NRI Annual Summary Report Requirements
(https://www.nri.nu.ca/sites/default/files/public/licence_application_guidelines20182.pdf)

- describe the research activities undertaken in the past year,
- a description of the datasets collected, and
- a summary of any research findings. In the case of multi-year Licenses, Annual Summary Reports are required in the same fashion, each year over the term of the License. You are also required to send to us copies of any final publications or reports (e.g. scientific journal articles, academic theses, etc.) that you generate based on your research.

Note on community members:

In addition to providing Annual Summary and Final Reports to NIRI, you are expected to share your research results with Nunavut agencies and community members, especially those groups/individuals that participated in your research. This will require that you develop a communication plan that identifies the target audiences for your and describes the methods that you will employ to communicate your research results to these audiences. Communication methods may include newsletters, posters, or fact sheets, radio interviews, developing video/pod casts, or in-person presentations. The appropriate suite of methods will depend on the nature of your target audience (e.g. age, background, language characteristics, and communication preferences). NRI can provide advice to help you to identify the most effective communication and outreach strategies to share your research.

Stream occupancy of young-of-year arctic grayling (Thymallus arcticus) and the associated impact from the wastewater treatment facility in Baker Laker, Nunavut: 2019 Annual Summary Report from the University of Waterloo.

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Research Activities Undertaken in 2019

During the summer of 2019 a total of 53 streams located near Baker Lake and along the all-weather access road to the Meadowbank mining complex (including Amaruq) were assessed for the presence/absence of Arctic Grayling (*Thymallus arcticus*) young-of-year. A subset of these streams and streams nearest to Baker Lake, were also assessed for changes in large-bodied fish population health and habitat that occur as a result of Baker Lake wastewater treatment. In 2019 we collected water, sediment and small bodied fish samples in selected lakes and streams nearest to Baker Lake and Amaruq site. To assess the presence/absence of young-of-year Arctic Grayling, each stream, visited on three occasions in 2019:

- Mid-late June to install water temperature sensors;
- Mid-July to early August to assess the presences/absences of Arctic Grayling young-of-year and to collect stream habitat variables; and
- Late August to early September to remove water temperature sensors.

Visual surveys were conducted, where a team of two visually searched for young-of-year within each stream. Habitat variables were then collected at each stream, including water velocity, water depth, discharge, substrate, and water temperature. These variables have the potential to influence, or limit the suitability of habitat for young-of-year Arctic Grayling, and may explain why fish are present or absent. We also looked at landscape level variables that could influence presence/absence, including stream slope, ecological land classification (i.e., vegetation community defined by substrate and moisture), and the total surface area of lakes that are upstream of the sample site. These landscape variables can influence the stream conditions. For instance, steep slopes can limit fish movement in a stream. Upstream lakes contribute to the flow of the stream, and having larger or more lakes upstream can ensure that the stream continues to flow throughout the summer, providing habitat for young-of-year Arctic Grayling.

Summary of Research Findings to Date

The protection of water quality and fish health is of paramount interest to northerners and is affected by a complex array of physical and biological factors, including concentrations of contaminants and productivity of the system. Data collected near Baker Lake wastewater facility in 2019 have demonstrated a concentration gradient with increased nutrients, conductivity and increasing pH nearest to the sewage discharge area, decreasing farther from the source. Preliminary results from fish collected in 2019 suggest ecological changes that correspond with water quality effects in waterbodies nearest to the wastewater discharge as compared to reference lakes. Finger Lake and Airplane lake, located immediately downstream of the wastewater discharge are eutrophic, have elevated chlorophyll a, are murky (based on secchi depth readings) and have elevated conductivity and nutrients as compared to reference lakes. Consistent with nutrient, chlorophyll increases and eutrophication, Ninespine stickleback are more abundant and heavier-at-length in lakes nearest to the wastewater discharge. Correspondingly, the 2019 results found increased abundance of Arctic grayling, burbot and ninespine stickleback in Airplane and Finger Lake, suggesting changes in water quality and habitat are impacting food-web structures as compared to reference lakes. If COVID restrictions are lifted, these results will be shared with community partners and the Kivalliq Inuit association in 2020, and further investigated in 2020 and 2021.

Arctic Grayling young-of-year were detected in 37 of the 53 streams (approximately 70%), including two streams that are within the passive wastewater system in Baker Lake, and two streams that are immediately upstream of the wastewater system. To date, analysis of 2019 data is limited to streams that are not influenced by wastewater, which includes 49 of the 53 streams sampled.

Young-of-year were found in streams with a diversity of habitat. Variables such as substrate (e.g., percentage of boulder, cobble, gravel substrate) did not explain the presence/absence of young-of-year within a stream, nor did depth, velocity, or water temperature. Instead, landscape variables were found to better explain the presence or absence of young-of-year within a stream. One of the best explanatory variables was the total surface area of the lakes upstream. If the upstream lake surface area was too small, meaning there were not enough lakes upstream or the lakes upstream were not big enough, then young-of-year were not present within the stream. This suggests that streams in this region rely heavily on upstream lakes to provide water and to sustain flow throughout the summer. It is likely that streams with smaller/fewer lakes upstream can go dry later in the summer, particularly during low precipitation years. A second variable that explained the presence/absence of young-of-year was ecological land

classification data. The land classification relates to the soil and moisture characteristics of the landscape surrounding the stream. Streams lower in the landscape, where moisture is high, and vegetation is dominated by shrubs and grasses, are suitable for young-of-year Arctic Grayling. In contrast, streams higher in the landscape, where moisture is low, and vegetation is sparse and dominated by lichen on boulders, are less likely to contain young-of-year Arctic Grayling. The difference between low and high landscapes highlights the importance of soil and moisture on maintaining stream connectivity throughout the summer. Streams higher in the landscape are more likely to dry out, or have subsurface flows (i.e., flow between boulders rather than overtop of boulders), limiting the habitat available for young-of-year. Overall, the two variables that best explain Arctic Grayling young-of-year presence/absence in streams (upstream lake surface area and land classification) show that maintaining stream flow, or connectivity of lake-stream networks is crucial for providing suitable habitat. Young-of-year in this region rely on the connectivity of lakes and streams to migrate back to lakes to overwinter. If COVID restrictions are lifted, these results will be shared with community partners and the Kivalliq Inuit association in 2020.