CREE DEVELOPMENT CORPORATION

LA GRANDE ALLIANCE

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PRE-FEASIBILITY STUDY – PHASES II & III – TRANSPORTATION INFRASTRUCTURE

REPORT NO.3 - TECHNICAL SURVEY

Final Version

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REPORT NO.3 - TECHNICAL SURVEY

PRESENTED TO:

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TABLE OF CONTENTS

1 INTRODUCTION & CONTEXT 1

1.1 La Grande Alliance 1

1.2 Transportation infrastructure study 3

1.3 Report no.3 objectives 8

2 MAIN FINDINGS - MARKET SURVEY 9

3 MAIN FINDINGS - SOCIO-ENVIRONMENTAL SURVEY 13

3.1 Existing social and environmental aspects 16

4 GEOTECHNICAL 17

4.1 Permafrost 17

4.2 Study Area 1 (SA1): Billy-Diamond Highway Railway – Rupert – La Grande 18

4.3 Study Area 2 (SA2): Road & Rail Extension, and Harbour – La Grande – Whapmagoostui/Kuujjuarapik 19

4.4 Study Area 3 (SA3): Route 167 - Renard Mine – Trans-Taiga Road 21

5 ROADS 22

6 RAILWAYS 26

7 CIVIL ENGINEERING STRUCTURES 29

8 HARBOUR WHAPMAGOOSTUI/KUUJJUARAPIK 30

9 CONSTRUCTION OVERVIEW 31

10 CONSTRUCTION COST ESTIMATES 33

TABLE OF CONTENTS

TABLE

Table 7-1	Summary Table	29
Table 10-1	La Grande Alliance's Phase II and III Capital Cost Estimates	33

FIGURES

Figure 1-1	Study Area	7
Figure 3-1	Protected Areas	15
Figure 3-2	Phase II and III Overall Study Area Collected Data Results	16
Figure 4-1	Distribution of permafrost in northern Quebec (Modified from Allard et al., 2012)	18
Figure 5-1	Route 167: Upgrade & Extension to Trans-Taiga – Proposed alignment	24
Figure 5-2	Roadway La Grande to Whapmagoostui/Kuujjuarapik - Proposed alignment	25
Figure 6-1	Proposed Railway Alignments	28
Figure 9-1	La Grande Alliance Proposed Infrastructure - Schedule Overview	32

TABLE OF CONTENTS

APPENDICES

A TECHNICAL NOTE 10 - GEOTECHNICAL

B TECHNICAL NOTE 11 - ROADS

C TECHNICAL NOTE 12 - RAIL

D TECHNICAL NOTE 13A - DEEP-WATER PORT – PHYSICAL ENVIRONMENTAL CONDITIONS

E TECHNICAL NOTE 13B - HARBOUR CONCEPT DESIGN

F TECHNICAL NOTE 14 - CIVIL ENGINEERING STRUCTURES

G TECHNICAL NOTE 15 - CONSTRUCTION OVERVIEW

H TECHNICAL NOTE 16 - CONSTRUCTION COST ESTIMATE

1 INTRODUCTION & CONTEXT

1.1 LA GRANDE ALLIANCE

La Grande Alliance refers to the *Memorandum of Understanding (MOU) on the Cree-Québec Sustainable Infrastructure Program in Eeyou Istchee Baie-James*, signed between the Cree Nation Government (CNG) and the Government of Québec on February 17, 2020. The purpose of the MOU is to provide a framework for Cree local and regional entities to work closely with relevant Québec government ministries to connect, develop and protect the territory of the Eeyou Istchee Baie-James region of northern Québec in an inclusive and participatory manner. The main objective of La Grande Alliance is to build a promising program for the strategic, predictable, and sustainable development of the territory over a 30-year time horizon.

La Grande Alliance consists of four avenues of future development – transportation infrastructure, communication, electrification, and protection – to devise a roadmap that takes into consideration innovative economic and technical opportunities and/or constraints, as defined by communities, land users and other relevant groups.

The Eeyou Istchee Baie-James region is rich in natural resources. However, historical development of these resources has resulted in projects often thrusted upon Indigenous and non-Indigenous communities alike, for whom the only option was to react. This scenario makes land use planning very challenging for communities and government officials, strategic transportation or energy infrastructure planning ambiguous for public services and government ministries, and investment by promoters of development projects risky and uncertain.

The link between transportation, communication and energy infrastructure and the potential for development is undeniable. The key, however, is to ensure that such infrastructure does not occur in environmentally or culturally sensitive areas. This is essential to avoid potential conflicts between development and the communities where this infrastructure is proposed to be built. Conversely, providing communities with the opportunity to contribute to the conception, planning, deliberation and evaluation of infrastructure, hand in hand with protection of some natural areas, has the potential for shaping the territory in an empowering way that brings long-term predictability to the region. In turn, this allows communities to plan their growth more easily, resources for protecting environment and wildlife to be deployed more efficiently, land use planners to work with more certainty, and investment by promoters and developers to be more secure.

The following report deals specifically with the transportation infrastructure component envisioned through the MOU.

1.1.1 THE CLIENT – CREE DEVELOPMENT CORPORATION

In conformity with the MOU, the CNG has mandated the Cree Development Corporation (CDC) to conduct a series of studies to examine the economic, technical, and socio-environmental aspects of a series of proposed large transportation infrastructures envisioned over three phases spread over 30 years.

The CDC is the modernization of the James Bay Native Development Corporation, created through the *James Bay and Northern Québec Agreement* (JBNQA) to “assist, promote and encourage the creation, diversification or development of businesses, resources, properties and industries within the territory with a view to stimulating maximum economic opportunities for Cree people and contributing to their general economic well-being”. Following the signature of La Grande Alliance MOU, the CNG mandated the CDC to carry out the Infrastructure Studies, part of which are the subject of this report.

1.1.2 PRECURSORS TO LA GRANDE ALLIANCE

The Agreements presented below allow the reader to better situate the MOU within the current legal framework in place in the region.

THE JAMES BAY AND NORTHERN QUÉBEC AGREEMENT

The JBNQA was signed on November 11, 1975, by the Government of Québec, the Government of Canada, Hydro-Québec, the Grand Council of the Crees of Québec and the Northern Québec Inuit Association. Described by many as the "first modern treaty", the JBNQA created a new legal and, eventually, constitutional framework for, among other things, local self-governance, land management, protection of the traditional Cree way of life as well as for the relationship between Québec and the Indigenous peoples of the James Bay and Northern Québec region. It was the foundation on which Crees laid over 80 subsequent agreements, regarding Cree rights, communities' self-governance and subsequent development of the territory.

THE PAIX DES BRAVES

The *Agreement respecting a new relationship between the Cree Nation and the Government of* Québec (better known and herein referred to as *Paix des Braves),* signed in February 2002 is a Nation-to-Nation Agreement between the Government of Québec and the Crees of Québec. The Agreement is not meant to replace the JBNQA, but rather to build a "development model based on the principles of sustainable development, partnership and respect for the traditional way of life of the Crees, as well as on a long-term economic development strategy, principles which are in conformity with (its) provisions." The Agreement includes specific modalities with regards to mining, forestry, and hydroelectric development on the territory, seen as the three sectors driving the regional economy at the time of signing. Furthermore, the Agreement is meant to provide greater autonomy to the Crees in the manner in which communities will develop in the future. Henceforth, development occurring on Cree traditional lands requires meaningful participation of the Crees at multiple levels, as well as benefit sharing frameworks that see Crees as more than simple stakeholders.

OTHER GOVERNMENT POLICIES

In addition to the Agreements presented above, the Northern Action Plan, proposed by the Government of Québec in May 2011, is a 25-year economic development program for the northern regions of Québec based on "sustainable development" which is intended to focus on the construction of transportation infrastructure, mining, and the development of renewable energy projects.

1.2 TRANSPORTATION INFRASTRUCTURE STUDY

The following components were the initial transportation infrastructures considered as part of the studies:

PHASE I (1-5 YEARS)[1] (THE PHASE I IS STUDIED BY OTHERS)

- **Roadway: Upgrading and paving of the community access roads** for Waskaganish, Eastmain, Wemindji and Nemaska.
- **Railway: Matagami to Rupert**

  A proposed railway line following, as much as possible, the Billy-Diamond Highway (BDH) starting from the town of Matagami to the km 257 of the BDH (Rupert River Bridge).
- **Railway: Grevet to Chapais**

  A return to service for the decommissioned railway line between Grevet (Lebel-sur-Quévillon) and Chapais (approximate distance of 147 km).

PHASE II (6-15 YEARS)

- **Railway: Rupert to La Grande**

  A proposed railway alignment following, as much as possible, that of the Billy-Diamond Highway (BDH) starting at km 257 (after the Rupert River Bridge, which is the junction point with the railway alignment developed by the Phase I consultant) all the way to La Grande River. The Phase II railway alignment extends over an approximate distance of 340 km.
- **Route 167: upgrading & extension to the Trans-Taiga Road**

  Upgrading and paving of the section from the Mistissini community access road to the Stornoway Renard Mine access road over an approximate distance of 204 km;

  Extension towards north to connect with the Trans-Taiga Road near km 408, over an approximate distance of 172 km.
- **Road: La Grande to Whapmagoostui/Kuujjuarapik**

  A proposed road corridor connecting Chisasibi community access road and Whapmagoostui/Kuujjuarapik, over an approximate distance of 207 km.

PHASE III (16-30 YEARS)

- **Railway: La Grande to Whapmagoostui/Kuujjuarapik**

  A railway which follows, as much as possible, the projected road leading to Whapmagoostui/Kuujjuarapik (from the junction with the Phase II railway alignment).. The Phase III railway alignment extends over an approximate distance of 219 km.
- **Port: at Whapmagoostui/Kuujjuarapik**

  A deep-water port along the Kuujjuarapik coastline between the Great Whale River's mouth and the entrance of the Manitounuk Strait.

[1] All dates indicated herein are hypothetical and would begin as of the start of the construction period. This therefore does not include all pre-project phases, most notably the Environmental and Social Impact Assessment that would be required if the infrastructures are pursued.

1.2.1 STUDY VISION AND APPROACH

The studies found herein have put **local communities at the centre of the transportation infrastructure development process. This way of working, initially proposed by the CDC, strives to shift the dominant paradigm away from natural resources as the main lever of development, towards community development. Natural resource development remains a vital element to this equation but is no longer the sole driver. In this sense, La Grande Alliance goes beyond a standard regional transportation plan but rather proposes a new model** for how the Cree and the Jamesian populations can work together to sustainably develop the existing network, thereby allowing the movement of natural resources in a manner that promotes the betterment of all.

The Feasibility Studies attempt to seek out and understand ways in which the proposed transportation infrastructures can improve the communities' quality of life. Transportation corridors are explored with the utmost respect for the land, its inhabitants, and Cree heritage. In this sense, the study fully embraces the concept of sustainable development, such that the infrastructures under study can only proceed if they are feasible from a technical, environmental, and economic perspective. Furthermore, it is understood that, to proceed, the proposed infrastructures will require the social acceptability of all communities in the region.

The Client's requirement to involve Cree and Jamesian communities at such an early stage of development reflects their requirement that local stakeholders be actively involved in the planning and management of land and economic development in Eeyou Istchee. The organization understands that Eeyou Istchee is extremely rich in natural resources, but firmly believes that it must not be seen simply as a source of raw materials for resource exploitation. The CDC is clear that development of the territory must be in accordance with traditional customs and founded on values of respect and gratitude to the land. Finally, it rejects the idea that infrastructure development and environmental protection are opposing, but rather are both key to harmonious development of a territory and its people.

1.2.2 STUDY OBJECTIVES

Understanding the value created through the development of an inclusive and comprehensive infrastructure program will generate stability and allow communities to better access opportunities associated with various aspects of regional development. The challenges and uncertainty created by climate change and geopolitical instability make community participation even more critical.

Therefore, several study objectives have been developed:

1. To better understand the implications, risks, and opportunities related to the various infrastructures contemplated in the study;
2. To maximize connections between communities and the main drivers of economic development in the region, throughout the territory;
3. To identify transportation corridors that concentrate the development footprint, so as to limit environmental impacts elsewhere, in a manner that is in harmony with other land use activities on the territory;
4. To minimize the emission of harmful greenhouse gases in the construction, operation and use of future infrastructure developments on the territory;
5. To identify opportunities to create meaningful jobs for the inhabitants;
6. To understand how to balance infrastructure development with environmental protection as well as the preservation and enhancement of Cree culture for the benefit of future generations.

Although an Opportunity Study was not previously carried out, CDC has included, as part of this mandate, the need to better define the purpose of the studied infrastructures in the three phases of the La Grande Alliance Study.

1.2.3 CONTEXT OF THE STUDY

For thousands of years, the Crees of Eeyou Istchee have lived off the land through hunting, fishing, and trapping. This large territory of 450,000 km² is now inhabited by around 22,000 people divided mostly in ten[2] Cree communities, five of which are located along the east coast of James and Hudson Bays: Waskaganish, Eastmain, Wemindji, Chisasibi and Whapmagoostui. The remaining five are inland communities: Waswanipi, Nemaska, Oujé-Bougoumou, Mistissini, and Washaw Sibi. Whapmagoostui is currently the only community not yet accessible by road.

The gap between the social and economic conditions of Indigenous and non-Indigenous people in Québec continues to be a major social problem. Issues continue to be insufficient housing, chronic unemployment and underemployment, low formal education levels and a flawed and heavily biased justice system. To combat these problems, many communities are implementing strategies that emphasize self-governance, autonomy, history, culture, spirituality, and identity. In this sense, many Crees believe that true economic development must grow from these elements and cannot be in opposition to them.

Changing climatic conditions, rapid demographic growth, and a growing interest in the resource potential in northern territories are all exerting pressure on Cree communities. Today's choices will no doubt influence the lives of future generations.

The Feasibility Studies are carried out in each community within the study area utilizing a network of Grande Alliance Community Information Officers (CIO). CIOs have been appointed by their communities to act as the local antennas of LGA, to ensure participation and engagement in the studies, and to confirm that issues and concerns raised by Cree communities are heard and addressed in the studies. These positions are funded through the CDC.

Jamesian communities, for their part, are relatively newcomers to the territory. However, recent governance agreements signed between them and the Crees show that they form an integral part of the territory and have an important voice in its future development. Although La Grande Alliance Transportation Infrastructure Feasibility Studies are a Cree initiative, the CDC has made it clear that any discussions about future programs need to include Jamesian communities and their concerns. The study therefore assumes that a successful program will require the active support of these communities as well. To this end, communications have been established with each of the Jamesian communities within the broad study area through their respective municipal administrations.

1.2.4 PHASES II AND III PRE-FEASIBILITY STUDY MANDATE

The CDC has mandated WSP in May 2021 to study the Whapmagoostui/Kuujjuarapik proposed road, the Route 167 upgrade and extension as well as the railway to be located along the Billy-Diamond Highway, from KM 257 to KM 544, then on to Whapmagoostui/Kuujjuarapik, following, as much as possible the same alignment of these roads. WSP and its Cree partners, Maamuu Consultants, Mishtuk Corporation and EnviroCree, share the vision of La Grande Alliance as the promise of a future shaped by the Crees for the Crees of the Eeyou Istchee Baie-James region.

This study aims to:

1. Consult previous analyses on the territory;
2. Document the current market conditions and forecast market for La Grande Alliance infrastructure program;
3. Initiate a sustained effort of communication, collaboration, and engagement;
4. Document the existing social and environmental aspects that could benefit and/or be impacted;
5. Developed proposed infrastructures in accordance with social and environmental aspects;

[2] An eleventh community, known as "MoCreebec" is composed of JBNQA Cree beneficiaries who live on the west side of James Bay, mostly in Moose Factory and Moosonee, Ontario.

6 Assess the technical feasibility of the proposed infrastructure;
7 Assess the risks and the financial viability of the proposed infrastructure;
8 Report and provide recommendations in a final report.

This Study will examine the possibility of implementing the specified transportation infrastructures to meet the needs of Cree and non-Indigenous residents in the short, medium, and long-term in the Eeyou Istchee territory.

1.2.5 STUDY AREA

As shown on Figure 1-1, the study area is located within the territory of the Eeyou Istchee Baie-James region of northern Québec. The study area is divided in three zones:

- Study Area 1 (SA1): Billy-Diamond Highway Railway – Rupert – La Grande
- Study Area 2 (SA2): Road & Rail Extension, and Harbour – La Grande – Whapmagoostui/Kuujjuarapik
- Study Area 3 (SA3): Route 167 - Renard Mine – Trans-Taiga Road.

It is to be noted that these study areas are slightly different that the ones described in La Grande Alliance MOU, thus, to suit the proposed infrastructures scope.

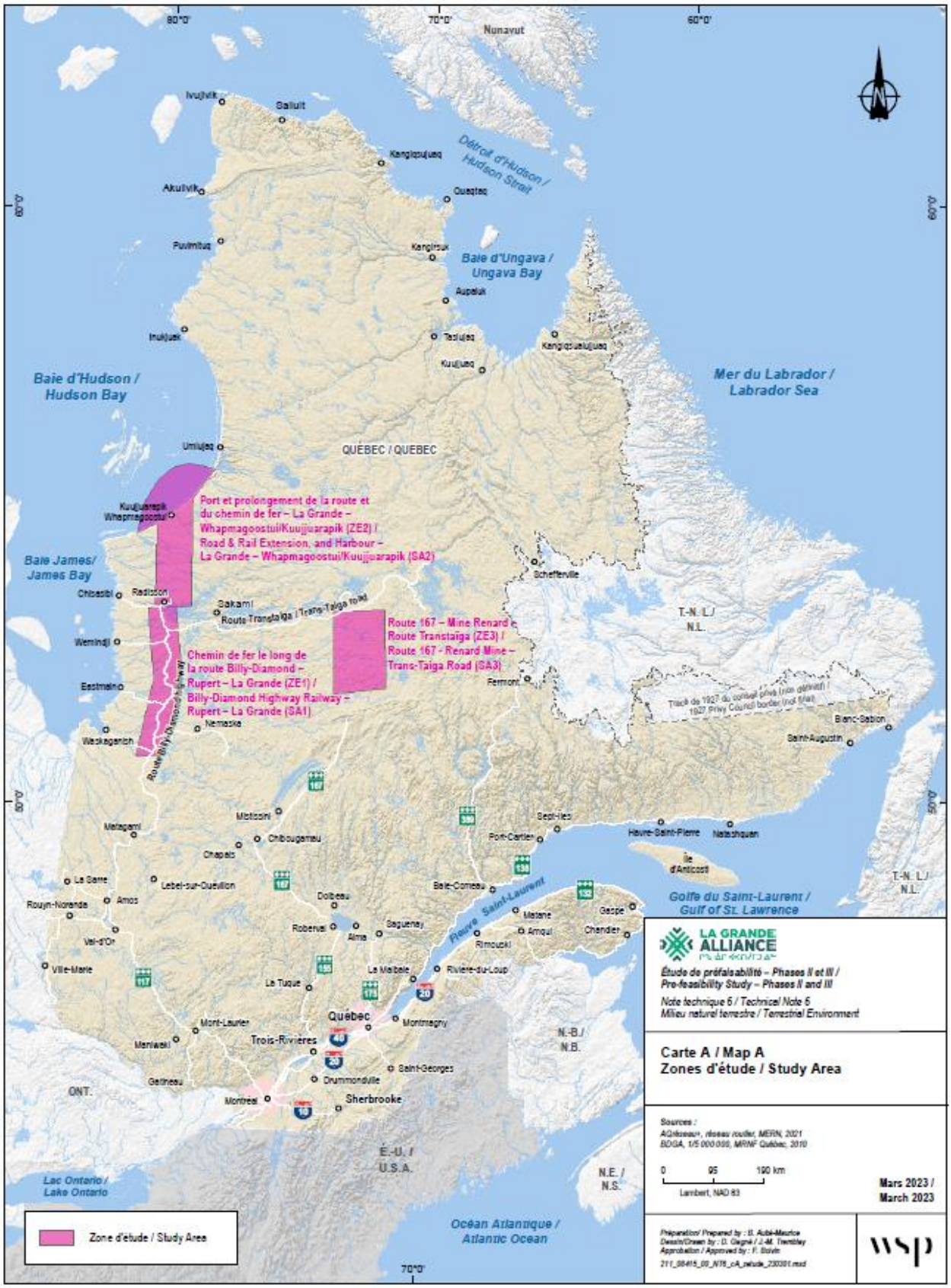


Figure 1-1 Study Area

1.3 REPORT NO.3 OBJECTIVES

The objective of Report 3 is to assess the technical feasibility of the proposed infrastructure applying a concept engineering design based on applicable laws, regulations, technical parameters and specific parameters designed at the outset by the client in the spirit of the overall approach of La Grande Alliance studies, i.e., the concept design must fully consider significant socio-environmental data, compiled in Report 2, including knowledge and perspectives gathered directly from Cree land users engaged prior to the design stage.

The list below provides examples of how information was considered in this highly innovative approach:

- Respect, as much as possible, the natural site topography (mountains and plains);
- Consider the overall geology of the study area; identify and locate deposits of aggregate materials;
- Avoid, as much as possible, lakes and rivers:
  - Minimize the length of crossings and bridges where these are unavoidable;
- Avoid, as much as possible, existing and projected protected areas:
  - Minimize encroachment and/or provide mitigation measures where these are unavoidable;
- Avoid, as much as possible, areas of cultural significance such as: current areas used by Cree land users, archeological sites, etc.;
  - Minimize encroachment and/or provide mitigation measures where these are unavoidable;
- Propose, wherever applicable, alignment variants that could offer added value:
  - Locations that minimize environmental footprint;
  - Locations that minimize construction cost;
  - Locations that minimize the impacts on already built camps and other facilities;
  - Etc.

It is important to note that an important proportion of the infrastructures proposed in Phases II and III are planned in undeveloped areas. For these areas, we have identified additional processes to limit environmental impacts, with a view of accounting for the sensitivity of planning new corridors in previously inaccessible areas (and entire regions), in line with the main sustainable development objectives of the overall program. Thus, for these areas the goal of the Pre-Feasibility Study is to identify and propose alignments that present the least risk.

The technical analysis included in this report includes the following information and analyses:

- Geotechnical;
- Railway;
- Roadway;
- Civil structures;
- Construction schedule overview;
- Construction cost estimates.

Given the multidisciplinary nature of the information, this current report has been conceived and presented to provide two levels of information:

- The report itself is a summary of the pertinent points and issues raised during each Study stage;
- The technical notes in the appendices provide a detailed methodology according to each discipline, the results of data collection, details, calculations, regulatory references, etc., necessary for a thorough understanding of each of the subjects addressed in the report.

2 MAIN FINDINGS - MARKET SURVEY

The Market Study was a joint exercice between WSP and phase I external consultant. The purpose of this Report 1 is to:

1. Document presents the market analysis;
2. Forecast market conditions for all components of La Grande Alliance proposed infrastructure program.

The more specific goals of the market study include:

- To assess the economic needs of the region relating to the proposed infrastructure, detailing regional economic sectors that could use the new infrastructure to foster economic growth;
- To provide a detailed socioeconomic profile of the Eeyou Istchee Baie-James region, including Cree and Jamesian communities, economic sectors, projects and outlook;
- To assess market potential and forecast freight, passenger traffic and revenue for the different transport infrastructures;
- To consult and interview potential users and communities to determine their current and future needs;
- To assess and propose means to enhance regional impacts given the expected demographic, social and economic growths with and without La Grande Alliance infrastructure program:
  - Analyze the strategic development opportunities related to La Grande Alliance infrastructure program, considering Protected Areas, culture, communications, energy, human resources;
  - Project population and economic growth on the territory over a given time horizon;
  - Project vehicle traffic of the status quo without La Grande Alliance proposed infrastructure, as well as the traffic of La Grande Allianceproposed infrastructure components.

The study area is a remote area in Northern Quebec. The territory of Eeyou Istchee Baie-James is vast, the climate is harsh and the distances between communities are significant, making the cost of transportation and therefore the cost of living very high.

Overall, most stakeholders have expressed the view that the existing transportation infrastructure is obsolete and needs to be upgraded, and that future socio-economic development in the Northern Quebec region relies greatly on the efficiency of the transportation infrastructure.

TRANSPORT NETWORK

In terms of road transportation, the Billy Diamond Highway and the Route du Nord constitute the road networks' backbone. From this backbone, the access roads are vital linkd that connect all communities except the northernmost communities in the study area (Whapmagoostui and Kuujjuarapik). These roads are used to provide supplies to the people living and working in the Eeyou Istchee James Bay region, to transport equipment and materials to Hydro-Québec power stations and to mining sites as well as to ship harvested lumber and exploited mining concentrates to the south.

Air transportation, for its part, plays an important role in serving the northernmost communities, particularly regarding perishable foodstuffs, as well as for emergency evacuation for patients requiring medical care, either to the hospital in Chisasibi or to the large urban centers in the south (Val d'Or or Montreal). Air transportation services to the region are mainly provided by Air Creebec and Air Inuit, but airfares for personal travel remain prohibitively high. Seven Cree communities currently have an airport nearby, but the lack of air support services coupled with limited length runways make the further development of air transportation difficult. Helicopters are usually used for activities related to exploration and development of forestry, mining, and hydroelectric resources, while a combination of helicopters and small seaplanes (beavers) are now used for the transportation of trappers to their trapping grounds, and of hunters and fishermen to the outfitters of the region.

Regarding rail transportation, Canadian National Railway (CN) provides services to Matagami and Chibougamau, but the quantity shipped by rail is relatively low compared to road, due in large part to higher cost of transportation.

The multimodal transhipment recently built next to the town of Matagami is currently expanding, and another one is currently planned next to Chibougamau. Both are expected to increase volume of goods transported by rail to and from the region.

Maritime transportation is fundamental for supplying Nunavik communities further. Freight is transported to all of the ports in James Bay and Hudson Bay as much as four times per year from a base located in Moosonee. Full warehousing facilities located in Wemindji and Chisasibi facilitate connexions with various smaller-scale community port infrastructures located in the study area.

SOCIO-DEMOGRAPHY AND COMMUNITIES

The study area is home to approximately 32,000 inhabitants, more than half of which are Cree. The Cree population can be characterized as young and rapidly growing, in comparison with the non-Cree population that is significantly older and decreasing. It is believed that this trend will continue to hold over the next decades. The education level amongst Cree-aged 15 and over has improved considerably over the last few decades, with 49 % now holding a high-school diploma.

The creation of the Cree Board of Health and Social Services of James Bay (CBHSSJB) in 1978, as per Section 14 of the JBNQA, has led to a full range of healthcare services available to the Cree population, which has greatly increased their quality of life. Although full-time hunting and trapping remains a very important economic sector for a proportion of the Cree population, the overall participation of the active population in the labour market has risen significantly since the signing fo the JBNQA. Today, most working Crees are employed in the public services sector. As the economy of Northern Quebec relies mainly on the extraction of resources, whether these be hydroelectric production, mining or forestry, many Cree companies and entrepreneurs have been established to support these sectors, resulting in a Cree workforce that is more skilled today compared to 20 years ago. However, the cyclical nature of mining and the boom-bust nature of hydroelectricity (i.e. many jobs in construction and comparably little in operations) have had undesirable negative impacts on the sustainability of Cree businesses in these sectors.

The lack of housing development projects is probably the greatest economic issue facing both Cree and Non-Cree communities in the study area. On the one hand, this has resulted in overcrowding in many Cree homes, while on the other hand it has been a clear constraint to attracting new residents to the region. Insufficient funding and high transportation costs, particularly for the northernmost communities, are the key factors limiting housing developments in the region.

With a young, growing and more skilled labour force, it is expected that over the next few years the Crees will have an increasing impact on the the economic dynamics of the region. In particular, the strong development of capacity in the construction and transportation sectors, will result in their playing a major role in future infrastructure development projects.

ECONOMY

Hydroelectricity, mining and forestry form the backbone of the Eeyou Istchee economy. These sectors create a significant number of jobs and economic opportunities for both Cree and Non-Cree communities in the study area. The demand for increased and improved transportation infrastructure will therefore continue to grow in the future. Hydro-Quebec’s existing infrastructure, most notably their power-generating turbines, are expected to reach the end of their useful life in the coming decades, resulting in a need to ensure that the existing network, built largely for this sector, is able to accommodate the resulting increase in demand.

The region is also rich in mineral deposits, of which several are currently at the project appraisal phase, with a large number of exploration projects that has grown significantly in recent years, and this more specifically related to lithium deposits.

Finally, the forestry sector is an export-oriented manufacturing industry, with many companies located in the southern part of the study area. Exploitation activities are expected to remain relatively low but stable due to numerous factors such as travel costs, difficult environmental conditions and existing regulations.

Construction is a very important and stable sector for the local economy in all communities in the region, and tends to grow in periods of high growth from the mining and electricity sectors, in terms of labour, equipment and materials. Housing development remains important in communities but small relative to the regional economy. Access roads prevent local housing economy to be integrated with regional projects. Cree workers, entrepreneurs and companies have a strong and proven record in the construction sector.

In particular, the Cree Construction and Development Corporation (CCDC) has a strong reputation in numerous fields such as civil engineering, roads, and buildings. However, the Eeyou Istchee territory is large and communities remain far apart and poorly served by the existing network. This severely limits economic integration, limiting the number of companies providing goods and services crucial for procurement for this industry, resulting in a large amount of financial capital leaving the region. Nevertheless, some important exceptions include Gestion ADC, which provides food services and logistics to many businesses operating in the region, Kepa Transport, which provides transportation services of goods, equipment and materials and Petronor, which specializes in the transport of petroleum products. Goods procurement for the communities of Whapmagoostui and Kuujjuarapik is coordinated by Fédération des coopératives du Nouveau-Québec.

The tourism sector in the study area is small but growing. For many years, Hydro-Québec's LG-1 and LG-2 power stations located near Chisasibi have attracted many visitors in the summer. Cree cultural tourism is a growing sector, with each community offering visitors a wide range of unique traditional activities to experience. Nevertheless, this sector continues to be limited due to the poor transportation network and the high price of flying up from the south.

TRAFFIC AND REVENUE FORECASTS

The demographic projections indicate that a sustained increase in local travel needs for both passenger and freight demand will be substantial over the next 20 years and beyond. The results of the Market Survey reveal that the medium-term development of several lithium-related mining sites within the study area, the intensity of passenger and freight transportation related to several Hydro-Québec installations as part of La Grande Complex would justify upgrading the transportation infrastructures.

Traffic forecasts tend to show that the freight traffic would amount realistically to a bracket between 600,000 and 900,000 Metric Tonnes Per Annum (MTPA). If the Duncan Lake major iron ore project came on line, potential traffic on the Billy-Diamond Highway along the Phase II corridor (Rupert-La-Grande) and the Phase I corridor (Matagami-Rupert River) will increase nearly ten-fold. Furthermore, such a large project would greatly affect the economics of the potential road (Phase I) and rail (Phase III) corridor northwards to Whapmagoostui/Kuujjuarapik, as well as the potential seaport in that community (Phase III).

Future traffic forecasts on the proposed infrastructure are subject to uncertainty and unpredictability, notably because of the difficulty to predict future international economic conditions. For sectors such as mining and, to a lesser extent, forestry, regional and national actors have little to no control over these conditions which tend to determine the financial feasibility of major projects. The feasibility of these projects are therefore both influenced by and can be an influence to the justification for infrastructure such as a railway or a deep-sea port in the region.

LA GRANDE ALLIANCE OPPORTUNITY

The demand for transportation can take the form of individuals' need to travel for school, work, leisure, or services. It also takes the form of businesses and companies offering services or goods in the region. Infrastructure improvements will likely stimulate activity and induce demand by increasing an area's attractiveness as well as improving connectivity between communities. This, in turn, induces investment that subsequently stimulates increased productivity.

The proposed infrastructures are an opportunity to position the Cree population by creating targeted programs to ensure the growing population has access to job opportunities these would create. These opportunities will originate firstly from the construction of La Grande Alliance infrastructure and then from the induced construction projects associated with the augmented attractiveness of the area. Secondly, opportunities will be associated with the operations and maintenance of the infrastructure as well as the other induced developed activities. Lastly, benefits will come from secondary induced activities associated with the increased attractiveness of an area better serviced

by an improved transportation network. Both employees and employers can develop highly skilled competencies through increased economic integration and hence a cumulative causation effect.

Hence, La Grande Alliance program with its multiple components will not only address the current issues related to transportation such as decreased greenhouse gas emissions, improved road safety and accessibility as well as a reduction in transportation costs but can also induce many latent opportunities for both the population living in the area and the companies offering goods and services. Clearly, the proposed La Grande Alliance program will increase the supply side of transportation to a great extent.

Although the evaluation of potential demand as part of this study was found to be weak relative to the foreseen costs of such infrastructure, La Grande Alliance the development could be seen as a strategic investment to position the Cree population in the management of their land and the resources they hold.

If a proposed infrastructure is approved to be developed, the key will no doubt be for it to be done in a manner that closely involves local communities, entities, entrepreneurs and companies, in conformity with the JBNQA, thus making the proposed infrastructures socially, economically, and culturally viable both during the construction and operation phases

3 MAIN FINDINGS - SOCIO-ENVIRONMENTAL SURVEY

In addition to presenting a wide variety of social and environmental parameters that will influence the design as well as being potentially impacted by the project, La Grande Alliance Phases II and III Pre-Feasibility includes a very *innovative approach* of consulting and engaging with the territory users prior to the technical design phase of the proposed infrastructures. This allows their input into the project as early as possible, whilst benefiting from their tremendous knowledge of the territory, its resources, and additional environmental considerations.

The purpose of the Socio-Environmental Survey is:

1. To initiate a sustained effort of communication, collaboration, engagement and responsiveness to the concerns and expectations of the population;
2. To document the existing social and environmental aspects that could influence, benefit and/or be impacted by the development of the proposed transportation infrastructures by:
   - Compiling and validating existing data with stakeholders through direct engagement with the Community Information Officers (CIOs). Information is systematically reviewed to evaluate both their veracity and relevance to the current context;
   - Identifying all areas for which there is currently insufficient data and published information to inform recommendations for additional site sampling campaign and future community engagement strategies.

These objectives need to specifically take into consideration protected areas on the territory (Figure 3-1).

The assessment of social acceptability is a fundamental objective of La Grande Alliance. Previous developments in the territory of Eeyou Istchee Bay James have all given rise to debates that have led to some divisions within or between Cree and Jamesian communities. That division has left its mark, both physically on the territory and emotionally in the collective memory of individuals and communities, as well as cumulative impacts that interact with each other at various scales. Before contemplating new projects, people are anxious to learn from the past, and to avoid past errors. It is this concern to do things differently that is sought in the framework of this study, the importance of documenting and considering the social, cultural, and historical context of the communities with regard to the developments envisaged in the framework of La Grande Alliance.

The notion of social acceptability must consider the idea that building consensus takes time, and is unlikely to be achieved. Rather, the goal must be a sustained effort of communication, collaboration, engagement and responsiveness to the concerns and expectations of the population. It requires privileging dialogue to build a relationship of trust and mutual respect between all stakeholders. The Community Information Officers (CIOs) of the Cree communities, the resource persons in each Jamesian municipality or locality, the study Liaison Officers, and the rest of the WSP/Maamuu consulting team are key to the assessment of social acceptability which, it should be noted, is in constant evolution.

The Pre-Feasibility Study is a preliminary stage and therefore represents a crucial opportunity to lay the foundations of this relationship, as well as a recognition that the population can influence the design decisions in a positive manner, through the process of sharing their local reality (needs, knowledge, opportunities, concerns, etc.).

WSP and its Liaison Officer implemented the following processes as part of the study:

- Sustained communication and coordination with Cree communities, via the CIO, as well as engagement in each Jamesian municipality or locality;
- Engagement that is politically neutral, impartial and transparent at all stages (e.g., data collection tools, data compilation, data analysis, data validation and sharing of results);
- Participation of local experts in discussions and integration of shared knowledge in the development of recommendations and measures, which in turn was shared with technical teams;

- Consideration and integration of concerns and expectations in the development of possible mitigation measures as well as modifications to proposed corridors;
- Communications between the client and stakeholders based on mechanisms of neutrality, impartiality and transparency throughout the studies, in plain and accessible language to meet public expectations of being informed and listened to without judgement;
- Validation and feedback on information shared and its incorporation into project design;
- Rigorous record keeping for all exchanges and incorporation of comments from Cree experts and CIOs in an effort to strengthen the relationship of trust with communities;

The methodology implemented by the WSP social team and the Liaison Officer consisted of a literature review and data collection with Cree and Jamesian residents of the region.

Regarding data collection with Cree communities, three subgroups were targeted:

- Cree land users (tallymen and other Cree experts) of the traplines located within the corridors under study;
- Specific groups or associations, both locally and regionally, such as the Elders' Council, the Youth Council and the Cree Trappers' Association;
- The general public.

In the Jamesian municipalities or localities, two subgroups were targeted:

- The public;
- Stakeholder groups and associations.

The WSP social team and the liaison officer implemented specific engagement and consultation activities for the different groups engaged. WSP would like to acknowledge and thank the outstanding collaboration of the CIOs who greatly contributed to the successful completion of engagement activities listed below, as well as the various Maamuu Cree associates mobilized in each of the Cree communities visited. Representatives of the Jamesian municipalities or localities also greatly contributed to the successful completion of engagement activities.

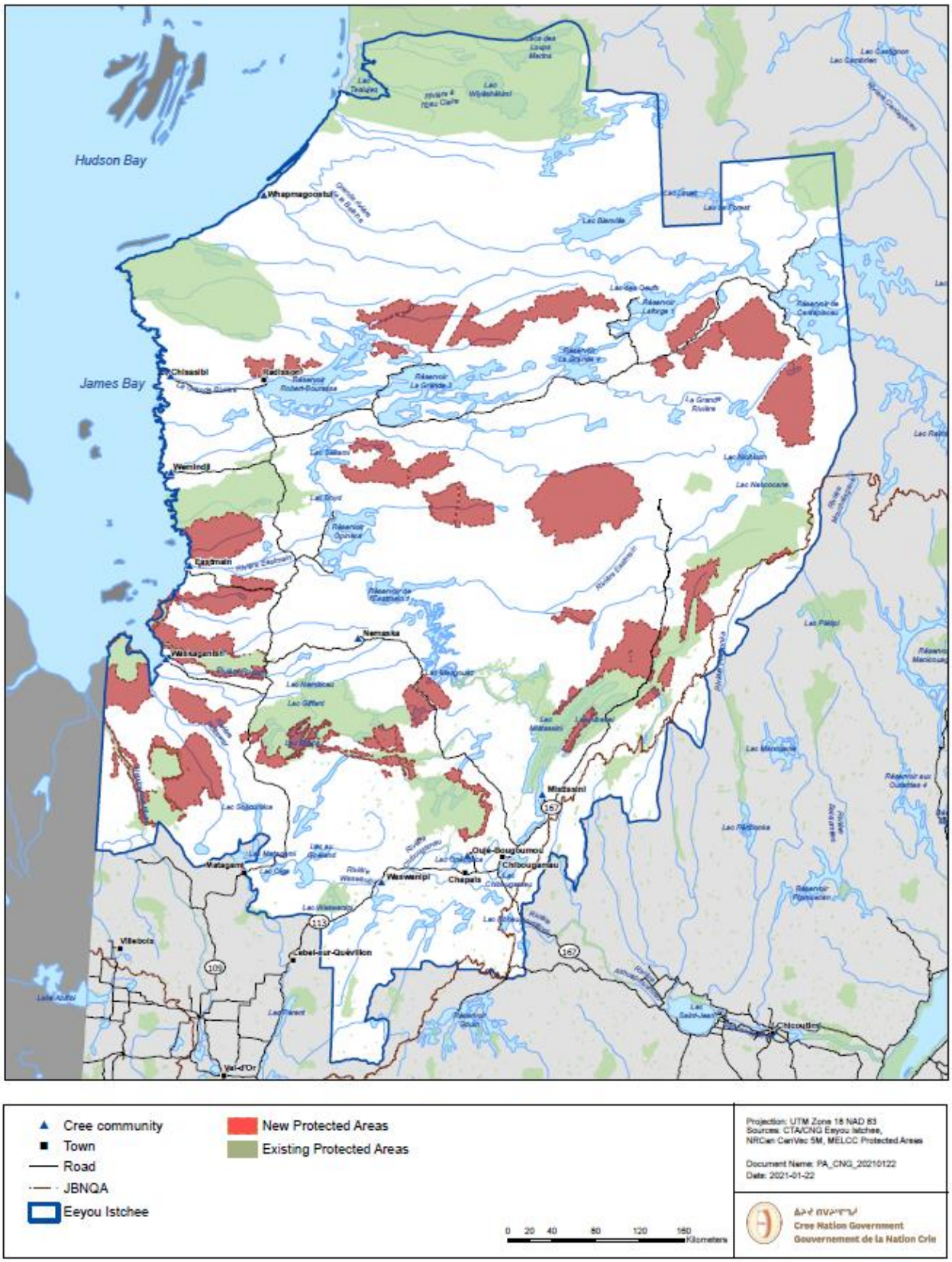


Figure 3-1 Protected Areas

3.1 EXISTING SOCIAL AND ENVIRONMENTAL ASPECTS

As mentioned in the introduction, La Grande Alliance Phases II and III Pre-Feasibility includes a very *innovative approach* of consulting and engaging with the territory users prior to the technical design phase of the proposed infrastructures. This allows their input into the project as early as possible, whilst benefiting from their tremendous knowledge of the territory, its resources, and additional environmental considerations. The figure below described the collected social and environmental data information pertaining to the Study Area:

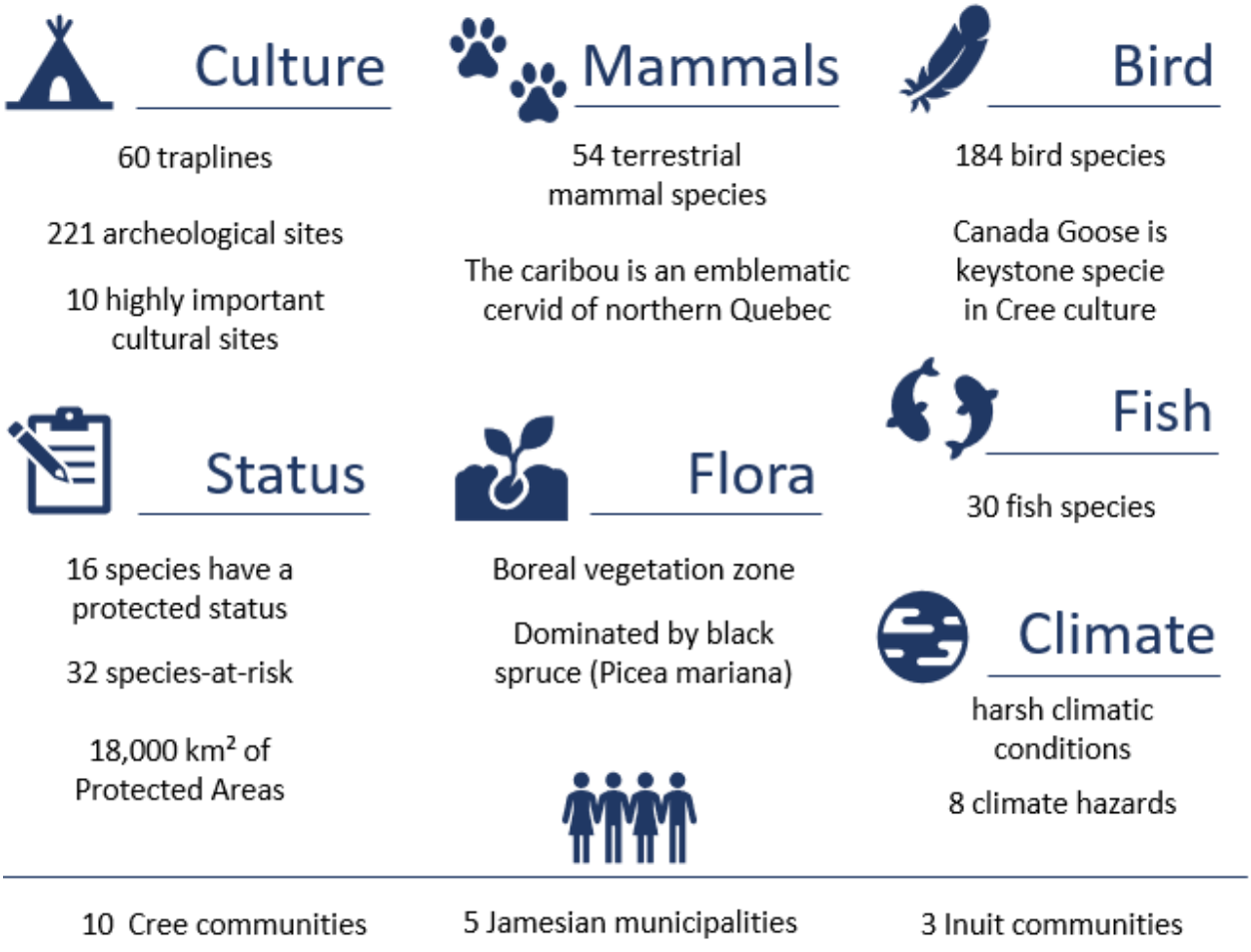


Figure 3-2 Phase II and III Overall Study Area Collected Data Results

4 GEOTECHNICAL

The purpose of this Section is to document the preliminary geotechnical assessment that was done for La Grande Alliance proposed transportation infrastructures. This assessment completed within the study area located in the territory of the Eeyou Istchee Baie-James region of northern Québec. The study area is divided in three zones:

- Study Area 1 (SA1): Billy-Diamond Highway Railway – Rupert – La Grande;
- Study Area 2 (SA2): Road & Rail Extension, and Harbour – La Grande – Whapmagoostui/Kuujjuarapik;
- Study Area 3 (SA3): Route 167 - Renard Mine – Trans-Taiga Road.

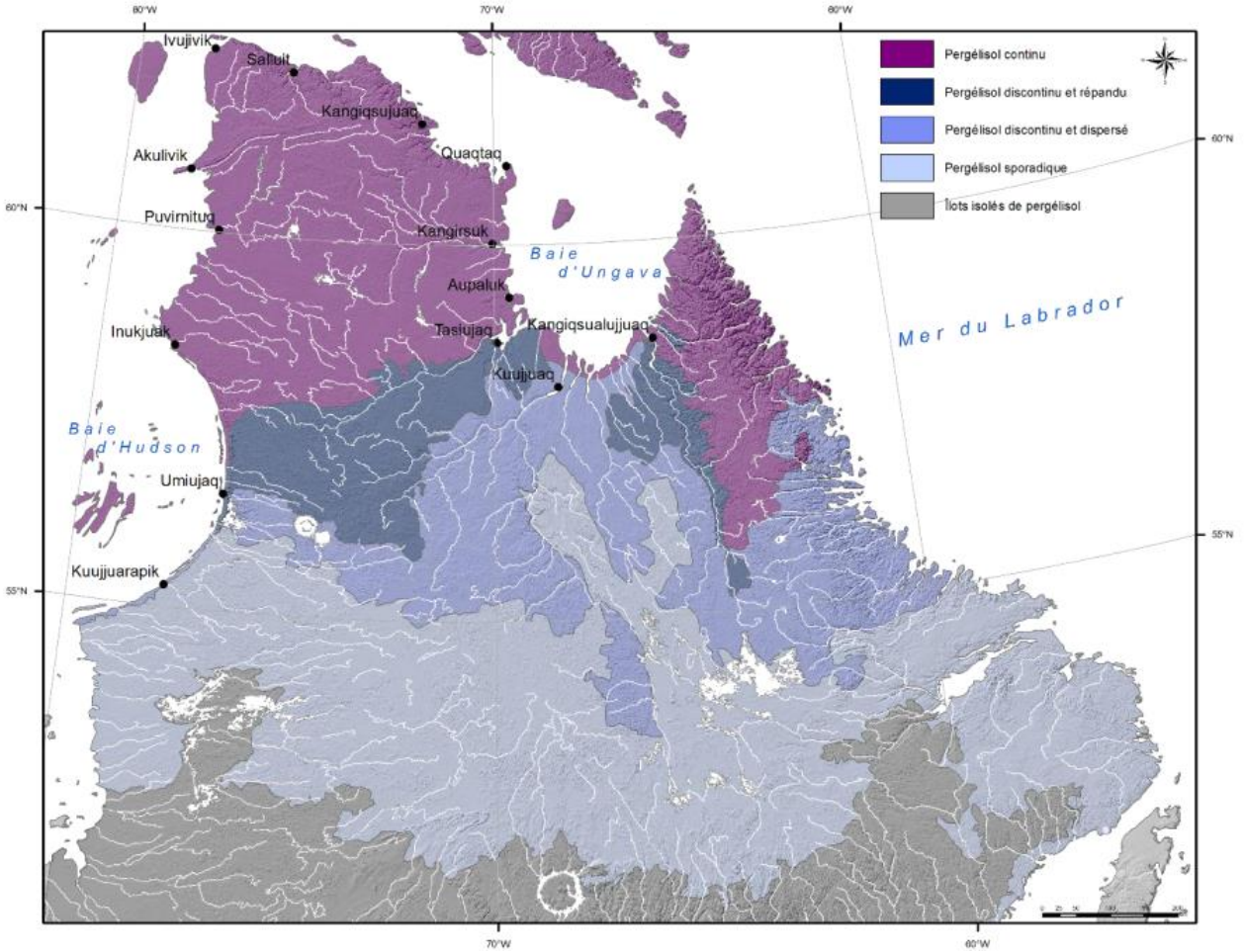
The objective of this preliminary assessment/desktop study was to analyze all available information to have a general overview of the deposits type as well as any potential geotechnical challenges and particularities associated with the proposed infrastructures.

The data collected consisted mainly of previous reports (sources of potential materials), geological maps, morpho-sedimentary zones maps, and borehole and test pits data. A review of existing data in the areas understudy led to the collection and compilation of available geotechnical and geomorphological data. The initial data included those provided by the Client (articles, previous MTQ studies, SDBJ, etc.), public databases such as SIGEOM, GESTIM and the Hydro-Québec database (Cherloc). Data was also obtained from the Centre for northern studies (CEN) at Université Laval and from the Direction générale de l'Abitibi-Témiscamingue at the MTQ.

It should be noted that, during the Study, the proposed roadway of La Grande to Whapmagoostui/Kuujjuarapik was moved to the feasibility stage and thus led to a preliminary field campaign to survey identified sites, and to manually collect soil and rock samples as well as a drilling rig that was carried out for the 6 selected potential quarry sites. The drilling data collected was analyzed and integrated into the Study's Geographic Information System (GIS).

4.1 PERMAFROST

According to the map Classification du pergélisol au Québec nordique (Allard et Seguin, 1987), permafrost is sporadic within the study area, except for Whapmagoostui/Kuujjuarapik area where permafrost is discontinuous and scattered. According to the Figure 4-1, sporadic permafrost (identified by the letter D) would represent less than 2% of the territory near Whapmagoostui/Kuujjuarapik area. This means that some patches of permafrost may be found in some areas concerned by the northern part of the study area. Moreover, fine-grained soils could contain ice in various forms and, therefore, must be considered unstable to thaw. The permafrost presence will therefore be monitored in areas where fine particles are present, i.e., in marine sediment deposits (silt and clay), in peatlands overlying fine sediments, and in till deposits composed mainly of fine particles. Some forms are identifiable on the aerial photographs and could be studied in greater detail to be avoided as much as possible when optimizing the various alignments.



Source: Extract from « Production de la 2ième approximation de la carte de pergélisol du Québec en fonction des paramètres géomorphologiques, écologiques, et des processus physiques liés au climat, March 2018 »

Figure 4-1 Permafrost distribution in northern Quebec (Modified from Allard et al., 2012)

4.2 STUDY AREA 1 (SA1): BILLY-DIAMOND HIGHWAY RAILWAY – RUPERT – LA GRANDE

This area is the foreseen location for the proposed 340 km railway infrastructures Rupert to La Grande. 40% of the of overburden over the proposed rail corridor (1 km buffer zone on either side of the alignment) is composed of organic soils (about 25%) and clayey soils (about 15%). These areas will pose the greatest challenge for the railway. Furthermore, approximately 44% of the alignment is composed of sand, gravel and till deposits, while the remaining 15% of the alignment is composed of rock. Problematic related to clayey and organic soils are, but not limited to, very low to low geotechnical resistance, susceptibility to freezing, long-term settlements and need in excavation of large slopes.

In terms of constraints, fine deep-water glaciomarine sediments that generally result in areas of clay deposits are found along the rail corridor alignment primarily in the northern part of the segment. The railway also crosses several sporadically scattered rocky areas distributed primarily in the central and northern portions of the alignment.

Approximately three areas of moderate slopes and three areas of steep slopes were identified at the center of the rail corridor alignment. Several wetlands were identified along the alignment, with a high proportion of these occurring in the northern portion of the transect. Some of the peatlands are particularly well developed and could represent a considerable risk of subsidence and settlement in the long term. Sixteen peatlands were identified, through photointerpretation, as major constraints, including five in the center of the Waskaganish rail corridor and 11 to the north.

In terms of potential granular material sources for construction purposes, fluvioglacial corridors occur more rarely in the portion south of the Eastman River. However, some till deposits have a grain size suitable for use as granular material. Reworked till is located to the southeast of the transect and could possibly compensate for the lack of granular sources in this area. Furthermore, several old quarries and gravel pits that are no longer in operation but that could be re-exploited (non-exclusive operating leases) are observed along the Billy-Diamond Highway. Some of these sites still contain appreciable quantities of quality material and are therefore easily accessible. To a lesser extent, there are also some sand and moraine deposits. As a result, the southern portion and the northern end of the study area have the highest proportions of borrow pits. In a 75-km portion of the alignment in Eastmain territory, between Kaministikuch and Duxbury lakes, located in the Eastmain and Wemindji communities, only four potential borrow pits have been identified. This will be an important limitation going forward. The morpho-sedimentary zones available on SIGEOM show a higher proportion of fluvioglacial sediments in the northern and central portions of the Waskaganish area.

The problematic areas (clay deposits, peatlands, and crossing of watercourses) should be further investigated with a preliminary drilling campaign and/or preliminary piezocone surveys including some in-situ testing, from which the soil and bedrock properties can be determined. The search for granular material sources by photointerpretation combined with field campaigns to collect spot samples should also be planned. Soil sampling in existing and potential borrow pits, as well as in potential quarries, is essential. Material availability is an important issue within this propose rail corridor along the existing road as the available quantities from sites are relatively small and new sources will need to be analyzed.

4.3 STUDY AREA 2 (SA2): ROAD & RAIL EXTENSION, AND HARBOUR – LA GRANDE – WHAPMAGOOSTUI/KUUJJUARAPIK

This area is the foreseen location for the proposed 219 km extension of the railway infrastructures from La Grande, the 207 km of roadway infrastructures extension as well from la Grande and a deep-water port along the Kuujjuarapik coastline (which was then redefined to a seasonal harbour).

The section below is divided into two subsections. First, the general data from the pre-feasibility study for the road and rail corridors is presented followed by a summary of the data from the road corridor specific feasibility study.

PRE-FEASIBILITY ANALYSIS

Previously to the La Grande Alliance transportation infrastructure study, road alignment studies were completed by Hydro-Québec and Poly-Géo The current proposed road alignment, shown on Figure 1-1, is very similar to the inland proposed concept from 2013, but more respectful of protected and highly sensitive areas such as *Réserve de territoire aux fins d'aire protégée du Lac-Burton-Rivière-Rogan-et-la-Pointe-Louis-XIV* and Rivière-Kanaaupscow-et-Lac-Kukamaw. The section between approximate stations 60+000 and 118+000 includes some alternatives that could be further studied in the next stage as each includes different benefits and impacts.

The stratigraphy of surface soils distributed along the proposed road corridor, for both alternatives 1 and 2, the rail corridor and considering a 1 km buffer zone on either side of the proposed alignments, is composed of slightly more than 50% of till, sand, and gravel deposits. The rest of the alignment is composed of an average of 20% of clayey

soils (i.e. silt and clay) and organic soils (from 17 % to 23 %), that may be problematic, and around 26% rock (from 24% to 29%).

In terms of constraints for the railroad corridor and the road corridor - alternatives 1 and 2 combined, in the Whapmagoostui/Kuujjuarapik area, fine deep-water glaciomarine sediments were in the lower elevations. The road and railway corridors cross these areas of fine materials mainly in the central and northern parts of the transect. A high proportion of these deposits are included in the water basins at the center of the road corridor. Although generally anticipated as little problematic given their small thicknesses, these deposits are prone to landslides in areas where they accumulate to large thicknesses.

Although the corridors cross several rock outcrops, these are generally sporadic and show little relief. Therefore, rock outcrops do not generally appear as a constraint to the road and the railway, except for two areas (km 48 and km 197) of moderate slope and one of steep slope (km 201) that were identified in photo-interpretations: two of these areas are located in the south-central part of the road corridor while the third is at the northern end. Also, a total of 22 major streams and water bodies are crossed by the proposed road segment, generally over short distances, while the railroad route intersects 19. However, a significant proportion of lakes are found in the southern part of the road corridor. Of these, three lakes are directly intersected by the proposed road. As for the proposed railway, it crosses a 400 m long stretch of water at km 93, in the center of the route. Wetlands are scattered throughout the corridors and are found in greater quantities at the northern portion of the road and railway corridors. They appear relatively undeveloped and easily crossed by the road and railway. Two more highly developed peatlands were identified in the south and center of the corridors (km 17 and km 130) in which they are considered as major constraints to the road's passage.

In the Whapmagoostui/Kuujjuarapik area, the unconsolidated deposits that dominate the shoreline bordering the port areas understudy are mainly composed of nearshore and prelittoral glaciomarine sediments generally consisting of sand, silt, and gravel deposits. Rock outcrops and bedrock covered by a thin layer of sediments are also found. Specifically, along the Great Whale River, the overburden are mainly composed of fine deltaic, prodeltaic, and deep water glaciomarine sediments which are made up of clays. Moreover, these sensitive clay deposits located near the Great Whale River are subject to reoccurring and sometimes major landslides. It should be noted that most of the drilling data recovered from previous studies in the SA2 area were found in the Whapmagoostui/Kuujjuarapik area. Geomorphological data specific to the port area (proposed seaport) are discussed in more detail in Technical Note 13B.

FEASIBILITY ANALYSIS

During the pre-feasibility mandate, the roadway of La Grande to Whapmagoostui/Kuujjuarapik area was moved to the feasibility stage. Given the remote context of the proposed roadway, the emphasis of the feasibility mandate was placed on finding sources of materials for the road construction. Existing data from previous studies were consulted and additional photo-interpretation works were carried out to identify material sources in the form of potential borrow pits and quarries. The search for borrow pits and quarries was limited to a 2 km radius on either side of the proposed main road corridor. This feasibility work done for the road corridor, described below, is likely to serve as an input for the rail corridor in terms of information on potential material sources since there are adjacent.

A first field visit was made, from July 11 to 15, 2022 to survey all identified sites, and to manually collect soil samples and rock samples from potential future borrow pits and quarries respectively. In total, 31 sites were visited including 15 potentials borrow pits and 16 rock outcrop zones for potential quarries. The soil samples were submitted to laboratory testing to determine if their inherent properties meet the current standards for a granular sub-base material. The rock samples recovered during the visit were reviewed by a geologist. A multi-criteria analysis was performed to select 6 sites along the proposed alignment of the main alternative (alternative 2) and located at an economically viable interval.

A second field campaign with a drill rig was carried out, from August 16 to September 7, 2022, for the 6 selected potential quarry sites. Two boreholes per site of around 15 m deep were drilled to recover sufficient rock core samples for laboratory testing. The results obtained in the laboratory generally show good intrinsic properties of the tested samples (soils and rock) for both granular sub-base and granular foundation materials. In terms of quantities, the road engineering team has defined the quantities of material required for the construction of the proposed road,

which has been divided into 20 segments (alternative 2). Overall, 5 of the 20 segments have a granular material deficit of between 70,000 m3 and 500,000 m3. These segments are in the northern portion of the proposed alignment, i.e., in the last two-thirds of the alignment to the north of the major borrow pit encountered near km 61. Surplus material is planned for the other 15 segments, so this surplus material could be used in the segments where a potential shortage is anticipated.

To pursue the geotechnical assessment of this area, a detailed mapping of the deposits and technical constraints (topography, low bearing capacity soils) should be done along the alignment. A future detailed drilling campaign from a geotechnical point of view (soil and rock sampling, in situ tests, other types of surveys to be considered) aimed initially at problematic areas (organic and clayey soils, water course crossing areas) that cannot be avoided, should be considered. Finally, it would be necessary to consider carrying out short drilling campaigns according to a regular grid to specify, among other things, the type of subgrade soils of the proposed road and the bedrock elevation.

4.4 STUDY AREA 3 (SA3): ROUTE 167 - RENARD MINE – TRANS-TAIGA ROAD

This area is the foreseen location for the proposed 204 km existing Route 167 upgrade and the 172 km road extension from the Stornoway Renard Mine access road to the Trans-Taiga. Overall, the distribution of overburden over the proposed road corridor (1 km buffer zone on either side of the proposed alignment) is composed of almost 100% of till, and to a lesser extent of sand and gravel. Less than 1% of the road corridor is covered with organic soils, and rock outcrops.

In terms of constraints, compared to the Waskaganish and Kuujjuarapik areas, there are no fine deep-water glaciomarine deposits. Although the corridor crosses few rock outcrops, the rock sometimes appears near the surface, resulting in steeper walls in some places. Photointerpretation works identified six areas of moderate slopes and four areas of steep slopes scattered throughout the road corridor understudy. A total of 20 major watercourses are crossed by the proposed road segment. Wetlands are found in very low proportions over the proposed road corridor and are scattered throughout the area in which they appear relatively undeveloped.

With respect to potential sources of granular material, the MERN GESTIM database identifies the presence of a few borrow pits located at the northern and southern ends of the segment, near existing roads. However, no borrow pits were identified at the center of the area due to the absence of roads. According to the morpho-sedimentary data available on SIGEOM, the sources of fluvioglacial materials on both sides of the proposed road appear to be well distributed over the entire alignment, except for an area extending over 25 km between segment 6 of alternative 01 and segment 3 of the main road, where granular materials are rarer. At this location, other fluvioglacial deposits are nevertheless identified along the periphery of the road, within a radius of 5 to 16 km of the proposed alignment. If the operation of these deposits would be less favourable due to the distance separating them from the road, the till deposits that cover most of the area could also be used as granular material in these areas where fluvioglacial sources are rarer.

To pursue the geotechnical assessment of this area, it would be pertinent to initiate photointerpretation works for surface deposits over a more limited pathway. Further photointerpretation analysis for granular material sources combined with a field campaign (as carried out in the summer of 2022 for the SA2 La Grande to Whapmagoostui/Kuujjuarapik roadway) to collect selected samples would also be pertinent. Soil sampling in existing borrow pits to confirm that their inherent properties meet current standards would also be relevant. From a geotechnical point of view, it would be pertinent to consider preliminary drilling campaigns as a priority at locations, along the alignment, where more problematic zones have been identified (water crossings, low bearing capacity soils).

Refer to Technical Note 10 for more detailed information on the geotechnical studies.

5 ROADS

This section provides the description of the proposed roadway infrastructures foreseen alignments included in the Phase II of La Grande Alliance Study, namely (see Figure 5-1s and 5-2):

- **ROUTE 167: UPGRADE & EXTENSION TO TRANS-TAIGA**
  - CH 305+000 to CH 411+700 (106.7 km): Upgrading and paving the existing section from Mistissini community access road to Albanel Lake access road;
  - CH 411+700 to CH 553+370 (141.7 km): No projected work other than MTQ's 5-year programmed projects since the road was recently built (opened in 2014);
  - CH 553+370 to CH 642+640 (89.3 km): Upgrading the existing Stornoway Renard mining road;
  - CH 642+640 to CH 814+710 (172 km): Proposed extension to Trans-Taiga Road.
- **ROADWAY: LA GRANDE TO WHAPMAGOOSTUI/KUUJJUARAPIK**
  - A proposed road corridor connecting Chisasibi community access road and Whapmagoostui/Kuujjuarapik, over 207 km.

Based on the results of this Technical Note, we have determined that it is possible to develop both proposed road infrastructures that follow best technical practice, social-environmental design drivers and in addition, respect the following drivers:

- Respect, as much as possible, the natural site topography (mountains and plains);
- Consider the overall geology of the study area, including the locations of aggregate material deposits;
- Avoid, as much as possible, lakes and rivers; minimize the length of crossings and bridges where these are unavoidable;
- Avoid, as much as possible, existing, and projected Protected Areas; minimize encroachment and/or provide mitigation measures where these are unavoidable;
- Minimize crossing and impacts on caribou migration corridors;
- Avoid, as much as possible, areas of cultural significance such as areas currently used by Cree land users, archeological sites, etc.; minimize encroachment and/or provide mitigation measures where these are unavoidable;
- Propose, wherever applicable, alignment variants that could offer added value, such as:
  - Locations that minimize environmental footprint;
  - Locations that minimize construction cost;
  - Locations that minimize the impacts on existing camps and facilities.

It is important to note that an important proportion of those proposed road infrastructures are planned in undeveloped areas. For these areas, we have identified additional processes to that further limit environmental risks impacts, with a view of accounting for the sensitivity of building new corridors in previously inaccessible areas (and entire regions), in line with the overall sustainable development objectives of the overall program which, it is hoped, will increase the overall social acceptability of these new corridors. Thus, for these areas tone of the main objectives of the goal of the Pre-Feasibility Study is to identify and propose alignments and locations that present the least risk, especially from the perspective of environmental sustainability and overall social acceptability of the proposed infrastructure.

Using the key drivers presented above, while at the same time respecting the related infrastructure retained Design Criteria, an alignment was developed first in plan, and then in profile. The design of any linear infrastructure is an iterative process to maximize the opportunities for improvement as more detailed information becomes available with the project development.

Therefore, the alignment presented at the Pre-Feasibility and Feasibility stage alignments do come with some is somewhat limited by the accuracy of information available at the time, as the collection of field data shall be carried out at future stage. As knowledge about fauna and flora is continuously evolving, the environmental factors and considerations will have to be updated at every step of the study. The environmental updates might result in the need for alignment correction/displacement to avoid sensible areas or mitigate the risks. Nevertheless, the various alignments presented in this report show on maps and figures on this mandate should be considered as potential corridors that require further optimization in the future steps.

As described in Technical Note 11, we recommend the use of MTQ road design standards (regional collector road) to ensure consistency in the construction of these roads and to facilitate their integration into the existing road network. We recommend that La Grande Alliance Implementation Committee asks the government to conclude a multiparty agreement on the financing of the construction, maintenance, and rehabilitation of these roads between HQ, MERN, the Société du Plan Nord, the Ministère des Finances du Québec, and the Secrétariat du Conseil du Trésor (SCT).

While it is recognized that building new corridors in previously inaccessible areas in the north needs to be done with extreme care for the environment and those who practice traditional activities in these areas, not to mention the uncertainty created by climate change and the potential social impacts of opening up the territory, we have nevertheless determined that it is possible to develop the proposed transportation infrastructures in a manner consistent with sustainable development.

Please refer to Technical Note 11 for more details.

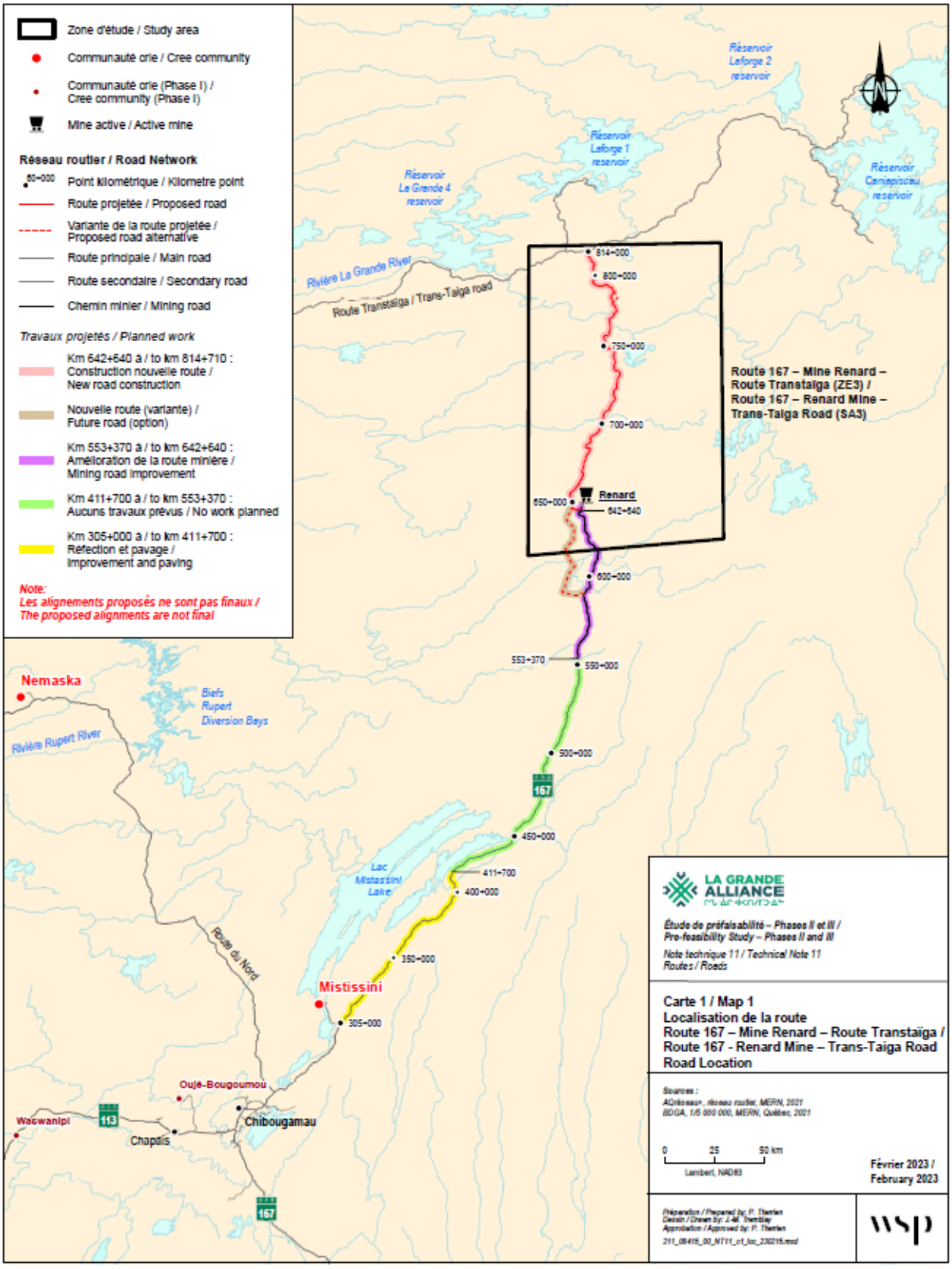


Figure 5-1 Route 167: Upgrade & Extension to Trans-Taiga – Proposed alignment

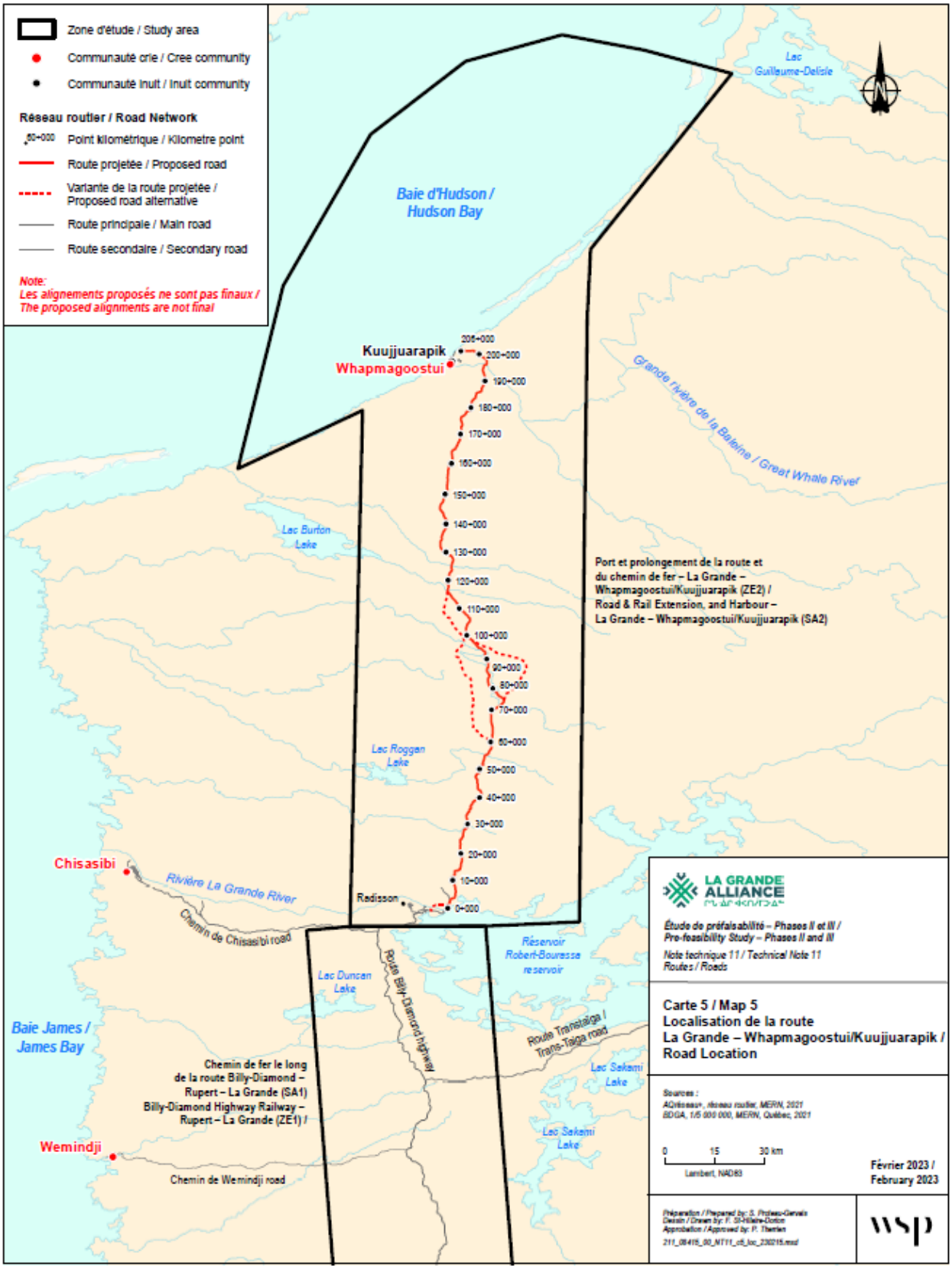


Figure 5-2 Roadway La Grande to Whapmagoostui/Kuujjuarapik - Proposed alignment

6 RAILWAYS

This section presents the pre-feasibility railway alignments developed by WSP for the following two segments:

PHASE II (6-15 YEARS)

- **Railway: Rupert to La Grande**

  A proposed railway alignment following, as much as possible, that of the Billy-Diamond Highway (BDH) starting at km 257 (after the Rupert River Bridge, which is the junction point with the railway alignment developed by the Phase I Consultant) all the way to La Grande River. The Phase II railway alignment extends over an approximate distance of 340 km.

PHASE III (16-30 YEARS)

- **Railway: La Grande to Whapmagoostui/Kuujjuarapik**

  A railway which follows, as much as possible, the projected road leading to Whapmagoostui/Kuujjuarapik (from the junction with the Phase II railway alignment). The Phase III railway alignment extends over an approximate distance of 219 km.

It is important to note that although there are railways in a comparable environment to the Study Zone - notably two mining railways further to the east on the Québec North Shore – there are no railways in the area covered by Phases II and III of La Grande Alliance.

Development of a Phase II and III pre-feasibility alignment involved following both best practice Railway Design Criteria and in addition, respecting the following environmental, technical, and economic drivers:

- Respect, as much as possible, the natural site topography (mountains and plains);
- Consider the overall geology of the study area, including the locations of aggregate material deposits;
- Avoid, as much as possible, lakes and rivers; minimize the length of crossings and bridges where these are unavoidable;
- Avoid, as much as possible, existing, and projected Protected Areas; minimize encroachment and/or provide mitigation measures where these are unavoidable;
- Minimize crossing and impacts on caribou migration corridors;
- Avoid, as much as possible, areas of cultural significance such as areas currently used by Cree land users, archeological sites, etc.; minimize encroachment and/or provide mitigation measures where these are unavoidable;
- Propose, wherever applicable, alignment variants that could offer added value, such as:
  - Locations that minimize environmental footprint;
  - Locations that minimize construction cost;
  - Locations that minimize the impacts on existing camps and facilities;
- Remain, as much as possible, in close proximity to existing and/or proposed roads;
- Remain within 1 km corridor centered on existing and/or proposed roads when surrounded by recognized Protected Areas on both sides;
- Minimize the number of times the railway crosses existing and/or proposed roads.

The conclusion of this pre-feasibility study is that it is possible to develop a railway alignment, stretching from slightly north-west of the Rupert River bridge to La Grande (Phase II) and a railway alignment from La Grande to Whapmagoostui/Kuujjuarapik that meets the Design Criteria and other social-environmental design drivers.

The overall length of the Phase II alignment is of 340 km, and its sinuous nature reflects the many lakes and the varied topography traversed. As requested, to minimize the environmental impacts, the railway alignment generally follows the Billy-Diamond Highway (70% of the total length). The approximately 30% which is not within 100 meter from the studied road is due to the railway design criteria that do not allow to follow the highway curves. However, some horizontal curves were designed with a speed reduced to 65 mph (±105 km/h) for passenger trains, which represents approximately 48 km, which represents about 14% of the 340 km-long alignment.

The overall length of the Phase III alignment is 219 km, and its sinuous nature reflects the many lakes and the varied topography crossed. As requested, to minimize the environmental impacts, the railway alignment generally follows the proposed road to Whapmagoostui/Kuujjuarapik (75% of the total length). the. The approximately 25% which is not within 100 meter from the studied road is due to the railway design criteria that do not allow to follow the road curves. The railway could potentially follow the roadway up to 100% of the way (within 100-m) with refined detailed engineering, i.e., combination of adjustment to the railway design criteria as well as road optimization to suit the railway. However, adjusting the road to always fit the railway alignment may result in higher road infrastructure cost.

For Phase III's alignment, in order to avoid waterbodies and to minimize the offset from the roadway corridor, the design speed in a considerable part of the horizontal curves of Phase III is reduced to 60 mph (±97 km/h) for passengers and 50 mph (±80 km/h) for freight, instead of 80 mph and 60 mph respectively. Those reduced speed zones sum up to approximately 69 km, which represents about 31% of the 219 km-long alignment.

One important challenge for phase III rail corridor is crossing La Grande River. Due to the heavy axle load and lack of space above the Dam structure, the rail corridor could not use the Dam or the spillway to cross the river. The length of this potential structure was estimated over 1 km long due to the topography and railway design slope limitation. This potential structure is preliminary located 4.5 km downstream from the Dam.

In terms of additional considerations, the design of a new railway typically required the determination of a best-practice railway alignment – which has as of now been carried out at a pre-feasibility level and the rightsizing, as a function of freight/ridership levels, infrastructure elements, rolling stock quantities, maintenance facilities, and ultimately staffing levels all tasks which will need to be carried out in future studies.

As the studies moves forward, future design activity should focus on detailed infrastructure design but also on the following aspects of a railway project that influence the technical aspects:

- Ownership structure – private or Cree-Quebec joint ownership, operations model – at one extreme with all management, operations, and maintenance services provided in-house and, at the other extreme, all services contracted out;
- Training: if a stand-alone, fully self-staffed operating entity is privileged, the significant upfront requirement for training to provide the unique skillsets needed to manage, operate, and maintain a railway must not be underestimated. The time required to carry out these training activities can rival the time required to construct such a railway.

We must emphasize that the proposed alignments are conceptual and preliminary. Further studies and discussions with land users will be required to refine that design. The main objective of this current study is to identify and document the main design guidelines to be considered. Other issues will likely emerge and will influence the detailed design. The innovative process used has the great advantage of opening the dialogue between all the stakeholders allowing them to be involved throughout all the phases of the project development.

The Figure 6-1 on the following page presents a map with an overview of the proposed railway location.

Refer to Technical Note 12 for more detailed information.

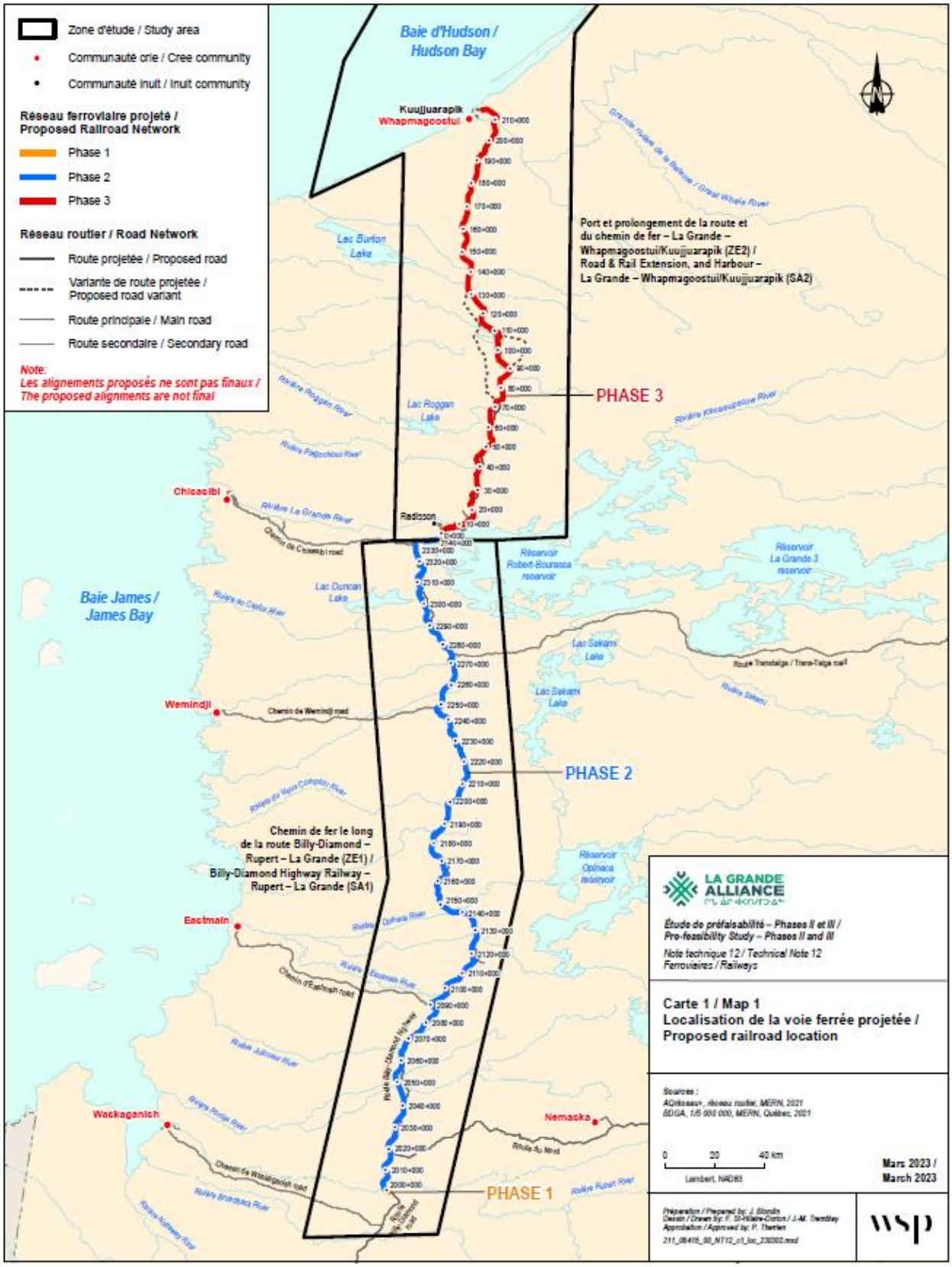


Figure 6-1 Proposed Railway Alignments

7 CIVIL ENGINEERING STRUCTURES

This section describes the proposed civil engineering structures required for the proposed roadway and railway alignments described in both Technical Note 11 - Roads and Technical Note 12 - Rails. The design of railway civil structures is mainly based on the AREMA regulations. The design of roadway civil structures is mainly based on the MTQ road and bridge design standards and CSA-S6 regulations and criteria. The civil structures were developed based on the same road and rail key factors:

- Respect, as much as possible, the natural site topography (mountains and plains);
- Consider the overall geology of the study area, including the locations of aggregate material deposits;
- Avoid, as much as possible, lakes and rivers; minimize the length of crossings and bridges where these are unavoidable.
- Avoid, as much as possible, existing, and projected Protected Areas; minimize encroachment and/or provide mitigation measures where these are unavoidable.
- Minimize crossing and impacts on caribou migration corridors.
- Avoid, as much as possible, areas of cultural significance such as areas currently used by Cree land users, archeological sites, etc.; minimize encroachment and/or provide mitigation measures where these are unavoidable.
- Propose, wherever applicable, alignment variants that could offer added value, such as:
  - Locations that minimize environmental footprint;
  - Locations that minimize construction cost;
  - Locations that minimize the impacts on existing camps and facilities;
- Remain, as much as possible, in close proximity to existing or proposed roads;
- Remain within 1 km corridor centered on existing or proposed roads when surrounded by recognized Protected Areas on both sides;
- Minimize the number of times the railway crosses existing or proposed roads.

The foreseen required civil engineering structures for La Grande Alliance proposed transportation infrastructures, are as per follows:

Table 7-1 Summary Table

INFRASTRUCTURE	TOTAL LENGTH	TOTAL BRIDGES NUMBER	MAJOR BRIDGES	BRIDGE LENGHT	% OF ROAD OR RAIL ON A BRIDGE	NUMBER OF BRIDGE PER 10 KM
Route 167: Tow (2) Upgrade	106 km 97 km	1*	-	n/a	n/a	n/a
Route 167: Extension to Trans-Taiga	172 km	23	2	0.5 km	0.5 %	1
Roadway: La Grande to Whapmagoostui/Kuujjuarapik	207 km	62	11	2 km	1 %	3
Railway: Rupert to La Grande	340 km	36	8	2.6 km	0,8 %	1
Railway: La Grande to Whapmagoostui/Kuujjuarapik	219 km	66	27	9.4 km	4 %	3

*Note *: Rehabilitation of one existing bridge by MTQ in the next 5 years*

Refer to Technical Note 14 for more detailed information.

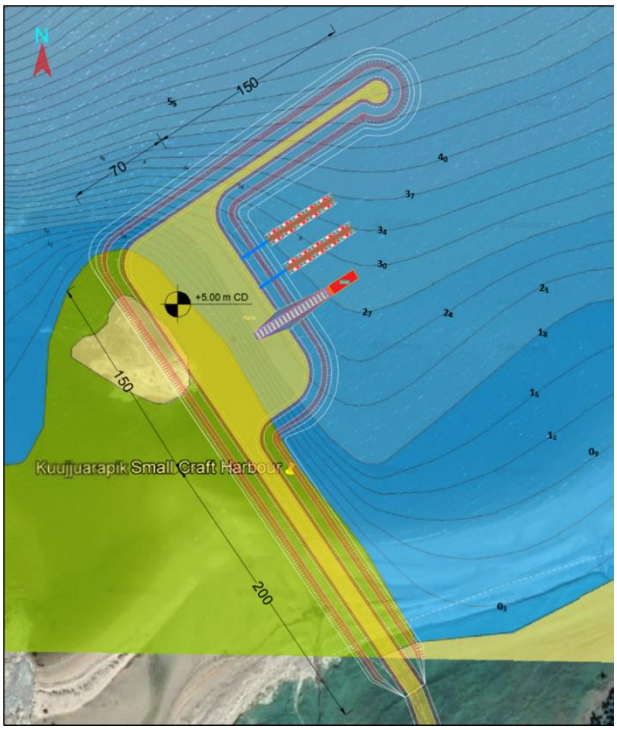
8 HARBOUR WHAPMAGOOSTUI/KUUJJUARAPIK

Using the results of a Multi Criteria Analysis, one of the four shortlisted zones near Kuujjuarapik was selected as the preferred site. That study was based on the available physical and environmental conditions including ice conditions, coastal geomorphology, coastal processes and accessibility along the Hudson Bay's shoreline coastline between the mouth of Great Whale River and the entrance of the Manitounuk Strait, and in the vicinity of Îles Qikirtaaruit.

Since the market survey and cargo forecast study results show that expected demand in the near and intermediate future is not sufficient to sustain a deep-water port investment, the study team has developed a conceptual design of a Small Craft Harbour to answer community needs, accommodating fishing vessels and transporting goods from sealift vessels to the shore. A site selection study has been conducted through available data including ice conditions, coastal geomorphology, coastal processes and accessibility.

Considering recent landslide upstream from the mouth of Great Whale River and the perceived risk of excessive sedimentation, the proposed Small Craft Harbour is considered as a mitigation measure providing an alternative to the community if the existing natural beach harbour would become non-operational. Details for the selected site and proposed Small Craft Harbour arrangement remain to be finalized but will allow for a future development of a Deep-Water Port when required.

The conceptual design proposed for the Whapmagoostui/Kuujjuarapik SCH includes a description of this potential infrastructure's requirements (harbour space, fishing fleet berthing/support zones and onshore facilities), harbour layout (as shown in the following sketch) and conceptual design of harbour elements including:



- Floats, or floating platforms/docks, that allow a relatively dense berthing pattern for 20 small boats (fishing boats) and easy access to get boats on and off.
- A shore access ramp located within the protected area of the harbour, which will be primarily used for loading/offloading of goods and commodities transferred from the Sealift provider to shore via dedicated barges.
- A shore-connected breakwater to shelter the berths/floats from the incident waves.
- A reclaimed onshore area to accommodate potential onshore operations and functions including service areas, office and parking areas, storage areas (including areas to store the floats during winter seasons), and access roads/approaches.
- An access causeway connecting the onshore area to the local roads.

The environmental and coastal geomorphological impacts of constructing the proposed SCH will need to be investigated in the next phases.

It should also be noted that the Inuit were not engaged in this process. As a result, several structures located in the vicinity of the harbour were not identified. Further discussion with communities and leadership is a mandatory next step for this component.

Refer to Technical Note 13A and 13B for more detailed information.

9 CONSTRUCTION OVERVIEW

For each component, a generic master project schedule was developed considering the various steps that will be required. This includes planning, obtaining approvals, environmental and social assessment, construction, and commissioning of the system. As agreed with the phase I consulting team, the year “0” has been established as 2028 for the beginning of construction and it is assumed that the first infrastructures will be ready for use by 2035.

Among the factors that will impact the schedule, the procurement mode selection to award the various contracts to execute the work is critical. However, since the project is such at an early stage, procurement analysis decisions are not yet available. We therefore considered a conservative approach based on a traditional delivery mode for this preliminary review. The preferred method of implementation will certainly be discussed and analyzed during the future stages of the project as it progresses. The various economic and project-specific issues (manpower, training, Cree culture, financing, potential participation of the private sector and others) will have to be integrated into the analysis for the choice of a procurement mode. The selected implementation and procurement option could also significantly influence the total delay as well as the scheduling/overlapping of some of the activities related to the realization of a project. Please note that procurement modes are further detailed in Technical Note 21. In addition, the isolated northern location of this project brings a unique aspect to the potential project. Weather conditions and challenges related to the availability of labour and materials will affect the schedule and the field work planning.

Many factors, such as laws & regulation, environment & soils conditions, site accesses, market conditions, and labour resource, can still influence this schedule assessment and must be further studied in the upcoming phases. It will be necessary to assess these issues and to mitigate risks to construction timelines. The timeline herein is realistic but remains theoretical as many contingencies, real or imagined, cannot be considered at such an early stage in the evaluation due to such a high level of uncertainty. Appropriate risk and sensitivity analyses will be required at future phases to evaluate timelines adequately.

As illustrated in the Figure 9-1, the proposed timeline for this study is anticipated as follows:

- **Phase I**
  - 2023-2029: Field investigation, consultation, permits, detailed engineering, and procurement;
  - 2030-2035: Railway Construction and start operation.
- **Phase II**
  - 2030-2035: Field investigation, consultation, permits, detailed engineering, and procurement;
  - 2035-2040: Roadway and Railway Construction and start operation.
- **Phase III**
  - 2035-2040: Field investigation, consultation, permits, detailed engineering, and procurement;
  - 2040-2045: Railway and Harbour Construction and start operation.

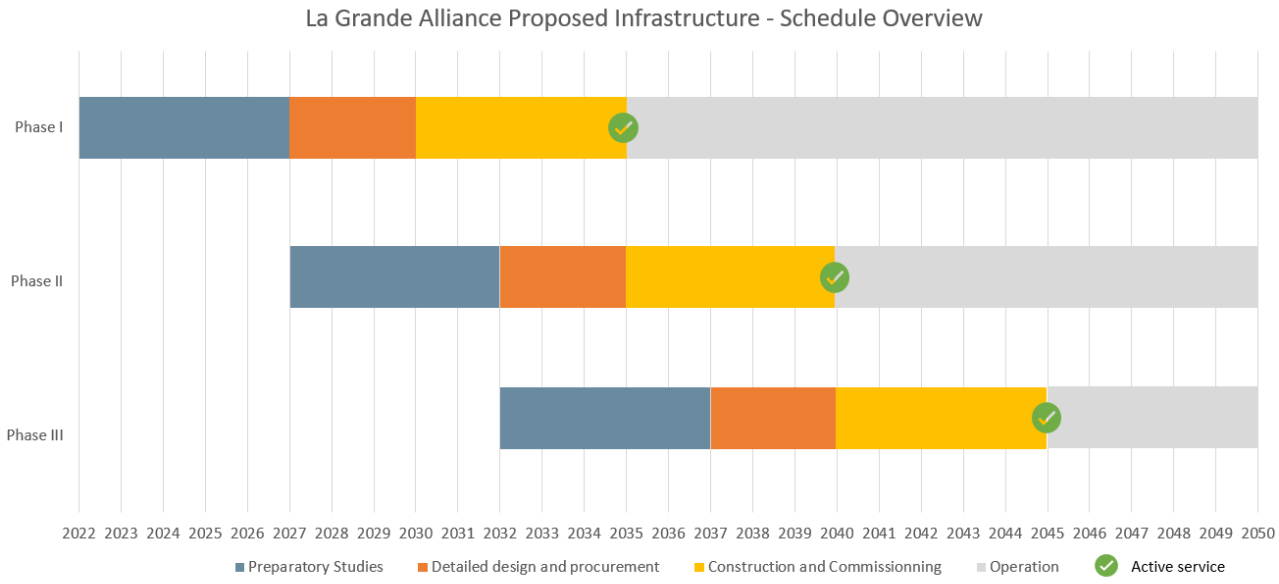


Figure 9-1 La Grande Alliance Proposed Infrastructure - Schedule Overview

Refer to Technical Note 15 for more detailed information.

10 CONSTRUCTION COST ESTIMATES

Construction cost estimates are based on unit costs or linear costs from recent projects completed by WSP teams in Canada and the U.S., with adjustments made to best suit the local northern context.

Construction cost estimates are based on the description and linear meter of the infrastructure described in Technical Notes 10 to 15 (geotechnical, roads, railroads, harbour, civil structures and construction overview). The determination of unit costs was the responsibility of each discipline leader. It was coordinated and validated by the cost estimator and the study management leaders.

Costs are quoted in CAD $2022. Construction costs are based on pre-tax values in August 2022 economic conditions. An escalation of the 2022 costs has been added to reflect the projected work as per anticipated construction schedule (refer to main assumptions section below) assuming a price indexation of 2.1% per annum based on the QIS Q1 2019 report and amounts to 2.1%. Capital costs do not include right-of-way acquisition, applicable taxes, and financing costs.

Table 10-1 La Grande Alliance's Phase II and III Capital Cost Estimates

PHASE II & III INFRASTRUCTURE		DISTANCE	COST ESTIMATE		COST RANGE
R-167	Upgrading MTQ section from Mistissini to km 411	106 km	$271M	$1,053M	$1.5M to $2.5M per km
	Maintaining MTQ unpaved section from km 411 to km 553	141 km	-		
	Upgrading Mine road from km 553 to Stornoway Renard mine	89 km	$100M		
	Extension Stornoway Renard mine to Trans-Taiga Road	172 km	$685M		
Roadway: La Grande to Whapmagoostui/Kuujjuarapik		207 km	$1,428M		$6M to $8M per km
Railway: Rupert to La Grande		340 km	$3,958M		$10M to $14M per km
Railway: La Grande to Whapmagoostui/Kuujjuarapik		219 km	$4,899M		$20M to $25M per km
Harbour at Whapmagoostui/Kuujjuarapik		-	$57M		-

Note 1: To simplify the presentation, each item amount has been rounded to tenths, according to the detailed data in the source cost estimate file.
Note 2: Class D Estimate -20% to +100% margin of error.

Refer to Technical Note 16 for more detailed information.