

▷⁵ḅ_ḥ▷^ḥḤ^c: 613-520-2600x1984, ḥḅḥ^bḍ^c:

Operations Phase: from 2023-07-04 to 2027-12-31

$$\Lambda \subset \mathbb{N} \triangleleft \mathbb{N} \xrightarrow{\sigma} \mathbb{N} \triangleleft \mathbb{N}^{\mathbb{N}} \supset \mathbb{C}$$

A	B	C	D	E	F
Ellesmere ice shelf, ice tongue, glacier, and fjord research area	Researching	Crown	Site of our ongoing research into fjord dynamics and ice shelf stability. We wish to amend our project to allow sediment coring/sampling in the fjord and sampling benthic organisms.	N/A	600 km to Grise Fiord, within the Tuvaqjuittuq Marine Protected Area

[illegible]

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ᐋᐅᓯᐃᑦᖆ	Joseph Shoapik	(Team member July 2022 Ellesmere Island)	2022-07-01
ᐋᐅᓯᐃᑦᖆ	Laisa Audlaluk-Watsko (met with team member Anna Crawford)	Nauttiguqtiit Guardians	2022-10-31
ᐋᐅᓯᐃᑦᖆ	Susie Qaunaq	Iviq HTA	2023-04-21
ᐋᐅᓯᐃᑦᖆ	Marty Kuluguqtuq	Hamlet	2023-04-21
ᖆᕐᐅᓯᐃᑦᖆ ᓱᕕᓴᑦ	Nancy Amaruilk	HTA	2023-04-21
ᖆᕐᐅᓯᐃᑦᖆ ᓱᕕᓴᑦ	SAO	Hamlet	2023-04-21
ᐋᐅᓯᐃᑦᖆ	Community meeting (~25 people attended) where we mentioned our interest in sampling and found there was support to continue to study this environment	Hamlet	2019-06-26
ᖆᕐᐅᓯᐃᑦᖆ ᓱᕕᓴᑦ	Community meeting (~8 people attended) where we mentioned our interest in doing this sampling and found there was support to continue our work	At South Camp Inn	2019-06-30

[illegible]

$a^b r^c \sigma^d \wedge c^e d^f \delta^g \sigma^h \gamma^i \gamma^j \gamma^k$

Transboundary

North Baffin

South Baffin

[illegible]

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Project transportation types

Transportation Type	ᐱᓕᐸ ᐃᑲᐅᐳᓂᐱᔭᐸ	Length of Use
Air	Some sites will be accessed by Twin Otter or by helicopter	
Water		
Land	Some sites can be accessed on foot, crossing land or glaciers	

Project accomodation types

Temporary Camp

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Ice auger	1-3	2 to 8 diameter	drilling holes in ice
Ice corer	1	5	taking short ice cores
ice-penetrating radar	3	50 cm x 50 cm	Measures ice thickness
Tracking beacons	2-5 per year	40 cm x 40 cm	Tracking the position of drifting ice
Ablation stakes	2-5 per year	3 m x 3 cm	Stakes positioned in the ice to measure melt
Uninhabited aerial vehicle (UAV)	1-2	50 cm diam	Mapping of ice features via stereo photography
Remotely operated vehicle (ROV)	1	60 cm x 80 cm	Mapping and measuring water properties under ice
Hole melter	1	1.5 x 1 x 1 m	Melting access holes through ice for instruments
Current meter/profiler	1-3	50 cm x 30 cm	Measure water currents
Temperature data loggers	10-20	1 x 10 cm	Measure temperature in water and ice
Conductivity-Temperature-Depth (CTD) datalogger/profiler	2-4	40 cm x 5 cm	Measure water properties
Helicopter	1	15 m x 5 m x 3 m	Transport
Twin Otter	1	20 x 20 x 10 m	Transport
Snowmobile	0-2	1 x 2 m x 80 cm	Transport (at times)
Icebreaker/ship	1	100 m	Transport to field site
Generator	1-2	30 x 50 x 20 cm	Power generation
Kemmerer Bottle	1-2	50 cm x 10 cm	Water sampling
Small boats/launches	1	10 m	Accessing ice islands or icebergs and surveying
Seismometer	4-6	20 x 20 x 20 cm	Record ice movement
Sediment corer	1	2 m x 0.5 m x 0.5 m	To core sediment at the bottom of the fiord (ocean floor)
Sediment traps	5	40 x 10 cm	Collects falling sediment in the ocean (attached to a mooring line)
Automatic weather stations	6-8	2-3 m tall	Measure temperature, wind, solar radiation, ice melt/snow fall
SmartBUOY	2	3 m long	Measures sea ice temperature and thickness (installed by

			SmartICE)
SmartQamutik	1	2 m	Measures sea ice thickness (surveys by SmartICE) when towed behind a skidoo
Timelapse cameras	6-10	1 m x 2 m	Cameras on a tripod that take images on a regular interval in Milne Fiord and Admiralty Inlet. Some will be mounted on weather stations.
GNSS receivers	8-10	1 m x 50 cm x 50 cm	Global Navigational Satellite System receivers (base stations on land and rovers on ice). Accurate positioning and ice motion measurements (both Milne Fiord and Admiralty Inlet)
Tide gauges	4-6	3 x 3 cm	A small pressure recorder that lies in shallow water near the shore to monitor tides

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Propane	fuel	3	20	60	Liters	Cooking/heating
Gasoline	fuel	3	25	75	Liters	Generator/snowmobiles
hazardous	hazardous	10	0.25	2.5	Liters	Powering UAVs, tracking beacons and some other instruments
Formalin (5%)	hazardous	1	1	1	Liters	Mixed with hypersaline water. 100 mL used as a preservative at the bottom of sediment traps to prevent organic matter from decaying. (5 sediment traps)
Aviation fuel	fuel	18	200	3600	Liters	Helicopter cache (Ellesmere Is)
Lithium batteries	hazardous	15	1	15	Kg	Powering equipment, tracking beacons and instruments
Diesel	fuel	1	200	200	Liters	Ice melting/power

$\triangleleft^b C d^c$
$$\Delta^b C j_c \sim \sigma \Delta^q \sigma^q$$

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Researching	ᐆᑦᑐᑦ ᐁᐋᑕᐇᐈᒻᓗᐨᐊᑦ	1 kg per day	removal from site	incineration in nearest community
Camp	ᐁᐸᐸᑦ ᐁᑦᐈᑕᐈᔭᓚᐸᐿᐴᑦ	up to 25 L per day	pour in sump away from lakes and streams; dispose of on ice so that it drains into the ocean	N/A
Researching	ᐆᑦᑐᑦ ᐁᐋᑕᐇᐈᒻᓗᐨᐊᑦ	1 kg per day	removal from site	disposal in nearest community
Camp	ᐹᐸᑕᑕᑦᓚᑦ	4 kg per day	removal from site	disposal or incineration in nearest community

$\Delta \rho_{\Gamma D C}^{\pm c} \quad \Delta b_{D C}^{c b} C D L R^c$

See the text box on the previous page for details (I had more than 1500 characters of text)

Additional Information

SECTION A1: Project Info

SECTION A2: Allweather Road

SECTION A3: Winter Road

SECTION B1: Project Info

SECTION B2: Exploration Activity

SECTION B3: Geosciences

SECTION B4: Drilling

SECTION B5: Stripping

SECTION B6: Underground Activity

SECTION B7: Waste Rock

SECTION B8: Stockpiles

SECTION B9: Mine Development

SECTION B10: Geology

SECTION B11: Mine

SECTION B12: Mill

SECTION C1: Pits

SECTION D1: Facility

SECTION D2: Facility Construction

SECTION D3: Facility Operation

SECTION D4: Vessel Use

SECTION E1: Offshore Survey

SECTION E2: Nearshore Survey

SECTION E3: Vessel Use

SECTION F1: Site Cleanup

SECTION G1: Well Authorization

SECTION G2: Onland Exploration

SECTION G3: Offshore Exploration

SECTION G4: Rig

SECTION H1: Vessel Use

SECTION H2: Disposal At Sea

SECTION 11: Municipal Development

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Milne Fiord is 35 km long, 5 to 10 km wide and has a maximum depth of just over 440 m. At the mouth of the fjord there is a large ice shelf. This very thick (up to 90 m, 50 m on average) landfast ice occupies much of the northern portion of the fjord and is about 120 km² in area. It was nearly 200 km² until a major break-up event in 2020. Within the fjord, behind the ice shelf, the ice is only 1-2 m thick and floats on a relatively fresh layer of water. This freshwater layer used to be considered an 'epishelf' lake but after 2020 it thinned considerably. A glacier flows into the fjord from the south and this ends in a floating ice tongue which is about 15 km long. The coastal area is within the Tuvaļjuittuq Marine Protected Area (MPA). The fjords and the ice shelves of northern Ellesmere Island are considered to be ecologically significant components of the MPA.

[illegible]

The northern coast of Ellesmere Island has very little wildlife. From time to time we see wolf, fox, hare, ptarmigan and ivory gull. We have only seen a seal once. The fjord waters provide habitats for plankton (both marine and freshwater). In 2017 we discovered an interesting habitat within the ice shelf under a thin section of the ice. A horizontal bench of ice with sediment on its surface was covered with scallops, worms, soft corals, brittle stars and sea anemones. We are not sure that this benthic (sea bottom) ecosystem exists anymore since our study site broke away in 2020.

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Our study site is far from Grise Fiord and Resolute Bay and is seldom visited. Some adventure tourists do visit nearby Quttinirpaaq Park (only a few a year). We have brought people from Grise Fiord and Resolute to Milne Fiord in the past and plan on doing so in the future.

Miscellaneous Project Information

$\Delta^{\text{fb}} \text{CD} \sigma^{\text{fc}}$ $\Delta^{\text{b}} \text{fb} \text{CD} \Gamma_L \Gamma_C$ $\text{fb} \Delta^{\text{c}} \sigma^{\text{fc}}$ $\langle \epsilon_D \Gamma' \rangle \Gamma^{\text{fb}} \text{CD} \sigma^{\text{d}} \sigma^{\text{fc}}$

Our activities take place within the Tuvaijuittuq Marine Protected Area, but we will mitigate our impacts (NM). 1) Sediment coring. [See conformity in NPC 149813]. Sediment coring at the bottom of the fjord (NM) will remove a small quantity of sediment and disturb the sediment in where we are coring. We propose to take 2-5 cores of sediment per year from the bottom of Milne Fiord over the next few years. This involves lowering a tube through the water, into the mud at the bottom of the fjord and pulling it

up. This will disturb the sediment and will temporarily cloud the water. It will affect an area of about 15 x 15 cm per core. Mitigation: We will be as careful as possible to recover good cores so we don't need to needlessly repeat the coring. We will also keep our coring activities to the minimum required to do our work. 2) Sediment traps. We seek permission to put a small amount of preservative at the bottom of sediment traps that we will keep on our oceanographic moorings to prevent organic matter from rotting. These collect sediment and algae that fall through the water column and the preservative will ensure that it remains until we can retrieve it in the following summer. The preservative is toxic in high concentrations (NM). Mitigation: We will mix the small amount of preservative we need with very salty water and place this in the sediment trap before lowering it into the water. The dense salty water will keep it at the bottom of the trap so it does not go into the environment. 3) Sampling benthic organisms. I am requesting permission to sample benthic organisms with the gripper arm of our Remotely Operated Vehicle including a total of ≤ 40 adult scallops, ≤ 10 adult brittle stars, ≤ 10 adult anemones, ≤ 10 adult worms, ≤ 10 adult sponges, ≤ 10 adult sea cucumbers, ≤ 10 adult soft coral, ≤ 10 adult hydrozoa, ≤ 20 worms tubes over the next few years. To our knowledge none of these species are endangered although their habitat on ice is unusual. Mitigation: We will only sample organisms if they are abundant (we will sample only less than 5% of the population and take photos of the rest). We will be careful not to disturb other organisms when we are doing this sampling. 4) Employment. We plan to hire field team members from Grise Fiord and this has a positive economic benefit, plus we get to work with great people!

Cumulative Effects

Given our small footprint at the site and the mitigation efforts detailed above, there should be no significant cumulative effects.

Impacts

$\mathcal{L}(\mathcal{A}) \cap \mathcal{L}(\mathcal{B}) = \mathcal{L}(\mathcal{A} \cap \mathcal{B})$

Physical																
Designated environmental areas																
Ground stability																
Permafrost																
Hydrology / Limnology																
Water quality																
Climate conditions																
Eskers and other unique or fragile landscapes																
Surface and bedrock geology																
Sediment and soil quality																
Tidal processes and bathymetry																
Air quality																
Noise levels																
Biological																
Vegetation																
Wildlife, including habitat and migration patterns																
Birds, including habitat and migration patterns																
Aquatic species, incl. habitat and migration/spawning																
Wildlife protected areas																
Socio-Economic																
Archaeological and cultural historic sites																
Employment																
Community wellness																
Community infrastructure																
Human health																

[illegible]

1	polygon	Ice island, iceberg and landfast ice research area [offshore areas only]
2	polygon	Ellesmere ice shelf, ice tongue, glacier, and fjord research area

