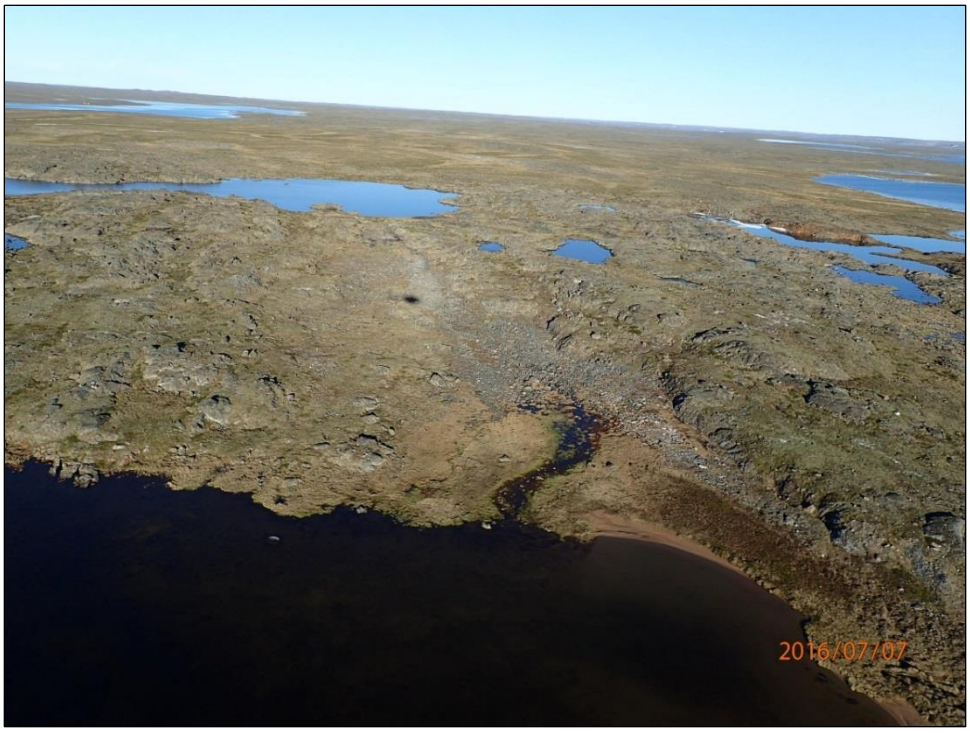

Photo B-21. Looking west at west side of Lake A47 (Foreground) showing 'Watercourse' A49-A47 and Lake A49 in the background. There is no surface connection between Lake A47 and A49. July 7, 2016.

Photo B-22. Watercourse' A49-A47, looking upstream from Lake A47. July 7, 2016.

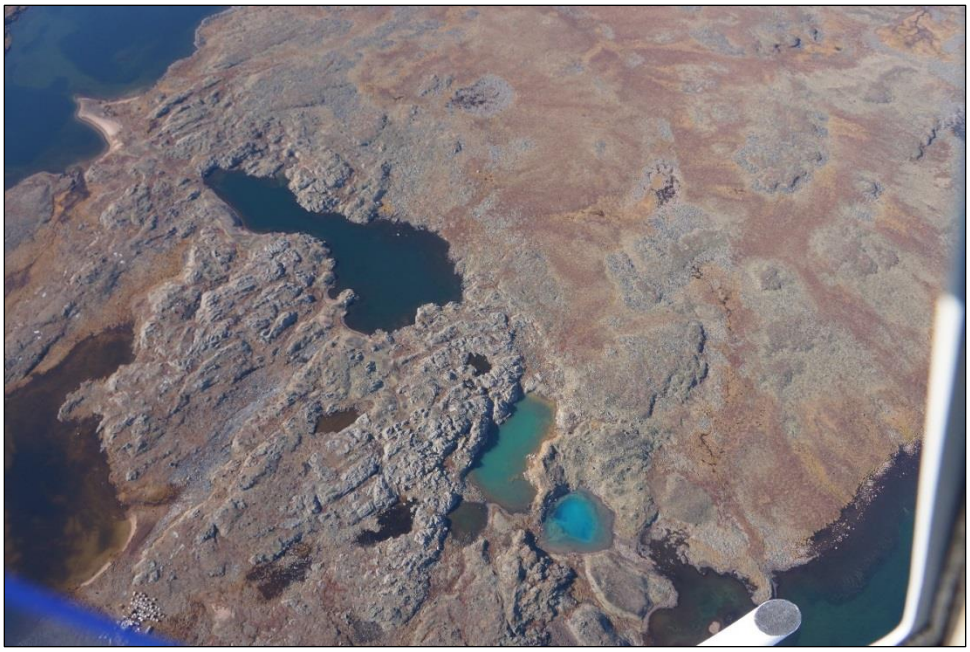

Photo B-23. Aerial view of, diagonally from upper left to lower right, Whale Tail Lake, Lake A49, two small lakes that drain to Nemo Lake, and Nemo Lake in the lower right. Part of Lake A47 is shown in the lower left.

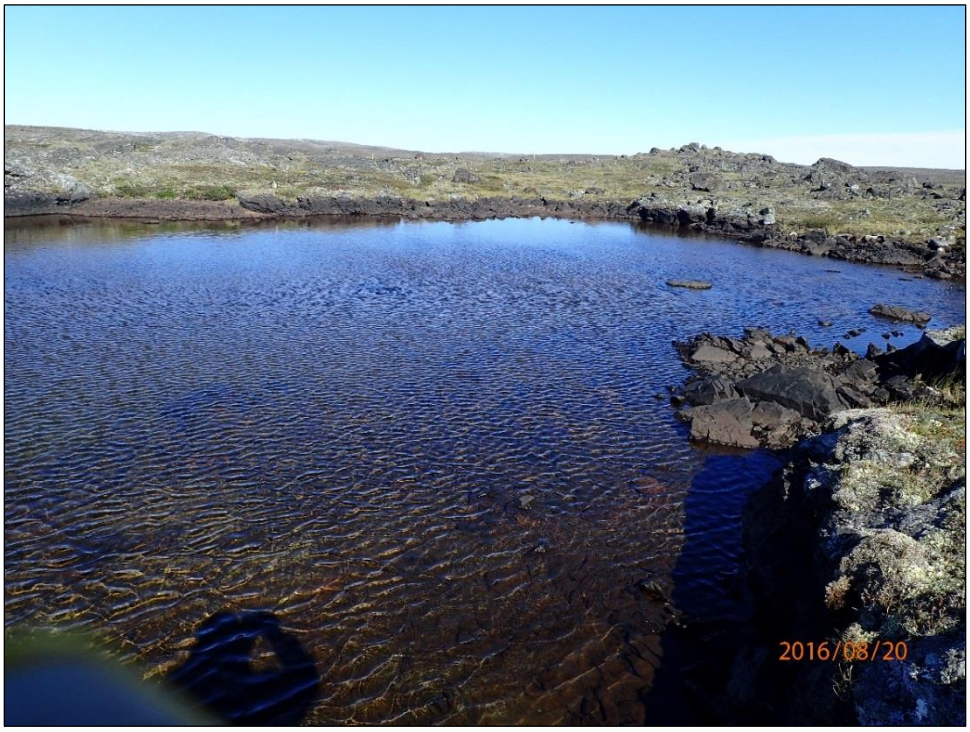

Photo B-24. North shore of Lake A49 August 20, 2016.

Photo B-25. South-west shore of Lake A49. August 20, 2016.

Appendix C. Complementary Measures

APPENDIX C. COMPLEMENTARY MEASURES

1. INTRODUCTION

Consistent with the Whale Tail Project Fisheries Act Authorization, a portion of fish habitat offsetting for the Whale Tail Pit Project Expansion will be comprised of complementary measures in the form of fisheries-related research. Research projects are 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.

The following research projects are proposed as complementary measures to partially offset fish habitat losses under both Section 35 and Section 36 of the *Fisheries Act* from the Whale Tail Pit Project Expansion. A conceptual design is provided for each project, for discussion with Fisheries and Oceans Canada (DFO), Kivalliq Inuit Association (KIA), Hunters and Trappers Organizations (HTOs), and other stakeholders. If there is agreement that the proposed projects are suitable, more detailed study designs will be developed during the regulatory phase. The research studies are planned to collect additional data over and above regular monitoring programs, and to assess scientifically driven hypotheses, independent of compliance monitoring.

A common goal will be to provide a tangible benefit for future assessments of northern fish populations. Outside of deliverables related to scientific publications, Agnico Eagle and all research groups will emphasize and facilitate local community input and capacity building as a component of each study. Each project team will follow a specific plan for community engagement, which will incorporate and document communications and capacity building within the local communities (see preliminary description for each project below).

Project descriptions for the conceptual complementary measures for Section 35 losses are provided in Section 2, and for Section 36 losses in Section 3.

2. CONCEPTUAL RESEARCH PLANS PROPOSED AS COMPLEMENTARY MEASURES (SECTION 35)

The following conceptual outline of a research study is proposed as part of the offsetting plan for Section 35 habitat losses.

The objectives, methods, timelines, project-specific deliverables, and preliminary community engagement plans of the associated research studies as determined at this time are described in detail below.

2.1 ASSESSMENT OF SEASONAL FISH MOVEMENT BETWEEN LARGE LAKES AND SEASONALLY CONNECTED SMALL LAKES AND PONDS

2.1.1 Summary

Little information is available in the literature regarding fish utilization of small lakes and ponds that are seasonally connected to larger Arctic lakes. Field investigations for the Whale Tail Project have determined that there is upstream movement of Ninepspine Stickleback and Slimy Sculpin into some streams that connect small lakes to a larger lake during or immediately after freshet and also that there is downstream movement of primarily young-of-the-year through these streams in the late summer, prior to freeze-up. This study will investigate fish movement to and from connected waterbodies.

2.1.2 Introduction

Many large Arctic lakes have smaller lakes and ponds that are seasonally connected via small, seasonal streams. Limited data exist on the fish utilization of these smaller lakes and ponds, but movements, if they occur, could play an important role in structuring the fish community and in fish energetics. Small lakes and ponds warm more quickly in the spring and reach higher temperatures during the summer than the larger lakes. Many do not contain large predators.

It is hypothesized that small-bodied fishes move into these small lakes and ponds in the spring, to spawn and that adults and young-of-the-year move downstream to the larger lakes in the fall. This would allow populations of these small-bodied fishes to take advantage of the higher temperatures and reduced predation in the small lakes and ponds. Juvenile Arctic Char may also utilize the smaller lakes and ponds seasonally.

The habitat model used to evaluate habitat impacts for the Whale Tail and IVR Projects assigns habitat values based on depth and substrate; it does not differentiate between larger lakes and smaller connected lakes. If the hypothesized movements do occur between lakes, this would support treating the smaller connected waterbodies as extensions of the larger system. If such movements do not occur, then the smaller lakes might move appropriately considered independently in the habitat models.

2.1.3 Background

Investigations of fish present in small connecting streams were conducted during baseline data collections for the Whale Tail Project. Electrofishing revealed that small-bodied fish and juvenile Arctic Char moved into the seasonal streams, which are frozen during the winter, during or immediately following freshet. The numbers of fish captured in the streams were generally low throughout the sampling season. The exception to this was one location downstream from a short steep section of one of the streams. There, large numbers of Ninespine stickleback were captured early in the season. This suggested that these fish were attempting to move upstream and their upstream movement was being impeded by the high velocities at this location.

In late June 2018, small-mesh fyke nets in two streams connecting Whale Tail Lake to upstream lakes and ponds captured fish moving upstream. In one of the streams, catches of Ninespine Stickleback in approximately 24-hour sets ranged from zero to 134; in the other stream, catches of Ninespine Stickleback ranged from zero to 35. Low numbers of juvenile Arctic Char were also captured.in both streams and adult Slimy Sculpin were captured in one. In August 2018, drift nets were set in these streams to capture fish moving downstream. From two to fifteen small Ninespine Stickleback were captured in approximately 24-hour sets in one stream. Up to 530 Ninespine Stickleback and 166 Slimy Sculpin were captured in 24-hour sets in the second stream. Based on size, most of the individuals of both species were young of the year. The drift net data suggest that at least one of the streams conveys significant numbers of YOY Slimy Sculpin and Ninespine Stickleback to the larger downstream lake. It is considered likely that the primary source of these individuals is the upstream lake and not the stream itself.

2.1.4 Objectives

This research study will aim to understand movements of fish between a large lake and smaller, seasonally connected lakes or ponds. This will contribute to knowledge regarding the contribution of the smaller waterbodies to the fish community structure and productivity of the aquatic system. This, in turn, will inform the treatment of the small, connected waterbodies in habitat models that are used to assess habitat losses and evaluate offsetting opportunities.

2.1.5 Methods

The following specific methods related to surveillance and analysis of fish populations are planned to be included as part of this study:

- Small-mesh fyke nets will be used to capture fishes moving upstream and downstream in at two locations in a connecting stream during the open-water season.
- Captured individuals will be marked with visible elastomer tags that indicate the location of capture and approximate date of capture and direction of movement. It is expected that these will include both small-bodied species (Ninespine Stickleback, Slimy Sculpin) and juvenile Arctic Char.
- Ratios of tagged to untagged fish will be used to estimate the total number individuals moving in each direction.
- In addition, drift nets will be used to capture young-of-the-year fish moving downstream during the open-water season.

Water temperature and flow will be monitored in the watercourses and the upstream and downstream lakes during the study. These data will provide insight into the numbers of fish undertaking migrations as well as the environmental factors that trigger fish movement.

2.1.6 Timeline

Field activities for this study are planned to begin in Summer 2020, in conjunction with other investigations being conducted as complementary measures under the Whale Tail Pit *Fisheries Act* Authorization. It is expected that the study will be completed in one field season and results will be reported by Summer 2021.

2.1.7 Project Deliverables

As is the case for all studies proposed as complementary measures an annual report to the MFRAG will be a study requirement (see details, Section 2.7). Publication of one or more manuscripts in peer-reviewed journals (e.g., Canadian Journal of Fisheries and Aquatic Sciences, Environmental Toxicology and Chemistry, Arctic Science, Arctic) will be targeted, as will presentation of results by the research team during at least one national conference (e.g., Canadian Conference for Fisheries Research).

This study will improve scientific understanding of relationships between productivity of northern fish communities and small, connected lakes that typically do not contain large predators, specifically Lake Trout. This information will be valuable for consideration by proponents and regulatory agencies during future assessments of impacts in northern aquatic systems.

2.1.8 Community Engagement

As a Whale Tail Pit project design component, flooding of the Whale Tail South area was discussed throughout consultations for Whale Tail pit permitting and the FEIS review process. Having identified in discussions with DFO an opportunity for research into fish population responses to the proposed flooding, the research team has begun to formulate a plan for further community engagement.

2.2 DATA MANAGEMENT

For all research projects included as complementary measures, biological and abiotic samples will be collected by trained personnel working under appropriate permits.

Archival and management of collected samples will be determined and coordinated by each research team based on the nature of their specific project. A sample handling protocol will be developed and included in the initial annual report to the MFRAG (see Section 2.7) for each project to ensure consistency within each research team and understand transferability of data between groups.

Throughout each project, all data collected will be stored and managed by the individual research teams, who will similarly produce a data management protocol to be included with the first annual report to the MFRAG. Metadata describing each project's objectives will be submitted to the Polar Data Catalogue within one year of study initiation. Upon study completion (i.e., publication or other, to be determined by the MFRAG), data collected may also be made available through this service.

2.3 LEVEL OF SUPPORT AND CONTRIBUTION TO OFFSETTING

This project is proposed as a complementary measure to address both Section 35 and Section 36 habitat losses arising from the Whale Tail Pit Project Expansion. The level of support provided by Agnico Eagle will be valued on the cost estimate for the proposed physical offsetting measures at 45% of the cost of constructed offsets. For Section 35 habitat losses, this would be equal to 2.2 HUs. Given the expected total cost of offsetting for the Whale Tail Pit Project Expansion, it is expected that it will be necessary to undertake this study as an add-on to other studies being undertaken at the Whale Tail site.

2.4 MFRAG ROLE, PLAN REVIEW AND UPDATES

A Meadowbank Fisheries Research Advisory Group (MFRAG) will be established to review and approve any changes to research projects proposed under the Fish Habitat Offsetting Plan for Whale Tail Pit and its role will be expanded to include research projects proposed as complementary measures for the IVR project. This group will include DFO, Agnico Eagle, KIA and a third party research advisor. The MFRAG will meet 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.

As described in the Whale Tail Pit Fish Habitat Offset Monitoring Plan (March 2018), criteria for success of all research projects are centered around publication of one or more manuscripts per study in a peer-reviewed journal, such that research outcomes would be broadly available to the scientific community. However, it is recognized that not all factors affecting outcomes of research projects and suitability of studies for such publication are within the control of Agnico Eagle, academic partners, or DFO. As a result, in certain instances, peer-reviewed publication may not be a viable route for dissemination of knowledge gained through these projects. In such cases, Agnico Eagle suggests discussions be undertaken by the MFRAG to determine a mutually agreeable solution (e.g., conference presentations, inter-agency workshops).

This plan describing complementary measures for the Whale Tail Pit Project Expansion fish habitat offsetting will be updated annually to reflect changes and progress in research projects and to track project funding to date.

2.5 PROJECT LEADS, RESEARCH TEAMS, AND PARTNERSHIPS

The following section describes research leads, research team members, and partnerships with organizations outside of the identified research team groups and Agnico Eagle for each study. Curriculum vitae (CV) for possible research lead are provided in Appendix C-1.

Project Title:

Assessment of seasonal fish movement between large lakes and seasonally connected small lakes and ponds.

Possible Lead Researcher:

Dr. Heidi Swanson
Assistant Professor and University Research Chair
Department of Biology
200 University Ave. W
University of Waterloo
Waterloo, Ontario, Canada N2L 3G1
Phone: (519) 888-4567 Extension 37387
Fax: (519) 746-0614
Email: heidi.swanson@uwaterloo.ca

Additional Research Team Members (excl. students):

None.

Outside Study Partners:

None.

3. CONCEPTUAL RESEARCH PLANS PROPOSED AS COMPLEMENTARY MEASURES (SECTION 36)

The following conceptual outline of a research study is proposed as part of the fish compensation plan for Section 36 habitat losses.

3.1 PROOF-OF-CONCEPT OF A SMALL-SCALE COMMUNITY-BASED ARCTIC CHAR HATCHERY IN THE KIVALLIQ REGION

The development of fish hatcheries in the Kivalliq Region offers potential to improve fisheries productivity, as well as establish community-led businesses and support economic growth in the region. Arctic char are a popular food-fish for local people, and community consultation identified that offsetting options that focused on improving Arctic char fisheries are preferred. This research plan aims to establish the feasibility of a small-scale hatchery that will provide a basis for future development opportunities that could be advanced through community-partnerships or other initiatives.

3.1.1 Summary

The development of a fish hatchery offers potential to enhance local fisheries productivity, focused on a popular fish for subsistence, Arctic char. The concept of a fish hatchery is relatively simple, and has been developed successfully before in Arctic environments. The feasibility of the hatchery will be assessed through: level of community support; availability and performance of the temporary hatchery facility; survival and fitness of the juvenile char.

3.1.2 Introduction

Fish hatcheries provide a rearing environment for juvenile fish, which can then either be grown as a food source (fish farms), or stocked in the wild to enhance natural fisheries. The development of fish hatcheries in the Kivalliq Region offers great potential for community-led businesses, economic growth, as well as means to improve fisheries productivity, through the additional hatchery-reared juveniles that are released into specific river systems.

Based on feedback obtained through community-consultation on fish offsetting options to date, there is a preference for projects that enhance Arctic char fisheries. There is some interest in the concept of a hatchery, although it is recognized that more work would be needed to confirm the feasibility of such an approach. This project aims to determine proof-of-concept for a small-scale hatchery based on three main points: community; facilities; and fisheries.

3.1.3 Background

Fish hatcheries have been successfully developed in other far-north (Arctic) environments, including Nunavik, the Yukon, as well as across Scandinavia. Arctic char respond well to hatchery conditions, and thrive in relatively simple conditions using standard commercial feed from salmon farms. The concept for the small-scale hatchery would be to obtain wild fish from the same watershed as the hatchery as broodstock, so that no adult fish would need to be kept in tanks. The hatchery would be for rearing and stocking only, as is the case in Kuujjuaq, Nunavik. The Nappukaliuvik Hatchery has

been active from 1999-2013, and 2017, and is an Inuit-led initiative. Monitoring of the Nepihjee River Arctic char population, led by Nunavik Research Centre, has taken place every summer following the creation of the hatchery and a fishway, which was constructed in 1998 at the mouth of the Nepihjee River to allow anadromous Arctic char to migrate past an impassable waterfall. In July 2018, approximately 12,000 juvenile char were released into Qamutitsait Lake, north of Kuujjuaq, after being hatched at the Nappukaliuvik hatchery in the winter, from eggs collected in the fall 2017. The program has been successful in populating the Nepihjee River system with Arctic char, as well as successful in creating youth employment opportunities, and training opportunities for students.

During community consultation in Baker Lake, the focus groups presented mixed opinions about a hatchery. There was interest in how the hatchery would work, and how this may enhance Arctic char populations. The Hamlet of Baker Lake and Baker Lake HTO in particular, could see the benefits for the community regarding employment and training, as well as potential opportunities to improve local Arctic char fisheries. However, some members of the Elder's focus group expressed concern that the fish produced would not be natural and may taste different. It was recognized in all Focus Groups that more work would be needed to confirm the viability of this option.

A key component of the proposed project is to demonstrate how a hatchery may enhance the local fisheries, and that only adults from the same watershed would be used as a source of juveniles, which would in turn, be returned to the same system as the broodstock. Although a hatchery could ultimately be used to support a fish-farm, where char are raised to adults, this is not the objective of the hatchery as currently proposed. As hatcheries are a new concept in the Kivalliq Region, an important component of the research will be to demonstrate how the hatchery will function, and to seek community engagement and determine support.

With support, leadership and hands-on participation from community members, the project will be used to determine the feasibility of 'facilities', meaning a suitable location for the building, with access to a water supply that can be recirculated with a simple bio-filter for water treatment. The facilities will also be selected based on proximity to a suitable watershed for obtaining adult char and releasing juveniles. If suitable facilities can be determined, with community buy-in on the concept, adult char will be fished and stripped of eggs and milt on the river bank, for fertilization and incubation at the hatchery.

Training will be provided for community member(s) to look after the hatchery during juvenile rearing. Once the juvenile char are 0.5 – 1 g in size, fish would be fin-clipped and released into the natal system. Based on numbers from existing char hatcheries in other far-north locations, a 10 m x 10 m rearing tank, can provide hundreds of thousands of juvenile char in one season. Community members would inform the location of the release points, and would be actively involved in transferring fish. A community-based monitoring program would then be implemented that would informally record fin-clipped char that are caught in the future year(s).

It is recognised that more rigorous, and long-term, fish monitoring may be needed in the future to confirm successful stocking rates, and contribution of hatchery-reared char to local fisheries. However, the objective of this initial research project is to confirm proof-of-concept, and whether community support exists, and whether a suitable location and facility can be selected that can successful support successful char rearing. It is anticipated that if this proof-of concept study is successful, that future work would build upon these outcomes.

3.1.4 Objectives

The research project will aim to establish a proof-of-concept for a small-scale hatchery in the Kivalliq Region, taking into account community support and engagement; location of suitable facilities; and successful rearing and stocking of hatchery-reared juvenile char. This study will provide information on whether an Arctic char hatchery has community support, and can practically produce healthy char that can supplement natural fish stocks. This research will directly underpin potential future plans for larger, or additional hatcheries, that could be located throughout the Kivalliq Region.

3.1.5 Methods

A brief outline of conceptual methods are provided here, which will be further refined during the planning stages.

Community

- Consultation and examples of hatcheries will be delivered in communities of interest (potentially Baker Lake and Rankin Inlet) to effectively demonstrate the concept of a hatchery.
- A concensus-based decision-making tool will be applied to determine whether the communities are supportive of the proof-of-concept hatchery facility operating for one season.
- Community engagement and incorporation of IQ will be sought to select the temporary hatchery facility and location of Arctic char broodstock and juvenile release points.

Facilities

- Set-up a temporary structure to house fibre-glass tanks, with a recirculating water system, bio-filer, heat, light, and an alarm monitor for water supply to the tanks.
- Provide training to one or two community members that will oversee the hatchery; provide daily feed after yolk-sac absorption; record performance metrics of the system; and fin clip prior to release.

Fisheries

- Record daily mortalities during incubation, as well as feed quantities; growth rates up to release date (approximately 0.5 -1g), and numbers of fish released.
- Implement a community-based recording system for any fin-clipped fish caught.

3.1.6 Timeline

Consultation for this study will continue in Q1 2019. Depending on the outcome of the consultation meetings, siting studies for the hatchery facilities could occur as early as Q3 2019, with implementation commencing in Q3-Q42019 or 2020, depending on the outcome of the previous phases in the approach. It is expected that the proof of concept would be completed within 18 months, and results reported thereafter.

3.1.7 Project Deliverables

As is the case for all studies proposed as complementary measures, an annual report to the MFRAG will be a study requirement. Publication of one or more manuscripts in peer-reviewed journals (e.g., Canadian Journal of Fisheries and Aquatic Sciences, Arctic Science, Arctic) will be targeted, as will presentation of results by the research team during at least one national conference (e.g., Canadian Conference for Fisheries Research). As this complementary measure is quite practical in application, the journal selected for the manuscript may be limited, and the value of the research may be best suited for conferences and workshops that consider the integration of community engagement as a key part of study results.

3.1.8 Community Engagement

The concept of a fish hatchery was discussed during the community consultation meetings and additional engagement will occur as an integral part of the project.

3.2 DATA MANAGEMENT

For all research projects included as complementary measures, biological and abiotic samples will be collected by trained personnel working under appropriate permits.

Archival and management of collected samples will be determined and coordinated by each research team based on the nature of their specific project. A sample handling protocol will be developed and included in the initial annual report to the MFRAG (see Section 3.7) for each project to ensure consistency within each research team and understand transferability of data between groups.

Throughout each project, all data collected will be stored and managed by the individual research teams, who will similarly produce a data management protocol to be included with the first annual report to the MFRAG. Metadata describing each project's objectives will be submitted to the Polar Data Catalogue within one year of study initiation. Upon study completion (i.e., publication or other, to be determined by the MFRAG), data collected may also be made available through this service.

3.3 LEVEL OF SUPPORT AND CONTRIBUTION TO OFFSETTING

This project is proposed as a complementary measure to address Section 36 habitat losses arising from the Whale Tail Pit Project Expansion. The level of support provided by Agnico will be valued on the cost estimate for the proposed physical offsetting measures at 45% of the cost of constructed offsets. For Section 36, this would be equal to 3.9 HUs. Given the expected total cost of offsetting for the Whale Tail Pit Project Expansion, it is expected that it will be necessary to undertake this study as an add-on to other studies being undertaken at the Whale Tail site.

3.4 MFRAG ROLE, PLAN REVIEW AND UPDATES

A Meadowbank Fisheries Research Advisory Group (MFRAG) will be established to review and approve any changes to research projects proposed under the Fish Habitat Offsetting Plan for Whale Tail Pit and its role will be expanded to include research projects proposed as complementary

measures. This group will include DFO, Agnico Eagle, KIA and a third party research advisor. The MFRAG will meet 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.

As described in the Whale Tail Pit Fish Habitat Offset Monitoring Plan (March 2018), criteria for success of all research projects are centered around publication of one or more manuscripts per study in a peer-reviewed journal, such that research outcomes would be broadly available to the scientific community. However, it is recognized that not all factors affecting outcomes of research projects and suitability of studies for such publication are within the control of Agnico, academic partners, or DFO. As a result, in certain instances, peer-reviewed publication may not be a viable route for dissemination of knowledge gained through these projects. In such cases, Agnico suggests discussions be undertaken by the MFRAG to determine a mutually agreeable solution (e.g., conference presentations, inter-agency workshops).

This plan describing complementary measures for the Whale Tail Pit Project Expansion fish habitat compensation will be updated annually to reflect changes and progress in research projects and to track project funding to date.

3.5 PROJECT LEADS, RESEARCH TEAMS, AND PARTNERSHIPS

Project Title:

Proof-of-Concept of a Small-Scale Community-Based Arctic Char Hatchery in the Kivalliq Region.

Lead Researcher:

To be determined.

Additional Research Team Members (excl. students):

To be determined: potential for Department of Fisheries and Oceans.

Outside Study Partners:

To be determined: potential for community-partnerships, including local HTOs, or the Hamlet Office.

Appendix C-1 Heidi Swanson CV

CURRICULUM VITAE

1. PERSONAL INFORMATION

Heidi Swanson, Assistant Professor and University Research Chair
Department of Biology
200 University Ave W, Waterloo, ON N3G 2L1
Phone: (519) 888-4567-37387
Email: hswanson@uwaterloo.ca

2. EDUCATION

Degree	Discipline	Institution	Date of Convocation
Doctor of Philosophy	Biology	University of New Brunswick	2010/05/17
Master of Science	Environmental Science and Ecology	University of Alberta	2004/06/10
Honour's Bachelor of Science	Biology	Queen's University	2001/05/20

3. RECOGNITIONS, AWARDS, FELLOWSHIPS (LIFETIME)

2018	**Early Researcher Award, Province of Ontario** • 38% success rate in 2018
2017	**Outstanding Performance Award, Faculty of Science, University of Waterloo** • Awarded by Dean in recognition of excellence in teaching and scholarship. Faculty members are eligible every 3 years (cannot be awarded in consecutive years)
2015	**University Research Chair, 2015-2022** • Approximately 5 awarded per year (University-wide) to "recognize exceptional achievement and pre-eminence in a particular field of knowledge"
2015	**Community Engagement Award, Northern Contaminants Program** • Awarded based on successful engagement of northern Indigenous peoples in research
2014	**Outstanding Performance Award, Faculty of Science, University of Waterloo** • Awarded by Dean in recognition of excellence in teaching and scholarship. Faculty members are eligible every 3 years (cannot be awarded in consecutive years)
2012	**W. Garfield Weston Postdoctoral Fellowship for Northern Research** • Four awarded nationally each year ($50,000 declined)
2010	**Izaak Walton Killam Postdoctoral Fellowship** • University of Alberta, two awarded institutionally in 2010 ($96,000)
2010	**L'Oreal-UNESCO Women in Science Research Excellence Award (Postdoctoral)** • Two awarded nationally each year ($20,000)

2008	**W. Garfield Weston Award for Northern Studies (PhD)** • Seven awarded nationally each year ($40,000)
2006	**Canadian Northern Studies Trust Graduate Scholarship** • 1 awarded nationally each year ($5,000)
2006	**NSERC Canada Graduate Scholarship – Doctoral** • 2 years, $35,000/year
2002	**Ralph Steinhauer Award of Distinction – MSc** • $15,000 awarded for excellence in scholarship
2002	**Alberta Ingenuity Incentive Award – MSc** • $15,000 awarded for excellence in scholarship and research
2001	**NSERC Postgraduate 'A' Scholarship - MSc** • 2 years, $17,000 per year
2000 and 2001	**NSERC Undergraduate Research Awards**

4. PROFILE

As a recognized expert in mercury accumulation, salmonid ecology, and food web ecology, I am a trained natural scientist with a passion for integrating the social and cultural values of Indigenous peoples and other stakeholders into my research. I have received >$3.5 M in funding and two outstanding performance awards (University of Waterloo - based on scholarship and teaching) in the first five years of my tenure-track position. I have published papers with trainees in a number of leading and high-impact journals. I have received national recognition for involvement of Indigenous communities in my research, and my current research program reflects commitment to conducting research that has social and economic impacts. I use a range of cutting-edge ecological and environmental analytical techniques, such as stable isotopes, fatty acid signatures, and otolith microchemistry, to understand fish and ecosystem ecology, and to trace contaminant flow through aquatic ecosystems.

5. EMPLOYMENT HISTORY

Position	Institution	Department	Start Date	End Date
Assistant Professor	University of Waterloo	Biology	Nov 2012	
Research Adjunct Professor	Western University	Geography	Feb 2017	Feb 2020
Killam Postdoctoral Fellow	University of Alberta	Biological Sciences	Sept 2010	Sept 2012
Biologist (Contract)	Department of Fisheries and Oceans	Central and Arctic	Jan 2010	Sept 2010
Curriculum developer (Contract)	Actua		May 2010	June 2010
PhD Student	University of New Brunswick	Biology	Jan 2006	Dec 2009
Oil Geomorphologist (Contract)	Eastern Canada Response Corporation	Shoreline assessment	April 2007	June 2007
Limnologist	Government of Alberta	Environment	July 2005	June 2006

Position	Institution	Department	Start Date	End Date
Aquatic Ecologist	Golder Associates Ltd	Biophysical	June 2004	July 2005
Field crew leader/ technician	Golder Associates Ltd	Aquatics	Summer 1997	Summer 200

*Seasonal (in between years of undergraduate education)

6. RESEARCH FUNDING HISTORY- >$3.5 M secured to support Swanson research program (of $>11 M in collaborative grants) between 2013 and 2018.

CIMP - Cumulative Impact Monitoring Program, Government of Northwest Territories
NCP - Northern Contaminants Program, Indigenous and Northern Affairs Canada
DFO - Department of Fisheries and Oceans Canada

For collaborative projects, amounts allocated to my research program are indicated in **bold parentheses.** Otherwise, all funds were allocated to my research program. Much of my work occurs in collaboration with community and Indigenous collaborators and Co-PIs. For grants below for which there is an Indigenous or community Co-I or Co-PI, I am responsible for preparing the proposal, the technical work within the proposal, and all interim, annual, final, and financial reporting.

Investigators	Funding Agency and Title	Total Amount (per annum)	Per annum amount	Project Period
Swanson, Low (Community Co-I), Branfireun, Brekke	**CIMP:** Understanding and predicting spatial variability in fish mercury levels in the Dehcho region	$187,000 (**$151,000)**	$62,300 **($50,300)**	2018-2021
Low (Community Co-I), Swanson, MacLatchy, Branfireun	**NCP:** Understanding fish mercury levels in Dehcho lakes	$100,655 **($73,155)**	$33,552 **($24,385)**	2018-2021
Swanson	**Early Researcher Award, Province of Ontario:** Understanding ecology, life history, and mercury levels in fish	$150,000	$30,000	2018-2023
Swanson	**DFO, Coastal Restoration Program:** Restoration of anadromous Arctic Char and Dolly Varden near Kugluktuk, NU	$1,261,890	$252,378	2018-2022
Fresque-Baxter, Dutton, Parlee,, True, Kelly, Ellis, Swanson, Wesche, Natcher	**POLAR Canada**: The state of Northwest Territories country food systems: planning for long-term sustainability	$250,000 **($80,000)**	$125,000 **($40,000)**	2017-2019

Investigators	Funding Agency and Title	Total Amount (per annum)	Per annum amount	Project Period
MacLatchy, Swanson, Lister, Branfireun	**NCP:** Investigation into relatively high Walleye mercury concentrations in Tathlina Lake	$28,000 **($19,500)**	$28,000 **($19,500)**	2017-2018
Low (Community Co-PI), Swanson, Branfireun	**NCP:** Variable fish mercury concentrations in the Dehcho: effects of catchment control and invertebrate community composition	$27,000 **($11,500)**	$27,000 **($11,500)**	2017-2018
Baltzer, Quinton, Swanson, Marsh, Rudolph, MacLatchy, and 17 others	**Canada First Research Excellence Fund:** Northern Water Futures	$2,000,000 **($97,000)**	$666,666 **($32,333)**	2017-2020
Branfireun, Swanson	**NSERC RTI:** An autonomous underwater vehicle for characterizing remote lakes	$150,000 **($0 – access to instrument)**	$150,000 **($0 – access to instrume nt)**	2017-2018
Marshall, Baerer, Boonstra, Copland, Danby, Flowers, Hik, Swanson, Schoof, Murray	**NSERC RTI**: Operations and maintenance support for the Kluane Lake Research	$272,000 **($0 – access to station)**	$136,000 (**$0 – access to station)**	2017-2019
Swanson, Low (Community Co-PI), Branfireun	**CIMP:** Variable fish mercury concentrations in the Dehcho: effects of catchment control and invertebrate community composition	$102,000 **($73,500)**	$51,000 **($36,750)**	2016-2018
Low (Community Co-PI), Swanson, Branfireun	**NCP**: Variable fish mercury concentrations in the Dehcho: Effects of catchment control and invertebrate community composition	$25,000 **($22,000)**	$25,000 **($22,000**	2016-2017
Swanson, Branfireun, Laird, Power	**NSERC RTI**: A field-portable ultra-trace mercury analysis system	$92,000	$92,000	2016-2017

Investigators	Funding Agency and Title	Total Amount (per annum)	Per annum amount	Project Period
Hutchinson, Torretti, Swanson, Parsons, Nesbitt	**Environment and Climate Change Canada Environmental Damages Fund**: Identification, characterization, and prioritization of degraded fish habitat in the Kitikmeot region of Nunavut, Canada	$160,000 **($21,000)**	$80,000 **($10,500)**	2016-2018
Low, Swanson, Evans	**NCP:** Mercury levels in food fish species: risk perception of eating traditional foods	$19,000 **($7,500)**	$19,000 **($7,500)**	2016-2017
Alatini (Indigenous Co-PI), Swanson, Kassi, Branfireun	**NCP:** Understanding contaminant levels in commonly consumed fish of Kluane Lake, Yukon	$24,000 **($15,125)**	$24,000 **($15,125)**	2015-2016
Swanson	**Fisheries and Oceans Canada:** Assessment of trace elements in Arctic char and lake trout otoliths from the Cambridge Bay area	$24,900	$24,900	2015-2016
Swanson	**Fisheries and Oceans Canada:** Assessment of trace elements in Bull Trout	$7,150	$7,150	2015-2016
Alatini (Indigenous Co-PI), Swanson, Kassi, Branfireun, Hik	**Dan Keyi Renewable Resource Council:** Fisheries and fish health in Kluane Lake, Yukon	$88,950 **($22,540)**	$88,950 **($22,540)**	2015-2016
Swanson	**NSERC Collaborative Research and Development:** Investigating occupancy, habitat use, and migrations of Arctic Grayling (Thymallus arcticus) in northern barrenland streams	$173,500	$43,393	2014-2018
Swanson, Muir, Krueger, Bronte, Sitar, Loseto, Sitar, Hansen	**Great Lakes Fishery Commission:** Trophic ecology and isotopic niche of humper Lake Trout (Salvelinus namaycush) in Lake Superior: comparisons with other morphotypes	$115,200	$38,400	2014-2017

Investigators	Funding Agency and Title	Total Amount (per annum)	Per annum amount	Project Period
Swanson	**NSERC Discovery:** Aquatic Ecology and Contaminant Accumulation in Northern Lakes: Understanding and Predicting Change	$130,000	$26,000	2014-2019
Swanson	**NSERC Northern Research Supplement:** Aquatic Ecology and Contaminant Accumulation in Northern Lakes: Understanding and Predicting Change	$75,000	$15,000	2014-2019
Jackson and 20 others	**NSERC Strategic Network:** Canadian Network for Aquatic Ecosystem Services: Mercury in anadromous fishes in the Hudson Bay Lowlands	$4,400,000 **($40,000)**	$880,000[1] **($20,0000)**	2014-2016
Swanson	**BC Lands and Forests:** Westslope Cutthroat Trout Habitat Research	$20,000	$20,000	2014
Swanson and Power	**NSERC Interaction Grant:** Addressing Innovative Options for Habitat Compensation in the Elk River, BC	$4,600	$4,600	2014
Swanson	**De Beers Canada Inc:** Movement and habitat use of Arctic grayling (Thymallus arcticus) near a diamond mine development	$325,000	$325,000	2013-2018
Swanson	**University of Waterloo:** Start-up funds	$200,000	$40,000	2013-2018
Zimmerman, Swanson, Koch, Schmutz, Carey	**Arctic Land Conservation Cooperative:** Biological Responses to Increasing Water Temperatures in Lakes of the Barrow/Atqasuk Focus Watershed: An Interdisciplinary Bioenergetics and Contaminants Study	$504,000 **($230,000)**	$100,800 **($46,000)**	2013-2018
Low (Community Co-I), Swanson	**CIMP:** Understanding Fish Mercury Levels in the Dehcho Region, NWT	$132,000 **($114,000)**	$44,000 **($38,000)**	2013-2015

Investigators	Funding Agency and Title	Total Amount (per annum)	Per annum amount	Project Period
Swanson	**Fisheries and Oceans Canada:** Preliminary assessment of trace elements in Arctic char and lake trout otoliths from the Cambridge Bay area	$25,000	$25,000	2013-2014
Low, Swanson, Townsend, Evans	**Health Canada Climate Change Adaptation:** A return to country food: examining risks and benefits and contaminant perceptions on the safety of traditional diet	$44,000 **($7,500)**	$44,000 **($7,500)**	2013-2015

[1]Averaged over 5 years, which was the total length of the grant. Co-Is participated for varying amounts of time (I was awarded funds for one 2-year MSc project).

7. CONTRIBUTIONS (Lifetime; Citations in parentheses)

Type	Number of contributions
Invited Presentations	32
Conference Presentations and Posters	77
Peer-reviewed journal articles	25 + 2 submitted (502)
Book Chapters	3 + 1 submitted (92)
Technical Reports	24 (6)
Conference Proceedings	1 (7)
Theses	3 (1)
Software	1

Contribution Details

7.1 Articles in Refereed Journals (Swanson trainees are underlined)

7.1.1 Submitted and In Press

1. Coulter, A.A., **Swanson, H.K**. and Goforth, R.R. 2018. Seasonal variation in resource overlap of invasive and native fishes revealed by stable isotopes. Biological Invasions. *In Press*
2. Baker, L.F., Artym, K.A., Lord, S.I., and **Swanson, H.K**. 201X. Source-sink spatial population structure inferred from movement of Arctic Grayling (*Thymallus arcticus*) after dewatering of a headwater lake. *PLOS One*. PONE-D-17-43112. *Revision submitted April 24, 2018.*

7.1.2 Published

1. Ratelle, M., Laird, M., Majowicz, S.E, Skinner, K., **Swanson, H.,** and Laird, B. 2018. Design of a human biomonitoring community-based project in the Northwest Territories Mackenzie Valley, Canada, to investigate the links between nutrition, contaminants and country foods. International Journal of Circumpolar Health 77(1): 151074. Doi: **10.1080/22423982.2018.1510714**
2. Giraldo, C., Stasko, A.D., Walkusz, W., Majewski,, A., Rosenberg, B., Power, M., **Swanson, H.,** and Reist, J.D. 2018. Feeding of Greenland halibut (Reinhardtius hippoglossoides) in the Canadian Beaufort Sea. Journal of Marine Systems 183: 32-41.

3. Laird, M.J.*, Henao, J.A., Reyes, E.S.*, Stark, K., Low, G., **Swanson, H.K**., and Laird, B.D. 2018. Mercury and omega-3 fatty acid profiles of wild –harvested fish of the Dehcho region, Northwest Territories: contaminant risks versus nutrient value. Science of the Total Environment 637-638: 1508-1517.

4. Stasko, A.D., Bluhm, B., Reist, J.D., **Swanson, H.K.,** and Power, M. 2018. Relationships between depth and δ15N of Arctic benthos vary among regions and trophic functional groups. Deep Sea Biology I 135:56-64.

5. Stasko, A.D., Bluhm, B., Michel, C., Archambault, P., Majewski, A., Reist, J.D., **Swanson, H.K**., Power, M., 2018. Benthic-pelagic trophic coupling in Canadian Beaufort Sea food webs along gradients of water mass structure and organic matter input. Marine Ecology Progress Series 594:1-18.

6. Burke, S.M., Zimmerman, C.E., Branfireun, B.A., Koch, J.C., and **Swanson, H**., 2018. Patterns and controls of mercury accumulation in lake sediments from the Arctic Coastal Plain of Alaska. Aquatic Sciences 80:1-15

7. Baker, L.F., Artym, K.J., and **Swanson, H.K**. 2017. Optimal sampling methods for modelling the occupancy of a stream fish species (Arctic Grayling; Thymallus arcticus) in the Barrenlands of Canada. Canadian Journal of Fisheries and Aquatic Sciences. 74:1564-1574.

8. Reyes, E.S.*, Henao, J.J.A., Kornobis, K.M., Hanning, R.M., Majowicz, S.E., Liber, K., Stark, K.D., Low, G., **Swanson, H.K**., and Laird, B.D. 2017. Associations between omega-3 fatty acids, selenium content, and mercury levels in wild-harvested fish from the Dehcho Region, Northwest Territories, Canada. Journal of Toxicology and Environmental Health A 80:18-31. 10.1080/15287394.2016.1230916

9. Brewster, J., Giraldo, C., **Swanson, H**., Walkusz, W., Loewen, T.N., Reist, J.D., Stern, G.A., and Loseto, L.L. 2016. Ecological niche of coastal Beaufort Sea fishes defined by stable isotopes and fatty acids. Marine Ecology Progress Series 559: 158-173. doi: 10.3354/meps11887

10. Gilbert, M.J.H., Donadt, C.R., **Swanson, H.K**., and K.B. Tierney. 2016. Low annual fidelity and early upstream migration of anadromous Arctic Char (Salvelinus alpinus) in a variable environment. Transactions of the American Fisheries Society 145: 931-942.

11. Stasko, A.D., **Swanson, H.K**., Majewski, A., Atchison, S., and J.D. Reist, and Power, M. 2016. Influences of depth and pelagic subsidies on the size-based trophic structure of Beaufort Sea fish communities. Marine Ecology Progress Series 543:159-166.

12. Giraldo, C., Stasko, A.D, Choy, E.S., Rosenberg, B., Majewski, A., Power, M., **Swanson, H.K.**, Loseto, L., and James D. Reist. 2016. Trophic variability of Arctic fishes in the Canadian Beaufort Sea: a fatty acids and stable isotopes approach. Polar Biology. Volume 39(7): 1267–1282.

13. **Swanson, Heidi K**., M. Lysy, M. Power, A. Stasko, J. Johnson, and J. Reist. 2015. A new probabilistic method for quantifying n-dimensional ecological niches and niche overlap. Ecology, 96(2): 318–324.

14. Chételat, J. Amyot, M., Arp, P., Blais, J., Depew, D.., Emmerton, C., Evans, M., Gamberg, M., Gantner, N., Girard, C., Graydon, J., Kirk, J., Lean, D., Lehnherr, I., Muir, D., Nasr, M., Poulain, A., Power, M., Rencz, A., Roach, P., Stern, G. and **Swanson, H.K**., and van der Velden, S. 2015. Mercury in freshwater ecosystems of the Canadian Arctic: Recent advances on its cycling and fate. Science of the Total Environment 509-510: 41-66.

15. Harris, L.N., Moore, J-S., McDermid, C.G., and **Swanson, H.K**. 2014. Long-distance anadromous migrations in a freshwater specialist: the Lake Trout (Salvelinus namaycush). Canadian Field Naturalist 128:260-264.

16. Zimmerman. C.E., **H.K. Swanson**, E.C. Volk, and A.J.R. Kent. 2013. Species and life-history affects the utility of using otolith chemical composition to determine natal stream-of-origin in

Pacific salmon. Transactions of the American Fisheries Society 142:1370–1380.

17. Kidd, K.A., D.C.G., Muir, M. Evans, X. Wang, D.M. Whittle, **H.K. Swanson,** T.A. Johnston, and S. Guildford. 2012. Biomagnification of mercury through lake trout food webs with different physical, chemical and biological characteristics. Science of the Total Environment 438:135-143.
18. **Swanson, H.K**., K.A. Kidd, and J.D. Reist. 2011. Quantifying importance of marine prey for two partially anadromous fishes. Canadian Journal of Fisheries and Aquatic Sciences. 68: 2020-2028.
19. St. Louis, V.L., A.E. Derocher, I. Stirling, J.A. Graydon, C. Lee, E. Joksch, E. Richardson, S. Ghorpade, A.K. Kwan, J.L. Kirk, I. Lehnherr, and **H.K. Swanson**. 2011. Differences in mercury bioaccumulation amongst polar bears (Ursus maritimus) from the Canadian high and sub Arctic. Environmental Science & Technology 45: 5922-5928.
20. **Swanson, Heidi K**., Nikolaus Gantner, Karen Kidd, Derek Muir, and Jim Reist. 2011. Comparison of mercury concentrations in landlocked, resident, and sea-run fishes from Nunavut, Canada. Environmental Toxicology and Chemistry 30 (6): 1459-1467.
21. **Swanson, Heidi K**., Karen A. Kidd, John A. Babaluk, Rick J. Wastle, Panseok P. Yang, Norman M. Halden, and James D. Reist. 2010. Annual marine migrations in lake trout (Salvelinus namaycush) from the central Canadian Arctic: insights from otolith microchemistry, stable isotope ratios, and comparisons to Arctic charr (S. alpinus). Canadian Journal of Fisheries and Aquatic Sciences 67: 842-853.
22. **Swanson, Heidi K**., Karen A. Kidd, and Jim D. Reist. 2010. Effects of partially anadromous Arctic charr (Salvelinus alpinus) on ecology of Arctic lakes. Ecosystems 13: 261-274.
23. **Swanson, Heidi K**., and Karen A. Kidd. 2010. Species, life history, and the presence of anadromous Arctic charr (Salvelinus alpinus) affect mercury concentrations in Arctic food fishes. Environmental Science &Technology 44: 3286-3292.
24. **Swanson, Heidi K**., Thomas A. Johnston, David W. Schindler, R. Andrew Bodaly, and D. Michael Whittle. 2006. Mercury bioaccumulation in forage fish communities invaded by rainbow smelt (Osmerus mordax). Environmental Science &Technology 40: 1439-1446.
25. **Swanson, H.K**., T.A. Johnston, W.C. Leggett, R.A. Bodaly, R.R. Doucett, and R.A. Cunjak. 2003. Trophic positions and mercury concentrations in rainbow smelt and native forage fishes in northwestern Ontario lakes. Ecosystems 6: 289-299.
26. Johnston, T.A., W.C. Leggett, R.A. Bodaly, R.R. Doucett, R.A. Cunjak, and **H.K. Swanson**. 2003. Temporal changes in mercury bioaccumulation by predatory fishes of boreal lakes following the invasion of an exotic forage fish. Environmental Toxicology and Chemistry 22(9): 2057-2062.

7.2 Chapters in Books

1. Vinson, M., Swanson, H.K, and Chavarie, L. 201X. Trophic ecology of Lake Charr. In: Muir, A., Krueger, C., Riley, S., and Hansen, M. (Editors). Lake Charr *Salvelinus namaycush*: Biology, Ecology, Distributionn, and Management. Wiley Publishers. *In Review.*
2. Reist, J.D., Dempson. B.J, Dunmall, K., Harris, L.N., Power, M., and **Swanson, H.K**. 2018. Salmonidae – Trouts and Salmons. In: Coad, B.W., and Reist, J.D. (Editors). Marine Fishes of Arctic Canada, University of Toronto Press.
3. Tonn, W.M., **Swanson, H.K**., Paszkowski, C., Hanisch, J., and Chavarie, L. 2016. Northern North American Fisheries. In: Craig, J.F. (Editor). The Ecology of Freshwater Fisheries, Wiley-Blackwell.
4. Wrona, F.J., Reist, J.D., Amundsen, P.A., Chambers, P.A., Christoffersen, K., Culp, J.M., de Cenzo, P.D., Forsstrom, L., Hammar, H., Heino, J. Heikkinen, R.K., Kahilainen, K.K., Lesack, L., Lehtonen, H., Lento, J., Luoto, M., Marsh, D., Marcogliese, D.J., Moquin, P.A., Mustonen, T.,

Prowse, T.D., Power, M., Rautio, M., **Swanson, H.K.,** Thompson, M., Heikki Toivonen, Vasiliev, V., Virkkala, R., and Zavalko, S. 2013. Freshwater Ecosystems, Chapter 13. pp. 335-377 In: Meltofte, H. (Editor). Arctic Biodiversity Assessment. Status and trends in Arctic biodiversity. Conservation of Arctic flora and fauna, Akureyi. www.arcticbiodiversity.is

5. Christiansen, J. S., Reist, J. D. Brown, R. J., Brykov, V. A., Christensen, G., Christoffersen, K., Cott, P., Crane, P., Dempson, J. B., Docker, M., Dunmall, K., Finstad, A., Gallucci, V. F., Hammar, J., Harris, L. S., Heino, J., Ivanov, E., Karamushko, O. V., Kirillov, A., Kucheryavyy, A., Lehtonen, H., Lynghammar, A., Mecklenburg, C. W., Mller, P. D. R., Mustonen, T., Oleinik, A. G., Power, M., Reshetnikov, Y. S., Romanov, V. I., Sandlund, O.-T., Sawatzky, C. D., Svenning, M., **Swanson, H. K**. and Wrona, F. J. 2013. Fishes. Pages 192- 145 (Chapter 6) in Arctic Biodiversity Assessment: Status and Trends in Arctic Biodiversity. Meltofte, H. Chief Scientist. Conservation of Arctic Flora and Fauna (CAFF), Arctic Council, Akureyri, Iceland.

7.3 Conference Proceedings

1. **Swanson, H. K**. and K.A. Kidd. 2009. A preliminary investigation on the effects of anadromous Arctic charr (Salvelinus alpinus) on food web structure and nutrient transport in coastal Arctic lakes. Pages 465-483 In: A. J. Haro, K. L. Smith, R. A. Rulifson, et al., eds. Challenges for Diadromous Fishes in a Dynamic Global Environment, Symposium 69, June 2007, Bethesda, Maryland.

7.4 Software

1. Lysy, M., Stasko, A.D*, and H.K. Swanson. 2015. nicheROVER: (Niche) (R)egion and Niche (Over)lap Metrics for Multidimensional Ecological Niches. R package. http://cran.r-project.org/web/packages/nicheROVER/index.html

7.5 Technical and Other Reports

1. **Swanson, H.K.,** Branfireun, B., and Low, G. 2018. Variable fish mercury concentrations in the Dehcho: effects of catchment control and invertebrate community composition. In: Synopsis of Research Conducted Under the 2017-2018 Northern Contaminants Program. Indigenous and Northern Affairs Canada. 12 pages.
2. **Swanson, H.K.,** Branfireun, B., MacLatchy, D., and Lister, A., 2018. Investigation into relatively high Walleye mercury concentrations in Tathlina Lake. In: Synopsis of Research Conducted Under the 2017-2018 Northern Contaminants Program. Indigenous and Northern Affairs Canada. 10 pages,
3. Stasko, A.D., **Swanson, H.,** Atchison, S., MacPhee, S., Majewski, A., de Montety, L., Archambault, P., Walkusz, W., Reist, J., and Power, M. 2017. Stable isotope data ($\delta^{15}N$, $\delta^{13}C$) for marine fishes and invertebrates from the Beaufort Regional Environmental Assessment Marine Fishes Project, August-September 2012 and 2013. Canadian Data Report of Fisheries and Aquatic Sciences 1270: vi + 63 p.
4. **Swanson, H.K.,** Branfireun, B., and Low, G. 2017. An investigation of variable fish mercury concentrations in Dehcho Lakes. NWT Cumulative Impact Monitoring Program 2017/18 Annual Report. 12 pages.
5. **Swanson, H.K.,** Branfireun, B., and Low, G. 2017. Variable fish mercury concentrations in the Dehcho: effects of catchment control and invertebrate community composition. In: Synopsis of Research Conducted Under the 2016-2017 Northern Contaminants Program. Indigenous and Northern Affairs Canada. 16 pages.

6. **Swanson, H.K**., Allen, E.W., Froese, K., and Zabel, N. 2016. Kugluktuk Water Quality and Fish Health Study. Prepared for: Diavik Diamond Mines Inc and Fisheries and Oceans Canada. 76 pp.
7. Zabel, N., Branfireun, B., Kassi, N. and **Swanson, H.K.** 2016. Contaminants and Nutrients in Traditional Food Fishes in Kluane Lake, YT. Prepared for: Kluane First Nation. 9 pp.
8. Laird, B., Ratelle, M., Power, M., Hanning, R., Stark, K., Majowicz, S., and **Swanson, H.K**. 2016. Contaminant biomonitoring in the Northwest Territories: investigating the links between contaminant exposure, nutritional status, and country food use. In: Synopsis of Research Conducted Under the 2015-2016 Northern Contaminants Program. Indigenous and Northern Affairs Canada. 8 pages.
9. **Swanson, H.,** and Low, G. 2016. Mercury levels in food fish species in lakes used by Dehcho community members with a focus on choice and risk perception of eating traditional country food. In: Synopsis of Research Conducted Under the 2015-2016 Northern Contaminants Program. Indigenous and Northern Affairs Canada. 10 pages.
10. **Swanson, H.,** Zabel, N., Branfireun, B., Kassi, N., and Alatini, M. 2016. Understanding contaminant levels in commonly consumed fish of Kluane Lake, Yukon. In: Synopsis of Research Conducted Under the 2015-2016 Northern Contaminants Program. Indigenous and Northern Affairs Canada. 10 pages.
11. **Swanson, H.K.**, Baker, L.F., and K.A. Artym. 2015. Investigation of the effects of dewatering of Kennady Lake on the occupancy, habitat use, and migrations of Arctic grayling (*Thymallus arcticus*) at Gahcho Kué project site, NT: Progress and results for 2014 and 2015. Prepared for De Beers Canada Inc. 18 pages.
12. Zabel, N., Hoffmann, J**.**, and **Swanson, H.K**. 2014. GIS analysis coupled with traditional knowledge interviews in an investigation of occurrence of anadromous Lake Trout (*Salvelinus namaycush*). Prepared for: Kitikmeot Inuit Association. 24 pages.
13. P. Outridge, K.G. Dunmall, C. Furgal, J. Gérin-Lajoie, L.N. Harris, G. Henry, K.A. Kidd, B. Kissinger, J.A. Knopp, S. Kokelj, T. Lantz, P. Latour, E. Lévesque, N.J. Mochnacz, I. Myers-Smith, L. Nguyen, D. Reid, J.D. Reist, C.D. Sawatzky, G.A. Stern**, H. Swanson.** 2013. ArcticNet Integrated Regional Impact Study – Region 1 Report - Chapter 3: Terrestrial and Freshwater Systems.
14. Northern Contaminants Program. 2013. Canadian Arctic Contaminants Assessment Report III: Mercury in Canada's North. Northern Contaminants Program (NCP), Aboriginal Affairs and Northern Development Canada, Ottawa. xxiii + 276 pp. Contributing authors include: **Heidi Swanson.**
15. Orihel, D., Swanson, H., and Venkiteswaran, J. 2013. Scientists, on Saving Science: Lessons from the Campaign to Save the Experimental Lakes Area. Limnology and Oceanopgraphy Bulletin 22(3): 76-78.
16. Provencher, J.F., N. Gantner, J. Schmale, **H.K. Swanson**, and J.L Baseman. 2012. Early Career Researchers and Mentors Work Together to Shape the Future of the Arctic Monitoring and Assessment Programme. *Arctic* 65 (1): 115-118.
17. **Swanson, H.K**. 2010. Two Ways of Knowing: Inuit Youth Trained in Scientific and Traditional Knowledge of Arctic char in Kugluktuk, Nunavut, Canada. In: Kaiser, B. (ed). Polar Science and Global Climate, an International Resource for Education and Outreach.
18. Golder Associates Ltd. 2009. Hope Bay Project Aquatic Studies. Final Report. Prepared for Hope Bay Mining Ltd., North Vancouver, BC by Golder Associates Ltd., Edmonton, AB. Golder Report No. 08-1373-0026-1000: 252 p. + 3 app. Contributing authors include: **Heidi Swanson**.

19. **Swanson, H.K.** 2008. Review of atmospheric emissions and associated environmental effects from conventional thermal electricity generation. Prepared for: Clean Air Strategic Alliance, Electricity Project Team. 96 pages.
20. **Swanson, H.K.** 2007. The effect of anadromous Arctic charr (Salvelinus alpinus) on food web structure and contaminant concentrations in coastal Arctic lakes. Arctic 60(4): 452.
21. **Swanson, H.K.** 2006. A Review of Submerged Oil Survey Methods at Wabamun Lake, AB. Alberta Environment, 14 pages. (This document was used as evidence in federal court).
22. Alberta Environment. 2006. Water Quality of Provincial Parks Lakes, 1995-2005. Authors: **H. Swanson** and R. Zurawell. Evaluation, Monitoring, and Reporting. Water Quality Division, Government of Alberta. **29 Technical Reports**, approximately 10 pages each.
23. Golder Associates Ltd. 2005. Doris North Project Aquatic Baseline Studies 2004. Contributing authors include: **H. Swanson.** Prepared for Miramar Hope Bay Ltd.
24. Golder Associates Ltd. 2004. Qualitative Environmental Risk Analysis of Mercury Mitigation Options at a Proposed Compensation Lake. Contributing authors: **Heidi Swanson**, Laura Mucklow, Mark Digel, and Dale Doram. Prepared for Canadian Natural Resources Ltd.

7.6 Presentations

7.6.1 Invited Presentations, Seminars, and Lectures

1. **Swanson, H.K.** 2018. We Want to Eat the Fish: investigating levels of mercury in northern fishes. Invited Lubinsky Memorial Public Lecture, University of Manitoba, Winnipeg, MB, March 1, 2018.
2. **Swanson, H.K.** 2018. Ecosysten connectivitiy as influenced by fish migrations: insights from studies of Northern Pike, Arctic Grayling, and Lake Trout. Invited Lubinksy Memorial Resarch Seminar: University of Manitoba, Winnipeg, MB, March 2, 2018.
3. **Swanson, H.K.** 2017**.** Ecosystem connectivity and ecology of fishes: insights from migrations and trophic ecology of Northern Pike, Arctic Grayling, and Lake Trout. Invited presentation at: Biology Seminar Series (Graduate Student Choice), Western University, London, ON, October 27, 2017.
4. **Swanson, H.K.** 2017. Variation in trophic ecology and life history of Lake Trout (*Salvelinus namaycush*): insights from the Coastal Arctic and Lake Superior. Invited presentation at: Integrative Biology Seminar Series, University of Guelph, Guelph, ON, October 17, 2017.
5. **Swanson, H.K**., Low, G., and Branfireun, B.A. 2017. Understanding and predicting mercury levels in food fishes in the Dehcho region: spatial trends. Oral presentation at: Eye on Environment Seminar Series, Government of the Northwest Territories, September 29, 2017. Yellowknife, NT.
6. **Swanson, H.K.** 2017. Community-driven research in understanding and predicting fish mercury levels in northern lakes: two case studies. Invited presentation at: Environment Canada (Canada Center for Inland Waters) Seminar Series, March 23, 2017.
7. **Swanson, H.K**. 2017. Community-driven research in understanding and predicting fish mercury levels in northern lakes: two case studies. Invited presentation at: Yukon Contaminants Committee Annual Meeting, Whitehorse, YT, March 1, 2017.
8. **Swanson, H.K.** 2016. Understanding mercury levels in northern food fishes with western science, Indigenous knowledge and field-based learning. Invited presentation at: Western University Geography Speaker Series, October 21, 2016.

9. **Swanson, H.K.** 2016. Understanding and predicting mercury levels in northern food fishes with science, Indigenous knowledge, and field-based learning. Invited plenary presentation at: Water Institute Research Symposium 2016, University of Waterloo, April 28, 2016.
10. **Swanson, H.K.** 2016. Mercury levels in northern fishes: ecology, life history, and links to human health. Invited evening presentation at: Society for Ecotoxicology and Chemistry (Laurentian Chapter) Southern Ontario Pub Night, January 27, 2016.
11. **Swanson, H.K.** 2015. Aquatic Ecology and Contaminant Accumulation in the North: Understanding and Predicting Change. Invited oral presentation at: Wilfrid Laurier University Biology Seminar Series, October, 23, 2015.
12. **Swanson, H.K.** The Life, Times, and Mercury Concentrations of Northern Charrs. Invited presentation at: 8th International Charr Symposium, Tromso, Norway, June 14-18th, 2015.
13. **Swanson, H.K.** 2015. Interactions of Life History and Mercury Accumulation in Northern Rivers. Invited oral presentation at: NSERC Canadian Network for Aquatic Ecosystem Services Annual Meeting, April 28-30, 2015.
14. **Swanson, H.K.** 2015. Aquatic Ecology and Contaminant Accumulation in the North: Understanding and Predicting Change. Invited keynote presentation at: Centre for Global Change Science, Graduate Student Research Symposium, University of Toronto, February 19-20, 2015.
15. **Swanson, H.K.** 2014. Understanding Mercury Levels in a Changing North: First Results for the Deh Cho region. Invited presentation at: "A Return to Country Food– Jean Marie River" Meeting and Workshop, Jean Marie River First Nation, NT, August 26-28, 2014.
16. **Swanson, H.K.** 2014. Science advocacy: a case study with the Experimental Lakes Area. Invited presentation at: Canadian Council for Deans of Science (Annual Meeting), Ottawa, ON, June 16, 2014.
17. **Swanson, H.K.** 2013. Contaminants and ecology in northern fishes. Invited presentation at: Evolution and Ecology Seminar Series, Université du Québec à Montreal, November 27, 2013.
18. **Swanson, H.K.** 2013. Science and Innovation Policy Case Study: The Experimental Lakes Area. Invited speaker and panelist at: Science Policy: Nuts and Bolts, Canadian Science Policy Conference, Toronto, ON, November 20, 2013.
19. **Swanson, H.K**. 2013. Mercury in Northern Fishes: Don't Forget the ECO in Ecotoxicology. Invited presentation at Department of Biology Seminar Series, Western University, October 4, 2013.
20. **Swanson, H.K**. 2013. The life, times, and mercury concentrations of northern fishes. Invited presentation at Colloquium Series, Department of Geography, York University, September 24, 2013.
21. **Swanson, H.K**. 2013. Eating the Fish: Understanding Mercury Levels in a Changing North. Invited presentation at: Ka'a'gee Tu "A Return to Country Food - Kakisa" Meeting and Workshop, Kakisa, NT, August 27-29, 2013.
22. **Swanson, H.K**. 2013. We Want to Drink the Water and Eat the Fish: Science in a Changing North. Invited keynote presentation at: Science for a Changing North, Sudbury Restoration Workshop 2013, Laurentian University, Sudbury, ON, May 1, 2013.
23. **Swanson, H.K**. 2013. Being a Good Guest: Lessons Learned from Scientific Outreach and Education in the Canadian Arctic. Invited presentation at: NSERC Canadian Network for Aquatic Ecosystem Services 1st Annual Meeting, Sudbry, ON, April 30, 2013.
24. **Swanson, H.K**. 2013. Importance of long-term research stations to Canada's scientific future. Invited presenter and panel member at: Science Café series, Science North, Sudbury, ON, February 5, 2013.
25. **Swanson, H.K.** 2012. Stories Fish Tell us: Tales from the Ear Bone. Invited evening outreach talk at Athabasca University, Athabasca, AB, October 3, 2012.

26. **Swanson, H.K.** 2012. Mercury rising? Interactions of fish life history, trophic ecology, and mercury bioaccumulation in coastal Arctic lakes. Invited speaker for: Graduate Seminar Series, Forestry and Natural Resources, Pudue University, West Lafayette, IN, September 25, 2012.
27. **Swanson, H.K.** 2012. Mercury rising? Interactions of fish life history, trophic ecology, and mercury bioaccumulation in Arctic lakes. Speaker for: Departmental Seminar Series, Department of Biology, Laurentian University, Sudbury, ON, March 23, 2012.
28. **Swanson, H.K.** 2011. Successes and lessons learned from conducting outreach and education in the Canadian North. Invited speaker for: North Star Mentorship Series, Circumpolar Students Association, University of Alberta, March 17, 2011.
29. **Swanson, H.K.** 2010. Transients in the north: effects of anadromous fishes on coastal freshwater ecosystems. Departmental Seminar (Ecology Series), Department of Biological Sciences, University of Alberta, Edmonton, AB. October 1, 2010.
30. **Swanson, H.K.** 2010. Community Engagement and Environmental Outreach: No Shortcuts, Big effort, Big reward. Invited oral presentation at: Nunavut Mining Symposium, Iqaluit, NU, April 13-15, 2010.
31. **Swanson, H.K.** 2008. Why are Arctic charr important to Arctic lakes and Arctic communities? Invited student speaker at Garfield Weston Foundation Annual Board Meeting, October 18, 2008.
32. **Swanson, H.K.** 2006. The effect of sea-run Arctic charr on food web structure and contaminant concentrations in coastal Arctic lakes. Invited student speaker at the Association for Canadian Universities in Northern Studies Annual General Meeting, Ottawa, ON, Oct. 20-21, 2006.

7.6.2 Conference presentations and posters

1. **Swanson, H.,** Vinson, M., and Chavarie, L. 2018. Differences in trophic ecology among morphotypes of Lake Char. Oral presentation at: 9th International Charr Symposium, Duluth, MN, June 18-21, 2018**.**
2. Kornis, M., Bunnell, D.B., **Swanson, H.,** Bronte, C. 2018. Spatiotemporal patterns in trophic niche overlap among Lake Char (*Salvelinus namaycush*) and nonnative salmonines in Lake Michigan, USA. Poster presentation at: 9th International Charr Symposium, Duluth, MN, June 18-21, 2018.
3. Kissinger, B., **Swanson, H**., Reist, J., and Tonn, W. 2018. Use of marine-influenced waters by Lake Charr throughout Arctic North America. Oral presentation at: 9th International Charr Symposium, Duluth, MN, June 18-21, 2018.
4. Vinson, M., and **Swanson, H.** 2018. Lean and siscowet Lake Char trophic overlap in Lake Superior. Oral presentation at: 9th International Charr Symposium, Duluth, MN, June 18-21, 2018.
5. Harris, L, Moore, J.S., Tallman, R., Yurkowkski, D., **Swanson, H.** 2018. The use of otolith microchemistry to investigate the anadromous migrations of Arctic char, Salvelinus alpinus, from the Cambridge Bay region of Nunavut. Oral presentation at: 9th International Charr Symposium, Duluth, MN, June 18-21, 2018.
6. Stasko, A.D., Bluhm, B., Reist, J., Majewski, A., Archambault, P., Michel, C., Atchison, S., MacPhee, S., Eert, J., **Swanson, H.**, Power, M. 2018. Combining SIA and biological traits to examine benthic-pelagic food web coupling in the offshore Beaufort Sea. Oral presentation at: Association for the Sciences of Limnology and Oceanography, Victoria, BC, June 11-15, 2018.
7. DeJong, R., Johnston, T., Keller, B., Gunn, J., and **Swanson, H.** 2018. Life history characteristics of Lake Whitefish (*Coregonus clupeaformis*), Cisco (*Coregonus artedii*), and Northern Pike (*Esox lucius*) in Hudson Bay Lowland rivers. Oral presentation at: Association for the Sciences of Limnology and Oceanography, Victoria, BC, June 11-15, 2018.

8. Burke, S.M., Zimmerman, C., Branfireun, B., and **Swanson, H**. 2018. Drivers of mercury bioacummulation in thermokarst lake food webs of the Arctic Coastal Plain of Alaska. Oral presentation at: Association for the Sciences of Limnology and Oceanography, Victoria, BC, June 11-15, 2018.

9. Burke, S.M., Doubek, J.P., Dugan, H.A., Ewing, H.A., MacDonald, L.A., Moreales-Williams, A.M., Skaff, N.K., Stockwell, J.D., Summers, J.C., and **Swanson, H.K**. 2017. Global trends and drivers of lake primary production. Poster presentation at: Global Lakes Observing Network 19 Meeting, New Paltz, New York, November 26-30, 2017.

10. **Swanson, H.K.,** Kassi, N., Zabel, N., Alatini, M., and Branfireun, B. 2017. Are the fish safe to eat? A collaborative study of contaminants in fish from Kluane Lake, YT. Oral presentation at: Society for Ecotoxicology and Chemistry North America Meeting, November 12-16, 2017.

11. **Swanson, H.K.**, Low, G., Evans, M., and Branfireun, B. 2017. Understanding and predicting fish mercury levels in the Dehcho region, NT. Poster presentation at: at: Society for Ecotoxicology and Chemistry North America Meeting, November 12-16, 2017.

12. Baker, L.F., Artym, K.J., Lord, S.I., and **Swanson, H.K.** 2017. Understanding of complex spatial-structuring of Arctic Grayling populations in the Northwest Territories, Canada. Oral presentation at: 8th Oppenheimer De Beers Group Research Conference, Johannesburg, South Africa, October 17-18.

13. **Swanson, H.K.**, Low, G., and Branfireun, B.A. 2017. Among-lake variability in food fish mercury concentrations in the Dehcho region, NT. Oral presentation at: Northern Contaminants Meeting 25th Anniversary Results Workshop, September 26-28, 2017, Yellowknife, NT.

14. Lescord, G., Johnston, T., Branfireun, B., Poste, A., Braaten, H., Gunn, J., and **Swanson, H.K.** 2017. A review of mercury research in freshwater ecosystems across the global boreal zone. Oral presentation at: The 13th International Conference on Mercury as a Global Pollutant, July 16-21, 2017, Providence, RI.

15. Branfireun, B.A., Zabel, N., and **Swanson, H.K.** 2017. Mercury and methylmercury in tributary inputs to Kluane Lake, Yukon Territory, Canada. Oral presentation at: The 13th International Conference on Mercury as a Global Pollutant, July 16-21, 2017, Providence, RI.

16. **Swanson, H.K.**, Branfireun, B.A., and Low, G. 2017. Catchment vs in-lake control of variability in mercury concentrations in lakes in the Dehcho region, NT. Oral presentation at: The 13th International Conference on Mercury as a Global Pollutant, July 16-21, 2017, Providence, RI.

17. **Swanson, H.K.** 2017. Kugluktuk Water and Fish Study. Oral presentation at: Nunavut Fisheries Strategy Meeting. April 25-27, 2017, Ottawa, ON.

18. Baker, L.F., Artym, K.J., and **Swanson, H.K.** 2017. Optimal sampling methods for modeling the occupancy of Arctic Grayling (Thymallus arcticus) in the Canadian barrenlands. Oral presentation at: Canadian Conference for Fisheries Research, Montreal, QC, January 6-9, 2017.

19. DeJong, R.A., Johnston, T.A., Gunn, J., Branfireun, B, and **Swanson, H.K.** 2017. Life history variation and mercury concentrations in three northern food fishes in the Hudson Bay lowlands. Oral presentation at: Canadian Conference for Fisheries Research, Montreal, QC, January 6-9, 2017.

20. Brewster, J., Giraldo, C., **Swanson, H.**, Walkusz, W., Loewen, T., Reist, J., Ostertag, S., Stern, G., and Loseto, K. 2016. Defining the niches of Beaufort coastal fishes using biotracers: stable isotopes, fatty acids, and total mercury. Oral presentation at: ArcticNet Science Meeting, Winnipeg, MB, December 5-9, 2016.

21. **Swanson, H.**, Low, G., Branfireun, B., Low, M., and Evans, M. 2016. Drivers of Spatial Variability in Fish Mercury Levels in the Dehcho region, NT, Canada. Oral presentation at: Society of Toxicology and Chemistry World Congress, Orlando, FL, November 6-10, 2016.

22. **Swanson, H.**, and Kelly, E. 2016. Integration of Indigenous knowledge in studies of northern ecotoxicology: lessons from David Schindler and other revolutionaries. Oral presentation at: Society of Toxicology and Chemistry World Congress, Orlando, FL, November 6-10, 2016.

23. McLean, S.M (industry collaborator)., Baker, L.F., Artym, K.J., and **Swanson, H**. 2016. Tracking Arctic Grayling downstream of the Gahcho Kue Mine. Oral presentation at 7th Oppenheimer De Beers Group Research Conference, Johannesburg, South Africa, October 18-19, 2016.

24. **Swanson, H.**, Low, G., Alatini, M., Kassi, N., and Branfireun, B.A. 2016. Understanding and predicting mercury concentrations in northern lakes. Oral presentation at: Canadian Ecotoxicity Workshop, Edmonton, AB, September 25-28, 2016.

25. Hoffmann, J., Muir, A., Vinson, M., Krueger, C., Bronte, C., Loseto, L., Hansen, M., Baker, L., Sitar, S., and **Swanson, H.K**. 2016. Trophic ecology of four morphs of Lake Trout in Lake Superior. Poster presentation at: International Association for Great Lakes Research, Guelph, ON, June 6-10, 2016.

26. Zabel, N., Hall, R., Branfireun, B., **Swanson, H.** 2016. Mercury dynamics in Kluane Lake from the Medieval Climate Anomaly to Present. Oral presentation at: Paleolimnology Symposium, Kingston, ON, May 27, 2016.

27. DeJong, R., Johnston, T., Keller, B., Gunn, J., **Swanson, H**. 2016. Life history influence on mercury concentration in fish inhabiting coastal rivers of the Hudson Bay Lowlands. Poster presentation at: Peter Yodzis Colloquium in Fundamental Ecology, Guelph, ON, May 9-11, 2016**.**

28. DeJong, R., Johnston, T., Keller, B., Gunn, J., **Swanson, H.** 2016. Life history influence on mercury concentration in fish inhabiting coastal rivers of the Hudson Bay Lowlands. Poster presentation at: NSERC Canadian Network for Aquatic Ecosystem Services 4th Annual Meeting & Workshop, Guelph, ON, May 3-5, 2016.

29. DeJong, R., Johnston, T.A., Gunn, J., Branfireun, B.A., and **Swanson, H.K.** 2016. The influence of life history on tissue mercury concentration in fish from coastal rivers of the Hudson Bay Lowlands. Oral presentation at: NSERC Canadian Network for Aquatic Ecosystem Services 4th Annual Meeting & Workshop, Guelph, ON, May 3-5, 2016.

30. Zabel, N., Hall, R., Branfireun, B.A., and **Swanson, H**. 2016. Paleoecological history and contemporary controls of mercury accumulation in Kluane Lake, Yukon. Oral presentation at: Annual Eastern Student Meeting of the Canadian Geophysical Union –Biogeosciences and Hydrology sections, Waterloo, ON, February 5-7. 2016.

31. Stasko, A.D., **Swanson, H.K.**, Majewski, A., Atchison, S., Reist, J.D., and Power, M. 2016. The size- and depth-based trophic structure of Beaufort Sea fish communities: An indicator of community change. Oral presentation at Arctic Frontiers (International Conference), Tromsø, Norway, 24-29 January 2016.

32. Stasko A.D., **Swanson, H.K.**, Majewski, A., Atchison, S., Reist, J.D., and Power, M. 2016. Body size, depth, and pelagic subsidies: Insights to fish trophic structure in the Beaufort Sea. Oral Presentation at: AkvaSem Seminar Series, UiT - The Arctic University of Norway, Tromsø, Norway, 22 April 2016.

33. Lewis, J.B., McPherson, M.D., Mochnacz, N.J., Cott, P., Poesch, M., Rennie, M.D., Baker, L.F., and **Swanson, H.K.** 2015. Occupy Nahanni: the Arctic Grayling quest for a society with vertical hierarchy and flatly distributed spawning habitat. Poster presentation at: Arctic Science Meeting, Vancouver, BC, December 8-12, 2015.

34. **Swanson, H.K.**, Low, G., Low, M., and B. Branfireun. 2015. Mercury levels in food fishes used by Dehcho community members. Poster presentation at: Northern Contaminants Program Results Meeting, Vancouver, BC, December 7-9, 2015. (Best Poster and Recognition of Northerner Involvement).

35. Alatini, M., Kassi, N., Zabel, N., Branfireun, B., and **H.K. Swanson**. 2015. Contaminants, nutrients, and the traditional value of food fishes in Kluane Lake, YT. Poster presentation at: Northern Contaminants Program Results Meeting, Vancouver, BC, December 7-9, 2015.

36. Burke, S.M., and **H.K. Swanson**. 2015. Historical changes in mercury and primary productivity in three Arctic Alaskan lakes with different temperature regimes. Poster presentation at: Global Lake Ecological Observing Network 'All Hands' Meeting. Chuncheon, South Korea, October 5-9, 2015.

37. De Jong, R., and **H.K. Swanson**. 2015. Interactions of life history and mercury accumulation in northern rivers. Oral presentation at: Science for a Changing North Annual Workshop, Sudbury, ON, February 18, 2015.

38. McPherson, M.D., Lewis, J.B., Mochnacz, N.J., **Swanson, H.K.**, Poesch, M. 2015. Searching for Arctic Grayling in Northern Mountain Streams: Testing a Distributional Monitoring Approach in the Little Nahanni River Watershed. Poster Presentation at: Canadian Conference for Fisheries Research (CCFFR), Ottawa, ON, Jan. 8 -11th, 2015.

39. **Swanson, H.K.**, M. Lysy, M. Power, A. Stasko, J. Johnson, and J. Reist. 2015. A new probabilistic method for quantifying n-dimensional niches and niche overlap. Oral presentation at: Canadian Conference for Fisheries Research, Ottawa, ON, January 8-11, 2015.

40. Giraldo, C., E. Choy, A. Stasko, B. Rosenberg, M. Power, **H. Swanson**, L. Loseto, and J.D. Reist. 2014. Trophic patterns of Arctic fishes in the Canadian Beaufort Sea: a fatty acid and stable isotope approach. Oral presentation at: ArcticNet Arctic Change Meeting, Ottawa, ON, December 9-12, 2014.

41. Stasko, A., M. Power, **H. Swanson**, P. Archambault, L. de Montety, A. Majewski, S. Atchison, and J. D. Reist. 2014. Evidence for size-structrued marine food webs in the Beaufort Sea: Comparison between dynamic shelf and stable mesopelagic bnethic habitats. Poster Presentation at: ArcticNet Arctic Change Meeting, Ottawa, ON, December 9-12, 2014.

42. **Swanson, H.K.**, A.M.M. Muir, C.K. Krueger, M. Vinson, C. Bronte, M. Hansen, L. Loseto, and S. Sitar. 2014. Trophic ecology of Humper Lake Trout from Lake Superior: comparisons with other morphotypes. Oral presentation at: International Association for Great Lakes Research, Hamilton, May 27-30, 2014.

43. Artym, K., and **Swanson, H.K**. 2014. Habitat use of barrenland Arctic Grayling (*Thymallus arcticus).* Poster presentation at: Canadian Conference for Fisheries Research, Yellowknife, NT, January 3-5, 2014.

44. **Swanson, H.K**., M. Lysy, J.D., Reist, W.M. Tonn, J. Johnson, L. Loseto, and M. Power. 2014. Trophic ecology of coastal fishes from Phillips Bay, Yukon Territory. Oral presentation at: Canadian Conference for Fisheries Research, Yellowknife, NT, January 3-5, 2014**.**

45. **Swanson, H.K**., G. Low, M. Low, E. Hardisty, A. Sanguez, L. Sanguez, V. Jumbo, B. Laird, and E. Reyes. 2013. Understanding and predicting fish mercury levels in the Dehcho region using models of bioaccumulation and biomagnification. Oral presentation at: 2nd Northwest Territories Environmental Monitoring Results Workshop, Yellowknife, NT, December 10-12, 2013.

46. Stasko, A.D., Reist, J.D., **Swanson, H.K**. and Power, M. 2013. Pelagic food web structure of the Canadian Beaufort Sea: A sneak-peek at complexity from shelf-break out. Oral presentation at: Arctic Net Science Meeting, Halifax, NS, 9-13 December, 2013.

47. Stasko A, Power, M., and **Swanson H**. 2013. Food Web Structure in the Beaufort Sea: the Stable Isotope Component. Beaufort Regional Environmental Assessment meeting, Winnipeg, MB, October 17, 2013.

48. Johnston, T.A., P.A. Cott, **H.K. Swanson**, A.D. Stasko, R.W.-K. Tang and J.M. Gunn. 2013. Ontogenetic patterns in isotopic composition of northern fishes. Oral presentation at 98th Annual Meeting of the Ecological Society of America, Minneapolis, MN, USA, 4-9 August 2013

49. Kidd, K, Clayden, M, Lescord, G, Finley M, **Swanson, H**. 2013. Effects of Lake Characteristics on the Trophic Transfer of Mercury through Food Webs. International Conference on Mercury as a Global Pollutant, Edinburgh, United Kingdom, 28 July – 2 August, 2013.

50. **Swanson, H.K**., W.M. Tonn, K.A. Kidd, M. Power, T.A. Johnston, J.D. Reist, R. J. Wastle, J.A. Babaluk, P.P. Yang, N.M. Halden, and C.E. Zimmerman. 2013. Life and times of anadromous lake trout (*Salvelinus namaycush*) in the Canadian Arctic. Oral presentation at: Canadian Conference for Fisheries Research, Windsor, ON, January 3-5, 2013.

51. **Swanson, H.K**., W.M. Tonn, K.A. Kidd, M. Power, T.A. Johnston, J.D. Reist, R. J. Wastle, J.A. Babaluk, P.P. Yang, N.M. Halden, and C.E. Zimmerman. 2012. Differences in ecology between life history types of lake trout (*Salvelinus namaycush*) in the Canadian Arctic. Invited workshop presentation at: Native Fishes Restoration Workshop, Great Lakes Fishery Commission, Ann Arbor, MI, December 12-14, 2012.

52. Johnston, T.A., P.A. Cott, **H.K. Swanson**, A.D. Stasko, R.W.-K. Tang and J.M. Gunn. 2012. Ontogenetic patterns in isotopic composition of northern fishes. Oral presentation at the 142nd Annual Meeting of the American Fisheries Society, St. Paul, MN, USA, 19-23 August 2012.

53. **Swanson, H.K**., Kidd, K.A., Reist, J.D., and Tonn, W.M. 2012. How do anadromous Arctic charr *(Salvelinus alpinus)* affect the ecology of coastal Arctic lakes? Oral presentation at: International Polar Year Conference, Montreal, QC, April 22-27, 2012.

54. **Swanson, H.K**., Kidd, K.A., and J.D. Reist. 2011. How does life history affect concentrations of PCBs in Arctic fishes? Poster presentation at: Society for Environmental Toxicology and Chemistry annual meeting, Boston, MA, November 13-17.

55. **Swanson, H.K**., Gantner, N., Kidd, K.A., Muir, D.C.G., and J.D. Reist. 2011. Mercury concentrations in landlocked, resident, and sea-run fishes from Nunavut, Canada. Poster presentation at: Arctic Monitoring and Assessment Program conference - 'The Arctic as a Messenger for Global Processes,' Copenhagen, Denmark, May 3-6, 2011.

56. **Swanson, H.K**., Griller, N., Kidd, K.A., and J.D. Reist. 2010. "Two ways of knowing" about Arctic char: Scientific and Traditional Knowledge Training for Inuit youth in Nunavut, Canada. Poster presentation at: International Polar Year Oslo Science Conference, Oslo, Norway, June 8-12, 2010.

57. **Swanson, H.K.,** Kidd, K.A., and J.D. Reist. 2010. Does the presence of anadromous Arctic char (*Salvelinus alpinus*) affect the ecology of coastal Arctic lakes? Oral presentation at: International Polar Year Oslo Science Conference, Oslo, Norway, June 8-12, 2010.

58. **Swanson, H.K.,** K.A. Kidd, J. Babaluk, R. Wastle, P. Yang, N. Halden, and J. Reist. 2010. Old, cold, salty lake trout (Salvelinus namaycush): anadromous lake trout in the Canadian Arctic. Oral presentation at: Canadian Conference for Fisheries Research, Winnipeg, MB, January 7-9, 2010.

59. **Swanson, H.K**., K.A. Kidd, and J.D. Reist. 2010. How do anadromous Arctic charr (*Salvelinus alpinus*) affect the ecology of coastal Arctic lakes? Oral presentation at: Canadian Conference for Fisheries Research, Winnipeg, MB, January 7-9, 2010.

60. **Swanson, Heidi K**. 2009. Interactions of fish ecology, life history, food web structure, and mercury bioaccumulation in coastal Arctic lakes. Ph.D. thesis. University of New Brunswick. 220 pp.

61. **Swanson, H.K**., K.A. Kidd, T.A. Johnston, and D.W. Schindler. 2009. When stable isotopes are not enough: the importance of basic ecology in models of fish mercury concentration. Oral presentation at: Society for Environmental Toxicology and Chemistry annual meeting, New Orleans, Louisiana, Nov. 19-23, 2009.

62. **Swanson, H.K.,** K.A. Kidd, J. Babaluk, R. Wastle, P. Yang, N. Halden, and J. Reist. 2009. Otolith microchemistry and stable isotope ratios reveal annual marine migrations in lake trout (charr) (*Salvelinus namaycush*) from the coastal Canadian Arctic. Oral presentation at: 6th International Charr Symposium, Stirling, Scotland, 15th-18th June, 2009.

63. **Swanson, H.K.,** K. Kidd, and J. Reist. 2009. Does the presence of anadromous Arctic charr (*Salvelinus alpinus*) affect food web structure and mercury concentrations in coastal Arctic lakes? Oral presentation at: 6th International Charr Symposium, Stirling, Scotland, 15th-18th June, 2009.

64. Gantner, N., **H. Swanson**, D. Muir, K. Kidd, and J. Reist. 2009. Comparison of mercury concentrations in resident, landlocked, and anadromous Arctic charr (*Salvelinus alpinus*) and lake charr (*S. namaycush)* from the West Kitikmeot region of Nunavut, Canada. Oral presentation (by H.K. Swanson) at 6th International Charr Symposium, Stirling, Scotland, 15th-18th June, 2009.

65. **Swanson, H.K**. and K.A. Kidd. 2008. Transients in the north: how interactions of life history, trophic ecology, and climate change may affect contaminant concentrations in coastal Arctic lakes. Oral presentation at: Society for Environmental Toxicology and Chemistry annual meeting, Tampa, Florida, Nov. 16-20, 2008. (Best Ph.D. Presentation award).

66. **Swanson, H.K**. and K.A. Kidd. 2008. Transient fish in the Canadian north: how do sea-run Arctic charr affect food web structure and contaminant concentrations in coastal Arctic lakes? Oral presentation (invited participant) at: Symposium for the New Generation of Polar Researchers, Colorado Springs, Colorado, May 4-11, 2008.

67. **Swanson, H.K**. 2008. Personal experience and perspectives on science outreach with Inuit communities and northern industry. Oral presentation and panelist member (invited participant) at: Symposium for the New Generation of Polar Researchers, Colorado Springs, Colorado, May 4-11, 2008.

68. **Swanson, H.K**. and K.A. Kidd. 2007. Effects of anadromous Arctic charr (*Salvelinus alpinus*) on food web structure and contaminant concentrations in coastal Arctic lakes. Poster presentation at: 8th International Student Conference for Northern Studies, Saskatoon, SK, Oct. 18-21st, 2007 (Best Ph.D. poster).

69. **Swanson, H.K.** and K.A. Kidd. 2007. Effects of anadromous Arctic charr (*Salvelinus alpinus*) on food web structure in coastal Arctic lakes. Oral presentation at: 2nd International Scientific Symposium on Diadromous Fishes, Halifax, NS, June 18-21, 2007.

70. **Swanson, H.K**., T.A. Johnston, D.W. Schindler, R.A. Cunjak, and D.M. Whittle. 2004. Mercury bioaccumulation in forage fish communities invaded by rainbow smelt (*Osmerus mordax*). Oral presentation at the Canadian Conference for Fisheries Research, St. John's, NFLD, Jan. 6-10, 2004.

71. **Swanson, H.K**. 2003. Mercury bioaccumulation in forage fish communities invaded by rainbow smelt (*Osmerus mordax*). M.Sc. Thesis. University of Alberta. 100 pp.

72. **Swanson, H.K**., T.A. Johnston, D.W. Schindler, R.A. Cunjak, and D.M. Whittle. 2003. Mercury concentrations in forage fishes: A growth story. Oral presentation at the American Fisheries Society Meeting, Quebec City, Quebec, August 10–13, 2003.

73. **Swanson, H.K**., T.A. Johnston, D.W. Schindler, R.A. Cunjak, R.A. Bodaly, and D.M. Whittle. 2003. Time since invasion and lake productivity as ecological determinants of the effects of rainbow smelt (*Osmerus mordax*) invasion on boreal lakes. Oral presentation (by H.K. Swanson) at the Canadian Conference for Fisheries Research, Ottawa, ON, Jan. 2-5, 2003.

74. **Swanson, H.K**., T.A. Johnston, W.C. Leggett, R.A. Bodaly, R.R. Doucett, and R.A. Cunjak. 2001. Trophic positions and mercury concentrations of rainbow smelt and native forage fishes in northwestern Ontario lakes. Oral presentation at American Fisheries Society Meeting, Phoenix, Arizona, August 19-23, 2001.

75. Johnston. T.A., **H.K. Swanson**, W.C. Leggett, R.A. Bodaly, R.R. Doucett, and R.A. Cunjak. 2001. Effects of rainbow smelt invasion on mercury concentrations of piscivorous fishes in lakes of northwestern Ontario and Manitoba. Oral presentation (by R.A. Bodaly) at USEPA Workshop on the Fate, Transport, and Transformation of Mercury in Aquatic and Terrestrial Environments, West Palm Beach, Florida, May 8-10, 2001.

76. **Swanson, H.K.** 2001. Mercury concentrations and $\delta^{15}N$ – determined trophic positions in rainbow smelt and native forage fishes in northwestern Ontario lakes. BSc. Honor's thesis, Queen's University, Kingston, ON. 52 pp.
77. **Swanson, H.K**., T.A. Johnston, W.C. Leggett, R.A. Bodaly, R.R. Doucett, and R.A Cunjak. 2001. Trophic positions and mercury concentrations in rainbow smelt and native forage fishes in northwestern Ontario lakes. Oral presentation (by H.K. Swanson) at the Canadian Conference for Fisheries Research, Toronto, ON, January 4-6, 2001.

7.7 Theses

1. **Swanson, Heidi K**. 2009. Interactions of fish ecology, life history, food web structure, and mercury bioaccumulation in coastal Arctic lakes. Ph.D. thesis. University of New Brunswick. 220 pp.
2. **Swanson, H.K** 2003. Mercury bioaccumulation in forage fish communities invaded by rainbow smelt (*Osmerus mordax*). M.Sc. Thesis. University of Alberta. 100 pp.
3. **Swanson, H.K.** 2001. Mercury concentrations and $\delta^{15}N$ – determined trophic positions in rainbow smelt and native forage fishes in northwestern Ontario lakes. BSc. Honor's thesis, Queen's University, Kingston, ON. 52 pp.

8 ACTIVITIES

8.1 Trainee Supervision and Trainee Achievements

8.1.1 PDF

Trainee	Role	Period	Current Status
1. Leanne Baker	Supervisor	2015 - present	Maternity Leave
Title of Research Project: Movement of Arctic Grayling in barrenlands landscapes in the Canadian Arctic *Achievements:* Baker has led the lab in applying two new techniques to our research program: occupancy modeling and acoustic telemetry (see contributions). She was invited to give a talk in South Africa in fall 2017 at a multi-stakeholder workshop, and she has led the lab in setting up our recently acquired portable mercury analyzer.			

8.1.2 PhD

Trainee	Role	Period	Current Status
1. Samantha Burke	Supervisor	2014-Present	In Progress
Title of Research Project: Mercury accumulation and food web structure in lakes on the Arctic Coastal Plain of Alaska. *Achievements:* Burke has been supported by an NSERC scholarship and a W. Garfield Weston Doctoral scholarship ($50,000, 7 awarded nationally), and she was accepted as a fully-funded international student fellow into the Global Lakes Ecological Observing Network (GLEON) in 2014. This fellowship has allowed her to participate in several international conferences and collaborative initiatives. The first paper from her PhD research was published in 2018.			

2. Ashley Stasko	Co-supervisor	2013- 2017	Completed, employed at Fisheries and Oceans Canada
Title of Research Project: Investigations into food web structure in the Beaufort Sea *Achievements:* Stasko received NSERC (Natural Science and Engineering Research Council) and Ontario Graduate Scholarships, as well as an NSERC Michael Smith Foreign Study Supplement. She spent six months studying with an international expert at University of Tromso, Norway, and has published three first-author papers. Stasko is working as a full-time research biologist with Fisheries and Oceans Canada.			

8.1.3 MSc

Trainee	**Role**	**Period**	**Current Status**
1. Rosie Smith	**Supervisor**	**2018 - Present**	**In Progress**
Title of Research Project: Movements of Arctic Char (*Salvelinus alpinus)* near Kugluktuk, NU *Achievements:* Smith was awarded an NSERC Canada Graduate Scholarship (CGS-M) and a University of Waterloo President's Graduate Scholarship prior to beginning her graduate studies in May 2018,			
2. Tara Boag	**Supervisor**	**2018 - Present**	**In Progress**
Title of Research Project: Ecological drivers of nutrient : mercury ratios in food fishes of the Dehcho region			
3. Jared Ellenor	**Supervisor**	**2018 - Present**	**In Progress**
Title of Research Project: Occupancy of Arctic Grayling in subarctic streams affected by wastewater discharge			
4. Stephanie Guernon	**Co-supervisor**	**2016- Present**	**In Progress**
Title of Research Project: Effects of community composition on methyl mercury concentrations in Arctic zooplankton communities *Achievements:* Guernon has been supported by a Fond de Recherche Nature et technologies (Quebec) scholarship, a W. Garfield Weston Award for Northern Research scholarship ($15,000, 15 awarded nationally) scholarship, an NSERC CREATE fellowship (EcoLac), and an excellence bursary from Université de Québec à Montreal. She received Northern Scientific Training Program grants in 2016 and 2017.			
5. Tom Jeffery	**Supervisor**	**2016 – Present (Part-time student)**	**In Progress**
Title of Research Project: An investigation of two populations of Arctic Lake Trout (*Salvelinus namaycush*) sixteen years after an industrial fish-out			
6. Brent Lewis	**Supervisor**	**2015 –2018 (Part-time student)**	**Completed; employed as a Resource Management Officer, Parks Canada**
Title of Research Project: Trophic ecology and habitat use of Arctic Grayling in the Nahanni mountains *Achievements:* Lewis was one of three students nationally who were invited to speak to the W. Garfield Weston Foundation annual meeting in January 2016. Lewis spoke to philanthropists regarding his research and the valuable experiences he gained as a recipient of the Weston Foundation-Wildlife Conservation Society Northern Research Award ($6,000) in 2015. He also received a Northern Scientific Training Program grant in 2016.			

7. Nelson Zabel	**Co-supervisor**	**2015 – 2017**	**Completed; employed as a Research Assistant at Wilfrid Laurier University**
Title of Research Project: Environmental controls of sediment mercury accumulation in a large, glacially-fed lake *Achievements:* Zabel was awarded the Graduate Seminar Award for the best MSc seminar at the Biology Graduate Symposium in 2016. He was also the recipient of a Weston Foundation-Wildlife Conservation Society Northern Research Award ($6,000), an Arctic Institute of North America Grant-in-Aid ($1,000), and a Northern Scientific Training Program grant ($2,400) in 2015.			
8. Rachel DeJong	**Supervisor**	**2014-2017**	**Completed; employed as a Research Assistant at Laurentian University**
Title of Research Project: Life history characteristics of Lake Whitefish (*Coregonus clupeaformis)*, Cisco (*Coregonus artedi*), and Northern Pike (*Esox lucius*) in rivers of the Hudson Bay Lowlands *Achievements:* Rachel DeJong was supported by a QEII Scholarship and a prestigious W. Garfield Weston Award for Northern Research ($15,000) (15 awarded nationally). She received the Golder Poster award at a regional conference, a Northern Scientific Training Program ($2,400) grant, and a Weston Foundation-Wildlife Conservation Society Northern Research grant ($6,000) in 2015.			
9. Justin Hoffman	**Supervisor**	**2014-2016**	**Completed; student at Teacher's College (Western Univeristy)**
Title of Research Project: Investigating trophic ecology and dietary niche overlap among morphs of Lake Trout in Lake Superior			
10. Kyle Artym	**Supervisor**	**2013-2016**	**Completed; Field researcher at Alberta Biodiversity Monitoring Institute**
Title of Research Project: Determining the habitat occupancy of young of year Arctic Grayling (Thymallus arcticus) in sub-arctic tundra streams while accounting for imperfect detection *Achievements:* Artym was supported by an NSERC CGS scholarship.			

8.1.3 BSc Honours Thesis

Trainee	Project	Period	Current Status
Jacob Basso	Methyl mercury concentrations in invertebrates from the Dehcho region	2017-2018	Applying to graduate school
Zoe Humphries	Concentrations of mercury in Lake Trout from Lake Superior	2016-2017	MSc student, University of Toronto
Sara Packull-McCormick	Method validation for a portable mercury analyzer	2016-2017	MSc student, University of Waterloo
Emilie Wilson	Concentrations of mercury in Lake Trout from Yukon Territory	2015-2016	Naturalist, Prince of Whales Whale Watching
Catherine Wong	Mercury concentrations in food fishes from the Dehcho region	2014-2015	Biologist, Integrated Resource Consultants
Chrissy Barr	Paleolimnological investigation of a thermokarst lake on the Arctic Coastal Plain	2014-2015	Veterinary School
Katherine Kornobis	Mercury concentrations in food fishes from the Dehcho region	2013-2014	Science teacher

8.1.4 Other

Trainee	Position	Period	Current Status
Isabel Hildegang	Technician	2018-present	
Rachel Broders	Technician	2018-present	
Ben Hlina	Technician	2017	PhD student, Carleton University
Sarah Ghorpade	Analyst	2017	PhD student, University of Waterloo
Amy Nguyen	Technician and lab manager	2017-present	
Angela Graham	Technician; Co-op student	2017	Veterinary School
Alex Crichton	Technician	2016-2017	Aquatic Biologist at Palmer Environmental Consulting Group
Shyann Hang	Technician; Co-op student	2016	Research Technician; Defense Research and Development Canada
Mason Elwood	Technician	2015-2016	Environmental Officer at DeBeers Canada Inc
Monica Yau	Technician	2015	Research Laboratory Manager at The Hospital for Sick Children
Sarah Lord	Technician	2014-2017	Fisheries and Forestry Biologist at Gwich'in Renewable Resources Board
Daryl Enstone	Technician	2014	Technician, School of Optometry, University of Waterloo
Paulina Servida	Technician; Co-op student	2014	IT project control coordinator at CIBC
Ryan Baumann	NSERC Undergraduate student	2013	Dentist

8.2 Teaching – Graduate and Undergraduate
Course numbers >600 indicate graduate, course numbers < 500 indicate undergraduate.

Year	Course Number	Institution	Course Name	Enrollment	Total lecture hours	Student evaluations (overall instructor score)
2018	Biol 631	Waterloo	Statistical Methods in Ecology	14	18	9.8/10
2018	Biol 489	Waterloo	Arctic Ecology	43	36	9.8/10
2017	Biol 631	Waterloo	Statistical Methods in Ecology	9	18	9.7/10
2017	Biol 489	Waterloo	Arctic Ecology	42	36	9.8/10
2016	Biol 489	Waterloo	Arctic Ecology	42	36	9.8/10
2015	Biol 150	Waterloo	Organismal and Evolutionary Ecology	470	36	9.5/10
2015	Biol 489	Waterloo	Arctic Ecology	40	36	9.7/10
2014	Biol 150	Waterloo	Organismal and Evolutionary Ecology	570	36	9.3/10
2014	Biol 489	Waterloo	Arctic Ecology	37	36	9.6/10
2013	Biol 150	Waterloo	Organismal and Evolutionary Ecology	575	36	9.1/10
2011	Biol 343	Alberta	Global Biogeochemistry	37	36	9.8/10

8.3 Interviews and Media Relations

1. Radio Canada International, 'Canada invests $1.2 million to help solve mystery of dwindling char numbers in Arctic Canada.' Radio interview for 'Eye on the Arctic' series on May 11, 2018. http://www.rcinet.ca/eye-on-the-arctic/2018/05/11/canada-invests-1-2-million-to-help-solve-mystery-of-dwindling-char-numbers-in-arctic-canada/
2. University of Waterloo Website, 'Feds invest $1.2 million into Waterloo research on Nunavut fisheries. Online article on May 8, 2018. https://uwaterloo.ca/water-institute/news/feds-invest-12-million-waterloo-research-nunavut-fisheries
3. CBC Radio North, 'Feds invest $1.2 million in Waterloo research on Nunavut fisheries.' Radio interview on May 8, 2018.
4. CBC News, 'Feds to invest more than $2.5M in Nunavut Fisheries Projects.' Online article on May 9, 2018. http://www.cbc.ca/news/canada/north/nunavut-fisheries-funding-1.4654018
5. Nunatsiaq News, 'Ottawa earmarks $1.2 million for western Nunavut Arctic char study.' Online article on May 10, 2018. http://nunatsiaq.com/stories/article/65674ottawa_earmarks_1.2_m_for_nunavut_arctic_char_research/
6. Press release, 'Government of Canada makes a significant Coastal Restoration Fund investment in Canada's Arctic through the Oceans Protection Plan.' Release on May 4, 2018. https://www.newswire.ca/news-releases/government-of-canada-makes-a-significant-coastal-restoration-fund-investment-in-canadas-arctic-through-the-oceans-protection-plan-681772001.html

7. Globe and Mail, Sponsored Content by Innovation.Ca – Research and Innoviation: 'Keys to survival: advancing food and water security.' Print article on November 22, 2016.

8. Toronto Star, 'Ontario Pledges $600,000 for river cleanup.' Print article on November 24, 2017.

9. Waterloo Record, 'First Nations students to help UW test Yukon fish.' Print article on March 28, 2016.

10. Yukon News, 'Good news from Kluane Lake.' Print article on February 3, 2016

11. CBC North, 'Permafrost study could help forecast mercury levels in Dehcho Lakes.' Radio interview, national news clip, and online print article, August, 7, 2015.

12. CBC Kitchener/Waterloo, 'NicheROVER model helps predicts effects of invasive species.' Radio interview for morning show, March 23, 2015

13. Alternatives Journal, 'Profile of Six Environmental Grads.' Print article, December 1, 2014

14. Deh Cho Drum, 'Mercury Research Expands in Deh Cho.' Print article, September 4, 2014.

15. CBC Sudbury, 'Mercury in northern lakes: links between human and environmental health, and effects of climate change.' Radio interview for afternoon 'Points North' show, April 30, 2013.

16. CBC Sudbury, 'Importance of long-term research stations and monitoring programs for environmental research.' Radio interview for afternoon 'Points North' show, February 5, 2013.

17. Western Sportsmen magazine, 'Anadromous Lake Trout Discovered.' Print article, May 1, 2013.

18. In Fisherman magazine. Print article about research on anadromous lake trout, July 2012.

19. CBC Yukon, 'Lake trout in the ocean.' Radio interview for morning show, July 2011.

20. BBC Polar Café, 'Mercury and Arctic char,' live and web-archive interview, June 2010.

21. Saint John Telegraph Journal, 'Researcher Braves Bears to Study Delicate Arctic Food Web.' Print article, June 2008.

22. CBC Radio North, 'Mercury and Arctic char.' Radio interview for morning show, July 2006.

8.4 Outreach, Engagement, and Capacity-Building

1. Facilitator and research partner **2013 - Present**

Contributes to culturally-appropriate two-way knowledge exchange and training to Indigenous workers, elders, and youth in collection and processing of scientific samples (reciprocal visits between researchers and community members); >150 days have been spent with Swanson in on-the-land camps since 2013. Participated in 'Nourishing our Future' documentary produced by Kluane First Nation (topic: food security, contaminants in country foods). Facilitate Indigenous leaders in functioning as Principal Investigators on research proposals.

2. Instructor (volunteer) **2013 - Present**

Provided on-the-land training to Inuit community members in water and fish sampling; worked directly with community Hunters and Trapper Association and Government of Nunavut. Lived in camp with elders and youth. Delivered curriculum relating to human and environmental health to over 60 youth from 6 First Nations in the Northwest Territories and Yukon.

3. Instructor (several contracts) **2010 - 2012**

Developed information sheets on water quality and contaminants for Indigenous peoples in the Northwest Territories, and taught material during 1-day to 1-week workshops for youth and adults.

Produced instructional manuals and videos for adult community monitors sampling water and fish, and provided training in the operation of water quality meters and long-term data loggers (videos viewed >2000 times on YouTube).

4. Youth trainer and educator (volunteer) 2010

Led two-day invited workshop for nine students (grades 10-12) from Cambridge Bay, Kugluktuk, Kugaaruk, Taloyoak, and Kugluktuk, Nunavut, Canada. Developed all curriculum, organized logistics, taught all material. Topics included: i) collecting environmental samples; ii) using water quality meters; iii) dissecting fish for contaminant analysis; iv) fish ageing; v) effects of climate change in the Canadian Arctic; vi) environmental effects of mining; vii) identifying invertebrates; and, viii) monitoring fish populations.

5. Career and Technology Studies Instructor 2009

Led one-week invited workshop to high school students in Kugluktuk, NU, developed all curriculum (30 hours experiential), and facilitated logistics. Co-taught material with two other western science instructors, three community elders, and one youth mentor. Ensured course met requirements for career and technology studies credit at high school level. Topics included: i) fish anatomy; ii) effects of climate change; iii) basic ecology; iv) field sampling; v) fish dissections for contaminant analysis; vi) fish ageing; vii) monitoring fish populations; viii) using water quality meters; ix) effects of mining and oil development on water quality; x) fish habitat and effects of development on fish habitat; xi) recording scientific data; xii) traditional knowledge; and, xiii) nutrition of country foods and store-bought foods.

8.5 Service to the Institution and Profession

8.5.1 Institution

8.5.1.1 University

Period	Name	Role
2016 – Present	Northern Studies Committee	Member
2013 - Present	Cooperative Ecosystem Studies Unit	Institutional Technical Contact

8.5.2 Faculty

Period	Name	Role
2018 - Present	HeforShe 10x10x10 Initiative	Faculty Representative
2016 – Present	Water Institute Strategic Planning Committee	Faculty Representative

8.5.3 Department

In addition to serving on >20 graduate student advisory committees in the Department since 2013, I have served/am serving on the following committees in the Department of Biology:

Period	Name	Role
2018 - Present	Departmental Advisory Committee on Appointments – Terrestrial Ecology Position	Member
2017 – Present	Graduate Studies Committee	Member
2017 – Present	Water Institute Senior Management Committee	Department Representative
2015 – 2016	First Year Curriculum Re-Development Committee	Member
2014 – 2015	Departmental Advisory Committee on Appointments – Aquatic Microbiology Position	Member
2014 – Present	Ontario Universities Program for Field Biology	Field Course Coordinator
2013 - 2014	Departmental Advisory Committee on Appointments – Faculty Lecturer Position	Member
2013 - 2017	Executive Committee	Member
2013 – Present	Outreach Committee	Member

8.5.3.1 Other

1. Hiring Committee, Water Institute Knowledge Mobilization Specialist, 2017
2. Represented Faculty of Science at 'Get Science Right' UWaterloo event 2015

8.5.4 Profession

8.5.4.1 Editorial Duties

1. Associate Editor, Canadian Journal of Fisheries and Aquatic Sciences, 2014-present
2. Associate Editor, Arctic Science, 2018-present

8.5.4.2 Refereeing for Journals

In addition to my Associate Editor duties (below), I review approximately 6-8 papers per year from the following journals: Proceedings of the Royal Society B, Limnology and Oceanography, Environmental Science & Technology, Hydrobiologia, Ecology, Canadian Journal of Fisheries and Aquatic Sciences, Science of the Total Environment, Journal of Great Lakes Research, Transactions of the American Fisheries Society, Oikos, Environmental Toxicology & Chemistry, Ecology of Freshwater Fishes, Freshwater Biology, Polar Biology.

8.5.2.3 Reviewing Grant Proposals

I review between 3 and 5 grant proposals per year from the following agencies: Natural Sciences and Engineering Research Council (NSERC) – Strategic grants and Discovery grants, MITACS, Great Lakes Fishery Trust (GLFT), Northern Contaminants Program, Norwegian Fram Centre Flagship Program, Alaska-Yukon-Kuskokwim Sustainable Salmon Initiative, North Pacific Research Board, Cumulative Impacts Monitoring Program, Great Lakes Fishery Commission.

8.5.2.4 Conference Organization

1. Society of Ecotoxicology and Chemistry North America meeting, Session Organizer and Co-Chair, 2017
2. Society of Ecotoxicology and Chemistry North America meeting, Session Organizer and Co-Chair, 2016
3. Co-convenor and program committee member for International Polar Year "From Knowledge to Action" Conference, 2012
4. Science committee member and Session Co-Chair, International Polar Year "Oslo Science Conference," 2010
5. Organizing committee member for Association of Canadian Universities for Northern Studies 8th International Student Conference, 2007

8.5.2.5 Memberships and Positions Held

1. Canadian Society for Ecology and Evolution, Member and Institutional Representative, 2017-present
2. Canadian Conference for Fisheries Research and Society of Canadian Limnologists, Student and Early Career Travel Award Coordinator, 2016-present
3. Circumpolar Biodiversity Monitoring Program, Freshwater Expert Network, Member, 2014-present
4. Alberta Lake Management Society Board of Directors, Director, 2012-2014
5. Society of Ecotoxicology and Chemistry, Member, 2013-present

8.5.2.6 External Thesis Examinations

1. Alexandra Sumner, Laurentian University, MSc, 2016

8.5.2.7 Technology and Knowledge Transfer Activity

1. ***Movement ecology and occupancy of Arctic Grayling:*** Through a research partnership with De Beers Canada Inc, my trainees and I have shown that some barrenland Arctic Grayling have a unique movement ecology and population spatial structure (Baker et al. 201X, revision submitted) that makes them particularly susceptible to disturbance. Our results are contributing to the development of an adaptive management plan at one of De Beers' diamond mine sites. At this same site, our research on habitat use by Arctic Grayling (Baker et al. 2017) has allowed implementation of a monitoring program that is faster, less expensive, and more robust than what was previously employed.

2. ***Food web structure in the Beaufort Sea:*** Results from Ashley Stasko's (completed PhD student) research on spatial structuring of energy flow and food webs in the Beaufort Sea (Stasko et al. 2016, 2018a, 2018b) is contributing to prioritization of marine protected areas in the Arctic, and development of community-based Arctic coastal monitoring plans (in collaboration with Fisheries and Oceans Canada).

3. ***Mercury accumulation in northern aquatic ecosystems and human health:*** Ongoing research on mercury bioaccumulation in northern fishes, causes of variation in mercury levels (e.g., Swanson et al. 2011, Swanson et al. 2010, Technical Reports 1,2,4-6,9,10,14), and resulting human exposure to mercury (Laird et al. 2018, Reyes et al. 2017) is enabling regulators to establish more informed fish consumption guidelines for northerners. Co-located human and environmental contaminant data is rare in the north, and as such, consumption guidelines for traditional foods have been necessarily conservative. With ongoing research, Northerners can be encouraged to continue consuming traditional foods while limiting exposure to contaminants.

8.6 International Collaboration

1. United States Geological Survey Alaska Science Center (Dr. Chris Zimmerman). Collaboration on a $500,000 project focused on effects of warming temperatures on ecology of lakes on North slope of Alaska (Swanson component $200,000). Collaboration on otolith microchemistry of salmon otoliths (see publication list).
2. United States Geological Survey, Great Lakes Science Center (Dr. Mike Hansen, Dr. Mark Vinson). Invited to lead (PI) a Great Lakes Fishery Commission Grant focused on trophic ecology of Lake Trout in Lake Superior (supported graduate student Hoffmann; see funding history).
3. Great Lakes Fishery Commission (Dr. Andrew Muir). See above re: Great Lakes Fishery Commission grant. Invited to co-author a book chapter on Lake Trout trophic ecology.
4. US Fish and Wildlife Service (Dr. Chuck Bronte). See above re: Great Lakes Fishery Commission grant.
5. Michigan State University (Dr. Chuck Krueger). See above re: Great Lakes Fishery Commission grant. Invited to deliver keynote talk at International Charr Symposium in Tromso, Norway (Krueger on organizing committee).

Appendix D. The Habitat Evaluation Procedure Model

APPENDIX D. THE HABITAT EVALUATION PROCEDURE MODEL

The Habitat Evaluation Procedure (HEP) model used for Agnico Eagle Meadowbank Mine projects can be described, for each fish species (spp 1-n) as:

$$\mathbf{HU}_{\text{spp 1-n}} = \sum_{\text{HT 1-13}} \left(\sum_{\text{sp,nu,fo,ow}} (\mathbf{HT}_{\text{1-13}} \times \mathbf{HSI}_{\text{sp,nu,fo,ow}} \times \textbf{life function weight} \times \textbf{species weight})\right) \times \textbf{access factor} \times \textbf{habitat co-factor}$$

Where $HT_{1\text{-}13}$ = area (ha) of habitat types 1 through 13
$HSI_{sp,nu,fo,ow}$ = habitat suitability index for each life function:

- sp = spawning use
- nu = nursery use
- fo = foraging use
- ow = overwintering use

HABITAT TYPES (HT1-13)

The foundation of the HEP is the delineation of areas that provide certain "habitat types" based on depth and substrate (Table D-1). Habitat types 1 – 9 are lake habitats and were components of the original Meadowbank HEP model. These habitats are delineated by intersecting depth and substrate polygons.

Table D-1. Physical Characteristics of the Habitat Types Used in the Whale Tail Lake HEP

Habitat Type	Depth Zone	Substrate
1	0-2 m	Fine
2	0-2 m	Mixed
3	0-2 m	Coarse
4	2-4 m	Fine
5	2-4 m	Mixed
6	2-4 m	Coarse
7	>4 m	Fine
8	>4 m	Mixed
9	>4 m	Coarse
10	Pit and Pit cap*	Pit and Pit cap*
11	connecting channels	Coarse
12	small streams	Fine
13	small streams	Coarse

Notes:
Habitat Type 10 is applied to all non-backfilled pit areas, independent of depth and substrate characteristics.
** Depth and substrate in pit and pit cap areas are not relevant to suitability, which is assigned 0 value (see Section 2.1.2).*

Habitat Type 10 was added to the HEP model during the development of the Phaser Lake offsetting plan at the request of DFO to address uncertainty with respect to fish utilization of the deep pit areas. At that time, DFO indicated that the uncertainty arises primarily because there are "no examples of successful re-establishment of self-sustaining fish populations in refilled pits in Canada's North upon which to base end pit lake design" and there is a possibility that the deep areas of flooded pit may become meromictic (i.e., permanently stratified) and therefore be unsuitable for fish (DFO letter to Agnico Eagle dated November 27, 2015). DFO requested that the deep areas of the pit be designated Habitat Type 10 and that zero habitat value be assigned to those deep areas. After reviewing that conceptual offsetting plan for Whale Tail Pit, DFO requested, at a meeting in Baker Lake on September 23, 2017, that, at Whale Tail, the entire pit area, regardless of depth and including the pit cap, be designated Habitat Type 10. This was done for the Whale Tail Pit final offsetting plan and is done for the IVR Pit calculations presented here.

In the offsetting plan for Whale Tail Pit, and in this offsetting plan, Habitat Type 11 was assigned to the connecting channels that occur between several of the lakes in the Whale Tail Pit study area. These channels are wide and have predominantly boulder and cobble substrates. They have shallow surface flow over most or all of their length during spring freshet and only interstitial flow over most or all of their length later in the open-water season. They freeze during the winter. The edge of the water in the connecting channels was observed in the field to correspond closely to the edge of the tundra vegetation. Therefore, these channels were delineated by digitizing the edge of the tundra vegetation in the July 21, 2011, satellite imagery. The upstream and downstream limits of the connecting channels are defined by the intersection of the upstream and downstream lake elevations with the DEM. When an area that is Type 11 habitat under baseline conditions is flooded during the post-closure phase, it becomes the lake habitat type with coarse substrate that corresponds to its new depth.

Habitat types 12 and 13 are also specific to the Whale Tail offsetting plan, and this offsetting plan, and represent small streams with fine and coarse substrate respectively. These streams were characterized from field measurements made using a point-transect method during the period July 5 through July 8, 2016 (C. Portt and Associates, 2018). Many of these small streams have multiple channels and the width of each of the channels was measured at transects across the watercourses and those widths were summed to determine the total wetted width at a transect. To facilitate GIS analysis, the primary flow path of each of these streams was digitized based on the July 21, 2011, satellite imagery and a 'stream polygon' was created by assigning the total wetted width to the digitized flow path at each transect location. This allows the areas of stream habitat to be visualized and calculated during baseline and subsequent stages using standard GIS techniques. The portion of stream habitat that is fine substrate (Habitat Type 12) or coarse substrate (Habitat Type 13) was calculated by multiplying the stream polygon area by the proportion of the points where substrate was fine or coarse based on the field measurements. In the post-closure phase, when Type 12 or 13 habitat was flooded due to increased water levels it was considered converted to lake habitat and the habitat type was assigned based on depth and substrate.

DETERMINATION OF SHORELINES

The shorelines used to determine baseline habitat areas in the Whale Tail Pit Conceptual Fish Habitat Offsetting Plan (Agnico Eagle, 2016) were from CanVec mapping. Comparison of these shorelines to

satellite imagery from July 21, 2011, indicated that the water levels represented by the CanVec shorelines were lower than those shown in the imagery. Water elevations were estimated by overlaying the digital elevation model for the study area and the July 21, 2011, satellite imagery for three lakes where actual water level data were available for 2015 and 2016 and the estimated elevations were compared to the field data[1]. The results (Table D-2) were shared with DFO (meeting held in Winnipeg, March 23, 2017) and it was agreed that the water elevations and shorelines used to calculate habitat areas in the final offsetting plan would be determined using DEM and the July 21, 2011, imagery.

Table D-2. Estimated Water Elevation

Parameter	Whale Tail Lake (A17)		Lake A18		Nemo Lake (C38)	
Water elevation estimated from July 21, 2011 imagery (masl)	153.02		154.05		156.00	
Year	2015	2016	2015	2016	2015	2016
Maximum water elevation (masl)	153.31	153.11	154.20	154.10	155.98	156.04
Minimum water elevation (masl)	152.46	152.59	153.80	153.78	155.65	155.70
Range (m)	0.85	0.53	0.40	0.32	0.33	0.34
Difference between estimated water elevation and the recorded maximum (m)	0.29	0.09	0.15	0.05	-0.02	0.04
Difference between estimated water elevation and the recorded minimum (m)	-0.56	-0.43	-0.25	-0.27	-0.35	-0.30
# of days water elevation was higher than the water elevation estimated from shoreline elevation	10	5	11	5	0	11

Notes:
Water elevation estimated from the July 21, 2011, imagery, the minimum, maximum and range of water elevations recorded in the field in 2015 and 2016.
Difference between the minimum and maximum water elevations recorded in the field and the water elevation estimated from the July 21, 2011, imagery, and the number of days each year that the recorded water elevation was higher than the water elevation estimated from the July 21, 2011, imagery, for 2015 and 2016.

PREPARATION OF DEPTH, SUBSTRATE AND HABITAT TYPE

In order to calculate the extents of each habitat type, bathymetry for each of the lakes was merged with the digital elevation model in GIS. Bathymetry for Whale Tail, Mammoth and Nemo Lakes was provided by Agnico Eagle. For the smaller lakes that were deep enough to operate a boat, bathymetry was determined using a Humminbird 798ci HD SI Sonar unit. The sonar unit recorded georeferenced standard and side-scan sonar data. Straight, parallel boat runs, orientated to best characterize the lake's features, were used to record slightly overlapping side-scan images of the lake bottom.

[1] The following determination of shoreline elevations was provided in response to DFO IR 4 and 7. Agnico Eagle (January, 2017). DFO IR 4 – Freshwater Environment – Habitat Alteration; DFO IR 7 – Monitoring, Mitigation and Management Plans – Conceptual Offsetting Plan. January 20th, 2017 submission RE: NIRB File No 16MN056 Application No: 124683/NWB File No. 2AM WTP ----: Information Requests Received from Parties Regarding Agnico Eagles Mines Ltd's "Whale Tail Pit" Project.

Additional sonar recordings were then made to obtain standard sonar data for as much of the lake bottom as was practical. A stake was driven into the ground at the water's edge on the day that the Sonar data were collected and this elevation was later determined by a survey crew, so that the depth data could be converted to elevations and integrated with the digital elevation model.

The side-scan images were processed using ReefMaster software (ver. 1.8) to create a single georeferenced side-scan mosaic of the lake's bottom, and the standard sonar data were processed to create maps of bottom hardness and water depth. ReefMaster determines bottom hardness by analysis of the sonar output/input ratio, and lag, to calculate a unitless relative hardness and roughness value that is displayed as a colour-coded map. The georeferenced data (side-scan image, bottom hardness and water depth maps, and visual point observations) were layered using GIS software (QGIS version 2.8). Visual point observations of the substrate were also made, either from the surface where the water was clear and shallow enough or using an Aqua-Vu 740c underwater colour video system where the water was deeper. All visual substrate observations were georeferenced with a Garmin GPSmap76CSx gps unit.

In anticipation of the need to prepare substrate mapping, on September 2, 2014, oblique aerial photographs were taken, from a helicopter, of the shoreline and near-shore areas of Mammoth Lake, Whale Tail Lake, Nemo Lake and the adjacent smaller lakes and ponds. Additional oblique photographs were taken in June and August 2016. Using the overlaid data, with reference to the oblique aerial photographs (n=229), the areas of the various substrate types were identified and hand digitized as polygons in GIS, creating substrate maps. With the exception of Nemo Lake this was done for each lake in its entirety. For Nemo Lake substrate mapping was only prepared in the area that would be impacted by the freshwater intake, as no other alterations of Nemo Lake are anticipated.

A few small, shallow ponds near the north end of Whale Tail Lake were too shallow to permit use of a boat and motor. The depths and substrates in these ponds were visually assessed from shore in 2015, and depth and substrate mapping was prepared based on those observations, aerial imagery, and the oblique aerial photographs taken in 2014 and 2015.

The habitat-type area calculations and mapping were completed by Dougan and Associates using standard GIS methods consistent with mapping procedures used in AEM (2012) and the Phaser Lake offsetting plan. The digital elevation model was used to determine depth and the depth information was overlain with the substrate layers, determined as described above, to delineate polygons with the characteristics of habitat types 1 through 9. The area of habitat types 1 – 9 was determined by summing the area of those polygons.

For the post-closure phase, depths were determined using the water elevations proposed for each phase and the digital elevation model. The substrate under baseline conditions was left unchanged unless a physical change was made to the habitat (i.e., a road was built). If connecting channels were flooded so that they became lake habitat, their new habitat types was assigned based on their depth and their existing coarse substrate. If small streams were flooded so that they became lake habitat their new habitat type was based on depth and their existing substrate. The substrate for terrestrial areas that are flooded post-closure was assigned based on the ecological land classification community types, as shown in Table D-3.

Table D-3. Substrate Category Assigned to Flooded Terrestrial Areas Based on the Terrestrial Ecological Land Classification Community Types that Are Present under Baseline Conditions

Habitat Type	Depth Zone
Coarse	Boulder/gravel
	Lichen/rock
Fine	Graminoid tundra
	Wet graminoid
	Sand
Mixed	Graminoid/Shrub tundra
	Heath tundra
	Heath upland
	Heath upland/rock complex
	Lichen tundra
	Shrub tundra
	Shrub/heath tundra

Habitat Suitability Index (HSI $_{sp,nu,fo,ow}$)

The habitat suitabilities that were used for the Whale Tail Pit offsetting plan have also been used for IVR Pit. The habitat suitability term represents the relative quality of each habitat type for each life function of each fish species present in the region. In the case of this HEP, the life functions spawning, nursery, foraging and overwintering were considered. Habitat suitability for each life function is indicated through a ranking of 0, 0.25, 0.5, 0.75 or 1. HSIs for all fish species[2] and habitat types used in this HEP are shown in Table D-4. The HSIs for the lake habitats (habitat types 1 – 9) were developed through a series of consultations and workshops beginning in July 2011 with KivIA, HTO, and DFO in Baker Lake, and a series of workshops held with Golder Associates and DFO between November 2011 and December 2011 (by webex and in Ottawa). The process is further described in AEM (2012). Further review of the HEP by Dr. Ken Minns (August 2017) recommended continued use of this method by Agnico Eagle. As stated previously, for the time being, it has been conservatively assumed that habitat type 10 will provide no fish habitat (i.e., all HSIs are zero) with the understanding that HSIs and the provision of habitat units will be re-evaluated if field investigations demonstrate that there is no stratification or that fish use the pelagic zone above a chemocline.

The HSIs for habitat types 11, 12, and 13 were assigned based on their habitat characteristics and the fish sampling conducted as part of the Whale Tail pit baseline investigations, taking into consideration the HSIs previously developed for lake habitats[3]. The connecting channels have primarily boulder and cobble

[2] Addresses, DFO 1- Freshwater Environment – Habitat Losses technical comment regarding consideration of all species, including bottom dwellers. Agnico Eagle (April, 2017). April 7, 2017 submission NIRB File No. 16MN056 Application No: 124683/NWB File No. 2AM WTP ---- : Receipt of Technical Review Comment Submissions for the NIRBs Review and NWB Consideration of Agnico Eagle Mines Ltd's " Whale Tail Pit" Project Proposal and associated Water License Application

[3] The stream habitat types were developed in response to DFO 4 and 8 Information Request. Agnico Eagle (January, 2017). DFO- 4 and 8 – Freshwater Environment- Habitat Alteration. January 20, 2017 submission RE: NIRB

substrate. There is shallow water above the substrate during the spring freshet in most of these channels but later in the summer there is only interstitial flow. No adult large-bodied fish have been observed or captured by electrofishing in these connecting channels and hoop nets set in or immediately downstream from these connecting channels in 2015 and 2016 captured no fish. A single Arctic Char was captured in a gill net set across the connecting channel between Lake A18 and Whale Tail Lake from June 22- 28, 2016 and July 2-8, 2016. Based on these data, these connecting channels do not provide foraging habitat for large-bodied fish (foraging HIS = 0). Juvenile Lake Trout and juvenile Lake Whitefish have been captured by electrofishing in the connecting channels and it has been assumed that juvenile Arctic Char and juvenile Burbot can also use this habitat during the open-water season. Therefore, for all large-bodied species the connecting channels have been assigned the same nursery HSIs as coarse substrate in the 0 – 2 m lake depth stratum. The connecting channels freeze during the winter and therefore have been assigned HSIs of zero for overwintering for all species and zero for spawning for fall/winter-spawning species, which includes all of the large-bodied species that are present.

Slimy Sculpin and Ninespine Stickleback, the two small-bodied species that are present in the study area, have both been captured in the connecting channels and are likely to use the shallow areas and interstitial spaces in much the same way that they do in shallow areas with coarse substrate in lake habitats. Therefore, for these two species the HSIs for coarse substrate in the 0 – 2 m deep stratum has also been used for the connecting channels.

These streams in the Whale Tail primary study area typically have multiple channels and are shallow, with mean depths ranging from 6 cm to 17 cm. Peat is the dominant substrate in the majority of the watercourses. These watercourses freeze in the winter and have been assigned HSIs of zero for overwintering for all species and zero for spawning for fall/winter-spawning species, which includes all of the large-bodied species that are present.

Electrofishing catches in these streams were dominated by Ninespine Stickleback and Slimy Sculpin and for these two species the HSIs for fine and for coarse substrates in the 0 – 2 m lake depth habitat (Habitat Types 1 and 3, respectively) were applied to Habitat Types 12 and 13 for spawning, nursery and foraging.

One or more juveniles of all of the large-bodied species were captured in the small streams, although the numbers were low. The nursery HSIs for fine and for coarse substrates in the 0 – 2 m lake depth habitat (Habitat Types 1 and 3, respectively) have been applied to Habitat Types 12 and 13 for the four large-bodied species.

The absence of adult large-bodied fish from the electrofishing catches in the small streams is consistent with little if any foraging in these shallow streams by large-bodied adults,as would be expected. It is thought that the few individuals that were captured in gill nets or hoop nets set in these streams were moving between lake habitats. The small streams have been assigned a HSI of zero (0) for foraging by the four large-bodied species.

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Table D-4. HSI Values for the Whale Tail Fish Species

Habitat Type	Depth	Substrate	Arctic Char				Lake Trout				Round Whitefish			
			SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
1	<2 m	Fines	0	0.25	0.25	0	0	0.25	0.25	0	0	0.25	0.75	0
2	<2 m	Mixed	0	0.25	0.25	0	0	0.5	0.5	0	0	0.75	0.5	0
3	<2 m	Coarse	0	0.5	0.5	0	0	1	0.75	0	0	0.75	0.5	0
4	2-4 m	Fines	0	0.5	0.5	0.75	0	0.5	0.5	0.75	0	0.25	1	0.75
5	2-4 m	Mixed	0.5	0.75	0.75	0.75	0.5	0.75	0.75	0.75	0.5	0.75	0.75	0.75
6	2-4 m	Coarse	1	1	1	0.75	1	1	1	0.75	1	1	0.75	0.75
7	>4 m	Fines	0	0.25	0.5	1	0	0.25	0.5	1	0	0.25	1	1
8	>4 m	Mixed	0.5	0.5	0.75	1	0.5	0.5	0.75	1	0.25	0.25	0.5	1
9	>4 m	Coarse	1	0.5	1	1	1	0.5	1	1	0.75	0.5	0.5	1
10*	pit area	pit area	0	0	0	0	0	0	0	0	0	0	0	0
11	connecting channel	Coarse	0	0.5	0	0	0	1	0	0	0	0.75	0	0
12	stream	Fines	0	0.25	0	0	0	0.25	0	0	0	0.25	0	0
13	stream	Coarse	0	0.5	0	0	0	1	0	0	0	0.75	0	0

Habitat Type	Depth	Substrate	Burbot				Slimy Sculpin				Ninespine Stickleback			
			SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
1	<2 m	Fines	0	0.25	0.25	0	0	0	0.25	0	1	1	1	0
2	<2 m	Mixed	0	0.75	0.5	0	0.25	0.25	0.5	0	0.5	0.5	0.75	0
3	<2 m	Coarse	0	1	0.5	0	1	1	1	0	0	0.25	0.75	0
4	2-4 m	Fines	0	0.25	0.25	0.75	0	0	0.25	0.75	0	0	0.5	0.75
5	2-4 m	Mixed	1	0.5	0.75	0.75	0.25	0.25	0.5	0.75	0	0	0.25	0.75
6	2-4 m	Coarse	0.75	0.5	1	0.75	0.75	0.75	1	0.75	0	0	0.25	0.75
7	>4 m	Fines	0	0	0.25	1	0	0	0	1	0	0	0	1
8	>4 m	Mixed	1	0	0.75	1	0	0	0.25	1	0	0	0	1

(continued)

Table D-4. HSI Values for the Whale Tail Fish Species (completed)

Habitat Type	Depth	Substrate	Burbot				Slimy Sculpin				Ninespine Stickleback			
			SP	NU	FO	OW	SP	NU	FO	OW	SP	NU	FO	OW
9	>4 m	Coarse	0.75	0.25	1	1	0.5	0.5	0.5	1	0	0	0	1
10	pit area	pit area	0	0	0	0	0	0	0	1	0	0	0	0
11	11	connecting channel	0	1	0	0	1	1	1	0	0	0.25	0.75	0
12	12	stream	0	0.25	0	0	0	0	0.25	0	1	1	1	0
13	13	stream	0	1	0	0	1	1	1	0	0	0.25	0.75	0

Notes:

[1] This table is intended to be indicative. It is subject to the development and implementation of a final Project construction schedule.

(sp=spawning, nu=nursery, fo=foraging, ow=overwintering).

**Habitat type 10 is applied to all pit and pit cap areas regardless of depth and substrate.*

Life Function Weight

For the Whale Tail Pit Project Expansion, the HEP values all life functions equally, with a weight of 0.25 each assigned for spawning, nursery, foraging and overwintering.

Species Weight

The overall species weights used in the HEP method sum to 1 across species. The species weights for various Meadowbank offsetting plans are comprised of a biomass weighting and a fishery value weighting:

Species weight = (biomass weight/2) x (fishery weight/2)

During the preparation of the Whale Tail Pit offsetting plan, however, DFO indicated a preference for all species to be weighted equally[4]. Therefore, in the final Whale Tail Pit offsetting plan and in this offsetting plan each of the six species that are present in the study area has a weight of 0.165 in the HEP calculations.

Access Factor

In a workshop conducted in February, 2012 (The Basic Concepts of No Net Loss Accounting - February 2012) Dr. Charles K. Minns suggested the use of an access factor when fish assemblages are expected to change in the offsetting scenario. According to this concept, the access factor is 1 for any species present in the habitat area, and 0 for any species not present, as illustrated in Table D-5. Each species receives an access factor in both the loss and gain calculations. Therefore, the opening of access to a habitat area for a species (that did not have access previously), results in an increase of habitat units. Similarly, the loss of access results in a loss of habitat units. These gains or losses may be complete (i.e., affect all species), or partial (only some species are affected). The presence or absence of a species in loss calculations is typically based on the observed presence/absence of each species during baseline monitoring studies (AEM, 2012, 2013, 2016). If a change in access is predicted for an offset scenario (i.e., due to the removal of a barrier to fish movement) the change would need to be confirmed as part of compensation monitoring.

Table D-5. Access Factor Theoretically Applied to Each Species for Habitat Loss and Gain Calculations, Based on Presence/Absence (or Anticipated Presence/Absence, for Offsetting Projects)

	Access Factor	
Scenario	**Losses**	**Gains**
Species Present	1	1
Species Not Present	0	0

[4] Agnico Eagle (January, 2017). KivIA – IR – Aquatic- Final fish habitat offsetting plan. January 20, 2017 submission RE: NIRB File No 16MN056 Application No: 124683/NWB File No. 2AM WTP ----: Information Requests Received from Parties Regarding Agnico Eagles Mines Ltd's "Whale Tail Pit" Project.

Agnico Eagle (April, 2017). DFO 5- Freshwater Environment – Changes to Lake Ecosystem Productivity. April 7, 2017 submission NIRB File No. 16MN056 Application No: 124683/ NWB File No. 2AM WTP ---- : Receipt of Technical Review Comment Submissions for the NIRBs Review and NWB Consideration of Agnico Eagle Mines Ltd's " Whale Tail Pit" Project Proposal and associated Water License Application

Typically, the access factors applied are based on the observed presence/absence of each species during baseline monitoring studies (AEM, 2012, 2013, 2016). For the Whale Tail Pit calculations, an access factor of 1 was applied for all six fish species that have been captured in the study area. An access factor of 1 has also been applied to all six fish species for the Whale Tail Pit Project Expansion calculations.

Habitat Co-factor

The habitat co-factor represents any changes to non-mapped habitat quality (thermal, hydrological, biological or chemical regimes) that will occur as a result of impacts or offsetting. The use of this factor is suggested by Dr. Ken Minns, and his suggested values as presented in a workshop for DFO in February, 2012 are shown in Table D-6. No habitat co-factor was applied to the HEP calculations for the Whale Tail Pit and none has been applied for the IVR Pit calculations.

Table D-6. Habitat Co-factor for Various Pre- and Post-Compensation Scenarios, According to Minns, 2012

Change in Regime	Description	Baseline Conditions Factor	Post-closure Factor
Degradation (expected)	Thermal, hydrologic, chemical and/or biological regime shifts away from preferred state for fish habitat	1	> 0 and < 1
No change	-	1	1
Enhancement (anticipated or proposed)	Thermal, hydrologic, chemical and/or biological regime expected to shift towards preferred state for fish habitat	> 0 and < 1	1

The changes in habitat area and habitat units that would result from the Whale Tail Expansion Project are provided, by habitat type, in Table D-7. The changes in habitat area and habitat units that would result from the construction of a sill between Lake A18 and Whale Tail Lake that would increase the upstream water elevation by 1 m are provided, by habitat type, in Table D-8.

Table D-7. Changes in Habitat Areas (HAs) and Habitat Units (HUs) that Would Result from the IVR Pit and Associated Infrastructure, by Habitat Type

	Hectares						Habitat Units					
	Section 35 Changes				Section 36 Losses		Section 35 Changes				Section 36 Losses	
Habitat Type	Losses due to IVR Pit and Pit Cap	Changes due to IVR Road	Losses due to A53-A17	Sub-total	Lake A53	Total	Losses due to IVR Pit and Pit Cap	Changes due to IVR Road	Losses due to A53-A17	Sub-total	Lake A53	Total
1	-3.48	-0.02	0.00	-3.51	-0.03	-3.53	-0.835	-0.005	0.000	-0.840	-0.007	-0.847
2	-3.61	0.06	0.00	-3.55	-0.21	-3.75	-1.015	0.018	0.000	-0.997	-0.058	-1.056
3	-1.92	-0.04	0.00	-1.96	-11.64	-13.60	-0.761	-0.016	0.000	-0.777	-4.608	-5.385
4	-0.27	0.00	0.00	-0.27	-1.46	-1.73	-0.102	0.000	0.000	-0.102	-0.549	-0.651
5	-0.39	0.25	0.00	-0.14	-0.70	-0.84	-0.226	0.145	0.000	-0.081	-0.411	-0.492
6	-1.01	-0.25	0.00	-1.25	-0.34	-1.60	-0.765	-0.189	0.000	-0.954	-0.260	-1.214
7	-0.73	-0.16	0.00	-0.89	-0.01	-0.89	-0.273	-0.059	0.000	-0.332	-0.002	-0.335
8	-0.21	0.16	0.00	-0.05	0.00	-0.05	-0.107	0.082	0.000	-0.025	0.000	-0.025
9	-0.13	0.00	0.00	-0.13	0.00	-0.13	-0.086	0.000	0.000	-0.086	0.000	-0.086
10	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
11	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
12	-0.12	0.00	-0.36	-0.47	0.00	-0.47	-0.021	0.000	-0.074	-0.094	0.000	-0.094
13	-0.02	0.00	-0.02	-0.04	0.00	-0.04	-0.007	0.000	-0.007	-0.013	0.000	-0.013
Total	**-11.88**	**0.00**	**-0.37**	**-12.25**	**-14.39**	**-26.65**	**-4.197**	**-0.025**	**-0.080**	**-4.302**	**-5.895**	**-10.197**

Note:
Losses due to IVR Pit and Pit Cap includes portions of Lakes and Ponds that become part of the Pit or Pit Cap, and thus Habitat Type 10, and portions of waterbodies that become dry post-closure.

Table D-8. Habitat Area (HAs) and Habitat Units (HUs) with and without a 1 m sill between Lakes A18 and Whale Tail Lake and the difference that result from the sill, by habitat type

Habitat Type	Hectares			Habitat Units		
	Without Sill between A18 and Whale Tail Lake	With Sill between A18 and Whale Tail Lake	Net Change	Without Sill between A18 and Whale Tail Lake	With Sill between A18 and Whale Tail Lake	Net Change
1	0.85	2.84	1.99	0.203	0.680	0.477
2	1.47	0.96	-0.51	0.412	0.269	-0.143
3	50.68	64.73	14.06	20.059	25.624	5.565
4	7.51	6.32	-1.18	2.815	2.371	-0.443
5	5.43	4.22	-1.21	3.168	2.463	-0.705
6	5.49	14.43	8.94	4.176	10.971	6.795
7	24.18	25.56	1.37	9.069	9.584	0.515
8	5.68	6.92	1.25	2.957	3.606	0.649
9	0.68	0.74	0.06	0.460	0.503	0.042
10	0.00	0.00	0.00	0.000	0.000	0.000
11	7.47	3.70	-3.76	2.255	1.119	-1.137
12	0.03	0.00	-0.03	0.005	0.000	-0.005
13	0.01	0.00	-0.01	0.004	0.000	-0.004
Total	**109.47**	**130.43**	**20.96**	**45.584**	**57.190**	**11.606**

Appendix E. Depth Zones and Substrate Classes Used to Derive the Habitat Types for the HEP Model

APPENDIX E. DEPTH ZONES AND SUBSTRATE CLASSES USED TO DERIVE THE HABITAT TYPES FOR THE HEP MODEL

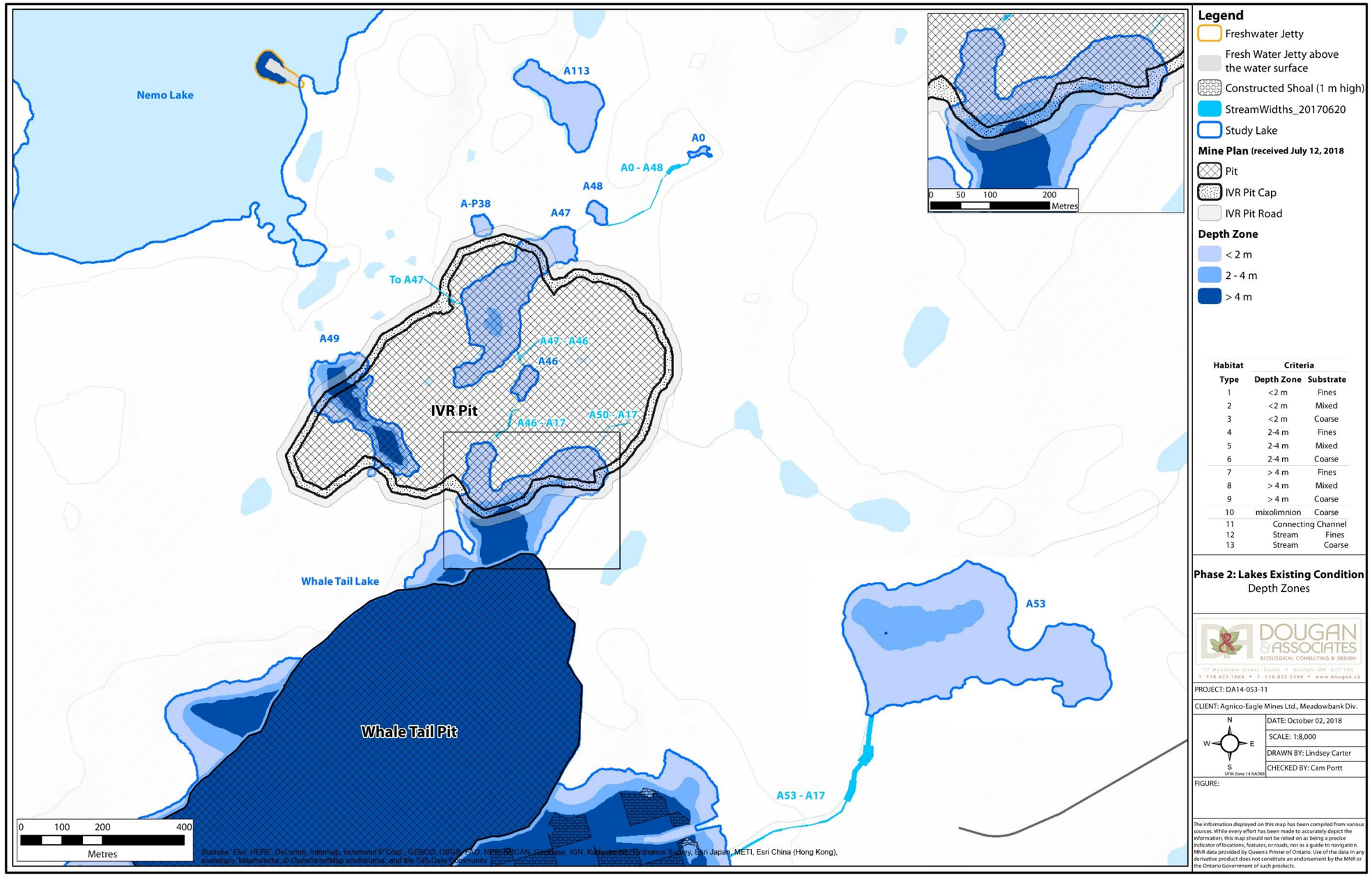

Figure E-1. Depth Zones Post-closure of Whale Tail Pit with the Approved Whale Tail Pit Offsetting Implemented and the IVR Pit, Pit Cap, and Perimeter Road Superimposed

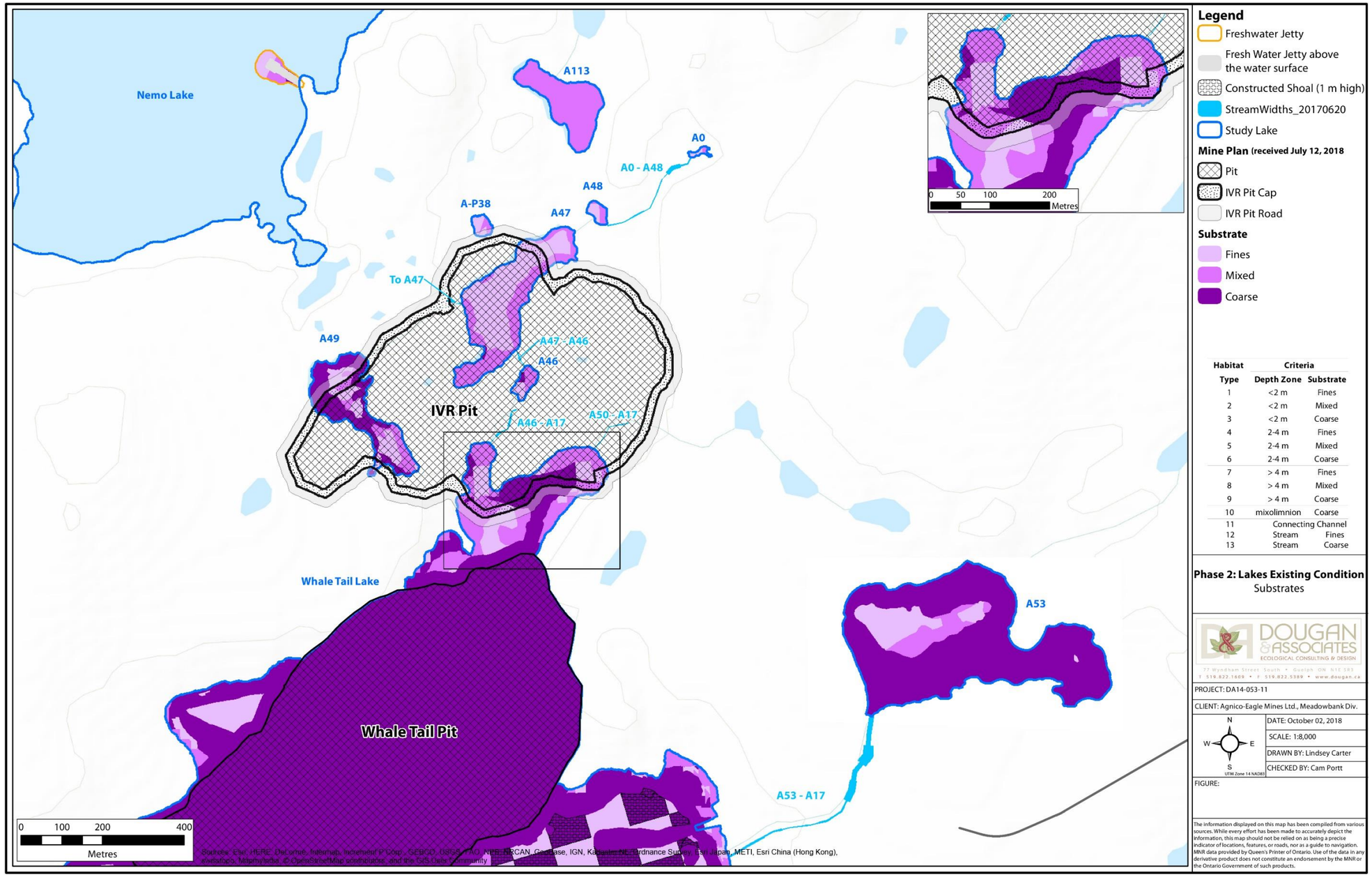

Figure E-2. Substrate Classes Post-closure of Whale Tail Pit with the Approved Whale Tail Pit Offsetting Implemented and the IVR Pit, Pit Cap, and Perimeter Road Superimposed

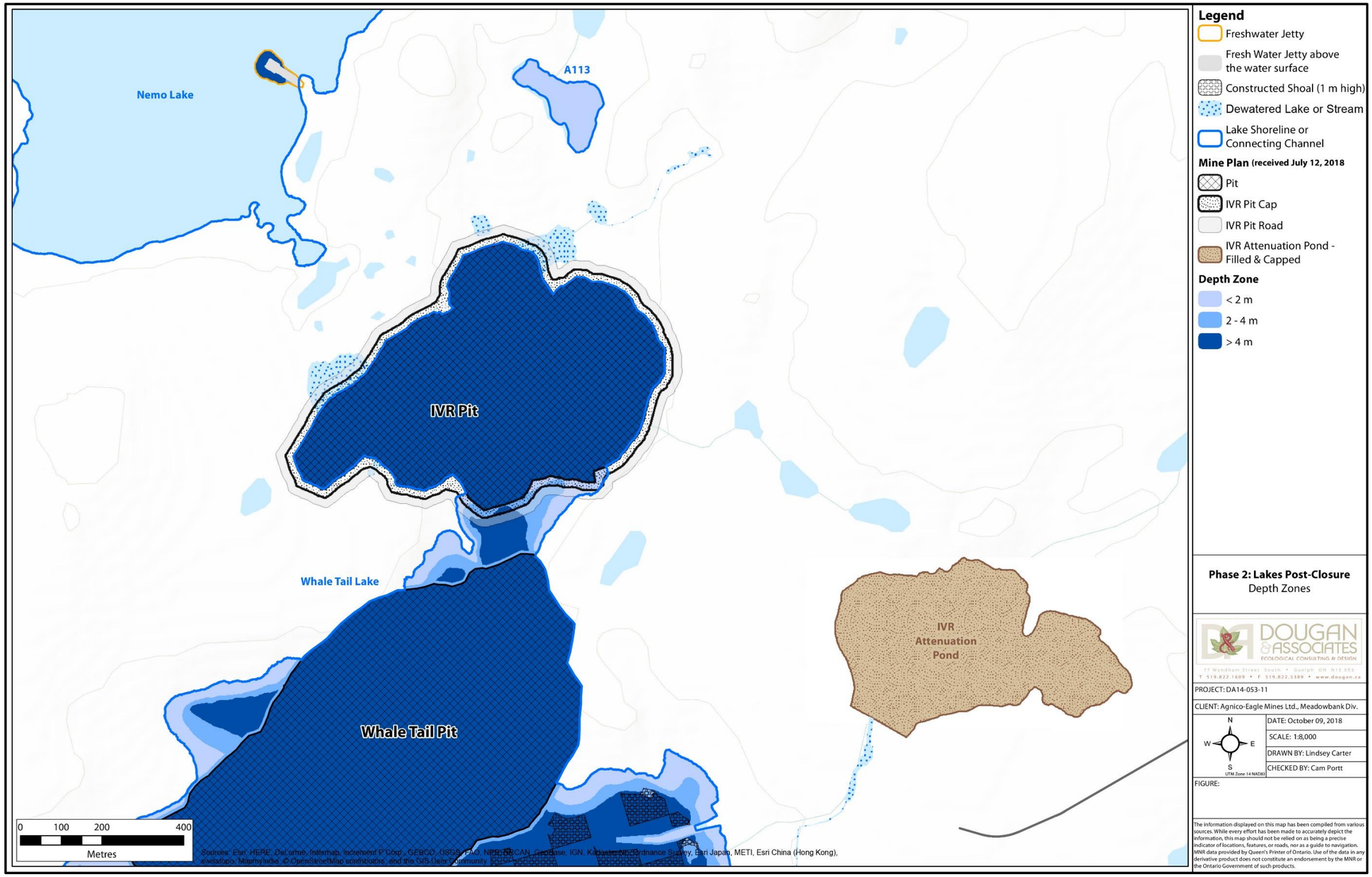

Figure E-3. Depth Zones Post-closure of Whale Tail Pit Project and Project Expansion with the Approved Whale Tail Pit Offsetting Implemented

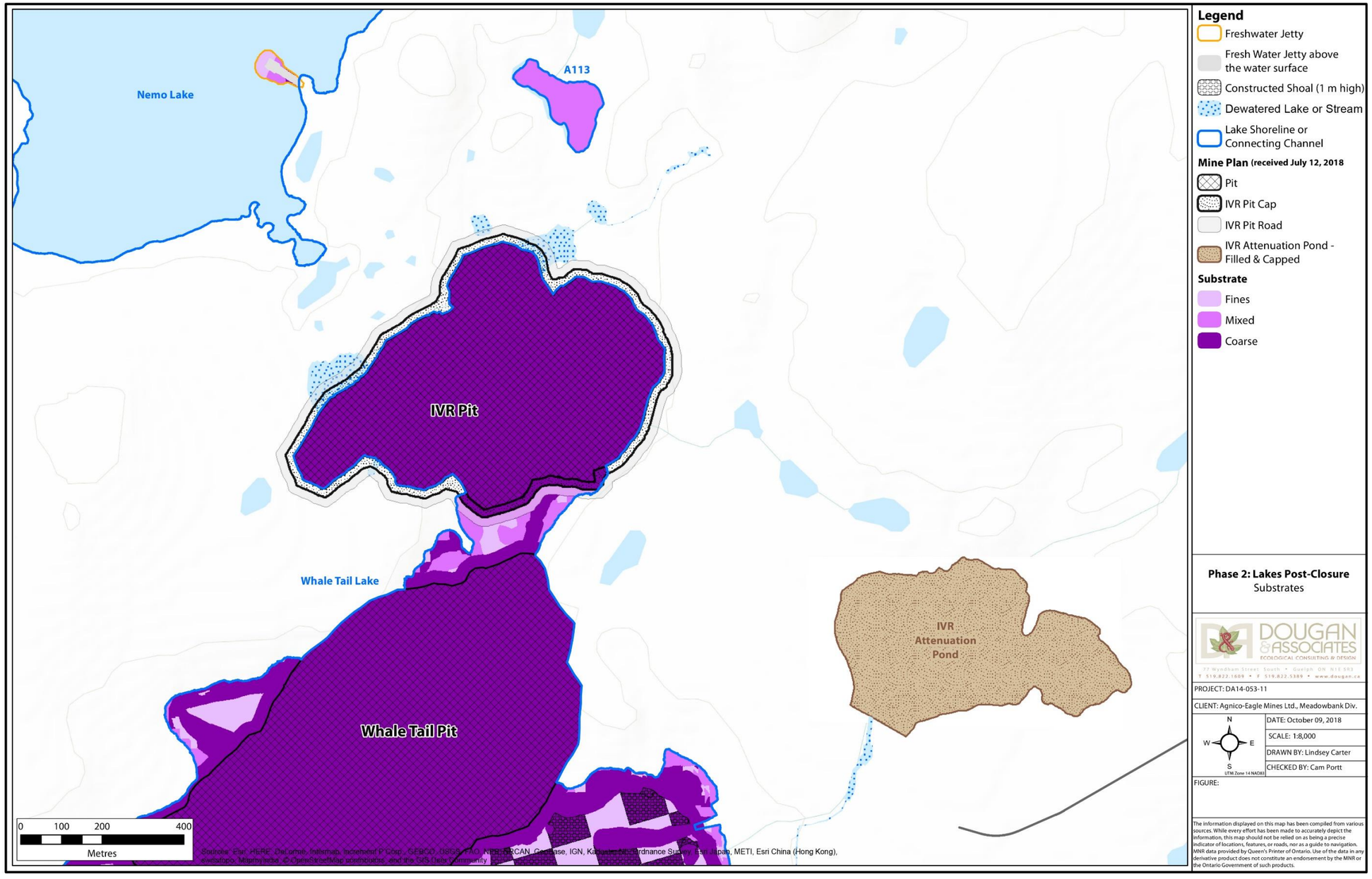

Figure E-4. Substrate Classes Post-closure of Whale Tail Pit Project and Project Expansion with the Approved Whale Tail Pit Offsetting Implemented