
To:	Josip Deronja, Engineering Manager City of Iqaluit	From:	Erica Bonhomme, Project Manager Nunami Stantec
File:	144902884	Date:	October 1, 2019

Reference: City of Iqaluit 2019 Emergency Water Supplementation Program – Water Quality Sampling Unnamed Lake

INTRODUCTION

Nunami Stantec Limited (Nunami) is pleased to submit this Water Quality Sampling Memorandum (Memo) for the City of Iqaluit's Unnamed Lake to Apex River Water Withdrawal Program in 2019 (herein referred to as the "2019 Emergency Water Supplementation Program"). This Memo addresses the baseline water quality parameters of Table 1 of the Northern Health guidance for water source approval (Northern Health, 2012), provided to Nunami by A.Gill August 15, 2019, and additionally as required based on correspondence between A.Gill and E.Bonhomme of Nunami up to August 21, 2019. Water quality samples were collected on July 4 and September 12, 2019 at five locations within Unnamed Lake, as shown on Figure A-1 (attached). Water quality sampling was outside of the scope outlined in Nunami's Operational Monitoring Plan (Nunami Stantec 2019).

The objective of water quality monitoring activities was to establish confirm suitable water quality in Unnamed Lake as a source of drinking water for the City of Iqaluit, prior to transfer to Lake Geraldine reservoir. This memo presents the methodology, regulatory framework, results and conclusions.

REGULATORY FRAMEWORK

Surface water chemical analytical results are compared to the following specific standards that are considered applicable to Unnamed Lake:

- Guidelines for Canadian Drinking Water Quality – Summary Table (Health Canada 2019),
- Northern Health Public Health Protection – Table 1. Required Water Quality Parameters (Northern Health 2019).

METHODS

Field staff conducted surface water sampling in accordance with Stantec Consulting Ltd. (Stantec)'s Standard Operating Procedures. Special care was taken at the sampling locations to not disturb sediment to minimize the amount that entered sample containers. In-situ physical water quality parameters (temperature, pH, dissolved oxygen, and conductivity) were measured using a YSI 556 multi meter.

All surface water samples were collected in laboratory-supplied containers with appropriate preservative and placed in insulated coolers. Samples were uniquely labeled, and control was maintained using chain of custody forms. Sample locations and the analyses performed for each sample are shown in Table 1 below.

Reference: City of Iqaluit 2019 Emergency Water Supplementation Program – Water Quality Sampling Unnamed Lake

Table 1 Sample location summary table

Location ID	Parameters Sampled	Date Sampled	Latitude	Longitude
SW19-01	General Chemistry, benzene/ toluene/ ethylbenzene/ xylene (BTEX) and Petroleum Hydrocarbons (PHCs), Metals, and Microbiology	July 4, 2019 and September 12, 2019 (BTEX, PHC, and mercury)	63.781474	-68.45223
SW19-02	General Chemistry, BTEX and PHCs, Metals, and Microbiology	July 4, 2019 and September 12, 2019 (BTEX, PHC, and mercury)	63.77787	-68.44533
SW19-03	General Chemistry, BTEX and PHCs, Metals, and Microbiology	July 4, 2019 and September 12, 2019 (BTEX, PHC, and mercury)	63.77353	-68.43791
SW19-04	General Chemistry, BTEX and PHCs, Metals, and Microbiology	July 4, 2019 and September 12, 2019 (BTEX, PHC, and mercury)	63.77522	-68.44123
SW19-05	General Chemistry, BTEX and Petroleum Hydrocarbons, Metals, and Microbiology	July 4, 2019 and September 12, 2019 (BTEX, PHC, and mercury)	63.77502	-68.44905

RESULTS

Analytical results for surface water are provided in Table A-1, attached. All water quality parameters were reported to be below the applicable standards with the exception of Total Alkalinity at all five locations and Lagelier Index (at 4°C) at four locations. Total alkalinity was below the lower threshold put forth in the Northern Health Public Health Protection Table 1, but it is noted that the lower limit of 30 identified in this standard is listed as approximate. Additionally, results for Langelier Index were slightly below the lower limit given by the Northern Health Public Health Protection Table 1, which is also listed as approximate.

Results for BTEX and PHC were all below the laboratory's detection limit. Total coliforms and Escherichia coli (E.Coli) were reported as zero colony-forming units (cfu) for all sample locations. Nutrient and metals analytical results were generally low, with many parameters reporting values below the laboratories detection limit.

Field parameters were measured using a YSI multi-parameter probe and are summarized in Table 2 below.

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Table 2 Field parameters summary table

Location ID	Temperature (°C)	pH	Conductivity (µs/cm)
SW19-01	9.03	7.03	30
SW19-02	9.04	7.05	30
SW19-03	9.00	6.96	29
SW19-04	8.62	7.06	29
SW19-05	12.22	7.8	34

CONCLUSIONS

Based on the results of the water quality sampling program conducted at Unnamed Lake, the following conclusions can be made:

- Water quality in Unnamed lake is considered to be good based on the reported analytical results,
- BTEX and PHC were below laboratory detection limits,
- Total Coliforms and E.Coli were reported at 0 cfu/100ml.

REFERENCES

Health Canada. 2019. Guidelines for Canadian Drinking Water Quality – Summary Table. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

Northern Health. 2012. PHP Guideline of Required water quality parameters for Water Source Approval. Accessed September 21, 2019 at:

https://www.northernhealth.ca/sites/northern_health/files/services/environmental-health/documents/guidelines-required-water-quality-parameters.pdf

Nunami Stantec. 2019. "City of Iqaluit 2019 Emergency Water Supplementation Program - Operational Monitoring Plan." Iqaluit.

Nunami Stantec Ltd.

Andrew Sullivan P.Eng. (NS); NT/NU registration pending
Environmental Engineer
Phone: (902) 468-7777
Andrew.sullivan@stantec.com

Erica Bonhomme M.Sc., P.Geo.
Team Lead, Environmental Services
Phone: 867-920-2882
erica.bonhomme@stantec.com

Attachment:

Figure A-1 – Sample locations
Table A-1 – Analytical Water Quality Results

Table A-1
Summary of Surface Water Analytical Results
Lake Geraldine Water Supply
Nunami Stantec Limited

Sample Location				SW19-01		SW19-02		SW19-03		SW19-04		SW19-05	
Sample Date				4-Jul-19	12-Sep-19	4-Jul-19	12-Sep-19	4-Jul-19	12-Sep-19	4-Jul-19	12-Sep-19	4-Jul-19	12-Sep-19
Sample ID				SW19-01	SW19-01	SW19-02	SW19-02	SW19-03	SW19-03	SW19-04	SW19-04	SW19-05	SW19-05
Sampling Company				STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory				BV	BV	BV	BV	BV	BV	BV	BV	BV	BV
Laboratory Work Order				B9I5722	B9P9085	B9I5722	B9P9085	B9I5722	B9P9085	B9I5722	B9P9085	B9I5722	B9P9085
Laboratory Sample ID	Units	Health Canada	Northern Health	KEV013	KUI442	KEV014	KUI443	KEV015	KUI444	KEV016	KUI445	KEV017	KUI446
General Chemistry													
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	n/v	<1.0	-	<1.0	-	<1.0	-	<1.0	-	<1.0	-
Alkalinity, Total (as CaCO3)	mg/L	n/v	30-500 ^D	16 ^D	-	16 ^D	-	16 ^D	-	16 ^D	-	17 ^D	-
Ammonia (as N)	mg/L	n/v	1.5 ₍₃₎ ^D	0.15	-	0.25	-	0.072	-	<0.050	-	<0.050	-
Bicarbonate(as CaCO3, Calculated)	mg/L	n/v	n/v	16	-	16	-	16	-	16	-	17	-
Chloride	mg/L	≤250 ^A	250 ^D	1.6	-	1.3	-	1.5	-	1.2	-	1.4	-
Electrical Conductivity, Lab	µmhos/cm	n/v	800 ^D	46	-	45	-	45	-	45	-	47	-
Hardness (as CaCO3)	mg/L	n/v	250 ^D	20	-	19	-	19	-	19	-	20	-
Langelier Index (at 20 C)	none	n/v	-2 to +2 ^D	-1.77	-	-1.85	-	-1.78	-	-1.79	-	-1.67	-
Langelier Index (at 4 C)	none	n/v	-2 to +2 ^D	-2.02 ^D	-	-2.10 ^D	-	-2.03 ^D	-	-2.04 ^D	-	-1.92	-
Nitrate (as N)	mg/L	10 ^B	10 ₍₃₎ ^D	<0.10	-	<0.10	-	<0.10	-	<0.10	-	<0.10	-
Nitrite (as N)	mg/L	1 ^B	1 ₍₃₎ ^D	<0.010	-	<0.010	-	<0.010	-	<0.010	-	<0.010	-
Orthophosphate (as P)	mg/L	n/v	n/v	<0.010	-	<0.010	-	<0.010	-	<0.010	-	<0.010	-
pH, lab	S.U.	7.0-10.5 ^A	6.5-8.5 ^D	7.48	-	7.43	-	7.49	-	7.47	-	7.54	-
Phosphorus, Total	mg/L	n/v	0.1 ₍₂₎ ^D	0.006	-	0.013	-	0.008	-	0.005	-	0.008	-
Saturation pH (at 20 C)	none	n/v	n/v	9.25	-	9.28	-	9.27	-	9.26	-	9.22	-
Saturation pH (at 4 C)	none	n/v	n/v	9.50	-	9.53	-	9.52	-	9.52	-	9.47	-
Sulfate	mg/L	≤500 ^A	500 ^D	2.7	-	2.5	-	2.4	-	2.4	-	2.8	-
Total Dissolved Solids (Calculated)	mg/L	≤500 ^A	500 ^D	23	-	22	-	22	-	22	-	24	-
Total Organic Carbon	mg/L	n/v	2.5 ^D	1.6	-	1.4	-	1.4	-	1.3	-	1.4	-
Turbidity, Lab	NTU	≤0.3/1.0/0.1 ^C	1 ^D	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-
BTEX and Petroleum Hydrocarbons													
Benzene	µg/L	5 ^B	5 ₍₉₎ ^D	-	<0.20	-	<0.20	-	<0.20	-	<0.20	-	<0.20
Toluene	µg/L	24 ^A 60 ^B	24 ₍₉₎ ^D	-	<0.20	-	<0.20	-	<0.20	-	<0.20	-	<0.20
Ethylbenzene	µg/L	1.6 ^A 140 ^B	2 ₍₉₎ ^D	-	<0.20	-	<0.20	-	<0.20	-	<0.20	-	<0.20
Xylene, m & p-	µg/L	n/v	n/v	-	<0.40	-	<0.40	-	<0.40	-	<0.40	-	<0.40
Xylene, o-	µg/L	n/v	n/v	-	<0.20	-	<0.20	-	<0.20	-	<0.20	-	<0.20
Xylenes, Total	µg/L	20 ^A 90 ^B	300 ₍₉₎ ^D	-	<0.40	-	<0.40	-	<0.40	-	<0.40	-	<0.40
PHC F2 (>C10-C16 range)	µg/L	n/v	n/v	-	<100	-	<100	-	<100	-	<100	-	<100
PHC F3 (>C16-C34 range)	µg/L	n/v	n/v	-	<200	-	<200	-	<200	-	<200	-	<200
PHC F4 (>C34-C50 range)	µg/L	n/v	n/v	-	<200	-	<200	-	<200	-	<200	-	<200
Chromatogram to baseline at C50	none	n/v	n/v	-	YES	-	YES	-	YES	-	YES	-	YES
Metals, Dissolved													
Calcium	mg/L	n/v	100 ₍₂₎ ^D	6.6	-	6.4	-	6.5	-	6.5	-	6.7	-
Magnesium	mg/L	n/v	30 ₍₂₎ ^D	0.80	-	0.77	-	0.74	-	0.76	-	0.81	-
Potassium	mg/L	n/v	400 ₍₂₎ ^D	<1	-	<1	-	<1	-	<1	-	<1	-
Sodium	mg/L	≤200 ^A	1,000 ₍₂₎ ^D	0.7	-	0.7	-	0.7	-	0.7	-	0.7	-
Metals, Total													
Aluminum	µg/L	<100/200 ₉ ^A	n/v	5.5	-	5.5	-	5.1	-	5.1	-	8.0	-
Antimony	µg/L	6 ^B	6 ₍₂₎ ^D	<0.50	-	<0.50	-	<0.50	-	<0.50	-	<0.50	-
Arsenic	µg/L	10 ^B	20 ₍₂₎ ^D	<1.0	-	<1.0	-	<1.0	-	<1.0	-	<1.0	-
Barium	µg/L	1,000 ^B	1,000 ₍₂₎ ^D	<2.0	-	<2.0	-	<2.0	-	<2.0	-	<2.0	-
Beryllium	µg/L	n/v	n/v	<0.50	-	<0.50	-	<0.50	-	<0.50	-	<0.50	-
Boron	µg/L	5,000 ^B	5,000 ₍₂₎ ^D	<10	-	<10	-	<10	-	<10	-	<10	-
Cadmium	µg/L	5 ^B	5 ₍₂₎ ^D	<0.10	-	<0.10	-	<0.10	-	<0.10	-	<0.10	-
Calcium	µg/L	n/v	100,000 ₍₂₎ ^D	6,700	-	6,800	-	6,700	-	6,900	-	7,400	-
Chromium	µg/L	50 ^B	50 ₍₂₎ ^D	<5.0	-	<5.0	-	<5.0	-	<5.0	-	<5.0	-
Cobalt	µg/L	n/v	n/v	<0.50	-	<0.50	-	<0.50	-	<0.50	-	<0.50	-
Copper	µg/L	≤1000 ^A 2,000 ^B	1,000 ₍₂₎ ^D	<1.0	-	<1.0	-	<1.0	-	<1.0	-	<1.0	-
Iron	µg/L	≤300 ^A	300 ₍₂₎ ^D	<100	-	<100	-	<100	-	<100	-	<100	-
Lead	µg/L	5 ^B	10 ₍₂₎ ^D	<0.50	-	<0.50	-	<0.50	-	<0.50	-	<0.50	-
Magnesium	µg/L	n/v	30,000 ₍₂₎ ^D	760	-	710	-	740	-	750	-	820	-
Manganese	µg/L	≤20 ^A 120 ^B	50 ₍₂₎ ^D	3.1	-	2.6	-	2.9	-	3.5	-	2.8	-
Mercury	µg/L	1 ^B	1 ₍₂₎ ^D	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01
Molybdenum	µg/L	n/v	n/v	<0.50	-	<0.50	-	<0.50	-	<0.50	-	<0.50	-
Nickel	µg/L	n/v	n/v	<1.0	-	<1.0	-	<1.0	-	<1.0	-	<1.0	-
Potassium	µg/L	n/v	400,000 ₍₂₎ ^D	<200	-	<200	-	<200	-	<200	-	<200	-
Selenium	µg/L	50 ^B	10 ₍₂₎ ^D	<2.0	-	<2.0	-	<2.0	-	<2.0	-	<2.0	-
Silicon	µg/L	n/v	n/v	480	-	460	-	460	-	450	-	540	-
Silver	µg/L	n/v	n/v	<0.10	-	<0.10	-	<0.10	-	<0.10	-	<0.10	-
Sodium	µg/L	≤200000 ^A	1,000,000 ₍₂₎ ^D	660	-	670	-	660	-	650	-	730	-
Strontium	µg/L	n/v	n/v	10	-	9.7	-	9.9	-	9.9	-	10	-
Thallium	µg/L	n/v	n/v	<0.050	-	<0.050	-	<0.050	-	<0.050	-	<0.050	-
Titanium	µg/L	n/v	n/v	<5.0	-	<5.0	-	<5.0	-	<5.0	-	<5.0	-
Vanadium	µg/L	n/v	n/v	<0.50	-	<0.50	-	<0.50	-	<0.50	-	<0.50	-
Zinc	µg/L	≤5000 ^A	5,000 ₍₂₎ ^D	<5.0	-	<5.0	-	<5.0	-	<5.0	-	<5.0	-
Microbiological Analysis													
Total Coliform Background	cfu/100mL	n/v	n/v	0	-	7	-	8	-	0	-	2	-
Total Coliforms	cfu/100mL	0 ^C	0 ^D	0	-	0	-	0	-	0	-	0	-
Escherichia coli (E.Coli)	cfu/100mL	0 ^C	0 ^D	0	-	0	-	0	-	0	-	0	-

See notes on last page.

Table A-1
Summary of Surface Water Analytical Results
Lake Geraldine Water Supply
Nunami Stantec Limited

Notes:	
Health Canada	Health Canada (June 2019). Guidelines for Canadian Drinking Water Quality—Summary Table. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.
A	Guidelines for Canadian Drinking Water Quality - Aesthetic Objectives/ Operational Guidelines
B	Guidelines for Canadian Drinking Water Quality - Maximum Acceptable Concentration
C	Guidelines for Canadian Drinking Water Quality - Microbiological Parameters
Northern Health	Public Health Protection, Environmental Health
D	Table 1. Required Water Quality Parameters
6.5 ^A	Concentration exceeds the indicated standard.
15.2	Measured concentration did not exceed the indicated standard.
<0.50	Laboratory reporting limit was greater than the applicable standard.
<0.03	Analyte was not detected at a concentration greater than the laboratory reporting limit.
n/v	No standard/guideline value.
-	Parameter not analyzed / not available.
(2)	Total metals required. Dissolved metals optional, but recommended if turbidity is elevated. Scan to include both high and low level metals.
(3)	Required for source water characterisation. If all are < 1 mg/L as N, later samples may be analysed for Total N only.
(9)	Required if hydrocarbon/gasoline type contamination is suspected. Contat laboratory for sampling procedure.
a	This is an operational guidance value, designed to apply only to drinking water treatment plants using aluminum-based coagulants; it does not apply to naturally occurring aluminum found in groundwater. The operational guidance values of 0.1 mg/L applies to conventional treatment plants, and 0.2 mg/L applies to other types of treatment systems.
i	High levels (above 500 mg/L) can cause physiological effects such as diarrhea or dehydration.