CREE DEVELOPMENT CORPORATION

LA GRANDE ALLIANCE

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

TECHNICAL NOTE 18
RISK AND MITIGATION MEASURES

FINAL VERSION

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EXECUTIVE SUMMARY

This technical note focuses on conducting a qualitative analysis to identify key risks and mitigation measures based on the current stage of development. The quantitative risk analysis will need to be completed with additional information (procurement models) in a subsequent stage.

The analysis is based on the approach developed in the context of the planning and implementation of major public infrastructure projects in Quebec. It allows to highlight the most important risks among those that have been identified in order to allow their consideration upstream of the proposed infrastructures development process.

A risk analysis workshop was held in November 2022 between the WSP team and members of the study's Technical Committee. The purpose of the workshop was to allow the experts to discuss the risks associated with the proposed infrastructure and to develop hypotheses regarding the probability and impact of the identified risks as well as to propose mitigation measures. During this stage, a non-restrictive approach was favored in order to identify as many risks as possible and cover all aspects of the Study. The discussions also focused on identifying opportunities or possibilities to be seized in the context of the future development of the proposed infrastructures.

A total of 56 risks were identified of which 3, or 5.4%, were rated as “very low” or “low”, 24 or 42.9%, were rated as “moderate” and 29 or 51.8%, were rated as “high” or “very high”. Of the 53 risks with severity levels above the tolerence threshold, 29 require immediate attention due to their “high” or “very high” severity.

Table Distribution of the Proposed infrastructures Risks

RISK CATEGORIES	VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	TOTAL
Planning phase	0	0	3	5	1	9
Design phase	0	1	4	1	0	6
Site conditions - Environment	1	0	1	3	0	5
Construction & Commissioning	0	0	8	5	0	13
Operation & Maintenance	0	0	3	3	0	6
Social & Political	0	0	3	5	0	8
Finance & Economy	0	0	0	3	1	4
Legal	0	1	2	2	0	5
Total	**1**	**2**	**24**	**27**	**2**	**56**

Among the general mitigation measures to be considered to minimize the risks of the proposed infrastructures, it is essential to continue to communicate and work in concert with the stakeholders and government authorities throughout the development of this proposed infrastructures in order to obtain agreement on the scope of work and the support of the stakeholders, and more particularly the Cree community.

The proposed alignments optimized solutions retained for the projected infrastructures will have to avoid or reduce the risks associated with the protected areas and the environment in conformity with the fundamental and cultural values of the Cree nation, notably by maintaining the involvement of the Cree population in the decision-making process leading to the choice of the infrastructures to be built in full knowledge of their impacts on the territory.

It is also important to mention that this study, with its engagement approach, is a mitigation measure in itself to reduce the risk of social acceptability. The fact that this study is conducted by the Cree Nation for the Cree population is an innovative way of doing things in Cree territory since the population is informed well in advance of potential future work and adjustments can be made to meet the expectations of the Cree population. This is a completely different approach from what was done in the past.

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1 INTRODUCTION

The monitoring of risks associated with the pre-feasibility of any major infrastructure project represents, in terms of sound project management, an essential activity that ensures the control of various events that could jeopardize the achievement of the objectives defined in the project plan, specifically with regards to the respect of cost parameters, completion deadlines, and project acceptability.

All activities associated with the risk workshop and analysis allow, among other things, to define the threats that could negatively affect the proposed Project and to identify the various action and mitigation plans to be put in place to minimize their negative impacts. In the long run, these initiatives allow for the creation of a monetary reserve, which, combined with the proposed Project budget, allows for proactive management of the overall cost envelope.

This exercise must be carried out at different phases of the entire proposed Project cycle since, depending on the progress and evolution of the study, the nature and level of importance/impact of the risks are likely to change over time. Thus, some threats already identified may materialize, new threats may arise, while others are bound to disappear. Depending on their status, the level of risk monitoring must be adapted: those identified as major must be monitored in a more specific and continuous manner, while minor threats will require more punctual attention over time and less sustained.

WSP's mandate includes conducting a qualitative analysis to identify the main risks and mitigation measures based on the current stage of the study (see Figure 1-1). The quantitative risk analysis as well as the analysis of potential procurement models will be confirmed in a subsequent study.

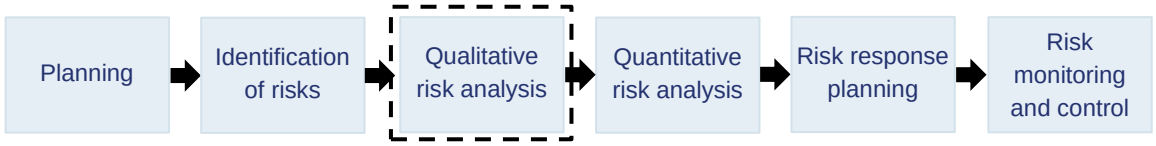

Figure 1-1 Risk Management Process

2 RISK QUALIFICATION APPROACH

The analysis is based on the approach developed in the context of the planning and implementation of major public infrastructure projects in Quebec. The qualitative analysis allows highlighting the most important risks among those identified to allow their consideration upstream of the foreseen infrastructures development process.

2.1 RISK MATRIX

The risk matrix is at the heart of the recommended approach since it groups all the identified risks and presents their probability of occurrence as well as their ranking according to their respective impact. Mitigation measures are also proposed for each identified risk. It is important to note that this matrix is based on the information available at the time it was completed, i.e., November 2022. It is an iterative tool that can be updated on an ongoing basis during the planning phase and on a regular basis in the risk monitoring and control process, during the design, construction and implementation and operation phases.

2.2 METHODOLOGY - 4 STEPS

The methodological approach of the qualitative risk analysis is illustrated in Figure 2-1. The qualitative analysis aims to highlight the most important risks of the future realization of the proposed infrastructures, so that they can be given greater attention and closer monitoring during the planning phase of the proposed infrastructures.

STEPS	APPROACH	HOW?	RESULTS
Identify	– Identify and describe all risks associated with the proposed infrastructures	– Experience and understanding of proposed infrastructures	
Evaluate	– Establish the probability of occurrence and the impact		
Categorize	– Categorize risks according to their severity	– Risk workshop with experts	– Risk matrix
Analyse	– Establish a tolerance level		

Figure 2-1 Steps of the Qualitative Risk Analysis

2.2.1 STEP 1 – RISK IDENTIFICATION

A risk is a possible event or condition whose occurrence would have a positive or negative impact on the project objectives. The risk identification process consists of identifying and describing the risks for the entire life cycle of the Project. These risks are identified based on the experience of the experts involved and their understanding of the Project. Only those risks that can potentially have a material impact are considered. These are the risks whose impact is materially correlated to the Project's objectives according to the triple constraint model, i.e., costs, delays and content (see Figure 2-2). These three objectives are interdependent and changes to any of the variables will affect quality.

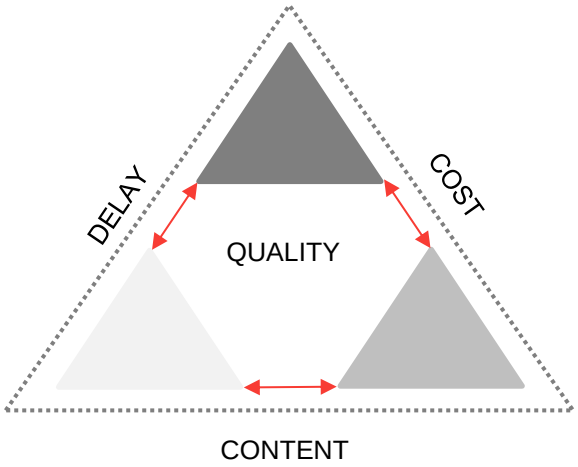

Figure 2-2 Triple Constraint Model

Within the framework of the proposed Project, the identified risks are divided into the following categories:

- Planning phase;
- Design phase;
- Site Conditions - Environment;
- Construction and Commissioning;
- Operation and Maintenance;
- Social and Political;
- Finance and Economics;
- Legal.

During this stage, an open-ended approach was used to identify as many risks as possible and to cover all aspects of the proposed Project. Discussions also focused on identifying opportunities or possibilities to be seized in the development of this study.

2.2.2 STEP 2 - RISK ASSESSMENT

The risk assessment consists in establishing the severity according to the probability of occurrence and the impact according to the following formula Severity = Probability x Impact. The severity analysis is performed according to the risk probability scale given in Table 2-1 and the impact definition parameters given in Table 2-2.

Table 2-1 Risk Probability Scale

SCALE		PROBABILITY
Almost certain	5	≥70%
Very likely	4	[50-69%]
Possible	3	[30-49%]
Unlikely	2	[10-29%]
Improbable	1	<10%

Table 2-2 Parameters of the Impact Analysis according to the Project's Objectives

OBJECTIVES	DEFINITIONS OF NEGATIVE RISK IMPACTS				
	Very low 1	Low 2	Moderate 3	High 4	Very high 5
Cost ($)	Over budget < 0.5%	Over budget 0.5 – 2%	Over budget 2 - 5%	Over budget 5 - 15%	Over budget > 15%
Delay	Increase in delays 0-3 months	Increase in delays 3-6 months	Increase in delays 6-12 months	Increase in delays 12-18 months	Increase in delays > 18 months
Content	Barely noticeable content reduction	Minor areas of content affected	Major areas of content affected	Reduction of content unacceptable for the organization	Unusable infrastructure
Quality	Barely detectable quality degradation	Only secondary structures are affected	Quality reduction requiring agency approval	Reduction in quality unacceptable to the organization	Unusable infrastructure

2.2.3 STEP 3 - RISKS RANKING

Risks are ranked according to their severity, as shown in Table 2-3, allowing the project team to plan levels of management effort accordingly. Mitigation measures were proposed for each of the identified risks. The analysis of the residual impact after the application of the mitigation measures was also considered, but this ranking has to be considered as preliminary due to the high level of uncertainty at this stage of the proposed project.

Table 2-3 Risk Ranking

SCORE	ACTION	COLOR
Very high (15-25)	Risk that requires immediate elimination measures	
High (9-12)	Risk that requires immediate preventive action	
Moderate (5-8)	Risk that requires proactive management	
Low (3-4)	Risk that requires periodic monitoring	
Very low (1-2)	Risk that does not require immediate action	

2.2.4 STEP 4 - RISK ANALYSIS

The risk analysis first refers to the establishment of the risk tolerance threshold for the Project based on the severity of the identified risks. Risks above the tolerance level will be quantitatively analyzed in a later phase of the proposed Project while the others will be placed on a watch list.

Table 2-4 Tolerance Thresholds according to Severity Levels

PROBABILITY		IMPACT				
		VERY LOW 1	LOW 2	MODERATE 3	HIGH 4	VERY HIGH 5
Almost certain	5	5	10	15	20	25
Very likely	4	4	8	12	16	20
Possible	3	3	6	9	12	15
Unlikely	2	2	4	6	8	10
Improbable	1	1	2	3	4	5

Tolerance threshold

3 RISK ANALYSIS WORKSHOP

A risk analysis workshop was held in November 2022 between the WSP team and members of the study's technical committee. This workshop was designed to allow the experts to discuss the risks of the proposed Project and develop hypotheses regarding the likelihood and impact of the identified risks, as well as proposed mitigation measures. During the workshop, the various experts exchanged views to explicitly feed the qualitative part of the risk table. More specifically, the aim was to obtain a consensus on the cause and consequence of a particular risk, to define the proposed project phases it affected, the probability of its occurrence, the strategy and response plan to address it, as well as the impacts of the latter on project costs, delays, and overall content, both before and after the defined mitigation measures.

3.1 GENERAL RISKS

The preliminary risk matrix included in Appendix A presents the risks identified and analyzed for the entire life cycle of the proposed infrastructures development. A total of 56 risks were identified of which 3 or 5.4% were rated as “very low” or “low”, 24 or 42.9% were rated as “moderate” and 29 or 51.8% were rated as “high” or “very high” severity (see Table 3-1).

Table 3-1 Distribution of Project Risks

LEVEL	OCCURRENCE	PERCENTAGE (%)
Very low	1	1.8%
Low	2	3.6%
Moderate	24	42.9%
High	27	48.2%
Very high	2	3.6%
Total	**56**	**100%**

At this stage of the study, the analysis provides a general overview of the risks associated with the various proposed infrastructures. The “Planning phase” and “Construction and Commissioning” categories present the highest occurrences, including “High” and “Very High” risks. Also notable is the “Social & Political” risk, which has a total of 8 important risks and is at the upper limit of the moderate risk range (see Table 3-2).

Table 3-2 Distribution of Project Risks

RISK CATEGORIES	VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	TOTAL
Planning phase	0	0	3	5	1	9
Design phase	0	1	4	1	0	6
Site conditions - Environment	1	0	1	3	0	5
Construction & Commissioning	0	0	8	5	0	13
Operation & Maintenance	0	0	3	3	0	6
Social & Political	0	0	3	5	0	8
Finance & Economy	0	0	0	3	1	4
Legal	0	1	2	2	0	5
Total	1	2	24	27	2	56
	3		53			

Of the 53 risks with severity levels above the tolerance level, 29 require immediate attention due to their “high” or “very high” severity.

3.1.1 PLANNING PHASE

Very high

- The proposed infrastructures study is delayed due to the difficulty in engaging or validating information with external stakeholders and land users. This information includes right-of-way acquisitions and other agreements (e.g. outfitters, leases, etc.).

High

- Risk that governmental or private stakeholders require a change in scope of work;
- The study is delayed due to missing First Nations, municipal, provincial or federal approvals (e.g., approvals and permits, funding, procurement strategy, RFQ/RFP documentation);
- Necessary third-party rights of way are available at a higher cost than originally estimated;
- There is a refusal of cooperation by the tallyman;
- There is insufficient historical and archaeological data known about the study area and its surroundings.

3.1.2 DESIGN PHASE

High

- The potential project is delayed during the design phase due to missing First Nations, municipal, provincial, or federal approval (e.g., approval and permits, funding, procurement strategy, RFQ/RFP documentation).

3.1.3 SITE CONDITIONS - ENVIRONMENT

High

- The environmental conditions of the site are unknown or poorly defined (e.g., presence of sensitive environments and vulnerable species - restriction periods, flood zones, etc.), additional work is required and the costs are higher than the initial estimate;
- Geotechnical conditions are different from those described in the preliminary studies, requiring a change in construction methods or a design revision (soil nature, instability, lack of local material, etc.);
- Archaeological artifacts are discovered during the construction phase.

3.1.4 CONSTRUCTION AND COMMISSIONING

High

- The project design or construction costs differ from the original estimate (by opening the bidder's envelope) due to unknown risks other than those identified in this list;
- The work does not comply with the plans and performance specifications;
- The project definition is changed during construction, which would result in a change to the design and specifications, resulting in a requirement to correct or restart construction or a deviation from the original construction plans;
- Construction deadlines are not met for various reasons (e.g., unknowns, politics, funding, etc.);
- Unforeseen weather conditions delay construction.

3.1.5 OPERATION AND MAINTENANCE

High

- Settlements occurred under projected infrastructure (presence of highly compressible peat deposits and permafrost that is vastly degrading under climate warming);
- Maintenance is not adequately funded during operation, requiring higher expenditures in subsequent years to address the accumulated deficit;
- Incidents of contamination are caused using the infrastructure.

3.1.6 SOCIAL AND POLITICAL

High

- Planning of new regulations by the government that could create new constraints to the studies (protected areas, legal status of a species, definition of allowable uses and impacts on natural habitat);
- Change in government (First Nation chief, municipal, provincial, federal) that could delay the project;
- Constraints in the approval and implementation of the infrastructure studied due to the large number of key players spread across many jurisdictions (Inuit, Cree, Jamesian, Provincial and Federal Government);
- Public opposition (local communities, media, leaders or others) likely to result in public action, pressure or media coverage that would negatively impact the elaboration of this potential project;
- Unpredictable local measure du to new pandemic.

3.1.7 FINANCE AND ECONOMY

Very high

- Initial construction budgets underestimate real future inflation.

High

- Initial construction budgets underestimate the actual costs of petroleum products and steel and other strategic materials;
- Exchange rates adversely affect project costs due to unfavourable foreign exchange market conditions; this would result in higher costs for the project's imported goods;
- Benchmark interest rates and credit spreads exceed financial assumptions due to adverse market conditions; this would result in higher project financing costs.

3.1.8 LEGAL

High

- Environmental approval may not be obtained in a timely manner or additional restrictions may be imposed by provincial or federal authorities; obtaining certificates of authorization may be delayed due to opposition from external stakeholders during public hearings;
- Changes made by the Government to certain general laws affecting the designer / contractor's regulations; therefore, there would be a risk that the change would entitle the designer / contractor to an offset or an extension of time.

4 GENERAL MITIGATION MEASURES

General mitigation measures to minimize the identified risks associated with the proposed infrastructures are provided in Appendix A. It is essential to continue to communicate and work with stakeholders and government authorities throughout the future development stages of the proposed infrastructures to obtain agreement on the scope of work and stakeholder buy-in.

The construction of the selected proposed infrastructures will have to avoid or reduce the risks associated with protected areas, the environment, the protection of the landscape as well as any other element deemed important by the Cree community. It will therefore be extremely important that the Cree community be involved, as well as all relevant stakeholders, from the planning phase.

The design optimization possible with the more detailed information to be provided by the future preparatory studies (surveys, geotechnical, archaeological, environmental, etc.) is another element that will greatly reduce the risks associated with the development of the proposed infrastructures.

Moreover, establishing a monetary risk reserve through a quantitative risk analysis is also recommended in future stages, thus when a procurement model will be reviewed and selected. The procurement model will furthermore allow to update the risk matrix (identifying the risks that would be removed/added, retained, transferred, or shared).

Attention should also be given to the interim situation (during construction conditions). Developing a Service Maintenance Plan will be critical to ensure that essential services are maintained to both Cree and Jamesian communities and major stakeholders as Hydro-Québec. This could represent some additional temporary work and installation that would need to be planned and implemented before construction start.

It is also important to mention that this study, with its engagement approach, is a mitigation measure in itself to reduce the risk of social acceptability. The fact that this study is conducted by the Cree Nation for the Cree population is an innovative way of doing things in Cree territory since the population is informed well in advance of potential future work and adjustments can be made to meet the expectations of the Cree population. This is a completely different approach from what was done in the past.

APPENDIX

A PRELIMINARY RISK MATRIX

A - IDENTIFICATION OF THE RISK					B - INITIAL WEIGHTING					C - ACTIONS AND MITIGATION MEASURES	D - FINAL WEIGHTING					Infrastructures				
#	Category	Sub-category	Description of the Risk **UNCERTAIN EVENT**	**CONSEQUENCES & EFFECTS** (unplanned	**Probability of occurrence**		**Impact**		**Initial rating**	**Mitigation**	**Probability of occurrence**		**Impact**		**Final rating**	**Railway phase 2**	**167 Road**	**Whapmagoostui Road**	**Railway phase 3**	**Small Craft Harbour**
1	SOCIAL & POLITICAL	Legal or regulatory change	Planning of new regulations by the government that could create new constraints to the studies (protected areas, legal status of a species, definition of allowable uses and impacts on natural habitat)	Delays, Cost, Scope and Quality	Almost Certain	5	Very high	5	25	Keeping an eye on regulations: all political levels are aligned towards sustainable development and more ecological protection measures.	Possible	3	Moderate	3	9	X	X	X	X	X
2	SOCIAL & POLITICAL	Political risks	That there is a change in government (First Nation chief, municipal, provincial, federal) that could delay the project	Delays	Very Likely	4	High	4	16	The change in government is not in our control, but if the infrastructure studied become a project that is supported by the Cree community, then the project will be less sensitive to the change of government.	Very Likely	4	Moderate	3	12	X	X	X	X	X
3	SOCIAL & POLITICAL	Governance risks	That there are constraints in the approval and implementation of the infrastructure studied due to the large number of key players spread across many jurisdictions (Inuit, Cree, Jamesian, Provincial and Federal Government)	Delays	Very Likely	4	High	4	16	Encourage the implementation of a specific steering and approval process for the infrastructure studied; Be aware of the requirements of the approval programs, in terms of content and deadlines to be considered; Develop that potential project that also meets the objectives of the areas affected by the approval programs; Proactively develop mitigation measures during the elaboration of this potential project.	Possible	3	High	4	12	X	X	X	X	X
4	SOCIAL & POLITICAL	Social Acceptability / Public Opposition within the Cree communities	That public opposition (local communities, media, leaders or others) likely to result in public action, pressure or media coverage that would negatively impact the elaboration of this potential project.	Delays, Cost, Scope and Quality	Very Likely	4	High	4	16	The fact that this feasibility study was conducted by the Cree Nation for the Cree population is in itself an important mitigation measure to reduce the risk of social acceptability. Strong communication plan during 2023 to present Study's results to the communities Hold engagement sessions with stakeholders during the planning phase for upcoming studies in order to be continuously informed about public concerns and to address these concerns as the studies progresses; Keep the public informed on an ongoing basis regarding the development of the infrastructure studies.	Possible	3	High	4	12	X	X	X	X	X
5	SOCIAL & POLITICAL	First Nation Culture and Archeological Sites protection	That external stakeholders (Non-government Organization and Activist group) do not adhere to the objectives defined for the project (balance between development and protection)	Delays, Cost, Scope and Quality	Possible	3	Moderate	3	9		Unlikely	2	Moderate	3	6	X	X	X	X	X
6	SOCIAL & POLITICAL	Labour conflict / Lack of Labour	That labour disputes and/or lack of labour in the construction industry cause delays in future studies, site investigation and construction.	Delays	Possible	3	Moderate	3	9	Proactive policies and programs to train local workforce (Crees) and initiate partnerships with local enterprises and public agencies (CNESST, CCQ ...)	Possible	3	Low	2	6	X	X	X	X	X
7	SOCIAL & POLITICAL	Reputational risk	Risk of damage to the reputation of partners and elected officials if the studies and the elaboration a potential project is poorly developed and/or poorly received by the population and/or not developed as promise to the Crees.	Delays, Cost, Scope and Quality	Possible	3	Moderate	3	9	Develop the project by ensuring the involvement of all Crees stakeholders throughout the process, from planning to implementation and operation. Set up a committee to regularly monitor the ongoing studies and future project.	Possible	3	Low	2	6	X	X	X	X	X
8	PLANNING PHASE	Project definition and scope change - external causes	Risk of governmental or private stakeholders require a change in scope of work.	Delays, Cost, Scope and Quality	Very Likely	4	High	4	16	Encourage the implementation of a specific steering and approval process for this project; Maintain CEO participation; Add Inuits as participative partners; Continue to communicate with third parties and government authorities throughout the studies and potential project to obtain agreement on the infrastructure projected and to obtain approval of the project components from all stakeholders.	Very Likely	4	Moderate	3	12	X	X	X	X	X
9	PLANNING PHASE	Project definition and scope change - internal causes	Inadequate strategic planning or insufficient resources to achieve them	Delays and Cost	Possible	3	High	4	12	Establish a project office and appoint leadership to manage the project and provide direction; Maintain CEO participation;	Unlikely	2	Moderate	3	6	X	X	X	X	X
10	PLANNING PHASE	Delays in project approval - external causes	That the project is delayed due to missing First Nations, municipal, provincial or federal approvals (e.g., approvals and permits, funding, procurement strategy, RFQ/RFP documentation)	Delays and Cost	Very Likely	4	High	4	16	Begin communications with third parties and government authorities at an early stage and do not begin any procurement phase until all required approval and all documentation (including contract documents, required funding, permits and approvals, etc.) is obtained and finalized.	Possible	3	Moderate	3	9	X	X	X	X	X
11	PLANNING PHASE	Delays in project approval - internal causes	That the Infrastructres studies are delayed due to Proponent not being defined. That the studies is delayed due to missing proponent approval (e.g., funding, procurement strategy, RFQ/RFP documentation)	Delays and Cost	Possible	3	High	4	12	Define the proponent before next studies phases. Do not start any procurement phase until the work is certain and all documentation (including contract documents, required funding, permits and approvals, etc.) is obtained and finalized	Unlikely	2	Moderate	3	6	X	X	X	X	X

A - IDENTIFICATION OF THE RISK					B - INITIAL WEIGHTING					C - ACTIONS AND MITIGATION MEASURES	D - FINAL WEIGHTING					Infrastructures				
#	Category	Sub-category	Description of the Risk **UNCERTAIN EVENT**	**CONSEQUENCES & EFFECTS** (unplanned	**Probability of occurrence**		**Impact**		**Initial rating**	**Mitigation**	**Probability of occurrence**		**Impact**		**Final rating**	**Railway phase 2**	**167 Road**	**Whapmagoostui Road**	**Railway phase 3**	**Small Craft Harbour**
12	PLANNING PHASE	Delays in right-of-way acquisitions/rights-of-way and other agreements with external stakeholders and land users (ex: outfitters, leases, etc.)	That the proposed infrastructure study is delayed due to the difficulty of reaching agreement with external stakeholders and land users.	Delays	Almost Certain	5	Very high	5	25	Begin communications with land users at an early stage; Consider alternative alignment in the studies	Very Likely	4	High	4	16	X	X	X	X	
13	PLANNING PHASE	Right-of-Way and Right-of-Way Acquisitions (ex: outfitters, leases, etc.)	Necessary third-party rights of way are available at a higher cost than originally estimated.	Cost	Very Likely	4	Moderate	3	12	Begin communications with land users at an early stage; Consider alternative alignment in the studies	Possible	3	Moderate	3	9	X	X	X	X	
14	PLANNING PHASE	Denial of land use permit	That there is a refusal for cooperation use by the tallyman.	Delays and Cost	Very Likely	4	Moderate	3	12	Ensure communication and collaboration with tallymen and authorities at an early stage to obtain early commitments; Conduct the environmental assessment study with diligence Consider alternative alignment in the studies; Deal with each issue on a case-by-case basis.	Possible	3	Moderate	3	9	X	X	X	X	
15	PLANNING PHASE	Procurement mode	That the choice of next studies procurement methods affect the elaboration of the project.	Delays, Cost and Scope	Possible	3	Moderate	3	9	Take all necessary steps to determine the most appropriate delivery method at the appropriate time in the project.	Unlikely	2	Moderate	3	6	X	X	X	X	X
16	PLANNING PHASE	Archeological potential	That there is insufficient historical and archaeological data known about the study area and its surroundings.	Delays and Cost	Very Likely	4	High	4	16	Ensure that an archaeological site's studies are completed and documented in a report covering the lands affected by the potential infrastructure; Ensure that all stakeholders are informed of the great sensitivity of the Cree to archeology.	Possible	3	High	4	12	X	X	X	X	X
17	DESIGN PHASE	Lack of understanding of the users/Client design parameters and performance requirements by the designer	That the designer understands the RFP requirements differently, resulting in the submission of inadequate detailed design components requiring drawing corrections and delayed design deliverables	Delays and Cost	Possible	3	Moderate	3	9	Engage a competent designer who can demonstrate the ability to work effectively with the Northern conditions and First Nations; Adequate monitoring of the designer by the Client (Cree committee); Specific procurement strategy for sensitive locations; Ensure quality of appropriate RFP documents	Unlikely	2	Moderate	3	6	X	X	X	X	X
18	DESIGN PHASE	Delay in delivery of detailed design and specifications - Availability of skilled labour.	That there is no firm with qualified personnel available to undertake the design whenever it is time to develop a project; Above market price to reflect the lack of qualified resources available.	Delays and Cost	Possible	3	Moderate	3	9	Monitor market conditions to ensure optimal scheduling with regard to other infrastructure projects in Quebec, Canada and the USA; Advise firms in advance of the upcoming project requirements.	Unlikely	2	Moderate	3	6	X	X	X	X	X
19	DESIGN PHASE	Delay in delivery of detailed design and specifications.	That the designer is unable to deliver the design due to lack of internal resources or unrealistic deadlines.	Delays	Possible	3	Moderate	3	9	In the contract with the designer, set key dates for design reviews under which detailed engineering drawings and specifications must be completed with contractual clauses providing penalties for delays; Adequate monitoring of the designer services by the Client (Cree committee);	Possible	3	Low	2	6	X	X	X	X	X
20	DESIGN PHASE	Lack of capacity of the users/client and their partners to review and approve detailed design components.	That the users/client (the proponent) lacks the resources to proceed with the review of intermediate or final design components developed by the designer, thereby delaying the design phase.	Delays	Possible	3	Moderate	3	9	Set up a Project Office: appointing a team dedicated to the project. Regular presentation to Cree proponent leadership (board of direction)	Unlikely	2	Low	2	4	X	X	X	X	X
21	DESIGN PHASE	Lack of inputs to proceed with the selected components	That the designer lacks inputs to proceed with the design and/or that the inputs provided are not up to date.	Delays and Cost	Possible	3	Moderate	3	9	Plan the pre-study activities well in advance due to seasonal limitations. Adequate monitoring of the designer services by the Client/Proponent;	Possible	3	Low	2	6	X	X	X	X	X
22	DESIGN PHASE	Delays in project approval - external causes	That the potential project is delayed during the design phase due to missing First Nations, municipal, provincial or federal approval (e.g., approval and permits, funding, procurement strategy, RFQ/RFP documentation)	Delays and Cost	Very Likely	4	Very high	5	20	Begin communications with third parties and government authorities at an early stage and do not begin the procurement phase until the planning package has been approved and all documentation (including contract documents, required funding, permits and approvals, etc.) is obtained and finalized.	Possible	3	High	4	12	X	X	X	X	X
23	SITE CONDITIONS - ENVIRONMENT	Existing and unknown environmental site conditions	That the environmental conditions of the site are unknown or poorly defined (e.g., presence of sensitive environments and vulnerable species - restriction periods, flood zones, etc.), that additional work is required and that the costs are higher than the initial estimate.	Delays and Cost	Very Likely	4	Moderate	3	12	Ensure that all studies are completed in accordance with provincial and federal requirements and take the necessary steps during design and construction;	Possible	3	Moderate	3	9	X	X	X	X	X
24	SITE CONDITIONS - ENVIRONMENT	Existing or future public utilities on the site (SDBJ, MTQ, HQ, etc.)	That the coordination with undocumented existing or future utilities results in delays and/or increased costs to a potential project;	Delays and Cost	Possible	3	Moderate	3	9	Involve the stakeholders from the beginning of the proposed infrastructure and have them assign personnel to carry out the project;	Unlikely	2	Moderate	3	6	X	X	X	X	X

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25	SITE CONDITIONS - ENVIRONMENT	Geotechnical conditions	That geotechnical conditions are different from those described in the preliminary studies, requiring a change in construction methods or a revision of the design (soil nature, instability, lack of local material, etc.)	Delays and Cost	Very Likely	4	Moderate	3	12	Perform a more detailed analysis to identify all potential sources of construction material: Evaluate transport costs and compare costs for different potential sources.	Possible	3	High	4	12	X	X	X	X	X
26	SITE CONDITIONS - ENVIRONMENT	Noise and vibration	That the necessary studies and the noise and vibration records were not produced during the planning / design phase or in the early studies phases.	Delays and Cost	Possible	3	Moderate	3	9	Ensure that all studies are completed in accordance with provincial and federal requirements and take the necessary steps during design and construction; Ensure education to tallyman and land users of potential noise and vibration from studied road and railway;	Unlikely	2	Very Low	1	2	X	X	X	X	X
27	SITE CONDITIONS - ENVIRONMENT	Archaeological discoveries	That archaeological artifacts are discovered during the construction phase.	Delays and Cost	Very Likely	4	High	4	16	Ensure that an archaeological site's studies are completed and documented in a report covering the lands affected by the project; Ensure that all stakeholders are informed of the great sensitivity of the Cree to archeology.	Possible	3	Moderate	3	9	X	X	X	X	X
28	CONSTRUCTION & COMMISSIONNING	Risk of initial inaccuracy on design or constructions costs	That the project design or construction costs differ from the original estimate (by opening the bidder's envelope) due to risks other than those identified in this list.	Cost	Very Likely	4	High	4	16	Make a realistic cost estimate considering the northern site conditions and reality; Include clauses in the contractor's tender documents; Review & Planning with other users (MTQ, SDBJ, HQ) to understand the construction market and avoid conflict/competition with other projects.	Possible	3	High	4	12	X	X	X	X	X
29	CONSTRUCTION & COMMISSIONNING	Coordination issues between design and construction teams	That there are delays during construction due to work coordination problems within the construction team or between the construction and design teams.	Delays and Cost	Possible	3	Moderate	3	9	Establish a Project Office: A team dedicated to the project; Properly define the project with technical assistance and continuity of expertise on the engineering side; Establish a process for monitoring and following up on the work and ensuring that quality and deadlines are met; Ensure the participation of contractors with the experience and capacity to participate in a major project; Reviewing the delivery of major projects in other cities to assist in developing realistic project delivery schedules.	Possible	3	Low	2	6	X	X	X	X	X
30	CONSTRUCTION & COMMISSIONNING	Availability and cost of raw materials	That raw materials are not available or in insufficient quantity and/or at a higher cost than originally estimated, resulting in higher construction costs.	Cost	Possible	3	Moderate	3	9	Make preparation work contracts and/or pre-purchases (equipment, granular, timber, etc.) when possible and profitable; Review & Planning with other users (MTQ, SDBJ, HQ) to understand the construction market and avoid conflict/competition with other projects.	Possible	3	Low	2	6	X	X	X	X	X
31	CONSTRUCTION & COMMISSIONNING	Availability and cost of labour and equipment	That labour and/or equipment are not available in sufficient quantity and/or at the expected cost.	Delays and Cost	Possible	3	Moderate	3	9	Monitor market conditions to try to fit in at the optimal time for current and future projects inform firms in advance of the upcoming need for the project; Develop new local contractors	Possible	3	Low	2	6	X	X	X	X	X
32	CONSTRUCTION & COMMISSIONNING	Inadequate construction methods	That the work does not comply with the plans and performance specifications.	Delays and Cost	Possible	3	Very high	5	15	Ensure adequate professional and independent site review of the work	Possible	3	Moderate	3	9	X	X	X	X	X
33	CONSTRUCTION & COMMISSIONNING	Scope change	That the project definition is changed during construction, which would result in a change to the design and specifications, resulting in a requirement to correct or restart construction or a deviation from the original construction plans.	Delays and Cost	Unlikely	2	Very high	5	10	Ensure that the planning phase is effectively managed with all relevant documents signed by all stakeholders and that the budget and associated project funding are available for the agreed scope of work approved by government authorities.	Possible	3	Moderate	3	9	X	X	X	X	X
34	CONSTRUCTION & COMMISSIONNING	Schedule	That construction deadlines are not met for various reasons (e.g., unknowns, politics, funding, etc.)	Delays	Possible	3	High	4	12	Provide a realistic timeline for completion and make it firm at the appropriate time; Ensure adequate professional and independent site review & schedule monitoring	Possible	3	Moderate	3	9	X	X	X	X	X
35	CONSTRUCTION & COMMISSIONNING	Devastation of resources (natural habitats for animals and plants) - Contamination	That incident of contamination is caused by the work and/or the actions of contractors and/or subcontractors (Spill of hazardous materials) impact to flora and fauna	Delays and Cost	Possible	3	High	4	12	Standard and communicate well measures for spill prevention; Establish a protocol in the case of a spill. Adequate monitoring on the site by an independent firm and ensure rapid communication with the Client/Proponent;	Unlikely	2	High	4	8	X	X	X	X	X
36	CONSTRUCTION & COMMISSIONNING	Devastation of resources (natural habitats for animals and plants) - Fire	That forest fire is caused by the work and/or the actions of contractors and/or subcontractors (Spill of hazardous materials).	Delays and Cost	Possible	3	High	4	12	Standard and communicate well measures for fire prevention; Establish a protocol in the case of a fire. Adequate monitoring on the site by an independent firm and ensure rapid communication with the Client/Proponent;	Unlikely	2	High	4	8	X	X	X	X	X

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37	CONSTRUCTION & COMMISSIONNING	Waste management	That management of residual materials is inadequate.	Delays and Cost	Possible	3	High	4	12	Include a strict waste management performance criteria's within contractual documents to protect sensitive habitat; Adequate monitoring on the site by an independent firm; Implement zero residual material (zero garbage); Plan to reuse or have a second life for used material for the proposed infrastructure.	Unlikely	2	Moderate	3	6	X	X	X	X	X
38	CONSTRUCTION & COMMISSIONNING	Health and Safety	That accidents occur that result in changes to the planned construction techniques.	Delays	Possible	3	High	4	12	Ensure that contractors have their own health and safety plan, conduct daily safety meetings, report violations and near misses, and adapt work practices to site conditions in ways that increase safety while working closely with the owner; Encourage workers to promote health and safety on the job site and be proactive in reporting items that are unsafe.	Unlikely	2	High	4	8	X	X	X	X	X
39	CONSTRUCTION & COMMISSIONNING	Site access	That the equipment is late, damaged or stolen due to poor site access conditions.	Cost	Possible	3	Moderate	3	9	Plan strategic delivery contingencies, secure drop-off storage areas. Work with local contractors / suppliers to reduce shipping.	Possible	3	Low	2	6	X	X	X	X	X
40	CONSTRUCTION & COMMISSIONNING	Weather conditions	Unforeseen weather conditions delay construction	Delays	Very Likely	4	Moderate	3	12	Plan realistic timelines including contingencies for northern weather conditions and limited construction period; Work with local contractors / labour that have expertise in the region weather and condition.	Possible	3	Moderate	3	9	X	X	X	X	X
41	OPERATION & MAINTENANCE	Inadequate performance of infrastructure and systems	That settlements occurred under projected infrastructure (presence of highly compressible peat deposits and permafrost that is vastly degrading under climate warming).	Cost	Very Likely	4	High	4	16	Use adequate methods for design and construction: Complete or partial removal of peat material underneath the roadway, stabilization of material by draining and preloading, building of pile-supported roadway through peat deposits, and building the embankment using bridging techniques and delaying pavement construction to allow postconstruction settlements.	Possible	3	Moderate	3	9	X	X	X	X	
42	OPERATION & MAINTENANCE	Inadequate performance of infrastructure and systems	That the slope instability on the riverbanks along the Great Whale River upstream jeopardize the proposed infrastructure.	Cost	Possible	3	High	4	12	Perform a detailed landslide hazard assessment through a review of visual imagery, paired with other geospatial information such as surficial and bedrock geology, satellite imagery, land use and vegetation cover. Adapt location of projected port according to hazard maps and following the most recent research performed in the area. Cross the river at a place where the conditions are well known.	Unlikely	2	High	4	8			X	X	X
43	OPERATION & MAINTENANCE	Higher than expected operating and maintenance costs.	That the operation and maintenance costs are higher than originally estimated.	Cost	Possible	3	Moderate	3	9	Provide for appropriate contingencies at each stage of the design based on the ability to pay for the responsible organizations; Identification of the Proponent for the operation and maintenance.	Possible	3	Low	2	6	X	X	X	X	X
44	OPERATION & MAINTENANCE	Inadequate maintenance funding	That maintenance is not adequately funded during operation, requiring higher expenditures in subsequent years to address the accumulated deficit.	Cost	Possible	3	High	4	12	Conduct a robust financial analysis in the planning phase that includes securing sufficient funds for both the construction and operating periods; Maintenance agreement program at the outset of the design;	Possible	3	Moderate	3	9	X	X	X	X	X
45	OPERATION & MAINTENANCE	Latent defects resulting in higher than expected maintenance costs.	Design or construction defects are discovered during the operation phase, requiring higher than expected operation and maintenance expenses and/or earlier than anticipated replacement of defective components.	Cost	Possible	3	Moderate	3	9	Plan a quality monitoring program for the infrastructure and systems; Plan a construction guarantee and first-year maintenance program by the contractor or the design-build contractor.	Unlikely	2	Moderate	3	6	X	X	X	X	X
46	OPERATION & MAINTENANCE	Contamination during the use	That incidents of contamination are caused by the use of the infrastructure.	Delays and Cost	Possible	3	High	4	12	Establish a protocol in the case of a spill. Establish a communication protocol with Cree Communities.	Possible	3	Moderate	3	9	X	X	X	X	X
47	FINANCE & ECONOMY	Indexing assumptions during construction	That initial construction budgets underestimate real future inflation.	Cost	Very Likely	4	High	4	16	The inflation is recently very hard to predict. Conduct a robust financial analysis of the feasibility and planning phase that includes a detailed analysis of CPI forecasts for labour and material prices for the next 30 years. Include a sensitivity analysis of the model to ensure a range of costs within the required confidence interval levels for the project.	Very Likely	4	High	4	16	X	X	X	X	X
48	FINANCE & ECONOMY	Petroleum and steel cost assumptions during construction	That initial construction budgets underestimate the actual costs of petroleum products and steel and other strategic materials.	Cost	Very Likely	4	Moderate	3	12	Enter into derivative contracts (forwards, futures, options) for hedging purposes; Provided contingencies in budget estimation	Possible	3	Moderate	3	9	X	X	X	X	X
49	FINANCE & ECONOMY	Assumptions and exchange rate changes during construction	Exchange rates adversely affect project costs due to unfavourable foreign exchange market conditions; this would result in higher costs for the project's imported goods.	Cost	Very Likely	4	Moderate	3	12	The exchange is recently hard to predict; Enter into derivative contracts (forwards, futures, options) for hedging purposes;	Possible	3	Moderate	3	9	X	X	X	X	X

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50	FINANCE & ECONOMY	Assumptions and changes in interest rate and credit spread prior to financial close	That benchmark interest rates and credit spreads exceed financial assumptions due to adverse market conditions; this would result in higher project financing costs	Cost	Very Likely	4	Moderate	3	12	Few imported goods; Enter into derivative contracts (forwards, futures, options) for hedging purposes; Find Canadian suppliers / contractor / designer.	Possible	3	Moderate	3	9	X	X	X	X	X
51	LEGAL	Obtaining environmental approval on time	Environmental approval may not be obtained in a timely manner or additional restrictions may be imposed by provincial or federal authorities; obtaining certificates of authorization may be delayed due to opposition from external stakeholders during public hearings.	Delays	Very Likely	4	Very high	5	20	Set up a specific steering and approval process; Be aware of the requirements of the approval programs, in terms of content and deadlines to be considered; Develop a project that meets the objectives of the areas & Cree community's; Proactively develop mitigation measures during the design stage.	Possible	3	High	4	12	X	X	X	X	X
52	LEGAL	Regulatory changes giving rise to compensatory events: nondiscriminatory, specific, etc.	That there are changes made by the Government to certain general laws affecting the designer / contractor's regulations; therefore, there would be a risk that the change would entitle the designer / contractor to an offset or an extension of time.	Delays and Cost	Possible	3	High	4	12	Coordinate with government officials regarding municipal, provincial and federal laws and regulations to obtain clarification of regulatory changes that may affect the potential project in the near future, while obtaining appropriate legal advice.	Possible	3	Moderate	3	9	X	X	X	X	X
53	LEGAL	"Force majeure" events	That the designer / contractor may avail himself of circumstances recognized as "force majeure" under the elaboration of the project or during the potential construction contract, and thus obtain compensation or an extension of the contractual deadlines.	Delays and Cost	Unlikely	2	High	4	8	This is essentially an uninsurable risk, although some elements considered a "force majeure" event may be potentially insured, and therefore would require the contractor to carry such insurance (e.g., terrorism insurance) if required by the proponent to attempt to reduce the impact of the risk.	Unlikely	2	High	4	8	X	X	X	X	X
54	LEGAL	Compliance and enforcement	That the infrastructure studied does not comply with the application of laws, regulations, policies, procedures, guides, standards, contractual obligations and assistance programs (e.g., creation of a new partnership with MTQ or SDBJ)	Delays, Cost, Scope and Quality	Unlikely	2	Moderate	3	6	Ensure a review of all laws, regulations, policies, procedures, guides, standards, contractual obligations and assistance programs that are applicable to the project.	Improbable	1	Moderate	3	3	X	X	X	X	X
55	LEGAL	Disagreement	That proponent have different interpretations of contractual clauses leading to claims, disputes or even cancellation of a contract.	Delays and Cost	Possible	3	Moderate	3	9	Ensure the clarity of all contract deliverables; Ensure that the level of risk transfer to the successful bidder is clear. Have a good relation or a partnership relation with designer / contractors	Unlikely	2	Moderate	3	6	X	X	X	X	X
56	SOCIAL & POLITICAL	Covid-19 Pandemic	Unpredictable local measure du to new pandemic	Delays and Cost	Possible	3	High	4	12	Add more contingency	Possible	3	Moderate	3	9	X	X	X	X	X