3AM-IQA1626 Application for Amendment – *"2022 Emergency Supplementation Project"* Supporting Submission

August 18, 2022

NUNAMI
STANTEC LIMITED

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1 INTRODUCTION

1.1 Purpose of this Document

The purpose of this document is to supplement the Application to Amend the City of Iqaluit's Type A Water Licence 3AM-IQA1626 as amended September 4, 2019. This document should be read in conjunction with and constitutes part of, that application. The application arises out of a need to respond to an emergency declared by the Minister of Community and Government Services on August 18, 2022 arising out of a potable water shortage for the City of Iqaluit.

2 DETAILS OF AMENDMENT APPLICATION

2.1 Purpose of Amendment

On August 12, 2022 the City declared a local state of emergency due to a potable water shortage, and asked the Chief Medical Officer of Health and Minister of Community and Government Services to recognize a public health emergency. The City predicts it will not be able to fill its drinking water reservoir to fill level prior to freeze-up in accordance with its water licence conditions due to ongoing historically low flows in the Apex River. This application proposes to supplement water to the reservoir from an additional source - Unnamed Lake.

2.2 Background

The City of Iqaluit (the "City") obtains its potable water from Lake Geraldine. Lake Geraldine is an engineered reservoir designed to contain the volume of water necessary to satisfy the drinking water needs of the City. The reservoir is refilled annually during spring and summer by natural inflows from snowmelt and precipitation. Drawdown of the available water in the reservoir occurs during winter. In years when natural inflows or precipitation are low and the reservoir does not fill to full capacity, or, when seasonal demand has been high, there is a potential for a shortage of drinking water available to the City over the winter.

In the summers of 2018 and 2019 the City faced potable water shortages and received approval from the Nunavut Water Board to supplement Lake Geraldine under emergency circumstances. In 2018, this supplementation occurred from the Apex River. In 2019 owing to greater water deficit, the City received approval to supplement from an additional water source – Unnamed Lake. In 2019 the City received Amendment #4 to its licence allowing supplementation of 500,000 cubic metres (m^3) annually from the Apex River. The City has been supplementing the reservoir annually from the Apex River since 2020 and is currently supplementing as river conditions allow.

2.3 Description of Emergency Circumstances

As of August 12, 2022 the City is again in a public health emergency situation due to a potable water shortage. The situation arises because of unforeseen water usage over winter and spring (contamination of treated water and firefighting), and ongoing exceptionally dry conditions, including flow conditions in the Apex River that have been equal to or lower than the minimum flows of the 42-year period of record (see Figure 2.1). **As of August 14, 214,560 m^3 had been transferred to the reservoir. As off August 14th, 425,828 m^3 of water would be needed to fill the reservoir** (see Figure 2.2). Please note that this volume represents the volume if the reservoir could be filled instantly. Table 2.1 below provides estimates of the volumes required when accounting for the time it would take to fill the reservoir and water withdrawn from the reservoir to meet the City's needs. The City predicts it will not be able to fill the reservoir to fill level prior to freeze-up in accordance with its licence conditions if ongoing low river flows persist.

Figure 2.1 Current flows in the Apex River compared to the 42-year period of record (1973-1997; 2006-2022)

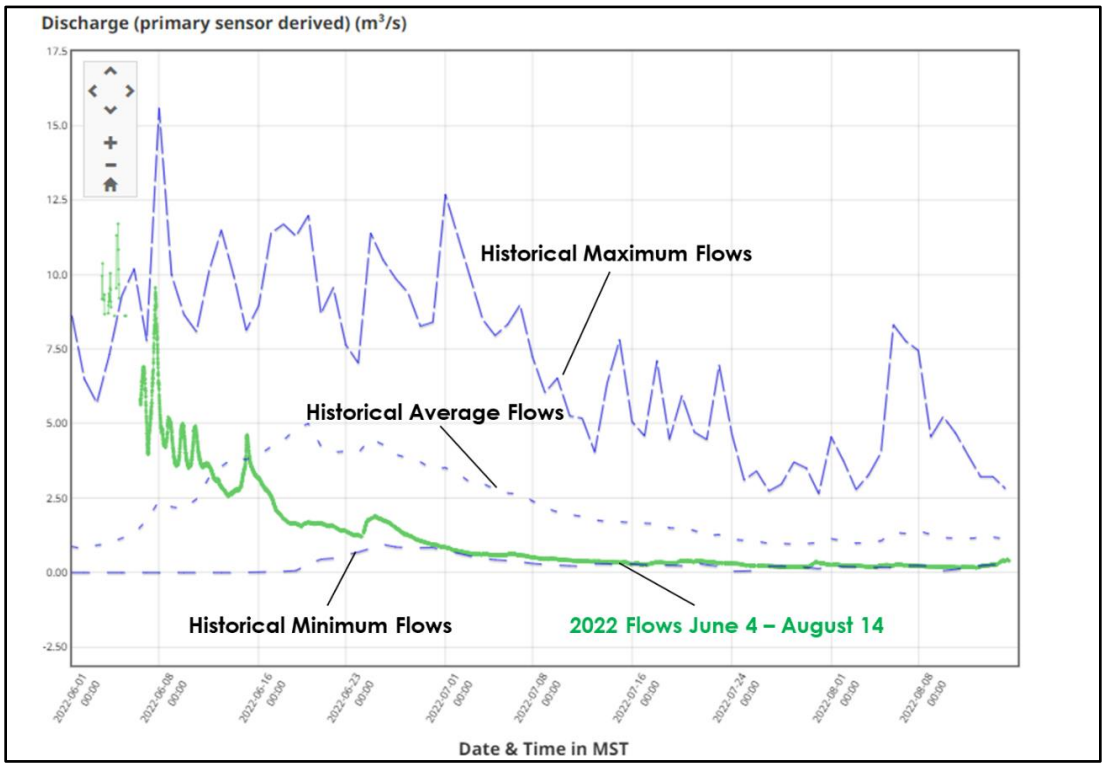
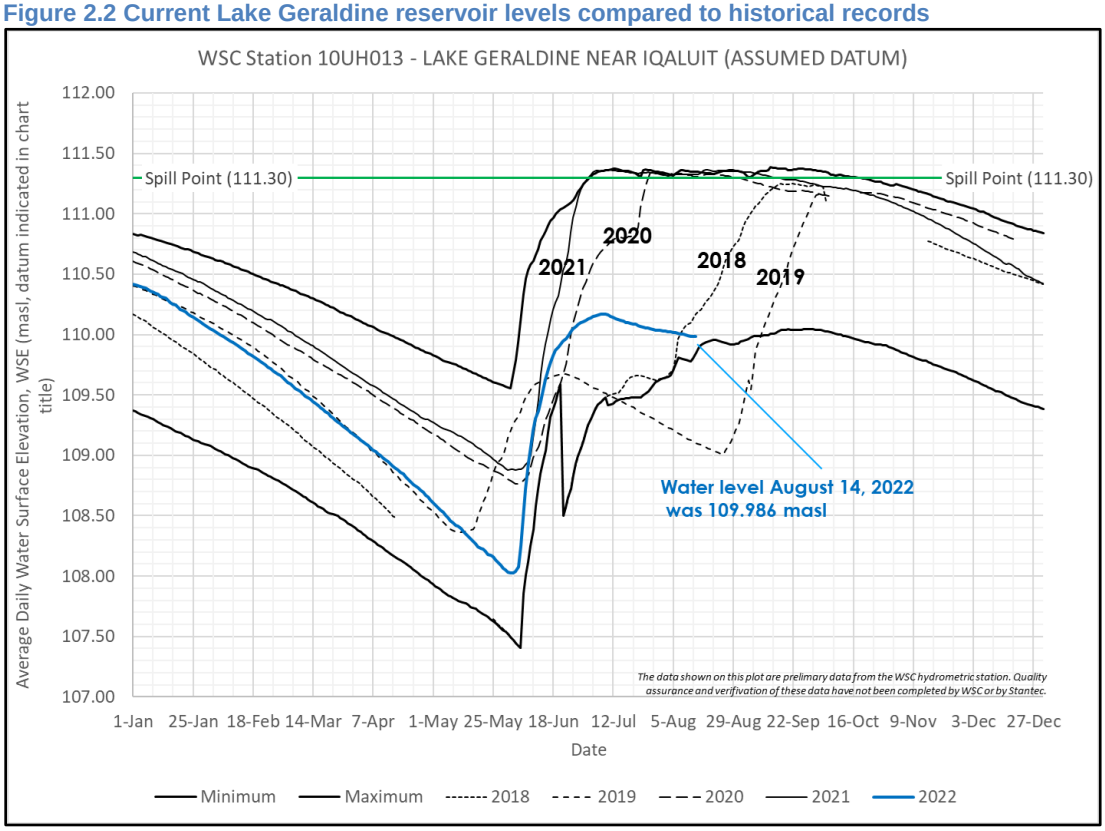


Figure 2.2 Current Lake Geraldine reservoir levels compared to historical records



The water licence currently allows the City to withdraw 10% of the flow from the Apex River when flows exceed 30% of the mean annual discharge (MAD) unless otherwise authorized by Fisheries and Oceans Canada (DFO). There are three existing submersible pumps, capable of total withdrawal rate of approximately 195 Litres per second (L/s). Pumping rates are currently adjusted daily to meet withdrawal limits, as based on reported flows immediately upstream of the pump location at Water Survey Canada (WSC) station Apex River 1km above Bridge to Nowhere (Station Number: 10UH015).

Table 2.1 summarizes the following:

1) The estimated required pumped volume for the City's potable water needs for winter 2022-2023, calculated as follows:
    a. Estimated Required Pumped Volume equals the estimated storage deficit from required volume for winter 2022-2023 (assuming a 4,000 m^3/day usage rate from October 1, 2022 – June 15, 2023) plus the anticipated usage from August 1 to September 30, 2022 (3,368 m^3/day, which is the 75th percentile usage value from June-July 2022) minus estimated natural inflows to fill the reservoir under historical minimum, 25th percentile, mean, median, 75th percentile, and maximum flows at WSC Station 10UH012 (Inflow to Lake Geraldine Near Iqaluit).
2) The estimated pumped volumes from the Apex River between August 15 and September 30, 2022 for various pumping rates (10% through 100%) under historical minimum, 25th percentile, mean, median, 75th percentile, and maximum flows scaled to the pumping location from the historical record at the WSC Station 10UH002 (Apex River at Apex).

In order to reach the fill level in the Lake Geraldine reservoir by the end of the open water season, the City would need to take much more than the allowable 10% of the flow within the Apex River.

The City has received an Authorization from Fisheries and Oceans Canada (DFO) under the *Fisheries Act* to take up to 80% of the flow of the Apex River and when flows are below 30% of the mean annual discharge as an option; however, as of August 15, the City has not exercised this option to "overpump" the river **because the Apex River alone (at the pumping location) will not have enough flow to fill the reservoir if minimum flow conditions continue** (see "Min" Column of Table 2.1). **An additional water source is required**.

Table 2.1: Estimated Required Pumped Volume and Estimated Pumped Volumes for Various Hydrologic Scenarios

ESTIMATED VOLUME REQUIREMENTS						
Historical Hydrologic Conditions at 10UH012	**Min**	**25%**	**Mean**	**Median**	**75%**	**Max**
Estimated Volume to Reservoir Spill (m^3)	542,479	515,091	449,254	481,481	391,625	202,582

PUMPING SCENARIOS						
% of 10UH015 Instantaneous Flows Pumped to Reservoir [1, 2, 3]	**Historical Hydrologic Conditions at 10UH002**					
	Min	**25%**	**Mean**	**Median**	**75%**	**Max**
10%	31,372	113,574	226,199	185,599	294,962	626,669
15%	47,058	170,361	339,299	278,398	442,443	703,187
20%	62,744	227,148	452,398	371,198	586,490	710,640
25%	78,430	283,934	565,155	463,997	676,191	710,640
30%	94,116	340,721	654,788	556,797	702,639	710,640
35%	109,802	397,508	693,236	635,974	710,640	710,640
40%	125,488	454,295	708,274	680,878	710,640	710,640
45%	141,174	511,082	710,640	699,522	710,640	710,640
50%	156,860	567,869	710,640	705,814	710,640	710,640
55%	172,546	620,784	710,640	708,605	710,640	710,640
60%	188,232	661,681	710,640	710,640	710,640	710,640
65%	203,918	687,082	710,640	710,640	710,640	710,640
70%	219,604	700,030	710,640	710,640	710,640	710,640
75%	235,290	706,544	710,640	710,640	710,640	710,640
80%	250,976	708,944	710,640	710,640	710,640	710,640
85%	266,662	710,326	710,640	710,640	710,640	710,640
90%	282,348	710,640	710,640	710,640	710,640	710,640
95%	298,034	710,640	710,640	710,640	710,640	710,640
100%	313,720	710,640	710,640	710,640	710,640	710,640

Green highlight - scenario can satisfy anticipated volume requirement for given hydrologic scenario

[1] Flows at WSC Station 10UH015 (pumping site) are 0.513 * flows at WSC Station 10UH002 Apex River at Apex, based on concurrent data from August-September 2021

[2] Assumes exact percentage is achievable through throttling of pumps; maximum pump rate (3 pumps) is estimated to be 195 L/s based on observed 2022 pumping

[3] Assumes emergency pump program from August 15 - September 30, 2022

3 PROJECT DETAILS

The City is proposing to add an additional source to its 2022 supplementation program, as it did under emergency circumstances in 2019. The City proposes to transfer water from “Unnamed Lake” to the Apex River upstream of the Apex River pump site (see Figure 3.1).

3.1 Scope of Amendment

The City is applying under emergency circumstances to:

- Withdraw up to 600,000 m^3 of water from “Unnamed Lake” in 2022
- Increase the amount of water allowed to be withdrawn from the Apex River at IQA-10 to 900,000 m^3 (from 500,000 m^3)
- Temporarily alter the flow of water in the Apex (Niaqunguk) River watershed

The period of the requested amendment is August 29 to October 31, 2022.

3.2 Description of Undertaking

The design of the 2022 emergency supplementation program is the same as in 2019, which was successful in filling the reservoir. A report of the 2019 emergency supplementation program was submitted to the Nunavut Water Board, Nunavut Planning Commission and Minister of Crown-Indigenous Relations and Northern Affairs Canada on November 29, 2019 (Nunami Stantec 2019).

The City proposes to withdraw water from the Unnamed Lake (IQA-13) and transfer it approximately 1.5 km via flexible hoses into the Apex River at a location approximately 2.3 km upstream of the existing Apex River pump location at IQA-10 (see Figure 3.1). The additional flow in the Apex River will then be captured and withdrawn at the existing Apex River pump location (IQA-10) using equipment in place for the 2022 supplementation project and conveyed by existing pipeline to Lake Geraldine (see Figure 3.1).

Figure 3.1 Project Overview (*see email attachment*)

3.2.1 Water Withdrawal Source - Unnamed Lake

Unnamed Lake is a large lake (1.1 million m^2 surface area) approximately 3 km north of the Apex River pumping location. A bathymetric survey of Unnamed Lake indicates a total water volume in excess of 6.6 million m^3 at the time of the survey (Tetra Tech 2019; Appendix B). The City is currently considering it as a long term water supplementary source, and reports of these studies will be completed in 2022; however, it has previously demonstrated (in 2019) that it can provide water necessary to fill the reservoir in addition to what will be supplied by the Apex River. The lake is seasonally connected to the Apex River. Outflow has been observed and measured during the months of June, July and August. The natural outflow follows a tributary of the Apex River that joins the main Apex River downstream of the Bridge on the Road to Nowhere and contributes to the overall flow in the lower Apex River. Surface water quality samples taken in early July 2019 demonstrate water at surface meets Health Canada's (June 2019) Guidelines for Canadian Drinking Water Quality for all parameters (Appendix A).

During engagement meetings with the Amaruq Hunters and Trappers Association (HTA) on ongoing studies of water supply, Indigenous land users have encouraged the City, since 2018, to look at using Unnamed Lake to obtain water, over the more easily accessed Sylvia Grinnell River, due to the cultural importance of that river. The City most recently engaged with the HTA on Unnamed Lake as a potential water supply in May 2022.

3.2.2 Amount to be Withdrawn from Unnamed Lake

The amount of additional water anticipated to be needed from Unnamed Lake is up to 600,000 m^3. This is based on the predicted maximum needed to be transferred to Lake Geraldine if flows in the Apex River continue along historical minimums (see first two rows of Table 2.1), plus 10% to account for losses during transfer from Unnamed Lake to the pump site (see Section 3.2.5). The Unnamed Lake withdrawal rate will be up to 200 L/s, which is 10% above the withdrawal rate of 180 L/s at the downstream Apex River pump location IQA-10. The withdrawal rate at Unnamed Lake will be adjusted daily based on natural flows in the Apex River at the IQA-10 pump location as further discussed in Section 3.2.5. Higher natural flows will allow withdrawal rates and amounts at Unnamed Lake to be reduced. For example, if natural flows in the Apex River continue along historical minimums (no available flow in Apex River), an estimated 545,000 m^3 will be required from Unnamed Lake. If flows were to begin tracking along the 25th percentile of historical flows, up to 515,000 m^3 would be required from a combination of both sources, and so on. Under historical maximums, no additional supplementation from Unnamed Lake would be required, as the Apex River alone could supply the necessary volume to the reservoir.

Based on the current information and the capacity of the pumps at Unnamed Lake and Apex River, the City anticipates 40 days of pumping at 200 L/s will be required to fill Lake Geraldine. An increase in natural inflows to Lake Geraldine (rain events) will reduce this timeframe. Supplementation from Unnamed Lake is anticipated to begin September 1, 2022.

3.2.3 Unnamed Lake Pump Setup

Water withdrawal from Unnamed Lake will require temporary installation of two submersible pumps, with a third available as backup. The pumps will be installed on floats offshore on Unnamed Lake with lines extending to shore. These pumps will be powered by a diesel-powered generator with integrated fuel storage and containment system. The pumps will connect to a short section of HDPE pipe to convey water to the height of land. At the top of the hill, a manifold will connect 10 flexible hoses that will be used to convey water downhill to the Apex River. To mitigate for potential fish entrainment, DFO Interim code of practice: End-of-pipe protection screens for small water intakes in freshwater (2020) will be applied.

Pumps and associated infrastructure will be transported to the Unnamed Lake pumping site using a road constructed in 2019. Fuel and personnel will be transported to site once per day to refuel the generator/pumps and to perform maintenance. Fuel will be stored within the integrated generator tank, which will be located within secondary containment. Recognizing the use of the water source as potable water supply, pumps, power and refueling will be located more than 30 m from shore and spill containment methods and procedures will be checked daily in accordance with the Spill Contingency Plan.

3.2.4 Conveyance Unnamed Lake to Apex River

The preferred conveyance route from Unnamed Lake to Apex River is approximately 1,500 m in length. Water is proposed to be conveyed using 10 trains of 4” flexible hoses available from the Government of Nunavut for emergency purposes. These hoses were employed during the 2019 Emergency Apex Pumping setup and have not been utilized for other purposes since then. Hose reels will be transported to site by road and laid out overland on foot.

3.2.5 Altering Flows in the Apex River

3.2.5.1 Discharge to Apex River

Up to 10 flexible hoses will be discharge water directly into a pool within the Apex River. Flow will be diffused to mitigate erosion by spacing out each of the hose discharge points and, if necessary, installing a splash pad or a section of HDPE pipe drilled with holes. This was not necessary in 2019.

Up to 200 L/s (0.2 m^3/s) of flow will be added to the Apex River. This is well within the range of natural summer streamflows based on flow recorded at the downstream hydrometric station located at the Apex River pump site (WSC 10UH015), therefore it is not expected to result in scour or erosion of the natural channel. As water from the discharge site flows downstream to the pumping location approximately 2.3 km, some water may be lost to adjacent channels or wet areas. Ten percent of the 200 L/s will be allocated as loss and the remaining 180 L/s will be withdrawn at the pumping location unless natural Apex River flows allow pumping at the full 195 L/s capacity of the pumps while keeping withdrawal below 10% of the instantaneous flow. Flows in the lower Apex River (downstream of the Apex pump location) are expected to be

unchanged. The amount of loss between the discharge location and pump location will be confirmed through monitoring.

3.2.5.2 Capture

Water from Unnamed Lake will flow from the discharge location in the Apex River downstream approximately 2.3 km to the Apex River pumping location (IQA-10). The pumps at the Apex River pumping location will be set to withdraw the amount of water as is added from Unnamed Lake (up to 180 L/s to account for losses). The WSC hydrometric station 10UH015 will record combined natural and added flows in the Apex River immediately upstream of the pump site. It is expected that all additional water flowing downstream in the Apex River from Unnamed Lake will be recorded at that hydrometric station.

When flows in this portion of the Apex River (as measured at WSC 10UH015) are below 30% MAD, withdrawal from the Apex River pumping location will not exceed 180 L/s. This reflects the design basis that if 200 L/s is added to the Apex River from Unnamed Lake, 10% of that water may be lost to areas of muskeg and side channels within the 2.3 km of reach between the two locations. Under this scenario, natural conditions downstream of the pumping location will be unchanged from natural conditions. The amount of losses will be confirmed at the start of the supplementation project, and the withdrawal rate from Apex River will be adjusted accordingly.

When natural flows in the Apex River are greater than 30% MAD, up to 195 L/s will be withdrawn at the Apex River. Depending on the natural flow of the river, less water may be withdrawn from Unnamed Lake, and more from Apex River to achieve a withdrawal rate of 195 L/s while not exceeding 10% of the natural instantaneous flow. For example, if the natural flow (i.e., not inclusive of supplemented flow) is 1 m^3/s, 100 L/s would be available to withdraw. The City would adjust the Unnamed Lake withdrawal to add 104 L/s (95 L/s plus 10%) to the river, so that a combined 195 L/s would be withdrawn at IQA-10. As with the <30% MAD scenario, keeping withdrawals within existing licence conditions (i.e., not withdrawing more than 10% of natural instantaneous flow when flows are above 30% MAD) will not adversely affect known downstream fish and fish habitat.

3.2.5.3 Other Flows Contributing to the Apex River

Unnamed Lake is seasonally connected to the Apex River via an outflow channel along its southern shore. During the period of withdrawal of September 1, 2022 to the end of the open water season (estimated to be October 15), this outflow may carry water. Drawing down water in Unnamed Lake has the potential to change the interconnectivity of Unnamed Lake to the Apex River. This is discussed further in Section 5.

3.2.6 Waste

No wastes will be discharged to the environment from the 2022 Emergency Supplementation Project.

4 ALTERNATIVES

The consideration of alternatives to Unnamed Lake as a supplementary water source to the Apex River supplementary source takes into account:

- Availability of pumping and conveyance equipment
- Ease of implementation
- Availability and quality of water
- Potential impacts to the environment
- Community input
- Past experience (the same design was executed in 2019)

The following alternatives were considered:

1. Taking all available water from Apex River at the pump site: This option was not selected as there is currently not enough flow in the Apex River to fill the reservoir. Also, taking all the flow at this location could result in harmful alteration degradation or destruction (HADD) of fish or fish habitat downstream of the pumping site (although there are other contributing flows to the Apex River downstream of the pumping site). As this is temporary supplementation project, the City did not wish to cause a permanent impact to fish.
2. Taking water from other, smaller lake sources within 1 km of the Apex River: there are several small (20,000 m^2 or less) lakes in and around the Apex River watershed. The City decided not to proceed with taking water from these lakes as their depth and presence of fish is unknown, therefore limiting the amount of water that could be taken without causing HADD of fish or fish habitat. Furthermore, installing, removing and moving pumping infrastructure to take water from several lakes would result in loss of pumping time.
3. Sylvia Grinnell River: The Sylvia Grinnell River would have adequate water to support the City's supplementation requirements; however, dry conditions in 2022 applicable to the Apex River are also being experienced in the Sylvia Grinnell River. Water would not be withdrawn when flows are less than 30% MAD due to the importance of this river as a fishery. Furthermore, water withdrawal from this river has not been supported by the Amaruq HTA during engagement meetings on water supply. Additionally, the existing infrastructure to pump and pipe water from the Sylvia Grinnell would be substantially more than that required for Unnamed Lake and this type of infrastructure is not available in Iqaluit. The City had previously considered transporting the water in 10,000 L water trucks up to 25 times daily for addition into the water supply. This option alone will not provide sufficient water for supplementing the reservoir, but approximately 10,000 m^3 could be supplied over a 41-day pumping period directly to residents during a limited timeframe.

5 ENVIRONMENTAL EFFECTS

5.1 Existing Conditions – Aquatic Resources

Fish are assumed to be present in Unnamed Lake, as traces of eDNA signatures for Arctic char (*Salvelinus alpinus*) were detected (WSP 2021). It is known to not be part of a commercial, recreational or Aboriginal fishery as based on information provided by local land users during engagement in 2019. The Apex River supports a resident population of Arctic char (Nunami Stantec 2017). All fish sampled from this population were collected at one site immediately below what is locally known as Swimming Lake. Two other reaches further downstream were sampled but no fish were captured. One site upstream at the Road to Nowhere bridge was also sampled with no fish captured. It is unknown whether fish are present in the upper Apex River at the pumping location. No fish are anticipated to be present at the Unnamed Lake discharge location due to a series of waterfalls approximately 800 m upstream of the pump site. No fish have been observed in the Upper Apex River during supplementary pumping from 2018 to 2022.

The resident population of Arctic char is not expected to be part of a commercial, recreational or Aboriginal (CRA) fishery; due to the small size of the individual fish within the population, which is common of resident populations. The Apex River is not known to have been a fishery in the past.

5.2 Potential Impacts – Aquatic Resources

Potential Impacts to aquatic resources are summarized in Table 5.1. Water withdrawals from Apex River at the pump site (IQA-10) are currently authorized. There are no additional potential effects from the 2022 Emergency Supplementation Project at this location.

Table 5.1 Potential impacts to aquatic resources from Unnamed Lake and Apex River water withdrawal

Activity	Water Quality	Hydrology	Fish and Fish Habitat
Installation, operation and removal of pumps and hoses in Unnamed Lake	• Change in sediment concentrations • Deposit of deleterious substance	• -	• Change in substrate composition • Increased potential for erosion or sedimentation
Water withdrawal from Unnamed Lake	• -	• Change in water level Unnamed Lake • Loss of connection between Unnamed Lake and Apex River	• Entrainment or impingement in pumps • Reduction or loss of fish habitat in Apex River or Unnamed Lake
Water discharge into Apex River	• Change in sediment concentrations • Change in temperature	• Increased flow	• Change in habitat from erosion or sedimentation • Change in seasonal habitat above the Apex pumping site due to increased flows

5.2.1 Potential Impacts to Water Quality

The placement of the water intake pumps using machinery, and the maintenance of the pumps, may cause bank and bed erosion leading to increased sediment entering the watercourse. Onshore activities, such as maintenance activities in work areas prone to erosion (e.g., on sand or fine materials), may also lead to increased sediment entering the waterbody. The use of machinery near water can lead to the deposit of deleterious substances (e.g., grease, oil) into the water which may affect the use of the water as a potable water source, and fish health.

5.2.2 Potential Impacts to Hydrology

Changes to water levels in Unnamed Lake may occur as a result of water taking, as up to 600,000 m^3 will be withdrawn from this lake. A bathymetric survey of the lake indicates 6.6 million m^3 of water are available in Unnamed Lake in summer. It is estimated that the lake levels may decrease by up to 1 m as a result of the supplementation project, based on surface area calculation, if no other inflows were to occur during the project; however, in 2019, the lake level decreased by only 10 cm over the 39-day supplementation project, during which just under 463,000 m^3 was withdrawn from Unnamed Lake (Numami Stantec 2019). Reducing the lake level in Unnamed Lake has the potential to reduce water surface elevation to below the invert elevation of the lake and thus reducing flows in the outflow tributary. This could result in a reduction of flows in the Apex River downstream of the pump site during this time. In 2019, the outflow from Unnamed Lake was not affected.

Adding water to the Apex River will increase the flows in the upper Apex River, between the input and withdrawal locations, for the duration of the supplementation program. This increase is not anticipated change flows downstream of the Apex pumping site as all additional water from Unnamed Lake entering the Apex River will be withdrawn at this location. Withdrawal from Apex River will not exceed 195 L/s, which is the maximum capacity of the installed pumps. When

streamflows in the Apex are less than 30% MAD as measured at WSC 10UH002, water withdrawn from the Apex River at IQA-10 will not exceed what is added to Apex from Unnamed Lake. Conditions downstream will be unchanged. When streamflows are greater than 30% MAD as measured at WSC 10UH015, no more than 10% of the instantaneous natural flow (i.e., excluding added flow) as measured at WSC 10UH015 will be withdrawn, as authorized by the existing water licence.

5.2.3 Potential Impacts to Fish and Fish Habitat

Withdrawals from the Apex River below 10% of the instantaneous flow when flows are greater than 30% MAD are authorized. A HADD of fish or fish habitat may occur if withdrawals exceed these limits, or if the outflow from Unnamed Lake is cut off. Potential effects are:

- reduction of fish habitat including overwintering habitat due to water withdrawal, and
- mortality of fish by stranding due to water withdrawal.

Changing (increasing) the flows in the Apex River can lead to erosion of the bed and banks of the river and may cause fish to be unable to move into or through areas of higher flows. The increased flows in the Apex River above the pump location will be within the annual natural range of flows. Changes in water temperature between water in Unnamed Lake and Apex River can also result in impacts to fish.

Impingement or entrainment of fish causing injury or death can occur when pumps are not fitted with fish screens meeting applicable guidelines.

5.3 Assessment of Residual Effects on Aquatic Resources

Residual environmental effects are those effects which remain after the application of mitigation. The classification of residual effects is presented in Table 5.2.

Table 5.2 Assessment Criteria for Potential Residual Environmental Effects

Criteria	Potential Outcomes			
Duration	**Short-Term:** Effect lasts for duration of pumping	**Medium-Term:** Effect remains through winter after pumping ceases	**Long-Term:** Effect lasts for more than a year after pumping ceases	
Frequency	**Once:** Effect occurs once	**Intermittent:** Effect occurs intermittently	**Continuous:** Effect occurs continuously	
Seasonal Timing	**Season-Specific:** Effect is restricted to a particular season or seasons	**Non Season-Specific:** Effect could occur year round		
Geographic Extent	**Project Footprint** Within project footprint	**Project Area** 500m surrounding project footprint	**Regional** 10 km buffer around the Project footprint	
Reversibility[1]	**Reversible or Irreversible**			
Magnitude of effect	**None/negligible**	**Low**[2]	**Moderate**[3]	**High**[4] [4]

NOTES:

[1] Reversibility: The likelihood that the environmental component will recover from an environmental effect.

[2] Low: The predicted trend in the measurable parameter under projected levels of development may result in a decline in the environmental component in the study area during the life of the Project, but levels should recover to baseline after Project closure.

[3] Moderate: The predicted trend in the measurable parameter under projected levels of development will likely result in a decline in the environmental component to lower than baseline, but stable levels in the study area after Project closure and into the foreseeable future.

[4] High: The predicted trend in the measurable parameter under projected levels of development could threaten the sustainability of the environmental component in the regional area, after Project closure, and into the foreseeable future.

5.3.1 Assessment of Effects on Water Quality

The City will implement mitigations during all project activities to reduce the effects of project activities on the aquatic environment.

Table 5.3 lists mitigations to be applied to reduce effects to water quality during supplemental pumping.

Table 5.3 Mitigations for potential effects to water quality

Potential Effect	Mitigation
Potential release of deleterious substance due to operation of machinery in and around water	• Machinery is to arrive on site in a clean condition and maintained free of fluid leaks, invasive species and noxious weeds. Eco friendly (e.g., biodegradable vegetable oil) hydraulic fluid and lubrication is to be used on equipment, where feasible. • Develop and implement a Spill Contingency Plan that minimizes risk of accidental spills or releases from entering a watercourse or water body during all phases of the pumping. • Whenever possible, operate machinery on land above the high water mark (HWM), to minimize disturbance to the banks and bed of the water body. • Wash, refuel and service machinery and store fuel and other materials for the machinery in such a way as to prevent any deleterious substances from entering the water. • Remove all construction materials from site upon project completion.
Potential increase in erosion and sedimentation from operation of machinery in and around water	• Install effective erosion and sediment control measures before starting work to prevent sediment from entering the water body. • Clearing of riparian vegetation should be kept to a minimum; use existing trails, roads or cut lines wherever possible to avoid disturbance to the riparian vegetation and prevent soil compaction. • Avoid areas of steep banks or slopes when entering or exiting water body. • Inspect and maintain erosion and sediment control measures and structures during the course of construction. • Repair erosion and sediment control measures and structures, if damage occurs. • Remove non-biodegradable erosion and sediment control materials once site is stabilized. • Minimize in-water works • Adhere to measures provided in the Erosion and Sedimentation Control Plan
Potential sediment entrainment during withdrawal from Unnamed Lake	• Position pumps offshore and away from the bottom of the lake • Follow DFO Interim code of practice: End-of-pipe protection screens for small water intakes in freshwater (2020)
Potential increase in sediment loads due to erosion at discharge point into Apex River	• Install effective erosion and sediment control measures such spreading out hose discharges in the river or using a diffuser or splash pad before starting work to prevent erosion and sediment from entering the water body. • Direct discharge directly into water at a deeper or rocky location

With the application of measures to reduce the potential for, and effects of sediments entering the Apex River and release of deleterious substance, the residual effects to water quality will be short-term, restricted to open-water season, limited to the project area and will be reversible. The residual effect to water quality is predicted to be negligible.

5.3.2 Assessment of Effects on Hydrology

Table 5.4 identifies the mitigations to be applied to reduce the potential effects on hydrology.

Table 5.4 Mitigations for potential changes to hydrology of Unnamed Lake and Apex River

Potential Effect	Mitigation
• Change in water level Unnamed Lake	• Withdraw only amount needed for supplementation. Withdrawal to cease when Lake Geraldine is full or if/when Apex River alone can meet supplementation requirements
Decrease in flows in Apex River	• When flows are <30% MAD as measured at WSC 10UH015, withdraw only what is added to Apex River from Unnamed Lake • When flows are >30% MAD as measured at WSC 10UH015, withdraw no more than 10% of instantaneous natural (i.e., not including added) flow as measured at WSC 10UH015.
Increase in flows in the Apex River	• Flows added to river (up to 200 L/s) are well within the range of flows observed in the Apex River annually • Withdraw all that is added – no change to flows in the Apex River downstream of withdrawal location
Loss of surface water connection between Unnamed Lake and Apex River	• Withdraw only amount needed for supplementation. Withdrawal to cease when Lake Geraldine is full or if/when Apex River alone can meet supplementation requirements

With the application of measures to reduce the potential for changes to hydrology of the Apex River, the residual effects to hydrology are short-term in duration, will be continuous during pumping, and will occur during open-water season. The residual effect to hydrology in the Apex River is reversible and the magnitude of the effect is negligible.

With the application of measures to reduce the potential for changes to hydrology of Unnamed Lake, the residual effects to hydrology are medium-term in duration, will be continuous during pumping, and have the potential to occur year-round. The geographic extent of this effect is downstream of the lake and potentially downstream into the Apex River. The residual effect to hydrology in Unnamed Lake and the magnitude of the effect is moderate. It is anticipated at the proposed withdrawal rates from Unnamed Lake, water levels in the lake are anticipated to recover during freshet in the following year. The recovery of water levels in Unnamed Lake was observed to occur during freshet of the following year after the previous withdrawal program.

5.3.3 Assessment of Effects on Fish and Fish Habitat

Table 5.5 lists mitigations to be applied to reduce effects to fish and fish habitat.

Table 5.5 Mitigations for potential effects to fish and fish habitat

Potential Effect	Description	Mitigation
Fish mortality and health	• Potential fish entrapment or entrainment during pumping	• Screen water intakes pipes to prevent entrainment or impingement of fish in accordance with DFO's Interim code of practice: End-of-pipe protection screens for small water intakes in freshwater (2020). Entrainment occurs when a fish is drawn into a water intake and cannot escape. Impingement occurs when an entrapped fish is held in contact with the intake screen and is unable to free itself. • Openings in the guides and seals are to be less than the opening criteria to make "fish tight". • Intakes are to be installed in a manner that prevents the uptake or entrainment of sediment and aquatic organisms associated with the bottom area. Screens should be located a minimum of 300 mm (12 in.) above the bottom of the watercourse. • Structural support is to be provided to the screen panels to prevent sagging and collapse of the screen. • Heavier cages or trash racks can be fabricated out of bar or grating to protect the finer fish screen, especially where there is debris loading (woody material, leaves, algae mats, etc.). A 150 mm (6 in.) spacing between bars is typical. • Make provision for the removal, inspection, and cleaning of screens. • Implement regular maintenance and repair of cleaning apparatus, seals, and screens is carried out to prevent debris-fouling and impingement of fish. • Shut down pumps when fish screens are removed for inspection and cleaning.
	• Potential effects to fish from changes in water temperature due to discharge of water from Unnamed Lake into the Apex River	• Spread out location of discharges if temperature difference between outlet and receiving water is >5 degrees Celsius • Water discharged from Unnamed Lake to the Apex River will be conducted on a ramp up procedure

Potential Effect	Description	Mitigation
Alteration of fish habitat	• Degradation of fish habitat in Apex River	• It is preferable to adjust pumping rate as required such that withdrawal rate is less than 10% of flow as measured or derived from hydrometric data, when flows are greater than 30% of mean annual discharge. • When flows are less than 30% mean annual discharge as measured at WSC 10UH015, withdraw as much as is added to the river, less 10% to account for losses. • Implement Sedimentation and Erosion Control Plan • Install effective erosion and sediment control measures such as a diffuser or splash pad before starting work to prevent sediment from entering the water body. • Direct discharge directly into water at a deeper or rocky location
	• Reduction or loss of fish habitat in Unnamed Lake due to drawdown	• Withdraw only amount needed for supplementation. Withdrawal to cease when Lake Geraldine is full or if/when Apex River alone can meet supplementation requirements • Withdrawal from Unnamed Lake will be less than 10% of the total lake volume

With the application of mitigation, HADD of fish or fish habitat is not anticipated. Water withdrawal during the 2019 emergency withdrawal did not result in any observed significant effects to fish or fish habitat (Nunami Stantec 2019). Assessment predictions are provided in Table 5.6.

Table 5.6 Assessment predictions on fish and fish habitat

Criteria	Fish Mortality and Health	Alteration of Fish Habitat
Duration	Short-term	Medium
Frequency	Continuous over project	Continuous over project
Seasonal timing	Fall	Fall
Geograhic extent	Project footprint	Project footprint
Reversibility	Reversible	Reversible
Magnitude of effect	Low	Low

6 MONITORING AND REPORTING

The 2022 Emergency Supplementation Project for the period of water withdrawal is intended to provide information to inform adjustments of system installation and pumping rates, and to collect information to identify potential effects to fish and fish habitat. Locations of monitoring stations proposed are shown in Figure 3.1. The monitoring plan includes:

- Metered monitoring of water withdrawal at the Unnamed Lake pump location (IQA-13)
- Metered monitoring of water withdrawal at the Apex River pump location (IQA-10)
- Streamflows as recorded at WSC 10UH002 and WSC 10UH015 will be monitored daily
- Water flow measurements will be taken weekly at locations: (1) upstream of the Apex River discharge site (Apex W-1); (2) tributary of Unnamed Lake upstream of confluence with the Apex River (Apex N-1)
- Daily water level measurements will be collected at Unnamed Lake near IQA-13

A report of the 2022 Apex River and Unnamed Lake Supplementation Project will be provided by March 31, 2023. This report will include:

- Daily and total amounts withdrawn from Unnamed Lake at IQA-13
- Daily and total amounts withdrawn from the Apex River at IQA-10
- Unnamed Lake drawdown as recorded by transducers and stadia rods
- Daily flows recorded at WSC 10UH002 and WSC 10UH015 compared against MAD
- General observations of flow conditions and channel conditions along the Apex River
- Summary of project implementation schedule, project setup and environmental mitigations

All data collected during the 2022 Emergency Supplementation Project will be used to advance the City's studies of long-term water supply.

7 REFERENCES

Fisheries and Oceans Canada. 2020. Interim code of practice: End-of-pipe fish protection screens for small water intakes in freshwater (dfo-mpo.gc.ca)

Nunami Stantec 2019. Final Report: Iqaluit 2019 Emergency Water Supply Project Report of Activities. Submitted by the City of Iqaluit to the Minister of CIRNAC, Nunavut Planning Commission and Nunavut Impact Review Board.

Nunami Stantec. 2017. Fish and Fish Habitat Assessment of the Niaqunguk (Apex) River, Lake Geraldine, and the Lake Geraldine Drainage Channel. Prepared for the City of Iqaluit.

Tetra Tech Canada Inc. 2019. Iqaluit DFO Bathymetric Lake Surveys.

WSP CANADA INC. (WSP). 2021. Unnamed Lake Fish and Fish Assessment Technical Report City of Iqaluit.

Appendix A: Unnamed Lake Surface Water Quality Results Summary

Appendix B:
Unnamed Lake Bathymetry