Kiggavik Project

Environmental Impact Statement

Tier 3 Technical Appendix 2A

Alternatives Assessment

December 2011

AREVA Kiggavik Project
Alternatives Assessment

Prepared for:

AREVA Resources Canada Inc.

PO Box 9204
817 45th Street West
Saskatoon, Saskatchewan
S7K 3X5

Prepared by:

Consult 5 Inc.

Project Number 0402

December 2011

AREVA Kiggavik Project

Alternatives Assessment

Prepared for:

AREVA Resources Canada Inc.

PO Box 9204
817 45th Street West
Saskatoon, Saskatchewan
S7K 3X5

Prepared by:

Consult 5 Inc.

4-1576 Tatlow Avenue
North Vancouver, B C
Canada, V7P 2Z7

Tel: +1 778 338 3743
E-mail: postmaster@consult5.com
Web site: www.consult5.com

Project Number 0402

December 2011

Authors:
Mark Vendrig M.Sc
Don Hovdebo

Reviewer:
Don Hovdebo

Table of Contents

List of Tables

List of Figures

List of Attachments

1. Introduction

During the design phases of a green field mine project, different alternatives for individual aspects or elements of the project are considered in an attempt to find the most optimal design. In designing a mining project, the optimal alternative from an engineering or economic perspective may not be the most optimal from an environmental, cultural or social perspective. An alternatives analysis of each alternative considered is required in order to weigh the advantages and disadvantages of each using criterion that includes an appropriate consideration of environmental, technical, cultural, economic and social considerations.

This Alternatives Assessment Report has been prepared to document in a transparent manner, the various project alternatives that AREVA Resources Canada Inc. (AREVA) has considered during the design stages of the proposed Kiggavik Project. The alternatives that are presented in this alternatives assessment report were all initially considered to be potentially viable. They have been tested through public engagement, evaluated against technical, environmental, social and cultural criteria and finally, assessed in detailed engineering and cost benefit studies. In some instances, based on these studies, some alternatives came to be considered as not viable and were not considered further. The alternatives presented in the environmental impact statement are considered to be viable alternatives.

In this report, the various alternatives considered for the project are presented and evaluated. Many questions that the project reviewers and the public raised during the extensive public engagement process undertaken by AREVA have been used in the project design, to conduct the environmental impact assessment, prepare the environmental impact statement and to guide the decision making in this alternatives assessment.

1.1. Nunavut Impact Review Board (NIRB) Requirements

The *Guidelines for the Preparation of an Environmental Impact Statement for AREVA Resources Canada Inc.'s Kiggavik Project*, May 2011, issued by the Nunavut Impact Review Board (Guidelines), specify that the Kiggavik Environmental Impacts Statement must include an explicit analysis of all alternative means of carrying out the Project components, including a "no-go" alternative, the identification and application of criteria used to determine the technical feasibility and economic viability of the alternatives to the Project (e.g., transportation, natural, social, economic and cultural environment).

In the Guidelines, it is stated that the analysis must be done to a level of detail which is sufficient to allow the NIRB and the public to compare the Project with the alternatives in terms of the economic costs and the environmental, social and economic impacts and benefits. AREVA was requested to include reasons for selection of the Project as the preferred alternative and the reasons for rejection of other alternatives.

In addition, the NIRB requested that when assessing the economic viability for each alternative, due consideration must be given to the vulnerability of the arctic ecosystem, as well as the potential for extension of the mine life and/or increased uranium ore production rates. The criteria used to evaluate alternatives reflects the potential concern for both the short-term (during construction and operations) and long-term (after decommissioning and reclamation) physical-chemical stability and environmental impacts of the Project. It also included a consideration of radiological doses to workers and the public when appropriate. Also, the associated cumulative effects of each alternative were considered, particularly the potential for cumulative impacts on the marine ecosystem and other traditional harvesting activities.

Furthermore, in conducting the alternatives assessment, AREVA has considered public opinions and preferences as a criterion in the assessment all of the alternatives. As a result, this report includes a discussion of how public engagement has influenced project planning and how public preferences have been considered in determining the preferred project alternatives. The NIRB Guidelines requires AREVA to focus on the project elements presented in Table 1. In addition to the NIRB requirements, AREVA presents additional alternative assessments in Sections 4, 8 and 11.

Table 1: The NIRB alternatives assessment requirements for the Kiggavik project.

Report Section	AREVA Alternatives Assessment	NIRB Item	NIRB Requirement
3	Power Supply Alternatives	7	Diesel power generation, including solar energy, wind energy, hydro and geothermal energy, etc.
4	Fresh Water Source Alternatives	-	-
5	Treated Effluent Discharge Alternatives	11	Methods for treatment of mill and waste water effluent
6	Waste Management Alternatives	9	To be defined
7	Andrew Lake Dewatering Alternatives	4	Accessing the uranium ore deposit under the northern edge of Andrew Lake
8	Mill Location Alternatives	-	-
9	Tailings and Mine Rock Disposal Alternatives	10	Tailings and mine rock storage alternatives
10	Access Road Alternatives	3	The access road from Baker Lake to the Kiggavik site including the winter road alternative and the all-weather road alternative with routing alternatives and road use after decommissioning
11	Airstrip Alternatives	-	-
12	Baker Lake Dock Alternatives	2	The location of the Baker Lake Dock and Storage Facility
13	Yellowcake Transport Alternatives	1	Transportation of uranium concentrate (yellowcake) from the Kiggavik site, including a “no road development” alternative
14	Marine Transport Alternatives	5 and 6	The marine shipping route, including different marine shipping alternatives for bringing in supplies to the Kiggavik site via the port of Churchill or via Chesterfield inlet and provide an estimate of cost variance for these alternate systems. A comparison of the economic and social benefits for marine trans-shipment via Churchill vs. trans-shipment via Chesterfield Inlet.

Report Section	AREVA Alternatives Assessment	NIRB Item	NIRB Requirement
0	15 Decommissioning and Reclamation Alternatives	8	Closure and reclamation alternatives
	All water from the site is captured in water storage ponds and treated in the effluent treatment works. No alternatives possible so this is not assessed.	12	Methods for mine de-watering

1.2. Summary of Alternatives Assessment

In this section the results of the alternatives assessment are presented in summary form (Table 2). The figures that have been used to inform the alternatives analysis process are presented in Figure 1 and Figure 2.

Table 2: Summary results from this alternatives assessment.

Presented in Section	Project Component	Preferred Alternative	Secondary Alternative(s)	Alternatives
3	Power generation.	Diesel generators in centralised or de-centralised powerhouse.	• None.	• Wind and diesel co-generation. • Gas turbines in centralised or de-centralised powerhouse.
4	Source of fresh water.	Siamese Lake.	• None.	• Judge Sissons Lake. • Kavisilik Lake. • Scotch Lake. • Skinny Lake. • Squiggly Lake.
5	Effluent treatment.	Ultra filtration pre-treatment single stage RO with chemical treatment.	Possible variations on process: • Addition of softening stage and increased Reverse Osmosis recovery. • Replacement of Ultra Filtration with multi-media filtration. • Segregation of feed stream. • Chemical treatment.	• Two stage Reverse Osmosis with evaporation of brine. • Ultra filtration pre-treatment with single stage Reverse Osmosis, chemical treatment with recycle to tails neutralisation.
5	Discharge of treated effluents.	Year-round discharge to Judge Sissons Lake; single or dual outfall.	None.	• Zero liquid discharge. • Seasonal discharge to Pointer Lake. • Year-round discharge to Sik Sik Lake engineered. • Wind.
6	Mine waste management.	Defined in waste management plans. Summary in this report.		
7	Andrew Lake dewatering.	Partial dewatering (maintain natural inflow/outflow).	None.	• Full dewatering. • Partial dewatering (construct drainage connections).
7	Andrew Lake mining.	Open-Pit.	None.	• Open-pit + underground. • Other means of accessing ore underneath Andrew Lake.

Presented in Section	Project Component	Preferred Alternative	Secondary Alternative(s)	Alternatives
8	Mill Location.	Kiggavik site.	None.	Sissons site.
9	Mine rock storage.	Temporary surface storage of special waste on lined pads, permanent surface storage of clean waste.	None.	None.
9	Tailings management.	Natural surround in-pit (subaqueous).	Pit liner.	• Underdrain. • Above-ground.
10	Access from Baker Lake to the Kiggavik site.	Winter road.	All weather road North Route with cable ferry.	• All weather road North Route with Thelon River bridge. • All weather road South route.
11	Airstrip location.	Pointer Lake.	None.	Drumlin.
12	Baker Lake dock location.	North shore site 1.	North shore sites 2 – 4.	• South shore. • Sagliq Island. • Chesterfield Inlet dock.
13	Yellowcake shipment.	Air only	None.	Air and marine.
14	Marine routes.	• Barge Churchill-Baker Lake. • Lighter ships at Helicopter Island, barge to Baker. • Barge East Coast to Baker Lake.		• Barge from Chesterfield Inlet dock site. • Ferry transport through Narrows (Churchill to Baker).
15	Decommissioning and reclamation.	Progressive rehabilitation with decommissioning and closure plan.		

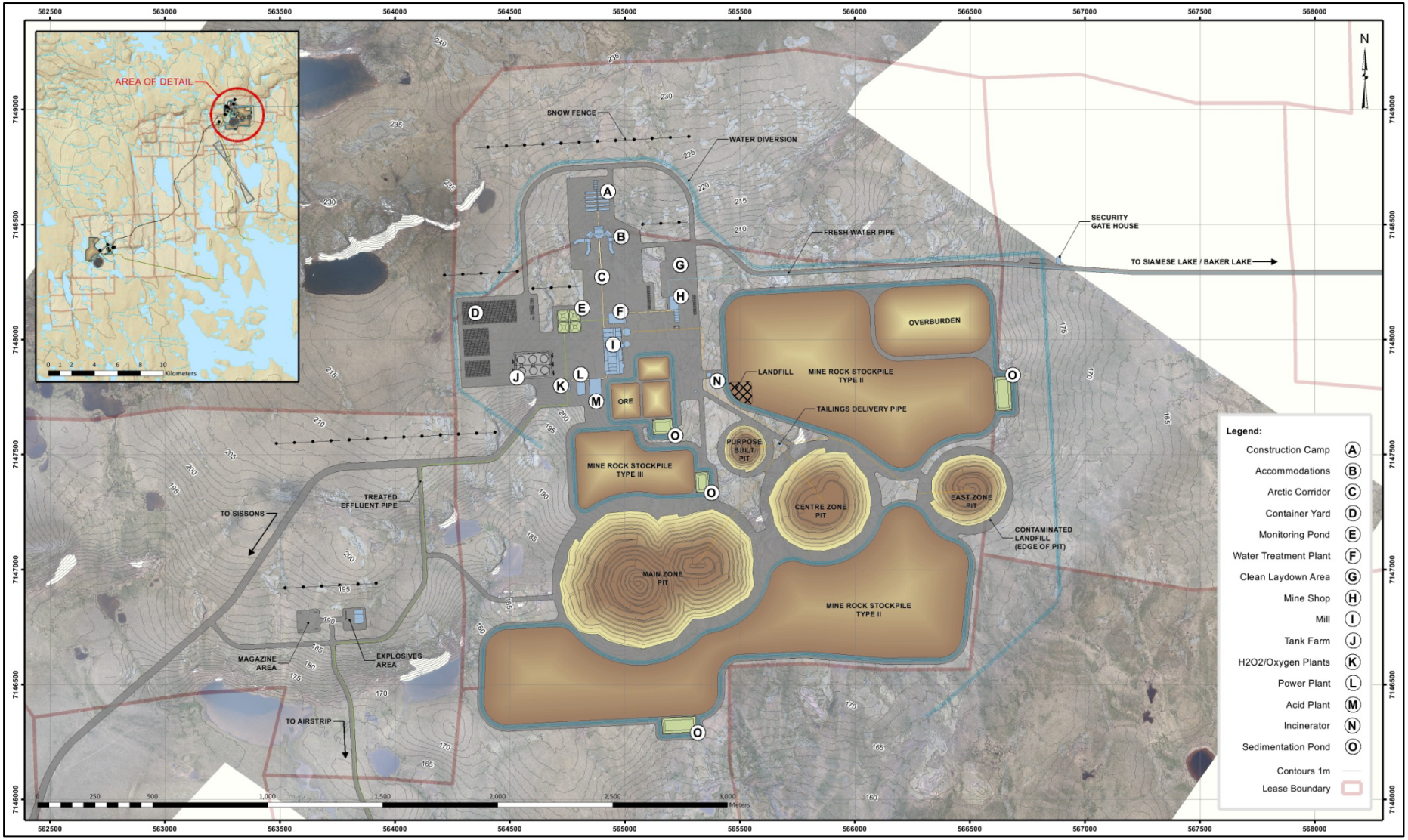


Figure 1: Kiggavik general site layout.

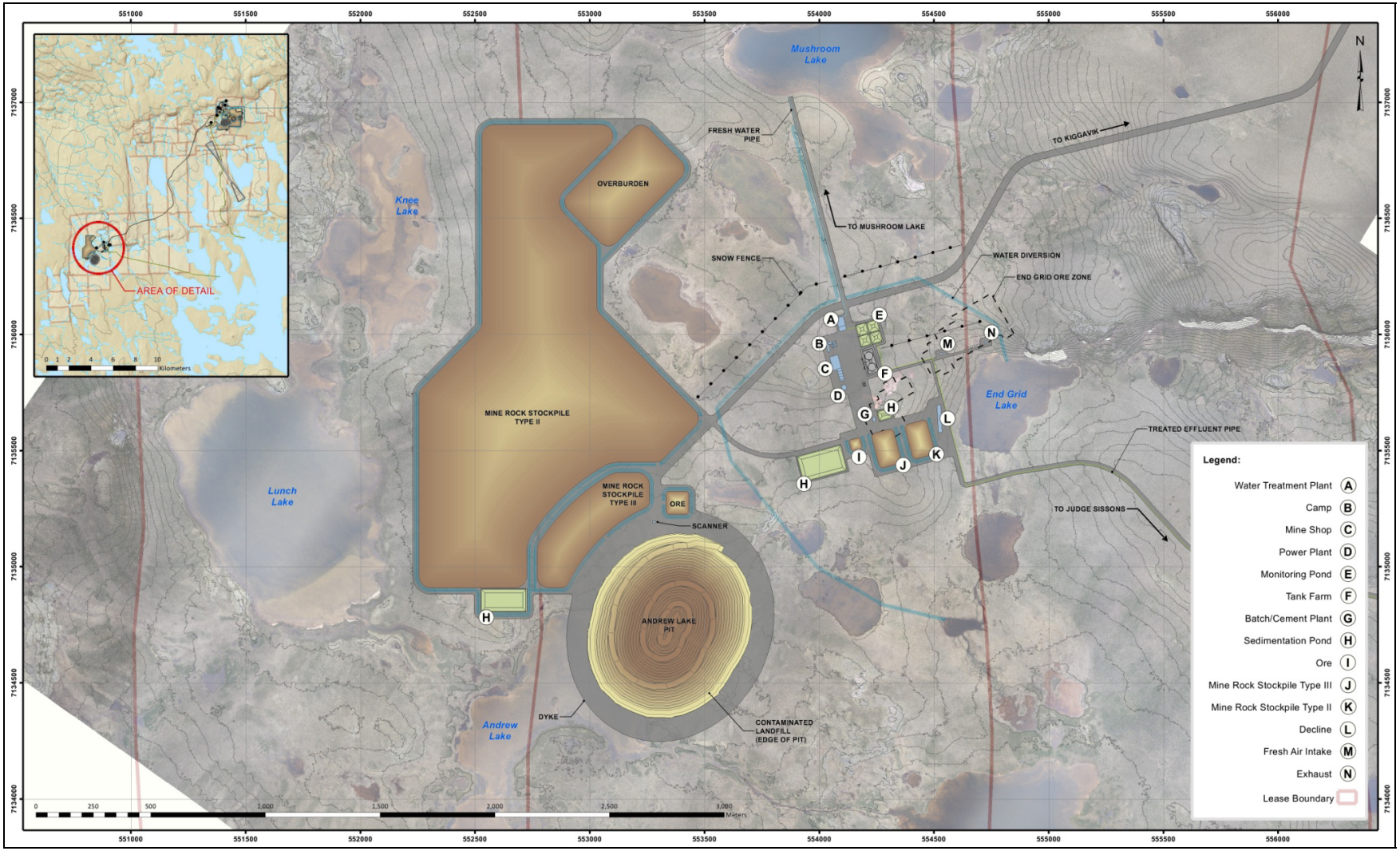


Figure 2: Sissons general site layout.

2. Methodology

The following provides a brief discussion of the methods used to conduct the alternatives assessment.

2.1. Initial Assessment

Initially, a very wide range of alternatives for each element of the project were identified prior to any in-depth analysis of feasibility. During this pre-screening process, it became obvious that some alternatives were not feasible for the project because of one or more key constraints. These alternatives were removed from further detailed analysis. In this manner, regulatory agencies and stakeholders will know that these alternatives were initially considered but rejected for sound technical, economic or environmental reasons.

By evaluating each of the remaining potentially viable alternatives in a transparent manner, it has been possible to determine what the optimal alternative is. All potentially viable alternatives are considered in the environmental impact assessment process, though the less favoured alternatives are assessed in less detail. This simplifies the impact assessment report as all items are assessed, but only the most favoured alternative is assessed in detail through the EIS process.

The alternatives assessment has been completed using a variant of the multiple accounts analysis methodology framework. This proven methodology allows for an unbiased quantitative assessment of all alternatives, taking into account technical, environmental and socio-economic considerations of the project in question.

The six primary actions within the framework can be summarised as follows:

1. Defining the alternatives for each project element, taking into account conceivable, practical and radiological appropriate approaches.

2. Defining site specific criteria against which site specific alternatives can be evaluated to ensure that the unique complexities of each different alternative are adequately assessed. At this point in the assessment the intent is to characterise each alternative to the extent that Step 3 and Step 4 can be completed using appropriate relevant information. The criterion applied to the alternative is specifically selected to fall within one of three general categories:

    a. Technical and operational
    b. Environmental
    c. Cultural and socio-economic.

3. Conducting a pre-screening assessment (also called a “fatal flaw analysis”). This is the first step in eliminating alternatives that are not appropriate for the Project. The elimination of

alternatives at this point is based on a primary set of criteria, selected by the proponent from the master categories developed in Step 2, and is intended to point out alternatives that are fatally flawed, and therefore not worthy of further evaluation. An alternative that would be economically unviable for the proposed project is an example of such a fatal flaw.

4. Defining an assessment rating matrix and ranking criteria. During this step, the criteria in each master category is reviewed and grouped together in such a way as to ensure that there would be no double accounting when alternatives were evaluated.

5. Completing the alternatives assessment. This step entails actual ranking of each alternative using a multidisciplinary team of experts and carrying out a quantitative comparison.

6. Completing a sensitivity analysis in order to evaluate any possible user imposed biases in the alternatives assessment.

2.2. Assessment Criteria

In Table 3, a description of the various criteria used in conducting the alternative analysis is provided. Each alternative under consideration was assessed against the criteria and a score was assigned based on the potential impacts or risks associated with each. The assessment included both the short term impacts of each alternative through the construction and operations phases of the mine life cycle, and the long term risks through the closure and post-closure phases. The assessment is particularly important with regard to engineered structures such as dams and stream diversions or other containment structures that would be required.

In Table 3 the typical availability of data for the impact assessment is described as:

- Y = Yes data is normally available.
- S = Sometimes data is available.
- N= No, data is not normally available.

This classification is useful to understand what type of data is available for the evaluation of a particular Criteria Set.

Table 3: Typical project environmental and social impact assessment checklist.

Criteria Groups and Criteria	Background Research	Desktop Study	Field Surveys	Field Monitoring	Public Engagement	Public Scoping	Typical Criteria Considered
Social, Cultural and Political Environment							
Socio-Economic							
Demographics	Y	Y	S	N	Y	Y	Demographic issues including: • Changes in community make up. • Building community capacity. • Disruption of trade.
Employment	Y	Y	Y	S	Y	Y	• Overall perceived socio-economic consequences, benefits and relative preferences. • Employment opportunities. • Capacity for employment. • Contracting opportunities. • Taxes and royalties.
Religious or spiritual beliefs	Y	Y	S	N	Y	Y	• Spiritual well-being. • Presence of archaeological or cultural sites.
Language(s)	Y	Y	S	N	Y	Y	• Distinct local language and preservation status. • Ability to communicate in common language.
Socio-political dynamics (e.g. tribal system)	Y	Y	S	N	Y	Y	• Maintenance of traditional lifestyle.
Land-use							
Housing (single family, multiple family)	Y	Y	S	N	Y	Y	• Availability of services.
Schools (pre-school to secondary	Y	Y	S	N	Y	Y	
Graveyards	Y	Y	S	N	Y	Y	• Presence of graveyard sites.
Hospitals/care facilities	Y	Y	S	N	Y	Y	• Availability of services.
Religious buildings or spiritual places	Y	Y	S	N	Y	Y	• Spiritual places • Presence of spiritual or cultural sites.
Recreational areas (formal parks to trails)	Y	Y	S	N	Y	Y	Other uses of land such as: • Subsistence food harvest. • Hunting. • Grazing lands. • Hunting lands. • Fishing areas. • Recreation. • Tourism. • Industrial. • Commercial.
Berry harvesting areas	Y	Y	S	S	Y	Y	
Grazing lands	Y	Y	S	S	Y	Y	
Hunting territories	Y	Y	S	S	Y	Y	
Fishing territories	Y	Y	S	S	Y	Y	
Private lands	Y	Y	S	N	Y	Y	
Cabins	Y	Y	S	S	Y	Y	
Tourism	Y	Y	S	S	Y	Y	
Travel routes	Y	Y	S	S	Y	Y	

Criteria Groups and Criteria	Background Research	Desktop Study	Field Surveys	Field Monitoring	Public Engagement	Public Scoping	Typical Criteria Considered
Public buildings and structures (other - libraries, government buildings, WWTP, etc.)	Y	Y	S	N	Y	Y	
Industrial, light Industrial, commercial, retail	Y	Y	S	N	Y	Y	
Maintain ingress and egress to businesses	Y	Y	S	N	Y	Y	• Safety considerations. • Access considerations.
Maintain ingress and egress to homes	Y	Y	S	N	Y	Y	
Political							
Land ownership	Y	Y	Y	N	Y	Y	• Inuit land rights. • Community and land owner opinion • Government feedback.
Right of ways	Y	Y	Y	N	Y	Y	
Easements	Y	Y	Y	N	Y	Y	
Local, regional, national political priorities	Y	Y	Y	N	Y	Y	
Stakeholder priorities	Y	Y	Y	Y	Y	Y	
Cultural							
Ancient burial sites	Y	Y	Y	S	Y	Y	• Spiritual well-being • Presence of burial or cultural sites
Archaeological sites	Y	Y	Y	S	Y	Y	• Presence of archaeological or cultural sites
Historical structures and buildings	Y	Y	Y	S	Y	Y	• Maintenance of traditional lifestyle
Intangible Heritage (songs, dance, gathering places, other traditions)	Y	Y	Y	S	Y	Y	• Ecological/cultural values in the sense of natural capital value.
Sacred places	Y	Y	Y	S	Y	Y	• Spiritual well-being . • Presence of sacred sites.
Public programs (tourism, museums, theatres, galleries)	Y	Y	Y	S	Y	Y	• Presence of programs.
Biological Environmental							
Fauna							
Terrestrial (mammal, rodent, etc.)	Y	Y	Y	S	Y	Y	• Potential impacts to land animals and their habitats • Potential for post closure/decommissioning recovery and rehabilitation related to these environmental vectors
Avian	Y	Y	Y	S	Y	Y	• Potential impacts to birds and their habitats. • Potential for post closure/decommissioning recovery and rehabilitation related to these environmental vectors
Aquatic (fresh water)	Y	Y	Y	S	Y	Y	• Potential impacts to fish and their habitats. • Potential impacts to aquatic animal species and their habitat. • Potential for post closure/decommissioning recovery and rehabilitation related to these environmental vectors
Aquatic (marine)	Y	Y	Y	S	Y	Y	
Wildlife migration routes (land, ocean, air)	Y	Y	Y	S	Y	Y	• Proximity to and potential disruption of migration routes.
Listed species	Y	Y	Y	S	Y	Y	• Potential impacts to species at risk and their habitat. • Potential for post closure/decommissioning recovery and

Criteria Groups and Criteria	Background Research	Desktop Study	Field Surveys	Field Monitoring	Public Engagement	Public Scoping	Typical Criteria Considered
							rehabilitation related to these environmental vectors
Flora							
Terrestrial (shrubs, grasses, etc.)	Y	Y	Y	S	Y	Y	• Potential impacts to species at risk and their habitat. • Potential impacts to terrestrial and aquatic plant species. • Potential for post closure/decommissioning recovery and rehabilitation related to these environmental vectors
Aquatic (fresh water)	Y	Y	Y	S	Y	Y	
Aquatic (marine)	S	S	S	S	S	S	
Restricted range plans	Y	Y	Y	S	Y	Y	• Potential impacts to species at risk and their habitat. • Potential for post closure/decommissioning recovery and rehabilitation related to these environmental vectors
Physical Environmental							
Ground Water							
Availability	Y	Y	Y	S	Y	Y	• Size and nature of aquifers.
Water quality (Normal conditions)	Y	Y	Y	S	Y	Y	• Water quality issues.
Potential for contamination	Y	Y	Y	S	Y	Y	Hydrogeological issues: • Potential migration of contaminated mine water. • Interference with surface water movement. • Potential loss of containment.
Surface Water							
Availability	Y	Y	Y	S	Y	Y	Hydrology issues: • Size of affected water body area (e.g. lake, stream) and watershed catchment boundaries. • Water quantity and storage issues. • Diversion and other water control structures that may be required. • Overall affected land footprint size of impoundment and related infrastructure (e.g. secondary polishing ponds dams saddle dykes, access roads and pipelines). • Considerations related to climate change adaptation (e.g. changes in water management or stability of foundations in permafrost).
Water quality (Normal conditions)	Y	Y	Y	S	Y	Y	• Water quality issues.
Potential for contamination	Y	Y	Y	S	Y	Y	• Ability to treat and/or re-cycle water. • Loss of containment potential.
Geology							
Geological substrate (various depths)	Y	Y	Y	N	Y	Y	• Geotechnical stability. • Chemical and physical characterisation of materials. • Physical and geochemical characterisation of mine rock materials. • Acid rock drainage or metal leaching.

Criteria Groups and Criteria	Background Research	Desktop Study	Field Surveys	Field Monitoring	Public Engagement	Public Scoping	Typical Criteria Considered
Tectonics and seismicity	S	S	S	N	S	S	• Seismic stability.
Volcanism	S	S	S	N	S	S	• Presence of volcanic features.
Landscape (Terrain)							
Steepness of slopes	Y	Y	Y	N	Y	Y	Topographical features: • Relief. • Complexity of topography.
Characteristics (Landforms, soils, wetlands, bogs, tundra, permafrost, bedrock)	Y	Y	Y	S	Y	Y	• Geology of bedrock. • Depth of permafrost.
Other Physical Environment							
Air quality	Y	Y	Y	Y	Y	Y	• Local weather conditions. • Atmospheric issues (e.g. particulates, heavy metals).
Noise	Y	Y	Y	Y	Y	Y	• Existing noise levels. • Potential future noise levels.
Visual	N	Y	Y	N	Y	Y	• Aesthetics of developments.
Paleontological resources	N	N	S	S	S	S	• Presence of resources.
Public Acceptability							
Community consultation	Y	Y	Y	Y	Y	Y	• Other factors considered significant by AREVA, the local community, stakeholders or NGO's. • Perceived community response.
Public scoping meetings	Y	Y	Y	Y	Y	Y	
NGO engagement (Canadian Nature Federation, etc.)	Y	Y	Y	Y	Y	Y	
Record of meetings and how comments/concerns were addressed	Y	Y	Y	Y	Y	Y	

2.3. Engineering and Economic Criteria

In this report, to ensure that the engineering and cost aspects of the alternatives are considered and reported, a matrix was developed to reflect the performance of the various alternatives in relation to each other (Table 4). Where possible, quantitative data was found as the base for input to the matrix, but where it was not available qualitative data was used and then ranked. In this evaluation the lowest scoring alternative was the preferred alternative.

The scoring was a relative comparison between alternatives. The alternative that had the best score in the social and environmental matrix was scored as one across the various categories that were scored. If other alternatives were more cost effective for example, a relative score below 1 was given. If an alternative was less cost effective then it was given a relative score above one. The actual costs and engineering scores are not provided as they are confidential to the company, but the relative scores provide an indication of the difference between the alternatives. The criteria evaluated are presented in Table 4.

Table 4: Economic and engineering evaluation matrix with description of criteria.

	Engineering or Technical Criteria			Economic Criteria				
	Difficulty	**Risk**	**Schedule**	**CAPEX**	**Habitat Compensation Cost**	**OPEX**	**Closure**	**Post Closure**
Typical Criteria Considered	Engineering precedent. Proposed technologies and the advantages and disadvantages of the technologies considered (e.g. proven technology used elsewhere or new technologies). Ability to engineer in remote locations. Likelihood of unforeseen technical difficulties or uncertainty. Feasibility to manage materials and activities. Transportation of materials. Construction material and volumes required are available. Containment structure design (e.g. size, hydraulic capacity, construction materials substrate, etc.). Possible use of impermeable or geo-textile liners or other materials. Diversion and other water control structures that may be required.	Economic risks and benefits. Risks for unforeseen conditions. Closure and post closure plan risks where some form of perpetual treatment or maintenance is required. Perceived community response. Risks associated with requirements for perpetual treatment or maintenance. Post closure risks and uncertainties. Flexibility with regard to technical, operational and environmental uncertainties	Regulatory review and construction timeline implications. Potential for increased capacity. Other factors considered significant by the project proponent, local community or the reviewers	Capital costs.	Fish habitat compensation and monitoring costs.	Operational costs.	Closure costs. Design and construction of covers over waste areas. Rehabilitation of aquatic and/or land ecosystems, including timeframes	Post-closure costs, including the costs of perpetual treatment or maintenance should it be required.

2.4. Evaluation of Alternatives

2.4.1. Data and Process

This alternatives assessment has been partially prepared based on Trade-off studies as well as the Best Value Decision Making studies that have been conducted during the project design phase. Based on these studies, preferred alternatives were identified and this information was used as an input for the alternatives assessment process. By combining these studies with public and regulator input from stakeholder consultation, the findings from the various baseline studies and the impact assessment process, a comprehensive view of the effects of the alternatives can be derived. To ensure the best alternative could be reported transparently and with confidence based on the broad ranging data available, several measures have been built into the process to ensure it remains unbiased and a representative evaluation of the knowledge gained from the studies conducted. The measures included in the alternatives assessment methodology are:

- The use of a multidisciplinary group of participants in the evaluations.
- The use of the Delphi technique to ensure inclusivity, transparency and convergence in scoring.
- Blind scoring of the evaluations to ensure participants could not skew the scoring.
- Reporting normalised data as well as total data.
- Using two different types of sensitivity analysis to ensure total scores and normalised scores pointed to the best alternative.
- Calculating derived perception scores, to identify trade-offs, as well as ensuring perceived sensitivity and benefit were consistent with decisions for social and environmental criteria.
- Using calculated engineering, technical and risk data along with CAPEX and OPEX for most alternatives to ensure that multiple aspects of the various criteria were used in scoring.

The extent of the various inputs did not allow a single participant to determine all the scoring, thereby reducing the opportunity for bias or reaching predetermined outcomes. These various aspects are described in more detail in the sections below.

2.4.2. Multidisciplinary Group

The approach used to score the environmental and social matrix as well as the engineering and economic matrix was to use a multidisciplinary team with good knowledge of the project. The team's primary purpose was to contribute their knowledge to the evaluation by identifying which criteria in the matrix were triggered and then to assist in providing an evaluation score for those criteria. Using a team allows checks and balances to be incorporated in the process to ensure that a balanced perspective is maintained throughout. The facilitator of the evaluation process ensures that all the participants are given an opportunity to contribute their criteria and then all are involved in scoring each criteria individually. Using a team approach also provides team members the opportunity to enhance knowledge by creating a forum for learning more about the strategies, resources, and approaches used by various disciplines.

The multidisciplinary team that contributed to the alternatives evaluation process included:

- Frederic Guerin AREVA.
- Nicola Banton AREVA.
- Diane Martens AREVA.
- Chase Carter AREVA.
- Roman Strzeszewski AREVA.

Facilitators were:

- Mark Vendrig Consult 5 Inc.
- Don Hovdebo ASKI Resource Management.

2.4.3. Delphi Technique

To ensure the evaluation of the alternatives was comprehensive and inclusive of all participants in the multi-disciplinary team, a Delphi Technique was used. The Delphi Technique is used for gathering data from respondents within their domain of expertise using a group communication process which aims to achieve a convergence of opinion on specific issues. The Delphi process is used in various fields, including program planning, needs assessment, policy determination and alternatives assessment. The Delphi approach is ideal for alternatives assessment as it attempts to address "what could or should be" scenarios, unlike normal evaluations which try to identify "what is" outcomes.

Through the process, participants explore or expose underlying assumptions, as well as evaluate judgments on a topic spanning a wide range of disciplines. The Delphi approach is well suited as a method for finding consensus as it is based on a series of questionnaires, or matrices, as used in this alternatives evaluation, and collecting several iterations of feedback or scoring from the multidisciplinary team. The feedback process allows and encourages the participants to reassess and modify their initial scoring based on the information provided by other participants. Doing multiple iterations of this approach achieves a convergence in scoring and evaluation providing all participants' confidence in the scoring result assigned to each criteria as their input and understanding of the evaluation has been incorporated in the assessment. It is important to note that all participants are required to input on each criteria being evaluated and that all participants are encouraged to share their reasoning for the evaluation. The facilitators ensure that personal dynamics are removed by ensuring that all participants are enabled to share and contribute their knowledge and evaluations.

2.4.4. Blind Scoring

To ensure the scoring of the various criteria for each alternative were completed with minimal bias the total scores were hidden from participants until all the criteria had been completely scored through the various iterations using the Delphi Technique. By subjecting each criteria to the Delphi Technique, any differences in scoring were supported with evidence and the scoring was then re-

evaluated. Although it is not impossible to bias the results, it is unlikely through blind scoring and using the Delphi Technique that a preferred alternative could be scored preferentially. In addition, the facilitators evaluated each scoring round to ensure that it was consistent with the information that was presented as evidence and challenged the multi-disciplinary team of participants if the scoring seemed inconsistent with available information and knowledge provided.

2.5. Scoring

A scoring system has been developed that allows the score to be assigned to ensure several different aspects of the social and environmental evaluation are reflected. The score accounts for:

- Score for each selected criteria.
- A total for each criteria set.
- A score for perceived public sensitivity.
- A score for perceived public benefit.

2.5.1. Environmental and Social Matrix Score

For this alternatives assessment, a scoring methodology has been developed for the environmental and social matrix that reflects the typical positive and negative influence of activities with a graduated scale from negligible to major or extreme (**Table 5**). Additionally, on the negative scale an unacceptable score is provided in the event that any particular criteria is scored as a fatal flaw, and would not be viable. On the negative scale, the extreme and high categories are marked as orange as they represent a part of the scoring system where AREVA becomes uncomfortable with the extent of the negative score and this is referred to as the alternative threshold in the report. In the scoring, the negligible influence indicates that there is no real differentiation between positive and negative and both of these are scored as '4' to indicate that lack of resolution. The intent of the scoring is to score negative project influences low and positive project influences high. In the social and environmental matrix the highest score reflects the most favoured alternative based on the analysis.

2.5.2. Perceived Public Sensitivity and Benefit

In the environmental and social matrix the scoring is partly based on the input from the public engagement record. Where the public or regulators have expressed concern or sensitivity related to a particular alternative or criteria this is reflected in the score. To ensure this information is retained and reflected in the presentation, a perceived public sensitivity score is assigned as indicated in **Table 5**. This is also done for both the positive and negative scale. For the perception scores, the more negative or positive an item is evaluated when linked to a public perception, the higher the score.

Table 5: Scoring methodology.

Negative		Perceived Public Sensitivity	Positive		Perceived Public Benefit
Unacceptable	Ff*				
Extreme	0	4	Major	8	4
**High	1	3	High	7	3
Moderate	2	2	Moderate	6	2
Low	3	1	Low	5	1
Negligible	4	0	Negligible	4	0

*Ff = Fatal flaw

** Scores high and above (1, 0 or Ff) are above the AREVA threshold and become undesirable.

2.5.3. Perceived Trade-offs

In the analysis, some alternatives reflect both a perceived public sensitivity and a perceived public benefit. In these instances it is possible to analyse the data for trade-offs. This allows the alternatives to be evaluated in a slightly different way, in that it provides insight into what the public perceive to be important. As an example, people may obtain employment for a particular activity, but that same activity may affect caribou. If people, as they do without exception in this report, place safeguarding of the environment over employment, then it provides an indication of what is important and how people are trading different alternatives off against each other. This is a useful indicator of consistency and reliability of the outcomes that are derived from the scoring system.

2.6. Reporting

In this report the structure shown in the following bullet list has been used for the analysis of alternatives:

- In the report:
  - Introduction to Alternatives
  - Description of Alternative
  - Considerations for Evaluation
  - Social and Environmental Analysis
  - Bar Charts
  - Radar Plots
  - Engineering, Technical and Economic Analysis
  - Best Alternative.
- In the appendices:
  - Analysis Tables
  - Summary Tables
  - Sensitivity Analysis
  - Bar Charts
  - Radar Plots

The reporting of the alternatives analysis is presented in the sections below.

3. Power Supply Alternatives

AREVA has considered several alternatives for the supply of power to the site. All power will be generated at the site due to it being remote from any large scale power generation sources. As the site has a good wind resource, the alternative of wind generation has also been included. Wind energy as well as the possibility of using clean burning gas turbines were considered as they were expected to have fewer environmental impacts. Wind energy would require standby generation units, as a continuous supply of power is required for the mine and processing operations. The wind turbines would contribute to a minor saving in diesel usage. Co-generation with a wind and diesel system is the proposed alternative that is considered in this report. The more conventional diesel generation systems have also been considered to supply power to the project. The three power supply systems that have been included in the analysis are described in Table 6. Two of the alternatives, diesel turbines and diesel Internal Combustion Engine (ICE) generation are presented in two configurations, centralised and decentralised. In a decentralised configuration, smaller power units are located at each of the sites, Sissons and Kiggavik. Under the centralised alternative, the main power generation units are located at the Kiggavik site and a power line feeds Sissons. As a standby for emergency situations, Sissons would have a small generating capacity only.

3.1. Alternatives Considered

In Table 6, the alternatives that have been considered by AREVA for the generation of power at the Kiggavik site are presented.

Table 6: Power supply alternatives.

Alter-native	Name	Description	Considered in Alternatives Evaluation*
1	Wind generation with diesel generation.	Seven Wind turbines with 810 kW turbines and a total capacity of 5.67 MW or 30% of the base load power requirements. Turbines would be located to the North of the Kiggavik site. A full diesel generation set is considered part of this alternative.	Yes
2	Decentralised diesel Internal Combustion Engine (ICE) generation.	Each plant is supplied with a generating unit and diesel storage tanks. No power line between the plants.	Yes
3	Centralised diesel Internal Combustion Engine (ICE)) generation.	A main diesel power generation unit with fuel storage tanks at Kiggavik. A power line connects to Sissons which has a small emergency generating capacity.	Yes
4	Decentralised Diesel Turbine.	Each plant is supplied with a generating unit and diesel storage tanks. No power line between the plants.	Yes
5	Centralised Diesel Turbine.	A main gas power generation unit with diesel storage tanks at Kiggavik. A power line connects to Sissons which has small diesel emergency generating capacity.	Yes

* All alternatives have been evaluated for viability. Only the viable alternatives are presented for analysis in this report.

3.1.1. Considerations for Evaluation

When considering the alternatives the following points need to be borne in mind:

- Seven wind turbines of 810 kW or total of 5.6 MW will save up to 6% diesel per year.
- Wind is variable source, requiring a secondary source, cannot be relied on for base load and it is difficult to store the power.

3.2. Environmental and Social Evaluation

The five viable power supply alternatives have been evaluated against the environmental and social matrix criteria with a final ranking as presented in Figure 3. The two diesel ICE alternatives were found to have the highest assessment score, followed by the decentralised diesel turbine system and then a very similar score between the wind and diesel co-generation alternative and the centralised diesel turbine system. The decentralised systems scored better than the centralised systems suggesting they would be the preferred alternative, especially in the diesel ICE system. The resolution of the result is however, not particularly strong, with a final score range from 39 to 43.

The wind and diesel co-generation and the diesel decentralised alternative were found to have a perceived public benefit that was related to the potential for both to be associated with additional employment opportunities. Wind has the highest perceived public benefit as it would require both diesel and wind turbine maintenance staff and operators. Wind also had the highest perceived public sensitivity associated with it, primarily due to the effects that turbine flicker and noise will have on animals. The fast spinning blades are also known to result in collisions with birds. Both factors will result in perceived sensitivity with the public. Although the wind alternative is associated with a reduction in the use of fuel and emissions, both gaseous and particulate, the perceived sensitivity outweighs the perceived benefit. Considering the potential trade-offs, sensitivities related to variations in the animal populations were found to be of likely greater concern than benefits associated with the employment opportunities. The data is interpreted to be indicating that maintaining animal populations was considered more important than jobs, though this would not reflect the view of all people.

With regards to the physical environment, the diesel generation units are associated with more particulate emissions, which when settling on snow, are known to cause more rapid melting due to their dark colour. The wind turbine and the diesel turbines are associated with more noise. The diesel turbines do a have a high frequency component that will affect animals, and the wind turbine blade tips will generate noise with effective buffer zones of about 750 m being required. The wind turbines will therefore contribute to an increase in the foot print of the operations due to their noise and the flicker associated with the rotating blades.

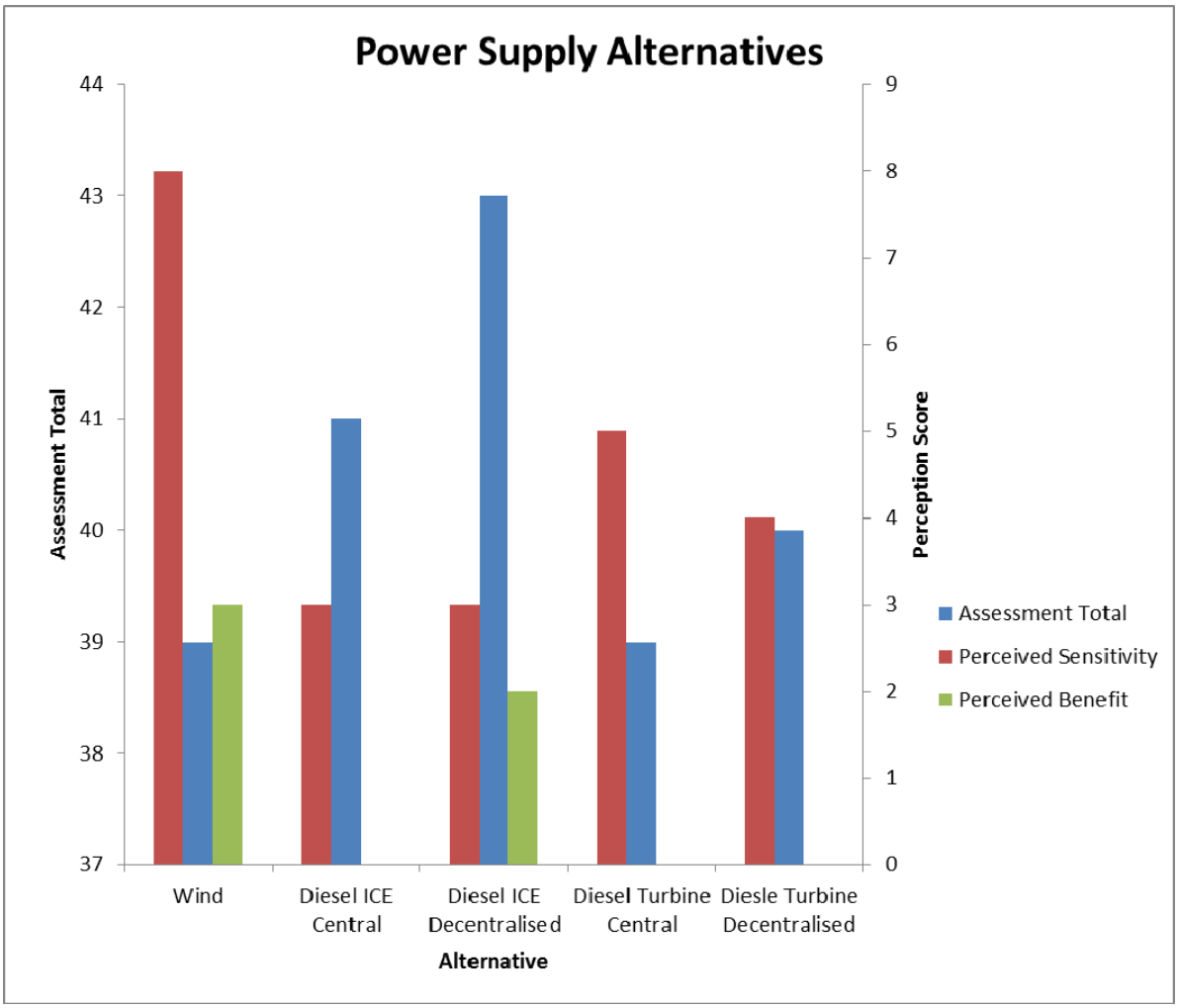


Figure 3: Graphical result of power supply alternatives assessment.

From the radar plots shown in Figure 4, it is clear that the wind and diesel co-generation was evaluated to score poorly on the physical environment and the biological environment criteria groups. The diesel ICE decentralised alternative scored well on all categories, but not very well on the physical environment criteria group. Sensitivity analysis of the results does show that the diesel ICE decentralised alternative is the favoured alternative under all cases of analysis. Even though the sensitivity analysis is clear that the decentralised diesel ICE alternative is the best, it is important to note that there is low resolution in the result. This low resolution does suggest that the difference between the various alternatives is not that great. The engineering, technical, risk and economic analysis is, in this case, required to ensure the resolution to identify the preferred alternative is clear.

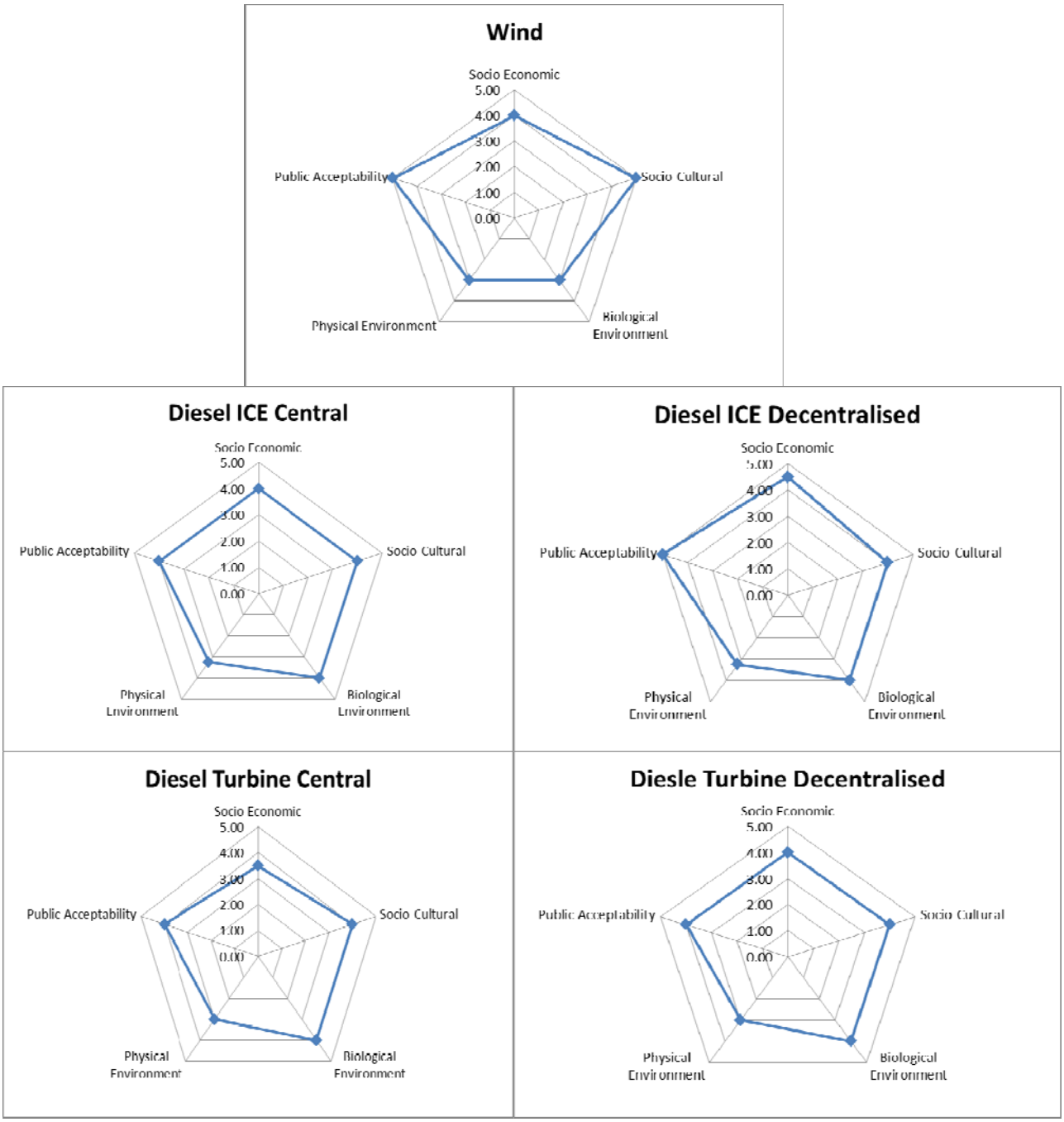


Figure 4: Comparative radar plots of environmental and social criteria for power supply alternatives.

3.3. Engineering and Cost Evaluation

The engineering and economic analysis presented in Table 7, indicates that the diesel decentralised alternative is preferred. This alternative is not the lowest OPEX, but overall is the best alternative. Note the lowest score for engineering, risk and cost is the favoured score. Again, as with the environmental and social analysis, the decentralised alternatives are preferable to the centralised ones and the wind and diesel co-generation alternative the least favoured.

Table 7: Comparative engineering, technical and economic criteria for power supply alternatives.

		Engineering/Technical				Economic		
Alternative		**Difficulty**	**Rank**	**Risk**	**Rank**	**CAPEX**	**OPEX**	**Score**
1	Wind and Diesel	Requires both wind turbine and backup power supply	3	Interruption of supply possible if wind stops. Need backup generation system.	5	1.8	0.6	10.4
2	Diesel ICE Central	Known technology.	1	The power line is the risk. Lightning, icing, wind, can interrupt supply. Need emergency supply at Sissons.	2	1.2	0.9	5.1
3	Diesel ICE Decentralised	Known technology.	1	Emergency generator required at both sites, but only one site would go down if there was a failure. Reduced environmental factor (lightning wind icing) risks to power line. Fuel at two locations, spillages and leakages and marginal increase in fuel transport.	1	1	1	4
4	Diesel Turbine Central	Difficult maintenance.	2	The power line is the risk. Lightning, icing, wind, can interrupt supply. Need emergency supply at Sissons.	4	1.1	1.1	8.2
5	Diesel Turbine Decentralised	Difficult maintenance.	2	Emergency generator required at both sites, but only one site would go down if there was a failure. Reduced environmental factor (lightning wind icing) risks to power line. Fuel at two locations, spillages and leakages and marginal increase in fuel transport.	3	1.15	1.1	7.25

The analysis also indicates that that the diesel turbines are less favoured than the diesel internal combustion engines but more favoured than the wind and diesel co-generation alternatives. The resolution between centralised diesel and decentralised diesel remains low.

3.4. Best Alternative

The diesel ICE decentralised power generation alternative is the best scoring alternative in both the environmental and social matrix and in the engineering and economics matrix. The diesel ICE alternatives are also the best scoring alternatives followed by diesel turbine and then wind and diesel co-generation. Sensitivity analysis confirms that decentralised diesel ICE power generation is the best alternative based on the analysis that has been conducted as part of this alternatives assessment.

The resolution between centralised diesel and decentralised diesel is low, but decentralised diesel is consistently the preferred alternative.

4. Fresh Water Source Alternatives

AREVA has considered the large water bodies surrounding the site and selected those with close proximity, accessibility and adequate water resources for inclusion in the alternatives assessment. The six water bodies that have been included in the analysis are described in Table 8. AREVA will work to minimise both the intake of fresh water from lakes and the release of treated effluents to surface water receptors. The fresh water resource and effluent discharge points alternatives assessment are dependent on one another as Judge Sissons Lake is considered in both.

The proposed water supply system will draw water from a lake through a screened pump intake and then pump it via an electrically heat-traced line to the clean water storage tank at the mill for industrial use and to the accommodation complex for potable use. Fresh water requirements during mill operation determine that the system must deliver a maximum flow of 8,000 m^3/day. A power line and maintenance road will be required in order to supply access and electricity to the heat trace and the pumping station.

4.1. Alternatives Considered

In Table 8, the alternatives that have been considered by AREVA for the source of fresh water at the Kiggavik site are presented.

Table 8: Fresh water resource alternatives.

Alter-native	Name	Description	Considered in Alternatives Evaluation
1	Judge Sissons Lake	The largest water body close to the mine operations and considered the best alternative for receiving the treated effluent from the operations. The lake is one of the furthest from the mine site.	Yes
2	Kavisilik Lake	A reasonably large water body located to the north east of the site, but the furthest away.	Yes
3	Scotch Lake	Close to the site, but potentially with a limited water resource under ice.	Yes
4	Skinny Lake	Accessible to the site with adequate water resources, but would require a dedicated pipeline route to service the pipe and intake.	Yes
5	Squiggly Lake	Drains to the Thelon River which has development and interest value to the public.	Yes
6	Siamese Lake	Accessible to the site with adequate water resources along the winter road route, approximately 8 km east of the site and with a maximum depth of 12 m.	Yes

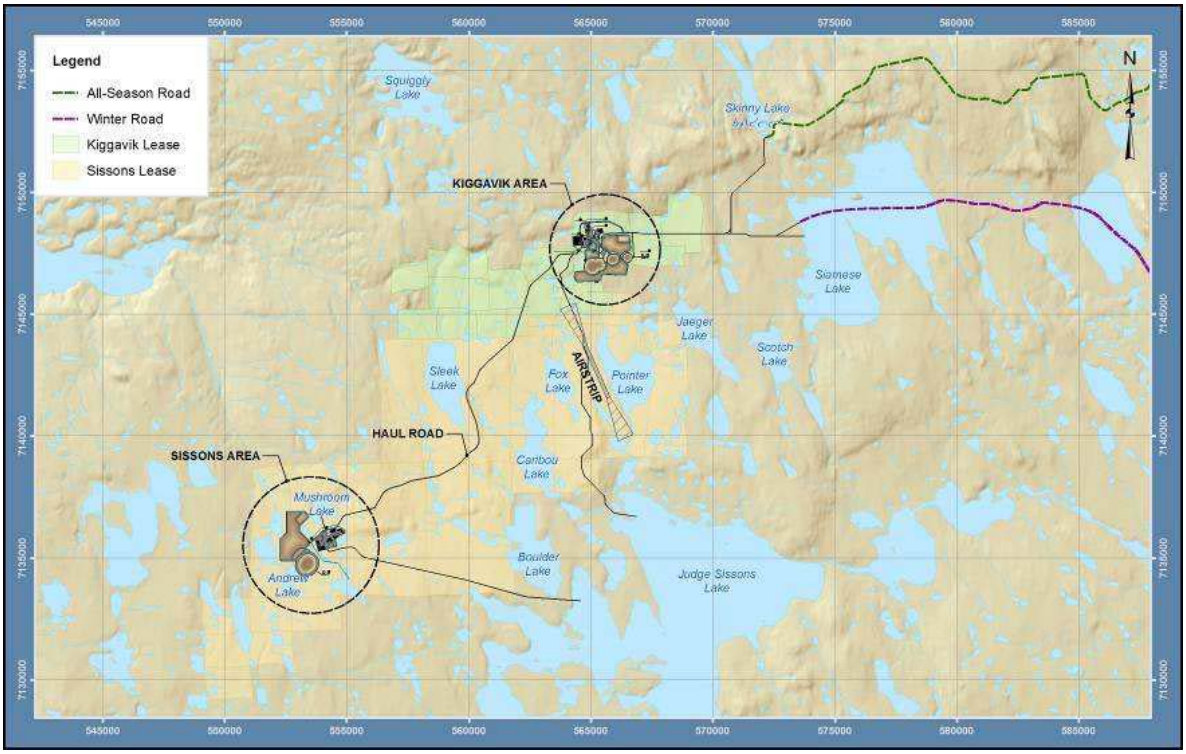


Figure 5: Map showing water intake and discharge point alternatives.

4.1.1. Considerations for Evaluation

The six lakes that have been considered all have available hydrological data, sufficient under-ice volume and sufficient depth. Guidelines indicate that 5% of the under ice volume may be used in the short-term without harming aquatic species. More may be taken over the long-term if it could be proven that aquatic species would be unaffected. Ideally, AREVA would like to keep their operations within one watershed, thus making the Thelon River catchment and the Squiggly Lake alternative less desirable. Scotch Lake has a restricted water supply and it may not be adequate as a source.

4.2. Environmental and Social Evaluation

The six viable alternatives have been evaluated against the environmental and social matrix criteria with a final ranking as presented in Figure 6. The full analysis is presented in Atatchment A. No perceived public benefit was identified in the analysis of water withdrawal from any water source. Evaluation against the criteria set also indicates that use of water from Siamese Lake has no perceived public sensitivity. This is a perception based on evaluation of respondents' input and review of the public engagement notes and should not be read as no real sensitivity within the public; it is merely an indicator of perceived public sensitivity. Scotch Lake and Squiggly Lake had the highest perceived public sensitivity, Scotch Lake due to its restricted water supply.

Siamese Lake scored the highest assessment score in the evaluation process, followed by Judge Sissons Lake, then Skinny Lake and then a large gap to Squiggly and Scotch Lakes. Siamese Lake

scored the highest in the sensitivity analysis across all categories and shared the high score with Judge Sissons Lake when Socio-economic factors were excluded. Judge Sissons Lake was identified as the best alternative for the effluent discharge, making it less desirable as the fresh water source.

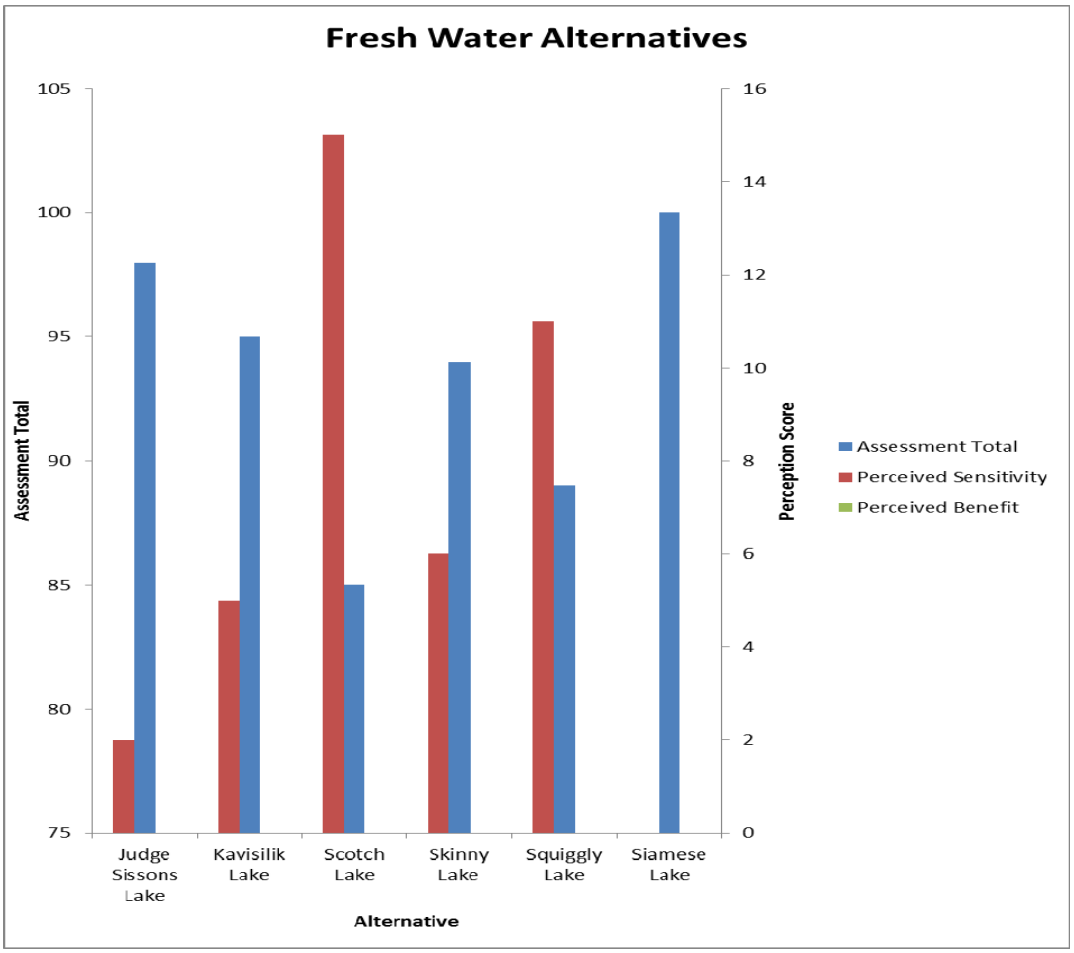


Figure 6: Graphical result of fresh water source alternatives assessment.

From the analysis of the social and environmental alternatives presented in the radar plots in Figure 7, it is apparent that Squiggly and Scotch Lakes are less desirable from a biological environment and socio-cultural perspective. Therefore, both of these have a higher perceived public sensitivity associated with them. In addition, Scotch Lake scores below the AREVA alternative threshold for regulatory compliance and aquatic biological sustainability. This AREVA alternative threshold makes it an undesirable choice even though it is a viable alternative, albeit with a limited water resource. Neither Kavisilik Lake nor Skinny Lake score well on the socio-cultural criteria and likewise their perceived public sensitivity is elevated. Unlike Squiggly and Scotch Lakes, Kavisilik and Skinny Lakes score better on the biological environmental side and their perceived public sensitivity is therefore lower than Squiggly and Scotch Lakes. Judge Sissons Lake is not as desirable as Siamese Lake based on the socio-environmental analysis and is the preferred alternative for treated effluent discharge. Siamese Lake, on all environmental and social evaluations, as well as sensitivity analysis, is the most desirable alternative and is expected to have the lowest perceived public sensitivity.

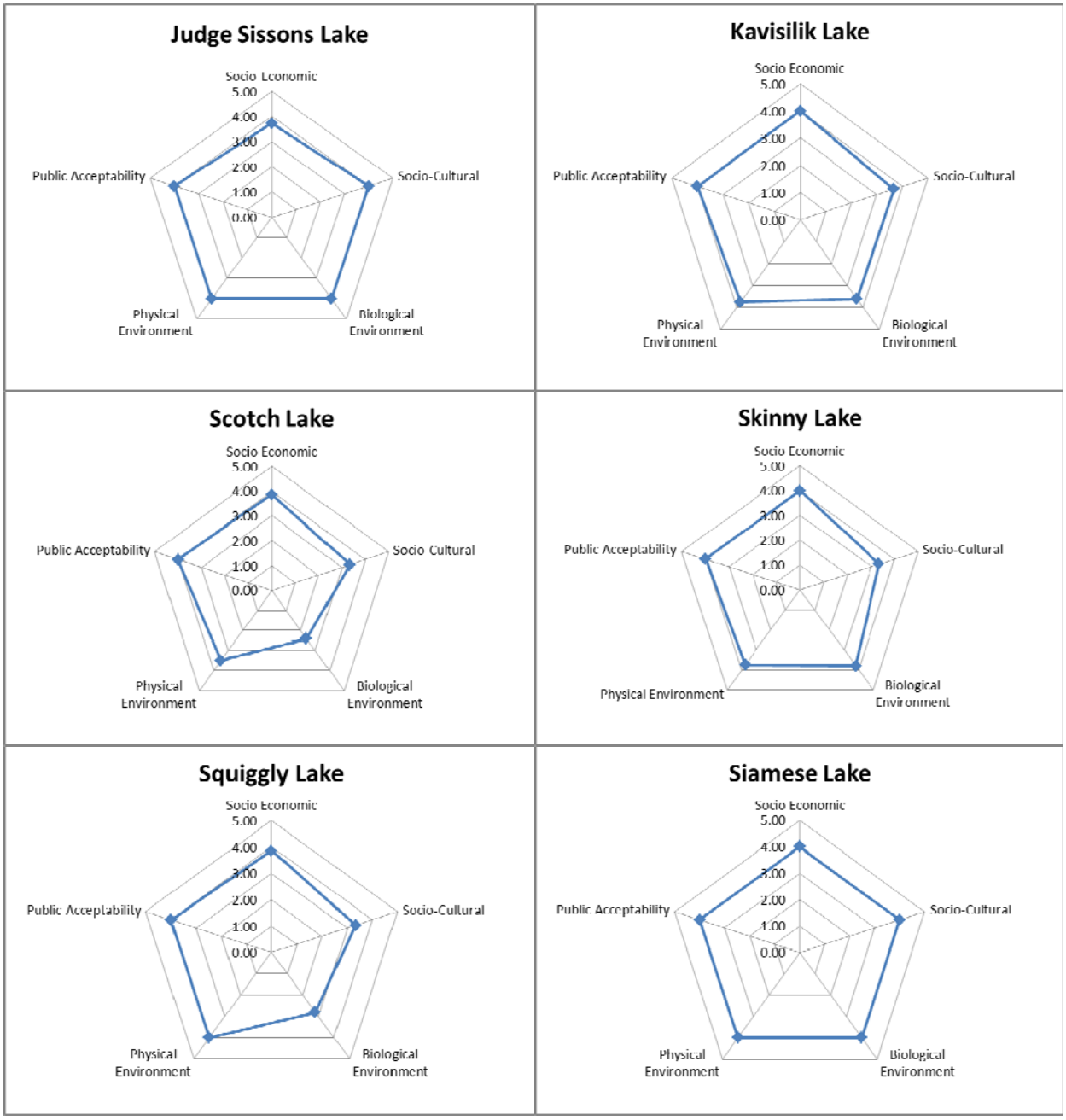


Figure 7: Comparative radar plots of environmental and social criteria for fresh water source alternatives.

4.3. Engineering and Cost Evaluation

The evaluation of the engineering aspects and cost for the supply of water were considered to be fairly similar for all the alternatives so no engineering matrix is presented. If the costs and engineering aspects are similar, there will be very little difference between the scores and it will be difficult to determine what the best alternative is.

4.4. Best Alternative

The Siamese Lake alternative is considered the best alternative for the project across socio-economic, environmental and perceived public sensitivity criteria. Sensitivity analysis confirms the Siamese Lake alternative as the best available on almost every environmental and social criteria.

5. Treated Effluent Discharge Alternatives

AREVA have considered various alternatives for discharge of treated effluent from the operations. It is important to note that only treated effluent will be released. The treated effluent will be monitored before release to ensure compliance with regulatory requirements and will be brought close to ambient release point temperature. Treated effluent is not pristine water, but it is of a quality that meets the regulated requirements for the site discharge point.

5.1. Alternatives Considered

AREVA developed four alternatives for the discharge of water at the site. Only three of the alternatives were considered to be feasible and are presented for evaluation as noted in Table 9.

Table 9: Alternatives for treated effluent discharge.

Alter-native	Name	Description	Considered in Alternatives Evaluation
1	Zero liquid discharge	Two-stage Reverse Osmosis (RO) with pre-treatment. RO residue treated in evaporator with in-pit disposal of concentrate. Solids will be highly saline and could mobilise in the future so it is considered a high environmental risk.	No Not considered environmentally, technically or economically viable.
2	Seasonal discharge to Pointer Lake	One-stage RO with pre-treatment, chemical precipitation. Storage of RO residue in a storage pit during nine winter months with chemical precipitation treatment in summer. Seasonal discharge to Pointer Lake during the three summer months only. 3 km of piping and the development of a storage pit.	Yes
3	Year round discharge to Sik Sik Lake	One-stage RO with pre-treatment and chemical precipitation. Year-round discharge to Sik Sik Lake, which is dammed and used as a water management structure. 5.8 km of piping.	Yes
4	Year Round Discharge to Judge Sissons Lake	One-stage RO with pre-treatment and chemical precipitation. Year-round discharge to Judge Sissons Lake. No storage of effluent required. 14.1 km of piping.	Yes

5.1.1. Considerations for Evaluation

During winter, lakes that are less than 2m deep will freeze to the bottom and have very little or no under-ice water volume. All lakes in the Judge Sissons watershed are considered to be stagnant in the winter because the inlet and outlet points are frozen. All considered alternatives require pipelines to be built across an area that is used by caribou in the spring migration (Figure 8). It is, however, expected that potential impacts from the pipeline on caribou can be mitigated. There are known grave sites and areas of spiritual significance close to the proposed sites, but none are directly affected by the proposed pipeline routes. The Sik Sik Lake alternative (Alternative 3) will require

the construction of a dam structure. Sik Sik Lake is a natural habitat for fish, who migrate into the lake in the warm season and migrate out when ice formation begins. They migrate out as they seek deeper lakes with enough under-ice water volume to survive the winter. Regulators indicate the outlet of the dam could be considered the final point of control, requiring Sik Sik Lake to be listed under Schedule 2 of the Metal Mining Effluent Regulations (MMER) if this alternative is selected.

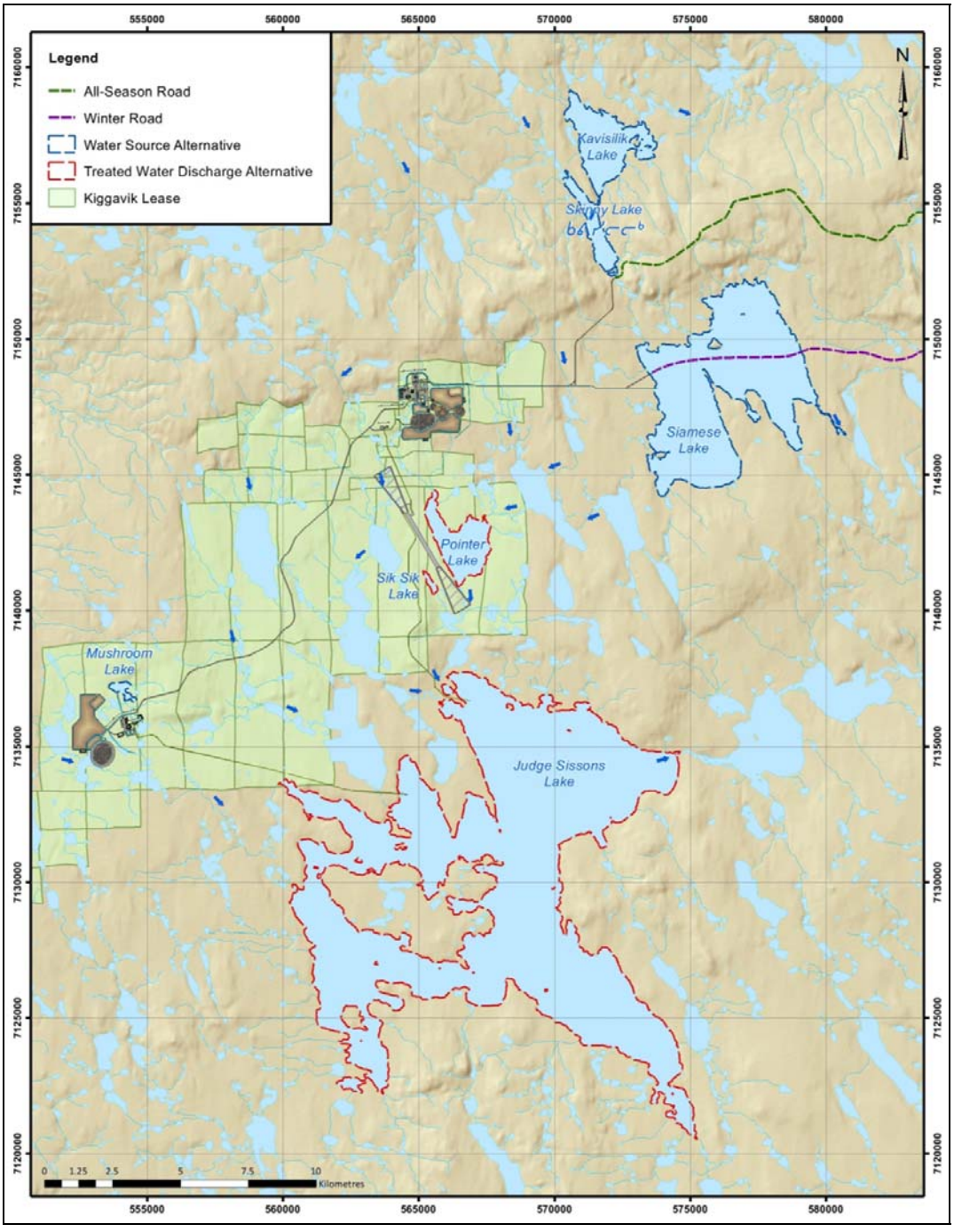


Figure 8: Water intake and discharge points.

5.2. Environmental and Social Evaluation

The three viable alternatives have been evaluated against the environmental and social matrix criteria with a final ranking as presented in Figure 9. No perceived public benefit was identified in the analysis as presented in the attachment.

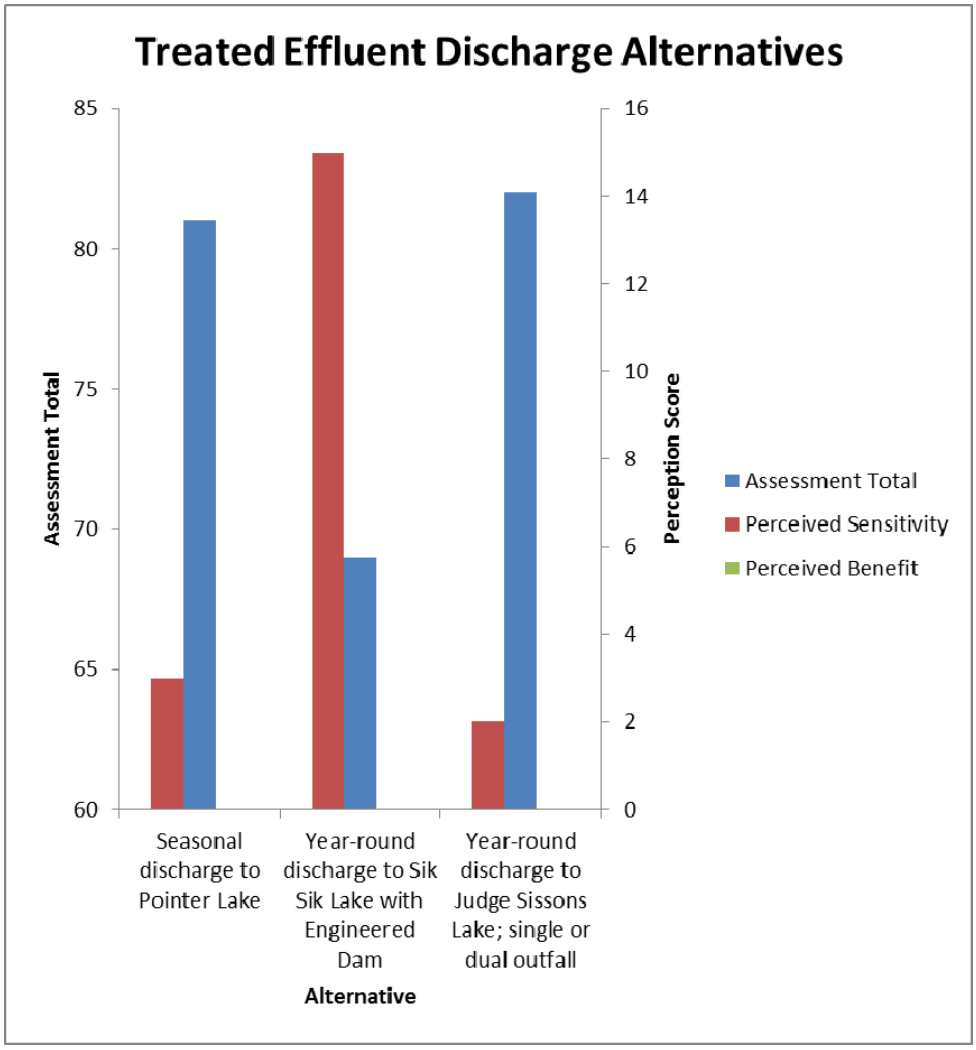


Figure 9: Graphical result for the discharge alternatives assessment.

- **Pointer Lake Discharge**: This alternative scores the second highest and has the second highest perceived public sensitivity. The sensitivity relates to the complexity of the water storage in winter with release from the pit during summer. The higher risk of potential water contamination is the key driver that differentiates this alternative from the highest scoring alternative with discharge to Judge Sissons Lake.
- **Sik Sik Lake Discharge**: The evaluation has shown that the Sik Sik Lake discharge point is not favoured as it will require listing of the lake and require a physical change to the environment. Sediment quality is expected to be the most affected in this alternative. This

alternative scores the lowest of all for socio-cultural, regulatory and physical environmental desirability.

- **Judge Sissons Lake Discharge**: This alternative scored the highest assessment total and the lowest perceived public sensitivity. The Judge Sissons Lake alternative does have the longest pipeline, representing the longest potential route for interaction with caribou, but this can be mitigated. This alternative was considered to have the lowest potential risk to water quality. Barring public acceptability, related primarily to the pipeline, this alternative was found to be the alternative of choice in four out of the five categories evaluated in the sensitivity analysis.

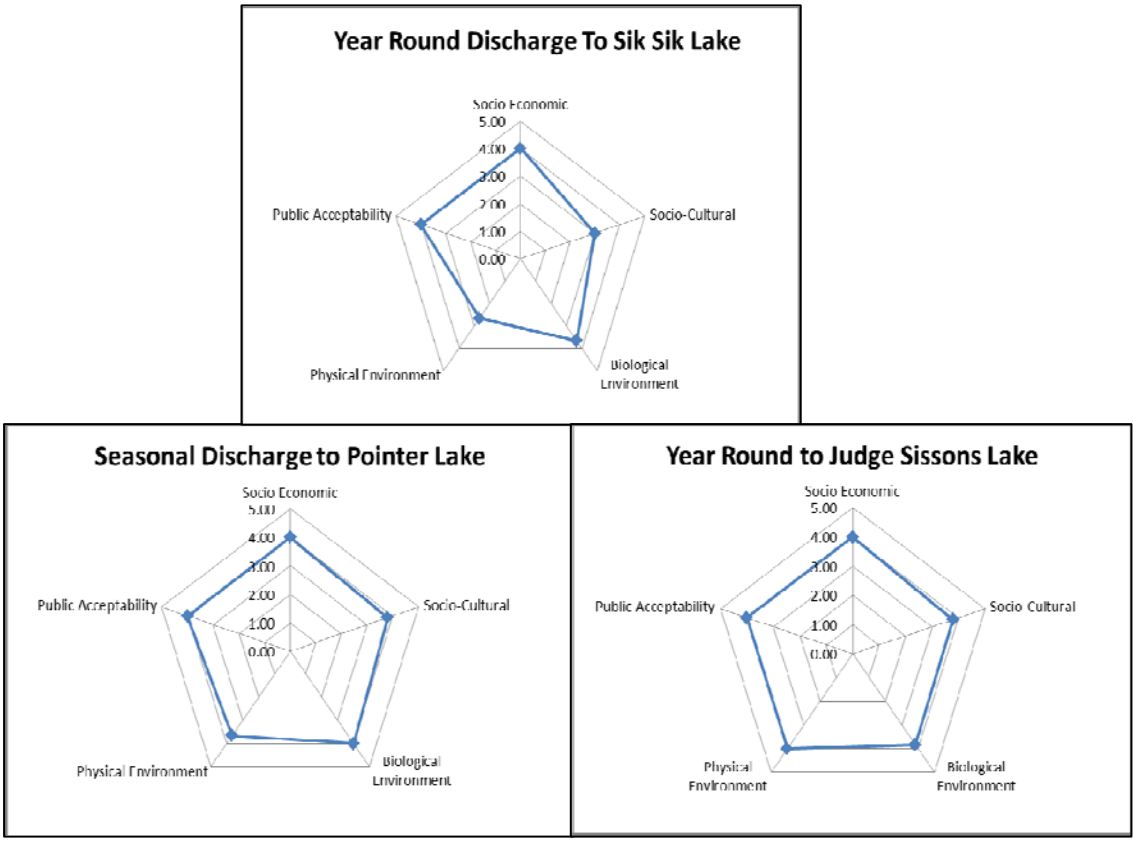


Figure 10: Comparative radar plots of environmental and social criteria for discharge alternatives.

Good resolution is achieved using social and environmental criteria, pointing to the Sik Sik Lake alternative not being the favoured alternative, but there is very little difference between the Pointer Lake and the Judge Sissons Lake alternatives.

5.3. Engineering and Cost Evaluation

The engineering technical and economic criteria were evaluated to determine the optimal alternative for the proposed project. The analysis is presented in Table 10. In the table, the blue cells represent the optimal alternative. In these tables, the lowest score is the optimal alternative based on a relative comparison to other alternatives. The best alternative in the socio-economic and environmental alternative is scored as "1" and the other alternatives are ranked against it. Qualitative data is ranked and the rank is used to score each item.

Table 10: Comparative engineering, technical and economic criteria for discharge alternatives.

Alternative		Engineering and Technical Criteria						Economic Criteria		Total Score (Low score is optimal)
		Difficulty	Rank	Risk	Rank	Schedule	Rank	CAPEX	OPEX	
1	Seasonal discharge to Pointer Lake	Higher cost for monitoring ponds as higher flows. Water treatment about 3 times bigger plant larger due to a larger flow.	3	Very wet year could result in a pit storage volume issues. Pointer lake volumes not affected by high volume flows. If Pointer Lake is not flushed out before the freeze, it would result in concentration build up in Pointer Lake. Beginning and end of season management risk. Vulnerable to system variations. More chemicals needed for process. More fuel needed for heating a bigger building.	3	2	3	3	1.5	13.5
2	Year-round discharge to Sik Sik Lake	Dam construction is a technical risk	2	Potential regulatory concern. Ecological risk assessment points to reduced flow into lake and potential need for remediation of sediments in Sik Sik Lake.	2	1.1	1	1.5	1.1	7.6
3	Year-round discharge to Judge Sissons Lake; single or dual outfall	1	1	Longer pipeline, therefore potential for leak risk. Winter operation, heat tracing. Judge Sissons has greater depth. No thermocline in lake, so water will not be too different from lake temperature. Less vulnerable to process variation changes than seasonal discharge. Less chemical needed for operation.	1	1	1	1	1	5

From this analysis, it is apparent that the Judge Sissons Lake alternative is considered the best alternative based on engineering, technical and economic criteria. The Judge Sissons alternative is scored as the most favourable in every category.

5.4. Best Alternative

The Judge Sissons discharge alternative is considered the best alternative for the project across socio-economic, environmental, perceived public sensitivity, engineering, technical and economic criteria. Sensitivity analysis confirms the alternative as the best available on almost every criteria.

6. Waste Management Alternatives

AREVA has developed various waste management plans with the objective of minimising waste generation, while maximising recycling and reusing materials where possible. Any unrecoverable materials will either be landfilled onsite, or if they are hazardous, removed and safely disposed of in appropriately licenced landfill facilities offsite. The waste management plans are largely based on proven methods used at AREVA's McClean Lake Operation located in Northern Saskatchewan as well as at Agnico Eagle's Meadowbank Project. As the waste management plans are based on operational experience, the best methods are known and an alternatives assessment has therefore not been undertaken. A summary of the waste management plans is presented below. Tailings and Mine rock disposal are described in a Section 9. Various Waste Management Plans are submitted as part of the ESIA.

6.1. Waste Facilities

Waste facilities planned for the project include:

- **Two industrial landfills:** Located on the edge of the Kiggavik and Andrew Lake clean waste rock piles
- **Contaminated landfill:** Located on the perimeter of the Tailings Management Facility (TMF).
- I**ncinerator:** Located near to the accommodation complex, housing a double chamber, controlled air incinerator similar to that used by Agnico-Eagle at the Meadowbank Project.

6.2. AREVA Waste Management

Waste management in the project will be achieved as follows:

- **Domestic Waste:** General waste materials from the accommodation complex and offices.
  - Recyclables will be sorted and transported off-site.
  - Non-recyclable domestic wastes such as food wastes, clean wood, organic matter, paper and cardboard will be incinerated.
- **Industrial Waste:** Bulk waste materials that are non-combustible.
  - Non-contaminated waste will either be reused or recycled.
  - Non reusable waste will be landfilled in the Kiggavik and Andrew Lake clean waste rock piles.
- **Chemically or Radiologically Contaminated Waste:** Waste originating from the mining, milling and water treatment areas. Contaminated material is collected in dumpsters and deposited in the contaminated landfill.
- **Sewage Sludge:** Solid waste from the domestic water treatment system.

  - Preferred disposal method is in a dedicated sewage disposal area on site for composting for later use as a soil amendment for site revegetation.
  - If wildlife is attracted, sewage sludge may be buried under mine rock or incinerated with burial of the ashes.
  - Treated sewage effluent will be combined with the water treatment plant discharge and discharged to Judge Sissons Lake (Alternatives for effluent discharge are presented in Section 5).
  - Sewage at the Baker Lake dock facility will be contained in an above-ground tank and disposed of in the Baker Lake community sewage lagoon.
  - During the construction phase, sewage will be incinerated.

- **Used Oil and Waste Fuels: C**ollected and stored in approved containment facilities.
  - Guideline conforming non-radiologically contaminated used oil will be incinerated.
  - Non-conforming or radiologically contaminated oil will be removed from site by a licensed carrier and delivered to a licensed receiver for recycling.

- **Incinerator Ash:** From the incineration of non-contaminated waste
  - Guideline compliant ash will be disposed of in the industrial landfills.
  - Ash that does not meet these guidelines will be disposed of within the TMF.
  - During construction, incinerated ash will be drummed and shipped offsite to a licensed facility or stored onsite until the industrial landfill is in operation.

- **Hazardous Substances and Waste Dangerous Goods: C**ollected in designated drums, tanks and other approved containers and shipped offsite for disposal at a licensed facility

7. Andrew Lake Dewatering Alternatives

The Andrew Lake Open Pit at the Sissons site has part of the deposit located below Andrew Lake. In order to develop the Andrew Lake Open Pit, there is a need to isolate and drain the north east end of Andrew Lake. AREVA would catch any fish in the dewatering area and return them to the main lake before building a dewatering structure in the lake. The dewatering structure is required to ensure the lake water and the pit are safely separated. The dewatering structure will be built to meet the Canadian Dam Association (2007) standards.

7.1. Alternatives Considered

AREVA developed four alternatives for the dewatering of part of Andrew Lake. Three of the alternatives were considered to be feasible and are presented for evaluation as noted in Table 11. Alternatives 2 and 3 can be more clearly seen in Figure 11.

Table 11: Alternatives for dewatering part of Andrew Lake.

Alter-native	Name	Description	Considered in Alternatives Evaluation
1	Full dewatering.	The whole of Andrew Lake would be drained and a channel constructed to connect the inflow and out flow points.	Yes
2	Partial dewatering (Construct drainage connections).	A dewatering structure is built across the north east part of Andrew Lake and a channel is constructed to connect the inflow and outflow points.	Yes
3	Partial dewatering (Maintain natural inflow and outflow).	A dewatering structure is built across the north east part of Andrew Lake and the inflow and outflow points are maintained as they currently exist.	Yes
4	No dewatering.	Underground mining is used. This would not require the dewatering of Andrew Lake.	No The ground conditions are not amenable to underground mining.

7.1.1. Considerations for Evaluation

The following points should be considered when evaluating the alternatives for the dewatering of part of Andrew Lake:

- The ideal is to minimise fish habitat loss.
- Ideally, the existing stream flow through the inlets and outlets should be maintained to keep as much of the fish habitat and migration routes consistent.
- A fish capture operation will be undertaken to return fish to the main body of Andrew Lake.

- Best construction practices will be used to minimise the silt load in the main body of the lake.
- Dewatering pumping will not increase flows much and as a result, no downstream erosion or sediment transport is expected beyond normal levels.

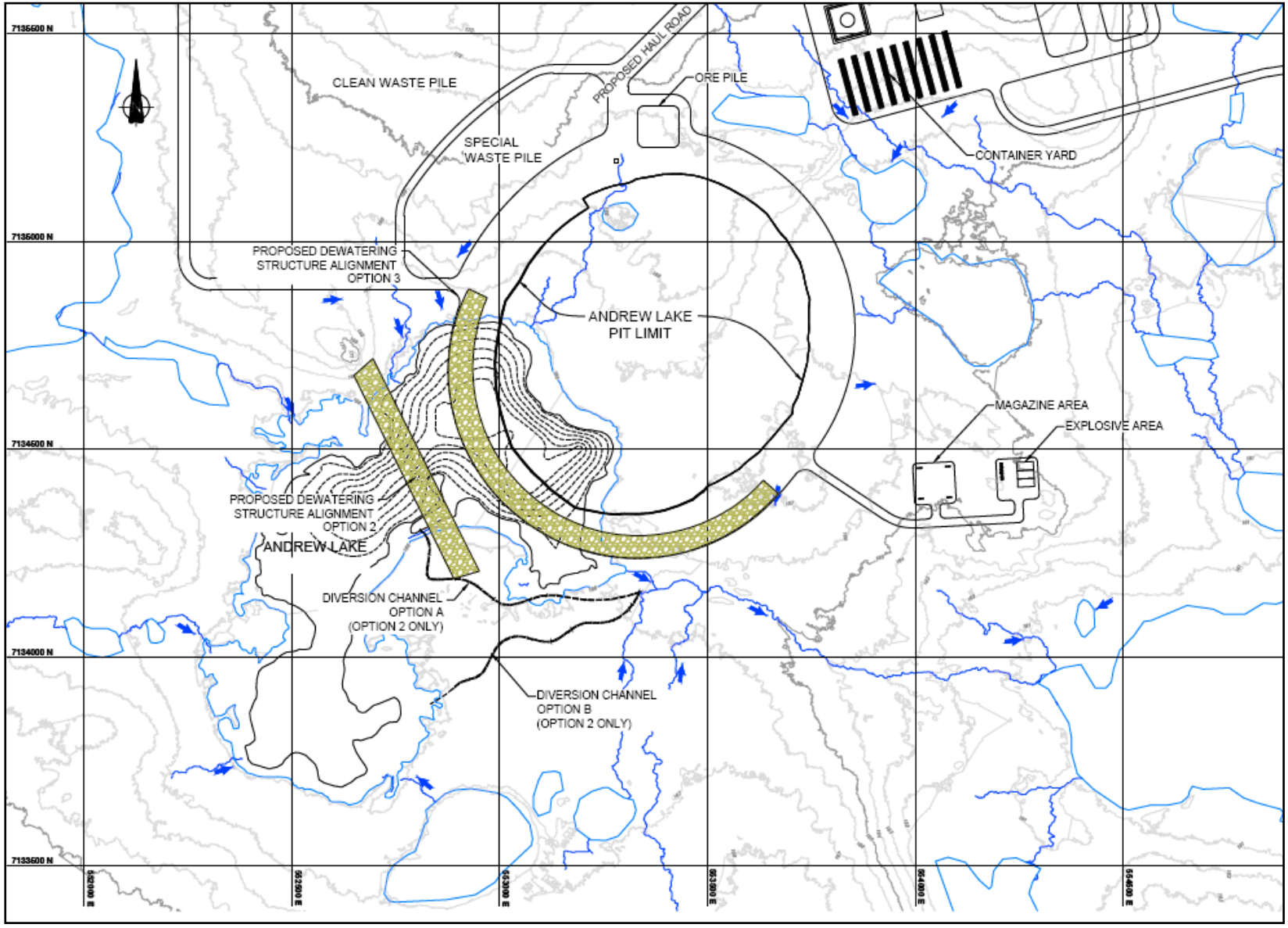


Figure 11: Andrew Lake partial dewatering alternatives.

7.2. Environmental and Social Evaluation

Based on the analysis of the social and environmental matrix, it is evident that the full dewatering of Andrew Lake, scores the lowest of the three alternatives, and the partial dewatering with maintenance of the natural inflow and outflow points scores the highest (Figure 12). Full dewatering is associated with the greatest perceived public sensitivity, and the highest scoring partial dewatering alternative, with the least. The perceived public sensitivity is primarily based on feedback from the regulators, as well as changes to the biological and physical environment.

There is good resolution between the partial dewatering alternatives and the full dewatering alternative, but less resolution between the partial dewatering alternatives. The partial dewatering alternatives are inferred from this to be the preferred way of dewatering.

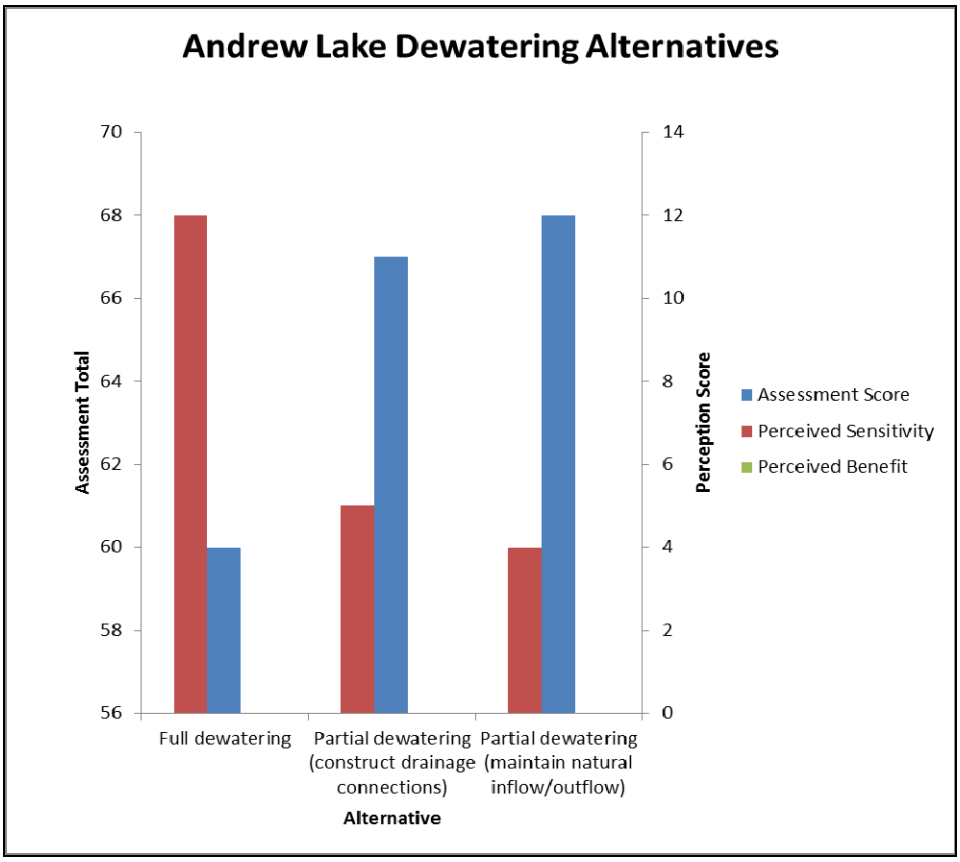


Figure 12: Graphical result of Andrew Lake dewatering alternatives assessment.

The engagement process revealed the regulator preferred not to dewater the lake entirely and also that full dewatering, as well as interfering with the natural inflow and outflow points, would be associated with more compliance and permitting issues. This is reflected in the socio-cultural criteria set as shown in the radar plots (Figure 13).

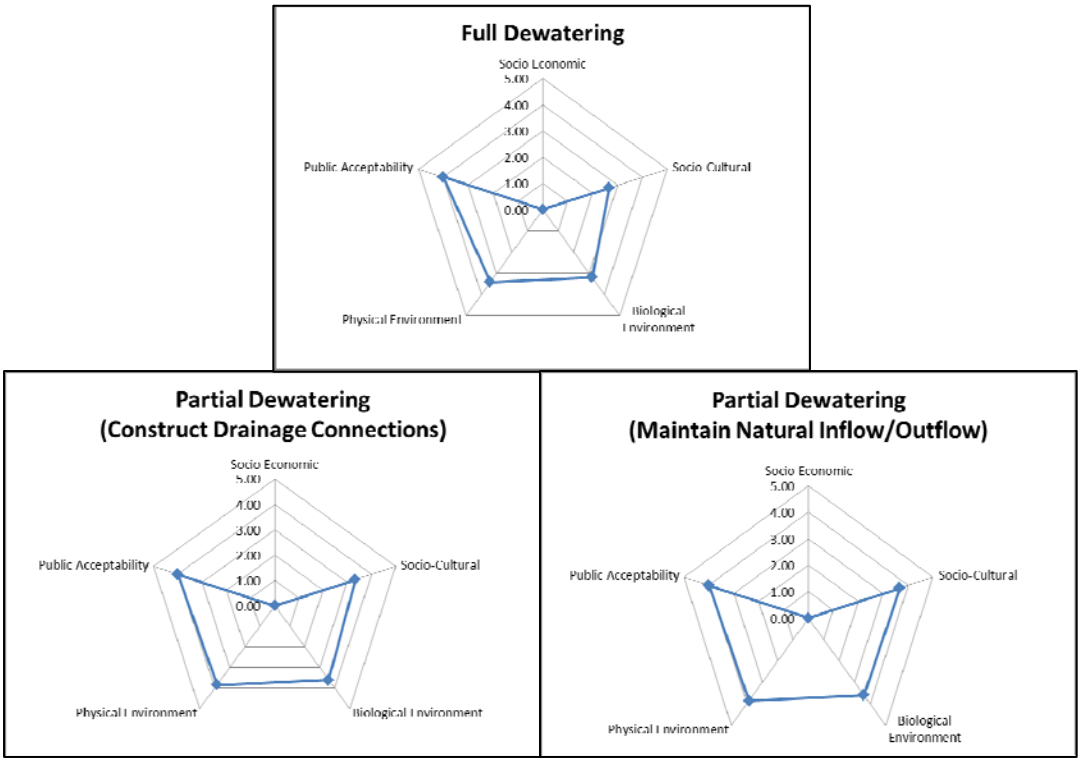


Figure 13: Comparative radar plots of environmental and social criteria for dewatering alternatives.

The biological environment would also be more affected with the full drainage of the lake as reflected in the radar plots where it scores lower than the partial dewatering alternatives. The main difference between the partial dewatering alternatives is that the alternative to maintain the natural inflow and outflow points requires less permitting and is therefore, likely to be more acceptable. The socio-economic criteria set does not have any score, as none of the criteria have been triggered for assessment. Sensitivity analysis puts the alternative with the maintenance of the inflow and outflow points as the preferred alternative under all sensitivity scenarios.

7.3. Engineering and Cost Evaluation

Relative scores for the engineering and cost criteria have been inferred as shown in Table 12. In this table, the lowest score is the optimal alternative based on a relative comparison to other alternatives. The best alternative in the socio-economic and environmental alternative is scored as "1" and the other alternatives are ranked against it.

Table 12: Comparative engineering, technical and economic criteria for dewatering alternatives.

Alternative	Engineering/Technical			Economic			Score
	Difficulty	Risk	Schedule	CAPEX	OPEX	FHCC*	
1	0.7	0.9	1.5	0.8	0.3	2	6.2
2	0.9	1	1.2	1.1	1	1.5	6.7
3	1	1	1	1	1	1	6

*Fish Habitat Compensation Costs

Analysis of the engineering and economic scores reveals that the complete drainage of Andrew Lake is the easiest, lowest risk, and most advantageous in terms cost. Full drainage has the best economic and engineering evaluation, but the lowest environmental and social evaluation and is also associated with the highest perceived public sensitivity. AREVA has therefore decided to go with the alternative that has the best social and environmental score, partial dewatering of Andrew Lake with maintenance of the inflow and outflow points. AREVA benefits in this alternative as it will probably be the least difficult to permit and will have the lowest impact on the schedule and has the lowest biological environment effects and perceived public sensitivity. However, this alternative is one of the more expensive alternatives. This is consistent with AREVA's wish to minimise the environmental effects of its operations and to seek the highest levels of public and regulatory acceptance in its choice of alternatives.

7.4. Best Alternative

In this analysis, the alternative to partially drain Andrew Lake by building a dewatering structure across it, while retaining the natural inflow and outflow points was found to be the optimal alternative. While this alternative is not the cheapest nor the easiest engineering alternative, it has been selected by AREVA as it scores the best on the environmental and social criteria set and is associated with the best score for minimising perceived public sensitivity. The choice that AREVA has made does have the advantage of probably being the easiest to permit, but this is not the driver for the selection as it scores less advantageously across risk, engineering difficulty and cost criteria. Partial draining of Andrew Lake while maintaining the inflow and outflow points is the best scoring alternative.

8. Mill Location Alternatives

Through the design phase of the project, AREVA has considered a variety of alternatives for the location of the mill. Ultimately, the alternatives were reduced to either the Kiggavik site or the Sissons site. Mill location is important as it needs to be close to the areas that are being mined, to the water resources and the tailings management facilities (TMF). AREVA has been faced with a challenge for the location of the mill, as the Kiggavik site has more opportunities for the disposal of tailings and is closer to water, but the Sissons site has more of the resource. To support the decision making process, AREVA has undertaken alternatives assessment at various times during the design process to ensure that the choice of mill location was appropriate to the proposed development, environmental constraints and the requirements of the regulators. The Kiggavik site was selected through the various alternatives assessment processes as the preferred location for the site. Furthermore, to confirm this choice, AREVA has also conducted siting alternatives assessments to ensure the optimal location for the mill could be found at the Kiggavik site. To ensure the mill location alternatives are considered against environmental and social, as well as engineering and economic factors they have been reassessed here. This section of the report covers the alternatives assessment of the mill location at the Sissons and the Kiggavik sites.

8.1. Alternatives Considered

Two alternatives have been considered for the mill location: Kiggavik and Sissons as presented in Table 13.

Table 13: Alternatives considered for the mill location.

Alter-native	Name	Description	Considered in Alternatives Evaluation
1	Kiggavik Mill	The mill is located near to the Kiggavik open pits where it has reasonable access to water. The pits will function as final storage areas for tailings. The pits will have adequate volume for the Sissons and Kiggavik tailings.	Yes
2	Sissons Mill	The mill is located near to the Sissons open pit and underground mine. The site has a longer distance to water for processing, but it has a greater supply of resource. A temporary pit would need to be created to the store the tailings which would then need to be moved to the Andrew Lake pit. The Andrew Lake pit would not be available for tailings storage for a number of years, delaying start-up of the mill.	Yes

8.1.1. Considerations for Evaluation

The following points require consideration during the evaluation of the mill location alternatives:

- Proximity to the known and potential future resources
- Proximity to the fresh water source
- Adequate capacity for tailings storage
- Proximity to the effluent discharge point.

8.2. Environmental and Social Evaluation

From the analysis of the environmental and social criteria sets, the Kiggavik site was found to be the top scoring alternative. Although the Kiggavik site was top scoring and indicated the lower perceived public sensitivity, the resolution of the scoring is low as suggested by the marginal difference between the scores for the two alternatives (Figure 14). No perceived public benefit was identified for the mill locations to favour either alternative so there is no trade-off apparent.

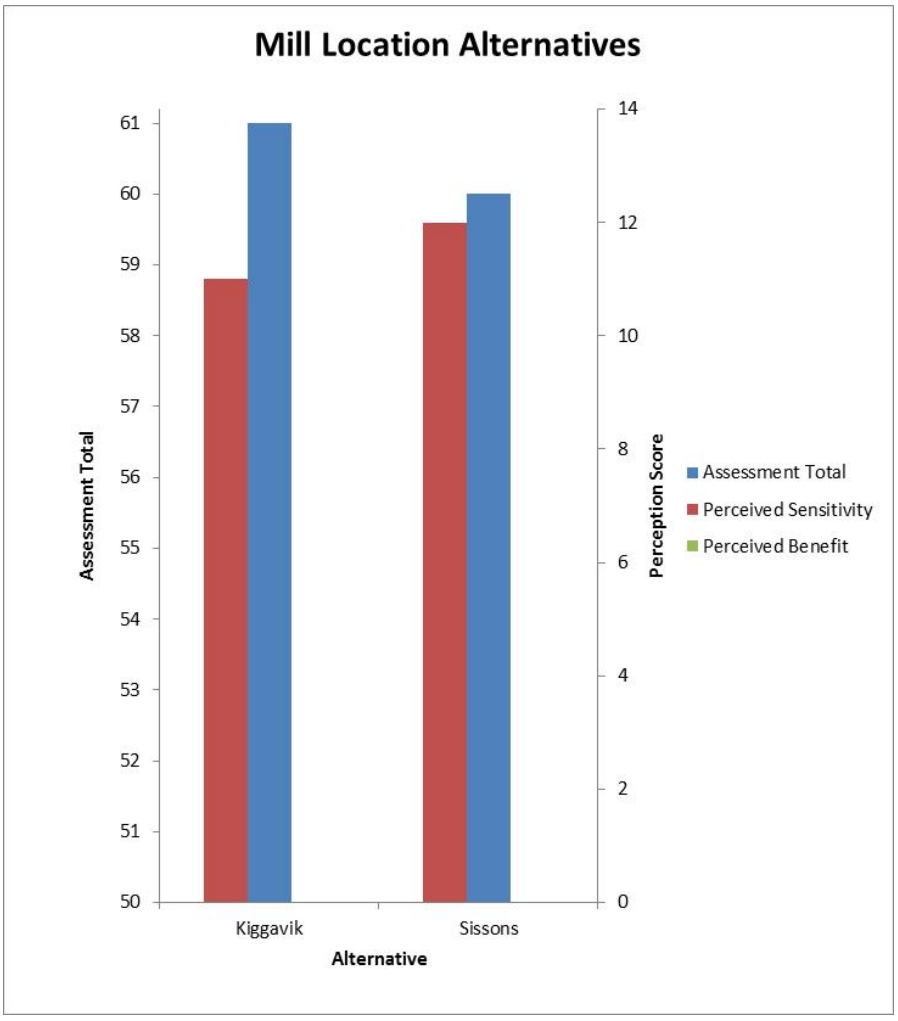


Figure 14: Graphical result of the mill location alternatives assessment.

The scoring is very similar for the two alternatives, but the key difference is in the physical environment criteria set where the potential for water contamination is higher at Sissons than at Kiggavik. The small variation in scoring is apparent in the radar plots presented in Figure 15.

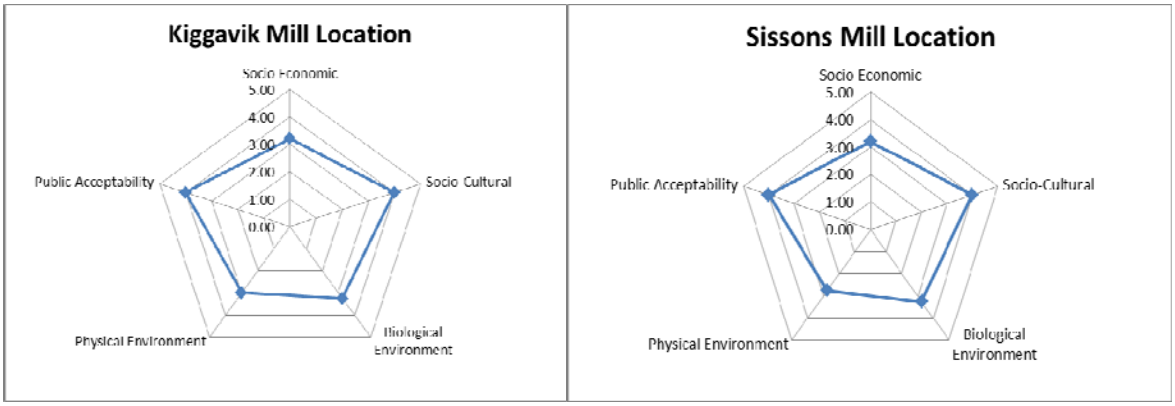


Figure 15: Comparative radar plots of environmental and social criteria for the mill location alternatives.

The sensitivity analysis confirms that there is minimal difference between the two sites from an environmental and social perspective and that the potential for water contamination is slightly higher at the Sissons site, as noted in the Physical Environment criteria set. The social and environmental analysis needs to be supported by the engineering and economics evaluation to ensure adequate resolution is achieved to find the optimal alternative.

8.3. Engineering and Cost Evaluation

The engineering, technical and economic criteria were evaluated to determine the optimal alternative for the proposed project. The analysis is presented in Table 14.

In these tables, the lowest score is the optimal alternative based on a relative comparison. The best alternative in the socio-economic and environmental assessment is scored as “1” and the other alternative is ranked against it. In this table all data was available in a form that could be quantitatively described. From Table 14, it is apparent that the Kiggavik Mill location is the optimal alternative as indicated by the blue cells that show the best alternative across each category. From an engineering perspective, Kiggavik has more availability earlier in the project life, is closer to the water source so construction and operation costs are lower than for Sissons and importantly, the footprint for Kiggavik will be smaller as it will not require an interim purpose built pit to hold tailings.

The resolution in the economic and engineering matrix is better than what was achieved for the environmental and social matrix. The Kiggavik site is the most cost effective alternative, will take the shortest time to get into operation and carries the lowest level of risk and potential for contamination of the surrounding surface water bodies. Kiggavik is scored as the best alternative for

the mill location, confirming the score from the environmental and social matrix. This is also consistent with the various previous alternatives assessments for the mill location.

Table 14: Comparative engineering, technical and economic criteria for the mill location alternatives.

Alternative		Engineering and Technical						Economic		
		Difficulty	Rank	Risk	Rank	Schedule	Rank	CAPEX	OPEX	Total
1	Kiggavik	Close to water source.	1		1	Kiggavik becomes available earlier in the project life.	1	1	1	5
2	Sissons	Distant from fresh water source.	2	Potential for contamination	2	Additional interim TMF required in purpose built pit or temporary TMF and then redeposit into Andrew Lake pit.	2	1.5	1.3	8.8

8.4. Best Alternative

The Kiggavik site has been confirmed as the optimal alternative for the mill location based on the output from both the environmental and social as well as engineering and economic analysis that has been conducted. The key environmental difference is that the Kiggavik site has less potential to cause surface water contamination and will result in a smaller footprint for the operations. The Kiggavik site is also the most cost effective alternative and the best engineering alternative across all the criteria that have been considered.

9. Tailings and Mine Rock Disposal Alternatives

The proposed tailings management approach for the Kiggavik Project is based on the "in-pit tailings management facility" concept. The approach is accepted by the regulatory agencies at uranium mills currently operating in northern Saskatchewan.

At the highest level of alternatives presented here, are the various techniques that are available for the storage of tailings. Only one of these techniques, in-pit disposal, is considered to be viable for the proposed AREVA operation. There are several different ways of configuring in-pit disposal at Kiggavik and these are presented here as alternatives. The alternatives presented for in-pit disposal, are in part determined by the location of the mill and the method of mining that will be used at the various Kiggavik and Sissons mine sites. The concept is to mine the pits and stockpile ore until the smallest pit is mined out and then start processing and place the tailings into the subsequent pits as they are developed. AREVA will produce thickened tailings that will be neutralised and treated to control radium-226 and metal concentrations. Tailings will be deposited subaqueously within the mined out pits. Subaqueous placement of tailings will prevent freezing of the tailings and enhance radiation protection.

As part of the closure of the pits, all mine rock Type III will be placed on top of the Main Zone tailings and then part of the Type II rock stockpile will be placed on top of that. This will then be covered with overburden and revegetated. In this way, the Type III mine rock is managed and is the only alternative that is considered at this time. The other TMFs will be covered with Type 2 mine rock.

Based on the engineering studies that have been undertaken and the alternatives assessments that have been completed previously, the tailings will be deposited in three open pits at the Kiggavik site. Based on the current mine schedule, tailings will be deposited into the East Zone Pit, followed by the Centre Zone and Main Zone pits. The East Zone Pit is sized to store tailings from the milling of the East Zone, Centre Zone and initial Main Zone ore, until such time that the Centre Zone Pit is ready to accept tailings. Similarly, the Centre Zone Pit is sized to store tailings from the milling of the Main Zone ore. The Main Zone pit is sized more traditionally to optimise resource extraction. The Main Zone pit is the largest of the three open-pits mined at Kiggavik. As such, it is also proposed to use the Main Zone pit for long-term management of potentially problematic mine rock resulting from open-pit mining of the Kiggavik deposits. The alternatives assessment presented here documents the historical assessments as well as subjects the viable alternatives to the assessment technique used in this report. The alternatives identified previously are used as the basis for comparison and are subjected to a comprehensive environmental and social assessment below.

9.1. Alternatives Considered

In Table 15, the alternatives that have been considered by AREVA for the storage of tailings waste at the Kiggavik site are presented. The first four alternatives compare the various techniques for tailings management. Only the in-pit technique is considered viable for Kiggavik. The in-pit

technique has been used to identify two possible alternatives that are evaluated in this report (Alternatives 1 and 2). Alternatives 6 and 7 are the mine rock Type II and Type III management techniques. As the rock will need to be close to the pits where it will be disposed of on the completion of mining, these are presented as the best methods for disposal on closure. The rock disposal techniques are not evaluated for alternatives as there are no viable alternatives.

Table 15: Alternatives considered for the management of tailings and mine rock.

Alter-native	Name	Description	Considered in Alternatives Evaluation
1	Tailings In-pit disposal - East zone becomes water pit, expanded centre zone becomes 1st TMF, main zone becomes 2nd TMF.	Placement of neutralised tailings into the various open pits that are mined at the site. Tailings are placed below the water surface and water is drained off the surface of the in pit TMF as the tailings consolidate. Currently being done at McLean Lake and allows for easier management. The in-pit disposal can be extended vertically if space is required. On completion consolidation drops the tailings below ground level and is sealed level with the surface. • Excavate East Zone and stockpile the ore until completion of the open pit. Once this initial ore body has been mined out the pit would be converted to a water storage facility. • Excavate an expanded Center Zone and stockpile the ore until pit completion. Once mined out, it would be converted into a TMF. Stockpiled ore would then be processed at the Kiggavik mill and neutralised tailings placed in the Center TMF. • Mine Main Zone and process the ore; the tailings produced would be disposed of in the Center TMF. Once mined out the pit would be converted to a second TMF for tailings from the processing of Andrew Lake and End Grid ore.	Yes
2	Tailings In-pit disposal - East zone becomes 1st TMF, purpose built pit for water, expanded centre zone for 2nd TMF, main zone becomes 3rd TMF.	Placement of neutralised tailings into the various open pits that are mined at the site. Tailings are placed below the water surface and water is drained off the surface of the in pit TMF as the tailings consolidate. Currently being done at McLean Lake and allows for easier management. The in-pit disposal can be extended vertically if space is required. On completion consolidation drops the tailings below ground level and is sealed level with the surface. • Excavate East Zone - same as Alternative 1. • Excavate a purpose built-pit. • Mine an expanded Center Zone and process ore using the purpose built-pit for tailings. • Convert the mined out Centre Zone pit into a TMF. • Mine Main Zone – same as Alternative 4a.	Yes
3	Tailings above ground disposal	Disposal of tailings in built structures or in an engineered stacked disposal system.	No Vulnerable to future climate changes and if permafrost develops in structures they may collapse. Dams may need perpetual monitoring.
4	Tailings In Lake disposal	Disposal of tailings below the water surface in an existing lake	No Not best practice for Uranium mines.
5	Tailings	Disposal of tailings in the abandoned underground	No

Alter-native	Name	Description	Considered in Alternatives Evaluation
	underground disposal	mine workings.	Insufficient volume and difficult to manage in the future.
6	Type II mine rock (Clean rock).	• Stored on surface in permanent above ground features. • Some of the Type II mine rock will be placed above the Type III waste in the pit.	No The storage proposed will not generate MLARD so only the location of the piles around the Kiggavik pits can be considered as alternatives.
7	Type III mine rock (Special Waste).	• Temporarily stored on surface on compacted bed with HDPE liner. • Placed immediately above tailings in pit on closure. • Covered with Type II rock. • Type II rock covered with overburden layer. • Type III can also be placed into main zone pit if capacity is needed.	No The Type III rock has MLARD potential and will only be temporarily stored on surface until closure when it will be placed in pit and covered with clean rock. Underground storage is not possible as there is insufficient volume, so there is no alternative but to store in the pits above the consolidated tailings.

9.1.1. Considerations for Evaluation

The following points require consideration during the evaluation of the tailings and mine rock management alternatives:

- The mine rock from the mining operations forms an integral part of the tailings completion process as described by the placement of all Type III and part of the Type II rock on top of the tailings after consolidation. The mine rock will be covered with overburden that will host revegetation on the surface once settlement has completed
- CNSC regulates uranium tailings disposal.
- In-pit disposal systems are already approved in Northern Saskatchewan.
- In-pit disposal reduces the mine foot print.
- The East zone is in the permafrost layer.
- The Centre zone is in the permafrost layer.
- The Main zone has the deepest part below the permafrost layer.
- The deep aquifer has a hydraulic conductivity lower than the hydraulic conductivity of the tailings and it is therefore likely that they will have a very low flow.
- Model results suggest that if permafrost melts, it will take several hundred years for the water from the TMF to reach a lake. The water will have water quality within the CCME guidelines.
- If permafrost remains, it will effectively contain and over time, freeze the tailings in place.
- A bottom pit liner could be used in the Main Zone, if necessary
- No drains will be used from the base of on any of the TMFs. Only surface water will be drained off as the tailings consolidate. All water taken from the surface will be re-circulated into the plant and treated before release.

- Type II mine waste is not expected to have potential MLARD issues.
- Type III mine rock will be temporarily stored on surface until closure when it will be placed on top of the consolidated tailings in the pit.
- Type III mine rock potentially has MLARD issues. It requires containment on closure, which will be achieved by placing in the open pit and on consolidated tailings during closure.
- Type II rock piles will be approximately 40 m high so will be visible on the landscape.

9.2. Environmental and Social Evaluation

Analysis of the results of the environmental and social matrix indicates that Alternative 2 has the highest assessment score. Alternative 1 scores about 20% less than Alternative 2, so resolution is considered good in this analysis. The final scoring is presented in Figure 16, and from this it is also evident that Alternative 2 has by far the lowest perceived public sensitivity. Alternative 1 has the highest perceived public sensitivity. Public sensitivity was driven primarily by concerns for the biological environment and the physical environment, which is consistent with the assessment of other alternatives that have been presented by AREVA. No perceived public benefit was determined through the analysis, so no trade-off was identified. From the sensitivity analysis, it is also clear that Alternative 2 has the best scores across all categories.

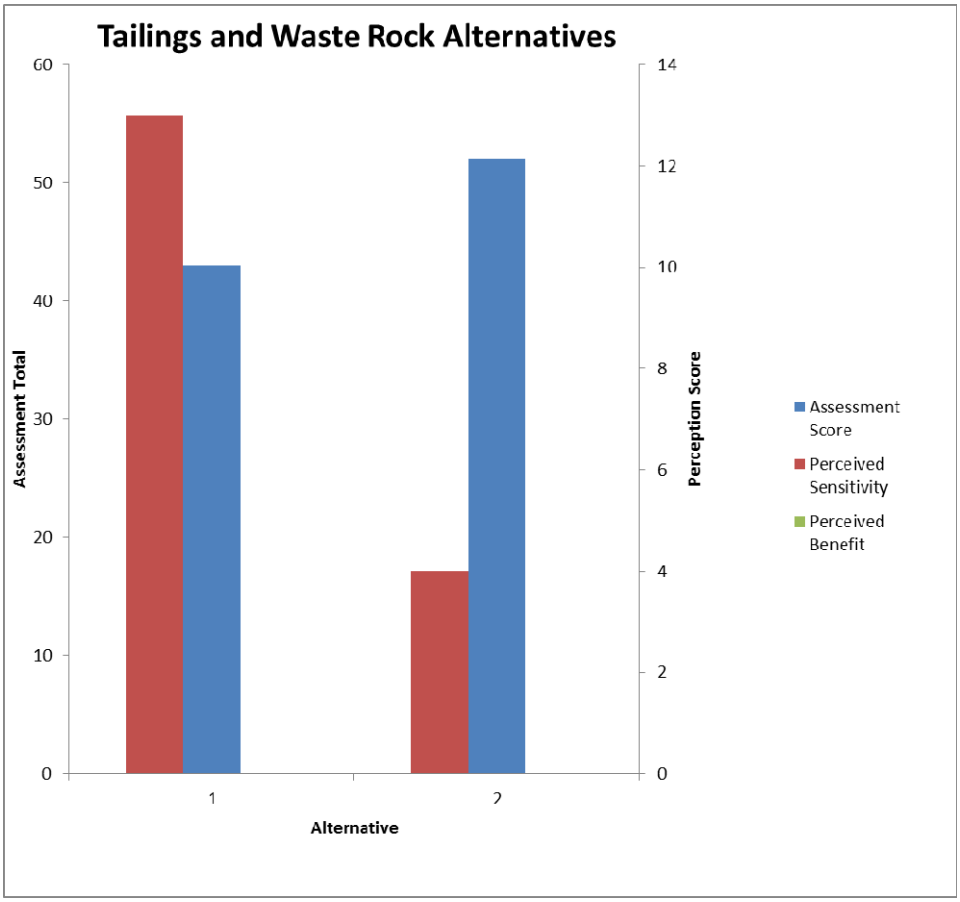


Figure 16: Graphical result of the tailings management alternatives assessment.

On analysis of the radar plots, it is evident that there is no score in the socio-economic criteria set. In all the other criteria sets, Alternative 2 scores the best. Public acceptability is scored the same across all alternatives primarily due to the regulator requiring compliance with the guidelines and that there has been very minimal response from the public to the presentations that have been made. The radar plots show that the concerns related to the biological and physical environment in Alternative 1 are the main drivers for the lower scores achieved for this alternative. Alternative 2 is the best scoring alternative.

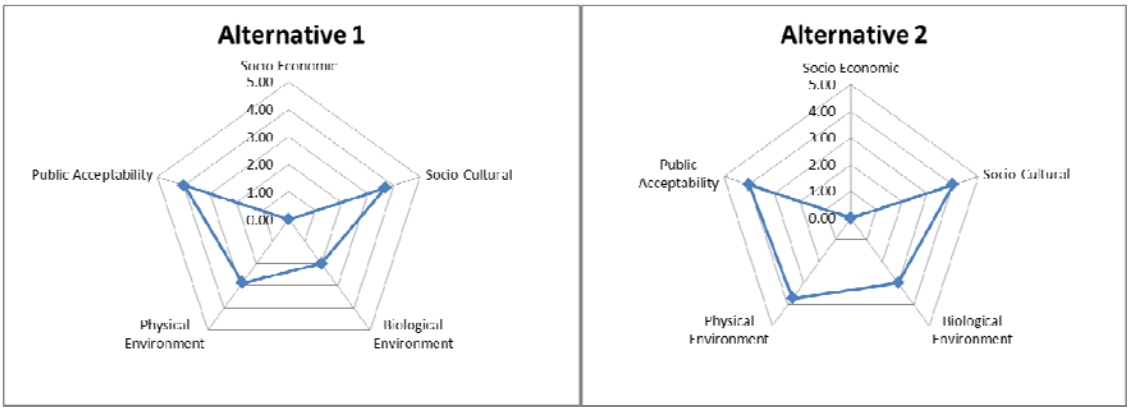


Figure 17: Comparative radar plots of environmental and social criteria for the tailings management alternatives.

9.3. Engineering and Cost Evaluation

No engineering and cost evaluation is presented here as it is considered unlikely that there will be much resolution from this analysis. The risk aspect has been considered in the environmental assessment where the potential for groundwater contamination is analysed. The only area where it is considered likely to achieve adequate resolution is with regards to the schedule which could be affected. Alternative 2 creates adequate capacity for the tailings and rock, while Alternative 1 has a higher likelihood that there will be an interim shortage of tailings storage capacity. The ability to quickly process and to continue processing ore would have an economic benefit for AREVA. This fundamentally confirms that Alternatives 2 is the better engineering alternative and supports the outcome from the environmental and social alternatives assessment.

9.4. Best Alternative

Alternative 2 is the best scoring alternative in the environmental and social matrix. Alternative 2 is also has the best score based on the engineering evaluation of schedule. This result is consistent with the detailed engineering alternatives assessments that were undertaken during the planning phase of the tailings management and mine rock management activities for the project.

10. Access Road Alternatives

AREVA has considered various alternatives to find the best route to access the site. A variety of routes and road styles, including all season roads and winter roads as well as alternatives to include ferries and bridges have been considered. All season roads have the advantage of allowing access to the site for most of the year, whereas the winter roads would leave the site isolated and dependent on other transport means for the ice free periods. The various alternative road routes are presented in Figure 18.

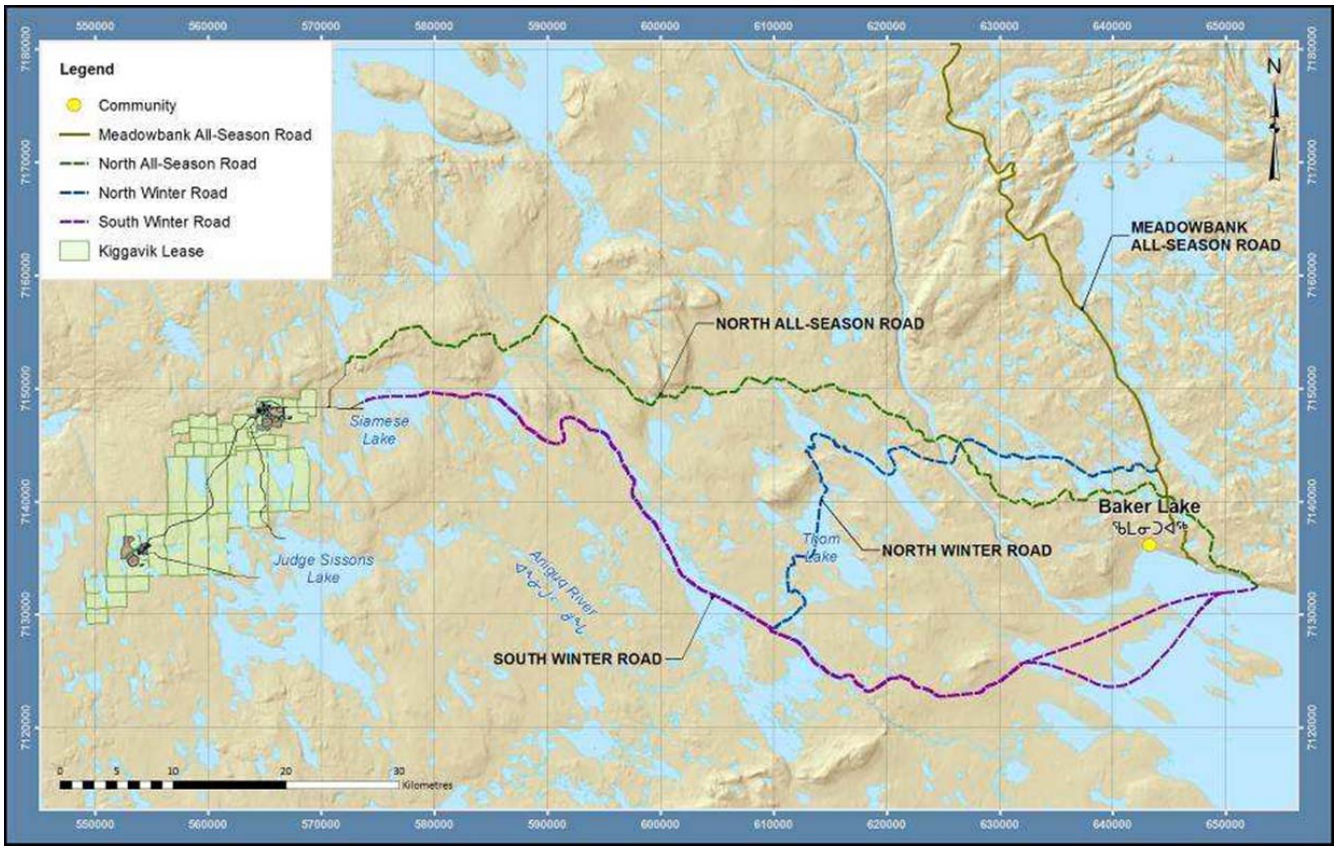


Figure 18: Kiggavik access road alternatives.

10.1. Alternatives Considered

Five alternatives were presented for consideration in the alternatives assessment, although six were originally considered. The winter road from End of the Narrows was also considered during the Feasibility Study, but was not presented for consideration as an alternative as it was removed from consideration during that phase of the project. The route that was considered began at the Narrows and stayed on the south side of Baker Lake for about 60 km, then followed the route of the Winter Roads as described above. The dock would have been located at the Narrows. The five alternatives that are presented for consideration are presented in Table 16, along with the route that was dropped during the feasibility study.

Table 16: Alternatives for access roads and routes.

Alter-native	Name	Description	Considered in Alternatives Evaluation
1	North All Season Road With Bridge	The route begins on the north shore of Baker Lake, and crosses the Thelon River on a new bridge. The dock would be located on the north shore of Baker Lake, east of the hamlet.	Yes
2	North All Season Road With Ferry	The route begins on the north shore of Baker lake; it would cross the Thelon River via cable ferry in summer months, and on an ice bridge in the winter months. The dock would be located on the north shore Baker Lake, east of the hamlet.	Yes
3	Winter Road North Route	The winter road will be constructed annually, with no road access to site during ice-free months. The dock would be located on the north shore of Baker Lake, east of the hamlet.	Yes
4	Winter Road South Route	The winter road will be constructed annually, with no road access to site during ice-free months. The dock would be located on the north shore of Baker Lake, east of the hamlet.	Yes
5	South All Season Road	The route begins on the south side of the Baker Lake, no river crossing would be required but could require a causeway or extended dock and additional infrastructure. The dock would be located on the south shore of Baker Lake.	Yes
6	Winter Road from End of the Narrows	The route begins at the Narrows and stays on the south side of Baker Lake for about 60 km, then follows the route of the Winter Road as above. The dock would be located at the Narrows.	No

10.1.1. Considerations for Evaluation

The following points are noted as considerations that need to be borne in mind when evaluating the alternatives:

- All Season Road, North Route:
  - Regulators have expressed concern with the bridge alternative as this could result in increased hunting pressure on caribou herds.
  - The Baker Lake community is interested in the bridge alternative as it opens access across the Thelon River.
  - The revised cost estimate for the all-weather road with bridge is higher than initially considered.
- All Season Road, South Route
  - The community of Baker Lake does not support this alternative.
  - The south shore is a sensitive bird nesting and fishing area.
  - The south side of Baker Lake is shallow.
  - Ground conditions are poor to moderate; the road would include a 120 m long bridge.
- Winter Roads
  - A winter road in the Baker Lake area is viable, though it would result in large amounts of traffic over a relatively short period of time.

10.2. Environmental and Social Evaluation

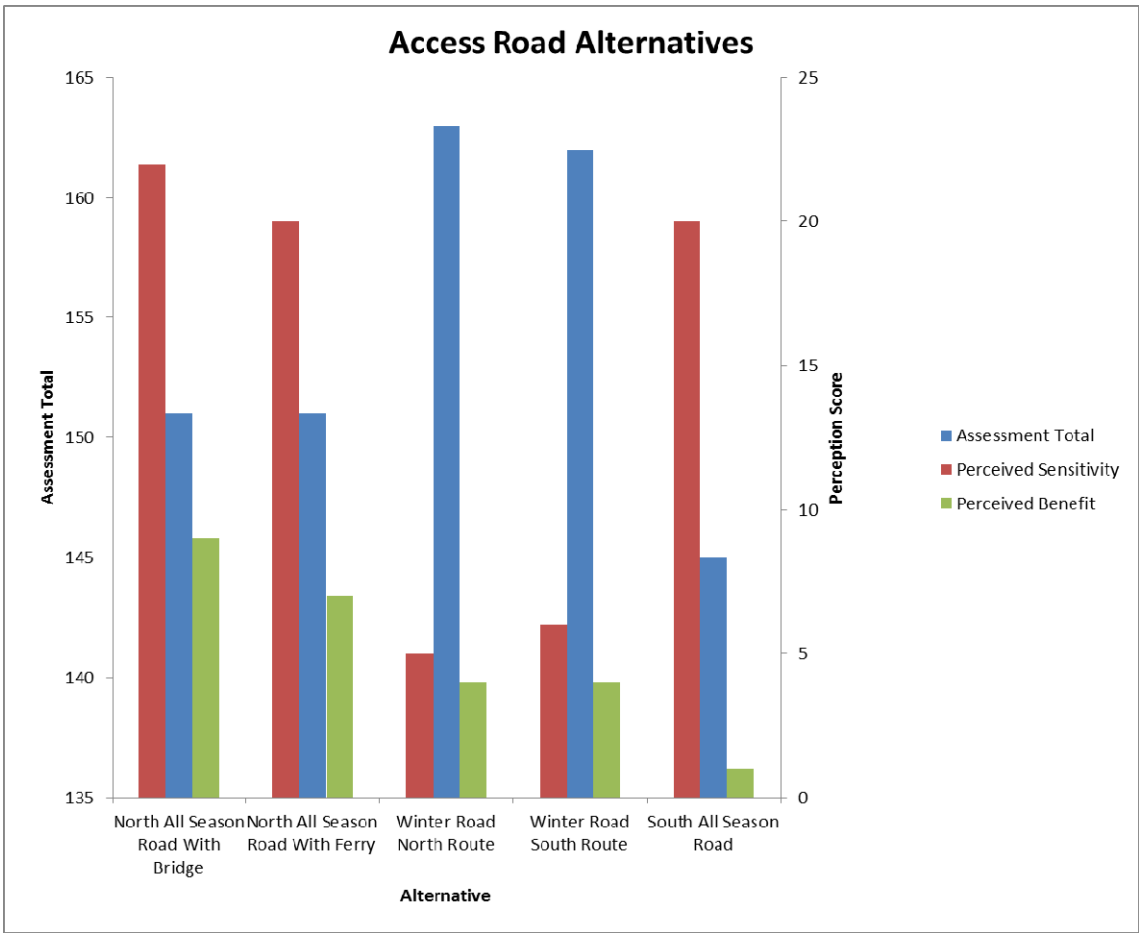


Figure 19: Graphical result of access route alternatives assessment.

Based on the evaluation of the social and environmental matrix, the Winter Road North Route was identified as the best alternative by a narrow margin (Figure 19). This alternative was also associated with lowest perceived public sensitivity, but ranked second best in perceived public benefit. The sensitivity analysis of this alternative also indicates that the Winter Road North Route is the best alternative across all categories except when the physical environment score is removed, which indicates that it is heavily favoured by the physical environmental acceptability (Figure 20). It scores a close second to the Winter Road South alternative when the physical environment is removed from the score. Overall scores for the Winter Road South and North Routes are almost identical in the analysis, suggesting there is very little difference between the two. The Winter Roads do however score considerably better than the All Season Roads, suggesting the type of road is also important in the selection.

The North All Season Road alternatives were tied for the third best alternative. The alternative with the bridge resulted in the highest perceived sensitivity of all alternatives, but also the highest perceived benefit. The ferry alternative had the second highest perceived public benefit.

With closer analysis of the overall result, there is an apparent trade-off between improved access and possibly more hunting of caribou against less access and less hunting of caribou. The trade-off favours less access and less hunting over the benefit of easier hunting with improved access. The Inuit regard their hunting practices to generally be sustainable so this may be identifying additional motivations such as disturbance of the caribou by road traffic and noise. Evidence for this potential concern is found in the public engagement record, where favouring minimal disturbance of the local environment and ecosystems is a consistent theme.

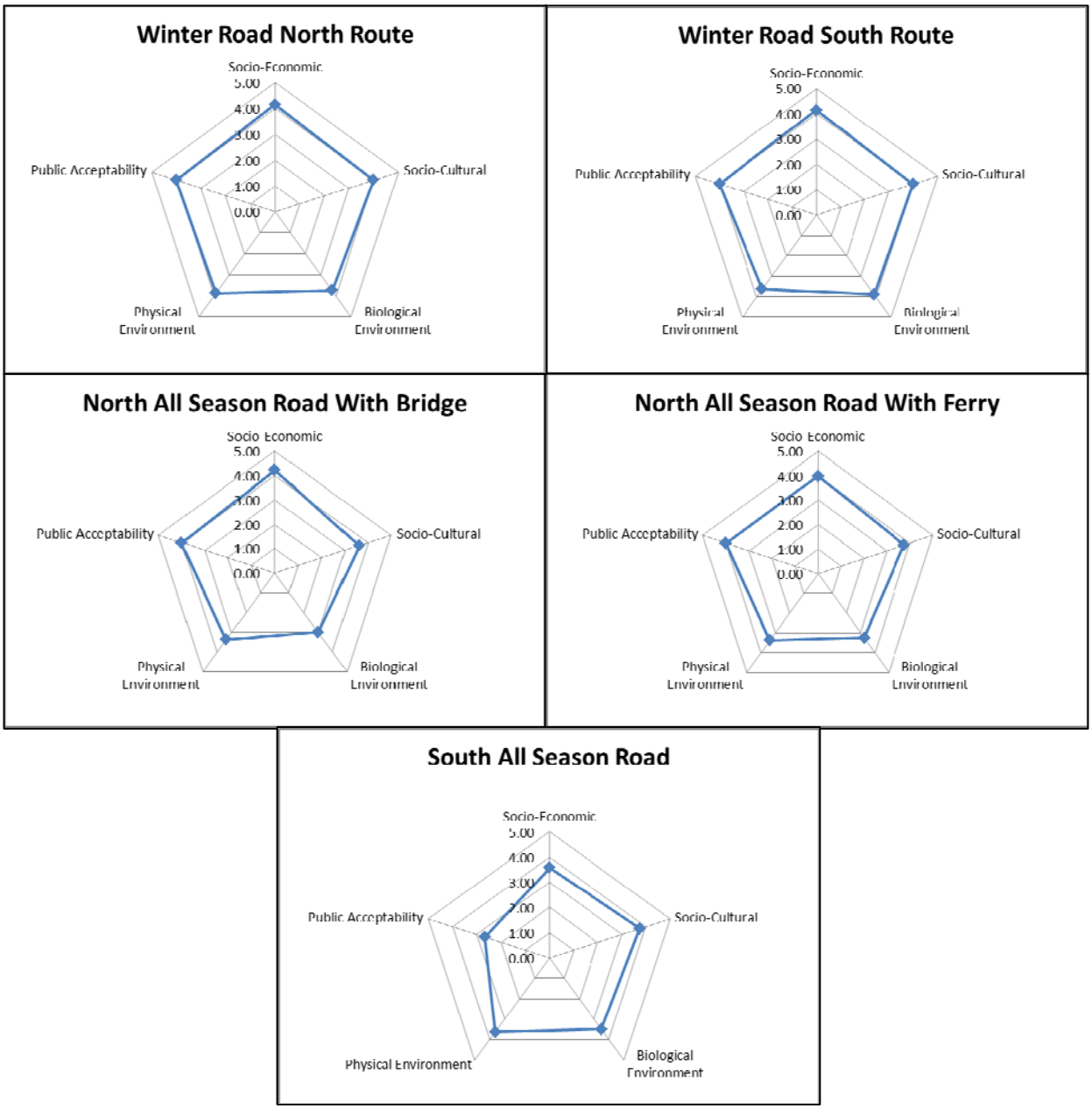


Figure 20: Comparative radar plots of environmental and social criteria for access route alternatives.

The South All Season Road scored moderately across all categories, but triggered the AREVA threshold on public acceptability. The alternative was not evaluated as the best in any category. This alternative also has the second highest perceived public sensitivity and the lowest perceived public benefit. In the evaluation of the type of road preferred, the Winter Roads score higher than the All Season Roads, suggesting there is a preference for the non-permanent roads. From this it is inferred that the short term traffic volume increase during winter is preferable to the all year round lower traffic volumes. From the social and environmental evaluation, the winter roads are preferred above other road types, and the Winter Road North Route is evaluated as the best alternative based on physical environment criteria and the South Route the better based on the biological environment criteria.

10.3. Engineering and Cost Evaluation

The engineering, technical and economic criteria were evaluated to determine the optimal alternative for the proposed project. The analysis is presented in Table 17. In the table, the blue cells represent the optimal alternative. In these tables, the lowest score is the optimal alternative based on a relative comparison to other alternatives. The best alternative in the socio-economic and environmental alternative is scored as "1" and the other alternatives are ranked against it. In this table all data was available in a form that could be quantitatively described.

Table 17: Comparative engineering, technical and economic criteria for access route alternatives.

Alternative		Engineering and Technical			Economic			Score
		Difficulty	Risk	Schedule	Capital	Operational	Closure	
1	North All Season Road With Bridge	3	0.8	2	1.7	0.5	3	11
2	North All Season Road With Ferry	2	1	1.5	1.2	0.8	1.5	8
3	Winter Road North Route	1.5	1	1	1	1	1	6.5
4	Winter Road South Route	1	1	1	1	1	1	6
5	South All Season Road	1.5	1.2	1.5	1.2	1	1	7.4

Although the North All Season Road is thought to bring the lowest risk and operational cost, the Winter Roads generally score better in more categories based on relative ranking. Based on the engineering, technical and cost evaluation, the Winter Roads score the best and the South Route is the preferred alternative.

10.4. Best Alternative

The best alternative road type has been found to be the Winter Road system, driven by their non-permanence and short period of intense activity. The Winter Road South was found to be the best of the Winter Road alternatives based on engineering, cost and the biological environment and

therefore the best overall alternative for access roads. There was however, little difference between the Winter Road North and South Routes.

11. Airstrip Alternatives

AREVA has made air transport to and from the site one of the key methods of transport for the project. The air transport is not only required for the movement of personnel but also for the transport of yellowcake. This means the airstrip is vital for operations and that moderately sized aircraft will need to visit the site. AREVA originally investigated four viable airstrip alternatives as shown in Figure 21. Of the four, Skinny Lake and Jaeger Lake airstrips were removed from consideration, as Skinny Lake airstrip was too far from the site and Jaeger Lake was too near to the water. Drumlin airstrip and Pointer Lake Airstrip, are the two that have been retained for further investigation.

11.1. Alternatives Considered

The various alternatives considered by AREVA are presented below. Only two of the four alternatives are considered in this analysis, as Jaeger Lake and Skinny Lake airstrips are excluded based on the reasons indicated in Table 18.

Table 18: Alternatives for the airstrip.

Alter-native	Name	Description	Considered in Alternatives Evaluation
1	Drumlin Airstrip	Located roughly 5 km directly east of the Kiggavik site. The runway would be located on a small ridge which would allow for easy drainage of the site. The airstrip would be serviced using the Siamese Lake service road which would need to be rerouted around the airstrip. The airstrip is not located on the current AREVA lease area.	Yes
2	Pointer Lake Airstrip	Located roughly 4 km directly south of the Kiggavik site. The airstrip would lie between Fox Lake and Pointer Lake in an area that forms part of the AREVA lease area. The airstrip would be serviced using the Judge Sissons Lake service road.	Yes
3	Jaeger Lake Airstrip	Located roughly 2.5 km east-south-east of the Kiggavik site with the bulk of the runway off lease land and a small part of the runway built up to the shore of Jaeger Lake. A new sole purpose service road would be required to service the airstrip.	No The airstrip is partially off the lease area and would have contact with the Jaeger Lake shoreline.
4	Skinny Lake Airstrip	Located roughly 8.5 km north east of the Kiggavik site, completely off the lease area, fairly close to and running parallel with Skinny Lake. A new service road would be required to service the airstrip. There are a number of archaeological sites around Skinny Lake.	No The airstrip is off the lease area, too far from the site and would require a substantial road to be constructed. The proximity of archaeological sites makes the site less attractive.

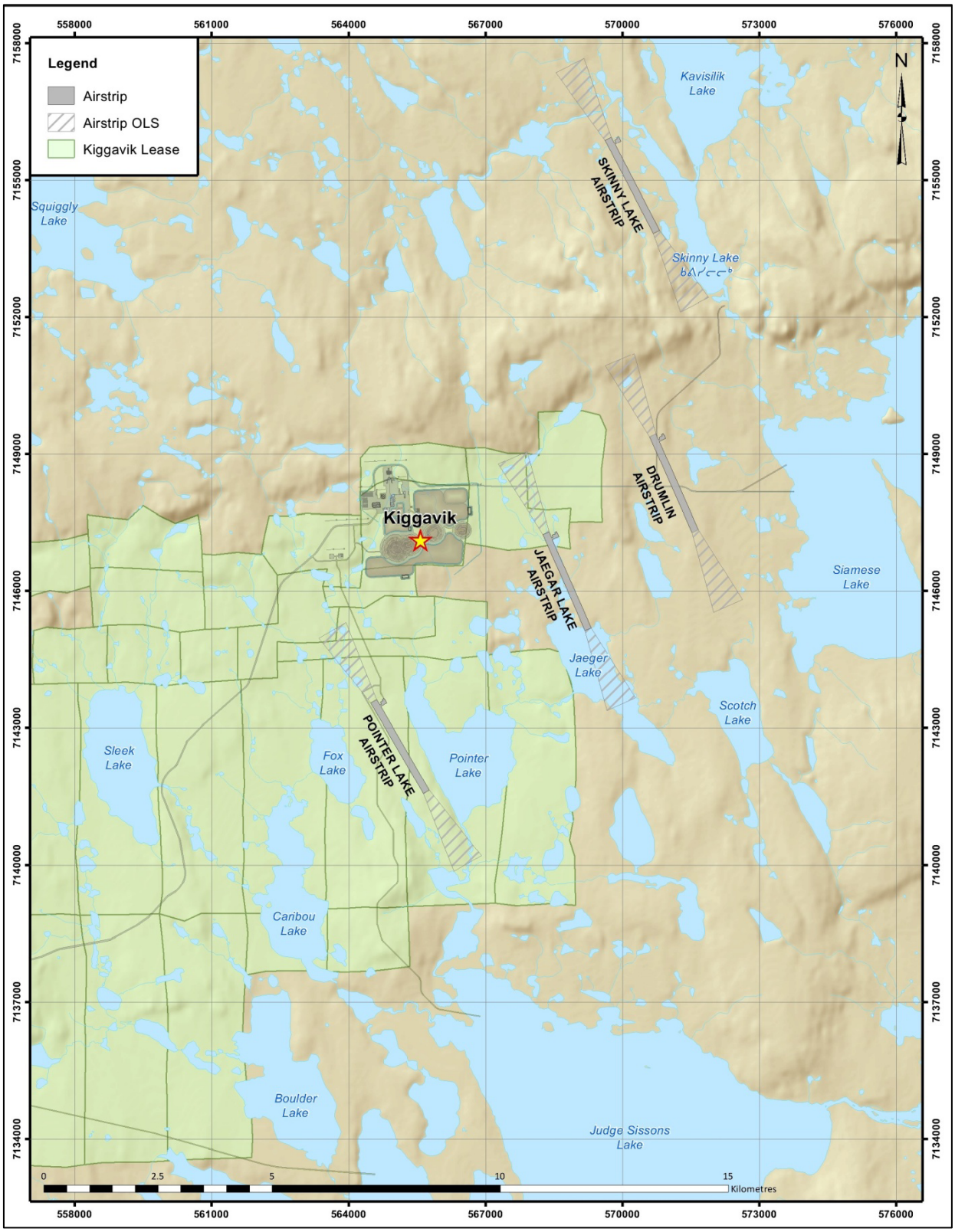


Figure 21: Airstrip alternatives.

11.1.1. Considerations for Evaluation

The following points require consideration during the evaluation of the airstrip alternatives:

- Ideally the airstrip should be in close proximity to the site.
- The airstrip requires a roughly north-north west to south-south east orientation, with a length of approximately 2500 m and a flight path clearance cone of 25 km^2 either side of the runway as shown in Figure 21.
- The treated effluent discharge alternative to discharge treated effluents from the Kiggavik site to Judge Sissons Lake on a year-round basis will require a service road. This service road could be used to service the Pointer Lake airstrip.
- The use of the Drumlin site would require the rerouting of an additional road.
- The Drumlin site is on a ridge which will make drainage and runoff control easier.
- Historical observations suggest fog occurrence is likely to be of less importance at Pointer Lake.
- The approach and departure flight path need to be considered in analysis due to the overflying aircraft and the noise they make when taking off and landing.

11.2. Environmental and Social Evaluation

The Pointer Lake Airstrip is the best alternative based on the analysis that has been conducted (Figure 22). The resulting score difference is large, indicating that the methodology used provides good resolution for the result. On analysis of the result it is also evident that Pointer Lake would have a lower perceived public sensitivity than Drumlin, stemming primarily from the location of the proposed airstrip on the lease area. The Drumlin airstrip site would be located off the site and this would require additional land being set aside for the mining operation as well as extend the footprint of the mine. Furthermore, the flight path to Drumlin is located more over land than the Pointer Lake alternative, which is on the south side over Judge Sissons Lake and on the north side over the area between the two mine sites. The area that is affected by the Pointer Lake Airstrip and the landing and take-off paths are therefore already impacted by mine activities or are less used by animals, as it is over water. When considering the radar plots presented in Figure 23, it is clear that the Pointer Lake Airstrip scores better on the biological environmental criteria set than the Drumlin Airstrip. The Drumlin Airstrip is thought to likely have more potential impact on the caribou migration as it extends the zone of impact associated with the proposed mine.

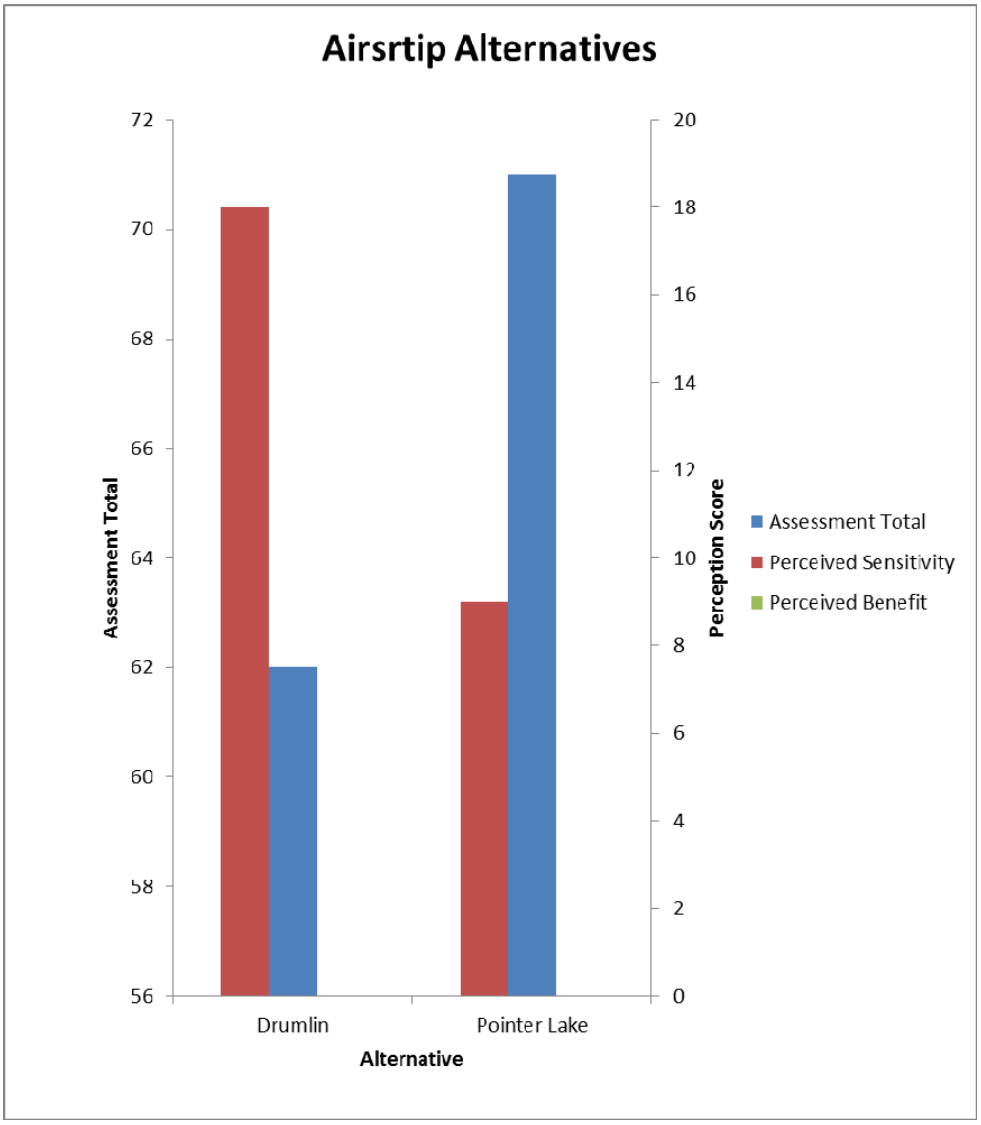


Figure 22: Graphical result of airstrip alternatives assessment.

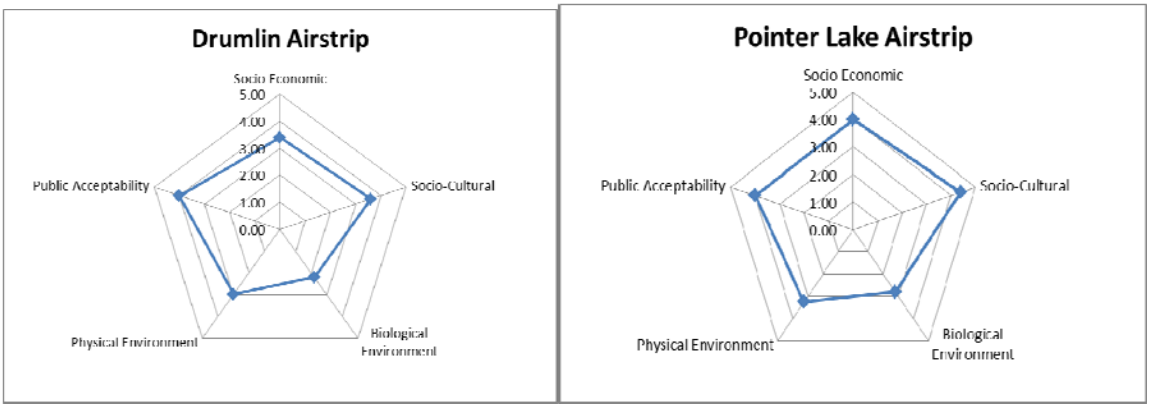


Figure 23: Comparative radar plots of environmental and social criteria for the airstrip alternatives.

From the radar plots it is also apparent that the social cultural scoring between the two alternatives also varies, with Pointer Lake having the better scoring of the two alternatives. This is driven primarily by the Pointer Lake Airstrip being located on the lease area and the containment of the proposed mine footprint area. The same reasoning is also applicable to the physical environment criteria set and the socio-economic criteria set. The key factor that makes Pointer Lake the higher scoring alternative appears to be that it keeps a compact footprint, whereas the Drumlin Lake Airstrip extends the area affected by the proposed mining operations. Analysis of the perceived public sensitivity indicates that the sensitivity associated with the air traffic on the biological environment would be the key driver. This is complimented by the lower perceived public sensitivity associated with Pointer Lake, which is related to the reduced footprint of that proposed alternative by keeping the development to the existing lease area.

The sensitivity analysis for the normalised data and for the raw data indicates that Pointer Lake is the highest scoring alternative in all cases.

11.3. Engineering and Cost Evaluation

The engineering, technical and economic criteria were evaluated to determine the optimal alternative for the proposed project. The analysis is presented in Table 19. In these tables, the lowest score is the optimal alternative based on a relative comparison. The best alternative in the socio-economic and environmental assessment is scored as "1" and the other alternatives are ranked against it. In this table all data was available in a form that could be quantitatively described.

Table 19: Comparative engineering, technical and economic criteria for airstrip alternatives.

Alternative		Engineering and Technical			Economic		Score
		Difficulty	Risk	Schedule	CAPEX	OPEX	
1	Drumlin Airstrip	0.9	1.5	1.5	1.5	1.4	6.8
2	Pointer Lake Airstrip	1	1	1	1	1	5

Although the Drumlin Airstrip is thought to be the easier engineering alternative, the Pointer Lake Airstrip scores better in every other category based on relative ranking. Pointer Lake has less fog, therefore represents a lower risk airstrip, and as it is based on existing lease land, it will not require additional lease agreements which could affect schedule. In addition from an economic perspective, Pointer Lake does not require a road to be rerouted, is closer to the main activity area of the mine and is less prone to being fogged in, therefore will have fewer flight disruptions, which all suggests that capital and operational costs will be lower. Based on the engineering, technical and cost evaluation, the Pointer Lake Airstrip is the preferred alternative.

11.4. Best Alternative

In both the social and environmental matrix and the engineering and economic matrix, the Pointer Lake Airstrip alternative is the highest scoring alternative. Sensitivity analysis confirms that the Pointer Lake alternative scores the highest consistently in the social and environmental analysis. There is no perceived public trade-off in the airstrip alternatives assessment, with the perceived effect on the biological environment a key driver in the scoring process. The Pointer Lake airstrip has the benefit of being located on the lease area and between the proposed mining operations at Kiggavik and Sissons, which effectively reduces the footprint area by comparison to the Drumlin Airstrip Alternative. The Pointer Lake Airstrip alternative is the better of the two alternatives based on this analysis.

12. Baker Lake Dock Alternatives

AREVA requires a Baker Lake dock facility with a tank farm, fuel loading facilities, laydown and storage areas and offices. The primary requirement for the dock is to handle the Kiggavik annual cargo requirements. At the four locations identified by AREVA on the north shore of Baker Lake, a freight handling and storage area could be located upland immediately above the dock causeway, which would extend approximately 100 m into the lake.

AREVA has considered a variety of alternatives for the location of the dock as presented in Figure 24 and Figure 25.

Figure 24: Proposed Baker Lake dock alternative locations.

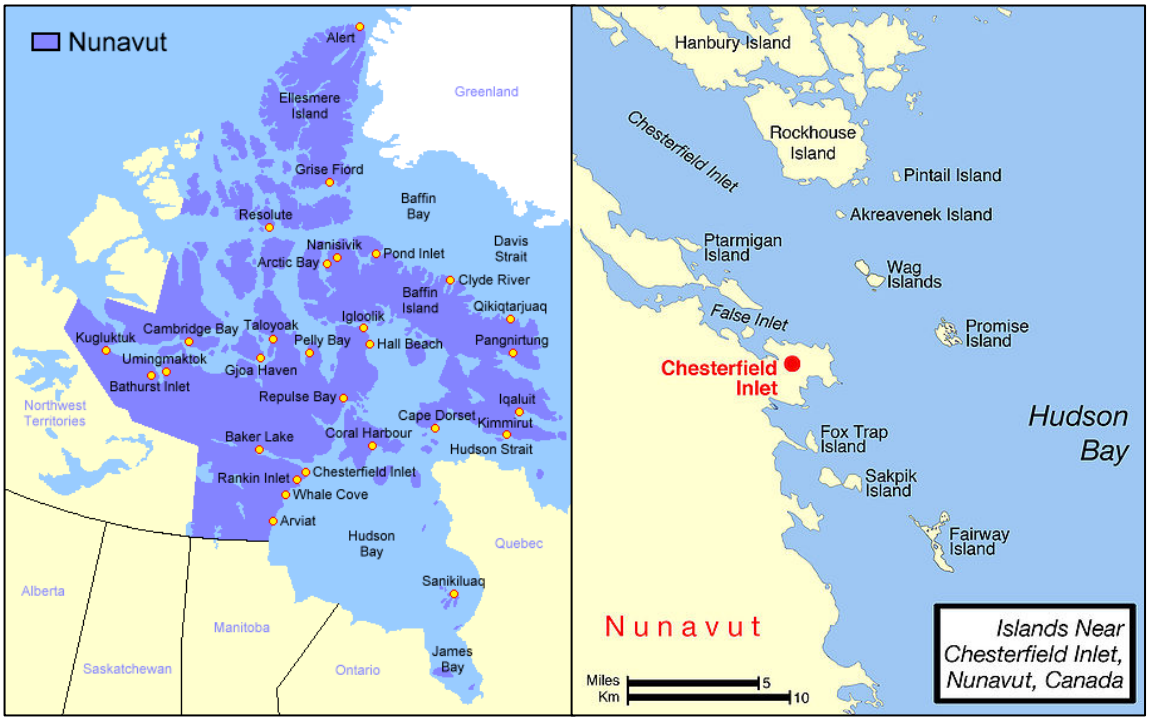


Figure 25: Location of Chesterfield Inlet in relation to Baker Lake

12.1. Alternatives Considered

AREVA have considered various alternatives during the development of the proposed project plans and has narrowed these down to four locations in two groups along the North Shore near to the Baker Lake community. Three other alternatives have also been considered during the planning process, but these have not been developed as they were all found to be associated with difficulties and concerns. In particular, the community would like to see a single operational dock, so AREVA has considered sharing the location currently used by Agnico-Eagle Mine (AEM), which is operational and has an existing storage facility, but is currently considered too small based on estimated cargo volumes. Furthermore, AREVA considered alternatives 4-6 in Table 20, and for the main reasons indicated, decided not to consider them further. Only the first two viable alternatives in Table 20 are considered in this alternatives assessment.

Table 20: Alternatives considered for the dock location.

Alter-native	Name	Description	Considered in Alternatives Evaluation
1	North Shore dock site 1	Located approximately 5 kilometers east south east of the Baker Lake community and several hundred meters east of the AEM dock.	Yes
2	North Shore dock site s 2-4	Located in a small cluster approximately 9 to 12 kilometers east south east of the Baker Lake community and about 5 km east of the AEM dock.	Yes
3	Agnico-Eagle Mine dock	Approximately 4.5 km east south east of the Baker Lake Community. This is an existing and operational site.	No Inadequate capacity for AREVA and the existing AEM operations.
4	South Shore	The dock would be located on the south shore of Baker Lake, requiring a causeway or extended dock and additional infrastructure to	No Depth concerns and coincides with fishing, bird nesting and

Alter-native	Name	Description	Considered in Alternatives Evaluation
		get to deep water. This dock location was intended to be integrated with the South all weather access road alternative.	animal migration areas, cabins, recreation areas .as well as has poor ground conditions making construction difficult.
5	Sagliq Island	The dock would be located on the South side of Baker Lake on Sagliq island and requires a long causeway and an extended dock to be built. Shifting sand bars are known to occur in the area.	No The area has a shallow depth, causeway will degrade fish habitat and require a HADD. Interferes with navigable water and travel routes as well as community fishing grounds.
6	Chesterfield Inlet dock	Built in Chesterfield Inlet area allowing for lightering of ships. Would still require docking facilities in Baker Lake.	Yes

12.1.1. Considerations for Evaluation

The following points need to be considered when evaluating the alternatives presented for analysis:

- The community of Baker Lake has indicated that their preferred alternative would be a single location developed to encompass the storage and unloading requirements of all the mining projects in the Baker Lake area.
- When the proposed AREVA dock is not in use, the unloading facilities could be used for other cargo purposes at the discretion of AREVA.
- The Baker Lake community have concerns about uranium concentrate being transported through and stored near to areas where people live.
- The Chesterfield Inlet dock location would bring more ship traffic closer to the whale migration routes on the western side of Hudson Bay, though studies suggest this is having little effect on the whales.
- The Chesterfield Inlet dock would still require docking facilities in the Baker Lake area thus creating two areas where docking and lightering activities would occur.
- Rankin Inlet is likely to become the port that will be developed in the Region.
- The Chesterfield Inlet area is currently being used by Agnico for lightering.

12.2. Environmental and Social Evaluation

Evaluation of the environmental and social alternatives assessment matrix reveals that the North Shore dock 1 alternative is the highest scoring alternative (Figure 26). The Dock 1 location is associated with the lower perceived public sensitivity and the higher perceived public benefit. The Baker Lake dock sites 2-4 are closer to community activities in that area and are therefore less favoured. The Chesterfield Inlet dock would still require some development in the Baker Lake area for local unloading and transport and its close proximity to the whale migration route has resulted in lower scoring. The resolution in the assessment total is almost 10%, which is reasonable. The resolution in the perceived public sensitivity is good, but much lower in the perceived public benefit. The benefit to the local Baker Lake community has been an important driver in the evaluation and this provides an opportunity to evaluate the trade-off that is inferred from the perceived public position. In this case, the perceived public benefit in terms of public acceptability is being traded off

against the perceived sensitivity related to the biological environment. This is consistent with the views identified from the public engagement process, where people preferred to have one dock and for the dock to be located away from sensitive biological and hunting areas. In the analysis, there was also a perceived benefit for socio-cultural and socio-economic criteria, indicating that people saw this to be consistent with their development ambitions, as well as that the dock located near to Baker Lake would bring economic development stimulation.

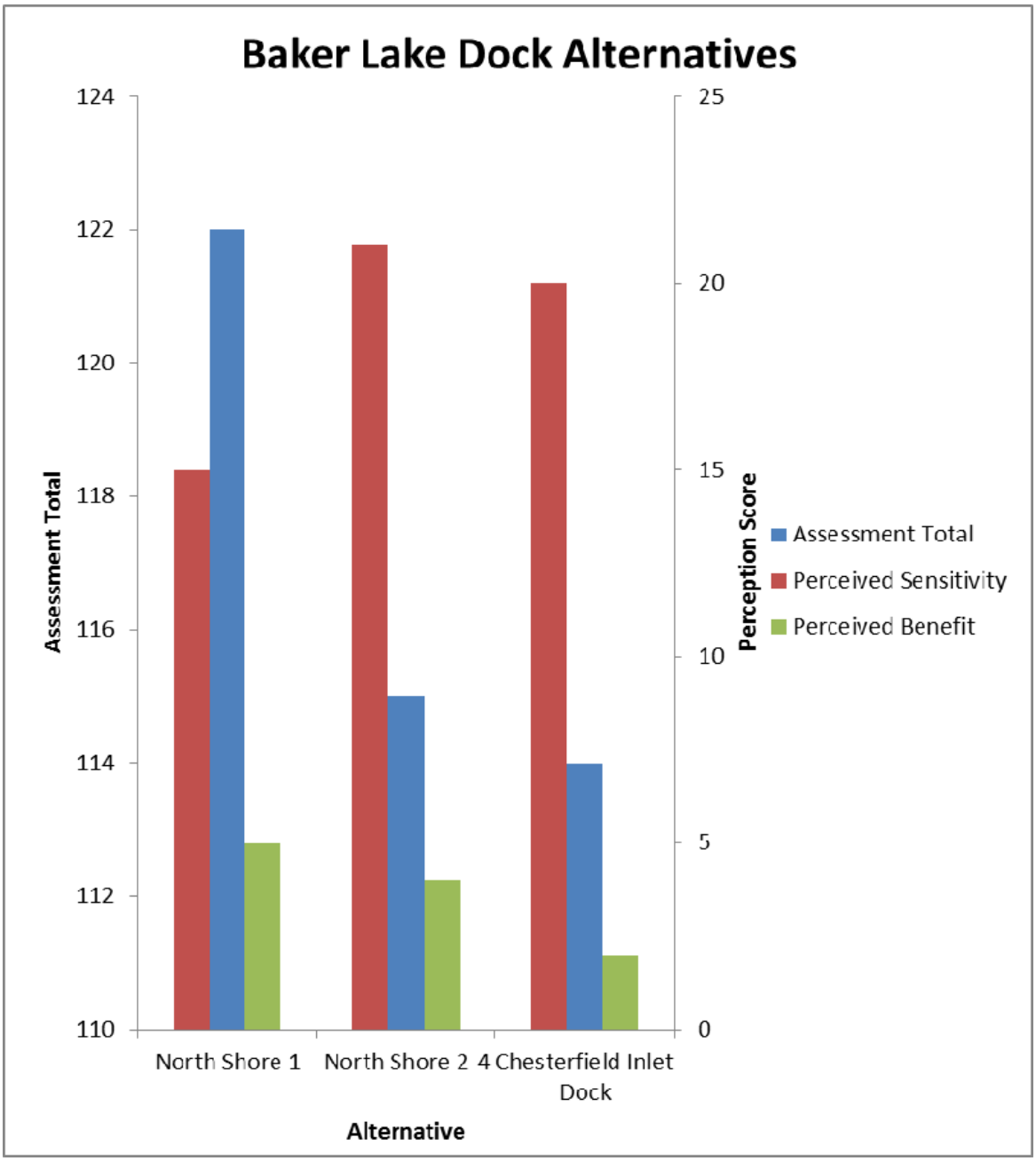


Figure 26: Graphical result of the dock location alternatives assessment.

The score for each of the environmental and social criteria sets is presented in the radar plots (Figure 27). Across all criteria sets, the North Shore Dock 1 scores better than the other alternatives. This is confirmed by the sensitivity analysis which shows North Shore Dock 1 as the best alternative. It is important to note in the radar plots that the public acceptability and the socioeconomic criteria sets score highly in this analysis, which is consistent with the perceived public benefit.

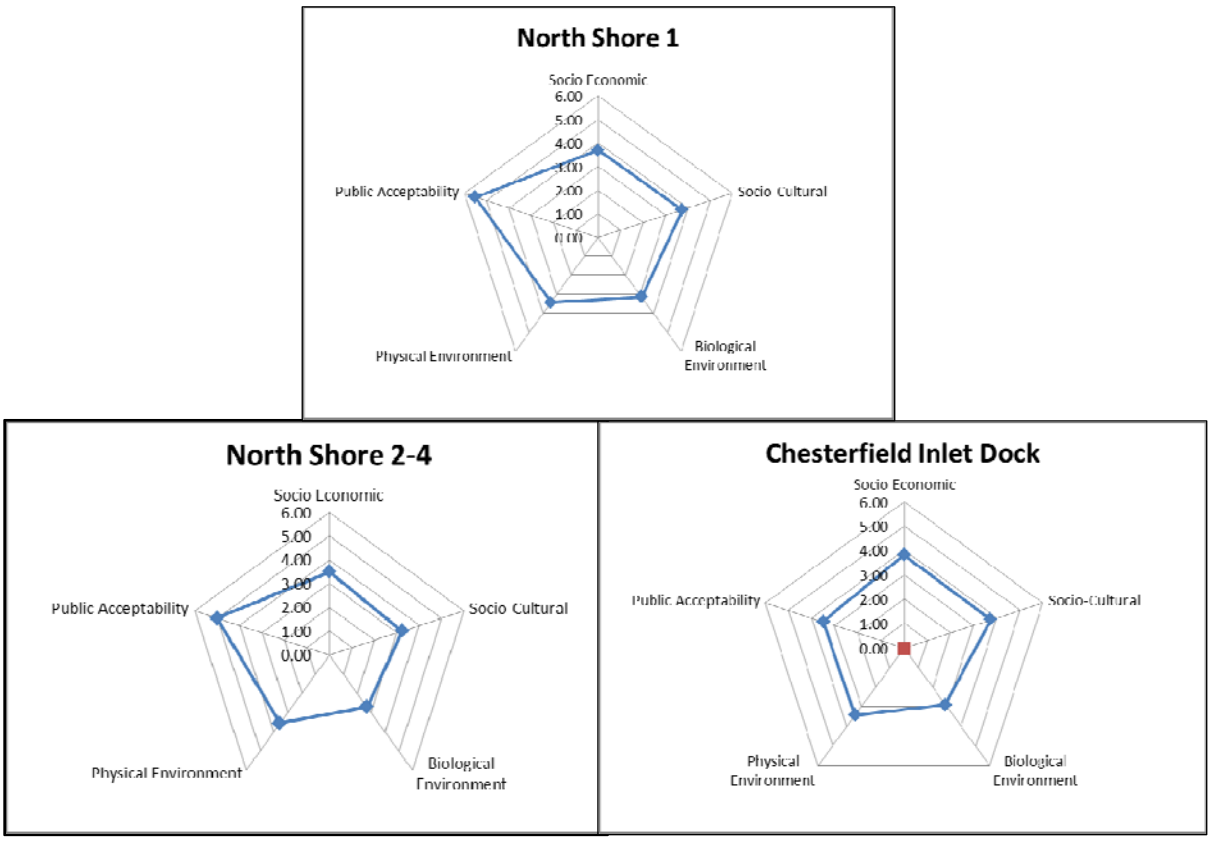


Figure 27: Comparative radar plots of environmental and social criteria for the dock location alternatives.

From this environmental and social analysis, the North Shore Dock at location 1 is the preferred alternative.

12.3. Engineering and Cost Evaluation

In this case, the engineering and cost evaluation has not been conducted as the various locations are so close to each other and would use a very similar design. There are some differences in the bathymetry and therefore the length of the dock as well as the length of the access road but the resolution that would be achieved in analysis would be marginal at best. The Chesterfield Dock would have a higher cost associated with it as it would require additional infrastructure to be put in place.

12.4. Best Alternative

The North Shore dock alternative at location 1 is considered the best alternative. The other sites at locations 2-4 are all viable but do not score as highly as location 1, which is confirmed by sensitivity analysis. The analysis has also shown that a consistent trade-off between socio-economic benefit and public acceptability is being made with the biological environment sensitivity. This trade-off reflects the public's hope that AREVA would be able to minimise the zone of influence by sharing the Agnico dock facilities. Although desirable, the Agnico facility is too small and the best alternative would be to keep the dock facilities for the various companies clustered close to each other.

13. Yellowcake Transport Alternatives

AREVA has developed two main alternatives for the transport of yellowcake or uranium concentrate, via primarily air or primarily air and marine routes. The use of the marine transport route would be seasonally controlled as the ice would prevent shipping in the winter months. These alternatives have been presented to the public as part of the engagement process, and feedback indicated that people would prefer not to have the yellowcake transported through or stored near to the Baker Lake community.

13.1. Alternatives Considered

AREVA has considered alternatives for the transport of yellowcake as presented in Table 21.

Table 21: Alternatives considered for the yellowcake transport alternatives.

Alter-native	Name	Description	Considered in Alternatives Evaluation
1	Air only	The yellowcake is loaded at the airstrip at Kiggavik and it is then flown south to the existing ground transportation network.	Yes
2	Air and Marine.	The yellowcake is loaded at the airstrip at Kiggavik and it is then flown south to the existing ground transportation network during the winter. During the open water season, the yellowcake is transported by truck form site to Baker Lake, from where it is barged to Churchill, Manitoba, or Chesterfield, Nunavut, and then via marine or rail transport to the south of Canada.	Yes

13.1.1. Considerations for Evaluation

The following points need to be considered with regards to the transportation of yellowcake:

- Yellowcake is a coarse powder that is insoluble in water.
- The yellowcake contains about 80% uranium oxide with low levels of radioactivity.
- Yellowcake is transported in sealed drums.
- Yellowcake transport and handling is regulated by the CNSC and Transport Canada. Neither has expressed a preference for either transport method, though both have concerns about yellowcake transport accidents and malfunctions.
- Local communities have expressed concern about the transport of yellowcake through Baker Lake and the storage of the material near to the community.
- The use of the marine transport route would be seasonally controlled as the ice would prevent shipping in the winter months.
- The cost of flying is higher than the cost of marine transport.
- The main environmental risk is associated with accidents and malfunction during transport. The following risk levels have been determined for yellowcake transport over the 15 year project life (Air and Marine has the lowest risk for accidents):
  - All Air 0.014 air accidents.
  - Air and Marine 0.004 marine accidents.
    $4x10^{-5}$ truck accidents.

13.2. Environmental and Social Evaluation

Based on the evaluation presented in the appendices and Figure 28, the Air Only alternative is identified as the highest scoring. The difference in the score of the two alternatives is greater than 10%, which is a reasonable resolution. There was no perceived public benefit score in this analysis, however, the perceived public sensitivity is higher for the Air and Marine alternative and this is principally driven by the concerns and comments raised by the Baker Lake community. The transport of yellowcake through Baker Lake scored "1" which is below the AREVA threshold, suggesting that it is undesirable at this time.

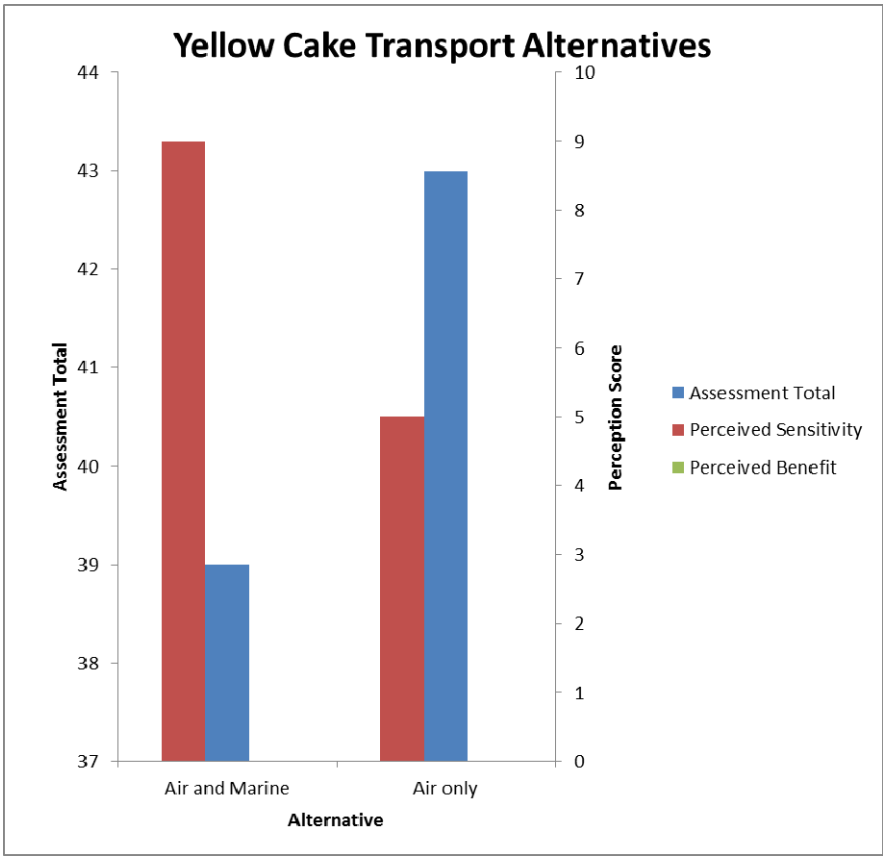


Figure 28: Graphical result of the yellowcake transport alternatives assessment.

Analysis of the radar plots reveals quite different criteria set scores (Figure 29). Except for the score on the physical environment criteria set, the Air Only alternative scores better than the Air and Marine alternative in all cases. The main issue is that flying produces more emissions than the Air and Marine alternative. From the sensitivity analysis that has been conducted, the Air Only alternative is the preferred alternative across all environmental and social criteria sets.

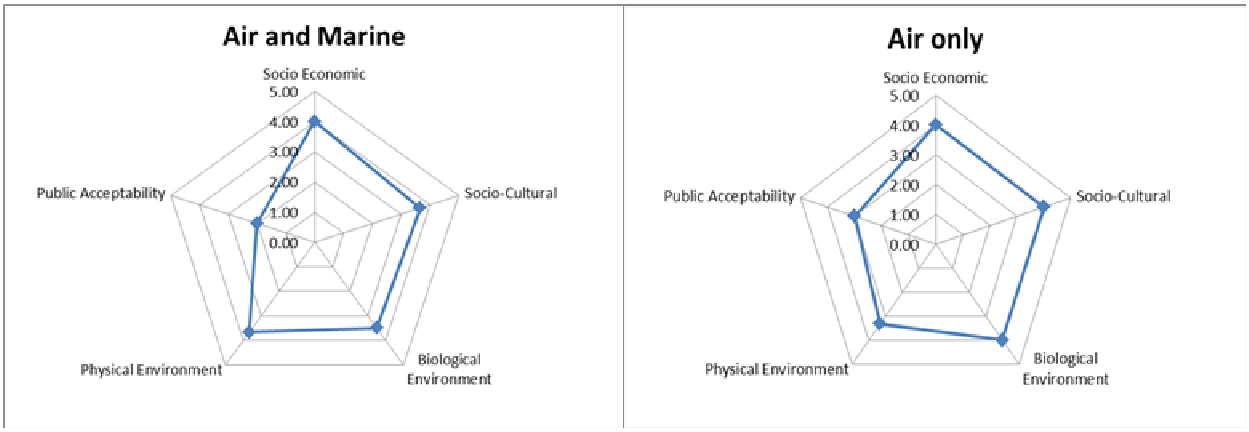


Figure 29: Comparative radar plots of environmental and social criteria for the yellowcake transport alternatives.

13.3. Engineering and Cost Evaluation

The engineering, technical and economic criteria were evaluated to determine the optimal alternative for the proposed project. The analysis is presented in Table 22. The relative figures used for the comparative analysis are based on the work of Sennes for risk and Golder Associates for the other variables. The difficulty and schedule variables have been inferred from the seasonal transport limitations if marine transport is used. In these tables, the lowest score is the optimal alternative based on a relative comparison. The best alternative in the socio-economic and environmental assessment is scored as "1" and the other alternative is ranked against it. In this table all data was available in a form that could be quantitatively described.

Table 22: Comparative engineering, technical and economic criteria for the yellowcake transport alternatives.

Alternative		Engineering and Technical			Economic	
		Difficulty	Risk	Schedule	Operational	Score
1	Air and Marine	1.5	0.3	1.5	0.65	3.95
2	Air Only	1	1	1	1	4

From Table 22, it is apparent that the Air and Marine alternative is the preferred alternative. This is in contrast to the environmental and social analysis which indicated that the Air Only alternative was the preferred alternative. From a risk perspective, the Air Only alternative is higher risk and on the economic side the Air Only alternative is also more expensive. However, the Air and Marine alternative is more difficult as it will require more handling and storage and the transport periods will be constrained by the seasons and the ice. In terms of resolution, overall the Air and Marine alternative is the better alternative, but the difference is small.

In this engineering analysis, the cost and risk are traded off against the difficulty and the schedule. Furthermore, in the environmental and social analysis, the All Air alternative was the preferred alternative and, in this sense, is also traded off against cost and risk. The community has also opted to support an alternative that does not bring the yellowcake near to the community, despite being aware that the yellowcake transport by air is associated with a higher risk generally. It needs to be borne in mind that although the risk for the All Air alternative is higher, it is not an unacceptable risk and that the transport of yellowcake is regulated by the CNSC and Transport Canada. In essence, Baker Lake reduces its potential risk exposure and this is seen as an important driver for them.

Having identified that there is a potential trade off in the alternatives assessment, AREVA has opted to go for the most publically acceptable alternative, even though the cost is higher. AREVA does however, benefit from a simpler transport operation and a schedule that is only constrained by caribou migration in large numbers along the flight path near Kiggavik. AREVA also notes that there is a clear risk advantage to use marine transport and they would like to reassess this alternative in the future once transport credibility has been established and operational performance can be presented to Baker Lake.

13.4. Best Alternative

Engineering and economic analysis indicates that the Air and Marine alternative is narrowly preferred over the All Air alternative, with cost and risk traded off against difficulty and schedule. The environmental and social analysis indicates that the All Air alternative is preferred, largely driven by the Baker Lake community's position that they would prefer not to have yellowcake near the community. The All Air alternative would take the yellowcake directly south, which avoids the community, but does have a higher risk associated with it. AREVA has opted to select the All Air alternative to ensure the Baker Lake community position is respected. Although the cost is higher, AREVA does benefit from an easier materials handling alternative that has more flexibility for scheduling. At this time, AREVA believes the All Air alternative is preferred, but would like to re-evaluate this in the future.

14. Marine Transport Alternatives

AREVA will need to transport site construction and operational supplies by annual sealift from southern ports to the Kiggavik site. Baker Lake currently receives supplies during the annual sealift which takes place in the open water season from August to October. Dry cargo and fuel are loaded onto ships or barges in southern ports and are then transported to Chesterfield Inlet via Hudson Strait and Hudson Bay. The annual cargo requirement to support the Kiggavik Mine Project is estimated to include about 55,000 tonnes of diesel fuel and about 91,000 tonnes of dry cargo, most of which will be shipped in 4,000 ISO shipping containers.

A section of the passage between Chesterfield Inlet and Baker Lake known as Chesterfield Narrows is relatively shallow and subject to strong currents that limit the size and timing of vessel transit. Most ocean-going vessels cannot pass the Narrows, so cargo is lightered onto barges for transportation to Baker Lake. The entire Kiggavik annual cargo requirement can be transported through the Chesterfield Inlet on 28 tides using 5,000 tonne barges. The total cumulative requirement for the annual sealift into Baker Lake is assumed to be 300,000 tonnes for all companies and the local community combined. The total cargo requirement can be transported through the Chesterfield Inlet on 60 tides using 5,000 tonne barges, leaving a 30% contingency.

Through the course of the project planning, AREVA has considered a variety of alternatives to bring cargo to the site that fall into the following three main groups: shipping or railing cargo to Churchill and then barging to Baker Lake, shipping to various lightering points and then barging to Baker Lake or barging directly to Baker Lake from Southern Ports. These various alternatives are described below for both fuel and dry cargo delivery. The various routes that could be used are shown in Figure 30.

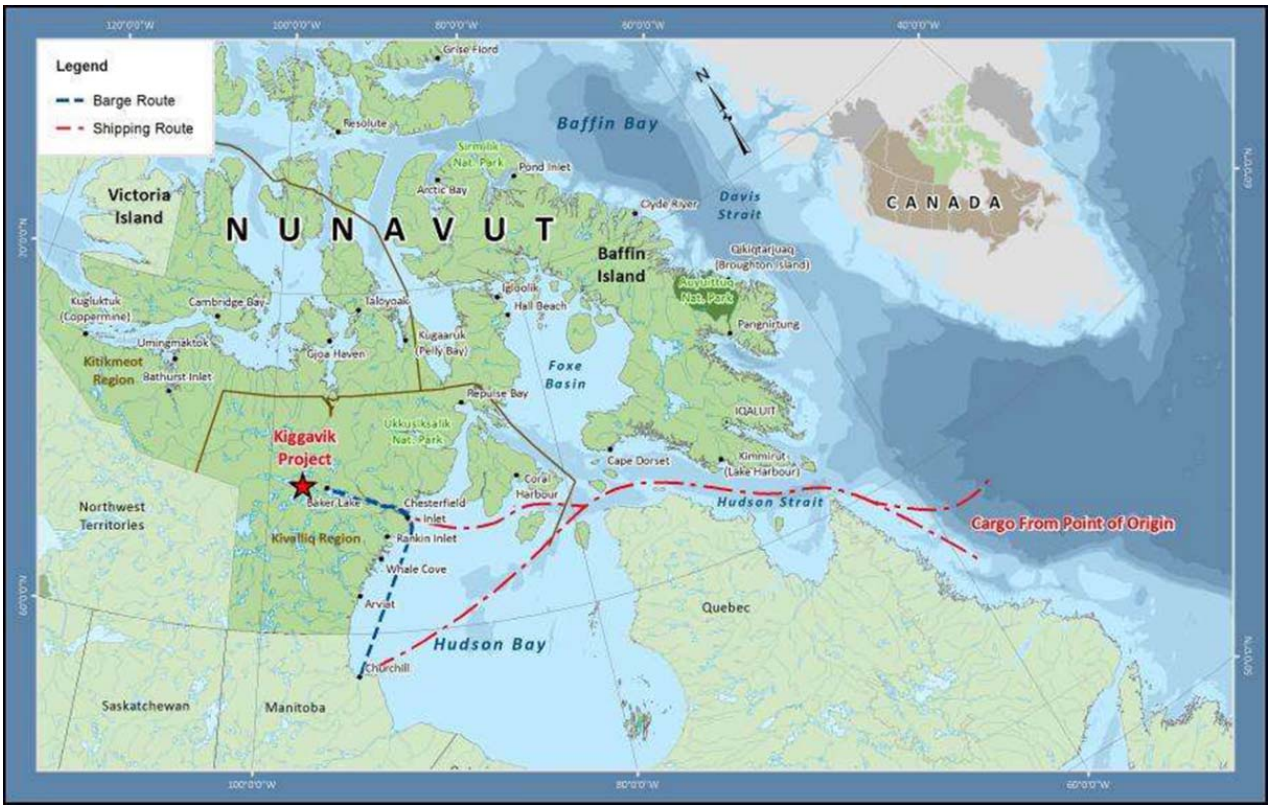


Figure 30: Route alternatives for shipping cargo to Baker Lake.

14.1. Alternatives Considered

AREVA has considered various alternatives as described in Table 23 below. Eight alternatives are presented, four for dry cargo handling and four for fuel transport.

Table 23: Alternatives considered for the marine transport alternatives.

Alter-native	Name	Description	Considered in Alternatives Evaluation
1	Dry Cargo - Shipped to Helicopter Island then Barged to Baker Lake.	Dry cargo may be carried on general cargo vessels fitted with unloading cranes direct to an anchorage at Helicopter Island which is located west of the Chesterfield Inlet. Cargo will be lightered from the cargo ships onto barges and will be delivered to the Baker Lake dock site.	Yes
2	Dry Cargo - Barged direct to Baker Lake from southern ports.	Dry cargo may be loaded on ocean-going barges in southern ports and delivered direct to Baker Lake.	Yes
3	Dry Cargo - Shipped direct to Churchill from southern ports then barged to Baker Lake.	Dry cargo may be loaded on large container ships in southern ports and delivered direct to the port of Churchill. The containers will be loaded on barges in Churchill and delivered direct to the Baker Lake dock site. Note: Minimal infrastructure currently exists for container handling and storage at Churchill. Ships must have their own cranes.	Yes

4	Dry Cargo - Railed direct to Churchill then barged to Baker Lake.	Dry cargo may be delivered to Churchill by rail then loaded on barges for delivery direct to Baker Lake. Note: This is a costly alternative.	Yes
5	Fuel – Ocean tanker to Ellis Island and then barged to Baker Lake.	Fuel is carried in ocean-going double hull tankers to an anchorage near Ellis Island which is located at the eastern end of Chesterfield Inlet. Fuel will be transferred to double bottom barges for delivery direct to Baker Lake.	Yes
6	Fuel – Ocean tanker to Churchill tank farm and then barged to Baker Lake.	Fuel may be carried in ocean-going double hull tankers direct to the Churchill tank farm. Fuel will be loaded from the tank farm into double hull barges for delivery direct to Baker Lake.	Yes
7	Fuel – Rail delivery to Churchill and the tug and barge to Baker Lake.	Fuel is delivered by rail from Edmonton to Churchill. A tug and barge system loads at Churchill and the fuel is delivered directly to Baker Lake. Note: This is a costly alternative.	Yes
8	Fuel – Combined rail and ocean delivery with barge to Baker Lake.	Fuel is carried in ocean-going double hull tankers to an anchorage near Ellis Island which is located at the eastern end of Chesterfield Inlet. Fuel will be transferred to double bottom barges for delivery direct to Baker Lake. In addition, one barge load is sent from Churchill. Note: Rail is a costly alternative.	Yes

14.1.1. Considerations for Evaluation

The following points need to be borne in mind when considering the alternatives:

- Marine mammal observers will be carried onboard tugs and vessels to monitor marine activities when transiting sensitive areas.
- Minimal infrastructure currently exists for container handling and storage at Churchill. Ships must have their own cranes to unload sea containers.
- The marine shipping company provides a comprehensive contingency plan capable of dealing with anticipated marine emergencies. The plan will include the supply of sufficient oil spill containment and clean up equipment and materials strategically located on vessels, as well as ashore, to deal with emergencies. Each vessel, including tugs and barges, will carry an oil spill emergency response kit and contingency plans for all marine emergencies.
- Trained personnel are available to deploy and operate the equipment.
- Shipping is regulated by transport Canada.
- AREVA will develop various management plans to ensure the safe transport and transferal of goods at ports and lightering points.
- The rail transport alternatives have been noted as costly in earlier project design phase studies.

14.2. Environmental and Social Evaluation

In the environmental and social evaluation of the alternatives, railing to Churchill with barging to Baker Lake has been found to be the highest scoring alternative for dry cargo, followed closely by barging direct to Baker Lake from Southern ports and shipping to Churchill and then barging to Baker Lake. For fuel transport the use of tank farm facilities at Churchill followed by barging to Baker Lake are the highest scoring alternatives for fuel transport. The method of transporting fuel to Churchill appears to have limited effect on the overall assessment score as all three alternatives score equally. The outcome of the analysis is graphically shown in Figure 31. The dry cargo and the fuel transport alternatives are discussed separately below.

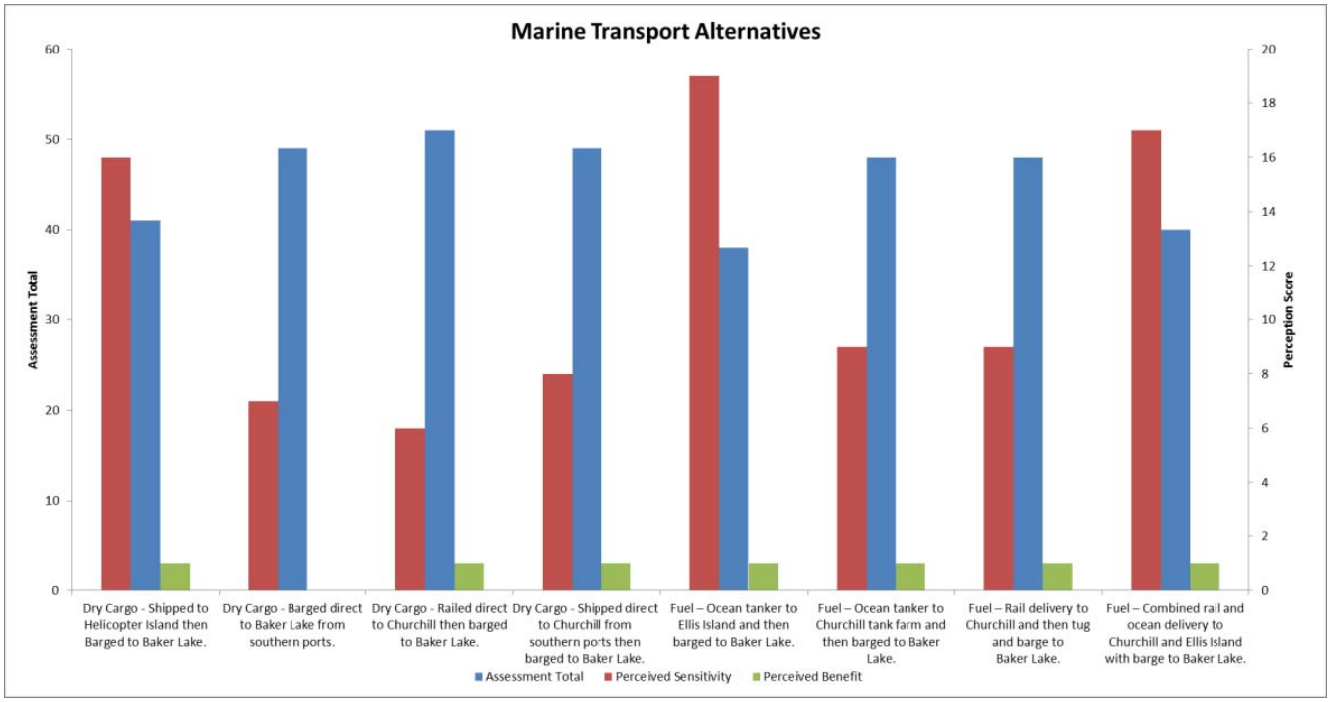


Figure 31: Graphical result of the cargo and fuel transport alternatives assessment.

Dry Cargo: From the analysis (Figure 31), good resolution in the four alternatives in excess of 10 % is apparent. The highest scoring alternative, direct rail to Churchill followed by barge transport to Baker Lake is associated with the lowest level of perceived public sensitivity. The lowest scoring alternative, lightering at Helicopter Island, is associated with by far the highest level of perceived sensitivity for dry cargo. The best scoring alternative is associated with low perceived public benefit similar to two other alternatives. Barging direct to Baker Lake has the lowest perceived public benefit as it will create fewer employment opportunities as it eliminates many of the intermediate material handling steps. NIRB specifically required a comparison of employment for this set of alternatives.

From the analysis for both dry cargo and fuel, it is apparent that the best environmental alternatives are associated with the least amount of material handling. The material handling is associated with

the greatest risk for accidents and loss with the potential to cause contamination. The environmentally best alternative is not the socioeconomic best alternative, as fewer jobs are created. This is borne out by the trade-off in perceived public sensitivity and benefit which is between biological risk and employment. The perceived sensitivity was found to be larger than the perceived benefit. This is consistent with the other evaluations in this report, where the perceived value of the natural environment was placed above almost all other criteria.

The socio-cultural and regulatory criteria set reveals that the potential permit requirements for lightering in the Chesterfield area are likely to be more onerous. This is reflected in the radar plots shown in Figure 32. The direct barging to Baker Lake from southern ports scores well for all criteria sets, although it offers the least potential for local employment and therefore does not hold the best overall assessment score. Sensitivity analysis confirms railing to Churchill followed by barging to Baker Lake is the highest scoring alternative across all criteria sets.

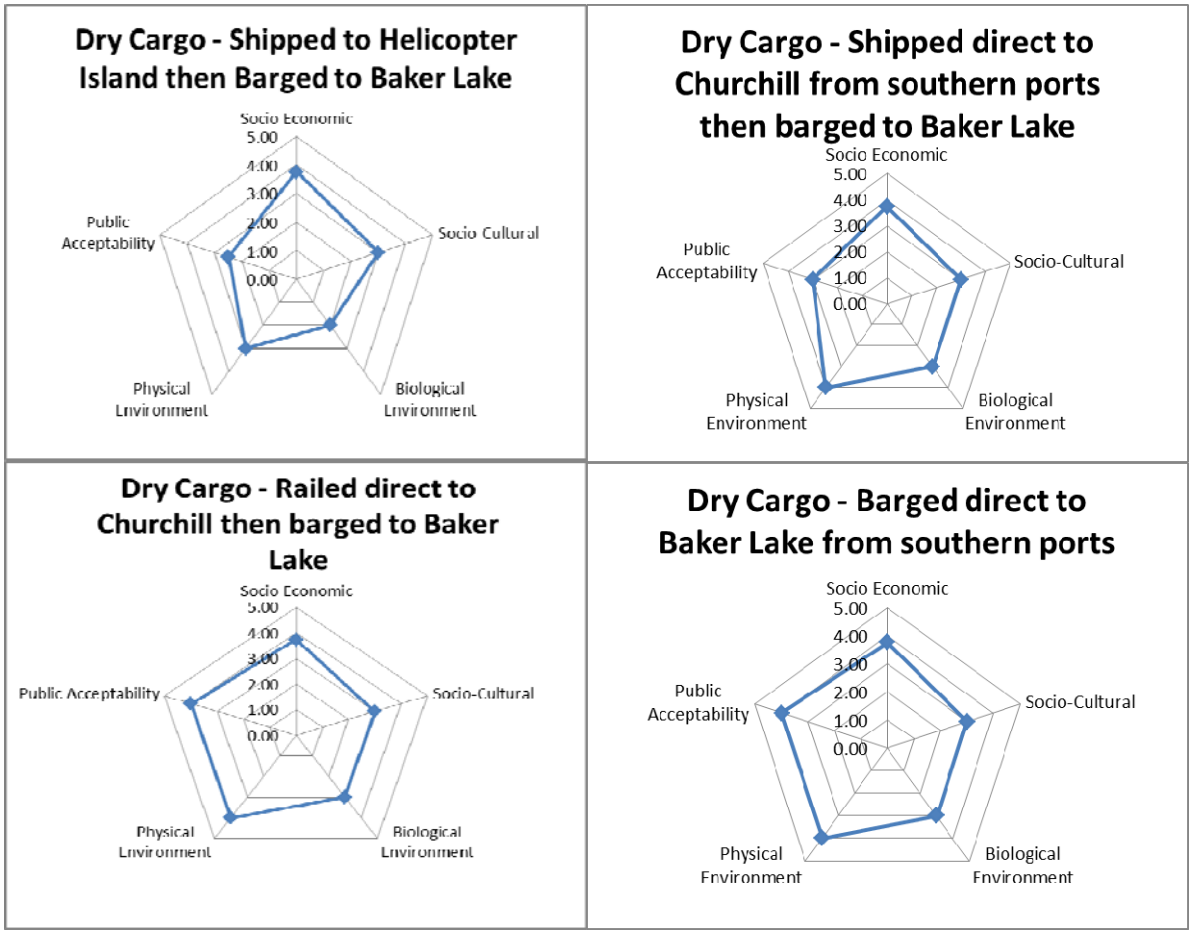


Figure 32: Comparative radar plots of environmental and social criteria for the dry cargo transport alternatives.

Fuel: The analysis of the four alternatives for the marine transport of fuel shows a clear preference for the routes via Churchill (Figure 31). The main reason for this is the risk of interference with listed species like the beluga that frequent the Kivaliq coastline up to Coral Harbour and the potential for contamination at transfer points in the Chesterfield area. Of all the transport alternatives

analysed, the worst scoring were consistently those with transfer of fuel around Ellis Island to the west of Chesterfield Inlet. These alternatives are also associated with the highest level of perceived public sensitivity based on the feedback that was recorded at public meetings. In all criteria sets, as seen in the radar plots (Figure 33) and as confirmed in the sensitivity analysis, the alternatives with routing fuel to Churchill and then transferring to a tank farm with subsequent reloading onto barges destined for Baker Lake are the highest scoring alternatives.

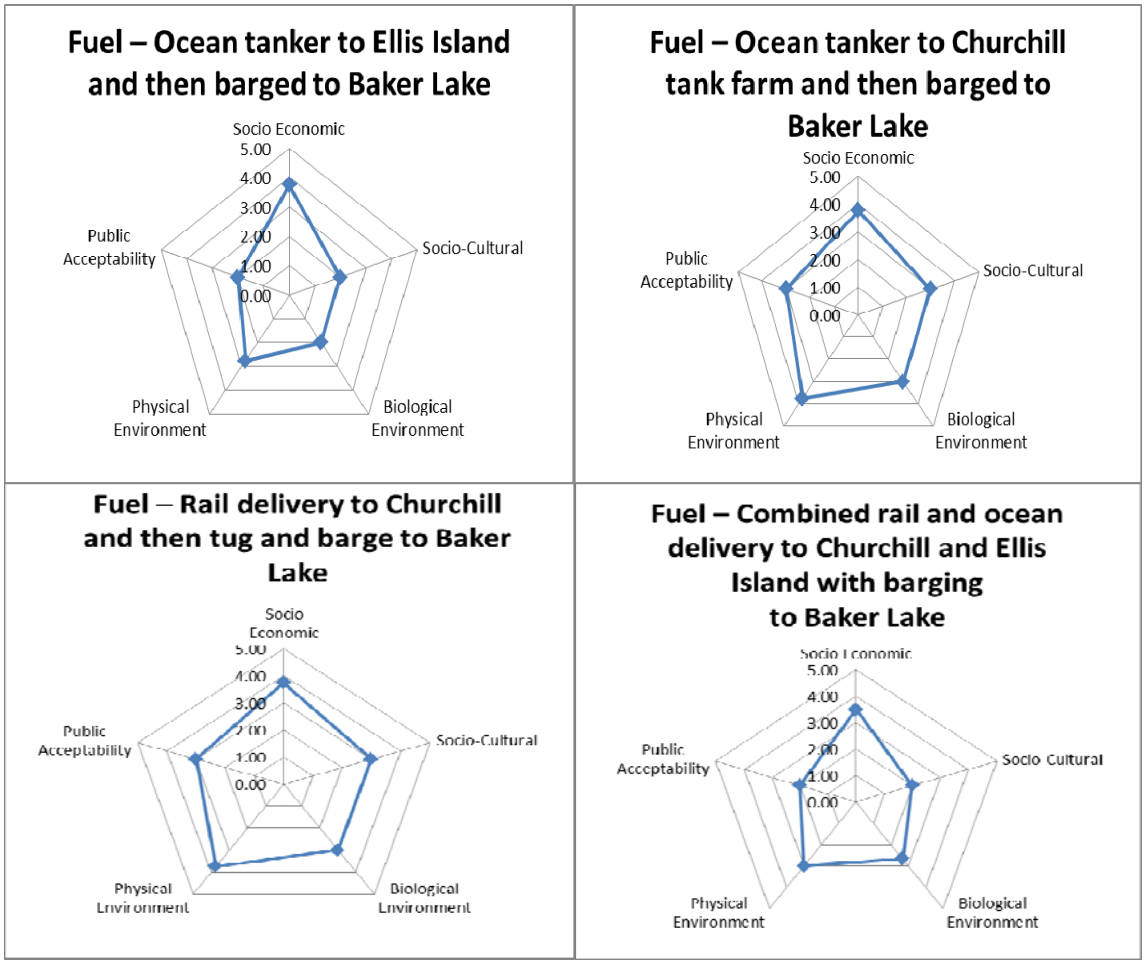


Figure 33: Comparative radar plots of environmental and social criteria for the fuel transport alternatives.

14.3. Engineering and Cost Evaluation

The engineering, technical and economic criteria were evaluated to determine the optimal alternative for the proposed project. The analysis is presented in Table 24. The relative figures used for the comparative analysis are based on the work reported by AREVA in their Marine Transport Supporting Document (March 2011). The difficulty, risk and cost variables have been inferred from the environmental and social matrix as well as the notes from the public engagement record as provided by AREVA. In the engineering and cost table, the lowest score is the optimal alternative based on a relative comparison. The best alternative in the socio-economic and environmental assessment is scored as "1" and the other alternative is ranked against it. In this table all data was

available in a form that could be quantitatively described. Dry cargo and fuel are considered separately.

Table 24: Comparative engineering, technical and economic criteria for the cargo and fuel transport alternatives.

		Engineering and Technical			Economic		
Alternative		Difficulty	Risk	Schedule	CAPEX	OPEX	Score
1	Dry Cargo - Shipped to Helicopter Island then barged to Baker Lake.	1.2	1.4	0.8	1.2	1.2	5.8
2	Dry Cargo - Barged direct to Baker Lake from southern ports.	0.9	1	0.9	0.8	0.9	4.5
3	Dry Cargo - Railed direct to Churchill then barged to Baker Lake.	1	1	1	1	1	5
4	Dry Cargo - Shipped direct to Churchill from southern ports then barged to Baker Lake.	1.2	0.8	1.2	1	1	5.2
5	Fuel – Ocean tanker to Ellis Island and then barged to Baker Lake.	1.4	1.5	0.6	1.2	0.8	5.5
6	Fuel – Ocean tanker to Churchill tank farm and then barged to Baker Lake.	1	1.2	1	1	1	5.2
7	Fuel – Rail delivery to Churchill and then tug and barge to Baker Lake.	1	1	1	1	1	5
8	Fuel – Combined rail and ocean delivery to Churchill and Ellis Island with barging to Baker Lake.	1.4	1.4	0.8	1.2	0.8	5.6

Dry Cargo: The need for construction of materials handling facilities at Churchill or Helicopter Island pushes the CAPEX up for Alternative 1, 3 and 4. The additional handling of materials not only increase the risk but also increases the OPEX and in the case of routing via Churchill it also affects schedule. The best alternative from this analysis is the direct barging of dry cargo to Baker Lake from southern ports.

Fuel: The alternatives to take fuel via Churchill are the better of the fuel alternatives, despite the Ellis Island alternative being more cost effective and quicker. The difference between the alternatives is that the fuel transfer at Ellis Island is seen as more difficult and a higher risk. The risk was also a key driver in scoring the Ellis Island alternative low in the environmental and social matrix. The cost of shipping via Churchill is higher, but this is these are the preferred alternatives. The best alternative based on the risk differentiation, is scored as the rail delivery to Churchill with subsequent barging to Baker Lake.

14.4. Best Alternative

Dry Cargo: The best alternative for shipping dry cargo is railing to Churchill followed by barging to Baker Lake based on the environmental and social as well as the engineering cost matrices.

Fuel: The best alternative is to route fuel to Churchill via rail and then barge to Baker Lake. Although not the cheapest alternative, this has the lowest risk associated with it. In both the environmental and engineering matrices, this was a key driving factor.

Employment: The alternatives that would generate the largest number of jobs would be those that require material handling at different points. This material handling is associated with risk and contamination potential and as such, the alternatives that minimise risk also minimises employment. The trade-off analysis revealed the perceived benefit of employment was outweighed by the perceived sensitivity associated with the effects on the biological environment.

15 Decommissioning and Reclamation Alternatives

The clear up of the site is required under the mining regulations as well as under CNSC guidelines. The opportunity to explore alternatives is limited as the site has to be returned to a safe and useable state. In this section, the approach AREVA will follow for decommissioning and reclamation is presented. The approach is based on AREVA experience gained through developing and decommissioning Saskatchewan mining projects including:

- Dialogue with provincial and federal regulators
- Various Environmental Impact Studies (EIS's) and support documents
- Preliminary decommissioning plans for the McClean Lake Operation
- Preliminary decommissioning plans for the Midwest Project
- The decommissioning of Cluff Lake.

The AREVA decommissioning policy is to follow progressive reclamation by starting clean-up and reclamation soon after mining operations are completed. The progressive reclamation program during the milling and mining operational phase ensures that a significant portion of work required, is complete when operations cease. AREVA will strive to leave the site in the following state after decommissioning is complete:

- Physically sound
- Safe for public use
- Meeting air, soil, and water quality objectives
- Imposing no burden on future generations.

14.5. Proposed Approach

The Project includes facilities that are not directly involved in the mining and milling of uranium, such as the accommodation complex, acid plant, aerodrome, water supply and power house. These buildings are not expected to contain radioactive materials and for the most part, should be salvageable. Salvageable buildings, surface structures and equipment will be dismantled and demobilised from the site. Similar to the construction phase, the decommissioning phase will involve the use of the ice roads from the site to a staging area at Baker Lake. During the winter months, salvageable materials will be shipped to Baker Lake in preparation for sea shipping to the south in the spring. Wherever possible, shipping containers will be used for ease of handling and durability. Non-salvageable buildings and structures will be dismantled or demolished and disposed of in either the Center or Main TMF. This material will be covered with Type II mine rock and then overburden. The proposed program for the decommissioning and reclamation of the site is presented in Table 25.

Table 25: Proposed program for the decommissioning and reclamation of the Kiggavik Sissons site.

Timing	Phase	Key Activities
Years 1 and 2	Progressive Rehabilitation	•Cap ventilation raises and portal at the Sissons Site and backfill Type 3 mine rock into Main Zone and Andrew Lake Pit. •Charge main Zone Pit with mine rock and complete consolidation process. •Treat consolidation pore-water.
Years 3 to 6	Post-Operations-Key Decommissioning Activities	•Demolish all non-essential buildings at Kiggavik and Sissons sites and dispose of debris in Main Zone TMF and Andrew Lake Pit. •Dewater purpose-built pit and Main Zone TMF. •Revegetation of the site and removal or covering of all surface soils that exceed radiological clearance standards. •Add soil covers to East/Centre TMF's, backfill and cover purpose-built pit. •Remove all culverts and water diversion structures.
Years 7 to 12	Mainly Post-Decommissioning Activities	•Monitor the success of the decommissioning program. •Maintenance and repair of erosion – fertilization and re-seeding where necessary. •Main Zone TMF pore-water treatment.
Years 13 to 16	Post Decommissioning	•Pore-water treatment at main Zone TMF until consolidation is complete then drain the water cover. •Backfill with mine rock and place soil cover as designed. •Remaining portion of the camp/shops offered to the local community.

As the decommissioning phase is undertaken after a future closure focussed EIS, the alternatives for decommissioning will be further developed in consultation with the regulators and the public over time.

15. References

AREVA Resources Canada (2088). Kiggavik Project Proposal, November 2008

AREVA Resources Canada (2011). Kiggavik Project Environmental Impact Statement, Tier 2 Volume 2 - Project Description, December 2011

AREVA Resources Canada (2011). Kiggavik Project Environmental Impact Statement, Tier 3 Technical Appendix 2S - Waste Management Plan, December 2011

AREVA Resources Canada (2011). Kiggavik Project Environmental Impact Statement, Tier 3 Technical Appendix 2U - Hazardous Materials Management Plan, December 2011

AREVA Resources Canada (2011). Kiggavik Project Environmental Impact Statement, Tier 3 Technical Appendix 3A - Public Engagement Documentation, December 2011

Nunavut Impact Review Board (2011). The Guidelines for the Preparation of an Environmental Impact Statement for AREVA Resources Canada Inc.'s Kiggavik Project, May 2011

Nunavummiut Makitagunarningit (2009). About Nunavummiut Makitagunarningit. November 2009.

Nunavummiut Makitagunarningit (2009). NM Fact Sheet #1: About Uranium, November 2009.

Nunavummiut Makitagunarningit (2009). NM Fact Sheet #2: About Uranium Mining, November 2009.

Nunavummiut Makitagunarningit (2009). NM Fact Sheet #3: Nuclear Issues in Nunavut, November 2009.

Nunavummiut Makitagunarningit (2009). NM Fact Sheet #4: How Uranium Development is regulated in Nunavut, November 2009.

Nunavummiut Makitagunarningit (2009). Media Release November 25, 2009.

Pembina Institute's Life Cycle Study of Nuclear Power (2007), Nuclear Power and Climate Change. Fact Sheet No. 1, May 2007.

Pembina Institute's Life Cycle Study of Nuclear Power (2007), Uranium Mining: Nuclear Power's Dirty Secret. Fact Sheet No. 2, May 2007.

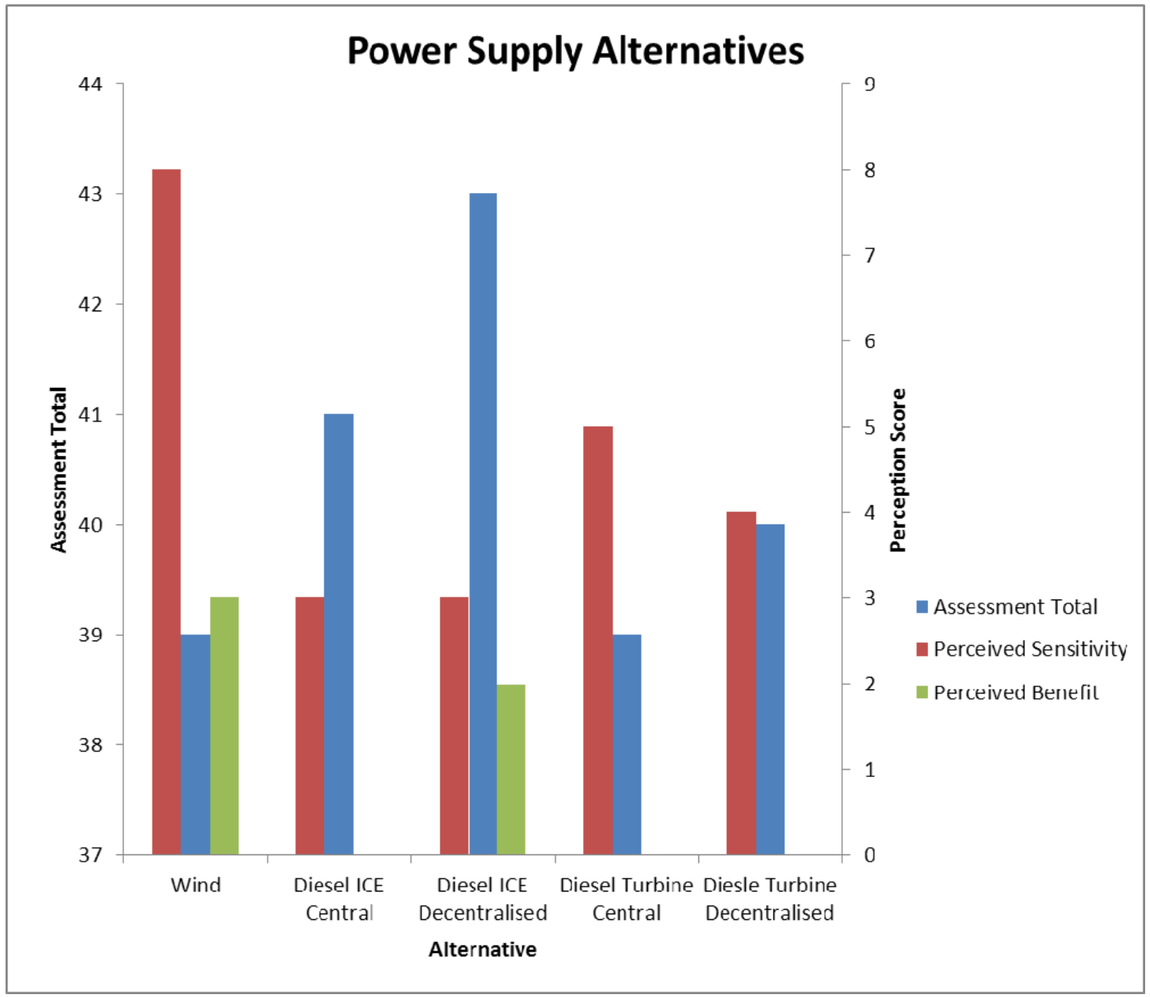
Attachment A:
Power Supply Alternatives Assessment

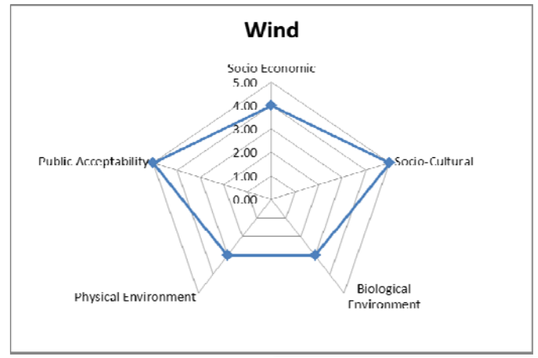
Summary

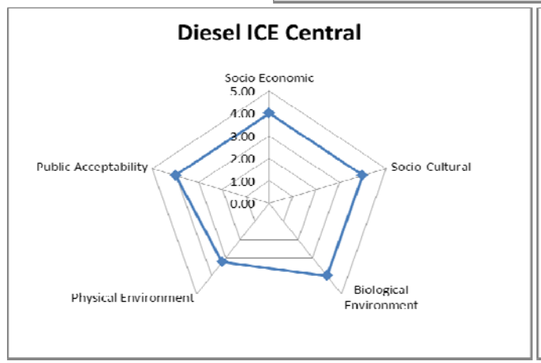
	Categories (Grouped Criteria)	Total			Socio-Economic			Socio-Cultural			Biological Environment			Physical Environment			Public Acceptability		
		Total Assessment Score	Total Perceived Public Sensitivity	Total Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit
	Number of Criteria				2			1			3			4			1		
Alternative																			
1	Wind	39	8	3	8	1	1	5	0	1	9	3	0	12	4	0	5	0	1
2	Diesel ICE Central	41	3	0	8	0	0	4	0	0	12	0	0	13	3	0	4	0	0
3	Diesel ICE Decentralised	43	3	2	9	0	1	4	0	0	12	0	0	13	3	0	5	0	1
4	Diesel Turbine Central	39	3	0	7	1	0	4	0	0	10	0	0	14	2	0	4	0	0
5	Diesel Turbine Decentralised	40	4	0	8	0	0	4	0	0	10	2	0	14	2	0	4	0	0
	Total					2	2		0	1		5	0		14	0		0	2
	Average Perceived Relative Importance (Total /No. of Criteria)					1.00	1.00		0.00	1.00		1.67	0		3.50	0		0.00	2.00

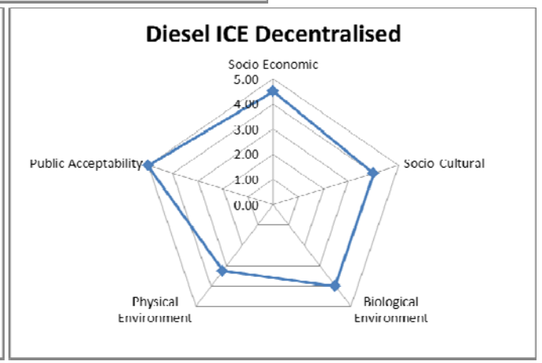
Radar Plot Averages

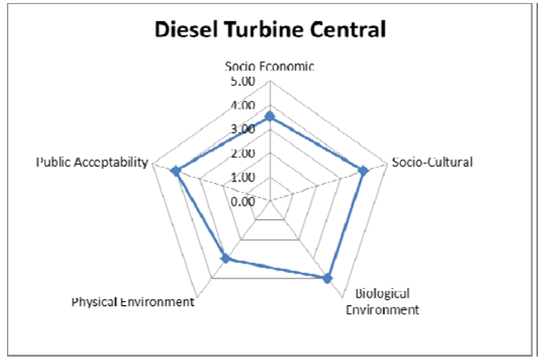
	Option	Socio Economic	Socio-Cultural	Biological Environment	Physical Environment	Public Acceptability	Score
1	Wind	4.00	5.00	3.00	3.00	5.00	2
2	Diesel ICE Central	4.00	4.00	4.00	3.25	4.00	2
3	Diesel ICE Decentralised	4.50	4.00	4.00	3.25	5.00	3
4	Diesel Turbine Central	3.50	4.00	3.33	3.50	4.00	1
5	Diesel Turbine Decentralised	4.00	4.00	3.33	3.50	4.00	1
		Indicates best option in each category based on category averages for each option					

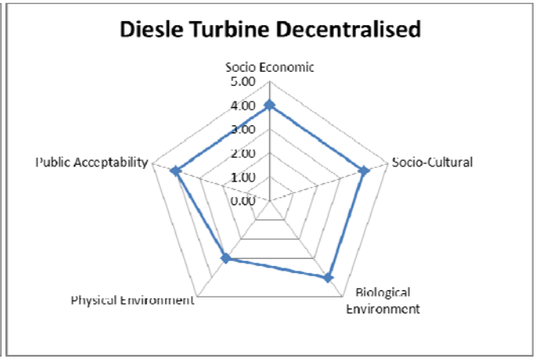












		Engineering/Technical					Economic			
Option		Difficulty	Rank	Risk	Rank	Score	CAPEX	Habitat CC	OPEX	Score
1	Wind	Requires both wind turbine and backup power supply	3	Interruption of supply possible if wind stops. Need backup generation system.	5	8	1.8		0.6	10.4
2	Diesel ICE Central	Known technology	1	Central power the power line is the risk. Lightning, icing, wind, can interrupt supply. Need emergency supply at Sissons.	2	3	1.2		0.9	5.1
3	Diesel ICE Decentralised	Known Technology	1	Emergency generator required at both sites, but only one site would go down if there was a failure. Reduced environmental factor (lightning wind icing) risks to power line. Fuel at two locations, spillages and leakages and marginal increase in fuel transport.	1	2	1		1	4
4	Diesel Turbine Central	Bigger unit than diesel for same output.	2	Central power the power line is the risk. Lightning, icing, wind, can interrupt supply. Need emergency supply at Sissons.	4	6	1.1		1.1	8.2
5	Diesel Turbine Decentralised	Bigger unit than diesel for same output.	2	Emergency generator required at both sites, but only one site would go down if there was a failure. Reduced environmental factor (lightning wind icing) risks to power line. Fuel at two locations, spillages and leakages and marginal increase in fuel transport.	3	5	1.15		1.1	7.25

Assignment of Values					
Negative		**Perceived Public Sensitivity**	**Positive**		**Perceived Public Benefit**
Unacceptable	ff				
Extreme	0	4	Major	8	4
High	1	3	High	7	3
Moderate	2	2	Moderate	6	2
Low	3	1	Low	5	1
Negligible	4	0	Negligible	4	0

Criteria Groups and Criteria	Assessed	Wind	Diesel ICE Central	Diesel ICE Decentralized	Diesel Turbine Central	Diesel Turbine Decentralised	Issue
Social-Economic							
Socio-Economic							
Demographics	N						
Employment (Gate keepers and ferry operators, drivers and road maintenance)	Y	5	4	5	3	4	Gas turbines require specialized maintenance. Diesel and wind could allow local people to be trained.
Religious or spiritual beliefs	N						
Language(s)	N						
Socio-political dynamics (e.g. tribal system)	N						
Landuse							
Housing (single family, multiple family)	N						
Schools (pre-school to secondary	N						
Graveyards	N						
Hospitals/care facilities	N						
Religious buildings or spiritual places	N						
Recreational areas (formal parks to trails)	N						
Berry harvesting areas	N						
Grazing lands - caribou	Y	3	4	4	4	4	The moving turbines may keep animals from the area.
Hunting territories -Caribou	N						
Hunting territories -Musk ox	N						
Hunting marine mammals	N						
Goose hunting	N						
Egg gathering	N						
Fishing territories	N						
Ice fishing	N						
Private lands	N						
Cabins	N						
Canoeing and hunting tourism	N						
Snowmobile routes	N						
Public buildings and structures (other - libraries, government buildings, WWTP, etc.)	N						
Industrial, light Industrial, commercial, retail	N						
Maintain ingress and egress to businesses	N						
Maintain ingress and egress to homes	N						
Perceived Public Sensitivity		1	0	0	1	0	
Perceived Public Benefit		1	0	1	0	0	
Category Total		**8**	**8**	**9**	**7**	**8**	
Social, Cultural and Regulatory Environment							
Regulatory							
Land ownership	N						
Right of ways	N						
Easements	N						
Local, regional, national land use plans complimentary	Y	5	4	4	4	4	Wind turbines are seen as clean development.
Local, regional, national land use plans conflict	N						
Regulator requirements and legality (compliance)	N						
Regulator priorities or feedback (formal)	N						

Criteria Groups and Criteria	Assessed	Wind	Diesel ICE Central	Diesel ICE Decentralized	Diesel Turbine Central	Diesel Turbine Decentralised	Issue
Cultural							
Ancient burial sites	N						
Archaeological sites	N						
Historical structures and buildings	N						
Intangible heritage (songs, dance, gathering places, other traditions)	N						
Sacred places	N						
Public Programs (museums, galleries)	N						
Perceived Public Sensitivity		0	0	0	0	0	
Perceived Public Benefit		1	0	0	0	0	
Category Total		**5**	**4**	**4**	**4**	**4**	
Biological Environment							
Fauna							
Terrestrial (mammal, rodent, etc.)	N						
Caribou	Y	3	4	4	3	3	May avoid area primarily due to noise.
Avian	Y	3	4	4	4	4	Wind turbines are known to result in some loss of birds due to collision with blades.
Aquatic (fresh water)	N						
Aquatic (marine)	N						
Wildlife migration routes (land, ocean, air)	Y	3	4	4	3	3	Noise from wind turbines and gas turbines may cause animals to change migration routes. Minor noise by comparison to mining operation.
Listed species	N						
Flora							
Terrestrial (shrubs, grasses, etc.)	N						
Aquatic (fresh water)	N						
Aquatic (marine)	N						
Restricted range plants	N						
Perceived Public Sensitivity		3	0	0	2	2	
Perceived Public Benefit		0	0	0	0	0	
Category Total		**9**	**12**	**12**	**10**	**10**	
Physical Environment							
Ground Water							
Availability	N						
Water quality (Normal conditions)	N						
Potential for contamination	N						
Surface Water							
Availability	N						
Water quality (Normal conditions)	N						
Potential for contamination	Y	4	3	3	4	4	Potential diesel spills in transport and use.
Geology							
Geological substrate (various depths)	N						
Tectonics and seismicity	N						
Volcanism	N						
Landscape (Terrain)							
Steepness of slopes	N						
Characteristics (landforms, soils, wetlands, bogs, tundra, permafrost, bedrock)	N						
Other Physical Environment							
Air quality	Y	4	3	3	4	4	Diesel results in particulates which are deposited as black particles accelerating snow melt, and may contain traces of organic compounds. Particles are respirable.
Noise	Y	2	3	3	2	2	Wind turbine blades do make a noise. Gas turbines have a high frequency noise.
Visual	Y	2	4	4	4	4	Wind turbines are considered to visually represent industrialization of the landscape. Diesel can form smoke.
Paleontological resources	N						
Perceived Public Sensitivity		4	3	3	2	2	
Perceived Public Benefit		0	0	0	0	0	
Category Total		**12**	**13**	**13**	**14**	**14**	
Public Acceptability							
Community consultation (Opinion expressed)	Y	5	4	5	4	4	Inferred from concerns relating to climate change and employment.

Criteria Groups and Criteria	Assessed	Wind	Diesel ICE Central	Diesel ICE Decentralized	Diesel Turbine Central	Diesel Turbine Decentralised	Issue
Public scoping meetings (Opinion expressed)	N						
NGO's engagement (Opinion expressed)	N						
Perceived Public Sensitivity		0	0	0	0	0	
Perceived Public Benefit		1	0	1	0	0	
Category Total		**5**	**4**	**5**	**4**	**4**	
Total Assessment Score		39	41	43	39	40	

Attachment B:
Fresh Water Source Alternatives Assessment

Summary

	Categories (Grouped Criteria)	Total			Socio-Economic			Socio-Cultural			Biological Environment			Physical Environment			Public Acceptability		
		Total Assessment Score	Total Perceived Public Sensitivity	Total Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit
	Number of Criteria				7			6			5			4			3		
	Alternative																		
1	Judge Sissons Lake	98	2	0	26	2	0	24	0	0	20	0	0	16	0	0	12	0	0
2	Kavisilik Lake	95	5	0	28	0	0	22	2	0	18	2	0	15	1	0	12	0	0
3	Scotch Lake	85	15	0	27	1	0	20	4	0	12	8	0	14	2	0	12	0	0
4	Skinny Lake	94	6	0	28	0	0	20	4	0	19	1	0	15	1	0	12	0	0
5	Squiggly Lake	89	11	0	27	1	0	20	4	0	14	6	0	16	0	0	12	0	0
6	Siamese Lake	100	0	0	28	0	0	24	0	0	20	0	0	16	0	0	12	0	0
	Average Perceived Relative Importance (Total /No. of Criteria)					4	0		14	0		17	0		4	0		0	0
						0.57	0.00		2.33	0.00		3.40	0.00		1.00	0.00		0.00	0.00

Radar Plot Averages

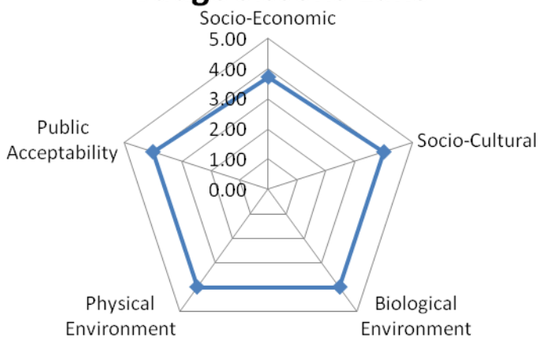
	Option	Socio Economic	Socio-Cultural	Biological Environment	Physical Environment	Public Acceptability	Score
1	Judge Sissons Lake	3.71	4.00	4.00	4.00	4.00	4
2	Kavisilik Lake	4.00	3.67	3.60	3.75	4.00	2
3	Scotch Lake	3.86	3.33	2.40	3.50	4.00	1
4	Skinny Lake	4.00	3.33	3.80	3.75	4.00	2
5	Squiggly Lake	3.86	3.33	2.80	4.00	4.00	2
6	Siamese Lake	4.00	4.00	4.00	4.00	4.00	5
		Indicates best option in each category based on category averages for each option					

Traditional Sensitivity Analysis

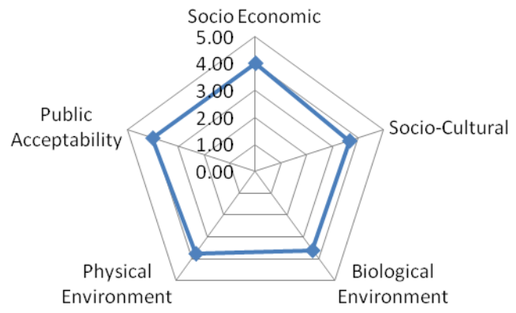
Option	Total	Rank	Excluding Socio Economic	Rank	Excluding Socio-Cultural	Rank	Excluding Biological Environment	Rank	Excluding Physical Environment	Rank	Excluding Public Acceptability	Rank	Score
Judge Sissons Lake	98	2	72	1	74	2	78	2	82	2	86	2	1
Kavisilik Lake	95	3	67	2	73	3	77	3	80	3	83	3	0
Scotch Lake	85	6	58	5	65	5	73	5	71	6	73	6	0
Skinny Lake	94	4	66	3	74	2	75	4	79	4	82	4	0
Squiggly Lake	89	5	62	4	69	4	75	4	73	5	77	5	0
Siamese Lake	100	1	72	1	76	1	80	1	84	1	88	1	5

Indicates best option in each category based on total less stepwise exclusion of category totals per option.

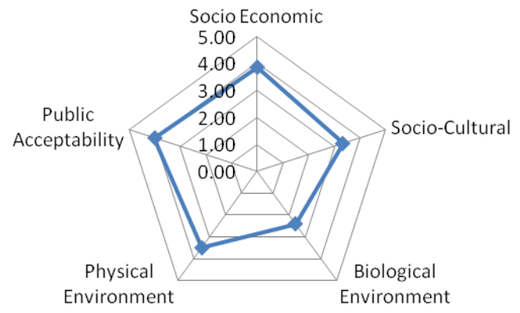
Judge Sissons Lake



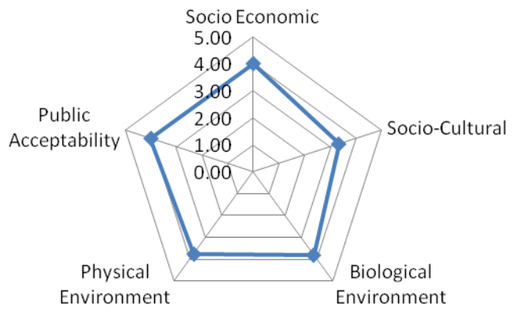
Kavisilik Lake



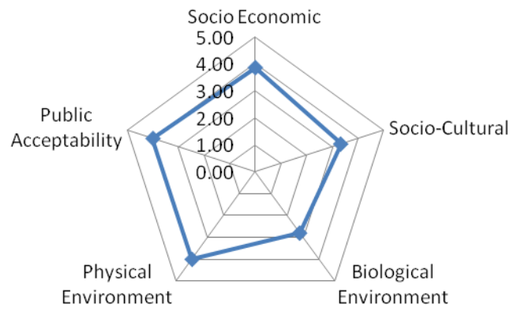
Scotch Lake



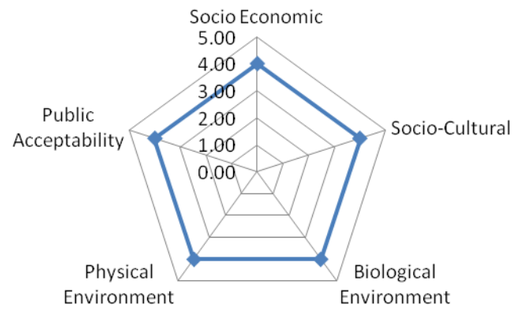
Skinny Lake

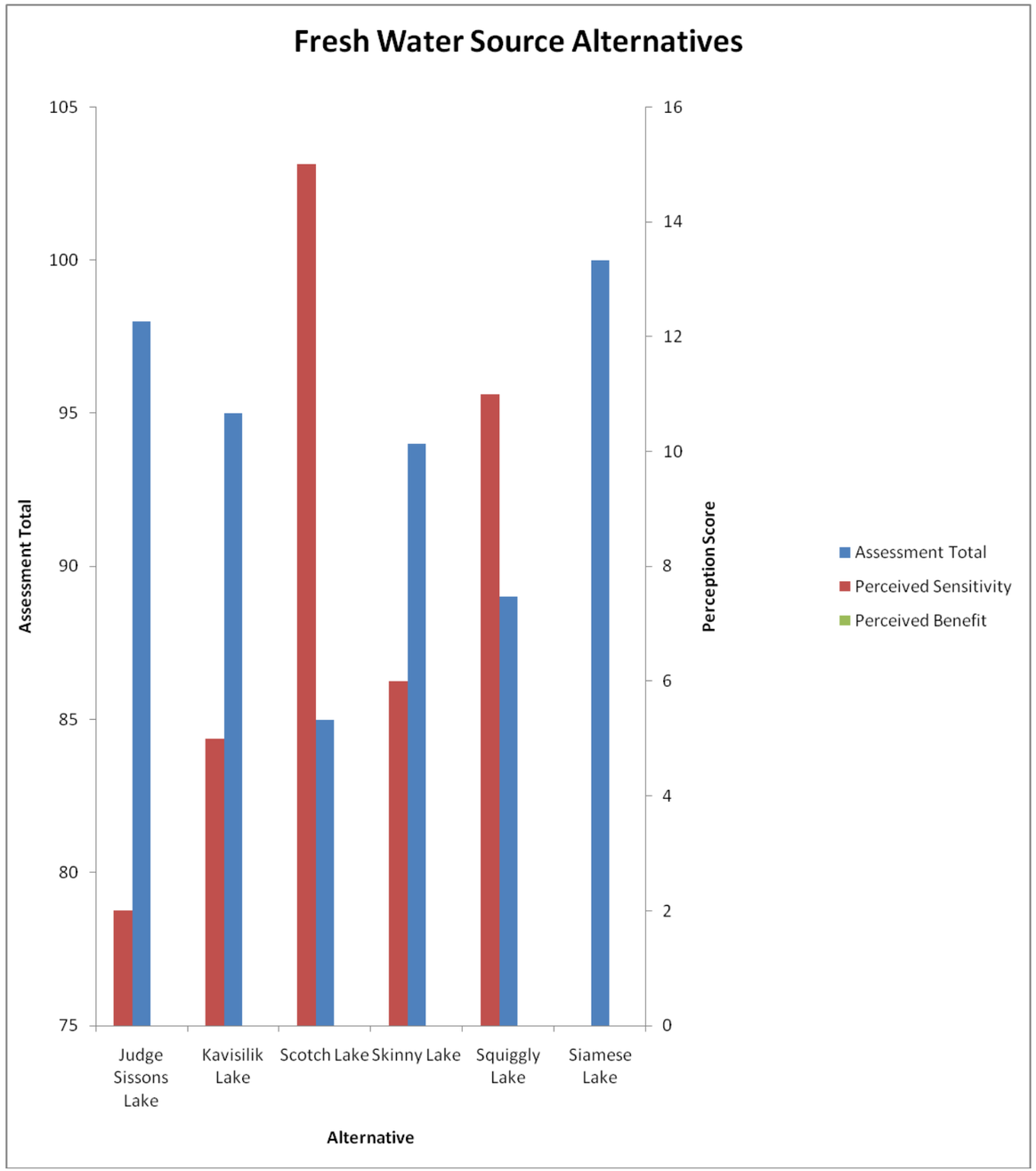


Squiggly Lake



Siamese Lake




Fresh Water Source Alternatives
105
100
95
90
85
80
75
16
14
12
10
8
6
4
2
0
Assessment Total
Perception Score
Assessment Total
Perceived Sensitivity
Perceived Benefit
Judge Sissons Lake
Kavisilik Lake
Scotch Lake
Skinny Lake
Squiggly Lake
Siamese Lake
Alternative

Assignment of Values					
Negative		Perceived Public Sensitivity	Positive		Perceived Public Benefit
Unacceptable	ff				
Extreme	0	4	Major	8	4
High	1	3	High	7	3
Moderate	2	2	Moderate	6	2
Low	3	1	Low	5	1
Negligible	4	0	Negligible	4	0

Criteria Groups and Criteria	Assessed	Judge Sissons Lake	Kavisilik Lake	Scotch Lake	Skinny Lake	Squiggly Lake	Siamese Lake	Issue	Source of Information
Social-Economic									
Socio-Economic									
Demographics	N								
Employment (Gate keepers and ferry operators, drivers and road maintenance)	N								
Religious Beliefs Spiritual	Y	3	4	4	4	4	4		
Language(s)	N								
Socio-political dynamics (e.g. caste system, tribal system)	N								
Landuse									
Housing (single family, multiple family)	N							Hunting cabin at Judge Lake	
Schools (pre-school to secondary	N								
Graveyards	M	3	4	4	4	4	4	IQ map of spiritual ground	
Hospitals/care facilities	N								
Religious buildings (churches etc)	N								
Recreational areas (formal parks to trails)	N								
Berry Harvesting	N								
Grazing lands - caribou	M	4	4	3	4	3	4	Scotch and Squiggly would require considerable additional infrastructure	
Hunting territories - Caribou	N								
Hunting territories - Musk ox	N								
Hunting marine mammals	N								
Goose hunting	N								
Egg gathering	N								
Fishing territories	Y	4	4	4	4	4	4	Potential issue related to drawdown on lake levels. Siamese noted as an important fishing area in traditional landuse maps.	
Ice fishing	M	4	4	4	4	4	4		
Private lands	N								
Cabins	Y	4	4	4	4	4	4		
Canoeing and hunting tourism	Y	4	4	4	4	4	4		
Snowmobile routes	N								
Public buildings and structures (other - libraries, government buildings, WWTP, etc.)	N								
Industrial, light Industrial, commercial, retail	N								
Maintain ingress and egress to businesses	N								
Maintain ingress and egress to homes	N								
Perceived Public Sensitivity		2	0	1	0	1	0		

Criteria Groups and Criteria	Assessed	Judge Sissons Lake	Kavisilik Lake	Scotch Lake	Skinny Lake	Squiggly Lake	Siamese Lake	Issue	Source of Information
Perceived Public Benefit		0	0	0	0	0	0		
Category Total		**26**	**28**	**27**	**28**	**27**	**28**		
Social, Cultural and Regulatory Environment									
Regulatory									
Land ownership	N								
Right of ways	Y	4	4	3	4	3	4		
Easements	N								
Local, regional, national land use plans Complimentary	Y	4	4	4	4	2	4	Thelon and Squiggly part of the Thelon River Management Plan (Nicola to provide name of draft document). AREVA decision not to encroach on this River system.	
Local, regional, national land use plans Conflict	N								
Regulator requirements and legality (compliance)	Y	4	2	1	2	4	4	Fish Habitat and decreased flows. Scotch volume is too small. Skinny and Kavisilik border line for adequate volume.	
Regulator priorities or feedback (formal)	N								
Cultural									
Ancient burial sites	N								
Archaeological Sites	Y	4	4	4	2	3	4	Skinny has archaeological sites and AREVA has decided to avoid this area. Nicola to send archaeological baseline.	
Historical structures and buildings	N								
Intangible Heritage (songs, dance, gathering places, other traditions)	M	4	4	4	4	4	4		
Sacred places	M	4	4	4	4	4	4		
Public Programs (museums, galleries)	N								
Perceived Public Sensitivity		0	2	4	4	4	0		
Perceived Public Benefit		0	0	0	0	0	0		
Category Total		**24**	**22**	**20**	**20**	**20**	**24**		
Biological Environment									
Fauna									
Terrestrial (mammal, rodent, etc.)	N								
Caribou	Y	4	4	3	4	2	4	Shorter preferred	
Avian	N								
Aquatic (fresh water)	Y	4	3	1	3	4	4		
Aquatic (marine)	N								
Wildlife migration routes (land, ocean, air)	Y	4	4	3	4	2	4		
Listed species	N								
Flora									
Terrestrial (shrubs, grasses, etc.)	Y	4	4	3	4	3	4	Scotch and Squiggly more surface disturbance due to road requirements	
Aquatic (fresh water)	Y	4	3	2	4	3	4		
Aquatic (marine)	N								
Restricted range plants	N								
Perceived Public Sensitivity		0	2	8	1	6	0		
Perceived Public Benefit		0	0	0	0	0	0		
Category Total		**20**	**18**	**12**	**19**	**14**	**20**		
Physical Environment									
Ground Water									
Availability	N								
Water quality (Normal	N								

Criteria Groups and Criteria	Assessed	Judge Sissons Lake	Kavisilik Lake	Scotch Lake	Skinny Lake	Squiggly Lake	Siamese Lake	Issue	Source of Information
conditions)									
Potential for contamination	N								
Surface Water									
Availability	Y	4	4	4	4	4	4	All have adequate recharge. Winter draw down accounted for in above points.	
Water quality (Normal conditions)	Y	4	3	2	3	4	4	This is because Dissolved oxygen levels may decrease with draw down.	
Potential for contamination	N								
Geology									
Geological substrate (various depths)	N								
Tectonics	N								
Volcanism	N								
Landscape (terrain)									
Steepness of slopes	N								
Characteristics (soils, wetlands, bogs, tundra, permafrost, bedrock)	N								
Other Physical Environment									
Air Quality	N								
Noise	M	4	4	4	4	4	4	Pumps located in pumphouse, so noise should be limited. No submersible pumps.	
Visual	Y	4	4	4	4	4	4		
Paleontological Resources	N								
Perceived Public Sensitivity		0	1	2	1	0	0		
Perceived Public Benefit		0	0	0	0	0	0		
Category Total		**16**	**15**	**14**	**15**	**16**	**16**		
Public Acceptability									
Community consultation (Opinion expressed)	Y	4	4	4	4	4	4		
Public scoping meetings (Opinion expressed)	Y	4	4	4	4	4	4		
NGO's engagement (Opinion expressed)	Y	4	4	4	4	4	4		
Perceived Public Sensitivity		0	0	0	0	0	0		
Perceived Public Benefit		0	0	0	0	0	0		
Category Total		**12**	**12**	**12**	**12**	**12**	**12**		
Total Assessment Score		98	95	85	94	89	100		

Attachment C:
Treated Effluent Discharge Alternatives Assessment

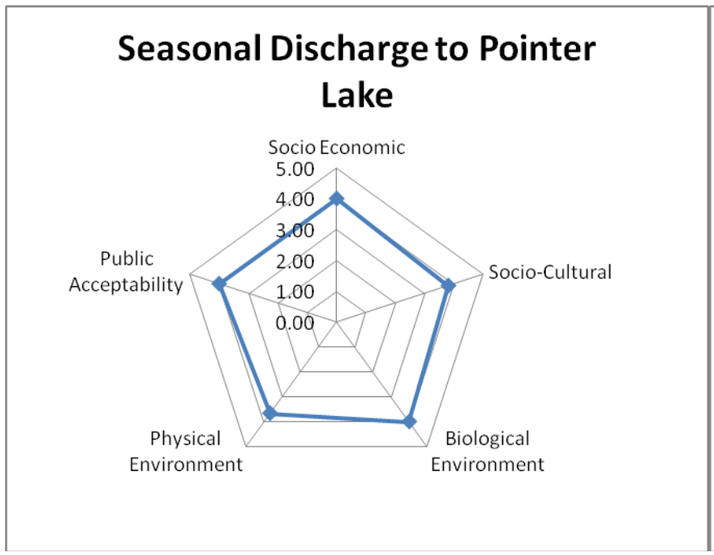
Summary

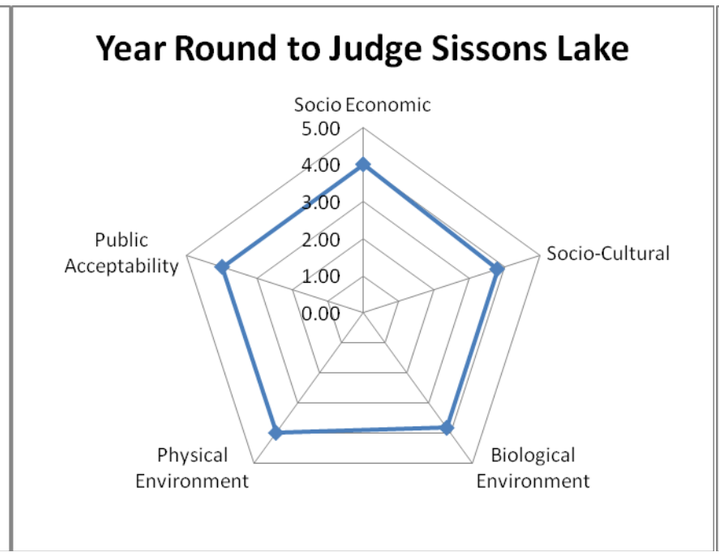
	Categories (Grouped Criteria)	Total			Socio-Economic			Socio-Cultural			Biological Environment			Physical Environment			Public Acceptability		
		Total Assessment Score	Total Perceived Public Sensitivity	Total Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit
	Number of Criteria				1			5			6			6			3		
	Alternative																		
1	Seasonal discharge to Pointer Lake	81	3	0	4	0	0	19	1	0	24	0	0	22	2	0	12	0	0
2	Year-round discharge to Sik Sik Lake with Engineered Dam	69	15	0	4	0	0	15	5	0	22	2	0	16	8	0	12	0	0
3	Year-round discharge to Judge Sissons Lake; single or dual outfall	82	2	0	4	0	0	19	1	0	23	1	0	24	0	0	12	0	0
	Total					0	0		7	0		3	0		10	0		0	0
	Average Perceived Relative Importance (Total /No. of Criteria)					0.00	0.00		1.40	0		0.50	0		1.67	0		0.00	0.00

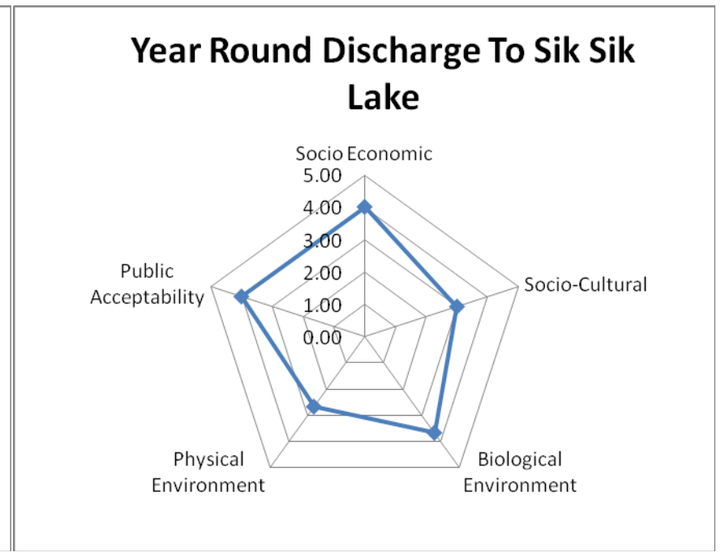
Radar Plot Averages

Option	Socio Economic	Socio-Cultural	Biological Environment	Physical Environment	Public Acceptability	Score
1	4.00	3.80	4.00	3.67	4.00	4
2	4.00	3.00	3.67	2.67	4.00	2
3	4.00	3.80	3.83	4.00	4.00	4
	Indicates best option in each category based on category averages for each option					

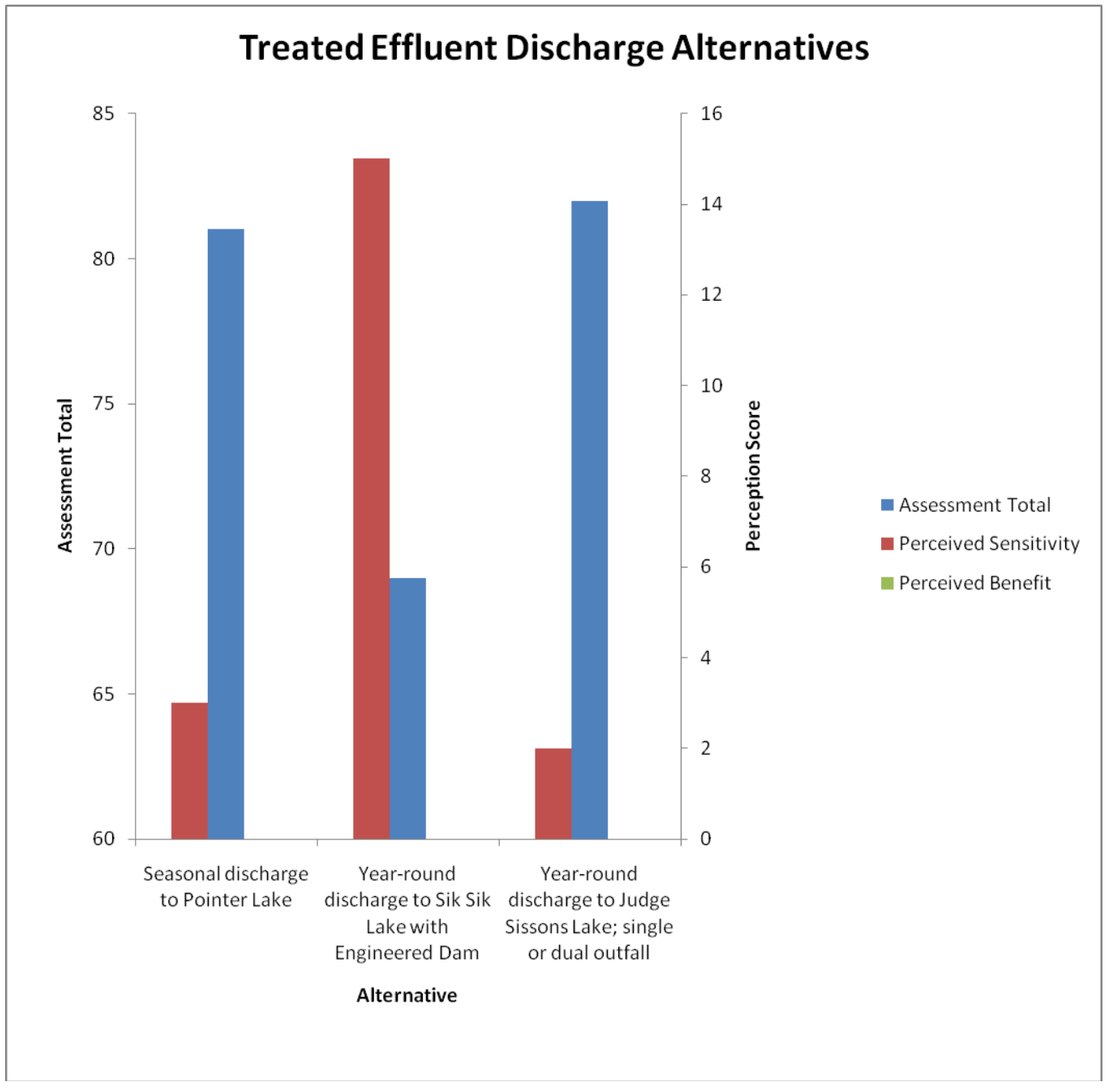
Traditional Sensitivity Analysis													
Option	Total	Rank	Excluding Socio Economic	Rank	Excluding Socio-Cultural	Rank	Excluding Biological Environment	Rank	Excluding Physical Environment	Rank	Excluding Public Acceptability	Rank	Score
1	81	2	77	2	62	2	57	2	59	1	69	2	1
2	69	3	65	3	54	3	47	3	53	3	57	3	0
3	82	1	78	1	63	1	59	1	58	2	70	1	4
	Indicates best option in each category based on total less stepwise exclusion of category totals per option.												







		Engineering/Technical							Economic			
Option		Difficulty	Rank	Risk	Rank	Schedule	Rank	Score	Capital	Operational	Score	Total Score
1	Seasonal discharge to Pointer Lake	Higher cost for monitoring ponds as higher flows. Bigger water treatment plant larger as it has a larger flow. Bigger plant 3x bigger	3	Very wet year could result in a pit storage volume issue. Pointer lake volumes not affected by high volume flows. If it was not flushed out by the freeze it would result in concentration build up in Pointer lake. Beginning and end of season management risk. Vulnerable to system variations. More chemicals need for process. More propane needed for heating, bigger building and prevent freezing of RO.	3	1 + for bigger plant	3	9	3	1.5	4.5	13.5
2	Year-round discharge to Sik Sik Lake engineered	2	2	Potential schedule 2 amendment. EC and DFO meeting. Ecological risk assessment would result in reduced flow into lake as it has small lakes below Sik Sik.	2	1	1	5	1.5	1.1	2.6	7.6
3	Year-round discharge to Judge Sissons Lake; single or dual outfall	1	1	Longer pipeline therefore potential for leak risk. Winter operation, heat tracing. Judge Sissons has greater depth, Caribou issue on longer pipeline. No thermocline in Lake, so water will not be too different from lake temperature. Less vulnerable to process variation changes than seasonal. Less chemical needed for operation.	1	1	1	3	1	1	2	5



Assignment of Values					
Negative		Perceived Public Sensitivity	Positive		Perceived Public Benefit
Unacceptable	ff				
Extreme	0	4	Major	8	4
High	1	3	High	7	3
Moderate	2	2	Moderate	6	2
Low	3	1	Low	5	1
Negligible	4	0	Negligible	4	0

Criteria Groups and Criteria	Assessment	Seasonal Discharge to Pointer Lake	Year Round Discharge to Sik Sik Lake	Year Round Discharge to Judge Sissons Lake	Issue	Source of Information
Social-Economic						
Socio-Economic						
Demographics	N					
Employment (Gate keepers and ferry operators, drivers and road maintenance)	N					
Religious Beliefs	N					
Language(s)	N					
Socio-political dynamics (e.g. caste system, tribal system)	N					
Landuse						
Housing (single family, multiple family)	N					
Schools (pre-school to secondary	N					
Graveyards	N					
Hospitals/care facilities	N					
Religious buildings (churches etc.)	N					
Recreational areas (formal parks to trails)	N					
Berry Harvesting	N					
Grazing lands - Caribou	Y	4	4	4	Spring caribou migration occurs in this area, but it is unlikely to be affected by discharge point in any lake.	
Hunting territories - Caribou	N					
Hunting territories -Musk ox	N					
Hunting marine mammals	N					
Goose hunting	N					
Egg gathering	N					
Fishing territories	N					
Ice fishing	N					
Private lands	N					
Cabins	N					
Canoeing and hunting tourism	N					
Snowmobile routes	N					
Public buildings and structures (other - libraries, government buildings, WWTP, etc.)	N					
Industrial, light Industrial, commercial, retail	N					
Maintain ingress and egress to businesses	N					

Criteria Groups and Criteria	Assessment	Seasonal Discharge to Pointer Lake	Year Round Discharge to Sik Sik Lake	Year Round Discharge to Judge Sissons Lake	Issue	Source of Information
Maintain ingress and egress to homes	N					
Perceived Public Sensitivity		0	0	0		
Perceived Public Benefit		0	0	0		
Category Total		**4**	**4**	**4**		
Social, Cultural and Regulatory Environment						
Regulatory						
Land ownership	N					
Right of ways	N					
Easements	N					
Local, regional, national land use plans Complimentary	Y	4	4	4	No conflict noted with any land use plans - Public engagement notes.	
Local, regional, national land use plans Conflict	N					
Regulator requirements and legality (compliance)	Y	3	2	4	The size of lakes will determine water quality upon discharge. Sik Sik is the smallest and Judge Sissons the largest.	
Regulator priorities or feedback (formal)	Y	4	1	4	Sik Sik Lake, requirement for dam will cause it to be listed under Schedule 2 of the MMER.	
Cultural						
Ancient burial sites	Y	4	4	3	Burial Site on the edge of Judge Sissons Lake. Figure 2 from Land and Wildlife Information.	
Archaeological Sites	N					
Historical structures and buildings	N					
Intangible Heritage (songs, dance, gathering places, other traditions)	Y	4	4	4	Area of Spiritual significance close to all three lakes. Figure 2 from Land and Wildlife Information.	
Sacred places	N					
Public Programs (museums, galleries)	N					
Perceived Public Sensitivity		1	5	1		
Perceived Public Benefit		0	0	0		
Category Total		**19**	**15**	**19**		
Biological Environment						
Fauna						
Terrestrial (mammal, rodent, etc.)	N					
Caribou	Y	4	4	4	Spring caribou migration occurs in this area, but it is unlikely to be affected by discharge point in any lake.	
Avian	?	4	4	4		
Aquatic (fresh water)	Y	4	3	4	Sik Sik is a smaller lake, so year round discharge will affect fish and also the dam will affect fish.	
Aquatic (marine)	N					
Wildlife migration routes (land, ocean, air)	Y	4	4	3	Pipelines: Judge Sissons has the longest pipeline across caribou spring migration route.	
Listed species	N					
Flora						
Terrestrial (shrubs, grasses, etc.)	Y	4	4	4		
Aquatic (fresh water)	Y	4	3	4	Sik Sik being a smaller lake will be more affected by year round discharge.	
Aquatic (marine)	N					
Restricted range plants	N					
Perceived Public Sensitivity		0	2	1		
Perceived Public Benefit		0	0	0		
Category Total		**24**	**22**	**23**		

Criteria Groups and Criteria	Assessment	Seasonal Discharge to Pointer Lake	Year Round Discharge to Sik Sik Lake	Year Round Discharge to Judge Sissons Lake	Issue	Source of Information
Physical Environment						
Ground Water						
Availability	Y	4	3	4	Requires a dam to be built in Sik Sik Lake thus affecting water availability.	
Water quality (Normal conditions)	N					
Potential for contamination	Y	4	3	4		
Surface Water						
Availability	Y	4	4	4		
Water quality (Normal conditions)	Y	3	1	4	Sik Sik being a small lake with all year round discharge will have quality affected most followed by Pointer and the Judge Sissons.	
Potential for contamination	Y	3	2	4	All systems treat water but there will be a greater inflow from a seasonal source. If anything goes wrong Sik Sik will be most affected due to size.	
Geology						
Geological substrate (various depths)	N					
Tectonics	N					
Volcanism	N					
Landscape (terrain)						
Steepness of slopes	N					
Characteristics (soils, wetlands, bogs, tundra, permafrost, bedrock)	Y	4	3	4	All year discharge into a small lake will likely have the greatest change on landscape because of potential melting and freezing periods being longer.	
Other Physical Environment						
Air Quality	N					
Noise	N					
Visual	N					
Paleontological Resources	N					
Perceived Public Sensitivity		2	8	0		
Perceived Public Benefit		0	0	0		
Category Total		**22**	**16**	**24**		
Public Acceptability						
Community consultation (Opinion expressed)	Y	4	4	4		
Public scoping meetings (Opinion expressed)	Y	4	4	4		
NGO's engagement (Opinion expressed)	Y	4	4	4		
Perceived Public Sensitivity		0	0	0		
Perceived Public Benefit		0	0	0		
Category Total		**12**	**12**	**12**		
Total Assessment Score		81	69	82		

Attachment D:
Andrew Lake Dewatering Alternatives Assessment

Summary

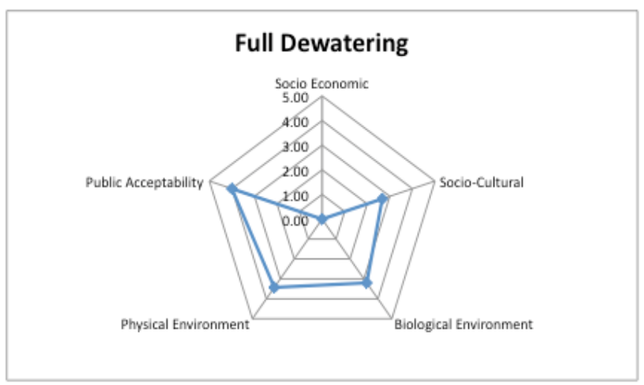
	Categories (Grouped Criteria)	Total			Socio-Economic			Socio-Cultural			Biological Environment			Physical Environment			Public Acceptability		
		Total Assessment Score	Total Perceived Public Sensitivity	Total Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit
	Number of Criteria				0			3			5			7			3		
	Alternative																		
1	Full dewatering	60	12	0	0	0	0	8	4	0	16	4	0	24	4	0	12	0	0
2	Partial dewatering (construct drainage connections)	67	5	0	0	0	0	10	2	0	18	2	0	27	1	0	12	0	0
3	Partial dewatering (maintain natural inflow/outflow)	68	4	0	0	0	0	11	1	0	18	2	0	27	1	0	12	0	0
	Total					0	0		7	0		8	0		6	0		0	0
	Average Perceived Relative Importance (Total /No. of Criteria)					0.00	0.00		2.33	0		1.60	0		0.86	0		0.00	0.00

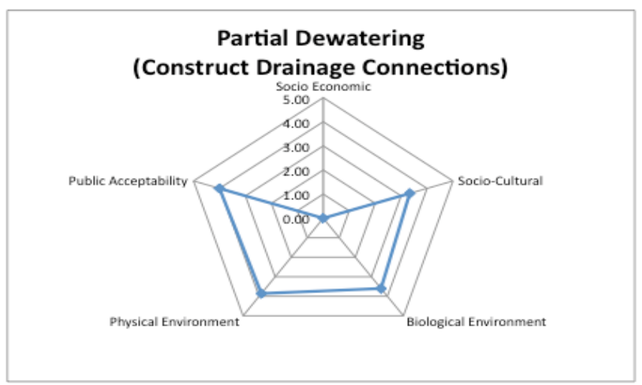
Radar Plot Averages

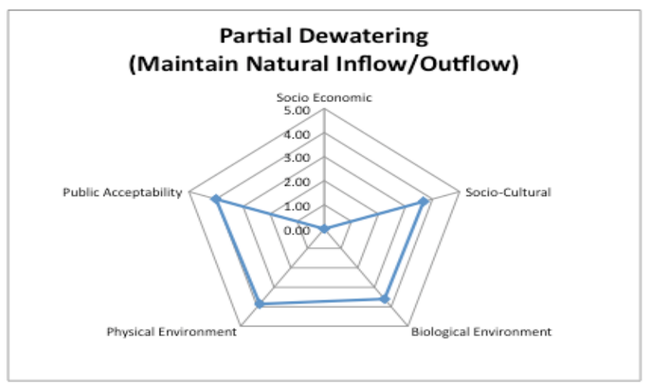
Option	Socio Economic	Socio-Cultural	Biological Environment	Physical Environment	Public Acceptability	Score
1	0.00	2.67	3.20	3.43	4.00	1
2	0.00	3.33	3.60	3.86	4.00	3
3	0.00	3.67	3.60	3.86	4.00	4
	Indicates best option in each category based on category averages for each option					

Traditional Sensitivity Analysis

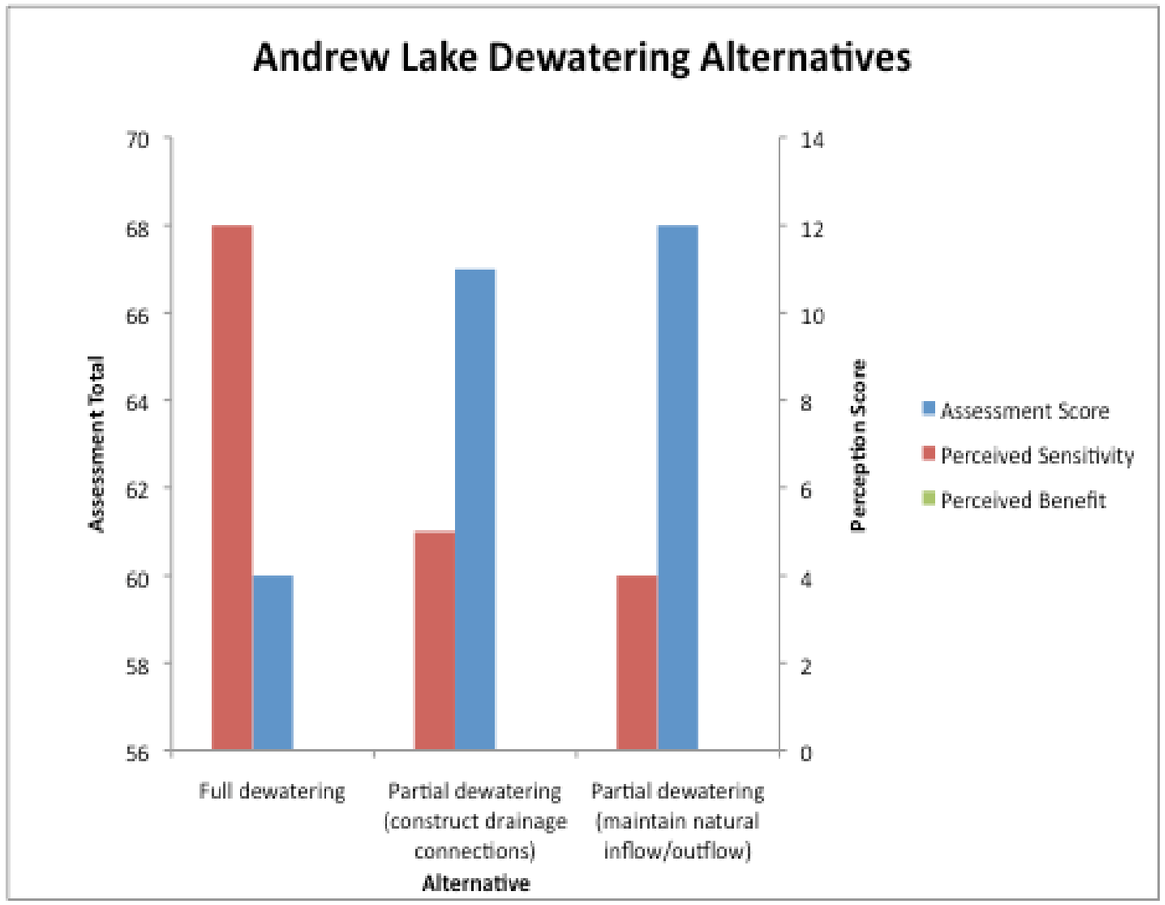
Option	Total	Rank	Excluding Socio Economic	Rank	Excluding Socio-Cultural	Rank	Excluding Biological Environment	Rank	Excluding Physical Environment	Rank	Excluding Public Acceptability	Rank	Score
1	60	3	60	3	52	2	44	3	36	3	48	3	0
2	67	2	67	2	57	1	49	2	40	2	55	2	1
3	68	1	68	1	57	1	50	1	41	1	56	1	5
	Indicates best option in each category based on total less stepwise exclusion of category totals per option.												







	Engineering/Technical				Economic		
Option	Difficulty	Risk	Schedule	Capital	Habitat CC	Operational	Score
1	0.7	0.9	1.5	0.8	2	0.3	6.2
2	0.9	1	1.2	1.1	1.5	1	6.7
3	1	1	1	1	1	1	6



Assignment of Values					
Negative		**Perceived Public Sensitivity**	**Positive**		**Perceived Public Benefit**
Unacceptable	ff				
Extreme	0	4	Major	8	4
High	1	3	High	7	3
Moderate	2	2	Moderate	6	2
Low	3	1	Low	5	1
Negligible	4	0	Negligible	4	0

Criteria Groups and Criteria	Assessment	Full dewatering	Partial dewatering (construct drainage connections)	Partial dewatering (maintain natural inflow/outflow)	Issue
Social-Economic					
Socio-Economic					
Demographics	N				
Employment (Gate keepers and ferry operators, drivers and road maintenance)	N				
Religious or spiritual beliefs	N				
Language(s)	N				
Socio-political dynamics (e.g. tribal system)	N				
Land use					
Housing (single family, multiple family)	N				
Schools (pre-school to secondary	N				
Graveyards	N				
Hospitals/care facilities	N				
Religious buildings or spiritual places	N				
Recreational areas (formal parks to trails)	N				
Berry harvesting areas	N				
Grazing lands - caribou	N				
Hunting territories -Caribou	N				
Hunting territories -Musk ox	N				
Hunting marine mammals	N				
Goose hunting	N				
Egg gathering	N				
Fishing territories	N				
Ice fishing	N				
Private lands	N				
Cabins	N				
Canoeing and hunting tourism	N				
Snowmobile routes	N				
Public buildings and structures (other - libraries, government buildings, WWTP, etc.)	N				
Industrial, light Industrial, commercial, retail	N				
Maintain ingress and egress to businesses	N				
Maintain ingress and egress to homes	N				
Perceived Public Sensitivity		0	0	0	
Perceived Public Benefit		0	0	0	
Category Total		**0**	**0**	**0**	
Social, Cultural and Regulatory Environment					
Regulatory					
Land ownership	N				
Right of ways	N				
Easements	N				
Local, regional, national land use plans complimentary	Y	4	4	4	
Local, regional, national land use plans conflict	N				
Regulator requirements and legality (compliance)	Y	2	3	3	
Regulator priorities or feedback (formal)	Y	2	3	4	Natural outlets preferred.
Cultural					
Ancient burial sites	N				
Archaeological sites	N				
Historical structures and buildings	N				
Intangible heritage (songs, dance, gathering places, other traditions)	N				
Sacred places	N				
Public Programs (museums, galleries)	N				
Perceived Public Sensitivity		4	2	1	

Criteria Groups and Criteria	Assessment	Full dewatering	Partial dewatering (construct drainage connections)	Partial dewatering (maintain natural inflow/outflow)	Issue
Perceived Public Benefit		0	0	0	
Category Total		**8**	**10**	**11**	
Biological Environment					
Fauna					
Terrestrial (mammal, rodent, etc.)	Y	4	4	4	
Caribou	N				
Avian	Y	4	4	4	
Aquatic (fresh water)	Y	2	3	3	
Aquatic (marine)	N				
Wildlife migration routes (land, ocean, air)	N				
Listed species	N				
Flora					
Terrestrial (shrubs, grasses, etc.)	Y	4	4	4	
Aquatic (fresh water)	Y	2	3	3	
Aquatic (marine)	N				
Restricted range plants	N				
Perceived Public Sensitivity		4	2	2	
Perceived Public Benefit		0	0	0	
Category Total		**16**	**18**	**18**	
Physical Environment					
Ground Water					
Availability	N				
Water quality (Normal conditions)	N				
Potential for contamination	N				
Surface Water					
Availability	Y	3	4	4	
Water quality (Normal conditions)	Y	3	3	3	
Potential for contamination	Y	4	4	4	
Geology					
Geological substrate (various depths)	N				
Tectonics and seismicity	N				
Volcanism	N				
Landscape (Terrain)					
Steepness of slopes	N				
Characteristics (soils, wetlands, bogs, tundra, permafrost, bedrock)	Y	3	4	4	
Other Physical Environment					
Air quality	Y	4	4	4	
Noise	Y	4	4	4	
Visual	Y	3	4	4	
Paleontological resources	N				
Perceived Public Sensitivity		4	1	1	
Perceived Public Benefit		0	0	0	
Category Total		**24**	**27**	**27**	
Public Acceptability					
Community consultation (Opinion expressed)	Y	4	4	4	
Public scoping meetings (Opinion expressed)	Y	4	4	4	
NGO's (Opinion expressed)	Y	4	4	4	
Perceived Public Sensitivity		0	0	0	
Perceived Public Benefit		0	0	0	
Category Total		**12**	**12**	**12**	
Total Assessment Score		60	67	68	

Attachement E:
Mill Location Alternatives Assessment

	Categories (Grouped Criteria)	Total			Socio-Economic			Socio-Cultural			Biological Environment			Physical Environment			Public Acceptability		
		Total Assessment Score	Total Perceived Public Sensitivity	Total Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit
	Number of Criteria				5			2			4			4			3		
	Alternative																		
1	Kiggavik	61	11	0	16	4	0	8	0	0	13	3	0	12	4	0	12	0	0
2	Sissons	60	12	0	16	4	0	8	0	0	13	3	0	11	5	0	12	0	0
	Total					8	0		0	0		6	0		9	0		0	0
	Average Perceived Relative Importance (Total /No. of Criteria)					1.60	0.00		0.00	0		1.50	0		2.25	0		0.00	0.00

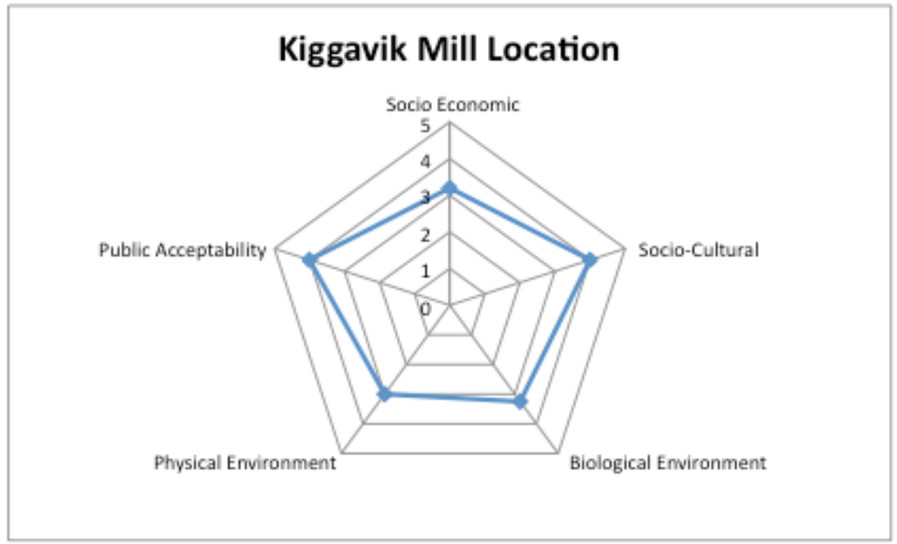
Radar Plot Averages

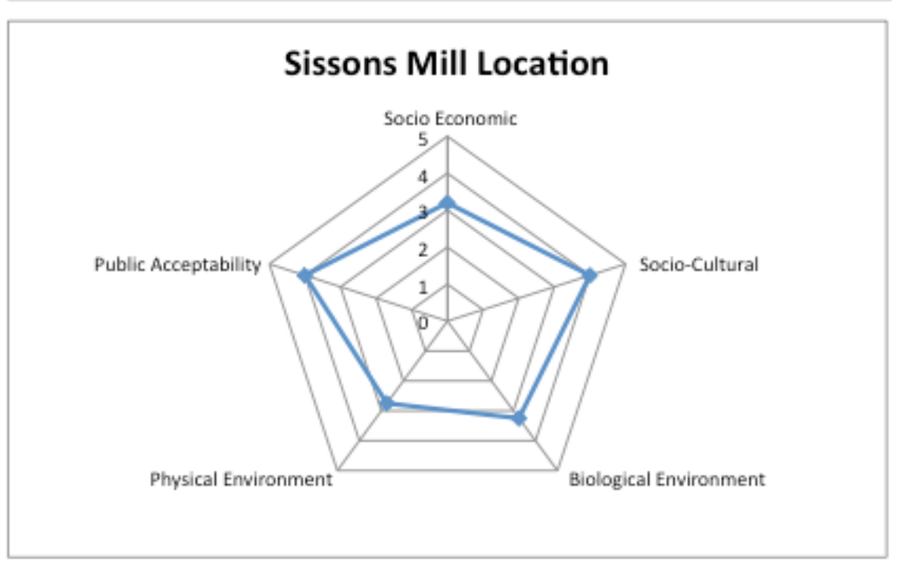
Option	Socio Economic	Socio-Cultural	Biological Environment	Physical Environment	Public Acceptability	Score
Kiggavik	3.20	4.00	3.25	3.00	4.00	5
Sissons	3.20	4.00	3.25	2.75	4.00	4
	Indicates best option in each category based on category averages for each option					

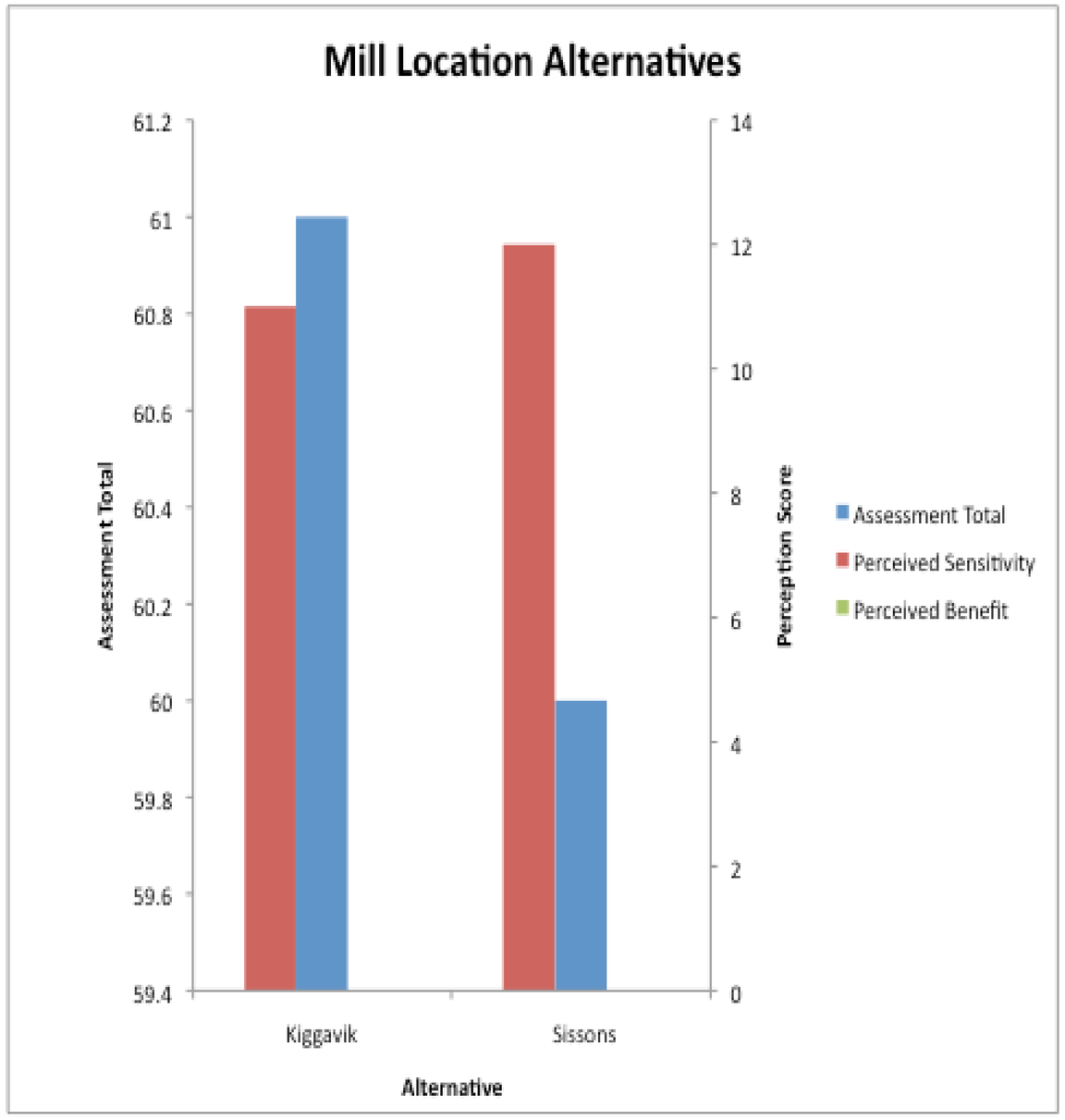
Traditional Sensitivity Analysis

Option	Total	Rank	Excluding Socio Economic	Rank	Excluding Socio-Cultural	Rank	Excluding Biological Environment	Rank	Excluding Physical Environment	Rank	Excluding Public Acceptability	Rank	Score
1	61	1	45	1	53	1	48	1	49	1	49	1	5
2	60	2	44	2	52	2	47	2	49	1	48	2	1
	Indicates best option in each category based on total less stepwise exclusion of category totals per option.												

	Engineering/Technical							Economic			
Option	Difficulty	Rank	Risk	Rank	Schedule	Rank	Score	Capital	Operational	Score	Total
Kiggavik	Close to water source.	1		1	Approval of TMF more rapid.	1	3	1	1	2	5
Sissons	Distance to fresh water source.	2	Potential for contamination.	2	Additional interim TMF required in purpose built pit, or temporary TMF and then redeposit into Andrew Lake pit.	2	6	1.5	1.3	2.8	8.8


Kiggavik Mill Location
Socio Economic
5
4
3
2
1
0
Socio-Cultural
Biological Environment
Physical Environment
Public Acceptability


Sissons Mill Location
Socio Economic
5
4
3
2
1
0
Socio-Cultural
Biological Environment
Physical Environment
Public Acceptability


Mill Location Alternatives
61.2
61
60.8
60.6
60.4
60.2
60
59.8
59.6
59.4
14
12
10
8
6
4
2
0
Assessment Total
Perceived Sensitivity
Perceived Benefit
Kiggavik
Sissons
Alternative

Assignment of Values					
Negative		**Perceived Public Sensitivity**	**Positive**		**Perceived Public Benefit**
Unacceptable	ff				
Extreme	0	4	Major	8	4
High	1	3	High	7	3
Moderate	2	2	Moderate	6	2
Low	3	1	Low	5	1
Negligible	4	0	Negligible	4	0

Criteria Groups and Criteria	Assessed	Kiggavik	Sissons	Issue
Social-Economic				
Socio-Economic				
Demographics	N			
Employment (Gate keepers and ferry operators, drivers and road maintenance)	Y	4	4	
Religious or spiritual beliefs	N			
Language(s)	N			
Socio-political dynamics (e.g. tribal system)	N			
Land use				
Housing (single family, multiple family)	N			
Schools (pre-school to secondary	N			
Graveyards	N			
Hospitals/care facilities	N			
Religious buildings or spiritual places	N			
Recreational areas (formal parks to trails)	N			
Berry harvesting areas	N			
Grazing lands - caribou	Y	2	2	
Hunting territories -Caribou	M	3	3	
Hunting territories -Musk ox	M	3	3	
Hunting marine mammals	N			
Goose hunting	N			
Egg gathering	N			
Fishing territories	N			
Ice fishing	N			
Private lands	N			
Cabins	N			
Canoeing and hunting tourism	N			
Snowmobile routes	M	4	4	
Public buildings and structures (other - libraries, government buildings, WWTP, etc.)	N			
Industrial, light Industrial, commercial, retail	N			
Maintain ingress and egress to businesses	N			
Maintain ingress and egress to homes	N			
Perceived Public Sensitivity		4	4	
Perceived Public Benefit		0	0	
Category Total		**16**	**16**	
Social, Cultural and Regulatory Environment				
Regulatory				
Land ownership	N			
Right of ways	N			
Easements	N			
Local, regional, national land use plans complimentary	Y	4	4	
Local, regional, national land use plans conflict	N			
Regulator requirements and legality (compliance)	Y	4	4	
Regulator priorities or feedback (formal)	N			
Cultural				
Ancient burial sites	N			
Archaeological sites	N			
Historical structures and buildings	N			
Intangible heritage (songs, dance, gathering places, other traditions)	N			
Sacred places	N			
Public Programs (museums, galleries)	N			
Perceived Public Sensitivity		0	0	
Perceived Public Benefit		0	0	
Category Total		**8**	**8**	

Criteria Groups and Criteria	Assessed	Kiggavik	Sissons	Issue
Biological Environment				
Fauna				
Terrestrial (mammal, rodent, etc.)	Y	3	3	
Caribou	Y	3	3	
Avian	M			
Aquatic (fresh water)	N			Major consumer of fresh water. Analysis in fresh water alternatives. Read the two sheets together.
Aquatic (marine)	N			
Wildlife migration routes (land, ocean, air)	Y	3	3	
Listed species	N			
Flora				
Terrestrial (shrubs, grasses, etc.)	Y	4	4	
Aquatic (fresh water)	N			
Aquatic (marine)	N			
Restricted range plants	N			
Perceived Public Sensitivity		3	3	
Perceived Public Benefit		0	0	
Category Total		**13**	**13**	
Physical Environment				
Ground Water				
Availability	N			
Water quality (Normal conditions)	N			
Potential for contamination	N			
Surface Water				
Availability	N			
Water quality (Normal conditions)	N			
Potential for contamination	Y	3	2	
Geology				
Geological substrate (various depths)	N			
Tectonics and seismicity	N			
Volcanism	N			
Landscape (Terrain)				
Steepness of slopes	N			
Characteristics (landforms, soils, wetlands, bogs, tundra, permafrost, bedrock)	N			
Other Physical Environment				
Air quality	Y	3	3	
Noise	Y	3	3	
Visual	Y	3	3	
Paleontological resources	N			
Perceived Public Sensitivity		4	5	
Perceived Public Benefit		0	0	
Category Total		**12**	**11**	
Public Acceptability				
Community consultation (Opinion expressed)	Y	4	4	
Public scoping meetings (Opinion expressed)	Y	4	4	
NGO's engagement (Opinion expressed)	Y	4	4	
Perceived Public Sensitivity		0	0	
Perceived Public Benefit		0	0	
Category Total		**12**	**12**	
Total Assessment Score		61	60	

Attachment F:
Tailings Disposal Alternatives Assessment

Summary

Categories (Grouped Criteria)	Total			Socio-Economic			Socio-Cultural			Biological Environment			Physical Environment			Public Acceptability		
	Total Assessment Score	Total Perceived Public Sensitivity	Total Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit
Number of Criteria				0			3			2			7			2		
Alternative																		
East zone becomes water pit, expanded centre zone becomes 1st TMF, main zone becomes 2nd TMF.	43	13	0	0	0	0	11	1	0	4	4	0	20	8	0	8	0	0
East zone becomes 1st TMF, purpose built pit, expanded centre zone for 2nd TMF, main zone becomes 3rd TMF.	52	4	0	0	0	0	12	0	0	6	2	0	26	2	0	8	0	0
Total					0	0		1	0		6	0		10	0		0	0
Average Perceived Relative Importance (Total /No. of Criteria)					0.00	0.00		0.33	0		3.00	0		1.43	0		0.00	0.00

Traditional Sensitivity Analysis

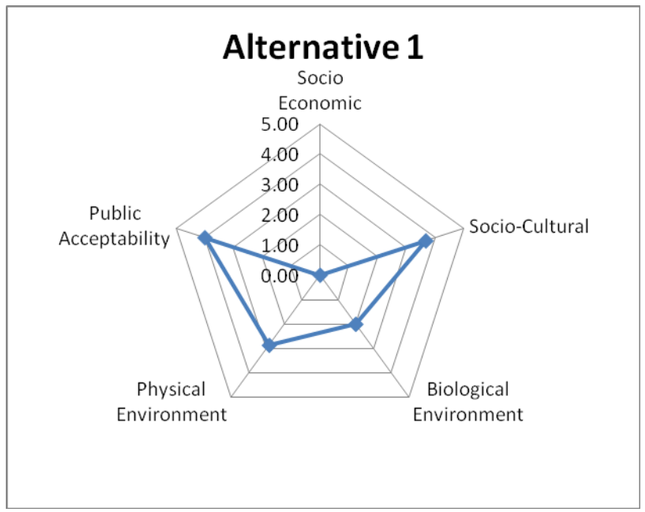
Option	Total	Rank	Excluding Socio Economic	Rank	Excluding Socio-Cultural	Rank	Excluding Biological Environment	Rank	Excluding Physical Environment	Rank	Excluding Public Acceptability	Rank	Score
1	43	3	43	3	32	3	39	3	23	2	35	3	0
2	52	1	52	1	40	1	46	1	26	1	44	1	5

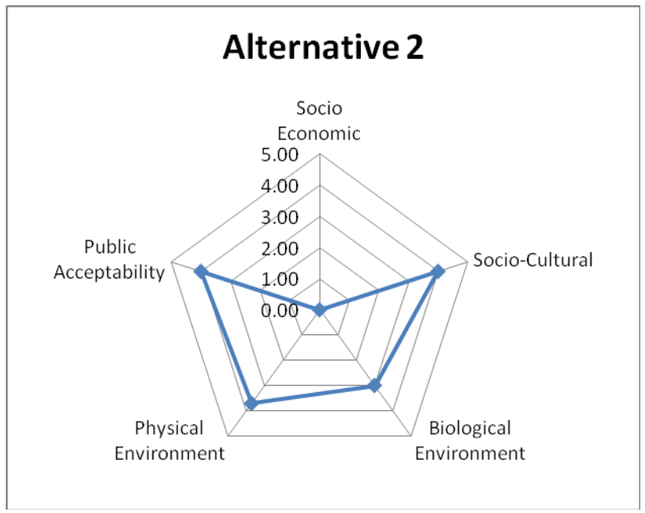
Indicates best option in each category based on total less stepwise exclusion of category totals per option.

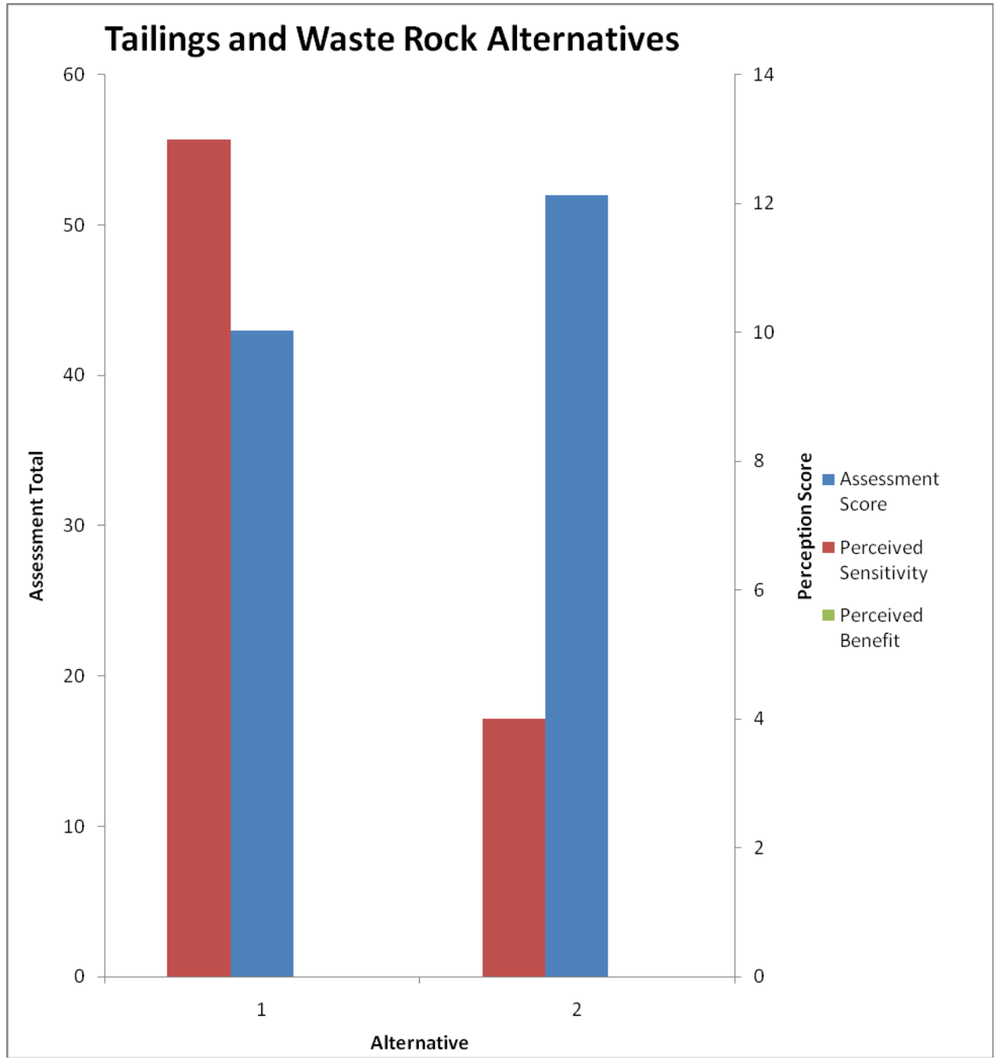
Radar Plot Averages

Option	Socio Economic	Socio-Cultural	Biological Environment	Physical Environment	Public Acceptability	Score
Alternative 1	0.00	3.67	2.00	2.86	4.00	1
Alternative 2	0.00	4.00	3.00	3.71	4.00	4

Indicates best option in each category based on category averages for each option


Alternative 1
Socio Economic
5.00
4.00
3.00
2.00
1.00
0.00
Socio-Cultural
Biological Environment
Physical Environment
Public Acceptability


Alternative 2
Socio Economic
5.00
4.00
3.00
2.00
1.00
0.00
Socio-Cultural
Biological Environment
Physical Environment
Public Acceptability


Tailings and Waste Rock Alternatives
Assessment Total
Perception Score
60
50
40
30
20
10
0
14
12
10
8
6
4
2
0
1
2
Alternative
Assessment Score
Perceived Sensitivity
Perceived Benefit

Assignment of Values					
Negative		Perceived Public Sensitivity	Positive		Perceived Public Benefit
Unacceptable	ff				
Extreme	0	4	Major	8	4
High	1	3	High	7	3
Moderate	2	2	Moderate	6	2
Low	3	1	Low	5	1
Negligible	4	0	Negligible	4	0

Criteria Groups and Criteria	Assessment	East zone becomes water pit, expanded centre zone becomes 1st TMF, main zone becomes 2nd TMF.	East zone becomes 1st TMF, purpose built pit, expanded centre zone for 2nd TMF, main zone becomes 3rd TMF.	Issue	Source of Information
Social-Economic					
Socio-Economic					
Demographics	N				
Employment (Gate keepers and ferry operators, drivers and road maintenance)	N				
Religious Beliefs	N				
Language(s)	N				
Socio-political dynamics (e.g. caste system, tribal system)	N				
Landuse					
Housing (single family, multiple family)	N				
Schools (pre-school to secondary	N				
Graveyards	N				
Hospitals/care facilities	N				
Religious buildings (churches etc)	N				
Recreational areas (formal parks to trails)	N				
Berry Harvesting	N				
Grazing lands - caribou	N				
Hunting territories -Caribou	N				
Hunting territories -Musk ox	N				
Hunting marine mammals	N				
Goose hunting	N				
Egg gathering	N				
Fishing territories	N				
Ice fishing	N				
Private lands	N				
Cabins	N				
Canoeing and hunting tourism	N				
Snowmobile routes	N				
Public buildings and structures (other - libraries, government buildings, WWTP, etc.)	N				
Industrial, light Industrial, commercial, retail	N				
Maintain ingress and egress to businesses	N				
Maintain ingress and egress to homes	N				
Perceived Public Sensitivity		0	0		
Perceived Public Benefit		0	0		
Category Total		**0**	**0**		

Criteria Groups and Criteria	Assessment	East zone becomes water pit, expanded centre zone becomes 1st TMF, main zone becomes 2nd TMF.	East zone becomes 1st TMF, purpose built pit, expanded centre zone for 2nd TMF, main zone becomes 3rd TMF.	Issue	Source of Information
Social, Cultural and Regulatory Environment					
Regulatory					
Land ownership	N				
Right of ways	N				
Easements	N				
Local, regional, national land use plans Complimentary	N				
Local, regional, national land use plans Conflict	Y	3	4	1. Starts slowly and 3. consumes more land. Slow development and larger impact inferred.	
Regulator requirements and legality (compliance)	Y	4	4	3. Has the largest foot print.	
Regulator priorities or feedback (formal)	Y	4	4	NIRB and CNSC require conformance with guidelines.	
Cultural					
Ancient burial sites	N				
Archaeological Sites	N				
Historical structures and buildings	N				
Intangible Heritage (songs, dance, gathering places, other traditions)	N				
Sacred places	N				
Public Programs (museums, galleries)	N				
Perceived Public Sensitivity		1	0		
Perceived Public Benefit		0	0		
Category Total		**11**	**12**		
Biological Environment					
Fauna					
Terrestrial (mammal, rodent, etc.)	Y	2	3	1. Has the potential to be short of space, 3. Has the largest foot print.	
Caribou	N				
Avian	N				
Aquatic (fresh water)	N				
Aquatic (marine)	N				
Wildlife migration routes (land, ocean, air)	N				
Listed species	N				
Flora					
Terrestrial (shrubs, grasses, etc.)	Y	2	3	1. Has the potential to be short of space, 3. Has the largest foot print.	
Aquatic (fresh water)	N				
Aquatic (marine)	N				
Restricted range plants	N				
Perceived Public Sensitivity		4	2		
Perceived Public Benefit		0	0		
Category Total		**4**	**6**		
Physical Environment					
Ground Water					
Availability	N				
Water quality (Normal conditions)	N				
Potential for contamination	Y	2	3	1. Will be potentially have a shortage of space, 3. Has more distributed sources which could leak.	

Criteria Groups and Criteria	Assessment	East zone becomes water pit, expanded centre zone becomes 1st TMF, main zone becomes 2nd TMF.	East zone becomes 1st TMF, purpose built pit, expanded centre zone for 2nd TMF, main zone becomes 3rd TMF.	Issue	Source of Information
Surface Water					
Availability	N				
Water quality (Normal conditions)	N				
Potential for contamination	Y	2	3	1. May be built vertically for capacity therefore potential for surface water contamination.	
Geology					
Geological substrate (various depths)	Y	4	4		
Tectonics	N				
Volcanism	N				
Landscape (terrain)					
Steepness of slopes	Y	3	4	1. May be built vertically for capacity therefore more slope change.	
Characteristics (soils, wetlands, bogs, tundra, permafrost, bedrock)	Y	3	4	1. May be built vertically for capacity therefore most likely to have change to landscape.	
Other Physical Environment					
Air Quality	Y	3	4	1. May be built vertically for capacity therefore more likely to liberate material in wind.	
Noise	N				
Visual	Y	3	4	1. May be built vertically for capacity therefore most likely to have change to landscape.	
Paleontological Resources					
Perceived Public Sensitivity		8	2		
Perceived Public Benefit		0	0		
Category Total		**20**	**26**		
Public Acceptability					
Community consultation (Opinion expressed)	Y	4	4		
Public scoping meetings (Opinion expressed)	Y	4	4	Compliance with guidelines required.	
NGO's engagement (Opinion expressed)	N				
Perceived Public Sensitivity		0	0		
Perceived Public Benefit		0	0		
Category Total		**8**	**8**		
Total Assessment Score		43	52		

Attachment G:
Access Road Alternatives Assessment

Summary

Categories (Grouped Criteria)	Total			Socio-Economic			Socio-Cultural			Biological Environment			Physical Environment			Public Acceptability		
	Total Assessment Score	Total Perceived Public Sensitivity	Total Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit
Number of Criteria				14			8			8			8			3		
Alternative																		
North All Season Road With Bridge	151	22	9	59	4	7	29	4	1	24	8	0	27	5	0	12	1	1
North All Season Road With Ferry	151	20	7	56	5	5	30	3	1	26	6	0	27	5	0	12	1	1
Winter Road North Route	163	5	4	58	1	3	32	1	1	30	2	0	31	1	0	12	0	0
Winter Road South Route	162	6	4	58	1	3	32	1	1	31	1	0	29	3	0	12	0	0
South All Season Road	145	20	1	50	7	1	30	2	0	28	4	0	29	3	0	8	4	0
Total					18	19		11	4		21	0		17	0		6	2
Average Perceived Relative Importance (Total /No. of Criteria)					1.29	1.36		1.38	0.5		2.63	0		2.13	0		2.00	0.67

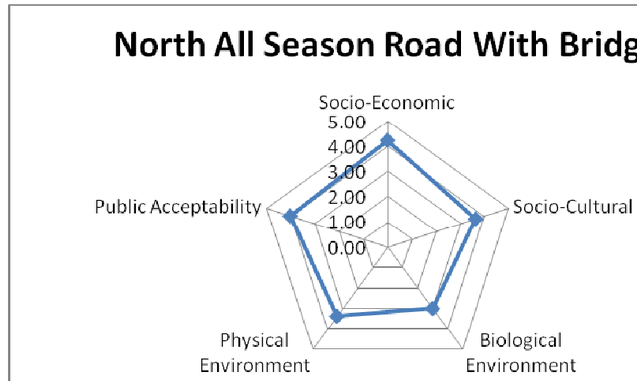
Radar Plot Averages

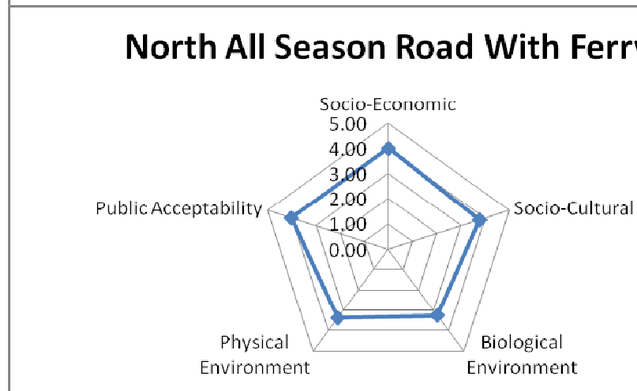
Option	Socio Economic	Socio-Cultural	Biological Environment	Physical Environment	Public Acceptability	Score
1	4.21	3.63	3.00	3.38	4.00	2
2	4.00	3.75	3.25	3.38	4.00	1
3	4.14	4.00	3.75	3.88	4.00	3
4	4.14	4.00	3.88	3.63	4.00	3
5	3.57	3.75	3.50	3.63	2.67	0
	Indicates best option in each category based on category averages for each option					

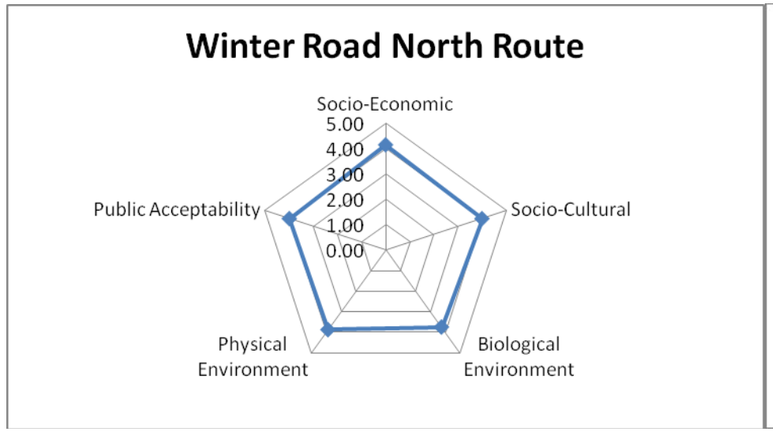
Traditional Sensitivity Analysis

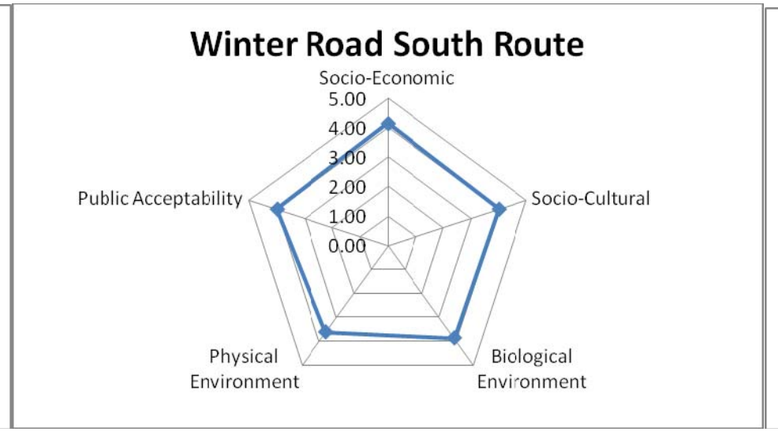
Option	Total	Rank	Excluding Socio Economic	Rank	Excluding Socio-Cultural	Rank	Excluding Biological Environment	Rank	Excluding Physical Environment	Rank	Excluding Public Acceptability	Rank	Score
1	151	3	92	4	122	3	127	3	124	3	139	3	0
2	151	3	95	3	121	4	125	4	124	3	139	3	0
3	163	1	105	1	131	1	133	1	132	2	151	1	3
4	162	2	104	2	130	2	131	2	133	1	150	2	1
5	145	4	95	3	115	5	117	5	116	4	137	4	0

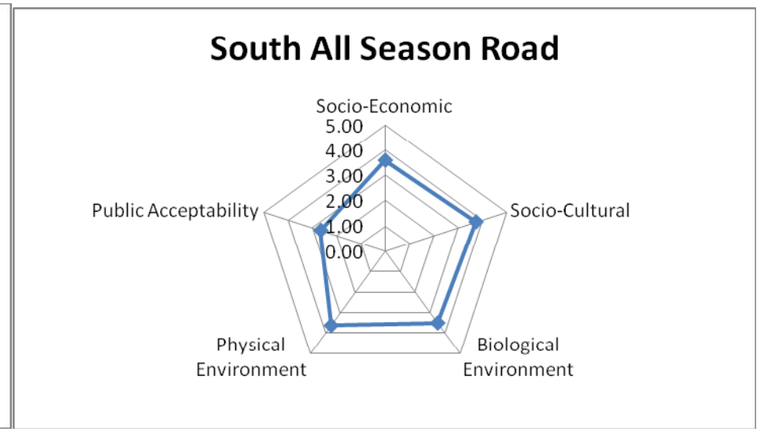
Indicates best option in each category based on total less stepwise exclusion of category totals per option.



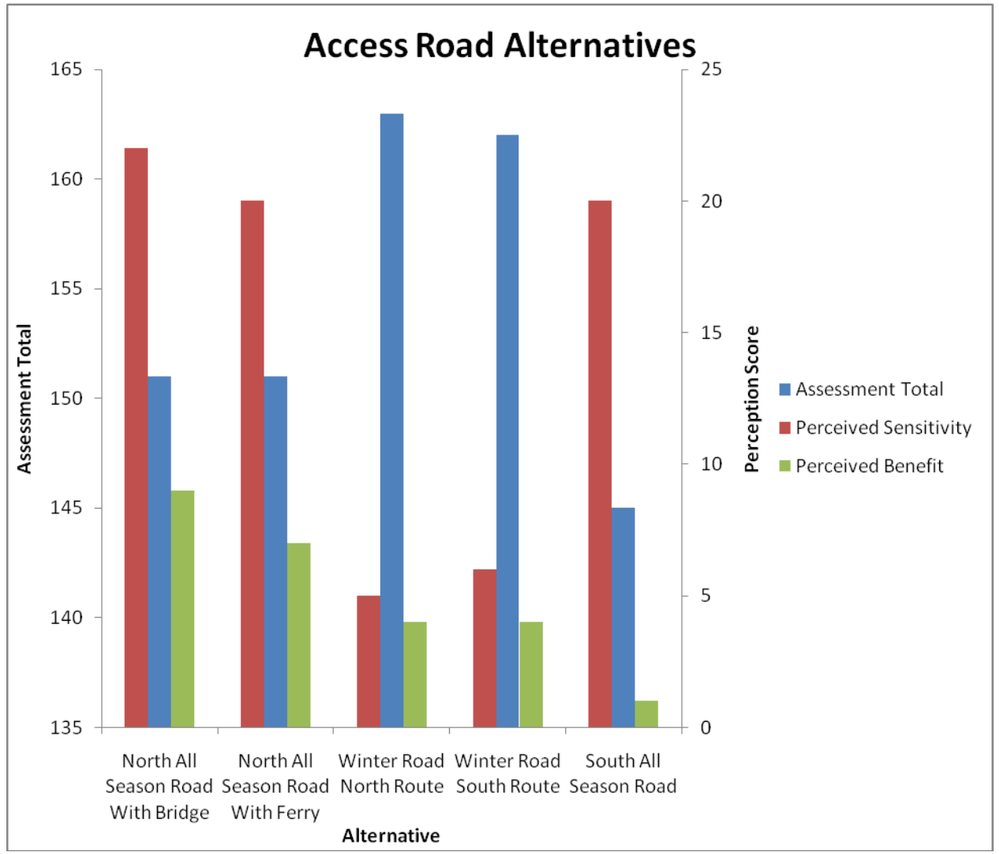








		Engineering/Technical			Economic			
Option		Difficulty	Risk	Schedule	Capital	Operational	Closure	Score
1	North All Season Road With Bridge	3	0.8	2	1.7	0.5	3	11
2	North All Season Road With Ferry	2	1	1.5	1.2	0.8	1.5	8
3	Winter Road North Route	1.5	1	1	1	1	1	6.5
4	Winter Road South Route	1	1	1	1	1	1	6
5	South All Season Road	1.5	1.2	1.5	1.2	1	1	7.4


Access Road Alternatives
Assessment Total
Perception Score
165
160
155
150
145
140
135
25
20
15
10
5
0
Assessment Total
Perceived Sensitivity
Perceived Benefit
North All Season Road With Bridge
North All Season Road With Ferry
Winter Road North Route
Winter Road South Route
South All Season Road
Alternative

Assignment of Values					
Negative		Perceived Public Sensitivity	Positive		Perceived Public Benefit
Unacceptable	ff				
Extreme	0	4	Major	8	4
High	1	3	High	7	3
Moderate	2	2	Moderate	6	2
Low	3	1	Low	5	1
Negligible	4	0	Negligible	4	0

Alternatives Evaluation

Criteria Groups and Criteria	Assessed	Assessment	Alternative 2	Assessment	Alternative 3	Assessment	Alternative 4	Assessment	Alternative 5	Assessment	Issue	Source of Information
Social-Economic												
Socio-Economic												
Demographics	N		N		N		N		N			
Employment (Gate keepers and ferry operators, drivers and road maintenance)	Y	5	Y	6	Y	7	Y	7	Y	5		
Religious Beliefs	N		N		N		N		N			
Language(s)	N		N		N		N		N			
Socio-political dynamics (e.g. caste system, tribal system)	M	4	M	4	M	4	M	4	M	4		
Landuse												
Housing (single family, multiple family)	N		N		N		N		N			
Schools (pre-school to secondary	N		N		N		N		N			
Graveyards	N		N		N		N		N			
Hospitals/care facilities	N		N		N		N		N			
Religious buildings (churches etc.)	N		N		N		N		N			
Recreational areas (formal parks to trails)	Y	3	Y	3	Y	4	Y	4	Y	2	South shore has many cabins	
Berry Harvesting	Y	4	Y	4	Y	4	Y	4	Y	4		
Grazing lands - caribou	Y	3	Y	3	Y	3	Y	3	Y	3		
Hunting territories -Caribou	Y	6	Y	5	Y	4	Y	4	Y	4	Bridge will increase access, ferry will restrict access to ferry point.	
Hunting territories -Musk ox	Y	6	Y	5	Y	4	Y	4	Y	4	Bridge will increase access, ferry will restrict access to ferry point.	
Hunting marine mammals	-		-		-		-		-			
Goose hunting	Y	4	Y	4	Y	4	Y	4	Y	2		
Egg gathering	Y	4	Y	4	Y	4	Y	4	Y	4		
Fishing territories	Y	6	Y	5	Y	4	Y	4	Y	2		
Ice fishing	N		N		N		N		N			
Private lands	N		N		N		N		N			
Cabins	Y	4	Y	4	Y	4	Y	4	Y	4		
Canoeing and hunting tourism	Y	4	Y	3	Y	4	Y	4	Y	4	Ferry cable interferes with access, South shore route has minimal tourism	
Snowmobile routes	Y	3	Y	3	Y	4	Y	4	Y	4		
Public buildings and structures (other - libraries, government buildings, WWTP, etc.)	N		N		N		N		N			
Industrial, light Industrial, commercial, retail	N		N		N		N		N			
Maintain ingress and egress to businesses	Y	3	Y	3	Y	4		4	Y	4		
Maintain ingress and egress to homes	N		N		N		N		N			
Perceived Public Sensitivity		4		5		1		1		7		
Perceived Public Benefit		7		5		3		3		1		
Category Total		**59**		**56**		**58**		**58**		**50**		

Social, Cultural and Regulatory Environment												
Regulatory												
Land ownership	N		N		N		N		N			
Right of ways	Y	4	Y	4	Y	4	Y	4	Y	4		
Easements	Y	4	Y	4	Y	4	Y	4	Y	4		
Local, regional, national land use plans Complimentary	Y	5	Y	5	Y	4	Y	4	Y	4	Thelon Planning document wants a road to the area	
Local, regional, national land use plans Conflict	N		N		N		N		N			
Regulator requirements and legality (compliance)	Y	4	Y	4	Y	4	Y	4	Y	4		
Regulator priorities or feedback (formal)	M	3	M	4	Y	5	M	5	M	4	Regulatory feedback on draft guidelines	
Cultural												
Ancient burial sites	N		N		N		N		N		Planning has avoided known sites	
Archaeological Sites	Y	3	Y	3	Y	4	Y	4	Y	3		
Historical structures and buildings	N		N		N		N		N			
Intangible Heritage (songs, dance, gathering places, other traditions)	Y	3	Y	3	Y	4	Y	4	Y	4	Thelon claimed as a heritage river with cultural value	NIRB guideline comments
Sacred places	M	3	M	3	M	3	M	3	Y	3	Thelon and IQ maps	
Public Programs (museums, galleries)	N		N		N		N		N			
Perceived Public Sensitivity		4		3		1		1		2		
Perceived Public Benefit		1		1		1		1		0		
Category Total		**29**		**30**		**32**		**32**		**30**		
Biological Environment												
Fauna												
Terrestrial (mammal, rodent, etc.)	Y	3	Y	3	Y	4	Y	4	Y	4	Grizzlies and wolverines	Terrestrial wildlife impact assessment; Public consultation
Caribou	Y	2	Y	2	Y	3	Y	4	Y	3	Caribou herds affected by increased hunting by easier access, loss of food due to dust, habitat loss, Caribou use routings to water repeatedly.	
Avian	Y	2	Y	3	Y	4	Y	4	Y	3	Peregrine nest displacement in North Road; Goose nesting area in south, south road borrow sites affect raptor sites	Memo from wildlife consultant in terrestrial wildlife impact assessment
Aquatic (fresh water)	Y	4	Y	4	Y	3	Y	3	Y	4	Under ice withdrawal of water and water crossings; less information on south route.	Aquatic biology impact assessment
Aquatic (marine)	N		N		N		N		N			
Wildlife migration routes (land, ocean, air)	Y	4	Y	4	Y	4	Y	4	Y	4	Caribou and migratory birds	Terrestrial wildlife impact assessment
Listed species	Y	2	Y	3	Y	4	Y	4	Y	3	Peregrine falcon, wolverine and grizzly	
Flora												
Terrestrial (shrubs, grasses, etc.)	Y	3	Y	3	Y	4	Y	4	Y	3		
Aquatic (fresh water)	Y	4	Y	4	Y	4	Y	4	Y	4	At crossings	
Aquatic (marine)												
Restricted range plants	N		N		N		N		N			
Perceived Public Sensitivity		8		6		2		1		4		
Perceived Public Benefit		0		0		0		0		0		
Category Total		**24**		**26**		**30**		**31**		**28**		
Physical Environment												
Ground Water												
Availability	N		N		N		N		N			
Water quality (Normal conditions)	N		N		N		N		N			
Potential for contamination	N		N		N		N		N			
Surface Water												
Availability	N		N		N		N		N		Water only withdrawn for winter road	

Water quality (Normal conditions)	Y	4	Y	4	Y	4	Y	4	Y	4		
Potential for contamination	Y	3	Y	2	Y	3	Y	3	Y	3		
Geology												
Geological substrate (various depths)	Y	4	Y	4	Y	4	Y	4	Y	4	Borrow sites	
Tectonics												
Volcanism												
Landscape (terrain)												
Steepness of slopes	Y	4	Y	4	Y	4	Y	4	Y	4		
Characteristics (soils, wetlands, bogs, tundra, permafrost, bedrock)	Y	4	Y	4	Y	4	Y	4	Y	4		
Other Physical Environment												
Air Quality	Y	3	Y	3	Y	4	Y	4	Y	3	Dust and vehicle emissions	
Noise	Y	3	Y	3	Y	4	Y	3	Y	3	Disturbance to caribou	Terrestrial wildlife assessment
Visual	Y	2	Y	3	Y	4	Y	3	Y	4	Road visible due to dust	Air dispersion modeling
Paleontological Resources	N		N		N		N		N			
Perceived Public Sensitivity		5		5		1		3		3		
Perceived Public Benefit		0		0		0		0		0		
Category Total		**27**		**27**		**31**		**29**		**29**		
Public Acceptability												
Community consultation (Opinion expressed)	Y	5	Y	5	Y	4	Y	4	Y	1	Most people support the bridge above the ferry on the north route	
Public scoping meetings (Opinion expressed)	Y	4	Y	4	Y	4	Y	4	Y	4	Need to ensure effects on caribou are considered, lower affect preferred	Access road engagement workshops
NGO's engagement (Opinion expressed)	Y	3	Y	3	Y	4	Y	4	Y	3	Biologists and NGOs express concern relating to increased caribou hunting	
Perceived Public Sensitivity		1		1		0		0		4		
Perceived Public Benefit		1		1		0		0		0		
Category Total		**12**		**12**		**12**		**12**		**8**		
Total Assessment Score		151		151		163		162		145		

Attachment H:
Air Strip Alternatives Assessment

Summary

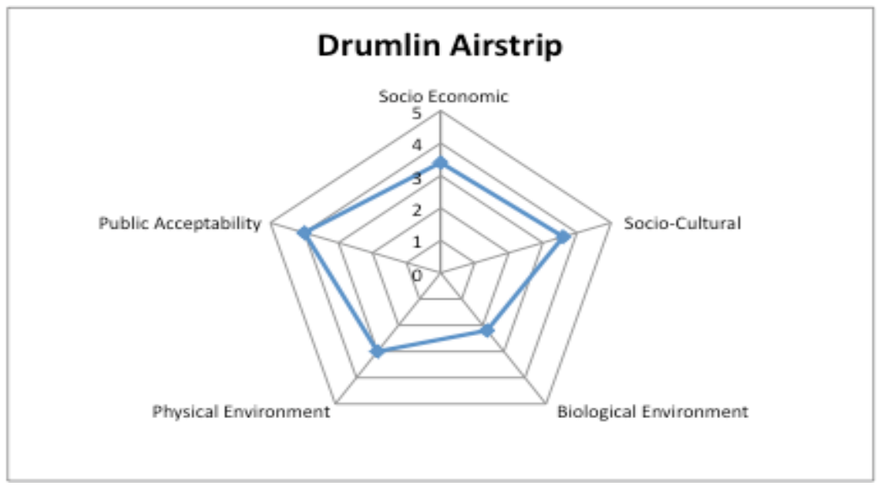
	Categories (Grouped Criteria)	Total			Socio-Economic			Socio-Cultural			Biological Environment			Physical Environment			Public Acceptability		
		Total Assessment Score	Total Perceived Public Sensitivity	Total Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit
	Number of Criteria				5			5			5			4			1		
	Alternative																		
1	Drumlin	62	18	0	17	3	0	18	2	0	11	9	0	12	4	0	4	0	0
2	Pointer Lake	71	9	0	20	0	0	20	0	0	14	6	0	13	3	0	4	0	0
	Total					3	0		2	2		15	0		7	0		0	0
	Average Perceived Relative Importance (Total /No. of Criteria)					0.60	0.00		0.40	0.4		3.00	0		1.75	0		0.00	0.00

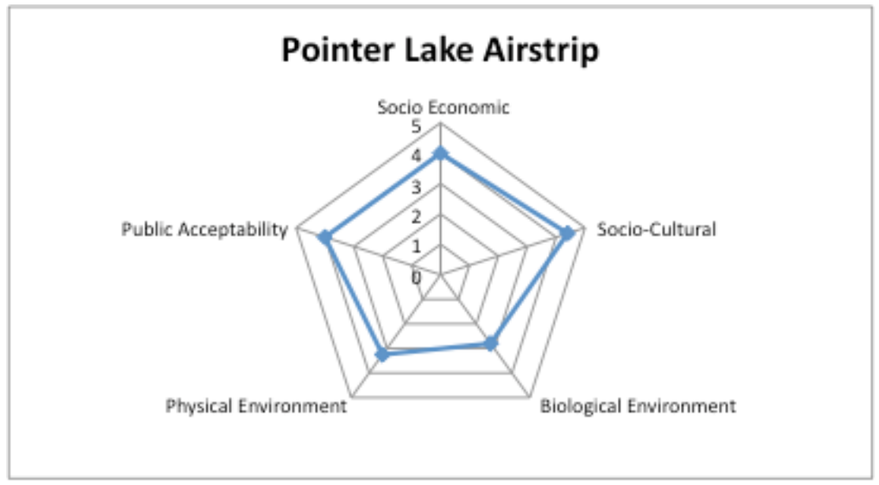
Traditional Sensitivity Analysis

Option	Total	Rank	Socio Economic	Rank	Excluding Socio-Cultural	Rank	Biological Environment	Rank	Physical Environment	Rank	Excluding Public Acceptability	Rank	Score
Drumlin	62	2	45	2	44	2	51	2	50	2	58	2	0
Pointer Lake	71	1	51	1	51	1	57	1	58	1	67	1	5
	Indicates best option in each category based on total less stepwise exclusion of category totals per option.												

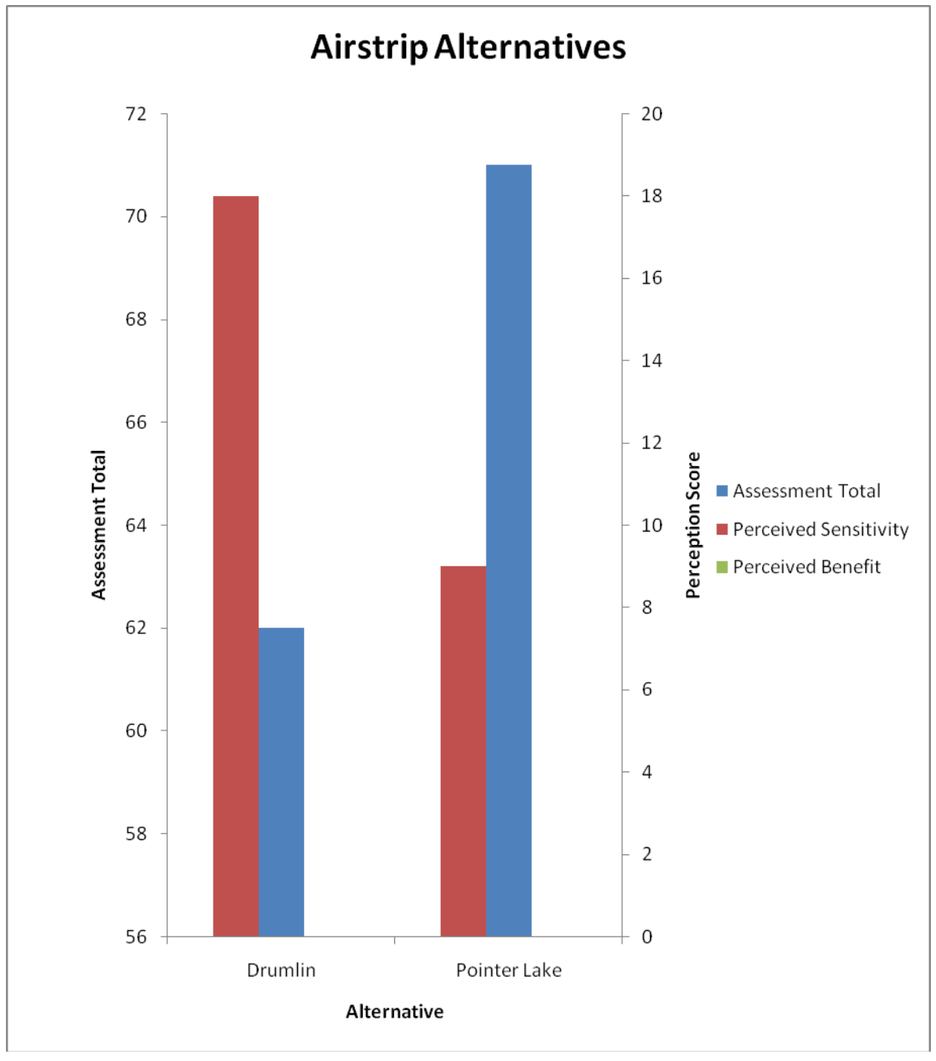
Radar Plot Averages

Option	Socio Economic	Socio-Cultural	Biological Environment	Physical Environment	Public Acceptability	Score
Drumlin Airstrip	3.40	3.60	2.20	3.00	4.00	1
Pointer Lake Airstrip	4.00	4.40	2.80	3.25	4.00	5
	Indicates best option in each category based on category averages for each option					





Option		Engineering/Technical			Economic		
		Difficulty	Risk	Schedule	Capital	Operational	Score
1	Drumlin Airstrip	0.9	1.5	1.5	1.5	1.4	6.8
2	Pointer Lake Airstrip	1	1	1	1	1	5



Assignment of Values					
Negative		**Perceived Public Sensitivity**	**Positive**		**Perceived Public Benefit**
Unacceptable	ff				
Extreme	0	4	Major	8	4
High	1	3	High	7	3
Moderate	2	2	Moderate	6	2
Low	3	1	Low	5	1
Negligible	4	0	Negligible	4	0

Criteria Groups and Criteria	Assessed	Drumlin	Pointer Lake	Issue
Social-Economic				
Socio-Economic				
Demographics	N			
Employment (Gate keepers and ferry operators, drivers and road maintenance)	Y	4	4	Currently use Baker Lake. Duplication of Baker Lake service. Work load, volume and pressure at Baker Lake Airport may reduce slightly by Mine airstrip operation.
Religious or spiritual beliefs	N			
Language(s)	N			
Socio-political dynamics (e.g. tribal system)	N			
Landuse				
Housing (single family, multiple family)	N			
Schools (pre-school to secondary	N			
Graveyards	N			
Hospitals/care facilities	N			
Religious buildings or spiritual places	N			
Recreational areas (formal parks to trails)	N			
Berry harvesting areas	N			
Grazing lands - caribou	Y	3	4	
Hunting territories -Caribou	Y	3	4	
Hunting territories -Musk ox	Y	3	4	
Hunting marine mammals	N			
Goose hunting	N			
Egg gathering	N			
Fishing territories	N			
Ice fishing	N			
Private lands (Privately owned)	N			
Cabins	N			
Canoeing and hunting tourism	N			
Snowmobile routes (Regular use and marked routes)	M	4	4	Check IQ maps for routes to traditional use areas
Public buildings and structures (other - libraries, government buildings, WWTP, etc.)	N			
Industrial, light Industrial, commercial, retail	N			
Maintain ingress and egress to businesses	N			
Maintain ingress and egress to homes	N			
Perceived Public Sensitivity		3	0	
Perceived Public Benefit		0	0	
Category Total		**17**	**20**	
Social, Cultural and Regulatory Environment				
Regulatory				
Land ownership (Land tenure and lease)	Y	3	4	Drumlin off lease area
Right of ways	Y	3	4	Drumlin off lease area
Easements	N			
Local, regional, national land use plans complimentary	Y	4	4	
Local, regional, national land use plans conflict	N			
Regulator requirements and legality (compliance)	Y	4	4	Flight path compliant for both, Pointer Lake is closer to fixed structures
Regulator priorities or feedback (formal)	N			
Cultural				
Ancient burial sites	N			
Archaeological sites	N			
Historical structures and buildings	N			
Intangible heritage (songs, dance, gathering places, other traditions)	M	4	4	Map shows spiritual area close to Pointer, but does not coincide with area.

Criteria Groups and Criteria	Assessed	Drumlin	Pointer Lake	Issue
Sacred places	N			
Public Programs (museums, galleries)	N			
Perceived Public Sensitivity		2	0	
Perceived Public Benefit		0	0	
Category Total		**18**	**20**	
Biological Environment				
Fauna				
Terrestrial (mammal, rodent, etc.)	Y	2	3	Pointer Lake would be located between the mine sites which would contain the noise footprint.
Caribou	Y	2	3	Pointer Lake is between Sissons and Kiggavik, effectively keeping the mine footprint small. Drumlin would extend the footprint.
Avian	Y	3	2	Pointer Lake flight path is located partly over watch which tends to attract more birds.
Aquatic (fresh water)	N			
Aquatic (marine)	N			
Wildlife migration routes (land, ocean, air)	Y	2	3	Caribou migration
Listed species	N			
Flora				
Terrestrial (shrubs, grasses, etc.)	Y	2	3	Drumlin requires additional infrastructure and requires road and pipeline realignment
Aquatic (fresh water)	N			
Aquatic (marine)	N			
Restricted range plants	N			
Perceived Public Sensitivity		9	6	
Perceived Public Benefit		0	0	
Category Total		**11**	**14**	
Physical Environment				
Ground Water				
Availability	N			
Water quality (Normal conditions)	N			
Potential for contamination	N			
Surface Water				
Availability	N			
Water quality (Normal conditions)	N			
Potential for contamination	Y	3	2	Drumlin is located on a ridge that would make drainage control easier. Drumlin is also located further from water.
Geology				
Geological substrate (various depths)	N			
Tectonics and seismicity	N			
Volcanism	N			
Landscape (Terrain)				
Steepness of slopes	N			
Characteristics (landforms, soils, wetlands, bogs, tundra, permafrost, bedrock)	N			
Other Physical Environment				
Air quality	Y	4	4	
Noise	Y	2	3	Pointer Lake would be located between the mine sites which would contain the noise footprint.
Visual	Y	3	4	Pointer Lake would be between the mine sites. Drumlin would be located outside of the proposed footprint area and be located on a ridge.
Paleontological resources	N			
Perceived Public Sensitivity		4	3	
Perceived Public Benefit		0	0	
Category Total		**12**	**13**	
Public Acceptability				
Community consultation (Opinion expressed)	Y	4	4	Airstrip switch from Baker Lake to Mine site. Baker Lake Hamlet prefer to upgrade BL airstrip.
Public scoping meetings (Opinion expressed)	N			
NGO's engagement (Opinion expressed)	N			
Perceived Public Sensitivity		0	0	
Perceived Public Benefit		0	0	
Category Total		**4**	**4**	
Total Assessment Score		62	71	

Attachment I:
Baker Lake Dock Alternatives Assessment

Summary

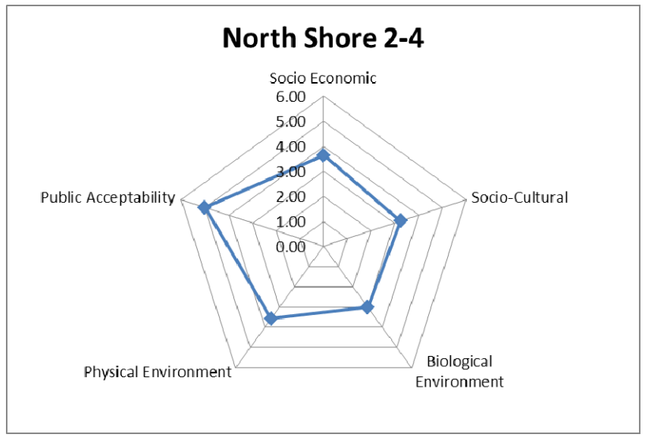
	Categories (Grouped Criteria)	Total			Socio-Economic			Socio-Cultural			Biological Environment			Physical Environment			Public Acceptability		
		Total Assessment Score	Total Perceived Public Sensitivity	Total Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit
	Number of Criteria				11			4			9			7			2		
	Alternative																		
1	North Shore 1	122	15	5	42	3	1	15	2	1	30	6	0	24	4	0	11	0	3
2	North Shore 2-4	115	21	4	40	6	2	13	3	0	27	9	0	25	3	0	10	0	2
3	Chesterfield Inlet Dock	114	20	2	42	3	1	15	2	1	26	10	0	24	4	0	7	1	0
	Total					12	4		7	2		25	0		11	0		1	5
	Average Perceived Relative Importance (Total /No. of Criteria)					1.09	0.36		1.75	0.5		2.78	0.0		1.57	0.0		0.50	2.50

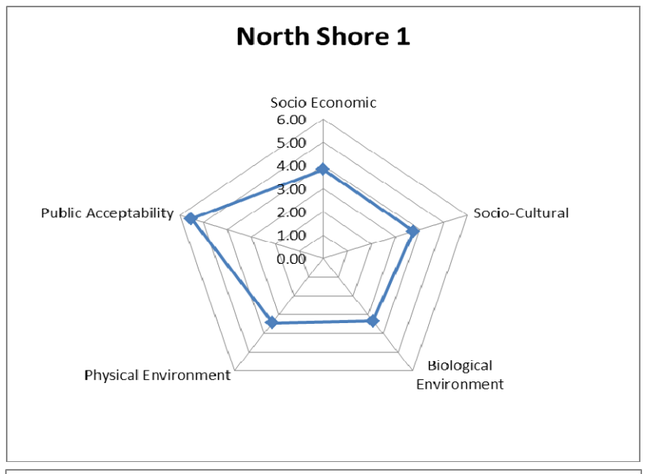
Radar Plot Averages

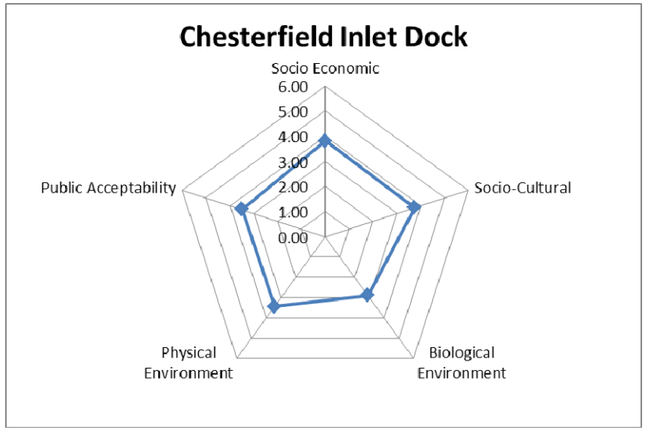
Option	Socio Economic	Socio-Cultural	Biological Environment	Physical Environment	Public Acceptability	Score
North Shore 1	3.82	3.75	3.33	3.43	5.50	4
North Shore 2-4	3.64	3.25	3.00	3.57	5.00	1
Chesterfield Inlet Dock	3.82	3.75	2.89	3.43	3.50	2
	Indicates best option in each category based on category averages for each option					

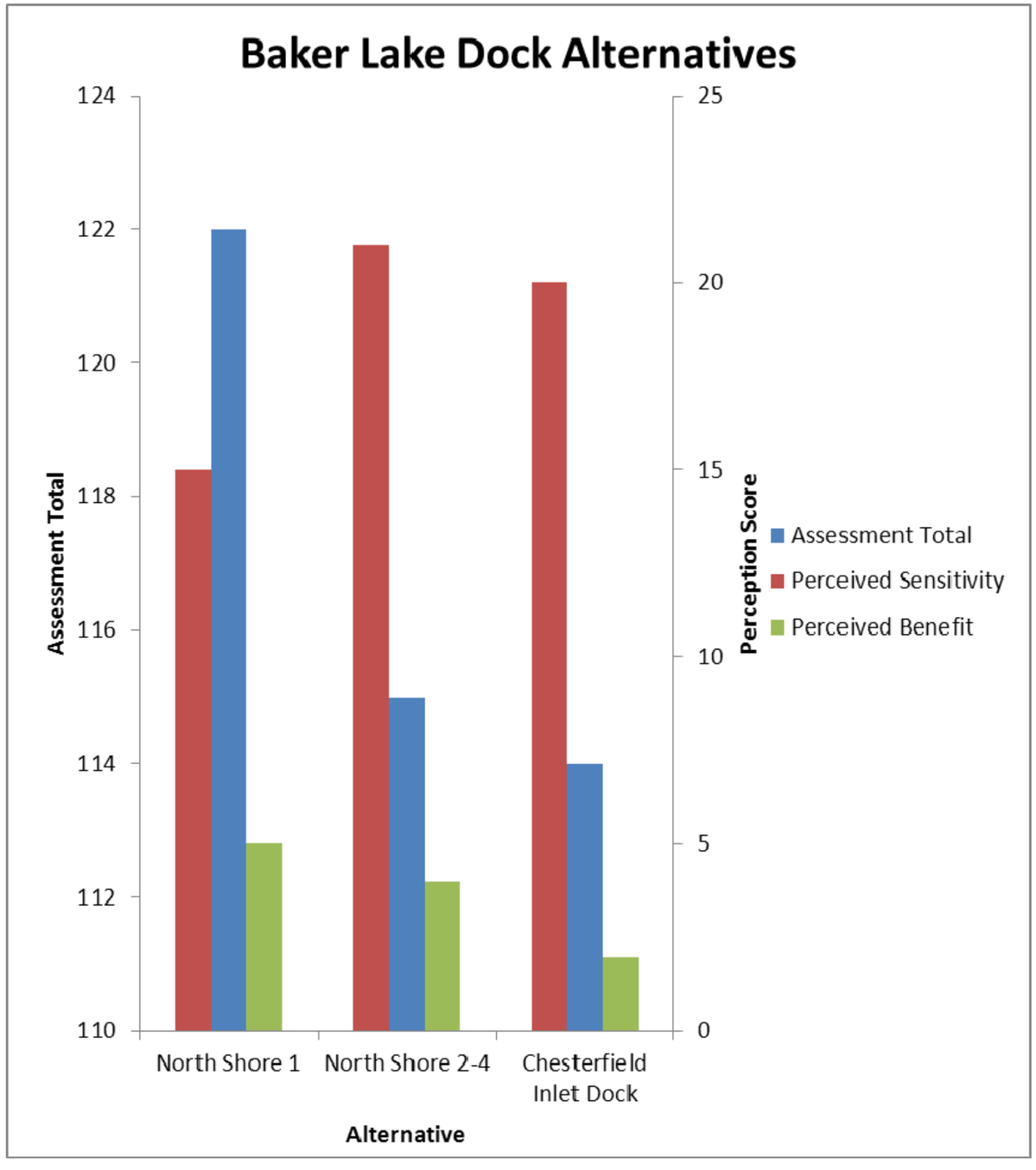
Traditional Sensitivity Analysis

Option	Total	Rank	Excluding Socio Economic	Rank	Excluding Socio-Cultural	Rank	Excluding Biological Environment	Rank	Excluding Physical Environment	Rank	Excluding Public Acceptability	Rank	Score
North Shore 1	122	1	80	1	107	1	92	1	98	1	111	1	5
North Shore 2-4	115	2	75	2	102	2	88	2	90	2	105	3	0
Chesterfield Inlet Dock	114	3	72	3	99	3	88	2	90	2	107	2	0
	Indicates best option in each category based on total less stepwise exclusion of category totals per option.												


North Shore 2-4
Socio Economic
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Socio-Cultural
Biological Environment
Physical Environment
Public Acceptability


North Shore 1
Socio Economic
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Socio-Cultural
Biological Environment
Physical Environment
Public Acceptability


Chesterfield Inlet Dock
Socio Economic
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Socio-Cultural
Biological Environment
Physical Environment
Public Acceptability


Baker Lake Dock Alternatives
124
122
120
118
116
114
112
110
Assessment Total
25
20
15
10
5
0
Perception Score
Assessment Total
Perceived Sensitivity
Perceived Benefit
North Shore 1
North Shore 2-4
Chesterfield Inlet Dock
Alternative

Assignment of Values					
Negative		Perceived Public Sensitivity	Positive		Perceived Public Benefit
Unacceptable	ff				
Extreme	0	4	Major	8	4
High	1	3	High	7	3
Moderate	2	2	Moderate	6	2
Low	3	1	Low	5	1
Negligible	4	0	Negligible	4	0

Criteria Groups and Criteria	Assessed	North Shore 1	North Shore 2-4	Chesterfield Inlet Dock	Issue	Source of Information
Social-Economic						
Socio-Economic						
Demographics	N					
Employment (Gate keepers and ferry operators, drivers and road maintenance)	Y	5	5	5		
Religious Beliefs	N					
Language(s)	N					
Socio-political dynamics (e.g. caste system, tribal system)	N					
Landuse						
Housing (single family, multiple family)	N					
Schools (pre-school to secondary	N					
Graveyards	N					
Hospitals/care facilities	N					
Religious buildings (churches etc.)	N					
Recreational areas (formal parks to trails)	N					
Berry Harvesting	N					
Grazing lands - Caribou	Y	3	2	3		
Hunting territories - Caribou	Y	4	5	4		
Hunting territories -Musk ox	Y	4	4	4		
Hunting marine mammals	N					
Goose hunting	N					
Egg gathering	N					
Fishing territories	Y	3	2	3		
Ice fishing	Y	4	4	4	Winter road operates in winter, but dock only operates in summer.	
Private lands	N					
Cabins	Y	3	2	3	2-4 have more cabins and the road will pass more cabins.	
Canoeing and hunting tourism	N					
Snowmobile routes	Y	4	4	4		
Public buildings and structures (other - libraries, government buildings, WWTP, etc.)	N					
Industrial, light Industrial, commercial, retail	Y	4	4	4	Agniko dock site will be affected by all AREVA alternatives.	
Maintain ingress and egress to businesses	Y	4	4	4	Agniko dock site will be affected by all AREVA alternatives.	
Maintain ingress and egress to homes/Cabins	M	4	4	4		
Perceived Public Sensitivity		3	6	3		
Perceived Public Benefit		1	2	1		
Category Total		**42**	**40**	**42**		
Social, Cultural and Regulatory Environment						
Regulatory						
Land ownership	Y	3	3	3		
Right of ways	Y	3	2	3		
Easements	N					
Local, regional, national land use plans Complimentary	Y	5	4	5		
Local, regional, national land use plans Conflict	N					
Regulator requirements and legality (compliance)	Y	4	4	4		
Regulator priorities or feedback (formal)	N					
Cultural						

Criteria Groups and Criteria	Assessed	North Shore 1	North Shore 2-4	Chesterfield Inlet Dock	Issue	Source of Information
Ancient burial sites	N					
Archaeological Sites	N					
Historical structures and buildings	N					
Intangible Heritage (songs, dance, gathering places, other traditions)	N					
Sacred places	N					
Public Programs (museums, galleries)	N					
Perceived Public Sensitivity		2	3	2		
Perceived Public Benefit		1	0	1		
Category Total		**15**	**13**	**15**		
Biological Environment						
Fauna						
Terrestrial (mammal, rodent, etc.)	Y	3	2	3		
Caribou	Y	3	2	3		
Avian	Y	3	3	3		
Aquatic (fresh water)	Y	3	3	3		
Aquatic (marine)	Y	4	4	2		
Wildlife migration routes (land, ocean, air)	N					
Listed species	Y	4	4	2	Chesterfield Inlet close to migration route. More ship traffic if dock is located here.	
Flora						
Terrestrial (shrubs, grasses, etc.)	Y	3	2	3		
Aquatic (fresh water)	Y	3	3	3		
Aquatic (marine)	N					
Restricted range plants	M	4	4	4		
Perceived Public Sensitivity		6	9	10		
Perceived Public Benefit		0	0	0		
Category Total		**30**	**27**	**26**		
Physical Environment						
Ground Water						
Availability	N					
Water quality (Normal conditions)	N					
Potential for contamination	N					
Surface Water						
Availability	N					
Water quality (Normal conditions)	Y	4	4	4		
Potential for contamination	Y	2	2	2		
Geology						
Geological substrate (various depths)	N					
Tectonics	N					
Volcanism	N					
Landscape (terrain)						
Steepness of slopes	Y	3	4	4		
Characteristics (soils, wetlands, bogs, tundra, permafrost, bedrock)	Y	4	4	4		
Other Physical Environment						
Air Quality	Y	3	3	3		
Noise	Y	4	4	3	1 is closer to community and adds to existing noise at nearby dock. 2-4 is in a quieter area so noise will be more pronounced.	
Visual	Y	4	4	4	2-4 Not as visible from Baker Lake, but 1 is in an existing industrial area that is visible.	
Paleontological Resources	N					
Perceived Public Sensitivity		4	3	4		
Perceived Public Benefit		0	0	0		
Category Total		**24**	**25**	**24**		
Public Acceptability						
Community consultation (Opinion expressed)	Y	6	5	3	Concern relating to marine mammal migration routes near Chesterfield Inlet.	
Public scoping meetings (Opinion expressed)	Y	5	5	4		

Criteria Groups and Criteria	Assessed	North Shore 1	North Shore 2-4	Chesterfield Inlet Dock	Issue	Source of Information
NGO's engagement (Opinion expressed)	N					
Perceived Public Sensitivity		0	0	1		
Perceived Public Benefit		3	2	0		
Category Total		**11**	**10**	**7**		
Total Assessment Score		122	115	114		

Attachment J:
Yellowcake Alternatives Assessment

Summary

	Categories (Grouped Criteria)	Total			Socio-Economic			Socio-Cultural			Biological Environment			Physical Environment			Public Acceptability		
		Total Assessment Score	Total Perceived Public Sensitivity	Total Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit
	Number of Criteria				1			3			2			3			3		
	Alternative																		
1	Air and Marine	39	9	0	4	0	0	11	1	0	7	1	0	11	1	0	6	6	0
2	Air only	43	5	0	4	0	0	12	0	0	8	0	0	10	2	0	9	3	0
	Total					0	0		1	0		1	0		3	0		9	0
	Average Perceived Relative Importance (Total /No. of Criteria)					0.00	0		0.33	0		0.50	0		1.00	0		3.00	0.00

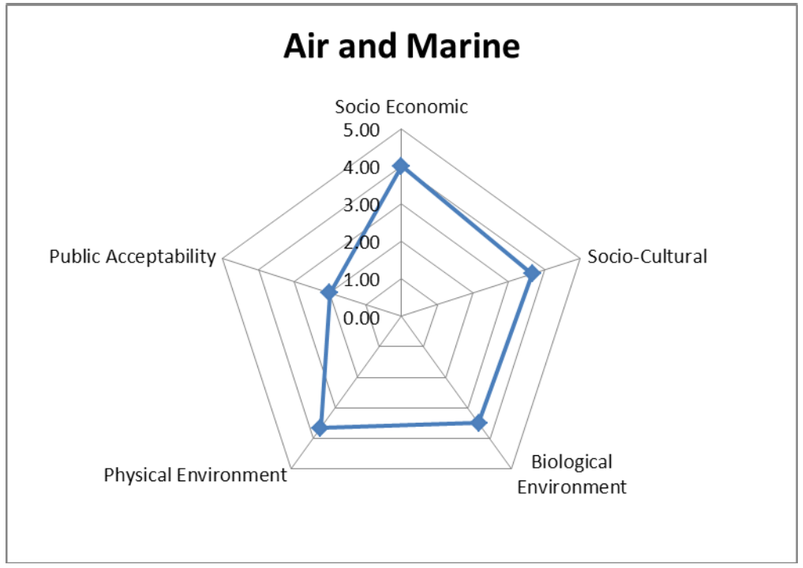
Traditional Sensitivity Analysis

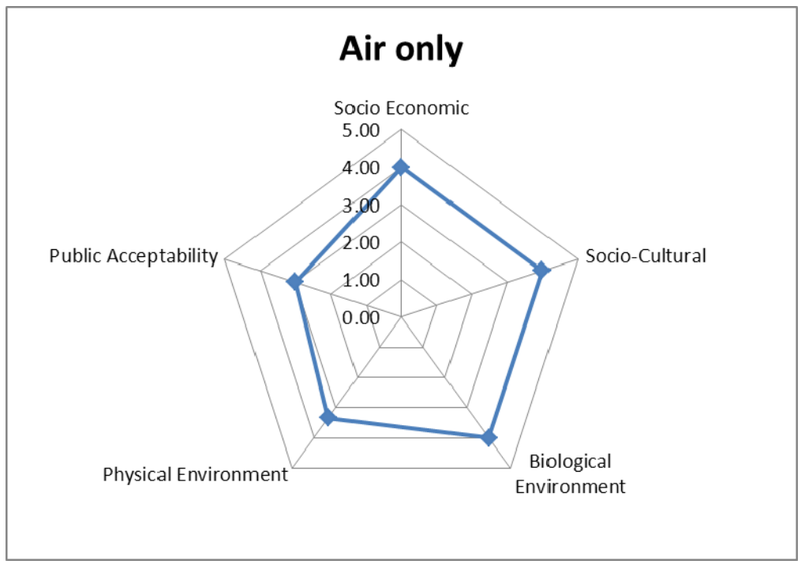
Option	Total	Rank	Excluding Socio Economic	Rank	Excluding Socio-Cultural	Rank	Excluding Biological Environment	Rank	Excluding Physical Environment	Rank	Excluding Public Acceptability	Rank	Score
1	39	2	35	2	28	2	32	2	28	2	33	2	0
2	43	1	39	1	31	1	35	1	33	1	34	1	5
	Indicates best option in each category based on total less stepwise exclusion of category totals per option.												

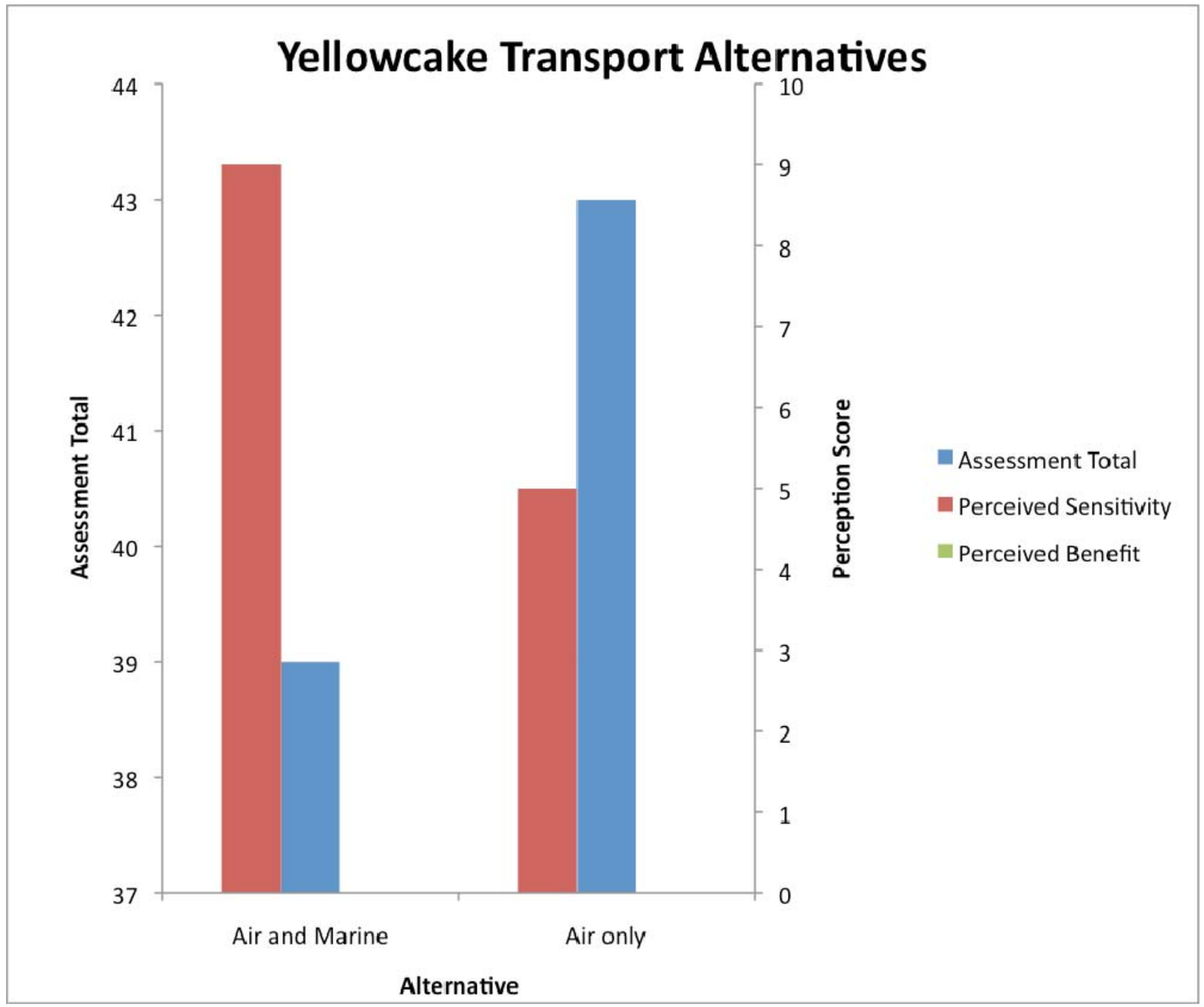
Radar Plot Averages

Option		Socio Economic	Socio-Cultural	Biological Environment	Physical Environment	Public Acceptability	Score
1	Air and Marine	4.00	3.67	3.50	3.67	2.00	2
2	Air only	4.00	4.00	4.00	3.33	3.00	4
		Indicates best option in each category based on category averages for each option					

		Engineering/Technical			Economic	
Option		**Difficulty**	**Risk**	**Schedule**	**Operational**	**Score**
1	Air and Marine	1.5	0.3	1.5	0.65	3.95
2	Air only	1	1	1	1	4







Assignment of Values					
Negative		**Perceived Public Sensitivity**	**Positive**		**Perceived Public Benefit**
Unacceptable	ff				
Extreme	0	4	Major	8	4
High	1	3	High	7	3
Moderate	2	2	Moderate	6	2
Low	3	1	Low	5	1
Negligible	4	0	Negligible	4	0

Criteria Groups and Criteria	Assessed	Air, Road and Marine	Air Only	Issue
Social-Economic				
Socio-Economic				
Demographics	N			
Employment (Gate keepers and ferry operators, drivers and road maintenance)	N			
Religious or spiritual beliefs	N			
Language(s)	N			
Socio-political dynamics (e.g. tribal system)	N			
Landuse				
Housing (single family, multiple family)	N			
Schools (pre-school to secondary	N			
Graveyards	N			
Hospitals/care facilities	N			
Religious buildings or spiritual places	N			
Recreational areas (formal parks to trails)	N			
Berry harvesting areas	N			
Grazing lands - caribou	N			
Hunting territories -Caribou	Y	4	4	Not considered a common hunting territory. Caribou will be affected but the plan is not to fly during migration if it occurs near the airstrip or project site.
Hunting territories -Musk ox	N			
Hunting marine mammals	N			
Goose hunting	N			
Egg gathering	N			
Fishing territories	N			
Ice fishing	N			
Private lands	N			
Cabins	N			
Canoeing and hunting tourism	N			
Snowmobile routes	N			
Public buildings and structures (other - libraries, government buildings, WWTP, etc.)	N			
Industrial, light Industrial, commercial, retail	N			
Maintain ingress and egress to businesses	N			
Maintain ingress and egress to homes	N			
Perceived Public Sensitivity		0	0	
Perceived Public Benefit		0	0	
Category Total		**4**	**4**	
Social, Cultural and Regulatory Environment				
Regulatory				
Land ownership	N			
Right of ways	N			
Easements	N			
Local, regional, national land use plans complimentary	Y	4	4	
Local, regional, national land use plans conflict	N			
Regulator requirements and legality (compliance) Radiological OHS and public (Dose and risk assessments). Also includes permits required.	Y	3	4	Legal compliance is there. Truck drivers assessed to have a slightly increased number of people exposed possibly with greater dose. Pilots also get a dose. Road leg will need more permits as it will involve a storage component.

Criteria Groups and Criteria	Assessed	Air, Road and Marine	Air Only	Issue
Regulator priorities or feedback (formal)	Y	4	4	CNSC and Transport Canada. No concerns either way.
Cultural				
Ancient burial sites	N			
Archaeological sites	N			
Historical structures and buildings	N			
Intangible heritage (songs, dance, gathering places, other traditions)	N			
Sacred places	N			
Public Programs (museums, galleries)	N			
Perceived Public Sensitivity		1	0	
Perceived Public Benefit		0	0	
Category Total		**11**	**12**	
Biological Environment				
Fauna				
Terrestrial (mammal, rodent, etc.)	N			
Caribou	Y	4	4	There will be no flights if large numbers of Caribou are migrating near the airstrip or by roads. Additional flights vs. empty backhaul trucks. No additional trucks required but there are additional flights. Air only option more preferred by community.
Avian	N			
Aquatic (fresh water)	N			
Aquatic (marine) During transport malfunction potential risk	Y	3	4	
Wildlife migration routes (land, ocean, air)	N			
Listed species	N			
Flora				
Terrestrial (shrubs, grasses, etc.)	N			
Aquatic (fresh water)	N			
Aquatic (marine)	N			
Restricted range plants	N			
Perceived Public Sensitivity		1	0	
Perceived Public Benefit		0	0	
Category Total		**7**	**8**	
Physical Environment				
Ground Water				
Availability	N			
Water quality (Normal conditions)	N			
Potential for contamination	N			
Surface Water				
Availability	N			
Water quality (Normal conditions)	N			
Potential for contamination (drum breach on accident)	Y	3	3	
Geology				
Geological substrate (various depths)	N			
Tectonics and seismicity	N			
Volcanism	N			
Landscape (Terrain)				
Steepness of slopes	N			
Characteristics (soils, wetlands, bogs, tundra, permafrost, bedrock)	N			
Other Physical Environment				
Air quality	Y	4	4	
Noise	Y	4	3	
Visual	N			
Paleontological resources	N			
Perceived Public Sensitivity		1	2	
Perceived Public Benefit		0	0	
Category Total		**11**	**10**	
Public Acceptability				
Community consultation (Opinion Expressed)	Y	1	3	NIRB, KIA and community concerned about yellow cake moving through communities. AREVA may revisit the road option in the

Criteria Groups and Criteria	Assessed	Air, Road and Marine	Air Only	Issue
				future once a performance track record has been established. This will require a full risk and environmental assessment. AREVA contractors already do road transport safely in other areas and countries on a regular basis.
Public scoping meetings (Opinion Expressed)	Y	3	4	
NGO's (Opinion Expressed)	Y	2	2	
Perceived Public Sensitivity		6	3	
Perceived Public Benefit		0	0	
Category Total		**6**	**9**	
Total Assessment Score		39	43	

Attachment K:
Marine Transport Routes Alternatives Assessment

Summary

	Categories (Grouped Criteria)	Total			Socio-Economic			Socio-Cultural			Biological Environment			Physical Environment			Public Acceptability		
		Total Assessment Score	Total Perceived Public Sensitivity	Total Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit	Assessment Score	Perceived Public Sensitivity	Perceived Public Benefit
	Number of Criteria				4			1			3			4			2		
	Alternative																		
1	Dry Cargo - Shipped to Helicopter Island then Barged to Baker Lake.	41	16	1	15	2	1	3	1	0	6	6	0	12	4	0	5	3	0
2	Dry Cargo - Barged direct to Baker Lake from southern ports.	49	7	0	15	1	0	3	1	0	9	3	0	16	0	0	6	2	0
3	Dry Cargo - Railed direct to Churchill then barged to Baker Lake.	51	6	1	15	2	1	3	1	0	9	3	0	16	0	0	8	0	0
4	Dry Cargo - Shipped direct to Churchill from southern ports then barged to Baker Lake.	49	8	1	15	2	1	3	1	0	9	3	0	16	0	0	6	2	0
5	Fuel – Ocean tanker to Ellis Island and then barged to Baker Lake.	38	19	1	15	2	1	2	2	0	6	6	0	11	5	0	4	4	0
6	Fuel – Ocean tanker to Churchill tank farm and then barged to Baker Lake.	48	9	1	15	2	1	3	1	0	9	3	0	15	1	0	6	2	0
7	Fuel – Rail delivery to Churchill and then tug and barge to Baker Lake.	48	9	1	15	2	1	3	1	0	9	3	0	15	1	0	6	2	0
8	Fuel – Combined rail and ocean delivery to Churchill and Ellis Island with barge to Baker Lake.	40	17	1	14	3	1	2	2	0	8	4	0	12	4	0	4	4	0
	Total					11	5		7	0		24	0		10	0		13	0
	Average Perceived Relative Importance (Total /No. of Criteria)					2.75	1.25		7.00	0		8.00	0		2.50	0		6.50	0.00

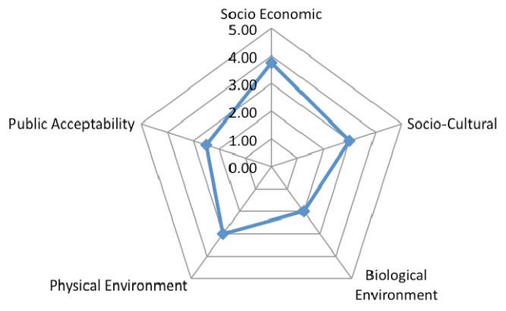
Traditional Sensitivity Analysis

Option	Total	Rank	Excluding Socio Economic	Rank	Excluding Socio-Cultural	Rank	Excluding Biological Environment	Rank	Excluding Physical Environment	Rank	Excluding Public Acceptability	Rank	Score
1	41	3	26	3	38	3	35	3	29	3	36	3	0
2	49	2	34	2	46	2	40	2	33	2	43	1	1
3	51	1	36	1	48	1	42	1	35	1	43	1	5
4	49	2	34	2	46	2	40	2	33	2	43	1	1
5	38	3	23	3	36	3	32	3	27	3	34	3	0
6	48	1	33	1	45	1	39	1	33	1	42	1	5
7	48	1	33	1	45	1	39	1	33	1	42	1	5
8	40	2	26	2	38	2	32	2	28	2	36	2	0

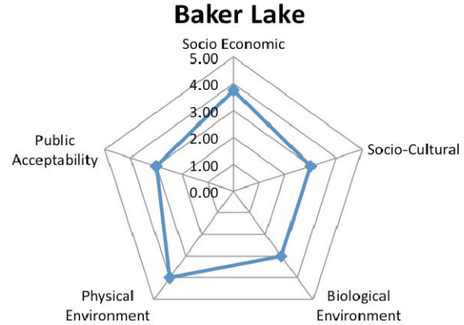
Indicates best option in each category based on total less stepwise exclusion of category totals per option.

Radar Plot Averages						
Option	Socio Economic	Socio-Cultural	Biological Environment	Physical Environment	Public Acceptability	Score
1	3.75	3.00	2.00	3.00	2.50	2
2	3.75	3.00	3.00	4.00	3.00	4
3	3.75	3.00	3.00	4.00	4.00	5
4	3.75	3.00	3.00	4.00	3.00	4
5	3.75	2.00	2.00	2.75	2.00	1
6	3.75	3.00	3.00	3.75	3.00	5
7	3.75	3.00	3.00	3.75	3.00	5
8	3.50	2.00	2.67	3.00	2.00	0
	Indicates best option in each category based on category averages for each option					

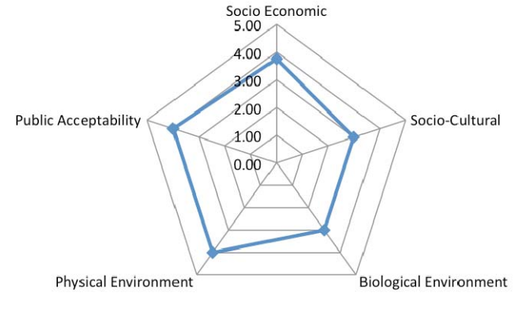
Dry Cargo - Shipped to Helicopter Island then Barged to Baker Lake



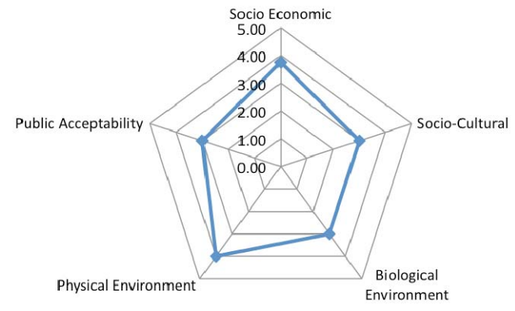
Dry Cargo - Shipped direct to Churchill from southern ports then barged to Baker Lake



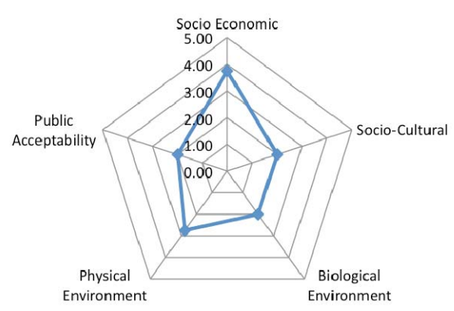
Dry Cargo - Railed direct to Churchill then barged to Baker Lake



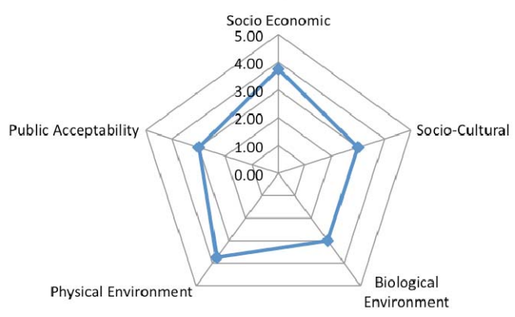
Dry Cargo - Barged direct to Baker Lake from southern ports



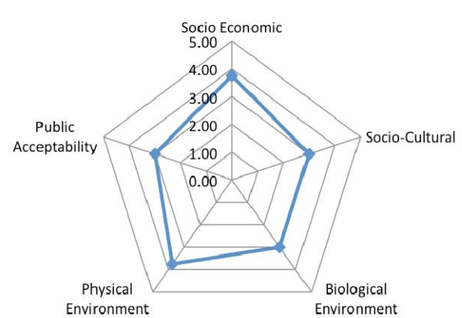
Fuel – Ocean tanker to Ellis Island and then barged to Baker Lake



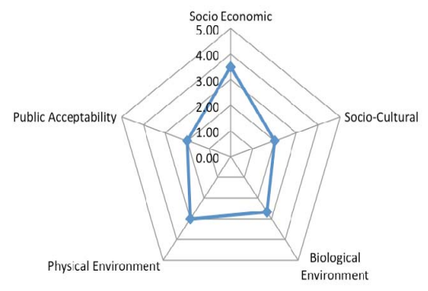
Fuel – Ocean tanker to Churchill tank farm and then barged to Baker Lake



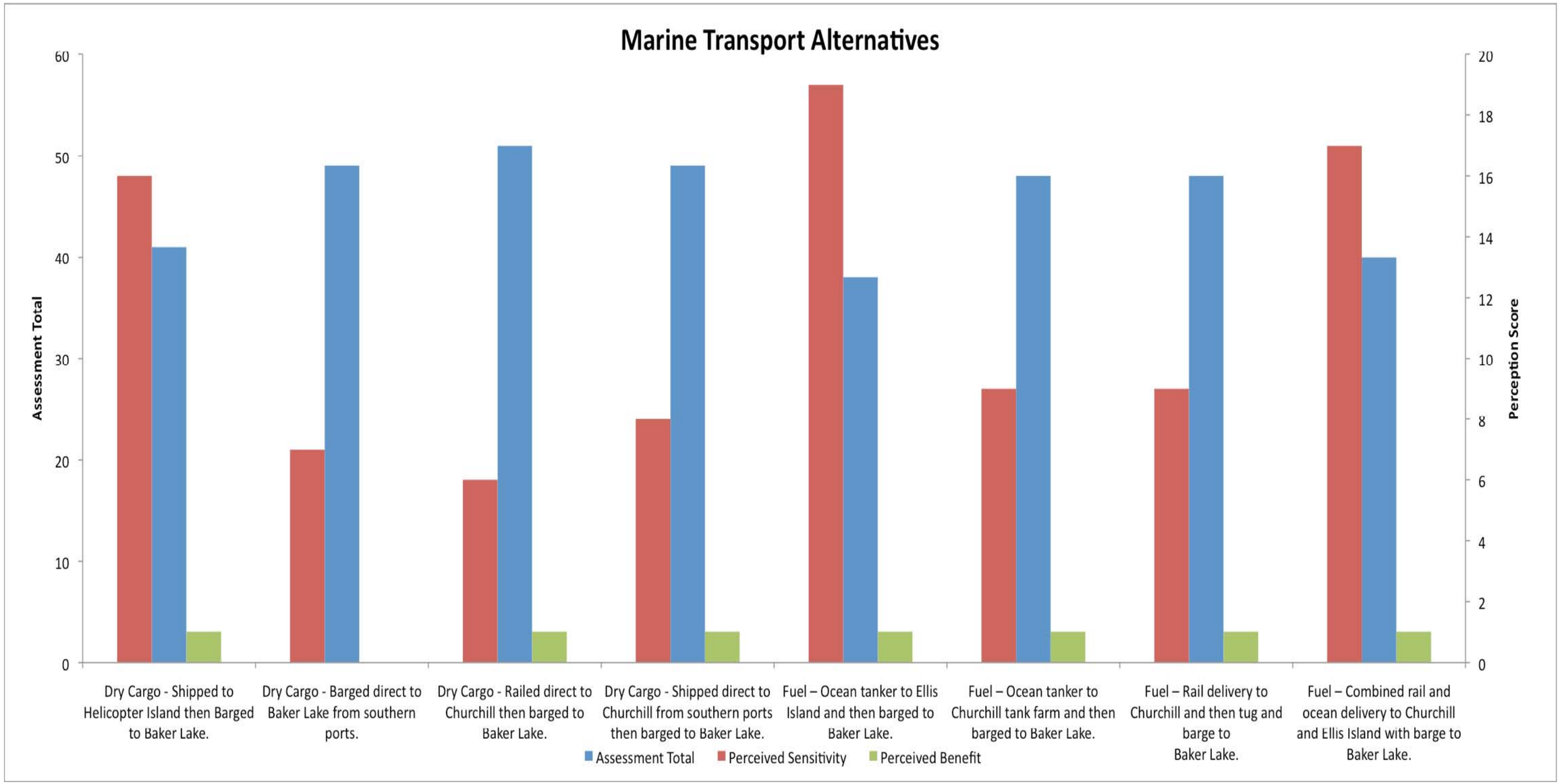
Fuel – Rail delivery to Churchill and then tug and barge to Baker Lake



Fuel – Combined rail and ocean delivery to Churchill and Ellis Island with barging to Baker Lake



		Engineering/Technical			Economic		
Option		Difficulty	Risk	Schedule	Capital	Operational	Score
1	Dry Cargo - Shipped to Helicopter Island then Barged to Baker Lake.	1.2	1.4	0.8	1.2	1.2	5.8
2	Dry Cargo - Barged direct to Baker Lake from southern ports.	0.9	1	0.9	0.8	0.9	4.5
3	Dry Cargo - Railed direct to Churchill then barged to Baker Lake.	1	1	1	1	1	5
4	Dry Cargo - Shipped direct to Churchill from southern ports then barged to Baker Lake.	1.2	0.8	1.2	1	1	5.2
5	Fuel – Ocean tanker to Ellis Island and then barged to Baker Lake.	1.4	1.5	0.6	1.2	0.8	5.5
6	Fuel – Ocean tanker to Churchill tank farm and then barged to Baker Lake.	1	1.2	1	1	1	5.2
7	Fuel – Rail delivery to Churchill and then tug and barge to Baker Lake.	1	1	1	1	1	5
8	Fuel – Combined rail and ocean delivery to Churchill with barge to Baker Lake.	1.4	1.4	0.8	1.2	0.8	5.6


Marine Transport Alternatives
Assessment Total
Perception Score
60
50
40
30
20
10
0
20
18
16
14
12
10
8
6
4
2
0
Dry Cargo - Shipped to Helicopter Island then Barged to Baker Lake.
Dry Cargo - Barged direct to Baker Lake from southern ports.
Dry Cargo - Railed direct to Churchill then barged to Baker Lake.
Dry Cargo - Shipped direct to Churchill from southern ports then barged to Baker Lake.
Fuel – Ocean tanker to Ellis Island and then barged to Baker Lake.
Fuel – Ocean tanker to Churchill tank farm and then barged to Baker Lake.
Fuel – Rail delivery to Churchill and then tug and barge to Baker Lake.
Fuel – Combined rail and ocean delivery to Churchill and Ellis Island with barge to Baker Lake.
Assessment Total
Perceived Sensitivity
Perceived Benefit

Assignment of Values					
Negative		Perceived Public Sensitivity	Positive		Perceived Public Benefit
Unacceptable	ff				
Extreme	0	4	Major	8	4
High	1	3	High	7	3
Moderate	2	2	Moderate	6	2
Low	3	1	Low	5	1
Negligible	4	0	Negligible	4	0

Criteria Groups and Criteria	Assessment	Dry Cargo - Shipped to Helicopter Island then Barged to Baker Lake.	Dry Cargo - Barged direct to Baker Lake from southern ports.	Dry Cargo - Railed direct to Churchill then barged to Baker Lake.	Dry Cargo - Shipped direct to Churchill from southern ports then barged to Baker Lake.	Fuel – Ocean tanker to Ellis Island and then barged to Baker Lake.	Fuel – Ocean tanker to Churchill tank farm and then barged to Baker Lake.	Fuel – Rail delivery to Churchill and then tug and barge to Baker Lake.	Fuel – Combined rail and ocean delivery to Churchill or Ellis Island with barge to Baker Lake.	Issue	Source of Information
Social-Economic											
Socio-Economic											
Demographics	N										
Employment (Gate keepers and ferry operators, drivers and road maintenance)	Y	5	4	5	5	5	5	5	5		
Religious Beliefs	N										
Language(s)	N										
Socio-political dynamics (e.g. caste system, tribal system)	N										
Landuse											
Housing (single family, multiple family)	N										
Schools (pre-school to secondary	N										
Graveyards	N										
Hospitals/care facilities	N										
Religious buildings (churches etc.)	N										
Recreational areas (formal parks to trails)	N										
Berry Harvesting	N										
Grazing lands - caribou	N										
Hunting territories -Caribou	N										
Hunting territories -Musk ox	N										
Hunting marine mammals	N										
Goose hunting	N										
Egg gathering	N										
Fishing territories	Y	4	4	4	4	4	4	4	4		
Ice fishing	N									Sea lift - Only occurs in summer so won't affect ice fishing	
Private lands	N										

Criteria Groups and Criteria	Assessment	Dry Cargo - Shipped to Helicopter Island then Barged to Baker Lake.	Dry Cargo - Barged direct to Baker Lake from southern ports.	Dry Cargo - Railed direct to Churchill then barged to Baker Lake.	Dry Cargo - Shipped direct to Churchill from southern ports then barged to Baker Lake.	Fuel – Ocean tanker to Ellis Island and then barged to Baker Lake.	Fuel – Ocean tanker to Churchill tank farm and then barged to Baker Lake.	Fuel – Rail delivery to Churchill and then tug and barge to Baker Lake.	Fuel – Combined rail and ocean delivery to Churchill or Ellis Island with barge to Baker Lake.	Issue	Source of Information
Cabins	N										
Canoeing and hunting tourism	Y	2	3	3	3	2	3	3	2	Use of Chesterfield lightening points will have more vessels in the area for longer than if staged via Churchill.	
Snowmobile routes	N										
Public buildings and structures (other - libraries, government buildings, WWTP, etc.)	N										
Industrial, light Industrial, commercial, retail	Y	4	4	3	3	4	3	3	3	Only affects Churchill as the other points will be marine lightering.	
Maintain ingress and egress to businesses	N										
Maintain ingress and egress to homes	N										
Perceived Public Sensitivity		2	1	2	2	2	2	2	3		
Perceived Public Benefit		1	0	1	1	1	1	1	1		
Category Total		**15**	**15**	**15**	**15**	**15**	**15**	**15**	**14**		
Social, Cultural and Regulatory Environment											
Regulatory											
Land ownership	N										
Right of ways	N										
Easements	N										
Local, regional, national land use plans Complimentary	N										
Local, regional, national land use plans Conflict	N										
Regulator requirements and legality (compliance)	Y	3	3	3	3	2	3	3	2	Ocean fuel transfer likely to require more permitting by comparison to existing fuel tank farm and port.	
Regulator priorities or feedback (formal)	N										
Cultural											
Ancient burial sites	N										
Archaeological Sites	N										
Historical structures and buildings	N										
Intangible Heritage (songs, dance, gathering places, other traditions)	N										
Sacred places	N										
Public Programs (museums, galleries)	N										
Perceived Public Sensitivity		1	1	1	1	2	1	1	2		
Perceived Public Benefit		0	0	0	0	0	0	0	0		
Category Total		**3**	**3**	**3**	**3**	**2**	**3**	**3**	**2**		

Criteria Groups and Criteria	Assessment	Dry Cargo - Shipped to Helicopter Island then Barged to Baker Lake.	Dry Cargo - Barged direct to Baker Lake from southern ports.	Dry Cargo - Railed direct to Churchill then barged to Baker Lake.	Dry Cargo - Shipped direct to Churchill from southern ports then barged to Baker Lake.	Fuel – Ocean tanker to Ellis Island and then barged to Baker Lake.	Fuel – Ocean tanker to Churchill tank farm and then barged to Baker Lake.	Fuel – Rail delivery to Churchill and then tug and barge to Baker Lake.	Fuel – Combined rail and ocean delivery to Churchill or Ellis Island with barge to Baker Lake.	Issue	Source of Information
Biological Environment											
Fauna											
Terrestrial (mammal, rodent, etc.)	N										
Caribou	N										
Avian	N										
Aquatic (fresh water)	N										
Aquatic (marine)	Y	2	3	3	3	2	3	3	2	All vessels will pass through Hudson straight and Hudson Bay - known marine mammal biomes. Chesterfield lightering likely to have higher number of vessels and vessel maneuvering.	
Wildlife migration routes (land, ocean, air)	Y	2	3	3	3	2	3	3	3	Kiggavik coast known as a beluga and seal migration route.	
Listed species	Y	2	3	3	3	2	3	3	3	The Beluga is considered near threatened.	
Flora											
Terrestrial (shrubs, grasses, etc.)	N										
Aquatic (fresh water)	N										
Aquatic (marine)	N										
Restricted range plants	N										
Perceived Public Sensitivity		6	3	3	3	6	3	3	4		
Perceived Public Benefit		0	0	0	0	0	0	0	0		
Category Total		**6**	**9**	**9**	**9**	**6**	**9**	**9**	**8**		
Physical Environment											
Ground Water											
Availability	N										
Water quality (Normal conditions)	N										
Potential for contamination	N										
Surface Water											
Availability	N										
Water quality (Normal conditions)	N										
Potential for contamination	Y	3	4	4	4	2	3	3	3	Ocean fuel transfer has the highest potential for surface contamination.	
Geology											
Geological substrate (various depths)	N										
Tectonics	N										
Volcanism	N										
Landscape (terrain)											
Steepness of slopes	N										

Criteria Groups and Criteria	Assessment	Dry Cargo - Shipped to Helicopter Island then Barged to Baker Lake.	Dry Cargo - Barged direct to Baker Lake from southern ports.	Dry Cargo - Railed direct to Churchill then barged to Baker Lake.	Dry Cargo - Shipped direct to Churchill from southern ports then barged to Baker Lake.	Fuel – Ocean tanker to Ellis Island and then barged to Baker Lake.	Fuel – Ocean tanker to Churchill tank farm and then barged to Baker Lake.	Fuel – Rail delivery to Churchill and then tug and barge to Baker Lake.	Fuel – Combined rail and ocean delivery to Churchill or Ellis Island with barge to Baker Lake.	Issue	Source of Information
Characteristics (soils, wetlands, bogs, tundra, permafrost, bedrock)	N										
Other Physical Environment											
Air Quality	Y	3	4	4	4	3	4	4	3	Chesterfield lightering will have more affect as the area does not have much current activity. Barges and boats will cause a greater affect.	
Noise	Y	3	4	4	4	3	4	4	3	Chesterfield lightering will have more affect as the area does not have much current activity. Barges and boats will cause a greater affect.	
Visual	Y	3	4	4	4	3	4	4	3	Chesterfield lightering will have more affect as the area does not have much current activity. Barges and boats will cause a greater affect.	
Paleontological Resources	N										
Perceived Public Sensitivity		4	0	0	0	5	1	1	4		
Perceived Public Benefit		0	0	0	0	0	0	0	0		
Category Total		**12**	**16**	**16**	**16**	**11**	**15**	**15**	**12**		
Public Acceptability											
Community consultation (Support expressed)	Y	2	3	4	3	2	3	3	2		
Public scoping meetings (Support expressed)	Y	3	3	4	3	2	3	3	2		
NGO's engagement (Support expressed)	N										
Perceived Public Sensitivity		3	2	0	2	4	2	2	4		
Perceived Public Benefit		0	0	0	0	0	0	0	0		
Category Total		**5**	**6**	**8**	**6**	**4**	**6**	**6**	**4**		
Total Assessment Score		41	49	51	49	38	48	48	40		