

Appendix 44

Whale Tail 2020 Fish Habitat Offset Monitoring Report



MEADOWBANK COMPLEX

WHALE TAIL PIT

2020 FISH HABITAT OFFSET MONITORING REPORT

In Accordance with

DFO *Fisheries Act* Authorization 16-HCAA-00370

and

DFO *Fisheries Act* Authorization 20-HCAA-00275

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EXECUTIVE SUMMARY

According to Fisheries and Oceans Canada (DFO) Authorization 16-HCAA-00370, Agnico Eagle maintains a Fish Habitat Offset Monitoring Plan (FHOMP; March, 2018) to determine the effectiveness of fish habitat offsetting features for the Whale Tail Pit Project.

In order to ensure that constructed offsets described under this Plan are functioning as fish habitat, assessment of the structure and successful utilization of these features by fish are the primary goals of the monitoring program. These offsets include a set of constructed shoals and an elevated water level (approx. 1 m) throughout Whale Tail Lake. According to the schedule described in the FHOMP, monitoring of these constructed features will generally begin following construction of the Mammoth Sill and grid shoals (est. 2026), and following re-flooding of the Whale Tail North basin (est. 2028). In 2020, no monitoring was required in relation to constructed offsets under the FHOMP.

In addition to the constructed habitat offsetting features, a portion of offsetting for Whale Tail Pit is provided through a suite of complementary measures (research projects). No physical monitoring is conducted in relation to research projects. However, progress monitoring is conducted to document annual activities, and results are summarized here to determine when criteria for success have been met.

Six research studies are underway as complementary measures for Whale Tail Pit offsetting (Table 1). Due to field season delays in 2020 as a result of the COVID-19 pandemic, some study periods have been extended by 1 year. No final publications have yet been submitted (which will fulfill criteria for success) but two are planned to be complete in 2021.

Table 1. Whale Tail Pit complementary measures (research projects). *Extended 1 year due to COVID delays (new dates shown). **May be extended 1 year due to COVID delays (TBD).

Study	Lead Researcher	Study Period
Study 1: Assessment of changes in aquatic productivity and fish populations due to flooding of Whale Tail South and downstream lakes during operations	H. Swanson	2018 – 2022**
Study 2: Assessment of impacts of the Baker Lake wastewater outflow on aquatic systems including fish and fish habitat	H. Swanson	2019 – 2026*
Study 3: Literature review and field validation of northern lake fish habitat preferences	S. Doka	2018 – 2021*
Study 4: Arctic Grayling occupancy modelling	H. Swanson	2018 – 2021
Study 5: End pit lake habitat use	TBD	2027 – 2035 (est.)
Study 6: eDNA methods development	J. Stetefeld	2018 - 2023

Offset monitoring under Fisheries Act Authorization 20-HCAA-00275 (July 17, 2020) is described in Section 8.2.2 of the Whale Tail Pit Expansion Project Fish Habitat Offsetting Plan (March, 2020). Monitoring activities under that plan were scheduled to begin following construction of the offsetting sill at Lake A18 (est. 2026). However, in fulfillment of Conditions 4.3.3, 5.1.1.2, and 5.3.1 of 20-HCAA-00275, Agnico will develop a pre-offsetting ecological monitoring program to assess the suitability of flooded areas in Whale Tail South as fish habitat, prior to construction of the A18 sill. This program will be based on the monitoring methods described in the approved Whale Tail Pit Expansion Project Fish Habitat Offsetting Plan (March, 2020), and formally initiated in 2021 (though it may make use of data collected in previous years). A final report will be provided to DFO by March 31, 2024. This program will be conceptualized as an update to the FHOMP, and provided to DFO and interested parties for discussion.

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SECTION 1 • INTRODUCTION

1.1 BACKGROUND

In accordance with Fisheries and Oceans Canada (DFO) Authorization 16-HCAA-00370, Agnico Eagle maintains a Fish Habitat Offset Monitoring Plan (FHOMP; Version 1, March 2018) to ensure that fish habitat offsetting described in the Fish Habitat Offsetting Plan for Whale Tail Pit (March, 2018; Appendix C – May 2018) is constructed and functioning as intended. This program is carried out as a targeted monitoring plan under the Meadowbank Aquatic Effects Monitoring Program (AEMP).

For clarity, Volume 1 (March 2018) of the FHOMP only describes monitoring for offsetting under *Fisheries Act* Authorization 16-HCAA-00370 for the Whale Tail Pit Project. The monitoring plan for offsetting associated with the Whale Tail Expansion Project (Fisheries Act Authorization 20-HCAA-00275 – issued July 17, 2020) is described in Section 8.2.2 of the Whale Tail Pit Expansion Project Fish Habitat Offsetting Plan (March, 2020). Monitoring activities under that plan were scheduled to begin following construction of the offsetting sill at Lake A18 (est. 2026).

However, in fulfillment of Conditions 4.3.3, 5.1.1.2, and 5.3.1 of 20-HCAA-00275, Agnico will develop a pre-offsetting ecological monitoring program to assess the suitability of flooded areas in Whale Tail South as fish habitat, prior to construction of the A18 sill. This program will be based on the monitoring methods described in the approved Whale Tail Pit Expansion Project Fish Habitat Offsetting Plan (March, 2020), and formally initiated in 2021 (though it may make use of data collected in previous years). A final report will be provided to DFO by March 31, 2024. This program will be conceptualized as an update to the FHOMP, and provided to DFO and interested parties for discussion.

This 2020 report therefore focuses only on monitoring for offsets described in the Fish Habitat Offsetting Plan for Whale Tail Pit (March, 2018; Appendix C – May 2018), according to Version 1 of the FHOMP.

1.2 SUMMARY OF OFFSETTING FEATURES

A series of in-water constructed features will create or enhance fish habitat to offset losses occurring in the North Basin of Whale Tail Lake. Acting as complementary offsetting measures, a suite of research projects has also been developed to address knowledge gaps in Northern fish habitat use and monitoring methods.

Further details for each are provided in the Fish Habitat Offsetting Plan for Whale Tail Pit (March, 2018; Appendix C – May 2018).

1.2.1 Constructed Offsets

1.2.1.1 Rock Shoals

Placement of rock material to change lake basin substrate from fine or mixed to coarse (i.e. the creation of rock shoals) is a commonly used fish habitat enhancement technique. This offsetting measure will occur in the dewatered area of Whale Tail Lake – North Basin outside of the pit, with the work conducted prior to reflooding.

Roads, jetties and other features will be scarified or converted to coarse substrate as necessary, prior to closure. A pit sill cap of coarse rock material will also convert fine substrate to coarse in areas where coarse substrate did not already exist. In addition, a network of shoals (termed grid shoals based on their conceptual design pattern) will convert half of the southern area of the North Basin to higher-value habitat.

1.2.1.2 Constructed Sill and Elevated Water Level

During the operations period when Whale Tail Lake – North Basin is dry, a permanent water control structure (sill) will be constructed just upstream of Mammoth Dike. Once the Whale Tail Dike is breached and flows resume its natural direction through Mammoth Lake, this feature will ensure that water levels in Whale Tail Lake and connecting channels remain at 1 m higher than baseline conditions. It is estimated that a 1 m increase in water levels upstream of the Mammoth Dike would create approximately 46.6 ha of new aquatic habitat.

1.2.2 Complementary Measures

The approved suite of complementary measures (research projects) includes six studies aimed at closing knowledge gaps regarding the biology and habitat requirements of northern fish species, developing tools and validating methods to facilitate and advance ongoing monitoring, and/or characterizing responses of fish-bearing aquatic systems to direct anthropogenic manipulations. These studies are:

1. Assessment of changes in aquatic productivity and fish populations due to flooding of Whale Tail South and downstream lakes during operations
2. Assessment of impacts of the Baker Lake wastewater outflow on aquatic systems including fish and fish habitat
3. Literature review and field validation of northern lake fish habitat preferences
4. Arctic grayling occupancy modeling
5. Pit lake habitat use assessment
6. eDNA methods development

1.3 OBJECTIVES

1.3.1 Constructed Offsets

As described above, the majority of habitat gains for Whale Tail Pit offsetting are planned to be achieved through habitat creation and enhancement efforts. These include:

- re-flooding of the de-watered Whale Tail Lake - North Basin following construction of habitat enhancement features (shoals);
- and
- maintaining an elevated water level in Whale Tail Lake compared to baseline conditions;

In order to ensure that offsets are functioning fish habitat as intended and projected, assessment of the structure and successful utilization of these features by fish are the primary goals of the monitoring program for habitat enhancement/creation offsets.

The overall objectives of this report are:

- a. To describe results of the physical and ecological monitoring programs conducted in relation to constructed offsetting features, as detailed in the FHOMP;
- b. To determine when the criteria for success identified in the FHOMP have been met.

1.3.2 Complementary Measures

No physical monitoring is conducted in relation to research projects. However, progress monitoring is conducted to document annual activities, and results are described here to determine when criteria for success have been met.

1.4 SCHEDULE FOR MONITORING

The complete schedule for monitoring of offsets is described in the FHOMP, Table 4 (March, 2018). That plan will be updated as necessary to reflect any changes in scheduled monitoring events, including those occurring due to changes in the operational timeline under the Whale Tail Expansion Project.

Generally, monitoring for constructed offsets is planned to begin following construction of the Mammoth sill and grid shoals (est. 2026), which will occur prior to re-flooding of the Whale Tail North area.

Progress updates for complementary measures will be provided annually.

SECTION 2 • MONITORING METHODS

2.1 CONSTRUCTED OFFSETS

The assessment of constructed habitat features includes monitoring methods with quantitative criteria for success (physical structure, interstitial water quality), as well as complementary “qualitative” tools (periphyton growth and fish use). All lines of evidence will then be integrated in a weight-of-evidence approach to make the final determination regarding habitat feature functionality.

A complete description of scheduled monitoring methods to assess the structure, water quality, periphyton, and fish use of the offsetting features is provided in the FHOMP. Details of monitoring completed in a given year will be provided here, including dates, locations, and any adjustments to standard methods.

In 2020, no monitoring was required to be conducted in relation to habitat enhancement features, because construction of the Mammoth sill and grid shoal offsets is not yet complete.

2.2 COMPLEMENTARY MEASURES

As required by Fisheries Act Authorization HCAA-16-00370, complete annual progress reports on complementary measures are provided to DFO by May 31 of the following year, including preliminary results and analyses.

An interim update is provided in this report for each project, along with a description of activities of the Meadowbank Fisheries Research Advisory Group (MFRAG) in the preceding year. Until research studies are complete and published, these interim updates will focus on general activities and methods, and do not include results and analyses.

SECTION 3 • RESULTS

3.1 CONSTRUCTED OFFSETS

In 2020, no monitoring was required to be conducted in relation to habitat enhancement features, because construction of the Mammoth sill and grid shoals not yet complete.

3.2 COMPLEMENTARY MEASURES

An update is provided here on activities of the Meadowbank Fisheries Research Advisory Group (MFRAG) and progress of each research study in 2020.

3.2.1 Activities of the MFRAG

As part of the Fish Habitat Offsetting Plan for Whale Tail Pit (March, 2018), the Meadowbank Fisheries Research Advisory Group (MFRAG) was conceptualized to provide a forum for input from key stakeholders. The MFRAG meets annually to review project progress reports, propose and approve or reject new projects or project components, and assess whether criteria for success have been met.

In 2019, Agnico Eagle confirmed interest in MFRAG participation by DFO, the Kivalliq Inuit Association (KIA), and the Baker Lake Hunters and Trappers Organization. As planned in the Fish Habitat Offsetting Plan for Whale Tail Pit, Appendix C (May, 2018), Agnico also identified a third party external advisor (Dr. Kelly Munkittrick, University of Calgary) who will participate in all MFRAG activities. A draft Memorandum of Understanding and Terms of Reference (TOR) were developed by Agnico, and reviewed by all parties. The initial meeting of the MFRAG was held on December 12, 2019 in Montreal, Quebec. Representatives from all member groups were in attendance. The group received presentations by lead researchers involved in each study, and had the opportunity for questions, comments, and open discussion. Each MFRAG member group was requested to provide written comments, if any, by February 28, 2020. Written comments were distributed to research study leads for consideration.

In 2020, the MFRAG TOR were finalized, and signed by all parties as of March, 2021. The second annual meeting of the MFRAG was held by video conference on December 2, 2020, with all member groups participating (Agnico, DFO, KIA, BLHTO). As in 2019, the group received presentations by lead researchers involved in each study, and had the opportunity for questions, comments, and open discussion. Each MFRAG member group was requested to provide written comments, if any, by January 13, 2020. Written comments were again distributed to all member groups and the research study leads for consideration. No major concerns with research study progress were raised during the meeting or in follow-up comments.

The participant list, agenda, and notes from the 2020 MFRAG meeting are provided in Appendix A.

3.2.2 Study 1 - Assessment of Changes in Aquatic Productivity and Fish Populations Due to Flooding (H. Swanson)

3.2.2.1 Research Objectives

This research study aims to understand changes in fish population productivity and habitat use during and after flooding occurs, as determined through relative abundance and/or biomass and condition factor within the resident fish population.

Since flooding activities were initially planned to occur over a relatively short term (2-3 years), the study focuses on small-bodied fish, which are expected to react first to changes in nutrient profiles.

Changes in productivity will be related to water quality variables and changes in lake morphometry (especially area). Use of newly flooded habitats will be assessed and related to habitat characteristics.

3.2.2.2 Research Methods

Assessments of fish population metrics take place annually over four field seasons both prior to and after flooding (2018, 2019, 2020, 2021) during two-week (approximate) field visits in late July and August.

The following field survey methods are included as part of this study:

- Shoreline electrofishing and/or visual surveys, both before and after flooding.
- Collection of small-bodied fishes (via electrofishing) for analysis of trophic ecology and growth parameters, both before and after flooding.
- Presence-only surveys, after flooding.

Assessments of changes in fish populations will take into account relationships with the following water quality parameters, some of which are planned to be collected through compliance monitoring programs, and some of which are supplementary:

- Quantity and quality of dissolved organic carbon;
- Total and dissolved concentrations of nitrogen and phosphorus;
- TSS;
- Chlorophyll-a;
- Major anions and cations;
- Total and dissolved metals;
- Stable isotope ratios on dissolved inorganic carbon; and
- Total and methyl mercury.

Some or all of the above assessments will be conducted in the following lakes: Whale Tail Lake (A17), A63, A65, A20, Mammoth Lake (A16), A76 (as feasible), and additional reference systems.

3.2.2.3 Summary of Activities

In 2018, 2019, and 2020 the study focused on the collection of baseline data (2018) and flooding year 1 and 2 data (2019 and 2020) for small-bodied fish species (slimy sculpin, ninespine stickleback) within the Whale Tail South area. Shoreline electrofishing was completed for small bodied fish in up to 10 waterbodies in the area of Whale Tail Lake: Whale Tail Lake,

Mammoth Lake, A63, A20, A65, A44, A76, B03, DS1 and Lake 8 (refer to Figure 1). Monitoring endpoints that were selected for analysis included abundance, length, weight, condition, age, catch per unit effort, and weight-at-age.

Furthermore, the University of Waterloo team has collected annual supplemental water quality data, which will be used to support the interpretation of fish population data. Additional water and sediment quality data collected under compliance monitoring programs will similarly be used in this assessment.

Finally, Agnico Eagle contracted baseline hydroacoustic surveys in Whale Tail Lake, Mammoth Lake, Lake 8 and A20, which in the future can be used to assess changes in habitat characteristics post flooding.

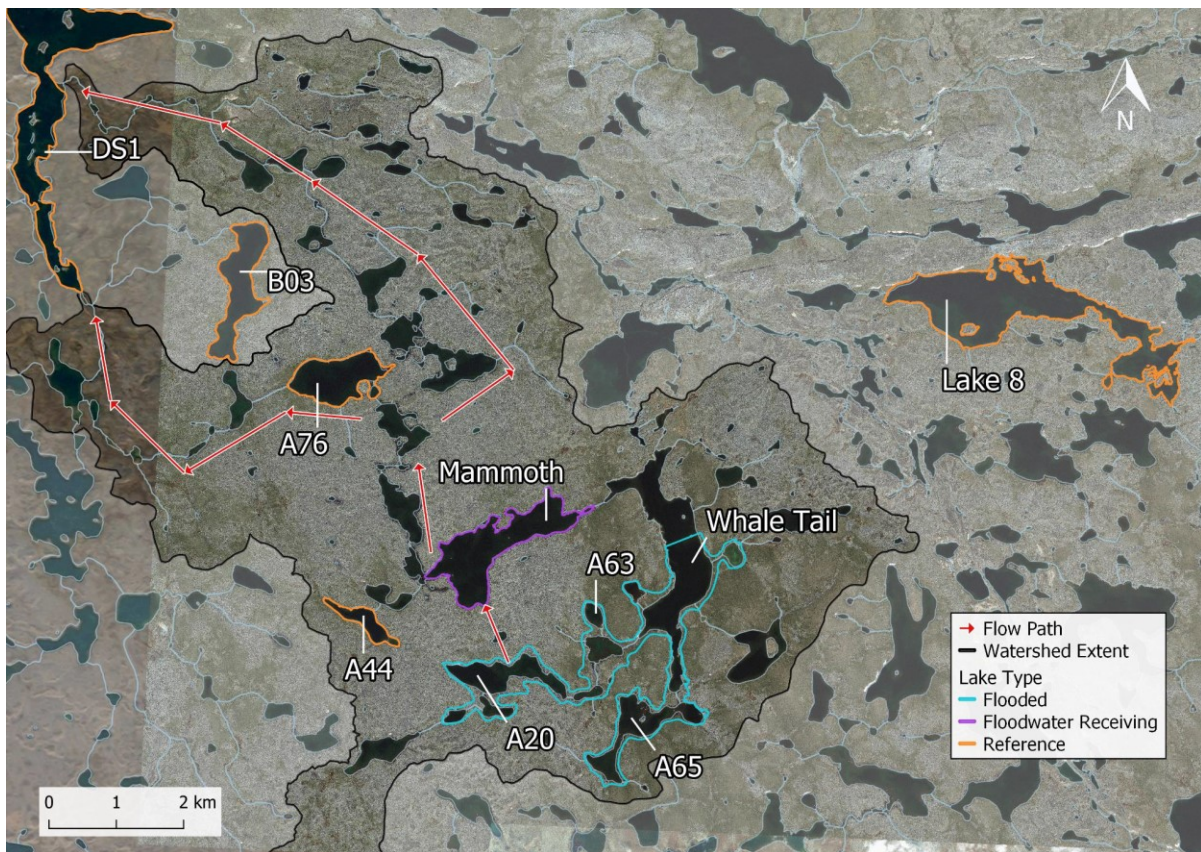


Figure 1. Whale Tail Productivity study area.

3.2.2.4 Study Completion

This study was scheduled for completion (final journal article submission) in 2022. However, due to COVID-related staffing restrictions, a one-year extension is anticipated, with the expected final field season in 2021 and study termination with final journal article submission in 2023.

3.2.3 Study 2 – Assessment of Impacts of the Baker Lake Wastewater Outflow on Fish Productivity and Fish Habitat (H. Swanson)

3.2.3.1 Research Objectives

A 5-year research program lead by Dr. Rob Jamieson (Dalhousie University) is underway to assess the current status of the wastewater treatment system in the hamlet of Baker Lake and develop designs for upgrades. As part of this holistic assessment, key questions related to understanding fish health, fish habitat, nutrient status and fish productivity are included as offsetting for the Whale Tail Pit project. The fish and fish habitat portion of the study is being conducted by Dr. Heidi Swanson, from the University of Waterloo.

The following objectives specific to fish and fish habitat have been developed:

1. Quantify the current fish habitat, fish health and fish productivity in the Arctic wastewater system.
2. Quantify changes in fish habitat, fish health and fish productivity associated with Arctic wastewater treatment system upgrades.

3.2.3.2 Research Methods

General study methods follow Environmental Effects Monitoring (EEM) protocols to assess changes in large-bodied fish population health and habitat that occur as a result of wastewater treatment upgrades. Supplemental methods similar to those employed in Study 1 will be used to further assess changes in productivity in small-bodied fish, which may occur under shorter time frames. Specific target lakes include those within the current wastewater flow path, as well as a reference system.

The EEM-style fish population health analysis will include investigation of the following effect indicators and endpoints pre- and post-construction, targeting two large-bodied fish species (Lake trout, Round whitefish, Burbot and/or Arctic grayling):

- Growth (energy use) – determined through size-at-age analysis
- Reproduction (energy use) – determined through relative gonad size (GSI)
- Condition (energy storage) – determined through weight-to-length ratio (condition factor; K) and relative liver weight (LSI)
- Survival – age distribution
- Fish tissue survey – concentrations of contaminants of local concern will be assessed in fish tissue

The EEM-style fish habitat analysis will include an assessment of impacts to the benthic invertebrate community, based on the following effect indicators and endpoints pre- and post-construction:

- Total benthic invertebrate density – number of animals per unit area
- Diversity index – Simpson's diversity index
- Taxa richness – number of taxa
- Community structure – Bray-Curtis similarity index

Further, to align with Study 1 methods, analysis of changes in fish population productivity will be assessed through:

- Hydroacoustics surveys (as feasible, depth-dependent) - kg fish/hectare
- Electrofishing and/or minnow trap surveys for small-bodied fish – growth parameters

Indicators of exposure to contaminants will also be assessed through exploration of two novel methods:

- Proteomics analysis of sensitive fish tissue (e.g. liver) to assess potential markers of contaminant exposure.
- Otolith analysis via laser-ablation ICP-MS to determine concentrations of trace elements, and exploration of this method for tracking history of exposure, and comparing to reference systems.

Assessments of changes in fish populations will take into account relationships with the following water quality parameters, some of which are planned to be collected through engineering-based objectives and some of which are specific to fish-related objectives:

- Dissolved organic carbon
- Total and dissolved concentrations of nitrogen
- Total and dissolved concentrations of phosphorus
- TSS
- Chlorophyll-a
- Major anions and cations

3.2.3.3 Summary of Activities

As shown in Figure 2, this study is focusing on:

- Finger Lake,
- Lagoon Lake,
- Airplane Lake,
- Baker Lake,
- the connecting streams, and
- reference lakes.



Figure 2. Baker Lake wastewater study lakes and reference lakes (2018).

In 2018 & 2019, the University of Waterloo completed field reconnaissance and collected water quality, sediment samples, fish tissue samples, and conducted presence/absence surveys.

2018:

- Reconnaissance year
- Collected water samples and sampled fish in Finger Lake and Airplane Lake
- Evaluated potential reference sites

2019:

- Selection of reference lakes
- Shoreline electrofishing, minnow trapping, gill netting in 5 waterbodies (Lagoon, Finger, Airplane lake, R1 and R2)
- Fish presence/ absence
- Collected ninespine stickleback and Arctic Grayling for health indicators, otoliths, and tissue
- Working in collaboration with UofM and Dalhousie, collected water quality samples and submitted for analysis.

2020: Due to restrictions under the COVID-19 pandemic, the 2020 field season could not proceed. The study period has thus been extended by one year.

3.2.3.4 Study Completion

With a 1-year extension due to COVID delays, this study is now scheduled for completion in 2026.

3.2.4 Study 3 – Literature Review and Field Validation of Northern Lake Fish Habitat Preferences (S. Doka)

3.2.4.1 Research Objectives

Habitat preferences of northern fish species are not well understood, which causes significant uncertainty in habitat-based offset calculations. This study aims to characterize habitat associations of Meadowbank-area lake fishes such as Lake Trout, Arctic Char, and Round Whitefish.

3.2.4.2 Research Methods

This study was planned to be conducted over three years, from 2018 – 2020. Field surveys occurred in 2018 and 2019. Methods include a literature review, data gap analysis, and field programs to assess various sampling techniques for identifying fish habitat associations.

3.2.4.3 Summary of Activities

Literature Review and Gap Analysis

Following closely the Centre of Environmental Evidence guidelines for systematic literature review, a graduate student with Lakehead University under the co-supervision of Dr. Mike Rennie and Dr. Susan Doka reviewed primary and grey literature sources as well as unpublished data (e.g. Golder & Associates 2016, DFO FishOut database) on 11 northern species, including Lake trout (*Salvelinus namaycush*), Burbot (*Lota lota*), Lake whitefish (*Coregonus clupeaformis*), Lake cisco (*Coregonus artedii*), Round whitefish (*Prosopium cylindraceum*), Arctic char (*Salvelinus alpinus*), Arctic grayling (*Thymallus arcticus*), Slimy sculpin (*Cottus cognatus*), Ninespine stickleback (*Pungitius pungitius*), Dolly varden (*Salvelinus malma*) and Bull trout (*Salvelinus confluentus*) with current fish distributions in lakes of Nunavut and the Northwest Territories (Mandrak, et al. in review) and expert input from individuals that have been in the field in recent years (Portt 2015).

The data extracted from the review has been analyzed using appropriate statistical methods to synthesize the information by life stage (3 stages: spawning, nursery, juvenile/adult habitats) for the 11 northern fish species. Habitat variables of interest include: substrate associations, thermal tolerances and preferences, timing windows, depth associations at different seasons, turbidity tolerances, species-species associations, flows and lake order, cover associations, pH and dissolved oxygen tolerances.

Field Programs

In 2018 Fisheries and Oceans in partnership with Lakehead University conducted ten days of sampling (August 20-30, 2018) in the vicinity of the Amaruq mine camp. The objective of this work was to perform reconnaissance sampling to test efficiencies and logistical challenges of using conventional methods used by scientific consultants and government researchers in the south to assess habitat and fish communities. A variety of equipment was used to meet this objective including, a multi-probe water quality sonde (EXO), passive and active fish sampling gears in both lakes and connecting channels (e.g. minnow traps, GoPro video footage, backpack electrofishing and drift nets) and hydroacoustic surveys (BioSonics MX) for physical habitat mapping (e.g. depth and substrate). The latter was conducted to complement hydroacoustic fish distribution data collected by Milne Technologies (mid-July 2018). Troubleshooting these methods in the field during 2018 informed how to standardize methods for fish habitat sampling in the North (Arctic Region) and how to proceed with habitat and fish assessment surveys during the 2019 field season.

Based on year one field tests and literature review results, field work in year two (2019) focussed on filling data gaps around habitat associations for small-bodied fishes, while assessing alternative sampling approaches. The 2019 field program consisted of an analysis of VIE tagging methods (mark recapture) to evaluate stream habitat preferences, as well as deep water electrofishing, near-shore electrofishing, and netting techniques. Those programs were conducted over two study periods, in late June and August/September.

3.2.4.4 Study Completion

Final reporting for this study was planned for 2020 but was delayed due to DFO staffing constraints under the COVID-19 pandemic. The study period has been extended one year, to 2021.

3.2.5 Study 4 – Arctic Grayling Occupancy Modelling (H. Swanson)

3.2.5.1 Research Objectives

Understanding the potential for occupancy of fluvial systems by fish species based on readily measurable habitat characteristics could facilitate and improve the accuracy of environmental impact assessment and offset planning. Objectives of this work are the development of occupancy models for Arctic grayling in the Meadowbank region, and a comparison of habitat predictors in this area with those observed in the NWT.

3.2.5.2 Research Methods

This three-year study was planned to be conducted from 2018 – 2021, with one reconnaissance field season (2018), a complete field season (2019) and a possible validation field season (2020). The 2020 field season could not proceed due to COVID-related restrictions. However, sufficient data as obtained in 2018 and 2019 to complete the study on time.

This study involves characterizing occupancy of Arctic grayling young-of-the-year in relation to stream habitat characteristics, consistent with methods developed previously in the Northwest Territories (Baker, 2017). Methods included visual presence-absence surveys for rearing young-of-year and assessment of habitat characteristics (e.g., stream width, depth, velocity, vegetation cover, bank formation, distance to overwintering habitat) for 50-m stream segments.

3.2.5.3 Summary of Activities

In 2018, initial reconnaissance and habitat characterization was conducted on four streams in Baker Lake, as well as three systems along the all-weather access road to Meadowbank (R02, R05, and R09). The purpose of the reconnaissance work was to:

- Develop a general understanding of the lake/river systems within the region;
- Test and refine habitat variable data collection/sampling methodology; and,
- Identify systems/streams suitable for occupancy modeling (i.e., connectivity throughout summer and access to overwintering habitat).

In 2019, a complete presence-absence survey and analysis of habitat characteristics was conducted for 49 streams in the area between Baker Lake and the Amaruq mine site (Figure 3). Surveys were conducted over 23 days from mid-July to August, 2019.

Predictive relationships between habitat characteristics and presence-absence of Arctic grayling YOY were developed.

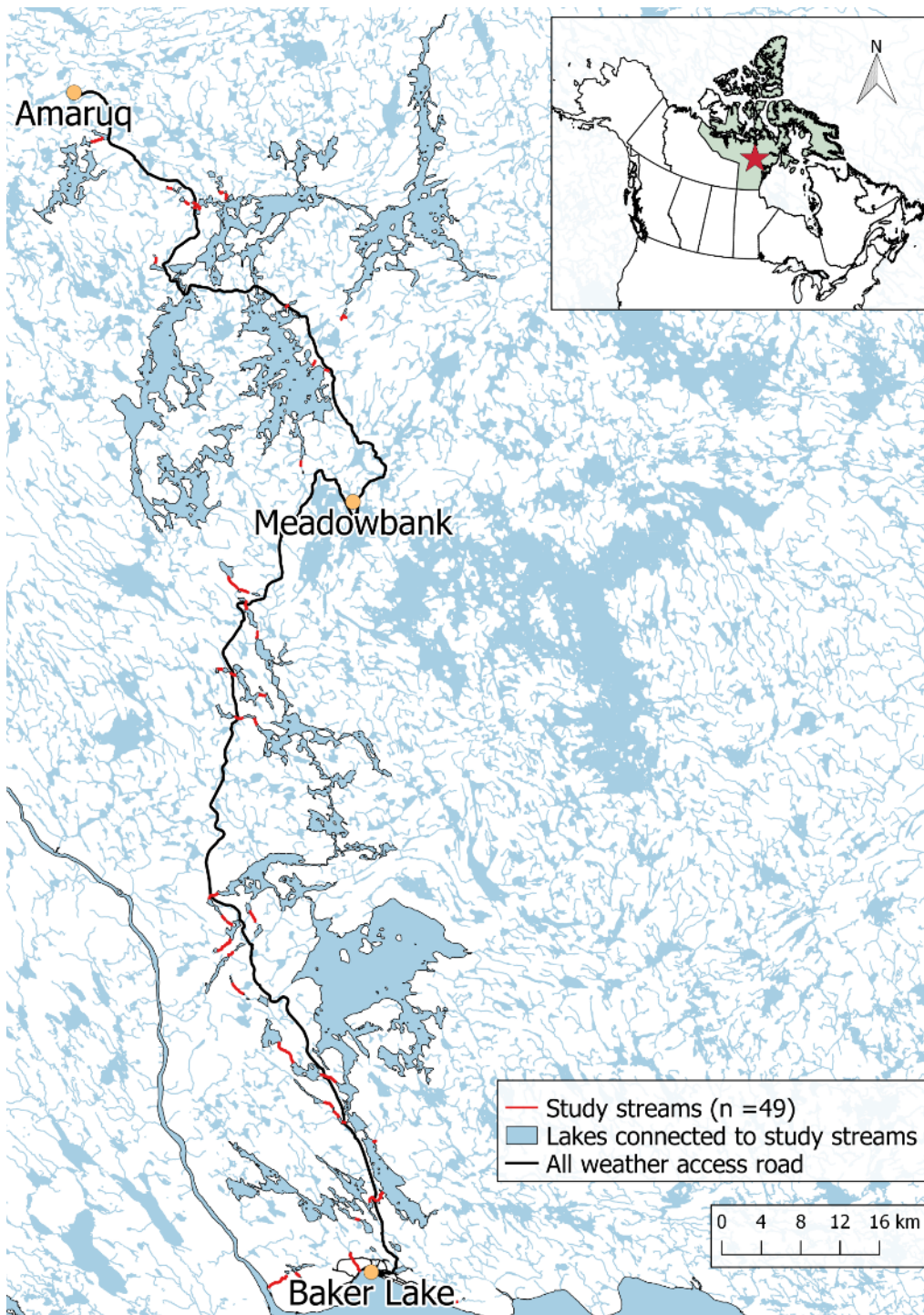


Figure 3. Arctic grayling occupancy study streams (2019).

3.2.5.4 Study Completion

Although the scheduled third field season could not be completed due to COVID-related restrictions, sufficient data was obtained in 2018 and 2019 to complete the study objectives. This work was published as Jared Ellenor's MSc thesis (University of Waterloo) in April, 2020, and is available from: <http://hdl.handle.net/10012/15969>. Manuscript submission for peer review continues to be targeted for March, 2021 as identified in the original study plan for this project.

3.2.6 Study 5 – End-pit Lake Habitat Suitability Assessment

3.2.6.1 Research Objectives

Fish use of re-flooded pit areas with good connectivity to natural systems is not well understood, yet these areas may represent a significant opportunity for fish habitat offsetting. Since multiple pits of various sizes at the Meadowbank site are planned to be reflooded in the relatively near term (2027 – 2029), there is an opportunity to thoroughly characterize fish use of pit lake habitat and population growth in re-flooded lakes through a research program. This study will aim to characterize fish use of new pit lake habitat in relation to habitat and water quality variables, and particularly in relation to reference systems. The research team and program details will be developed by the MFRAG prior to study initiation (est. 2026).

3.2.6.2 Summary of Activities

In accordance with Condition 4.2.1.3 of the FAA for Whale Tail Pit (16-HCAA-00370), Agnico Eagle submitted to DFO a literature review and study outline regarding end pit lake habitat assessment in March, 2019.

As described in the 2018 study plan for this project (see Fish Habitat Offsetting Plan for Whale Tail Pit, Appendix C), flooding of pits at the Meadowbank site is currently planned to be complete in between 2027 - 2029 (Phaser, Vault, and Whale Tail Pits), after which time field studies could begin. Initial literature reviews and methods development will occur in the years prior to pit reflooding.

Alternatively, Agnico will collaborate with other industry partners if appropriate sites are available in other locations in the nearer term. To this end, Agnico has begun to seek out potential partner sites through conversations with environment representatives at other metal mine, diamond mine, and oil sands sites throughout 2019. To date, no appropriate study lakes or interested industry research partners have been identified. However, Agnico continues to pursue this option and welcomes any input in this regard.

3.2.7 Study 6 – eDNA Methods Development (J. Stetefeld, M. McDougall)

3.2.7.1 Research Objectives

Traditional fish population monitoring techniques which rely on field catches remain challenging particularly in remote Northern locations due to non-standardized sampling methods, high costs, labour intensity, and their invasive nature. eDNA methods present a potentially useful tool for rapid and non-invasive assessments of fish communities but have not been significantly developed or validated for Arctic systems. The main goal of this project is to develop and optimize monitoring tools based on eDNA metabarcoding technology to assess fish species assemblages (presence/absence and relative abundance) in the Kivalliq region.

Objectives are:

1. Development and optimization of the eDNA metabarcoding technique adapted for the arctic environment as a substitute for current fish species determination approaches.
2. Producing guidelines for handling and analyzing of samples and deliver the method and provide training to the local community.
3. Produce long-term reliable and precise baseline data on the distribution of aquatic associated fish species in the Amaruq mine site lakes using developed eDNA technology.
4. Producing data on the physiochemical properties of the lake water including dissolved mineral content to understand if any changes in stated parameters affect the eDNA/fish assemblage results.
5. Examine the impact of flooding Whale Tail Lake South Basin with the coincident changes in physiochemical properties of the aquatic area (e.g., increase in turbidity, dissolved solids) on the fish population using developed eDNA technique.
6. Collecting baseline eDNA and water quality data on lakes nearby Amaruq mine site outside the mining activity (potential candidates include B3 or DS1) and use them as a control for population changes.

3.2.7.2 Research Methods

This study involves a 5-year plan to develop and utilize an eDNA metabarcoding approach to measure fish assemblages in the Amaruq area. Environmental DNA metabarcoding technology will be developed and optimized to detect fish species including Arctic Char, Arctic Grayling, Lake Trout, Round Whitefish, Burbot, Slimy Sculpin, Ninespine Stickleback, Hybridized Lake Trout/Arctic Char and analyze their relative abundances. For water quality data, temperature, pressure, dissolve oxygen, pH, salinity, conductivity, and dissolved metals

including Cu/ Zn/ Cd/Fe/Hg/Mn will be measured (some metrics may be obtained through regular compliance monitoring programs).

The first two rounds of sampling were completed before significant in-water construction (July 2017). The second round of sampling was done in August, 2018, during construction of the Whale Tail Dike. The third round of sampling was done in August 2019, during flooding of the Whale Tail South area. Additional sampling will be completed after flooding (2021). The results will be used to assess the influence of mining activity on changes in fish species populations, as measured through eDNA methods.

3.2.7.3 Summary of Activities

In 2017, one week of preliminary field investigations were conducted, to collect water samples for laboratory analysis using previously published, conventional methods (Whatman GF/C filters).

In August 2018 and 2019, Matt McDougall and Fabian Heide visited the Amaruq mine site and, assisted by Jeff Hart of the Kivalliq Inuit Association, collected 211 eDNA samples from 9 lakes. Various filter types were tested for eDNA yield; sample volumes were determined by balancing the need for higher sampling with time per sample. Though the turbidity of the lakes is very low, finer particulates quickly clog all filters tested. Filters tested were: Whatman glass microfiber GF/C with a nominal porosity of 1.2µm, Whatman glass microfiber GF/F with a nominal porosity of 0.7µm, Millipore Isopore polycarbonate PC 0.4µm, and Millipore Isopore polycarbonate PC 0.2µm. eDNA filters were stored in 95% ethanol. At each eDNA sampling site, water samples were collected for elemental analysis and water chemistry parameters were recorded.

In 2019, laboratory methods for sample processing were refined, including validation of new primers. A publication on the complete methods for sampling and processing of Arctic lake fish eDNA samples is expected to be produced in 2021 (originally planned for 2020, but delayed due to COVID restrictions on laboratory access).

In furthering the training objectives of this project, the first eDNA sampling workshop was held at the University of Manitoba in February 2019 and 2020, with 4 and 7 members of the Kivalliq Inuit community in attendance, respectively. The 3 day workshops featured a number of lecturers in the eDNA community, as well as a hands-on DNA extraction laboratory and have laid the foundation for further involvement of the Inuit community in eDNA sampling. In the 2019 season, 2 of the trainees from the program assisted in sample collection. This field training will set the stage for sampling independent of the University of Manitoba.

3.2.7.4 Study Completion

This study is on track for completion in 2023, as originally planned.

SECTION 4 • ASSESSMENT OF SUCCESS

4.1 CONSTRUCTED OFFSETS

No monitoring has yet been conducted for constructed offsets, so success can not yet be evaluated.

Initial monitoring is expected to occur in 2026, after construction of the Mammoth Sill, grid shoals, and road scarification, and prior to flooding of the former lake basin in Whale Tail North.

4.2 COMPLEMENTARY MEASURES

Criteria for success for each research project are focussed on publication of study results in the peer-reviewed literature, or similar primary sources. None of the research programs have reached this stage, but two are scheduled for completion in 2021.

As a result of COVID-related delays or restrictions, original timelines for study completion have been extended by one year for three of the six studies (Table 2).

With the exception of Study 2 (delayed one year), all studies were initiated according to the timeline proposed in the Fish Habitat Offsetting Plan for Whale Tail Pit, Appendix C (May, 2018).

In the interim, several studies have been presented at academic conferences, and two MSc theses publications have been completed.

Whale Tail Pit – Fish Habitat Offset Monitoring Report
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Table 2. Target study publication dates and publication or presentation references. *Wastewater study initiation was delayed one year compared to dates proposed in the Fish Habitat Offsetting Plan for Whale Tail Pit, Appendix C (May, 2018), so publication dates are adjusted accordingly. **Study completion delayed due to COVID interruptions in 2020.

Study	Study Initiation	Target Final Publication Submission Date		Publications and Presentations
		Original	Current	
Study 1: Productivity (H. Swanson)	2018	2022	2023**	Ellenor, J., Portt, C., and Swanson, H.K. 2019. Variation in Slimy Sculpin (<i>Cottus cognatus</i>) monitoring endpoints at six Barrenland lakes in central Nunavut. Poster presentation. Canadian Conference for Fisheries Research on January 3-6, 2019.
Study 2: Wastewater (H. Swanson)	2019	2021/2024*	2022/2026**	Bronte McPhedran presented preliminary findings and research methods at Young Environmental Scientists SETAC conference in Texas, on March 9-11, 2020.
Study 3: Habitat Preferences (S. Doka)	2018	2020	2021**	MSc Thesis: Hancock H., 2020. Physical habitat associations of fish species in the Kivalliq region of Nunavut, Canada. Lakehead University, Orillia, Ontario. Available at: http://ceelab.ca/wpcontent/uploads/2020/10/Hannah final- thesis-10132020.pdf Two presentations have been given at scientific fora by the graduate student, Hannah Hancock of Lakehead University: at Canadian Conference for Fisheries Research in London ON in January, 2019 and at the American Fisheries Society -Ontario Chapter meeting in Orillia ON in February, 2019.
Study 4: Arctic Grayling Occupancy (H. Swanson)	2018	2021	2021	MSc Thesis: Ellenor, J. 2020, June. Habitat use of young-of-year Arctic Grayling (<i>Thymallus arcticus</i>) in Barrenland streams of central Nunavut, Canada.

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Study	Study Initiation	Target Final Publication Submission Date		Publications and Presentations
		Original	Current	
				University of Waterloo, Waterloo, Ontario. Available from http://hdl.handle.net/10012/15969 . Ellenor J., Swanson, H. K., 2019. Factors influencing how Arctic Grayling (<i>Thymallus arcticus</i>) use Barrenland streams near Baker Lake, Nunavut. Platform presentation. ArcticNet Annual Scientific Meeting on December 2-5, 2019.
Study 5: End Pit Lake Habitat Use (Researcher TBD)	2027	2030-2034	2030-2034	-
Study 6: eDNA Study (J. Stetefeld/M. McDougall)	2018	2020, 2023	2021, 2023	-

SECTION 5 • ACTIONS

5.1 CONSTRUCTED OFFSETS

According to the Fish Habitat Offset Monitoring Plan (Table 4), no monitoring is planned in relation to constructed offsets for Whale Tail Pit in 2021.

5.2 COMPLEMENTARY MEASURES

In 2021, field programs, laboratory assessments, and data analysis will continue for studies 1, 2, and 6 as feasible. Delays in 2021 field programs may arise due to site travel restrictions under COVID-19.

Study 3 (literature review and field validation of northern lake fish habitat preferences) is planned to be completed, and final research reports produced.

Study 4 (Arctic grayling occupancy) objectives will be completed, with a manuscript expected to be submitted for publication in March 2021.

For Study 5 (End-pit lake habitat suitability), Agnico will continue to look for an appropriate alternate study sites, academic and industry research partners.

A third meeting of the MFRAG is planned for November or December 2021, though the timeframe may be adjusted based on member suggestions.

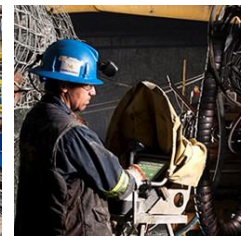
APPENDIX A

2020 MFRAG Meeting Agenda and Notes



MEADOWBANK FISHERIES RESEARCH ADVISORY GROUP

December 2, 2020



2020 MFRAG MEETING

WELCOME

➤ Welcome and thank you to all MFRAG members and presenters

MFRAG Member Groups

- Fisheries and Oceans Canada
 - ~~Alasdair Beattie~~
 - José Audet-Lecouffe
 - Edyta Ratajczyk
- Agnico Eagle
 - Alexandre Lavallée
 - Robin Allard
 - Leilan Baxter
 - Marie-Pier Marcil (observer)
- Kivalliq Inuit Association
 - Luis Manzo
- Baker Lake Hunters and Trappers Organization
 - Carmen Ikuutaq
 - Philip Putumiraqtuq
- Designated External Advisor
 - Kelly Munkittrick, Munkittrick Environmental

MFRAG Presenters

- Heidi Swanson, University of Waterloo
- Susan Doka and David Reddick, DFO Science
- Matthew McDougall, University of Manitoba
- Leilan Baxter, Agnico Eagle

2020 MFRAG MEETING

WELCOME

➤ Background – What is the MFRAG?

- In July 2018, DFO issued Fisheries Act Authorization 16-HCAA-03700 for Agnico's Whale Tail Pit Project at the Meadowbank site near Baker Lake.
- The accepted fish habitat offsetting for this project includes a suite of complementary measures (research projects) developed by Agnico in consultation with DFO and the identified researchers.
- As part of this program, Agnico and DFO conceptualized an advisory group to review project progress and provide a forum for input from key stakeholders as these projects are carried out.
- Five of these projects are underway now at the Meadowbank site, and one is in the concept phase.
- The main intent of the MFRAG is to **confirm projects stay on track** with regards to original objectives and timelines, and to allow members to provide any additional input from their unique perspectives.

2020 MFRAG MEETING

WELCOME

➤ Project topics

1. Change in fish population productivity related to terrestrial flooding (2018 – 2022)
2. Advancements in habitat suitability characterization for Arctic fish species (2018 – 2020)
3. Impacts of municipal wastewater discharge on fish health (2019 – 2025)
4. *Characterization of fish habitat use in end pit lakes (est. 2027 – 2035)*
5. Methods development in eDNA monitoring of Arctic fish populations (2017 – 2022)
6. Arctic grayling habitat occupancy modelling (2018 – 2021)

➤ Today we will receive updates from the research teams on the progress of each project, and have an opportunity to ask questions.

➤ MFRAG members will also have the opportunity to review today's presentations and provide written comments later.

2020 MFRAG MEETING

WELCOME

- Please use this meeting to comprehend the status of each project, and ask any questions that will help in developing your eventual written comments (if any).
- As described in the TOR, key considerations for written comments are:
 - Has there been any change to the project's **overall goal or objectives**? If so, is this acceptable to you? The MFRAG as a whole will need to approve these changes, if any.
 - Do you have any comments on **study methods**? These have generally been developed by the researchers and approved in original study plans, but comments are welcome especially if/when new methods are introduced.
 - Any input on **community engagement** plans? These continue to evolve over the course of each project and any suggestions in light of Covid-19 limitations are especially helpful at this time.
 - Consider the overall project **timeline and deliverables**/criteria for success (publications). Do you have any major concerns about delays, if any?
 - Overall, **are you satisfied** that the study continues to be carried out as planned, or with acceptable changes?

2020 MFRAG MEETING

AGENDA

11:00 – 11:20 am

Greetings/introduction (Agnico)

Finalization of MFRAG MOU/TOR with discussion as needed

11:20 am – 12:35 pm

Research presentations and question period (~ 25 min each)

1: Heidi Swanson - Changes in Aquatic Productivity (11:20 – 11:45)

2: Susan Doka –Habitat Preferences of Northern Fish Species (11:50 – 12:15)

3: Heidi Swanson – Baker Lake Wastewater Assessment (12:20 – 12:35) (after Leilan's presentation)

(20 Min Break)

12:55 - 2:05 pm

Research presentations and question period (~ 25 min each)

4: Leilan Baxter – End Pit Lake Habitat Suitability (12:55 – 1:05) 10 min

5: Matt McDougall – eDNA Methods Development (1:10 – 1:35)

6: Heidi Swanson – Arctic Grayling Occupancy Modelling (1:40 – 2:05)

(5 Min Break)

2:10 – 2:30 pm

Summary and discussion of timelines and deliverables for each project.

Closing remarks

Meeting ended at 2:45pm

2020 MFRAG MEETING

SIGNING OF THE MOU

- Round table discussion of any final comments on the last version of the MOU/TOR
- Next steps
- All MFRAG members are in agreement with the last version of the TOR sent on December 1, 2020. The document will be dated and circulated for signature by each member.

2020 MFRAG MEETING

RESEARCH UPDATE PRESENTATIONS

- 1: Heidi Swanson - Changes in Aquatic Productivity (11:20 – 11:45)
 - José Audet-Lecouffe questions were related to if dissolved oxygen was measured in the field and if a 4 year study is enough for the project
 - Kelly Munkittrick questions were related to a potential 2021 field season, chlorophyll A measurement
 - Philip Putumiraqtuq questions were related to dissolved oxygen measurement and if an impact was observed when the water level get higher
 - Robin Allard question was related to the consideration of the weather
 - More questions to be sent by email
- 2: Susan Doka –Habitat Preferences of Northern Fish Species (11:50 – 12:15)
 - Kelly Munkittrick questions were related to the robustness of the statistics, electroshocking for slimy sculpin, comments on sample size
 - Philip Putumiraqtuq questions were related to how many burbot and slimy sculpin were found (rare in the area)
- 3: Heidi Swanson – Baker Lake Wastewater Assessment (12:20 – 12:35)
 - Project paused in 2020 and extended one year (2025) due to covid
 - José Audet-Lecouffe questions were related to the growth of Artic Grayling in the reference vs exposed lake
 - Kelly Munkittrick asked if kidney and liver tissue will be analysed
 - Philip Putumiraqtuq asked if a difference was observed between the exposed and reference areas
- 4: Leilan Baxter – End Pit Lake Habitat Suitability (12:55 – 1:05)
 - Kelly Munkittrick asked if contact had been made with Derek Gray re. Tuk Highway study (reflooded gravel pits monitoring)
 - Susan Doka questions were related to whether a telemetry study could be part of this project.
 - José Audet-Lecouffe asked about the start date of the project.
- 5: Matt McDougall – eDNA Methods Development (1:10 – 1:35)
 - Edyta Ratajczyk asked if there is a difference between winter and summer season (potential degradation with higher temperature). More questions to be sent by email.
 - Kelly Munkittrick asked about the sample size and how the data will be used to develop population estimates.
- 6: Heidi Swanson – Arctic Grayling Occupancy Modelling (1:40 – 2:05)
 - Susan Doka ask if the model will be applied to other regions.
 - Philip Putumiraqtuq asked if field work was completed in 2020.

2020 MFRAG MEETING

DISCUSSION

- ➔ Summary and discussion of project timelines, major changes, or other MFRAG member comments at this time.

Study	Principle Investigator	Timeline	Criteria for Success	Comments:
Aquatic Productivity	Swanson	2018 - 2022	Journal article submission (2022)	<i>Discuss 1 year extension.</i>
Northern Fish Habitat Preferences	Doka	2018 - 2020	CSAS or other technical document (2020)	<i>Discuss 1 year extension.</i>
Baker Lake Wastewater	Swanson	2019 – 2025	Journal article submission (2025)	<i>Study extended 1 year due to covid. Otherwise no change.</i>
End Pit Lake	TBD	Est. 2027 – 2035	TBD with MFRAG (likely peer-reviewed publications)	<i>Delayed 1 year based on updated closure plan.</i>
eDNA	Stetefeld/ McDougall	2017 – 2023	Journal article submission (2020 and 2023)	<i>First publication delayed to 2021 due to covid. Final publication on track for 2022.</i>
Arctic Grayling Occupancy	Swanson	2018 - 2021	Journal article submission (2021)	<i>Study on track (completion 2021)</i>

2020 MFRAG MEETING

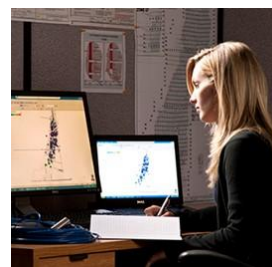
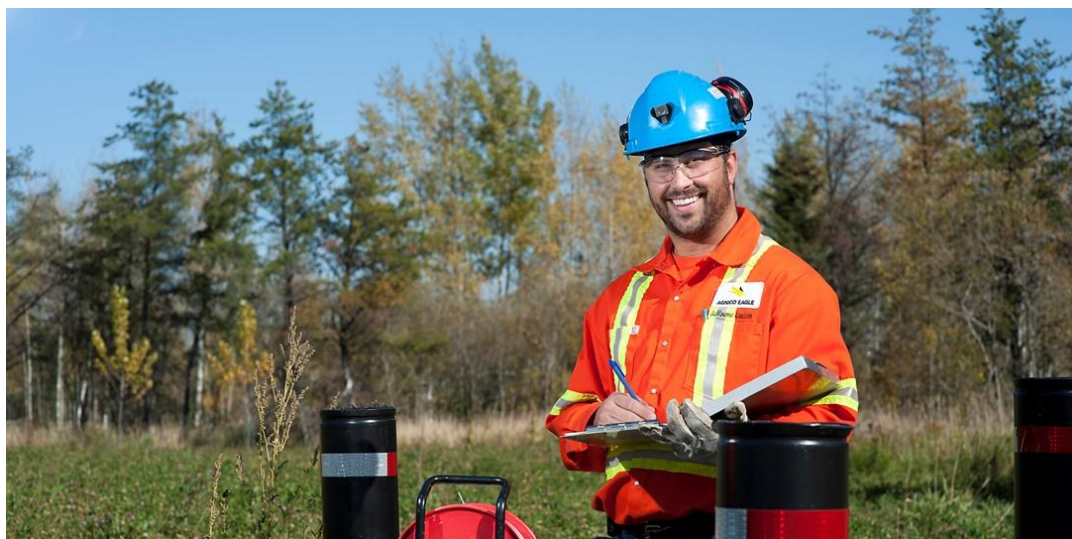
CLOSING REMARKS

- Discuss submission date for written comments.
 - 4 “business weeks”? January 13
 - These will be provided to all members and researchers.
 - **Agreed by all members.**

- Timing for next MFRAG meeting
 - Needs to be after May, summer can be difficult, so this time of year seems to work best
 - **Agreed by all members.**

- Thanks all for your participation
 - TOR will be sent out this week for final signatures
 - The meeting material (presentations) and minutes will be provided by Agnico to all members (December 4) for review and comment (Jan 13).
 - An annual summary of MFRAG activities based on those minutes will be included in Agnico’s Annual Report to the NIRB (March 31).
 - **Agreed by all members.**

 - **José Audet-Lecouffe recalled Agnico about the condition in the WT Expansion Fisheries Act Authorization (20-HCAA-00275 Condition 5.3.3) to discuss with DFO the potential extension of these research programs.**



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