

NON-TECHNICAL ANNUAL REPORT – LICENCE #02 058 19N-M

1. Project Overview

Advisian was retained by Fisheries and Oceans Canada – Small Craft Harbours Program (DFO-SCH) to conduct an engineering feasibility study for the construction of a small craft harbour (SCH) in four communities in Nunavut: Clyde River, Arctic Bay, Grise Fiord, and Resolute Bay. To inform the feasibility study, the Four Harbour Field Program (hereafter referred to as the Field Program) was undertaken from August 9 to 20, 2019, during the open water season, to conduct environmental, geoscience, geophysics and archaeological baseline studies (Field Surveys) in each location as detailed in Table 3-1 and depicted in Appendix 1 (Figure 1). Meetings with Hamlets, the Hunters and Trappers Organizations (HTO/HTA) and Inuit Qaujimagajatuqangit (IQ) workshops were conducted in each community prior to the Field Program to inform the field activities, the socio-environmental baseline, and the harbour design concepts. Early engagement allowed the team to discuss the field program being planned with each community, receive feedback and discuss concerns about the field activities being proposed and begin coordination for local field support.

Program permits obtained for the field surveys are provided in Section 5.3, Table 5-1. A summary of the IQ Program is provided in Section 5.5.

This letter provides the summary details for the 2019 field season to fulfil the requirements for the Nunavut Research Institute (NRI) post field program reporting.

2. Program Name

Four Harbour Field Program (the Field Program)

3. Program Location

Project location details are provided in Table 3-1. All locations are in the Qikiqtaaluk Region.

Table 3-1: *Field Program Locations*

Location	Location Description	Latitude	Longitude	Date Present
Clyde River	located in Patricia Bay on the northeast coast of Baffin Island	70° 28.189'N	68° 34.616'W	August 12 to 13
Arctic Bay	the northwest coast of Baffin Island (Borden Peninsula)	73° 1.529'N	85° 7.203'W	August 9 to 10
Grise Fiord	located on the southern shore of Ellesmere Island in Jones Sound	76° 25.001'N	82° 54.935'W	August 15 to 16
Resolute Bay	located on the south shore of Cornwallis Island in Parry Channel	74° 41.472'N	94° 51.549'W	August 18 to 20

4. Proponent and Representative Details

Contact information for the proponent and representative are provided in Table 4-1.

Table 4-1: Proponent and Contact Information

Contact Category	Details
Name of Business / Company	Fisheries and Oceans Canada – Small Craft Harbour Branch (DFO-SCH)
Name of Proponent	Eleanor McEwan, P.Eng., Project Engineer
Proponent Mailing Address	Central and Arctic Region, Freshwater Institute 501 University Crescent Winnipeg, Manitoba R3T 2N6 Phone: 204-984-1102 Fax: 204-983-7166 Email: Eleanor.McEwan@dfo-mpo.gc.ca
Name of Consultant / Primary Contact	Victoria Burdett-Coutts, Marine Biologist, R.P.Bio.
Consultant Mailing Address	Suite 500 - 4321 Still Creek Drive Burnaby, British Columbia V5C 6S7 Office: 778-945-5501 Mobile: 778-839-2372 Fax: 604-298-1625 Email: Victoria.Coutts@advisian.com

5. Field Program

5.1 Program Scope

The field program consisted of the following:

- Marine Field Study
- Wildlife Field Study
- Vegetation Field Study
- Geoscience Field Study
- Geophysics Field Study
- Archaeological Field Study

Dates that surveys were performed in each community are provided in Table 3-1, and the proposed methodology is available online through the registries of the Nunavut Planning Commission (NPC) and the Nunavut Impact Review Board (NIRB) as well as the NRI application for the Field Program.

5.2 Study Areas

Study Areas were developed prior to mobilization into the field to encompass the following Project components:

- SCH
- Haul Road and Quarry; (collectively referred to as the HRQ Study Area)
- Disposal at Sea sites (not confirmed if required)

All Study Areas will be designed to include the maximum footprint required for construction plus a 100 m buffer (see Figures 2 to 5 in Appendix 1). Collectively the study areas will be referred to as the Project Study Areas.

5.3 Program Permits

The field survey was carried out with issuance of the permits outlined in Table 5-1. Communications with NRI Research Liaison Moshia Cote, confirmed that a Social Science Research Permit application was not required, as the scope for IQ would be considered under the Research License.

Table 5-1: Program Permits

Regulatory Authority	Permit/File No	Permit Type
NRI	02 058 19N-M	Research License
NPC	149159	Conformity Determination
NIRB	19YN031	Screening Decision Report
GN-CH	No. 2019-51A – Arctic Bay	Class 2 Territory Archaeologist Permit
	No. 2019-52A – Grise Fiord	
	No. 2019-53A – Resolute Bay	
	No. 2019-54A – Clyde River	
DFO	S-19/20-1018-NU	License to Fish for Scientific Purposes

5.4 Field Surveys

Results of the field based programs are summarized in this section. Further details can be provided to interested parties upon request and with approval from DFO-SCH. A summary of the field program results will be shared with the relevant communities should the SCHs proceed to the detailed design and permitting stage.

5.4.1 Marine Field Survey

The marine field survey consisted of the following:

- Fish and fish habitat
- Water quality

- Sediment quality
- Benthic infaunal
- Drogue

5.4.1.1 Fish and Fish Habitat

Habitat characteristics within the intertidal zone was generally similar between all four locations, with a primarily sandy substrate and varying presence of gravel and cobble. Rockweed (*Fucus* sp) was present in all locations, but most abundant in Clyde River and Arctic Bay. Amphipods were observed in Clyde River and Grise Fiord, with no marine invertebrate observations in Arctic Bay or Resolute Bay. There were no observations of marine fish in the intertidal zone for any of the four locations, however sculpins were observed subtidally.

Habitat characteristics in the subtidal SCH and DAS Study Areas was generally low to moderate value, with no habitat in the footprint contributing to the ongoing productivity of marine fish. Substrate conditions within the SCH Study Areas for all four locations was predominantly sand with intermittent cobble and boulders. When hard substrates were available, there was typically kelp species present. The truncate soft-shell clam and brittle stars were the most commonly observed organism for all sites. Representative images of the intertidal, SCH subtidal and DAS subtidal are provided in Photo 5-1, Photo 5-2 and Photo 5-3.



Photo 5-1: Intertidal Photo Panel. a) Clyde River, b) Arctic Bay, c) Grise Fiord, D) Resolute Bay



Photo 5-2: Subtidal (SCH Study Area) Photo Panel. a) Clyde River, b) Arctic Bay, c) Grise Fiord, D) Resolute Bay

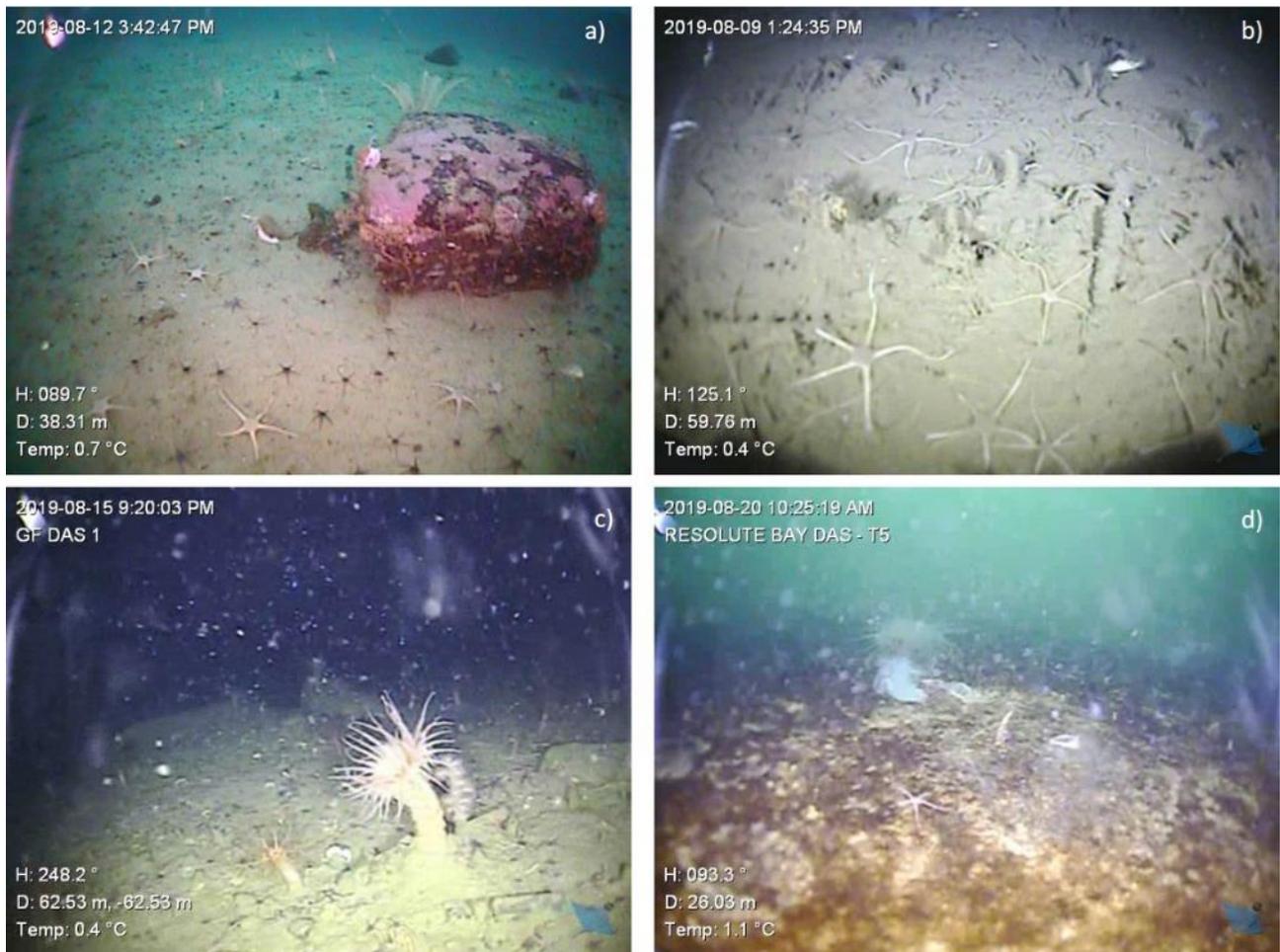


Photo 5-3: Subtidal (DAS Study Area) Photo Panel. a) Clyde River, b) Arctic Bay, c) Grise Fiord, D) Resolute Bay

5.4.1.2 Water and Sediment Quality

Water and sediment quality samples were collected in each of the four locations by the methodologies as outlined in the NRI application for the program. Details of the survey results can be provided upon request.

There was no sediment collection the DAS Study Areas, therefore this aspect of the survey was not completed.

5.4.1.3 Drogue

Collection of surface current data was required to characterize surface current patterns within the vicinity of the DAS Study Area. This data will be used to calibrate the sediment dispersion model for the DAS site during the detailed design and permitting phase. The drogue is essentially a surface float with a GPS tracker, the surface float was set up with an AIS system, which enabled it to be tracked throughout the day so that its location was known for retrieval (see Photo 5-4).



Photo 5-4: Drogue Start Up in Resolute Bay

5.4.2 Wildlife Field Survey

Terrestrial wildlife species identified or detected included unidentified lemming species at Clyde River, fox tracks (*Vulpes vulpes* or *Alopex lagopus*) at Arctic Bay, muskoxen (*Ovibos moschatus*) scat at Grise Fiord, and arctic fox (*Alopex lagopus*) at Resolute Bay. Polar bear (*Ursus maritimus*) was also observed near Clyde River and Resolute Bay.

In general, habitat near the SCH Study Areas were of limited value for terrestrial wildlife. Human development extended to the edge of the ocean and the beaches were developed with structures and boats along their length. Habitat available in proximity to the HRQ Study Areas were similarly considered low quality at Clyde River, Grise Fiord, and Resolute Bay. Habitat available in proximity to the Arctic Bay HRQ Study Areas were considered moderate quality.

During bird surveys (including non-migratory, migratory, and marine birds), a total of twelve bird species were observed at Clyde River, nine bird species were observed at Arctic Bay, six bird species were observed at Grise Fiord, and 11 bird species were observed at Resolute Bay. Overall, a combined total of 22 bird species were observed during field surveys. Overall, the HRQ Study Area offer some value for nesting birds

and no bird species would use the DAS Study Area for nesting. No nesting or breeding behaviour was identified, but this does not preclude the potential for birds to nest in the HRQ Study Area. Details of the survey results can be provided upon request.

5.4.3 Vegetation Field Survey

The vegetation field surveys focused on the HRQ Study Area. During the rare plant surveys, 54 vegetation species were identified and a total of 64 rare plant searches were conducted at Clyde River. During the rare plant surveys at Arctic Bay, 63 vegetation species were identified and a total of 46 rare plant searches were conducted. During the rare plant surveys at Grise Fiord, 65 vegetation species were identified and a total of 48 rare plant searches were conducted. During the rare plant surveys at Resolute Bay, 46 vegetation species were identified and a total of 60 rare plant searches were conducted. None of the vegetation species identified during the field surveys are listed as species at risk or invasive.

Five communities were mapped within the HRQ Study Area at Clyde River and a Disturbed Human-Cause (DHC) community was most dominant. Six communities were mapped within the HRQ Study Area at Arctic Bay and an Upland Dwarf Shrub (UDS) community was most dominant. Seven communities were mapped within the HRQ Study Area at Grise Fiord and an Upland Lichen Barren (ULB) community was most dominant. At Resolute Bay, five communities were mapped within the HRQ Study Area and an ULB community was most dominant.

Based on the Species at Risk Public Registry, Porsild's bryum was predicted to be the only potential vegetation species at risk within the HRQ Study Area. However, no individuals were identified during vegetation field surveys. Overall, based on review of habitat and species identified, Project related disturbances to vegetation and species at risk were considered low. Details of the survey results can be provided upon request.

5.4.4 Geological Field Survey

A geological survey was required to identify potential quarry locations for sourcing the required fill and rock armour for the SCH construction. The survey consisted of a visual assessment of exposed bedrock and noting rock type, major structural defects, weathering and field estimate of rock strength. The geologist tagged potential quarry locations and delineated possible quarry extents. This information was also collected to inform future environmental studies and provide the spatial extent for borehole locations in a future geotechnical program. Representative rock samples were collected at locations which were identified as potential for source rock. The rock samples were sent to a laboratory for screening level Acid Rock Drainage (ARD), strength and durability testing. Several quarry options were considered in each location that ranged from 1.2 km to 5 km from the communities. Laboratory testing confirms that the bedrock meets the rock strength, rock durability and ARD requirements for use as rock armour. However, in Clyde River, initial testing indicates that the rock does not meet the abrasivity requirements, with further testing required to confirm suitability. Bedrock is composed of Granitic Gneiss to Gneiss, Diabase, Granite, and Dolostone in Clyde River, Arctic Bay, Grise Fiord and Resolute Bay respectively.

Drilling was not in the scope of the field survey.

5.4.5 Geophysics Field Survey

A geophysical field survey was undertaken to aid in assessing sub surface materials within the footprint of the proposed SCH sites. Survey methodology is available in the NRI application.

The survey included a single beam bathymetric survey, sub-bottom acoustic profiling and seismic refraction.

During community visits in November 2018 and May 2019, Hamlets and HTO/HTA members in each community were consulted on the overall summer field program which included a detailed description of the geophysical survey work being proposed. No concerns were raised from the Hamlets or HTAs/HTOs when the proposed geophysics program was discussed, and all approved with proceeding as planned.

Each HTO/HTA was contacted directly by the field team prior to arrival in the community and advised of the exact dates that the geophysics survey would be conducted. During the last round of community consultations in November 2019, Hamlets and HTO/HTA members were asked to provide feedback on the field program conducted and whether there were any issues or concerns with the activities conducted. No concerns or issues were raised in any of the communities in regard to effects to marine mammals .

Results of the geophysics program for all locations shows a foreshore, intertidal and subtidal area that is composed of sand, gravel and sporadic boulders. For the most part, the transitions between the vertical zonation (intertidal/subtidal) are similar with fewer boulders observed in the subtidal zone. Results from sub-bottom profiling and seismic refraction indicate the surface layer comprising sands and gravels to be compact to dense and up to 33 m, 6 m, > 50 m and 9 m thick for Clyde River, Arctic Bay, Grise Fiord and Resolute Bay, respectively.

5.4.6 Archaeology Field Survey

Archaeological Impact Assessments (AIA) were completed in each of the locations (see Table 5-1 for respective permits). The objectives of the AIAs were to inventory and record archaeological resource sites within each of the project areas and to assesses their potential impacts by the developments.

Archaeologists interprets the significance of a site based on an understanding of the landscape, the relationship between archaeological sites, and in some cases the relationships between occupations within a single site. Therefore, removal or mixing of cultural material or sites negatively effects their interpretative value. Methodology used for the AIA survey is provided in the NPC and NRI applications.

A summary report and an AIA will be submitted to GN-CH by Lifeways on behalf of DFO-SCH (and Advisian). The AIAs in the respective communities resulted in recording two archaeological sites in Clyde River, three sites in Grise Fiord, five sites in Resolute Bay, and revisiting a previously recorded site in Arctic Bay. In Clyde River and Arctic Bay, the archaeological sites are outside of the proposed construction footprint areas and therefore will not require further study in the detailed design and permitting phase assuming spatial boundaries of the Projects do not change. In Grise Fiord, two sites are within a potential quarry. In Resolute Bay, one site is within a potential quarry, and another site is within 20 m of an existing road. These sites may be impacted by the Project, and so will require further study during the detailed design and permitting phase.

5.5 Inuit Quajimajatuqanjit (IQ)

In addition to the above field program, as per the terms and conditions of the NIRB Screening Decision Report (NIRB File No.: 19YN031), communities were engaged regarding planning and field program activities. Early engagement with the community allowed for a collaborative approach between the field team and community members during the field surveys including coordinating local resources for personnel and equipment. IQ was gathered through desktop review and design workshops with HTO/HTA board members and land use and environmental knowledge workshops (IQ workshops) with local knowledge holders prior to field work to identify existing conditions of important environmental and socio-economic resources in and around each of the four communities.

Key knowledge holders were identified by the HTO/HTA in each community. Participants included elders and active land users. In advance of the workshops, the IQ facilitator engaged with the various discipline leads to confirm the information required for each component.

Verification workshops were conducted in November 2019 after the field studies were complete to discuss the baseline results and verify that local knowledge had been accurately and appropriately presented in the study.

The following is a summary of the IQ program conducted:

- Clyde River: Two design workshops in November 2018 and May 2019 with members of the Nangmoutaq HTO and one joint design meeting with the HTO and Mayor and Council in November 2019.
- Arctic Bay : Three design workshops in November 2018, June 2019, and November 2019 with members of the Ikajutit HTA.
- Grise Fiord: Three design workshops in November 2018, May 2019, and November 2019 with Mayor and Council, Ivig HTO board members, and local hunters.
- Resolute Bay: Three design workshops in November 2018, June 2019, and November 2019 with members of the Resolute Bay HTA.
- Land use and environmental knowledge workshops (IQ workshops) with knowledge holders in Clyde River and Grise Fiord in May 2019 and in Arctic Bay and Resolute Bay in June 2019.
- Verification workshops at each of the four communities in November 2019.

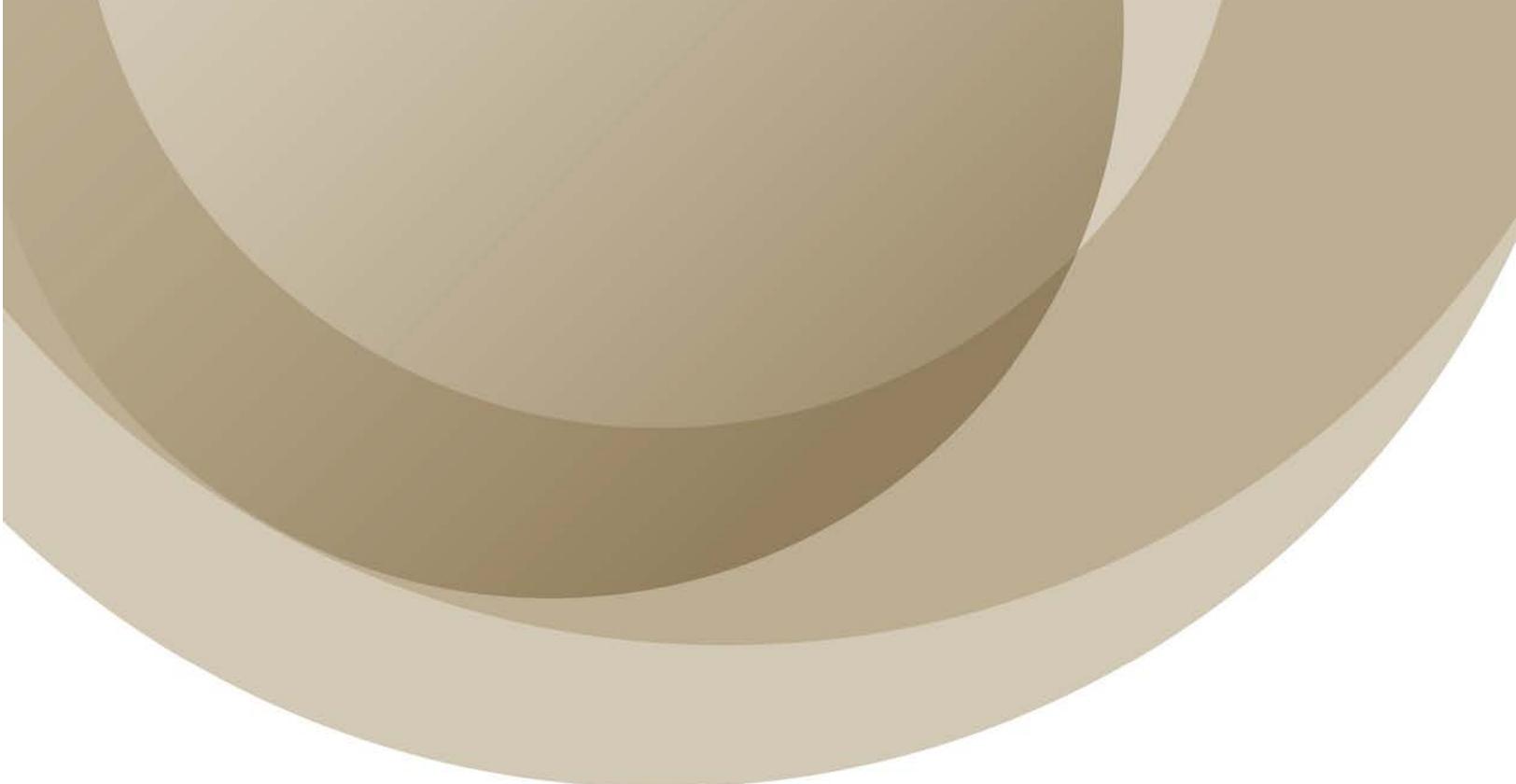
Local interpreters were hired as required to support all workshops. Before the start of the IQ workshops, knowledge holders were asked to read a project information sheet and consent form and then complete and sign the form before the start of the IQ workshops. The consent form was provided in English and Inuktitut and described the workshop's objectives, methods, and uses for the information, allowed the knowledge holder to specify where a copy of the transcript and map should be sent, and whether the knowledge holder wished to be acknowledged by name for their contribution. To better understand the potential interactions between harvesting rights and anticipated Project activities, discussions during the workshop focused on harvest locations, water and ice access, potential DAS sites, fishing, marine and land mammals, birds and other wildlife and the potential locations of the proposed SCH, quarry and haul routes in relation to land use activities (e.g. fishing, hunting, gathering and trapping). Land use and areas of cultural or ecological value were marked on maps and later verified and digitized following review with the participants.

IQ was joined with results from the field program to allow the Project team, in collaboration with community members, to make informed decisions on the design and construction planning of the SCHs that reflect local people's needs, priorities, and values.

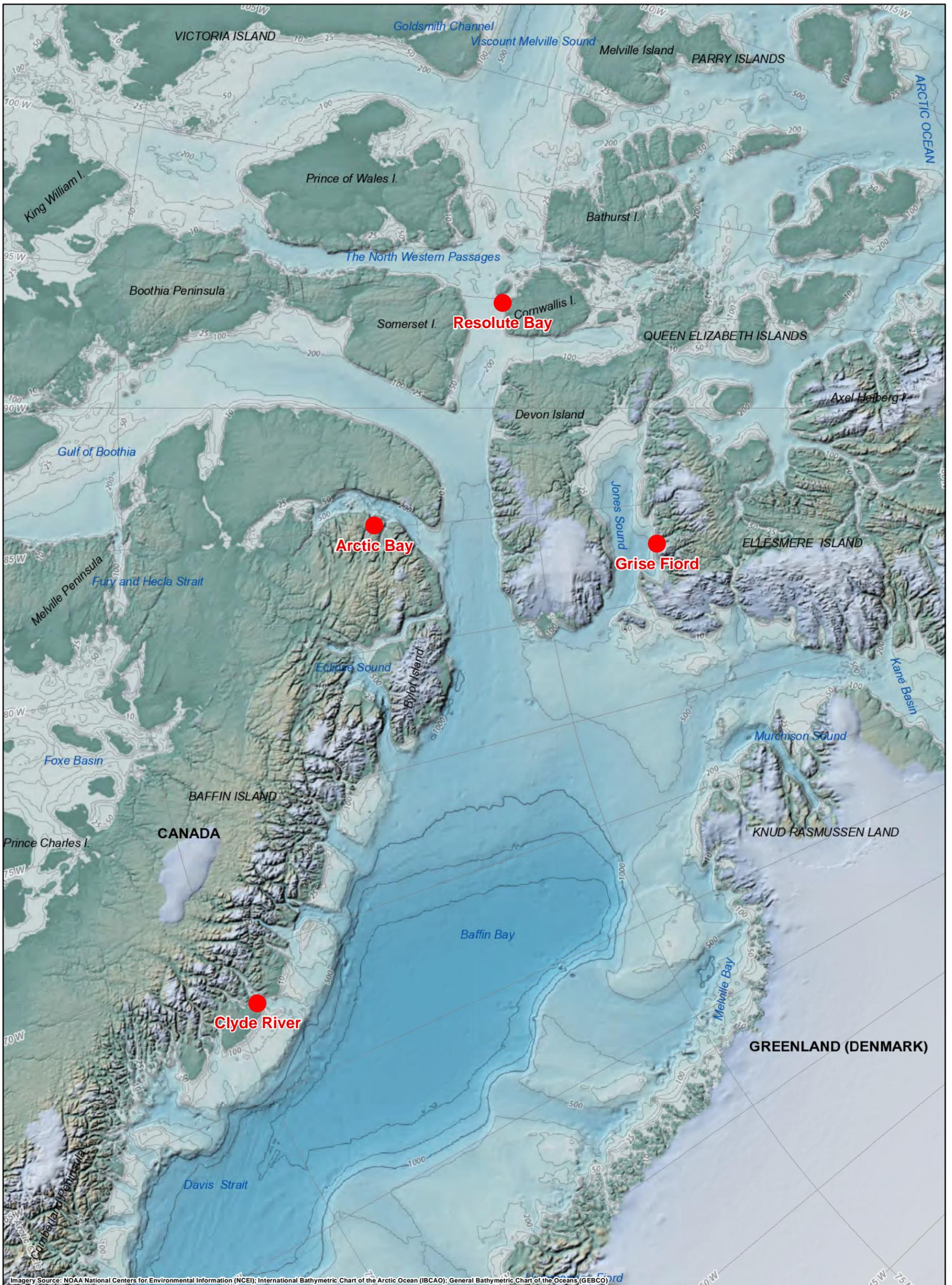
6. Conclusion

The Field Program described in this document, contributed the field collection component of the ESES conducted to support the overall Feasibility Assessment for the Lancaster Sound Project. This information, along with the desktop study will provide a basis for the future detailed design and permitting phase.

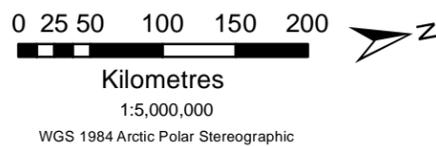
The Field Program was completed by August 20, 2019 and IQ verification workshops were completed by November 2019. Data will be used for subsequent phases of the Project, and more detailed results may be available upon request to DFO-SCH.



Appendix 1 Figures



Imagery Source: NOAA National Centers for Environmental Information (NCEI); International Bathymetric Chart of the Arctic Ocean (IBCAO); General Bathymetric Chart of the Oceans (GEBCO) [©]rd

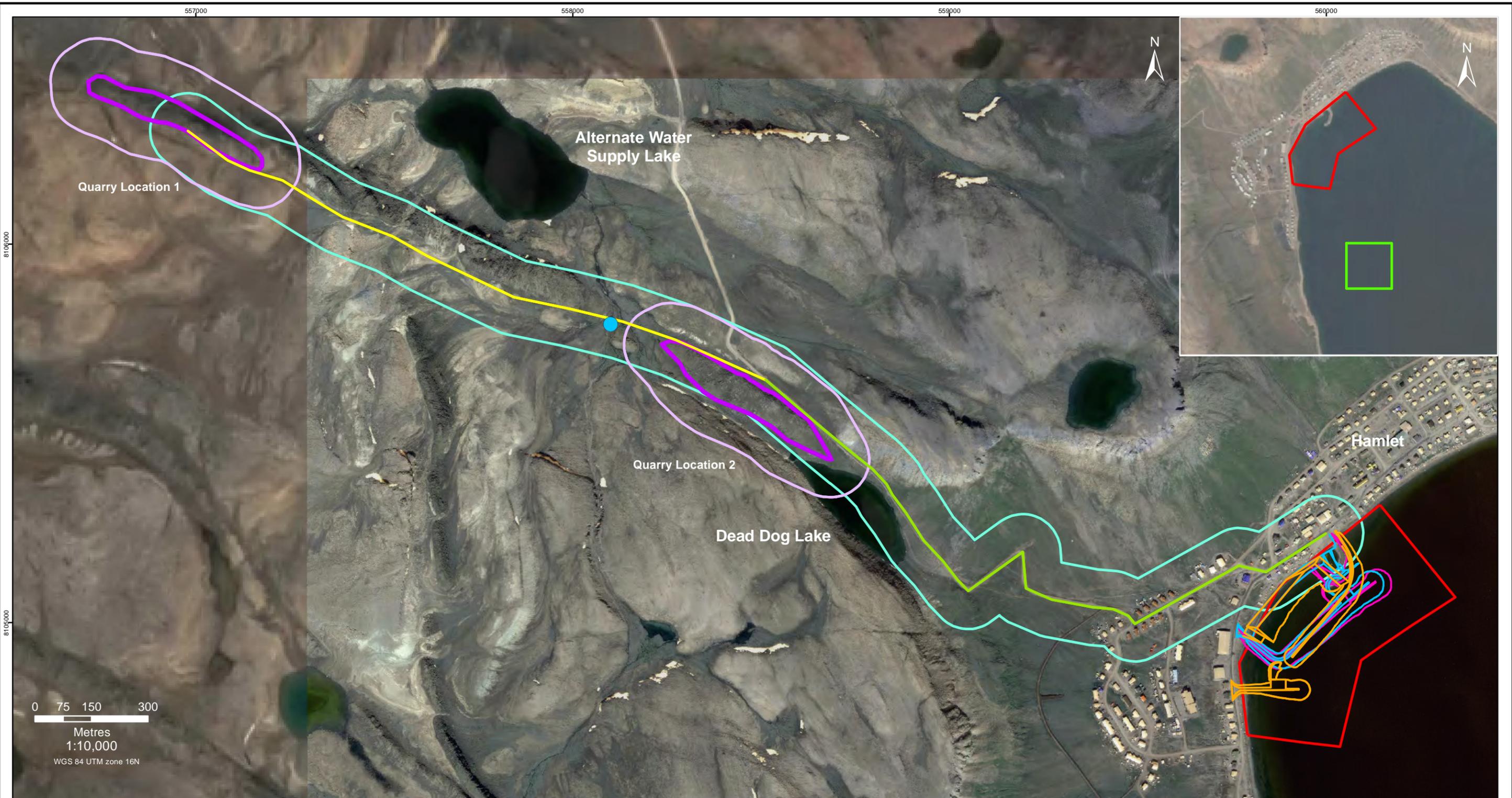


FISHERIES AND OCEANS CANADA
 SMALL CRAFT HARBOUR
 FOUR HARBOUR FEASIBILITY STUDY

FOUR HARBOUR FEASIBILITY STUDY LOCATIONS

	Date: 07-JAN-20	Drawn by: KR	Edited by: KR	App'd by: VB
	Project No. 307071-01306			
	FIG No. 1			REV 0

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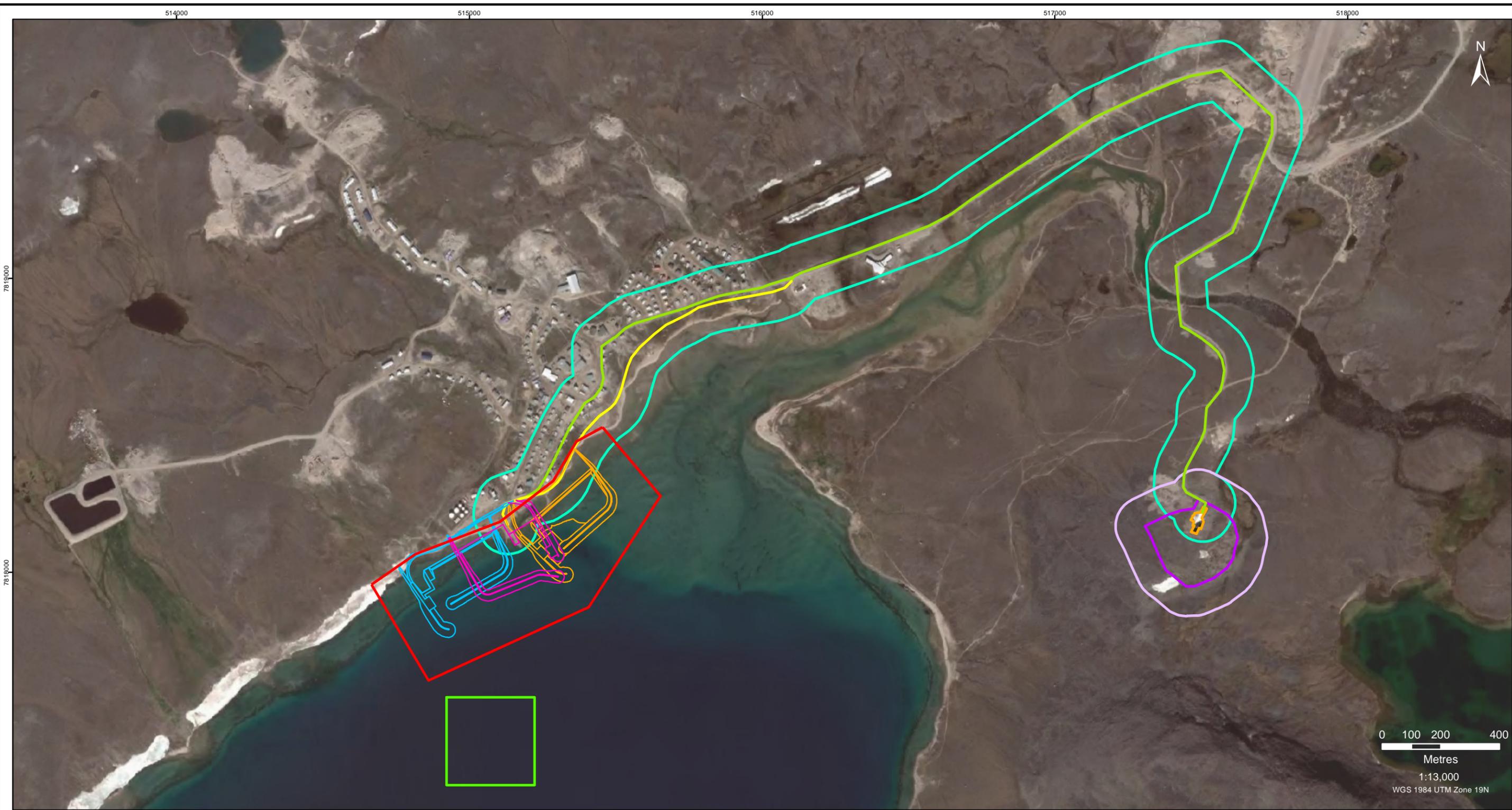
Legend	
SCH Footprint	Potential Haul Road
Option 1 (Pink line)	Existing Road/Track (Green line)
Option 2 (Blue line)	New Haul Road (Yellow line)
Option 3 (Orange line)	
Quarry	Study Area
Potential (Purple outline)	SCH (Red outline)
	DAS (Green outline)
	Haul Road (Cyan outline)
	Quarry (Light Purple outline)

● Potential creek crossing for access to Location 1 Quarry

FISHERIES AND OCEANS CANADA
 ARCTIC BAY HARBOUR DEVELOPMENT
 ENVIRONMENTAL AND SOCIO-ECONOMIC BASELINE SURVEY
PROJECT COMPONENTS AND STUDY AREAS (QUARRY, HAUL ROAD, SMALL CRAFT HARBOUR, DISPOSAL AT SEA SITE)

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		FIG No. 2	0

Imagery Source: CHS July 2017; GoogleEarth, July 2016 Locations approximate.



Legend

SCH Footprint	Potential Haul Road	Quarry	Study Area
Option 1	Existing Road/Track	Existing	SCH
Option 2	New Haul Road	Potential	DAS
Option 3			Haul Road
			Quarry

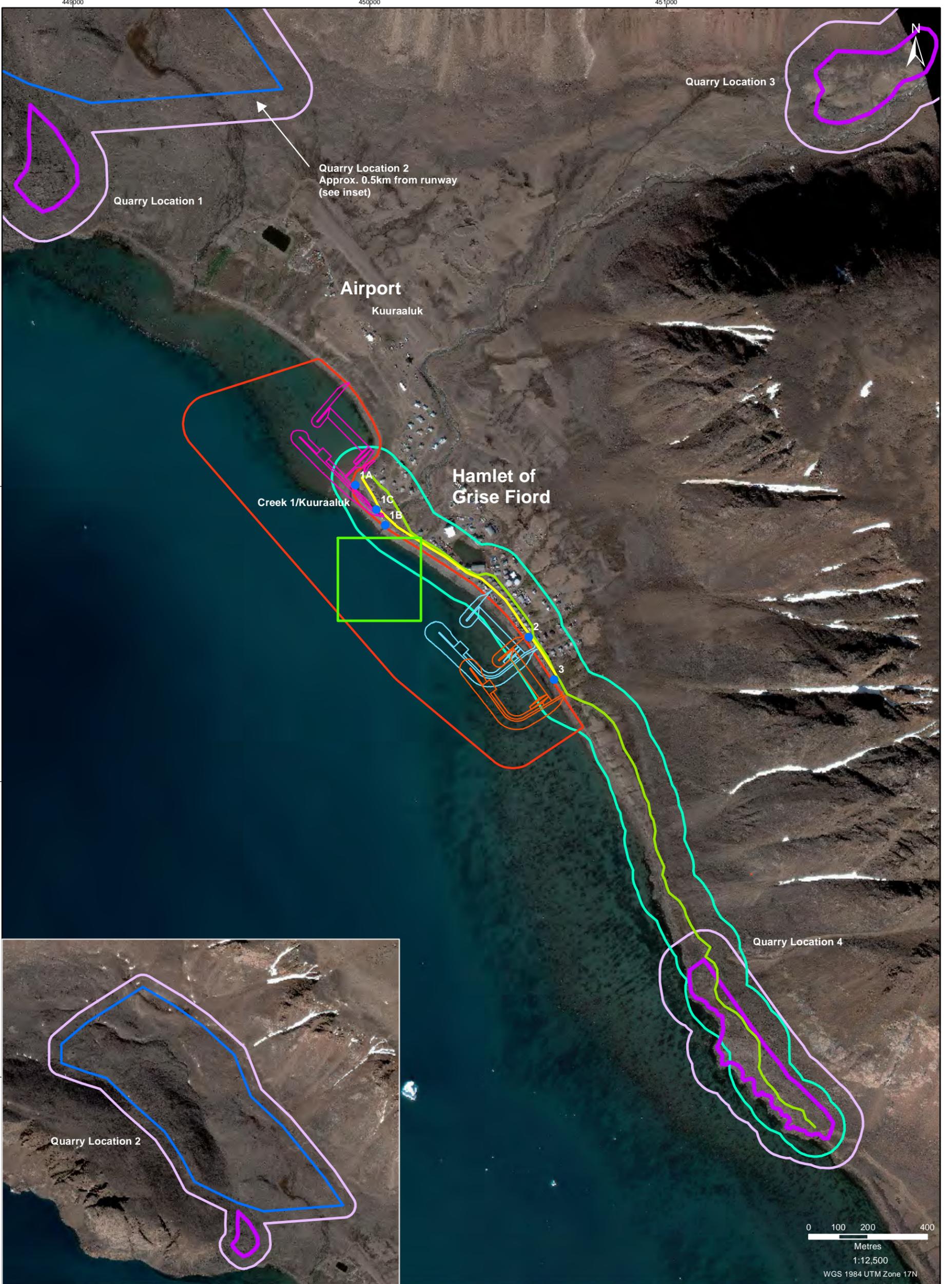
Imagery Source: GoogleEarth, July 2016
Locations approximate.

FISHERIES AND OCEANS CANADA
CLYDE RIVER HARBOUR DEVELOPMENT
ENVIRONMENTAL AND SOCIO-ECONOMIC BASELINE SURVEY
PROJECT COMPONENTS AND STUDY AREAS (QUARRY, HAUL ROAD, SMALL CRAFT HARBOUR, DISPOSAL AT SEA SITE)

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FIG No. 3			

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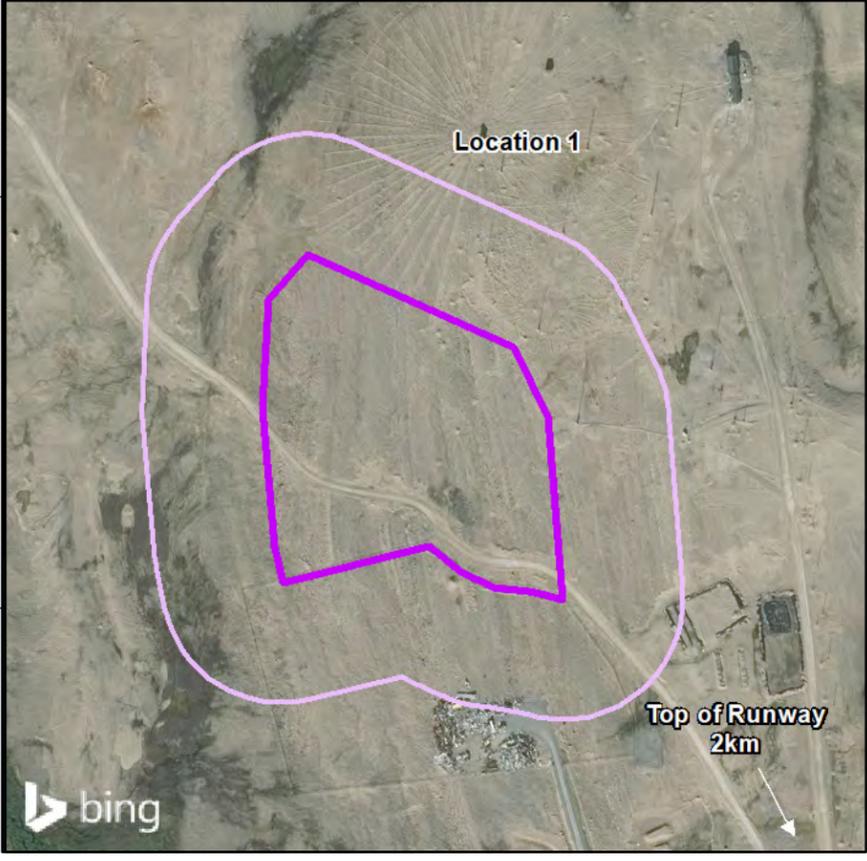
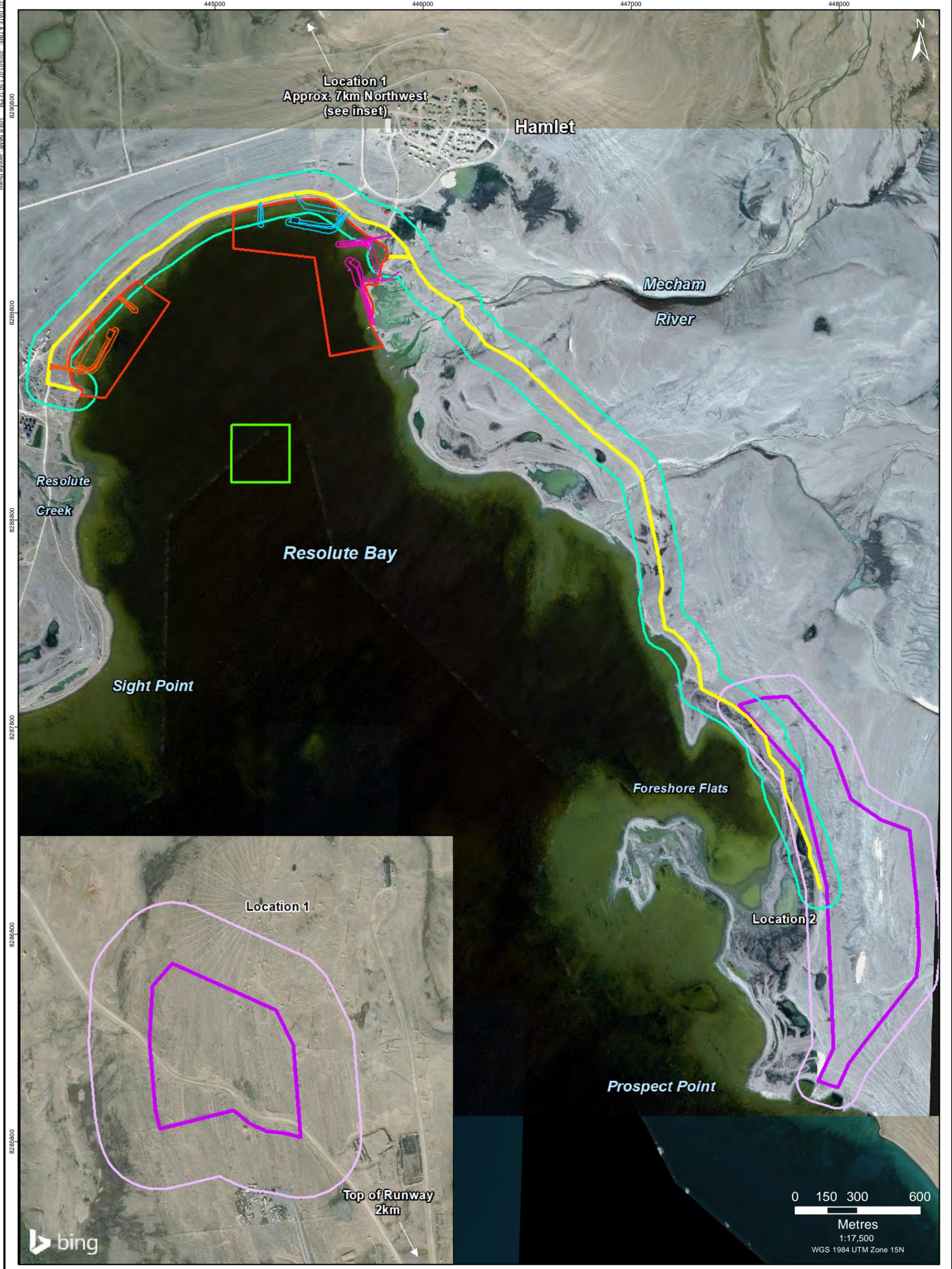
PLOT DATE & TIME: 2020-01-07 1:48:23 PM
 USER NAME: Jennifer Huang
 SAVE DATE & TIME: 2020-01-06 1:37:58 PM
 ISSUING OFFICE: BURBANK/ GIS
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Legend	
SCH Footprint	Potential Haul Road
Option 1 (Pink line)	Existing Road/Track (Green line)
Option 2 (Cyan line)	New Haul Road (Yellow line)
Option 3 (Orange line)	
Quarry	Study Area
Reconnaissance (Blue outline)	SCH (Red outline)
Potential (Purple outline)	DAS (Green outline)
	Haul Road (Cyan outline)
	Quarry (Purple outline)
	Fresh Water Creek (Blue dot)

Aerial Image: CHS July 2016.
Locations approximate.

FISHERIES AND OCEANS CANADA GRISE FIORD HARBOUR DEVELOPMENT ENVIRONMENTAL AND SOCIO-ECONOMIC BASELINE SURVEY PROJECT COMPONENTS AND STUDY AREAS (QUARRY, HAUL ROAD, SMALL CRAFT HARBOUR, DISPOSAL AT SEA SITE)			
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		FIG No 4	B
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Legend

SCH Footprint	Potential Haul Road	Study Area
Option 1 (Pink line)	New Haul Road (Yellow line)	SCH (Red outline)
Option 2 (Cyan line)	Quarry (Purple outline)	DAS (Green outline)
Option 3 (Orange line)	Potential (Magenta outline)	Haul Road (Cyan outline)
		Quarry (Purple outline)

Aerial Image: CHS August 2016; Bing
Locations approximate.

FISHERIES AND OCEANS CANADA
RESOLUTE BAY HARBOUR DEVELOPMENT
ENVIRONMENTAL AND SOCIO-ECONOMIC BASELINE SURVEY
PROJECT COMPONENTS AND STUDY AREAS (QUARRY, SMALL CRAFT HARBOUR, HAUL ROAD, DISPOSAL AT SEA SITE)

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FIG No. 5			

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