



Keewatin Glacial Dynamics – Additional information

Fieldwork July 28th-August 13th, 2023

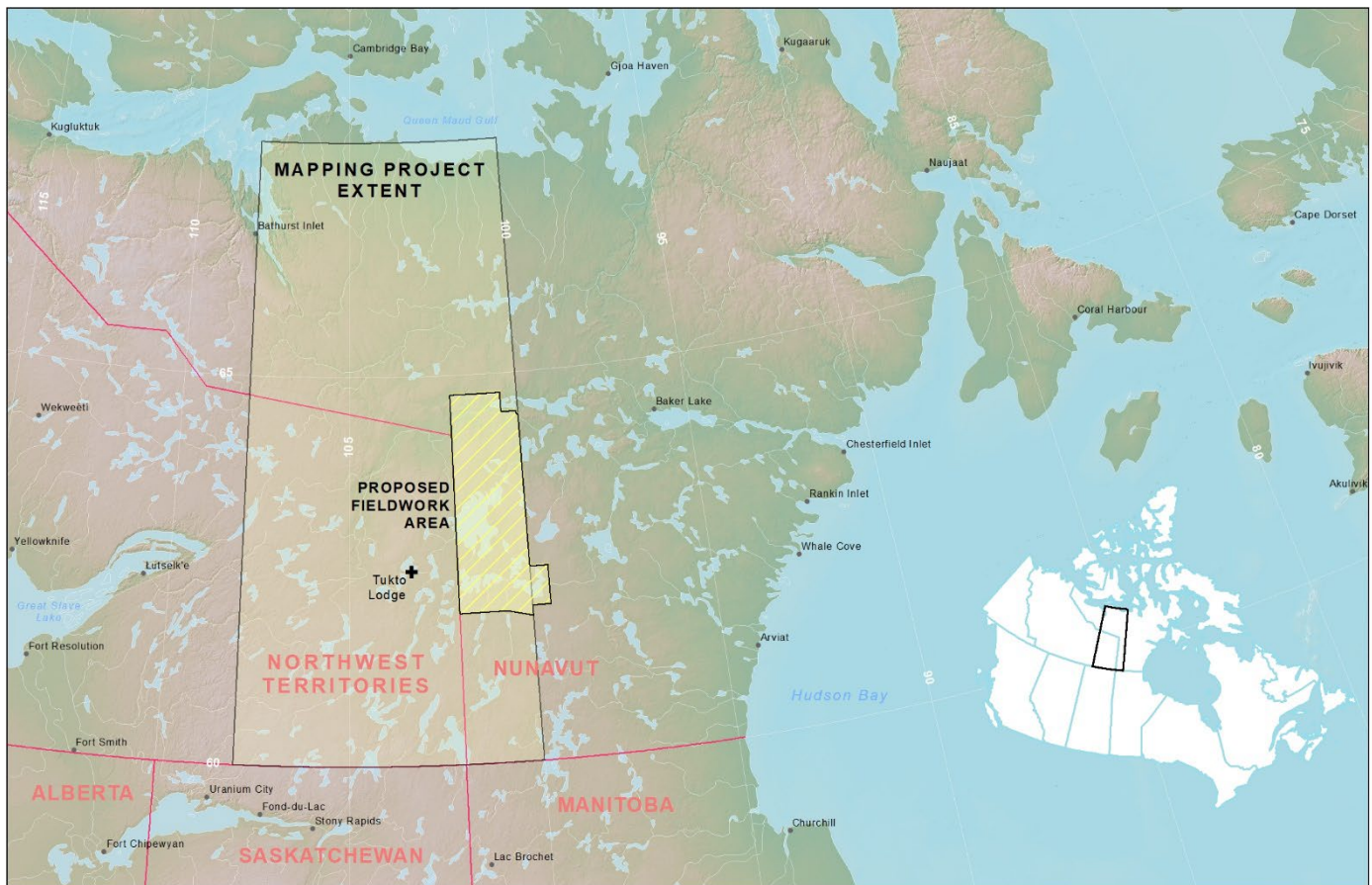


Figure 1. Extent of the “Synthesis of the glacial dynamics of the Laurentide Ice Sheet in the west-central Keewatin” mapping project in Nunavut and Northwest Territories, and location of the proposed fieldwork area for the 2023 summer (yellow hatch).

1. Introduction

The landscapes we see today in northern Canada are a product of what happened during and since ancient glaciations. Whether it is the land, the forests or the animals, everything evolved with the rhythm of growth and decay of the ice sheets. It is therefore important to understand the history of these glaciation and deglaciation cycles to provide a context for studies on climate change, archeology, geology, ecology, etc. Much is known about these glaciations in the south, but in northern Canada, extensive regions remain poorly studied because of their remoteness and hence knowledge there is limited. Therefore, the Geological Survey of Canada initiated in 2022 a 4-year research project to compile and understand the history of ancient glaciations in mainland Nunavut and Northwest Territories (**Fig. 1**). The project titled “Synthesis of the glacial dynamics of the Laurentide Ice Sheet in the west-central Keewatin” and led by GSC researchers Janet Campbell and Etienne Brouard, aims to provide the age of the glacial terrains and the composition of materials that lay over bedrock. The project also aims to map the glacial landforms using satellite imagery

and to model glacial history using new and published data. This knowledge will help to show how sediments were transported by ice and help trace how glaciers disappeared.

2. Location and schedule of activities

This proposed four-year activity will produce a comprehensive framework of the glacial/deglacial history of the west-central region of the Laurentide Ice Sheet. High-resolution satellite imagery products (ArcticDEM/Landsat) were mosaicked and compiled, and legacy datasets were integrated in a georeferenced (GIS) dataset during the GEM-GeoNorth foundational year (2021-22). The geodatabase and other products form the basis for the remote mapping of glacial landforms and in the identification of glacial landsystems. Two seasons of targeted fieldwork (2023 and 2024) will fill in identified knowledge gaps and validate the remote geomorphic mapping. Specifically, the targeted fieldwork will 1) document and sample for till composition to support characterisation of terrains and regional glacial



transport patterns, 2) test for potential of inheritance in relict terrains and for minimal timing of ice-free conditions following the retreat of the ice sheet using terrestrial cosmogenic nuclide (TCN) dating techniques, and 3) record ice-flow indicators for interpretation of the regional ice-flow chronology. Radiocarbon dating of organic material from peat deposits, wood and/or marine shells or by optically-stimulated/infrared-stimulated luminescence (OSL/IRSL) dating of various sandy deposits will also be used when possible to increase the overall resolution of the regional ice history.

The proposed 2023 fieldwork area is located in the Kivalliq region and therefore activities focussed on consultation and co-development with Inuit organizations (Bake Laker and Arviat) were held during the week of March 11th to March 18th 2023 to present the proposed activity, to assess interest and to discuss community priorities and concerns. Bilingual (English – Inuktitut) presentations were delivered in Baker Lake to the Hamlet Office as well the Hunters and Trappers Organization on March 13, 2023. The same presentation was given on March 16th to the Hunters and Trappers Organization in Arviat. These presentations and related discussions in both Baker Lake and Arviat were effective in gaining insights into the interest related to geoscience in our glacial geology project. The project lead also met with Luis Manzo, KIA in Rankin Inlet to discuss the proposed field activities.

To provide the data for the study, two 2.5-weeks fieldwork seasons have been planned: one from July 27th to August 13th, 2023, and one in 2024. The field work is planned for after the caribou calving season is finished to minimise stress on the animals. Field work will be followed by analytical, compilation and publication work in Ottawa. All data will be published in geodatabase and shapefile formats and will be available in future on NRCan open geoscience portal. Results will be shared with affected communities digitally, in print form, and by in-person sharing sessions upon request.

3. Physical Environment

The proposed fieldwork area extends over ~32,245 km² from 102°W to 99.5°W and from 61.86°N to 64.75°N (Fig. 2). The area encompasses 2 physiographic divisions of the Kazan physiographic region of the Canadian Shield: The Thelon Lowlands and the Kazan Uplands. The Thelon plain is characterized by the large river valley in which the Thelon River flows. This valley is characterized by relatively flat terrain laying at low elevations (80-350 m). The Kazan uplands are in turn characterized by more rugged hilly terrain at elevations ranging from ~200 to ~400 m, and hosts large lakes such as Dubawnt Lake, Angikuni Lake and Kamilukuak Lake.

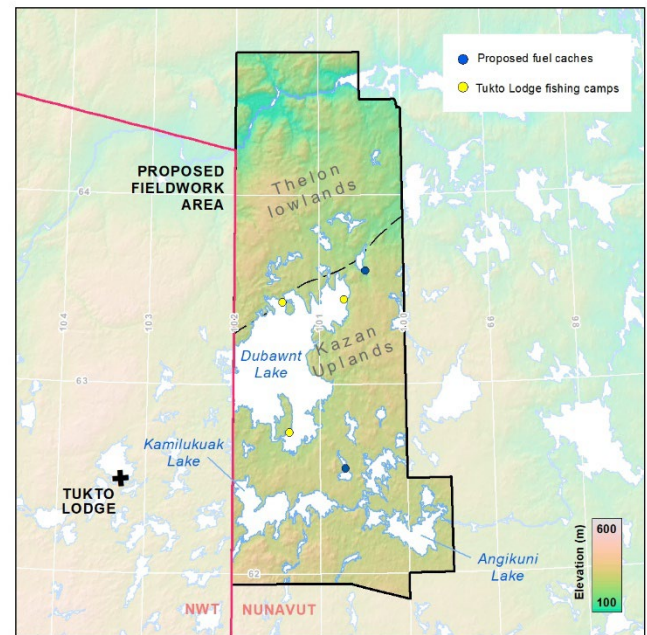


Figure 2. Physiography of the proposed fieldwork area.

The physiography of the region is in part reflecting the general bedrock geology (sedimentary rocks of the Thelon Basin vs. crystalline rock of the Rae Craton (Fig. 3) and the differential erosion by glaciers during the glaciation cycles (Batchelor et al., 2019). The ancient glaciations left a record of different landforms and landscapes that include eskers, moraines, raised beaches which are reported on the Glacial Map of Canada (Prest et al., 1968) and on the available surficial geology maps (Geological Survey of Canada, 2017a, b, c, d, 2019) (Figs. 4-5). These maps show that the fieldwork area is mostly covered by glacial sediments (till and glaciofluvial sediments) and glacio-lacustrine sediments.

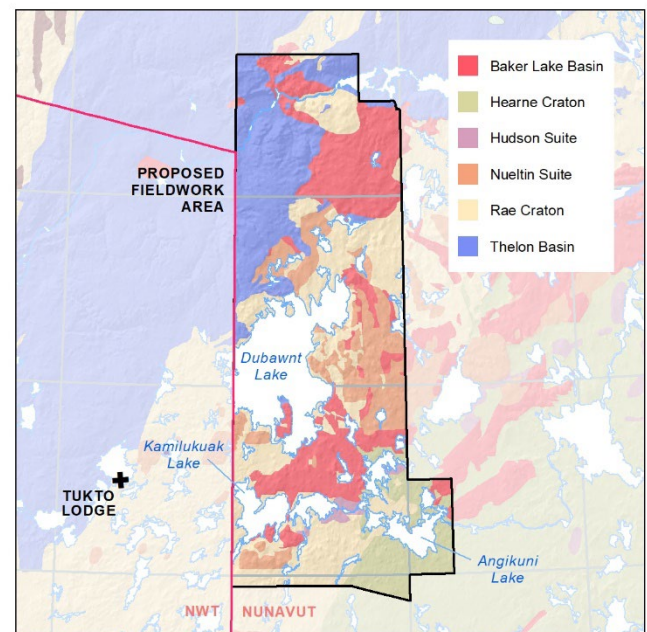


Figure 3. Geology of the proposed fieldwork area.

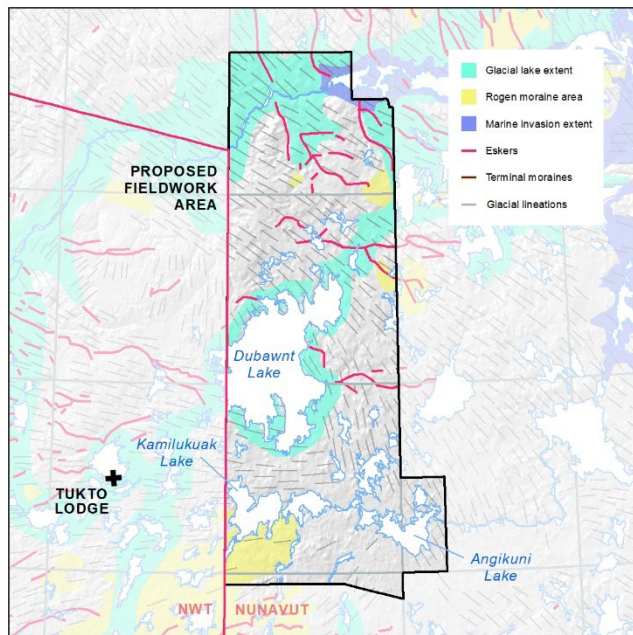


Figure 4. Principal glacial features in the proposed fieldwork area

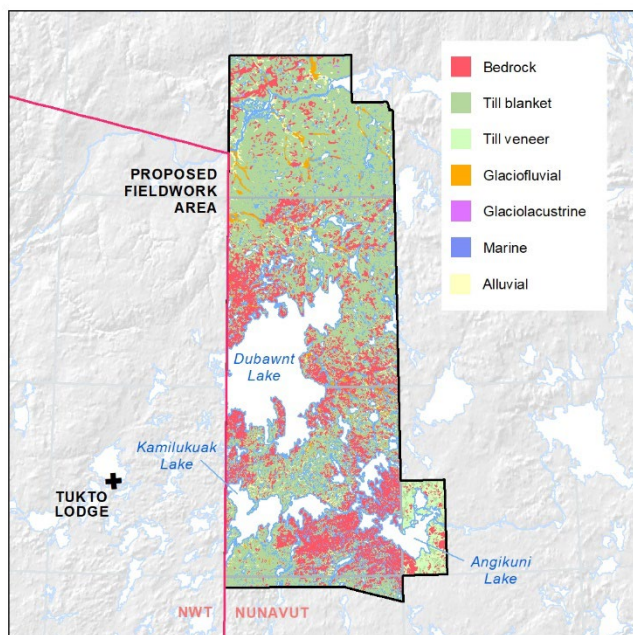


Figure 5. Surface geology of the proposed fieldwork area

The southern part of the region is mostly characterized by continuous permafrost with medium to low ground ice, while the northern part shows continuous permafrost with low ground ice content (Fig. 6). Usually continuous permafrost is associated with features including wedge-shaped polygons, ice lenses, thermokarsts, etc., but none is reported on the surficial geology maps.

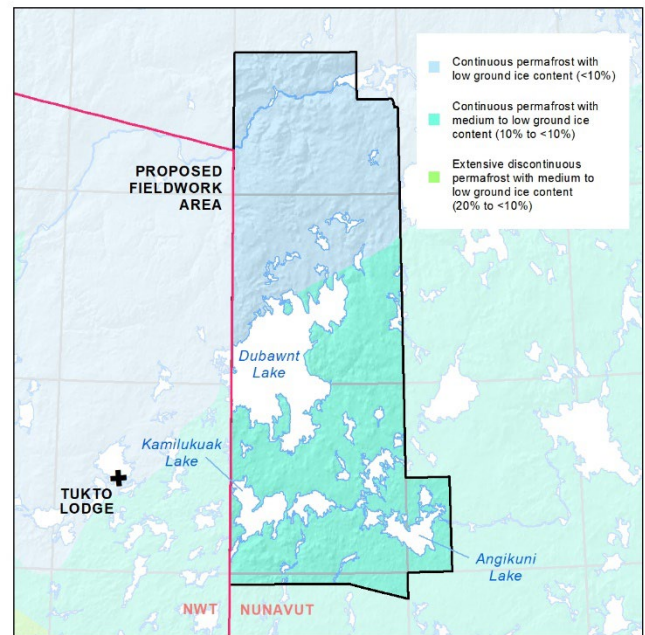


Figure 6. Zones of permafrost in the proposed fieldwork area

4. Biological Environment

The proposed fieldwork area is characterized by a vegetation comprising subarctic woodland-tundra, low arctic shrub tundra and mid-arctic dwarf shrub tundra (Baldwin et al., 2020) (Fig. 7). Subarctic woodland-tundra covers the south of the proposed fieldwork area and Thelon valley. It forms a mosaic of shrub tundra, scattered patches of woodland, and exposed soil and rock. Extensive wetlands and numerous small water bodies occupy much of the general landscape. Low arctic shrub tundra covers most of the study area and forms a mosaic of patchy to continuous low vegetation and exposed soil and rock. Extensive wetlands and numerous small water bodies are common throughout this zone. Mid-arctic dwarf shrub tundra covers a small area in the northeastern part of the study area. This area is characterized by mosaic of patchy to continuous prostrate vegetation and exposed soil and rock.

The northern part of the proposed fieldwork area overlaps with the Thelon Wildlife Sanctuary (TWS) which was created in 1927 to protect Muskox (Fig. 8). The area is a key wildlife area for a variety of wildlife including the barren-ground caribou. The migrating route and calving grounds of the different caribou herds, i.e., Ahiak, Bathurst, Beverly, Quamanirjuaq and Wager Bay overlap with the proposed fieldwork area (Environment and Climate Change Canada,



2021).

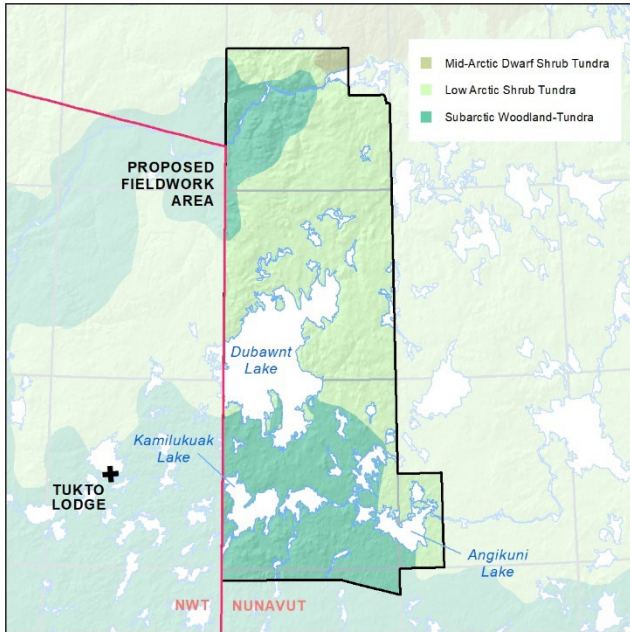


Figure 7. Vegetation zones in the proposed fieldwork area

The proposed project also takes place within habitats for many other far-ranging wildlife species such as muskox, wolves, wolverine, arctic hare, arctic fox, grizzly bears, and migratory and non-migratory birds. The range of certain terrestrial species at risk in Nunavut, listed on Schedule 1 of the federal Species at Risk Act (SARA) overlaps with the proposed area. These include Barren-ground Caribou (Napaaqtuqangituqmiut Tutungit; **Fig. 8**), Grizzly Bear (Akłait; **Fig. 9**) and Wolverine (Qavvik; **Fig. 10**). The proposed fieldwork area also overlaps with the range of different bird species also listed as Species at risk: Peregrine Falcon (Kiggaviarjuk or Kigavik; **Fig. 11**), Red-necked Phalarope (Aupaluktuq Saurraq or Aupaqtuq Saarvaq; **Fig. 12**), Rusty Blackbird (Kajuangajuq Qiqniqtaq Qupanuaq; **Fig. 13**) and the Short-eared Owl (Siutikituq Ukpik; **Fig. 14**) (Environment and Climate Change Canada, 2021).

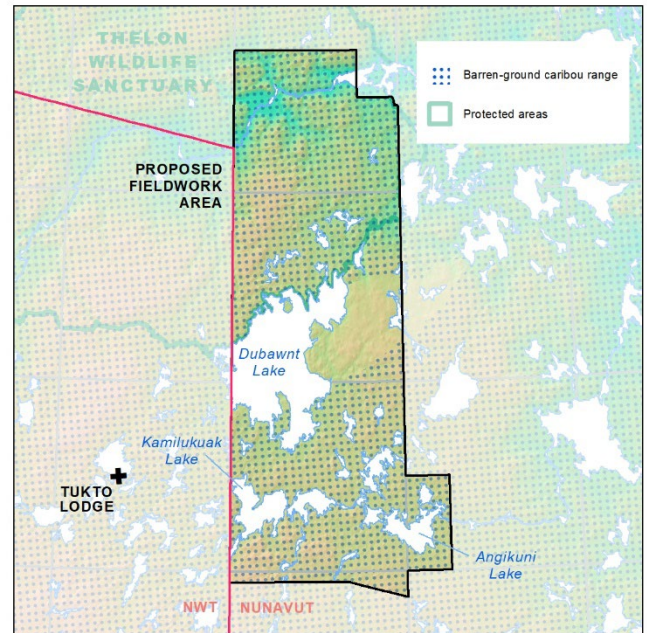


Figure 8. Range of the barren-ground caribou in the proposed fieldwork area

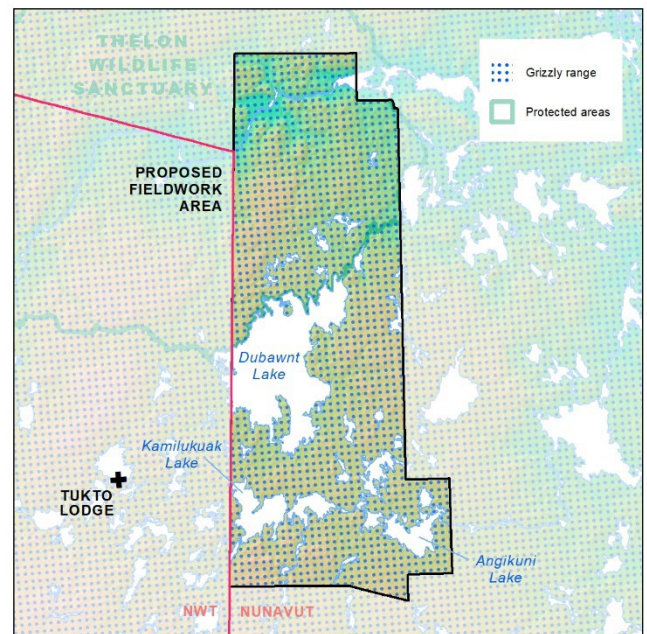


Figure 9. Range of the grizzly in the proposed fieldwork area

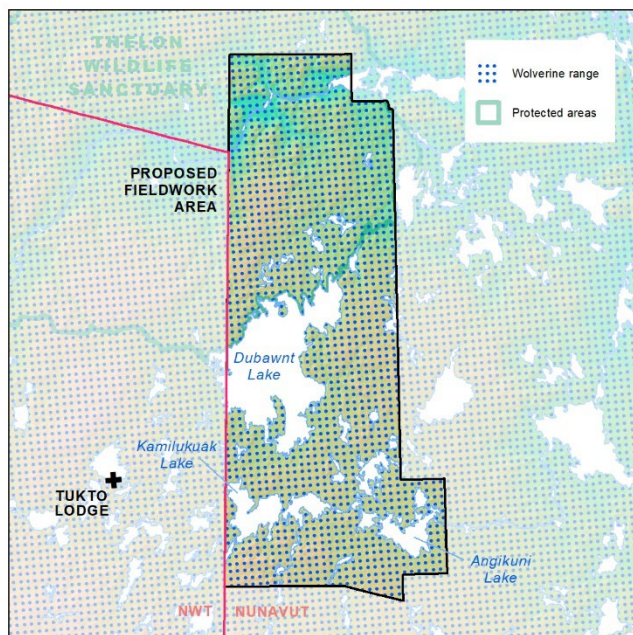


Figure 10. Range of the wolverine in the proposed fieldwork area

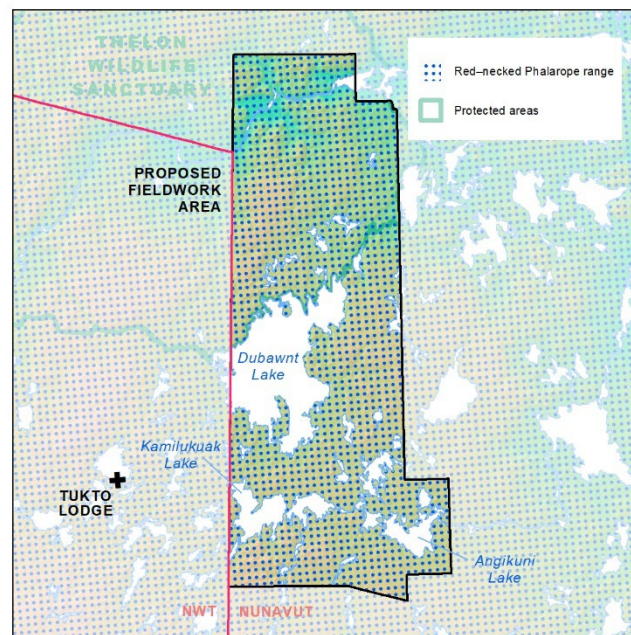


Figure 12. Range of the red-necked phalarope in the proposed fieldwork area

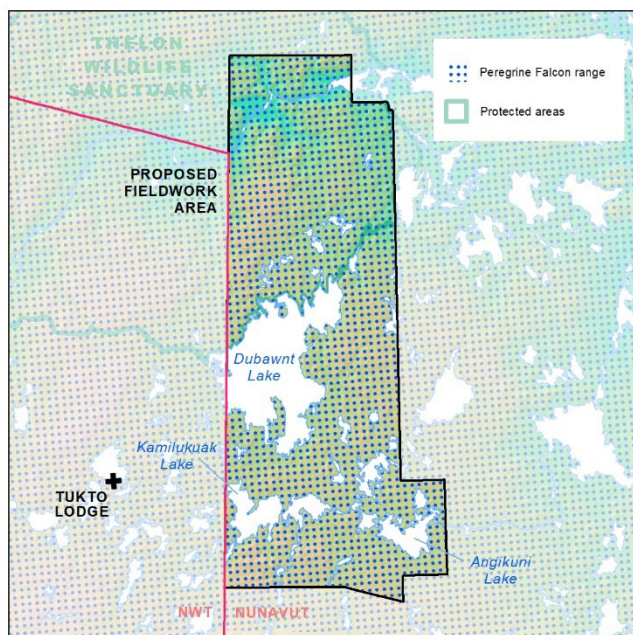


Figure 11. Range of the peregrine falcon in the proposed fieldwork area

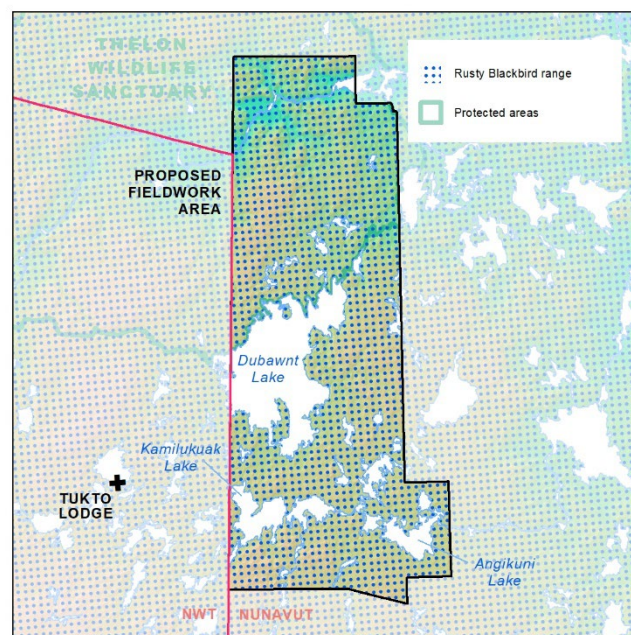


Figure 13. Range of the rusty songbird in the proposed fieldwork area

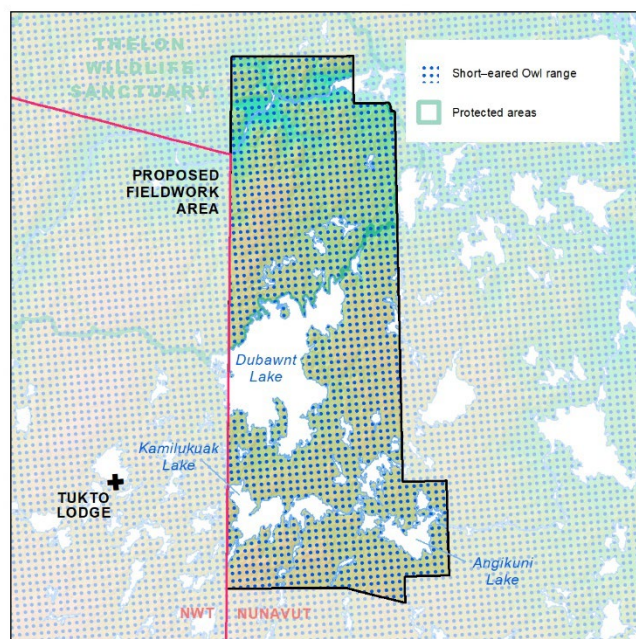


Figure 14. Range of the short-eared owl in the proposed fieldwork area

5. Socioeconomic Environment

Our proposed work is on NU Crown lands and overlaps with the Thelon Wildlife Sanctuary. The nearest Inuit Owned Lands belong to the communities of Baker Lake (200 km) and Arviat (300 km). Three temporary fishing outposts belonging to/operated by Tukto Lodge are located around Dubawnt Lake (**Fig. 1**). The northwestern camp may have a dock that make it easy to cache fuel using a floatplane. Hence, this camp may be used to cache fuel for our activity. We have been in contact with the Territorial Archaeologist and have filled a Site Data Request Form to obtain the position of known archeological site within our proposed field area. We are waiting to get the positions.

6. Preliminary plan

The area of interest extends along the NWT border, southwest of Baker Lake, stretching from the east part of the Thelon Wildlife Sanctuary to north of Ennadai Lake (**Fig. 1**). The field work will be however be based outside the study area, out of Tukto Lodge, Mosquito Lake, NWT, which is the closest accommodation to the field area. The field crew will arrive at Tukto Lodge on July 26th by floatplane and the helicopter crew will arrive on the 27th. On the 28th, fieldwork in Nunavut will begin and with the entire crew returning to the lodge in Northwest Territories at the end of each day. The helicopter will therefore be stationed and primarily refueling at the lodge.

7. Description of undertaking and equipment

To access sites on the ground, the helicopter will depart from Tukto Lodge, fly high (>1,000 ft) to avoid disturbance to

wildlife and then land at pre-determined sites of interest for glacial geology. Field work at each site will involve making observations, collecting GPS locations and hand-held compass measurements, taking photographs, and collecting samples of surface earth materials. Small soil samples will be collected with a hand shovel and small bedrock samples from will be taken using a small rock saw. The soil sample holes (≤ 1 m depth) will be filled in before leaving the sites. No camps, buildings, ditches, trenches, dams, roads or other structures will be constructed. Field data will be downloaded daily from handheld computers into a geospatial database.

Report of the field work in English and Inuktitut will be prepared and released in Fall 2023.

7.1 Equipment

7.1.1 Helicopter

One Astar 350B2 helicopter will be used daily to access field sites. Exterior Height: 10 ft 4 in Wing Span: 35 ft 1 in Length: 35 ft 11 in diameter

7.1.2 Shovels

Three (3) 1-meter shovels will be use daily to dig holes to take soil samples.

7.1.3 Battery-powered rocksaw

One battery-powered rocksaw will be used daily to collect bedrock or boulder samples.

7.1.4 Hammers

Three (3) 12-inches hammers will be used daily to collect bedrock or boulder samples.

7.1.5 Chisels

Three (3) 12-inches chisels will be used daily to collect bedrock or boulder samples.

7.1.6 Compasses

Four (4) compasses will be used daily to collect orientation of ice movement indicators.

7.1.7 Field tablet

One 12-inches field tablet will be used daily to collect data and navigate.

7.1.8 Digital cameras

Two (2) digital cameras will be used daily to take pictures of landscapes and samples.



7.2 Detailed daily routine:

- › At lodge : Mobilization of field equipment for the day. Print daily map and timeline with itinerary/route for lodge officer. Print map for helicopter pilot. Discuss daily plan (stations, sampling, responsibilities, safety) with the team.
- › In helicopter : Regulations for helicopter flying requires that the helicopter pilot cannot work more than no more than 10hrs daily, no more than 60h per week and have one day off for every 6 days of works. With a maintenance of about 2hrs each day this leaves about 8 hours of work/flying out of the pilot daily maximum hours. Fly >1,000 ft high in between waypoint/stations.
- › Arriving at station: Make sure there is no wildlife near the field stations.
- › At site : If helicopter has to go to refuel, will leave drop-pack and communication devices with ground team. Record field station in tablet. Take photos of environment. Record position from handheld GPS in the field notebook. Take photos of features, lakes, team members working, helicopter or anything that could be useful for publications and presentations. In personal field notebook, take note of anything found useful.
- › Soil sampling : Take a 3-kg and a 10-kg till sample from a hand-dug $\leq 1\text{m}$ -deep pit in a mud boil if possible (see McClenaghan et al., 2020 for till sampling protocols). Record sediment characteristics and sample information in field tablet. Label the bags accordingly. Take a photo of hole and sample bags with labeling. Fill the sample hole in.
- › Bedrock sampling: Take 3 to 5 hand-sized bedrock samples for age dating if possible - Record individual samples in field tablet. Label the bags accordingly. Take a photo of bedrock before, during and after sampling, and of sample bag with labeling.
- › Boulder sampling: Take 3 to 5 hand-sized boulder samples for age dating if possible. Record individual samples in field tablet. Label the bags accordingly. Take a photo of boulder before, during and after sampling, and of sample bag with labeling.
- › Luminescence sampling : Take 5 12-inches sand samples for age dating if possible. Record individual samples in field tablet. Label the tubes accordingly. Take a photo of sand before, during and after sampling, and of sample tube with labeling.
- › Ice-flow indicator measurement : Measure striae orientation measurements and record in field tablet. Take photos of outcrop and of striae with a pen and a compass.
- › Leaving site: Gather samples in the helicopter. Discuss with pilot next site. Take off to next site.

- › Back to the lodge: Helicopter lands at the lodge. Daily demobilization of equipment. Upload data from the day. Plan field sites and flight plan for next day.

8. Fuel

Three fuel caches will be established for the fieldwork. The main fuel cache will be at Tukto Lodge and will have a maximum of 18 barrels (< 4,000 L) at any one time. The fuel will be stored in neat orderly rows in berms with enough space in between rows to permit inspection. Bungs will face 12 o'clock (up) to minimize any leakage, in the unlikely event a seal breaks. Spill kits will be available at the Tukto Lodge.

To ensure safe operations in the event of weather emergency situations or extend fly distances, there will also be 2 small fuel caches of 5-7 sealed drums located outside of the Thelon Wildlife Sanctuary. One cache is proposed to be at 63.596°N/100.444°W, with a second cache proposed at 62.555°N/100.709°W (**Fig. 2**). The northern cache could be placed at 62.43°N/101.43°W if it is a more suitable/easier accessible location. The drums will be placed at least 31m from any watercourse or lake on dry sediments. Once the fuel caches will be established, we will notify the CIRNAC engineer within 30 days of establishing the cache. All fuel caches will be removed at the end of the fieldwork in August 2023.

8.1 Spill Procedure

In the case of any spill or other environmental emergency, it is necessary to react in the most immediate safe and environmentally responsible manner. No spill or incident is so minor that it can be ignored and every spill must be reported.

The basic steps of the spill response plan are as follows:

1. Ensure the safety of all persons at all times.
2. Identify and find the spill substance and its source, and, if possible, stop the process or shut off the source.
3. Inform the on-site coordinator or his/her designate at once, so that he/she may take the appropriate actions. Appropriate action includes the notification of the spill to the 24-hour Spill Report Line and CIRNAC Water Resource Officer. A copy of the Spill Report form can be found in **Appendix I**.
4. Contain the spill or environmental hazard, as per its nature, and as per the advice of the Spill Line and CIRNAC Water Resources Officer as required.
5. Implement any necessary clean-up and/or remedial action.



8.2 Chain of command

1. Immediately notify and report the 24-hour Spill Report Line at (867) 920-8130, the CIRNAC Water Resource Officer at (867) 975-4550, and Kivalliq Inuit Association at (867) 645-5731.
2. A Spill Report Form (**Appendix 1**) is filled out as completely as possible before or after contacting the 24-hour Spill Report Line. A copy of the guidelines for completing the Spill Report form is found in **Appendix II**.
3. Notify Anishka Da Silva, GEM-GeoNorth Science Project Officer at (613) 447-1369.

8.3 Contacts for spill response/assistance and further reporting

Nunavut & NWT 24-hour Spill Report Line

(867) 920-8130

Water Resources Inspector for Crown-Indigenous Relations & Northern Affairs Canada (formerly INAC)

Iqaluit, NU

(867) 975-4550

24-hour pager (867) 766-3737

GN-Dept of Environment (DOE)

(867) 975-7700

Manager of Pollution Control and Air Quality

(867) 975-7748

Kivalliq Inuit Association, Lands Department

32-4 Sivulliq Avenue

340 Rankin Inlet, Nunavut XOC-0G0

Ph.: (867) 645-5731

Toll free 1-800-220-6581

FAX: (867) 645-2348

Michel Plouffe

GeoNorth Program Coordinator

Geological Survey of Canada, Natural Resources Canada

239-601 Booth St.

Ottawa, ON K1A 0E8

Telephone: (613) 218-4728

Nunavut Water Board, Head Office Gjoa Haven

(867) 360-6338

Fisheries and Oceans Canada, Habitat Impact Biologist

(867) 979-8007

Government of Nunavut Emergency Health information

(867) 975-5910

8.5 Spill Equipment

Spill kits will be at the Tukto Lodge and will be carried in the helicopter at all times. Spill kits consist of:

- › Heavy PVC tarp, impermeable to Jet A aviation and gasoline spills, sized in accordance with fuel containers (12'x14' for drums of Jet A, 4'x4' for plastic jerry cans, if used)
- › Aluminum stakes to secure impermeable tarp to ground
- › Particulate absorbent
- › Petroleum sorben pads
- › 2 pair PVC gloves
- › 2 pair safety goggles
- › Disposable bags
- › 1 shovel
- › Fire extinguisher

8.6 Spill Response Actions for Aviation Fuel

Take action only if safety permits. Stop the source flow if safe to do so and eliminate all ignition sources. Never smoke when dealing with these types of spills.

8.6.1 On Land

- › Build a containment berm using soil material or snow and place a plastic tarp at the foot of the berm for easy capture of the spill after all vapours have dissipated.
- › Remove the spill by using absorbent pads or excavating the soil, gravel or snow.
- › Remove spill splashed on vegetation using particulate absorbent material.
- › Contact regulatory agencies for approval before commencing with the removal of any soil, gravel or vegetation.

8.6.2 On Muskeg

- › Do not deploy personnel and equipment on marsh and vegetation.
- › Remove pooled gasoline or Jet A with sorbent pads and/or skimmer.
- › Flush with low pressure water to push toward collection point.
- › On advice from regulatory agencies, burn only in localized areas, e.g. trenches, piles or windrows.



- › Do not burn if root systems can be damaged (low water table).
- › Minimize damage caused by equipment and excavation.

8.6.3 On Water

- › Contain spill as close to release point as possible.
- › Use containment boom to capture spill for recovery after vapours have dissipated.
- › Use absorbent pads to capture smaller spills.
- › Use skimmer for larger spills.

8.6.4 On Snow and Ice

- › Build a containment berm around spill using snow.
- › Remove the spill using absorbent pads or particulate sorbent material/
- › The contaminated ice and snow must be scraped and shovelled into plastic buckets with lids, 205 litre drums, or polypropylene bags

8.6.5 Storage and Transfer

All contaminated water, ice, snow, soil and clean-up supplies will be stored in closed, labelled containers. All containers will be stored in a well-ventilated area away from incompatible materials.

8.6.6 Disposal

Any contaminated material will be shipped to an appropriate and approved disposal facility. The DOE monitors the movement of hazardous wastes from generators, carriers to receivers, through a tracking document (Waste Manifest). A waste manifest will accompany all movements.

9. Waste

Operations will be based from the Tukto Lodge, such that there are no foreseen waste issues related to sewage, greywater, food or garbage as the company operating the lodge will handle the disposal of all wastes. Any garbage produced during the field operations would be small (i.e., waste from a lunch or snack) and will be packed out of the site and returned to the lodge for proper disposal. All such wastes will be kept inaccessible to wildlife at all times

10. Environmental impacts and mitigation measures

10.1 Impacts on the physical environment

Impacts on the physical environment are likely to be localized, of low-magnitude, reversible and restricted to the short period of the proposed project activities, the cumulative effect will therefore be minimal. While we will be shoveling

small hole (and refilling them) and collecting small rock sample we believe that our work will provide baseline environmental data for surface and bedrock geology as well as sediment and soil quality, that will be available for decision making. In the same way, our work will report unique glacial landscapes that could be used to preserve sites of scientific/environmental value.

10.2 mitigation measures for impacts on the physical environment

To avoid any possible disturbance of lacustrine habitat and for safety reasons, we won't fly over the lakes.

Holes where samples will be taken will be filled back before leaving the sites.

The helicopter will fly high (> 1,000 ft) to keep noise levels low.

10.3 impacts on the biological environment

Impacts on the physical environment are likely to be localized, of low-magnitude, reversible and restricted to the short period of the proposed project activities, the cumulative effect will therefore also be minimal.

10.4 mitigation measures for impacts on the biological environment

The helicopter will fly high (> 1,000 ft) to keep noise levels low and to avoid disturbance of wildlife. If wildlife is present at a site of interest, the helicopter will not land and will go to the next planned site. If this occurs, planned sites will be revisited at a latter date if wildlife has left the area.

While on the ground, the crew will avoid disturbance of vegetation. The exception will be the immediate site of the sample hole.

The crew will avoid working in fragile environments (wetlands).

The crew will report sightings of species lists in section 3.

The crew will keep all garbage and debris in bags placed in a covered metal container or equivalent until disposed of at an approved facility. All such wastes shall be kept inaccessible to wildlife at all times

10.5 Impacts on the socioeconomic environment

Based on the remote character of the fieldwork/field area, there is no potential risks to health, safety or livelihoods of Nunavut residents, nor there is any anticipated short-term socio-economic impact. A field assistant or wildlife monitor from one of the communities is proposed if available. Our work will provide baseline environmental data for surface and bedrock geology as well as sediment and soil quality that could be used for decision-making on socioeconomic developments outside of protected areas.



10.6 mitigation measures for impacts on the socioeconomic environment

The results (baseline data) of our work will be published publicly and transmitted to governing bodies.

We will submit annual report for each fiscal year to the NRI/Nunavut Climate Change Centre (climatechange@gov.nu.ca).

12. Emergency Response Plan

The field team leader must perform pre-emergency planning tasks before undertaking any field activity in order to effectively coordinate on-site emergency response plans with employees, local emergency service providers and Natural Resources Canada. The team will be linked with 2-way radios, portable satellite phones and InReach Explorer+ devices to the helicopter. The team will carry one satellite phone at all times while in the field and will call the Tukto Lodge in case of emergency or in case of concerns while in the field (if the helicopter pilot cannot be reached or if the helicopter is down). Tukto Lodge can then radio the helicopter or start search and rescue protocols. If Tukto Lodge does not respond during an emergency, the team will contact the Expeditor (owner of Tukto Lodge) and/or the local RCMP. If no contact can be made, the team is instructed to push the SOS button on the InReach Explorer+ device. In all cases of an emergency or medical evacuation, the team will also contact the Director as soon as it is possible (see 12.7 for emergency contacts).

At all sites accessed by helicopter, the team is instructed to stay relatively close to the helicopter (visual contact) and to return back to the helicopter or advise the pilot in case of concerns or for an emergency. If the helicopter leaves the team in the field for refueling, the team will stay together at the drop-off site with the emergency drop-pack and all communication devices.

12.1 Search and rescue protocols

If crew has not returned within 2 hours of the scheduled return time and has not contacted the person in charge of the Tukto Lodge (owners or the employee) to advise a change in schedule, emergency procedures will be initiated. The Tukto Lodge will work in collaboration with the local RCMP, and the National Search and Rescue if search and rescue procedures are required. The team is to stay put and await rescue.

12.2 Medical evacuation procedures

If a medical evacuation is needed and the helicopter is down, the team is instructed to call the Tukto Lodge who will send a rescue team. Any medical evacuations will involve return of the injured persons to the Athabasca Health Facility in Stony Rapids by helicopter or floatplane. If required, they will be transferred to Saskatoon in the most expedient manner

depending on aircraft availability. After stabilization of injured person(s), the Director will be notified of the situation. If contact with the Director is not possible, communication will be made with ESS Emergency #.

12.3 Gathering area/places

Crew is staying at Tukto Lodge and will follow their emergency procedures.

12.4 Maps and routes of field team members

The crew will access and work in designated areas less than 260 km from the base camp (Tukto Lodge). The helicopter will also refuel as needed at 2 fuel caches located about 150-180 km from the lodge.

12.5 Planned workplaces inspections before and during fieldwork

Each accessed sampling/observation site will be accessed only once during about 1 hour and left with minimal disturbance.

12.6 Briefing on the safety of the planned workplaces before and during the fieldwork

The field party leader will discuss field operations and safety procedures with the team at the beginning of the field work. All crew members must read and sign the field checklist and will be reminded again of their obligation to follow the health and safety procedures prescribed by the LM Sector of the Natural Resources Canada upon their arrival in Tukto Lodge.

12.7 Emergency Contacts

Tukto Lodge / Wings over Kissinging

1 - 289 PTH 12 N

Steinbach Manitoba, R5G 1T8,
Canada

Phone: (204) 326-6369

Mailing address

P.O. Box 40

Stony Rapids SK S0J 2R0

Director

Geneviève Marquis

Central Division Director

Geol. Survey of Canada/Commission géologique du Canada

Land & Minerals Sector/Secteur des terres et minéraux

Natural Resources Canada

239-601 Booth Street, Ottawa, Ontario K1A 0E8

Phone: (343) 550-1198



Program Manager

Michel Plouffe

GEM-GeoNorth Program Manager

Geol. Survey of Canada/Commission géologique du Canada

Land & Minerals Sector/Secteur des terres et minéraux

Natural Resources Canada

239-601 Booth Street, Ottawa, Ontario K1A 0E8

michel.plouffe@NRCan-RNCan.gc.ca

Phone: (613) 218-4728

Project Manager

Danny Wright

Sub-Division Head

Geol. Survey of Canada/Commission géologique du Canada

Land & Minerals Sector/Secteur des terres et minéraux

Natural Resources Canada

239-601 Booth Street, Ottawa, Ontario K1A 0E8

michel.plouffe@NRCan-RNCan.gc.ca

Phone: (613) 947-8760

Project Officer

Anushika Da Silva

GEM-GeoNorth Project Officer

Geol. Survey of Canada/Commission géologique du Canada

Land & Minerals Sector/Secteur des terres et minéraux

Natural Resources Canada

239-601 Booth Street, Ottawa, Ontario K1A 0E8

michel.plouffe@NRCan-RNCan.gc.ca

Phone: (613) 447-1369

Closest professional medical assistance:

Athabasca Health Facility

PO Box 124, Black Lake SK S0J 0H0

Phone: 306-439-2200

Fax: 306-439-2212

Hours: 9:00am-5:00pm (Emergency Services 24/7)

Doctor Clinics:

2:00pm to 5:00pm Monday - Thursday

Closest police station (specify district):

Stony Rapids RCMP

Johnson St

Stony Rapids SK S0J 2R0

Telephone: 306-439-2185

Fax: 306-439-2071

Provided language(s): English only

13. Permit and licences

The applicant is applying for all necessary Land Use and Scientific Research permits and licences. These include: Nunavut Research Institute.

Previous work related to this project has been screened by NIRB in 2018 (NIRB application ID 18YN005). This activity is related to projects J. Campbell 2018 Nunavut research license 01 009 17N-A, and I. McMartin, 2017 Nunavut research license 03 009 17N-A.

With respect our request to work within the Thelon Wildlife Sanctuary, in 2018 we were given permission by NPC, NRIB, NRI and the Kitikmeot Inuit Association to conduct this type of research within the Sanctuary, respecting the wildlife and birds' avoidance and disturbance restrictions.

14. Contacts

14.1 Project Co-lead:

Janet E. Campbell

Research Scientist/ Field Supervisor

GEM-GeoNorth Program Manager

Geol. Survey of Canada/Commission géologique du Canada

Land & Minerals Sector/Secteur des terres et minéraux

Natural Resources Canada

601 Booth Street, Ottawa, Ontario K1A 0E8

(343)543-5045

14.2 Project Co-lead

Etienne Brouard

Research Scientist

Geol. Survey of Canada/Commission géologique du Canada

Land & Minerals Sector/Secteur des terres et minéraux

Natural Resources Canada

601 Booth Street, Ottawa, Ontario K1A 0E8

(343)543-4318

14.3 Corporate Office – Program Manager:

Michel Plouffe

GEM-GeoNorth Program Manager

Geol. Survey of Canada/Commission géologique du Canada

Land & Minerals Sector/Secteur des terres et minéraux

Natural Resources Canada

239-601 Booth Street, Ottawa, Ontario K1A 0E8

michel.plouffe@NRCan-RNCan.gc.ca

Phone: (613) 218-4728



15. References

- Baldwin, K., Allen, L., Basquill, S., Chapman, K., Downing, D., Flynn, N., MacKenzie, W., Major, M., Meades, W., Meidinger, D., Morneau, C., Saucier, J.P., Thorpe, J., Uhlig, P. 2020. Vegetation Zones of Canada: a Biogeoclimatic Perspective. Information Report GLC-X-25, Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre, 1-172, <https://cfs.nrcan.gc.ca/publications/download-pdf/40507>.
- Environment and Climate Change Canada. 2021. Species at risk in Nunavut 2021. EC21221, Environment and Climate Change Canada, 1-93.
- Geological Survey of Canada. 2017a. Reconnaissance surficial geology, Beverly Lake, Nunavut, NTS 66-C (Preliminary, Surficial Data Model v. 2.3 conversion of Map 40-1989). Geological Survey of Canada, Canadian Geoscience Map 322, 1:125,000, <https://doi.org/10.4095/304239>.
- Geological Survey of Canada. 2017b. Reconnaissance surficial geology, Ennadai, Nunavut, NTS 65-F. Geological Survey of Canada, Canadian Geoscience Map 224, 1:125,000, <https://doi.org/10.4095/299727>.
- Geological Survey of Canada. 2017c. Reconnaissance surficial geology, Kamilukuak Lake, Nunavut, NTS 65-K (ed. Prelim., surficial data model v.2.2 conversion). Geological Survey of Canada, Canadian Geoscience Map 221, 1:125,000, <https://doi.org/10.4095/297331>.
- Geological Survey of Canada. 2017d. Reconnaissance surficial geology, Tulemalu Lake, Nunavut, NTS 65-J (ed. prelim., surficial data model v.2.3 conversion). Geological Survey of Canada, Canadian Geoscience Map 325, 1:125,000, <https://doi.org/10.4095/305967>.
- Geological Survey of Canada. 2019. Reconnaissance surficial geology, Dubawnt Lake, Nunavut, NTS 65-N (ed. surficial data model v.2.3.14 conversion). Geological Survey of Canada, Canadian Geoscience Map 368, 1:125,000, <https://doi.org/10.4095/308431>.
- McClenaghan, M.B., Spirito, W.A., Plouffe, A., McMartin, I., Campbell, J.E., Paulen, R.C., Garrett, R.G., Hall, G.E.M., Pelchat, P., Gauthier, M.S. 2020. Geological Survey of Canada till-sampling and analytical protocols: from field to archive, 2020 update. Geological Survey of Canada, Open File 8591, Natural Resources Canada, 1-73, <https://doi.org/10.4095/326162>.
- Prest, V.K., Grant, D.R., Rampton, V.N. 1968. Glacial map of Canada. Geological Survey of Canada, "A" Series Map 1253A, 1:5,000,000, <https://doi.org/10.4095/108979>.



Natural Resources
Canada

Ressources naturelles
Canada

APPENDIX I

NT-NU SPILL REPORT

OIL, GASOLINE, CHEMICALS AND
OTHER HAZARDOUS MATERIALS



NT-NU 24-HOUR SPILL REPORT LINE

Tel: (867) 920-8130 • Email: spills@gov.nt.ca

REPORT LINE USE ONLY

A	Report Date: MM DD YY	Report Time:	<input type="checkbox"/> Original Spill Report OR <input type="checkbox"/> Update # _____ to the Original Spill Report		Report Number:
	Occurrence Date: MM DD YY	Occurrence Time:			
C	Land Use Permit Number (if applicable):		Water Licence Number (if applicable):		
D	Geographic Place Name or Distance and Direction from the Named Location:			Region: <input type="checkbox"/> NT <input type="checkbox"/> Nunavut <input type="checkbox"/> Adjacent Jurisdiction or Ocean	
E	Latitude: _____ Degrees _____ Minutes _____ Seconds		Longitude: _____ Degrees _____ Minutes _____ Seconds		
F	Responsible Party or Vessel Name:		Responsible Party Address or Office Location:		
G	Any Contractor Involved:		Contractor Address or Office Location:		
H	Product Spilled: <input type="checkbox"/> Potential Spill	Quantity in Litres, Kilograms or Cubic Metres:	U.N. Number:		
I	Spill Source:	Spill Cause:	Area of Contamination in Square Metres:		
J	Factors Affecting Spill or Recovery:	Describe Any Assistance Required:	Hazards to Persons, Property or Environment:		
K	Additional Information, Comments, Actions Proposed or Taken to Contain, Recover or Dispose of Spilled Product and Contaminated Materials:				
L	Reported to Spill Line by:	Position:	Employer:	Location Calling From:	Telephone:
M	Any Alternate Contact:	Position:	Employer:	Alternate Contact Location:	Alternate Telephone:

REPORT LINE USE ONLY

N	Received at Spill Line by:	Position:	Employer:	Location Called:	Report Line Number:
Lead Agency: <input type="checkbox"/> EC <input type="checkbox"/> CCG/TCMSS <input type="checkbox"/> GNWT <input type="checkbox"/> GN <input type="checkbox"/> ILA <input type="checkbox"/> AANDC <input type="checkbox"/> NEB <input type="checkbox"/> Other: _____			Significance: <input type="checkbox"/> Minor <input type="checkbox"/> Major <input type="checkbox"/> Unknown		File Status: <input type="checkbox"/> Open <input type="checkbox"/> Closed
Agency:		Contact Name:	Contact Time:	Remarks:	
Lead Agency:					
First Support Agency:					
Second Support Agency:					
Third Support Agency:					



Natural Resources
Canada

Ressources naturelles
Canada

APPENDIX II



Instructions for Completing the NT-NU Spill Report Form

This form can be filled out electronically and e-mailed as an attachment to spills@gov.nt.ca. Until further notice, please verify receipt of e-mail transmissions with a follow-up telephone call to the spill line. Forms can also be printed and faxed to the spill line at 867-873-6924. Spills can still be phoned in by calling collect at 867-920-8130.

A. Report Date/Time	The actual date and time that the spill was reported to the spill line. If the spill is phoned in, the Spill Line will fill this out. Please do not fill in the Report Number: the spill line will assign a number after the spill is reported.
B. Occurrence Date/Time	Indicate, to the best of your knowledge, the exact date and time that the spill occurred. Not to be confused with the report date and time (see above).
C. Land Use Permit Number /Water Licence Number	This only needs to be filled in if the activity has been licenced by the Nunavut Water Board and/or if a Land Use Permit has been issued. Applies primarily to mines and mineral exploration sites.
D. Geographic Place Name	In most cases, this will be the name of the city or town in which the spill occurred. For remote locations – outside of human habitations – identify the most prominent geographic feature, such as a lake or mountain and/or the distance and direction from the nearest population center. You must include the geographic coordinates (Refer to Section E).
E. Geographic Coordinates	This only needs to be filled out if the spill occurred outside of an established community such as a mine site. Please note that the location should be stated in degrees, minutes and seconds of Latitude and Longitude.
F. Responsible Party Or Vessel Name	This is the person who was in management/control/ownership of the substance at the time that it was spilled. In the case of a spill from a ship/vessel, include the name of the ship/vessel. Please include full address, telephone number and e-mail. Use box K if there is insufficient space. Please note that, the owner of the spilled substance is ultimately responsible for any spills of that substance, regardless of who may have actually caused the spill.
G. Contractor involved?	Were there any other parties/contractors involved? An example would be a construction company who is undertaking work on behalf of the owner of the spilled substance and who may have contributed to, or directly caused the spill and/or is responding to the spill.
H. Product Spilled	Identify the product spilled; most commonly, it is gasoline, diesel fuel or sewage. For other substances, avoid trade names. Wherever possible, use the chemical name of the substance and further, identify the product using the four digit UN number (eg: UN1203 for gasoline; UN1202 for diesel fuel; UN1863 for Jet A & B)
I. Spill Source	Identify the source of the spill: truck, ship, home heating fuel tank and, if known, the cause (eg: fuel tank overfill, leaking tank; ship ran aground; traffic accident, vandalism, storm, etc.). Provide an estimate of the extent of the contaminated/impacted area (eg: 10 m ²)
J. Factors Affecting Spill	Any factors which might make it difficult to clean up the spill: rough terrain, bad weather, remote location, lack of equipment. Do you require advice and/or assistance with the cleanup operation? Identify any hazards to persons, property or environment: for example, a gasoline spill beside a daycare centre would pose a safety hazard to children. Use box K if there is insufficient space.
K. Additional Information	Provide any additional, pertinent details about the spill, such as any peculiar/unique hazards associated with the spilled material. State what action is being taken towards cleaning up the spill; disposal of spilled material; notification of affected parties. If necessary, append additional sheets to the spill report. Number the pages in the same format found in the lower right hand corner of the spill form: eg. "Page 1 of 2", "Page 2 of 2" etc. Please number the pages to ensure that recipients can be certain that they received all pertinent documents. If only the spill report form was filled out, number the form as "Page 1 of 1".
L. Reported to Spill Line by	Include your full name, employer, contact number and the location from which you are reporting the spill. Use box K if there is insufficient space.
M. Alternate Contact	Identify any alternate contacts. This information assists regulatory agencies to obtain additional information if they cannot reach the individual who reported the spill.
N. Report Line Use Only	Leave Blank. This box is for the Spill Line's use only.