

NPC 150563: Assessing the ecological risk associated with critical mineral extraction and low-sulfur fuels in Northern ecosystems

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**Proposal Status: Conformity Determination Issued**

[Overview Documents](#)

[Project Overview](#)

Type of application: New

Proponent name:

Tamzin Blewett

Proponent company:

University of Alberta

Project Description:

Global climate change presents a unique problem in that the poles (i.e., Arctic and Antarctic) are warming at an accelerated rate compared to more temperate latitudes. As a consequence, permafrost in Arctic regions is softening, and sea ice coverage is declining, allowing for increased shipping activities, oil and gas extraction, mineral mining, and tourism, all with the potential to release contaminants into the environment. Cambridge Bay and Port Iqaluit are particularly susceptible to increased metal contaminants from intensified mineral extraction in these areas and oil-based contaminants from increased shipping traffic and vessel movement. Furthermore, the use of low-sulfur fuels is becoming more common in the Arctic to reduce air pollution from these increased activities. However, these newer fuels have different chemical properties, and their effects on cold-adapted Arctic organisms are not well understood. In addition, current water quality guidelines are based on sensitivities of animals from more temperate latitudes. As a result, these guidelines do not account for the specific environmental factors associated with cold water environments and ecosystems, nor reflect the sensitivity of Arctic species to pollutants. Therefore, we want to improve protocols to protect Northern ecosystems from human-associated disturbances. This research aims to find out whether or not Arctic species are more sensitive to pollutants than the temperate species currently used to set water quality standards. By doing so, we hope to develop better guidelines that specifically protect Arctic environments. This project aims to understand Arctic organisms' sensitivity to two types of toxicants: metal contaminants (copper, zinc, cobalt, nickel, and lithium) and oil-related chemicals (including perfluoroalkyl and polyfluoroalkyl substances (PFAS))

and other substances from low-sulfur fuels). We will expose three types of organisms found in the Arctic to these toxicants of interest using Arctic-relevant concentrations under Arctic-relevant conditions (e.g., temperature, water chemistry). By testing different concentrations of exposure, we aim to identify the most vulnerable species and expand our knowledge to help communities, stakeholders, and policy-makers protect the Arctic environment. Sea-ice algae, copepods, and Daphnia (water fleas) will be collected in and around Cambridge Bay, NT. Specifically, algae and copepods will be collected in May 2025 from the sea ice between Cambridge Bay and the Dease Strait, while Daphnia and water samples will be collected in August from Greiner Lake. The exposures in May will last three weeks, while those in August will take five weeks. All experiments will be safely contained within CHARS labs, and water used in tests will be treated before disposal to remove any harmful substances. Different cleaning methods, such as biochar filtration, chelating resins, and activated charcoal, will be used to remove metals and chemicals, ensuring that no potentially harmful contaminants are released into the environment during the research project. After the exposures have been completed, the organisms will be shipped back to Quebec City (Institut national de la recherche scientifique; INRS) and/or Edmonton (University of Alberta) for further studies to look at how these contaminants build up over time and affect Arctic organisms over more extended time frames. This fieldwork is part of a 3-year NSERC Alliance grant and a 3-year DFO grant; throughout the tenure of the grant, community engagement will occur to communicate our research with the residents of Cambridge Bay. The project team will conduct community meetings and presentations each year of the project. These events will include demonstrations of the equipment used in the proposed studies as well as updates on the research project outcomes and information about the current status and policy surrounding critical minerals. During our field sampling, we plan on having a member of the local hunters and trappers organization (HTO) with us to make sure that we are supporting the local community while also learning directly from community members. Finally, we plan on participating in community feasts with the local HTO to build further connections with the local indigenous community.

#### [Project Schedule](#)

Start Date:

2025-04-28

End Date:

2025-09-30

#### [Project Map](#)

List of project geometries:

Id

Geometry

Location Name

[14249](#)

polygon

Greiner Lake site for Daphnia collection

[14251](#)

polygon

Cambridge Bay Sea-ice associated algae collection area

[14136](#)

point

Outflow of sewage lagoon, leading into river/bay

[14137](#)

point

Downstream of sewage lagoon, closest to outflow

[14138](#)

point

Downstream of sewage lagoon, intermediate distance

[14139](#)

point

Downstream of sewage lagoon, longest distance

[14140](#)

point

Lake where Cambridge Bay drinking water is taken from

NPC Planning regions:

**No Approved Plan**

## Project Land Use and Authorizations

Project Land Use:

Scientific Research

Licensing Agencies:

Nunavut Research Institute

Government of Canada - Fisheries and Oceans Canada

Nunavut Water Board

Government of Nunavut - Department of Environment

## Material Use

Equipment:

Type

Quantity

Type

Use

Ice Auger

2

121cm x 39.04cm x 29.67cm

Auger used to core sea ice for collection of sea ice algae. Supplied by Viventem.

16' Aluminum boat

1

490cm x 170cm x 70cm

Boat to travel to field sites in Greiner lake for August Daphia collection. Supplied by CHARS/Viventem

ATV

2

210.8cm x 121.9cm x 119.4cm

ATV to travel to Greiner lake for August Daphnia collection. Supplied by CHARS/Viventem.

Skidoo

2

317cm x 102.4cm x 109.5cm

Skidoos to travel to field sites in Cambridge Bay for May algae/copepod collection.  
Supplied by Viventem.

Algae Sieves

4

15.7cm x 14.7cm x 5.3cm

Algae sieves to sift out sea ice algae for May fieldwork.

Seawater Pumps

2

33cm x 12.7cm x 16.5cm

Pump to collect seawater for rearing of algae and copepods. Supplied by Viventem.

PHYTO-PAM-II

1

60 cm x 40 cm x 34 cm

Fluorometer to measure phytoplankton photosynthesis.

[https://www.walz.com/products/chl\\_p700/phyto-pam/introduction.html](https://www.walz.com/products/chl_p700/phyto-pam/introduction.html)

MultiVac 310 – MS – A Multi-Branch Filtration System

1

60cm x 15cm x 20cm

Filtration system for quickly and efficiently filtering water samples.

Fuel Use:

Type

Container

Capacity

Use

Gasoline

6

20

Fuel for skidoos, boats, and ATVs. Will only require ~15L per week for collection of organisms.

Hazardous Material and Chemical Use:

Type

Container

Capacity

Use

Sodium hydroxide (NaOH)

1

1

0.1 kg of solid pellets. Used to pH correct water for exposures. Stored in a plastic container, double bagged, when in solution it will be stored in a fume hood cabinet with other corrosive materials, inside a plastic bin

Nitric Acid (HNO<sub>3</sub>)

3

1

ACS grade, acid used for cleaning glassware. Contained in plastic container, double bagged, stored in a fume hood cabinet with other corrosive materials, inside a plastic bin.

Ethanol

1

1

500 mL, used for sanitization of work stations and equipment. Contained in plastic container, double bagged, stored in a fume hood cabinet with other corrosive materials, inside a plastic bin.

Nitric Acid (HNO<sub>3</sub>)

1

1

Ultratrace grade, acid used to dissolve metals in exposure waters. Contained in plastic container, double bagged, stored in a fume hood cabinet with other corrosive materials, inside a plastic bin.

Water Consumption:

Daily Amount (m<sup>2</sup>)

Retrieval Method

Retrieval Location

0

May – Sea Ice associated algae collection area; August – Greiner lake

Saltwater (May)/freshwater (August) collected from sampling sites via pump or bucket. Water will be brought to Canadian High Arctic Research Station for culturing organisms.

#### Waste and Impacts

Environmental Impacts:

Environmental impacts of this study are expected to be minimal due to toxicant exposures occurring in controlled laboratory environments in small volumes of water at the Canadian High Arctic Research Station (CHARS). Experiments will utilize increasing concentrations of metals (Nickel, Copper, Zinc, Cobalt, Lithium) and low sulfur fuel oil (including oil co-contaminants such as antioxidant, surfactants and per- and -Polyfluorinated Substances (PFAS)) to identify the sensitivity of Arctic animals (sea-ice algae, copepods, and water fleas) to potential increases in aquatic concentrations. High concentrations of toxicants in exposure water will be used during this experiment and nitric acid baths used to clean glassware/plasticware between experiments. Therefore, mitigation measures will be utilized to reduce potential pollution of Nunavut waters. After exposures, water will be treated with biochar and chelix resin treatment to remove dissolved metals before disposing water down sinks under flowing water. Biochar will be shipped to Edmonton (University of Alberta) or Quebec City (INRS) for appropriate disposal. For oil exposures, water will be treated with activated charcoal to reduce concentrations and/or shipped back to Edmonton for disposal. Additionally, nitric acid bath will be neutralized with acid-neutralizing powder, then the pH of the solution will be checked to confirm neutral pH (> 6).

Water will then be filtered to remove any excess metal from solution before being disposed in the sink under flowing water.

#### Waste Management:

Waste Type

Quantity Generated

Treatment Method

Disposal Method

Greywater

80.2 L per metal, total of 401 L

Alternative options include diluting the test solutions with tap water at CHARS to achieve safe levels for marine life (70 µg/L for Ni, 3 ug/l for Cu, 10 ug/l for Zn based on BC guidelines, 1 ug/l for Co based on an Australian guideline) before disposal in the sink under flowing water. Note that these 4 trace elements are naturally present in the environment and are essential micronutrients for algae, plants and/or animals.

Biochar will be used to remove metals from test solutions (biosorption technique), and the biochar will be shipped back to INRS in Quebec for disposal. A chelex resin may also be applied to low-salinity samples.

Greywater

280 L of Low sulfur fuel exposure water

Activated charcoal should be sufficient to remove oil contamination; however, if it does not completely remove low sulfur fuels, we will also ship water to the University of Alberta to reduce any environmental contamination.

Exposure water will be treated with activated charcoal to reduce concentrations and both water and charcoal will be shipped back to the University of Alberta for disposal

Hazardous waste

65 L

No additional treatment procedures

Acid bath will be neutralized with acid-neutralizing powder, then the pH of the solution will be checked to confirm neutral pH (> 6). Water will then be filtered to remove any excess metal from solution before being disposed in the sink under flowing water.



