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DRAFT - Iqaluit Nukkiksautiit Project Environmental & Regulatory Evaluation

REF # 199-006 DRAFT

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Commonly Appearing Abbreviations

CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada
CPL	Canadian Projects Limited
ECCC	Environment and Climate Change Canada
FEED	Front End Engineering and Design
DFO	Fisheries and Oceans Canada
GN	Government of Nunavut
HEP	hydroelectric power
IOL	Inuit Owned Land
IQ	Inuit Qaujimajatuqangit
KPC	Knight Piesold Consulting
LVP	Landsvirkjun Power
MAD	mean annual discharge
mASL	metres above sea level
NIRB	Nunavut Impact Review Board
NLCA	Nunavut Land Claim Agreement
NNC	Nunavut Nukkiksautiit Corporation
NGL	Nunavut Nukkiksautiit Corporation, Growler Energy, Landsvirkjun Power
NuPPA	Nunavut Planning and Project Assessment Act
NPC	Nunavut Planning Commission
NWB	Nunavut Water Board
QIA	Qikiqtani Inuit Association
QEC	Qulliq Energy Corporation
SEM	Sikumiut Environmental Management Limited
SIJJA	SIJJA Consulting
TC	Transport Canada
TLA	Territorial Lands Act
WSC	Water Survey of Canada

Executive Summary

1.0 Introduction

Growler Energy Inc. (Growler) and Nunavut Nukkiksautiit Corporation (NNC), in collaboration with the Qikiqtani Inuit Association (QIA), are investigating opportunities related to renewable energy development on Inuit Owned Land (IOL) in the Iqaluit area, hereafter referred to as the Iqaluit Nukkiksautiit Project. This Inuit-led study focuses on water and wind power potential in the region, to reduce reliance on diesel fuel for electricity generation. Sikumiut Environmental Management Limited (SEM) has been retained to provide professional consulting services for environmental assessment and regulatory support. Stakeholder and Indigenous consultation services are being provided by the Firelight Group (Firelight), and SIJJA Consulting (SIJJA). Specialist engineering services are supplied by Canadian Projects Limited (CPL), Landsvirkjun Power (LVP), and Frobisher Energy Services (Frobisher). The Iqaluit Nukkiksautiit Project is currently in Phase 2 – Generation and Selection of the Preferred Alternatives.

1.1 Scope of Work

SEM has been tasked with supporting the Project selection and definition process by addressing the following:

1. Summarize the existing environmental baseline information for each of the candidate Project Alternatives;
2. Provide input to the ranking and selection of Project Alternatives by addressing environmental and regulatory risks associated with each;
3. Identify the baseline information needs (work scope, schedule, and budget) to proceed with the environmental assessment and permitting processes for the selected Project; and
4. Provide an overview description of the applicable regulatory considerations, extending to actual construction/commissioning of the selected Project.

1.2 Project Background

Electricity in Iqaluit is currently supplied by six diesel generators, with a total nominal capacity 17.6 MW. Total electricity generation in 2021 was 59.2 GWh, equating to ~15 million litres of diesel fuel (Canadian Projects Limited, 2023). While there are challenges in locating electricity generation alternatives in the region, there is considerable impetus for the reduction of carbon loading and the utilization of renewable sources. Load profiles indicate increased daily demands mid-day and evening, with higher overall demand during winter season. Future consideration will be given to transitioning of thermal heating from heating oil to electrically based heating. This measure would substantially increase system demand in the winter season. Some combination of hydroelectricity, wind, and pumped storage hydro energy system will be required to displace or replace diesel and heating oil-based energy demand.

During the period 2005-2012 the Qulliq Energy Corporation (QEC), as the sole electrical utility in Nunavut, undertook a series of studies to determine the feasibility of developing hydroelectric generation to supply electricity to the City of Iqaluit, offsetting or replacing the existing diesel generation plant (Qulliq Energy Corporation, 2013). The objectives were to meet Iqaluit's energy requirements with a cost-effective renewable energy source, to stabilize and potentially reduce overall energy costs for QEC and ratepayers, and to reduce reliance on fossil fuel (diesel generated power). The resulting development would reduce the community's carbon footprint and reduce QEC's exposure to fuel price risks / market volatility.

Starting in 2005, Phase I Prefeasibility studies were undertaken by Knight Piésold Consulting (KPC) to identify and rank potential hydroelectric project sites within a 100 km radius of Iqaluit. Between 2006 and 2008, further comprehensive studies on engineering, environmental baselines, Inuit knowledge and financial analysis were conducted to narrow down preferential hydro sites.

In 2006, site visits were made to review geotechnical conditions and identify specific locations for project components. As a result, fourteen (14) potential hydroelectric projects sites were identified and ranked. Six of these were identified as appropriate for further investigation: Armshow River – Long, Armshow River – Right Lake, Jaynes Inlet, McKeand River, Anna Maria Port, and Cantley Bay.

The Phase II Prefeasibility Studies initiated in 2007, focused on four project sites: the Armshow River – Mainstem, Armshow River – Right Lake, Cantley Bay, and Jaynes Inlet. Public consultations took place to gather more information from land users, hunters, cabin owners, and other key stakeholders on the relevant social and economic drivers influencing project selection decisions . In 2008, the selected Iqaluit Hydroelectric Project was described as a staged development of hydroelectric power from sites in Jaynes Inlet (12.5 MW) followed by Armshow South (7.3 MW) (Qulliq Energy Corporation, 2013). In 2014 however, the Iqaluit Hydroelectric project was put on hold by QEC due to the large capital investment required.

More recently, in the 2021 Canadian federal budget, the Minister of Northern Affairs announced funding for infrastructure projects across Inuit Nunangat as part of the government's Indigenous Community Infrastructure Fund. In response, the QIA re-opened the door to renewable energy in Iqaluit with an application to the fund, in partnership with Growler and LVP. The organization is funded over four years, and, in addition to Iqaluit, is examining renewable energy projects in Sanikiluaq, Pond Inlet, and Igloolik. The scope of work for Iqaluit involves a re-assessment of hydro-electric generation options as well as consideration of wind-generation and pumped-storage hydroelectricity (PSH). The re-evaluation of hydroelectric opportunities is to include alternative layouts conducive to terrain and climate, such as lateral diversions and tunnels. Load forecasting is also being revised in terms of the total energy demand in Iqaluit over the next fifty years and is to encompass the demand for thermal energy.

1.3 History of Environmental Studies

The available baseline environmental information is almost exclusively the result of the previous hydroelectric project feasibility studies. The work undertaken had been incrementally focused geographically in response to and as a consequence of efforts to select the most suitable hydroelectric generation sites. The 2005- 2008 examination of watersheds near Iqaluit followed a sequenced approach. An initial reconnaissance identified candidate sites on five watersheds. A limited program of baseline environmental field surveys was conducted of the candidate watersheds, with an increased level of effort focused on the two most attractive sites and culminating with a project proposal (Iqaluit Hydroelectric Project) submitted for review by the Nunavut Impact Review Board (NIRB File No. 13UN006) (Qulliq Energy Corporation, 2013). Following a July 15, 2013 determination by the Minister that an EIS would be required, draft Environmental Assessment Guidelines were issued by NIRB in August 2013, however further work was suspended when the project was put on hold.

The initial Phase 1 Prefeasibility examination (2005-2006) was reconnaissance in nature and produced limited environmental baseline material. The Phase II Prefeasibility Studies initiated in 2007, focused on four projects sites: the Armshow River – Mainstem, Armshow River – Right Lake, Cantley Bay, and Jaynes Inlet. The work carried out for environmental assessment included preliminary fisheries and aquatic surveys to document fish presence using various sampling methods, overview descriptions of fish habitat, and a consideration of fish movement patterns (i.e. determine anadromy) using strontium analysis of otoliths. Aerial surveys were also undertaken to identify raptor use and delineate raptor habitat. Desktop reviews were conducted of soil and vegetation as well as terrestrial wildlife and archaeology. An Inuit knowledge (IQ) study was initiated in 2006.

In 2008, updated hydrological analyses were completed at four of the preferred sites: Armshow River, Armshow South, Cantley Bay, and Jaynes Inlet. During 2008 and 2009, environmental baseline studies were completed for the Jaynes Inlet site by LGL Limited, NordEco, North/South Consultants Inc., and KPC. These studies focused on freshwater ecosystems, marine ecosystems, birds, carnivores, small mammals, and caribou. This work included a descriptive Ecological Land Classification report produced in 2009 by KPC, a Spring 2009 Environmental Baseline Study Report by RSW Inc., and an Environmental Baseline Studies Final Report by RSW Inc. issued in 2011.

In 2012 KPC prepared a Draft Gap Analysis and Risk Assessment of Supplemental Environmental Baseline Studies. The report indicated that most of the key environmental components at Jaynes Inlet were addressed to meet minimum requirements, but supplemental baseline programs were recommended either to fill gaps or strengthen the existing dataset. Considerably less baseline information was available for the Armshow River system. Aquatics surveys were at a reconnaissance level and no terrestrial work had been completed. The gap analysis was completed at a time when project elements were not fully developed, e.g. transmission corridor routing, sources of aggregate. The level of information available was, however, deemed adequate to support the environmental registration process.

The 2012 Gap Analysis report noted that collection of supplemental baseline studies targeted for 2013, was to include soil and vegetation surveys, terrestrial wildlife surveys, hydrology surveys, water and sediment quality studies, and fish/fish habitat surveys. Further engineering studies were also planned, including geotechnical drilling, test pitting and surface geological and terrain mapping.

On November 23, 2012 the Nunavut Impact Review Board (NIRB) received QEC's "Iqaluit Hydro-Electric Baseline Study" project proposal. Several permits were granted to QEC for studies slated to occur from March 2013 to February 2015, including: a Scientific Research License from the Nunavut Research Institute (NRI), a Land Use Permit from Aboriginal Affairs and Northern Development Canada (AANDC), and a Type B Water License from the Nunavut Water Board (NWB). The field studies proposal and associated licenses were registered under ID# 12YA048 in the public NIRB registry. However, it appears that these studies were not initiated.

In February 2013, QEC submitted the proposal for the Iqaluit Hydroelectric Project to NIRB thereby initiating the environmental screening process for the sites at Jaynes Inlet and Armshow River South (Qulliq Energy Corporation, 2013). A series of study applications were also submitted in 2013, including to the QIA for Access of Inuit Owned Land, Nunavut Parks for a Nunavut Territorial Parks Use Permit, AANDC for a Land Use Permit for Crown Land, and the NWB for a General Water License. NIRB started its review in July of 2013 and issued the Draft Guidelines for the Preparation of an Environmental Impact Statement (EIS) to QEC in August of 2013. The final version of the EIS Guidelines was issued to QEC in November of 2013. However, the project was shelved shortly thereafter.

In 2017 the NIRB acknowledged an update from QEC regarding the project and requested that QEC continue to provide annual updates to advise whether the company intends to re-engage the assessment process. For planning purposes and to ensure the required funding is in place to facilitate the next steps in the review process, the Board advised that a minimum of three (3) months' notice will be required to reactivate the review process.

The Project Proposal as submitted to NIRB (KPC, 2013) provided a review of previous baseline work and includes a listing of References for baseline studies (see Table 1.3.1 below).

Table 1.3.1 List of Selected References cited in KPC 2013.

#	Citation
1	Knight Piésold Ltd. 2006a. Identification and Ranking. Ref. No. VA103-137/1-1, Rev 0 dated January 17, 2006.
2	Knight Piésold Ltd. 2006b. Phase II Pre-Feasibility Report. Ref. No. VA103-137/1-3, Rev A dated August 25, 2006
3	Knight Piésold Ltd. 2006c. Summary of IQ and Land Use Information. Ref. No. VA103-137/1-2,Rev 0 dated October 2, 2006.
4	Knight Piésold Ltd. 2008a. Qikiqgijaarvik Hydrological Analysis. Ref. No. VA103-00137/2-1, Rev 0 dated September 18, 2008.
5	Knight Piésold Ltd. 2008b. Tungatalik Hydrological Analysis. Ref. No. VA103-00137/2-4, Rev 0 dated September 18, 2008.
6	Knight Piésold Ltd. 2008c. Akulikutaaq Hydrological Analysis. Rev. No. VA103-137/2-3, Rev 0 dated September 18, 2008.
7	Knight Piésold Ltd. 2008d. Kangalait Hydrological Analysis. Ref. No. VA103-137/2-2, Rev 0 dated September 18, 2008.
8	Knight Piésold Ltd. 2008e. Iqaluit Hydroelectric Project – 2007 Environmental Baseline Studies - Environmental Baseline Report. Report Ref. No. NB103-137/2-1, Rev. 0, dated April 18, 2008
9	Knight Piésold Ltd. 2011. Qulliq Energy Corporation - Iqaluit Hydroelectric Projects – Comprehensive Development Report. Knight Piésold Ref. No. VA103-137/6-1, Rev. 0 dated April 13, 2011.
10	Knight Piésold Ltd. 2012. Updated Hydrological Analyses - Qikiqgijaarvik and Tungatalik Sites Memo Ref. No. NB12-00472, dated October 16, 2012
11	North/South Consultants Inc. 2008. Aquatic Environment Investigations at the Armshow River, Baffin Island, Winter 2008. May 2008.
12	RSW Inc. 2011. Jaynes Inlet HEP - Environmental Baseline Study - Final Report. Dated April 2011

In our review of material on file, Table 1.3.2 was constructed to list the baseline environmental studies and data collection conducted to support the Iqaluit Hydroelectric Project during the period 2005 – 2012. Note (in bold) several cited reports are not in our possession, nor are the original data files in most cases.

Table 1.3.2 Review of Environmental Baseline Studies and Data Collection – Iqaluit Hydroelectric Project.

Year	Undertaking	Source Reference, Notes
2006	Aug 2006 – WSC installed and operated streamflow monitoring stations	Armshow, Armshow South, Cantley and Jaynes
	2006 – LIDAR mapping of the five candidate sites contracted by QEC	Summarized in Identification and Ranking Report (reference VA103-137/1-1). **Copy of data needed**.
	March 2007 (report on 2006 field studies) Fisheries Assessments for Five Potential Hydroelectric Generating Sites on Southern Baffin Island. By North/South Consultants.	KPC Comprehensive Development Report (CDR) App. E - 474/1666.
	Raptors (KPC) 2006 Raptor Survey of Five Candidate Hydro-electric Sites. Letter report dated March 12, 2007.	Summarized in KPC CDR Section 2.3. KP Ref. No. NB07-00210. **Copy of report needed.**
	Land use and IQ (KPC). Summary of IQ and Land Use Information. KP Ref. No. VA 103-00137/1-2 Rev A Aug. 26, 2006	Summarized in KPC CDR p.556/1666. **Copy of report needed.**
	Archaeology (Govt. Nunavut CLEY)	Summarized in KPC CDR Section 2.3. KPC CDR App. F p. 558/1666. **Copy of report needed**.
2007	2007 Environmental Baseline Studies Summary of the Environmental Baseline Report (Ref. No. NB 103-00137/2-2) Dated April 11, 2008. Reporting on four sites, three short-listed rivers.	KPC CDR App. F 550/1666
2008	Knight Piesold Ltd. 2009 Iqaluit Hydro-Electric Project- Jaynes Inlet. - Final Environmental Baseline Studies Summary Report (Ref. No. NB103-00137/4-4) submitted to Qulliq Energy Corporation Aug. 6, 2009	See KPC CDR App. G. p. 565 of 1666
	Pisiak D. J. and W.J Bernhardt. 2008. Aquatic Environment Investigations at Potential Hydroelectric Generating Sites on Southern Baffin Island. A report prepared for Knight Piésold by North/South Consultants Inc. xi + 241 p	Referenced in KPC CDR App. G p. 554/1666). **Copy of report needed.**
	Jan. 31 2008 : Socio-Economic Impact Assessment, Iqaluit Hydro Electric Development Project. Report by Enokseot Holdings Ltd.	KPC CDR App. H p 1186/1666
2009	Bernhardt, W.J., K. G. Dawson, and M. Gillespie. 2009. Aquatic Environment Investigations at Jaynes Inlet, southern Baffin Island. A report prepared for Knight Piésold by North/South Consultants Inc. xv + 406 p.	KP CDR App. G p.600/1666
	2009 Spring baseline surveys Jaynes Inlet RSW- Spring 2009 Environmental Baseline Studies Report	KPC CDR App.J p 1435/1666
	March 26, 2009 – Climate Change Impacts Assessment McBean, et al.	KPC CDR App.I - p 1372/1666
	2009 – LIDAR survey of Jaynes Inlet project area.	KPC CDR, p. 10/1666. **Copy of data needed.**

Table 1.3.2 Review of Environmental Baseline Studies and Data Collection – Iqaluit Hydroelectric Project (cont'd).

Year	Undertaking	Source Reference, Notes
2009	January 31, 2009. Bird and terrestrial Mammal Surveys, QEC Iqaluit Hydro Project – Final Baseline Studies Report. A report prepared for Knight Piésold Ltd. by LGL Ltd.	Appendix B p 1007/1666
	Michael A.D. Ferguson. Caribou Habitat Suitability and Related Inuit Qaujimajatuqangit for the Proposed Hydroelectric Generating Site on the Jaynes Inlet Watershed on Southern Baffin Island. June 2009.	Appendix C p 1037/1666
	Knight Piésold Ltd. Ecological Land Classification 2009 Final Report (Ref. No. NB103-00137/4-2)	Appendix D p 1094/1666
2011	April 13, 2011.KPC Comprehensive Development Report (CDR) (VA103-137/6-1)	
	April 2011 RSW/ Environnement élllimité Inc. Environmental Baseline Study Final Report (P48 0770 E0054 DOC) Integrates previous seasonal studies (2005 to 2010).	
2012	Sept. 14, 2012. Draft Gap Analysis and Risk Assessment (cover letter, tables, Appended review of baseline reports and data gaps).	
	Oct. 2012 Water Survey of Canada report on 2011 and 2012 field operations of hydrometric gauges	

The available baseline biophysical information can be summarized as follows:

- Jaynes Inlet – broad scope of baseline surveys completed; however, selected supplemental studies are required to support an EIS.
- Armshow River – limited aquatic surveys completed; no terrestrial surveys conducted.
- Cantley Bay –desktop study only.
- McKeand River South – desktop study only.
- Sylvia Grinnell River – no information available.
- McKeand River North – no information available.

Note, there may be some field data generated by the proposed Chidliak Diamond Mine located near McKeand River North.

2.0 Summary of Alternatives

The current examination encompasses hydroelectric, wind generation and pumped storage schemes for electric power generation and energy storage, including potential combinations of generation that can meet the current and anticipated electric power demand for Iqaluit. As summarized in Table 2.1, the possibilities include five locations for a wind turbine farm along with one possible wind turbine-pumped storage site. Eight hydroelectric power options are also being considered, including all those evaluated in the 2005 pre-feasibility studies by KPC.

Combinations of alternatives are under consideration such as the incorporation of a wind farm and pumped storage to candidate hydroelectric sites. At the direction of the client however, the environmental risk of each generation component is to be considered separately since complete development scenarios have yet to be selected. Note that the risk rating assigned to each scenario will not necessarily be additive (i.e. combining two low-risk generation options does not necessarily result in a low risk rating).

Common to all alternatives will be a transmission corridor to Iqaluit; the farther the generation location from the community, the longer the corridor. Specifics regarding the size and scale of candidate wind turbine sites have yet to be developed, preventing any comparison based on the footprint area of each. The general location of each alternative is given in Figures 2.1-2.2. Overview maps of the proposed transmission corridors for various alternatives, general arrangements as presented by KPC in 2005- 2011, and early concept sketches provided by CPL in 2023 are all given in Appendix A.

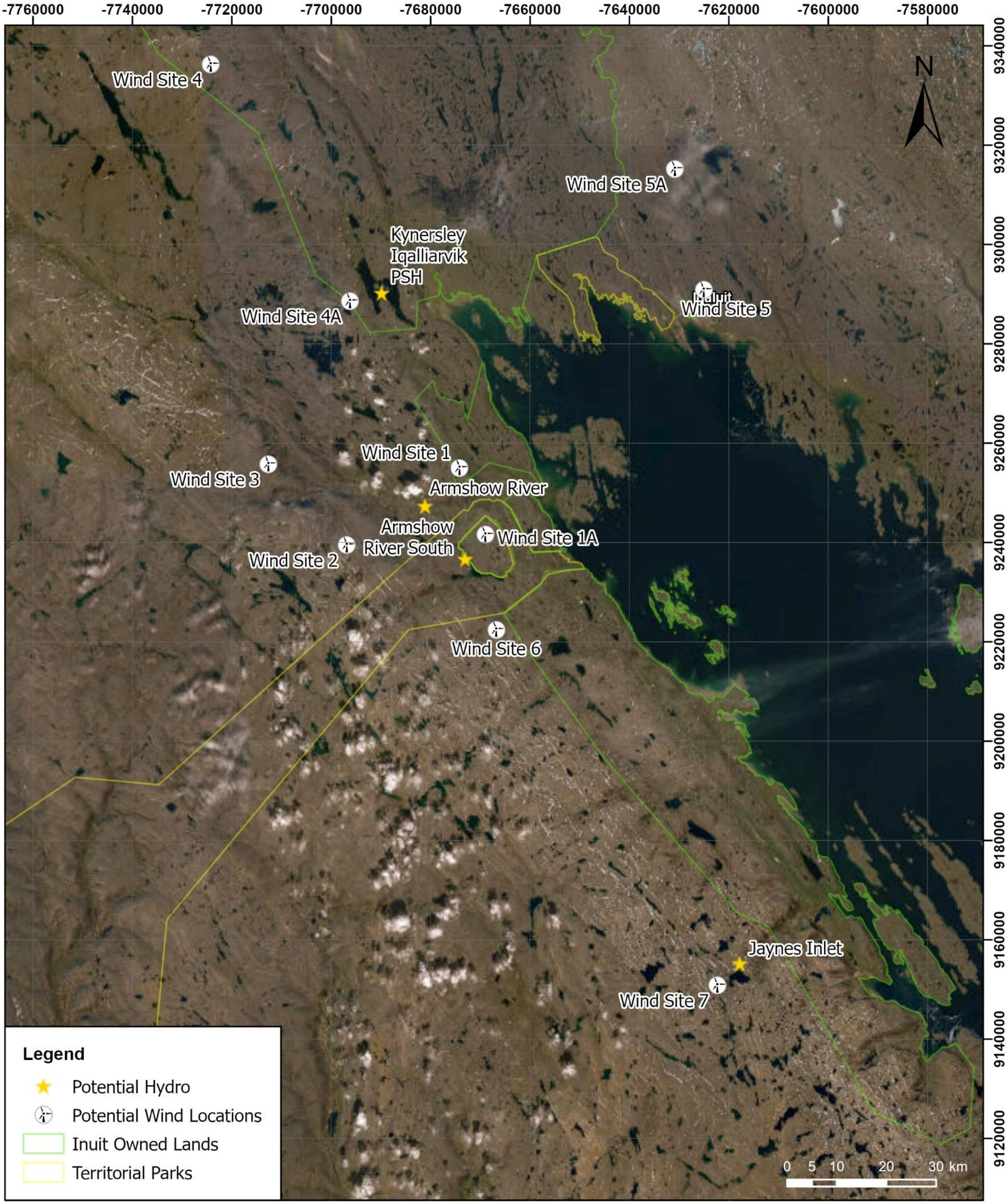
Table 2.1 Index of Project Alternatives.

ID	Location	Type	Sub Alternative	Figure#
1AC	Armshow River	Conventional HEP	Short	2.3
1BC	Armshow River	Conventional HEP	Long	A.4, A.7, A.10, A.11
2CP	Armshow River - Three Lakes	Conventional HEP + PSH	tunnel / shaft preferred, penstock less feasible	A.5, A.26
3AC	Armshow River - South Lake (aka Right Lake)	Conventional HEP	Penstock to the North (powerhouse locations)	A.6, A.8, A.12, A.26
3BC	Armshow River - South Lake (aka Right Lake)	Conventional HEP	Tunnel to the East	A.26
4AC	Jaynes Inlet	Conventional HEP	Penstock	A.13, A.15,
4BC	Jaynes Inlet	Conventional HEP	Tunnel / Penstock	A.14, A.27
5AC	Cantley Bay	Conventional HEP	Base Case	A.17-A.21
5BC	Cantley Bay	Conventional HEP	McKeand River Diversion	
6AC	McKeand River	Conventional HEP	South Dam	A.22
6BC	McKeand River	Conventional HEP	North Dam	A.23, A.24
7C	Sylvia Grinnell River	Conventional HEP	-	A.25

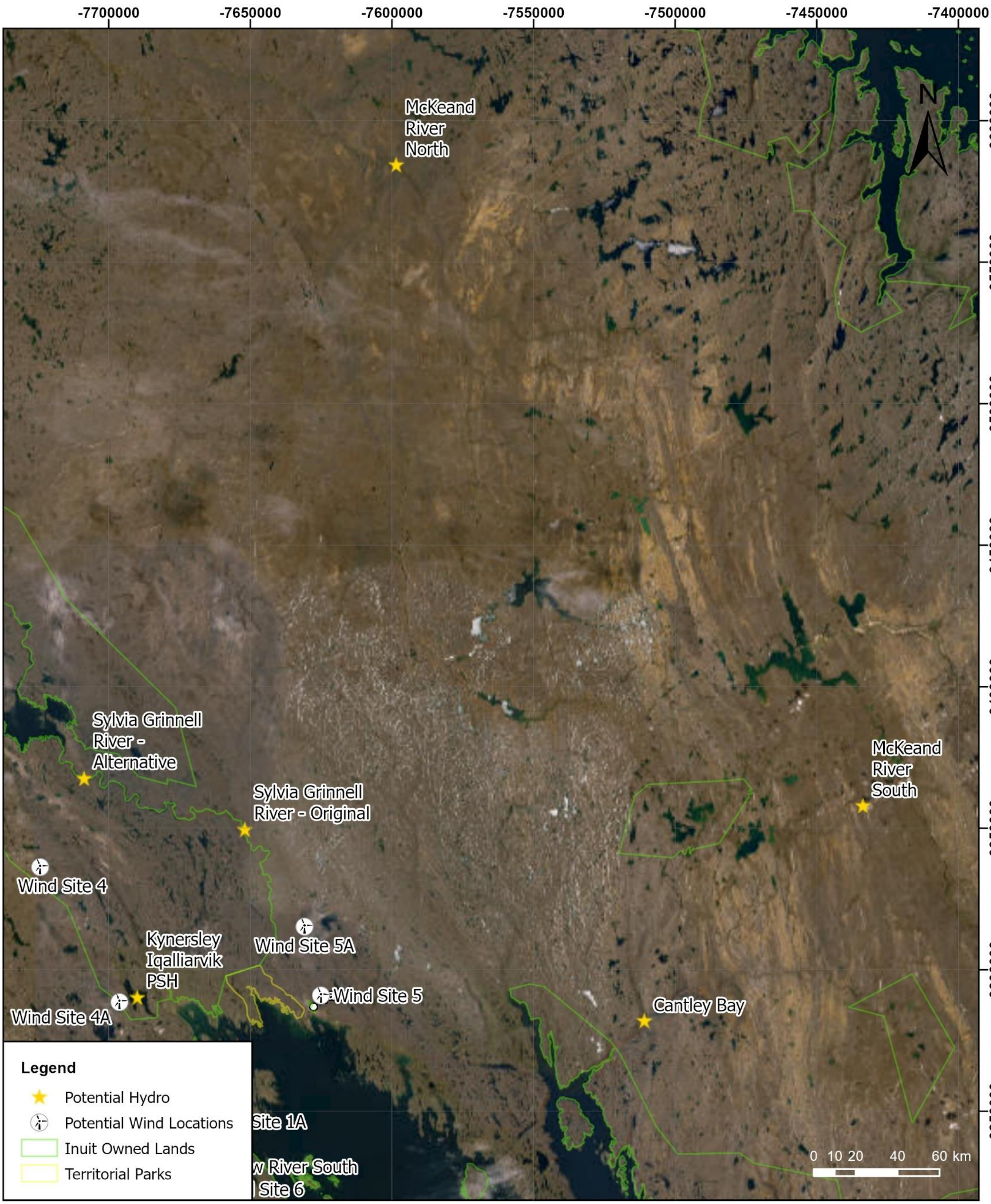
Table 2.1 Index of Project Alternatives (cont'd).

ID	Location	Type	Sub Alternative	Figure#
8P	Kynersley Iqalliarvik Lakes	PSH (closed-loop)		A.28
11W	Iqaluit North (Wind Site 5 or 5A)	Wind		A.29
12W	Qasitujuak Lake Ridge (Wind Site 4 or 4A)	Wind		A.28
13W	Armshow River Lower Ridge (Wind Site 1 or 1A)	Wind	tunnel / shaft	A.26
14W	Armshow River Highlands (Wind Site 2, 3, or 6)	Wind		A.26
15W	Jaynes Inlet Highlands (Wind Site 7)	Wind		A.27

Each alternative was assigned an identification number according to the geographical area in which it would be located, followed by a letter indicating the sub-alternative (A or B), and ending with a letter code indicating the type of electricity generation (C = conventional hydroelectric power, P = pumped storage hydro, W = wind).



Growler Energy	Iqaluit Nukkiksautiit Project	PREPARED BY: BC	PREPARED BY: sem
	Figure 2.1 Overview of Project Alternatives (South)	COORDINATE SYSTEM: WGS 1984 Web Mercator	DATE: 03/16/2023



Growler Energy	Iqaluit Nukkiksautiit Project	PREPARED BY: BC	PREPARED BY: sem
	Figure 2.2 Overview of Project Alternatives (North)	COORDINATE SYSTEM: WGS 1984 Web Mercator	DATE: 03/16/2023

2.1 Physical Features and Activities

For this screening exercise, common components amongst the alternatives were assumed to include:

- site access roads or routes; accompanied by:
    - terrain/vegetation disturbance
    - waterbody diversions/realignments;
    - water crossings;
    - water management infrastructure to divert, control, collect and discharge surface drainage and groundwater seepage to the receiving environment;
- construction workspace and laydown areas;
- storage for fuels, explosives and hazardous wastes;
- energy supply source for construction (assumed to be temporary);
- waste disposal using a portable incinerator and/or transportation to Iqaluit for disposal (assuming proper methods of disposal for all waste streams, and of a quantity that the landfill in Iqaluit is capable of handling);
- temporary worker accommodations;
- creation of new borrow pits and quarries; and
- construction of temporary marine wharf facilities (in some regions) for construction equipment transfer.

Hydroelectric generation projects were assumed to include:

- dam structures (earthen or concrete);
- a storage reservoir;
- a powerhouse containing generating units/turbines;
- spillway structures;
- water intake structures and penstocks; and
- transmission lines, electrical substations, and grid tie-in points.

Wind power generation projects were assumed to include:

- access roads of sufficient width and grade for transport of turbine components;
- laydowns for turbine assembly;
- a concrete turbine base and anchor points augured in concrete;
- wind turbine generators, each of 2.5 MW capacity spaced 300m apart;
- meteorological towers (erected during site feasibility investigation); and
- transmission lines, electrical substations, and grid tie-in points.

Pumped storage hydro (PSH) projects were assumed to include:

- a high elevation and a low elevation water reservoir, accompanied by dams and controlled flow-release structures;
- a pump station containing a generator/motor and a turbine/pump;
- a penstock/tunnel for water flow between the reservoirs;
- a powerhouse containing generating units/turbines;
- transmission lines, electrical substations, and grid tie-in points.

A summary of the available information upon which this screening exercise was completed for each alternative is given below in Table 2.2. Where a PSH scenario is noted, the height of the dam / reservoir size for the higher elevation waterbody is given first. Energy storage capacity of the PSH scenarios nor energy generation capacity for the wind scenarios was defined at the time of this report. The range of transmission lengths given for wind alternatives considers the shortest path of the closest site to Iqaluit, up to if all the indicated multiple sites were developed including the furthest away. Further details regarding the geographic extent of components are given in Section 5.1.

Table 2.2 Summary of Key Alternative Physical Features.

ID	Location	Capacity (MW)	Dam Height (m)	Reservoir Size (ha)	Approximate Transmission (km)
1AC	Armshow River Mainstem - Short	18	80	770	47
1BC	Armshow River Mainstem - Long	19	60	1,630	47
2CP	Armshow River - Three Lakes PSH	UN	10 , UN	580 , 80	56
3AC	Armshow River - South North Penstock	8.8	25	670	47
3BC	Armshow River - South East Tunnel	8.8	25	670	47
4AC	Jaynes Inlet – Penstock	14.6	30	860	96
4BC	Jaynes Inlet – Tunnel & Penstock	14.6	30	860	96
4BCP	Jaynes Inlet PSH	UN	30 , 15	860 , 10	96
5AC	Cantley Bay	15	105	580	50
6AC	McKeand River South	13	60	10500	62
6BC	McKeand River North	20	80	4800	140
7C	Sylvia Grinnell River	8	50	31000	33
8P	Kynersley Iqalliarvik PSH	UN	2, 3	1500 , 1000	17
11W	Iqaluit North (Wind Site 5 or 5A)	10-100	NA	NA	1-12
12W	Qasitujuak Lake Ridge (Wind Site 4 or 4A)	10-100	NA	NA	29-47
13W	Armshow River Lower Ridge (Wind Site 1 or 1A)	10-100	NA	NA	56-60.3
14W	Armshow River Highlands (Wind Site 2, 3, or 6)	10-20	NA	NA	47-95.5
15W	Jaynes Inlet Highlands (Wind Site 7)	10-20	NA	NA	47+10

UN = unknown at time of evaluation

3.0 Summary of Biophysical Environment

SEM was tasked with reviewing the environmental and regulatory materials that were prepared for the previous proponents by KPC (among others), as provided by the NNC. Appendix B presents a series of maps indicating the locations of various environmental baseline studies conducted previously for the Jaynes Inlet Project as proposed in 2013. Studies were mostly focused within the immediate project area, i.e. the Local Study Area (LSA), with fewer studies spread throughout the Infrastructure Regional Study Area (IRSA) (approximately 10 km radius of the generation site), and the Transmission Line Corridor (TLC) (a 10 km-wide swath from the project area to Iqaluit).

A literature and information search of environmentally sensitive ecosystems and species which may be present within the areas under consideration was also conducted to fill knowledge gaps.

For this study, SEM is not responsible for summarizing the human environment, however the link between resource use and ecological importance is assumed to be present. The current evaluation will benefit from revision to include land and resource use information gained from socio-economic studies.

3.1 Air Quality

Effects on air quality will be restricted to the construction period, and receptors of air pollution effects may be restricted to construction personnel in areas which are far away from any permanent settlements. Air quality baseline measurements have not been performed within any of the areas being considered. These may not be required to register a project with the NIRB, however are anticipated to be required as part of an EIS. Air quality data collected by Environment Canada at the station in Iqaluit may be used to initiate the environmental assessment process.

3.2 Climate and Meteorology

Climate information was compiled for the Jaynes Inlet and Armshow River areas in the Climate Change Impacts Assessment, prepared in 2009 by G.A. McBean Consulting. Additional climate change analysis information was included in the KPC 2008 hydrological analysis for the region. In those studies, climate data from the government of Canada's Iqaluit (Station # 2402592) and Kimmirut (Station # 2402673) meteorological stations was assessed for climate trends. Data from both stations showed high year to year variability and only slight trends in annual precipitation, with no statistically significant trends present from about 1970-2006.Temperature trends in Iqaluit showed a slight cooling trend from 1950 to 1970, but a warming trend of 0.5 ºC per decade between 1970 and 2006. Temperature trends in in Kimmirut exhibited a warming trend of 0.8 ºC per decade between 1970 and 2006. The climate record of Iqaluit for the period 1961-1990 indicates a mean annual air temperature of -9.6 ºC, with mean July and February temperatures of 7.7 ºC and -26.8 ºC, respectively. The mean temperature is above freezing for four months, between June and September.

Climate information from previous assessments was updated using current modelling data, which incorporates state-of-the-science methodology and more up-to-date historical climate data. Climate and meteorological data from the Climate Atlas of Canada (Prairie Climate Centre, 2023) were used to assess climate trends for each of the following regions. The Climate Atlas of Canada uses downscaled data derived from 24 CMIP5 global climate models. Predictions were developed for 10 by 10 km grids using the high carbon (RCP8.5) scenario, which assumes that GHG emissions will continue to increase at current rates. It should be noted that the Climate Atlas of Canada uses a baseline period between 1976 to 2005 for comparison to the immediate future (2021-2050) and the near future (2051-2080).

Sea ice concentrations and length of ice season are expected to decline significantly in the future. In addition, warmer temperatures may increase permafrost degradation. This will cause increased rates of rock weathering and loading of nutrients, sediment, dissolved organic and inorganic carbon, and possible contaminants to the waterbodies in the region. Permafrost degradation could also increase infiltration of water into the ground, affecting the relationship between precipitation and discharge. The magnitude of peak-runoff in spring and early summer may be reduced by thawing permafrost. It is also possible that the loss of permafrost coupled with enhanced evaporation in a higher temperature climate may cause shallow Arctic River and lake systems to dry out. Careful monitoring of water levels, permafrost layer depth, evaporation and precipitation will be required to deduce the net effect of these factors on the volume of water available for hydroelectric generation.

3.2.1 Armshow River Region

The Armshow River Grid was selected to gather climate and meteorological data for the Armshow River, Jaynes Inlet, Kynersley-Iqalliarvik lakes, the Qasitujuak Lake Ridge, and the Iqaluit North regions. Total annual mean precipitation is projected to increase from 461mm (1976-2005) to 580 mm by 2051-2080, with increases occurring every season. The seasonal increases were estimated to be 37 mm for winter, 19 mm for spring, 27 mm for summer and 34 mm for fall. The annual mean temperature is projected to increase from -9.8 °C (1976-2005) to -4.1 °C by 2051-2080. It was predicted that seasonal increases will occur for annual mean temperature, with the greatest increases in winter (+10 °C) followed by summer and fall (+5 °C), and spring (+4 °C). Due to these climate shifts, the frost-free season was expected to increase from 57 days (1976-2005) to 106 days. Furthermore, the average dates of the frost-free period were expected to shift from June 29 to August 29 (1976-2005) to June 7 to September 25 by 2051-2080. The annual net number of freeze-thaw days was expected to decline from 38.5 days (1976-2005) to 32.8 days by 2051-2080.

3.2.2 Ward Inlet Region

The Ward Inlet Grid was selected to gather climate and meteorological data for the Cantley Bay and McKeand River South region. Total annual mean precipitation is projected to increase from 460 mm (1976-2005) to 564 mm by 2051-2080, with increases occurring every season. The seasonal increases were estimated to be 31 mm for winter, 16 mm for spring, 24 mm for summer and 32 mm for fall. The annual mean temperature is projected to increase from -9.6 °C (1976-2005) to -4.1 °C by 2051-2080. It was predicted that seasonal increases will occur for annual mean temperature, with the greatest increases in winter (+9 °C) followed by spring and fall (+5 °C), and summer (+4 °C). Due to these climate shifts, the frost-free season was expected to increase from 50 days (1976-2005) to 100 days. Furthermore, the average dates of the frost-free period were expected to shift from July 3 to August 26 (1976-2005) to June 10 to September 22 by 2051-2080. The annual net number of freeze-thaw days was expected to decline from 40.1 days (1976-2005) to 33.6 days by 2051-2080.

3.2.3 Chidliak Bay Region

The Chidliak Bay Grid was selected to gather climate and meteorological data for the McKeand River North region. Total annual mean precipitation is projected to increase from 460 mm (1976-2005) to 572 mm by 2051-2080, with increases occurring every season. The seasonal increases were estimated to be 32 mm for winter, 17 mm for spring, 27 mm for summer and 35 mm for fall. The annual mean temperature is projected to increase from -10.5 °C (1976-2005) to -5.0 °C by 2051-2080. It was predicted that seasonal increases will occur for annual mean temperature, with the greatest increases in winter (+9 °C) followed by spring and fall (+5 °C), and summer (+4 °C). Due to these climate shifts, the frost-free season was expected to increase from 39 days (1976-2005) to 93 days. Furthermore, the average dates of the frost-free period were expected to shift from July 7 to August 19 (1976-2005) to June 12 to September 17 by 2051-2080. The annual net number of freeze-thaw days was expected to decline from 38.4 days (1976-2005) to 29.9 days by 2051-2080.

3.2.4 Sylvia Grinnell Lake Region

The Sylvia Grinnell Lake Grid was selected to gather climate and meteorological data for the Sylvia Grinnell River region. Total annual mean precipitation is projected to increase from 435 mm (1976-2005) to 551 mm by 2051-2080, with increases occurring every season. The seasonal increases were estimated to be 33 mm for winter, 18 mm for spring, 29 mm for summer and 36 mm for fall. The annual mean temperature is projected to increase from -10.2 °C (1976-2005) to -4.4 °C by 2051-2080. It was predicted that seasonal increases will occur for annual mean temperature, with the greatest increases in winter (+9 °C) followed by spring and fall (+5 °C), and summer (+4 °C). Due to these climate shifts, the frost-free season was expected to increase from 57 days (1976-2005) to 107 days. Furthermore, the average dates of the frost-free period were expected to shift from June 29 to August 28 (1976-2005) to June 5 to September 24 by 2051-2080. The annual net number of freeze-thaw days was expected to decline from 37.3 days (1976-2005) to 31.5 days by 2051-2080.

3.3 Noise and Vibration

It is anticipated that the greatest noise emissions will be generated during the construction period, thus a qualitative analysis of background noise prior to construction will be beneficial to assess the effects of noise on the surrounding environment. Noise and vibration assessments have not been performed within any of the areas being considered. These may not be required to register a project with the NIRB, however are anticipated to be required as part of an EIS.

3.4 Geological Features, Surficial and Bedrock Geology and Geochemistry

A summary of the bedrock geology for each of the regions, adapted from the KPC Comprehensive Development Report, is given below in Table 3.4.1. Site reconnaissance of the six short listed project sites was done in August 2006 to assess the surficial geology and terrain hazards and to modify project layouts based on observed site conditions. An examination of the geomorphology or geochemistry has not been conducted at any of the areas being considered. This is information is not anticipated to be required to register a project with NIRB, however changes in river morphology as related to fish habitat and water quality would require assessment in the EIS. As well, the acid rock drainage (ARD) and metal leaching (ML) potential would need to be assessed at locations where rock would be blasted and crushed, as ARD/ML has the potential to affect long-term water quality.

Table 3.4.1 Summary of Bedrock Geology (Knight Piésold Consulting Ltd, 2011).

Location	Description
Armshow River / Jaynes Inlet	The Armshow River and Jaynes Inlet region is positioned on substantial monzogranitic plutons (Cumberland batholith) which intrude the platformal, basement and foreland basin. The Cumberland batholith consists of coarse to medium grained gigantic metaplutonic rocks. The most prominent rock type is orthopyroxene-biotite-monzogranite that is massive to weakly foliated. Garnet-biotite-orthopyroxene-cordierite and epidote bearing phases occur to a lesser extent. Bedrock geology is comprised of competent weathered granite that is locally migmitized.
Cantley Bay	Cantley Bay is positioned on highly metamorphosed rock. Bedrock geology is comprised of weathered granite, predominantly migmatite with foliation dipping Northwest.
McKeand River North / South	McKeand River is situated on metamorphic rock, most likely formed from deeply eroded Precambrian basement rock complexes. Bedrock geology is primarily hypersthene granite.
Sylvia Grinnell River	Bedrock geology is primarily of igneous origin – monzogranite (Cumberland Batholith). Principal rock type is orthopyroxene-biotite-monzogranite that is massive to weakly foliated. Minor garnet-biotiteorthopyroxene-cordierite and epidote bearing phases are present. Surficial Geology of Sylvia Grinnell River consists of till, outwash, deltaic gravel and sandy alluvium. Till is a clast supported silty sand; clasts are granule to large boulder size. Outwash is sand and minor silt and gravel.

3.5 Hydrological Features and Hydrogeology

KPC prepared a hydrological assessment in 2009 for the proposed hydroelectric developments at Jaynes Inlet, Armshow River, and Cantley Bay. The Jaynes River watershed, and the majority of the Armshow River watershed, are located on the Baffin Upland ecoregion, a high plateau located in the interior of the Meta Incognita Peninsula on southern Baffin Island. The lower catchment of the Armshow River is in the lower region of the coastal Meta Incognita Peninsula ecoregion. The majority of the Cantley River watershed is located on the Hall Peninsula Upland ecoregion, a high plateau located in the interior of the Hall Peninsula on southern Baffin Island.

The mean annual precipitation in all three regions ranges from 300 to over 500 mm. The hydrological regime in the region typically consists of early summer snow melt and late summer permafrost melt and rainfall. Throughout the period between November and May, the rivers are mainly frozen and have little to no streamflow. As part of feasibility studies and environmental baseline work, hydraulic modelling for the region can be updated using the WSC's station data at Sylvia Grinnell River near Iqaluit, for which historical data exists from 1971-2001 and 2006-2018 and real-time hydrometric data exists from 2021 to present. The need for additional stream and lake gauging programs can be devised once an alternative is selected.

Historical hydrometric data (water level and flow) is available for McKeand River near the South confluence, however, is limited to the years of 2007-2008. Investigations of the hydrological environment were not completed by the previous proponents within the Kynersley or Iqalliarvik lakes.

3.5.1 Jaynes River

The Jaynes River watershed is north-east facing and its elevation ranges from 750 mASL in its upper headwaters to 0 mASL where it drains into Jaynes Inlet on Frobisher Bay. The location of the proposed intake for the 2013 Jaynes Inlet Project was at the outlet of the largest lake within the Jayne Inlet catchment, with an elevation of 451 mASL and a drainage area of 203 km^2.

A total of four successful discharge measurements were collected at the streamflow gauging station installed by Water Survey of Canada (WSC) on the Jaynes River in August 2006. The measurements ranged from a low of 0.7 m^3/s to a high of 28.5 m^3/s. Based on the mean annual discharge (MAD) of 2.9 m^3/s at the gauge site, this equates to a range of 24% of MAD to 983% of MAD. This information was used to develop a stage-discharge rating curve for the gauge, with an overall uncertainty of +/- 7.3%. The rating curve was developed using a conservative approach with respect to energy generation modelling given the limitations of the available data. The MAD calculated from the regression analysis was 3.9 m/s^2, which equates to a mean annual unit runoff of 19 $L/s/km^2$. This differs significantly from the estimate of between

11 and 15 L/s/km^2 that was determined based on regional information available on comparable rivers (Apex River, Sylvia Grinnell River, and Soper River).

As of the 2008 report, very little data had been collected on the Jaynes River (1 year of concurrent streamflow data and four discharge measurements), therefore there was significant uncertainty associated with the rating curve developed for Jaynes River. Given this uncertainty, it was considered prudent to scale down the calculated flows by 25%, resulting in an MAD of 2.9 m^3/s and mean annual unit runoff of 14 L/s/km^2 which was consistent with regional patterns at the time. Historical hydrometric data (water level and flow) collected by the WSC is available for Jaynes River at the outlet of Jaynes Lake (2006-2013), and Jaynes River 10 km below the outlet of Jaynes Lake (2012-2014), which can be used to update the provided estimates.

3.5.2 Armshow River

The Armshow River watershed is north-east facing and the Armshow River mainstem ranges in elevation from 650 mASL in its upper headwaters to 0 mASL where it discharges into the Bay of Two Rivers on Frobisher Bay. Armshow River South ranges in elevation from 750 mASL in its upper headwaters to 50 mASL at its confluence with the mainstem. The location of the proposed intake for the 2013 Armshow River HEP on the mainstem has an elevation of 49 mASL and a drainage area of 2026 km2. The location of the proposed intake for the 2013 Armshow River South HEP has an elevation of 49 mASL and a drainage area of 278 km2.

A total of five successful discharge measurements were collected at the streamflow gauging station installed by WSC in August 2006 on the Armshow River mainstem. The measurements ranged from a low of 2.6 m3/s to a high of 212 m3/s. Based on the MAD of 24.9 m3/s, this equates to a range of 10% to 852% MAD. This information was used to develop a stage-discharge rating curve for the gauge, with an overall uncertainty of +/- 5.4%. There was uncertainty associated with the rating curve as it was defined by only five data points with unknown accuracy. The MAD calculated from the regression analysis was 33.2 m3/s which equates to a mean annual runoff of 16 L/s/km2. This was slightly higher than the estimate of between 10 and 15 L/s/km2 that was determined based on information available on comparable rivers (Apex River, Sylvia Grinnell River and Soper River).

A total of three successful discharge measurements were collected at the streamflow gauging station installed by WSC in August 2006 on the Armshow River South. The measurements ranged from a low of 1.9 m3/s to a high of 29.6 m3/s. Based on the MAD of 3.5 m3/s, this equated to a range of 54% to 843% of MAD. This information was used to develop a stage-discharge rating curve for the gauge, with an overall uncertainty of +/- 2.5%. There is uncertainty associated with the rating curve as it was defined by only three data points with unknown accuracy. The MAD calculated from the regression analysis was 4.7 m3/s, which equated to a mean annual runoff of 17 16 L/s/km2. This was significantly higher than the estimate of between 11 and 15 L/s/km2 that was determined based on information available on comparable rivers (Apex River, Sylvia Grinnell River and Soper River).

As of the 2008 report, very little data had been collected on the Armshow River South (1 year of concurrent streamflow data and three discharge measurements), therefore there was significant uncertainty associated with the rating curve developed for the Armshow River South. Given this uncertainty, it was considered prudent to scale down the calculated flows by 25%, resulting in a mean annual discharge of 3.5 m^3/s and a mean annual unit runoff of 13 L/s/km^2, which was consistent with regional patterns at the time. A similar situation was encountered for the Armshow River mainstem, thus it was considered prudent to scale down the calculated flows by 25%, resulting in a mean annual discharge of 24.9 m^3/s and a mean annual unit runoff of 12 L/s/km^2. Historical hydrometric data (water level and flow) is available for Armshow South River at the outlet of Armshow South Lake (2006-2014), Armshow River near the mouth (2006-2014), and Armshow North River at outlet Armshow North Lake (2006-2014) which can be used to update the provided estimates.

3.5.3 Cantley River

The Cantley River watershed is south-west facing and ranges in elevation from 740 mASL in its upper headwaters to 0 mASL where it discharges into Frobisher Bay. The location of the proposed intake for the Cantley Bay HEP as proposed in 2008 has an elevation of 122 mASL and a drainage area of 1787 km^2.

A total of five successful discharge measurements were collected at the streamflow gauging station installed by WSC on the Cantley River in August 2006. The measurements ranged from a low of 0.2 m^3/s to a high of 325 m^3/s. Based on the MAD of 23.1 m^3/s at the gauge site, this equated to a range of 1% MAD to over 1400% MAD. This information was used to develop a stage-discharge rating curve for the gauge, with an overall uncertainty of +/- 50%. Most of the error was associated with the extreme low (1%) MAD and extreme high (1400%) MAD, which are difficult to measure accurately. The MAD calculated from the regression analysis was 23.1 m^3/s, which equated to a mean annual unit runoff of 13 L/s/km^2. This was in line with the estimate of between 10 and 15 L/s/km^2 that was determined based on regional information available on comparable rivers (Apex River, Sylvia Grinnell River and Soper River). The calculated mean annual discharge rate seemed appropriate given the regional dataset, however, an uncertainty of +/- 25% was be considered due to the limited site data and uncertainty in the Cantley River rating curve.

3.6 Groundwater and Surface Water Quality

Aquatic environmental studies in Jaynes Inlet were conducted throughout 2007-2009, and an overview of the reaches studied is given below in Figure 3.6.1. Routine water quality data (as elaborated below in Figure 3.6.2) was collected from freshwater areas of the Jaynes Inlet River system, including nine survey areas along the lower reaches, the Upper Lake, the Lower Lake, as well as the evaluation of water quality and CTD profiling in the Jaynes Inlet estuary and the Cincinnati Press Channel. Maps of water quality sampling sites are included in Appendix B.

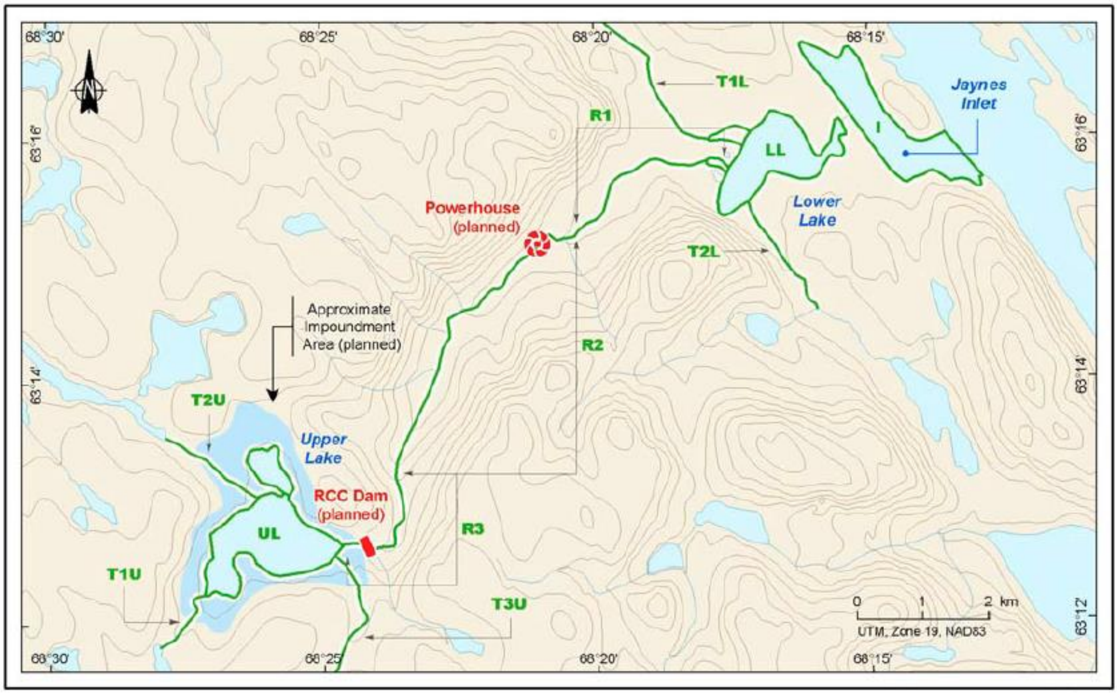


Figure 3.6.1 Aquatic Areas Studied within the Jaynes Inlet LSA (QEC 2011)

Review of materials did not indicate that any investigation of groundwater was completed in the Jaynes Inlet region. No investigation of surface water quality or groundwater quality was completed within any of the other proposed areas, however it was assumed that water quality characteristics in the river systems at the Armshow River, Jaynes Inlet, and Cantley Bay sites were comparable based on 2007 preliminary aquatic environment data.

The need for collection of water quality data can be devised once an alternative is selected, however is anticipated to be required to complete an aquatic environment description for an EIS with regards to physical parameters measured *in situ* (i.e., water temperature, dissolved oxygen, pH, conductivity, and turbidity) and routine water quality parameters (as elaborated below in Figure 3.6.2).

Routine Water Quality Parameters	Metals and Ions	
Alkalinity	Aluminum	Sodium
Bicarbonate (HCO_3)	Antimony	Strontium
$CaCO_3$	Arsenic	Tellurium
Carbonate (CO_3^{2-})	Barium	Thallium
Hydroxide (OH^-)	Beryllium	Tin
Nitrogen	Bismuth	Titanium
Ammonia	Boron	Tungsten
Nitrate	Cadmium	Uranium
Nitrite	Calcium	Vanadium
Total Kjeldahl nitrogen	Cesium	Zinc
Carbon	Chloride Dissolved	Zirconium
Total organic carbon	Chromium	
Dissolved organic carbon	Cobalt	
Phosphorus	Copper	
Total phosphorus	Hardness ($CaCO_3$)	
Orthophosphate	Iron	
Water clarity	Lead	
Total dissolved solids	Magnesium	
Total suspended solids	Manganese	
Turbidity (NTU)	Mercury	
Real colour (TCU)	Molybdenum	
pH	Nickel	
Conductivity (uS/cm)	Potassium	
Algal pigments	Rubidium	
Chlorophyll a (Chl a) (ug/L)	Selenium	
Pheophytin (ug/L)	Silicon Dissolved	
Reactive silica (SiO_2)	Silver	

Figure 3.6.2 Routine Water Quality Parameters, Metals, and Ions Measured in Water Samples within the Jaynes Inlet Study Region from 2007-2009.

3.6.1 Jaynes River, Upper Lake, and Lower Lake

In situ surface water measurements and routine water quality samples were taken from nine locations along the Jaynes Inlet river, from the mouth of the river at Frobisher Bay along the mainstem tributary to 0.5 km upstream of the upper lake. Based on analysis of field measurements and routine water quality parameters, freshwater in the Jaynes River system was described as well oxygenated, clear (low turbidity and total suspended solids (TSS)), near neutral (pH 6.5-7.0), soft (hardness less than 60mg/L as $CaCO_3$), dilute (low conductivity and total dissolved solids(TDS)), nutrient poor (low phosphorus and nitrogen), and having low primary productivity (low chlorophyll-a and pheophytin-a concentrations). The lower reaches of the Jaynes River watershed can be categorized as either oligotrophic or ultra-oligotrophic based on total phosphorus and chlorophyll-a concentrations. Dissolved oxygen, pH, nitrate, nitrite, and ammonia levels in each routine water quality sample were all within the Canadian Council of Minsters of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQGs) for the Protection of Aquatic Life. Most metal and major ion samples were within the CEQGs with two exceptions: one sample had a copper concentration that just barely surpassed the CEQG, and one sample had a lead concentration that was roughly 2.5 times the suggested CEQG. These are presumed to have been collected from stations WC-1 and WC-14S respectively, as these sites had the higher concentrations noted in previous tables given in the report, however it is difficult to be certain due to cryptic sample names on the analytical certificates included.

In the Upper and Lower lakes, the water column was sampled at the top (0.5 from the surface) and at the bottom (1m from the floor). Vertical temperature, oxygen, and conductivity profiles collected from the Upper Lake and the Lower Lake indicated there was no thermal stratification in either lake during the summer or fall, however there were slight decreases in water temperature with depth. Dissolved oxygen concentrations in both lakes were at saturation (10.95 to 13.32 mg/L or 102% to 106% saturation), and specific conductance was low. The pH was near neutral (6.8-7.4). Total suspended solids (TSS) concentrations were low, with values ranging from 0.2 to 1.0 mg/L (surface and bottom samples), and turbidity values from 0.2 to 0.37 NTU. As a result, the water in the Upper Lake and Lower Lake can be described as very clear. Chlorophyll-*a* (Chl *a*) concentrations were low, with values varying from 0.06 to 0.42 g/L (surface and bottom samples). Water in the Jaynes Inlet system is classified as ultra-oligotrophic based on total phosphorus (TP) and Chl *a* results attained from both lakes. TP concentrations measured for the Lower Lake and Upper Lake were less than 0.003 mg/L and Chl *a* concentrations measured for the Lower Lake and Upper Laker were 0.06 g/L and less than 0.42 g/L, respectively. None of the parameters in the CCME CEQGs for the protection of aquatic life were exceeded in either of the lakes.

3.7 Sediment Quality

Sediment was sampled at three stations in the Lower Lake and three stations in the Upper Lake of the Jaynes Inlet Project area in 2009. Marine sediment was sampled at three stations in the Jaynes Inlet estuary. Sampling locations are included in Appendix B. No investigation of sediment was completed within any of the other areas under consideration.

The need for collection of sediment quality data can be devised once a project is selected, however is anticipated to be required to complete an EIS with regards to: sediment composition and grain size, total organic carbon (TOC), nitrogen, total phosphorus, metals and major ions, and polycyclic aromatic hydrocarbons (PAHs).

At Jaynes Inlet, most sediment from the Upper Lake and Lower Lake consisted of sand (51-90%) and silt (4.4-47%), with some gravel (<0.1-12%) present. The TOC values ranged from 1.6-6.5 g/kg. All the sampled parameters were below the concentrations listed in the CCME Canadian Sediment Quality Guidelines (CSQGs) for the Protection of Aquatic Life, with the exception of copper at station 1 in the Upper Lake. Most of the sediment collected for analysis in the estuary consisted of sand (39-87%) and silt (0.2-48.8%), with some gravel (0.2-29%) present. The TOC values ranged from 1.6-7.1 g/kg. The concentrations of the sampled parameters in the estuary were all below the limits set in the CSQGs.

3.8 Freshwater Environment – Lower Trophic Community

Freshwater lower trophic community levels were sampled from nine survey areas along the lower portions of the Jaynes River system in 2007-2009, including the Upper and Lower lakes, the river between them, and several of the tributaries. Samples were analyzed to gain an understanding of the composition, distribution, and abundance of periphyton, zooplankton, drifting aquatic invertebrates, and benthic invertebrates. Locations of study are given in Appendix B. No investigation of the freshwater lower trophic community was completed within any of the other proposed areas.

3.8.1 Jaynes River

Throughout the areas sampled at Jaynes River, the periphyton community was found to be comprised of algae, fungi, and bacteria which develop on submerged rocks and other substrates in the waterways. The lower reaches of the Jaynes River watershed are covered in low concentration of periphyton. The abundance of periphyton was more prevalent in the summer than in the fall of 2008. The Upper Lake and Lower Lake zooplankton composition and density consisted of small numbers of cladocerans (water mites), and larger numbers of cyclopoid copepods (small crustaceans).

Drifting aquatic invertebrates are an essential food source for fish in general, particularly for Arctic char. The diversity of drifting invertebrates varied between sites but looked to be greatest in the downstream portion of the Lower Lake. The majority of invertebrates drifting down the tributaries were chironomid larvae. The abundance of the invertebrate populations seemed to be higher in the summer than in the fall at most sites, but there did not appear to be a distinct difference between areas. In contrast, fall had a higher diversity of drifting invertebrate taxa than summer did. Nematoda (worms), Ostracoda (small crustaceans), Hydracarina (water mites), and Chironomidae (midges) make up the benthic invertebrate populations in the Upper and Lower Lakes. Chironomidae was the most abundant group found among all the benthic invertebrate samples collected in the Upper Lake and Lower Lake.

3.9 Fish and Fish Habitat

In 2006, North/South Consultants Inc. conducted preliminary fish surveys to identify the presence of migratory or landlocked Arctic char (*Salvelinus alpinus*) and to visually detect naturally-occurring barriers to migratory fish passage in Jaynes River, Armshow River, Cantley River, and McKeand River. This information was supplemented by literature review for Sylvia Grinnell River. A summary of the findings is provided below in Table 3.9.1.

Fish sampling in 2006 was conducted using an array of methods (hoop nets, electrofishing, angling, and gill nets) throughout each of the watersheds. Further details regarding the 2006 surveys are given in the following sections. Further studies of fish and fish habitat were conducted within the Jaynes Inlet Project area from 2007-2009, locations of which are given in Appendix B. No further studies have been conducted in the other areas under consideration.

Table 3.9.1 Migratory versus Landlocked Arctic Char and Barriers to Fish Passage.

Location	Arctic Char Population	Natural Barrier(s)
Jaynes River	Three distinct freshwater resident populations, including dwarf variants in the headwater lake (based on physical appearance, strontium analysis of otoliths later confirmed).	An abrupt set of waterfalls at the mouth of the river blocks anadromous fish access to the system. Numerous sets of falls and rapids along the river preclude the upstream movements of fish, hence the three distinct populations.
Armshow River	Majority along mainstem believed to be freshwater residents, however strontium analysis of otoliths verified that one (1) had fed in a marine environment, indicating that fish passage between upstream areas and Frobisher Bay is possible. Significant concentration of anadromous char at the mouth of the river.	Visual assessment did not indicate barriers to upstream fish movements along the mainstem. Series of rapids/falls upstream of the river mouth may act as a barrier at varying times of year depending on flow conditions.
Cantley River	Based on physical appearance most of the larger fish caught in the river looked to be freshwater residents. Strontium analysis of the otoliths of a small population of captured fish from the lake of Reach 3 suggested that none of those fish had fed in a marine environment and were most likely freshwater inhabitants.	Possible barrier to upstream fish movement was a substantial series of rapids at the upstream end of Reach 1.
McKeand River	Strontium analysis of otoliths on a limited number of fish captured indicated that those fish had spent their entire lives in freshwater. Likely that most char caught in 2006 were freshwater residents.	Possible barrier comprised of a large set of waterfalls located near the mouth of the river, however because water flow was high at the time of the site visit the falls appeared more like a large rapid. Although water velocity was high, it seemed that char may be able to ascend the falls under those circumstances. There did not appear to be any other impediments, such as river morphology or flow conditions, to prevent fish from migrating upstream.
Sylvia Grinnell	Confirmed anadromous population, migrate downstream to feed in a marine environment in June and begin their upstream migration in August. Recreational migratory fishery around the territorial park. Freshwater resident population may also be present.	Nonapparent. Falls at the mouth of the river system does not prevent the upstream movement of fish. Arctic char gather at the base of the falls until a high tide allows them to ascend the falls.

3.9.1 Jaynes River

Fish habitat within the lower portion of the Jaynes River was described in four reaches based upon topography and aquatic habitat: an overview of the reaches studied in 2006 is given below in Figure 3.9.1. Reach 1 contains a broad, flat area at the confluence of several valleys and includes a large lake that is connected to the ocean by a short section of riffle habitat. Entrance to the river is through a series of abrupt rapids that was hypothesized to obstruct fish passage. The river runs across a large delta with fine substrate mainly composed of sand and silt. Reach 2 is upstream of the delta where the valley becomes narrower and the river is more contained, with pools dispersed throughout long sections of riffle and rapid habitat. Reach 3 consists of a long succession of rapids and falls which is undoubtedly an obstacle to fish migration. Throughout this reach, there are numerous vertical drops greater than 5 meters. Reach 4 comprises a high elevation headwater lake and inflowing tributaries that would form the proposed reservoir as envisioned in 2006.

In 2007-2008 North/South Consultants Inc. carried out further aquatic studies during the summer and fall to identify fish habitat utilization and fish movements, and completed contaminant analysis of fish muscle tissue. Fisheries sampling was conducted using a variety of capture techniques including gill-netting, hoop-netting, electrofishing, and angling. 195 Arctic char and 3 threespine stickleback were captured during summer 2008, and 122 Arctic char and 104 threespine stickleback were captured during fall 2008. Neither of these species are listed on Schedule 1 of the SARA as of March 2023, however Arctic char are an important food source for people in the region and are fished recreationally. Arctic char were distributed throughout the lower reaches of the Jaynes Inlet watershed and were present in all survey areas in 2008. Compared to char, sticklebacks are much scarcer in Jaynes Inlet; all of the fish that were caught were in lower lake tributaries within 1 km of the lower lake.

Arctic char in the Jaynes Inlet system are exclusively freshwater residents. There are at least three distinct populations of freshwater resident Arctic char, divided by substantial falls that impede fish movements. The Lower Lake and its tributaries are home to one community, the Upper Lake and lower-most portions of its tributaries are home to another, and at least one population lives in the headwaters upstream of the Upper Lake. The Upper Lake population of char is believed to stay in the lake year-round, while young char from the Lower Lake may enter the tributaries in the summer.

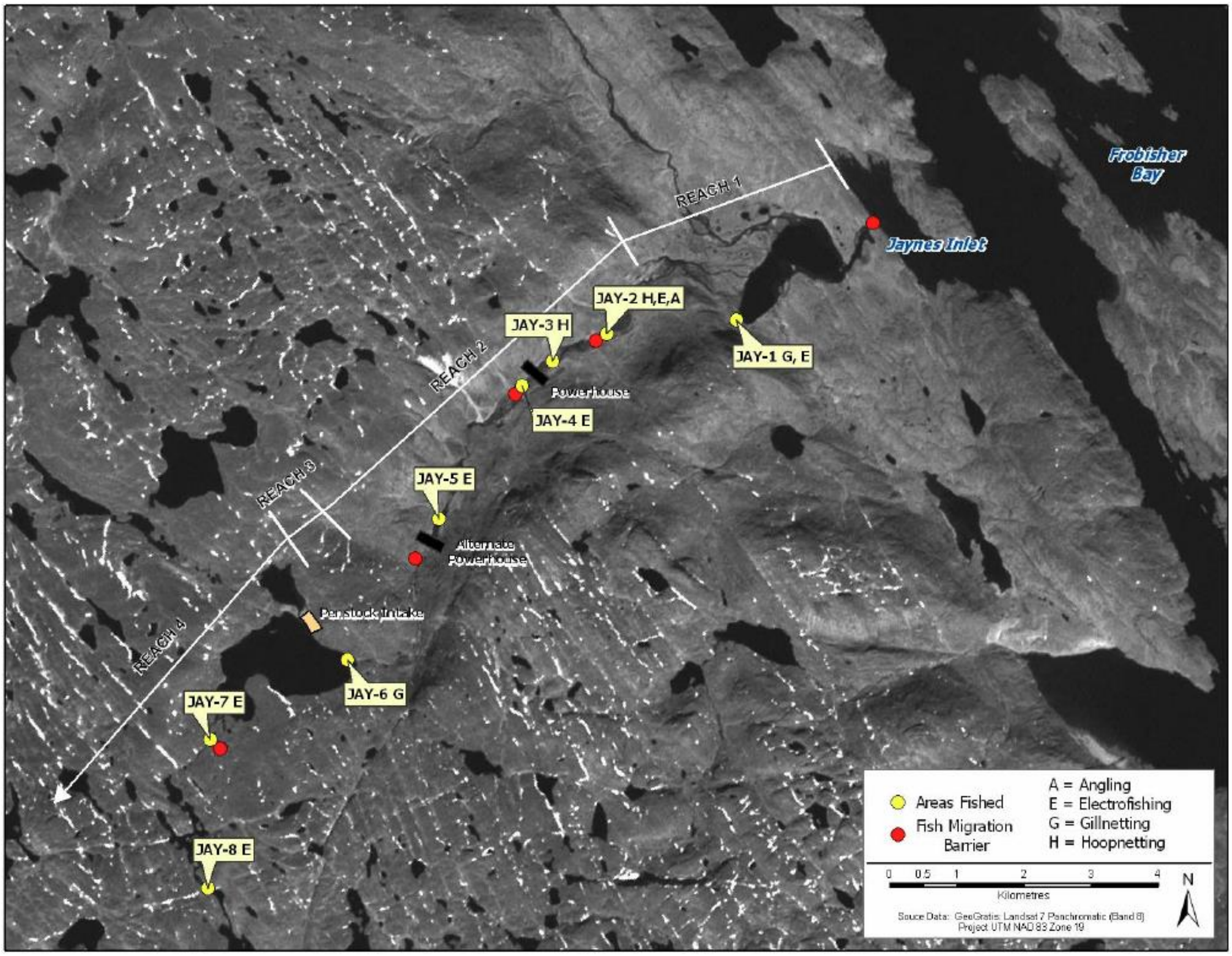


Figure 3.9.1 Preliminary Fishing Studies within the Jaynes River Watershed (North/South Consultants 2006).

Strontium content Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) analysis of otoliths indicated that none of the sampled char from the Lower Lake had ever been in a marine environment. The sizable set of falls at the outlet of the river system prevents anadromous char from moving upstream.

Fish muscle tissue for Arctic char captured at Jaynes Inlet in 2007 and 2008 were analyzed for trace metal contaminants. Most trace elements were either absent or present in concentrations below the laboratory detection limit. Mercury concentrations ranged from 0.03-0.44 ppm for analyzed fish. For comparison, the Canadian Food Inspection Agency prescribed a maximum limit of 0.5 ppm total mercury in retail fish. The suggested tolerable daily intake established by Health Canada for methylmercury is 0.2 µg per kg of body weight per day, and there are currently no territorial fish advisories in Nunavut.

3.9.2 Armshow River

Fish habitat within the Armshow River was described in five reaches: an overview of the reaches studied in 2006 is given below in Figure 3.9.2. Reach 1 extends upstream from the river's mouth to approximately 4.8 km upstream from the Bay of Two Rivers. The river flows through a broad valley and mostly consists of riffle habitat with a few pools or rapids. The bottom substrate in the river is mainly made up of boulders and cobble, and water velocity is fast. Reach 2 extends upstream along the mainstem and is composed primarily of fast flowing water that moves through a constrained valley. There is a large set of rapids or falls in the center of this reach that was hypothesized to prevent fish migration. Habitat mainly encompasses pool and rapid sequences, and the substrate is mostly bedrock and boulder/cobble, with small areas of gravel and sand. Reach 3 includes a broad, flat valley approximately 8km upstream of the river mouth where the river widens and slows down as it proceeds up the main section of the river. Habitat is comprised of runs, large pools, and occasional rapids. Substrate is primarily made up of boulders and cobble, although gravel and sand bars can be found. Reach 4 continues upstream past the proposed reservoir and contains straight sections of river constrained by a small valley and a sharp elevation change. Habitat is predominantly rapids/riffles and runs, with large pools dispersed. Reach 5 contains the headwater lake and its outflowing tributary which constitutes the Right Lake of Armshow. Where the tributary joins the Armshow mainstem is distinguished by a sharp elevation change, fast water, and riffle habitats.

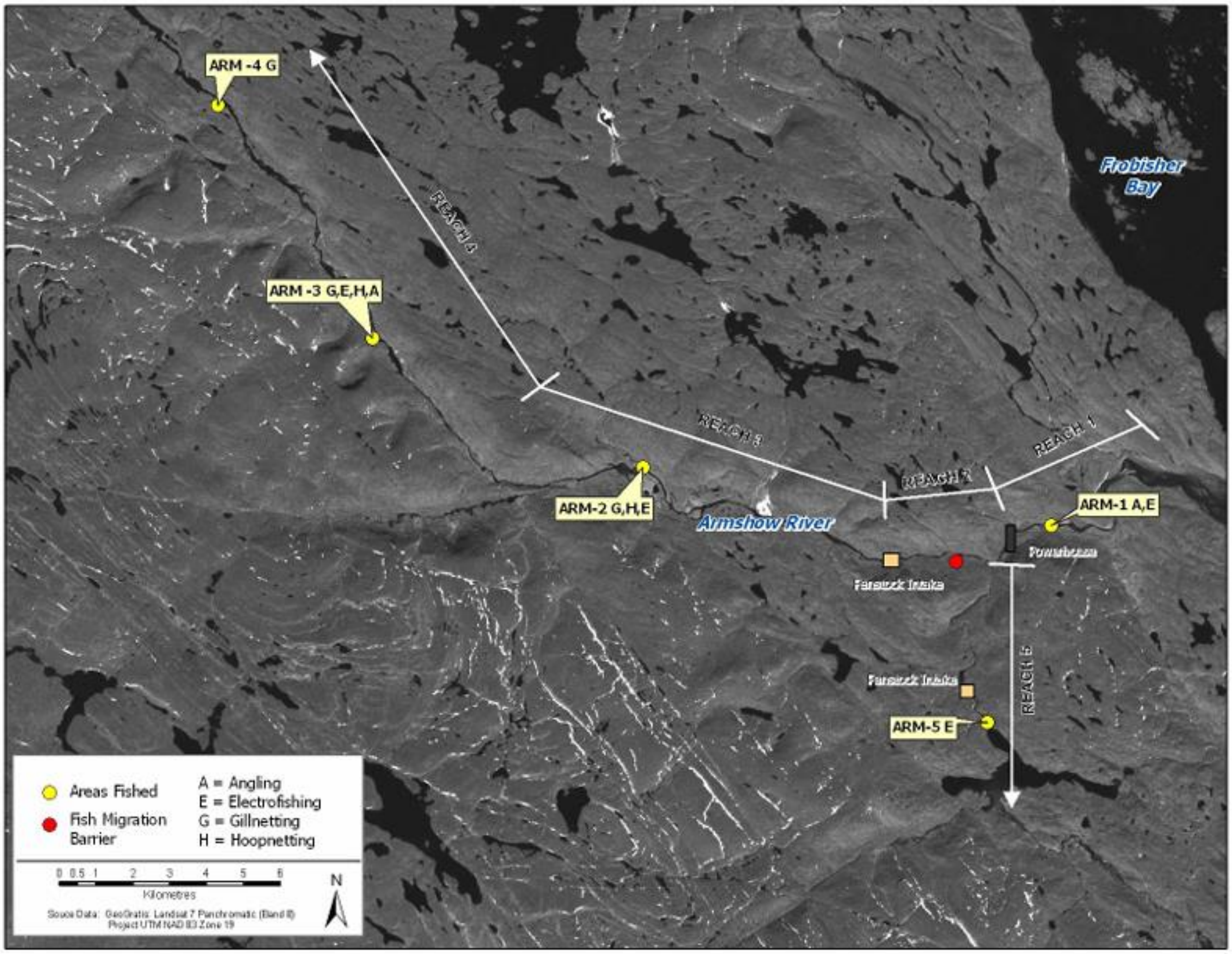


Figure 3.9.2 Preliminary Fishing Studies within the Armshow River Watershed (North/South Consultants 2006).

Visual assessment of the Armshow River revealed that there did not seem to be any barriers to upstream fish movements along the Armshow River mainstem, even though a series of rapids/falls upstream of the river mouth may act as a barrier at varying times of year depending on flow conditions. Arctic char were captured all along the Armshow River mainstem and a significant concentration of anadromous char were found at the mouth of the river. Fish passage to upstream areas within the river mainstem does not appear to be restricted for anadromous fish, despite the fact that the majority of the char discovered throughout the proposed development site are believed to be freshwater residents. Strontium analysis of otoliths verified that one captured Arctic char had fed in a marine environment, indicating that fish passage between upstream areas and Frobisher Bay is possible.

3.9.3 Cantley River

Fish habitat within Cantley River was described in four reaches in 2006, as depicted below in Figure 3.9.3. Reach 1 is primarily made up of fast flowing water over boulder and large cobble substrate and stretched from the mouth of the river to approximately 3km upstream to just above the proposed powerhouse site. A large portion of this reach is made up of run and pool habitat, while rapids make up the remaining portion. Reach 2 is typified by swiftly moving water through a confined valley, creating rapids and riffles. Reach 3 consists of a wide valley that would contain most of the proposed reservoir, about 5.0 km upstream from the upper extent of tidal influence. Through this area, the topography is comparatively flat, and the river expands significantly as it meanders through the valley. There are many wide pool and side channels, and a sizeable lake is located near the upper end of this reach. Reach 4 returns to fast flowing water, resulting in rapids and pool sequences in a small valley with a rapid elevation increase.

Visual assessment of Cantley Bay hypothesized that the only possible barrier to upstream fish movement was a substantial series of rapids at the upstream end of Reach 1. Based on physical appearance of Arctic char during the study, most of the larger fish that were caught in this river looked to be freshwater residents. Strontium analysis of the otoliths of a small population of captured fish from the lake of Reach 3 suggested that none of those fish had fed in a marine environment and were most likely freshwater inhabitants.

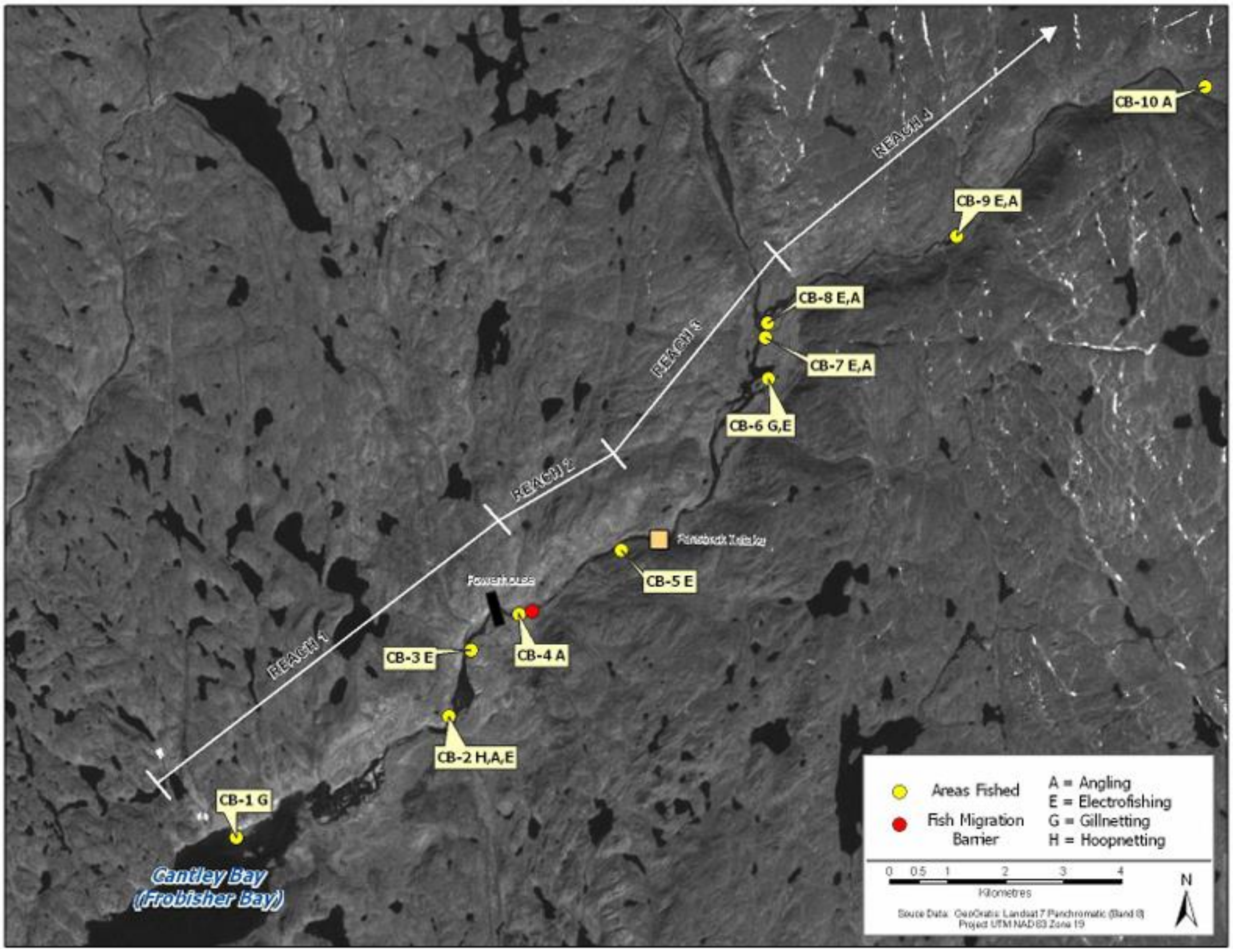


Figure 3.9.3 Preliminary Fishing Studies within the Cantley Bay Watershed (North/South Consultants 2006)

3.9.4 McKeand River

Fish habitat within the McKeand River was described in three reaches in 2006, locations of which are given below in Figure 3.9.4. In the areas studied it was found that the aquatic habitat is primarily comprised of run (70%) and rapid sequences (30%). Water depth was greater than 2.0 m in most areas, and water velocity was estimated to be 1.5 m/s in run habitat. Along the McKeand River, there is almost no floodplain; the river is constrained and barely meanders except in the upper portions of Reach 3.

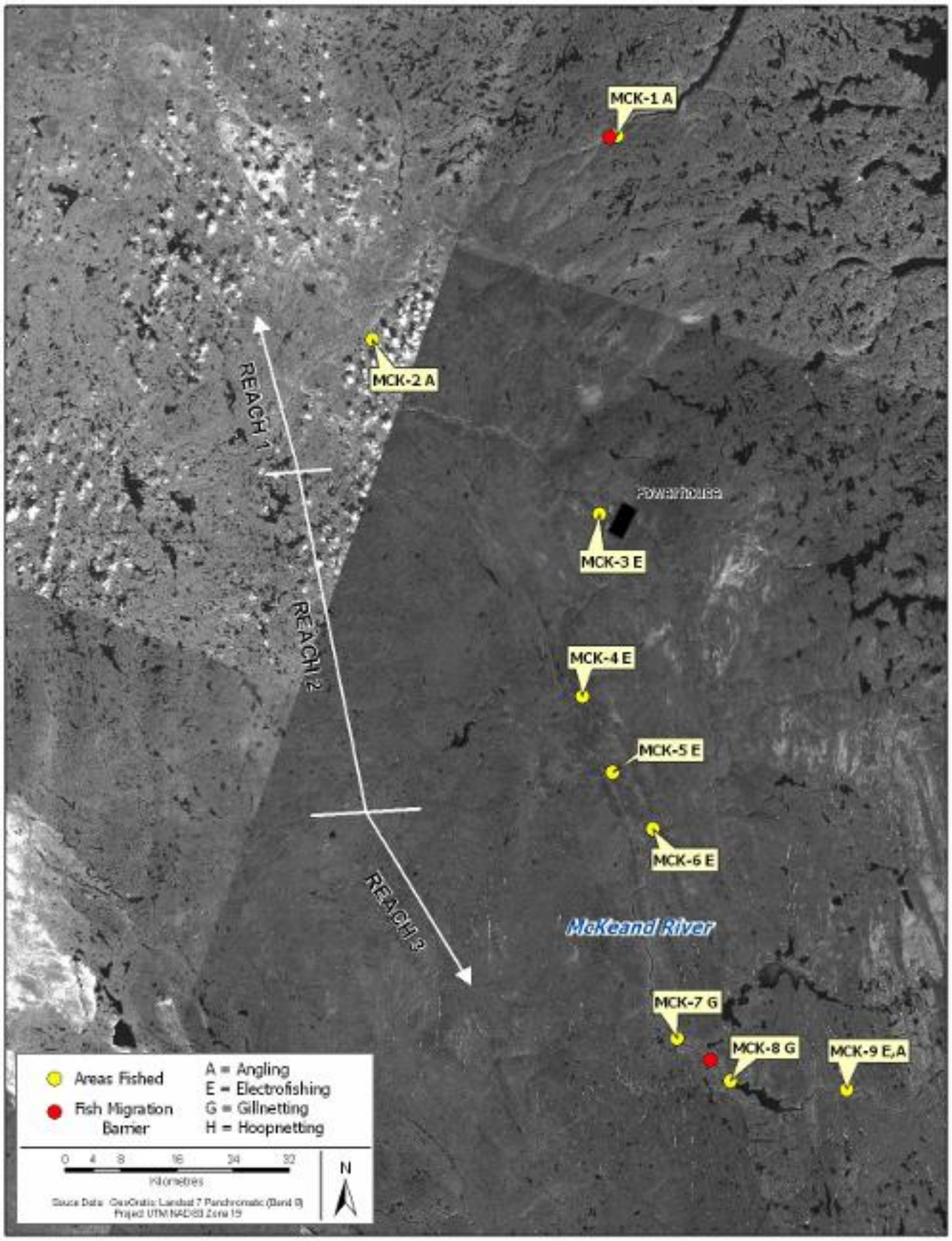


Figure 3.9.4 Preliminary Fishing Studies within the McKeand River North Watershed (North/South Consultants 2006).

The study revealed that McKeand River contained Arctic char throughout, even in areas that are over 100 km upstream of the river mouth at Irvine Inlet. It could not be determined from the fish surveys whether anadromous Arctic char can ascend a large set of waterfalls located near the mouth of the river because water flow was high at the time of the site visit, making the falls appear more like a large rapid. Although water velocity was high, it seemed that char may be able to ascend the falls under those circumstances. There did not appear to be any other impediments, such as river morphology or flow conditions, to prevent fish from migrating upstream. Large rapids exist far upstream of the proposed development site which might act as a possible barrier to fish movements. The preliminary fish surveys executed along the McKeand River in 2006 covered approximately 200 km, including locations upstream and downstream of the planned development area. Strontium analysis of otoliths on a limited number of fish captured upstream of the development site indicated that those fish had spent their entire lives in freshwater, and it is likely that most of the arctic char caught in this study were freshwater residents.

3.10 Marine Environment

Field campaigns to describe the marine environment were conducted in the nearshore marine area of Jaynes Inlet in summer and fall 2008, and spring 2009. Sampling locations are included in Appendix B. No investigation of the marine environment was completed near any of the other proposed areas.

Sampling in the Jaynes Inlet estuary and Cincinnati Press Channel was accompanied by conductivity-temperature-depth (CTD) profiles, and a description of the nearshore marine habitat. Water quality data collected included: alkalinity, nitrogen (ammonia, nitrate, nitrite), total phosphorus, organic carbon, water clarity (TDS, TSS, turbidity, colour), pH, conductivity, and algal pigments (chlorophyll-*a*, and pheophytin). Efforts were made to characterize the marine environment within the Jaynes Inlet estuary at both low tide and high tide.

Vertical CTD profiles taken during high tide showed that most mixing of fresh and marine waters occurred within the intertidal bay. The Jaynes Inlet River empties into Frobisher Bay in a small, confined, narrow channel and therefore tidal influence has a significant impact on water depth within the bay, which varies from about 6 m at high tide to less than 1 m at low tide. The shorelines of the intertidal bay and surrounding areas are made up of bedrock outcrops and slender beaches consisting of boulders, cobble, and finer grain sediments. Substrate within the bay is comprised of clay and sand, and smaller amounts of boulder and cobble interspersed.

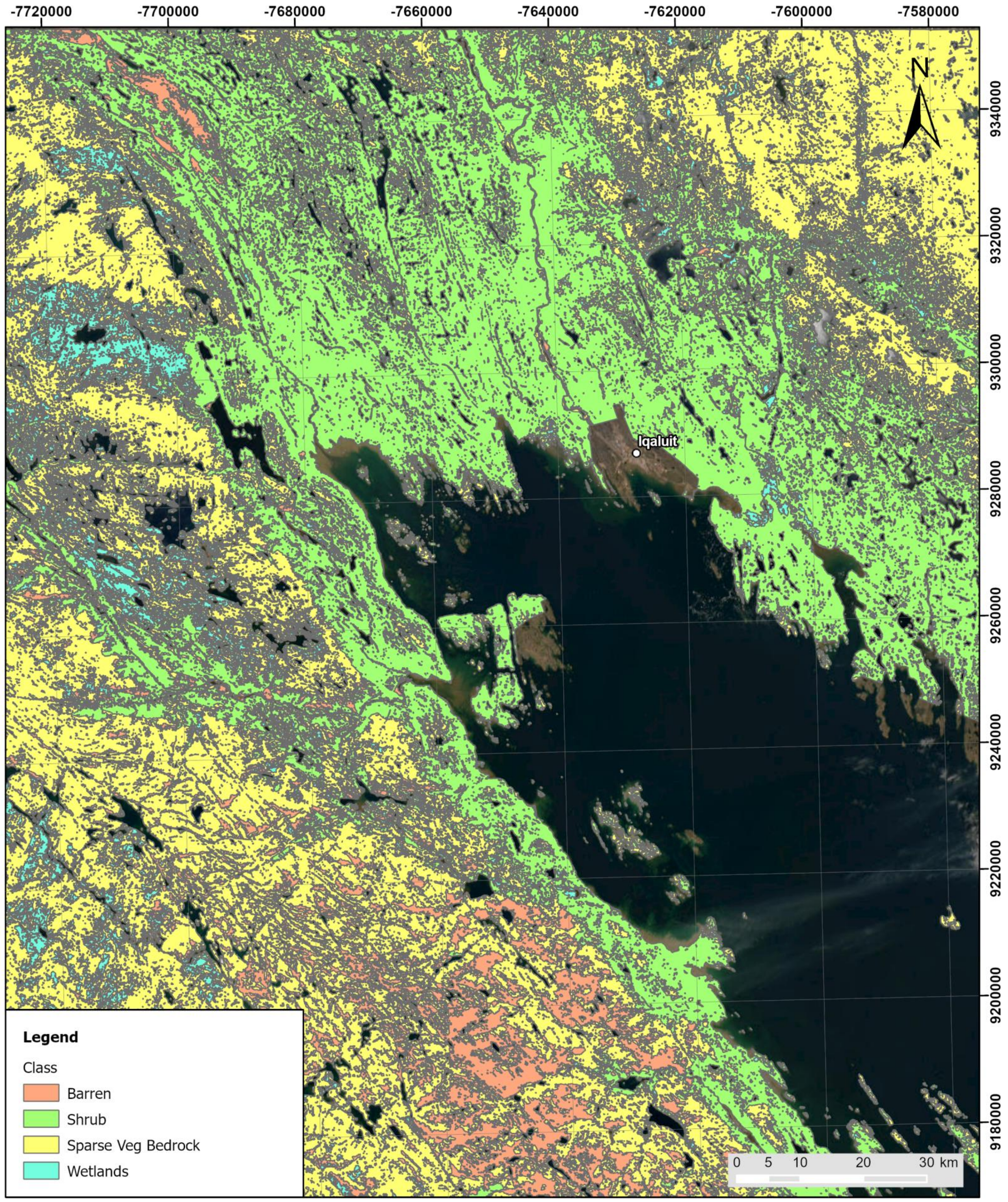
TSS concentrations ranged from 10.6 to 20.0 mg/L at high tide and from 0.8 to 21.0 mg/L at low tide. These latter values correspond to turbidity values of 0.93 to 1.40 NTU, which indicates that the TSS are primarily made up of fine sand. Chl *a* concentrations acquired were extremely low, varying from 1.3 to 2.2 µg/L at high tide and from 0.2 to 1.85 µg/L at low tide. Marine water quality in the Inlet and Channel can be typified as clear, nutrient-poor (low phosphorus and nitrogen), near neutral pH, and exhibiting low primary productivity (low Chl *a*). All sampled parameters were below the concentrations established in the CCME CEQGs for the protection of aquatic life.

3.11 Terrestrial Landforms & Vegetation

From 2006-2008 KPC conducted desktop analysis of satellite vegetation data, surficial geology, and topography to develop a vegetation map and ecological land classification (ELC) encompassing the Iqaluit region, including the Jaynes Inlet and Armshow River areas and a portion of the Cantley Bay area. An updated ELC for the region was completed by SEM in 2023. The SEM ELC study classified local ecosystems, including vegetation classes and associated habitats through use of Sentinel-2 satellite imagery obtained on September 23, 2022. Multiple data strips were merged into a single raster and a composite image was created using the red, green, and infrared bands of the data. A series of supervised classifications were run on this dataset, and the classes were modelled after the similar ELC study conducted by KPC in 2008. Once the classifications were completed and matched the ground surface, the raster was converted to a shapefile and each class was assigned unique symbology as appears below in Figure 3.11.1.

Landscape conditions vary widely in the region. There are moist lowlands, wet slopes, well-drained slopes, dry terraces, and bedrock hilltops. The abundance of plant communities ranges from barren (least abundant) to continuous (most abundant). In general, the low-lying areas, especially along the coastline, are the most productive. The lower portions of inland valleys are also very productive, likely due to the high moisture conditions and protection from abrasive high winds. Vegetation productivity is lower typically at higher elevations, however, for most downstream portions of the proposed infrastructure in Armshow River, Jaynes Inlet, and Cantley Bay, the local ecosystems are mapped as highly productive.

Three previous field studies focused on vascular plant species in Frobisher Bay were referenced by KPC to better understand the landscape ecology of the region. Calder (1951) conducted a study of the flora of a section of the north shore of Frobisher Bay, McLaren (1964) published a study of the flora in the vicinity of Ogac Lake on the south coast of Frobisher Bay, and Avens Associates Ltd. (1991) conducted an inventory of plant species for the then proposed Silvia Grinnell Park. A total of 207 vascular plant species were identified within the Frobisher Bay region, with 164 from Sylvia Grinnell Park, 141 from the north shore study and 124 from the south shore study.



Growler Energy	Iqaluit Nukkiksautiit Project	PREPARED BY: JMC	PREPARED BY: sem
	Figure 3.1 Iqaluit Region Ecological Land Classification(2023)	COORDINATE SYSTEM: WGS 1984 Web Mercator	DATE: 03/04/2023

3.11.1 Jaynes Inlet

Conclusions drawn from the more detailed ELC completed in 2008 focused on the Jaynes Inlet Regional Study Area (RSA), indicated in Appendix B. A total of 16 plant community types were found to exist that can be categorized into six dominant community components. These include lichens, moss, sedge, wood rush, heath, and dwarf birch. Lichens occur most frequently as the dominant community throughout the Jaynes Inlet Regional Study Area (RSA), with five plant community types. Heath is the second most dominant with four community types, followed by sedges with three community types. Communities dominated by dwarf birch (two community types), wood rush (one community type) and moss (one community type) occur less frequently.

Field vegetation studies were conducted in spring 2009 by RSW Inc. within the Jaynes Inlet Project area, locations of which are given in Appendix B. Due to the lack of aerial photos and large size of the local study area (50 km^2), it was decided to gather data on a topographic basis. Sampling efforts were stratified to cover the main vegetation habitats and focus on the rarest habitats. A total of 127 vegetation units were sampled, and 161 information sites were chosen to collect various data on the topographic situation, geomorphological features, slope, soil texture, rockiness, etc. A total of 137 plant species were identified, with hilltop habitats being characterized by a lower species diversity. Lichen-dominated vegetation predominantly occurs in these dry substrate conditions, partially due to the low amounts of organic material and abundance of frost shattering in the soils. Lichens outnumber vascular plants in this community type and those vascular plants that are present tend to form dense mats. Important species in this dry habitat are Arctic white heather *(Cassiope tetragona)* and Entireleaf Mountain Avens *(Dryas integrifolia)*. The number of species along the valley was variable, depending on the habitat conditions. The lichens, moss, sedge, wood rush, heath and dwarf birch plant communities dominated the valley area. None of the species observed during the field work are listed in Schedule 1 of the SARA as of March 2023. In areas with rivers and small tributaries, observed wetlands were quite small and dominated by sedge species forming the Grassland Tundra. The floodplain and its deposits around the lower lake, where plant communities in dry sandy and gravelly places are dominated by species like Bog billberry *(Vaccinum uliginosum) and* crowberry *(Empetrum nigrum)*. The coastal escarpment lacked suitable habitat and was quite poor in species abundance.

3.11.2 McKeand River North

Desktop review of the terrestrial environment and vegetation was not completed by the previous proponents within the McKeand River North watershed. Peregrine Diamonds conducted environmental baseline studies from 2009-2017 and De Beers continued data collection from 2019-2021 for the adjacent Chidliak Diamond Mine Project (De Beers Group, 2022). According to the publicly available data from those studies, the mid-arctic climate causes the region’s vegetation to be discontinuous, with low shrub tundra vegetation like purple saxifrage, Dryas spp., and various rushes and sedges predominating. The broad erosion surface orientated along plains of geological weakness characterizes the ecoregion’s overall physiographic aspect. In higher elevations, there are valleys that are dissected with steep-sides and filled with glaciers and hummocky surfaces that are sparsely covered by sandy till. Bedrock outcrops are common, and Turbic Cryosols are the dominant soils.

3.12 Terrestrial Wildlife and Wildlife Habitat

A desktop terrestrial wildlife review was conducted as part of the pre-feasibility and preliminary environmental baseline studies in the Jaynes Inlet, Armshow River, and Cantley Bay regions. Incidental observations of terrestrial wildlife were also documented during 2006 aerial surveys.

Reported observations gathered through the Inuit knowledge IQ study conducted in 2006, as well as harvest data collected from the Nunavut Wildlife Harvest Study, were collated and summarized by KPC to account for land use activities and wildlife observations. The Armshow River mainstem had the highest amount of recreational activity, mostly revolving around the harvest of fish and caribou, as well as whales and walrus in the coastal vicinity. Although no caribou were observed at that time in Armshow River, caribou tracks were identified, especially along the riverbanks. Cantley Bay accounted for the most mammal and bird observations overall; notably five active raptor nests were recorded. One sub-adult caribou was observed and a few lightly traveled caribou trails were noted.

Within the watershed of the McKeand River North, the previous proponents did not conduct any assessments of terrestrial wildlife and wildlife habitat. Peregrine Diamonds performed environmental baseline studies from 2009 to 2017, and De Beers continued data collection for the adjacent Chidliak Diamond Mine Project from 2019 to 2021 (De Beers Group, 2022). In those studies, it was found that low productivity results in low populations of terrestrial mammals in the ecoregion, including the arctic hare, arctic fox, arctic wolf, and caribou. Few caribou have been seen since 2009, and surveys conducted over several years indicate that caribou are present in the nearby study area at very low population densities.

The Government of Nunavut completed comprehensive aerial surveys of caribou in 2012 in the South Baffin Region (Jenkins, Goorts, & Lecomte, 2012), as well as aerial surveys and ground surveys in 2014 throughout all of Baffin Island (Campbell, Goorts, Lee, Boulanger, & Pretzlaw, 2015). Both studies were paired with collection of Inuit knowledge collected in 10 communities (Jenkins, Goorts, & Lecomte, 2012; Campbell, Goorts, Lee, Boulanger, & Pretzlaw, 2015). Those studies indicated low numbers of caribou throughout the South Baffin Region, with an estimated abundance of caribou between 1065 – 2067 animals aged one year or older in 2012 (Jenkins, Goorts, & Lecomte, 2012) and between 3,169 – 5,935 adults, yearlings, and calves in 2014. Previous projections of population size range between 60,000 and 180,000 for early 1990's (Jenkins, Goorts, & Lecomte, 2012). Examination of telemetry data revealed that the average annual distance travelled during spring by the South Baffin caribou was 137 km, while distances travelled during fall were considerably greater at 282 km/year (Campbell, Goorts, Lee, Boulanger, & Pretzlaw, 2015). Different times of year are important for the lifecycle of caribou on South Baffin Island, which can be broken into 6 seasons: 1-Spring Migration (April 1st to May 29th), 2- Calving (May 30th to June 25th), 3- Post-calving and summer (June 26th to August 12th), 4- Late Summer and Fall Migration Pre-breeding (Aug 13th to October 22nd), 5- Breeding/Fall Migration post-breeding (Oct 23rd to December 15th), and 6- Winter (December 16th to April 4th) (Campbell, Goorts, Lee, Boulanger, & Pretzlaw, 2015). According to this data, developments at McKeand River and Cantley Bay may pose the greatest concern for interactions with caribou, as these overlap with historic and current sensitive calving areas, as well as the spring migratory and post-calving period (Campbell, Goorts, Lee, Boulanger, & Pretzlaw, 2015). Alternatives in Armshow River and Sylvia Grinnell River are situated within the spring migration range of South Baffin caribou. There is also some potential for overlap during the rut and early winter periods for the options at Sylvia Grinnell and Iqaluit North.

Wildlife surveys for birds and terrestrial mammals was completed by LGL Ltd. and RSW Inc. between 2008-2009 for the Jaynes Inlet Project, locations of which are given in Appendix B. The main components of the terrestrial mammal surveys included a general representation of mammal species present within an approximately 10 km radius of the generation site called the Infrastructure Regional Study Area (IRSA) and within a 10 km-wide swath for the Transmission Line Corridor (TLC) from the project area to Iqaluit, a detailed description of mammal species richness and relative abundance in the immediate Local Study Area (LSA), identification of species at risk, and a delineation of habitat use by mammal species present in the LSA. Some geographic overlap exists between the locations of these studies and the alternatives in the Armshow River, Kynersley Iqalliarvik lakes, and Iqaluit areas, and findings can generally be extended to those areas. Further details regarding the Jaynes Inlet studies are given in the following section.

3.12.1 Jaynes Inlet

Terrestrial studies conducted in summer 2008 used several methods to survey small mammals and carnivores in the Jaynes Inlet area: small mammal trapping, transects for mammal sign, and incidental observations. An environmental baseline study conducted in spring 2009 used aerial helicopter surveys and ground-based transects for mammals and mammal signs. Sightings of large and medium sized mammals were recorded during helicopter surveys within the IRSA and TLC, and one helicopter transect was conducted to locate potential denning sites. Ground-based transects used for bird surveys (as detailed in Section 3.13) were concurrently surveyed for signs of mammals (sightings, tracks, scats, browse, dens, etc.). A total of 13 transects covering approximately 9,900 m in various habitat types were surveyed, a summary of the findings is presented below in Table 3.12.1.

Table 3.12.1 Summary of Terrestrial Mammal Species Observations in Jaynes Inlet Region.

Common Name	Scientific Name	Mammal Sightings and Signs[1] (Location)	
		2008	2009
Arctic hare	*Lepus arcticus*	Scats (UL, LV)	2 (UL), scats (UL, LV, LL)
Brown lemming	*Lemmus trimucronatus*	7 (LV), runs/ burrows	Runways/tunnels/scats (UL, LV, LL)[2]
Greenland Collared lemming	*Dicrostonyx groenlandicus*	1 (LV)	Runways/tunnels/scats (UL, LV, LL)[2]
Grey wolf	*Canis lupus*	Tracks (UL)	Tracks (LV), scats (LL)
Arctic fox	*Alopex lagopus*	Tracks (UL)	Tracks/scats (UL, LV, LL)
Red fox	*Vulpes vulpes*	Tracks (UL)	Tracks/scats (UL, LV, LL)
Ermine/Short-tailed weasel	*Mustela erminea*	1 (LV), tracks (UL)	1 (LL), tracks/scats (LV)
Barren-ground caribou	*Rangifer tarandus groenlandicus*	2 (LV, TLC)	2 (LV), tracks/scats (LV, LL)

[1]Signs include tracks, scats, overgrazing, trails, dens, runways, and tunnels.
[2] Since no trapping was performed in 2009, Brown Lemming signs could not be differentiated from Collared Lemming signs as both were known to be found in the study area.
Infrastructure Regional Study Area = IRSA, Lower Lake = LL, Lower Valley = LV, Transmission Line Corridor = TLC, Upper Lake = UL, Upper Valley = UV

Visual observations or signs were recorded for eight small mammals and carnivores during the 2008 field surveys; and seven terrestrial mammal species were recorded during the 2009 field surveys, however, eight species were likely present in the study area. As of March 2023, the Barren Ground Caribou is listed as Endangered by COSEWIC and is under consideration for status change from Special Concern on Schedule 1 of the SARA. No other terrestrial SARA were observed in those studies.

Arctic Hares were not seen in the 2008 wildlife surveys, and the lack of sightings suggested that the species was not abundant in the Jaynes Inlet area. Arctic Hares were observed twice in the 2009 wildlife surveys, and scats were found at all elevations and ecosystem types. Brown Lemmings were much more common than Greenland Collared Lemmings. Incidental observations of lemming runs, scats, and burrows were noted in all parts of the study area in 2008. Small mammal traps captured only one Greenland Collared Lemming compared to 13 Brown Lemmings. No direct observations of lemmings were made in 2009; however, numerous indicators such as runways, tunnels, and scats were found in different habitat types. Nearly six times as many recent lemming signs were found in areas at lower elevations than habitat around the Upper Lake. Brown lemmings appeared to prefer moist habitats with a high proportion of vegetation cover, based on trapping methods. These results imply that the region surrounding the Lower Lake contains more appropriate or even vital habitats for Brown Lemmings. The Brown Lemming prefers a wetland environment, where it feeds on plants such as sedges and grasses. The Collared Lemming, on the other hand, favours a drier environment, where it primarily feeds on forbs and shrubs.

Foxes and wolves are known to be present in the study area, but none were seen during the field programs, and no evidence of den sites was found. Grey wolf tracks were discovered on the beach near the northeast edge of the Upper Lake in 2008, and tracks were discovered in the lower valley along the north bank of the river near the proposed location of the powerhouse in 2009. Scats were detected close to the Lower Lake. No foxes were observed, even though Arctic Fox and Red Fox traces and scats were found in a variety of habitats. Two sightings of caribou and a few recent tracks and scats were recorded during the 2008 and 2009 terrestrial mammal field programs. There were numerous indications of previous Caribou use from the Upper Lake to the Lower Lake, including bones, trails, and overgrazed areas.

NordEco conducted caribou-specific studies in September 2008-April 2009 to determine whether the core development area was suitable for caribou habitat, to assess the vegetation map of Jaynes Inlet produced by the Canada Centre for Remote Sensing, and to have discussions with the Amarok Hunters and Trappers Organization (HTO) about any potential local concerns relative to caribou. Using a pixel-nested-plot sampling design, randomly selected plot locations were surveyed in the upper valley and lower valley. It was inferred that not many caribou were using the area in 2008, since there were very few sightings of caribou during the field program and faeces collected were more than a year old. Most plots showed some signs of previous caribou grazing; extensive sign of past heavy grazing was seen in Plot 03 and less so in Plot 12 on prostrate dwarf shrub tundra. Such evidence included thick clumps of dislodged moss, loose and broken pieces of small shrubs, exposed soil among vegetated clumps, grazed surfaces of moss, and fragmented pieces of lichen. Vegetation plot analyses revealed that all vegetation types exhibited signs of caribou grazing to some degree but plots on graminoid moss tundra showed less sign. Past heavy grazing could explain the low abundance of lichens noted in 2008 for some plots. The few caribou in the region had avoided areas that were still recovering from former heavy grazing and had been foraging where there were a variety of lichens. Based on the number of animal faeces, the greatest amount of caribou use was associated with the prostrate dwarf shrub vegetation type, and the least amount of caribou use was related to the graminoid-moss tundra vegetation type.

Further fieldwork was conducted in April 2009 to determine whether caribou might have access to forage in the late winter by measuring snow cover hardness and depth within the Jaynes Inlet watershed. Snow depth and hardness did not show any recurring trends relative to vegetation or soil type, or any of the physical characteristics of elevation, slope, and aspect. According to the information gathered from the Amarok HTO in 2008-2009, there were very few caribou in the area, despite the fact that they foraged and over-wintered in the area throughout the late 1990s and/or early 2000s.

3.13 Birds and Bird Habitat

A desktop avifauna review was conducted as part of the pre-feasibility and preliminary environmental baseline studies in the Jaynes Inlet, Armshow River, and Cantley Bay regions. In addition to desktop review, aerial surveys were conducted in 2006 to look for potential sites for raptor nests, especially those of Peregrine Falcons (*Falco peregrinus*) given that these are an ecologically important predator species. The subspecies of Peregrine Falcon present in Nunavut (*anatum/tundrius*) was previously listed as Special Concern on Schedule 1 of the SARA, however, was de-listed in February of 2023 largely due to the recovery of this species because of the ban of organochlorine pesticides in Canada. None of the other avian species observed throughout the pre-feasibility or environmental studies are currently listed under the SARA.

KPC completed cursory wildlife surveys in 2006, during which aerial raptor surveys were completed to identify habitat use within the potential flooded boundary of each candidate site. No raptors or nest sites were recorded for Jaynes Inlet. One adult Peregrine Falcon was spotted in Armshow River but no active nests were discovered within the proposed flooded boundary of the project site. On cliffs at the Armshow River's lower end, a gull colony with about 25 pairs of Glaucous Gulls (*Larus hyperboreus*) and flightless young were identified. One active Gyrfalcon (*Falco rusticolus*) nest was found within the proposed flooded boundary of the Cantley Bay project site, however little suitable raptor nesting habitat was identified in the 2006 aerial surveys. One active and two empty Peregrine Falcon nests were found at McKeand River, however the available nesting habitat for raptors was sub-optimal with mostly gently sloping hills.

It is important to note that the Cantley Bay site stood out from the other preferred candidate hydroelectric developments owing to its five confirmed active raptor nests and had the most mammal and bird observations recorded overall based on data compiled for the 2007 environmental baseline studies from Land Use Information Series Maps, the Government of Nunavut Raptor Data Base, and Knight Piésold Ltd.

The prior proponents did not carry out any further evaluations of birds in the McKeand River North watershed, however some studies have been conducted for the adjacent Chidliak Diamond Mine. It was found that the available habitat for the majority of breeding bird species is considered unproductive in the region. Throughout the study area, waterfowl and waterbirds were widely dispersed and occupied lakes, small ponds, the McKeand River and its larger tributaries (and the adjacent uplands) in low densities. No waterfowl or waterbird sensitive areas were identified. Five species of raptors were spotted in the area, and evidence of possible nesting sites for the Peregrine Falcon, Gyrfalcon, Snowy Owl, and Common Raven was documented (De Beers Group, 2022).

As described above in Section 3.12, wildlife surveys for birds and terrestrial mammals were completed by LGL Ltd. and RSW Inc. between 2008-2009 for the Jaynes Inlet Project within the IRSA, the TLC, and the LSA. Some geographic overlap exists between the locations of these studies and the proposed alternatives in Armshow River, Kynersley-Iqalliarvik, the lower portion of the Sylvia Grinnell, and Iqaluit areas, and findings can generally be extended to those areas. Further details regarding the Jaynes Inlet studies are given in the following section.

3.13.1 Jaynes Inlet

Bird surveys were completed by LGL Ltd. during the post-breeding season between August 5 and 12, 2008 and by RSW Inc. during the breeding season between July 16 and 22, 2009, locations of which are given in Appendix B. Ground-based surveys and aerial surveys were conducted to determine the presence, abundance, distribution, and habitat use of various bird species. 19 bird species were observed in 2008 and 22 bird species were observed in 2009. The following Table 3.13.1 summarizes the species observed according to the area in which they were recorded. The Lower Valley (LV) corresponds to the region that starts at the first set of falls nearest the estuary and includes the Lower Lake and up the valley to the mouth of the river. The Upper Valley (UV) corresponds to the region starting from the mouth of the river at the Upper Lake and surrounding watershed. The Transmission Line Corridor (TLC) corresponds to the 2013 proposed transmission corridor which departs from Iqaluit and continues along the head of Frobisher Bay and along the coast.

Table 3.13.1 Summary of Bird Species Observations in Jaynes Inlet Region.

Guild	Common Name	Scientific Name	Bird Sightings and Signs[1] (Location)	
			2008	2009
Loons	Red-throated Loon	*Gavia stellata*	3 (LV)	1 (LV), 2 (Inlet)
	Common Loon	*Gavia immer*	1 (LV)	1 (UL), 2 (LV), 2 (TLC)
Ducks	Common Eider	*Somateria mollissima*	55 (Inlet)	9 (Inlet), 1 (TLC), Nest (LV)
	Red-breasted Merganser	*Mergus serrator*	9 (Inlet)	1 (LV), 2 (TLC)
	Long-tailed Duck	*Clangula hyemalis*	37 (Inlet)	23 (LV), 3 (Inlet), 2 (TLC)
	Northern Pintail	*Anas acuta*	12 (Inlet)	8 (LV)
Geese	Canada Goose	*Branta canadensis*	229 (LV)	20 (LV), 19 (Inlet), 1 (IRSA), 37 (TLC), Scats/tracks (UL)
Hawks	Rough-legged Hawk	*Buteo lagopus*	7 (LV)	2 (IRSA)
Falcons	Peregrine Falcon	*Falco peregrinus*	1 (LV)	2 (LV), 1 (IRSA)
	Gyrfalcon	*Falco rusticolus*	0	1 (IRSA), 1 (TLC)
Owls	Snowy Owl	*Bubo scandiacus*	32 (TLC), Pellets (LV)	Pellets (LV)
Gulls	Glaucous Gull	*Larus hyperboreus*	573 (TLC), 54 (Inlet), 2 (UL)	29 (Inlet), 10 (LV)
	Herring Gull	*Larus argentatus*	2 (LV), 1 (TLC)	1 (Inlet), 1 (TLC)
	Iceland Gull	*Larus glaucoides*	75 (TLC), 3 (LV)	0
	Great Black-backed Gull	*Larus marinus*	1 (LV)	0
Plovers	Semipalmated Plover	*Charadrius semipalmatus*	0	3 (LV)
Passerines	Common Raven	*Corvus corax*	2 (LV), 4 (TLC)	2 (LV), 7 (TLC)
	Horned Lark	*Eremophila alpestris*	1 (LV)	4 (LV)
	American Pipit	*Anthus rubescens*	37 (LV), 20 (UL)	38 (LV), 21 (UL), 6 (Inlet)
	Lapland Longspur	*Calcarius lapponicus*	4 (LV)	3 (LV)
	Snow Blunting	*Plectrophenax nivalis*	2 (UL), 3 (TLC)	2 (UL), 3 (LV), 2 (TLC)
	Northern Wheatear	*Oenanthe oenanthe*	0	1 (LV)
	Hoary Redpoll	*Carduelis hornemanni*	0	1 (UL)
Ptarmigan	Rock Ptarmigan	*Lagopus muta*	0	Scats (UL), Scats (LV)

[1]Signs include tracks, scats, pellets or previously occupied nests.
Infrastructure Regional Study Area = IRSA, Lower Lake = LL, Lower Valley = LV, Transmission Line Corridor = TLC, Upper Lake = UL, Upper Valley = UV

The findings of the post-breeding surveys in 2008 found that birds do not frequently use much of the Jaynes Inlet area during that season. Canada Geese were the most abundant waterfowl species in the study area. Flocks of geese were seen grazing in the lower valley to prepare for migration, and it appeared that the grassy plains surrounding the lower lake is an important area for grazing and moulting. The inlet itself is a crucial region, used by several waterfowl species for brood-rearing and moulting. The cliffs along the bank of the river valley are nesting areas for Common Raven, Rough-legged Hawk, and Peregrine Falcon. The upper valley area is sparsely vegetated and barren, very few birds were found in this habitat. An unusually high number of Snowy Owls were found along the possible transmission line route. Snowy Owls are nomadic, and their migratory patterns are unpredictable; prey availability may be the reason why large numbers of Snowy Owls were seen.

The results of the breeding surveys in 2009 demonstrated that within the LSA bird species richness and abundance was higher at lower elevations, such as in the Lower Valley area. Vegetation productivity is greater at lower elevations and habitats provide better cover, food, and weather conditions. Waterfowl and loon observations predominated in the local study area for this reason. Long-tailed Duck and Canada Goose were the most abundant species, followed by Northern Pintail. Helicopter scans of the IRSA revealed that none of the higher elevation lakes or ponds were being utilized by loons or ducks, however 70% of the surveyed lakes had ice cover in mid-July. The main aquatic birds that appeared to frequent the Upper Lake region was the Canada Goose: numerous scats and tracks were observed along ground-based surveys. No Snowy Owls were seen in the IRSA or along the TLC in 2009, however, pellets were found in the lower valley region. A helicopter survey conducted to detect cliff-nesting raptors found a Rough-legged Hawk and an active nest on the north slope of the IRSA. In the southern IRSA, near the mouth of Jaynes Inlet, a Rough-legged Hawk was spotted soaring and old nesting sites were observed. One Peregrine Falcon was observed during the aerial raptor survey, accompanied by an active nest located in the lower valley area on a cliff beside the main river.

4.0 Regulatory Context

The regulatory process by which a project will be approved can have significant implications on the overall project schedule, as well as cost. The following provides a brief overview of regulatory factors which may distinguish the alternatives under consideration. Appendix C contains a detailed description of permitting requirements for construction and operation of renewable energy infrastructure, as well as for the right to commence environmental baseline studies of the selected project.

All project combinations will be assessed pursuant to the Nunavut Land Claim Agreement (NLCA) and the *Nunavut Planning and Project Assessment Act* (NuPPAA). The Nunavut Planning Commission (NPC) is the point of entry into the integrated regulatory system in Nunavut. The project will first be assessed for conformance to any applicable Land Use Plan (LUP), followed by screening conducted by the Nunavut Impact Review Board (NIRB), and approval by the Nunavut Water Board (NWB) where applicable. Coordination of the environmental assessment process amongst the NPC, NIRB, NWB, federal agencies, and the municipal government is possible and can be beneficial to the overall project schedule. Critical to every project schedule is the requirement that the environmental assessment (i.e. the NIRB project certificate) be completed before other regulatory authorizations will be issued.

Given that the previously proposed Iqaluit Hydroelectric Project in 2013 was subject to a full environmental impact review by NIRB, any of the hydroelectric and PSH alternatives under consideration will likely require the same level of examination. Depending on the footprint and number of turbine generators, the various wind farm candidates (in the absence of associated pumped storage or hydroelectric generation) may not go to full review. The scope of study to prepare an Environmental Impact Statement (EIS) to the satisfaction of the NIRB will be both broad and comprehensive. Initiating studies in the near term would serve to save time on the overall project approval schedule while contributing information to support selection of a preferred development scenario.

Baseline environmental information requirements are explicitly prescribed by the DFO to quantify fish habitat subject to harmful alteration, disruption or destruction (HADD), associated with any of the hydroelectric generation and pumped storage options. The requirements to negotiate an acceptable offset plan and obtain a *Fisheries Act* Authorization (FAA), will add a regulatory and design complexity to those types of projects.

With respect to siting considerations, land tenure issues provide a distinction whereby the necessity for negotiating leases upon multiple types of land adds to the overall regulatory complexity and cost of the project. Projects sited upon Commissioner's Land (untitled lands not within municipal boundaries nor federal lands) will be less expensive to develop upon than Inuit Owned Lands, where a commercial lease and an IIBA would need to be negotiated. Right-of-Way agreements, such as for transmission line corridors, penstocks, and access roads, are less of a deterrent than for siting of generation but still need to be taken into account. Projects sited within the boundaries of Territorial Parks, such as the Katannilik or Sylvia Grinnell parks, are likely to arouse significant public concern.

The Nunavut Water Board places an additional regulatory burden on the various hydroelectricity options by requiring annual water use fees based on the generation capacity of the project. The various options being considered for hydroelectric development are estimated to be able to produce between 10-50 MW of power annually and would fall under the Type A group, meaning that they would be classified by the NWB as follows: Class 2 – 5-10 MW with $4,000 annual fee, Class 3 – 10-20 MW with $10,000 annual fee, or Class 4 20-50 MW with $30,000 annual fee. There is no precedent of pumped-storage hydro (PSH) in Nunavut, thus the inclusion of the technology introduces some regulatory uncertainty for water licensing however it is assumed that PSH would be included in the hydroelectricity category.

A summary of the regulatory distinctions amongst the alternatives under consideration are given in Table 4.1. The extent of intrusion into Inuit Owned Lands (IOL) and Territorial Parks was rated on a scale of 1-5, where 1 was no intrusion, 2 was some intrusion (a small portion of the envisioned linear infrastructure), 3 was a moderate amount of intrusion (a large portion of the envisioned linear infrastructure), 4 was a large amount of intrusion (the generation site is very close to the land or is surrounded by a parcel of it), and 5 was an incredibly large amount of intrusion (the generation site is sited upon the land).

Table 4.1 Summary of Distinguishing Project Development-Related Authorizations.

ID	Location	NIRB EIS	DFO FAA	IOL	Park	NWB WUL Class
1AC	Armshow River Mainstem - Short	Y	Y	3	3	3
1BC	Armshow River Mainstem - Long	Y	Y	3	3	3
2CP	Armshow River - Three Lakes PSH	Y	Y	3	2	
3AC	Armshow River - South North Penstock	Y	Y	4	2	2
3BC	Armshow River - South East Tunnel	Y	Y	4	2	2
4AC	Jaynes Inlet – Penstock	Y	Y	4	2	3
4BC	Jaynes Inlet – Tunnel & Penstock	Y	Y	4	2	3
4BCP	Jaynes Inlet PSH	Y	Y	5	2	
5AC	Cantley Bay	Y	Y	2	1	3
6AC	McKeand River South	Y	Y	1	1	3
6BC	McKeand River North	Y	Y	1	1	4
7C	Sylvia Grinnell River	Y	Y	4	4	2
8P	Kynersley Iqalliarvik PSH	Y	Y	5	1	
11W	Iqaluit North (Wind Site 5 or 5A)	N	N	1	1	NA
12W	Qasitujuak Lake Ridge (Wind Site 4 or 4A)	Y	N	5	1	NA
13W	Armshow River Lower Ridge (Wind Site 1 or 1A)	Y	N	5	5	NA
14W	Armshow River Highlands (Wind Site 2, 3, or 6)	Y	N	4	2	NA
15W	Jaynes Inlet Highlands (Wind Site 7)	Y	N	4	2	NA

5.0 Evaluation of Environmental and Regulatory Sensitivity

An environmental sensitivity evaluation was completed to support the process of screening the many candidate options currently under consideration. Given the level of detail available on the candidate projects, as well as the uneven availability of environmental (biophysical) information, a major challenge has been to select comparable risk factors. Nevertheless, a small set of relevant factors have been identified and applied to the required assessment. Information regarding each alternative under consideration was obtained from CPL where available, however some assumptions were made in the absence of project definition. At the current stage of planning, it has not been possible to develop complete, distinct project scenarios, e.g. bringing together the ingredients of wind generation and storage with hydro generation. Consequently, this evaluation is focused on the identified individual components. Once combined into discrete development scenarios, the risk evaluation will need to be revised as the results are not cumulative.

SEM was tasked with contributing to CPL's Project Selection Risk Screening Matrix (the matrix) on the parameters of Biophysical Environment, Protected Areas, and Regulatory. An initial draft of the matrix included parameters for NIRB (percentage of similarity of the project to the scope of the Jaynes Inlet and Armshow River hydroelectric projects proposed to NIRB in 2013) and Inuit Owned Land (percentage of the project footprint on IOL including transmission line), however these were removed due to the redundancy with the parameters under SEM's purview. The following Table 5.1 describes each parameter and the 1-5 numeric scale on which they were ranked (1 being the most favorable and 5 being the least).

SEM conducted several ranking sessions involving in-house environment professionals - environmental assessment specialists, aquatic and terrestrial biologists, professional engineers, and permitting specialists. Rationale for the rankings is provided in the subsequent sections, and the results assigned to each alternative are provided in Table 5.2.

Table 5.1 Project Selection Risk Screening Parameters and Interpretation.

Parameter	Description	Scale Interpretation
Biophysical Environment	The geographic extent of project components and distinguishing components of the biophysical environment were considered together to indicate potential project-biophysical environment interactions including vegetation/habitat as well as aquatic, terrestrial, and avian species. It includes potential adverse effects on Species at Risk, contaminant uptake (ecological risk), population dynamics and habitat disturbance/disruption/destruction. It considers the potential for residual adverse effects to be Significant. It does not include the consideration of induced effects (harvesting/resource use, economy, tourism).	1. No negative residual effects; no mitigation measures required. 2. Small number of negative residual effects; all addressed with standard (proven) mitigation measures. 3. At least one predicted negative residual effect, addressed with standard (proven) mitigation/monitoring measures. 4. At least one predicted negative residual effect, requiring custom-designed mitigation and monitoring measures. 5. Several predicted negative residual effects, some requiring custom-designed (unproven) mitigation and monitoring measures and/or compensation requirements.
Regulatory	Anticipated or dictated level of effort to fulfill regulatory requirements in terms of time and cost, and the potential extent of regulatory stakeholder concerns. Involvement of multiple authorities or agencies across multiple levels of jurisdiction.	1. Project very likely to occur with minimum time, financial and regulatory requirements (NIRB review not required). 2. Project likely to occur with minimal time, financial and regulatory implications (NIRB likely to conduct review and release with terms and conditions). 3. Project may be possible with time, financial and regulatory implications. 2-3 years of regulatory framework before breaking ground. (NIRB full review and EIS required, involvement with DFO/NWB for water crossings only, some land tenure issues). 4. Project may be possible but with extensive time, financial and regulatory implications. 3+ years of regulatory framework components before breaking ground. (NIRB full review and EIS required, some involvement with DFO, many land tenure issues). 5. Project may be possible but will require extensive time, financial and regulatory implications such as extensive protection measures to avoid or reduce detrimental effects to fish habitat or species at risk habitat. Negotiation of IIBA for water rights or subsurface rights on IOL.

Table 5.1 Project Selection Risk Screening Parameters and Interpretation (cont'd).

Parameter	Description	Scale Interpretation
Protected Areas	Extent of intrusion by project infrastructure into areas designated in legislation, e.g. national or territorial parks, or reserves (wildlife/ecological/conservation).	1. Negligible to no intrusion. 2. Limited intrusion by a small portion of the linear infrastructure. 3. Moderate amount of intrusion of a large portion of the linear infrastructure. 4. Large amount of intrusion by core project features (e.g. the generation site). 5. Key project features are entirely contained within a protected area.

5.1 Geographic Extent and Biophysical Environment

The foremost parameter to reflect differences in biophysical effects is the physical extent (footprint) of each candidate project. Keeping the common components amongst the proposed alternatives in mind (as described in Section 2.0), the geographic area which is going to be disturbed comprises several project elements:

- surface area of affected watersheds
- surface area of land disturbance due to flooding of reservoirs
- length of transmission corridors
- length of access roads
- length of penstock / tunnel
- number / size of marine wharf facilities

The sum of these surface areas provides an approximation of the quantity of terrestrial and aquatic habitat that will be directly affected by the candidate infrastructure. The footprint of each alternative may also serve as an indirect indicator of sensory disturbance such as noise during construction, atmospheric pollution from vehicle emissions and dust, and water quality degradation via runoff or pollutant spills. For this exercise, the greater the geographic extent, the greater the environmental risk.

Input data were obtained from CPL and the comprehensive development report by KPC, and results are presented in Table 5.1.1, ranked by size of affected area.

In compiling the geographic area ranking, the following estimates and assumptions were made:

- The estimated total freshwater aquatic area affected is confined to the reservoir surface areas. The size of the affected watershed was considered separately. The approximate amount of terrestrial habitat to be lost by creation of reservoirs was devised by subtracting the size of the existing waterbody (estimated using Google Earth imagery) from the indicated surface area of the reservoir.

- Streams which may experience altered flow regimes due to diversions into dams/penstocks/tunnels, or waters crossed by transmission spans/access roads are not accounted for in this exercise.

- The footprint of aquatic environment corresponding to each marine barge was conservatively estimated at 0.05 hectares (ha). This includes a rough estimate of the size of the barge itself, and the anticipated effects to the surrounding local marine environment for the construction of the barge and associated vessel berthing.

- It was assumed that transmission corridors would be constructed 60 m wide to account for electrical infrastructure and accompanying access trails. It was assumed that access roads required to transport wind turbine components are already accounted for in this estimate.

- The terrestrial footprint for penstocks was estimated to be 10 m wide along the entire length of the penstock.

- The terrestrial footprint for tunnels was estimated to be 10 m wide along the entire length of the tunnel, however this does not account for the more substantial surface disturbance associated with tunnel excavation and the need for disposal of excavated material.

- The length of access roads is in addition to those already accounted for along the transmission corridors, e.g. the access roads pertain to those leading from the marine barge to the powerhouse construction site. Access roads were assumed to be 10 m wide along the entire length of the road.

- Where multiple sites for wind farms are given, the estimates for all the wind alternatives assumes the worst-case scenario in which every wind site will be developed, up to the maximum capacity range. It was assumed that access roads for wind turbine construction will be in line with transmission corridors. None of the wind alternatives incorporates the aquatic or terrestrial disturbance created by the pairing with either a conventional hydroelectric power or a pump-storage hydro scheme.

- The terrestrial footprint of disturbance for each wind area was calculated by dividing the maximum capacity range by 2.5 MW to obtain the maximum number of turbines. Assuming each turbine requires a 300 m radius, the surface area of terrestrial disturbance per turbine was calculated at 28.3 ha. For example, wind developments having 100 MW capacity were assumed to affect a minimum of 1,132 ha of terrestrial habitat.

- The length of the transmission corridor for the standalone Kynersley Iqalliarvik and Qasitujuak Lake Ridge wind alternative was estimated based on a kml file provided by CPL. It was assumed that both tied in together at the confluence of the lines approximately 12km northwest of Iqaluit.

- The access road for Armshow River – Three Lakes PSH was assumed to be 23.6km long (an additional 10km from those at Armshow River South to account for the upstream placement of the powerhouse). The transmission corridor for Armshow River – Three Lakes PSH was assumed to be 56 km (the same as the Armshow River – Three Lakes hydroelectric option as presented in 2005). The size of the lower PSH reservoir was estimated based on the size of the existing lake given in Google Earth. The penstock for Armshow River – Three Lakes PSH was estimated to be approximately 3 km long from the CPL concept sketch pdf file provided.

- The Armshow River Highlands Wind was assumed to include site 2, 3, and 6 based on the higher elevations of those areas.

- The location of the Jaynes Inlet Highlands wind farm was not given in the kml provided by CPL, and the location was estimated from the Screening Alternatives Workshop presentation. The transmission corridor/road was assumed to be 10km longer than the HEP scenarios.

- For the Jaynes Inlet PSH scenario, it was estimated that water from the lower reservoir would be pumped through a penstock 7.5 km all the way up to the upper reservoir.

- The location of Wind Site 5A for Iqaluit North was estimated from the concept sketches. The transmission corridor/road lengths were estimated: for Wind Site 5A it is 12 km long, while for Wind Site 5 is 1 km, totalling 13km together.

- The Cantley Bay McKeand Diversion alternative was not described in any of the provided materials; thus it was omitted from evaluation.

Table 5.1.1 Geographic Extent of Each Alternative.

ID	Description	Watershed (ha)	Size of Existing Waterbod(ies) (ha)	Upper Storage Reservoir (ha)	Lower Storage Reservoir (ha)	Wind Turbines Footprint (ha)	Transmission (km)	Penstock (km)	Tunnel (km)	Access Road (km)	Marine Barge Landings (count)	Estimated Total Aquatic Area Affected (ha)	Estimated Total Terrestrial Area Affected (ha)	Total Area Affected (ha)
7C	Sylvia Grinnell River	298,000	9,800	31,000	0	0	33	0.5	0	33	0	31,000	21,432	52,432
6AC	McKeand River South	419,300	7,800	10,500	0	0	62	0.1	0	0	1	10,500	3,072	13,572
6BC	McKeand River North	775,700	500	4,800	0	0	140	0.5	0	50	1	4,800	5,191	9,991
1BC	Armshow River Mainstem - Long	202,600	407	1,630	0	0	47	6.2	0	13.6	1	1,630	1,525	3,155
8P	Kynersley Iqalliarvik	11,100	2,100	1,500	1,000	0	30	0	4.5	0	0	2,500	585	3,085
4AC	Jaynes Inlet - Penstock	20,300	250	860	0	0	96	6	0	5.2	1	860	1,197	2,057
4BC	Jaynes Inlet - Tunnel & Penstock	20,300	250	860	0	0	96	3.4	2.5	5.2	1	860	1,197	2,057
4BCP	Jaynes Inlet PSH	20,300	390	860	10	0	96	10.9	2.5	5.2	1	870	1,075	1,945
1AC	Armshow River Mainstem - Short	214,800	239	770	0	0	47	3.1	0	13.6	1	770	830	1,600
13W	Armshow River Lower Ridge Wind (Site 1 & 1A)	0	0	0	0	1,132	60.3	0	0	0	1	0	1,494	1,494
12W	Qasitujuak Lake Ridge Wind	0	0	0	0	1,132	51	0	0	0	0	0	1,438	1,438
2CP	Armshow River - Three Lakes PSH	7,700	310	580	80	0	56	3	0	23.6	1	660	713	1,373
3BC	Armshow River - South Lake East Tunnel	27,800	350	670	0	0	47	2	5	13.6	1	670	623	1,293
3AC	Armshow River - South Lake North Penstock	27,800	350	670	0	0	47	6.76	0	13.6	1	670	622	1,292
5AC	Cantley Bay Base	178,400	200	580	0	0	50	5.1	0	7	1	580	692	1,272
11W	Iqaluit North	0	0	0	0	1,132	13	0	0	0	0	0	1,210	1,210
15W	Jaynes Inlet Highlands Wind (Site 7)	0	0	0	0	226	106	0	0	0	1	0	862	862
14W	Armshow River Highlands Wind (Site 2, 3, & 6)	0	0	0	0	226	95	0	0	0	1	0	796	796

The total area affected ranged from approximately 790 ha up to 52,000 ha and was split into the following five categories: very small (less than 1,000ha), small (1,000 – 2,000 ha), medium (2,000 – 3,000 ha), large (3,000 – 10,000 ha), and very large (more than 10,000 ha). In addition to the geographic extent of each alternative, the presence of sensitive, ecologically important, or socio-economically important species and habitats contributed to heightened rankings of the biophysical risk. In summary, these include:

- Migratory arctic char, an ecologically and recreationally important species: scientific literature confirmed they are present in the Sylvia Grinnell River and field studies in 2006 confirmed they are present in the Armshow River mainstem. Not including estuarine areas, landlocked arctic char are present in Jaynes River, Cantley River, and McKeand River. It is unknown if any are present in the Kynersley and Iqalliarvik lakes, however it can be assumed they would be landlocked due to poor connectivity to the marine environment.

- Barren-ground caribou, a species at risk that is also culturally important for Inuit: protected calving grounds overlap heavily with the McKeand River areas. 2014 telemetry data also indicated potential for overlap with Cantley Bay. Sylvia Grinnell River is situated within their spring migration range, as well as Armshow River to a lesser extent.

- Protected migratory birds including common species of raptors, passerines, and waterfowl which are also a food source: congregations of avifauna in coastal areas and in wetlands along low-lying river valleys pose a concern for wind developments.

Further information regarding the biophysical environment is given in Section 3.0.

In the very large categories are the Sylvia Grinnell River, McKeand River South, and McKeand River North hydroelectric alternatives. These three alternatives entail the creation of a very large reservoirs that will correspond with a widespread loss of terrestrial habitat upon flooding following dam construction. As well, the existing waterbodies constitute an enormous area of freshwater aquatic habitat that would require extensive mitigation measures for the HADD of migratory fish/habitat. Sylvia Grinnell River contains and important migratory population of arctic char, and the McKeand River region is known to support the already struggling caribou population in the area during the calving season. As such, all three projects were assigned a "5" on the biophysical ranking scale.

The large category contains the Armshow River Mainstem – Long hydroelectric option and the Kynersley Iqalliarvik lakes PSH. The loss of terrestrial habitat as well as conversion of riverine habitat to lacustrine habitat for the Armshow River Mainstem – Long alternative will comprise over 1,000 ha, and will affect a migratory population of arctic char. Hence the alternative was rated at a "5" on the biophysical ranking scale. The loss of terrestrial habitat due to reservoir flooding will not be as severe for the closed-loop PSH system at Kynersley Iqalliarvik lakes. However, the offsetting plan for fish habitat altered or lost due to a PSH development will need to be creative, and the drawdown of PSH reservoir may necessitate inter-basin fish transfers between multiple watersheds. The transmission corridor for the Kynersley Iqalliarvik lakes is shorter than for Armshow River, and effects to the marine environment are expected to be less. For those reasons, Kynersley Iqalliarvik PSH was assigned a "4" on the biophysical ranking scale.

Medium sized alternatives included the two hydroelectric options and one PSH variation at Jaynes Inlet. There is far more biophysical information available for the Jaynes Inlet region compared to any other site. The loss of terrestrial habitat due to reservoir flooding will not be as severe as for the Armshow River Mainstem option. However, the proximity to the marine environment is cause for concern and the transmission corridor is amongst the longest of those under consideration. For those reasons, each of the Jaynes Inlet options was assigned a "4" on the biophysical ranking scale.

The small category included the rest of the hydroelectric and PSH alternatives within the Armshow River and Cantley Bay regions, and the wind developments at Armshow River Lower Ridge, Qasitujuak Lake Ridge, and Iqaluit North. Of those, the sizes of the Armshow River Mainstem and Cantley Bay watersheds are very large and the expected effects to the aquatic environment are potential issues of concern. The long transmission corridors for those alternatives would constitute fragmentation of a large amount of terrestrial habitat as well as crossing over numerous waterbodies along the route to Iqaluit. Migratory arctic char exists in the Armshow River system, whereas in Cantley Bay calving caribou are of concern. For those reasons, the alternatives were assigned a "5" on the biophysical scale. The Armshow River Lower Ridge alternative was rated at a "4" on the biophysical scale as these are nearer coastal wetland areas which may be important for migratory birds. The Qasitujuak Lake Ridge wind alternative entails a longer transmission corridor, and the northernmost wind site appears to overlap with a caribou calving area, hence the rating of "4" on the biophysical scale. The Iqaluit North wind alternative has the shortest transmission corridor and is nearest to the already disturbed region of Iqaluit, hence the rating of "2" on the biophysical scale.

The very small category comprises the smaller set of wind alternatives at Jaynes Inlet Highlands and Armshow River Highlands. The only available distinguishing feature amongst these two candidate wind farms is the length of transmission corridors, and potential for interaction with caribou or other terrestrial wildlife. The Jaynes Inlet Highlands was rated at a "4" on the biophysical scale as it entailed the longest transmission corridor amongst any of the alternatives except for McKeand River North. The Armshow River Highlands was rated at a "3" on the biophysical scale, as it entails a shorter transmission corridor and is situated away from any caribou calving areas and far enough away from the coast or any wetlands to be less of a concern for migratory birds.

5.2 Regulatory

The regulatory process by which a project will be approved can have significant implications on the overall project schedule, as well as cost. The chosen project, no matter which alternative or combination, will be assessed by the NPC and NIRB to determine the required level of environmental assessment. Coordination of the environmental assessment process amongst the NPC, NIRB, NWB, federal agencies, and the municipal government is possible and can be beneficial to the overall project schedule. It is however key to the overall project schedule that the environmental assessment (i.e., the NIRB project certificate) must be completed before other regulatory authorities may grant interests in land, issue licenses, permits, or other authorizations.

Projects considered to be the most complex from a regulatory perspective typically involve higher numbers of authorities/agencies across multiple levels of jurisdiction. The “number of permits required” is not a sufficient way to measure how complex a project may become. The extent of regulatory stakeholder concerns, and therefore the time and cost required to obtain final project approval, is a better way to assess this metric.

As described above in Section 4.0, the projects in question that are the most complex would involve preparation and approval of an EIS with NIRB, preparation of an Offset Plan and approval of an FAA with DFO. As such those projects were rated at a “5” on the regulatory scale. Alternatives requiring negotiation of multiple or costly land tenure or access agreements such as within IOL were rated higher on the regulatory scale as well. Legally protected areas in the region relevant to the evaluation are comprised of the Kataniilik Territorial Park and the Sylvia Grinnell Territorial Park. The extent of intrusion by project infrastructure was rated on a scale of 1-5. The Armshow Lower Ridge in particular is situated almost completely on IOL and is surrounded by the Kataniilik Territorial park, which will make permitting for transmission more difficult hence the rating of “4” on the regulatory scale and a “5” on the protected areas scale.

Table 5.2 Results of Project Selection Risk Screening.

Project ID	Location	Biophysical Environment	Regulatory	Protected Areas
1AC	Armshow River Mainstem - Short	5	5	3
1BC	Armshow River Mainstem - Long	5	5	3
2CP	Armshow River - Three Lakes PSH	5	5	2
3AC	Armshow River - South North Penstock	5	5	2
3BC	Armshow River - South East Tunnel	5	5	2
4AC	Jaynes Inlet – Penstock	4	5	2
4BC	Jaynes Inlet – Tunnel & Penstock	4	5	2
4BCP	Jaynes Inlet PSH	4	5	2
5AC	Cantley Bay	5	5	1
6AC	McKeand River South	5	5	1
6BC	McKeand River North	5	5	1
7C	Sylvia Grinnell River	5	5	4
8P	Kynersley Iqalliarvik PSH	4	5	1
11W	Iqaluit North (Wind Site 5 or 5A)	2	3	1
12W	Qasitujuak Lake Ridge (Wind Site 4 or 4A)	4	3	1
13W	Armshow River Lower Ridge (Wind Site 1 or 1A)	4	4	5
14W	Armshow River Highlands (Wind Site 2, 3, or 6)	3	3	2
15W	Jaynes Inlet Highlands (Wind Site 7)	4	4	2

6.0 Conclusions

SEM has completed a draft version of the Environmental and Regulatory Evaluation for the Iqaluit Nukkiksautiit Project. The intention of this evaluation was to summarize previous environmental studies and current regulatory context relating to the hydroelectric, wind generation, and pumped storage schemes for renewable energy development near Iqaluit. SEM provided an overview of the existing environmental baseline data for each of the project alternatives in terms of the freshwater and marine aquatic environment, bird and terrestrial mammal species presence and habitat description, fish abundance, distribution, and habitat description, vegetation and ecological land classification, hydrological features, geological features, and climate change assessment. Furthermore, the project alternatives were ranked comparatively according to biophysical environment, protected areas, and regulatory criteria. The disturbance/disruption of the biophysical environment and the potential adverse effects have been examined at a high level in order to assist with choosing an alternative which is the least concerning from an environmental standpoint. Effort and issues associated with the regulatory process in Nunavut was discussed in detail. Obtaining regulatory approval involves assessment by the Nunavut Planning Commission and Nunavut Impact Review Board and ensuing environmental permitting. Environmental and regulatory concerns connected to each alternative were addressed to assist Growler Energy and Nunavut Nukkiksautiit Corporation with the screening analysis. Moreover, the baseline data requirements were determined to move forward with the environmental assessment and permitting process for the selected project alternative. Lastly, SEM has given a general overview of the relevant regulatory considerations, extending to the construction and commissioning of the selected alternative.

7.0 Recommendations

The information that has been gathered so far provides a broad overview of the biophysical environment in South Baffin Island, such that the general project areas do not differ significantly from one another in terms of species diversity or richness except on a local scale. The requirements to register the project with NIRB are less extensive than for an EIS, and desktop studies will be sufficient to do so once a projected is suitably defined. However, if hydroelectric or pumped-storage components are incorporated into the design, an EIS will probably be required. To accelerate the approval process, it will be beneficial to begin collecting the necessary level of baseline data prior to project registration.

Additional fish sampling efforts will need to be carried out for the hydroelectric and pumped storage hydro projects to update the previously collected data and to assess current fish movement patterns and habitat utilization of Arctic char or other fish species. Further freshwater and marine aquatic studies will need to be accomplished to supplement existing data collected for the candidate hydroelectric project river systems; in-stream flow measurements, water and sediment quality sampling, periphyton and benthic invertebrate sampling, identification of aquatic species at risk (polar bear, beluga whale), and evaluation of marine wildlife present (whales, walruses, seals) in the estuaries will be beneficial.

To address the requirements to obtain the federal FAA for a hydroelectric development, it will be necessary to complete a quantitative description of aquatic habitat within the selected project footprint, and any interconnected waterbodies which would be affected by the development. It will also be necessary to identify and define areas of the river system that may be of critical importance to fish. To evaluate project-related impacts on fish, obtaining a basic knowledge of the seasonal distribution, density, and community composition of periphyton, drifting aquatic invertebrates, and benthic invertebrates is needed as these organisms are important food sources for fish.

Bird and terrestrial mammal species present within the selected regional study area will need to be described as part of the EIS preparation. The presence of birds and bird habitat along the waterways of the proposed hydroelectric facilities should not present significant barriers to development if proper mitigation and monitoring strategies are implemented. To properly assess habitat preferences for bird species that may be present and the potential effects of project development, an acoustic or camera survey for migrating birds, further ground-based surveys, and additional aerial surveys will need to be conducted. As well, it is recommended to conduct winter resident surveys to ensure sufficient coverage for the entire year, especially with the possible introduction of wind turbines to the project design. Wildlife habitat suitability modelling will be required to identify habitat that may be lost or altered as a result of project development and to avoid important caribou foraging/migration/calving areas and carnivore denning sites.

During the next phase of project design, SEM recommends incorporating the following siting and mitigation measures in Table 6.1 below.

Table 6.1 Project Design Environmental Considerations.

Component / Infrastructure	Potential Effects	Design Consideration / Mitigation Measures
Wind Turbine	• Displacement of bird species. • Terrestrial habitat loss or fragmentation. • Avoidance behaviour for wildlife – change in migration routes. • Possible siting along migratory bird flyway. Elevated risk of collision with wind turbines.	• Avoid construction near sensitive habitat to minimize disruptions – raptor nesting (rocky coasts or steep cliffs), waterfowl habitat for feeding and brood-rearing (wetlands). • Avoid construction during bird breeding season.
Transmission Corridor	• Caribou habitat loss or alteration – decreased foraging ability due to vegetation clearing. • Terrestrial habitat loss or fragmentation. • Displacement for wildlife species – direct mortality, changes to migration routes, changes to predator/prey availability. • Fish habitat loss or alteration	• Use existing roads or other already disturbed routes. • Use shortest path between generation to output site where possible. • Avoid construction near sensitive wildlife habitat – caribou calving areas and migration paths. • Avoid areas of higher vegetation productivity with a focus on areas suitable for caribou foraging - grasses, sedges, shrubs, and forbs. • Avoid wetland areas associated with coastal, riparian, and valley environments, including lowland polygons, fens, and marshes.
Hydroelectric Dam / Reservoir	• Restriction of Arctic Char migration. • Fish habitat loss or alteration. • Possible methylmercury contamination in muscle tissue. • Affect subsistence char harvesting, an important food source and cultural activity to the Inuit community. • Terrestrial habitat loss or fragmentation.	• Avoidance of watercourses containing migratory fish. • Consideration of barriers to movement – incorporation of fish passage infrastructure to facilitate both upstream and downstream movement. • Use existing waterbodies rather than creating man-made reservoirs. • Avoid construction near sensitive habitat – raptor nesting (steep cliffs), waterfowl habitat for feeding and brood-rearing (wetlands). • Avoid wetland areas associated with coastal, riparian, and valley environments. • Where flooding of storage reservoir occurs, it may be possible to create fish habitat in the catchment area.

Table 6.1 Project Design Environmental Considerations (cont'd).

Component / Infrastructure	Potential Effects	Design Consideration / Mitigation Measures
Access Road	• Caribou habitat loss or alteration – decreased foraging ability due to vegetation clearing. • Displacement for wildlife species – direct mortality, changes to migration routes, changes to predator/prey availability. • Fish habitat loss or alteration	• Use existing roads or other already disturbed routes. • Use shortest path between access points if possible. • Avoid construction near sensitive wildlife habitat – caribou calving areas and migration paths. • Avoid areas of higher vegetation productivity with a focus on areas suitable for caribou foraging - grasses, sedges, shrubs, and forbs. • Minimize the number of water crossings.
Barge dock	• Estuarine habitat loss or alteration. • Accidental release of pollutant spills and oil/fuel from vessels. • Increased turbidity from dredging, levelling, and trenching which harms fish and benthic organisms. • Overall decreased water quality. • Displacement of benthic invertebrate communities, marine mammals (Bowhead Whale, Beluga Whale, and Ringed Seal), marine fish (Arctic Char, Dolly Varden Char, Arctic Cod, and Greenland Halibut). • Avoidance behavior for migratory seabirds and waterfowl.	• Routing should be planned to avoid marine mammals. A marine mammal observer can assist with navigation. • Ensure all vessels are equipped with pollution control materials. • Avoid construction during the breeding season for wildlife species.

8.0 References

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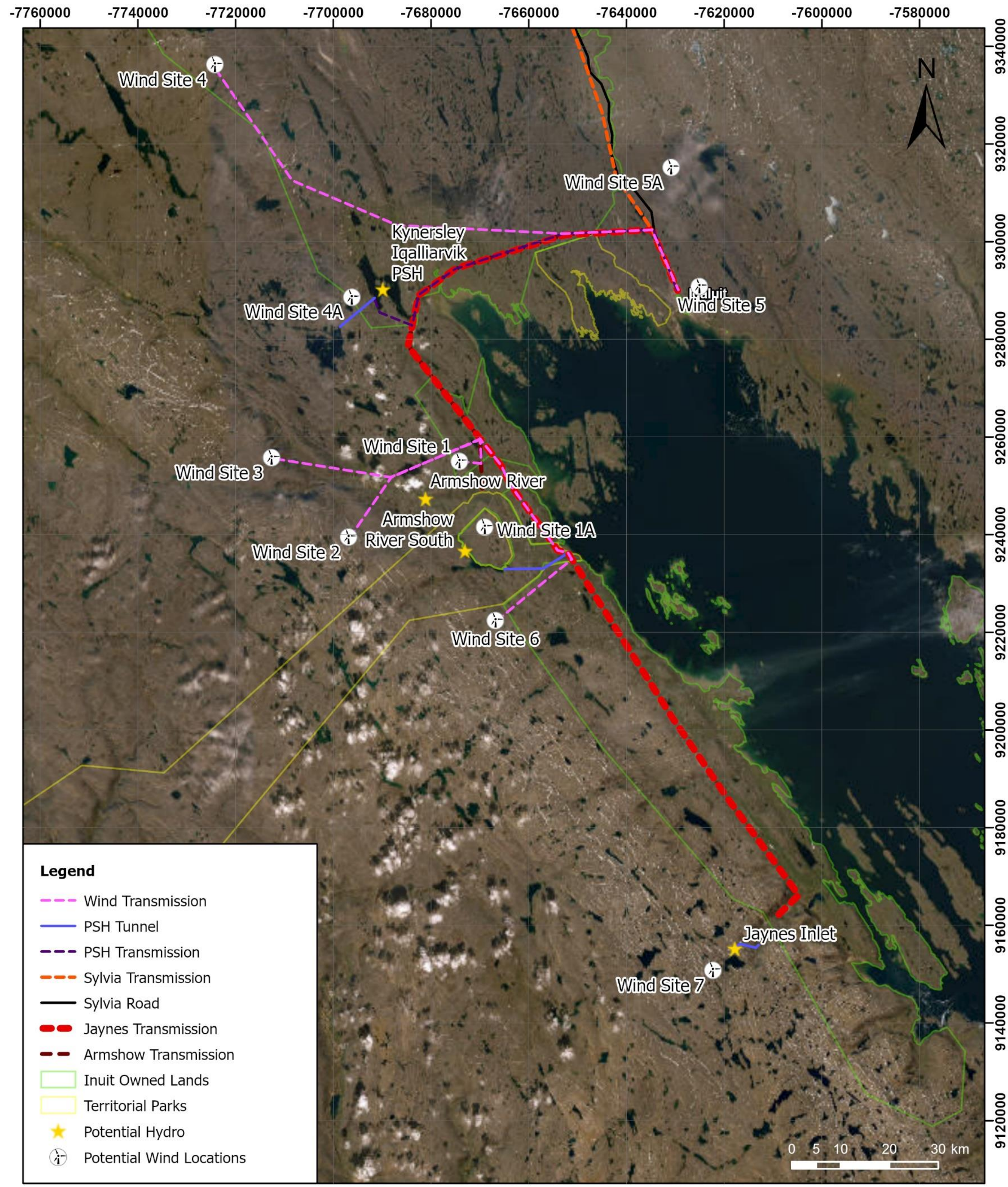
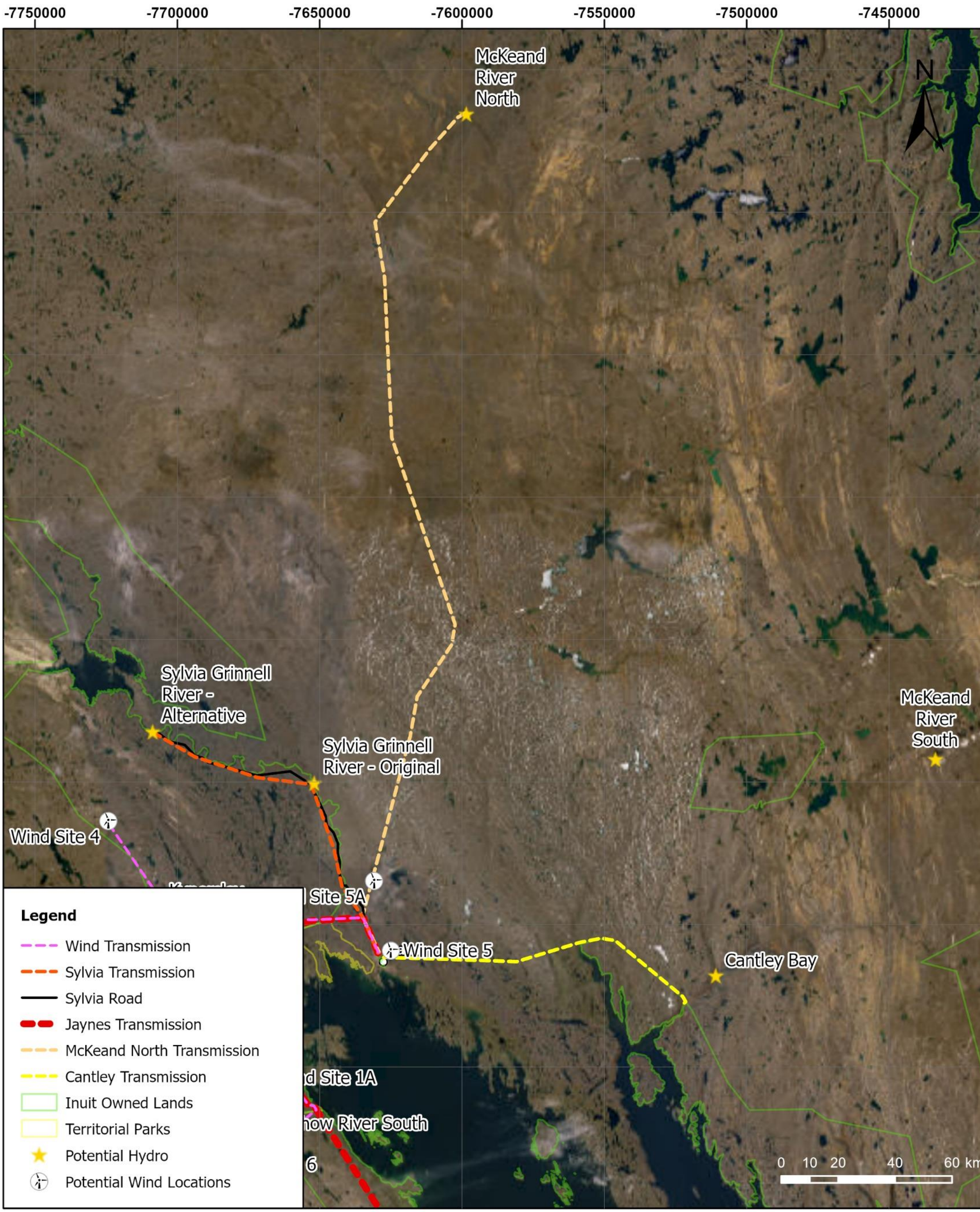
Appendix A

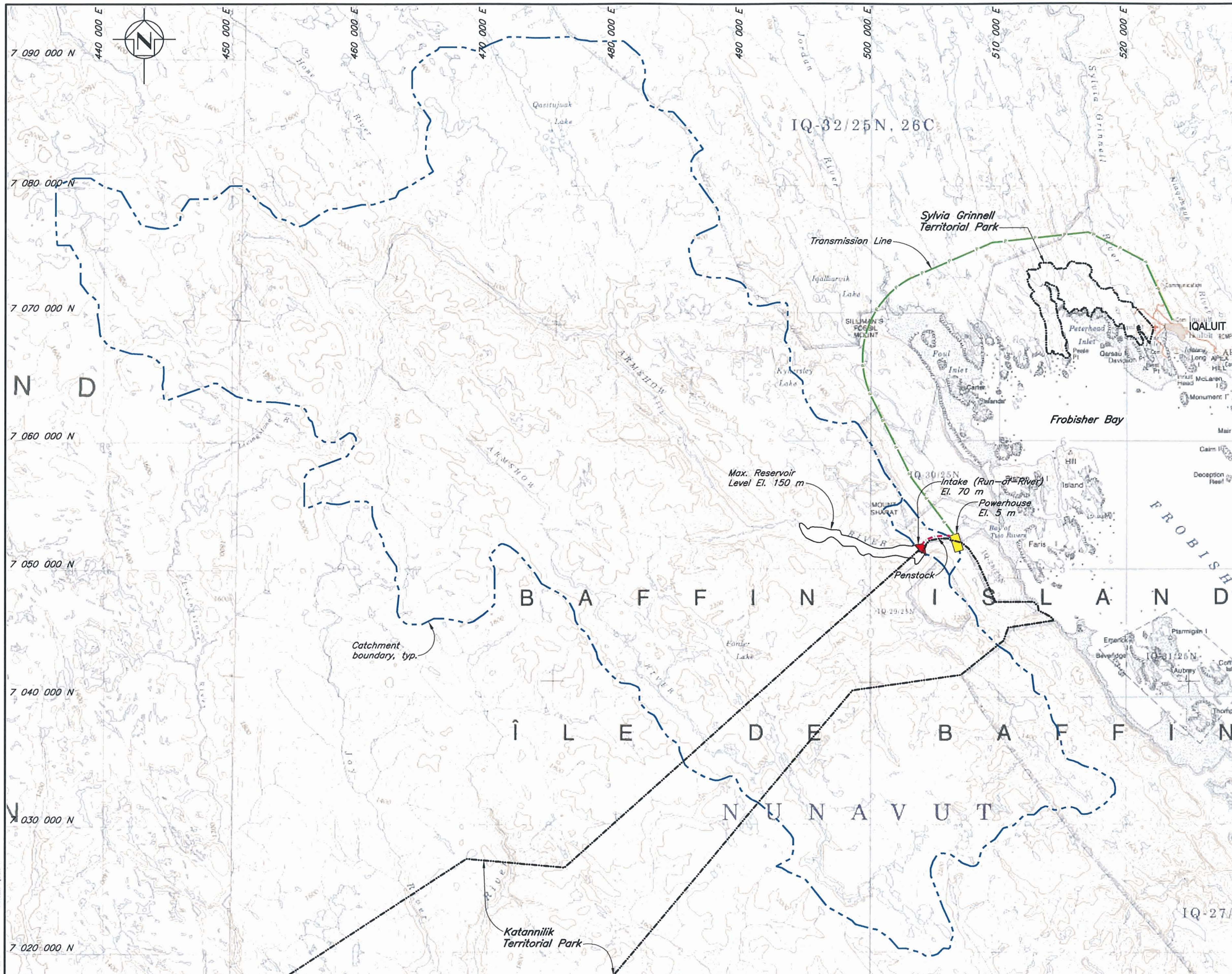
Project Alternative Maps and Concept Sketches



Growler Energy	Iqaluit Nukkiksautiit Project	PREPARED BY: BC	PREPARED BY: sem
	Figure A.1 Overview of Proposed Transmission Routing (South)	COORDINATE SYSTEM: WGS 1984 Web Mercator	DATE: 03/08/2023



Growler Energy	Iqaluit Nukkiksautiit Project	PREPARED BY: BC	PREPARED BY: sem
	Figure A.2 Overview of Proposed Transmission Routing (North)	COORDINATE SYSTEM: WGS 1984 Web Mercator	DATE: 03/08/2023



QULLIQ ENERGY CORPORATION

IQALUIT HYDRO-ELECTRIC GENERATION SITES

ARMSHOW RIVER (SHORT) PROJECT GENERAL ARRANGEMENT

Knight Piésold CONSULTING

PROJECT/ASSIGNMENT NO.	REF. NO.	REV.
VA103-137/1	1	0

FIGURE 5.7

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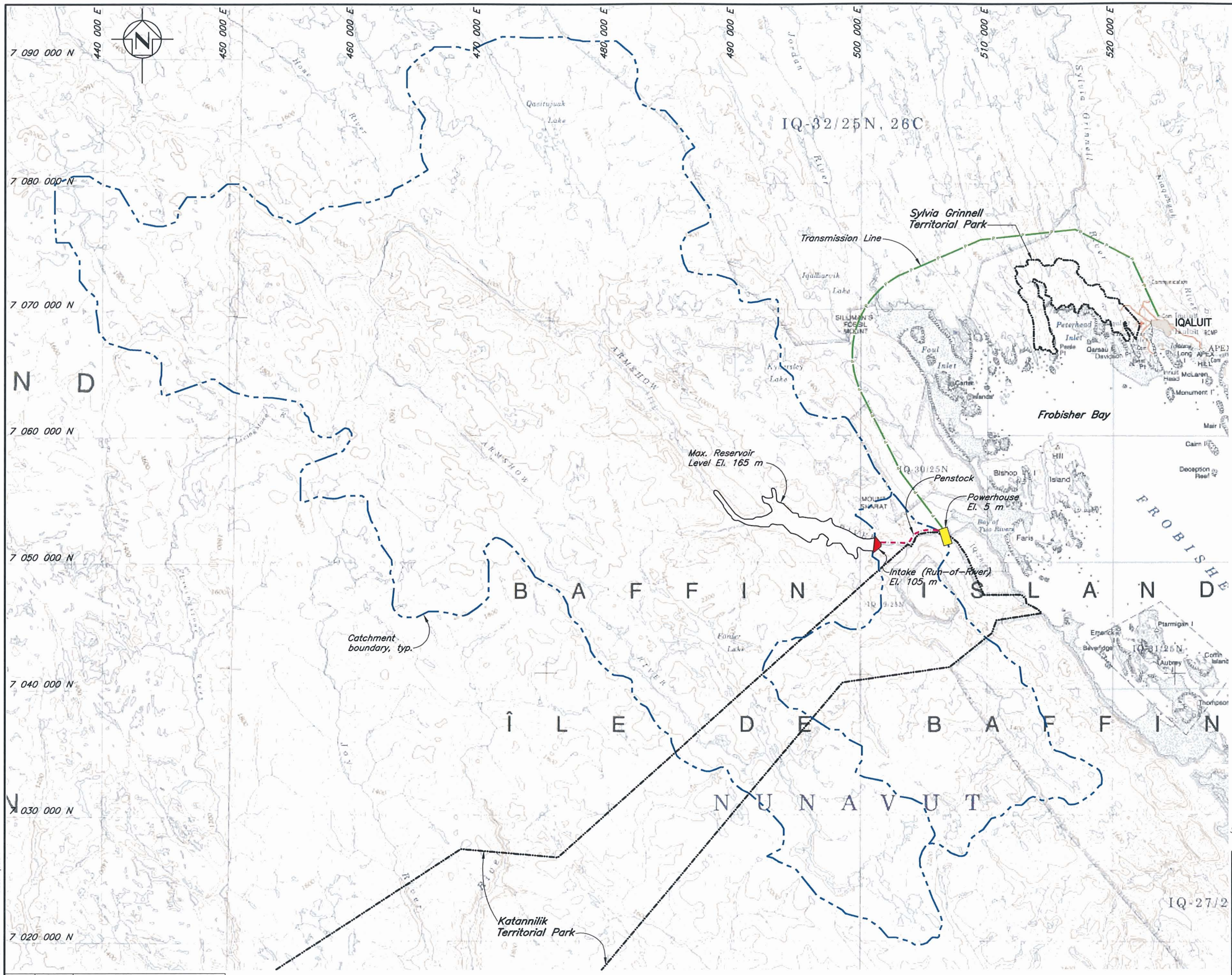


REV. A	14NOV'05	ISSUED FOR REPORT

QULLIQ ENERGY CORPORATION

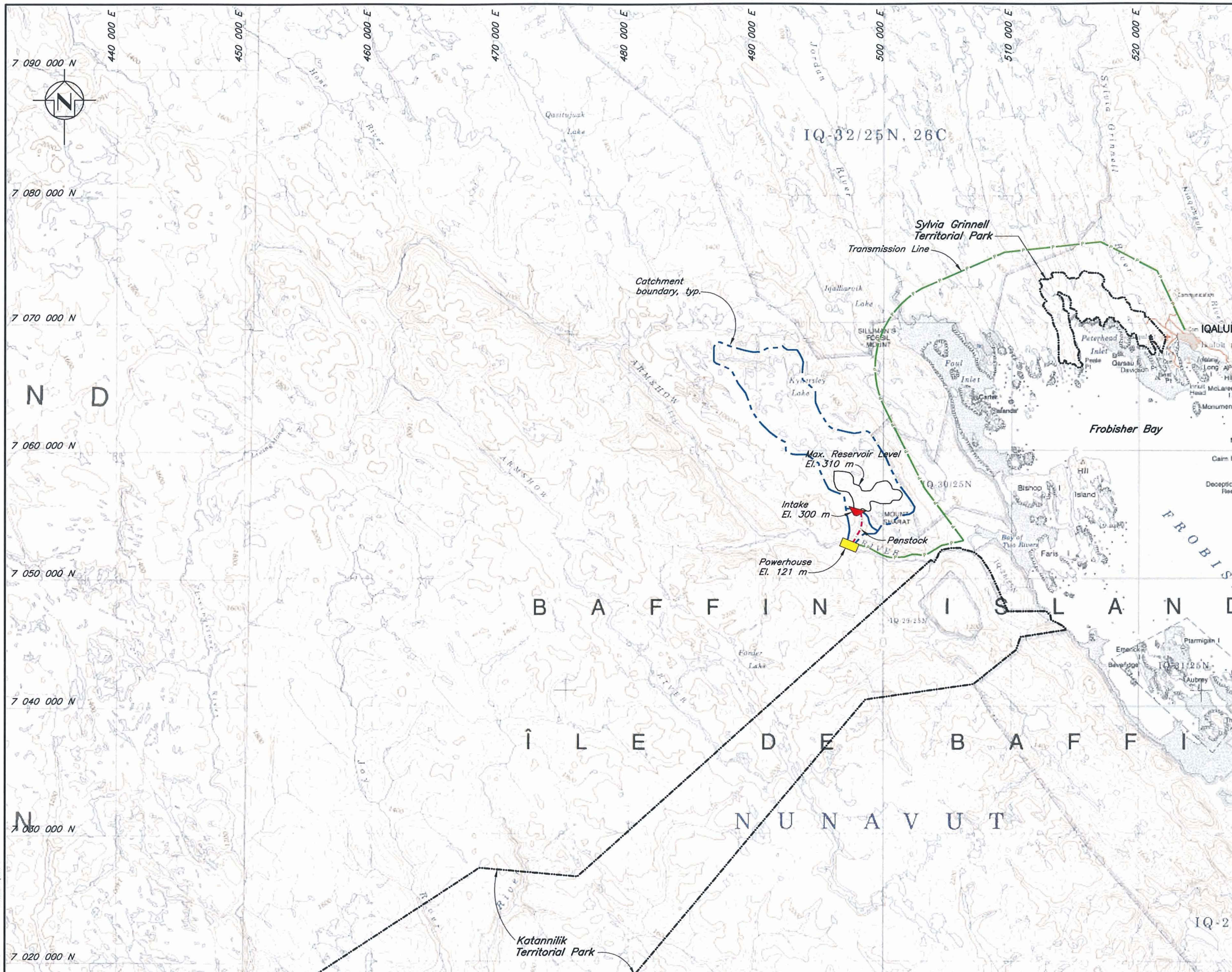
IQALUIT HYDRO-ELECTRIC GENERATION SITES

ARMSHOW RIVER (LONG)
PROJECT GENERAL ARRANGEMENT

Knight Piésold CONSULTING

PROJECT/ASSIGNMENT NO.	REF. NO.	REV.
VA103-137/1	1	0

FIGURE 5.8



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QULLIQ ENERGY CORPORATION

IQALUIT HYDRO–ELECTRIC GENERATION SITES

ARMSHOW RIVER (3–LAKES) PROJECT GENERAL ARRANGEMENT

Knight Piésold CONSULTING

PROJECT/ASSIGNMENT NO.	REF. NO.	REV.
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FIGURE 5.9

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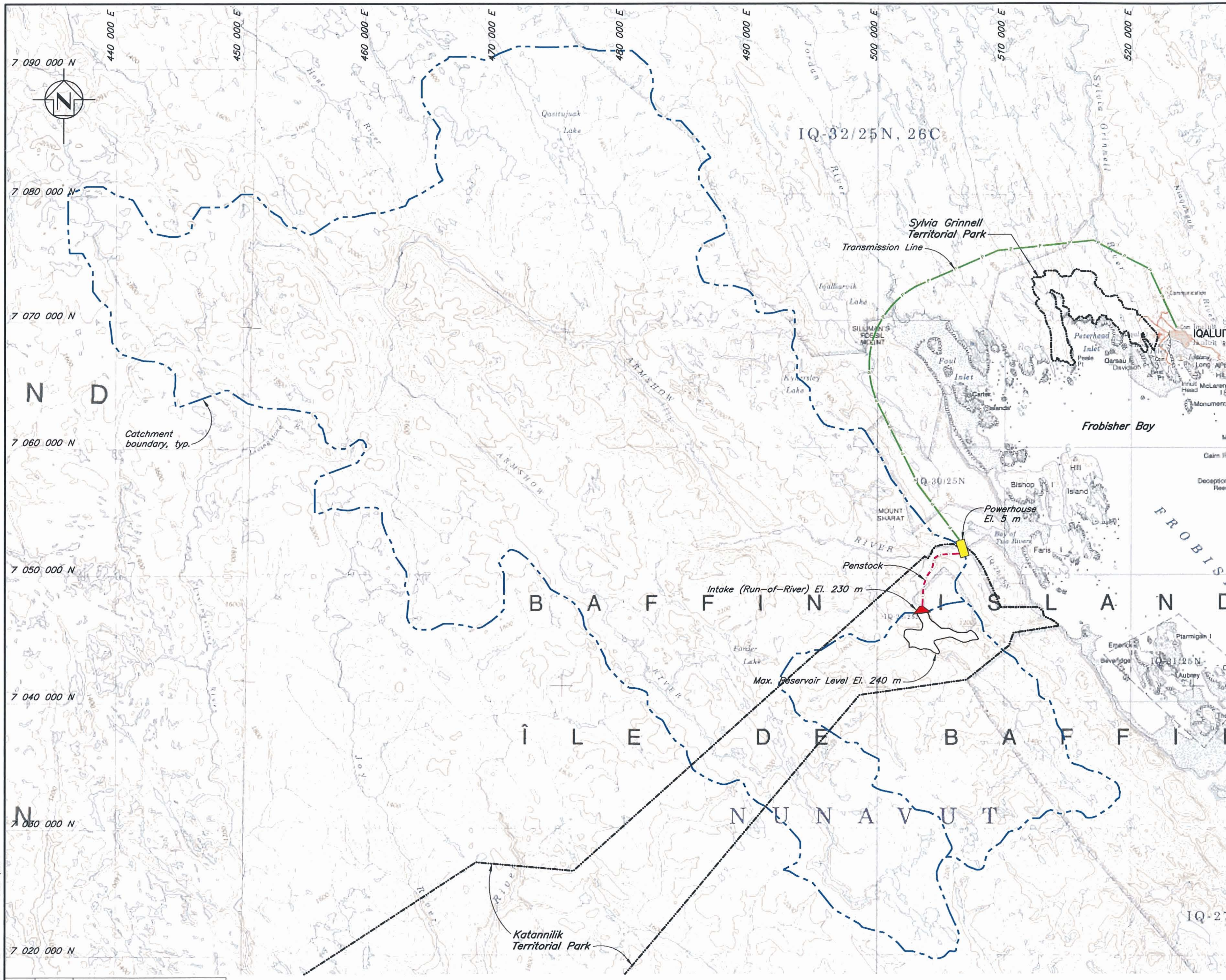


QULLIQ ENERGY CORPORATION

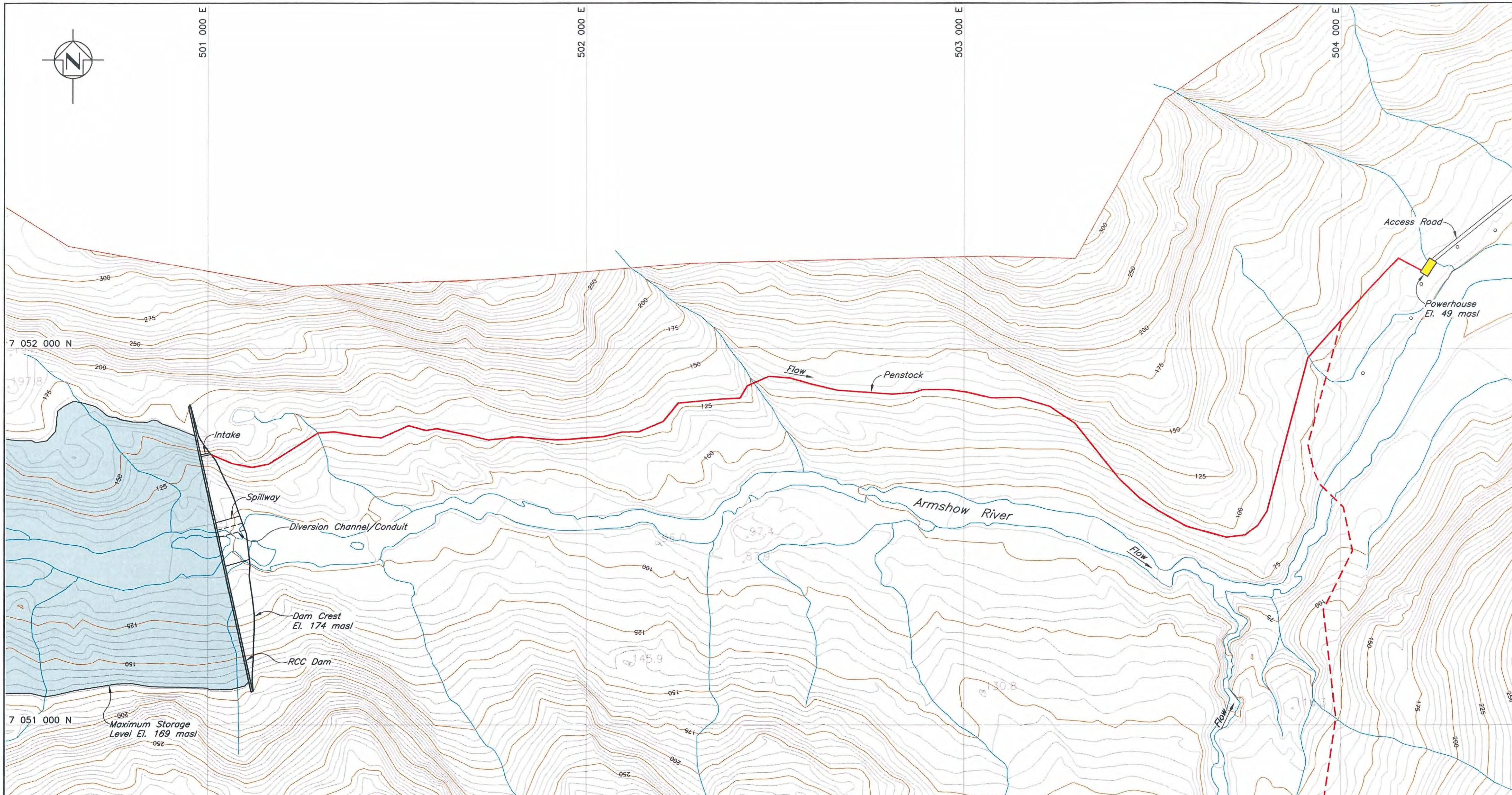
IQALUIT HYDRO–ELECTRIC GENERATION SITES

ARMSHOW RIVER (RIGHT LAKE) PROJECT GENERAL ARRANGEMENT

Knight Piésold CONSULTING

PROJECT/ASSIGNMENT NO.	REF. NO.	REV.
VA103–137/1	1	0

FIGURE 5.10



LEGEND

- Powerhouse Site
- Armshow Long Penstock Route
- Armshow Right Lake Penstock Route
- Tunnel
- Reservoir Inundation Area

QULLIQ ENERGY CORPORATION

IQALUIT HYDROPOWER PROJECT–PREFEASABILITY STUDY

ARMSHOW RIVER PROJECT
GENERAL ARRANGEMENT

Knight Piésold CONSULTING

PROJECT/ASSIGNMENT NO. VA103-137/1 | REF. NO. 2

FIGURE 4.1 | REV. 0

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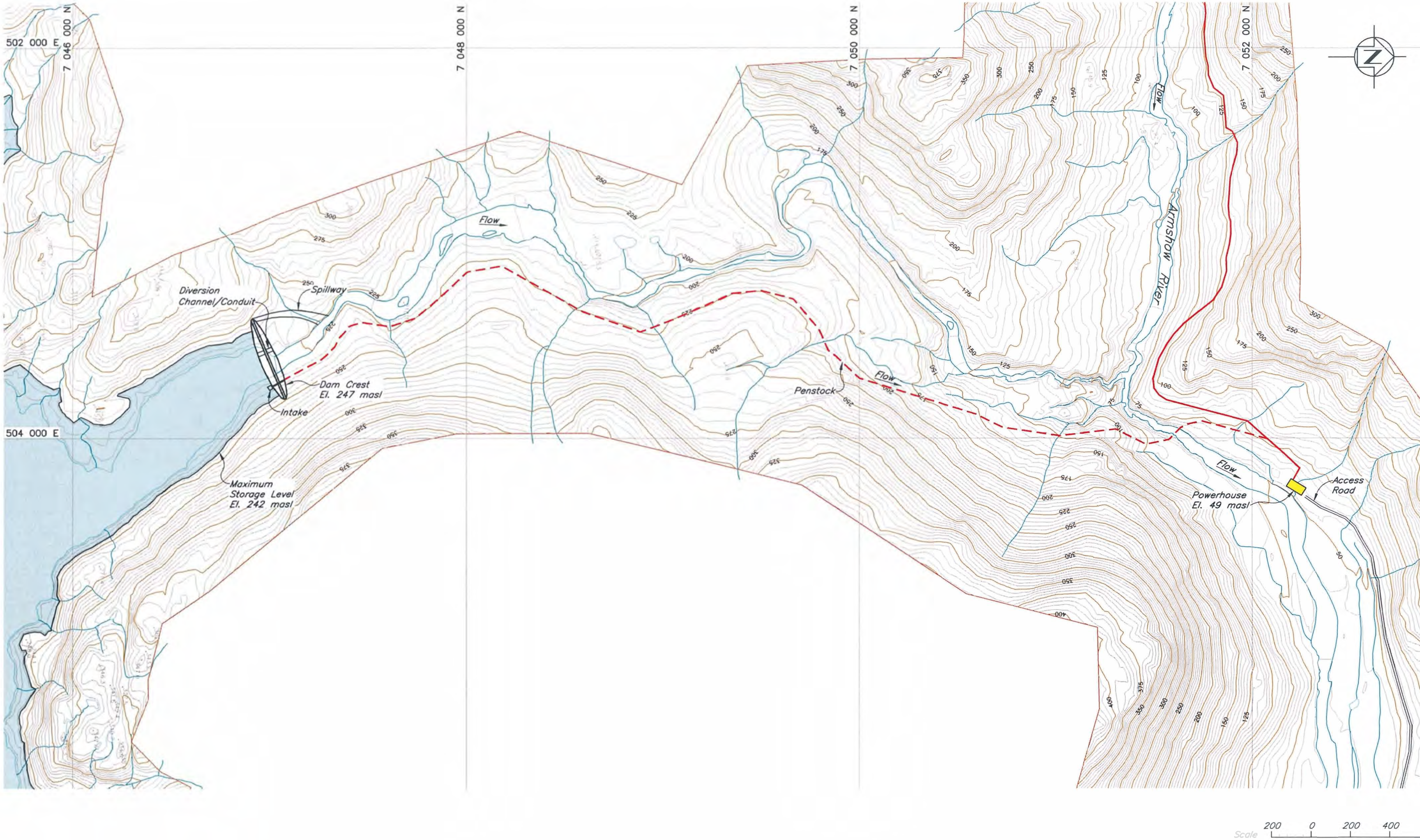
VANCOUVER B.C.



LEGEND

- Powerhouse Site
- Armshow Long Penstock Route
- Armshow Right Lake Penstock Route
- Tunnel
- Reservoir Inundation Area

QULLIQ ENERGY CORPORATION

IQALUIT HYDROPOWER PROJECT–PREFEASABILITY STUDY

ARMSHOW RIVER (RIGHT LAKE) PROJECT GENERAL ARRANGEMENT

Knight Piésold CONSULTING

PROJECT/ASSIGNMENT NO. VA103-137/1 | REF. NO. 2

FIGURE 4.2 | REV 0

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QULLIQ ENERGY CORPORATION	
IQALUIT HYDROPOWER PROJECT–PREFEASABILITY STUDY	
ARMSHOW RIVER PROJECTS BARGE DOCK & ACCESS ROAD LAYOUT	
Knight Piésold CONSULTING	PROJECT/ASSIGNMENT NO. VA103-137/1 — REF. NO. 2
	FIGURE 4.7 — REV. 0

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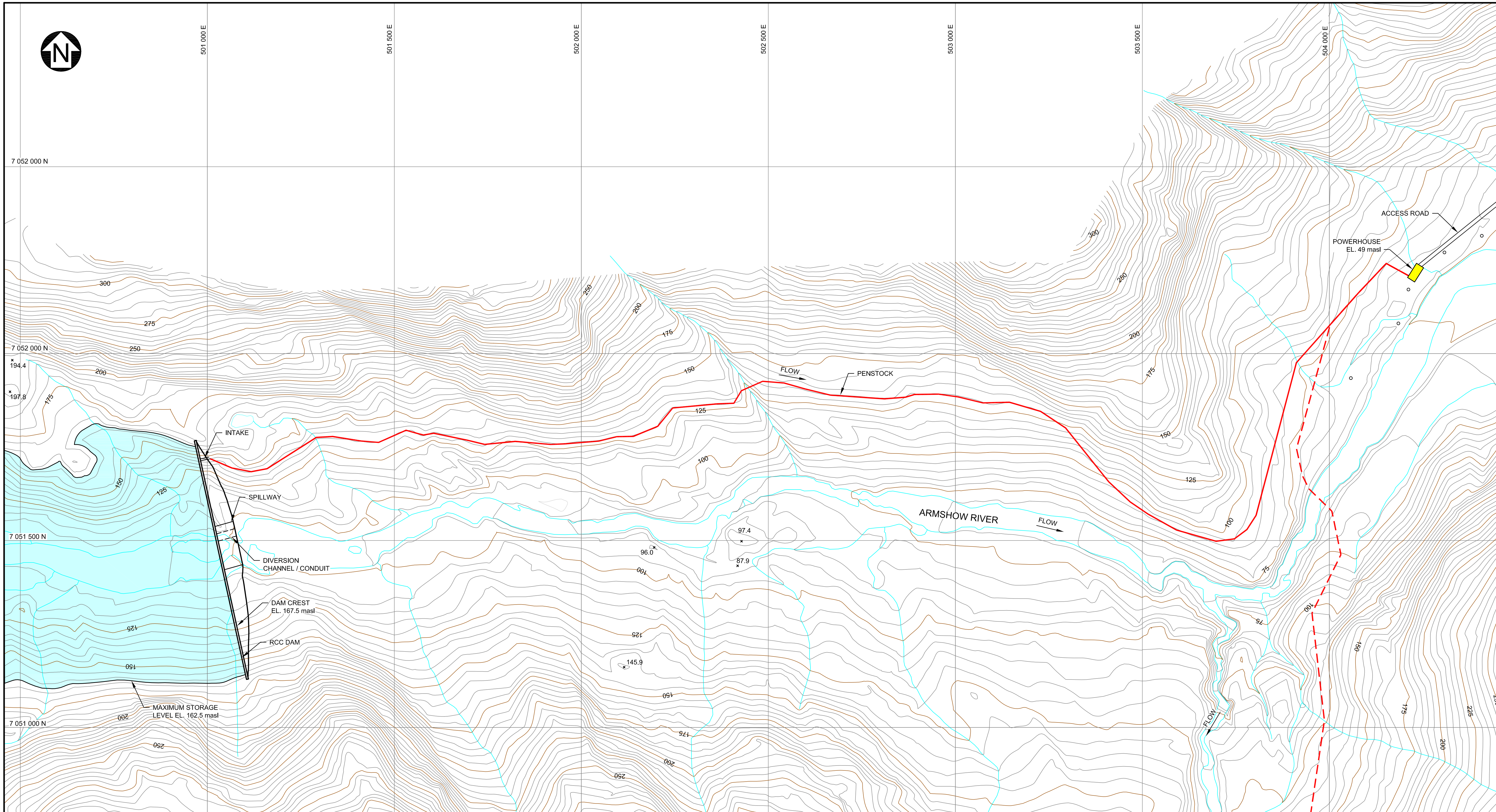

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LEGEND:

	POWERHOUSE SITE
	ARMSHOW LONG PENSTOCK ROUTE
	ARMSHOW RIGHT LAKE PENSTOCK ROUTE
	RESERVOIR INUNDATION AREA

QULLIQ ENERGY CORPORATION

IQALUIT HYDROELECTRIC PROJECTS

ARMSHOW RIVER - 10MW
GENERAL ARRANGEMENT

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA103-137/6	VA11-00302

FIGURE 1	REV 0

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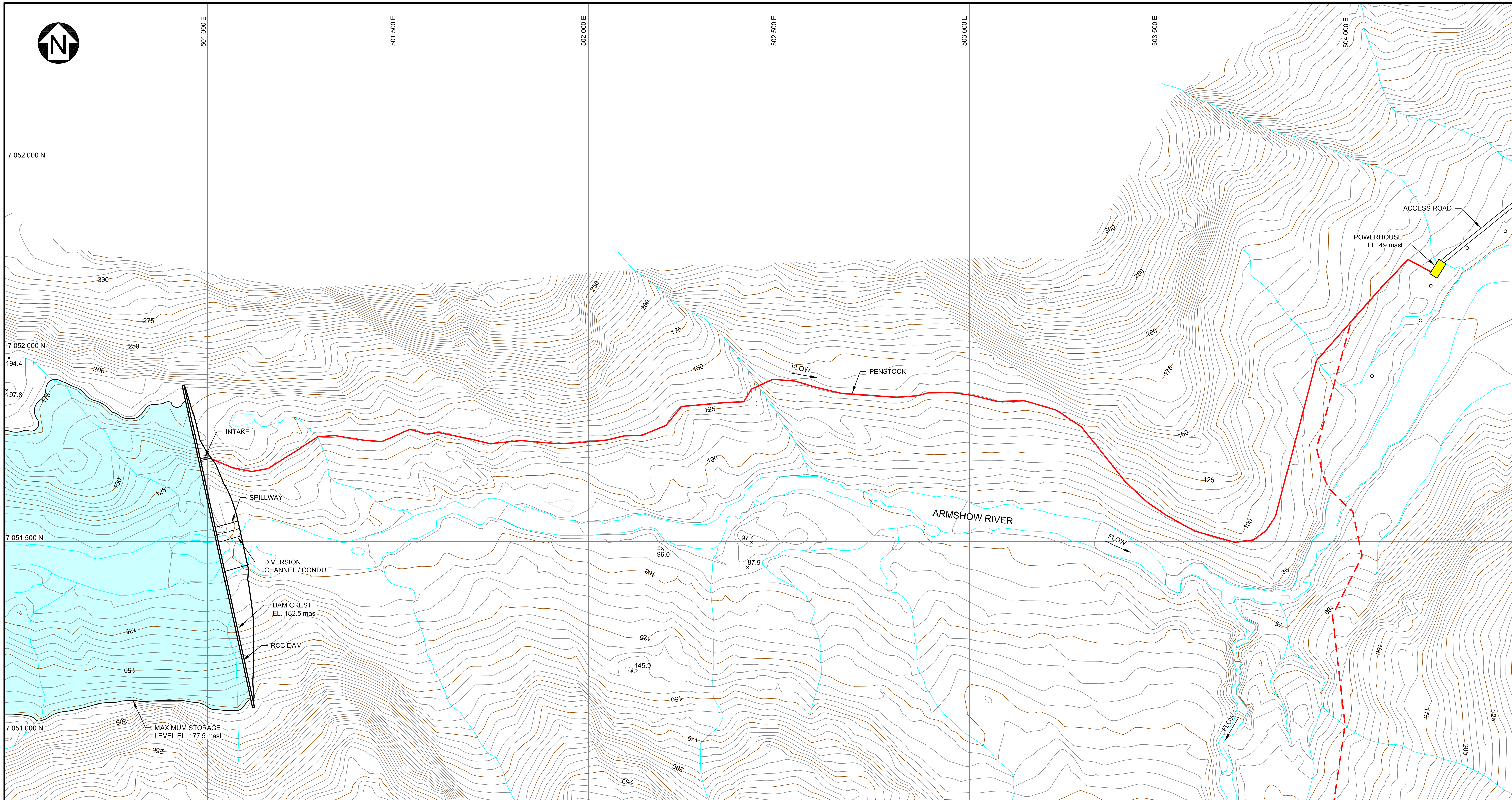

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SCALE A

LEGEND:

- POWERHOUSE SITE
- ARMSHOW LONG PENSTOCK ROUTE
- ARMSHOW RIGHT LAKE PENSTOCK ROUTE
- RESERVOIR INUNDATION AREA

QULLIQ ENERGY CORPORATION

IQALUIT HYDROELECTRIC PROJECTS

ARMSHOW RIVER - 20MW
GENERAL ARRANGEMENT

Knight Piésold
CONSULTING

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FIGURE 2		REV 0

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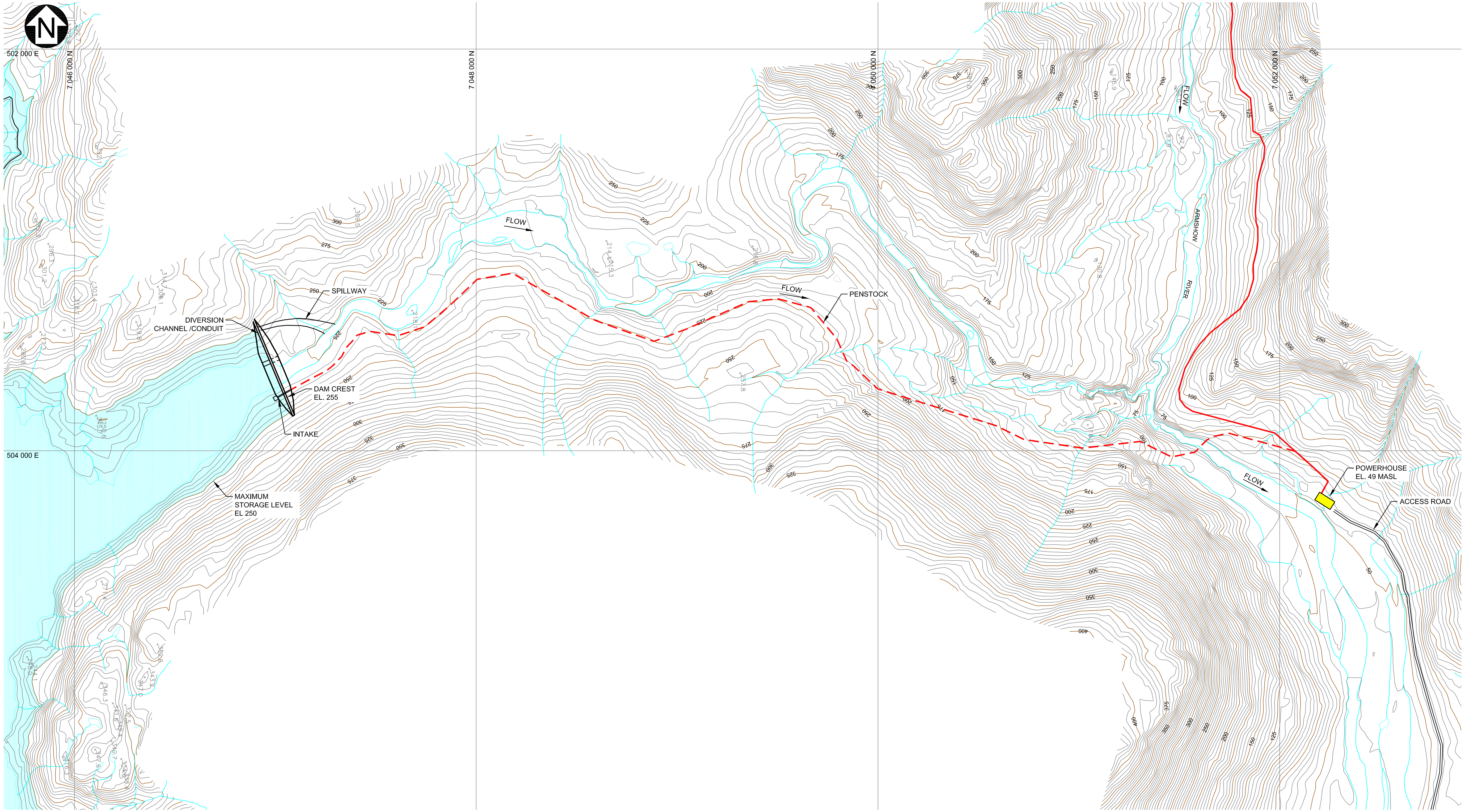

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LEGEND:

- POWERHOUSE SITE
- ARMSHOW LONG PENSTOCK ROUTE
- ARMSHOW RIGHT LAKE PENSTOCK ROUTE
- RESERVOIR INUNDATION AREA

QUILLIQ ENERGY CORPORATION

IQALUIT HYDROELECTRIC PROJECTS

ARMSHOW SOUTH - 6MW
GENERAL ARRANGEMENT

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA103-137/1	VA11-00302

FIGURE 3 REV 0

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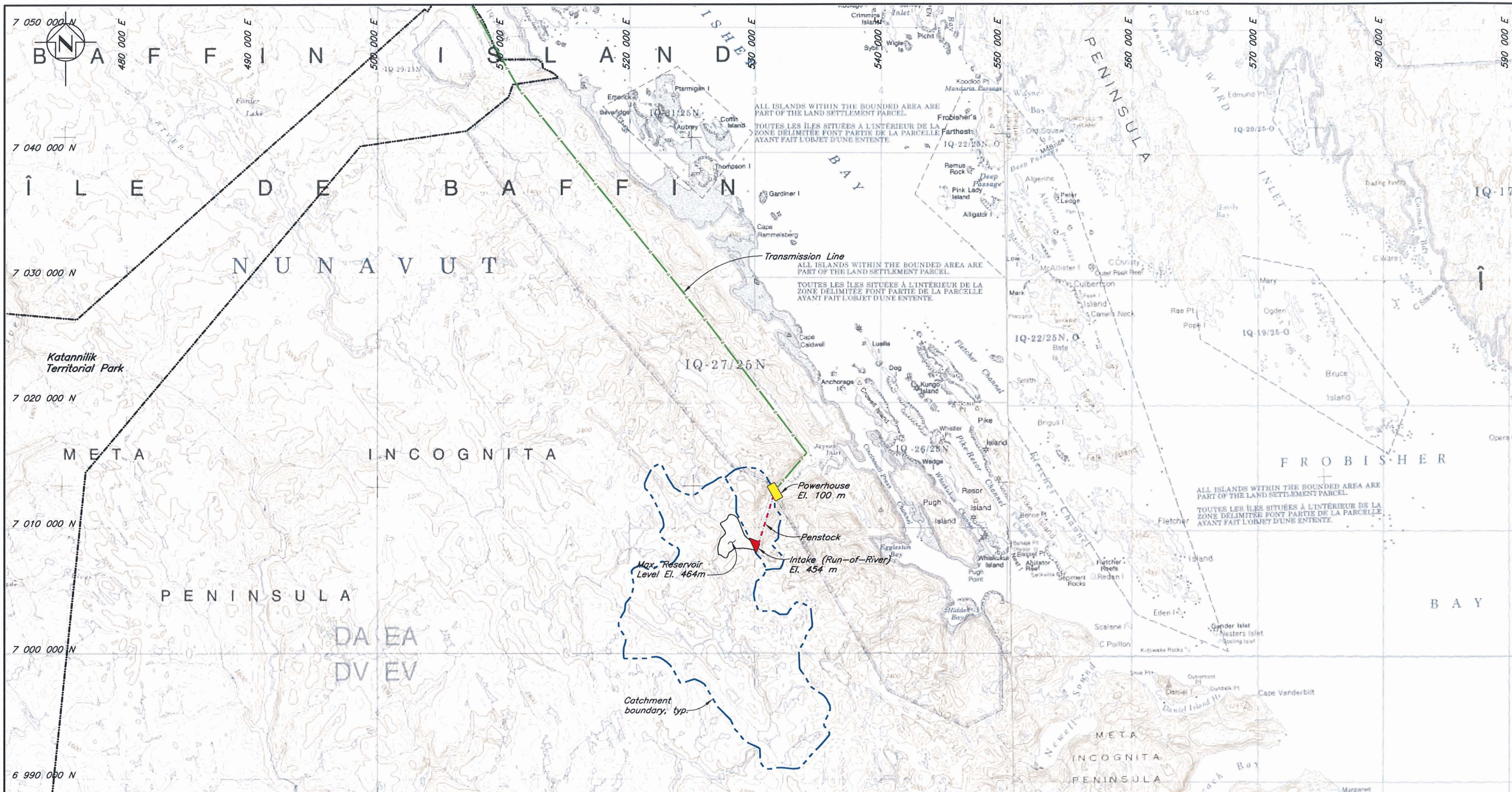

QULLIQ ENERGY CORPORATION

IQALUIT HYDRO–ELECTRIC GENERATION SITES

JAYNES INLET
PROJECT GENERAL ARRANGEMENT

Knight Piésold CONSULTING

PROJECT/ASSIGNMENT NO.	REF. NO.	REV.
VA103–137/1	1	0

FIGURE 5.13

REV. 0	14NOV'05	ISSUED FOR REPORT

LEGEND

	Powerhouse Site
	Penstock Route
	Alternative Penstock Route
	Tunnel
	Reservoir Inundation Area

QULLIQ ENERGY CORPORATION

IQALUIT HYDROPOWER PROJECT–PREFEASABILITY STUDY

JAYNES INLET PROJECT GENERAL ARRANGEMENT

Knight Piésold CONSULTING

PROJECT/ASSIGNMENT NO. VA103-137/1 | REF. NO. 2

FIGURE 4.3 | REV. 0

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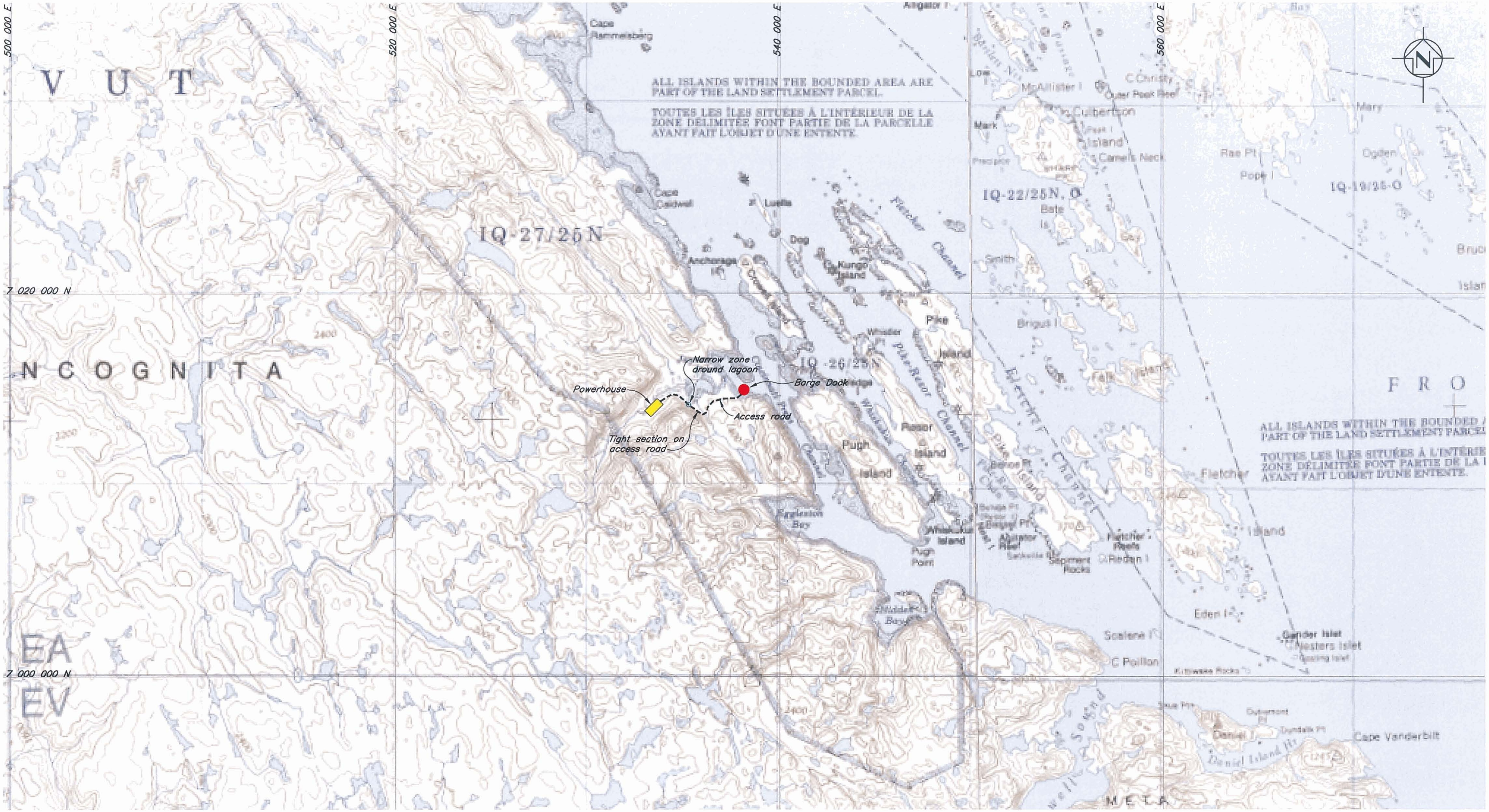

QULLIQ ENERGY CORPORATION

IQALUIT HYDROPOWER PROJECT–PREFEASABILITY STUDY

JAYNES INLET PROJECT
BARGE DOCK & ACCESS ROAD LAYOUT

Knight Piésold CONSULTING

PROJECT/ASSIGNMENT NO.	REF. NO.
VA103-137/1	2
FIGURE 4.8	REV. 0

REV. 0	29SEP'06	ISSUED FOR REPORT

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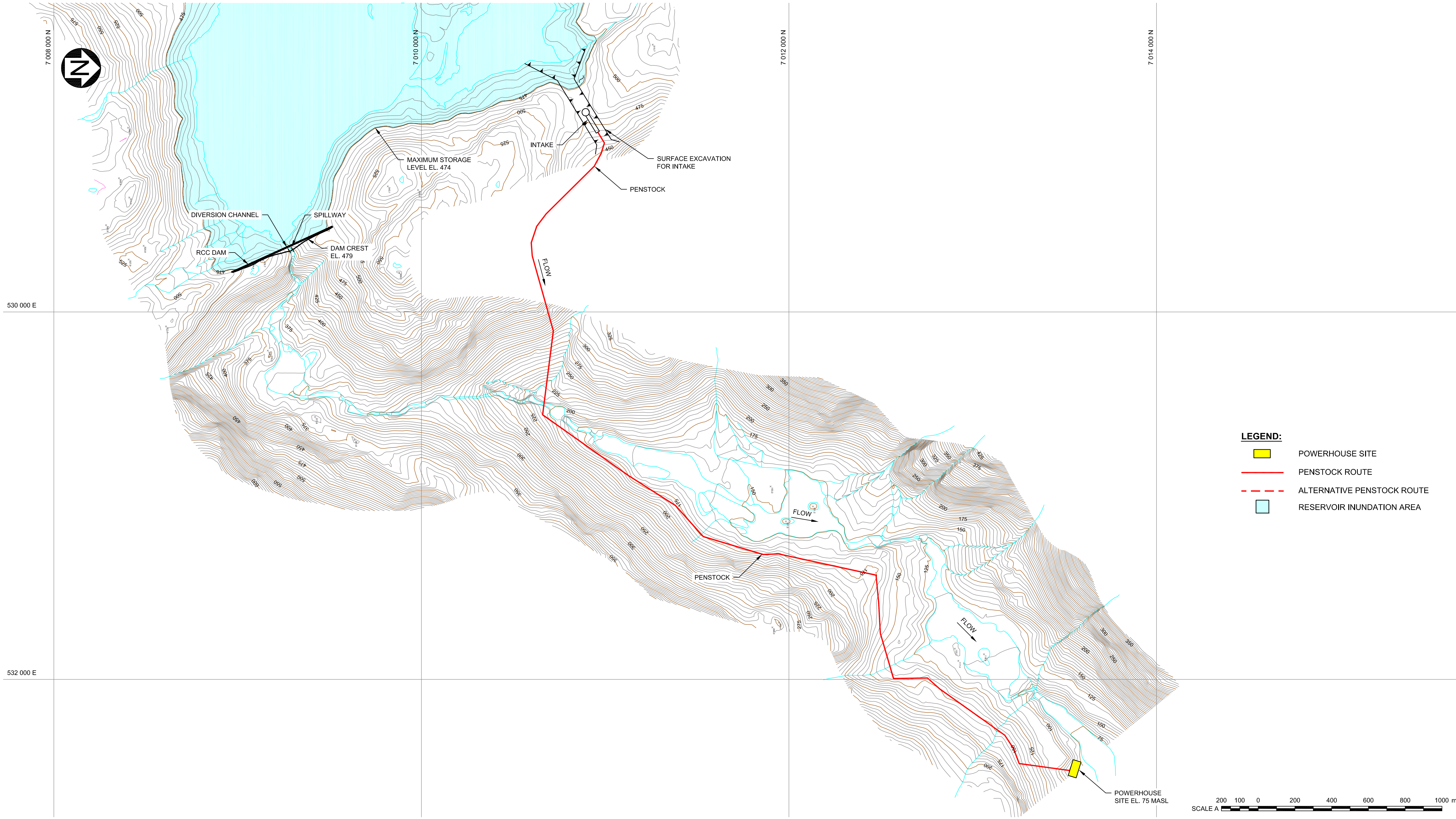

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QULLIQ ENERGY CORPORATION

IQALUIT HYDROELECTRIC PROJECTS

JAYNES INLET - 10MW GENERAL ARRANGEMENT

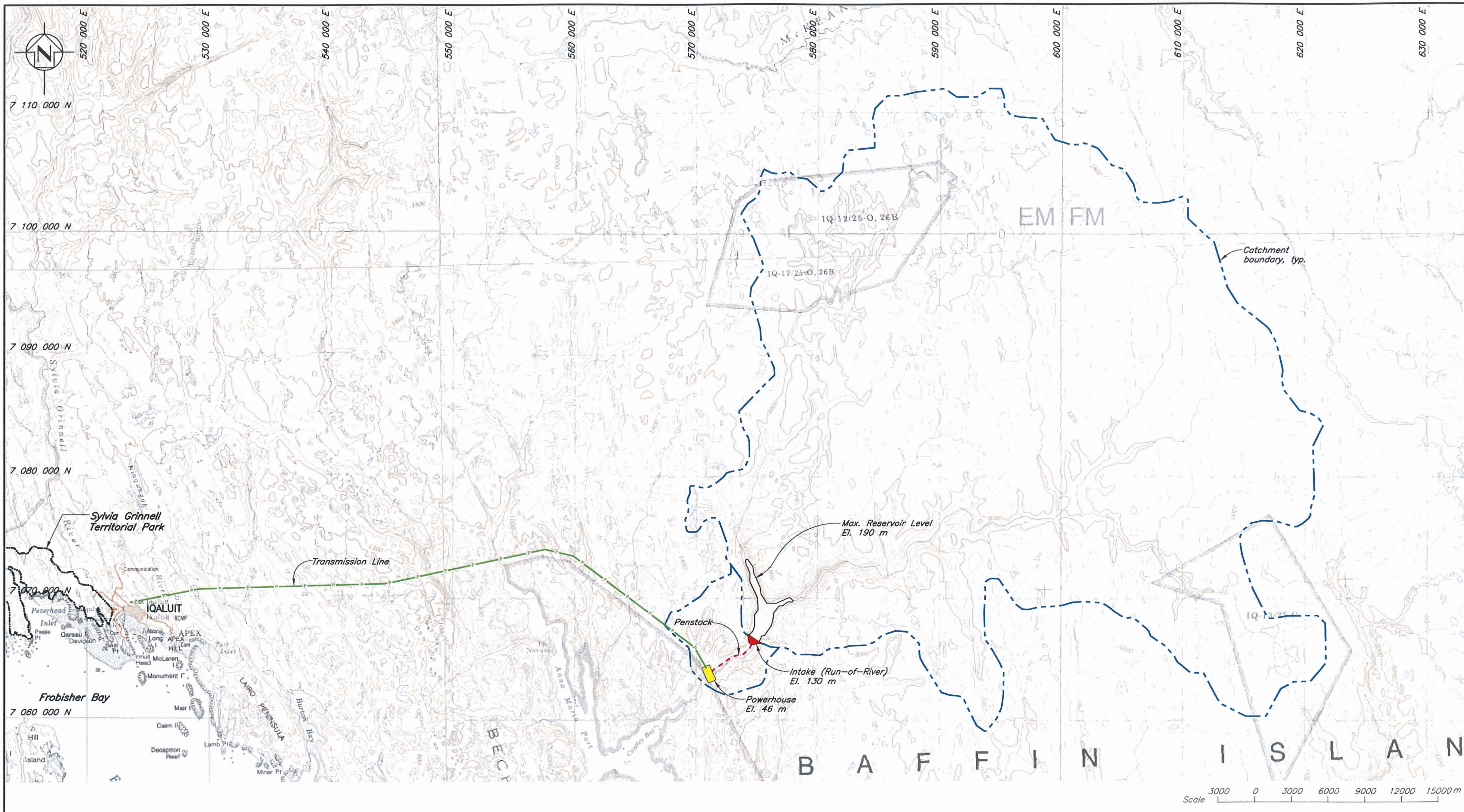
Knight Piésold CONSULTING

P/A NO. VA103-137/6

REF NO. VA11-00302

FIGURE 6

REV 0



QULLIQ ENERGY CORPORATION

IQALUIT HYDRO–ELECTRIC GENERATION SITES

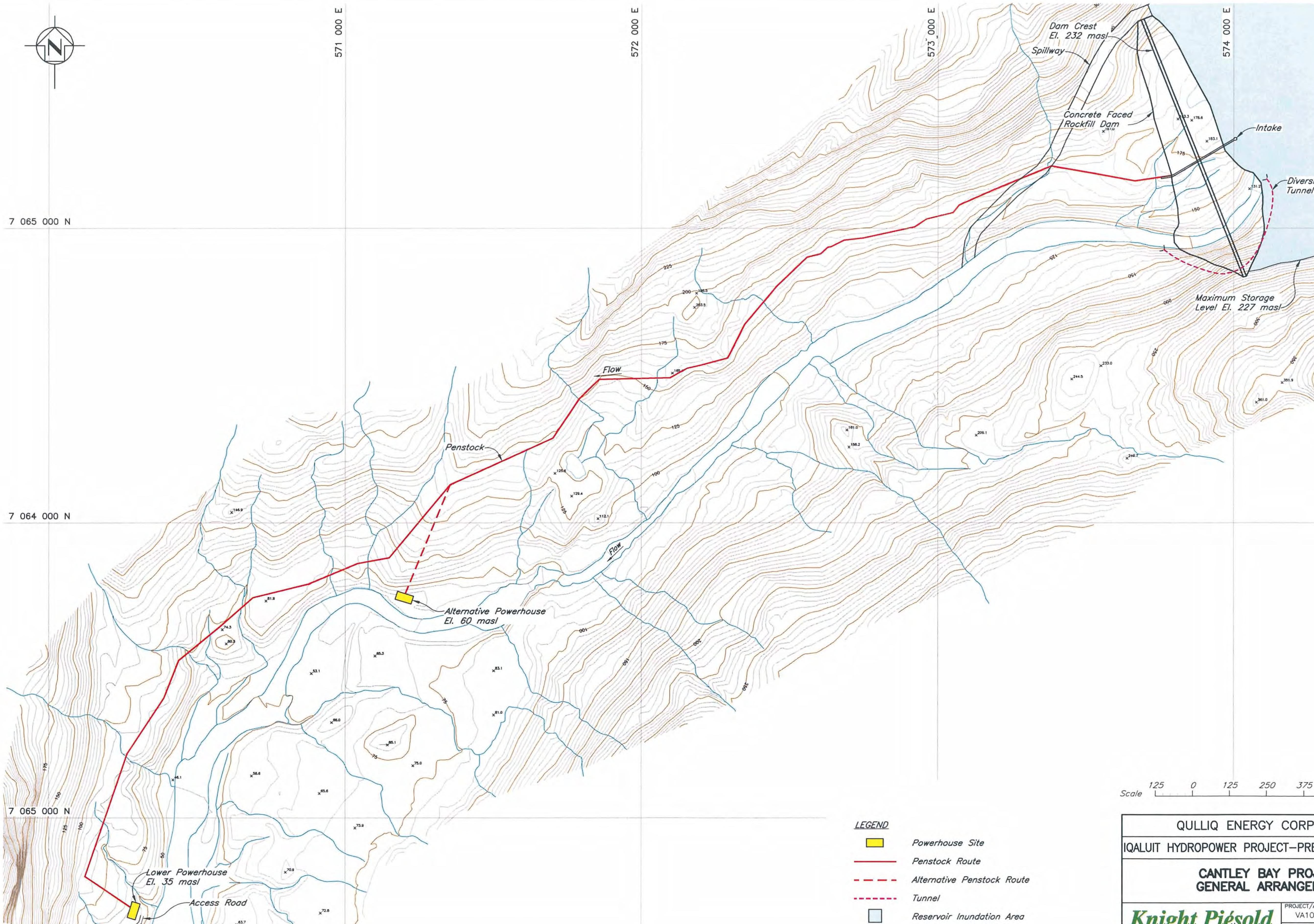
CANTLEY BAY
PROJECT GENERAL ARRANGEMENT

Knight Piésold CONSULTING

PROJECT/ASSIGNMENT NO.	REF. NO.	REV.
VA103–137/1	1	0

FIGURE 5.1

REV. 0	14NOV'05	ISSUED FOR REPORT



LEGEND

(yellow box)	Powerhouse Site
(solid red line)	Penstock Route
(red dashed line)	Alternative Penstock Route
(red dotted line)	Tunnel
(blue box)	Reservoir Inundation Area

QULLIQ ENERGY CORPORATION

IQALUIT HYDROPOWER PROJECT–PREFEASABILITY STUDY

CANTLEY BAY PROJECT
GENERAL ARRANGEMENT

Knight Piésold CONSULTING

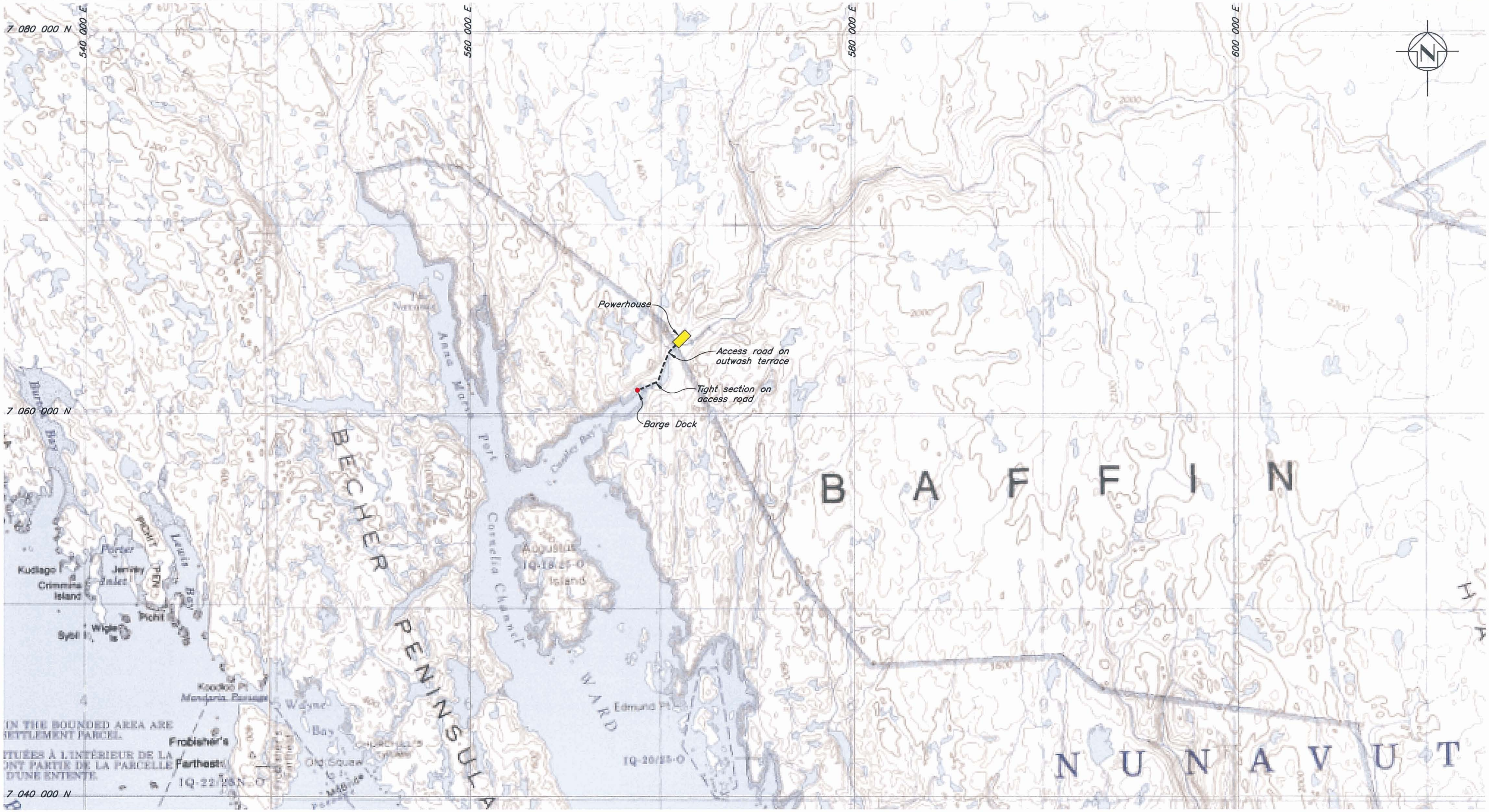
PROJECT/ASSIGNMENT NO.	REF. NO.
VA103-137/1	2

FIGURE 4.4 REV. 0

REV. 0	29SEP'06	ISSUED FOR REPORT

XREF FILE : CANTLEY_Topo

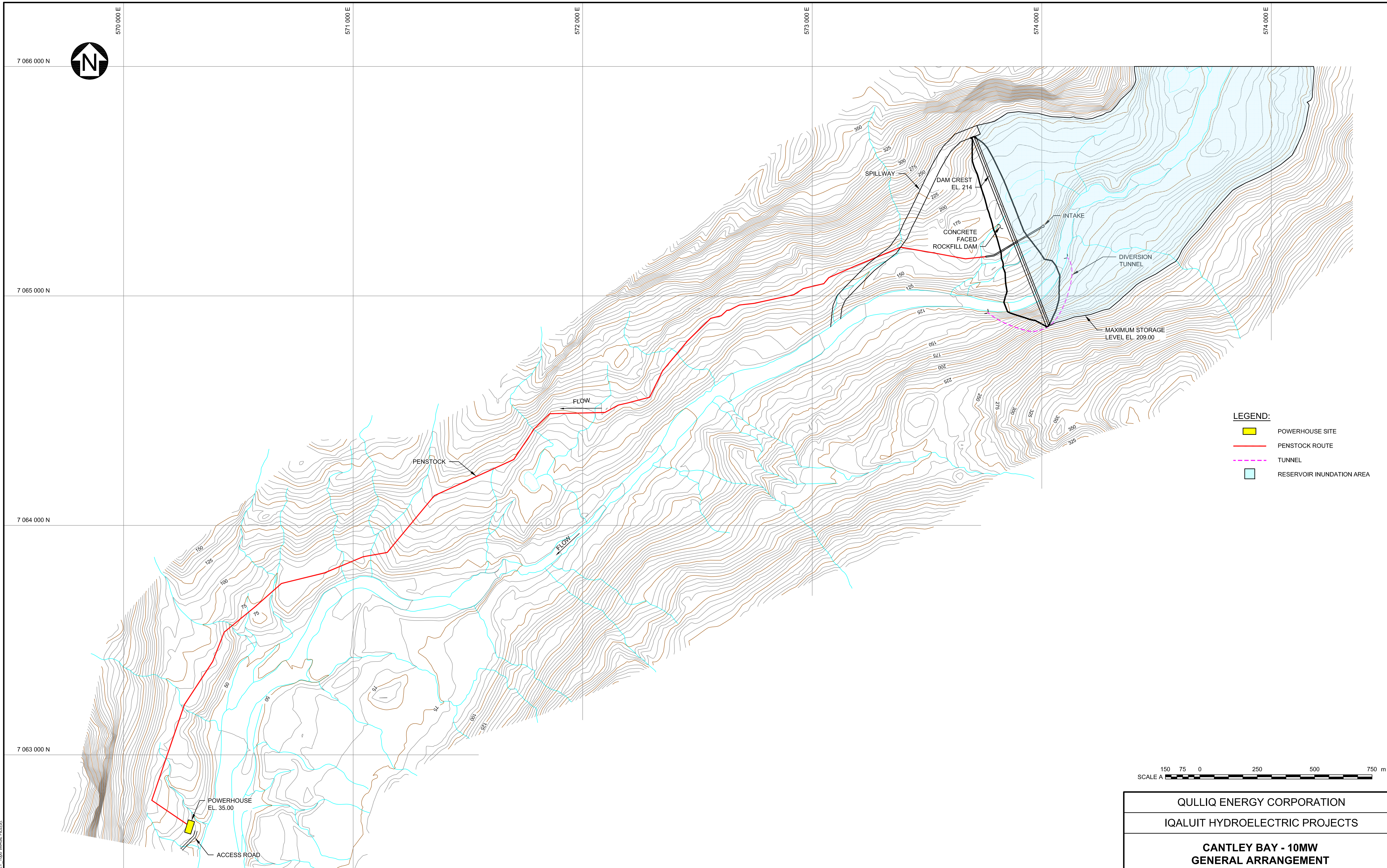
VANCOUVER B.C. CAD FILE: M:\1\03\00137\01\A\Acad\Figs\B30.dwg 1=12500 PLOT 1=1(PS) Sep 27 2006 by:schizar



QULLIQ ENERGY CORPORATION	
IQALUIT HYDROPOWER PROJECT–PREFEASABILITY STUDY	
CANTLEY BAY PROJECT BARGE DOCK & ACCESS ROAD LAYOUT	
Knight Piésold CONSULTING	PROJECT/ASSIGNMENT NO. VA103-137/1 · REF. NO. 2 · FIGURE 4.9 · REV. 0

REV.	DATE	DESCRIPTION
REV. 0	29SEP'06	ISSUED FOR REPORT

VANCOUVER B.C. CAD FILE: M:\1\03\00137\01\A\Acad\Figs\B38.dwg 1=30000 PLOT 1=1(PS) Sep 26 2006 by:SC



SAVED: M:\1\03\00137\06\A\cad\FIGS\CANTLEY\B01_r0 - VA11-00302, 2/11/2011 11:46:06 AM , DPETRUSE PRINTED: 2/11/2011 2:16:43 PM, Layout1, DPETRUSE
XREF FILE(S): CANTLEY Topo IMAGE FILE(S):

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	11FEB'11	ISSUED WITH LETTER	JWV	VJG	JWV	SRM

QULLIQ ENERGY CORPORATION

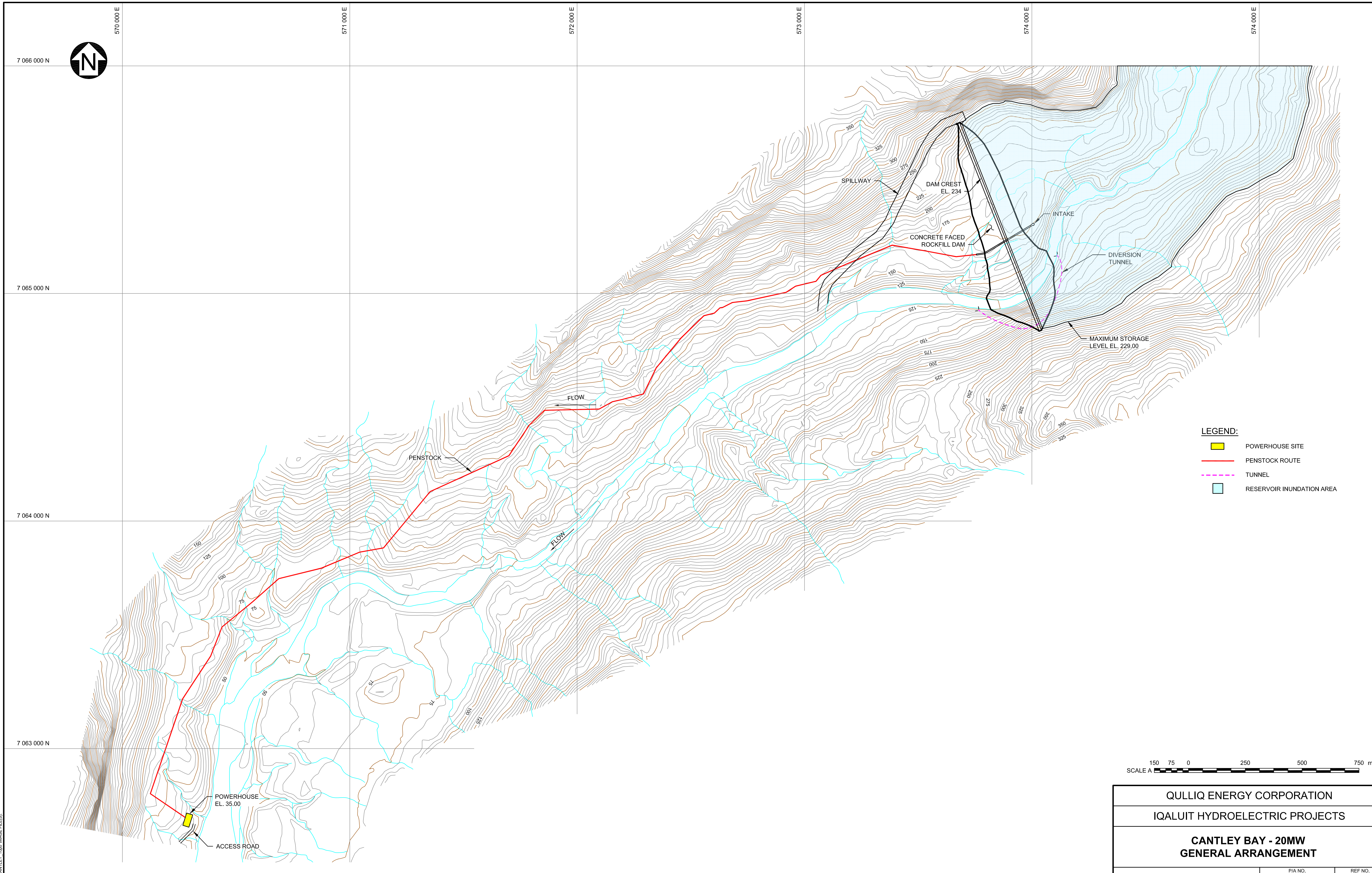
IQALUIT HYDROELECTRIC PROJECTS

CANTLEY BAY - 10MW
GENERAL ARRANGEMENT

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA103-137/6	VA11-00302

FIGURE 4 REV 0



SAVED: M:\1\03\00137\06\A\cad\FIGS\CANTLEY\B02_r0 - VA11-00302 . 2/11/2011 11:48:22 AM , DPETRUSE PRINTED: 2/11/2011 2:19:54 PM, Layout1, DPETRUSE

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
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QULLIQ ENERGY CORPORATION

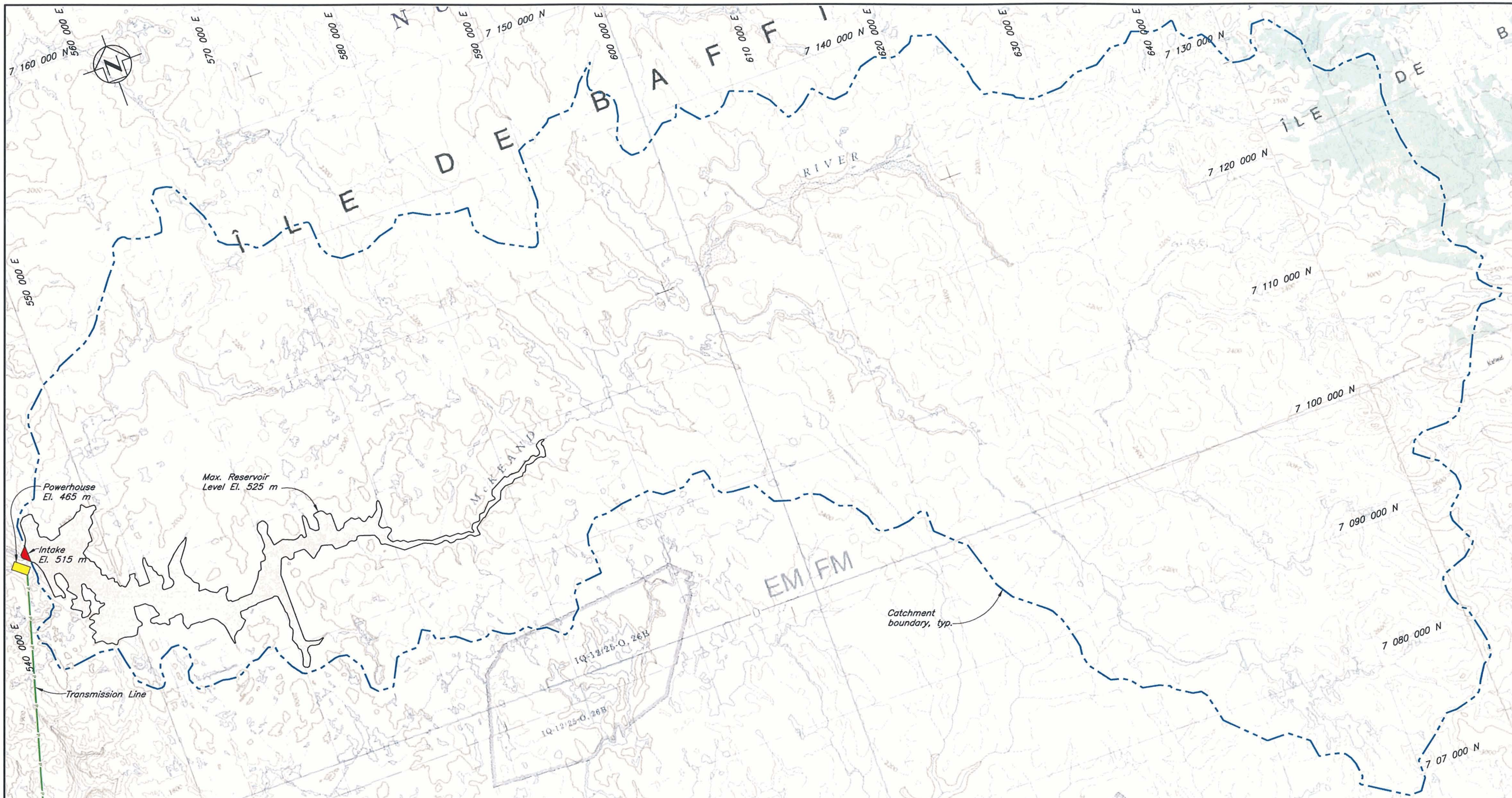
IQALUIT HYDROELECTRIC PROJECTS

CANTLEY BAY - 20MW
GENERAL ARRANGEMENT

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA103-137/6	VA11-00302

FIGURE 5 REV 0

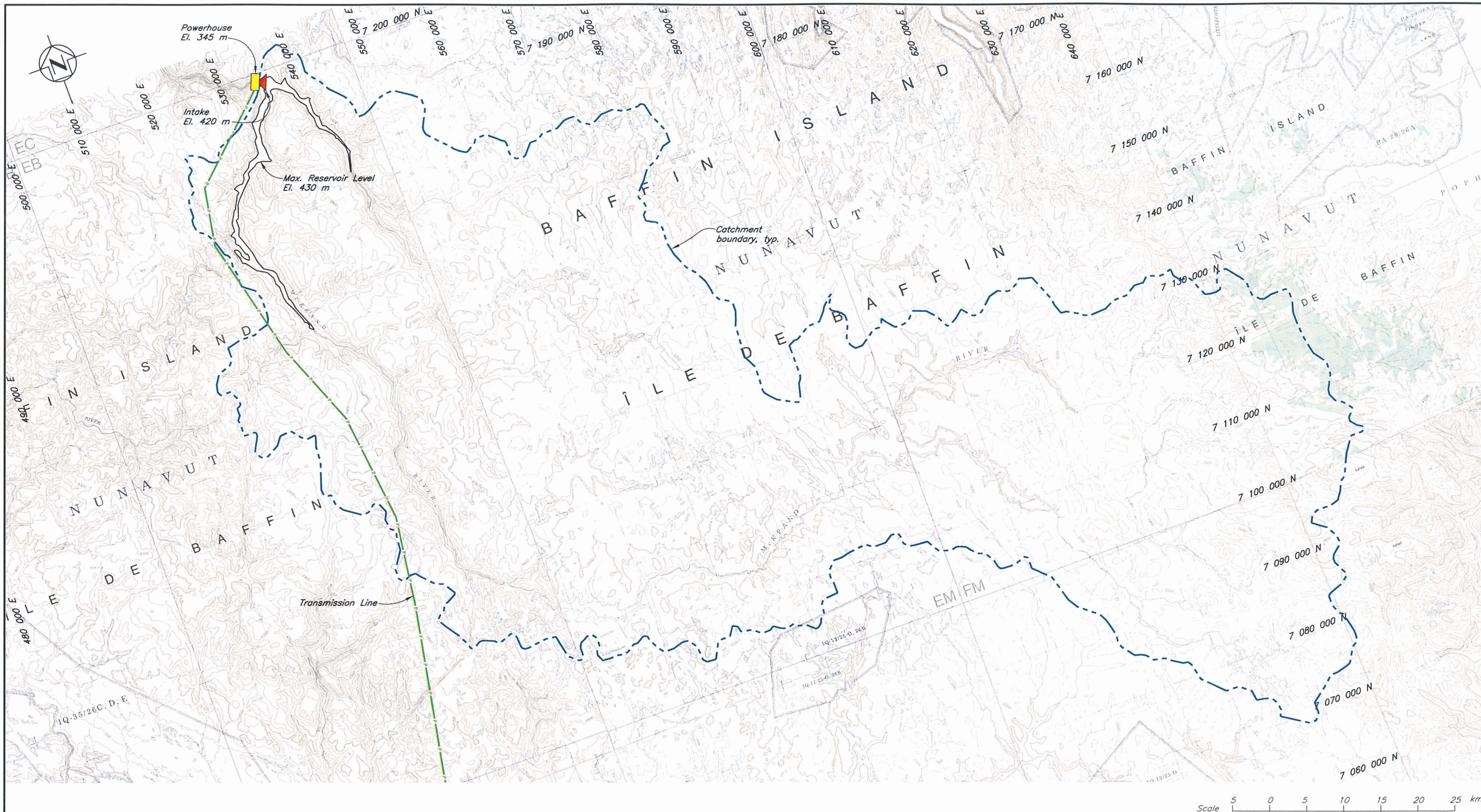


CAD FILE: M:\1\03\00137\01\A\Acad\Figs\B06.dwg 1=300000 PLOT 1=1(PS) Nov 14 2005 by:SC Time @ 10:57 VANCOUVER B.C.

XREF FILE: - IMAGES: Iqaluit 1

QULLIQ ENERGY CORPORATION	
IQALUIT HYDRO-ELECTRIC GENERATION SITES	
McKEAND RIVER (SOUTH) PROJECT GENERAL ARRANGEMENT	
Knight Piésold CONSULTING	PROJECT/ASSIGNMENT NO. VA103-137/1 · REF. NO. 1 · REV. 0
	FIGURE 5.11

REV. 0	14NOV'05	ISSUED FOR REPORT



QULLIQ ENERGY CORPORATION

IQALUIT HYDRO–ELECTRIC GENERATION SITES

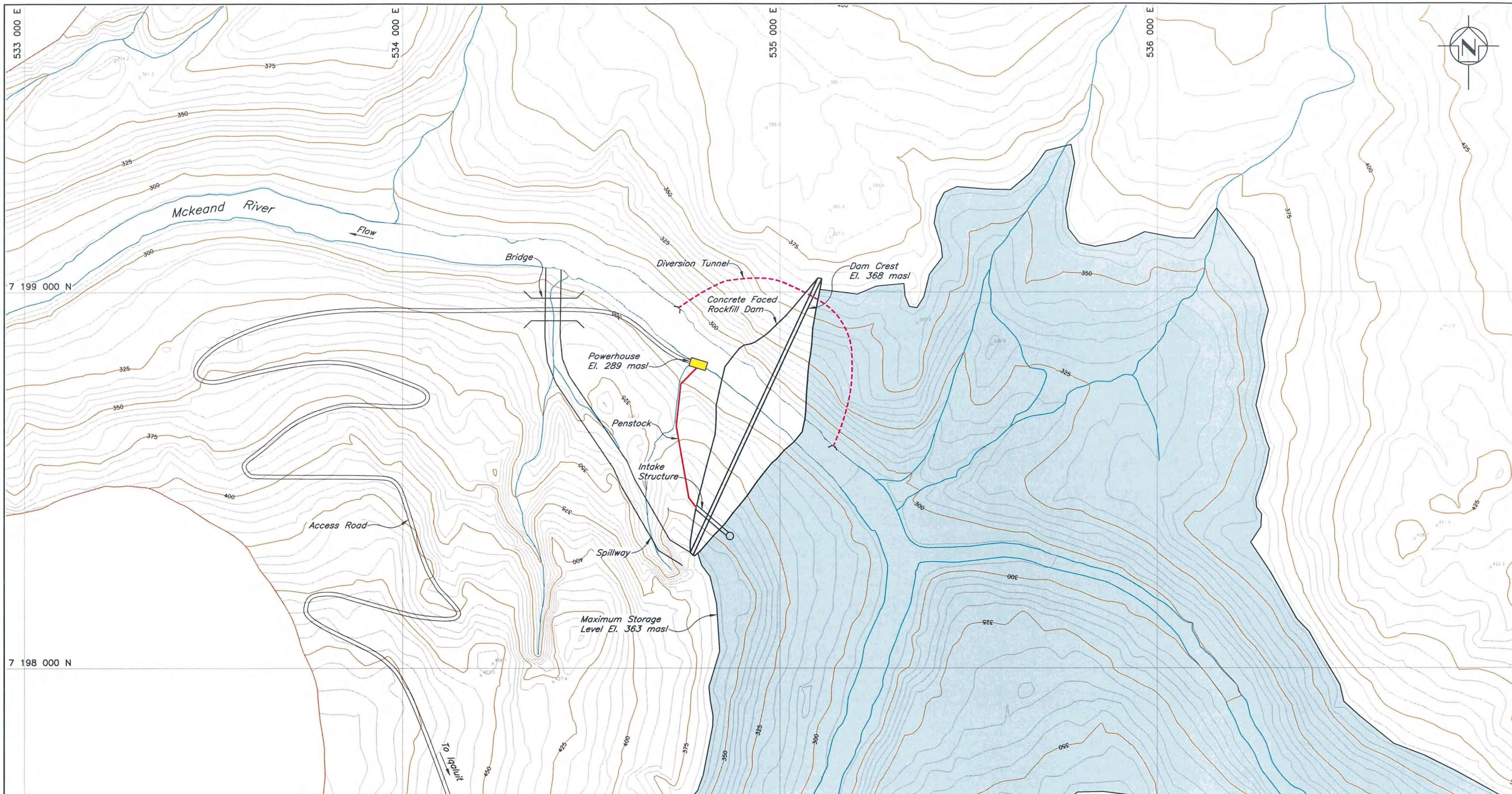
McKEAND RIVER (NORTH)
PROJECT GENERAL ARRANGEMENT

Knight Piésold CONSULTING

PROJECT/ASSIGNMENT NO.	REF. NO.	REV.
VA103–137/1	1	0

FIGURE 5.12

REV. 0	14NOV'05	ISSUED FOR REPORT



Scale 100 0 100 200 300 400 500 m

NOTE:

Maximum 10% grade on road.

LEGEND

- Powerhouse Site
- Penstock Route
- Tunnel
- Reservoir Inundation Area

QULLIQ ENERGY CORPORATION

IQALUIT HYDROPOWER PROJECT–PREFEASABILITY STUDY

MCKEAND RIVER PROJECT GENERAL ARRANGEMENT

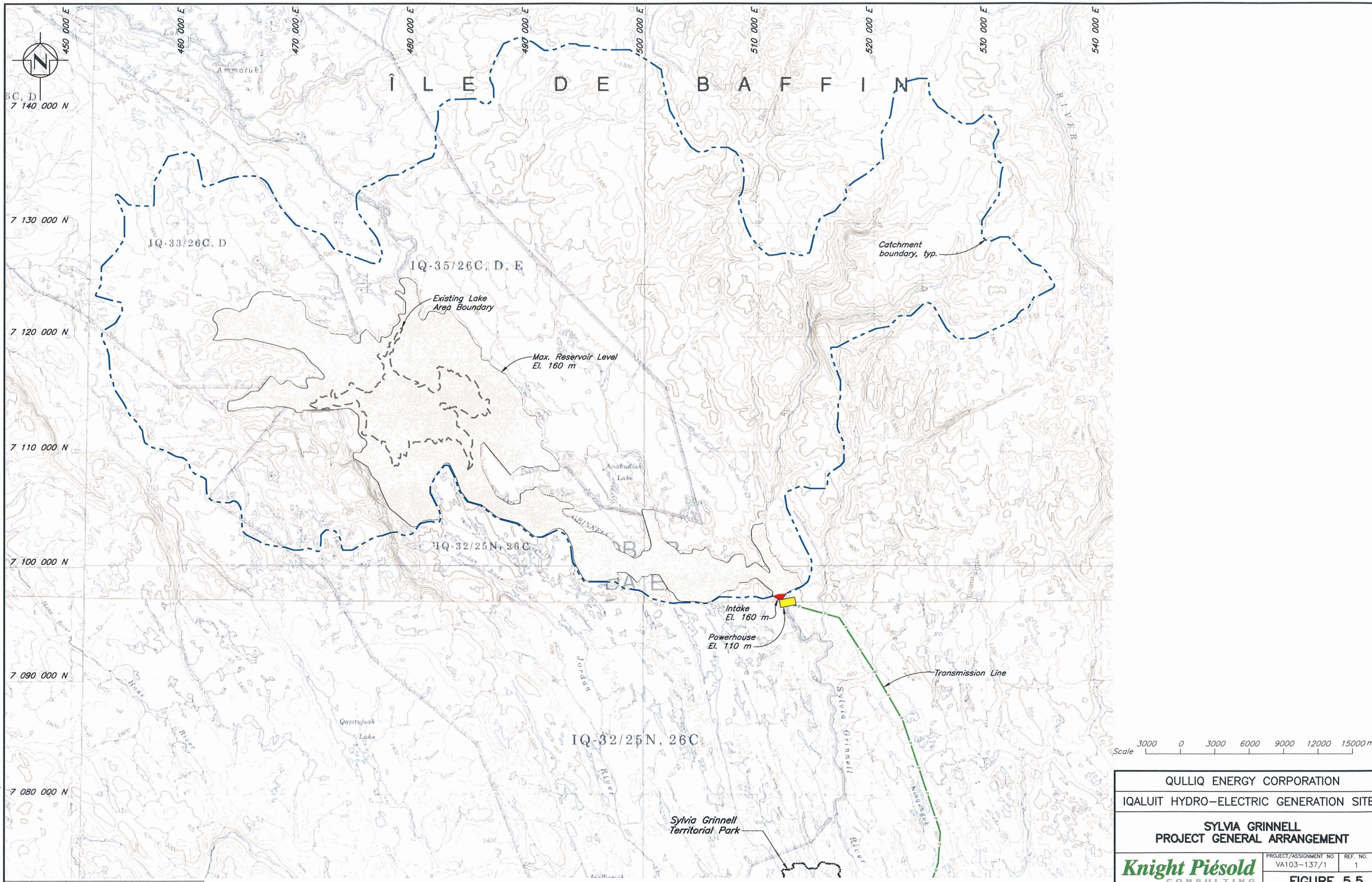
Knight Piésold CONSULTING

PROJECT/ASSIGNMENT NO.	REF. NO.
VA103-137/1	2
FIGURE 4.6	REV. 0

VANCOUVER B.C. CAD FILE: M:\1\03\00137\01\A\Acad\Figs\B31.dwg 1=10000 PLOT 1=1(PS) Sep 26 2006 by:schizer

XREF FILE : MCKEAND

REV. 0	29SEP'06	ISSUED FOR REPORT



QULLIQ ENERGY CORPORATION

IQALUIT HYDRO–ELECTRIC GENERATION SITES

SYLVIA GRINNELL PROJECT GENERAL ARRANGEMENT

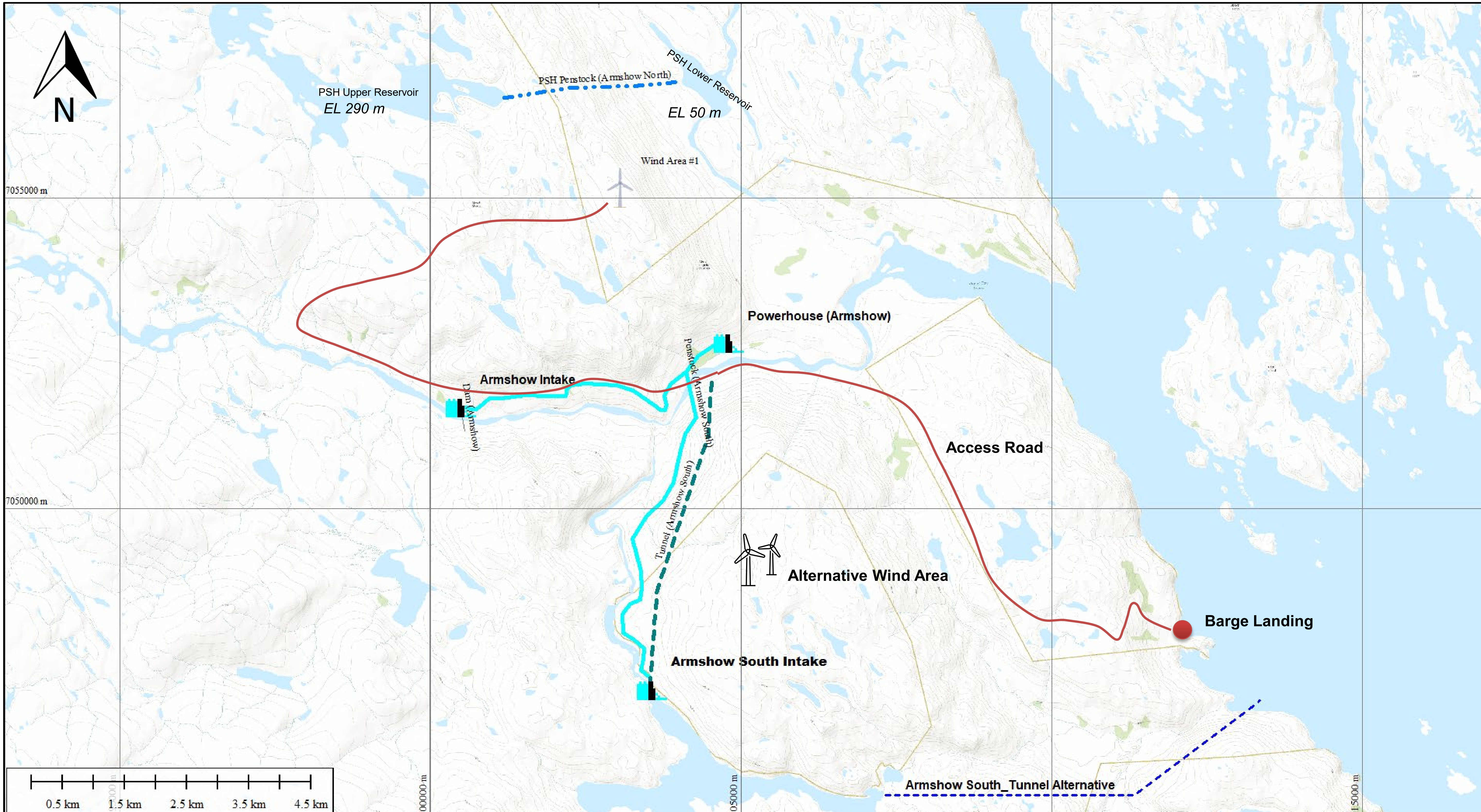
Knight Piésold CONSULTING

PROJECT/ASSIGNMENT NO.	REF. NO.	REV.
VA103-137/1	1	0

FIGURE 5.5

REV. 0	14NOV'05	ISSUED FOR REPORT

XREF FILE: - IMAGES: Iqaluit 1



Notes
1.

NUNAVUT NUKKIKSAUTIIT CORP.

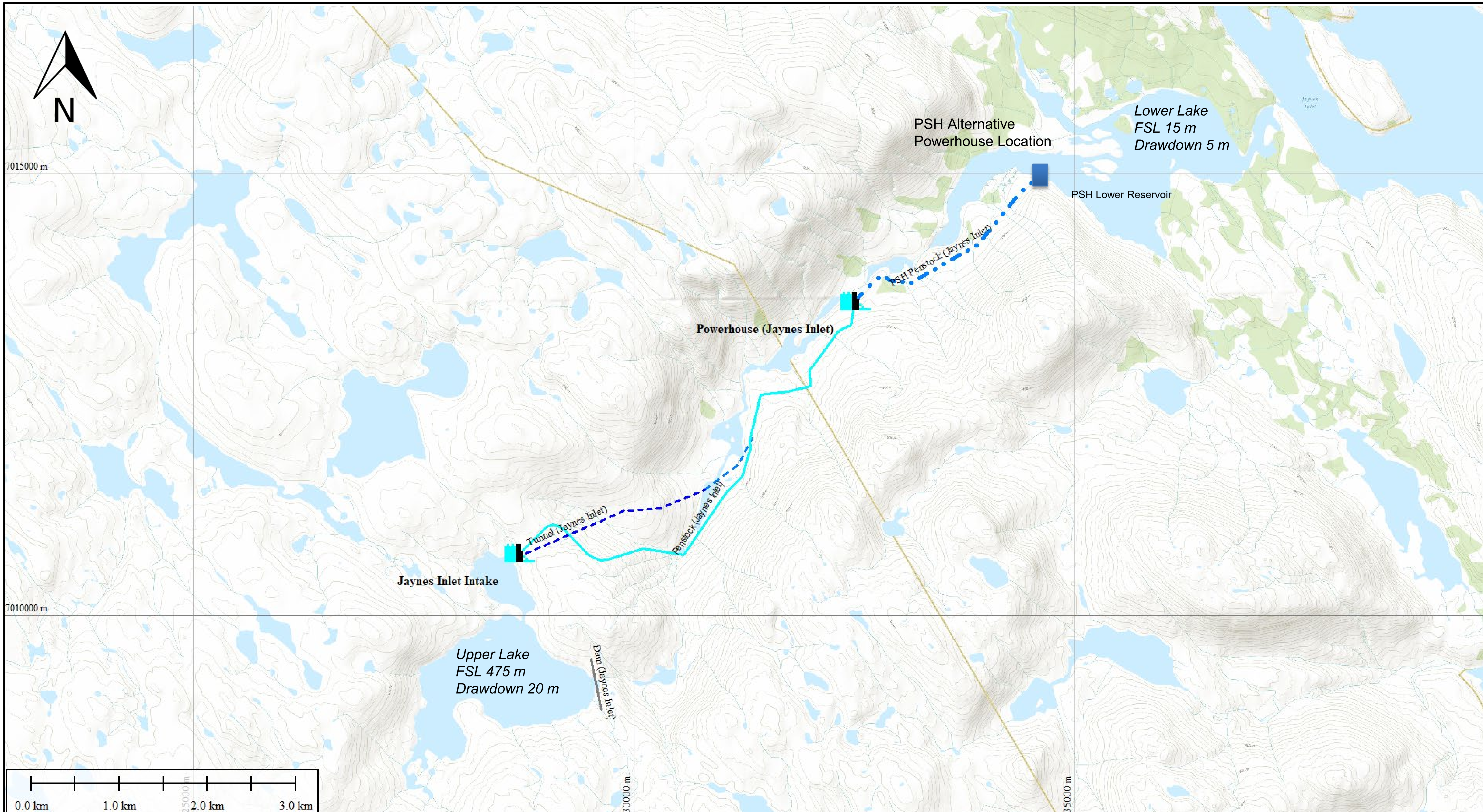
IQALUIT RENEWABLES

Armshow River
Hydro, PSH, & Wind Options

CANADIAN PROJECTS LIMITED

Figure X.X

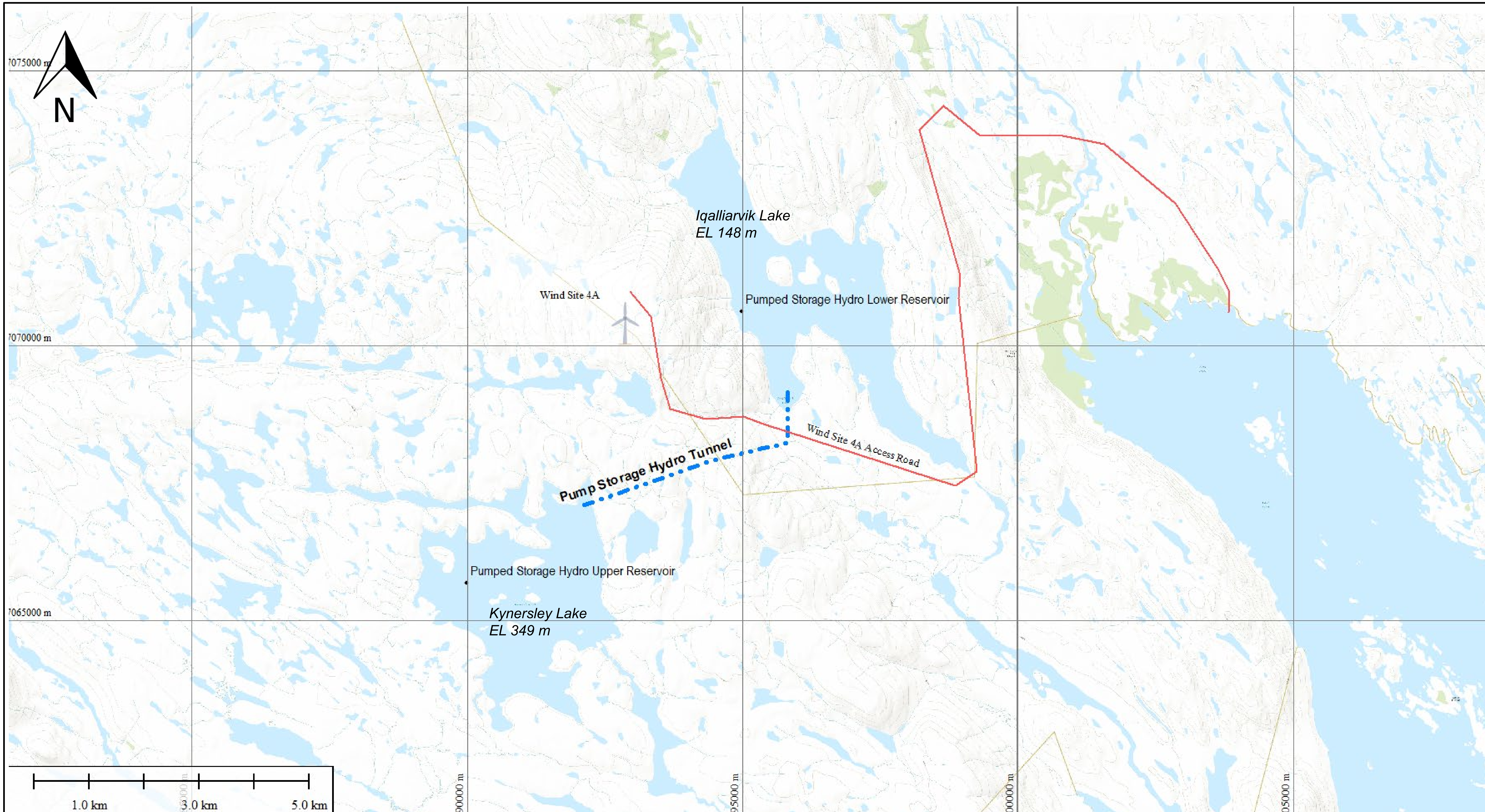
1090-001-3.2 Figures Ver 1.1 21-Sep-2017



Notes
1.

NUNAVUT NUKKIKSAUTIIT CORP.
IQALUIT RENEWABLES
Jaynes Inlet Hydro & PSH Options
CANADIAN PROJECTS LIMITED — **Figure X.X**

1090-001-3.2 Figures Ver 1.1 21-Sep-2017



Notes
1.

NUNAVUT NUKKIKSAUTIIT CORP.

IQALUIT RENEWABLES

Kynersley Iqalliarvik Lakes
Wind and PSH Site

CANADIAN PROJECTS LIMITED

Figure X.X

1090-001-3.2 Figures Ver 1.1 21-Sep-2017

Notes
1.

NUNAVUT NUKKIKSAUTIIT CORP.

IQALUIT RENEWABLES

North of Iqaluit Wind Site

CANADIAN PROJECTS LIMITED

Figure X.X

1090-001-3.2 Figures Ver 1.1 21-Sep-2017

Appendix B

Maps of Environmental Baseline Studies for Jaynes Inlet as of 2011

Qulliq Energy Corporation

Regional and Local Study Areas

Sources: **April 2011**

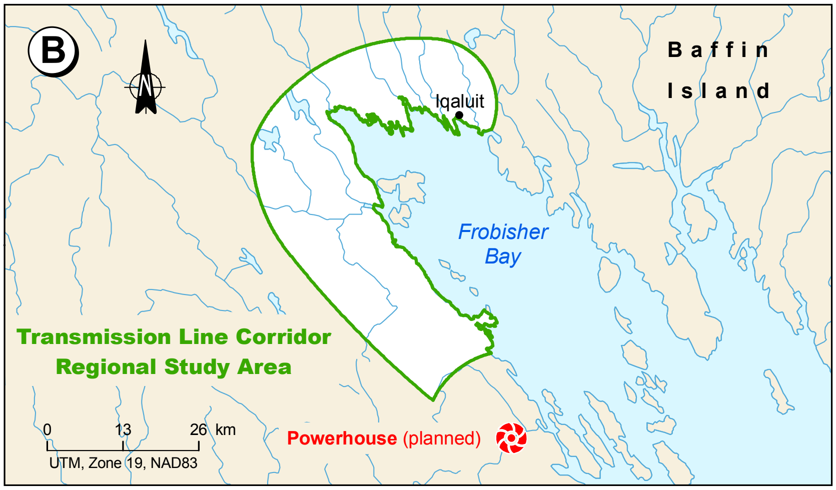
Base: NTDB, 1:250,000, 2001

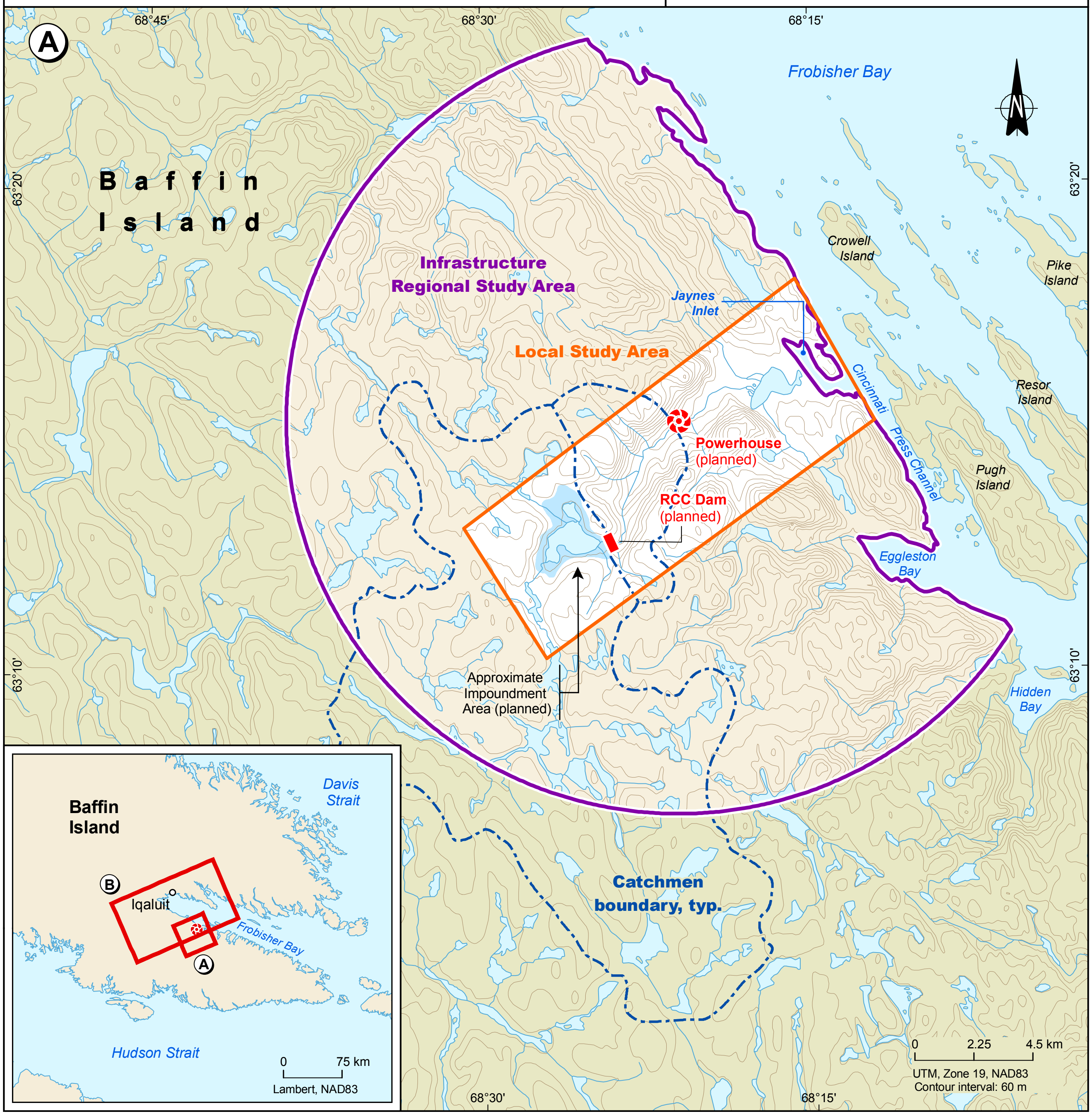
Mapping: Carto-Média
File: CM_1890_m1-1-2_024_110414.mxd

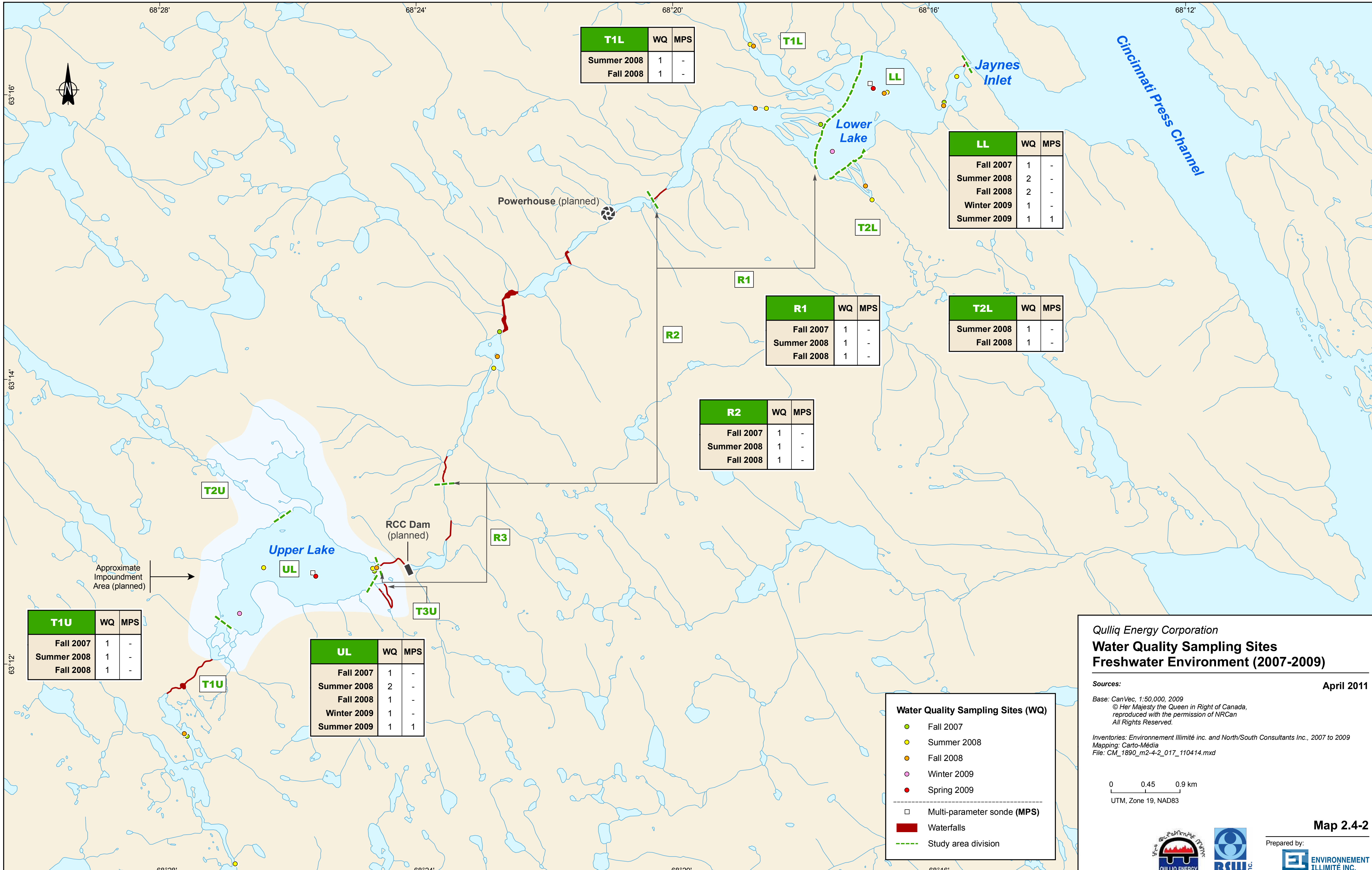
Map 1.1-2

Prepared by:

ENVIRONNEMENT ILLIMITÉ INC.







Qulliq Energy Corporation
Water Quality Sampling Sites
Freshwater Environment (2007-2009)
Sources:
April 2011
Base: CanVec, 1:50,000, 2009
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All Rights Reserved.
Inventories: Environnement Illimité inc. and North/South Consultants Inc., 2007 to 2009
Mapping: Carto-Média
File: CM_1890_m2-4-2_017_110414.mxd
0 0.45 0.9 km
UTM, Zone 19, NAD83
Map 2.4-2
Prepared by:
ENVIRONNEMENT ILLIMITÉ INC.
QULLIQ ENERGY
RSW inc.
Water Quality Sampling Sites (WQ)
Fall 2007
Summer 2008
Fall 2008
Winter 2009
Spring 2009
Multi-parameter sonde (MPS)
Waterfalls
Study area division
Cincinnati Press Channel
Jaynes Inlet
Lower Lake
Upper Lake
Powerhouse (planned)
RCC Dam (planned)
Approximate Impoundment Area (planned)
T1L
LL
T2L
R1
R2
R3
T2U
UL
T3U
T1U
68°28'
68°24'
68°20'
68°16'
68°12'
63°16'
63°14'
63°12'
T1L | WQ | MPS
Summer 2008 | 1 | -
Fall 2008 | 1 | -
LL | WQ | MPS
Fall 2007 | 1 | -
Summer 2008 | 2 | -
Fall 2008 | 2 | -
Winter 2009 | 1 | -
Summer 2009 | 1 | 1
R1 | WQ | MPS
Fall 2007 | 1 | -
Summer 2008 | 1 | -
Fall 2008 | 1 | -
T2L | WQ | MPS
Summer 2008 | 1 | -
Fall 2008 | 1 | -
R2 | WQ | MPS
Fall 2007 | 1 | -
Summer 2008 | 1 | -
Fall 2008 | 1 | -
T1U | WQ | MPS
Fall 2007 | 1 | -
Summer 2008 | 1 | -
Fall 2008 | 1 | -
UL | WQ | MPS
Fall 2007 | 1 | -
Summer 2008 | 2 | -
Fall 2008 | 1 | -
Winter 2009 | 1 | -
Summer 2009 | 1 | 1

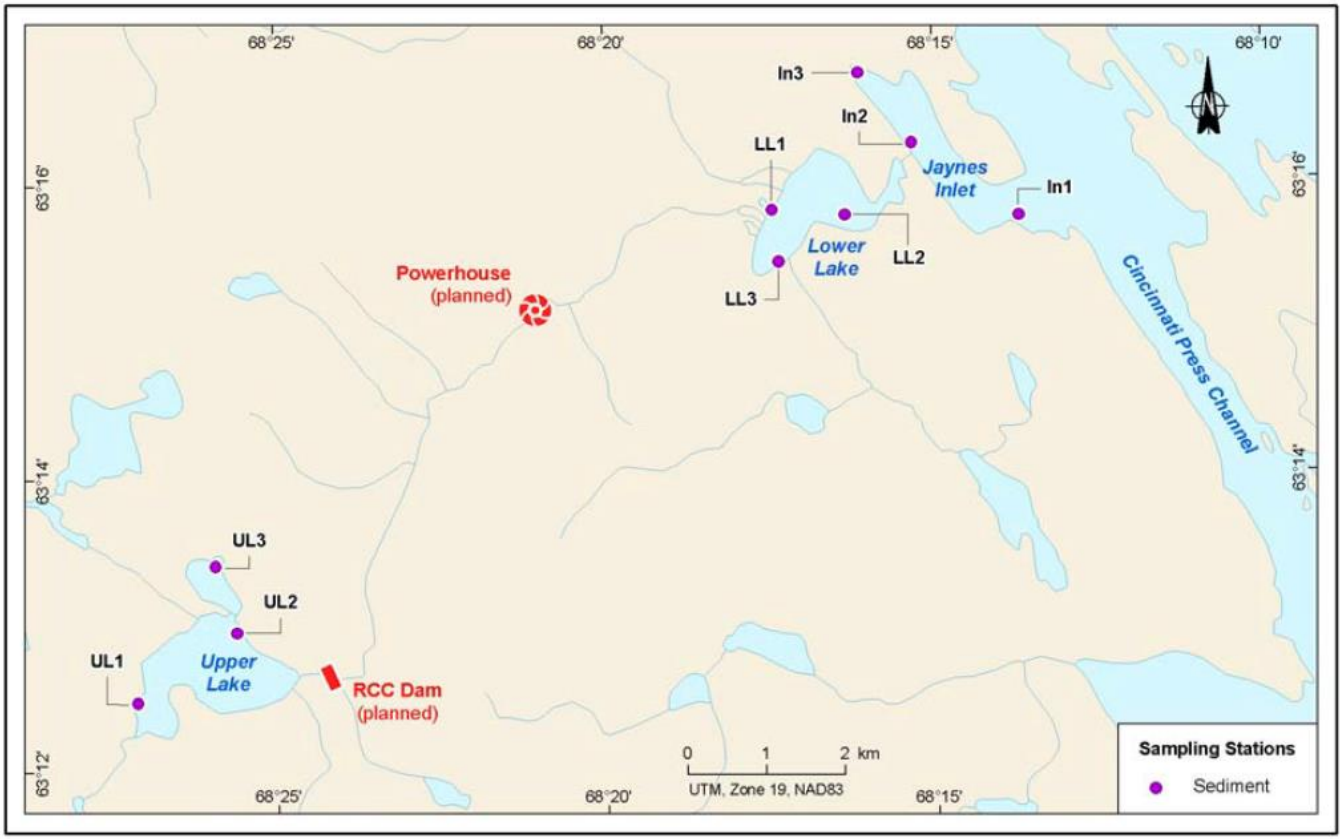
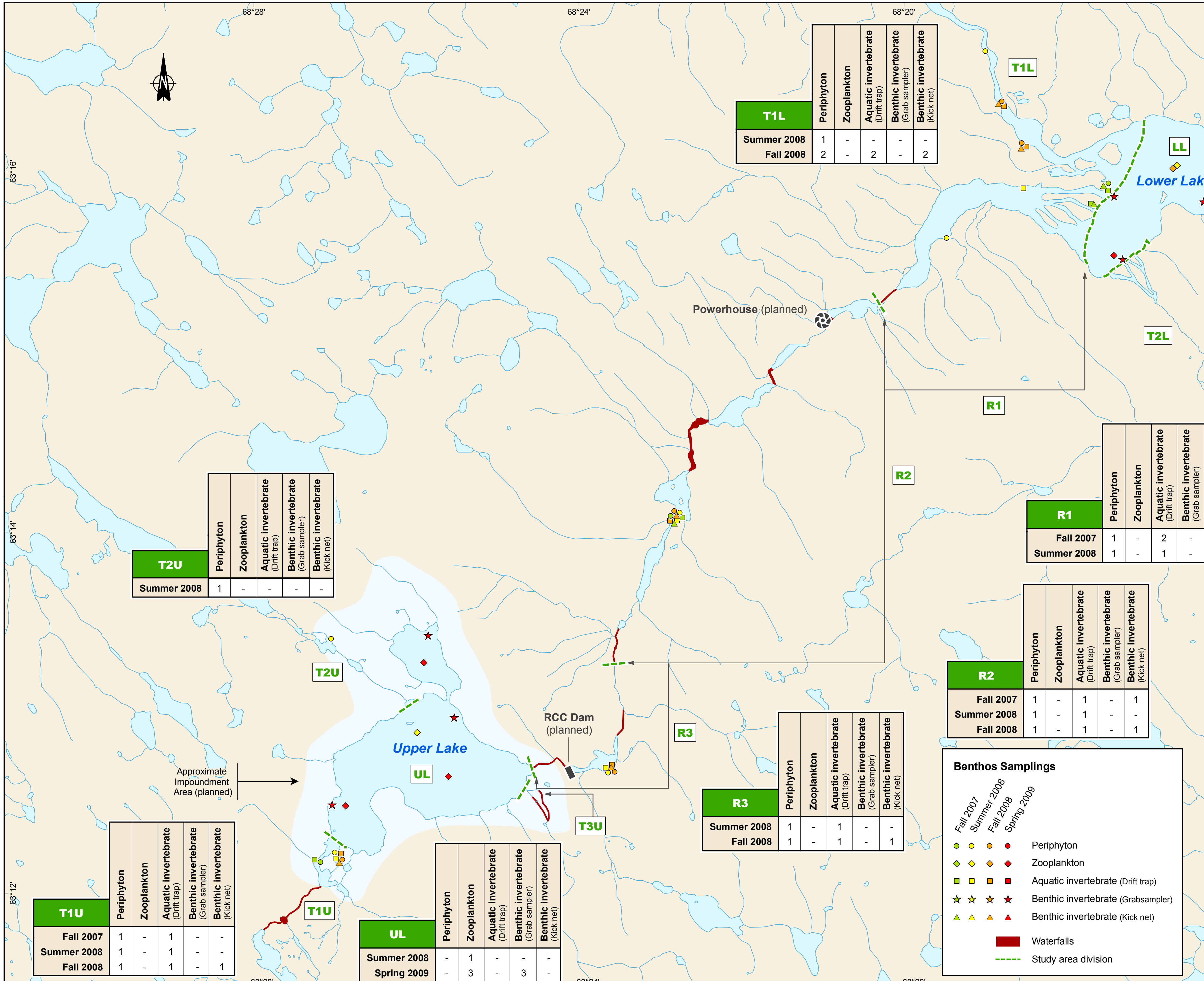


Figure B.3 Sediment Sampling Sites in the LSA (QEC 2011).



T1L	Periphyton	Zooplankton	Aquatic invertebrate (Drift trap)	Benthic invertebrate (Grab sampler)	Benthic invertebrate (Kick net)
Summer 2008	1	-	-	-	-
Fall 2008	2	-	2	-	2

I	Periphyton	Zooplankton	Aquatic invertebrate (Drift trap)	Benthic invertebrate (Grab sampler)	Benthic invertebrate (Kick net)
Spring 2009	-	-	-	2	-

LL	Periphyton	Zooplankton	Aquatic invertebrate (Drift trap)	Benthic invertebrate (Grab sampler)	Benthic invertebrate (Kick net)
Fall 2007	1	-	1	-	1
Summer 2008	1	1	1	-	-
Fall 2008	1	1	1	-	1
Spring 2009	-	2	-	3	-

R1	Periphyton	Zooplankton	Aquatic invertebrate (Drift trap)	Benthic invertebrate (Grab sampler)	Benthic invertebrate (Kick net)
Fall 2007	1	-	2	-	2
Summer 2008	1	-	1	-	-

R2	Periphyton	Zooplankton	Aquatic invertebrate (Drift trap)	Benthic invertebrate (Grab sampler)	Benthic invertebrate (Kick net)
Fall 2007	1	-	1	-	1
Summer 2008	1	-	1	-	-
Fall 2008	1	-	1	-	1

R3	Periphyton	Zooplankton	Aquatic invertebrate (Drift trap)	Benthic invertebrate (Grab sampler)	Benthic invertebrate (Kick net)
Summer 2008	1	-	1	-	-
Fall 2008	1	-	1	-	1

T2U	Periphyton	Zooplankton	Aquatic invertebrate (Drift trap)	Benthic invertebrate (Grab sampler)	Benthic invertebrate (Kick net)
Summer 2008	1	-	-	-	-

T1U	Periphyton	Zooplankton	Aquatic invertebrate (Drift trap)	Benthic invertebrate (Grab sampler)	Benthic invertebrate (Kick net)
Fall 2007	1	-	1	-	-
Summer 2008	1	-	1	-	-
Fall 2008	1	-	1	-	1

UL	Periphyton	Zooplankton	Aquatic invertebrate (Drift trap)	Benthic invertebrate (Grab sampler)	Benthic invertebrate (Kick net)
Summer 2008	-	1	-	-	-
Spring 2009	-	3	-	3	-

Qulliq Energy Corporation

Lower Trophic Level – Periphyton, Zooplankton and Invertebrate Sampling Sites (2007-2009)

Sources:

April 2011

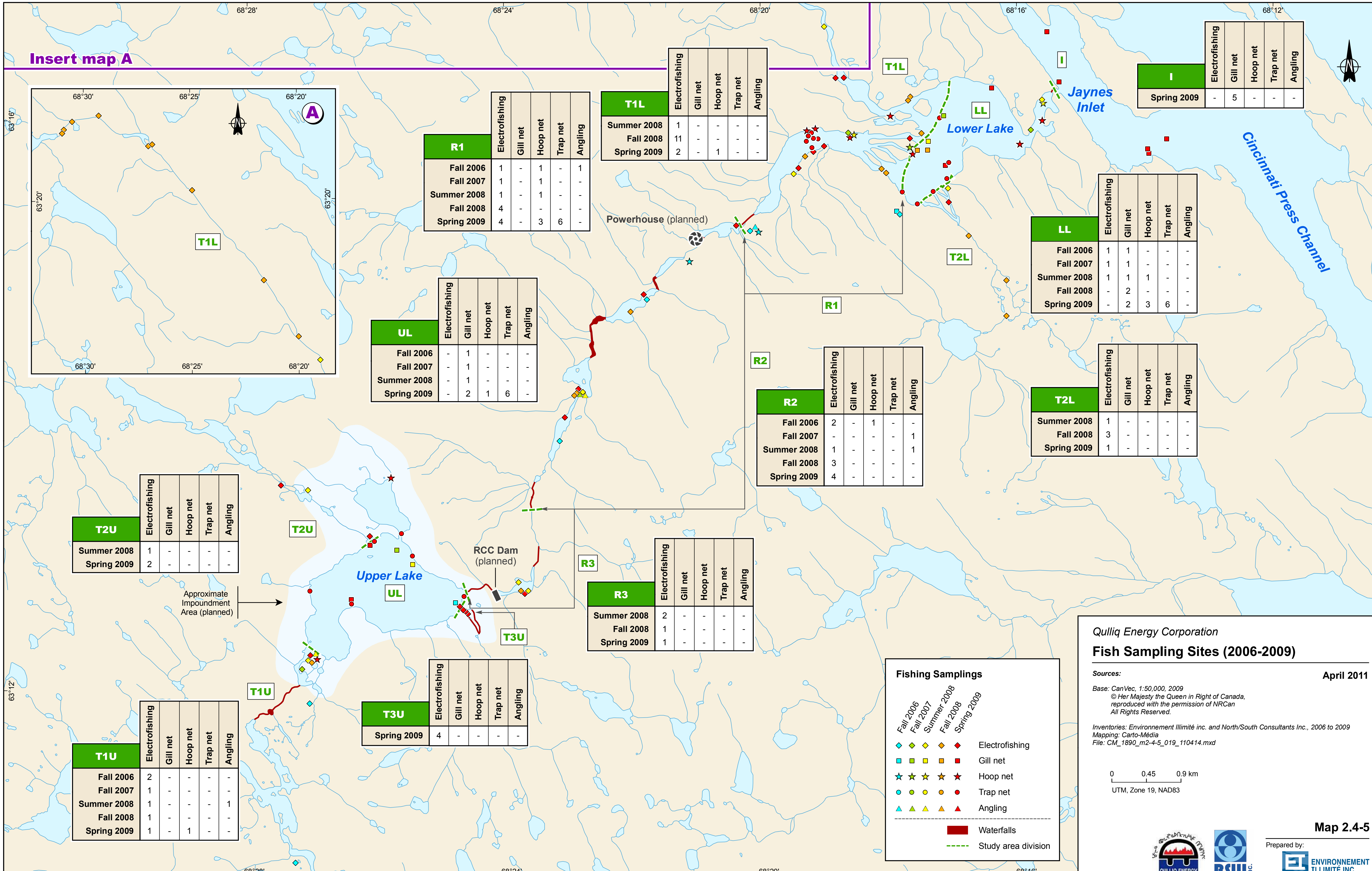
Base: CanVec, 1:50,000, 2009

Inventories: Environnement Illimité inc. and North/South Consultants Inc., 2007 to 2009
Mapping: Carto-Média
File: CM_1890_m2-4-4_020_110414.mxd

0 0.4 0.8 km
UTM, Zone 19, NAD83

Map 2.4-4

Prepared by:



R1	Electrofishing	Gill net	Hoop net	Trap net	Angling
Fall 2006	1	-	1	-	1
Fall 2007	1	-	1	-	-
Summer 2008	1	-	1	-	-
Fall 2008	4	-	-	-	-
Spring 2009	4	-	3	6	-

T1L	Electrofishing	Gill net	Hoop net	Trap net	Angling
Summer 2008	1	-	-	-	-
Fall 2008	11	-	-	-	-
Spring 2009	2	-	1	-	-

I	Electrofishing	Gill net	Hoop net	Trap net	Angling
Spring 2009	-	5	-	-	-

LL	Electrofishing	Gill net	Hoop net	Trap net	Angling
Fall 2006	1	1	-	-	-
Fall 2007	1	1	-	-	-
Summer 2008	1	1	1	-	-
Fall 2008	-	2	-	-	-
Spring 2009	-	2	3	6	-

UL	Electrofishing	Gill net	Hoop net	Trap net	Angling
Fall 2006	-	1	-	-	-
Fall 2007	-	1	-	-	-
Summer 2008	-	1	-	-	-
Spring 2009	-	2	1	6	-

R2	Electrofishing	Gill net	Hoop net	Trap net	Angling
Fall 2006	2	-	1	-	-
Fall 2007	-	-	-	-	1
Summer 2008	1	-	-	-	1
Fall 2008	3	-	-	-	-
Spring 2009	4	-	-	-	-

T2L	Electrofishing	Gill net	Hoop net	Trap net	Angling
Summer 2008	1	-	-	-	-
Fall 2008	3	-	-	-	-
Spring 2009	1	-	-	-	-

T2U	Electrofishing	Gill net	Hoop net	Trap net	Angling
Summer 2008	1	-	-	-	-
Spring 2009	2	-	-	-	-

R3	Electrofishing	Gill net	Hoop net	Trap net	Angling
Summer 2008	2	-	-	-	-
Fall 2008	1	-	-	-	-
Spring 2009	1	-	-	-	-

T3U	Electrofishing	Gill net	Hoop net	Trap net	Angling
Spring 2009	4	-	-	-	-

T1U	Electrofishing	Gill net	Hoop net	Trap net	Angling
Fall 2006	2	-	-	-	-
Fall 2007	1	-	-	-	-
Summer 2008	1	-	-	-	1
Fall 2008	1	-	-	-	-
Spring 2009	1	-	1	-	-

Qulliq Energy Corporation

Fish Sampling Sites (2006-2009)

Sources: April 2011

Base: CanVec, 1:50,000, 2009
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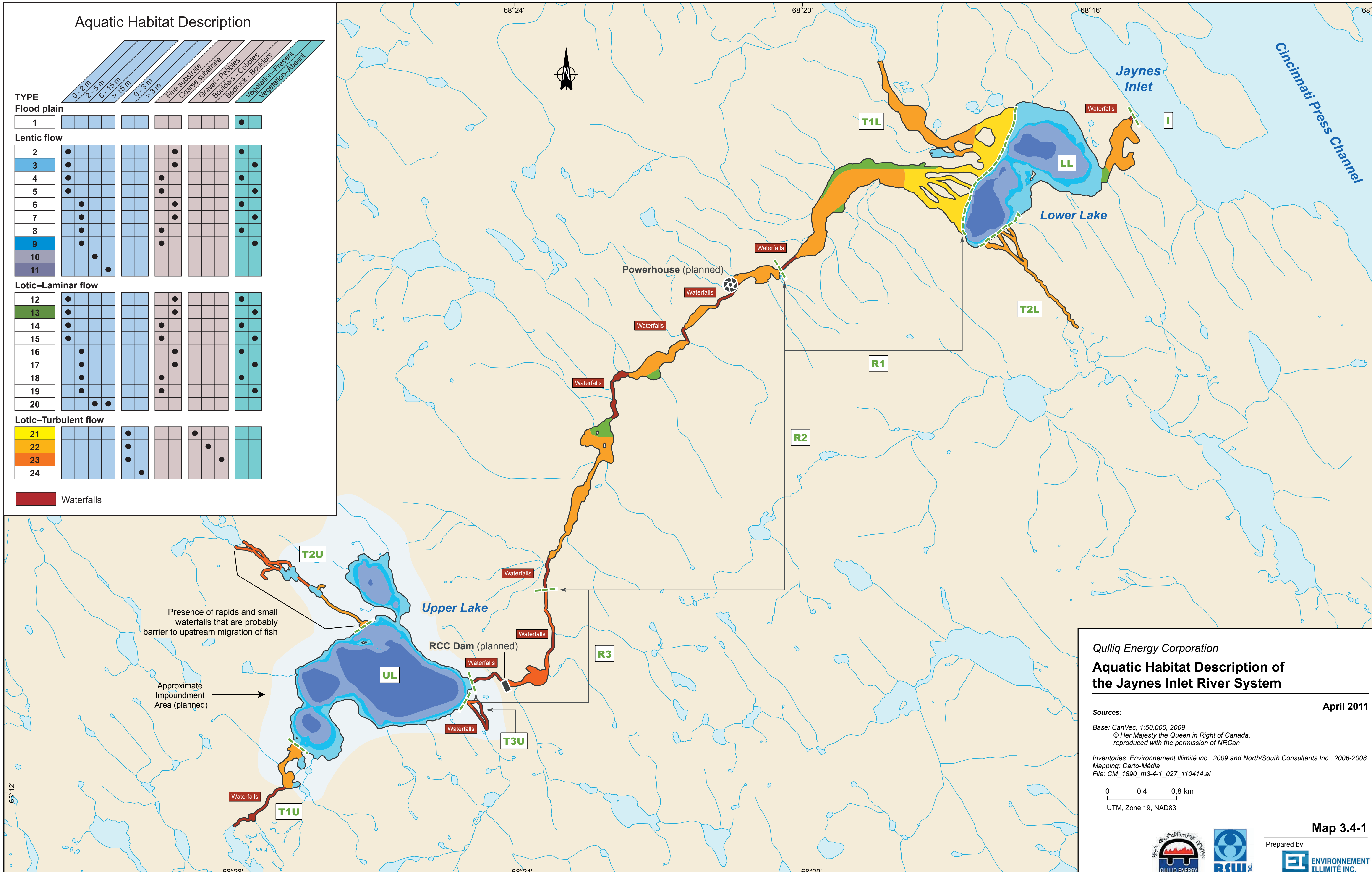
Inventories: Environnement Illimité inc. and North/South Consultants Inc., 2006 to 2009
Mapping: Carto-Média
File: CM_1890_m2-4-5_019_110414.mxd

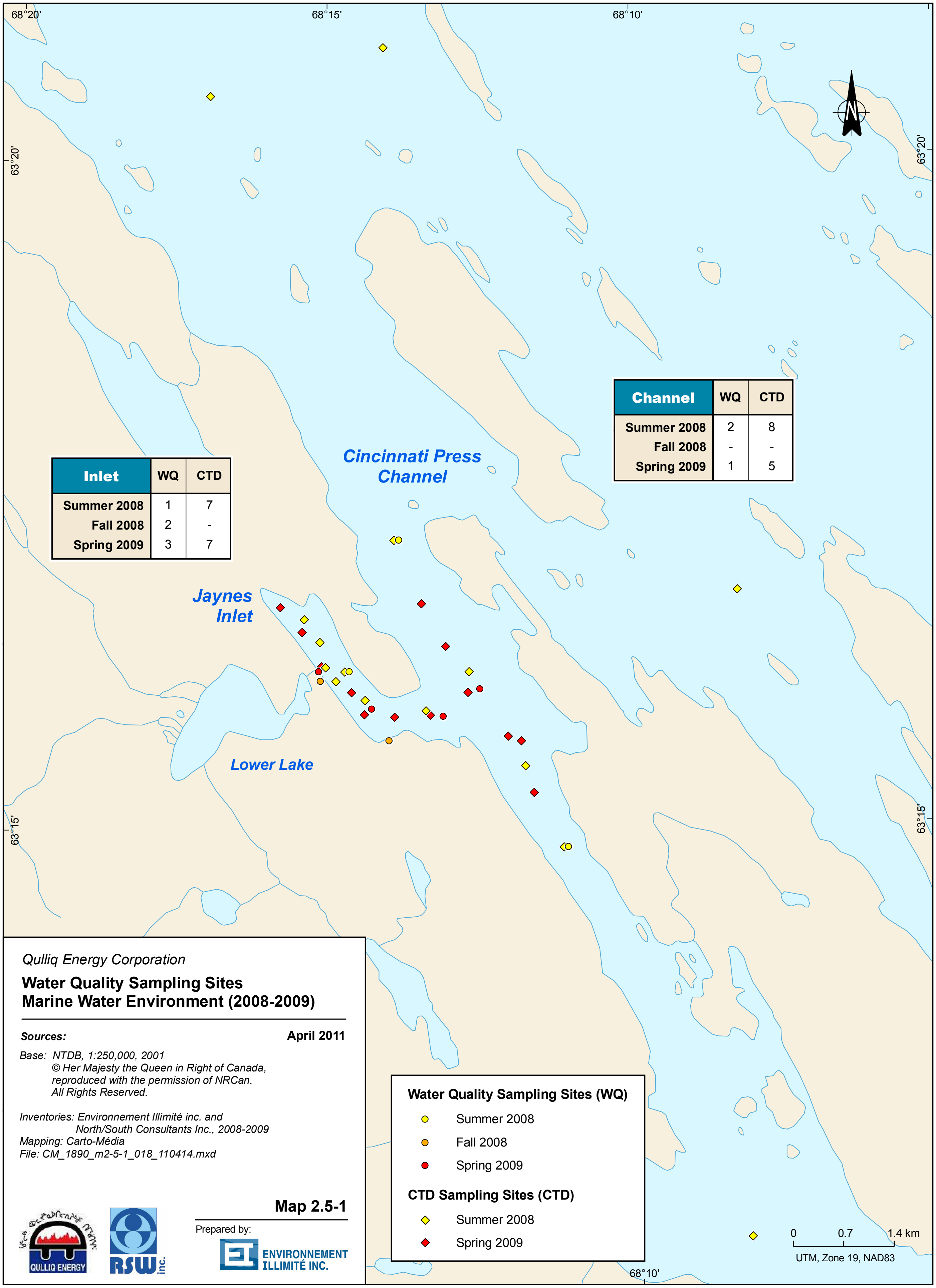
0 0.45 0.9 km
UTM, Zone 19, NAD83

Map 2.4-5

Prepared by:
ENVIRONNEMENT ILLIMITÉ INC.



Aquatic Habitat Description
0 - 2 m
2 - 5 m
5 - 15 m
> 15 m
0 - 3 m
> 3 m
Fine substrate
Coarse substrate
Gravel - Pebbles
Boulders - Cobbles
Bedrock - Boulders
Vegetation-Present
Vegetation-Absent
TYPE
Flood plain
1
Lentic flow
2
3
4
5
6
7
8
9
10
11
Lotic–Laminar flow
12
13
14
15
16
17
18
19
20
Lotic–Turbulent flow
21
22
23
24
Waterfalls
68°24'
68°20'
68°16'
68°12'
63°16'
63°14'
63°12'
68°28'
Jaynes Inlet
Cincinnati Press Channel
I
T1L
LL
Lower Lake
T2L
R1
R2
R3
Powerhouse (planned)
Waterfalls
T2U
Upper Lake
Presence of rapids and small waterfalls that are probably barrier to upstream migration of fish
RCC Dam (planned)
UL
Approximate Impoundment Area (planned)
T3U
T1U
Qulliq Energy Corporation
Aquatic Habitat Description of the Jaynes Inlet River System
April 2011
Sources:
Base: CanVec, 1:50,000, 2009
© Her Majesty the Queen in Right of Canada, reproduced with the permission of NRCan
Inventories: Environnement Illimité inc., 2009 and North/South Consultants Inc., 2006-2008
Mapping: Carto-Média
File: CM_1890_m3-4-1_027_110414.ai
0 0,4 0,8 km
UTM, Zone 19, NAD83
Map 3.4-1
Prepared by:
QULLIQ ENERGY
RSW inc.
ENVIRONNEMENT ILLIMITÉ INC.



Inlet	WQ	CTD
Summer 2008	1	7
Fall 2008	2	-
Spring 2009	3	7

Channel	WQ	CTD
Summer 2008	2	8
Fall 2008	-	-
Spring 2009	1	5

Qulliq Energy Corporation

Water Quality Sampling Sites
Marine Water Environment (2008-2009)

Sources: **April 2011**

Base: NTDB, 1:250,000, 2001
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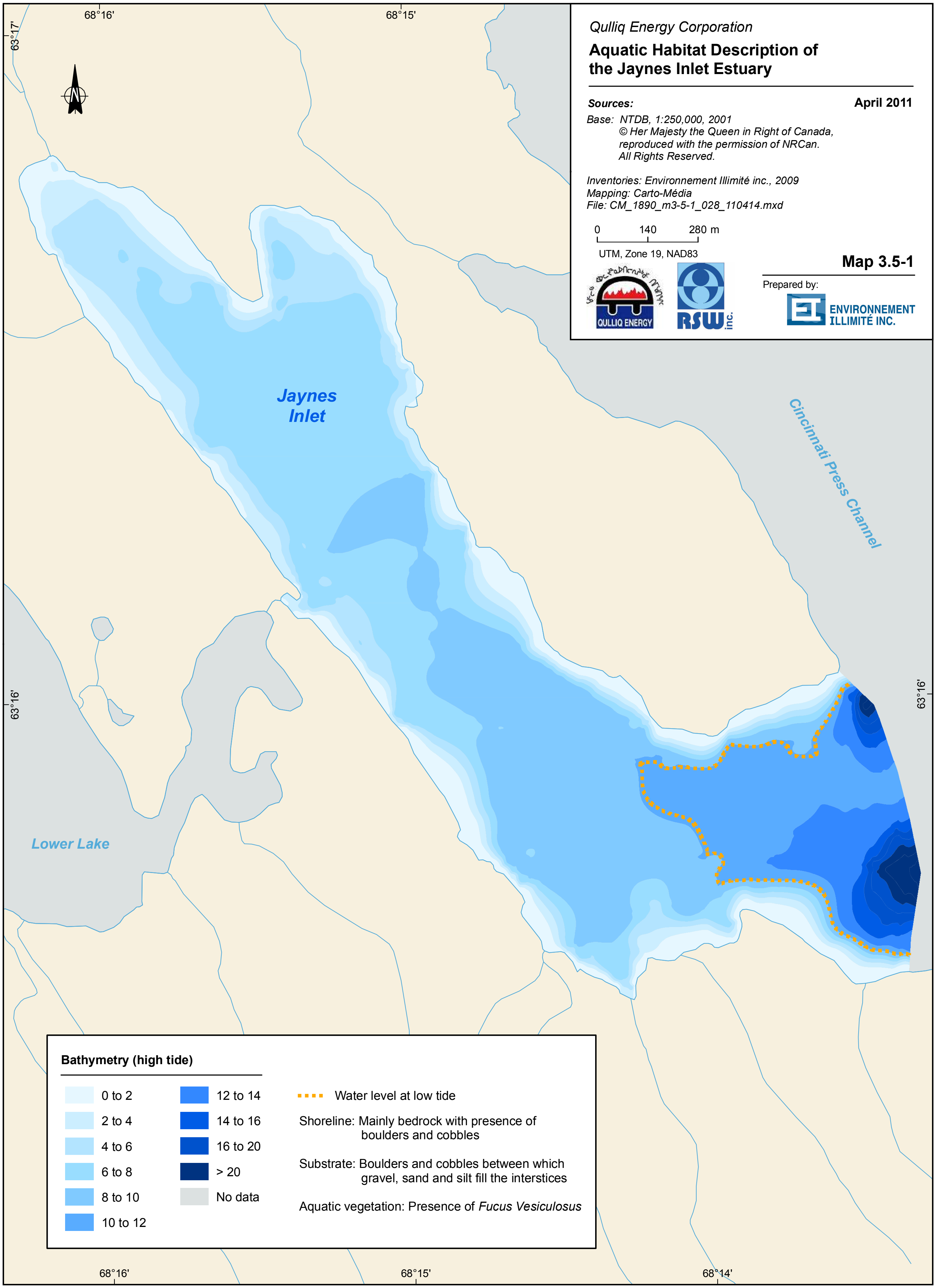
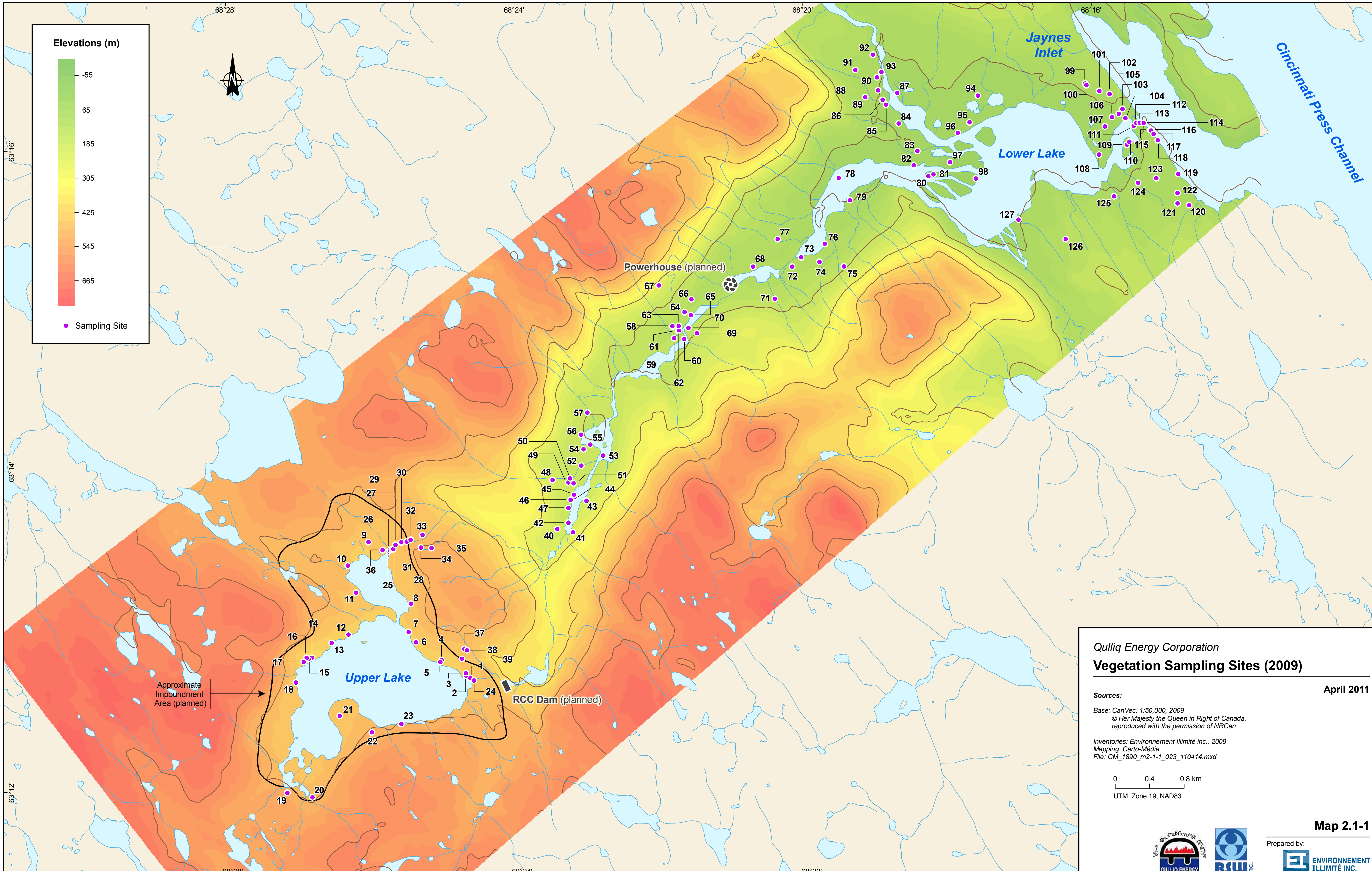
All Rights Reserved.

Inventories: Environnement Illimité inc. and North/South Consultants Inc., 2008-2009
Mapping: Carto-Média
File: CM_1890_m2-5-1_018_110414.mxd

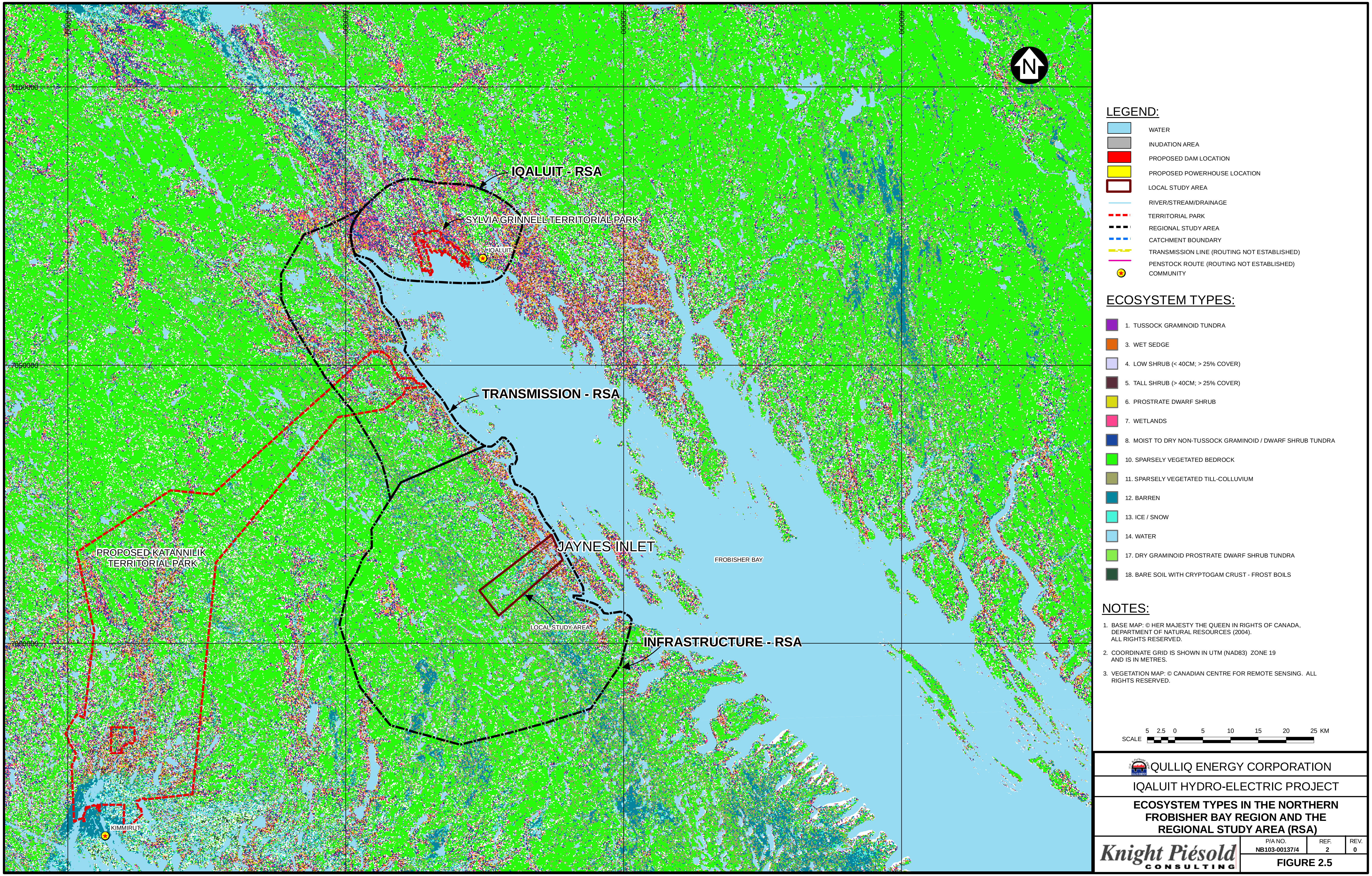
Map 2.5-1



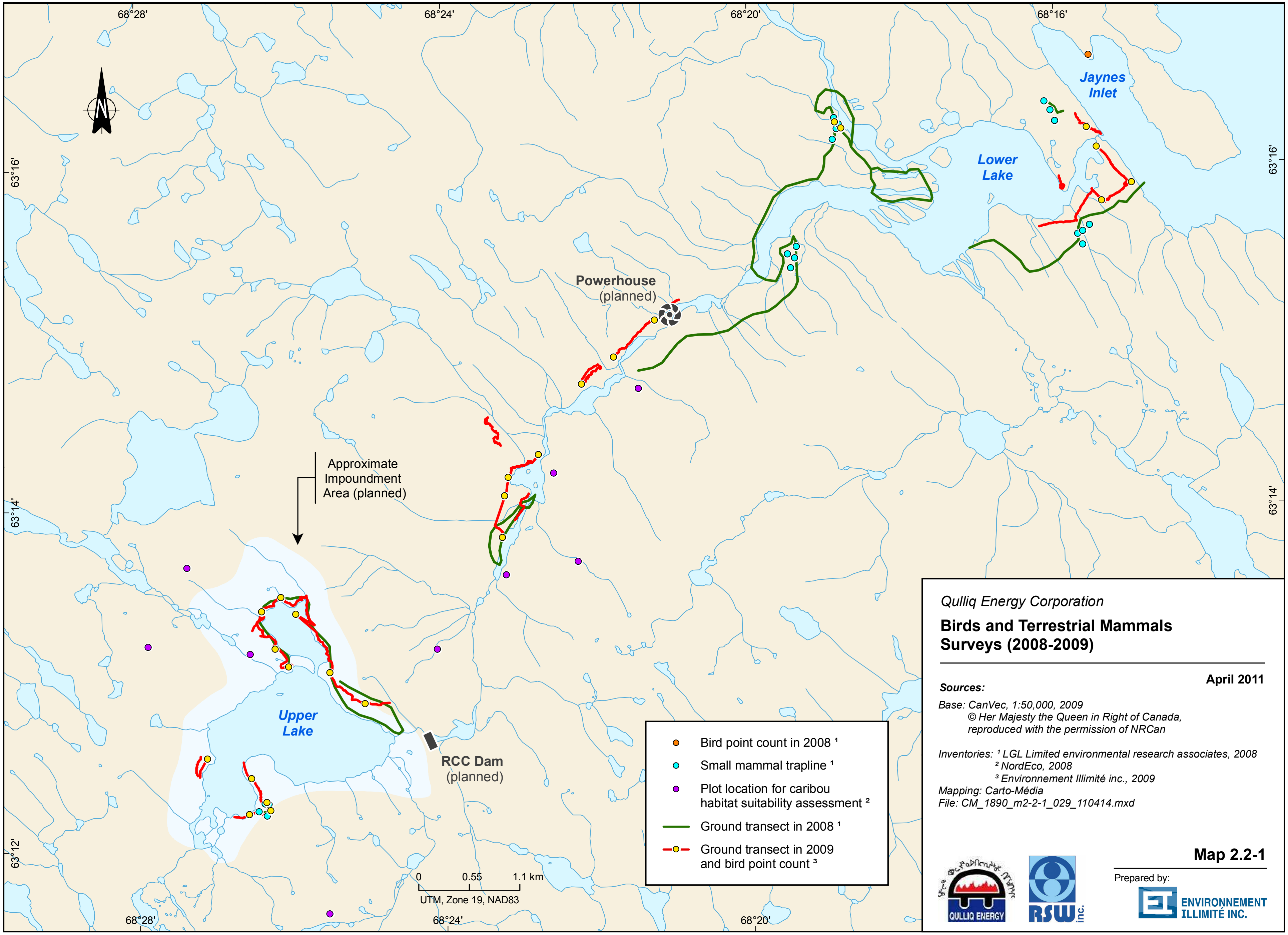
Qulliq Energy Corporation
Aquatic Habitat Description of the Jaynes Inlet Estuary
Sources:
April 2011
Base: NTDB, 1:250,000, 2001
© Her Majesty the Queen in Right of Canada, reproduced with the permission of NRCan. All Rights Reserved.
Inventories: Environnement Illimité inc., 2009
Mapping: Carto-Média
File: CM_1890_m3-5-1_028_110414.mxd
0 140 280 m
UTM, Zone 19, NAD83
Map 3.5-1
Prepared by:
QULLIQ ENERGY
RSW inc.
ENVIRONNEMENT ILLIMITÉ INC.
68°16'
68°15'
68°14'
63°17'
63°16'
Jaynes Inlet
Cincinnati Press Channel
Lower Lake
Bathymetry (high tide)
0 to 2
2 to 4
4 to 6
6 to 8
8 to 10
10 to 12
12 to 14
14 to 16
16 to 20
> 20
No data
Water level at low tide
Shoreline: Mainly bedrock with presence of boulders and cobbles
Substrate: Boulders and cobbles between which gravel, sand and silt fill the interstices
Aquatic vegetation: Presence of Fucus Vesiculosus

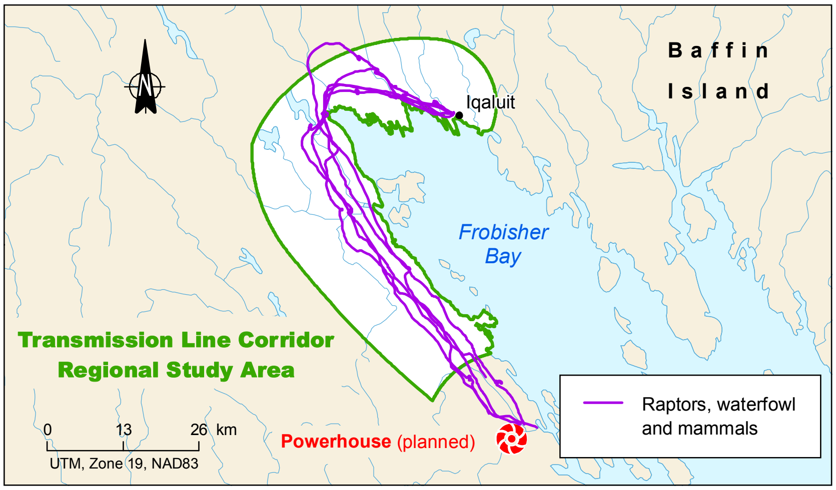


Elevations (m)
-55
65
185
305
425
545
665
Sampling Site
Jaynes Inlet
Cincinnati Press Channel
Lower Lake
Powerhouse (planned)
Upper Lake
RCC Dam (planned)
Approximate Impoundment Area (planned)
Qulliq Energy Corporation
Vegetation Sampling Sites (2009)
April 2011
Sources:
Base: CanVec, 1:50,000, 2009
© Her Majesty the Queen in Right of Canada, reproduced with the permission of NRCan
Inventories: Environnement Illimité inc., 2009
Mapping: Carto-Média
File: CM_1890_m2-1-1_023_110414.mxd
0 0.4 0.8 km
UTM, Zone 19, NAD83
Map 2.1-1
Prepared by:



IQALUIT - RSA
SYLVIA GRINNELL TERRITORIAL PARK
IQALUIT
TRANSMISSION - RSA
JAYNES INLET
FROBISHER BAY
LOCAL STUDY AREA
INFRASTRUCTURE - RSA
PROPOSED KATANNILIK TERRITORIAL PARK
KIMMIRUT
N
LEGEND:
WATER
INUDATION AREA
PROPOSED DAM LOCATION
PROPOSED POWERHOUSE LOCATION
LOCAL STUDY AREA
RIVER/STREAM/DRAINAGE
TERRITORIAL PARK
REGIONAL STUDY AREA
CATCHMENT BOUNDARY
TRANSMISSION LINE (ROUTING NOT ESTABLISHED)
PENSTOCK ROUTE (ROUTING NOT ESTABLISHED)
COMMUNITY
ECOSYSTEM TYPES:
1. TUSSOCK GRAMINOID TUNDRA
3. WET SEDGE
4. LOW SHRUB (< 40CM; > 25% COVER)
5. TALL SHRUB (> 40CM; > 25% COVER)
6. PROSTRATE DWARF SHRUB
7. WETLANDS
8. MOIST TO DRY NON-TUSSOCK GRAMINOID / DWARF SHRUB TUNDRA
10. SPARSELY VEGETATED BEDROCK
11. SPARSELY VEGETATED TILL-COLLUVIUM
12. BARREN
13. ICE / SNOW
14. WATER
17. DRY GRAMINOID PROSTRATE DWARF SHRUB TUNDRA
18. BARE SOIL WITH CRYPTOGAM CRUST - FROST BOILS
NOTES:
1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA, DEPARTMENT OF NATURAL RESOURCES (2004). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 19 AND IS IN METRES.
3. VEGETATION MAP: © CANADIAN CENTRE FOR REMOTE SENSING. ALL RIGHTS RESERVED.
SCALE 5 2.5 0 5 10 15 20 25 KM
QULLIQ ENERGY CORPORATION
IQALUIT HYDRO-ELECTRIC PROJECT
ECOSYSTEM TYPES IN THE NORTHERN FROBISHER BAY REGION AND THE REGIONAL STUDY AREA (RSA)
Knight Piésold CONSULTING
P/A NO. NB103-00137/4
REF. 2
REV. 0
FIGURE 2.5
NORTH BAY, ON


68°28'
68°24'
68°20'
68°16'
63°16'
63°14'
63°12'
N
Jaynes
Inlet
Lower
Lake
Powerhouse
(planned)
Approximate
Impoundment
Area (planned)
Upper
Lake
RCC Dam
(planned)
0
0.55
1.1 km
UTM, Zone 19, NAD83
Bird point count in 2008 ¹
Small mammal trapline ¹
Plot location for caribou
habitat suitability assessment ²
Ground transect in 2008 ¹
Ground transect in 2009
and bird point count ³
Qulliq Energy Corporation
Birds and Terrestrial Mammals
Surveys (2008-2009)
April 2011
Sources:
Base: CanVec, 1:50,000, 2009
© Her Majesty the Queen in Right of Canada,
reproduced with the permission of NRCan
Inventories: ¹ LGL Limited environmental research associates, 2008
² NordEco, 2008
³ Environnement Illimité inc., 2009
Mapping: Carto-Média
File: CM_1890_m2-2-1_029_110414.mxd
Map 2.2-1
Prepared by:
QULLIQ ENERGY
RSW inc.
ENVIRONNEMENT
ILLIMITÉ INC.



Qulliq Energy Corporation

Aerial Surveys: Cliff-Nesting Raptors, Waterfowl and Mammals

Sources: **January 2010**

Base: NTDB, 1:250,000, 2001
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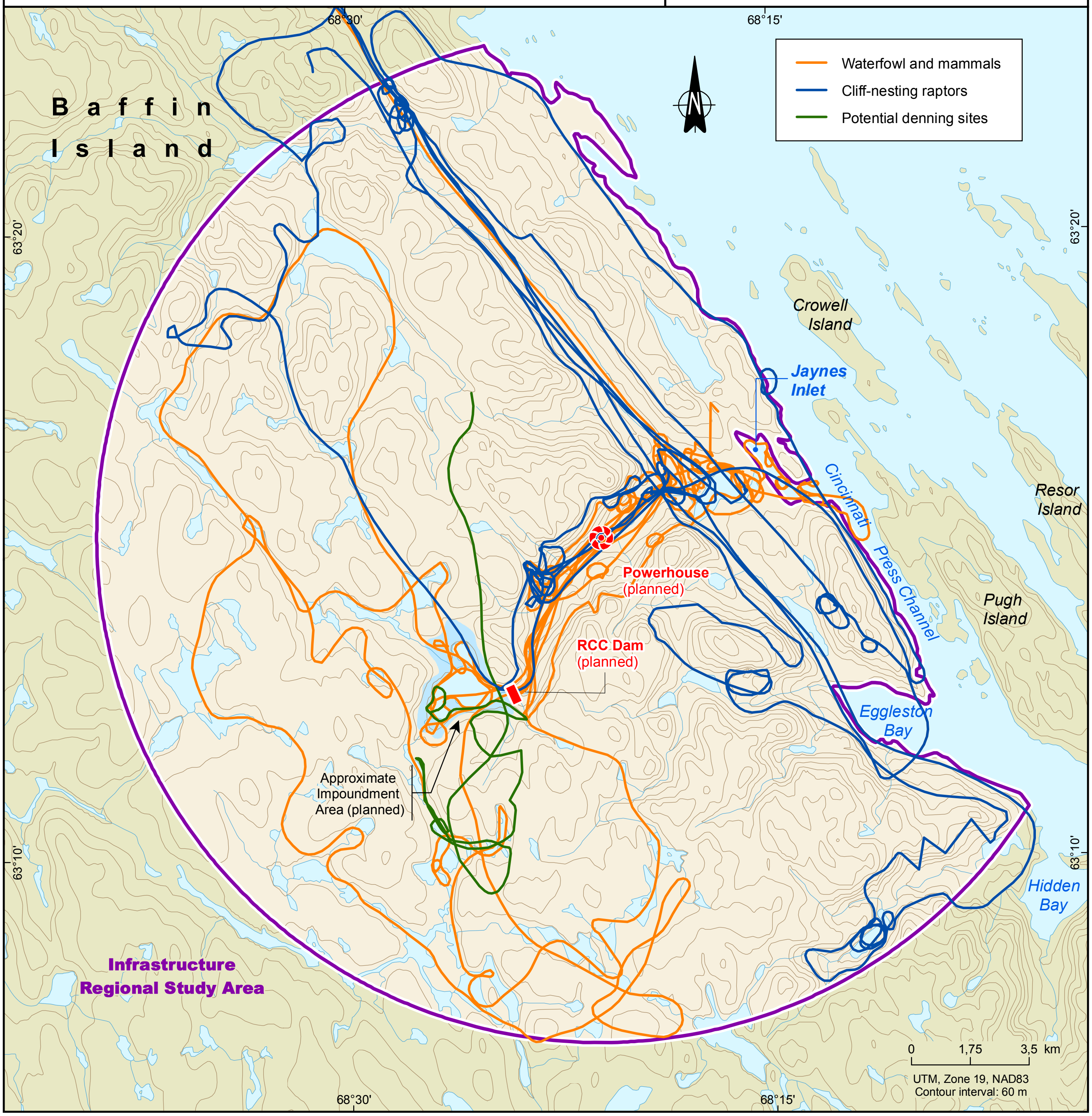
Inventories: Environnement Illimité inc., 2009
Mapping: Carto-Média
File: CM_1890_m4_007_100106.mxd

Map 4

Prepared by:



Appendix C

Detailed Regulatory Context

Summary of Permitting Requirements for Project Construction

During the preparation and planning phases of the selected project, it is recommended to complete or obtain the following at a minimum (Lawson Lundell LLP, 2006):

- Draft project proposal that is well-defined in terms of a complete standalone project or a phased project;
- Negotiation agreements in principle (AIP) for land tenure, such as leases, rights-of-way, and other land interests;
- Draft negotiation of an Inuit Impact Benefit Agreement (IIBA) and a Compensation Agreement;
- Preparation of a registry and applications for licenses and permits;
- In the case of a HEP or PSH project, negotiation of a HADD and an approved Offset Plan; and
- Records of meaningful stakeholder and Inuit consultation and engagement.

It also goes without saying that the negotiation a Power Purchase Agreement with QEC as the sole utility is a critical step towards project commissioning. During pre-feasibility studies conducted by QEC back in 2006, the overall project schedule was set to commence with pre-feasibility studies and baseline environmental work from 2006-2007. The environmental assessment, permitting, and compensation/benefit negotiations phases were predicted to span from 2007-2008, with construction mobilizing in 2009 and finishing in 2012. This proved to be an unrealistic prediction, given that the project was not submitted to NIRB until 2013, and the field studies required to complete an EIS were planned to span two years.

Major projects in the South Baffin region processed under the above-described regulatory framework in the last decade include Baffinland's Mary River Mine and De Beers Canada's Chidliak Diamond Mine. The Mary River site is located about 160 km south of the community of Pond Inlet and 1000 km northwest of Iqaluit. The Mary River Project was assessed by the NIRB from 2008 – 2012. Project facilities include the iron ore mine area at Mary River and port area at Steensby Inlet, with a railway line and access road connecting the two. Marine access and shipping through the construction phase, and periodically since beginning operation in 2018, occur seasonally through Milne Inlet and the existing Milne Inlet Tote Road. Access to the Project sites for personnel is via chartered aircraft. The Mary River Project is obligated to conduct annual environmental monitoring programs and reports them to the NIRB.

The Chidliak Project is located on the Hall Peninsula on Baffin Island, in the vicinity of the McKeand River North project alternative under consideration in this study. De Beers Canada acquired the Chidliak Project in September 2018 as part of the purchase of Peregrine Diamonds Ltd., and according to the DeBeers project proposal environmental baseline data in the project area has been collected over the last thirteen years. These data are not public aside from a summary given in the Chidliak Project Proposal. The proposal was submitted to the NPC in April 2022, and was then referred to the NIRB for screening in May 2022. In November 2022, the NIRB determined the project requires a review under Article 12, Part 5 or Part 6 of the Nunavut Agreement and Part 3 of the NuPPAA. In a document published by the NIRB in March 2023, the anticipated process for the NIRB's review of the project will begin in March-April 2023 whereby a Draft Scope and Draft IS Guidelines will be issued for public comment. Community Scoping/Guideline meetings are anticipated to be held in Iqaluit, Pangnirtung, and Kimmirut in May-June 2023. Final IS Guidelines are not expected to be issued until September 2023.

Nunavut Planning Commission Process

The first step to initiate the regulatory process in Nunavut is a submission to the NPC, and as such is required for both the field studies envisioned and project construction and operation. The NPC is mandated under Article 11 of the NLCA to develop, implement and monitor land use plans. The purpose of a land use plan, as stated in Article 11.3.2 of the NLCA is to "protect and promote the existing and future well-being of the residents and communities of the Nunavut Settlement Area, taking into account the interests of all Canadians, and to protect, and where necessary, to restore the environmental integrity of the Nunavut Settlement Area." Land use plans developed under the authority of the NPC apply to all land use activities that occur on Crown Land, Inuit Owned Land or other privately held lands. The development of municipal plans is the responsibility of the municipal governments. For added clarity, plans do not apply to, or within, the boundaries of National Parks, National Historic Parks or National Historic Sites administered by the Parks Canada Agency, or Territorial Parks once they have been established. The NPC reviews all applications for project proposals to determine whether they are in conformity with the plans. Project proposals that are not in conformity with the plans cannot proceed further into the regulatory system unless the appropriate Minister exempts the project proposal from conformity with the approved plan. Where project proposals are in conformity with the plans, the proposal (along with the NPC conformity determination and any recommendations) is advanced through to the next level of the regulatory system.

There are two regional land use plans currently in effect: the North Baffin Regional Land Use Plan and the Keewatin Regional Land Use Plan. The project alternatives under consideration are both outside the boundaries of the two regional plans in effect. However, the NPC is in the process of developing a Nunavut-wide land use plan (LUP) and once approved, it will guide resource use and development throughout the territory. In any case, the first step to project approval in Nunavut is applying to the NPC. The initial submission requirements for project proposals must contain a description of the project and must meet the specific form and content requirements for project proposals that are set out in the by-laws and rules of the NPC. A summary of the proposed project should be provided in English, Inuktitut, and French as appropriate.

Once an application is submitted, NPC staff will determine if the required material has been submitted, are complete, and if any additional information is required. At this stage, a notice of receipt of the application will be placed on the Public Registry. If it is found that the required information has not been provided or is incomplete, it will be returned to the Proponent with a written explanation from the Executive Director (or a delegate) outlining the reasoning.

A project proposal will be determined to conform to the LUP if it is a use that is consistent with the applicable terms and conditions and is not prohibited by the LUP. Unless an activity is specifically prohibited within a Limited Use area or is subject to certain conformity requirements within a Conditional

Use area or a Limited Use area, all land and water uses associated with projects are considered to conform to the LUP. The initial screening and conformity determination can take up to 45 days once the application has been submitted to the NPC. NPC staff may, at any time during the review, make a written request to the Proponent for additional information and that any time required by the Proponent to provide the required information will not count as part of the 45 days.

NPC will prepare a letter outlining the results of the conformity determination including whether the project proposal conforms to the land use plan and any applicable terms, conditions, recommendations, or relevant information. If the project proposal is not exempt from screening, or if the NPC determines that it has concerns, the Executive Director (or a delegate) will send the project proposal with the conformity determination and any recommendations to the NIRB in order for it to conduct a screening.

If a project is to be carried out entirely in a Mixed-Use area, there are no prohibited uses or conformity requirements that apply, and the project conforms to the LUP. Proponents are encouraged to consider Valued Components when planning a project and must identify anticipated impacts to Valued Components in project proposals submitted to the NPC and report to the NPC on actual impacts to Valued Components. Regulatory authorities may also consider Valued Components when reviewing projects pursuant to their own jurisdictional mandates.

It is important to note that hydroelectric facilities, wind turbines taller than 15m in height, linear infrastructure, and associated components are prohibited in Limited Use Planning Areas indicated in the LUP at all times of year. If a proponent proposes to develop linear infrastructure, such as a transmission corridor or an access road, in a Limited Use area that expressly prohibits this type of project, the proponent must apply for a Plan amendment. Temporary winter roads are authorized wherever restrictions on linear infrastructure are not required. If the project does not conform to the LUP, the proponent may:

1. modify and resubmit the project proposal;
2. apply for a minor variance, if eligible (which can take up to 30 days upon notice of receipt);
3. apply for a plan amendment (which must be completed at least 60 days in advance of an in-person Commission meeting for it to be considered);
4. request a ministerial exemption from the requirements of the LUP; or
5. abandon the project.

Once the locations of components of the various projects under consideration are finalized, they will need to be assessed for overlap with the Limited Use areas identified in the 2021 Draft Land Use Plan put forth by the Commission. Limited Use planning areas have specific prohibitions against hydroelectric projects, wind turbines over 15m in height, linear infrastructure such as transmission lines and roads, and associated components at all times of year. Limited Use planning areas which may overlap and/or indirectly interact with project components include several Class 1 Migratory Birds/Migratory Bird Sanctuaries, Caribou Calving Areas, Caribou Post-Calving Areas, Future Territorial Parks including Katannilik Park, Canadian Heritage Rivers including Soper River, and essential Char Fishing Rivers.

Nunavut Impact Review Board Process

The NIRB is the sole permanent body in Nunavut charged with conducting impact assessment in the Nunavut Settlement Area and is an institution of public government established in accordance with Articles 10 and 12 of the NLCA with its authority defined in the NuPPAA. The NIRB is composed of eight members and one chairperson, who are appointed or nominated by the DIO, the Government of Canada, and the Territorial Government.

Authorizing agencies are prohibited from issuing licences or approvals for a project until the NIRB's screening is complete. Upon receiving the project proposal from the NPC, the NIRB's initial screening process may take up to 45 days to complete and includes a public commenting opportunity. Screening by the NIRB is designed to determine whether proposed projects require a full environmental review, or whether they should instead be allowed to proceed and receive their required permits, licenses, and approvals without further assessment. In the screening process, the NIRB gathers input from many organizations including proponents, hamlets, the Government of Nunavut, Hunters and Trappers Organizations, the Government of Canada, the public, non-governmental organizations, and regional Inuit associations. After gathering the requisite information, the NIRB will submit a screening decision report to the responsible Minister. There are four options for the NIRB when submitting a screening decision:

1. Approve with terms and conditions – the board may recommend that a project be approved and go directly to licensing when the impacts are well known and can be managed; or

2. Additional review is required – the board may decide a project be sent for a full environmental and socio-economic impact review because of the potential for significant impacts; or

3. Send back to proponent for clarification – the board can recommend that a proposal be returned to the proponent because it was not advanced enough for proper screening; or

4. Modify or abandon the project – when the impacts of a project are considered to be unacceptable, the board may recommend that the proposal be modified or abandoned completely.

Reviews are more comprehensive assessments generally reserved for major development projects or projects that may cause significant public concern. If the project proposal needs to undergo further review, the process could take up to two years, in which there are three phases to the process:

i) Phase 1 – Scoping & Guidelines Creation (~90 days)

   (a) Project scoping

(b) Issue Environmental Impact Statement (EIS) guidelines

ii) Phase 2 – Draft Environmental Impact Statement (~160 days)

(a) Prepare and submit draft EIS.

(b) Review draft EIS for conformity with guidelines.

(c) Technical review of draft EIS

(d) Technical meeting

(e) Pre-hearing conference

iii) Phase 3 – Final Environment Impact Statement (~125 days)

(a) Submission of final EIS

(b) Compliance review of final EIS

(c) Technical review of final EIS

(d) Final hearing

(e) Issue final report to Minister for decision

After completion of a project review, a NIRB Project Certificate will be obtained outlining the ongoing monitoring requirements and project-specific terms and conditions, as well as those included in any approvals issued by the NWB.

When considering a proposed project and prior to submitting a project proposal to the NPC and NIRB it is recommended that the proponent begin consultations as soon as possible with individual members of an affected community, as well as organized community interest groups. The NIRB recommends that consultation occur throughout the life of the project.

As previously detailed, the QEC proposed Iqaluit Hydroelectric Project progressed through the environmental assessment process up to Phase I (b), where the NIRB issued the final Environmental Impact Statement (EIS) guidelines in November of 2013. After the QEC shelved the project, the NIRB communicated that QEC could re-engage the assessment process by making the required EIS submission to the NIRB for the next phase of the Review process. The NIRB advised that a minimum of three (3) months' notice will be required pre-submission to ensure that the required resources and capacity are in place to address any forthcoming submission and reactivate the Review process in a timely manner.

A change of proponents for a proposed project in Nunavut is not unheard of. It may be possible to resume the environmental assessment process where QEC left off, by preparing an amended project proposal for the NPC and NIRB and submitting an EIS. Engagement with the NPC and NIRB during the project planning phase will be required to explore this possibility. In any case, it stands to reason that once a project alternative is chosen, it is very likely that the proponents will be required to collect the level of baseline environmental information necessary to complete an EIS. The final scope of the NIRB's assessment of the Iqaluit Hydroelectric Project Proposal can provide some insight as to what may be required and is elaborated upon in the following section 4.2.1. It is also important to note that the field work envisioned also constitutes a proposal submission to the NIRB, however the studies are more likely to be approved with terms and conditions after the initial screening rather than undergo further review. Desktop level studies should be sufficient to complete the applications to the NPC and NIRB for field studies.

Environmental Impact Statement Requirements

Given that the previously proposed Iqaluit Hydroelectric Project in 2013 was subject to a full environmental impact review, it is very likely that any of the HEP alternatives under consideration would be subject to the same and the level of collected biophysical baseline information will need to satisfy those requirements. Due to the lack of project definition at this time, it is unknown whether the various wind farms combined with PSH would be subject to a full environmental review. The EIS scoping process conducted by NIRB in 2013 identified the potential impacts of the proposed project as well as the valued components of the physical and social environment. The scope list included the physical works and activities for all stages of the project, identified components of the eco-systemic and socio-economic environments, and provided a list of the Valued Ecosystem Components (VECs) and Valued Socio-Economic Components (VSECs) which QEC was required to discuss within its EIS. The anticipated minimum information required to complete an EIS, as outlined both in the NuPPAA and the NIRB EIS scoping document from 2013, is as follows:

1. Project Description, including the purpose and need for the Project:

    a. Project Proposal Summary
    b. Project Components (including the proposed hydroelectric, pumped-storage, and wind infrastructure to be constructed and operated, ancillary infrastructure such as transmission lines, powerhouses, substations, roads, penstocks, tunnels, wharves, and airstrips to be constructed and operated, and supporting information regarding equipment to be brought on site, temporary accommodations, fuel storage, sewage disposal, greywater disposal, management of solid waste, and water utilization)
    c. Abandonment, Decommissioning and Reclamation plans

2. Anticipated eco-systemic and socio-economic impacts of the Project, caused by the project components, activities, and undertakings. Appropriate temporal and spatial boundaries,

information from scientific sources, and traditional knowledge must be considered regarding the following factors:

a. Air quality;
b. Climate and meteorology including climate change;
c. Noise and vibration;
d. Terrestrial environment, including:
    i. Terrestrial ecology;
    ii. Landforms and soils;
    iii. Permafrost and ground stability; and
    iv. Geotechnical hazards.
e. Geological features including discussion of geology and geochemistry;
f. Hydrological features (including water quality) and discussion of hydrogeology, including;
    i. Stream hydrology, including sediment loading to streams, stream thermal conditions and contaminant loading to streams;
    ii. Flows, including instream flows, flooding and dewatering;
    iii. Water quantity/water balance; and
    iv. Estuarine hydrology (the freshwater flow regime into the marine environment).
g. Groundwater and surface water quality, including surface runoff and snowmelt;
h. Freshwater aquatic environment, including:
    i. Aquatic ecology;
    ii. Fish passage;
    iii. Fish spawning;
    iv. Landlocked fish and habitat;
    v. Freshwater, including but not limited to effects on water quality, quantity and ice conditions downstream of the impoundment area;
    vi. Sediment quality;
    vii. Aquatic biota including fish as defined in the *Fisheries Act,* aquatic macrophytes, benthic invertebrates and other aquatic organisms;
    viii. Aquatic habitat including fish habitat as defined in the *Fisheries Act*; and
    ix. Commercial, recreational and Aboriginal fishery as defined in the *Fisheries Act*.
i. Terrestrial vegetation (including Porsild's bryum);
j. Terrestrial wildlife and wildlife habitat, including:
    i. Representative terrestrial mammals to include caribou, caribou habitat migration and behaviour, wolverine, polar bears, wolves, foxes and less conspicuous species that may be exposed to contaminants (include species at risk); and
    ii. Wildlife migration routes and crossings.
k. Birds and bird habitat, including:

   i. Raptors (including Peregrine falcons);
   ii. Migratory birds; and
   iii. Seabirds (including eider and gull species) (where applicable to the selected alternative).

l. Marine environment (where applicable to the selected alternative), including:
   i. Marine ecology;
   ii. Marine water;
   iii. Sea ice;
   iv. Sediment quality;
   v. Marine biota including fish as defined under the *Fisheries Act* and benthic flora and fauna;
   vi. Marine habitat including fish habitat as defined in the *Fisheries Act*;
   vii. Marine wildlife;
   viii. Marine mammal harvest; and
   ix. Commercial, recreational and Aboriginal fishery as defined in the *Fisheries Act*.

m. Socio-economic factors, including:
   i. Economic development opportunities;
   ii. Employment;
   iii. Education and training;
   iv. Contracting and business opportunities;
   v. Population demographics;
   vi. Benefits and revenues (tax, royalties, etc.);
   vii. Navigation; and
   viii. Energy Security.

n. Traditional activity & knowledge including:
   i. Land and resource use;
   ii. Use of proposed Katannilik Territorial Park and Itijjagiaq Trail;
   iii. Food security;
   iv. Language; and
   v. Cultural and commercial harvesting.

o. Non-traditional land use and resource use, including:
   i. Visual and aesthetic resources;
   ii. Protected areas; and
   iii. Use of proposed Katannilik Territorial Park and Itijjagiaq Trail.

p. Heritage resources such as:
   i. Archaeology;
   ii. Palaeontology; and
   iii. Cultural sites.

q. Health and well-being of the community, including:
    i. Individual and community wellness; and
    ii. Family and community cohesion.
r. Community infrastructure and public services;
s. Health and safety including employee and public safety;
t. Residual and cumulative effects; and
u. Transboundary effects

3. Anticipated effects of the Environment on the Project, throughout the project's life including the following factors:

    a. Climate and meteorology including climate change and extreme weather events (storms, droughts, heavy rainfall events);
    b. Permafrost;
    c. Geotechnical hazards including slope movement, differential or thaw settlement, frost heave, and ice scour;
    d. Subsidence;
    e. Flooding and/or drought; and
    f. Unfavourable geological conditions.

4. Steps which the proponent proposes to take including any contingency or risk management plans, to avoid and mitigate adverse impacts caused by the proposed project components and activities. Plans must extend, where relevant, through all project phases and must take into account appropriate temporal and spatial boundaries, and draw from scientific sources, best practices and traditional knowledge. Suggested plans are:

    a. Emergency and spill response
    b. Hazardous materials management;
    c. Accidents and malfunctions;
    d. Regulatory requirements;
    e. Temporary closure plans; and
    f. Mitigation measures.

5. Steps which the proponents propose to take to optimize benefits of the selected project, with specific consideration being given to expressed community and regional preferences. Factors evaluated must include:

a. Compensation and benefits;
b. Health benefits;
c. Human health and well-being;
d. Employment
e. Education and training
f. Land Use
g. Contracting and business opportunities; and
h. Any non-confidential details from an Inuit Impact and Benefit Agreement

6. Steps which the Proponent proposes to take to compensate interests adversely affected by the Project, including all non-confidential process and content details pertaining to any Inuit Impact and Benefit Agreement pursued in connection with the Project.

7. The monitoring programs or post-project analysis proposed by the Proponent to identify and manage eco-systemic and socio-economic interests potentially affected by the Project.

8. The interests in lands, waters and other resources which the Proponent has secured or seeks to secure, including a list of regulatory approvals and the authorizing authorities.

9. Options for implementing the Project including project alternatives, alternatives to individual components/activities, alternate timing and development options, as well as presenting the "no go" option as it pertains to the overall Project.

10. Other matters that the NIRB considers relevant, including:

    a. Impacts of infrastructure previously undeveloped and untested in the Arctic;
    b. Traditional knowledge;
    c. Statement of consultation principles and practices;
    d. Significant effects analysis;
    e. Sustainability analysis;
    f. Interactions with Valued Ecosystem Components and Valued Socio-Economic Components;
    g. Discussion of similar developments in the North; and
    h. Long-term lifespan of development

Details regarding the general principles and formatting for an EIS can be found in the NIRB Proponent's Guide.

In formulating an EIS, the VECs/VSECs must be selected based on ecological importance to the existing environment, the relative sensitivity of environmental components to project influences, and their relative social, cultural, or economic importance. The potential impacts resulting from the various activities associated with the selected project alternative must be identified as positive or negative in nature. The VEC/VSEC interactions identified must also be supplemented with a determination of probability and significance for each resulting effect in order to assign adequate measures to mitigate a negative effect if negative and, if possible, enhance a positive effect. The significance of project-related impacts will need to be determined in consideration of the impact's frequency, duration, and geographical extent as well as magnitude relative to natural or background levels, and whether they are reversible in nature. A description of each potential effect, its' projected significance, and assigned mitigation measures must be detailed. This work requires a significant level of information regarding the existing biophysical environment, and environmental baseline studies will need to be scoped accordingly.

Nunavut Water Board Process

The Nunavut Water Board (NWB) was established in 1996 and is responsible for the regulation, use and management of water in the Nunavut Settlement Area (NSA), except for the use of water for navigational purposes. Water refers to any stream, river, lake, or other body of inland water on the surface or under ground in the NSA. Persons or organizations wishing to use water or deposit waste that may enter water within Nunavut must apply for a water license from the NWB unless the water is used for a domestic purpose, to extinguish a fire, the use/deposit of waters within a national park, or the instream use of water does not consume water or impact water quality. According to the Final Licensing Process Report by Lawson Lundell LLP prepared in 2006, the use of water anywhere in Nunavut for a hydro-electric project would require a water license issued by the Nunavut Water Board.

Regulations for water use would be applicable for any field camps established during the completion of baseline studies. These regulations include that the proponent would not extract water from any fish-bearing waterbody unless the water intake hose is equipped with a screen of appropriate mesh size to ensure that there is no entrapment of fish. Additionally, small streams and lakes cannot be used for water withdrawal unless approved by the NWB. The proponents must seek permission from the NWB to use water in any manner, or to disturb any stream, lakebed, or the banks of any definable water course.

When a water license application is received by the NWB, it is referred to the Nunavut Impact Review Board (NIRB) for screening. Where NIRB determined that a water license application requires a review to assess potential environmental and socio-economic effects, the NWB must not issue the license until a NIRB project certificate has been granted. The process for review of a major water license by the NWB will generally commence once the NIRB environmental review process has been completed.

A water license may be either type A or type B based on criteria that are outlined in the Northwest Territories Water Regulations (NTWR). A type A license is required for projects with the potential to cause a relatively large qualitative or quantitative effect, whereas a type B license is typically required for a smaller scale project. Type A licenses are subject to a public hearing process before the NWB approves the application and issues the license, while type B licenses do not typically require a public hearing. If one component of a project requires a type A license, the entire project will be reviewed as a type A license as the Board is not in favour or splitting projects into multiple licenses. In these circumstances, the hydroelectric development being proposed is a large-scale project with environmental and socio-economic impacts and will thus require a type A license. Licenses may be issued for a term of up to 5 years, and in all cases the term of a license cannot exceed 25 years. A water license can be renewed for a maximum term of another 25 years on application, either with or without changes to the existing license.

A water license application includes an application fee and annual water use fees that are based on the size and nature of the project. In the case of hydroelectric projects, there are seven classes:

- Class 0 – ≤ 150 kW, no extra fee
- Class 1 – > 150 kW but < 5,000 kW, $1,500 annual fee
- Class 2 – ≥5,000 kW but < 10,000 kW, $4,000 annual fee
- Class 3 – ≥ 10,000 kW but < 20,000 kW, $10,000 annual fee
- Class 4 – ≥ 20,000 kW but < 50,000 kW, $30,000 annual fee
- Class 5 – ≥ 50,000 kW but < 100,000 kW, $80,000 annual fee
- Class 6 – ≥ 100,000 kW, $90,000 annual fee for the first 100,000 kW of authorized production and $1,000 for each 1,000 kW of authorized production more than 100,000 kW.

The various options being considered for hydroelectric development are estimated to be able to produce between 10-50 MW of power annually, meaning that they would be classified as either Class 2, 3, or 4. There is no precedent of pumped-storage hydro (PSH) in Nunavut, thus the inclusion of the technology introduces some regulatory uncertainty for water licensing however it is assumed that PSH would be included in the hydroelectricity category. Early engagement with the NWB is recommended if PSH is to be included in the project selected for development. Ultimately, the class issued to the project will be dependent on the final capacity of the facility and specifications of the location that is selected. All projects that fall under classes 1 to 6 would require a type A license and thus a public hearing. Notices of public hearings are published at least 60 days in advance of the scheduled hearing, and information on water license application is also made available to the public before the hearing. The public hearing is held in the community or communities within Nunavut that will be most impacted by the project. The Board may waive the requirement for a public hearing where no public concerns are expressed, however the Board will hold a public hearing if it feels that it is in the best interest of the public to do so.

All license issuances, amendments, renewals, and cancellations of water licenses with an associated public hearing require the approval of the minister of Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC). The minister has 45 days to decide and must provide justification if the application is not approved. The minister does have the ability to extend the 45-day period by notifying the NWB within the first 45 days. However, if no decision has been made within the 90 days, the Minister is deemed to have approved the application.

The terms and conditions associated with a water license may include the provision of a security deposit, which must cover the period starting with the effective date of the license up to and including two years following the expiry date of the license. The security deposit is kept for safekeeping with the Securities Deposit Division, Government Services and Public Works Canada, and the Office Manager will advise the licensee of any action. Finally, a compensation agreement with the DIO is required under Article 20 of the NLCA for substantial effects on water quality, quantity, and flow. The NWB is authorized to determine the amount of compensation appropriate for any given water use.

Federal Approvals Process

In 2008, Article 12 of the NLCA was formally amended to remove the applicability of the federal *Impact Assessment Act* (IAA) in the Nunavut Settlement Area. This eliminated potential for duplication in the impact assessment process and leaves the NIRB as the sole agency responsible for conducting impact assessment in Nunavut. The NIRB's impact assessment process is very similar to that under the Impact Assessment Agency of Canada (IAAC) with differences in process steps. Further, the NIRB reports its findings from the impact assessment to the final decision-making authority, known as the responsible Minister(s), while under IAA the findings are reported to the Minister of Environment.

That being said, authorizations from federal agencies such as Fisheries and Oceans Canada (DFO) and Transport Canada (TC) will be required for some components of the envisioned field studies as well as for the construction and operation of the project once selected. The following sections 4.4.1-4.4.3 give an overview of the requirements. Federal agency involvement as relates to land tenure is given in the following section 4.5.

Fisheries and Oceans Canada Fisheries Authorization Process

Any project that has the potential to affect fish and fish habitat will have to be assessed to determine the nature of the potential impact, means to mitigate any potential effects, and after all mitigations are considered what residual impacts will there be to fish and their habitats. The mandate to protect fish habitat is administered by Fisheries and Oceans Canada (DFO) under the federal *Fisheries Act*. The DFO conserves and protects fish and fish habitat by applying the fish and fish habitat protection provisions, which include:

- a prohibition against causing the death of fish, by means other than fishing (Section 34.4);
- a prohibition against causing the harmful alteration, disruption or destruction of fish habitat (Section 35);
- a framework of considerations to guide the Minister's decision-making functions (Section 34.1); and,
- ministerial powers to ensure the free passage of fish or the protection of fish or fish habitat with respect to existing obstructions (Section 34.3).

The pollution prevention provisions of the *Fisheries Act* are a shared responsibility with Environment and Climate Change Canada (ECCC). Section is 36(3) of the Act states that no one is permitted to deposit deleterious substances in water frequented by fish.

Management of inland fisheries has largely been delegated to the provinces and the Yukon Territory, while the administration of the fish and fish habitat protection provisions has remained with the federal government across Canada. The Government of Canada is committed to a nation-to-nation, Inuit-Crown and government-to-government relationship based upon the recognition of rights, respect, cooperation and partnership. To support this commitment, the *Fisheries Act* includes the:

- Requirement for the Minister to consider the adverse effects that decisions made under the Act may have on the rights of the Indigenous peoples of Canada (Section 2.4);

- Requirement for the Minister to consider, when making certain decisions related to the fish and fish habitat protection (and pollution prevention) provisions of the Act, the Indigenous knowledge of the Indigenous peoples of Canada that has been provided to the Minister (Section 34.1(1) (g)); and

- Requirement to protect the confidentiality of Indigenous knowledge that is provided to the Minister in confidence, except under limited circumstances (subsection 61.2 (1)).

Fish and Fish Habitat Protection Provisions

The provisions of the *Fisheries Act* are the authorities for regulation of works, undertakings or activities that risk harming fish and fish habitat. The “death of fish by means other than fishing” (subsection 34.4(1)), and the “harmful alteration, disruption or destruction (HADD) of fish habitat” (subsection 35(1)) are the two core prohibitions of the act.

DFO administers the fish and fish habitat protection provisions using a hierarchy of “avoid, mitigate and offset”. This hierarchy emphasizes that efforts should be made to first prevent (avoid) the occurrence of harmful impacts. When avoidance is not possible, then efforts should be made to minimize (mitigate) the extent of harmful impacts on fish habitat caused by the proposed work, undertaking, or activity in question. Any residual harmful impacts should then be addressed by offsetting; offsetting measures typically counterbalance this loss through positive contributions to the aquatic ecosystem.

Proponents are required to determine whether their proposed work, undertaking, or activity has the potential to cause impacts to fish and fish habitat. Initially a Request for Review is submitted to DFO to determine whether a Fisheries Act Authorization (FAA) is required if the death of fish or the HADD of fish habitat cannot be avoided or mitigated. Residual impacts must be authorized by the Minister of Fisheries and Oceans Canada as an exemption from the regulations. This exemption would be a Ministerial authorization or FAA granted to proponents in accordance with the Authorizations Concerning Fish and Fish Habitat Protection Regulations. Steps in the authorization process are outlined in Figure 4.4.1.1.

When considering an application for authorization, DFO will require information such as:

- A detailed description of the proposed work, undertaking or activity, including its purpose, construction methods and associated infrastructure;
- Geographic location and presence of important ecosystem features;
- A description and the results of any consultations regarding the proposed work, undertaking or activity, with Indigenous communities or groups, and the public;
- A detailed description of the fish and fish habitat found at the location and within the area of the proposed work, undertaking or activity;
- A detailed description of the likely effects of the work, undertaking or activity on fish and fish habitat;
- A detailed description of the measures and standards, monitoring measures, and contingency measures to implemented;
- A quantitative and detailed description of the death of fish and the HADD of fish habitat after measures and standards are implemented;
- The number of habitat credits plans to use to offset the death of fish and the harmful alteration, disruption or destruction of fish habitat;
- A detailed description of a plan to offset the death of fish and the harmful alteration, disruption or destruction of fish habitat.

Residual impacts must be addressed by offsetting which include measures that counterbalances unavoidable death of fish and HADD of fish habitat resulting from a work, undertaking or activity. FAAs are granted subject to the proponent developing an acceptable offset plan. DFO has several priorities and guiding principles to inform proponents in the development of fish offsetting plans. Measures to offset should support regional fisheries management objectives and give priority to restoration of degraded fish habitat. Offsetting projects can be categorized in four main approaches as described below:

Habitat Restoration and Enhancement: This approach is the most preferred by DFO for habitat offsetting projects. It involves the physical manipulation of existing fish habitat to improve its capacity to produce and sustain fish. This category focuses on areas where the habitat conditions are considered poor or degraded as these areas provide opportunity for the most ecological benefit.

Habitat Creation: This category involves the development or expansion of aquatic habitat into a terrestrial area. Examples of this measure include the creation of a stream, lake, or wetland. The created habitat should provide the same or greater capacity to produce and sustain fish through the incorporation of biological considerations. Habitat creation must include biological considerations to ensure the area is self-sustaining for fish populations.

Chemical or Biological Manipulations: Measures from this category include manipulating the water body chemistry to address water quality issues, stocking of fish or shellfish, and taking measures to control an invasive species. Measures from this option can have long reaching and unintended consequences if the initial site conditions are not properly understood. Measures from this category should only be used when other types of measures to offset are unavailable and when site-specific issues are well understood.

Complementary Measures: Complementary measures involve actions which maintain or enhance the conservation and protection of fish and fish habitat not necessarily within the HADD. These measures may be considered when there is limited understanding of fish populations or when there are limited opportunities for in-kind measures to offset fish habitat. This measure is often used in conjunction with other methods to supplement any deficiencies and is generally not accepted by DFO on its own to offset an entire project.

Steps	Considerations
Step 1: Characterize the residual impacts: death of fish and harmful disruption, destruction or destruction	Quantify the residual adverse impacts on fish and fish habitat resulting from the works, undertakings and activities
Step 2: Select measures to offset	Follow guiding principles for measures to offset
Step 3: Determine the amount of measures to offset required	Quantify measures to offset Balance measures to offset with the residual impacts on fish and fish habitat Account for uncertainty Address implementation time lags
Step 4: Establish the monitoring and reporting plan	Describe methods to assess the effectiveness of the measures to offset Describe contingency measures
Step 5: Submit offsetting plan to Fisheries and Oceans Canada for review	Estimate offsetting plan implementation cost Provide financial guarantee Secure access to lands and water bodies

Figure C.1 Authorization Process for Projects Resulting in HADD of Fish Habitat.

Fish Passage and Environmental Flows

Hydroelectric developments involve the construction of dams and creation of impoundments to divert water to a generating station. This can result in the creation of a physical obstruction to migration for fish, reduction and/or elimination of sufficient water flows for migration, and impacts to downstream fish habitats through flow reductions. Obstruction is defined in the *Fisheries Act* as any “slide, dam or other obstruction impeding the free passage of fish”. Proposed works that have the potential to obstruct fish passage, modify flow or result in the entrainment of fish may result in harmful impacts to fish or fish habitat. Section 34.3 of the *Fisheries Act* provides the Minister with the authority to ensure free fish passage, sufficient water flows, and to manage or control obstructions for the protection of fish or fish habitat.

If the Minister considers that it is necessary to ensure the free passage of fish, Section 34.3(2) of the *Fisheries Act* allows the minister to require: removal of the obstruction; construction of a fishway; implementation of a program to catch, transport and release fish above the obstruction; installation of diversion systems, fish screens, or other devices to prevent unwanted passage of fish into water intakes, channel or canals; and the maintenance of flows necessary to permit the free passage of fish.

DFO reviews and approves plans for fish passage structures prior to implementation. DFO can approve the fish passage requirement through a written order, inclusion of the requirement within a Fisheries Act Authorization (FAA), or approval can be given without a written order, if done in cooperation with the proponent. When a Ministerial authorization is issued, the conditions of the authorization may include measures to provide for fish passage around the obstruction, to identify the water flow requirements necessary to permit the free passage of fish downstream of the obstruction, or to require fish-guards or screens over water intakes. In either case, the approval must include details of the place, form, and capacity of the fish passage requirement. Once the fish passage solution is operational DFO can require the owner to make changes to ensure the fish passage requirement is being met.

The requirement for the provision of fish passage and provision of sufficient water flow for habitat protection, migration and operation of fish passage facilities is most commonly in association with anadromous fish, however fish passage for landlocked species may be considered if access to habitat is essential to their life history. In the Iqaluit region of Nunavut, the species of most concern would be the Arctic charr (*Salvelinus alpinus*). It would be necessary to fully understand the life history, habitat utilization, population characteristics, timing and size of migration and other factors to fully assess requirements of a proponent under Section 34.3 of the *Fisheries Act*. There are many alternatives for upstream fish passage including fish lifts (elevator), technical fishways, nature-like fishways, ‘trap and truck (haul)’ operations, and many others. Alternatives for downstream passage can include systems in spillways and canals, screens and other systems preventing entrance into penstocks, turbine passage with fish friendly turbines (FFTs), pumps and sluices, and these are often enhanced with stimulation or avoidance technologies (light and sound, water velocity) most based on fish behavior.

Attracting fish to upstream fish passage structures or guiding them to downstream passage facilities are probably among the most important design considerations for fish passage effectiveness. Flow management above and below obstructions is the key to attracting and guiding fish. For example, flow releases near a fish-way entrance are used to help migrants heading upstream to locate the facility. Providing directional flows can guide downstream migrants towards bypasses.

The requirement for water release below a dam or impoundment will depend on the nature of the habitat downstream of the structure. Environmental flows are broadly defined as the quantity, quality and timing of water flows required to sustain freshwater ecosystems and the human livelihoods and well-being that depend on these ecosystems. If the downstream habitats are considered to be productive, then flow releases would be required to prevent a HADD of that habitat. If the downstream reach is used primarily for migration, then the required flows would be necessary for fish to migrate up to and find a fish passage structure. There are many approaches and methods that are used to determine the appropriate flow requirements and these approaches often vary by jurisdiction and the environmental goals and levels of protection set in that jurisdiction. It will be important to fully characterize the fish population(s), habitat utilization, timing and size of migration and other factors in the areas under consideration, as the provision of fish passage must be incorporated into the overall considerations for project alternatives.

Aquatic Species at Risk

The *Species at Risk Act* (SARA) is a federal government commitment to prevent wildlife species from becoming extinct and to secure the necessary actions for their recovery. The purposes of the Act are to prevent Canadian indigenous species, subspecies, and distinct populations from becoming extirpated or extinct, to provide for the recovery of endangered or threatened species and encourage the management of other species to prevent them from becoming at risk. Environment and Climate Change Canada (ECCC), Fisheries and Oceans Canada (DFO) and Parks Canada (PC) are the core Departments responsible for the implementation of SARA and jointly manage the federal SAR Program.

A proponent that wants to develop a project in areas where aquatic species at risk are present will have to seek approval from DFO for the project. The Minister of Fisheries and Oceans may authorize an activity that would otherwise be prohibited under SARA if the activity is:

- scientific research relating to the conservation of the species and being conducted by qualified persons; or

- benefiting the species or required to enhance the species' chance of survival in the wild: or

- incidentally affecting the species (its purpose is not to affect the species)

The Minister must believe the following conditions are met:

- all reasonable alternatives to the activity that would reduce the impact on the species have been considered and the best solution has been adopted;

- all feasible measures will be taken to minimize the impact of the activity on the species or its critical habitat or the residences of its individuals; and

- the activity will not jeopardize the survival or recovery of the species.

Approval can take the form of a: (i) SARA permit, (ii) Fisheries Act Authorization, and (iii) fishing license that contains conditions for the protection of aquatic species at risk.

There are a number of marine mammal and fish species within Nunavut that are currently listed or under consideration for listing under SARA (ECCC 2001). Attention will need to be given to the marine areas which will be directly or indirectly affected by components of the project alternatives under consideration during environmental baseline studies. These studies must be conducted to understand the likelihood that these species are present in those areas by quantifying the suitability of the habitat that is present.

Aquatic Invasive Species Regulations

The Aquatic Invasive Species Regulations, under the *Fisheries Act*, include a number of prohibitions against importation, possession, transportation, release, and introduction of non-indigenous species. The regulations also include exemptions to these prohibitions and requires a valid permit or licence for introducing any aquatic species into an area where it's not indigenous.

There are over 160 species listed in the schedule of the regulations and listed species are subject to certain prohibitions in specific geographic areas. In the Arctic one of the most common means of introduction of non-indigenous species is from the ballast water in ships from other regions in Canada and the world. The purpose of the Canadian Ballast Water Regulations, under the *Canada Shipping Act*, is to prevent ecological and environmental damage resulting from the discharge of ballast water. Under these regulations, Canadian vessels everywhere and foreign vessels operating in Canadian waters are required to:

- Develop and implement a ballast water management plan;

- Obtain a certificate attesting that their ballast management plan meets requirements;
- Keep records of ballast water regulations and be subject to inspections to verify compliance with the regulations; and
- Comply with a performance standard to limit organisms discharged.

These requirements must be considered when planning for marine transport of equipment and supplies, and for establishing a marine base for equipment transfer.

Introductions and Transfers Requirements

Hydroelectric developments and other projects that involve the diversion of water between watersheds will require approval and/or licensing/permitting under the National Code on Introductions and Transfers of Aquatic Organisms (the Code). These diversions have the potential for fish to also move between watersheds which has potential ecological, disease and genetic risks.

The Code is administered by the National Introductions and Transfers Program Committee, a federal–provincial–territorial group with representation from individual Introductions and Transfers Committees (ITC) across Canada. The ITC review applications for the intentional transfer or release of live fish into natural waters. Decisions are made following the principles in the Code and members of the ITC include DFO and provincial and territorial government experts, such as veterinarians and scientists. DFO issues licences for introductions and transfers under Section 56 of the Fishery (General) Regulations in all provinces and territories except Quebec, Ontario, Manitoba, Saskatchewan and Alberta where provincial officials authorize those activities. There is no ITC in Nunavut and review of applications and licensing of introduction and transfers in the territory has historically been conducted by the DFO's Central and Arctic Region's ITC, which included membership from the Government of Nunavut.

Transport Canada Navigable Waters Approval Process

Transport Canada's (TC) Navigation Protection Program (NPP) administers the *Canadian Navigable Waters Act* (CNWA). The CNWA regulates work that are proposed to construct, place, alter, rebuild, remove, or decommission works that are in, on, over, under, through or across any navigable water[1]. A "work" is defined by TC as any structure, device or other thing whether – temporary or permanent, that is made by humans, including a structure, device or other thing used for the repair or maintenance of another work. A work also includes the dumping of fill or the excavation or dredging of materials from the bed of any navigable water.

There are three possible applications or notifications the TC NPP that could be required:

1. *Application for Approval* to the NPP
   - If the work is causing any interference with navigation and is either considered a major work or a work located on a scheduled waterway.
   - You can also voluntarily apply to the NPP if your minor work is located on a non-scheduled waterway.
2. *Notification of Work on a Non-Scheduled Waterway*
   - If the work is located on a non-scheduled waterway and is not a major work.
3. *No interference with Navigation Notification of Work*
   - If the work does not have any interference with navigation.

[1] Navigable water means a body of water, including a canal or any other body of water created or altered as a result of the construction of any work, that is used or where there is a reasonable likelihood that it will be used by vessels, in full or in part, for any part of the year as a means of transport or travel for commercial or recreational purposes, or as a means of transport or travel for Indigenous peoples of Canada exercising rights recognized and affirmed by Section 35 of the *Constitution Act*, 1982, and

(a) there is public access, by land or by water;

(b) there is no such public access but there are two or more riparian owners; or

(c) Her Majesty in right of Canada or a province is the only riparian owner.

SEM will use the NPP's Project Review Tool to determine which type of application/notification should be submitted to TC, through the NPP external submission website (https://npp-submissions-demandes-ppn.tc.canada.ca/applications). Typically, for time-sensitive work, it is recommended to submit an *Application for Approval* instead of a *Notification of Work on a Non-Scheduled Waterway (Public Resolution)*.

Major works considered by TC to always require an Application for Approval include: aquaculture facilities, bridges, causeways, water control structures, and ferry cables. Minor works classified by TC include erosion-protection works, aerial cables, submarine cables, buried pipelines, outfalls and water intakes, dredging, and watercourse crossings.

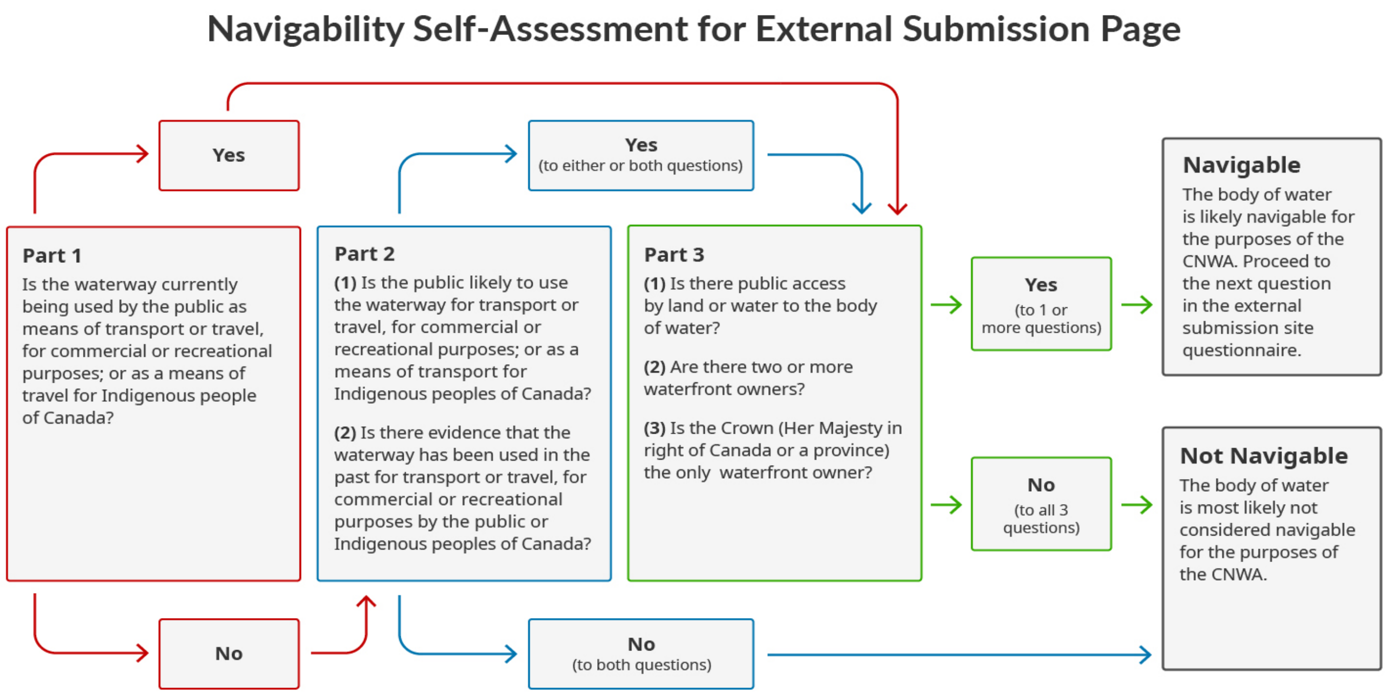


Figure C.2 **CNWA Self Assessment Decision Chart.**

Application for Approval

An *Application for Approval* should be submitted for major works (i.e., the proposed hydroelectric power dams and pumped-storage hydro). The submission of an *Application for Approval* will automatically publish information on the registry of the Common Project Search (CPS), inviting the public to comment on the project. If the application is deemed successful, the NPP will issue an approval document, all terms and conditions must be met and an NPP Officer may inspect the work site for compliance.

To complete the submission details regarding the waterbody to be affected are required including the extent of historical use by the public for navigation purposes, current use, land use or ownership, the depth and width of the waterbody and the composition of the bottom substrate.

The selected project alternative will need to be more well-defined and described in terms of the structures to be developed, operations, and methods of construction. An optional environmental review component is also included in the application for information regarding anticipated impacts, mitigation, waste/debris management, cumulative impacts and whether the project is subject to environmental assessment.

Mandatory components of the application include a map showing location of project, top/plan drawing with dimensions, side/profile drawing with dimensions, and a general arrangement drawing (depicting new and existing work).

Notification of Work on a Non-Scheduled Waterway

A *Notification of Work on a Non-Scheduled Waterway* should be submitted for minor works (i.e., watercourse crossings as part of access road construction, intakes and outfalls for hydro options of tunnels/penstocks).

The submission of a *Notification of Work on a Non-Scheduled Waterway* will automatically publish information on the registry of the CPS. A public notice should be posted in newspapers, on-site signage, community notice boards, tv/radio ads, or the project specific website. The notice must contain information specified in the notice template prepared by TC, and a copy of the public notice should be kept as an NPP Officer might request to see it. The public will have 30 days (starting on the date the notice is published) to review the project plans and to formulate any comment related to navigation. If comments are received, there will be 45 additional days, starting after the 30 days comment period to resolve these concerns. If unable to resolve the concerns, the commenter may contact the NPP within 15 days after those 45 days, requesting a review and decision on whether an approval under the CNWA is required.

To complete the submission the selected project alternative will need to be more well-defined and described in terms of the structures to be developed (length and width of work from ordinary high-water mark), operations, and methods of construction. Mandatory components of the application include a map showing location of project, top/plan drawing with dimensions, side/profile drawing with dimensions, and a general arrangement drawing (depicting new and existing work).

No Interference with Navigation Notification of Work

A *No Interference with Navigation Notification of Work* should be submitted for work that does not interfere with navigation (i.e., performing upgrades to existing water crossing structures while maintaining navigation, construction of a tunnel beneath a waterbody, or horizontal directional drilling beneath a waterbody).

The submission of a *No Interference with Navigation Notification of Work* will automatically publish information on the registry of the CPS. A public notice should be posted in newspapers, on-site signage, community notice boards, tv/radio ads, or the project specific website. The notice must contain information specified in the notice template prepared by TC, and a copy of the public notice should be kept as an NPP Officer might request to see it.

To complete the submission the selected project alternative will need to be more well-defined and described in terms of the structures to be developed (length and width of work from ordinary high-water mark), operations, and methods of construction. Justification will need to be given as to why the work is considered not to interfere with navigation.

Aviation Safety Approvals

With the introduction of wind turbines to the potential project alternatives, as well as the possibility of transmission corridors or other structures of varying heights above ground, approvals pertaining to aviation safety must be sought. Transport Canada (TC) has exclusive regulatory responsibility for overseeing aviation safety, however other aviation stakeholders such as NAV Canada and the federal Department of National Defence (DND) must also be consulted where appropriate.

TC primarily determines if there is a need to mark or light structures and determines conformance to the applicable Airport Zoning Regulations. An application for an Aeronautical Assessment Form for Obstacle Notice and Assessment Obstruction Evaluation submission will be required for new structures (or alterations to existing structures that increase the height) if the structure is:

- of such a height as to penetrate an airport obstacle limitation surface specified in the Aerodrome Standards and Recommended Practices Manual – TP312;
- within 6 km of the centre of an aerodrome;
- higher than 90 m above ground level (AGL) within 3.7 km of the centreline of a recognized VFR route such as, but not limited to, a valley, a railroad, a transmission line, a pipeline, a river or a highway;

- higher than 150 m AGL at any other location; or
- a component of a catenary wire crossing where any portion of the wires or supporting structures exceed 90 m AGL.

The form must be submitted at least 90 days prior to the activity. The information required to submit the application includes a 1:50,000 scale map, or the most detailed map available showing ground contour elevations to allow determination of the structure's latitude and longitude, height of the structure above ground, and ground elevation. It is recommended that a record of contact with the airport is included in the application.

Should TC determine that marking of a wind turbine is necessary, surface painting will be required in either a white or off-white colour. In Canada, special paint bands for the blade ends are not required because the blades are rotating, and the display would not be as effective as that of a fixed object. Should lighting be necessary, a red medium intensity flashing beacon of 2000 candela nominal output will be required on the nacelle. Light units are not mounted on the blades because the technical impracticality of such installation. To reduce the amount of lighting where installations of multiple wind turbines are concerned, the required lights are installed at intervals of 900m. The lights should be provided with means to make them flash in unison.

Once assessment is completed and the application approved, the proponent will receive a signed copy of the submission. The assessment expires in 18 months from the date of the assessment unless extended, revised, or terminated by the issuing office. If there is a change to the intended installation, a new submittal is required.

NAV Canada advises developers whether their projects may have an impact on civil navigation systems such as air traffic control (ATC) radar systems, and on airways and flight instrument approach procedures at airports. Navigational aids are susceptible to reflection interference from wind turbines, and due to the height of wind turbines, they can cause interference even if they are far away. Developments of several wind turbines together have a cumulative effect. A Land Use Proposal Submission form and approval from NAV Canada may be required for project components that will be sited near the airport at Iqaluit, including wind turbines, transmission lines, and cranes, or for blasting activities, and submissions should be made early in the project planning process. DND should also be consulted via the “Wind turbine impact assessment for industry” online submission, to determine whether project components may have an impact on their infrastructure. DND general guidelines for consultation zones for wind developments include up to 100km away from an air defence radar, down to 10km away from a military installation.

Land Tenure Process

Any of the proposed project alternatives will require authorizations or agreements for access to the land required, such as for hydroelectric dams, power generating facilities, flooding of reservoirs, routing of penstocks or tunnels, wind turbines, transmission lines, access roads, construction laydown areas, and worker accommodations. The four categories of land rights in Nunavut include:

- Inuit Owned Lands (IOL), as created by the Nunavut Land Claim Agreement (NLCA) between the government of Canada and the Inuit of Nunavut and administered by the applicable Designated Inuit Organization (DIO);
- Federal Crown Lands, administered by Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC);
- Commissioner's Lands, administered by the Government of Nunavut Department of Community and Government Services (GN CGS); and
- Municipal Land, which are surveyed lands and are defined by the zoning within the applicable community. For the proposed projects the only municipality within the geographic region of interest is the city of Iqaluit.

The proposed projects may require land rights over more than one type of land classification. For example, a reservoir might require use of both Crown land and IOL, and a transmission line corridor may cross various types of land. In most cases, the acquisition of land rights will be the subject of permits or agreements (such as leases or rights-of-way) negotiated with the land title owner. Information regarding the application processes required for each type of land are given below in Sections 4.5.1-4.5.4.

Inuit Owned Lands

Following the ratification of the NLCA, approximately 356,000 km^2 of land in the Nunavut Settlement Area became IOL. It will be necessary to get permission to gain access onto IOL wherever project components or activities cross into those boundaries. These boundaries as included in the project alternatives maps in Section 2.0 and Appendix A. The Nunavut Tunngavik Incorporated (NTI) is the corporate body which holds title to the IOL on behalf of the beneficiaries of the NLCA, and the surface rights are managed by the applicable DIO in accordance with NTI's procedures and policies. There are two types of IOL: those which include title to mines and minerals and those which are surface only. Generally, persons other than Inuit may not access IOL without the consent of the DIO (which on Baffin Island is the QIA). The NLCA Article 21 provides allowances for limited types of access by the public for purposes such as personal or casual travel, emergencies, and recreation, however these provisions do not preclude the need for licenses, leases, or right-of-way agreements for fieldwork and project development. Application for access onto IOL requires a detailed project description, including a summary of potential environmental impacts and mitigation measures such as a fuel spill contingency plan and a reclamation plan. Depending on the type of work or land use requirements, different activities will trigger the need for different types of access approvals. Authorization categories for QIA Land Use Licenses are:

- Class 0 - Low level activities that generate minimal environmental impact and involve fewer than 10 persons. ATV or snowmobile transport only. Amateur prospecting, camping and localized, non-disruptive scientific research involving fewer than 5 persons.
- Class I - Low level activities that generate minimal environmental impact and involve more than 10 persons on the land at any one time. ATV or snowmobile transport only. Commercial prospecting, camping and scientific research activities.
- Class II - Use of any vehicle other than a snowmobile or ATV, such as aircraft transportation. Use of any explosives. Construction work or any other commercially related activities, such as drilling, digging, grading, or smaller-scale fuel cache. Establishment of a campsite to be used for up to 100 person-days (for example; 4 people for 25 days).
- Class III - Project involves heavy machinery, land alteration or large-scale storage of fuel or other bulky items. Levelling, grading, clearing, cutting, or snow ploughing of any line, trail, or right-of-way exceeding 1.5 m in width but not exceeding 4 ha. Establishment of any campsite that is to be used for more than 100 person days.

It is likely that a Class II License would be required for environmental baseline studies conducted on IOL, however further scoping of studies and fieldwork planning will be required to confirm this.

Hydroelectric or wind projects will likely require long term leases for various components of the projects, such as flood reservoirs, generation facilities, transmission lines, access roads, etc. Commercial leases are necessary to obtain an exclusive right to occupancy to a limited area of IOL for commercial purposes. Authorization categories for commercial QIA Land Use Leases are:

- Class I - Small scale commercial activity that does not require a Class II or III lease.
- Class II - Moderately sized commercial projects between 1 – 4 hectares in size, construction, and storage of 4,000 – 8,000 liters of fuel. Construction or operation of a building/number of buildings with a total floor space between 500-2,000 m^2. Employment of 10-100 persons.
- Class III - Large scale commercial projects exceeding 4 hectares, involving construction, storage of more than 8,000 litres of fuel, storage of bulky or toxic items. Construction/operation or a wharf

or docking facility for the movement of goods and materials. Generation of more than 100 kWh of electric power. Construction or operation of a building/number of buildings with a total floor space greater than 2000 m^2. Employment of greater than 100 employees.

It is likely that are large hydroelectric or wind-power project would require a Class III Commercial Lease, however further design scoping and planning will be required to confirm this.

The proposed project alternatives will also require Right-of-Way Agreements, particularly for transmission line corridors, penstocks, and access roads on IOLs. A Right-of-Way may be granted for exclusive or non-exclusive use of a strip of IOL for a period of time for the purpose of:

- commercial transportation of people, goods, or materials by road;
- petroleum or water transportation by pipeline; or
- electricity transmission.

The construction or maintenance of any works on a Right-of-Way requires a Land Use License as described above.

Application fees and annual fees or royalties are scaled depending on the type of land authorization requested and the authorization category that is required. The period of authorization that may be granted depends on the type of license/lease being requested: up to two years for licenses, up to five years for a residential/recreational lease and level I and II commercial leases, and up to forty years for a level III commercial lease. Once the site(s) for the project have been selected, it may be appropriate for the proponents to approach the QIA and seek assurances that the required land will not be disposed of for any other purpose pending completion of the regulatory review process of the project. These assurances may be obtained through preliminary negotiations of a memorandum of understanding (MOU) or and agreement in principle (AIP) for land leases and right of way agreements.

Inuit enjoy an unrestricted right of access to IOL to carry out traditional activities, therefore extensive consultation is undertaken prior to the disposal of land. The QIA will not issue a permit unless the applicant's proposal has been screened by other regulatory bodies in Nunavut, such as the NPC, the NIRB, and the NWB. Projects that occur in proximity to IOLs do not require a permit from the QIA, however consultation is often required to ensure that the proposed activities do not disrupt the traditional land uses of the local community and to ensure that culturally significant areas are not affected.

Federal Crown Lands

Federal Crown lands in Nunavut are governed by the terms of the *Territorial Lands Act* (TLA), and are administered by CIRNAC (formerly known as Aboriginal Affairs and Northern Development Canada (AANDC) or Indian Affairs and Northern Development Canada (INAC)). Aside from IOL and a small percentage of the Nunavut Settlement Area being privately owned (mostly in municipalities), the remainder of land in Nunavut is Crown land. Field research will require a Land Use Permit from CIRNAC depending on the size of the camp and the type of work. Construction of access roads, trails, transmission lines, or other rights-of-way greater than 1.5m in width on Crown land also requires a Land Use Permit. Depending on the type of work or land use requirements, different activities will trigger the need for either a Class A or Class B Land Use Permit as described in Sections 8 and 9 of the Territorial Land Use Regulations. Class A permits are required for more significant types of activities on the land and are screened by NIRB. A Class A permit is required for:

- Use of more than 150 kg of explosives within 30 days;
- Use of vehicles that exceed 10 tons;
- Use of power-driven machinery for drilling exceeding 2.5 tons;
- A campsite used for more that 400 person-days;
- Fuel Storage greater than 80,000 litres or a single container over 4,000 litres;
- Self propelled machinery for moving the earth;
- Stationary power machinery for prospecting, moving earth or clearing land; or
- Creating a line, trail or Right of Way exceeding 1.5 metres wide and 4 ha in area.

Class B permits are distributed amongst a Land Advisory Committee for comments. A Class B permit is required for:

- Use of more 50-150 kg of explosives within 30 days;
- Use of vehicles between 5-10 tons;
- Use of power-driven machinery that exerts over 35 kpa of pressure on the ground;
- A campsite used for 100-400 person-days;
- Fuel Storage between 4,000- 80,000 litres or a single container between 2,000 - 4,000 litres; or
- Creating a line, trail or Right of Way exceeding 1.5 metres wide but not exceeding 4 ha in area.

It is likely that a Class B land use permit would be required for environmental baseline studies conducted on Crown lands, however further scoping of studies and fieldwork planning will be required to confirm this.

Special note should be made of the time required to allow for application processing. The application should be submitted early enough to allow the minimum processing time for environmental and public screening, thus preventing any delays in the commencement of a land use operation. In Nunavut, most Land Use Permits take 42 days from the date the application is received to the date of issuance. In the event that further studies or investigations respecting the land are required, Section 25 (1)(c) of the Territorial Land Use Regulations may be invoked and allows extended screening time for up to one year. Land Use fees are payable at the time of application based on the estimated number of hectares required for the land use operation. The period of the permit can be held for up to two years, with maximum of one year extension.

As previously stated, hydroelectric or wind projects will require long term leases for various components of the projects on Crown lands. Provisions relating to applications to purchase or lease territorial lands are contained in the TLA. Ministerial approval is required if more than 640 acres of territorial land is being leased or sold. Once the site(s) for the project have been selected, it may be appropriate for the proponents to seek assurances from CIRNAC indicating that any Crown lands required for the development will be reserved or not otherwise disposed of prior to the project completing the regulatory approval process. The *Dominion Water Power Act*, also administered by CIRNAC, contains provisions for reserving lands necessary for power projects.

CIRNAC encourages all applicants to conduct community consultations with appropriate community councils, resource users, and Inuit organizations located in the general area of any proposed activities, prior to submission of applications. The feedback and/or results of any consultation efforts conducted as part of the application process by the proponents should be included in the application submission.

Commissioner’s Lands

The Commissioner’s Land Act governs all access and disposition of surface rights on Commissioner’s lands and is administrated by the Government of Nunavut Department of Community and Government Services (GN CGS). The Commissioner of Nunavut has the power to authorize the sale, lease, or other disposition of Commissioners land. Commissioner's land as defined in section 49 of the *Nunavut Act* may be divided into five types:

- Any land within the 100 Foot Strip along the seacoast, navigable rivers and lakes from the ordinary high-water mark, unless fee simple title or a reserve has been issued to another entity;

- Lots on the Inventory of Government and Crown Agency Lands selected by the Government of the Northwest Territories and its agencies, as per the NLCA Article 14 Section14.1.1 (b)(iii). (Otherwise known as the Government Exemption List);
- Block Land Transfer lands outside municipal boundary;
- Lots that have fee simple title issued to the Commissioner; or
- Untitled Land within the municipal boundary excluding Federal Lands.

An application for Commissioner's land will need to be made to the GN CGS for the lands required for the project, as well as for access to Commissioner's lands for the purposes of constructing a temporary field camp and conducting field studies.

Territorial Parks

A special consideration for the proposed project alternatives is those of Territorial Parks. These lands are surveyed and withdrawn under the Nunavut *Territorial Parks Act* as one of several different types of territorial parks allowed for in the legislation, such as natural environment parks, outdoor recreation parks, or historic parks. Establishing and developing a Territorial Park or other special place in Nunavut takes place over many years, through close consultations and involvement with residents of nearby communities, and with the best available traditional, local and scientific knowledge. To establish a Territorial Park, the Minister of the Government of Nunavut Department of Environment (GN DOE) must apply to formally withdraw the park lands from federal Crown lands, and transfer management responsibility for those lands to the Commissioner. To allow time for Nunavut Parks and the community to complete the more detailed inventories and assessments of park resources, to finalize park boundaries, and complete Park Master and Management Plans, the Minister requests that the Crown set aside lands in the proposed park study area through an Interim Land Withdrawal request. The Interim Land Withdrawal sets the study area aside from other uses that may affect a future park, for an agreed upon period.

Proposed Territorial Parks, such as the Katannilik Territorial Park, are essentially held in federal reserve until they transition to the GN. This may pose a particular source of regulatory complexity for the proposed project alternatives in Armshow River and Jaynes Inlet, as the first site of the Armshow River South is proposed to be located within the boundaries of the proposed Katannilik Territorial Park and the preliminary transmission corridor from Jaynes Inlet crosse through the boundary. These are likely to arouse significant public concern. The development of a hydroelectric facility upstream from the established Sylvia Grinnell Territorial Park is a significant source of regulatory risk, as well as environmental risk given the waterway is a well-known migratory char river and several other species of value inhabit the surrounding land.

In keeping with Section 8 of the *Territorial Parks Act*, a Park Use Permit must be issued by the park Superintendent prior to occupation, research or industrial activities can proceed within the park boundaries. As well, a registration and de-registration process for Nunavut Territorial Parks has been established such that registration is mandatory for all visitors to Katannilik Territorial Park, however it is unclear as to whether these are required for commercial purposes or field work.

Municipal Lands

The administration of the developed lands failing within incorporated communities remains with the municipality as per Article 14 of the NLCA. Within the city of Iqaluit, the municipal corporation holds title in fee simple to most legally surveyed lots within municipal boundaries. Municipal lands may be sold, leased, or otherwise disposed as permitted by the *Cities Towns and Villages Act (Nunavut)*. Project components within municipal boundaries must meet the requirements of local government by-laws with respect to matters such as zoning and development permits. If the proposed project does not follow the zoning by-laws, a variance or by-law amendment will be required. The terms and conditions of any purchase, lease or right-of-way agreement with a municipality will be subject to negotiation.

Third-Party Interests

The existence of third-party interests (such as mineral rights or outpost camps) should be identified in connection with lands which would be required for any particular hydro-electric or wind-power project. If a third party holds an interest in lands by fee simple, lease, or mineral claim, access to the lands could be acquired by negotiation. The NLCA Article 7 makes provision for outpost camps which are occupied as tenants-at-will. Holders of tenancies at will are entitled to reasonable notice that the government indents to make use of the lands for public purposes.

Municipal Approvals Process

Development permits are issued by the Hamlet to build a structure or change the way land is used. Before issuing a permit, the Hamlet ensures the development follows Hamlet by-laws. Depending on the scale of the project, the Development Permit may be approved by the Development Officer or by Council. A site plan is required as part of a completed development permit, which shows the lot of interest as well as the surrounding lots. The site plan must also show the location of any existing buildings, and the layout of the proposed structure. It should also show the vehicle access, parking area, servicing areas, fuel tanks, landscaping and other features (listed in the Zoning Bylaw). Decisions on Development Permit applications that are complete with all required accompanying information are made within 40 days. If no decision is given after 40 days the application may be considered refused and may be appealed by the applicant.

Summary of Permitting Requirements for Phase 3 Studies

Initial authorizations required to conduct fieldwork in Nunavut are very similar to those required for project development, with the addition of subject-specific authorizations. These requirements are determined by the methodology, location, and scope of field activities. Previously discussed authorizations that are required for fieldwork for this project may include:

- Review by the NPC to assess potential cumulative impacts and determine whether the research project conforms to a regional land use plan (detailed above)
- Environmental impact screening by the NIRB if deemed necessary by the NPC (detailed above)
- Authorization issued by the Nunavut Water Board to collect water samples or use potable water for a research camp (detailed above)
- Land use permit from CIRNAC for projects on federal Crown Lands that exceed 100 person days of fieldwork
- Permission from the QIA for access to or use of IOL for research purposes
- Municipal development permit to build or install permanent research infrastructure on municipal lands in Iqaluit

Similar to the planning conducted for the Jaynes Inlet and Armshow River supplemental baseline studies in 2013, it is assumed that a temporary remote field camp will be required for projects located more than half a day's trip away from the nearest community. It is also assumed that any proposed field camp would require at minimum an ATV staging area, multiple aboveground fuel storage areas, a secondary emergency shelter, storage for potable drinking water and food, and a waste storage area. Further scoping of environmental baseline studies will be required to confirm exact requirements, however it has been assumed that soil and vegetation surveys, terrestrial wildlife surveys, hydrology surveys, water and sediment quality studies, and fish/fish habitat surveys would be required. Further engineering studies may also be required, including geotechnical drilling, test pitting and surface geological and terrain mapping.

Requirements for subject or activity-specific authorizations for conducting research in Nunavut are detailed in the below sections 4.7.1-4.7.4. Anticipated timelines for obtaining the required research authorizations are given in Table 4.7.1. Authorizations pertaining to socio-economic or traditional knowledge research are outside SEM's scope for this project, and thus are not included.

Table C.1 Summary of Potential Research-Related Authorizations and Expected Timelines.

Agency	Enabling Legislation	Authorization	Estimated Agency Review
NPC	*Nunavut Planning and Project Assessment Act* (S.C. 2013, c. 14, s. 2)	Conformity Determination	45 days
NIRB		Screening Decision / Project Certificate	45 days – 2 years
NWB	*Nunavut Waters and Nunavut Surface Rights Tribunal Act* (S.C. 2002, c. 10)	Water License (likely Class B but may be Class A)	3 months
CIRNAC	*Territorial Lands Act* (R.S.C., 1985, c. T-7)	Crown Land Use Permit (may be Class A or Class B)	42 days
GN CGS	*Commissioner's Land Act*	Commissioner's Land Use Permit	30-60 days
City of Iqaluit	Nunavut *Cities, Towns, and Villages Act*	Development / Building Permit	30-60 days
QIA	Nunavut Land Claims Agreement (1992)	IOL Access Permit (may be Land Use Licence, Commercial Lease, and/or Right-of-Way Agreement)	TBD
NRI	Consolidation of *Scientists Act* (R.S.N.W.T. 1988,c.S-4)	Scientific Research License	120 days – 1 year
GN DOE	Consolidation of *Wildlife Act* (S.Nu. 2003,c.26)	Wildlife Research License	60-70 days
	Territorial Parks Act	Nunavut Territorial Parks Use Permit	TBD
DFO	*Fisheries Act* (R.S.C., 1985, c. F-14)	Experimental Fishing License (S52 License)	30 days
GN CLEY	Nunavut Archaeological and Palaeontological Sites Regulations (SOR/2001-220)	Archaeology and Palaeontology Permit	1 year

Additional licenses may be required depending on the scope of environmental baseline studies and for the construction of temporary field camps, fuel storage, and waste disposal. Further planning will be required to understand the full extent of permitting.

Nunavut Research Institute Scientific Research License

Anyone intending to conduct research in Nunavut in the health, social, or physical/natural sciences disciplines may be required to obtain a research license under the Nunavut *Scientists Act*, as administrated by the Nunavut Research Institute (NRI). A license is required for most types of primary research involving the collection and analysis of new (original) information. Secondary research, based exclusively on the consolidation, review, and synthesis of existing published information, is not generally licensed under the Act. Licensable primary research can employ a wide range of methodologies in multiple disciplines (e.g. observation, experimentation, case studies, field sampling, remote research, etc.). To be considered valid licensable research, a research project must meet clear standards of scientific quality (rigor) and demonstrate a high degree of ethical/responsible conduct specific to the research discipline. Physical/natural science research topics licensable by NRI applicable to the proposed projects include:

atmospheric science, hydrology, limnology, water quality, geology, geomorphology, soil science, environmental engineering, oceanography, and sea ice. There is no deadline and no fee to apply for a scientific research license, however NRI recommends contacting the Manager of Research Liaison to ensure the correct application forms are completed, and the application process is initiated at least 120 days prior to the date on which field research is intended to commence. The *Scientists Act* allows Nunavut's Science Advisor up to one full year to review a research license application before issuing a license.

It is also important to note that the NPC and NIRB screenings must be completed prior to application to the NRI. If making an application a new research license or license renewal for a project that was previously screened by NIRB, submission of a project proposal to the NPC is not required. However, an online application for a physical/natural sciences research license with NRI is still required. Any new research activities that were not part of the original project proposal must be described, and NRI can assist with determining whether a new NIRB screening is needed. Examples of significant changes to studies that might warrant a new review by the NPC and NIRB include:

- the inclusion of new field research location(s) (where the new location(s) may result in impacts to different communities, is in a new planning region, or occurs in an area with a special designation such as park or wildlife area or IOL;
- a significant increase (more than 10%) in the number of person days, and/or additional water use or waste generation that will require approval by the NWB; or
- new research activities not previously screened by NIRB and for which NIRB has not recommended terms and conditions to mitigate potential impacts.

A different form is required to be completed depending on the type of research to be conducted. Information required for the Land, Freshwater & Marine Based Research Application Form
includes:

1) A map of research locations, which clearly indicates camp sites and research sites;

2) A 500 word non-technical project summary, in English and Inuktitut, which describes the research objectives and rationale (why is the study needed), research questions the project will answer, where, when, and for how long will the field research be undertaken, methods that will be used to conduct fieldwork, potential impacts to the environment, wildlife, or people and how the impacts will be avoided and mitigated, how the data generated by the research will be stored and managed, how Nunavut residents will be involved in the research, and how, when, and to whom the research results will be shared in Nunavut;

3) A technical project proposal description describing:

   a) Objectives: Objectives for the overall project. These must be well-defined short-term and long-term objectives;

   b) Rationale: Rationale for the project. This should be a detailed section that clearly lays out the scientific basis for the proposed work;

   c) Progress to Date: Progress and results of any work complete to date. This section should also include information on any progress in the areas of capacity building, communications and/or the use of Indigenous knowledge;

   d) Methodology: Describe project design, field research methodology, data analysis techniques, where and when the work will be carried out over the lifetime of the project;

   e) Data management: Describe the data management plan, including where and when the data and metadata records will be stored; and

   f) Research outputs: Describe the major research outputs to be generated through the project (academic theses, publications, presentations, reports, etc.).

In determining whether to issue a research license, Nunavut's Science Advisor will conduct consultation with select community groups, Inuit organizations, government departments, and any other representative groups that may be impacted by a proposed research project. The consultation process ensures that the Nunavummiut and the organizations that represent them are fully aware of research plans and have an opportunity to seek clarification, identify concerns, and offer suggestions related to the project. Consulted agencies are also asked to recommend approval or rejection of the research, and they may also recommend terms and conditions to mitigate potential impacts and to ensure meaningful local engagement in the research. Feedback received through the consultations is relayed directly to the applicant, who is given an opportunity to respond as needed. Modifications to the research project (e.g. changes to the methods, location, and timing of fieldwork) may be required to avoid impacts and disruptions identified through the consultation process. The Science Advisor may decide to extend the license application review period when additional time is needed to address concerns raised during the consultation process. The agencies which NRI typically consults with in the licensing process varies depending on the nature of the research. Examples of the agencies most often consulted includes municipal councils, Hunters and Trappers Organizations (HTOs), government departments and agencies, and community interest groups. Consulted agencies are given 30 days to provide feedback to NRI.

An application to NRI can be made for a multi-year license for a research project that will continue longer than a single calendar year. Holders of multi-year licenses are required to re-apply each year if there are significant changes to the project scope, including the field team size and composition, research objectives, study methodology or changes in the location, timing, and duration of fieldwork. The Manager of Research Liaison must be notified of planned research field dates in each calendar year at least 30 days prior to the anticipated field research commencement date, and the names of all research personnel to be involved in new research activity must be provided. An Annual Summary Report is required by NRI before December 31 detailing research activities completed in the current calendar year. A multi-year license may only be renewed for three consecutive years, after which a new application is required.

A scientific research license authorizes the applicant to conduct specific activities as detailed in the license and cannot be used for opportunistic data or sample collection that is outside the scope of the license. License-holders cannot share research samples or specimens with other investigators for research purposes unless it was clearly authorized in the license. A new scientific research license must be obtained for any new research/analysis using any archived samples and specimens collected under the purview of a separate license. New locations can be added to an existing research license by requesting an amendment in writing to the Manager of Research Liaison. Amendments will similarly require approval of the communities nearest to the proposed new field locations and may also require a new review of the project by the NPC and/or a new screening by the NIRB. If several candidate locations for fieldwork have been identified it is better to include all candidate locations in the application, even if being able to conduct activities at all locations is not anticipated. It is much easier to remove field locations from a license than it is to add new ones.

Video footage of wildlife cannot be collected without first notifying the Nunavut Film Development Corporation. Video documentation of wildlife may also require permission from Nunavut's Department of Environment (as detailed in Section 4.7.2).

Research activities that are exempt from licensing by NRI are subject to other licensing requirements as detailed below in Sections 4.7.2-4.7.4.

Nunavut Department of Environment Wildlife Research License

The Government of Nunavut Department of Environment (GN DOE) is responsible for ensuring measures are in place to protect the natural environment, managing and regulating wildlife resources through their sustainable use and supporting a sustainable renewable resource-based economy. Within the GN DOE, the Wildlife Management Division (GN WMD) is responsible under the *Nunavut Wildlife Act* for managing terrestrial wildlife and its habitat. A Wildlife Research License is required for studies of terrestrial wildlife (including plants, insects, and animals), polar bears, and birds, as issued by the GN WMD.

Similar to the NRI Scientific Research License, the application for a Wildlife Research License requires a description of the research to be undertaken including:

- Method(s) used for transportation to/from and within study area(s). i.e. plane, helicopter, snowmobile, boat, ATV, on foot, etc.
- Whether a new field camp will be established, or location of a current camp to be used
- Details regarding invasive work with wildlife, such as:
  - radio collaring: duration of use, model, retrieval method
  - culling/collecting: method and estimated quantity
  - marking: method/device and estimate of mark permanency
  - drugging: permit and delivery details (requires animal care form)
  - banding: quantity and type
  - netting: method / equipment
  - trapping: type (live/dead), method used, trap model, estimated quantity to be captured
  - sample collection: type, method of collection, quantity, type of analysis and where it will be conducted
  - radio transmitters: method applied, duration, retrieval method
- Study area including a map (GIS shapefiles with metadata accepted)
- Proposed waste disposal, including of deceased animals
- Bear deterrent plan

In determining whether to issue a wildlife research license, the GN WMD will issue the application to reviewers both within the department (such as the Regional Wildlife Manager, Conservation Officers from communities in the vicinity of the project) and outside the department (HTOs, Regional Wildlife Organization, the NRI, and the Nunavut Wildlife Management Board). Reviewers are given 40-45 business days to respond with comments, and any outstanding issues are brought to the attention of the applicant. The overall estimated time to process applications is estimated at 60-70 days. The approval letter defining major activities and/or conditions, together with the permit, serve as the authorization required to carry out a project. This documentation should always be kept at the research site. Final reports, or progress reports, must be provided to the relevant HTOs and to the GN WMD within 6 months to 1 year upon completion of the permit's duration (i.e. between July and December of the calendar year proceeding the research). Multi-year research permits are allowed up to a maximum of 3 calendar years. Researchers with multi-year permits are required to submit an annual report.

DFO Experimental License

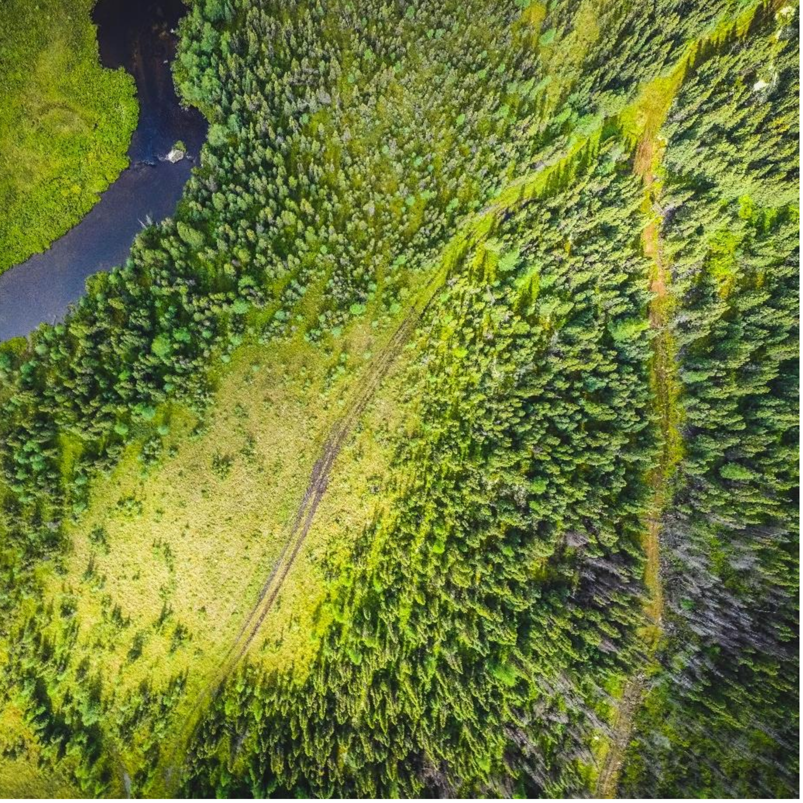
A license to collect fish for scientific purposes is required for studies of marine/freshwater mammals, fish, invertebrates and fish habitat (including aquatic plants), issued by DFO, under the federal *Fisheries Act*. The application for a license issued pursuant to Section 52 of the Fishery (General) Regulations is required for activities associated with capturing aquatic organisms for the purpose of measuring species abundance, distribution, and biological characteristics for the purpose of assessing stock status, for environmental impact assessment, or for environmental monitoring programs. Details required to complete the application include:

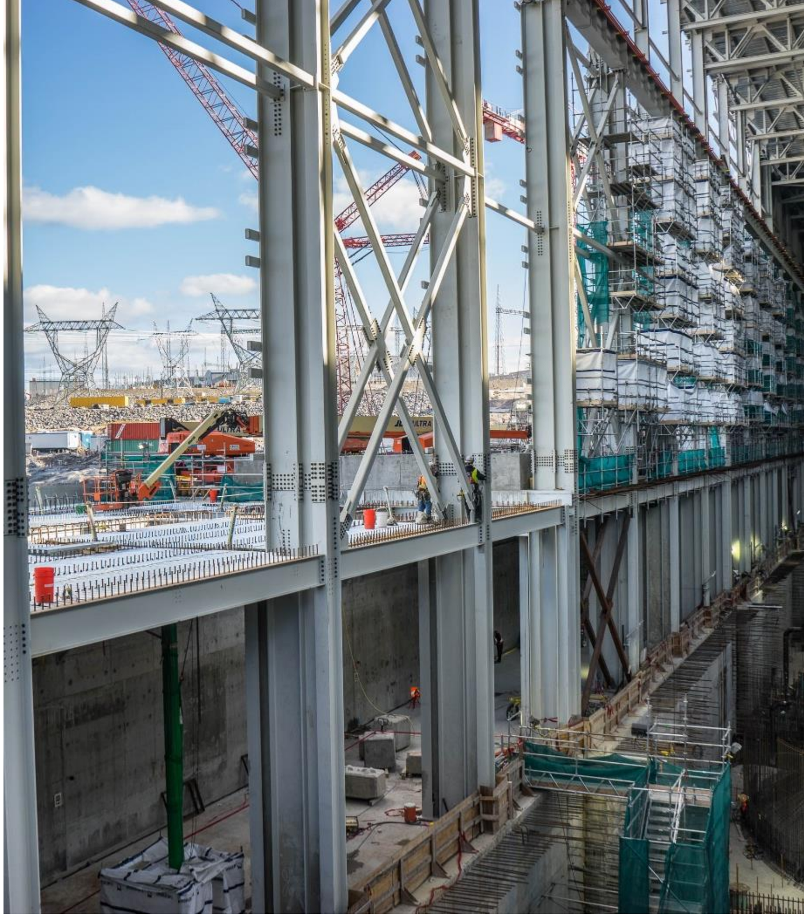
- Applicant information and names of individuals assisting with the activity
- The targeted species
- Details of where the activity is to occur and the gear being used
- Identification of the vessel (if one is being used)
- Information on any fish introductions and/or transfers that will take place under the licence, (e.g. species to be introduced, number of, life stages, etc.
- A summary of research activities, methods of collection, details on the disposition of the specimens (including release methods and location), precautions that will be taken to avoid unintended fish mortality, and information on handling of non-target species.

A new experimental fishing license is usually required once every year (fishing season). An electronic report containing records of the dates fished, numbers of fish of each species counted, and any biological characteristics data collected is usually required to be submitted to DFO within 90 days of the licence end date.

Nunavut CLEY Archaeological Research License

Archeology and paleontology research requires a permit issued by the Nunavut Department of Culture Elders, Language and Youth (CLEY) under the Nunavut Archaeological and Palaeontological Sites Regulations of the *Nunavut Act*. Two classes of permits have been established depending on whether investigations involve excavation or the removal of artifacts or specimens. A Class 1 Permit authorizes the documentation of an archaeological or palaeontological site, including preparing a site map, recording the site's geographic location, and the number, type, and distribution of features. A Class 1 Permit does not authorize the collection of artifacts or specimens, nor the alteration or disturbance of a site in any manner. A Class 2 Permit does authorize collection, alteration and disturbance, but has extensive and detailed requirements and will only be issued to professionally qualified archaeologists and palaeontologists. A Class 1 Permit will likely be required for field studies to examine the proposed site(s) for evidence of historic use, and the application must be made to the Chief Archaeologist of the Heritage Division. Applications are forwarded to the Inuit Heritage Trust for coordination of community review. Other agencies which the Heritage Division may consult during the application review period include the archaeological, palaeontological, conservation and curatorial staff at the Prince of Wales Northern Heritage Centre, the Canadian Museum of Civilization, and the Canadian Museum of Nature. Any concerns raised during the review period are brought to the applicant.





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