OISEAUX AQUATIQUES

2.3.1 PLAN D’ÉCHANTILLONNAGE

Le plan d’échantillonnage consistait, d’une part, à inventorier la sauvagine et les autres oiseaux aquatiques qui utilisent les lacs, les rivières et les milieux humides présents dans les deux zones d’étude (TK et Puimajuq), lors d’un survol héliporté. D’autre part, ces milieux ont également été recensés lors des inventaires au sol et qui visaient principalement les oiseaux terrestres et les oiseaux de rivage (en bordure).

2.3.2 MÉTHODE D’INVENTAIRE

2.3.2.1 SAUVAGINE ET AUTRES ESPÈCES AQUATIQUES

Pour inventorier la sauvagine dans les zones d’étude, un survol héliporté a été effectué le 26 juillet 2015. La méthode de dénombrement de la sauvagine et des autres espèces aquatiques est inspirée de celle utilisée par le Service canadien de la faune d’Environnement Canada dans le cadre du *Plan conjoint sur le canard noir (PCCN)* (Bordage *et al*. 2003), maintenant désigné *Suivi de la sauvagine des hautes-terres du Québec méridional (SHAU)*. Tous les milieux aquatiques et leurs rives ont été survolés en hélicoptère et les oiseaux ont été dénombrés à vue (cartes 2 et 3). Lors de l’inventaire, la vitesse de l’hélicoptère était de 30 à 60 km/h, à une altitude variant entre 10 et 30 m. Chaque observation a été notée sur la carte papier. La position des oiseaux a également été prise à l’aide d’un GPS. De plus, tous les détails relatifs à l’observation ont été pris en note sur un formulaire papier (espèce, nombre d’individus adultes ou immature, sexe, lorsque possible, nombre et âge des cannetons, présence de nids et nombre d’œufs, comportement etc.). Les individus formant des groupes distincts ont été inscrits avec un numéro séquentiel différent.

Ainsi, des survols de 6 et de 15 minutes ont respectivement été réalisés aux sites TK et Puimajuq. Les conditions météorologiques lors des survols étaient adéquates pour la réalisation des inventaires (annexe B).

De plus, les plans d'eau et les milieux humides présents au voisinage des deux gisements ont aussi été inventoriés au sol afin de vérifier l'utilisation des zones d'étude par la sauvagine et les autres oiseaux aquatiques. Ainsi, tous les milieux propices à la présence de la sauvagine, et situés à l'intérieur des parcelles d'inventaires visant les oiseaux terrestres et les oiseaux de rivage, ont été scrutés afin d'en vérifier la présence (section 2.3).

Enfin, mentionnons également que lors de tous les déplacements, incluant ceux en hélicoptère, à pied et en camion, tous les individus observés ont été pris en note, que ce soit à l'intérieur ou à l'extérieur des zones d'étude.

2.3.3 ANALYSE DES DONNÉES

En raison du faible nombre d'espèces et d'individus observés, seule une liste des mentions de présence a été produite pour les espèces de la sauvagine.

2.4 OISEAUX DE PROIE ET GRAND CORBEAU

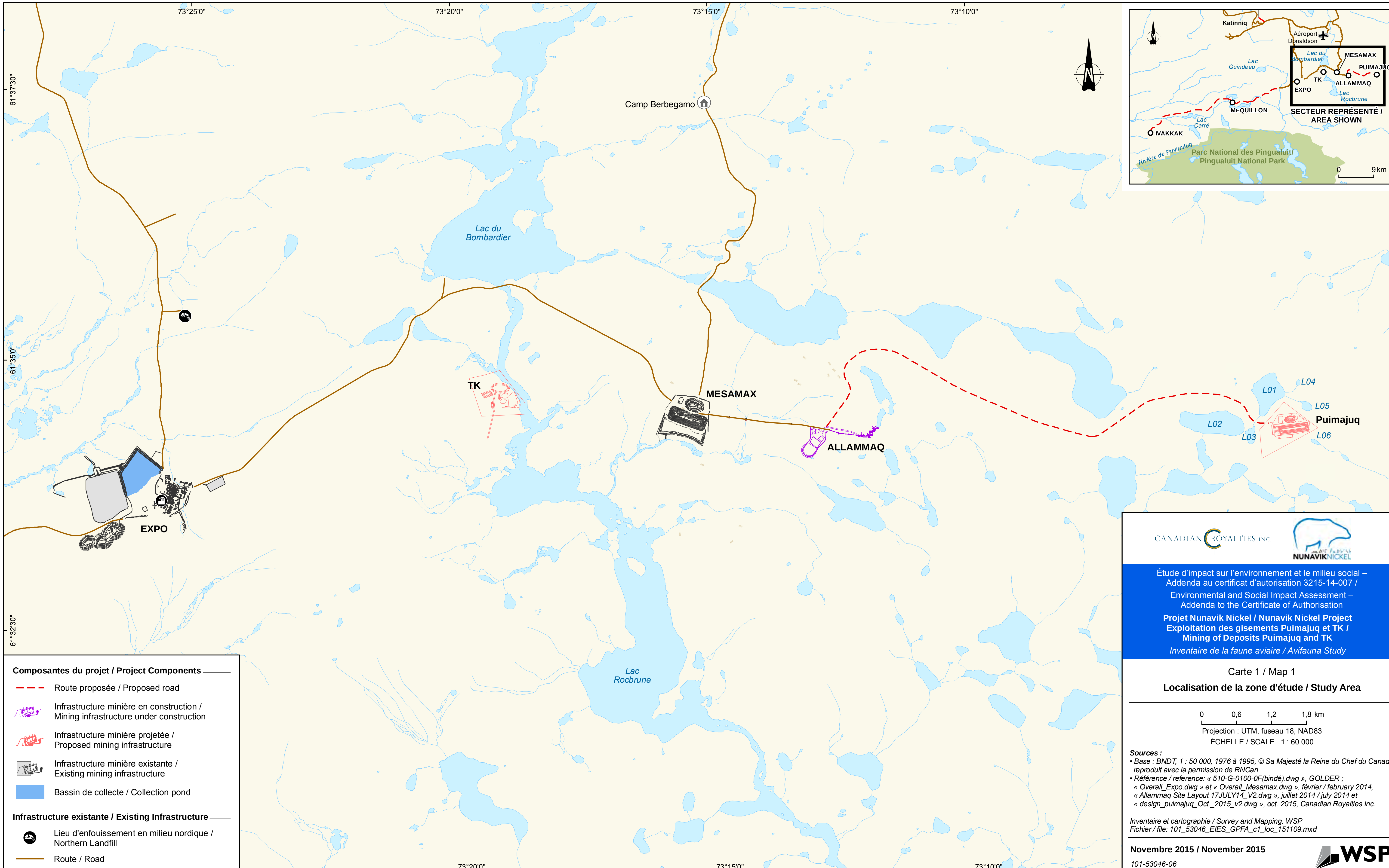
2.4.1 PLAN D'ÉCHANTILLONNAGE ET MÉTHODE D'INVENTAIRE

Aucun inventaire spécifique aux oiseaux de proie et au grand corbeau n'a été effectué, puisque les zones d'étude ne comportaient pas de substrat de nidification adéquat pour ces espèces. En effet, cette espèce niche dans les habitats fortement profilés, tels que les falaises (Boarman et Heinrich, 1999).

Toutefois, tous les individus qui ont été observés lors des autres inventaires de terrain ont été pris en note. En dépit du fait qu'il n'y ait pas de substrats de nidification adéquats pour ces espèces dans les zones d'étude, il est possible que ces dernières les traversent (en vol) ou les utilisent pour s'alimenter.

2.4.2 ANALYSE DES DONNÉES

En raison du faible nombre d'espèces et d'individus observés, seule une liste des mentions a été produite. La présence de couples a été déterminée à partir d'indices de nidification observés sur le terrain.



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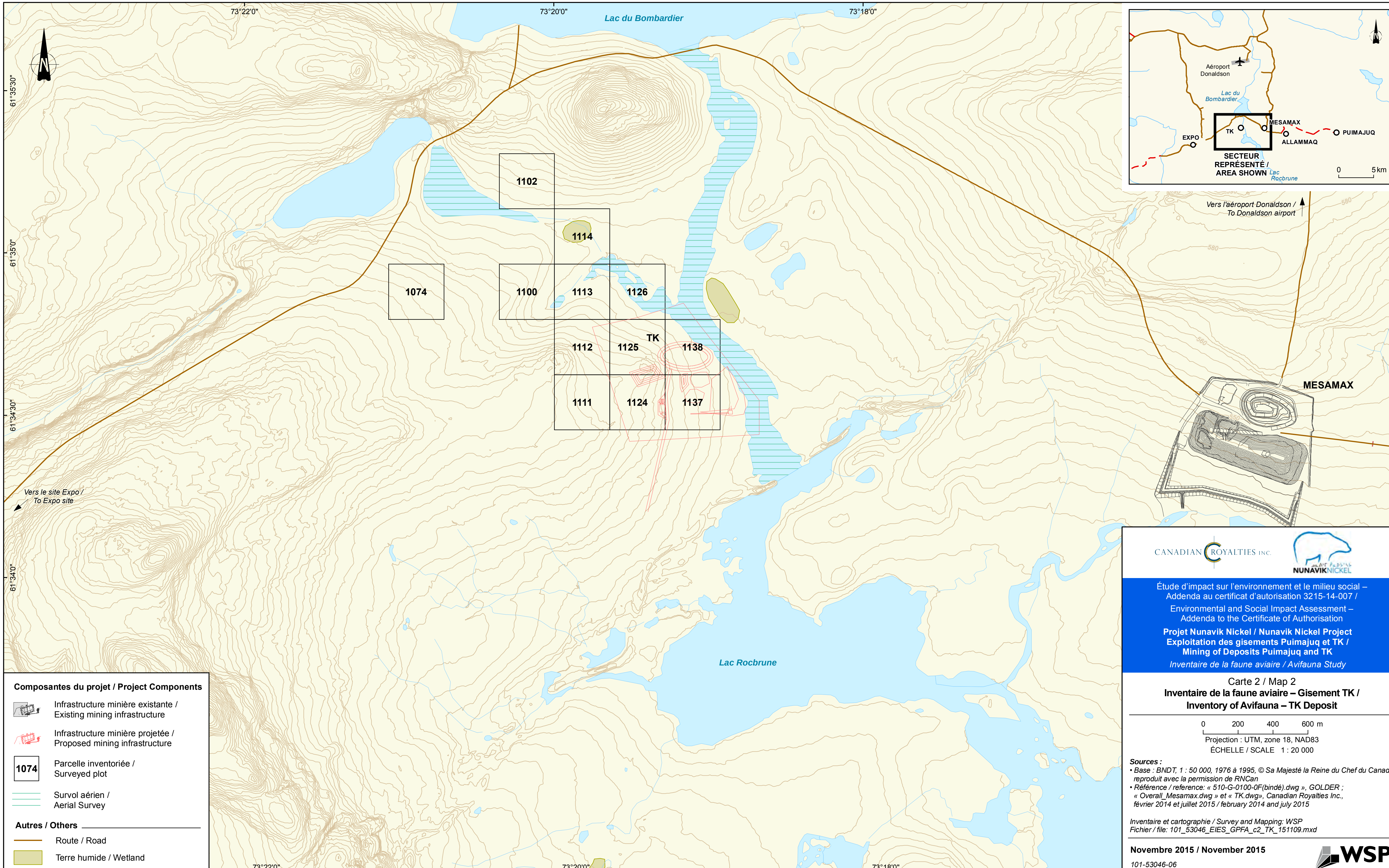

Composantes du projet / Project Components

- Infrastructure minière existante / Existing mining infrastructure
- Infrastructure minière projetée / Proposed mining infrastructure
- 1074 Parcelle inventoriée / Surveyed plot
- Survol aérien / Aerial Survey

Autres / Others

- Route / Road
- Terre humide / Wetland

CANADIAN ROYALTIES INC.

NUNAVIK NICKEL

Étude d'impact sur l'environnement et le milieu social – Addenda au certificat d'autorisation 3215-14-007 /

Environmental and Social Impact Assessment – Addenda to the Certificate of Authorisation

Projet Nunavik Nickel / Nunavik Nickel Project
Exploitation des gisements Puimajuq et TK /
Mining of Deposits Puimajuq and TK

Inventaire de la faune aviaire / Avifauna Study

Carte 2 / Map 2

Inventaire de la faune aviaire – Gisement TK /
Inventory of Avifauna – TK Deposit

0 200 400 600 m

Projection : UTM, zone 18, NAD83

ÉCHELLE / SCALE 1 : 20 000

Sources :
- *Base : BNDT, 1 : 50 000, 1976 à 1995, © Sa Majesté la Reine du Chef du Canada, reproduit avec la permission de RNCan*
- *Référence / reference: « 510-G-0100-0F(bindé).dwg », GOLDER ; « Overall_Mesamax.dwg » et « TK.dwg», Canadian Royalties Inc., février 2014 et juillet 2015 / february 2014 and july 2015*

Inventaire et cartographie / Survey and Mapping: WSP
Fichier / file: 101_53046_EIES_GPFA_c2_TK_151109.mxd

Novembre 2015 / November 2015

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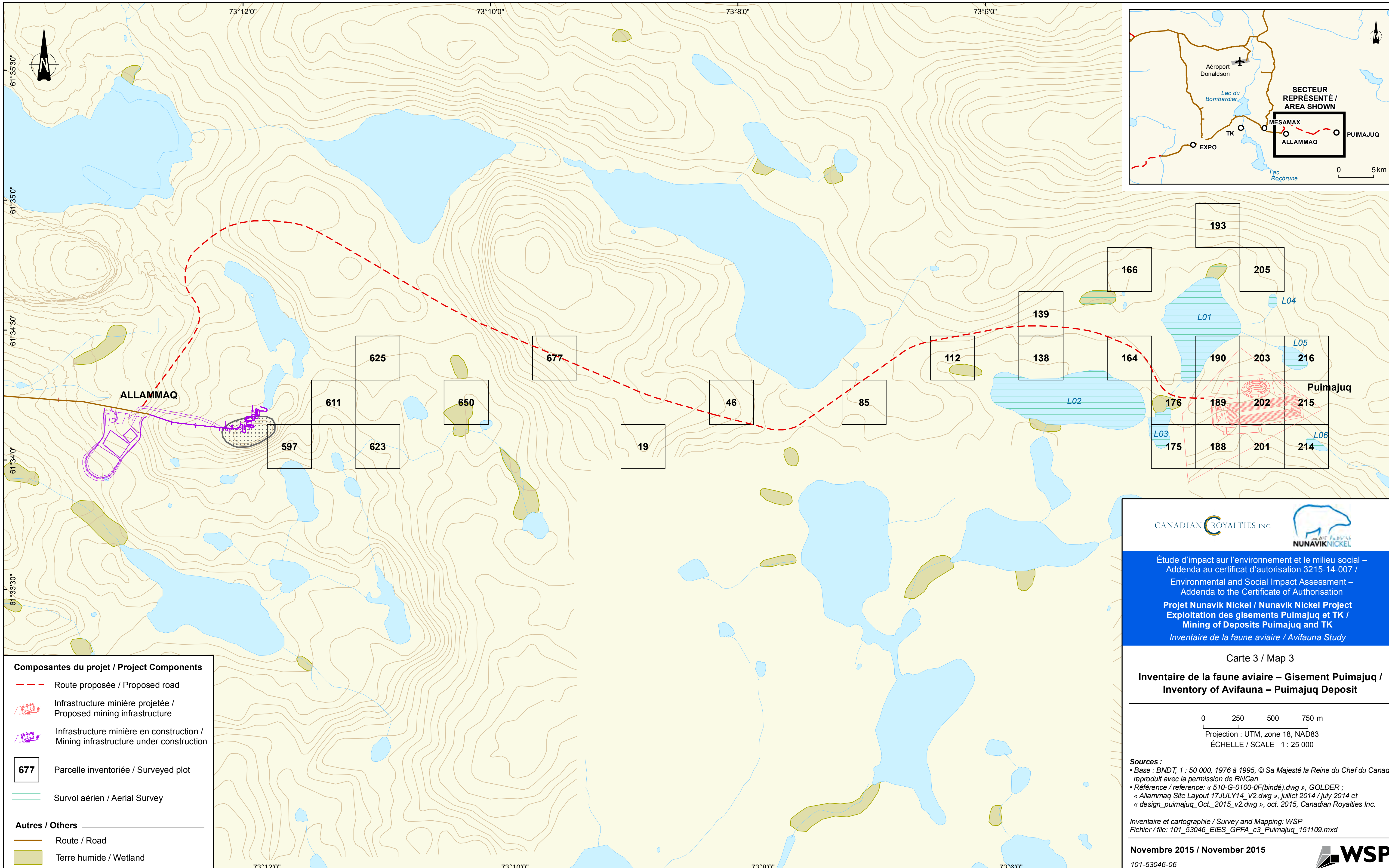
WSP

Format : Tabloid (11 x 17)



Format : Tabloid (11 x 17)

2.5 OISEAUX TERRESTRES

2.5.1 PLAN D’ÉCHANTILLONNAGE

L’inventaire des oiseaux terrestres a été réalisé à l’intérieur de parcelles de 10 ha, de façon analogue aux travaux d’Andres (2006). Une grille de parcelles a été superposée à la zone d’étude et un certain nombre de parcelles ont été inventoriées (cartes 2 et 3). Le choix des parcelles inventoriées s’est fait en fonction de l’emplacement prévu des infrastructures minières et du type d’habitat présent dans la zone d’étude.

2.5.2 MÉTHODE D’INVENTAIRE

Dans chaque parcelle, un dénombrement complet de tous les individus de toutes les espèces a été effectué, tout en prenant soin de ne pas compter d’individus en double. Pour ce faire, trois transects équidistants ont été effectués par l’observateur. Les indices de nidification étaient notés selon ceux de l’Atlas des oiseaux nicheurs du Québec (2010).

Au total, 39 parcelles de 10 ha (12 au gisement TK et 27 au gisement Puimajuq) ont été inventoriées (cartes 2 et 3). Les inventaires ont eu lieu les 21 et 22 juillet 2015 au site TK et du 23 au 25 juillet au site Puimajuq. Les données sur l’habitat général de chaque parcelle et les conditions d’observation sont présentées aux annexes C et D.

2.5.3 ANALYSE DES DONNÉES

Le nombre de couples dans chaque parcelle a d’abord été déterminé par la présence de deux individus, dont au moins un était un mâle. Pour certaines espèces comme le pipit d’Amérique, chez qui l’apparence du mâle et de la femelle est similaire, deux individus ensemble ont été considérés comme un couple. Chaque couple, famille (un individu ou un couple accompagné d’un ou de plusieurs jeunes) et adulte ou couple adoptant un cri d’alarme agressif et insistant, a ensuite été considéré comme un équivalent-couple (É-C). Ensuite, chaque femelle ou adulte au sexe indéterminé non apparié à un mâle a été considéré comme 0,5 É-C additionnel.

Finalement, la présence de jeunes encore dépendants des adultes (non accompagnés) a été considérée comme 1 É-C additionnel, seulement si le nombre d’É-C total dans la parcelle était inférieur à 1 selon les calculs précédents.

Les individus observés en vol n’ont pas été comptabilisés dans les analyses.

Par la suite, les valeurs d’É-C pour chaque espèce ont été ramenées en nombre d’É-C/10 ha. De plus, la constance d’observation des espèces a été calculée en divisant le nombre de parcelles, où une espèce a été détectée, par le nombre total de parcelles inventoriées.

2.6 OISEAUX DE RIVAGE

2.6.1 PLAN D'ÉCHANTILLONNAGE ET MÉTHODE D'INVENTAIRE

Les oiseaux de rivage nicheurs ont été inventoriés selon le même plan d'échantillonnage que les oiseaux terrestres, c'est-à-dire à partir de parcelles de 10 ha (carte 2 et 3; section 2.5.3). Une attention particulière a été portée lors des inventaires visant le groupe de la sauvagine et des autres oiseaux aquatiques.

Toutes les autres observations liées à ce groupe (p. ex. présence de dépression qui aurait pu être utilisée par un oiseau de rivage) ont été prises en note.

2.6.2 ANALYSE DES DONNÉES

Les É-C d'oiseaux de rivage nicheurs ont été calculés de la même manière que pour les oiseaux terrestres (section 2.5.3).

2.7 ESPÈCES À STATUT PARTICULIER

Aucun inventaire spécifique aux espèces à statut particulier n'a été effectué. Toutefois, en dépit du fait qu'il n'y ait pas de substrats de nidification adéquats pour ces espèces dans les zones d'étude, il est possible que ces dernières la traverse (en vol) ou l'utilise pour s'alimenter. C'est le cas du faucon pèlerin qui a été observé (nidification possible) lors d'un inventaire réalisé en 2008 dans le secteur d'Allammaq (GENIVAR, 2009).

3 RÉSULTATS

3.1 RÉSUMÉ

Au total, dix espèces d'oiseaux ont été observées à l'intérieur des zones d'étude (tableau 3.1). Aucune espèce à statut particulier n'a toutefois été répertoriée. Un total de six espèces a été dénombré au site TK et huit espèces au site Puimajuq. De plus, trois espèces additionnelles ont été observées à l'extérieur des zones d'étude lors des déplacements. Il s'agit du lagopède alpin, du pluvier semipalmé et du plongeon huard.

Dans les deux zones d'étude, la nidification a été confirmée pour trois espèces (l'alouette hausse-col, le plectrophane des neiges et le plectrophane lapon), alors qu'elle a été considérée comme probable pour une espèce (pipit d'Amérique) et possible pour deux espèces (bécasseau semipalmé et plongeon catmarin). Trois autres espèces (faucon gerfaut, grand corbeau et harelde kakawi), ont été considérées comme non nicheuses dans le secteur, puisqu'elles n'arboraient pas de comportement de reproduction ou que les zones d'étude ne présentaient pas d'habitat de nidification potentiel pour l'espèce.

3.2 SAUVAGINE ET AUTRES ESPÈCES AQUATIQUES

3.2.1 RICHESSE SPÉCIFIQUE

Dans les zones d'étude, seulement trois espèces de sauvagine et une espèce d'autres oiseaux aquatiques ont été répertoriées. Il s'agit de l'harelde kakawi, de la bernache du Canada et du plongeon catmarin (tableau 3.2). Ces trois espèces ont été observées au site du gisement de Puimajuq. De plus, un plongeon huard a été observé à l'extérieur de la zone d'étude. Mentionnons qu'aucune colonie ou autres espèces aquatiques (p. ex. laridés) n'a été répertoriée dans les zones d'étude.

3.2.1.1 TK

Aucune espèce de sauvagine et d'autres espèces aquatiques n'a été observée lors des inventaires.

3.2.1.2 PUIMAJUQ

Lors de l'inventaire aérien de la sauvagine du 26 juillet, un groupe de 16 bernaches du Canada adultes a été observé, en bordure du lac L02. Mentionnons également que des fèces et des traces fraîches (probablement de l'espèce), de même que des plumes, été aperçues dans le même secteur le 23 juillet. Aucun comportement de reproduction n'a toutefois été noté. Il pourrait donc s'agir d'un regroupement prémigratoire. L'espèce pourrait toutefois nicher dans le secteur, puisque ce dernier est favorable à sa nidification. En effet, la bernache du Canada niche généralement dans les milieux ouverts (p. ex. toundra), situés à proximité de plans d'eau (lac, étang, rivières, marais, etc.) (Mowbray *et al*., 2002).

Tableau 3.1 Liste des espèces observées lors des inventaires de terrain de 2015

Nom français	Nom scientifique	Nom anglais	Statut de nidification[1]	Site		
				TK	Puimajuq	Extérieur des zones d'étude
Espèces observées à l'intérieur de la zone d'étude						
Alouette hausse-col	*Eremophila alpestris*	Horned Lark	CO	5 individus (dont un juvénile)	1 adulte	N/A
Bécasseau semipalmé	*Calidris pusilla*	Semipalmated Sandpiper	PO	0	1 adulte	0
Bernache du Canada	*Branta Canadensis*	Canada Goose	OB	0	1 groupe de 16 individus	N/A
Faucon gerfaut	*Falco rusticolus*	Gyrfalcon	OB	1 adulte	0	0
Grand corbeau	*Corvus corax*	Common Raven	OB	3 individus (même couple ou individu)	1 individu	0
Harelde kakawi	*Clangula hyemalis*	Long-tailed duck	OB	0	3 individus observés 3 fois au même endroit	0
Pipit d'Amérique	*Anthus rubescens*	American Pipit	PR	5 individus	0	N/A
Plectrophane des neiges	*Plectrophenax nivalis*	Snow Bunting	CO	23 individus (dont 2 juvéniles)	16 individus	N/A
Plectrophane lapon	*Calcarius lapponicus*	Lapland Longspur	CO	32 individus (dont 2 juvéniles)	29 individus	N/A
Plongeon catmarin	*Gavia stellata*	Red-throated Loon	PO	0	2 observations (probablement même individus ou couple)	0
Espèces observées à l'extérieur des zones d'étude						
Lagopède alpin	*Lagopus muta*	Rock Ptarmigan	PO	0	0	1 adulte
Pluvier semipalmé	*Charadrius semipalmatus*	Semipalmated Plover	PR	0	0	1 couple
Plongeon huard	*Gavia immer*	Common Loon	PO	0	0	1 adulte

[1]*Statut de nidification : CO : Confirmé, PR : Probable, PO : Possible, OB : Espèce observée, sans comportement de nidification*

Tableau 3.2 Liste des espèces d'anatidés et de plongeons observés dans les zones d'étude

Nom français	Nom scientifique	Nom anglais	Statut de nidification[1]	Nombre total d'individus observés	
				TK	Puimajuq
Harelde kakawi	*Clangula hyemalis*	Long-tailed duck	OB	0	3 individus observés 3 fois au même endroit
Plongeon catmarin	*Gavia stellata*	Red-throated loon	PO	0	2 observations (probablement même individu ou couple)
Bernache du Canada	*Branta canadensis*	Canada Goose	OB	0	1 groupe de 16 individus

[1]*Statut de nidification : PO : Possible, OB : Espèce observée, sans comportement de nidification*

Lors des inventaires spécifiques aux oiseaux terrestres et aux oiseaux de rivage, trois femelles d'harelde kakawi ont été observées pour la première fois le 23 juillet sur le lac situé au nord-ouest du bail minier (lac L01). Le 24 juillet, les trois individus ont été revus lors du passage en hélicoptère (transport de l'équipe au terrain), de même que lors des inventaires visant les oiseaux terrestres et les limicoles effectués au nord du même lac. Il s'agissait de trois femelles n'affichant pas de comportement reproducteur. Lors du survol héliporté effectué le 26 juillet, les individus n'ont pas été revus. En dépit du fait que ce groupe d'oiseaux ne démontrait pas de comportement de reproduction, l'espèce pourrait nicher dans le secteur. En effet, elle niche dans la toundra, à proximité de plans d'eau comme les étangs, ou sur des îlots entourés d'eau (Robertson et Savard, 2002).

De plus, un plongeon catmarin a été observé au vol, à environ 200 m à l'est de la parcelle 0046 le 24 juillet 2015. Le lendemain, un individu a également été observé dans le même secteur. Il s'agissait probablement du même individu ou du même couple. Cette espèce niche habituellement dans les milieux humides comme les étangs peu profonds où il y a présence de limon et/ou de végétation en décomposition (Barr *et al*, 2000). Il peut également utiliser les étangs plus profonds (1,0 à 1,5 m), les grands lacs peu profonds, de même que les rives basses dans les zones marécageuses.

3.3 OISEAUX TERRESTRES

3.3.1 RICHESSE SPÉCIFIQUE ET ABONDANCE RELATIVE

3.3.1.1 TK

Au total, quatre espèces d'oiseaux terrestres ont été observées au site TK. Il s'agit du plectrophane lapon, du plectrophane des neiges, de l'alouette hausse-col et du pipit d'Amérique (tableau 3.3). Les espèces les plus fréquentes sont le plectrophane lapon (2,0 É-C/10 ha) et le plectrophane des neiges (1,0 É-C/10 ha). Pour ce qui est de l'alouette hausse-col et du pipit d'Amérique, les densités similaires avec des valeurs respectives de 0,3 É-C/10 ha et 0,2 É-C/10 ha. En termes de constance, le plectrophane lapon et le plectrophane des neiges ont été observés dans la plupart des parcelles du gisement TK, avec des valeurs respectives de 91,7 % et 83,3 % (tableau 3.3).

Tableau 3.3 Diversité, constance et densité moyenne des espèces d'oiseaux terrestres au site TK (n=12)

Espèce	Densité (ÉC/10 ha)		Constance (%)
	Moyenne	Écart-type	
Plectrophane lapon	2,0	1,5	91,7
Plectrophane des neiges	1,0	0,8	83,3
Alouette hausse-col	0,3	0,5	25,0
Pipit d'Amérique	0,2	0,3	33,3

La nidification du plectrophane lapon, du plectrophane des neiges et de l'alouette hausse-col a été confirmée dans ce secteur, alors que la nidification du pipit d'Amérique est probable. En effet, pour les trois espèces dont la nidification a été confirmée, des jeunes peu mobiles ont été observés dans les parcelles inventoriées. Pour le pipit d'Amérique, des adultes et un couple ont été observés, sans toutefois détecter de signes plus probants de nidification.

3.3.1.2 PUIMAJUQ

Au site Puimajuq, trois espèces ont été observées. Il s'agit du plectrophane lapon, du plectrophane des neiges et de l'alouette hausse-col (tableau 3.4). Les espèces les plus fréquentes sont le plectrophane lapon (0,7 É-C/10 ha) et le plectrophane des neiges (0,3 É-C/10 ha). Pour l'alouette hausse-col, la densité est très faible (< 0,1 ÉC/10 ha). Au niveau des valeurs de constance, le plectrophane lapon a été observé dans moins de 50 % des parcelles, alors que le plectrophane l'a été dans moins de 20 % des parcelles (tableau 3.4). Le statut de nidification du plectrophane des neiges et du plectrophane lapon est jugé probable, alors que celui de l'alouette hausse-col est considéré possible. Aucun jeune n'a cependant été observé au site Puimajuq.

Tableau 3.4 Diversité, constance et densité moyenne des espèces d'oiseaux terrestres au site Puimajuq (n=27)

Espèce	Densité (ÉC/10 ha)		Constance (%)
	Moyenne	Écart-type	
Plectrophane lapon	0,7	0,9	48,2
Plectrophane des neiges	0,3	0,9	18,5
Alouette hausse-col	< 0,1	0,1	3,7

3.3.2 UTILISATION DE L'HABITAT

Le plectrophane des neiges utilise les milieux où les zones rocheuses sont présentes en grandes proportions (photo 1 de l'annexe E). L'espèce niche généralement dans les secteurs rocheux situés à proximité de zones herbacées pour s'alimenter (Montgomerie et Lyon, 2011).

Quant au plectrophane lapon, il a davantage été observé dans des zones de toundra sèche et humide (photos 2 et 3 de l'annexe E), ainsi que certaines zones rocheuses qui leur sont adjacentes (photo 1 de l'annexe E). Selon Hussel et Montgomerie (2002), cette espèce niche typiquement dans la toundra humide, dans la toundra où les *hommocks* (monticule de végétation) sont bien présents, et souvent dans des habitats relativement plats. Toutefois, l'espèce utilise également les habitats plus secs et en pentes. De plus, l'espèce évite les terrains rocheux et dénudés (champs de blocs) où le plectrophane des neiges est présent en forte densité.

Les quelques individus observés d'alouette hausse-col et de pipit d'Amérique fréquentaient les habitats de toundra sèche, mais également les habitats où la proportion de zones rocheuses était élevée. L'alouette hausse-col peut nicher dans les zones marécageuses, mais préfère généralement les habitats dégagés où la végétation y est très basse (Beason, 1995). Quant au pipit d'Amérique, il niche au sol dans les prairies sèches ou humides, ainsi qu'en bordure des rives érodées (partiellement protégées par de la végétation ou de la roche en surplomb) (Hendricks et Verbeek, 2012). Le fait que la zone du gisement TK est plus humide et en bordure de la rivière de Puvirnituq pourrait expliquer en partie pourquoi l'espèce a été observée uniquement dans ce secteur.

3.3.3 AUTRES ESPÈCES D'OISEAUX TERRESTRES

Mentionnons qu'à l'extérieur de la zone d'étude, un lagopède alpin a été observé lors d'un des déplacements en hélicoptère. Cette espèce niche dans la toundra et les zones rocheuses (Montgomerie et Holder, 2008).

3.4 OISEAUX DE RIVAGE

3.4.1 RICHESSE SPÉCIFIQUE ET ABONDANCE RELATIVE

3.4.1.1 TK

Aucun individu de ce groupe n'a été observé lors des inventaires effectués dans les parcelles situées au site TK.

3.4.1.2 PUIMAJUQ

Une seule espèce d'oiseaux de rivage a été observée à l'intérieur de la zone d'étude lors des inventaires, soit le bécasseau semipalmé dans la parcelle 0085. La densité a donc été calculée uniquement pour cette espèce (tableau 3.5). Au site Puimajuq, la densité calculée pour le bécasseau semipalmé est de 0,2 É-C/km^2. Cette densité doit toutefois être considérée avec prudence, considérant que l'espèce n'a été recensée qu'à une seule parcelle. Ce bécasseau niche généralement à proximité de cours d'eau ou d'étangs, de même qu'au-dessus des hommocks ou sur les côtés. Les nids peuvent aussi être situés à proximité ou en dessous de petits arbustes ou dans une touffe de carex, dans les zones plus humides (Hicklin et Gratto-Trevor, 2010).

Tableau 3.5. Diversité, constance et densité moyenne des espèces d'oiseaux de rivage dans les zones d'étude

Espèce	Site TK (n=13)			Site Puimajuq (n=27)		
	Densité (É-C/km²)		Constance (%)	Densité (É-C/km²)		Constance (%)
	Moyenne	Écart-type		Moyenne	Écart-type	
Bécasseau semipalmé	0	0	0	0,2	1,0	3,7

Mentionnons également que des dépressions remplies (nid potentiel) de feuilles pouvant appartenir à l'espèce ont été observées à l'intérieur des parcelles 0139 et 0677.

3.4.2 AUTRES ESPÈCES

Le 9 août 2015, un couple de pluvier semipalmé a été observé à l'ouest de la zone d'étude du site TK, du côté ouest de la route lors des inventaires de végétation réalisés pour CRI (J. Deshaye, comm. pers.). Cette espèce n'avait pas été observée lors des inventaires visant la faune aviaire. Elle niche dans les habitats bien drainés, là où il y a présence de gravier, de dunes de sable, de plages rocheuses ou encore à l'intérieur des terres, sur les landes à lichens (Nol et Blanken, 2014). L'espèce pourrait nicher au site du site TK.

3.5 OISEAUX DE PROIE ET GRAND CORBEAU

Lors des inventaires réalisés le 22 juillet, une seule espèce d'oiseaux de proie a été observée. Il s'agit du faucon gerfaut, observé dans la zone d'étude du site TK. Ce faucon adulte volait au-dessus de la parcelle 1130, en direction est. Cette espèce niche dans la toundra arctique et alpine, souvent le long des rivières et du littoral de la mer (Booms *et al*., 2008). La plupart des sites de nidification sont situés sur des falaises escarpées. L'espèce peut également réutiliser les nids d'autres espèces comme le grand corbeau et l'aigle royal. Toutefois, de tels sites de nidification ne sont pas présents dans les zones d'étude.

Pour le grand corbeau, une mention de présence a été notée dans le secteur de Puimajuq, et trois dans le secteur de TK. Les trois mentions effectuées dans le secteur de TK sont probablement le même individu ou le même couple, puisque ces observations ont été effectuées à l'intérieur d'un rayon de 5 km (Morneau et Benoit, 2005). Ce couple (ou individu) serait toutefois différent de celui du site Puimajuq. Les individus observés étaient probablement en quête alimentaire et nichent possiblement à l'extérieur des zones d'étude.

4 CONCLUSION

Au total, dix espèces d'oiseaux ont été observées à l'intérieur des deux zones d'étude et trois autres espèces ont été aperçues à l'extérieur de celles-ci. Aucune espèce à statut particulier n'a été répertoriée. Les espèces les plus abondantes sont le plectrophane lapon et le plectrophane des neiges.

Pour l'ensemble des espèces recensées, la nidification est confirmée pour trois d'entre elles, probable pour une espèce et possible pour deux autres. Mentionnons également que quatre espèces observées ont été considérées comme non nicheuses, puisqu'elles n'arboraient pas de comportement reproducteur.

En somme, la faune aviaire inventoriée dans les zones d'étude des gisements TK et Puimajuq est peu diversifiée et peu abondante pour la plupart des espèces. Ces résultats vont de pair avec le fait que les habitats inventoriés sont peu diversifiés et généralement secs (forte présence de roches, toundra sèche).

RÉFÉRENCES BIBLIOGRAPHIQUES

→ ANDRES, B.A. 2006. An arctic-Breeding Bird Survey on the Northwestern Ungava Peninsula, Québec, Canada. *Arctic*. 59 (3): 311-318.

→ BARR, J. F., C. Eberl et J. W. Mcintyre. 2000. *Red-throated Loon (Gavia stellata), The Birds of North America Online (A. Poole, Ed.)*. Ithaca: Cornell Lab of Ornithology. [En ligne] [http://bna.birds.cornell.edu/bna/species/513]

→ BEASON, R. C. 1995. *Horned Lark (Eremophila alpestris), The Birds of North America Online (A. Poole, Ed.)*. Ithaca: Cornell Lab of Ornithology. [En ligne] [http://bna.birds.cornell.edu/bna/species/195]

→ BOARMAN, W. I. et B. Heinrich. 1999. *Common Raven (Corvus corax), The Birds of North America Online (A. Poole, Ed.).* Ithaca: Cornell Lab of Ornithology. [En ligne] [http://bna.birds.cornell.edu/bna/species/476]

→ BOOMS, T. L., T. J. Cade et N. J. Clum. 2008. *Gyrfalcon (Falco rusticolus), The Birds of North America Online (A. Poole, Ed.)*. Ithaca: Cornell Lab of Ornithology. [En ligne] [http://bna.birds.cornell.edu/bna/species/114]

→ BORDAGE, D., C. Lepage et S. Orichefsky. 2003. *Inventaire en hélicoptère du Plan conjoint sur le Canard noir au Québec - printemps 2003*. Rapport du Service canadien de la faune, région du Québec, Environnement Canada, Sainte-Foy, Québec 24 pages et annexes.

→ GENIVAR 2009. *Projet Nunavik Nickel. Étude d'impact sur l'environnement et le milieu social – addenda n° 4. Projet d'exploitation du gisement Allammaq et augmentation de la capacité de traitement du concentrateur.* Évaluation environnementale. Rapport de GENIVAR Société en commandite pour Canadian Royalties Inc. 221 p. et annexes.

→ HENDRICKS, P. et N. A. Verbeek. 2012. *American Pipit (Anthus rubescens), The Birds of North America Online (A. Poole, Ed.)*. Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America [En ligne] [http://bna.birds.cornell.edu/bna/species/095]

→ HICKLIN, P. et C. L. Gratto-Trevor. 2010. *Semipalmated Sandpiper (Calidris pusilla), The Birds of North America Online (A. Poole, Ed.).* Ithaca: Cornell Lab of Ornithology. [En ligne] [http://bna.birds.cornell.edu/bna/species/006]

→ HUSSELL, D. J. et R. Montgomerie. 2002. *Lapland Longspur (Calcarius lapponicus), The Birds of North America Online (A. Poole, Ed.)*. Ithaca: Cornell Lab of Ornithology. [En ligne] [http://bna.birds.cornell.edu/bna/species/656]

- MOWBRAY, T. B., C. R. Ely, J. S. Sedinger and R. E. Trost. 2002. Canada Goose (Branta canadensis), The Birds of North America Online (A. Poole, Ed.). Retrieved from the Birds of North America Online: [En ligne] [http://bna.birds.cornell.edu/bna/species/682]

- MONTGOMERIE, R. et K. Holder. 2008. *Rock Ptarmigan (Lagopus muta), The Birds of North America Online (A. Poole, Ed.).* Ithaca: Cornell Lab of Ornithology. [En ligne] [http://bna.birds.cornell.edu/bna/species/051]

- MONTGOMERIE, R. et B. Lyon. 2011. *Snow Bunting (Plectrophenax nivalis), The Birds of North America Online (A. Poole, Ed.)*. Ithaca: Cornell Lab of Ornithology. [En ligne] [http://bna.birds.cornell.edu/bna/species/198]

- MORNEAU, F. et R. Benoit. 2005. *Complexe de la Romaine. Étude d'avant-projet. Étude de la faune aviaire. Oiseaux de proie.* Rapport présenté à Hydro-Québec Équipement, Direction Développement de projets et Environnement. Québec, FORAMEC. 64 p et annexes.

- NOL, E et M. S. Blanken. 2014. *Semipalmated Plover (Charadrius semipalmatus), The Birds of North America Online (A. Poole, Ed.)*. Ithaca: Cornell Lab of Ornithology. [En ligne] [http://bna.birds.cornell.edu/bna/species/444]

- ROBERTSON, Gregory J. et J.-P. L. Savard. 2002. *Long-tailed Duck (Clangula hyemalis), The Birds of North America Online (A. Poole, Ed.)*. Ithaca: Cornell Lab of Ornithology. [En ligne] [http://bna.birds.cornell.edu/bna/species/651]

Annexe A

DONNÉES BRUTES D’INVENTAIRES D’OISEAUX TERRESTRES ET DE LIMICOLES

Annexe A : Données brutes des inventaires d'oiseaux terrestres et de limicoles

Site	Parcelle	Observateur[1]	Date	Espèce[2]	Mâle	Femelle	Sexe inconnu	Juvénile	Code de l'Atlas[3]	In/out	É-C (Oiseaux terrestres et de rivage)	Commentaires
TK	1102	ED/MOL	21 juillet 2015	PLNE	1				H	In	0,5	
TK	1102	ED/MOL	21 juillet 2015	PLLA	1				AT	In	1,0	
TK	1074	ED/MOL	21 juillet 2015	PLNE		1			H	Out	0,0	
TK	1074	ED/MOL	21 juillet 2015	PLLA	1				H	In	0,5	
TK	1074	ED/MOL	21 juillet 2015	ALHA	1	1		1	JE	In	1,0	
TK	1074	ED/MOL	21 juillet 2015	PLLA		1			H	In	0,5	
TK	1100	ED/MOL	21 juillet 2015	PLNE	1				A	In	1,0	
TK	1100	ED/MOL	21 juillet 2015	PLNE	1				H	In	0,5	
TK	1100	ED/MOL	21 juillet 2015	PLLA	1			1	JE	In	1,0	
TK	1100	ED/MOL	21 juillet 2015	PLLA	1				H	In	0,5	
TK	1100	ED/MOL	21 juillet 2015	PIAM			1		H	In	0,5	
TK	1100	ED/MOL	21 juillet 2015	PLLA	1				A	In	1,0	
TK	1100	ED/MOL	21 juillet 2015	PLLA		1			H	In	0,5	
TK	1114	ED/MOL	21 juillet 2015	PLNE	1				H	In	0,5	
TK	1114	ED/MOL	21 juillet 2015	PLLA	1				H	In	0,5	
TK	1114	ED/MOL	21 juillet 2015	PLNE	1				H	In	0,5	
TK	1114	ED/MOL	21 juillet 2015	PLLA	1				H	In	0,5	
TK	1114	ED/MOL	21 juillet 2015	PLLA	1	1			A	In	1,0	
TK	1114	ED/MOL	21 juillet 2015	PLNE		1			DD	In	1,0	
TK	1137	ED/MOL	22 juillet 2015	PLLA	1				A	In	1,0	
TK	1137	ED/MOL	22 juillet 2015	FAGE			1		-	In	-	Vol, passe au-dessus de la parcelle 1138 et vol vers est
TK	1124	ED/MOL	22 juillet 2015	PLNE	1				H	In	0,5	
TK	1124	ED/MOL	22 juillet 2015	GRCO			1		OUT	In	-	Cri, déplacement
TK	1124	ED/MOL	22 juillet 2015	PLNE	1				H	In	0,5	
TK	1111	ED/MOL	22 juillet 2015	PLNE	1	1			H	In	0,5	
TK	1111	ED/MOL	22 juillet 2015	PLLA		1			H	In	0,5	
TK	1111	ED/MOL	22 juillet 2015	PLLA	1	1			AT	In	1,0	
TK	1111	ED/MOL	22 juillet 2015	PIAM			2		P	In	1,0	
TK	1111	ED/MOL	22 juillet 2015	PLNE	1				H	In	0,5	
TK	1112	ED/MOL	22 juillet 2015	PLLA					A	In	1,0	
TK	1112	ED/MOL	22 juillet 2015	PLLA	1				A	In	1,0	
TK	1112	ED/MOL	22 juillet 2015	PLNE					H	In	0,5	
TK	1112	ED/MOL	22 juillet 2015	PIAM			1		H	In	0,5	
TK	1112	ED/MOL	22 juillet 2015	PLLA	1				A	In	1,0	
TK	1112	ED/MOL	22 juillet 2015	PLLA	1				A	In	1,0	
TK	1112	ED/MOL	22 juillet 2015	PLLA					A	In	1,0	
TK	1125	ED/MOL	22 juillet 2015	ALHA	1				H	In	1,0	
TK	1125	ED/MOL	22 juillet 2015	PLNE					H	In	0,5	
TK	1125	ED/MOL	22 juillet 2015	PLLA					H	In	0,5	
TK	1138	ED/MOL	22 juillet 2015	PLLA	1				A	In	1,0	
TK	1138	ED/MOL	22 juillet 2015	GRCO			1		H	In	-	
TK	1138	ED/MOL	22 juillet 2015	PLLA	1				A	In	1,0	
TK	1138	ED/MOL	22 juillet 2015	PLNE			1		A	In	1,0	
TK	1126	ED/MOL	22 juillet 2015	PLNE	1	1		2	AT JE	In	1,0	
TK	1126	ED/MOL	22 juillet 2015	PLLA	1	1			A	In	1,0	
TK	1126	ED/MOL	22 juillet 2015	ALHA		1			A	In	1,0	
TK	1126	ED/MOL	22 juillet 2015	PLLA	1				A	In	1,0	
TK	1126	ED/MOL	22 juillet 2015	PLLA	1	1			A	In	1,0	
TK	1126	ED/MOL	22 juillet 2015	PLNE	1				H	In	0,5	

Site	Parcelle	Observateur[1]	Date	Espèce[2]	Mâle	Femelle	Sexe inconnu	Juvénile	Code de l'atlas[3]	In/out	É-C (Oiseaux terrestres et de rivage)	Commentaires
TK	1113	ED/MOL	22 juillet 2015	PLNE	1	1			H	In	1,0	
TK	1113	ED/MOL	22 juillet 2015	PLLA	1				A	In	1,0	
TK	1113	ED/MOL	22 juillet 2015	PLLA		1			A	In	1,0	
TK	1113	ED/MOL	22 juillet 2015	PLNE		1			H	In	0,5	
TK	1113	ED/MOL	22 juillet 2015	PIAM			1		H	In	0,5	
TK	1113	ED/MOL	22 juillet 2015	PLLA	1	1		1	AT	In	1,0	
TK	1113	ED/MOL	22 juillet 2015	PLLA	1				AT	In	1,0	
TK	1113	ED/MOL	22 juillet 2015	PLNE	1	1			H	In	1,0	
TK	1113	ED/MOL	22 juillet 2015	GRCO			1		-	Out	-	Au vol au-dessus, va vers ouest
Puimajuq	0216	ED/MOL	23 juillet 2015	HAKA		3			X	In	-	Sur lac/pas de comportement nicheur
Puimajuq	0203	ED/MOL	23 juillet 2015	-	-	-	-	-	-	-	-	Aile d'oiseau mort
Puimajuq	0190	ED/MOL	23 juillet 2015	PLLA	1				H	In	0,5	
Puimajuq	0190	ED/MOL	23 juillet 2015	PLLA	1	1			P-A	In	1,0	
Puimajuq	0189	ED/MOL	23 juillet 2015	PLLA	1				H	In	0,5	
Puimajuq	0202	ED/MOL	23 juillet 2015	-	-	-	-	-	-	-	-	
Puimajuq	0215	ED/MOL	23 juillet 2015	PLLA	1				H	In	0,5	
Puimajuq	0214	ED/MOL	23 juillet 2015	-	-	-	-	-	-	-	-	
Puimajuq	0201	ED/MOL	23 juillet 2015	GRCO			1			Out	-	Vol
Puimajuq	0188	ED/MOL	23 juillet 2015	PLLA	1				H	In	0,5	Cri
Puimajuq	0175	ED/MOL	23 juillet 2015	-	-	-	-	-	-	-	-	
Puimajuq	0176	ED/MOL	23 juillet 2015	-	-	-	-	-	-	-	-	
Puimajuq	0205	ED/PC	24 juillet 2015	PLLA	1				A	In	1,0	
Puimajuq	0205	ED/PC	24 juillet 2015	PLNE		1			H	In	0,5	
Puimajuq	0193	ED/PC	24 juillet 2015	-	-	-	-	-	-	-	-	
Puimajuq	0166	ED/PC	24 juillet 2015	-	-	-	-	-	-	-	-	
Puimajuq	0164	ED/PC	24 juillet 2015	-	-	-	-	-	-	-	-	
Puimajuq	0138	ED/PC	24 juillet 2015	-	-	-	-	-	-	-	-	Coupole vide (pas d'œufs), possiblement BESE
Puimajuq	0139	ED/PC	24 juillet 2015	-	-	-	-	-	-	-	-	Coupole vide (pas d'œufs), possiblement BESE
Puimajuq	0139	ED/PC	24 juillet 2015	PLLA	1							
Puimajuq	0112	ED/PC	24 juillet 2015	PLLA	1				A	In	1,0	
Puimajuq	0085	ED/PC	24 juillet 2015	BESE			1		H	In	0,5	
Puimajuq	0085	ED/PC	24 juillet 2015	PLLA			1		H	Out	0,5	
Puimajuq	0046	ED/PC	25 juillet 2015	PLLA			1		A	In	1,0	
Puimajuq	0046	ED/PC	25 juillet 2015	PLLA			1		A	In	1,0	
Puimajuq	0046	ED/PC	25 juillet 2015	PLCA			1		H	Out	1,0	Même secteur que celui entendu la veille, probablement même couple ou individu
Puimajuq	0046	ED/PC	25 juillet 2015	PLLA	1				H	In	0,5	
Puimajuq	0019	ED/PC	25 juillet 2015	PLLA			1		H	In	0,5	
Puimajuq	0019	ED/PC	25 juillet 2015	PLLA	1				A	In	1,0	
Puimajuq	0019	ED/PC	25 juillet 2015	PLLA	1				A	In	1,0	
Puimajuq	0019	ED/PC	25 juillet 2015	PLLA	1				H	In	0,5	
Puimajuq	0019	ED/PC	25 juillet 2015	PLNE	1				-	In	-	Aile
Puimajuq	0677	ED/PC	25 juillet 2015	PLLA			1		H	In	0,5	
Puimajuq	0650	ED/PC	25 juillet 2015	PLLA	1				A	In	1,0	
Puimajuq	0650	ED/PC	25 juillet 2015	PLLA		1			H	In	0,5	
Puimajuq	0650	ED/PC	25 juillet 2015	PLNE	1				OUT	In	0,0	
Puimajuq	0650	ED/PC	25 juillet 2015	PLLA	1				A	In	0,5	
Puimajuq	0625	ED/PC	25 juillet 2015	PLLA		1			A	In	1,0	

Site	Parcelle	Observateur[1]	Date	Espèce[2]	Mâle	Femelle	Sexe inconnu	Juvénile	Code de l'atlas[3]	In/out	É-C (Oiseaux terrestres et de rivage)	Commentaires
Puimajuq	0625	ED/PC	25 juillet 2015	PLNE	1				H	In	0,5	
Puimajuq	0625	ED/PC	25 juillet 2015	PLLA		1			H	In	0,5	
Puimajuq	0625	ED/PC	25 juillet 2015	ALHA	1				H	In	0,5	
Puimajuq	0625	ED/PC	25 juillet 2015	PLLA			1		A	In	1,0	
Puimajuq	0623	ED/PC	25 juillet 2015	PLLA	1				H	In	0,5	
Puimajuq	0623	ED/PC	25 juillet 2015	PLNE	1	1			P	In	1,0	
Puimajuq	0623	ED/PC	25 juillet 2015	PLNE	1	1			P	In	1,0	
Puimajuq	0623	ED/PC	25 juillet 2015	PLNE	1	2			A	In	2,0	
Puimajuq	0623	ED/PC	25 juillet 2015	PLLA	1	1			P-A	In	1,0	
Puimajuq	0597	ED/PC	25 juillet 2015	PLLA			1		H	In	0,5	
Puimajuq	0597	ED/PC	25 juillet 2015	PLLA	1				A	In	1,0	
Puimajuq	0597	ED/PC	25 juillet 2015	PLNE	1				A	In	1,0	
Puimajuq	0597	ED/PC	25 juillet 2015	PLNE	1	1			P	In	1,0	
Puimajuq	0597	ED/PC	25 juillet 2015	INCONNU								Aile oiseau mort
Puimajuq	0611	ED/PC	25 juillet 2015	PLNE	1				H	In	0,5	
Puimajuq	0611	ED/PC	25 juillet 2015	PLNE	1				A	In	1,0	

[1]Observateur : ED : Émilie D'Astous, MOL : Martin-Olivier Lévesque, PC : Patrick Corriveau
[2]Espèce : PLNE : Plectrophane des neiges, PLNE : Plectrophane lapon, ALHA : Alouette hausse-col, GRCO : Grand corbeau, HAKA : Harelde kakawi, PLCA : Plongeon catmarin, BESE : Bécasseau semipalmé
[3]Code de l'Atlas : A : Comportement agité ou cris d'alarme de la part d'un adulte pendant la période de reproduction de l'espèce dans un habitat de nidification propice, AT : Adulte transportant de la nourriture pour un ou plusieurs jeunes, DD : Oiseau tentant de détourner l'attention du nid ou des jeunes en simulant une blessure ou en utilisant une autre parade de diversion, H : Espèce observée pendant sa période de reproduction dans un habitat de nidification propice, JE : Jeune ayant récemment quitté le nid (espèces nidicoles) ou jeune en duvet (espèces nidifuges), incapable d'un vol soutenu, Couple observé pendant la période de reproduction de l'espèce dans un habitat de nidification propice, X : Espèce observée pendant sa période de reproduction, mais dans un habitat non propice à sa nidification (aucun indice de nidification).

Annexe B

CONDITIONS D’OBSERVATION LORS DES SURVOLS AÉRIENS

Annexe B : Conditions d'observation lors des survols aériens

Date	Secteur	Équipe	Nbre de vols	Heure		T°[2]	Néb.[3]	Précipitation	Vent		Conditions d'observation
				Début	Fin				Force[4]	Origine	
26 juillet	Puimajuq	ED	1	14h23	14h38	20	60	Aucune	4	NE	Excellentes
26 juillet	TK	ED	1	14h13	14h19	20	50	Aucune	4	NE	Excellentes

[1]ED : Émilie D'Astous
[2]T° : Température en °C
[3]Néb. : Nébulosité : Pourcentage (%) de la couverture nuageuse
[4]Force du vent selon l'échelle de Beaufort

Annexe C

DESCRIPTION DES HABITATS DES PARCELLES

ANNEXE C-1

DESCRIPTION DES HABITATS DES PARCELLES - GISEMENT TK

Annexe C-1 : Description des habitats des parcelles - gisement TK

Parcelle	Habitat général	Habitat (%)							
		Toundra sèche	Toundra sèche et roche	Roche	Toundra humide	Toundra humide et roche	Toundra herbeuse et humide	Eau	Autre
1102	Toundra herbeuse et humide	15	25	-	-	-	55	5	
1074	Toundra sèche	80	-	-	-	-	20	+	
1100	Roche	40	-	50	-	-	10	+	
1114	Toundra sèche	30	15	20	-	-	10	+	Rivière (25 %)
1137	Toundra herbeuse et humide	35	10	-	-	-	55	+	
1124	Roche	10	25	65	-	-	-	0	
1111	Toundra sèche	50	0	40	-	-	10	+	
1112	Roche	-	40	50	-	-	10	+	
1125	Toundra sèche et roche	10	50	20	-	-	20	+	
1138	Toundra sèche et rivière	30	15	-	-	-	5	+	Lit de la rivière (15 %), Rivière (35 %)
1126	Rivière	30	-	5	-	-	20	+	Lit de la rivière (10 %), Rivière (35 %)
1113	Toundra sèche	65	0	10	-	-	10	+	Rivière (15 %)

ANNEXE C-2

DESCRIPTION DES HABITATS DES PARCELLES - GISEMENT PUIMAJUQ

Annexe C-2 : Description des habitats des parcelles - gisement Puimajuq

Parcelle	Habitat général	Habitat (%)							
		Toundra sèche	Toundra sèche et roche	Roche	Toundra humide	Toundra humide et roche	Toundra herbeuse et humide	Eau	Autre
0216	Lac et toundra sèche	30	10	-	-	-	20	-	Lac (40 %)
0203	Toundra humide	30	15	-	45	-	10	+	
0190	Lac	25	-	5	15	-	-	-	Lac (55 %)
0189	Toundra sèche	90	10	-	-	-	-	-	
0202	Toundra sèche	80	20	-	-	-	-	-	Présence de forages
0215	Toundra sèche	70	30	-	-	-	-	-	
0214	Toundra sèche et roche	20	40	10	10	-	-	-	Lac (20 %)
0201	Toundra sèche	70	10	-	15	-	-	5	
0188	Toundra sèche	40	20	-	-	-	30	10	
0175	Lac et toundra sèche	25	10	-	20	-	-	-	Lac (45 %)
0176	Toundra sèche	50	30	5	10	-	-	5	Lac (+ %)
0205	Toundra sèche et roche	35	55	-	10	-	-	-	
0193	Toundra sèche et roche	-	80	-	-	-	20	-	
0166	Toundra sèche et roche	-	70	-	20	-	10	+	
0164	Toundra sèche et roche	-	60	5	-	30	5	+	
0138	Toundra sèche et roche	-	40	-	-	35	20	5	
0139	Toundra sèche et roche	-	75	-	-	25	-	+	
0112	Toundra sèche et roche	-	70	20	-	5	5	+	
0085	Toundra sèche et roche	20	60	-	-	20	-	-	
0046	Toundra sèche et roche	-	50	15	15	-	20	+	
0019	Toundra sèche et roche	-	80	20	-	-	-	-	Piquet d'arpentage

Annexe C-2 : Description des habitats des parcelles au gisement Puimajuq (suite)

Parcelle	Habitat général	Habitat (%)							
		Toundra sèche	Toundra sèche et roche	Roche	Toundra humide	Toundra humide et roche	Toundra herbeuse et humide	Eau	Autre
0677	Toundra sèche	90	10	-	-	-	-	-	
0650	Toundra sèche/humide et roche	-	40	15	-	40	-	+	Lac (5 %)
0625	Toundra sèche et roche/roche	-	45	45	10	-	-	+	
0623	Roche/Toundra sèche et roche	-	30	40	15	-	10	5	
0597	Toundra sèche et roche	15	20	25	5	-	5	-	Présence de neige, Butte de roche (affleurement rocheux=20 % de la parcelle), Lac (10 %)
0611	Roche	-	30	60	-	-	10	-	

Annexe D

DESCRIPTION DES CONDITIONS D'OBSERVATION LORS DES INVENTAIRES DANS LES PARCELLES

ANNEXE D-1

DESCRIPTION DES CONDITIONS D'OBSERVATION AU GISEMENT TK

Annexe D-1 : Description des conditions d'observation au gisement TK

Parcelle	Date	Habitat	Observateur[1]	Début	Fin	T°[2]	Nébulosité[3]	Précipitation	Force du vent[4]	Origine du vent	Conditions d'observation
1102	21 juillet 2015	Toundra herbeuse et humide	ED/MOL	15h49	16h20	15	20	Aucune	4 à 5	Ouest	Moyennes
1074	21 juillet 2015	Toundra sèche	ED/MOL	13h44	14h08	15	15	Aucune	4	Ouest	Bonnes
1100	21 juillet 2015	Roche	ED/MOL	14h25	15h03	15	15	Aucune	4	Ouest	Moyennes
1114	21 juillet 2015	Toundra sèche	ED/MOL	15h10	15h45	15	0	Aucune	4	Est	Moyennes
1137	22 juillet 2015	Toundra herbeuse et humide	ED/MOL	9h27	10h00	10	10	Aucune	4	Est	Bonnes
1124	22 juillet 2015	Roche	ED/MOL	10h02	10h29	10	10	Aucune	4 à 5	Est	Moyennes
1111	22 juillet 2015	Toundra sèche	ED/MOL	10h30	11h06	10	10	Aucune	4	Est	Bonnes
1112	22 juillet 2015	Roche	ED/MOL	11h12	11h52	10	5	Aucune	3 à 4	Est	Bonnes
1125	22 juillet 2015	Toundra sèche et roche	ED/MOL	12h32	12h48	10	5	Aucune	4	Est	Moyennes
1138	22 juillet 2015	Toundra sèche et rivière	ED/MOL	12h50	13h25	10	5	Aucune	4	Est	Moyennes
1126	22 juillet 2015	Rivière	ED/MOL	13h27	14h15	10	10	Aucune	4	Est	Moyennes
1113	22 juillet 2015	Toundra sèche	ED/MOL	14h17	14h54	10	0	Aucune	3 à 4	Est	Bonnes

[1]Observateur : ED : Émilie D'Astous, MOL : Martin-Olivier Lévesque;
[2]T° : Température en °C;
[3]Nébulosité : % de la couverture nuageuse
[4]Force du vent : selon l'échelle de Beaufort

ANNEXE D-2

DESCRIPTION DES CONDITIONS D’OBSERVATION AU GISEMENT PUIMAJUQ

Annexe D-2 : **Description des conditions d'observation au gisement Puimajuq**

Parcelle	Date	Habitat	Observateur[1]	Début	Fin	T°[2]	Nébulosité[3]	Précipitation	Force du vent	Origine du vent	Conditions d'observation
0216	23 juillet 2015	Lac et toundra sèche	ED/MOL	9h43	10h20	7	N/A	Brume	4	Est	Moyennes
0203	23 juillet 2015	Toundra humide	ED/MOL	10h21	10h51	7	10	Brume	2 à 4	Est	Moyennes
0190	23 juillet 2015	Lac	ED/MOL	10h55	11h23	7	10 à 20	Brume	2 à 3	Est	Moyennes
0189	23 juillet 2015	Toundra sèche	ED/MOL	11h28	11h56	8	30	Brume	1 à 3	Est	Moyennes
0202	23 juillet 2015	Toundra sèche	ED/MOL	12h17	12h44	8	15	Aucune	1 à 3	Est	Bonnes
0215	23 juillet 2015	Toundra sèche	ED/MOL	12h47	13h18	8	20	Aucune	2 à 3	ESt	Bonnes
0214	23 juillet 2015	Toundra sèche et roche	ED/MOL	13h22	13h56	10	10	Aucune	2	Est	Bonnes
0201	23 juillet 2015	Toundra sèche	ED/MOL	13h59	14h25	12	20	Aucune	2	Est	Bonnes
0188	23 juillet 2015	Toundra sèche	ED/MOL	14h30	15h01	12	20	Aucune	2 à 3	Est	Moyennes
0175	23 juillet 2015	Lac et toundra sèche	ED/MOL	15h04	15h47	12	10	Aucune	2 à 3	Est	Moyennes
0176	23 juillet 2015	Toundra sèche	ED/MOL	15h48	16h15	15	10	Aucune	2 à 4	Est	Moyennes à Bonnes
0205	24 juillet 2015	Toundra sèche et roche	ED/PC	8h50	9h39	15	10	Aucune	0 à 1	Est	Excellentes
0193	24 juillet 2015	Toundra sèche et roche	ED/PC	9h43	10h20	15	20	Aucune	1	ESt	Excellentes
0166	24 juillet 2015	Toundra sèche et roche	ED/PC	10h46	11h15	15	15	Aucune	0 à 1	Sud	Excellentes
0164	24 juillet 2015	Toundra sèche et roche	ED/PC	11h26	11h52	18	15	Aucune	1	Sud	Excellentes
0138	24 juillet 2015	Toundra sèche et roche	ED/PC	12h40	13h13	18	35	Aucune	1	SE	Excellentes
0139	24 juillet 2015	Toundra sèche et roche	ED/PC	13h19	13h50	18	70	Aucune	1	SE	Excellentes
0112	24 juillet 2015	Toundra sèche et roche	ED/PC	14h25	15h05	15	95	Aucune	2	Ouest	Excellentes
0085	24 juillet 2015	Toundra sèche et roche	ED/PC	15h10	15h47	18	100	Aucune	0 à 2	Ouest	Excellentes
0046	25 juillet 2015	Toundra sèche et roche	ED/PC	8h26	9h03	15	95	Aucune	1	-	Excellentes
0019	25 juillet 2015	Toundra sèche et roche	ED/PC	9h17	9h52	18	100	Aucune	1	SE	Excellentes
0677	25 juillet 2015	Toundra sèche	ED/PC	10h15	10h44	18	100	Aucune	0 à 2	SE	Excellentes
0650	25 juillet 2015	Toundra sèche/humide et roche	ED/PC	11h07	11h35	18	100	Aucune	2	Est	Excellentes
0625	25 juillet 2015	Toundra sèche et roche/roche	ED/PC	11h49	12h22	20	95	Aucune	1	SE	Excellentes
0623	25 juillet 2015	Roche/Toundra sèche et roche	ED/PC	13h08	13h52	20	95	Aucune	1	Est	Excellentes
0597	25 juillet 2015	Toundra sèche et roche	ED/PC	14h03	14h40	20	75	Aucune	1 à 2	ESt	Excellentes
0611	25 juillet 2015	Roche	ED/PC	15h07	15h40	20	75	Aucune	2 à 3	Est	Excellentes

[1]Observateur : MOL : Martin-Olivier Lévesque, PC : Patrick Corriveau, ED : Émilie D'Astous;
[2]T° : Température en °C;
[3]Nébulosité : % de la couverture nuageuse
[4]Force du vent : selon l'échelle de Beaufort

Annexe E

DOSSIER PHOTOGRAPHIQUE DES INVENTAIRES

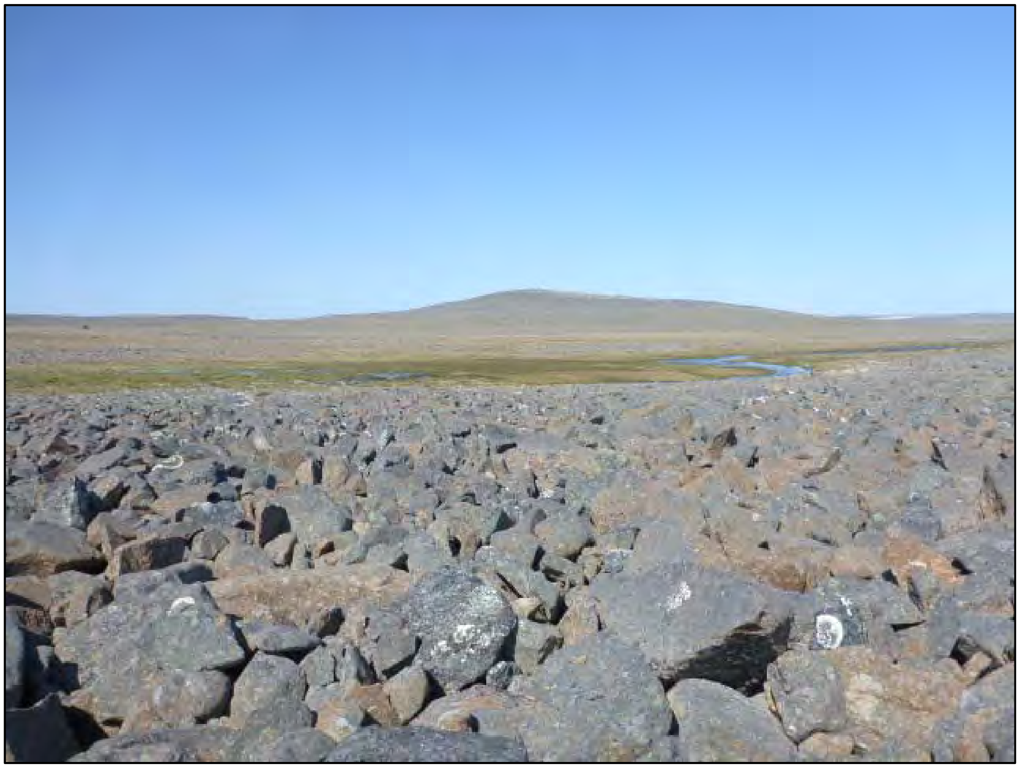


Photo 1. Zone rocheuse, gisement TK (parcelle 1100)

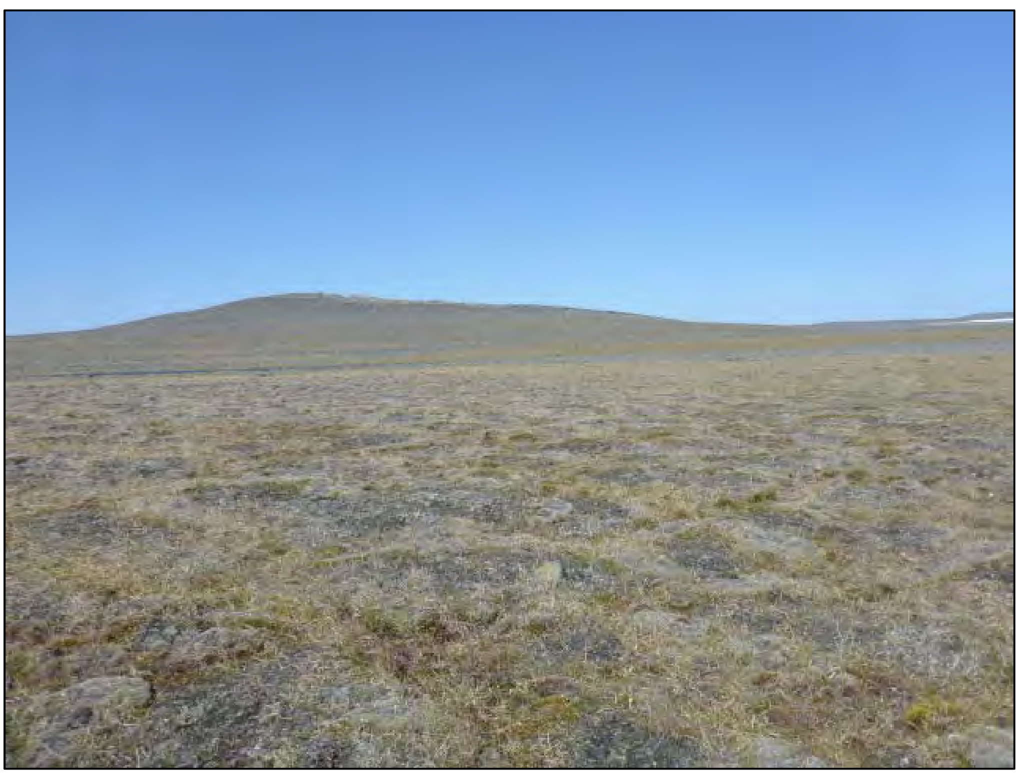


Photo 2. Toundra sèche, gisement TK (parcelle 1114)

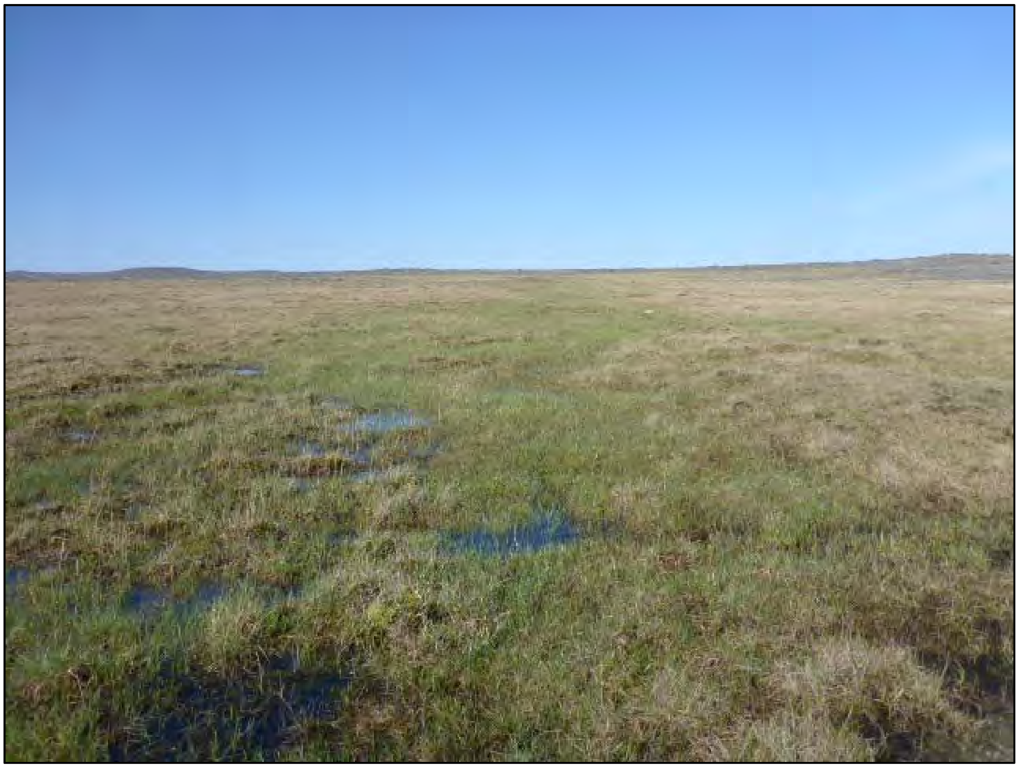


Photo 3. Toundra herbacée et humide, Gisement TK (parcelle 1137)

Photo 4. Rivière, gisement TK (parcelle 1138)

WSP

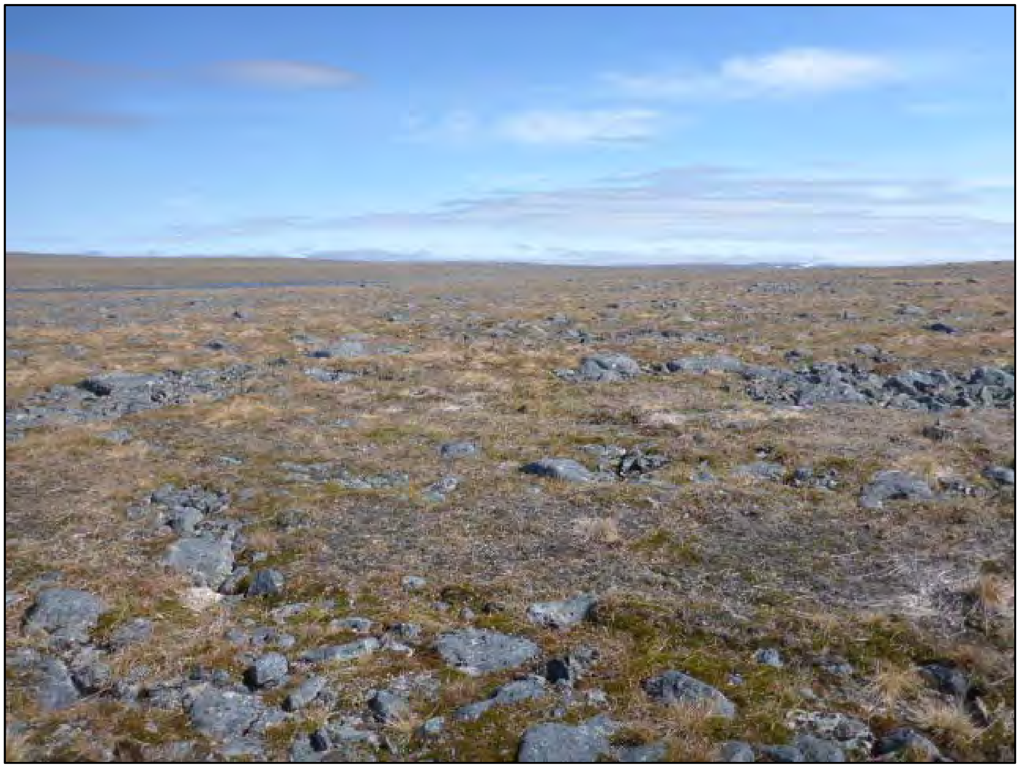


Photo 5. Toundra sèche et roche, gisement Puimajuq (parcelle 0214)

Photo 6. Bordure de lac, gisement Puimajuq (parcelle 0216)

Photo 7. Lac, gisement Puimajuq (parcelle 0190)

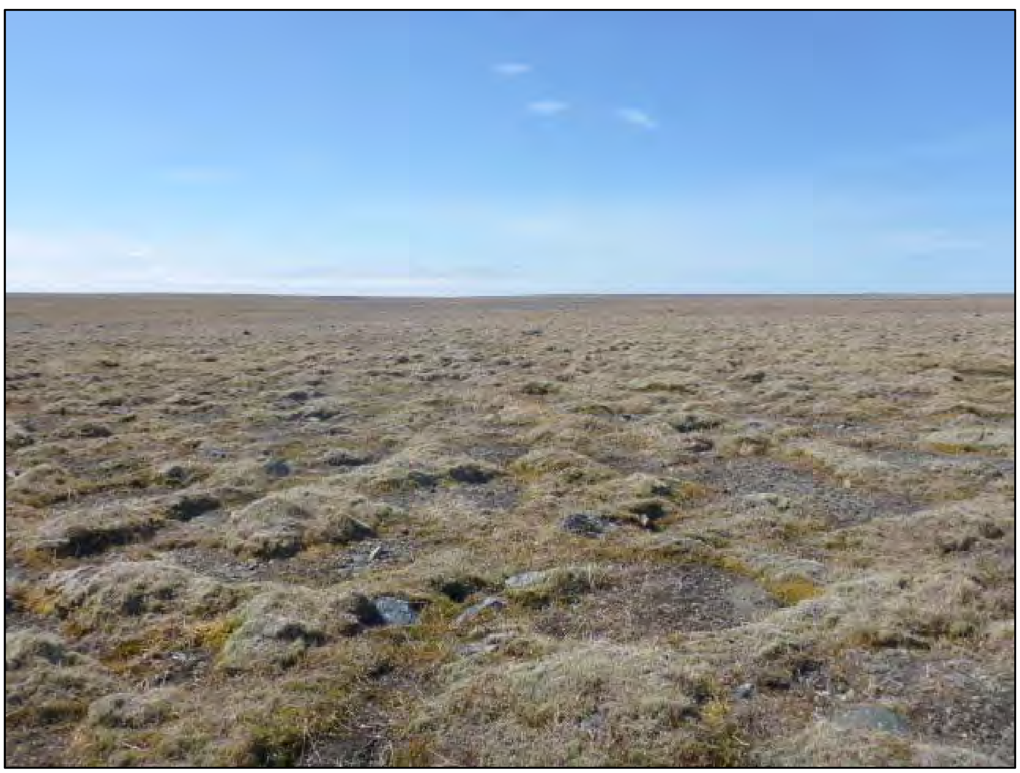


Photo 8. Toundra sèche, gisement Puimajuq (parcelle 0202)

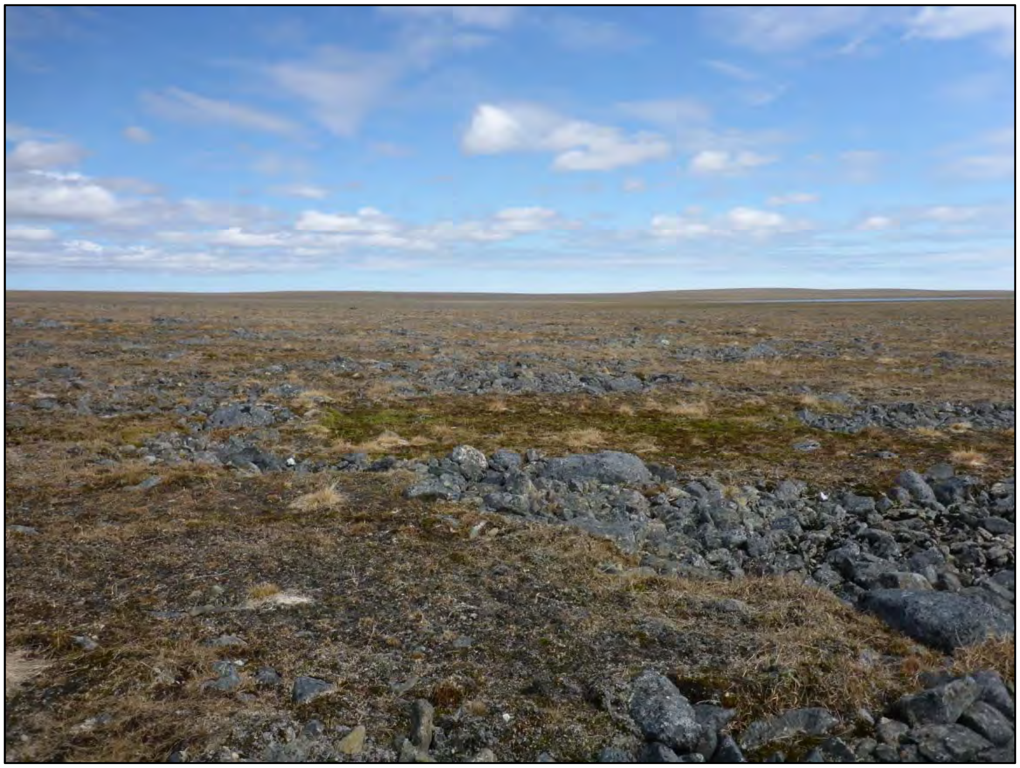


Photo 9. Toundra sèche et roche, gisement Puimajuq (parcelle 0139)

Photo 10. Zone rocheuse, gisement Puimajuq (parcelle 0611)

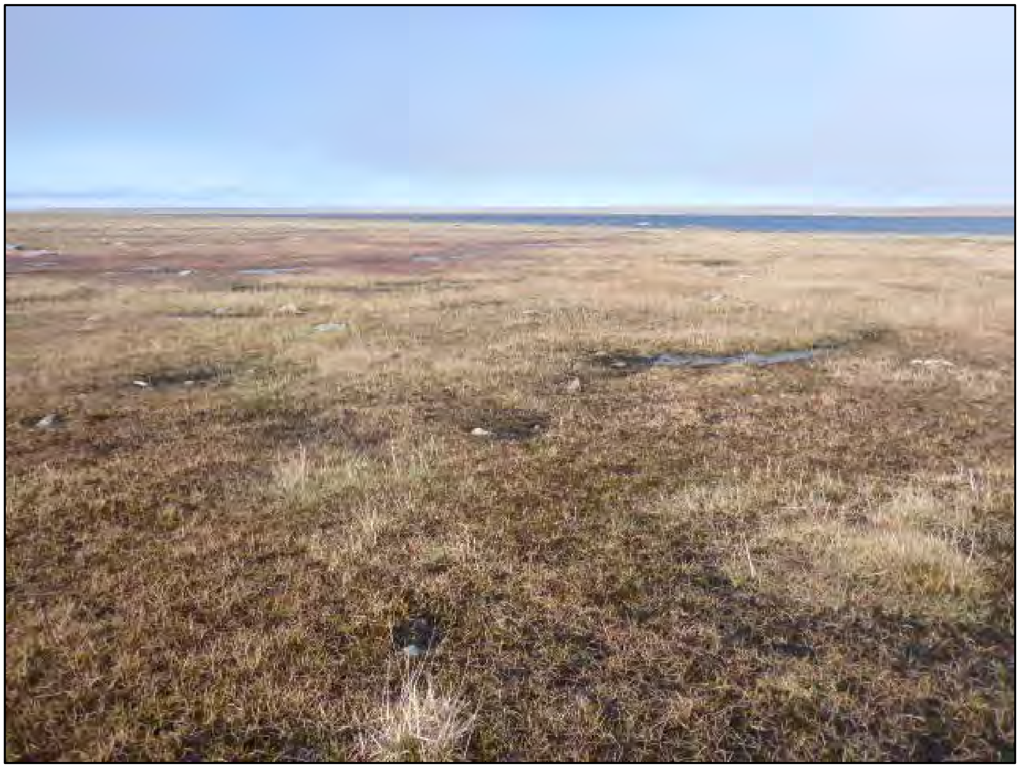


Photo 11. Toundra humide, gisement Puimajuq (parcelle 0203)

Photo 12. Toundra humide et roche, gisement Puimajuq (parcelle 0650)

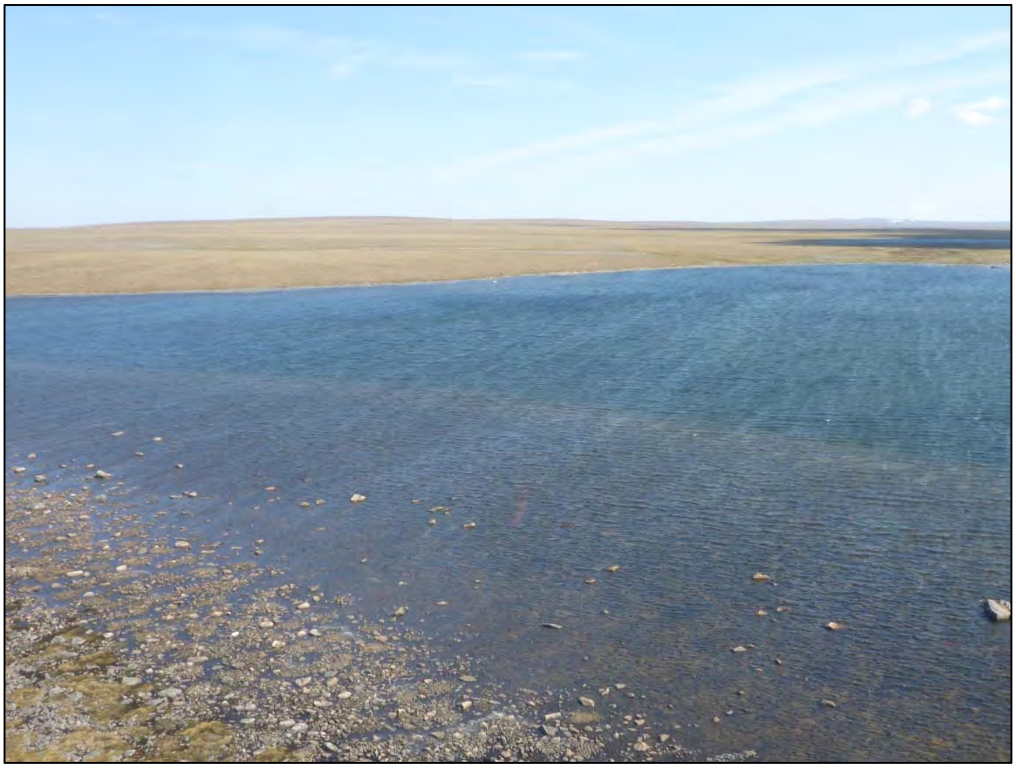


Photo 13. Vue aérienne, lac situé au nord-ouest du gisement Puimajuq

Photo 14. Vue aérienne, gisement Puimajuq (parcelle 0202)

WSP

Photo 15. Vu aérienne d’un petit lac, gisement Puimajuq (parcelle 0214)

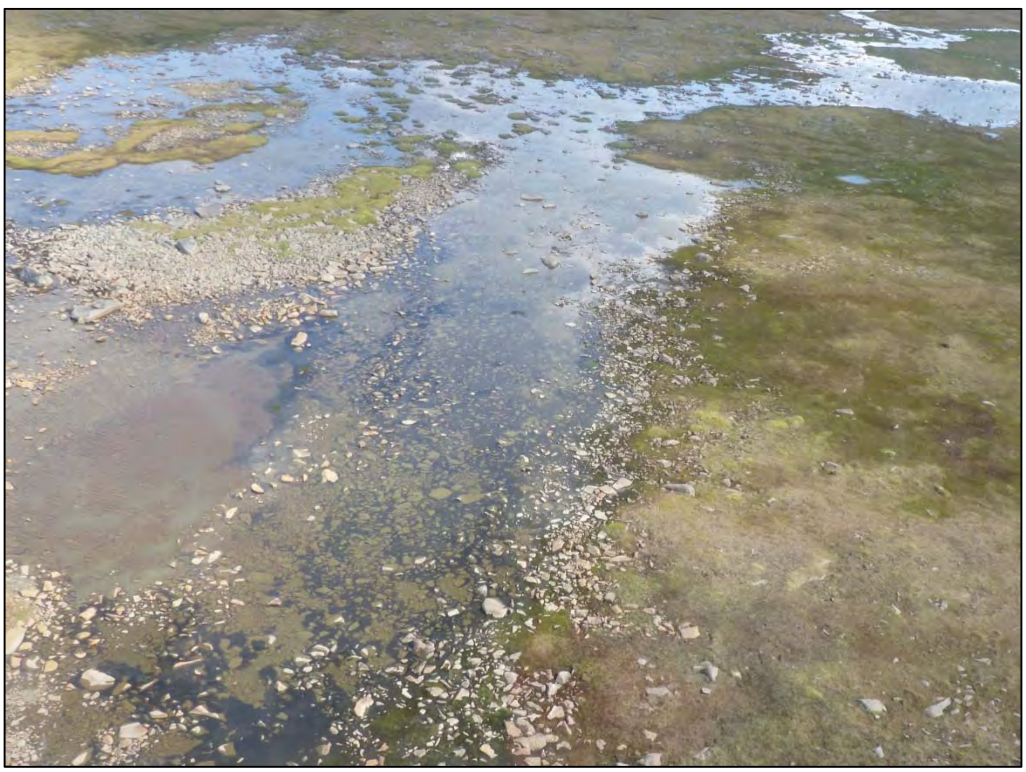


Photo 16. Vue aérienne d’une partie de la rivière du gisement TK

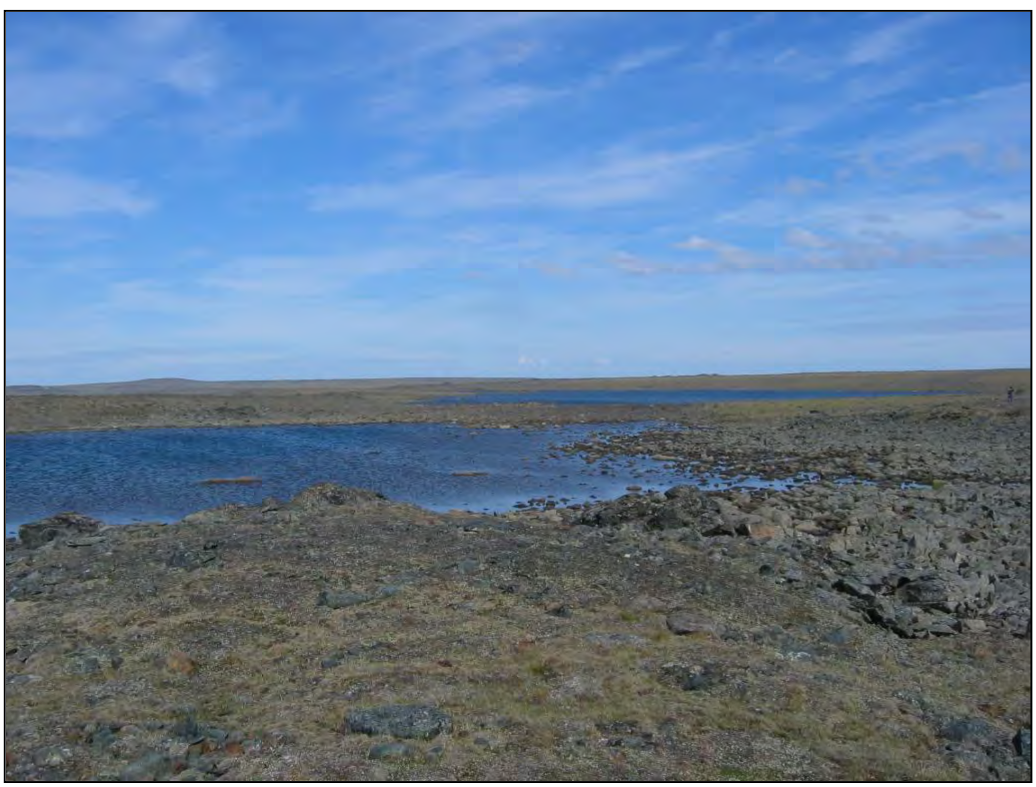
Appendix 6

THEORETICAL ARCHEOLOGICAL POTENTIAL STUDY (ARTEFACTUEL, 2015)

Octobre 2015

Projet Nunavik Nickel

Étude de potentiel archéologique
Gisement Puimajuq



Artefactuel
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Ce projet a été réalisé dans le cadre d'un contrat pour services professionnels de WSP Canada inc.

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Photo page couverture : Vue de la zone à potentiel 3, vers le nord-est (photo Artefactuel 2008-157-5752)

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1. MANDAT

Artefactuel, coop de travail, a été mandaté par WSP Canada inc. pour réaliser une étude de potentiel archéologique théorique du gisement minier Puimajuq et le secteur de sa route d'accès prévu (Figure 1). Cette étude devait permettre de déterminer les endroits où des sites archéologiques sont plus susceptibles de se trouver, en se basant sur les connaissances archéologiques déjà acquises pour le Nunavik en général et pour la région en particulier. Aucun inventaire ou prospection de terrain n'a eu lieu afin de confirmer ou d'infirmer ce potentiel dans le cadre de ce mandat.

Ce rapport d'étude de potentiel présentera d'abord les données déjà connues sur le patrimoine archéologique de la région. D'abord, la séquence culturelle du Nunavik sera présentée, ce qui permettra de mettre en exergue l'importance de différentes caractéristiques du milieu dans l'établissement préhistorique. Les recherches réalisées et les sites connus à proximité de la région à l'étude seront également recensés. Une attention particulière sera donnée à la caractérisation de l'occupation du territoire à l'intérieur des terres. Les critères pris en compte pour la qualification des zones de potentiels seront décrits en méthodologie. Le résultat de l'évaluation sera présenté sous la forme de cartes de sensibilité. Des recommandations pour la préservation du patrimoine archéologique seront finalement émises.

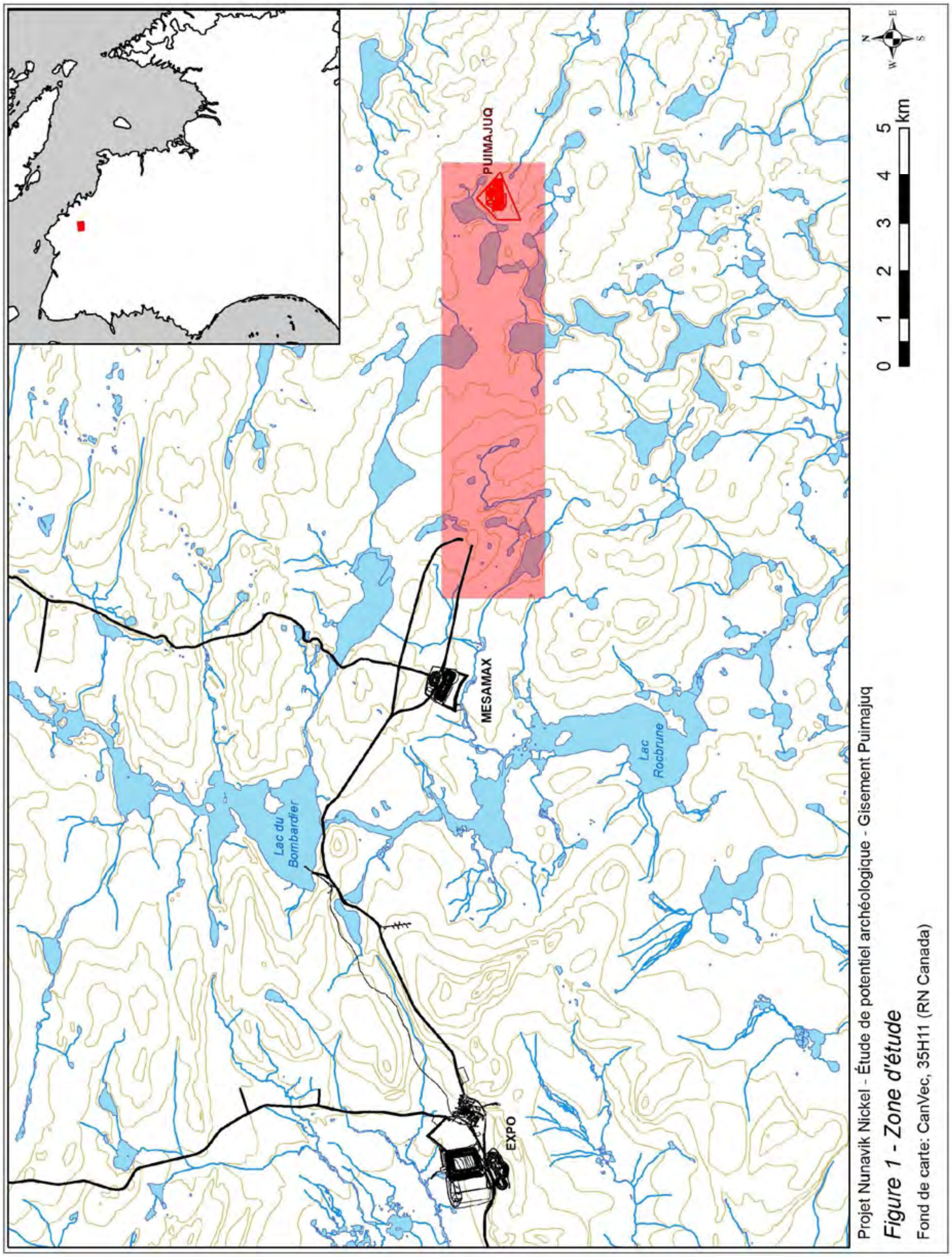

Figure 1 : Localisation de la zone d'étude

2. ÉTAT DES CONNAISSANCES ARCHÉOLOGIQUES

2.1. Cadre culturel

2.1.1. Le Paléoesquimau ancien

L'Arctique québécois a été peuplé par des groupes paléoesquimaux anciens autour du quatrième millénaire avant aujourd'hui (A.A.). L'implantation sur ce nouveau territoire ne semble pas avoir été faite de façon unidirectionnelle, puisque l'on note la présence de deux faciès distincts du Paléoesquimau ancien sur le territoire : un premier s'apparentant au Prédorsétien classique, provenant sans doute du nord-ouest, dans la moitié ouest du Nunavik, et un second rappelant plutôt l'Indépendence I du Groenland du côté est. La limite entre ces faciès culturels, qui se distinguent par l'exploitation différentielle de certaines matières lithiques, dans les formes architecturales et dans certains traits technologiques, serait située dans le secteur du cap de la Nouvelle-France, entre Douglas Harbour et Salluit (Gendron 2007, Gendron et Pinard 2000). Ces deux migrations distinctes semblent toutefois être quasi-contemporaines : la plus vieille date obtenue sur un site à l'est du Cap est de 3 950 +/- 50 ans A.A. (site JjEv-17, île Ukivik, région de Kangiqsujuaq; Gendron 2007), alors que du côté ouest elle est de 3 800 +/- 70 ans A.A. (site GhGk-4, au nord de Kuujjuarapik; IcA 1992). Bien qu'aucun site de l'intérieur des terres ne puisse être clairement attribué à cette période, l'on pourrait situer la région à l'étude à cheval entre les deux aires de dispersions.

L'économie prédorsétienne a été décrite comme généraliste et opportuniste, exploitant les ressources du territoire au gré des rencontres sans véritable planification des activités de subsistance, et ce, tant pour les ressources lithiques que fauniques (Desrosiers et Rahmani 2007, Nagy 2000). Bien que la plupart des sites connus se trouvent en contexte côtier, on ne peut affirmer une orientation fortement maritime des activités cynégétiques, comme ce sera le cas pour les périodes subséquentes. Les ressources exploitées comprennent tant les mammifères marins, chassés à l'aide de harpon propulsé à la main (Gendron et Pinard 2001), que de mammifères terrestres, chassés à la lance et à l'arc (Maxwell 1985). Les sites archéologiques sont petits et peu de structures d'entreposage sont connues (Labrèche 2005), dénotant une mobilité accrue des groupes (Murray 1999). Les quelques vestiges d'habitation qui ont pu être associés au Prédorsétien classique prennent la forme de cercles de tente avec un aménagement axial composé de deux séries de pierres parallèles et d'un foyer central, ou de dépressions aménagées dans les champs de blocs (Gendron 2001, Gendron et Pinard 2001). Les champs de blocs semblent d'ailleurs constituer un environnement privilégié pour les sites prédorsétiens classiques (Plumet 1976), du moins sur la côte (IcA 2008). La technologie se manifeste par un outillage taillé de très petite dimension, caractéristique de la Tradition microlithique de l'Arctique d'où les Paléoesquimaux anciens du Québec sont issus. On retrouve ainsi dans la culture matérielle lithique une variété de microlames, de burins taillés, de grattoirs, racloirs et bifaces, ainsi que des couteaux à pédoncules (Maxwell 1980). L'os, le bois et l'andouiller étaient également utilisés (IcA 2006), bien qu'ils aient laissé peu de traces archéologiques.

2.1.2. Le Paléoesquimau récent

Le passage du Paléoesquimau ancien au Paléoesquimau récent – soit du Prédorsétien au Dorsétien dans la région qui nous occupe – fait l'objet de débats depuis les débuts de l'archéologie de l'Arctique (voir Desrosiers 2009 pour une synthèse exhaustive). Une transition, impliquant une continuité chez les groupes humains au moins dans certaines régions, est généralement évoquée (Houmard 2011). Celle-ci mettrait en jeu une évolution culturelle liée à une meilleure connaissance du territoire (Nagy 2000) ainsi qu'à un refroidissement du climat qui a bel et bien été démontré pour la période impliquée (soit de 3 400 A.A. à 1 900 A.A.; Kasper et Allard 2001). Une hypothèse alternative, selon laquelle le développement dorsétien au Québec serait dû à l'arrivée de nouveaux groupes dans la région du détroit d'Hudson après un abandon du Nunavik autour de 2 500 A.A., a parfois été soulevée (Gendron 2007, IcA 2006). En tenant compte des recherches récentes qui ont quelque peu réaménagé la chronologie culturelle arctique, la période dorsétienne proprement dite débuterait autour de 2 000 ans A.A. (IcA 2015, Gendron 2007).

Plus orientées vers les ressources maritimes que celles de leurs prédécesseurs (IcA 2004), les stratégies dorsétiennes d'exploitation des ressources deviennent plus organisées. La banquise profite de la détérioration du climat pour apparaître plus tôt et disparaître plus tard, ce qui facilite la chasse aux mammifères marins (IcA 2006) – comme le phoque, le morse, et possiblement le béluga (Maxwell 1984). Une exploitation intérieure existe toujours, visant particulièrement le caribou lors de migrations, le petit gibier, ou le poisson en rivières, mais à une moins grande échelle qu'au

Prédorsétien (Rocheleau 1982). L'organisation logistique de l'exploitation semble avoir mené à une sédentarité accrue, se manifestant par des sites plus riches et des structures d'habitation plus élaborées (Murray 1999). Des cercles de tentes se manifestent sur les sites estivaux, alors que les sites d'occupation en périodes froides montrent l'apparition de maisons semi-souterraines construites dans les dépôts meubles (Gendron et Pinard 2001), occupées dans l'attente que les conditions permettent la construction d'igloos sur la banquise (Maxwell 1985). Des maisons longues de 12 à 35 m, type architectural unique à cette période, font leur apparition dans des zones écologiques riches, représentant possiblement des lieux d'exploitation communautaire (Jensen 2005). L'amélioration de l'organisation de l'exploitation se manifeste par ailleurs par l'apparition d'une série de structures secondaires qui persisteront dans les périodes subséquentes : caches de nourriture ou de matériel, pièges, affûts de chasse et inuksuit (Labrèche 2005).

L'arc et la flèche disparaissent du coffre à outils, alors que de nouveaux traits techniques font leur apparition : aménagement d'une cannelure distale sur les pointes lithiques, fabrication de burin en néphrite ou de pointe en ardoise par polissage, utilisation de la stéatite pour la confection de bols et de lampes (IcA 2004). On voit également apparaître des équipements facilitant l'utilisation de la banquise (patins de traîneaux, couteaux à neige, crampons; Maxwell 1984). L'une des caractéristiques les plus spectaculaires de la culture matérielle dorsétienne est un art d'une facture particulièrement soignée, qui prend la forme de petites représentations animales ou de visages, ou de décorations sur des outils symboliques décorés.

2.1.3. Le Néoesquimau

À la suite d'un réchauffement climatique modifiant le couvert glaciaire sur la mer et par conséquent le comportement des mammifères marins (Barry *et al* 1977), de nouveaux groupes humains venant de l'Alaska, chasseurs de grandes baleines, atteignent le Nunavik vers 700 A.A. (IcA 2006). Les modalités de remplacement des populations paléoesquimaudes par les Néoesquimaux, dont les premiers représentants sont les Thuléens, ne sont pas encore tout à fait comprises; l'assimilation qui était proposée depuis longtemps (Plumet 1994) semble avoir été impossible si l'on considère les datations récentes qui marquent un écart plutôt considérable entre les derniers sites dorsétiens et les premiers sites thuléens au Nunavik (IcA 2006). La disparition du Dorsétien serait le résultat d'une émigration, voire une extinction, suivant une période où le milieu était devenu moins favorable à la subsistance dorsétienne (Newton 2005). Un contact et des échanges culturels entre les deux groupes culturels pourraient avoir eu lieu à l'extérieur du Nunavik, autour du Golfe de Foxe, par exemple (Houmard 2015).

L'économie thuléenne semble avoir été encore plus orientée vers la mer que celle du Dorsétien, et l'établissement semble pouvoir être qualifié de généralement insulaire, la majorité des sites se trouvant sur des îles plutôt que sur la terre ferme (IcA 1993). Un seul site est connu à l'intérieur des terres à la grandeur du Nunavik, mais cet état de fait peut être dû à la quasi-absence de recherche dans ce contexte (Lofthouse 2003). Sur la côte et les îles, les Thuléens occupaient souvent les mêmes zones que les Dorsétiens, mais pas toujours les mêmes sites. Les tentes sont toujours utilisées en été, mais se dotent souvent une plate-forme de couchage du côté opposé à l'entrée, et certaines se composent d'un muret de plusieurs assises de pierres (Gendron et Pinard 2001). La construction d'igloos en hiver se poursuit, et les maisons semi-souterraines se dotent d'un couloir d'entrée et intègrent souvent des ossements de baleines à leur structure (Gendron et Pinard 2001).

La culture matérielle est caractérisée par le quasi-abandon de la pierre taillée pour la remplacer par la pierre polie, tout en utilisant davantage l'os et l'ivoire. Les techniques de chasse s'améliorent avec le retour de l'arc et la flèche et l'utilisation d'un propulseur pour lancer les harpons et les lances (Maxwell 1985). Le chien, qui ne semble pas avoir été utilisé au Dorsétien, refait son apparition pour tirer les traîneaux, améliorant ainsi la mobilité des groupes. Les outils deviennent plus spécialisés, chaque gibier ou type de chasse profitant d'une arme précise. Une tradition artistique existe toujours, mais devient de plus en plus utilitaire.

2.1.4. Période historique

Les Inuit actuels sont les descendants directs des Thuléens. Les modes de vie de la période historique sont fort semblables à ceux de la période thuléenne, étant donné la faible intensité des contacts avec l'extérieur jusqu'à la fin du XIX^{e} siècle. Au Québec, ces contacts ont d'abord été faits de façon timide avec les missionnaires, possiblement dès le XVII^{e} siècle (IcA 2006), puis de façon plus soutenue à partir de la deuxième moitié du XIX^{e} siècle avec l'établissement de postes de traite qui vont amener des modifications substantielles dans les traditions culturelles, comme l'utilisation de nouveaux outils ou de nouveaux matériaux (Gilbert 2006). Près de la région à l'étude, un poste est ouvert à la baie Déception en 1925 (IcA 2006). Les habitations resteront sensiblement les mêmes, bien que le canevas remplacera éventuellement les peaux (Gendron et Pinard 2001). On verra s'ajouter aux cercles de tentes des pierres de charges satellites, servant à attacher des cordes pour mieux ancrer la couverture de canevas.

L'équipement trouvé sur les sites archéologiques de la période historique représente généralement les mêmes équipements qu'au Thuléen, mais fabriqués dans de nouveaux matériaux, notamment le fer. On trouve également du matériel associé à la traite des fourrures, comme des perles de verre. Il faut noter par contre que peu de sites historiques ont été fouillés jusqu'à maintenant (IcA 2004).

2.2. Recherches antérieures

Les recherches archéologiques en Arctique se sont généralement concentrées sur les côtes, qui ont toujours été davantage occupées que l'intérieur des terres. C'est pour ces raisons que les modalités d'occupation de ce territoire sont moins bien documentées que les régions côtières. Cela dit, quelques prospections y ont tout de même été menées, notamment dans le cadre des travaux miniers. De fait, le secteur des mines de nickel est possiblement le territoire le mieux connu archéologiquement de l'arrière-pays, ayant été exploré par Arkéos (2008), Artefactuel (2008a, 2008b), Chrétien (2007), l'Institut culturel Avataq (2008, 2009), Labrèche (1992, 1993, 1995, 2005) et Morin (1981). Les superficies explorées demeurent toutefois restreintes, la plupart de ces interventions ayant été de très petite envergure. Malheureusement, la plupart des rapports de prospection n'indiquent pas clairement le territoire visité physiquement sur le terrain, se contentant d'indiquer grossièrement les aires d'études générales. Il faut ainsi souligner le travail de précision qui a été fait, en ce sens, par Arkéos, Artefactuel et Chrétien, permettant de s'assurer de l'absence de « faux négatifs », c'est-à-dire des zones réputées avoir été prospectées négativement, mais qui n'ont jamais été visitées dans les faits. Ces diverses interventions ont mené à la découverte de seize sites archéologiques intérieurs (Tableau 1).

D'autres prospections ont assurément été faites ailleurs à l'intérieur des terres, puisque des concentrations de sites sont répertoriées à différents endroits, mais ces interventions ne sont pas recensées dans le SIG du MCC. De telles concentrations sont enregistrées au lac Payne, au cratère du Nouveau-Québec (Pingualuit) et, dans une moindre mesure, aux lacs Klotz et Nallusarqituq (Tableau 1).

Tableau 1 : Sites archéologiques connus à l'intérieur des terres

Borden	Localisation	Identités culturelles	Travaux	Sources
IhFg-1	Rive nord de la rivière Arnaud, à 15 km à l'est du lac Payne	▪ Néoesquimau	▪ Inpection visuelle	Plumet 1980, 1981; Plumet *et al*. 1978
IhFh-1	Au sud-est du lac Payne	▪ Dorsétien	▪ Sondages	Taylor 1957, 1958, 1968
IhFh-10	Rive nord de la rivière Arnaud, à 5 km du lac Payne	▪ Indéterminé	▪ Fouille	Lee 1966
IhFh-2	Au sud-est du lac Payne	▪ Dorsétien	▪ Sondages	Taylor 1957, 1958, 1968
IhFh-3	Au sud-est du lac Payne	▪ Dorsétien	▪ Sondages	Taylor 1957, 1958, 1968
IhFh-4	Rive nord de la partie est du lac Payne	▪ Dorsétien	▪ Sondages	Taylor 1957, 1958, 1968
IhFh-5	Au sud-est du lac Payne	▪ Dorsétien	▪ Sondages	Taylor 1957, 1958, 1968
IhFh-6	Rive nord de la rivière Arnaud, à la sortie du lac Payne	▪ Indéterminé	▪ Fouille	Lee 1966
IhFh-7 (Michea)	Rive nord de la rivière Arnaud, à la sortie du lac Payne	▪ Néoesquimau ▪ Inuit moderne	▪ Fouille	Lee 1966, 1967, 1970
IhFh-8 (Legault)	Rive sud de la rivière Arnaud, à la sortie du lac Payne	▪ Indéterminé	▪ Inspection visuelle	Lee 1966
IhFh-9 (Rousseau)	Rive sud de la rivière Arnaud, à la sortie du lac Payne	▪ Indéterminé	▪ Inspection visuelle	Lee 1966
IhFi-1 (Bernier)	Rive nord du lac Payne, à son extrémité est	▪ Indéterminé	▪ Inspection visuelle	Lee 1966
IhFi-2 (Rosary)	Rive nord du lac Payne, à son extrémité est	▪ Indéterminé	▪ Fouille	Lee 1966
IhFi-3 (Taylor)	Rive nord du lac Payne, à son extrémité est	▪ Indéterminé	▪ Inspection visuelle	Lee 1966
IhFi-4 (Gauthier)	Rive nord du lac Payne, à son extrémité est	▪ Indéterminé	▪ Inspection visuelle	Lee 1966
IhFi-5 (Black Spruce)	Rive sud du lac Payne, à son extrémité est	▪ Indéterminé	▪ Fouille	Lee 1966
IhFi-6 (Cartier)	Rive sud du lac Payne, à son extrémité est	▪ Thuléen ▪ Inuit moderne	▪ Fouille	Lee 1966, 1967, 1970, 1974; Plumet 1969; Taillon et Barré 1987
IhFi-7 (Gagnon)	Rive sud du lac Payne, à son extrémité est	▪ Indéterminé	▪ Inspection visuelle	Lee 1966
IhFi-8 (Brouillette)	Rive sud du lac Payne, à son extrémité est	▪ Indéterminé	▪ Inspection visuelle	Lee 1966
IhFi-9	Au sud de l'embouchure de la rivière Arnaud, près du lac Payne	▪ Indéterminé	▪ Inspection visuelle	Lee 1966
JaEs-1	Rive sud de la rivière Arnaud	▪ Néoesquimau	▪ Inspection visuelle	Lee 1968; Plumet 1980, 1981
JaEw-1	Confluence des rivières Hamelin et Arnaud	▪ Néoesquimau	▪ Inspection visuelle	Plumet 1980, 1981; Plumet *et al*. 1978
JcFh-1	Extrémité est du lac Klotz, au nord du déversoir de la rivière Lepelle	▪ Inuit historique	▪ Inspection visuelle	Plumet 1980, 1981; Plumet *et al*. 1978
JcFh-2	Extrémité est du lac Klotz, au nord du déversoir de la rivière Lepelle	▪ Inuit historique	▪ Inspection visuelle	Plumet 1980, 1981; Plumet *et al*. 1978
JcFi-1	Rive nord-est du lac Nalluajuk, près du lac Klotz	▪ Inuit historique	▪ Inspection visuelle	Plumet 1980, 1981; Plumet *et al*. 1978
JfFj-1	Nord-ouest du lac Nantais	▪ Inuit historique	▪ Inspection visuelle	Plumet 1980, 1981; Plumet *et al*. 1978
JgFh-1	Près d'un petit lac à un kilomètre du lac Nallusarqituq	▪ Indéterminé	▪ Inspection visuelle	Labrèche 1989
JhFi-1	Rive est du lac Nallusarqituq	▪ Indéterminé	▪ Sondages	Labrèche 1989
JhFi-2	Près de la rive du lac Nallusarqituq	▪ Indéterminé	▪ Sondages	Labrèche 1989
JhFj-1	À un kilomètre au sud-est du cratère de Pingualuit	▪ Indéterminé	▪ Sondages	Labrèche 1989
JhFj-2	À l'est du cratère de Pingualuit, près d'un petit lac	▪ Indéterminé	▪ Inspection visuelle	Labrèche 1989
JhFj-3	Derrière un petit lac situé en retrait de la rive sud du lac Manarsulik, près du cratère de Pingualuit	▪ Indéterminé	▪ Sondages	Labrèche 1989
JhFj-4	À l'extrémité sud d'un esker près du cratère de Pingualuit	▪ Indéterminé	▪ Sondages	Labrèche 1989
JhFj-5	Au sud-est du lac Manarsulik, près du cratère de Pingualuit	▪ Indéterminé	▪ Sondages	Labrèche 1989
JhFj-6	Sur un esker près du cratère de Pingualuit	▪ Indéterminé	▪ Inspection visuelle	Labrèche 1989
JhFk-1	Au sommet d'une colline au sud du cratère de Pingualuit	▪ Indéterminé	▪ Sondages	Labrèceh 1989
JhFk-2	Au sommet d'une colline au nord du cratère de Pingualuit	▪ Indéterminé	▪ Sondages	Labrèceh 1989
JhFk-3	Entre le cratère de Pingualuit et le lac Manarsulik	▪ Indéterminé	▪ Inspection visuelle	IcA 2011
JjFh-1 (de l'esker)	Sur un esker près du chemin qui mène à la mine Raglan	▪ Indéterminé	▪ Inspection visuelle	Chrétien 2007
JjFi-1 (Donaldson)	Près d'un lac au sud de la rivière Puvirnituq	▪ Néoesquimau	▪ Sondages	Labrèche 1993
JjFi-2 (Expo)	Sur une colline à l'est de la route qui mène au camp Expo	▪ Néoesquimau	▪ Inspection visuelle ▪ Sondages	Artefactuel 2008a
JjFj-1 (Langis)	Au pied d'une colline à l'est du lac Mequillon	▪ Indéterminé	▪ Inspection visuelle	Chrétien 2007
JjFm-1	Dans une vallée au sud du lac Long	▪ Néoesquimau	▪ Sondages	IcA 2008
JjFn-1	Sur la rive est du lac Cross	▪ Inuit historique	▪ Sondages	Arkéos 2008
JjFn-2	Sur la rive est du lac Cross, à son extrémité nord	▪ Inuit moderne	▪ Sondages	Arkéos 2008
JkFh-1	Sur la colline de l'antenne radio près de la rivière Puvirnituq	▪ Inuit historique ▪ Inuit moderne	▪ Sondages ▪ Collecte de surface	Labrèche 1992, 1993
JkFk-1	Sur la rive gauche d'un tributaire de la rivière Déception	▪ Inuit moderne	▪ Inspection visuelle	Labrèche 1992
JkFk-2	Sur la rive gauche d'un tributaire de la rivière Déception	▪ Inuit moderne	▪ Inspection visuelle	Labrèche 1992

Tableau 1 (suite): Sites archéologiques connus à l'intérieur des terres

Borden	Localisation	Identités culturelles	Travaux	Sources
JkFk-3	Sur la rive gauche d'un tributaire de la rivière Déception	▪ Indéterminé	▪ Inspection visuelle	Labrèche 1992
JkFl-1	Sur le bord de la rivière à 4 km au sud-ouest de Purtuniq	▪ Inuit moderne	▪ Inspection visuelle	Labrèche 1992
JkFl-2	Près de la rivière Déception	▪ Indéterminé	▪ Inspection visuelle	IcA 2009
JkFm-1	Au sud du lac Watts, à la jonction de la rivière Kangilialuk et un tributaire	▪ Indéterminé	▪ Inspection visuelle	IcA 2009
JlFk-1	Sur la rive nord-est de la rivière Déception	▪ Thuléen	▪ Inspection visuelle	IcA 2009
JlFk-2	Sur la rive est de la rivière Déception	▪ Indéterminé	▪ Inspection visuelle	IcA 2009
KaFe-1	Sur la rive nord de la rivière Déception	▪ Indéterminé	▪ Inspection visuelle	IcA 2009
KaFf-1	Sur la rive nord de la rivière Déception	▪ Néoesquimau	▪ Inspection visuelle	IcA 2009
KaFg-2	Près de l'exutoire du lac Françoys-Malherbe	▪ Paléoesquimau ▪ Inuit historique	▪ Inspection visuelle	IcA 1998; Labrèche 1992
KaFg-3	Sur la rive nord d'un petit lac à 5,5 km du lac Françoys-Malherbe	▪ Inuit historique ▪ Inuit moderne	▪ Inspection visuelle	IcA 1998, Labrèche 1992, 1993
KaFg-4	Entre deux branches d'un ruisseau, à l'est du lac Françoys-Malherbe	▪ Néoesquimau	▪ Inspection visuelle ▪ Sondages	IcA 1998, Labrèche 1993

Comme peu d'interventions ont été réalisées sur les sites intérieurs – les sites découverts ont généralement fait l'objet que d'une inspection visuelle et les attributions culturelles sont souvent incertaines –, il est difficile d'y établir un modèle d'occupation du territoire. Il est généralement convenu que l'intérieur des terres était occupé afin de venir compléter les ressources côtières, pour varier la diète ou lors des saisons moins productives, ou simplement en tant que lieu de passage. L'exploitation de ressources localisées particulières, comme des matières premières lithiques ou des rivières particulièrement productives, est sans doute responsable de la pénétration des groupes vers l'arrière-pays. L'occupation intérieure répondrait ainsi à des besoins ponctuels, comblés généralement par des petits groupes lors d'expéditions de courte durée. Ceci produit des sites plus petits et légers, dont les cercles de tentes sont de parfaites représentations. Labrèche (2005) a d'ailleurs démontré que le nombre de structures d'habitation par site est plus bas à l'intérieur des terres qu'en région côtière, ce qui concorde avec l'idée de groupes restreints. Le nombre de structures secondaires est également plus petit, ce qui est conforme avec l'hypothèse que les expéditions intérieures visaient un but précis (d'où le peu de variété de structures sur les sites) et étaient de plus courte durée (d'où le petit nombre de caches et leurs faibles dimensions). Des structures secondaires précises peuvent être construites selon l'objectif de l'expédition intérieure ou du site particulier (affûts de chasse, pièges, *saputit* (barrages à poissons)). Des cairns sont érigés afin de localiser les sites pour éventuellement y revenir, ou pour baliser les routes menant de la côte à ces sites, ou vers d'autres secteurs côtiers occupés (comme Douglas Harbour ou Kangiqsujuaq). En résumé, que ce soit pour l'exploitation ponctuelle d'une ressource ou lors du déplacement entre deux secteurs, « le mode d'établissement à l'intérieur des terres serait caractérisé par une plus grande mobilité, et les lieux où l'on ne fait que passer sont marqués par des tentes et peu d'autres vestiges » (Labrèche 2005 : 184).

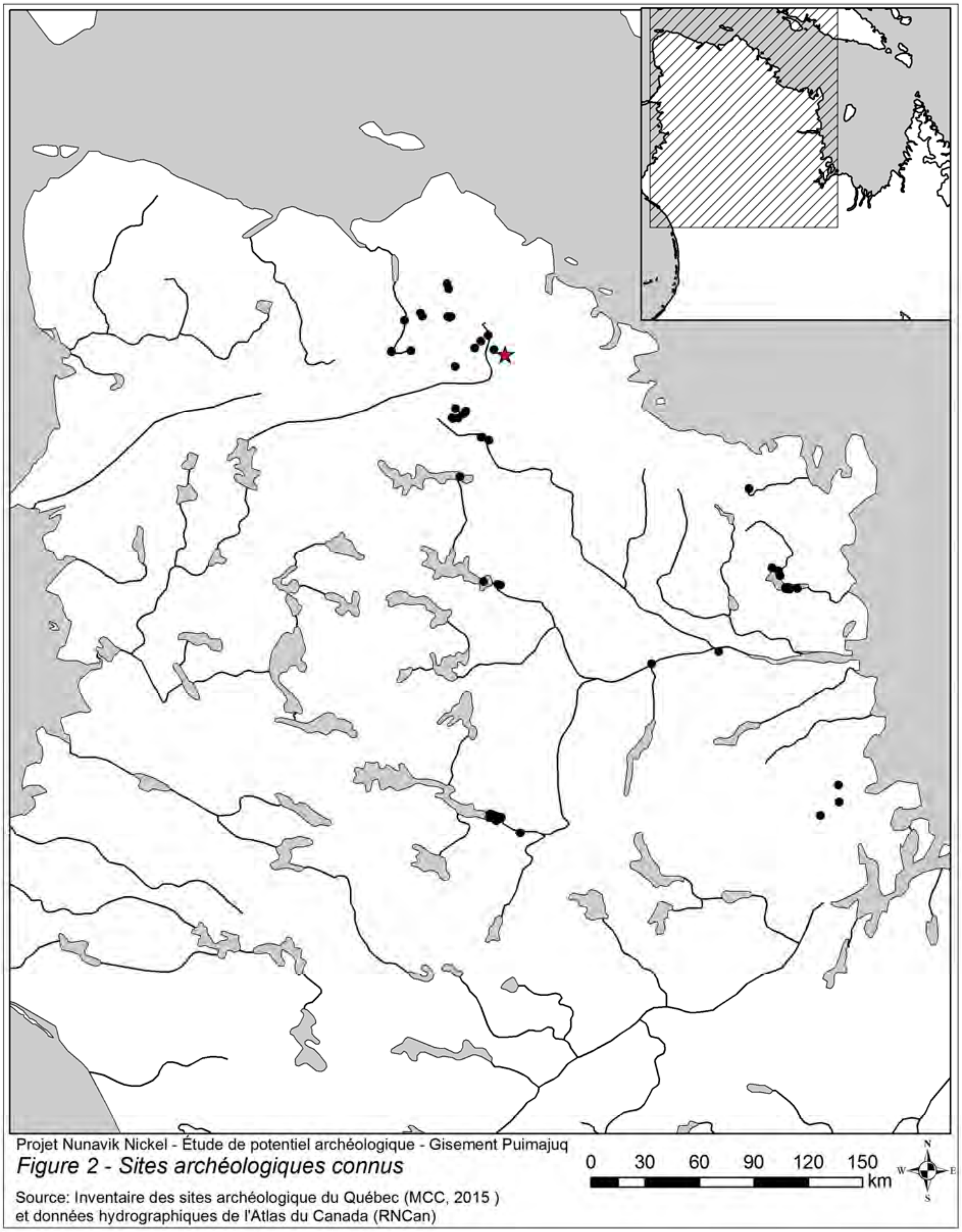

Figure 2. Sites archéologiques connus à l'intérieur des terres; l'étoile représente la zone d'étude.

3. MÉTHODOLOGIE

3.1. Généralités

Il est clair, en étudiant l'historique de la recherche, que l'intérieur des terres a reçu beaucoup moins d'attention que les régions côtières ou insulaires – les quelques prospections qui y ont eu lieu étaient de petites envergures, et la proportion du territoire effectivement explorée est beaucoup plus petite que sur la côte. Il ne s'agit pas que d'un biais de la recherche : en général, l'arrière-pays est effectivement plus hostile à l'occupation humaine, en raison de la rareté des ressources alimentaires et des difficultés de déplacement. L'économie maritime a par ailleurs toujours été plus importante, étant donné la facilité d'accès et la quantité de ressources disponibles : les ressources terrestres sont également disponibles en zone côtière, alors que l'inverse n'est pas vrai. Par contre, admettre que l'intérieur des terres était occupé moins intensivement ne signifie pas qu'il ne l'était pas du tout : la présence de sites dorsétiens, thuléens et historiques intérieurs, dans différents secteurs du Nunavik, montre qu'il y a eu des pénétrations au moins ponctuelles vers l'arrière-pays. C'est ainsi qu'il semble peu productif que de considérer le potentiel intérieur faible de façon globale, en le comparant au potentiel côtier, comme certaines études l'ont fait (Morin 1981, Labrèche 1992). L'évaluation du potentiel a tout à gagner en prenant ces deux contextes de façon individuelle, et en identifiant les zones à potentiel relativement plus fort dans chacun des contextes. De toute façon, les activités intérieures étant nécessairement différentes que les activités côtières (Labrèche 2005), les critères de potentiel seront naturellement différents d'un endroit à l'autre.

Il faut par ailleurs faire une distinction entre le potentiel d'établissement par les groupes humains passés et le potentiel de trouver des traces de cet établissement. Comme il s'agit ici d'une étude de potentiel archéologique plutôt que d'une étude de l'établissement proprement dit, nous nous concentrons sur les critères affectant les chances de découvrir des sites archéologiques. Ainsi, comme l'a bien noté Labrèche (1992 : 12) : « Si les chances de découvrir un site dans une zone de tourbière sont faibles, il n'est pas exclu que les Inuit aient pu y installer une maison de neige ». Les zones de potentiel archéologique sont ainsi nécessairement plus restreintes que les zones propices à l'établissement.

Un élément est absent des critères de potentiel, et cette absence peut sembler étonnante vu l'importance de cette ressource pour les groupes préhistoriques : il s'agit des sources de matière première lithique. La raison en est que très peu de sources de matières premières sont répertoriées, et aucune n'est située près de la zone d'étude. Des carrières de stéatite ont bien été localisées en périphérie des terrains miniers plus au nord, mais celles-ci n'ont pas été exploitées à la période préhistorique (Labrèche 1993, IcA 2008). Par ailleurs, le quartz, qui constitue la majorité du matériel lithique trouvé sur les sites de la région, se trouve un peu partout sur le territoire, bien que souvent de trop mauvaise qualité pour être taillé. Aucune zone d'extraction n'est pour l'instant connue.

Notons en terminant que l'évaluation du potentiel s'est faite de façon déductive plutôt qu'inductive – c'est-à-dire qu'il s'est basé sur des hypothèses concernant la localisation des sites issues des différentes études antérieures touchant l'établissement, notamment celles de Labrèche (2005), de l'institut culturel Avataq (2004, 2010a) et de Gilbert (2004). La quantité et la variabilité des sites connus, ainsi que la qualité des données géographiques font en sorte qu'une analyse empirique – qui évaluerait le potentiel en reproduisant le contexte des sites connus – ne peut que rester générale. Ceci est particulièrement vrai pour l'intérieur des terres, où les sites connus se situent dans des contextes différents dont le seul point commun est souvent d'être près du réseau hydrographique (figure 2). Par ailleurs, il a été démontré que, par définition, les modèles prédictifs de localisation empiriques ne font que reproduire des connaissances déjà acquises, et ne permettent pas d'identifier des secteurs potentiellement sensibles, mais qui n'ont jamais été explorés (par ex., Church *et al*. 2000). Comme c'est le cas d'une bonne proportion du territoire arctique, l'approche déductive paraît être une meilleure avenue.

De façon générale, la topographie joue un rôle important dans le choix d'une localisation. Une légère pente, permettant un bon drainage, ou un terrain plat seront privilégiés. Labrèche (1992) propose également que la protection contre les vents dominants ait été un critère de localisation. Toutefois, lors d'une évaluation statistique de la localisation des sites dorsétiens au sud du détroit d'Hudson, il a été démontré que ce n'était pas le cas : les localités exposées aux vents semblaient même être en partie privilégiées (Gilbert 2004). L'hypothèse alternative selon laquelle la couverture visuelle était plus importante que la protection contre les vents a donc été posée. Ainsi, les secteurs surélevés par rapport aux alentours offrent de bons panoramas tout en étant eux-mêmes de bons points de repère, et pourraient ainsi être favorisés. On peut ainsi penser aux moraines, drumlins et eskers, qui peuvent en outre former des axes de communications surélevés et secs dans un environnement souvent gorgé d'eau (IcA 2010a).

Le réseau hydrographique est d'égale importance pour l'établissement, que ce soit en tant que sources de nourriture et d'eau potable ou comme voie de transport (Labrèche 1993, IcA 2010a). Même si les rivières ne sont pas nécessairement navigables (Labrèche 1992), elles peuvent agir comme point de repère important dans le déplacement des populations – il n'est d'ailleurs pas étonnant de réaliser que les sentiers de motoneige actuels suivent souvent le cours des rivières. Des routes traditionnelles ont ainsi été recensées le long de la rivière Déception, entre le lac Esker et le lac Nuvulik, et le long de la rivière Puvirnituq jusqu'au lac Rinfret (IcA 2008). Les transports sont par ailleurs facilités en hiver avec le gel des lacs et rivières (Labrèche 1992). Les points de confluence entre les éléments hydrographiques seront des secteurs d'intérêt particulier pour la pêche, alors que zones où s'étranglent les étendues d'eau peuvent avoir servi de traverse, tant pour les humains que pour les caribous exploités par les chasseurs (Chrétien 2007, Gilbert 2004, Labrèche 1992). Par contre, les rives des cours d'eau ou des lacs sont parfois particulièrement marécageuses, ce qui milite tant contre leur attrait pour l'établissement que pour leur potentiel de découverte lorsqu'effectivement occupées (Chrétien 2007, IcA 2010a).

3.2. Sources des données

Les données géographiques proviennent des banques de données CanVec, 12^{e} édition, de Ressources naturelles Canada. Pour la région d'étude, seules des données topographiques sous forme de courbes de niveau impériales sont disponibles. Elles ont été converties en modèle numérique de terrain (MNT) matriciel d'une résolution de 50 m. À partir du MNT, une couverture de pente et une couverture de relief ombragé (ou *hillshade*), nécessaire pour l'analyse visuelle de la topographie, ont été dérivées. Les entités hydrographiques linéaires et surfaciques, les eskers et les zones humides ont été utilisés tels quels.

3.3. Les critères de potentiel en milieu intérieur

Le Tableau 2 présente les critères évalués pour déterminer le potentiel de découverte de sites archéologiques. Le critère de la pente a été considéré comme une condition *sine qua non* : si une localisation présente une pente supérieure à dix degrés, elle fut considérée à potentiel nul même si les autres critères de potentiel convergent. Si cette condition peut sembler sévère, surtout lorsqu'on considère la résolution du MNT utilisé, elle se justifie par le fait qu'une très forte proportion du paysage la respecte. Les zones marécageuses répertoriées dans les données CanVec ont été, de la même façon, exclues des zones de potentiel.

Tableau 2 : Critères de potentiel

Critère	Hypothèse	Mise en œuvre
Pente	Un terrain relativement plat est plus propice à l'établissement qu'un terrain en pente.	Pente $\leq 10^{o}$
Distance au réseau hydrique	Les lacs et rivières offrent différents avantages qui les rendent attrayants (ressources, eau, voie de communication).	Distance au réseau hydrique (linéaire ou surfacique) ≤ 250 m
Jonction hydrique	Les confluences, embouchures et exutoires, dans le réseau hydrique sont des secteurs de choix au sein du réseau hydrique, pour la pèche et la chasse.	Distance aux jonctions ≤ 500 m
Eskers	Les eskers offrent souvent des points de vue intéressants, tout en permettant un passage au sec.	Tampon de 50 m autour des eskers
Hauts points	Les hauts points du paysage permettent un contrôle sur un vaste paysage, tout en demeurant généralement secs. Il peut s'agir de colline, d'esker, de drumlin ou de moraines.	Évaluation visuelle assistée

Ces critères ont été utilisés comme guides pour déterminer des secteurs où le potentiel de trouver des sites semblaient meilleur, selon la nature des caractéristiques présentes et la topographie locale. Il s'agit donc d'une analyse plus informelle que systématique – les dimensions de la zone d'étude le permettent, et la distribution des critères dans l'espace l'exige afin d'avoir des zones de potentiel suffisamment isolées dans l'espace. Autrement, l'ensemble de la zone d'étude aurait été considéré à moyen ou faible potentiel, et l'utilité de l'étude en aurait été fortement limitée.

4. RÉSULTATS

La Figure 3 présente la modélisation de chacun des critères de potentiel que l'on trouvait dans le tableau 2, à l'exception des eskers. Ceux-ci avaient été inclus parmi les critères, suivant la littérature (par exemple, Chrétien 2007, IcA 2010a, Pintal 2005), mais plusieurs eskers existants ne sont pas représentés dans les données CanVec. Par exemple, les sites JjFi-1 (Labrèche 1993) et JjFh-1 (Chrétien 2007) sont situés, selon leur découvreur, sur des eskers qui sont absents des données géographiques. Aucun esker n'était ainsi répertorié dans l'actuelle zone d'étude. L'analyse topographique, qui visait à identifier les collines au sein de la zone d'étude, aura sans doute pu combler une partie de cette lacune.

La superposition de ces critères et l'évaluation visuelle des données ont permis d'identifier cinq zones de potentiel au sein de l'aire d'étude (Figure 4). Deux de ces secteurs combinent l'ensemble des critères de potentiel, et peuvent donc être considérés comme des zones de potentiel archéologique : les zones 2 et 3. La première, située au coin nord-est de l'aire d'étude, représente le flanc d'une colline importante, elle-même à l'extérieur de l'aire d'étude, qui offre un panorama important sur l'intérieur de l'aire d'étude et son réseau hydrique. La seconde, située au nord de la colline du gisement Allammaq, est rendue intéressante par la présence des lacs, mais également, et surtout, par le point de repère relativement important que constitue la colline elle-même dans le paysage environnant (photo ARTE 2008-157-5747).

Les trois autres zones offrent un potentiel moindre pour l'établissement, mais pourraient tout de même recéler des vestiges archéologiques – elles sont ainsi considérées comme des zones d'intérêt. La zone 1, à l'endroit même du gisement Puimajuq, profite d'un réseau hydrique bien développé tout en se trouvant sur un plateau légèrement plus élevé, et, donc, probablement plus sec que les terres autour des lacs plus à l'ouest. La zone 6 profite du même plateau, tout en bordant un lac de plus grande importance. La zone 4, quant à elle, représente un plateau surélevé et au sec au centre de l'aire d'étude, la traversant du nord au sud. À partir de ses flancs est et ouest, le champ de vision permet de contrôler un vaste territoire, possiblement jusqu'à la rivière Puvirnituq à l'ouest.

Il importe de noter que les zones identifiées dans le courant de cette analyse montrent un intérêt ou un potentiel archéologique, mais que cette valeur est relative à l'aire d'étude elle-même. Lorsque l'on place celle-ci dans un contexte géographique plus large, force est d'admettre que son intérêt archéologique diminue de façon non négligeable (Figure 5). Par exemple, des collines plus importantes la bordent au nord-est et au sud-est, offrant ainsi de meilleurs points de vue et, du côté nord-est, une meilleure voie de communication vers la rivière Wakeham. Un peu plus loin au nord, une série de collines allongées d'est en ouest mènent encore plus facilement vers cette même rivière ou à celle qui va joindre le bras sud de Douglas Harbour. La vallée de la rivière Puvirnituq, avec ses quelques lacs plus importants – notamment, près de l'aire d'étude, les lacs du Bombardier et Rocbrune – semble également être un secteur plus attractif pour l'établissement. En d'autres termes, bien que des zones plus propices à l'occupation humaine aient été désignées au sein de l'aire d'étude, celle-ci se trouve globalement dans un secteur à faible potentiel général. D'ailleurs, une prospection a déjà eu lieu au sein de la zone de potentiel 3 (Artefactuel 2008b) et n'a pas permis de mettre au jour des vestiges d'occupation humaine.

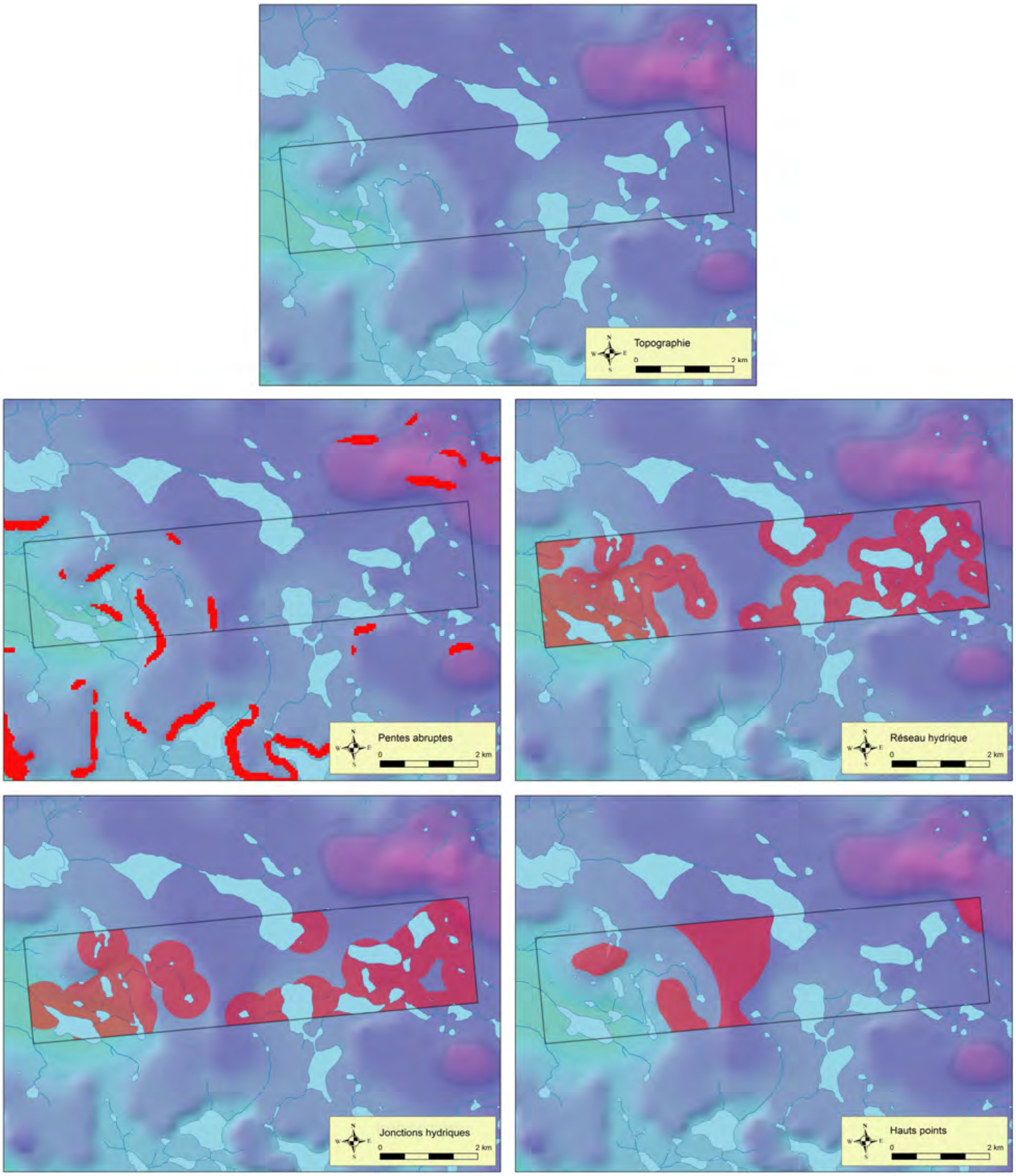

Figure 3 : Modélisation des critères de potentiel

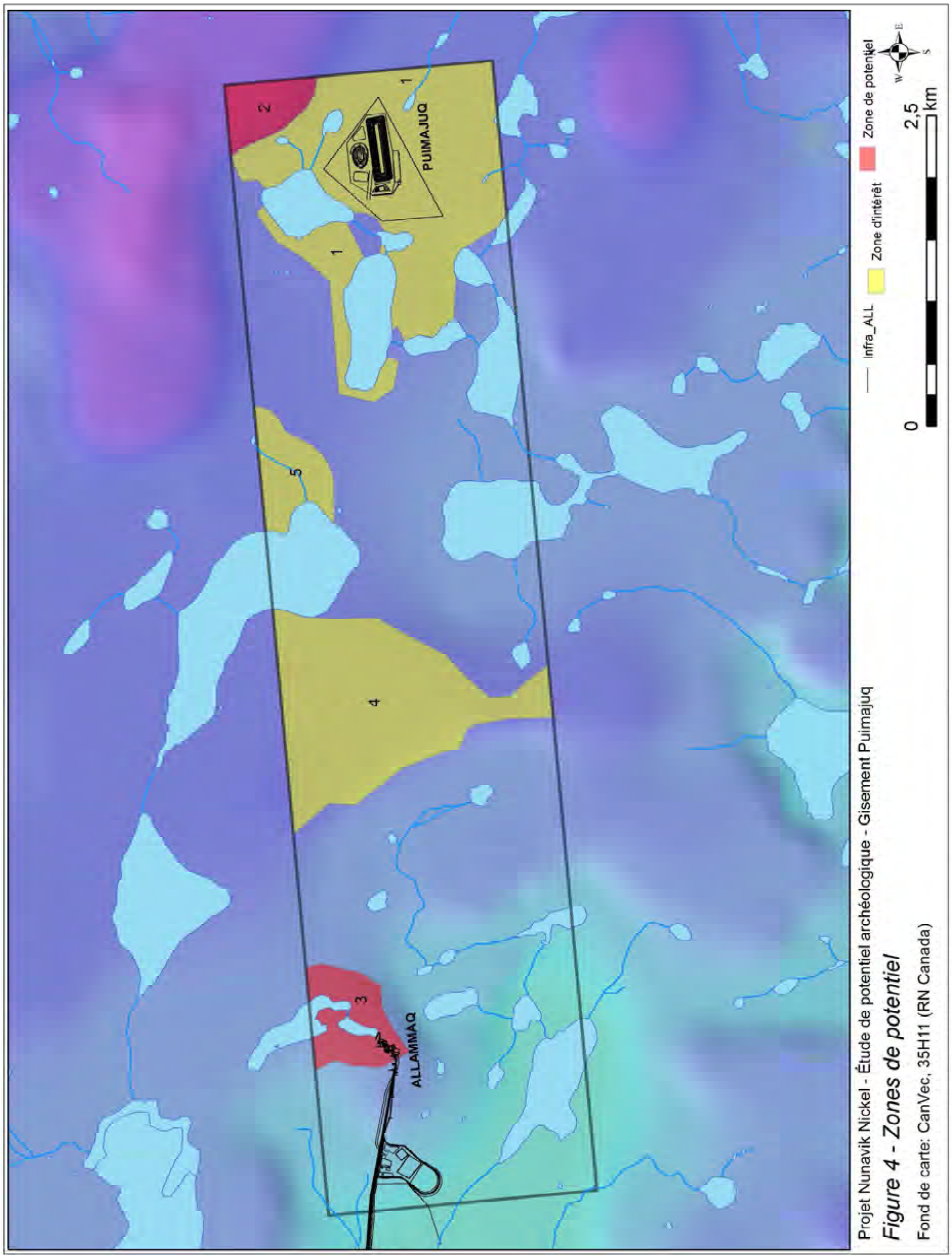

Figure 4 : Zones de potentiel

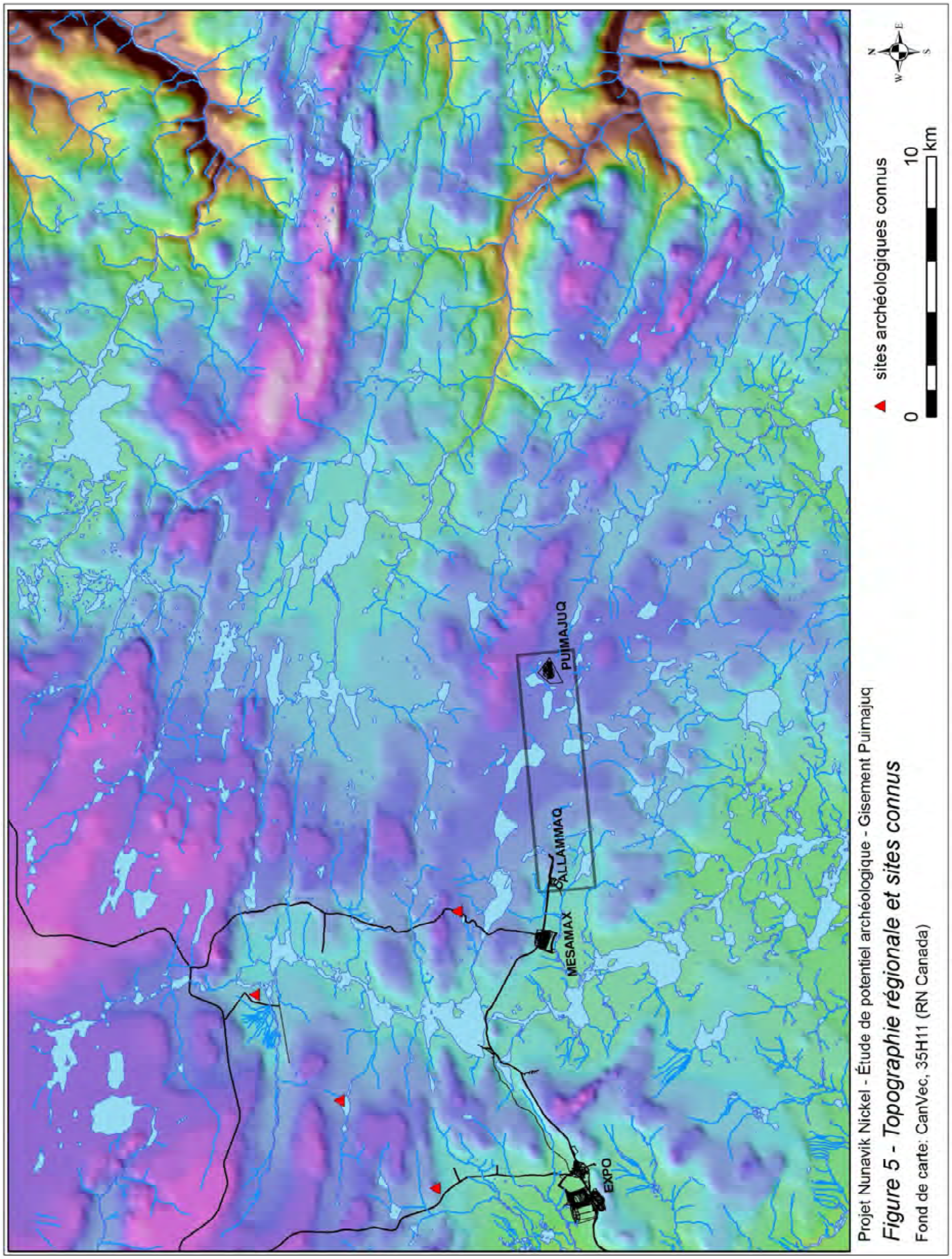

Figure 5 : Topographie régionale et sites connus

Figure 6. Vue de la colline du gisement Allammaq, vers le nord-ouest (photo Artefactuel 2008-157-5747)

5. CONCLUSIONS ET RECOMMANDATIONS

Dans le cadre de l'évaluation environnementale reliée au développement et l'exploitation du gisement Puimajuq, la coopérative Artefactuel a été mandatée afin de réaliser une étude de potentiel archéologique théorique. Cette étude devait permettre de déterminer les endroits où des sites archéologiques étaient le plus susceptibles d'être découverts au sein d'une aire d'étude comprenant les infrastructures prévues et leur chemin d'accès.

Le peu de connaissances disponibles sur l'établissement à l'intérieur des terres, l'absence de critères de localisation forts, comme on en trouve en région côtière, et une opposition entre certains critères de localisation (hydrographie *versus* hauts points) rendait difficile une analyse systématique du potentiel archéologique. L'évaluation s'est ainsi faite de façon plus informelle.

Deux zones ont été considérées comme ayant un potentiel archéologique au sein de l'aire d'étude, et trois zones d'intérêt ont également été délimitées. Les secteurs à potentiel représentent des endroits qui rassemblent quelques-unes des caractéristiques typiques de localisation des sites archéologiques dans la région. Elles devraient être systématiquement visitées préalablement à tous travaux de construction qui pourraient les affecter. Le potentiel archéologique des zones d'intérêt est plus faible, mais n'a pas pu être exclu complètement.

Il faut garder à l'esprit que le potentiel de découverte demeure globalement plus faible à l'intérieur des terres que sur les côtes, simplement parce que ce territoire était moins occupé par le passé. Le secteur d'étude lui-même paraît avoir un potentiel généralement faible, lorsque comparé à d'autres régions à proximité. Malgré cela, il est important d'évaluer celui-ci et de procéder aux inventaires de terrain, étant donné que les sites sont plus petits et plus dispersés et donc plus difficiles à localiser, et par le fait même beaucoup moins bien documentés. Même si l'arrière-pays a toujours été occupé moins intensivement, son exploitation a toujours fait partie des modes de vie des occupants du Nunavik, et constitue une clef pour comprendre le patrimoine régional.

La qualité des données géographiques a également un impact sur la définition des zones de potentiel (Gilbert 2007). Les données topographiques CanVec, au 1:50 000, ne permettent pas l'étude de la topographie à l'échelle locale, qui a un impact certain sur l'établissement. En fait, ce sont tous les éléments du paysage d'importance locale qui sont exclus des données CanVec : ruisseaux, petits eskers, zones humides de petites superficies, etc. La détermination des zones de potentiel théorique se veut donc une première étape, qui doit être complétée lors des interventions de terrain. Celles-ci permettront d'une part de réduire la superficie des zones de potentiel par les caractéristiques locales (zones marécageuses, terrain trop accidenté, etc.), et d'autre part d'identifier des zones de potentiel supplémentaires de petite superficie.

6. BIBLIOGRAPHIE

Arkéos
2008 *Projet Cross Lake (mine Raglan). Inventaire archéologique du secteur minier et de la route d'accès.* Jacques Whitford, rapport inédit.

Artefactuel
2008a *Projet Nunavik Nickel; Inventaire archéologique des bancs d'emprunt*. GÉNIVAR, rapport inédit.
2008b *Projet Nunavik Nickel; Inventaire archéologique autour du gisement Allammaq*. GÉNIVAR, rapport inédit.

Barry, R.G., *et al*.
1977 « Environmental Change and Cultural Change in the Eastern Canadian Arctic During the Last 5000 Years ». *Arctic and Alpine Research* 9 (2): 354-371.

Chrétien, Y.
2007 *Projet Nickélifère Raglan Sud. Étude d'impact sur l'environnement et le milieu social. Rapport sectoriel final. Inventaire archéologique*. GÉNIVAR, rapport inédit.

Church, T., R. J. Brandon et G. R. Burgett
2000 « GIS Applications in Archaeology : Method in Search of Theory ». Dans *Practical Applications of GIS for Archaeologists; A Predictive Modeling Kit* (dir. K.L. Westcott et R.J. Brandon), pp. 135-155. Londres : Taylor & Francis.

Desrosiers, P.
2009 *À l'origine du Dorsétien; Apport de la technologie lithique des sites GhGk-63 et Tayara (KbFk-7) au Nunavik*. Thèse de doctorat, Université de Paris I.

Desrosiers, P. et N. Rahmani
2007 « Essai sur l'exploitation des matières premières lithiques au Nunavik durant le Paléoesquimau ». Dans *Des Tuniit aux Inuit; Patrimoines archéologique et historique au Nunavik* (dir. D. Arsenault et D. Gendron), 95-124. Québec : CÉLAT.

Gendron, D.
2007 « L'occupation ancienne de la rive sud du détroit d'Hudson : Bilan et perspectives ». Dans *Des Tuniit aux Inuit; Patrimoines archéologique et historique au Nunavik* (dir. D. Arsenault et D. Gendron), 23-26. Québec : CÉLAT.

Gendron, D. et C. Pinard
2000 « Early Palaeo-Eskimo Occupations in Nunavik : A Re-Appraisal ». Dans *Identities and Cultural Contacts in the Arctic* (dir. M. Appelt, J. Berglund et H.C. Gulløv), 129-142. Copenhague : Danish Polar Center.
2001 « Cinq mille ans d'occupation humaine en milieu extrême : des Paléoesquimaux aux Inuit ». *Revista de Arqueologia Americana* 20 : 159-188.

Gilbert, L.

2006 *Le patrimoine archéologique de l'Arctique québécois, dans le cadre du Répertoire Canadien des Lieux Patrimoniaux*. MCC, rapport inédit.

2007 « Analyse de l'établissement dorsétien à l'aide d'un système d'information géographique – La problématique des données ». Dans *Des Tuniit aux Inuit; Patrimoines archéologique et historique au Nunavik* (dir. D. Arsenault et D. Gendron), 199-211. Québec : CÉLAT.

2004 *Analyse de l'établissement dorsétien au sud du détroit d'Hudson (Nunavik, Québec)*. Mémoire de maîtrise, Université Laval.

Houmard, C.

2015 « Dorsétiens et Thuléens dans l'Arctique de l'Est canadien, quelle modalité de remplacement (~XIIIe siècle apr. J.-C.)? ». *Les nouvelles de l'archéologie*, 141 : 38-43.

2011 *Caractérisation chrono-culturelle et évolution du paléoesquimau dans le golfe de Foxe (Canada); Étude typologique et technologique des industries en matières dures d'origine animale*. Thèse de doctorat, Université Laval.

Institut culturel Avataq (IcA)

2015 *Chronologie de l'Arctique*. En-ligne : http://www.avataq.qc.ca/fr/L-institut/Departements/Archeologie/Decouvrir-l-archeologie/Chronologie-de-l-Arctique. Consulté en octobre 2015.

2011 *Fieldwork in the Kangiqsujuaq region; Sivulitta Inuusirilaurtangit Atuutilaurtanigill, CURA Project; Third year, summer 2010*. Municipalité de Kangiqsujuaq, rapport inédit.

2010a *Étude de potential archéologique, été 2010: rapport final*. Administration régionale Kativik, rapport inédit.

2009 *Prospection archéologique à Raglan : sites découverts en dehors de la propriété minière*. SNC-Lavallin, rapport inédit.

2008 *Inventaire archéologique à la mine Raglan; Rapport de recherche*. SNC-Lavalin, rapport inédit.

2006 *Étude de potentiel archéologique et inventaire archéologique des emplacements suggérés pour l'installation de la nouvelle centrale géothermique de Kuujjuaq, Nunavik*. Hydro-Québec, rapport inédit.

2004 *Bassin de la rivière Koroc : Origine des populations et potentiel archéologique*. Adminstration régionale Kativik, rapport inédit.

1998 *Projet Raglan; Suivi des mesures d'atténuation et de protection des ressources archéologiques, juin 1998*. Falconbridge/Roche, rapport inédit.

1993 *The Natturalik Archaeology Project, Nunavik, 1991*. MCCQ, rapport inédit, vol 1: 22 p.; vol 2 : 109 p.

1992 *Archaeological Salvage Excavation of the GhGk-4 Site, 1990, Whapmagoostui, Nunavik*. MCC, rapport inédit.

Kasper, J.N. et M. Allard

2001 « Late-Holocene Climatic Change as detected by the Growth and Decay of Ice Wedges on the Southern Shore of Hudson Strait, Northern Québec, Canada ». *The Holocene* 11 (5): 563-577.

Labrèche, Y.

2005 *Appropriation et conservation des ressources alimentaires chez les Inuit de Kangiqsujuaq-Salluit, Québec Arctique : perspective ethnoarchéologique*. Thèse de doctorat, Université de Montréal.

1995 *Projet Raglan, intervention archéologique dans le corridor routier Baie-Déception/ Katinniq en juin 1995*. Falconbridge/Roche, rapport inédit.

1993 *Projet Raglan, inventaire archéologique, 1992*. Falconbridge, rapport inédit.

1992 *Projet Raglan, étude de potentiel et préinventaire archéologiques, corridor routier de Donaldson à baie Déception*. Falconbridge, rapport inédit.

1989 *Ethno-archéologie de la région de Pingualuit (cratère du Nouveau-Québec), Nunavik*. Institut culturel Avataq, rapport inédit.

Lee, T.E.

1974 *Preliminary report on Cartier site investigations, Ungava, 1974*. Québec : Centre d'études nordiques.

1970 « Pre-Colombian European traces in Ungava peninsula ». *The Arctic Circular* 20 (2) : 32-36.

1968 *Archaeological discoveries, Payne Bay region, Ungava, 1966*. Québec : Centre d'études nordiques.

1967 *For Chimo and Payn lake, Ungava, archaeology 1965*. Québec : Centre d'études nordiques.

1966 *Payne Lake, Ungava peninsula, archaeology, 1964.* Québec : Centre d'études nordiques.

Lofthouse, S.

2003 *A Taphonomic Treatment of Thule Zooarchaeological Materials from Diana Bay, Nunavik (Arctic Quebec)*. Mémoire de maîtrise, Université McGill. 143 p.

Maxwell, M.S
1984 « Pre-Dorset and Dorset Prehistory of Canada ». *Handbook of North American Indian*, vol. 5: *Arctic* (dir. D. Damas), 359-368. Washington: Smithsonian Institution.
1985 *Prehistory of the Eastern Arctic*. Orlando: Academic Press.
1980 « Archaeology of the Arctic and Subarctic Zones ». *Annual Review of Anthropology* 9: 161-185.

Morin, B.
1981 *Projet minier Raglan, inventaire archéologique des sites Donaldson, Katinik, Douglas Harbour*. Falconbridge, rapport inédit.

Murray, M.S.
1999 « Local Heroes : The Long-Term Effects of Short-Term Prosperity – An Example from the Canadian Arctic ». *Wolrd Archaeology* 30 (3): 466-483.

Nagy, M.
2000 « From Pre-Dorset Foragers to Dorset Collectors : Palaeo-Eskimo Cultural Change in Ivujivik, Eastern Canadian Arctic ». Dans *Identities and Cultural Contacts in the Arctic* (dir. M. Appelt, J. Berglund et H.C. Gulløv), 143-148. Copenhague : Danish Polar Center.

Newton, J.I.M.
2005 « Thule Culture ». Dans *Encyclopedia of the Arctic* (éd. M. Nuttal), 2026-2027. New York: Routledge.

Pintal, J.-Y.
2005 *Potentiel archéologique des propriétés minière de Canadian Royalties, Fosse d'Ungava*. Roche, rapport inédit.

Plumet, P.
1994 « Le Paléoesquimau dans la baie du Diana (Arctique québécois) » *Threads of Arctic Prehistory : Papers in Honour of William E. Taylor, Jr.* (dir. D. Morrison et J.L. Pilon), 103-143. Hull: Musée canadien des civilisations.
1981 « Les structures de blocs dans l'Arctique québécois ». *The Archaeological Association of the University of Calgary*, 207-249.
1980 *Liste des sites archéologiques du Nouveau-Québec-Labrador enregistrés au laboratoire d'archéologie de l'UQAM, programme Tuvaaluk, 1967-1979*. MAC, rapport inédit.
1978 *Rapport provisoire de la mission Tuvaaluk 77*. UQAM, rapport inédit.
1976 *Archéologie du Nouveau-Québec : Habitats Paléoesquimaux à Poste-à-la-Baleine*. Québec : Centre d'études nordiques, collection Paléo-Québec no 7.
1969 *Archéologie de l'Ungava : le problème des maisons longues à deux hémicycles et séparations intérieures*. Paris : École pratique des Hautes-Études-Sorbonne.

Rocheleau, C.
1982 *Les schèmes d'établissement de la culture dorsétienne au Nouveau-Québec*. Mémoire de maîtrise, Université de Montréal.

Taillon, H. et G. Barré
1987 *Datations au 14C des sites archéologiques du Québec*. MAC, rapport inédit.

Taylor, W.E. Jr.
1968 *The Arnapik and Tyara Sites : An Archaeological Study of Dorset Culture Origins*. Memoirs of the Society for American Archaeology # 22.
1958 « Archaeological work in Ungava, 1957 ». *The Arctic Circular* 10 (2) : 25-27.
1957 *Ungava, Québec, field catalogue, Payne bay, Payne lake*. Musée national de l'Homme, rapport inédit.

Appendix 7

ASSESSMENT METHOD FOR PROBABLE IMPACTS

APPENDIX 7 Assessment Method for Probable Impacts

Impacts of the PDMP are assessed for each component of the physical, biological and human environments identified in section 7.1.2. For each component, impacts associated with each of the sources of impacts (section 7.1.1) are identified, described and assessed, for the construction and operation phases of the Puimajuq mine.

The significance of an impact depends on the intensity of the disturbance, its extent, duration and likelihood to occur, and takes into account the application of general and specific mitigation measures. The intensity of the impact includes the value placed on the treated component and the degree of disturbance. Each of these aspects is presented below.

A7.1 Environmental component value

The value of a component is established using its ecosytemic and socioeconomic values.

A7.1.1 Ecosystemic value

The ecosystemic value is only given to components of the biological environment. This value expresses the relative importance of a component regarding its interest to the ecosystem, taking into account its qualities (sensitivity, integrity, resilience), its role and its function. It also incorporates notions such as representation, distribution, diversity, sustainability, rarity or uniqueness. The value can be high, medium or low.

- → High: the component presents a high ecosystemic role, a major interest in terms of biodiversity and exceptional qualities whose conservation and protection are the subject of consensus within the scientific community.
- → Medium: the component presents a strong interest and recognized qualities whose conservation and protection are a source of concern without being the subject of consensus.
- → Low: the component presents an interest and qualities whose conservation and protection are the subject of little concern.

A7.1.2 Socioeconomic value

The socioeconomic value of a given environmental component takes into account its significance for the local or regional population, interest groups, managers and specialists. It expresses the desire or the popular or political will to preserve the integrity or the original character of a component. It is considered to be:

- → High: when the component is subject to legal or regulatory protection measures (threatened or vulnerable species, recognized wildlife habitats, conservation parks, etc.) or when essential to human activities (drinking water, registered archeological sites)
- → Medium: when the component is valued at social, economic or cultural levels, or is used by a significant portion of the population concerned, but not subject to legal protection

→ Low: when the component is only slightly or not appreciated or used by the population

Assigning a level of value for each of the components of the environment and its justification are based on information collected from Inuit populations (Table 1). No socioeconomic value is given to components of the physical environment.

Table 1 Socioeconomic value given to components of the environment.

COMPONENT OF THE ENVIRONMENT	SOCIOECONOMIC VALUE	JUSTIFICATION
Biological environment		
Drabas with special status	Medium	
Aquatic fauna	High	Several species are fished by the population and are an important source of food for Nunavik communities. Fishing is an integral part of their lifestyle.
Human environment		
Use of territory by Inuit	High	
Economy and employment	High	The project provides new economic opportunities. The creation of new companies and the financial health of existing companies are a major interest for these communities.

A7.1.3 Overall environmental value

When the overall economic value of a component incorporates an ecosystemic and a socioeconomic value, it corresponds to the higher of these two values (Table 2).

Table 2 Grid to determine value of components of human and biological environments.

SOCIOECONOMIC VALUE	ECOSYSTEMIC VALUE		
	HIGH	MEDIUM	LOW
High	High	High	High
Medium	High	Medium	Medium
Low	High	Medium	Low

A7.2 Mitigation and improvement measures

General and specific mitigation measures are actions or project implementation modalities that prevent a probable negative impact or decrease the degree of disruption of an environmental component. A series of general mitigation measures will be applied to decrease negative impacts in the construction and operation phases. Moreover, specific mitigation measures will be proposed in certain cases to further reduce a specific impact on a sensitive or high value component. All these measures are considered when assessing the degree of disruption and intensity of the impact on an environmental component. For positive impacts, improvement measures are sometimes proposed to maximize the project's advantages and positive benefits.

A7.3 Intensity of the impact

The intensity of the impact combines the overall environmental value of a component and its degree of disruption (negative impact) or of modification (positive impact), which correspond to the magnitude of structural and functional changes of the component. It depends on the sensitivity of the environmental component with regard to proposed interventions. Depending on the nature of the impact, changes can be positive or negative and the effects can be direct or indirect. The intensity of the impact also takes into account the cumulative, synergistic or deferred effects which, beyond the simple cause-and-effect relation, can amplify the disruption of a component when the environment is particularly sensitive. Therefore, when a measure is deemed effective, it will reduce the degree of disruption or intensity of the impact on an environmental component.

The intensity of the impact can be high, medium or low.

- → High: the impact involves the environmental integrity of the component or strongly and irreversibly modifies the component or its use.
- → Medium: the impact causes a reduction in the quality or the use of the component without compromising its environmental integrity.
- → Low: the impact only slightly modifies the quality, use or integrity of the component.

A7.4 Spatial extent of impacts

The spatial extent of impacts on the component corresponds to the spatial scope or radius of effects on said component, as well as the protection of an affected population. The spatial extent of impacts can be regional, local or isolated.

- → Regional: the impact affects a large area to a great distance from the project site, where it is felt by several populations or by a high proportion of the population.

- → Local: the impact affects a relatively restricted area within, close to or at a certain distance from the study area, or it is felt by a limited proportion of the population.
- → Isolated: the impact only affects a very restricted area within or close to the project, or is only felt by a limited percent of the population.

A7.5 Duration of impacts

The duration of impacts on an environmental component corresponds to the temporal dimension—the period of time during which the impacts will affect it. This criterion takes into account the intermittent nature of one or more impacts. The duration of an impact can be long, medium or short.

- → Long: the duration is long when an impact is felt in a continuous or discontinuous way for a period exceeding five years. This is often a permanent and irreversible impact.
- → Medium: the duration is medium when an impact is experienced temporarily, continuously or discontinuously. These are impacts still occurring several months after the end of construction work, but whose duration is less than five years.
- → Short: the duration is short when an impact is experienced temporarily, continuously or discontinuously, during the construction phase or for several months after the beginning of the operating phase. These are impacts whose duration varies from a few days to the entire time of construction.

A7.6 Probability of occurrence of impacts

The probability of occurrence of impacts corresponds to the actual probability that an impact could affect a component. The probability of occurrence can be high, medium or low.

- → High: an impact will manifest itself in some way.
- → Medium: an impact may occur, but it cannot be ensured.
- → Low: an impact is not likely or would occur only as the result of an accident.

A7.7 Significance of a probable impact

The overall significance of impacts is derived from a comprehensive judgment of experts who examine the effect of a source of impact on an environmental component and who incorporate the criteria of intensity, extent, duration and probability of occurrence. The significance of an impact also includes the effect of the proposed mitigation measures. The assessment is therefore conducted as a reprise and constitutes the residual impact.

The combinations used to determine the level of significance are predetermined. The relationship between each of the criteria allows for an overall judgment on the significance of the impact in five classes: very strong, strong, medium, low and very low (Table 3). This matrix includes the same number of very low and low classes of significance as it does for very strong and strong.

The assessment of impacts on an environmental component is consequent upon the effects from all identified sources of impacts.

Table 3 Combinations of criteria to determine the significance of an impact on an environmental component.

INTENSITY	EXTENT	DURATION	PROBABILITY OF OCCURRENCE	SIGNIFICANCE
Strong	Regional	Long	High	Very low
			Medium	Very low
			Low	Strong
		Medium	High	Very low
			Medium	Very low
			Low	Strong
		Short	High	Very low
			Medium	Very low
			Low	Strong
	Local	Long	High	Very low
			Medium	Very low
			Low	Strong
		Medium	High	Very low
			Medium	Strong
			Low	Strong
		Short	High	Strong
			Medium	Strong
			Low	Strong
	Isolated	Long	High	Strong
			Medium	Strong
			Low	Medium
		Medium	High	Strong
			Medium	Medium
			Low	Medium
		Short	High	Strong
			Medium	Medium
			Low	Medium
Medium	Regional	Long	High	Strong
			Medium	Strong
			Low	Medium
		Medium	High	Strong
			Medium	Medium
			Low	Medium
		Short	High	Medium
			Medium	Medium
			Low	Medium
	Local	Long	High	Strong
			Medium	Medium
			Low	Medium
		Medium	High	Medium
			Medium	Medium
			Low	Medium
		Short	High	Medium
			Medium	Medium
			Low	Low

INTENSITY	EXTENT	DURATION	PROBABILITY OF OCCURRENCE	SIGNIFICANCE
			High	Medium
		Long	Medium	Medium
			Low	Medium
			High	Medium
	Isolated	Medium	Medium	Medium
			Low	Low
			High	Medium
		Short	Medium	Low
			Low	Low
			High	Medium
		Long	Medium	Medium
			Low	Low
			High	Medium
Low	Regional	Medium	Medium	Medium
			Low	Low
			High	Medium
		Short	Medium	Low
			Low	Low
			High	Low
		Long	Medium	Low
			Low	Low
			High	Low
	Local	Medium	Medium	Low
			Low	Very low
			High	Low
		Short	Medium	Very low
			Low	Very low
			High	Low
		Long	Medium	Very low
			Low	Very low
			High	Low
	Isolated	Medium	Medium	Very low
			Low	Very low
			High	Low
		Short	Medium	Very low
			Low	Very low

Appendix 8

FORM

FORMULAIRE DE SURVEILLANCE ENVIRONNEMENTALE

IDENTIFICATION DU PROJET		
Promoteur :		Canadian Royalties Inc. – Nunavik Nickel
Titre du projet :		
Date de réalisation des travaux :		
Date de réalisation de la surveillance :		
Activité de surveillance réalisée :	☐	Visite sur le terrain lors des travaux
	☐	Autre activité de surveillance (spécifier) :
	☐	Surveillance du chantier assurée par :
Entrepreneur :	☐	

MESURES D'ATTÉNUATION		FOURNIR		MESURE RÉALISÉE			COMMENTAIRES (Si non, expliquez)
		Photo (s)	**Document (s)**	**oui**	**non**	**n/a**	
Mesures standard							
1	Au début des travaux, l'entrepreneur doit présenter un plan d'intervention en cas de déversement accidentel de contaminants. S'assurer que le plan d'intervention contient, au minimum, un schéma d'intervention et une structure d'alerte, et qu'il est placé dans un endroit facile d'accès et à la vue de tous les employés.						
2	Avoir sur place du matériel d'intervention en cas de déversement accidentel de contaminants, dont un dispositif de captage des phases flottantes (dans le cas de déversement de produits pétroliers), ainsi que des clôtures antiérosion (pour contenir la migration des particules fines issues de l'érosion de remblais temporaires et de secteurs remaniés vers des zones terrestres et aquatiques).						
3	Exécuter sous surveillance et dans une zone dédiée continue toutes manipulations de carburant, d'huile, d'autres produits pétroliers ou de contaminants y compris le transvidage afin d'éviter les déversements accidentels.						

4	En cas de déversement, rapporter immédiatement la situation aux intervenants. Rapporter immédiatement la situation au service d'urgence d'Environnement Canada (1-866-283-2333) et à Urgence Environnement du Québec (1-866-694-5454) pour un déversement terrestre et/ou à la Garde côtière canadienne - pollution maritime (1-800-363-4735). Gérer les sols contaminés selon la réglementation provinciale en vigueur. Consigner l'événement dans un registre						
5	Ne pas rejeter de débris, rebuts, déchets, matériaux, etc., dans le milieu aquatique. Si du minerai se retrouve dans le milieu marin, récupérer ce minerai.						
6	La machinerie et autres équipements hydrauliques œuvrant en berge, dans la zone de marnage et sur l'eau utiliseront une huile hydraulique biodégradable						
7	Entreposer les produits pétroliers au dépôt pétrolier déjà aménagé. Entreposer les produits chimiques et les hydrocarbures à plus de 60 m de la baie Déception. S'assurer que les installations d'entreposage sont conformes à la réglementation en vigueur.						
8	Avant le début des travaux, identifier une aire d'entretien de la machinerie, d'entreposage et de manipulation des matières dangereuses. Ce site doit être situé à au moins 30 m de la rive de la baie Déception.						
9	Maintenir la machinerie et les camions en parfait état de fonctionnement. Vérifier quotidiennement la présence de fuite de contaminants sur le matériel, qui doit être réparée immédiatement, le cas échéant.						
10	Ramasser quotidiennement et trier les différents déchets générés selon qu'ils constituent des matières résiduelles récupérables ou des matières résiduelles vouées à l'élimination au sens du Règlement sur l'enfouissement et l'incinération des matières résiduelles ou des matières dangereuses résiduelles (MDR) et au sens du Règlement sur les matières dangereuses en vigueur.						
11	Émettre un avis aux navigateurs avant le début des travaux afin de les informer de la nature et de la durée des travaux.						

12	Éviter de laisser tourner inutilement les moteurs la machinerie et des camions lorsque ces derniers ne sont pas utilisés.						
13	Utiliser de la machinerie, des équipements et des véhicules en bon état de fonctionnement afin de minimiser l'émission de contaminants atmosphériques.						
14	Durant le transport terrestre, les matériaux contenant des particules fines doivent être recouverts de bâches fixées solidement.						
15	Si l'entrepreneur doit utiliser un abat-poussière (autre que l'eau), celui-ci doit être certifié par le Bureau de normalisation du Québec (BNQ).						
16	Surveiller visuellement l'émission de poussières et prendre action afin de la contrôler au besoin.						
17	Limiter la vitesse des véhicules terrestre sur le chantier à 15 km/h.						
18	Il est interdit de brûler des déchets à ciel ouvert.						
19	Limiter au strict nécessaire le décapage, le déblaiement, l'excavation, le remblayage et le nivellement des aires de travail afin de respecter la topographie naturelle et de prévenir l'érosion.						

Commentaires (observations sur le terrain, mauvaise gestion des déchets, présence d'huiles usées, fuites sur la machinerie, travaux réalisés pas pris en compte dans l'évaluation environnementale, etc. - tout détail n'étant pas mentionné dans les mesures d'atténuation) :

RÉALISATION DE LA SURVEILLANCE			
Préparé par:			
Date:			
Titre :			
Compagnie/organisme :			
No de tél. :			
Je certifie que les renseignements fournis ci-dessus sont exacts et complets et qu'ils correspondent à mon interprétation des travaux.			
Signature :		Date :	
Titre :			
Compagnie/organisme :			