City of Iqaluit

Drinking Water Management Program

Type of Document:
Final

Project Name:
Development of Drinking Water Program

Project Number:
OTT-00246002-B0

Prepared By:
EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6
Canada
T: 613-688-1899
F: 613-255-7337
www.exp.com

Ian Crawford, C.E.T.
Project Manager – Infrastructure Services

Simon Plourde, P.Eng.
Project Engineer – Infrastructure Services

Date Submitted:
June 2020

Legal Notification

This report was prepared by EXP Services Inc. for the account of **The City of Iqaluitt.**

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. EXP Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Table of Contents

Page

List of Appendices

List of Figures

List of Tables

Page

1 Introduction

The City of Iqaluit (City) currently holds a water licence that permits the taking of 1,100,000 m^3 annually from Lake Geraldine. Current water consumption is approaching this regulatory limit. The current rate of water use is also approaching the available runoff from the watershed to Lake Geraldine. Thus, it is very much in the interest of the City to achieve the greatest potential capability from the current water source. The City has requested assistance in the development of A Drinking Water Management Program. This program will provide the City with a strategy and necessary tools that will assist with the optimization of a vital community resource, the water source from Lake Geraldine. The Drinking Water Management Program will be broken down into three sections;

- A Water Audit
- A Water Loss Control Strategy
- A Water Demand Strategy

The City is served by a water distribution system that incorporates adaptations for the local climate and permafrost conditions. Some of these adaptations have a bearing upon water waste efficiency and unaccounted water. This includes both intended flows from the water system and unintentional losses. Among the intended water consumption that is not directly used by customers are bleed flows used as measures to avoid freeze of both watermains and sewers. In some instances, these bleeds have been intentionally provided, as no closed loop circulation is possible. In other instances, bleeds have been initiated as an operational response to localized freeze issues. These types of bleeds are found both on the public distribution networks and within buildings. Unintended water loss attributable to leaks varies from the experience in southern Canada due to the extensive use of high-density polyethylene (HDPE) piping and encasement of the piping in frozen soil for much of the year. The water distribution system includes a limited amount of operational ductile iron piping. Leakage from this piping has frequently been the result of failure due pipe freeze. For the remainder of the system, leakage is usually associated with service connection saddles and flanged connections at access vaults. These leakage issues may be exacerbated by climate change.

The initial step in the project, a water audit, represents more than just a determination of the fate of the water taken from the source. Initial findings include estimates of per capita water consumption and the portion of City water production that is unaccounted for. Opportunities to improve the accuracy of the water audit are identified. One of the most important outcomes of the audit is direction for subsequent activities. This will be led by the development of an improved sense of where water is lost, and direct efforts that can lead to more efficient use of the limited drinking water resources available to the City.

A water loss strategy has been developed with the intention of reduction in unintended use of water. Priorities have been developed based upon the amount of potential water saving. This portion of the study will provide a list of programs the City can advance. In addition to those listed in section 5.3 of the RFP and consideration will be given to improved freeze protection measures.

The water demand strategy represents a program of both City and customer activities that will optimize intentional water consumption. Priorities have been developed based upon potential water savings that can be achieved for each element of the program. The water demand strategy can be found in appendix I of this report. Elements of this program include:

- City funded programs to encourage lower water use. These could include plumbing fixture retrofit programs
- Amendments to City standards that will lead to lower water use
- Identification of water system operating methods that can be optimized
- Documentation, rationalization, and control of intended water losses under municipal control (such as water distribution system bleeds)
- Enhancements to freeze protection measure with the intent of reduction of water consumption

2 Water Audit

2.1 Introduction

EXP Services Inc. has been retained by the City of Iqaluit to conduct a drinking water management study for the City of Iqaluit. Among the initial activities of this study is an audit of drinking water consumption based upon the information received. This has included the gathering of population, Lake Geraldine water consumption, water meter records and water system bleeds data. The following summarizes the results of this data gathering and provides the analytical findings.

2.2 Data Sources

The following sources of information have been consulted during the preparation of this memorandum.

- Raw water consumption data, as provided by the City of Iqaluit.
- Population data, as provided from the Nunavut Bureau of Statistics web site.
- The annual report to the Nunavut Water Board, as obtained from the Water Board online registry.
- Metered water use information as provided, through the City of Iqaluit, from the billing system contractor.
- Mapping of the locations of water system bleeds, as provided by the City through Colliers Project Leaders.

2.3 Population

Population data is available from the Nunavut Bureau of Statistics. The Bureau provides population estimates for the period 2001 to 2016 for each community. For the purposes of this analysis population data from the period 2008 to 2016 has been used, as this aligns with the period for the water consumption data that was provided by the City. The data is presented in the table below, along with percentage of growth in population from 2008 as the base year.

Table 2.1 – Population and Population Growth

Year	Population	Growth from 2008
2008	6454	-
2009	6593	102.2%
2010	6755	104.7%
2011	6916	107.2%
2012	7013	108.7%
2013	7123	110.4%
2014	7343	113.8%
2015	7456	115.5%
2016	7590	117.6%

2.4 Lake Geraldine Water Consumption

The City has provided data for raw water consumption directly from Lake Geraldine for the period 2008 to 2017. This data, together with the growth in population are presented in the following table and graph.

Table 2.2 – Raw Water Consumption and Population Growth

Year	Raw Water Consumption (m^3)	Consumption Growth from 2008	Change from Preceding Year	Population Growth from 2008
2008	929,130	-		-
2009	901,550	97.0%	97.0%	102.2%
2010	877,090	94.4%	97.3%	104.7%
2011	839,610	90.4%	95.7%	107.2%
2012	871,670	93.8%	103.8%	108.7%
2013	930,360	100.1%	106.7%	110.4%
2014	990,140	106.6%	106.4%	113.8%
2015	1,088,690	117.2%	110.0%	115.5%
2016	1,249,150	134.4%	114.7%	117.6%
2017	1,208,200	130.0%	96.7%	

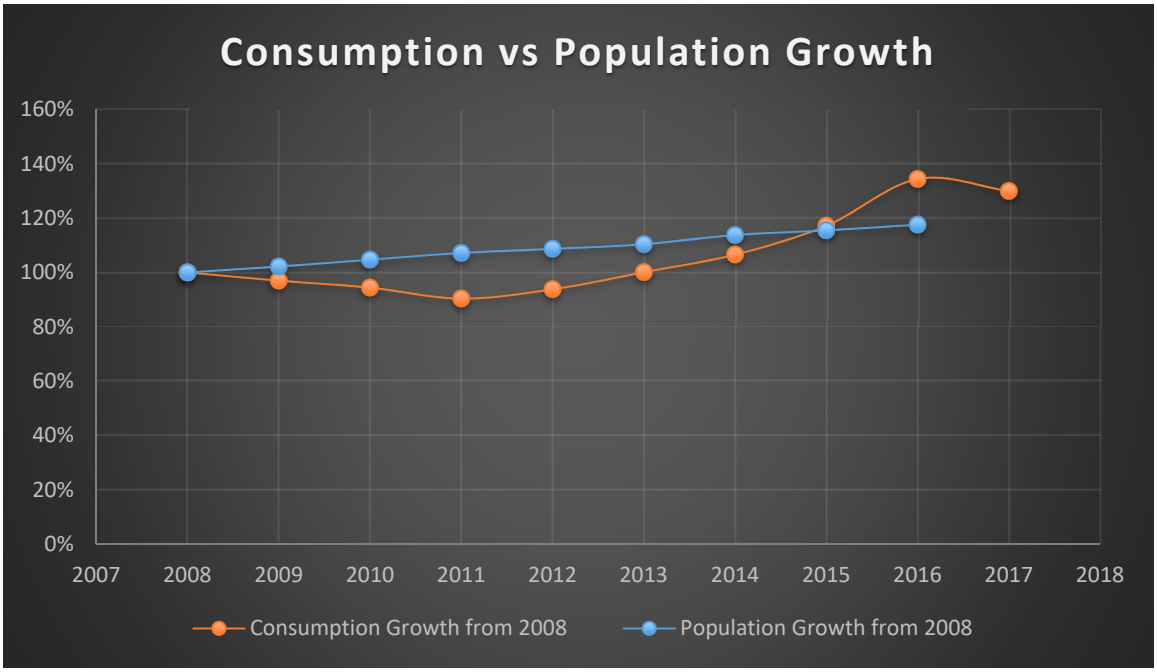


Figure 2.1-Consumption vs Population Growth

The above data represents water consumption at the intake into the water treatment plant. This data does not account for water losses within the plant, such as backwash flows. These demands are anticipated to be modest and in the range of 2% to 5% of total water taking.

The following observations are drawn from the above data.

- Water consumption was stable at approximately 930,000 m^3 annually for the 6 year period between 2008 and 2013.
- Water consumption rose over the period from 2014 to 2017, with the most dramatic increase occurring in 2016.
- Growth in water consumption appears to be largely independent of growth in population.

2.5 2015 Annual Report to the Nunavut Water Board

The most recent Annual Report that is available from the Nunavut Water Board Registry is for the year 2015. This report provides information regarding the total taking of water from Lake Geraldine, together with data regarding flow treated at the City wastewater treatment plant. The following table summarizes water taking and wastewater treatment volumes.

Table 2.3 – Raw Water and Wastewater Volumes 2015

Month	Raw Water		Wastewater (m^3)
	Taking (m^3)	Variation from Average	
January	90,450	0%	84,009
February	84,790	-7%	74,358
March	99,880	10%	87,315
April	92,300	2%	41,691
May	92,570	2%	3,302
June	88,300	-3%	81,686
July	90,700	0%	87,976
August	90,500	0%	83,171
September	91,400	1%	79,899
October	92,000	1%	83,924
November	83,500	-8%	77,133
December	92,300	2%	82,704
Annual	1,088,690	0%	867,168
Monthly Average	90,724		

The annual report notes that the wastewater plant was out of service due to mechanical issues for 44 days during April and May. There is also a note that suggests that total wastewater flows were estimated during periods when flow diverted to the lagoon based upon average flows. Exclusion of the data form April and May leads to a water taking of 903,802 m^3 and a wastewater flow of 822,175 m^3.

The following observations are drawn from this data.

- Water is taken from Lake Geraldine at an almost constant rate throughout the year.
- When data for April and May is excluded total wastewater flow is 91% of the raw water volume. This indicates that almost all the water taken from Lake Geraldine is discharged into the sewer system.

2.6 Metering Records

It is reported that water meters are read by City staff and that data is transmitted to a service contractor for preparation of billing information. The City has requested data from this contractor. The following table summarizes information drawn from this data.

Table 2.4 – Summary of Metered Water Use

Year	Metered Consumption (m^3)
2008	519,371
2009	566,770
2010	519,467
2011	566,812
2012	546,013
2013	504,013
2014	528,232
2015	525,638
2016	565,018
2017	10,527,694

It appears that the data for 2017 is in error. On this basis the data for 2017 has been excluded from the analysis.

The following table and graph presents annual metered water use, growth in metered use from 2008 and the growth in population from 2008.

Table 2.5 – Metered Water Use Analysis

Year	Metered Consumption (m^3)	Metered Consumption Growth from 2008	Population Growth from 2008	Raw Water Consumption Growth from 2008
2008	519,371	-	-	-
2009	566,770	109.1%	102.2%	97.0%
2010	519,467	100.0%	104.7%	94.4%
2011	566,812	109.1%	107.2%	90.4%
2012	546,013	105.1%	108.7%	93.8%
2013	504,013	97.0%	110.4%	100.1%
2014	528,232	101.7%	113.8%	106.6%
2015	525,638	101.2%	115.5%	117.2%
2016	565,018	108.8%	117.6%	134.4%

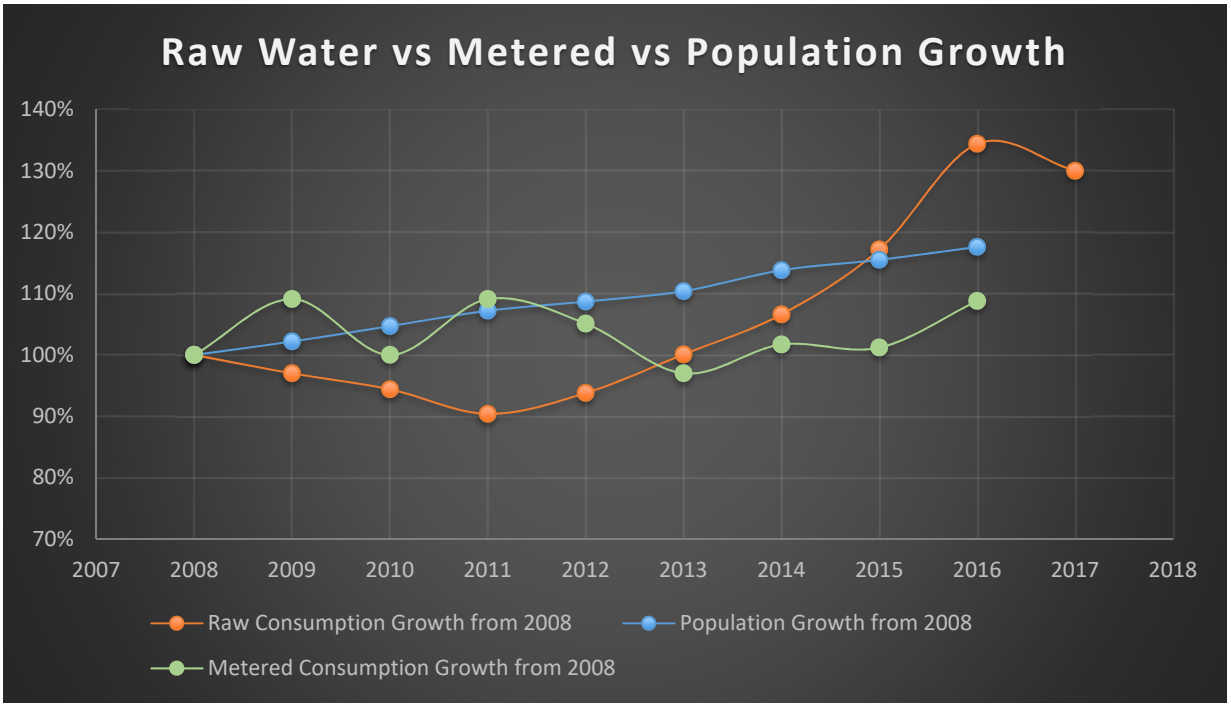


Figure 2.2-Raw Water vs Metered vs Population Growth

The following observations may be made from the metered consumption data.

- Metered consumption, as provided from billing records was almost constant between 2008 and 2015. There was a modest increase from 2015 to 2016.
- There does not appear to be a correlation between reported metered consumption and population growth.

2.7 Correlation of Raw Water and Metered Data

The following table and graph summarizes raw water consumption and metered records for the period 2008 to 2016.

Table 2.6 – Raw Water Consumption and Metered Data

Year	Raw Water Consumption (m^3)	Metered Consumption (m^3)	Ratio Metered Data to Raw Water Consumption
2008	929,130	519,371	55.9%
2009	901,550	566,770	62.9%
2010	877,090	519,467	59.2%
2011	839,610	566,812	67.5%
2012	871,670	546,013	62.6%
2013	930,360	504,013	54.2%
2014	990,140	528,232	53.3%
2015	1,088,690	525,638	48.3%
2016	1,249,150	565,018	45.2%

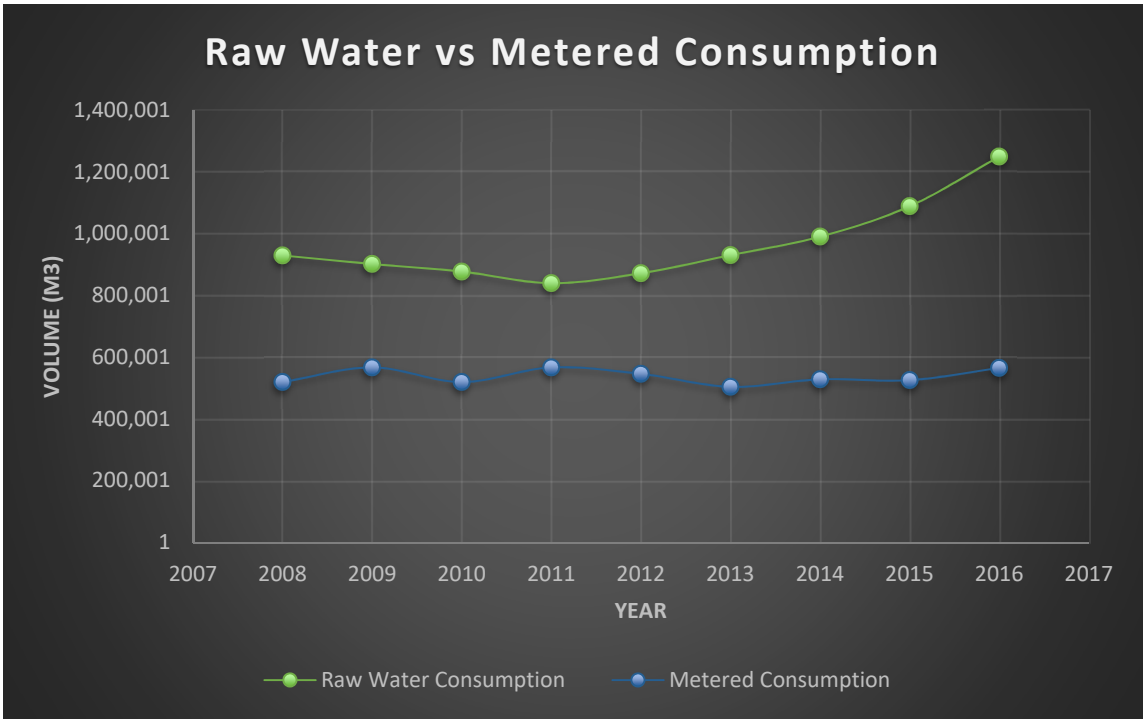


Figure 2.3-Raw Water vs Metered Consumption

The following observations are drawn from this data.

- Recently metered, and thus billed, water consumption is less than ½ of the water taking from Lake Geraldine.
- The portion of the water taking from Lake Geraldine that is reported by the meter readings has decreased by approximately 4% annually since 2011.

2.8 Estimate of Unaccounted Water

The raw water consumption and metered use data have been used to prepare the estimate of unaccounted for water summarized in the following table.

Table 2.7 – Unaccounted Water Estimate

Year	Raw Water (m^3)	Metered (m^3)	Unaccounted	
			(m^3)	(%)
2008	929,130	519,371	409,759	44.1%
2009	901,550	566,770	334,780	37.1%
2010	877,090	519,467	357,623	40.8%
2011	839,610	566,812	272,798	32.5%
2012	871,670	546,013	325,657	37.4%
2013	930,360	504,013	426,347	45.8%
2014	990,140	528,232	461,908	46.7%
2015	1,088,690	525,638	563,052	51.7%
2016	1,249,150	565,018	684,132	54.8%

Water use that was not captured by the billing system has generally been of the order 40%. This portion of total water consumption has increased over 2015 and 2016 to more than 50% of the water taken from Lake Geraldine.

2.9 Per Capita Water Demands

The following table summarizes the estimate of per capita water demands, both in terms of raw water consumption and metered use.

Table 2.8 – Per Capita Water Consumption

Year	Population	Per Capita Consumption	
		Raw Water (L/capita-day)	Metered (L/capita-day)
2008	6454	394	220
2009	6593	375	236
2010	6755	356	211
2011	6916	333	225
2012	7013	341	213
2013	7123	358	194
2014	7343	369	197
2015	7456	400	193
2016	7590	451	204

The following are noted regarding per capita water consumption.

- The metered demands during the initial years of the evaluation are consistent with expectations for a northern community.
- The gradual decline in per capita metered consumption does not align with expectations. This decline has been modest.
- There has been an ongoing increase in raw water per capita consumption since 2011. This is contrary to the trend of metered demand.

2.10 Water Bleeds

Water is bleed from the distribution system at various locations. These bleeds have frequently been implemented to reduce the risk of freeze of the watermains or sewer lines. In response to a request, the City has provided a hand marked drawing depicting the locations of known water system bleeds. These drawings highlighted 18 locations where bleeds were operating throughout the city's utilidor. A brief review of the Plateau Subdivision drawings identified a pair of locations where there are known bleeds. For current purposes it will be assumed that there are 20 bleeds currently operating.

The water system bleeds have frequently been provided on an as-needed basis to reduce the risk of freeze. There does not appear to be a system to track the location, purpose, flow rate and cross connection measures for the bleeds. There also does not appear to be a process of review of the ongoing need for bleeds at the various locations where they have been installed.

An estimate of water use arising from 20 bleeds has been made. It has been assumed that each bleed represents a constant water demand of 20 L/min. This leads to an estimated annual water demand of approximately 200,000 m^3. It appears that bleeds represent approximately 1/3 of the unaccounted water consumption.

2.11 General Observations

The following general observations are drawn from the above analysis.

- Raw water consumption was relatively stable between 2008 and 2013. Water demand rose from 2014 onwards. The rate of water consumption appears to rise more dramatically than population.
- It appears that almost all the water taken from Lake Geraldine is conveyed to the wastewater treatment plant.
- Metered water use does not appear to be strongly influenced by population growth.
- Metered water use for 2015 and 2016 represents less than ½ of the water taken from Lake Geraldine.

- There has been an ongoing increase in per capital raw water demands. At the same time there has been a gradual decline in the metered per capita water use. These appear to be contradictory trends.

- It appears that distribution system bleeds represent approximately 1/3 of the unaccounted water consumption.

2.12 Potential Issues for Consideration

The variation in trends between raw water use and metered demands suggest some questions for consideration.

- Does the current metering system capture all water users? The issues to consider include metering of all water use into buildings and reading of all water meters.

- Does the system that manages meter reading include adjustments for some water users that lead to under-reporting?

- Are the existing water meters un-reporting consumption? This could be for a list of reasons including meter wear and age.

- Has there been a documented increase in the number of watermain breaks, and what was the management of those breaks? This might include the site of a break, type of break, response, period required to implement the response and actions during the interim.

- Is there an opportunity for conservation through management of the watermain bleeds? This would include the resolution of the issues that lead to the institution of these bleeds.

3 Water Loss Control Strategy

3.1 Introduction

As with any business, it is not feasible to have a product fall short of reaching its end consumer. Nor is it an efficient use of resources to process a raw product to a high quality only to have it lost. The loss of treated water carries a significant cost, both environmental as well as economic. Therefore, there is significant value in the proper accounting of the authorized water usage but also the water that is lost. This information enables the development and validation of a water loss control strategy which will reduce the costs associated with treated water and lead to a more sustainable product and service.

The focus of a water loss control strategy emphasizes the reduction of water use that is not the result of end-user consumption. Throughout the City of Iqaluit's (City) distribution network, water loss can occur at various locations in two forms, intended and unintended. Examples of unintended losses include leaks and breaks. While intended forms are within the control of the operator, in the City's case, the majority of intended water loss is the result of water bleeds.

The following memorandum examines these losses and presents potential loss control strategies as well as priorities for actions in response to those losses.

3.2 Unintended Losses

Unintended losses associated with the municipal water distribution network can be further sub-categorized in two manners, real and apparent losses. Real loss occurrences are those in which water exfiltrates the distribution network before endpoint consumption, such as leaks from piping, valves, hydrants, service connections, as well as water loss due to piping failures (main breaks). Apparent losses transpire through unauthorized consumption, data handling errors, administrative errors, and metering inaccuracies or failures. Accounting procedure errors may occur due to misread meters, overlapping billing cycles, improper calculations, unit of measurement conversions, or computer programming errors. These losses are generally viewed as mistakes which can be identified and corrected. A thorough review of the entire billing procedure would merit examination. It is believed this task would not be a costly expenditure, especially when considering hard construction costs to achieve similar goals. Additionally, this could be completed in a flexible time frame.

As noted above, another form of unintended apparent water loss can also be a result of inaccurate metering or unauthorized consumption (unmetered). This can be rectified by means of a water meter calibration program, as all water meters should be calibrated in accordance with the manufacturer's recommendations. As with all metering devices, water meters are not 100% accurate and can lose their sensitivity over time. Accuracy varies with type, use, and age of the meter, thus the need for calibration and re-calibration. The magnitude of the calibration program

could be scaled as deemed appropriate. For example, the City could review the accuracy of 100 meters at random locations throughout the City. This data would provide an idea of the current level of metering accuracy. This ensures that any decisions related to the operation, maintenance or capital improvements are based on information of reasonable accuracy. In addition, there would be value in reviewing the policies and procedures regulating how water servicing and monitoring are conducted within the City. This is to ensure there are no gaps in the process which would reduce the number of unauthorized consumers.

Managing the unauthorized consumption of water is not an easy task. This can take place in many forms. Activities such as meter tampering, meter bypassing, unauthorized connections, and unauthorized hydrant usage all contribute to unintended apparent water losses. Estimating and controlling these users will require monitoring and reporting mechanisms, educating/informing the prominent unintentional culprits, and by-law enforcement. Common activities in Iqaluit that are likely the main users of unauthorized consumption are the contractors, through fire hydrant connections, testing, unauthorized tanker fills ups, etc... Communicating these policies to each of the contractors will aid in controlling this user group.

Returning to real losses, the majority of the water distribution piping in Iqaluit is composed of high-density polyethylene (HDPE), robustly joined using fusion techniques. HDPE has several favourable properties such as flexibility, strength, and corrosion resistance. The City's current commissioning process also requires in-field pressure testing post-fusion and prior to any new piping being put into service. The newly fused piping must pass hydrostatic testing of a multiple of 1.5 times pipes rating, and thus over 2 times the anticipated operating pressures in the system. This is to confirm the integrity of the fused joints as well as the pipe. Therefore, it is considered unlikely that leakage is occurring from the HDPE piping directly. All the appurtenances for the distribution network such as valves, ports, drains, and hydrants are contained within the access vaults (AVs) or manholes (MHs). Outside these chambers are solely the distribution and service piping. Leakage from mainline valves was noted as an issue during the 2018 inspection program. A possibility could be the implementation of an acoustic leak detection program. However, a piping leak detection program is challenging with HDPE piping as well as the excessive noise created by all the service pumps. An appropriate preventative maintenance/inspection program coupled with data monitoring would mitigate these impacts and aid in identifying these leaks.

The water distribution network in Lower Iqaluit (see Appendix A) was constructed more than 40 years ago, using small diameter ductile iron piping and concrete MHs. This material is more vulnerable to deterioration than the HDPE piping. Although the piping is still currently in operation, it is approaching the end of its useful service life. It should also be noted that excavation of this piping to resolve localized issues is challenging. As a long-term plan, the replacement of this ageing infrastructure is appropriate. There may be opportunities to integrate these upgrades with other re-development initiatives in the City.

Watermain breaks and leaks occur, on an occasional basis within the City's distribution network. These usually lead to an immediate loss of a large quantity of water and a drop in pressure, especially mainline breaks. Commonly, these breaks tend to occur at the exterior flanged connections to the maintenance structures. It is presumed that the cause can be related to some form of differential movement. It is presumed that leaks and breaks of larger magnitude are reported by customers or Utilidor staff within a reasonable time frame. A more subtle loss of water frequently occurs as a result of main break repairs or corrective actions which lead to the institution of additional bleeds to avoid freeze. The combination of water loss during the initial break, ongoing loss due to bleeds, potential future leaks at the repair couplers, and disruption of customer service all indicate that the repair of breaks, as they arise, has a high priority.

There are occasional leaks from service connections. Due to the fashion that the system was constructed, combined with the installation in frozen soil, leaks at service connections are usually obvious. The volume of water loss at these locations is usually modest, but leaks at service connections give rise to other issues including damage to served buildings and water introduction into the insulation system for the water main piping. Repairs to leaking service connections are considered to have a high priority for reasons other than the reduction of water loss.

3.3 Intended Water Loss

Intended water loss can arise in a variety of forms. This can be through maintenance, commissioning, or testing operations where unmetered quantities of water are intentionally released from the distribution network. The City's water distribution network is unique when compared to water distribution networks in Southern Canada. Under general operating conditions, the majority of the network's designed freeze protection is primarily achieved by circulating water through a pre-determined flow path back to a heating station prior to freezing. Thus, the use of a looped water network within each of the City's districts. Each of these loops incorporates a heating station where heat can be injected and then the water would then again be circulated through the loop. The primary form of intended water loss in Iqaluit is water bleeds which are usually located within an AV or MH. These bleeds have been instituted to reduce the risk of the freeze of both the water and sewer systems. As noted above, bleeds tend to become a quick solution to a more complex problem, generally relating to circulation and freeze protection.

During the survey of the network's structures, it was believed that there is no formal bleed management system. Elements of this system should include the following:

- The reason for the bleed.
- The date the bleed was initiated or deactivated.
- The flow rate that is appropriate at the bleed.
- A frequency for the review of the need for the bleed and the appropriate amount.
- Consistent piping schematic.

A management system for water system bleeds is felt to have a high priority.

3.4 System Operational Knowledge

During the examination of various water use issues, it was noted that information about system operation was scarce. We are of the understanding that the City is in the process of instituting system-wide Supervisory Control and Data Acquisition (SCADA). This system can provide data that will be very helpful for the estimation and management of water loss. More specifically, diurnal variations in water use indicate minimum demands, such as those that would arise at night. Demand information from the two booster stations could help understand and quantify demand amounts and consumption patterns. As an example, monitoring of water circulated through the Plateau Water Booster Station No. 2 in comparison to billing records for Plateau consumers would provide reliable benchmark data. This approach could also be taken with other districts within the City; however, they would require the development, implementation, monitoring, and analysis whilst the tools required are already built into both existing booster stations.

The City does not currently have a usable hydraulic or thermal model for the water distribution system. These tools can be especially useful for the management of water loss. The water distribution system in Iqaluit is also unique in terms of the measures required to reduce freeze risk. A growingly more frequent response to the risk of freeze is the institution of bleeds. The flow rate of the bleeds may often be greater than what is appropriate due to the lack of tools that allow for system analysis. This approach can give rise to a list of ongoing issues including excessive water use, disruption of circulation patterns and flow rates, and increased energy consumption for water heating. At this time, there is no integrated method to evaluate the impact of bleeds. Hydraulic and thermal models of the water system would be very useful operational tools. For this reason, it is recommended that the preparation of these models be assigned a high priority. This model should include all of the water distribution piping, as well as the piping and equipment associated with freeze prevention.

Currently, the municipal design standards were last revised over 15 years ago. Due to the frequency of specific challenges relating to water loss occurrences as well as changes to the environment such as climate change, modifications to current design standards may warrant review. Examples of standards to review could be structure anchoring requirements, burial depths, and flexible connections between the structures and the mainline.

3.5 2018 Inspection Summary

The completion of the water audit study determined that nearly 50% of the City's potable water was unaccounted for after leaving the Water Treatment Plant. Following the completion of this audit, EXP assessed the internal condition of each AV and MH within the City's water distribution network. This field program took place during the late summer of 2018 and consisted of a visual

inspection from the surface within each structure that contained water infrastructure within the City's Utilidor. Photos and notes were taken of observations from within each structure focusing on; current condition, bleeds, leaks, appurtenances condition, accessibility, etc... Upon completion of this investigation, the data gathered was analyzed and reports were prepared for each water distribution loop individually, see appendix B through Appendix H. The reports provided comments on each structure as well as an assessment of the current condition of each distribution loop.

3.5.1 Transmission of Key Findings

During the inspections, it was apparent that common observations were recurring consistently throughout each separate water network. The typical observations made were:

3.5.2 Unintended Leaks

Most of the leaks were occurring at an appurtenance within the structure. The leaks were either visually observed or audibly heard within the structure.

3.5.3 Water Bleeds

There were significantly more bleeds installed within the Utilidor then what the City had documented and informed exp of. Many of these bleeds were installed post initial construction and not as per the intended design. It is assumed they were used to prevent the freeze of the sewers or the water mains in that area. It was also frequently observed that many of the bleeds did not utilize a backflow preventer, this increases the risk of contamination.

3.5.4 Unintended Flow Patterns

From the information available at the time of inspection, it is assumed that there are several districts where circulation is likely not occurring. The water network in Iqaluit is meant to flow on a preset pattern, and several issues would cause unintended patterns. In summary, these are:

- Incorrect valve configurations which are not oriented as per the intended design. The extent of valve observations was limited to visibility from the surface, and it is very likely that additional structures where certain observations could not be made also have these issues present as well.
- Supply and return water mains that are interconnected by using 2" jumper lines installed on lateroles.
- Service installations where the service's supply and return piping was not connected to the same water main. This creates a short circuit that interferes with intended flow

patterns. This observation was quite limited as most service connections are completed outside the structures and would not be visible.

- Circulation pumps within the structures were not functioning and probably not salvageable.

3.5.5 Sanitation Concerns

Most of the structures which have water and sewer piping within the AV or MH did not have the sanitary cleanout cover installed. Sewage was present inside a large portion of the structures. In certain instances, there was evidence of sewage up to the access hatch/cover. This significantly increases the risk of contamination of the City's water and puts the public at risk.

3.5.6 Incomplete Inspections

Several structures could not be inspected during the field program. This was due to the pipes being submerged in sewage/water/debris and thus not allowing for a visual inspection. These structures need to be cleaned and inspected. It is believed that the source of the clear water encountered within the structures is either groundwater or water from a leak. These structures should be inspected to determine if the infrastructure is leaking.

3.5.7 Structure not Visible

Several structures were not visible from the surface. It is assumed they were buried. These structures should all be found, inspected, and accessible at all times.

A summary of the number of identified common issues has been populated in Table 1.1.

Table 3.1 – Water Network Issue Summary

	Leaks Identified	Bleeds Installed within Structure	Incorrect Flow Patterns	Sanitation Concerns	Inspection Incomplete due to Water / Debris / Sewage	Structures Not Visible from Surface
Total	**34**	**47**	**16**	**94**	**78**	**12**

3.6 Potential Water Loss Control Strategies

There are several strategies which the City of Iqaluit could advance to aid in reducing water loss throughout the distribution system.

3.6.1 Supervisory Control and Data Acquisition Systems (SCADA)

As noted above, it is understood the City is currently undertaking this initiative. The SCADA system will provide the City with a variety of benefits, not only in the reduction of water loss. The system will provide a real-time view of pressures, flow, and quality.

3.6.2 Hydraulic and Thermal Modelling

The development and ongoing maintenance of a computer-generated model would be a great tool to aid in understanding the system operating functionality. The model can be used to determine the impacts of various scenarios, (i.e. new developments, shutdowns, repairs or valve manipulations) and guide decisions based on calculated outcomes.

3.6.3 Design Standards

The City's current design standards were created in 2004 and have not been modified since. A thorough review and modification as needed to these standards would enhance the sustainability of the municipal water distribution system. Additionally, the City should ensure that staff members (and consultants) are adequately trained in the inspection and installation of new infrastructure. Good documentation of infrastructure, competent design reviews, and consistent inspection and maintenance practices will mitigate future water leakage in the distribution system over a long period.

3.6.4 Metering & Billing Review

Ensuring that the City's metering program is adequately functioning is essential. The data acquired from the meters along with the management software has a significant impact on not only the evaluation of water systems performance (water audit) but the revenue generated by this asset. Thus, ensuring the accuracy of water meters along with a detailed review of the current metering and billing system would be of value. Should mistakes be found, correction should only be required once. This would increase the accuracy of water audits which quantify how much water is lost.

3.6.5 Leak Detection & Repair Response Preparedness

The efficiency of leak detection and response is instrumental in reducing water loss. There is the option to have a leak detection survey conducted to aid in locating unreported water leaks. However, as noted above, due to the configuration of the distribution system, there are limitations to the efficiency of these surveys. Alternatively, the development of routine maintenance and inspection plans will assist in conserving water by detecting leaks frequently. This could also be coupled with district monitoring programs to quantify in localized regions where greater water loss is occurring.

Detecting the leak is only the start, as the speed and quality of the leak repair are also critical in reducing water loss and preserving infrastructure. The City should have policies and procedures in place on how to handle these repairs. This would include; personnel to make assessments and gather information on the urgency of the leak/break, a means to document the issue as well as the necessary repairs (including temporary servicing requirements), appropriate and competent resources to complete quality repairs, adequate material in inventory, agreements in place for quick engagement with appropriate contractors and consultants (if required).

3.6.6 Preventative Maintenance

As with any mechanical components, maintenance is essential to long-term functionality of the system. It is understood that valve functionality within the City is often an issue. However, it is understanding that there is no established preventative maintenance and inspection plan. All components should be closely inspected, exercised, and documented at some predetermined frequency. The development and implementation of this plan would lead to a reduction in future water loss.

3.6.7 Documentation and Record-Keeping

As with any asset management program, document control is essential. The City has a history of personnel turnover and it is important to not lose valuable information during these transitions. Additionally, all staff would greatly benefit from appropriate avenues to capture, review, and save information on the City's distribution network. This applies to; work permits, designs, as-builts, inspections, functionalities, inventories, complaints, preventative maintenance schedules, warranties, material inventories, etc…This assignment is no easy undertaking and would likely require the implementation of some software as well as appropriate policies and resources to manage.

3.6.8 Infrastructure Renewal

Upgrading, rehabilitating and replacing infrastructure can reduce water losses. As with all infrastructure, water main piping is designed for specific service life and therefore requires rehabilitation or upgrades. Changes in developments, planning, demands, the network as a whole, design standards, and the environment should always be considered. Ideally, for renewal assignments, it is suggested to pair this with other projects to share and minimize the overall indirect costs associated with water upgrades.

3.6.9 By-Law enforcement

By-law enforcement is necessary to reduce the illegal use of water from hydrants and tapped water lines. Efforts should be made to engage the community in assisting by-law and inspection activities to reduce the theft of water. Additionally, illegal access to the water system raises

concerns about water quality, contamination, and other health situations through improper connections and usage.

3.6.10 Zone Metering

The implementation of zone metering would allow the Utilidor to evaluate water losses. This would enable water loss analysis within a specific region of the distribution system. It will enhance the operators' understanding of water use and overall system and re-circulation into that area. This can also provide another tool to be used in determining priorities of repairs and increase the accuracy of subsequent water audits.

3.6.11 Nighttime Flow Analysis

It is always anticipated that the lowest demands imposed on the system occur during the middle of the night, roughly between 2 am and 4 am. Flow data that can be captured during these windows can assist the operators to determine the quantity and potential size of water leaks. This analysis paired with zone metering would aid the City in assessing system water usage and leakage flow rates.

3.7 Summary

The preceding memorandum has considered issues related to unintended water loss, intended water loss, system operational knowledge, and potential control strategies to implement. The following priorities are proposed for efforts to address these concerns.

3.7.1 High Priorities

- Water main breaks should be repaired at the earliest opportunity. Confirmation of the stock of repair materials and available equipment should be reviewed at an appropriate frequency.
- Management of water distribution system bleeds should be implemented and maintained. This system should capture location, dates, reason for the bleed, bleed flow rate and date for review of need.
- Completion of a SCADA system, followed by a formalized system to review and analyse water consumption data provided by the system on a scheduled basis.
- Repair of leaking water service connections.

3.7.2 Moderately High Priority

- Preparation of hydraulic and thermal models for the water distribution system.

- The development of a detailed preventative maintenance & frequent system inspection plan.

3.7.3 Moderate Priority

- Development of, and implementation of, a plan to replace the ageing piping in the water distribution system. This includes any remaining asbestos cement piping, as well as the ductile iron water mains.
- Review and revision of the latest municipal design guidelines.
- A detailed review of billing procedures as well as meter calibration

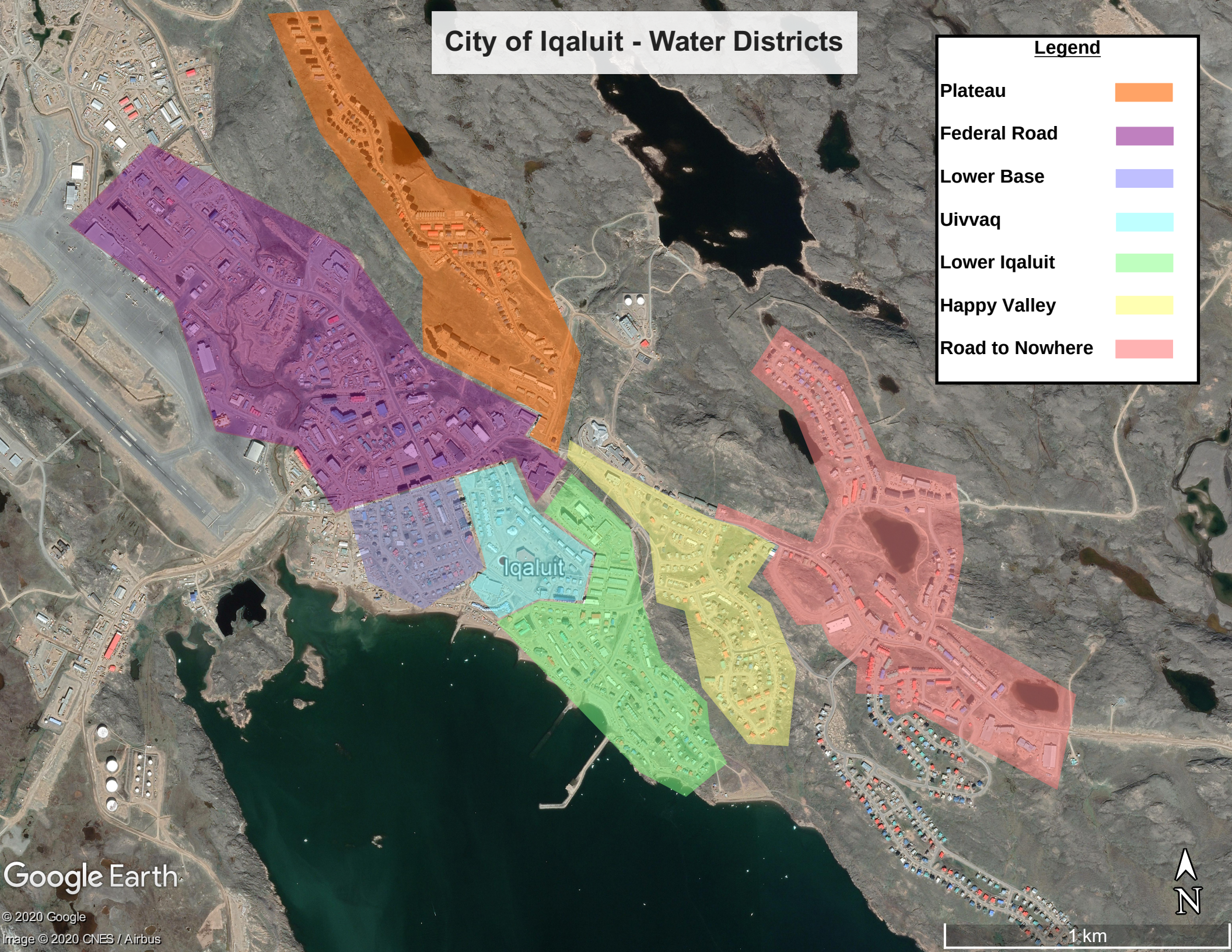
3.7.4 Low Priority

- Leak detection survey for the water distribution network
- By-law enforcement

References

Federation of Canadian Municipalities and National Research Council. (2003). “Water Use and Loss in Water Distribution Systems.” A Best Practice by The National Guide to Sustainable Municipal Infrastructure.

Appendix A – City of Iqaluit Distribution Zones


City of Iqaluit - Water Districts
Legend
Plateau
Federal Road
Lower Base
Uivvaq
Lower Iqaluit
Happy Valley
Road to Nowhere
Iqaluit
Google Earth
© 2020 Google
Image © 2020 CNES / Airbus
N
1 km

Appendix B – Road to Nowhere 2018 Inspection Summary

January 16, 2019

Mr. Erik Marko
Project Manager – Colliers
Suite 700, 150 Isabella Street
Ottawa, Ontario

Project # **OTT-00248529-A0**

Water Distribution Network Issues – Road to Nowhere, Expansion, and Lake Area Loop

Dear Mr. Marko:

Introduction

The City of Iqaluit (City) has requested that exp assist the City in repairing and rehabilitating their water distribution network. A visual assessment of each AV and MH in the City has been completed and exp is now in the process of analyzing the data and determining the current state of the system. This letter addresses exp's findings of the Road to Nowhere, Expansion, and Lake area network. The information highlighted in this report is being utilized to provide the City with suggested corrective actions to re-instate the water distribution system back to its intended functionality.

Transmission of Key Road to Nowhere, Expansion, and Lake Area Loop Findings

The table below (Table 1.1), illustrates the findings of the visual inspection that was completed from the top (at the hatch) of each structure within the Road to Nowhere, Expansion, and Lake Area network. The sequence of each structure has been set to follow the water's designed flow pattern as it flows from the Booster Station No. 1 through each structure and eventually recirculated back through to Booster Station No. 1 where heat is added then recirculated again through the loop.

General comments are made for each structure within the table 1.1. Corrective action comments about cleaning and installing the sanitary clean out lid have not been included but, as a general note, most of the structures require thorough cleaning/disinfection and the re-installation of the lid for the sanitary cleanout as well as the laterolet caps. The subsequent paragraphs are highlighting the major issues observed within this network.

AV 326 – *see image in Table 1.1* – This is a critical structure within this water network. This is the first structure that the water passes through to supply the network, as well as the last structure for the recirculation piping prior to returning to the Booster Station. Currently the structure is full of water all the way to the surface. This needs to be pumped out and investigated.

AV 500 – *see image in Table 1.1* – This is a very important structure within this network as it contains important infrastructure to help with circulation, such as pumps and check valves. The structure appears to have had an extension added to raise the access to the surface grade. This caused for low visibility during the time of inspection and requires re-inspection of the structure following proper confined space entry procedures. Water was observed within the structure, and the cause should be determined (ground water or potable). Also, it was mentioned to our staff that the re-circulation pumps within the structure are not functioning. Further investigation required.

AV 333 – *see image in Table 1.1* – This structure has two large service connections which tie into the supply watermain. One of the services has been correctly configured, the service supply and return are connected to the same watermain pipe. However, the second service's return piping is not visible and is assumed to be connected outside the vault. There is the potential that the service return is connected to the wrong watermain pipe (recirc main) and thus creating a short circuit. This issue is not confirmed and solely a suspicion because the recirculation main would be the first pipe uncovered by the contractor as they dig towards the utilidor trench to connect the service return. It is possible they would connect to recirculation main pipe as it would make for a much easier installation. Any information that City has on this connection would be useful to alleviate the concern of a short circuit.

AV 516 – *see image in Table 1.1* – Currently the structure is full of water all the way to the surface. This needs to be pumped out and investigated.

First Recommendations

The current condition of the Road to Nowhere, Expansion, and Lake Area water system appears to be in okay condition. More information is still required to properly complete the assessment. No major leaks were uncovered but a few minor leaks were identified, and should all be repaired. There were also two structures which had water all the way to the hatch. It is assumed that this is because of a leak within the structure, they should be pumped out and investigated. Several other structures had clear water within the structure, it is assumed that this was caused by groundwater but further investigation should be conducted to confirm it was not potable water.

Upon discussions with City staff, the circulation pumps within AV 500 are not operational. Due to the structures configuration, the investigation did not provide great insight into the current condition of the components within. Further investigation within this structure needs to be conducted. It appears the circulation pattern is still as per the intended design but confirmation of the position of select valves needs to be provided. These structures are identified in table 1.1

As a general observation, it is evident that several areas that have problematic sewers that are causing sewage to backup into the access vault. This does increase the risk of contamination of the potable water and repairs should be made to the sewers to reduce this risk.

Based on the first review of this network, exp suggests that a meeting be had with the City after they have reviewed this report to discuss the rehabilitation of this loop. Exp wants to ensure the City understands the magnitude of the scope and level of effort required to rehabilitate the Road to Nowhere, Expansion,and Lake Area loop back to intended functionality and to also discuss options on how to proceed.

We trust the above information meets your requirements. Should you have any additional questions please do not hesitate to contact the undersigned.

Yours truly,

EXP Services Inc.

Simon Plourde
Engineering Designer
Infrastructure Services

Ian Crawford, CET
Project Manager
Infrastructure Services

AV #	Comment	Photo	Corrective Action
AV 326	• Pump out and inspect • Critical structure for Booster Station No. 1 and Road to Nowhere Loop		Yes – pump out and inspect
AV 327	• Incorrect AV numbering on sign, structure is AV 327 not AV 213 • Protective coating inside structure failing, probably due to high moisture from standing water.		Yes – install correct sign for structure ID

			
AV 328	• Protective coating inside structure failing, probably due to high moisture from standing water. • Sanitary cleanout cover not installed		No

AV 500	• Critical structure for Road to Nowhere Loop, contains key infrastructure.
	  • Circulation Pumps
	  • Check Valve
	• Deep and large structure, utilizes safety landing.
	• Significant water within structure, requires further investigation
	• Sanitary cleanout cover not installed
			Yes – Enter structure and determine cause of water. Also investigate condition of pumps and valve configurations.

AV 329	Structure could not be accessed, need to cut lock and investigate		Yes – access and investigate

AV 330	• Sanitary cleanout cover not installed • Protective coating inside structure failing, probably due to high moisture from standing water. • Debris inside structure		No
AV 331	• Sanitary cleanout cover not installed • Evidence of serious sewer backups within structure • Limited visibility, pump out, clean and re-investigate		Yes – pump out and reinvestigate

AV 332	• Photo was taken prior to completion of Joamie Court • Bleed was eliminated as part of Joamie construction • Evidence of sewer backups within structure		No
AV A	• No exceptions noted		No

AV B	• No exceptions noted		No
AV C	• No exceptions noted		No
AV D	• No exceptions noted		No

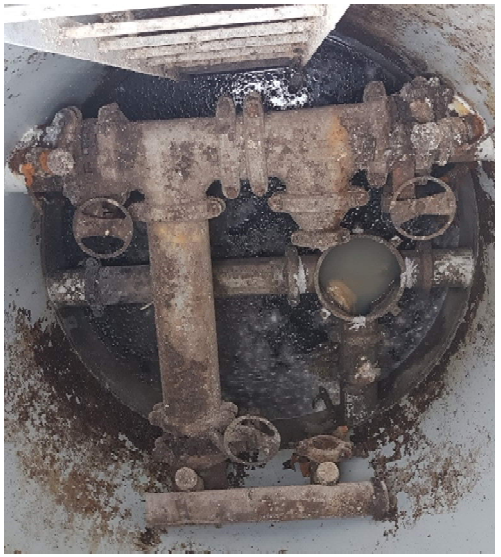
AV C	Previously reviewed, see above		
AV B	Previously reviewed, see above		
AV A	Previously reviewed, see above		
AV 332	Previously reviewed, see above		
AV 331	Previously reviewed, see above		
AV 333	• Multiple large services connected to the supply main • Service return connected to laterolet, it is the correct watermain pipe • Return piping for the larger service cannot be seen, it is assumed to be done outside the structure • there is a possibility of a short circuit as the service return piping would need to crossover the return main and connect to the supply main (same pipe the service supply is connected to). Need more information. • Sanitary cleanout not installed • Protective coating within the structure is starting to fail, probably due to high moisture. • Evidence of sewer backups		Yes – investigate second service connections return piping

AV 334	• Connection of return piping for the larger service cannot be seen, which watermain it connects to cannot be determined • there is a possibility of a short circuit if the service's return is connected to a different main then the service's supply is connected to. Need more information. • Sanitary cleanout cover not installed • Evidence of sewer backups		Yes – clean and investigate service return connection inside the vault
AV 335	• Above ground sanitary quick connect access • Cap missing, and should be locked • Recirculation piping should be abandoned • Protective coating within the structure has failed, probably due to high moisture • Sanitary cleanout cover not installed	 	Yes – install sanitary quick connect cap

AV 338	• Visibility low, requires significant cleaning • Recirculation piping is out of service • Evidence of sewage backups • Sanitary cleanout cover not installed		Yes – clean and investigate
AV 337	• Structures protective coating has failed, due to high moisture • Evidence of sewage backups • Sanitary cleanout cover not installed		No

AV 336	• Structures protective coating has failed		No
AV 337	Previously Reviewed, see above		
AV 338	Previously Reviewed, see above		
AV 339	• Visibility low, requires significant cleaning • Key structure in loop, water supply splits to separate areas • Recirculation piping is out of service • Evidence of serious sewage backups • Sanitary cleanout cover not installed		Yes – clean and reinvestigate

AV 340	• Evidence of serious sewage backups • Sanitary cleanout cover not installed • Laterolet cap missing		No
AV 341	• Recirculation piping out of service • Evidence of serious sewage backups • Sanitary cleanout cover not installed • ¾” valve installed on laterolet, possibly used as a bleed, no backflow preventer		Yes – if using bleed, it requires back flow preventers

AV 342	• Recirculation piping is out of service • Evidence of sewer backups • Sanitary cleanout cover not installed		No
AV 343	• Connections available for future development. • Recirculation piping not in service • Evidence of sewer backups • Sanitary cleanout cover not installed		No

AV 351	• Key structure in loop supplying arena and school • Valve on right side of hydrant should be closed, confirmation required • Jumpers present on laterolet, unsure of other connection point • Evidence of sewer backups • Cleanout cover not installed		Yes – confirm valve closure, and jumper connection point
AV 356	• Evidence of sewer backups • Sanitary cleanout cover not installed • No other exceptions noted		No

AV 357	• School service within vault, old piping shows short circuit as service return was connected to return main. Currently good • Old recirculation piping should be properly blanked, appears to currently only have an old valve • Evidence of sewer backups • Sanitary cleanout not installed		Yes – properly blank old service return piping
AV 358	• Active bleed at end of line to help promote circulation • Large service for the arena • Future connections at structure available, if they are used the service configuration will need to be altered to not create short circuit • Protective coating within structure has failed, probably due to high moisture • Evidence of sewer backups • Sanitary cleanout not installed		No
AV 357	Previously reviewed, see above		
AV 356	Previously reviewed, see above		

AV 351	Previously reviewed, see above		
AV 351A	Missing, possibly buried		Yes – locate and inspect
AV 352	• Two future connections available (right side) • Evidence of sewer backups • Sanitary cleanout not installed		No
AV 353	• Watermain diverts to service a cul de sac • Evidence of sewer backups • Sanitary cleanout not installed • No other exceptions noted		No

AV 354	• Evidence of sewer backups • Sanitary cleanout not installed • No other exceptions noted		No
AV 353	Previously reviewed, see above		
AV 355	• Laterolet on left side has been modified and is missing the cap • Evidence of sewer backups • Sanitary cleanout not installed • No other exceptions noted		No
AV 345	Structure inaccessible, grinder required for lock		Yes – access and investigate

AV 344	• Valve on 4” piping should be closed, watermain does a 180º turn • Evidence of sewer backups • Sanitary cleanout not installed		
AV 345	Previously reviewed, see above		
AV 346	• Evidence of minor leak around laterolet • Watermain diverts to service a cul de sac		Yes – repair laterolet

AV 347	• Evidence of minor leak around laterolet • Sanitary cleanout cover is not installed		Yes – very minor leak at laterolet
AV 346	Previously reviewed, see above		
AV 348	• Evidence of sewer backups • Sanitary cleanout not installed • No other exceptions noted		

AV 349	• Miscellaneous piping on structure access ladder • Sanitary cleanout not installed • No other exceptions noted		No
AV 350	• Water should be pumped out of structure • No exceptions noted		No
AV 334	Previously reviewed, see above		
AV 333	Previously reviewed, see above		

AV 331	Previously reviewed, see above		
AV 330	Previously reviewed, see above		
AV 329	Previously reviewed, see above		
AV 500	Previously reviewed, see above		
AV 327	Previously reviewed, see above		
AV 326	Previously reviewed, see above		
Booster Station No 1			
AV 523	• Two bleeds are utilized within structure, probable circulation issues • Appears to have a large service connection welded onto the 90º bend, not typical configuration • Assuming smaller pipe is the service return piping • Sanitary cleanout cover not installed		No

AV 522	• Water in structure is clear, possible ground water infiltration or potable water, investigate to confirm • No other exceptions noted		Yes – investigate water source
AV 521	• Water in structure is clear, possible ground water infiltration or potable water, investigate to confirm • No other exceptions noted		Yes – investigate water source

AV 520	• Water in structure is clear, possible ground water infiltration or potable water, investigate to confirm • No other exceptions noted		Yes – investigate water source
AV 518	• Large service connection, both supply and return for service are within structure, small leak noted from service supply • Unused penetrations present, for future use • Sanitary cleanout not installed • Evidence of sewer backups • Pressure gauge installed on laterolet • Laterolet appears to be used as a bleed, no backflow preventer		Yes – Inspect service supply, small leak observed. Ensure if bleed is used a backflow preventer is installed

AV 517	• Appears to have a large service connection welded onto the 90° bend, not typical configuration • Possibly leak on service connections, investigate • Evidence of sewer backups, cleanout cover may not be properly installed		Yes – investigate service connections for a leak
AV 516	• Pump out and inspect		Yes – pump out and inspect, possible leak

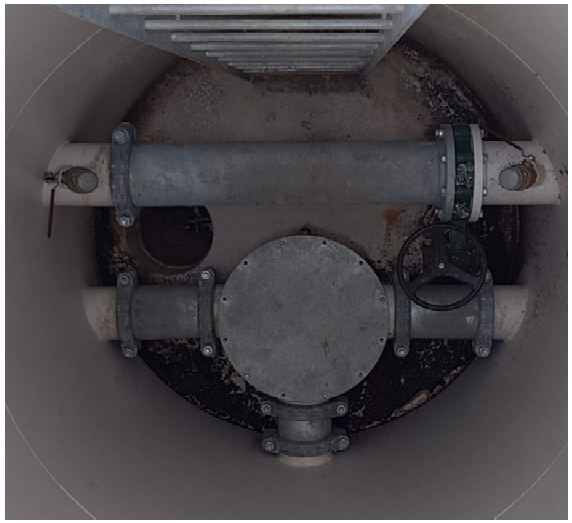
AV 503	• Key structure for water network • Pending the configuration in AV 516, the valve above the hydrant would need to be in the closed position. The hollow ring left of the hydrant may be a spade which would serve the same purpose of blanking the line • Watermain reduced from a 250mm to a 200mm • Bleed used within structure, not directed to cleanout • Evidence of sewer backups		Yes – investigate AV 516 and then check valve configurations within AV 503.
AV 504	• Leak at bleed • Corrosion on wall indicates it's the bleed has been broken for a period of time • Sanitary cleanout not installed • Evidence of sewer backups		Yes – repair bleed

AV 505	• Water in structure is clear, possible ground water infiltration or potable water, investigate to confirm • No other exceptions noted		Yes – investigate source of water
AV 506	• No exceptions noted		

AV 507	• Sanitary cleanout not installed • Evidence of sewer backups		No
AV 508	• Sanitary cleanout not installed • Evidence of sewer backups		No

AV 509	• Sanitary cleanout not installed • Evidence of sewer backups		No
AV 510	• Two bleeds utilized within the structure, possible circulation issues in the area • Sanitary cleanout not installed • Evidence of sewer backups		Yes – ensure backflow preventers are utilized

AV 511	• Water in structure is clear, possible ground water infiltration or potable water, investigate to confirm • No other exceptions noted		Yes – investigate water source, probably ground water
AV 512	• No exceptions noted		No

AV 513	• Low visibility, noticeable sheen on the water • Investigate water source		Yes – investigate water source
AV 514	• No exceptions noted		No
AV 505	Previously reviewed, see above		
AV 504	Previously reviewed, see above		

AV 515	• Sanitary appears to be using a drop pipe • No exceptions noted		No
AV 503	Previously reviewed, see above		
AV 502	• Small leak observed at spool piece, investigate and repair • Sanitary cleanout not installed • Evidence of sewer backups		Yes – minor leak, repair

AV 501	• Sanitary cleanout not installed • Evidence of sewer backups • No other exceptions noted		No
AV 500	Previously reviewed, see above		
AV 328	Previously reviewed, see above		
AV 327	Previously reviewed, see above		
AV 326	Previously reviewed, see above		
Booster Station No 1	End of loop		

Appendix C – Happy Valley 2018 Inspection Summary

November 19, 2018

Mr. Erik Marko
Project Manager – Colliers
Suite 700, 150 Isabella Street
Ottawa, Ontario

Project # **OTT-00248529-A0**

Water Distribution Network Issues – Happy Valley Loop

Dear Mr. Marko:

Introduction

The City of Iqaluit (City) has requested that exp assist the City in repairing and rehabilitating their water distribution network. A visual assessment of each AV and MH in the City has been completed and exp is now in the process of analyzing the data and determining the current state of the system. This letter addresses exp's findings of the Happy Valley Loop's current state. The information highlighted in this report is being utilized to provide the City with suggested corrective actions to re-instate the water distribution system back to its intended functionality.

Transmission of Key Happy Valley Loop Findings

The table below (Table 1.1), illustrates the findings of the visual inspection that was completed from the top (at the hatch) of each AV within the Happy Valley Loop. The sequence of each structure has been set to follow the flow of water as it passes by the Hospital Reheat Station and flows throughout the Happy Valley Loop network and eventually returns to the Hospital Reheat Station. There were several structures that could not be found or were full of water and sewage and could not be properly investigated. It is suggested that these structures be pumped out and detailed photos be taken and sent to EXP. General comments are made for each AV within the table. Corrective action comments about cleaning and installing the sanitary clean out lid have not been included but, as a general note, most of the structures require thorough cleaning/disinfection and the re-installation of the lid for the sanitary cleanout. Also, the re-installation of the laterolet caps would help reduce the risk of contamination.

The major issues found within the structures are summarized in greater detail below.

MH 104 – *see image in Table 1.1* – **-** *see image in Table 1.1* - This is a critical structure/junction point that could not be found. The use of a bar finder and a backhoe is suggested to uncover and access this structure. Once found, investigate internal components. It is also possible that this structure was modified during the hospital project, please send any information related to that project or known information regarding this structure/area.

MH 95 – *see image in Table 1.1* – There is a significant leak that appears to be coming from the base of the hydrant. Once leak has been repaired and the structure has been drained, re-inspection of internal components will need to be completed.

MH 68 - *see image in Table 1.1* – There is a significant leak that appears to be coming from the base of the hydrant. Once leak has been repaired and the structure has been drained, re-inspection of internal components will need to be completed.

MH 69 - *see image in Table 1.1* - This is a critical structure/junction point that could not be found. The use of a bar finder and a backhoe is suggested to uncover and access this structure. Once found, investigate internal components.

MH 96 - *see image in Table 1.1* – This is a critical structure/junction point that could not be found. The use of a bar finder and a backhoe is suggested to uncover and access this structure. Once found, investigate internal components.

AV 227 - *see image in Table 1.1* – Grading work needs to be done on the surface to prevent the structure from being buried through erosion. There is a run of pipe that goes from AV 227 to AV 226, the valve on this line should be closed, otherwise it is a short circuit to the flow pattern. The water is supposed to flow from AV 238 to AV 227 to AV 228. Confirmation of this valve closure is required.

AV 229 - *see image in Table 1.1* – Confirmation of the valves current configuration is required. There is piping connecting AV 229 to AV 232, the valve inside AV 229 should be closed as this line is supposed to be abandoned.

AV 232 - *see image in Table 1.1* – Confirmation of how the residences on Nirnait Lane are serviced is required. It appears they are on trucked service and the line from AV 232 to AV 229 should be abandoned. If this is the case, the valve should be closed, please confirm. There is recirculation piping inside this structure, based on the current state of the recirculation piping, the recirculation components inside and outside this structure are probably not salvageable.

AV 233 - *see image in Table 1.1* – There is a leak on the laterolet that needs to be fixed. There is recirculation piping within this structure, we do not believe it is intended to be in service (depending on answer from AV 232). There is a large service connection, the valve on this service connection appears to be in a half open position?

AV 234 - *see image in Table 1.1* – The recirculation network should start at this AV structure. Water is fed to AV 235 and should return through 2” recirculation lines. The recirculation piping appears in tact inside this structure, but the key appurtenances do not appear functional or salvageable (ie- self powered regulators). Based on the state of this and all downstream structures it is probable that recirculation lines are frozen and not functional nor salvageable. A very significant level of effort will be required to bring this system back to intended design.

AV 235 - *see image in Table 1.1* – This structure contains the intended start of the recirculation line, however, based on the images it is clearly dismantled. The recirculation line has been modified and is now being used as a bleed to ensure the watermain does not freeze.

AV 226 - *see image in Table 1.1* – There are several bleeds being used within the AV, of which a few do not have backflow preventers, these should be utilized at any bleed. The reason for so many bleeds in this AV is unknown, possibly because the system is not functioning as intended and water is being fed from AV 227 (confirmation of valve within AV 227 is required). The water flow in this structure should be coming from AV 234. The recirculation components inside the structure are not functional and probably not salvageable (self-powered regulator and flow meter). It is assumed that the recirculation piping from AV 227 is probably frozen as well.

AV 225 - *see image in Table 1.1* – There is a leak on the laterolet that should be repaired. The recirculation piping appears in tact inside this structure, but the key appurtenances do not appear functional or salvageable (ie- self powered regulators). Based on the state of this and all other recirculation components, it is probable that recirculation lines are frozen and not functional nor salvageable. A very significant level of effort will be required to bring this system back to intended design.

AV 239 - *see image in Table 1.1* – There is a leak present on the bleed that is being utilized within this AV. The configuration of the recirculation piping within the AV is not oriented as per typical details. It is assumed the recirculation piping outside this AV is probably frozen.

AV 224 - *see image in Table 1.1* – The recirculation piping inside this structure has been dismantled. The key appurtenances do not appear functional or salvageable (ie- self powered regulator). Based on the state of this structure and all other structures it is probable that recirculation lines are frozen and not functional nor salvageable. A very significant level of effort will be required to bring this system back to intended design.

AV 240 - *see image in Table 1.1* – The recirculation piping inside this structure has been dismantled. It is probable that some sort of bleed has been used in the past to ensure flow and that the watermain doesn't freeze, ensure the bleed has a backflow preventer. A very significant level of effort will be required to bring this system back to intended design.

AV 223 - *see image in Table 1.1* – There are 2 recirculation pumps within this AV to promote circulation from the recirculation lines. It is assumed that the recirculation line is frozen and possibly not salvageable. It also appears the hydro meter has been removed. A pressure reducing valve in on the main and should typically be in the closed configuration. Bleeds are being utilized within the AV without a backflow preventer. Appurtenances on the recirculation line do not appear salvageable either. The recirculation piping should flow to MH 96 (need to find this MH), it is assumed this piping is also frozen. A very significant level of effort will be required to bring this system back to intended design.

MH 92 - *see image in Table 1.1* – Appears that the T on the watermain is being blanked by solely the use of a valve. This poses a higher risk of contamination; this piping should be properly blanked.

MH 73 - *see image in Table 1.1* – This structure had very limited visibility due to the structures collar being shifted, but it appears there was a leak within. Adjust access to structure, install backflow preventer on bleed, and repair leak.

MH 75 - *see image in Table 1.1* – This is a critical structure/junction point that could not be found. The use of a bar finder and a backhoe is suggested to uncover and access this structure. Once found, investigate internal components.

MH 76 - *see image in Table 1.1* – Limited visibility to the structure due to the above ground sewer. The sewer configuration of this structure is not typical and possess a greater contamination risk. A leak was also identified, repair the leak.

First Recommendations

Based on the current conditions of the Happy Valley system it is evident that a very extensive repair and rehabilitation program will need to be developed. Several leaks have been identified and should all be repaired. There is no recirculation occurring within the Happy Valley loop as evident by missing or dismantled piping inside the structures. It is assumed that a large quantity of the recirculation piping is also frozen and possibly not salvageable. The appurtenances within the access vaults are also assumed to not be salvageable, these are; flowmeters, regulators, and pumps. It is also quite possible that sections of watermain are being supplied through unintended flow patterns, further information is required on current valve configurations, these requests are identified in table 1.1. Because of these conditions, a large quantity of bleeds (several without backflow preventers) have been installed throughout the years to ensure flow is occurring and that piping doesn't freeze. Further there were 4 structures that could not be found. These are all very important structures which are critical junction points within the network, these structures need to be found. It has been noted on several structures as well that access into the vault or manhole appears inadequate, this needs to be corrected to ensure that each structure is safely accessible.

There is a gap in information between the piping near MH 104 and the hospital reheat station. It is believed that modifications may have been made in this area as part of the Hospital project, EXP requests that any record drawings or information regarding this area be provided to aid in the study.

Based on the first review of this network, exp suggests that a meeting be had with the City after they have reviewed this report to discuss the rehabilitation of this loop. Exp wants to ensure the City understands the magnitude of the scope and level of effort required to rehabilitate the Happy Valley Loop back to intended functionality and to also discuss options on how to proceed.

We trust the above information meets your requirements. Should you have any additional questions please do not hesitate to contact the undersigned.

Yours truly,

EXP Services Inc.

Simon Plourde
Engineering Designer
Infrastructure Services

Ian Crawford, CET
Project Manager
Infrastructure Services

Table 1.1 – Happy Valley Loop Structures

Structure	Comment	Photo	Corrective Action
104	No photo available – Don't believe this MH exists any more since Hospital was re-done?.		
103	• 200mm watermain and 50mm recirculation piping • Inadequate structure access • Cleanout cover not installed		Yes – modify structure access
95	• Large leak from hydrant base • Depth of standing water suggests downstream sewer problems • Once fixed, pump and take photos of the interior. • Cleanout cover not installed • Inadequate structure access		Yes – major leak, repair structure access and pump out and investigate

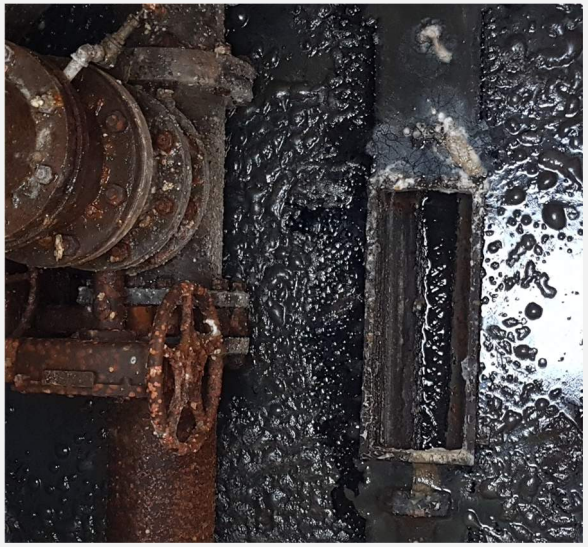
68	• Watermain location appears to outside of photo frame • Water in chamber appears clear, notes indicate noticeable leak • Cleanout cover not installed		Yes – repair leak
69	• Manhole appears to be buried as it cannot be located		Yes – need to find this critical structure
70	• Dirty; requires cleaning and disinfection • Bleed into sewer • Cleanout cover not installed		No

71	• Dirty; requires cleaning and disinfection • Watermain not visible • Structure access inadequate • Cleanout cover not installed		Yes – modify structure access, pump out and re-inspect.
72	• Full of water, pump out and inspect • Structure access inadequate • Booster station No. 1 ties into this structure		Yes – modify structure access, pump out and re-inspect

AV 325	• No exceptions noted		No
100	• Knife gate valves for direction of sewage flow • Clarity of water suggests infiltration or a leak • Watermain not clearly visible • Watermain is lower in elevation then sewer • Cleanout cover not installed		Yes – pump out and inspect for leaks

99	• Clarity of water suggests infiltration or possibly a leak • Access challenging and inadequate due to unusual access tube • Cleanout cover not installed		Yes – modify access
98	• Clarity of water suggests infiltration or possibly a leak. • Access challenging and inadequate due to unusual wooden access box		Yes – modify access

97	• Clarity of water suggests infiltration or a leak • Access into structure inadequate • Cleanout cover not installed		Yes – pump out and inspect for leak
96	Manhole is not visible; could not locate		Yes – need to find this critical structure
216	• Heavy corrosion on valve • High level in sewer suggests downstream issues (collapsed pipe?) • Hose in AV suggests ongoing thawing required • Requires cleaning and disinfection • Cleanout cover not installed		Yes – test valve, probably replace. Repair sewer.

217	• Dirty; requires cleaning and disinfection • Accumulation suggests sewer backups • Cleanout cover not installed		Yes – clean and and repair sewer
237	• Standing water suggest previous backup • Requires pump out • No unusual water observations • Cleanout cover not installed		Yes – clean and disinect and repair sewer

238	• Requires pump out • Fitting on laterolet suggests usage as a bleed, no backflow preventer • Cleanout cover not installed		Yes – install backflow preventer

227	• Access tube due to AV depth
	• Cover almost buried due to upslope erosion
	• Appears to have a bleed present
	• Need confirmation that valve is closed or open
	• Internally complex due to watermain from AV 228
	  • Internal not visible
	  • Valve on piping that goes to AV 226 should be closed to prevent short circuit
			Yes – investigate valve configuration and condition of AV, grading work around AV cover

AV 228	• Dirty; suggests previous sewer backups • Bleed at AV, but does not appear to be directed towards clean-out • Cleanout cover not installed		
AV 229	• Return for watermain from AV 232 (not in service) • Valve should be closed to prevent short circuit (piping directed to AV 232) • Cannot confirm valve position • Cleanout cover not installed		Yes – confirm valve is closed

230	• Heavy corrosion around laterolet, possible leak • Cleanout cover not installed		Yes – investigate laterolet
231	• No watermain exceptions noted • Cleanout cover not installed		No

232	• Contains recirculation line from AV 229
	  • Valves appear closed, supposed to be closed at it appears lots between AV 232 and AV 229 are on trucked service
	  • Recirculation piping form AV 229 out of service
	• Supply valve to AV 229 appears to be open, should be closed
	• Cleanout cover not installed
			Yes – confirm valve positioning

AV 233	• Leak on laterolet
	• Large service connection
	  • Service valve appears to be in half open configuration
	  • Service return not present inside AV, assume it's outside AV
	• Recirculation piping should be out of service
	• Cleanout cover not installed
			Yes – repair leak. Significant level of effort required to get recirculation system functioning as originally designed

AV 234	• Large service connection
	• Location where recirculation should be active from AV 235
	  • Self-powered regulator probably not functional/salvageable
	  • Flow meter removed
	  • Valves appear to be open
	• Cleanout cover not installed
			Yes – Significant level of effort required to get recirculation system functioning as originally designed

AV 235	• Recirculation piping has been removed, piping is underwater sitting on the bottom of vault.
	• Recirculation piping was replaced with a bleed, currently active with heavy flow rate (appears to have backflow preventer)
	• Recirculation piping clearly out of service
	  • Fitting for flow meter is open
	  • Recirculation piping from AV 235 to 234 is probably frozen
	• Cleanout cover not installed
			Yes – Significant level of effort required to get recirculation system functioning as originally designed

AV 226	• Supply to AV 227
	• Multiple bleeds installed, some missing backflow preventers
	• Laterolet valve does not appear to be holding, small leak
	  • Fitting suggests laterolet was used as a bleed, again without backflow preventer
	• Multiple bleed from piping to AV 227
	  • Is watermain currently fed from AV 227?
	• Recirculation piping out of service
	  • Fitting for flow meter is open
	  • Self-powered regulator probably not functional/salvageable
	• Cleanout cover not installed
			Yes – backflow preventers and check laterolet valve. Significant level of effort required to get recirculation system functioning as originally designed

225	• Clean-out cover missing
	• Recirculation from AV 239
	  • Probably not in service
	  • Self-powered regulator probably not functional/salvageable
	• Supply valve to AV 239 open
	• Leak on laterolet
			Yes – fix leak. Significant level of effort required to get recirculation system functioning as originally designed

239	• Circulation piping still present, but not as per typical piping configuration • Heavy flow at the bleed • Leak on bleed		Yes – fix leak. Significant level of effort required to get recirculation system functioning as originally designed

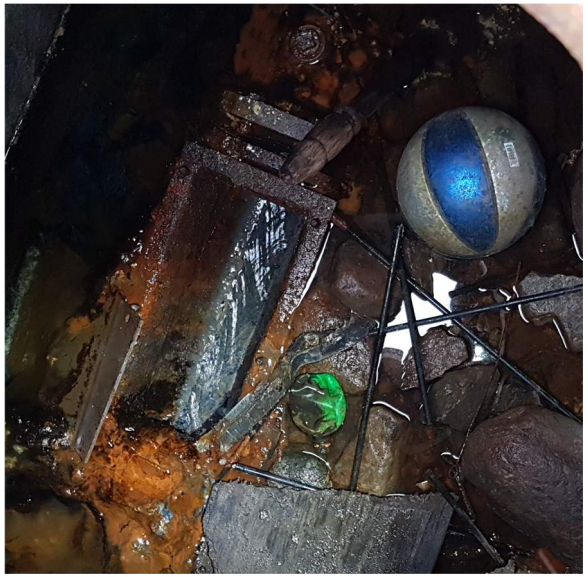
224	• Supply to AV 240 • Recirculation piping missing • Self-powered regulator probably not functional/salvageable • Cleanout cover not installed		Yes - Significant level of effort required to get recirculation system functioning as originally designed
240	• Recirculation piping removed • Would expect to see a bleed here, possibly using the laterolet. • Needs a backflow preventer • Cleanout cover not installed		Yes – Significant level of effort required to get recirculation system functioning as originally designed

223	• Dirty; requires cleaning
	• Pressure reducing valve on main, should be normally closed
	• Recirculation
	  • 2 pumps in AV, probably not functional or serviceable
	  • Piping at the main appears to be removed
	  • Automated valve may no longer be serviceable
	  • Recirculation piping goes to MH 96, probably all froze
	• No meter on electrical service. Is there power?
	• Appears that laterolet has been used as a bleed without backflow preventer
	• Cleanout cover not installed
		
		 
			Yes – install backflow preventer
			
			Confirm valve configuration
			
			Significant level of effort required to get recirculation system functioning as originally designed

93	• Access inadequate
	• Water service saddle on sewer
	  • Connection point for bleed?
	  • Connection for sump pump that has been removed
	• Plugged service saddle on water
	  • Purpose?
	• Cleanout cover not installed
			No

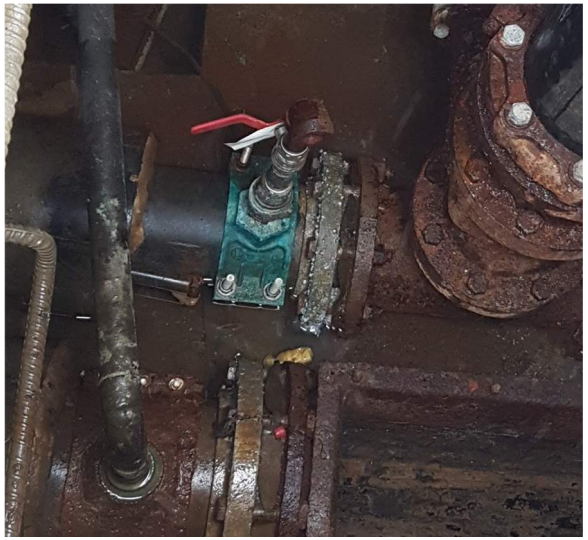
92	• Sump pump may still be in place, probably not functional • Purpose of valved connection uncertain • High contamination risk • Cleanout cover not installed		Yes – properly blank ‘T’ on the watermain

91	• Cover buried • Chamber filled with water; no observations possible • Possibly downstream sewer issues?		Yes – pump out and investigate
89	• Sump pump appears to still be in place, probably not functional • Infiltration or possibly a leak • Cleanout cover not installed		Yes – pump out and investigate

88	• Watermain is lower than the sewer • Sump pump appears to be in place, probably not functional • Evidence of previous backups • Possibly infiltration or leak • Cleanout cover not installed		Yes – pump out and investigate
87	• Evidence of previous backups • Watermain is lower than the sewer • Debris, including rocks; requires cleaning • Possibly infiltration or leak • Cleanout cover not installed		Yes – pump out and investigate

86	• Infiltration or possibly a leak • Sump pump appears to be in place, probably not functional • Cleanout cover not installed		Yes – pump out and investigate
85	• Infiltration or leak • Sewer is higher in elevation then watermain • Sump pump appears to be in place, probably not functional • Cleanout cover not installed		Yes – pump out and investigate

73	• Frame and cover shifted, very limited internal view • Active bleed with no backflow preventer • Cleanout cover not installed		Yes – fix access and install backflow preventer

74	• Sump pump in place, probably not functional • Service saddle on watermain probably used as a bleed with no backflow preventer present • Cleanout cover not installed		Yes – install backflow preventer
75	• Manhole could not be located, probably buried	N/A	Yes – find this structure
90	• Largely filled with debris; internal observations not possible		Yes – clean and evaluate structure components

76	• Sewer dropping through cover
	  • Public safety issues
	• Very limited internal examination due to sewer
	• Internal water appears to be relatively clear
	  • Objects below water level appear visible
	  • Appears to be a significant internal water leak (audible)
		
		 
			Yes – fix leak and re-arrange the sewer

69	• Can't find structure	N/A	Yes – find it, very important structure
68	• Already reviewed		
95	• Already Reviewed		
103	• Already Reviewed		

Appendix D – Lower Iqaluit 2018 Inspection Summary

January 9, 2019

Mr. Erik Marko
Project Manager – Colliers
Suite 700, 150 Isabella Street
Ottawa, Ontario

Project # **OTT-00248529-A0**

Water Distribution Network Issues – Lower Iqaluit Loop

Dear Mr. Marko:

Introduction

The City of Iqaluit (City) has requested that exp assist the City in repairing and rehabilitating their water distribution network. A visual assessment of each AV and MH in the City has been completed and exp is now in the process of analyzing the data and determining the current state of the system. This letter addresses exp's findings of the Lower Iqaluit network. The information highlighted in this report is being utilized to provide the City with suggested corrective actions to re-instate the water distribution system back to its intended functionality.

Transmission of Key Lower Iqaluit Loop Findings

The table below (Table 1.1), illustrates the findings of the visual inspection that was completed from the top (at the hatch) of each structure within the Lower Iqaluit Loop. The sequence of each structure has been set to follow the water's designed flow pattern as it is transmitted from each structure and eventually circulated through the Building 222 Reheat Station to have heat added within the loop. It should be noted that the infrastructure within Lower Iqaluit is some of the oldest in the City. A large portion of the piping is still ductile iron and most of the structures are old concrete manholes as opposed to the new standard access vaults.

There were several structures that could not be found or were full of water/sewage and could not be visually investigated from the surface. The presence of sump pumps in many of structures indicates consistent groundwater issues in the area. However, it is suggested that these structures be pumped out and thoroughly investigated. This is to ensure that the watermain piping is not leaking and confirming that the water observed in the structures is ground water and not potable water.

General comments are made for each structure within the table 1.1. Corrective action comments about cleaning and installing the sanitary clean out lid have not been included but, as a general note, most of the structures require thorough cleaning/disinfection and the re-installation of the lid for the sanitary cleanout as well as the laterolet caps.

Missing and Inaccessible Structures

The following list of structures were inaccessible at the time of the inspection. This was due to either not being able to physically open the lid or that the structure was buried and not visible. The use of a bar finder and a backhoe is suggested to uncover and gain access to the structures that could not be found. Once found, investigate the internal components.

- MH 21
- MH 30
- MH 60
- MH 59
- MH 45
- PT A
- MH 24
- MH 26

Watermain Inspections Not Possible

The following list of structures could not be visually investigated due to debris, water, and sewage. These structures require pumping followed by inspection. It is probable that several structures have ground water infiltration issues, however it would be prudent to confirm the current state of the watermain.

- MH 8
- PT A2
- MH 14
- MH 15
- MH 13
- MH 22
- MH 20
- MH 23B
- MH 31
- MH 32
- MH 32B
- MH 63
- MH 65
- MH 66
- MH 38
- MH 37
- MH 36
- MH 35
- MH 62
- MH 61
- MH 48
- MH 47
- MH 46
- MH 58
- MH 42
- MH 41
- MH 40
- MH 27

AV 400 – *see image in Table 1.1* – This is a key structure/junction in Lower Iqaluit Loop. Water is transmitted from AV 9A to AV 400 and then over to the 222 Building to have heat added. However, as seen in the image, it appears the valve on the piping that is coming from AV 9A is closed. Confirmation of this closure is required. If it is closed, the Lower Iqaluit Loop is not being supplied as designed

MH 22 – *see image in Table 1.1* – During the investigation, it was noted, that audible sounds were observed that seemed to be representative of a leak. Structure requires cleaning and further investigation to confirm the cause of the noise. If a leak is identified, repair.

MH 39 – *see image in Table 1.1* – Major leak identified at the valve, repair the leak.

MH 24A – *see image in Table 1.1* – Significant leak identified at the flanged connection of the 45° bend, repair the leak.

First Recommendations

Based on the current conditions of the Lower Iqaluit Water system, it is evident that a very extensive repair and rehabilitation program will need to be developed. There are still 36 structures which could not be visually inspected, these structures should be inspected prior to investigating corrective actions for the loop. Of the structures that were accessible and visually clear, two significant leaks were identified and should be repaired.

Upon reviewing the images, it appears possible that some of the current valve configurations are not as per the intended design. Thus, it is likely that sections of watermain are being supplied through unintended flow patterns, further information is required confirming the current configurations, these requests are identified in table 1.1. Because of these flow conditions, bleeds have been installed throughout the years to ensure flow is occurring and that piping doesn't freeze. It was noted that several bleeds did not have backflow preventers, any bleed should have backflow preventers installed. It was also noticed within several structures, the watermain was at a lower elevation then the sanitary sewer and in some cases completely submerged in sewage. This configuration significantly increases the risk of contamination, it is strongly recommended that a cleaning program be put in place and that the sanitary clean out lids be re-installed.

It was also observed in several structures, that access into the vault or manhole appears inadequate. This needs to be corrected to ensure that each structure is safely accessible.

Based on the first review of this network, exp suggests that a meeting be had with the City after they have reviewed this report to discuss the rehabilitation of this loop. Exp wants to ensure the City understands the magnitude of the scope and level of effort required to rehabilitate the Lower Iqaluit Loop back to intended functionality and to also discuss options on how to proceed.

We trust the above information meets your requirements. Should you have any additional questions please do not hesitate to contact the undersigned.

Yours truly,

EXP Services Inc.

Simon Plourde
Engineering Designer
Infrastructure Services

Ian Crawford, CET
Project Manager
Infrastructure Services

Table 1.1 – Lower Iqaluit Loop Structures

Structure	Comment	Photo	Action Required
AV 305	• Sewer Cleanout not installed • Evidence of previous backups and surcharges • Requires cleaning and pumping		No
MH 9	• Water servicing removed from MH 9 in 1985 (approx.) and was replaced with AV 9A • Sewage dropping into structure at very high flow rate • Appears to have extensive corrosion, potential that mechanical components don't operate as intended		No

AV 9A	• Piping under ladder is believed to be a service, no recirculation piping visible, may be outside structure. • Piping going to MH 84 (going up, vertically in the photo) is supposed to be abandoned. Cannot tell configuration of valve. • Large service connection visible, return piping installed on laterolet		Yes – confirm valve going to MH 84 is closed
MH 8	• Key structure in Lower Iqaluit network as the water supply loops back and ties into the structure, thus completing the loop • Originally constructed with open sewer benching • Requires pumping and cleaning • Water level suggests possible downstream sewage issues • Access does not appear adequate • Piping from MH 8 to AV 11 is supposed to have been abandoned • Electrical equipment (heater and sump pump) still in place but probably not functional		Yes – Modify access and determine source of water, leak or infiltration

MH 7	• Originally constructed with open sewer benching • Appears to have extensive corrosion, potential that mechanical components don't operate as intended • Requires pumping and cleaning • Water level suggests downstream sewage issues • Upper pipe appears to be sewer from AV 10, water line coming from AV 10 was previously abandoned		No
PT A2	• Low visibility • Requires cleaning and draining		Yes – determine source of water, leak or infiltration

AV 400	• Sewage backup issues present • Cleanout cover not installed • Appears to have various jumpers installed • Furthest Valve to the right appears to be closed, this valve should be open as the supply for Lower Iqaluit is supposed to come through this piping • Bleed present but not active, appears to have backflow preventer		Yes, confirm that the valve is in the closed position. If closed, discuss with Public Works why this was shut, frozen pipes? Or?
MH 6	Could not locate structure, possibly buried		Locate and investigate
MH 14	• Open sewer benching • Little information can be gathered without entry into structure		Yes – determine source of water, leak or infiltration

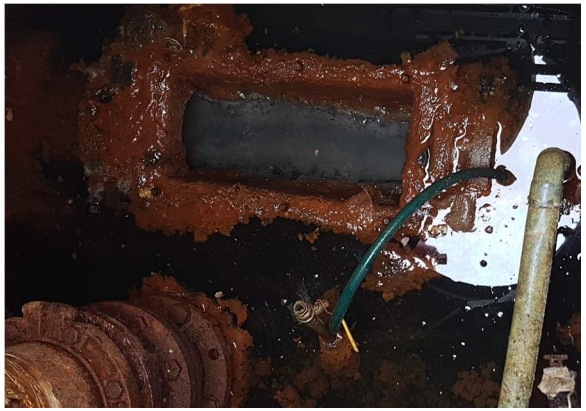
MH 15	• Requires pumping • Clear water inside structure, probably groundwater but possibly potable • Low visibility, further information not obtainable without pumping		Yes – determine source of water, leak or infiltration
MH 13	• Contains valving to control water flow direction • Requires pumping and cleaning as none of the internals visible • Internal condition suggests sewage back-up to substantial depth		Yes – clean and pump out then investigate
Building 222 Reheat Station			

MH 13	Previously reviewed, see above		
MH 22	• Requires pumping and cleaning • Audible sounds suggest water flow present • Further internal observations required		Yes – access to determine causes of noise and repair
MH 21	Could not open, frame and cover seized together.		Yes – Fix access issue and gather information
MH 20	• Requires pumping and cleaning • Open sewer benching • Structure access damaged • Internal conditions could not be observed • Requires internal access and re-inspection		Yes – Fix structure access, investigate structure after cleaning and pumping

AV 19A	• No exceptions noted		No
MH 23B	• Requires pumping and cleaning • Internal conditions could not be evaluated due to internal water		Yes –Investigate structure after cleaning and pumping, determine source of water

AV 23A	• Requires pumping • Installed to separate water from sewer • High humidity due to standing water is damaging coatings • Piping going to MH 33 is to have been abandoned.		No
MH 30	Could not locate; probably buried		Locate and investigate
MH 31	• Requires cleaning and disinfection • Open sewer benching • Indications of sewage back-up to near surface elevation • Watermain is not visible, supposed to be a 150mm ductile iron pipe		Yes – investigate water piping after cleaning

MH 32	• Requires cleaning and disinfection • Open benching • Indications of sewage back-up to near surface elevation • Watermain is not visible, supposed to be a 150mm ductile iron pipe		Yes – investigate water piping after cleaning
MH 32A	• Requires pumping and cleaning • Clean-out cover missing • Copper piping probably for sump pump that is no longer in service		No

MH 32B	• Requires pumping and cleaning • Clean-out cover missing • Appears to previously have used garden hose for bleed; currently broken from nozzle. • Does not appear to have black flow prevention • Copper piping for sump pump; not in service		Yes – if bleed is utilized, backflow preventer required. After pump out investigate watermain
MH 63A	• Clean-out cover missing • Water and Sewer both drop vertically • Insulation added for additional freeze protection • Water present at bottom of structure, probably groundwater but could be potable • Bleed installed with missing backflow preventer • Minor leak from end of bleed, structure has water in it upto top of clean out		Yes – if bleed is utilized, backflow preventer required

MH 63	• Requires pumping water at bottom • Frame and cover raised using a combination of CSP and concrete collar. • Inadequate structure access • This is an important junction/structure within Lower Iqaluit loop. • Structure has quite a bit of water that appears transparent, possible leak or groundwater.		Yes – repair access, investigate source of water in structure.
MH 65	• Structure access appears inadequate • Structure has water that appears transparent, possible leak or groundwater • Cleanout cover not installed		Yes – repair access, investigate source of water in structure.

MH 66	• Transparent water within structure, appears to be ground water infiltration but could possibly be a leak • Pumping and cleaning required • Appears to be top of sewer run		Yes – investigate source of water in structure.
MH 39	• Large structure with 2 access points • Significant leak at valve • Water pipe going to MH 48 should be out of service • Electrical equipment still present but probably not functional		Yes – repair major leak

			
MH 38	• Requires pumping • Frame and cover raised using a combination of CSP and concrete collar. • Clean-out cover missing • Appears to contain groundwater		Yes – investigate water source within structure

MH 37	• Requires pumping and cleaning • Structure appears to have relatively clear water, possible leak or groundwater		Yes – investigate water source within structure
MH 36	• Requires pumping, removal of debris and cleaning • Clean-out cover missing • Sewer appears to have previous backups • Sump pump and heater present but probably not functional		Yes – investigate water source within structure

MH 35	• Requires pumping and cleaning • Clean-out cover missing		Yes – investigate water source within structure
MH 62	• Requires pumping and cleaning • Further comments require pump out		Yes – investigate water source within structure

MH 61	• Requires pumping and cleaning • Significant corrosion, indicative of long standing water issues • Appears to have experienced sewage back-up and surcharge • Further comment requires cleaning and re-inspection		Yes – investigate water source within structure
MH 60	• Access appears to be buried • Internal inspection not possible • Important junction in water network		Yes – Uncover access and investigate

MH 59	• Structure appears to be buried • Internal inspection not possible		Yes – Uncover access and investigate
MH 48	• Large structure with 2 access points • Sump pump installed but probably not functional • Piping to MH 39 should have a valve that is in the closed position • Cleanout cover not installed • Relatively clear water present, possible leak or infiltration		Yes – investigate water in structure and ensure valve to MH 39 is closed

MH 47	• Requires pumping • Clean-out cover in place		Yes – investigate water source within structure
MH 46	• Requires pumping • Clean-out open • Piping in place for a bleed, not operating during inspection • Structure needs to be accessed to see other piping which connects to watermain		Yes – investigate water source within structure

MH 58	• Requires pumping • CSP riser installed over concrete structure • Clean-out open, water inside structure is filled to rim of clean-out; draining into sewer • Watermain not visible		Yes – Investigate water source, groundwater or leak
MH 46B	• Unused electrical equipment remains in place • Sump pump, electric heater, connection to thaw tube • Clean-out cover missing, start of sanitary run • Requires cleaning • Structure generally dry • Newer ball valve installed, assuming it was used as a bleed.		Yes – if using ball valve as a bleed, install backflow preventers

MH 46A	• Clean-out cover appears to be in place • Appears to be a retro-fitted cover • Thaw tube still in place • Requires pumping		No
MH 45	Structure not visible; probably buried		Yes – Locate and uncover
MH 43	• Requires pumping and cleaning • Clean out cover removed • Watermain crosses over sewer main • Evidence of previous backup and surcharges		No

MH 42	• Requires pumping and cleaning • Important junction in watermain network • No internal observations possible		Yes – clean and investigate
PT A	• Could not open wooden box; inspection not possible		Yes – access and investigate
MH 42	Previously reviewed, see above		

MH 41	• Requires pumping and removal of debris • Clean-out cover missing • Appears filled with groundwater to clean-out rim • Top end of sewer system • No evidence of sewage back-up		Yes – investigate water source
MH 40	• Requires pumping • Lower sewer piping not visible • Upper piping appears more recent (thaw laterolets) • Valve on lower piping between newer piping is supposed to be in closed position		Yes – investigate water source, confirm valve is closed

AV 40A	• Requires pumping • Cleanout not installed • Original configuration had water entering and returning within the structure, appears to have been extended. • Where (structure) the water returns, unknown • Piping for a bleed present, doesn't appear active • Corrosion around laterolet indicates minor leak		Yes – investigate water source, repair laterolet
MH 40	Previously reviewed, see above		
MH 24A	• Leak at 45° bends flanged connection • Requires pumping and cleaning, contamination risk is high with leak present • Electrical components are present but probably not functioning		Yes – Repair leak
MH 24	Could not locate; probably buried		Yes – Locate and investigate

AV 25A	• Appears to have been provided to separate water from sewage (MH 25) • Requires pumping • Corrosion around laterolet indicates a minor leak		No
MH 26	• Wooden box has been constructed above the structure • Limited visibility • Appears to have ½ piping either acting as a service or as a bleed into the structure		Yes – Correct odd configuration and investigate internal componentns

MH 27	• Filled with debris, cleaning required		Yes – clean and insepct
MH 8	Previously reviewed, see above		

Appendix E – Lower Base 2018 Inspection Summary

January 11, 2019

Mr. Erik Marko
Project Manager – Colliers
Suite 700, 150 Isabella Street
Ottawa, Ontario

Project # **OTT-00248529-A0**

Water Distribution Network Issues – Lower Base Loop

Dear Mr. Marko:

Introduction

The City of Iqaluit (City) has requested that exp assist the City in repairing and rehabilitating their water distribution network. A visual assessment of each AV and MH in the City has been completed and exp is now in the process of analyzing the data and determining the current state of the system. This letter addresses exp's findings of the Lower Base network. The information highlighted in this report is being utilized to provide the City with suggested corrective actions to re-instate the water distribution system back to its intended functionality.

Transmission of Key Lower Base Loop Findings

The table below (Table 1.1), illustrates the findings of the visual inspection that was completed from the top (at the hatch) of each structure within the Lower Base Loop. The sequence of each structure has been set to follow the water's designed flow pattern as it flows from the Trigram building through each structure and eventually recirculated back through the Trigram Reheat Station to have heat added within the loop.

General comments are made for each structure within the table 1.1. Corrective action comments about cleaning and installing the sanitary clean out lid have not been included but, as a general note, most of the structures require thorough cleaning/disinfection and the re-installation of the lid for the sanitary cleanout as well as the laterolet caps. The subsequent paragraphs are highlighting the major issues observed within this network.

AV 201 – *see image in Table 1.1* – This is a very critical AV as part of the Lower Base network as well as for the Airport loop. The recirculation line from Lower Base as well as the returning supply from Airport are combined into one recirculation line within this AV and are then directed towards the Trigram building to have heat added. There is also a pressure reducing valve installed within this AV on the supply line for Lower Base and Airport Loop. Under normal conditions is be in the closed configuration. In a low-pressure event the valve opens, and additional water is added in both directions of the Airport loop to provide additional water and pressure for fire conditions. We believe the current state of this valve is open and thus the circulation pattern is not per design conditions.

AV 415 - *see image in Table 1.1* - There is a potential that this AV is short circuiting the loop. The water that flows through this AV is feeding Lower Base. Exp needs confirmation on the current configuration of one of the valves within this AV. If the valve (closest to the sanitary cleanout) is in the closed configuration everything is okay. If it is open, a short circuit has been created and further investigation of where this piping goes will need to be confirmed.

AV 405 - *see image in Table 1.1* – There is a significant leak coming from the return line on the service within this structure. There also appears to be a leak at the laterolet of the service supply. Both should be repaired.

AV 404 - *see image in Table 1.1* – This is a very critical structure within the Lower Base network. The structure appears to be bowed out of shape, structural integrity should be assessed. Confirmation of the mechanical components along the 2" jumper should be assessed to ensure they are functioning as intended.

AV 412 - *see image in Table 1.1* – Structure was not found and is probably buried. Need to locate, access and investigate.

AV 435 - *see image in Table 1.1* – There is a leak at the laterolet, this should be repaired. Also investigate as another leak is possible, picture shows water on the piping.

AV 207 - *see image in Table 1.1* – This is a very critical AV for Lower Base. The recirculation of water from Lower Base starts within this AV. However, it appears that the current valve configuration on the recirculation line is closed. Thus, it is assumed that no circulation is occurring, and Lower Bases' recirculation lines are possible frozen.

AV 206 - *see image in Table 1.1* – There are 2 recirculation pumps within this AV to promote circulation from the Lower Base network. With the valve configuration in AV 207 it appears no circulation can be achieved. Also, it appears as though one of the service connections return pipes is connected to the hydrant's barrel. This needs to be corrected and the return piping needs to be connected to the watermain.

First Recommendations

The current condition of the Lower Base Water system, it is evident that a very extensive repair and rehabilitation program will need to be developed. It is probable that no recirculation is occurring, and if so it is also possible that a significant portion of the recirculation piping is frozen. If so, the water is not returning to the trigram building as intended. The flow pattern generally appears to be correct throughout the network and there was not a large number of bleeds being utilized within the loop. Further investigation is required to confirm.

Based on the first review of this network, exp suggests that a meeting be had with the City after they have reviewed this report to discuss the rehabilitation of this loop. Exp wants to ensure the City

understands the magnitude of the scope and level of effort required to rehabilitate the Lower Base Loop back to intended functionality and to also discuss options on how to proceed.

We trust the above information meets your requirements. Should you have any additional questions please do not hesitate to contact the undersigned.

Yours truly,

EXP Services Inc.

Simon Plourde
Engineering Designer
Infrastructure Services

Ian Crawford, CET
Project Manager
Infrastructure Services

AV #	Comment	Photo	Corrective Action
AV 200	• Heated water returning into the supply from the Trigram building through 4” piping • Recirculation piping that feeds into the Trigram building (re-circulation from Lower Base and Airport Loop are combined) • Install cleanout cover		No
AV 201	• CLA-VAL pressure reducing valve, model 100-20 for high (fire) flow conditions • Here is where Lower Base and Airport Loop recirculation lines are combined and head to trigram building in 1 recirculation line to have heat added • Internal appurtenances configuration appears similar to design • Piping for CLA-VAL Pressure reducing valve is missing pilot controls. In current condition it appears the valve is in full open configuration which should only occur during fire conditions. If correct, then reverse feed of airport loop and lower base on a constant basis. • Appears a service connection was made on the laterolet, not sure where the service return is. Or this could be the return from the 4” service at bottom of the 2- 90-degree bends	 	YES Pilot piping needs to be re-installed. Could be a major issue as Lower Base and Airport would need to function as intended. All piping would need to be operational and thawed.

AV 414	• Requires cleaning • 4” service to government of Canada building • Connection of service re-circulation pipe not clear, appears there’s a 1” return just discharging into vault • Supply splits to feed Airport Loop and Lower Base here • Install cleanout cover		YES Verify that the small pipe is connected. Please send photos. Connection should be made for the small diameter piping if it is a service recirculation or atleast install a backflow preventer
AV 415	• 2 – large services (8” and 6”) for large buildings • Not sure where the 8” watermain and sewer heading south go (direction towards the ladder) • Water is supposed to do a 180 loop here and go to feed Lower Base • Install cleanout cover		YES Need confirmation if valve beside cleanout is open or closed. Possible short circuit here
AV 414	• See above, the 6” main returns from AV 415 and then heads east to AV 413 (supply Lower Base)		

AV 413	• Appears to be 2 – services and re-circulations pipes, configuration appears correct • Install cleanout cover		YES Needs cleaning and another photo to properly assess
AV 205	• Watermains cross, but do not interconnect • Jumpers in place, but laterolet valves appear to be closed. If these jumpers are activated, the flow patterns for both the Airport Loop and Lower Base are affected and the 2 separate loops would be interconnected. • Circulation is supposed to be in service for Lower Base, but pumps not operating. • Install cleanout cover		No Ensure the jumpers are not activated

AV 405	• Service return piping has a significant leak • Interesting to see a laterolet on service supply, evidence of leak around laterolet as well due to corrosion. • Evidence of sewage backups • Sanitary cleanout cover not installed		Yes Repair leaks (x2)
AV 404	• Structure appears to be bowed out of shape, structural failure possibly • Jumper connected has a flow regulator and flow meter, condition unknown • Pressure reducing valve present, appears to be in working order • Large service connection, return piping appears to be located on other side of valving • Sanitary cleanout cover not installed • Evidence of sewer backups		Yes Investigate structure further, piping configuration as well as structural assessment

AV 305	• Sewer Cleanout not installed • Evidence of previous backups and surcharges • Requires cleaning and pumping		No
MH 9	• Water servicing removed from MH 9 in 1985 (approx.) and was replaced with AV 9A • Sewage dropping into structure at very high flow rate • Appears to have extensive corrosion, potential that mechanical components don't operate as intended		No

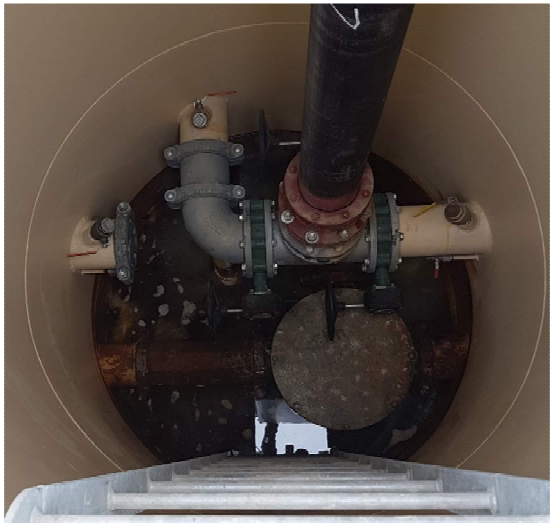
AV 9A	• Piping under ladder is believed to be a service, no recirculation piping visible, may be outside structure. • Piping going to MH 84 (going up, vertically in the photo) is supposed to be abandoned. Cannot tell configuration of valve. • Large service connection visible, return piping installed on laterolet		Yes – confirm valve going to MH 84 is closed
MH 8	• Key structure in Lower Iqaluit network as the water supply loops back and ties into the structure, thus completing the loop • Originally constructed with open sewer benching • Requires pumping and cleaning • Water level suggests possible downstream sewage issues • Access does not appear adequate • Piping from MH 8 to AV 11 is supposed to have been abandoned • Electrical equipment (heater and sump pump) still in place but probably not functional		Yes – Modify access and determine source of water, leak or infiltration

MH 7	• Originally constructed with open sewer benching • Appears to have extensive corrosion, potential that mechanical components don't operate as intended • Requires pumping and cleaning • Water level suggests downstream sewage issues • Upper pipe appears to be sewer from AV 10, water line coming from AV 10 was previously abandoned		No
PT A2	• Low visibility • Requires cleaning and draining		Yes – determine source of water, leak or infiltration

AV 400	• Sewage backup issues present • Cleanout cover not installed • Appears to have various jumpers installed • Furthest Valve to the right appears to be closed, this valve should be open as the supply for Lower Iqaluit is supposed to come through this piping • Bleed present but not active, appears to have backflow preventer		Yes, confirm that the valve is in the closed position. If closed, discuss with Public Works why this was shut, frozen pipes? Or?
AV 401	• Limited visibility, pump out and inspect		Yes – pump out and inspect

AV 402	• Recirculation piping out of service • 2 penetrations not utilized • Evidence of sewer back ups • Sanitary cleanout not installed		No
AV 404	Previously reviewed, see above		
AV 412	Structure is buried		Yes Locate, expose, and investigate

AV 411	• Evidence of corrosion on back side of hydrant • Structure's protective coating appears to be failing, pitting evident • Watermain crosses over other main, not interconnected • Sanitary cleanout cover not installed • Evidence of sewer backup		Yes Investigate around hydrant barrell and connections, minor leak possible
AV 431	• Sanitary clean out cover not installed • Evidence of sewer backups		No

AV 432	• Extensive corrosion on sanitary piping • Sanitary clean out cover not installed • Evidence of Sewer backups		No
AV 433	• Corrosion on sanitary sewer • Cleanout appears installed, possibly not tightened or gasket has failed or was removed • Evidence of sewer backups • Future water connection not utilized		No

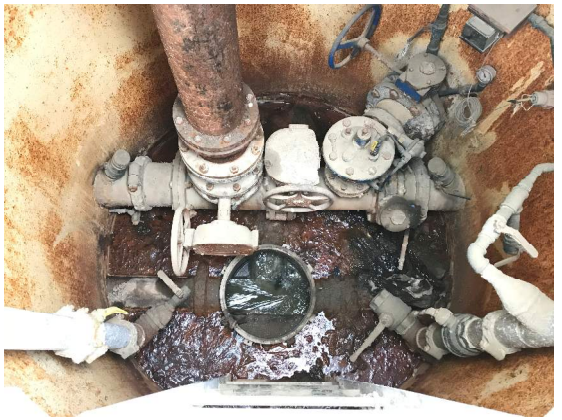
AV 434	• Future water connection not utilized, also not capped • Sanitary cleanout lid isn't bolted • Standing water in structure		No
AV 435	• Laterolet appears to be leaking • Piping is wet, which indicates another leak, investigate • Large service connection present • Sanitary cleanout cover not installed • Protective coating within structure is failing, pitting evident		Yes Repair leak at laterolet and investigate for further leaks within structure
AV 411	Previously reviewed, see above		

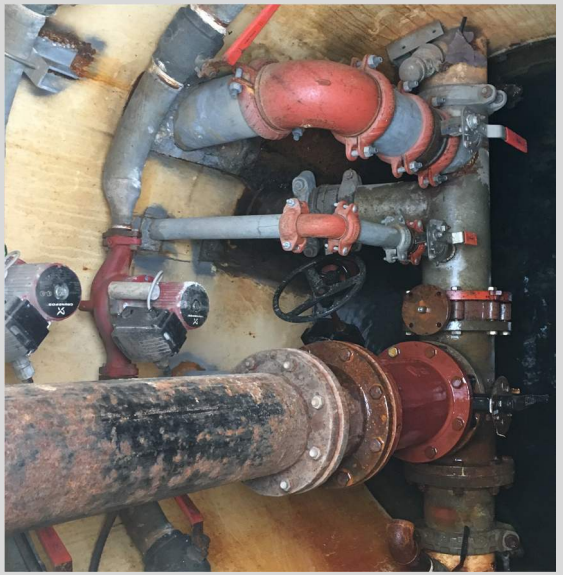
AV 410	• Corrosion around laterolet indicates minor leak • Corrosion around hydrant, possible leak at flanged connections • Sanitary cleanout cover not installed • Evidence of sewer backups • AV protective coating is pitting		Yes Repair minor leak at laterolet, investigate hydrant
AV 440	• Gasket of sanitary cleanout has been removed • No other exceptions noted		No

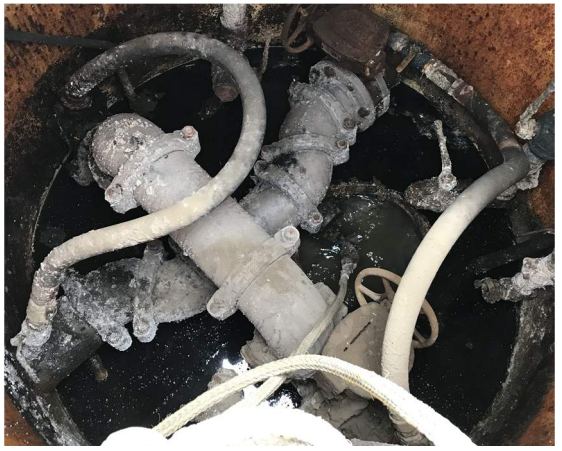
AV 439	• Sanitary cleanout cover removed • Evidence of sewer backup downstream		No
AV 438	• Evidence of sewer backup downstream • Cleanout cover may be missing bolts or gasket		No

AV 437	• Sanitary cleanout cover is not installed • Evidence of major sewer backups • Watermain appears okay, visibility limited		No
AV 409	• Large boulder on piping • Corrosion around hydrant flanges, may be a minor leak • Valve between the two T's should be in the closed position • Sanitary cleanout not installed • Evidence of previous sewer backup		Yes Investigate hydrant and remove debris. Also confirm valve configuration
AV 410	Previously reviewed, see above		
AV 409	Previously reviewed, see above		

AV 408	• Sanitary cleanout not installed • Evidence of previous sewer backup		No
AV 407	• Odd corrosion on hydrant T, probably a leak • Sanitary cleanout not installed		Yes Investigate hydrant as a minor leak is probably present

AV 207	• Automatic valve to supply AV 407 under high pressure sensed by low pressure on outlet side • Recirculation main to provide circulation from Lower Base • Very key AV, start of recirc from Lower Base that goes to Trigram • Appears the valves for recirculation from Lower Base are in closed configuration • Install cleanout cover	  	YES Investigate recirculation loop to confirm if valves are closed or not If they are closed, then certainly no reciruclation from Lower Base

AV 206	• Circulation pumps for Lower Base
	  • Reported not in service
	• Hydrant leaking
	• 2 Service connections
	  • 1 connection appears to be good
	  • 1 connections return appears to tie into hydrant barrel
	• Valve before hydrant is missing the spin wheel
	• Fix exterior, damage to structure at surface
	• Install cleanout cover
			YES
			
			Confirm if pumps are functional
			
			Confirm if service return is in the hydrant barrel
			
			Fix damage to exterior

			
AV 205	• Watermains hard piping crosses, but does not interconnect • Jumpers in place, but valves appear to be closed. Jump on the 2 mains changes flow intents. If jumper is active, then Airport Loop and Lower Base loop interconnected. • Recirculation supposed to be in service for Lower Base, but pumps not operating. • Install cleanout cover		Yes Confirm if jumpers are operational

AV 204	• Large service connection present • Return appears to be outside of AV • Circulation supposed to be in service for Lower Base, but pumps not operating. • Purpose for electrical cable unknown (or is it a 1” service?) • Install cleanout cover		YES Confirm if that is in fact an electrical cable or if it is a service return
AV 203	• Piping that is returning form airport loop splits and goes to Trigram building and to supply Uivaaq Loop • Recirculation supposed to be in service from Lower Base • Install cleanout cover		No

AV 202	• 3” return for circulation of Lower Base • Appears to have 2 service connections		YES Needs cleaning and another photo to properly assess
AV 201	Previously reviewed, see above.		
AV 200	Previously reviewed, see above. Lower Base loop now complete. Water has returned to Trigram for heat to be added		

Appendix F – Federal Road 2018 Inspection Summary

October 3rd, 2018

Mr. Erik Marko
Project Manager – Colliers
Suite 700, 150 Isabella Street
Ottawa, Ontario

Project # **OTT-00248529-A0**

Water Distribution Network Issues – Federal Road/Airport Loop

Dear Mr. Marko:

Introduction

The City of Iqaluit (City) has requested that exp assist the City in repairing and rehabilitating their water distribution network. A visual assessment of each AV and MH in the City has been completed and exp is now in the process of analyzing the data and determining the current state of the system. This letter addresses exp's findings of the Federal Road/Airport Loop's current state. The information highlighted in this report is being utilized to provide the City with suggested corrective actions to re-instate the water distribution system back to its intended functionality.

Transmission of Key Airport Loop Findings

The table below (Table 1.1), illustrates the findings of the visual inspection that was completed from the top (at the hatch) of each AV within the Airport Loop. The sequence of each AV has been set to follow the flow of water as it passes by the Trigram Building and flows throughout the Airport Loop network and eventually returns to the Trigram building to add heat. General comments are made for each AV within the table. Comments about cleaning and installing the sanitary clean out lid have not been included but, as a general note, the majority of the AV's require cleaning and the re-installation of the lid for the sanitary cleanout as well as the laterolet caps. The major issues found within the AV's are summarized in greater detail in the subsequent paragraphs.

AV 201 – *see image in Table 1.1* – This is a very critical AV as part of Airport Loop as well as for the Lower Base loop. The recirculation line from Lower Base and the returning supply from Airport are combined into one recirculation line within this AV and are then directed towards the Trigram building to have heat added. There is also a pressure reducing valve installed within this AV that under normal conditions is be in the closed configuration. In a low-pressure event the valve opens and therefore additional water is added in both directions of the loop to provide additional water and pressure for fire conditions. We believe the current state of this valve is open and thus the circulation pattern is not per design conditions.

AV 415 - *see image in Table 1.1* - There is a potential that this AV is short circuiting the loop. The water that flows through this AV is feeding Lower Base. Exp needs confirmation on the current configuration of one of the valves within this AV. If the valve (closest to the sanitary cleanout) is in the closed configuration everything is okay. If it is open, a short circuit has been created and further investigation of where this piping goes will need to be confirmed.

AV 416 - *see image in Table 1.1* - Based on the number of bleeds at this location (3) we believe there is something wrong with the piping very close to this AV. That could be frozen mains, frozen service line, or possibly the buildings circulation pump isn't working. This area should be investigated right away.

AV 3 - *see image in Table 1.1* – From the photos taken it appears that the valve which controls the watermain from AV 3 to AV 264 is still in the open configuration. With the addition of the airport infrastructure a loop has been completed from AV 5 back to AV 264 and thus if this line (AV 3 to AV 264) is open, a short circuit has been created. Ideally, AV 3 is cleaned out and photos are sent back to EXP to confirm current state.

AV 256 - *see image in Table 1.1* – From the photos taken it is evident that a repair has been made to one of the existing spool pieces. This repair was made by utilizing a robar, this should be a prefabricated spool piece. Also, the main appears to have odd corrosion on the main that could indicate failure is near. May need to also replace this spool piece.

AV 214 - *see image in Table 1.1* – It appears the return piping from a service connection is connected to its own supply. This should be repaired and connected to the main directly.

AV 213 - *see image in Table 1.1* – The "T" in this AV is supplying water to AV 271 and appears to loop back and just bleed into the AV. Pending the information gathered in the Government of Nunavut building (see AV 271 information), these bleeds could possibly be removed and the recirculation piping could connect back into the main. For this to happen, it needs to be confirmed that the recirculation lines are not frozen and operational.

AV 271 - *see image in Table 1.1* – The most recent utility atlas shows that AV 271 is the end of a loop that services Ikaluktuuiak Drive off of the water supply coming down Mivvik Street (AV 213). However, the watermain continues into the Government of Nunavut (GN) building. There is supposed to be a recirculation pump within the mechanical room that loops and returns water back through the recirculation piping towards AV 213. Access is needed within this room to determine the current state of the components. Also, with the photo is difficult to see if the recirculation piping within AV 271 is connected. Lastly, the spool piece has very odd corrosion that could be a sign of failure coming. This spool piece should be replaced.

AV 212 - *see image in Table 1.1* – A strap on style saddle was utilized for the service connection. This connection is at higher risk of contamination of the water system. The proper "T" fitting needs to be installed here.

AV 209 - *see image in Table 1.1* – This AV is supposed to utilize two recirculation pumps. Both pumps appear to be missing. They will need to be reinstalled, but for them to be of value, confirmation that the recirculation lines (from AV 210 to AV 208) are in working order is needed.

AV 210 - *see image in Table 1.1* – The watermain supply ends at this AV and is supposed to be connected back to the recirculation piping. However, with the current state it is impossible to confirm if that connection is in place. Cleaning is needed, and photos need to be returned to exp to confirm.

AV 207 - *see image in Table 1.1* – This is a very critical AV for Lower Base. The recirculation of water from Lower Base starts within this AV. However, it appears that the current valve configuration on the recirculation line is closed. Thus, it is assumed that no circulation is occurring, and Lower Bases' recirculation lines are possible frozen.

AV 206 - *see image in Table 1.1* – There are 2 recirculation pumps within this AV to promote circulation from the Lower Base network. With the valve configuration in AV 207 it appears no circulation can be achieved. Also, it appears as though one of the service connections return pipes is connected to the hydrant's barrel. This needs to be corrected and the return piping needs to be connected to the watermain.

First Recommendations

Exp is still working on recommendations to rehabilitate the Airport Loop's water distribution network to its intended functionality. Based on the current conditions of the system it is evident that an extensive repair and rehabilitation program will need to be developed. Exp will need to study the current condition of the trigram building to ensure that it is functioning as intended. We believe that investigatory work near the RCMP building and AV 416 would be a good starting point as we believe there are frozen pipes along federal road that are restricting circulation through this area. The configuration of the valve in AV 201 indicates that circulation is not being achieved and could possibly explain why the City requires the use of a 2" bleed throughout the winter at AV 423. A program to aid in determining the location of frozen sections of pipe will need to be established collaboratively with the City, Colliers, and exp.

We trust the above information meets your requirements. Should you have any additional questions please do not hesitate to contact the undersigned.

Yours truly,

EXP Services Inc.

Simon Plourde
Engineering Designer
Infrastructure Services

Ian Crawford, CET
Project Manager
Infrastructure Services

AV #	Comment	Photo	Corrective Action
AV 200	• Heated water returning into the supply from the Trigram building through 4” piping • Recirculation piping that feeds into the Trigram building (re-circulation from Lower Base and Airport Loop are combined) • Install cleanout cover		No
AV 201	• CLA-VAL pressure reducing valve, model 100-20 for high (fire) flow conditions • Here is where Lower Base and Airport Loop recirculation lines are combined and head to trigram building in 1 recirculation line to have heat added • Internal appurtenances configuration appear similar to design • Piping for CLA-VAL Pressure reducing valve is missing pilot controls. In current condition it appears the valve is in full open configuration which should only occur during fire conditions. If correct, then reverse feed of airport loop and lower base on a constant basis. • Appears a service connection was made on the laterolet, not sure where the service return is. Or this could be the return from the 4” service at bottom of the 2- 90 degree bends	 	YES Pilot piping needs to be re-installed. Could be a major issue as Lower Base and Airport would need to function as intended. All piping would need to be operational and thawed.

AV 414	• Requires cleaning • 4” service to government of Canada building • Connection of service re-circulation pipe not clear, appears there’s a 1” return just discharging into vault • Supply splits to feed Airport Loop and Lower Base here • Install cleanout cover		YES Verify that the small pipe is connected. Please send photos. Connection should be made for the small diameter piping if it is a service recirculation or atleast install a backflow preventer
AV 415	• 2 – large services (8” and 6”) for large buildings • Not sure where the 8” watermain and sewer heading south go (direction towards the ladder) • Water is supposed to do a 180 loop here and go to feed Lower Base • Install cleanout cover		YES Need confirmation if valve beside cleanout is open or closed. Possible short circuit here
AV 414	• See above, the 6” main returns from AV 415 and then heads east to AV 413 (supply Lower Base)		

AV 413	• Appears to be 2 – services and re-circulations pipes, configuration appears correct • Install cleanout cover		YES Needs cleaning and another photo to properly assess
AV 205	• Watermains cross, but do not interconnect • Jumpers in place, but laterolet valves appear to be closed. If these jumpers are activated, the flow patterns for both the Airport Loop and Lower Base are affected and the 2 separate loops would be interconnected. • Circulation supposed to be in service for Lower Base, but pumps not operating. • Install cleanout cover		No Ensure the jumpers are not activated

AV 416	• There are 3 visible bleeds here • Possible that with the number of bleeds present might indicate that the building circulation pump is not functioning. We believe this service is for the RCMP building. • Install cleanout cover		Yes There is frozen pipe somewhere here. Start checking to see which lines are frozen Also possibly check circulation pump inside mechanical room is working (RCMP)
AV 417	• Nothing unusual, no exceptions taken		No

AV 418	• Nothing unusual, no exceptions taken		No
AV 419	• Nothing unusual, no exceptions taken		No
AV 420	• Nothing unusual, no exceptions taken		No

AV 421	• Nothing unusual, no exceptions taken		No
AV 422	• Nothing unusual with internals • Cover insulation should be re-secured	 	YES Repair cover

AV 423	• Nothing unusual, no exceptions taken		No
AV 1	• Filled with water (initial investigation, Aug 2018) • Reviewed again in Sept 2018 and Vault has drained itself. • Corrosion around laterolet indicates possible leak	 	YES Investigate laterolet Repair Cover

AV 2	• Nothing unusual		No
AV 3	• Recirculation piping out of service • Bleed on laterolet doesn't have a backflow preventer • Replace clean-out cover • Valve to piping to AV 264 appears to be open. This should be closed • Watermain piping from AV 3 to AV 264 should not be in service now that airport extension has completed another loop connecting AV 5 back to AV 264. If AV 3 to AV 264 is still operational then this creates another short circuit. • Install cleanout cover		YES Clean to get better assessment, send pictures Bleed needs backflow preventer Valve should be closed
AV 4	• Rusting indicates long term high water level • Install cleanout cover		YES Clean to get better assessment, send pictures

AV 4A	• Service connection and return inside vault • Both service pipes valved • Watermain offset up for sewer crossing		No
AV 5	• Rusting indicates long term high water level • Purpose for various hoses unknown • Service connection • Bleed is active, cannot see backflow preventer • Recirculation piping probably inactive • Install cleanout cover		YES Ensure backflow preventer on bleed
ATB-04	• No exceptions noted		No

ATB - 03	• No exceptions noted • Install cleanout cover		No
ATB - 02	• No exceptions noted • Install cleanout cover		No
ATB - 01	• No exceptions noted		No

AV 264	• Piping not unusual • Recirculation piping out of service • Install cleanout cover		No
AV 263	• Piping not unusual • Recirculation piping out of service		No
AV 262	• Piping not unusual • Recirculation piping out of service • Laterolet valve appears to be open?		YES Check laterolet valve configuration

AV 261	• Piping not unusual • Recirculation piping out of service • Install cleanout cover		No
AV 260	• Piping not unusual • Recirculation piping out of service • Install cleanout cover • Corrosion around laterolets indicates possible leaking		YES Investigate corrosion around laterolets
AV 259	• Internal piping in good order • Supply to new airport service building • Service return appears to connect behind hydrant, probably on laterolet • Purpose of second (2”?) pipe uncertain. Requires further review • Recirculation to right in photos out of service, spoke with Kudlik about when they installed this AV and they confirmed recirculation piping was not in use		No

AV 258	• Piping in good order • Nothing unusual • Recirculation to right in photos out of service, spoke with Kudlik and confirmed.		No
AV 257	• Recirculation piping out of service • Un-used connection (4”), spool piece appears to be missing. • Install cleanout cover		No
AV 256	• Dirty, requires cleaning • Service connection • Repair sleeve suggests previous failure of piping for service connection supply • Recirculation appears connected to main • Corrosion of internal painted piping • Install clean-out cover		YES Investigate corrosion around laterolet Proper repair of service connection

AV 255	• Recirculation out of service • Corrosion of painted piping • Large diameter service connection • Return appears to be external to AV • Replace clean-out cover • Corrosion around laterolet and service penetration may indicate possible leaks		YES Investigate laterolets and service connection peneteration
AV 215	• Internal piping not unusual • Recirculation out of service		No

Av 214	• Requires pump out to fully confirm
	• Recirculation piping seems to be used for service connections
	  • Appear to be 2 services
	  • 1 services' re-circulation appears to be connected to its own supply and not the main
	  • Recirculation should be out of service.
			Yes
			
			Cleanout for further investigation
			
			Service return should be connected to main

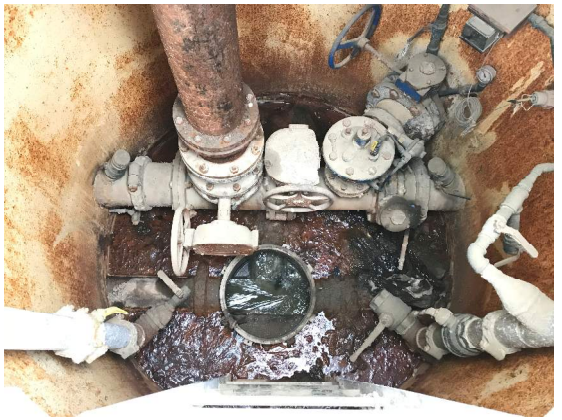
AV 213	• 2 Bleeds present
	• Supply towards AV 271
	• Recirculation appears to be bleed piping into clean-out
	  • Connected to recirculation piping
	  • Recirculation is supposed to be out of service
	• Install cleanout cover
			YES
			
			Investigate if the bleeds can have water (confirm backflow preventer present)
			
			Pending above, look at connecting to main instead of bleeding

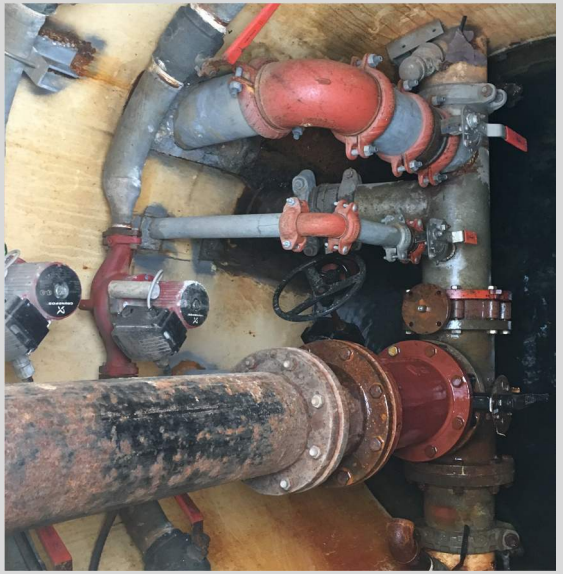
AV 270	• No irregularities • 3” re-circulation line • Large service present, configuration is correct • Install cleanout cover		No
AV 300A	• Large service’s return connected on laterolet • Service supply which crosses the re-circulation line, cannot confirm which pipe the service re-circulation is connected to. Possible short circuit if not installed on water supply main. • Install cleanout cover		No

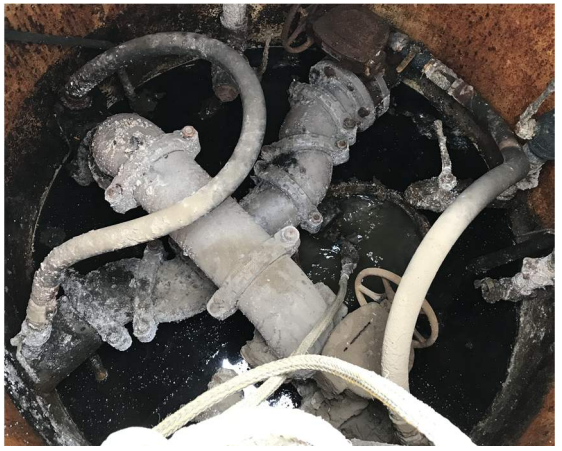
AV 271	• Bleed installed on laterolet • Odd corrosion on spool piece adjacent to bleed • Need to know if re-circulation piping is connected, hard to visualize but does not appear to be (by ladder). • Install cleanout cover • The watermain heads to Government of Nunavut Building, apparently there is a re-circulation pump in the building and that's where the supply turns to the return.		YES Need to know if re-circulation piping is connected. Need access to GN building to find re-circ pump and determine if active or not Probably replace corroded spool piece

AV 212	• Install cleanout cover
	• Recirculation piping should be out of service
	• 2 service connections
	  • Return piping appears to be external to AV for both services
	• Strap-on style outlet for 1 service connection
	  • Higher cross contamination risk
		
		 
			YES
			
			Install proper "T"s for service connections

AV 208	• Requires cleaning, clean-out cover replacement • Has the recirculation piping been used as a bleed? • Recirculation piping returning from AV 210 and 209 ties back into the supply going to AV 207. • Install cleanout cover		No
AV 209	• Re-circulation piping should be in service • Appears to have electrical wiring • Supposed to have re-circulation pumps, appear to be missing • Install cleanout cover		YES Want to confirm that recirculation lines aren't frozen from AV 208 to 210 Once above is confirmed, installation or recirculation pumps
AV 210	• Watermain dead ends here, just passed hydrant • Recirculation piping should be connected to watermain supply to complete a 180 turn, can't confirm due to no visibility. • Install cleanout cover		Yes Clean and confirm recirculation piping is connected

AV 207	• Automatic valve to supply AV 407 under high pressure sensed by low pressure on outlet side • Recirculation main to provide circulation from Lower Base • Very key AV, start of recirc from lower base that goes to Trigram • Appears the valves for recirculation from Lower Base are in closed configuration • Install cleanout cover	 	YES Need photos of recirculation loop to confirm if valves are closed or not If they are then current no reciruclation from Lower Base

AV 206	• Circulation pumps for Lower Base
	  • Reported not in service
	• Hydrant leaking
	• 2 Service connections
	  • 1 connection appears to be good
	  • 1 connections return appears to tie into hydrant barrel
	• Valve before hydrant is missing the spin wheel
	• Fix exterior, damage to structure at surface
	• Install cleanout cover
			YES
			
			Confirm if pumps are functional
			
			Confirm if service return is in the hydrant barrel
			
			Fix damage to exterior

			
AV 205	• Watermains cross, but do not interconnect • Jumpers in place, but valves appear to be closed. Jump on the 2 mains changes flow intents. If jumper is active, then airport loop and lower base loop interconnected. • Recirculation supposed to be in service for Lower Base, but pumps not operating. • Install cleanout cover		No

AV 204	• Large service connection present • Return appears to be outside of AV • Circulation supposed to be in service for Lower Base, but pumps not operating. • Purpose for electrical cable unknown (or is it a 1” service?) • Install cleanout cover		YES Confirm if that is in fact an electrical cable or if it is a service return
AV 203	• Piping that is returning form airport loop splits and goes to Trigram building and to supply Uivaaq Loop • Recirculation supposed to be in service from Lower Base • Install cleanout cover		No

AV 202	• 3” return for circulation of Lower Base • Appears to have 2 service connections		YES Needs cleaning and another photo to properly assess
AV 201	Previously reviewed, see above.		
AV 200	Previously reviewed, see above. Airport Loop now complete. Water has returned to Trigram for heat to be added		

Appendix G – Plateau 2018 Inspection Summary

Sept 6th, 2018

Mr. Erik Marko
Project Manager – Colliers
Suite 700, 150 Isabella Street
Ottawa, Ontario

Project # **OTT-00248529-A0**

Water Distribution Network Issues – Plateau Development

Dear Mr. Marko:

Introduction

The City of Iqaluit (City) has requested that exp assist the City in repairing and rehabilitating their water distribution network. A visual assessment of each AV and MH in the City has been completed and exp is now in the process of analyzing the data and determining the current state of the system. This letter addresses exp's findings of the Plateau Development's current state. The information highlighted in this report is being utilized to provide the City with suggested corrective actions to re-instate the water distribution system back to its intended functionality.

Transmission of Key Plateau Development Findings

The table below (Table 1.1), illustrates the findings of the visual inspection that was completed from the top (at the hatch) of each AV within the Plateau development. The sequence of each AV has been set to follow the flow of water as it leaves the Booster Station No. 2 (BS2) and flows throughout the Plateau network and eventually returns to BS2. General comments are made for each AV within the table. Comments about cleaning and installing the sanitary clean out lid have not been included but, as a general note, the majority of the AV's require cleaning and the re-installation of the lid for the sanitary cleanout. The major issues found within the AV's are summarized in greater detail in the subsequent paragraphs.

AV 602 – *see image in Table 1.1* - The supply watermain (with the fire hydrant) appears to be in good working order with no evident issues other than minor corrosion staining at the laterolet. This could be indicative of a very minor leak at the laterolet. On the recirculation watermain, it appears the current configuration of the middle valve (between the 2 – T's) is not as per intended functionality. When the photo is enhanced (see image in table, very pixilated) it appears this valve is in the open position. As per the intended design, this valve is supposed to be in the closed position. With the valve in the closed position, all the water that is flowing through the re-circulation main is forced to become the supply for Plateau Phase 4.

AV 603 – *see image in Table 1.1* - It appears there has been a service connection made post manufacturing within this AV. The major issue here is that both the supply and return service are not connected to the same main pipe. This now creates a short circuit within the system. A service connection needs to have both the supply and return connected to the same main pipe. The next issue which is enhanced because of the short circuit is that there does not appear to be any valves on this service's supply or return piping. Thus, trying to isolate this service will require a significant level of effort, if there are no valves then the supply and recirculation main will need to be shutoff as the current configuration creates a backfeed of water.

AV 615 – *see image in Table 1.1* – A 2" jumper has been added within this AV. The jumper is connecting the supply to the return pipe which is short circuiting the system. It is assumed that this jumper has been installed due to frozen watermain pipe(s). The jumper was probably put in place to restore service to affected customers.

First Recommendations

Exp is still working on recommendations to rehabilitate the Plateau water distribution network to its intended functionality. A program to aid in determining the location of frozen sections of pipe will need to be established collaboratively with the City, Colliers, and exp. The program will require documenting and gathering information such as; which residences loose service as corrective actions are made. Knowing which areas are affected will help locate frozen pipes that need to be thawed. Exp has a few ideas on how to minimize community disturbances and gather information from residents/residences but input from all parties will be needed prior to the detailed development of this plan.

With the findings noted above, AV 603 has been identified as an initial action required prior to correcting the Plateau's system. The service connection within AV 603 must be fixed before any major efforts are made within the Plateau's distribution network. The service's return and supply piping must be connected to the same watermain to discontinue the short circuit. From the photos taken, it appears there are no valves on the service pipes and thus the watermain (both supply and recirculation) will probably need to be shutdown to complete this repair. With the unknowns of this distribution network there is the risk that the current configuration is working as a jumper and providing service to other residences whom do not have water supply due to frozen pipe(s). Therefore, a plan based on the current state will need to be in place prior to starting this work so that once the service is corrected, if need be, service can be provided to any other users who are unintentionally affected.

We trust the above information meets your requirements. Should you have any additional questions please do not hesitate to contact the undersigned.

Yours truly,

EXP Services Inc.

Simon Plourde
Engineering Designer
Infrastructure Services

Table 1.1

AV #	Notes	Photo	Corrective Action Needed
Booster Station No. 2			
AV 601	• No exceptions noted		No
AV 602	• The Re-circulation main should loop AV 612 • Valve on re-circulation should be closed, which would force circulation to AV 612. • Valve appears to be open and allows water to pass straight through. No effect on upper part of plateau, only effects Phase 4	 	Yes

AV 603	• Service connection connected to Supply • Service return connected to Re-circulation • Short Circuit created by this connection • Both service connections need to be on the same main (either supply or re-circ) • No valves on the service connections		Yes
AV 604	• Potential connection future connection for watermain as one penetration isn't in use • No other exceptions noted		No
AV 605	• No exceptions noted		No
AV 606	• No exceptions noted		No

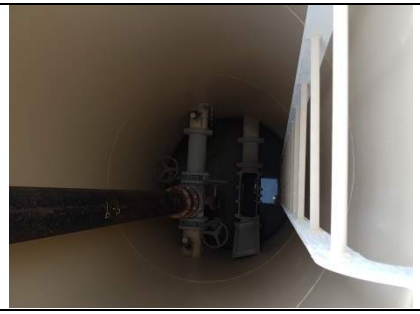
AV 607	• Structure needs to be cleaned • Service supply and re-circulation lines appear to have valves • No other exceptions noted		Cleaning
AV 608	Could not access AV – please provide access		
AV 611	• Service connection supply is on the main water line. • Service connection re-circulation is on the re-circulation main. • Under current conditions this is okay as the system loops within this AV. However, if future growth goes past AV 611, both service connections need to be on the same watermain.		No
AV 608	Already reviewed – See above		
AV 610	• No exceptions noted		No
AV 617	• No exceptions noted		No

AV 616	• Bleed installed on 2” laterolet, • No backflow preventer installed on bleed		No
AV 612	• No exceptions noted		No
AV 613	Could not access AV – please provide access		
AV 614	• No exceptions noted		No

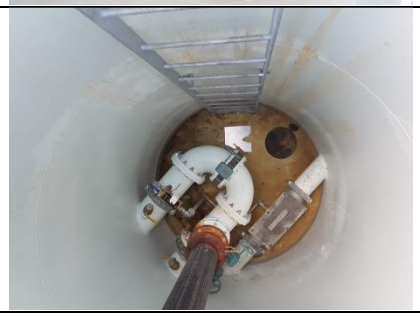
AV 615	• Jumper installed from supply to return • Probably installed to provide service due to frozen pipes		Yes
AV 619	• No exceptions noted		No
AV 620	Could not access AV – please provide access		
AV 621	• No exceptions noted		No
AV 622	• Could not access AV – please provide access		

AV 625	• No exceptions noted		No
AV 626	• No exceptions noted		No
AV 627	• Service connection from same water main • Appears to be valves are installed on service connection • No other exceptions noted		No
AV 628	• Service connections are from the same water main • Appears to be valves are installed on service connection • No other exceptions noted		No

AV 629	• Service connection from same water main • Backflow preventer present on the bleed • Appears to be valves are installed on service connection • No other exceptions noted		No
AV 628	Already reviewed – See above		
AV 627	Already reviewed – See above		
AV 626	Already reviewed – See above		
AV 625	Already reviewed – See above		
AV 624	• No exceptions noted		No
AV 623	• No exceptions noted		No
AV 622	Already reviewed – See above		
AV 621	Already reviewed – See above		
AV 620	Already reviewed – See above		
AV 619	Already reviewed – See above		

AV 615	Already reviewed – See above		
AV 618	• Very dirty, can't review		Yes
AV 617	Already reviewed – See above		
AV 610	Already reviewed – See above		
AV 609	• No exceptions noted		No
AV 606	Already reviewed – See above		
AV 605	Already reviewed – See above		
AV 604	Already reviewed – See above		
AV 603	Already reviewed – See above		
AV 602	Already reviewed – See above		

AV 612A	• Assuming service return is installed on the same water main outside the AV • Corrosion around laterolet indicates possibly small leak • No other exceptions noted		No
AV 613A	• Assuming service return is installed on the same water main outside the AV • Corrosion around laterolet indicates possibly small leak • No other exceptions noted		No
AV 631	• Bleed to sewer installed • Does not appear to have a backflow preventer installed • No other exceptions noted		No
AV 632	• No exceptions noted		No

AV 633	• No exceptions noted		No
AV 634	• Bleed present, there appears to be a backflow preventer		No
AV 633	Already reviewed – See above		
AV 632	Already reviewed – See above		
AV 631	Already reviewed – See above		
AV 613	Already reviewed – See above		
AV 612	Already reviewed – See above		
AV 602	Already reviewed – See above		
AV 601	Already reviewed – See above		
Booster Station No. 2			

Appendix H – Uiivaq Loop 2018 Inspection Summary

January 29, 2019

Mr. Erik Marko
Project Manager – Colliers
Suite 700, 150 Isabella Street
Ottawa, Ontario

Project # **OTT-00248529-A0**

Water Distribution Network Issues – Uivvaq Loop

Dear Mr. Marko:

Introduction

The City of Iqaluit (City) has requested that exp assist the City in repairing and rehabilitating their water distribution network. A visual assessment of each AV and MH in the City has been completed and exp is now in the process of analyzing the data and determining the current state of the system. This letter addresses exp's findings of the Uivvaq Loop network. The information highlighted in this report is being utilized to provide the City with suggested corrective actions to re-instate the water distribution system back to its intended functionality.

Transmission of Key Uivvaq Loop Findings

The table below (Table 1.1), illustrates the findings of the visual inspection that was completed from the top (at the hatch) of each structure within the Uivvaq Loop. The current configuration of this loop has completed phase 4, which was constructed in 2009. Phase 5 & 6 have not yet been completed. The current configuration of Phase 4 has not yet achieved a closed circuit and thus, at each end of loop (AV 445 and AV 10), bleeds are utilized to help prevent the risk of freezing. It is noted that several vaults were constructed for the ultimate design and have penetrations for future piping which are currently not in service. The start of this loop branches off near the end of the federal road/airport loop at AV 205. The ultimate design closes the loop and has the water returning to the Trigram building to have heat added.

General comments are made for each structure within the table 1.1. Corrective action comments about cleaning and installing the sanitary clean out lid have not been included but, as a general note, most of the structures require thorough cleaning/disinfection and the re-installation of the lid for the sanitary cleanout as well as the caps for the laterolets.

AV 451 – *see image in Table 1.1* – Structure is full of clear water, it is probable that there is a leak within the structure. Pump out, investigate and repair as needed.

MH 55 – *see image in Table 1.1* – Leak identified on the existing bleeds valve. Structure requires cleaning and pump out to finalize inspection.

MH 54 – *see image in Table 1.1* – Structure is full of clear water, it is probable that there is a leak within the structure. Pump out, investigate and repair as needed.

First Recommendations

Based on the current condition of the Uivvaq Loop system, minor repairs will be required. As noted above, the loop has not yet been constructed to the final design. Currently no re-circulation is occurring within the loop, water is being bled at each end structure to reduce the risk of freeze. There is a significant amount of work remaining to achieve final design and achieve recirculation within this system to have heat added.

Upon reviewing the images, there are a couple structures that could possibly have leaks but require pumping and further investigation to confirm. There were also a couple structures that had evidence of significant sewage backups. These structures at a higher risk of contaminating the watermain. As a general note, ensuring that all bleeds utilize backflow preventers and that caps are installed on laterolets will help mitigate this risk.

Based on the first review of this network, exp suggests that a meeting be had with the City after they have reviewed this report to discuss the rehabilitation of this loop. Exp wants to ensure the City understands the magnitude of the scope and level of effort required to rehabilitate the Lower Iqaluit Loop back to intended functionality and to also discuss options on how to proceed.

We trust the above information meets your requirements. Should you have any additional questions please do not hesitate to contact the undersigned.

Yours truly,

EXP Services Inc.

Simon Plourde
Engineering Designer
Infrastructure Services

Ian Crawford, CET
Project Manager
Infrastructure Services

Table 1.1 – Uivvaq Loop Structures

Structure	Comment	Photo	Action Required
AV 203	• Supply from Federal road splits, 1 pipe is returning to Trigram building which completes the Federal loop, the other is the supply source for Uivvaq Loop • Recirculation piping is from Lower base, probably frozen • Sanitary cleanout cover not installed		No
AV 450	• Penetrations in place for future connections for final configuration of the water system • Penetrations in place for future connections for final configuration of the water system • Sanitary cleanout cover not installed • Evidence of sewer backups		No

AV 451	• Structure full of clear water, investigate water source • Piping inside structure appears to be smaller then manufactured penetrations. Piping appears to be 6” and penetrations are sized for 8” penetrations • Penetrations in place for future connections for final configuration of the water system • Sanitary cleanout not installed		Yes – pump out and investigate water source
AV 452	• Penetrations in place for future connections for final configuration of the water loop • Sanitary cleanout not installed • No other exceptions noted		No

AV 447	• Penetrations in place for future connections for final configuration of the water loop • Sanitary cleanout not installed • No valve installed in structure • No other exceptions noted		
AV 446	• Return piping is not in service, this is setup for final configuration • Large service installed properly • Sanitary cleanout not installed • No other exceptions noted		No

AV 445	• Penetrations in place for future connections for final configuration of the water loop • Active bleed utilized as final configuration is not complete and no recirculation is occurring • Sanitary cleanout not installed • No other exceptions noted		No
MH 55	• Leak at the valve on the bleed, valve is closed but not holding • Appears to have a flow meter installed • Debris and water in the structure, clean and re-investigate		Yes – repair leak, clean and pump out remaining structure and investigate

MH 54	• Water and debris inside structure, limited visibility • Clean out and re-inspect		Yes – pump out and re-inspect
AV 53	• Evidence of serious sewer backups, sewage on top ladder rung • Downstream sewer issues • Sanitary cleanout cover not installed		No

AV 52	• Watermain crosses over sewer • Large service connection installed • Sanitary cleanout cover not installed		No
AV 11	Lock needs to be cut on structure for access		Yes – gain access and inspect
AV 10	• Bleed utilized in structure as no recirculation is occurring • Records shows that watermain from AV 10 to MH 7 is not in service, however the final completion of this water network plans to flow water from AV 10 to MH 7 • Caps not installed on laterolet • Evidence of serious sewer backups, sewage on top ladder rung • Sanitary cleanout cover not installed		No

Appendix I – Water Demand Strategy

Discussion Paper

Iqaluit Water Demand Strategy

MCINTYRE Solutions

October, 2018

Special thanks to the following for their contribution to the research and analysis contained in this report:

Arctic College	Philip Otukol and Richard Leblanc
Baffin Corrections	Mickey McLeod and Michael Warren
Colliers	Dixon Weir
City of Iqaluit	Susan Avery, Geneva Chislett, Stephanie Clark, Amy Elgersma, Todd Gardner, Matthew Hamp, Jennifer Jarvis and Barry Rogers
Discovery Hotel	Dianne Ploughman
EXP	Ian Crawford and Simon Plourde
Frobisher Inn	Tammy Matchett
Government of Nunavut	Paul Diamond and Tony Rumbolt
Iqaluit Airport	John Hawkins
Iqaluit Housing Assoc.	Erika Alexander and Shawn Wooldridge
Legislative Assembly	Peter Markwell
NCC Properties	Naomi Grandahl and Dale Skidgmore
Neptune Meters	Claude Perreault
Northern Futures	Michelle Armstrong
Northview REIT (aka NCC)	Linay Freda
Nova Builders	Debbie Hannah and Glenna Hansen
Nunastar Properties	Allan Fougere and Mike Powell
Nunavut School Board	Brad McFaul
Nunavut Tunnagarvik	Rick Lefray
Outcrop	Chris Ferris, Jen Hayward, and Ed Picco
Pairijait	Jim Taylor
Public Services & Procurement Canada	Nick Cooper and Rick Laprade
Qikiqtaaluk Properties	Napatchie DeCouto and Jayco Goupil
Qikiqtani General Hospital	TJ Campbell and Rene Gagne

Contents

Photo Source: http://nunatsiaq.com August 26, 2015

Supply versus Demand Management

Water **supply management** addresses the production and distribution of water and aims to reduce losses and waste as water makes its way from Geraldine Lake Reservoir to customers. Supply management is within the control of the City as it owns and operates the water system.

Water **demand management** is concerned with consumption and how households, businesses, and institutions use water. While the City can influence water consumption, once water passes the property line it is the owner, facility operator, and tenants and other end-users that control water use.

The City's Water Demand Strategy will focus on how to promote and support the wise use of water by water customers.

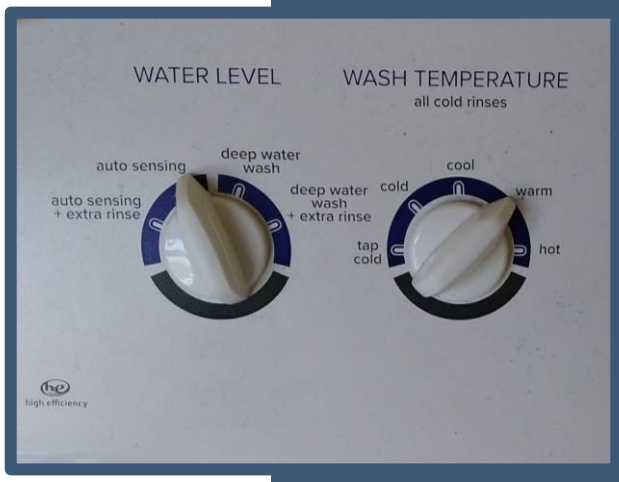
Purpose and Methodology

The City of Iqaluit is developing a Water Demand Strategy to support achievement of its sustainable community objectives. The first step in the process is to analyze how water is used today, and to identify opportunities and challenges to improving water efficiency in the community.

The purpose of this Discussion Paper is to highlight key findings and to begin to identify options for a long-term Water Demand Strategy.

The following activities were carried out to prepare this document:

- Review of background documents and discussions regarding territorial and municipal laws, Iqaluit's water supply and distribution system, current operations, historic consumption, and water metering and pricing.
- Literature review regarding Inuit water traditions, rights, needs, and concerns; and arctic-climate water demand programs.
- Interviews with a selection of high volume users and facility tours:
  - Artic College
  - Baffin Correction Centre
  - City Facilities
  - Discovery Hotel
  - Government of Nunavut
  - Hospital
  - Legislative Assembly
  - Medical Boarding Home
  - NCC Properties
  - NPR Properties
  - Nunastar Properties
  - Public Works & Government Services Canada
  - Qikiqtani Laundry Service
  - Qikiqtaaluk Properties
  - School Board
- Documentation and follow-up with interviewees.
- Identification of common themes, opportunities and barriers.



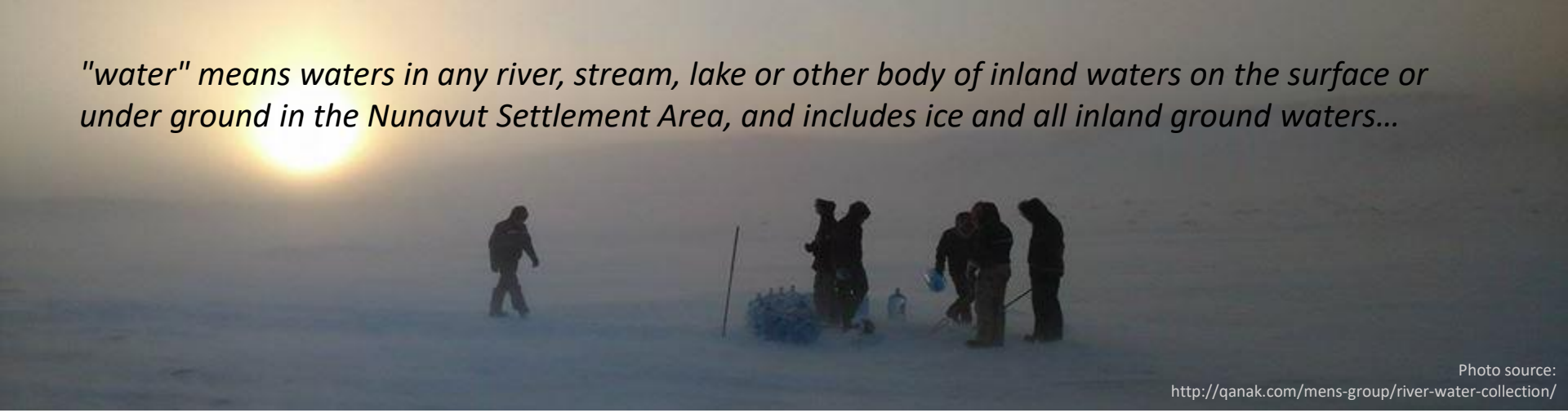


Photo source:
http://qanak.com/mens-group/river-water-collection/

Nunavut Land Claims Agreement

The *Nunavut Agreement* identifies several rights, benefits, and obligations related to water management. These commitments must be respected during development and implementation of a Water Demand Strategy for Iqaluit.

Article 5.7.16 provides all Inuit the right of free and unrestricted access for the purpose of harvesting to all lands, water and marine areas within the Nunavut Settlement Area including all Crown lands, Parks and Conservation Areas, and, to all lands vested in a municipal corporation. (Limited restrictions apply per Article 5.7.17.)

Article 13 established the Nunavut Water Board (NWB) as a jointly-administered governmental organization to regulate the use and management of water. This organization licences the City's drinking water system and controls land development within the watershed.

Article 14 allows the allocation of land and future changes in municipal boundaries to provide municipalities with sufficient land for basic sanitation services including a community water supply.

Article 22.2.6 permits municipalities and a Designated Inuit Organizations (DIO) to enter into fee-for-services agreements to govern the supply of local services to Inuit Owned Lands, including a drinking water supply.

Article 32.2.1 provides Inuit with the opportunity to exercise self-determination in relation to social and cultural policy, programs, and services, including their method of delivery, and a requirement that they reflect Inuit goals and objectives.

Qikiqtani Truth Commission (QTC)

Many Nunavummiut have experienced problems with municipal drinking water as evidenced by testimony contained in the *Final Report: Achieving Saimaqatigiingniq*, 2010 of the Qikiqtani Truth Commission.

> *One of the inducements that brought Inuit into settlements during the 1950s and 1960s was the promise of free or low-rent housing. Many discovered that the number of houses was inadequate, most houses were too small, quality was poor and the costs increased.*
>
> *Another witness, Joshua Alookie, said his parents were promised running water, good housing, good schooling and employment opportunities in Qikiqtarjuaq. Mr. Alookie's parents had to wait almost 20 years after relocating before they had indoor plumbing.*

Maintaining a safe, reliable, and affordable drinking water supply is fundamental to the provision of appropriate housing and protection of public health—two key themes identified by the Commission.

In addressing water efficiency, care must be taken to honour previous commitments and ensure that policies and programs support quality housing and health for all.

Iqaluit Sustainable Community Plan

The *Iqaluit Sustainable Community Plan*, 2014 captures the community's vision for water management and use:

- *Everyone in the community understands where our water comes from and works together to protect it.*
- *Water conservation is part of the way we live and do business.*
- *We monitor growth to ensure that water and wastewater facilities have the capacity to meet the needs of our growing community.*
- *We effectively plan for the upgrades that are required as facilities age and our population grows.*
- *We continually work to improve our piped Utilidor system and the infrastructure that supports it.*
- *For areas on trucked services that are too costly to convert to piped services, we have improved service delivery and flooding is a very rare occurrence.*
- *We also monitor climate change impacts on the quality and quantity of our water supply, and we adapt to these changes.*

The sustainability plan also contains 5-year actions for water demand management:

- *Include stricter residential and commercial water conservation requirements in next General Plan.*
- *Work with residents and businesses to reduce water consumption through behaviour change.*

Development of a Water Demand Strategy provides an opportunity for the City to engage the community in a discussion of the drinking water system, use of water resources, and options for ensuring sustainable consumption over time.

Community Profile

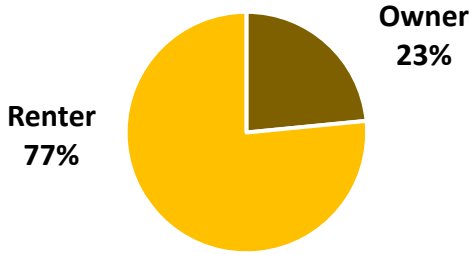
Iqaluit is one of the fastest growing communities in Canada. In 2016, the population was 7,740—a 15.5% increase over 2011. This compares to 12.7% growth in the Territory and a national increase of 5.0% during the same period. Almost 30% of residents surveyed in 2016 had moved to Iqaluit within the previous 5 years. (Statistics Canada, 2016)

The number of dwellings grew to 2,749 by 2016—a 16.1% increase over 2011. Physical growth of the city since 2001 has required expansion of the drinking water system, increased system maintenance and repair, and greater focus on managing water supply and demand.

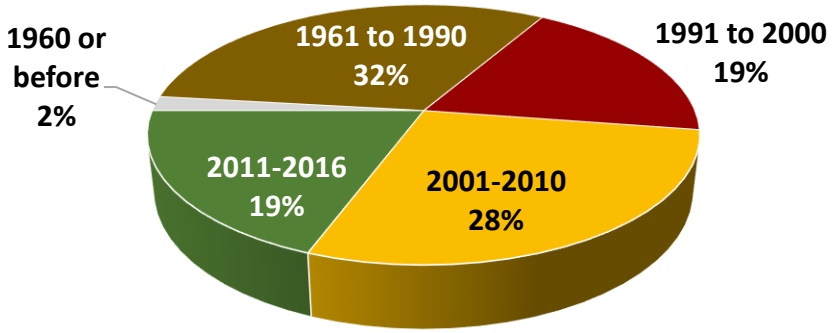
Most Iqalummiuq rent housing, with many organizations leasing units for their employees. Thirty-nine percent (39%) are leased to the federal, territorial, or municipal governments. Twenty-three percent (23%) are leased to Nunavut Housing Corporation to supplement its own housing stock. The remainder is largely leased to businesses and private individuals. Major lessors and their landlords play a significant role in managing water demand in Iqaluit.

Over 60% of all housing was built post 1991. This means there is a high likelihood that over half the dwelling units and other building have water efficient fixtures per plumbing codes introduced in the 1990s. This is supported by observations during several walk-throughs carried out in August 2018 with landlords and facility managers.

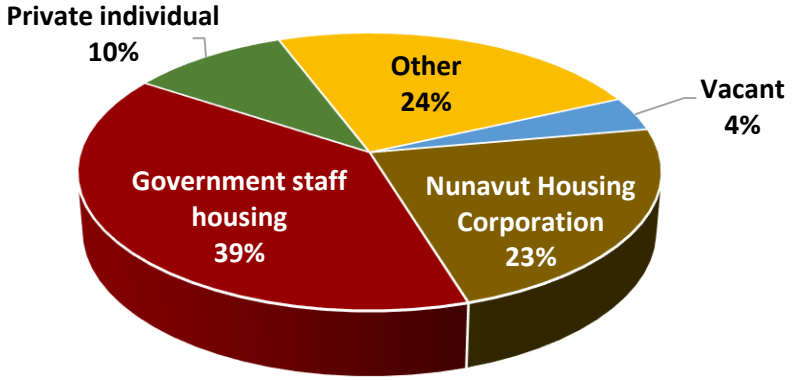
Home Ownership, Iqaluit 2016
(Statistics Canada)



Year of Construction (% dwelling units)
Iqaluit 2016 (Statistics Canada)



Rental Market by Lease Holder, Iqaluit 2017
(CMHC, 2018)



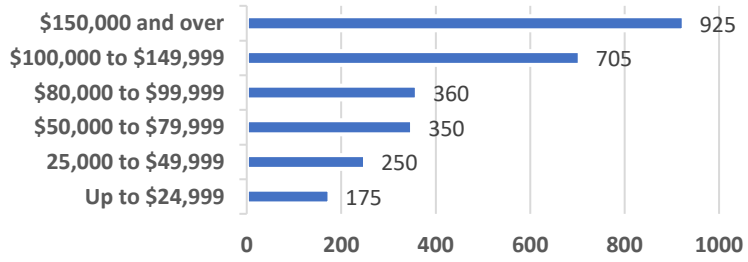
Iqaluit is the capital of Nunavut and centre of business and administration in the territory. In 2016, almost all residents were English-speaking, with 40% having Inuktitut as their mother tongue, and 6% saying French. Roughly 23% said Inuktitut is the primary language spoken at home. Iqaluit is perhaps the only capital city in Canada where government business is conducted in an indigenous language on a regular basis.

While after-tax household incomes in Iqaluit are relatively high, so is the cost of living. In 2017, the average monthly rent for a 2-bedroom apartment was $2,648. And, many items in a typical food basket are double the average price in Canada. This places additional pressure on utilities to ensure that basic services such as drinking water are affordable.

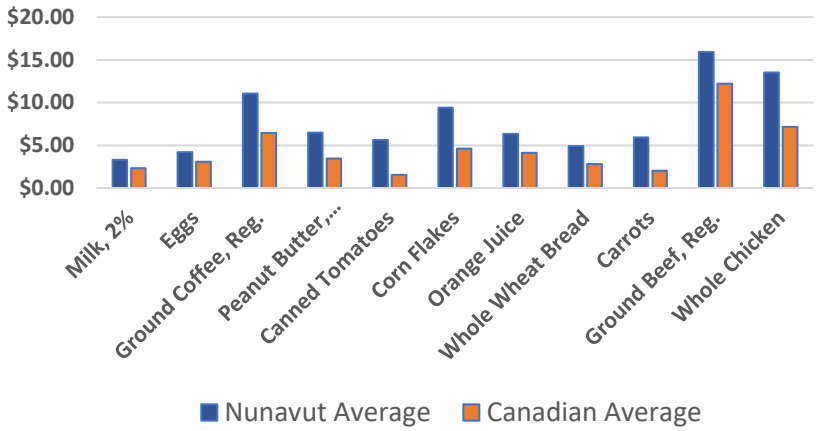
Approximately 15% of households had 5 or more occupants, though the percentage is likely higher due to the number of short and long-term visitors that stay in private residences. Levels of overcrowding in Nunavut are twice the national average according to Canada Housing and Mortgage Corporation (CMHC). Overcrowding and associated social challenges can result in abnormally high water use, particularly in public housing.

After-tax Household Income, 2015

Number of Households (Statistics Canada, 2016)

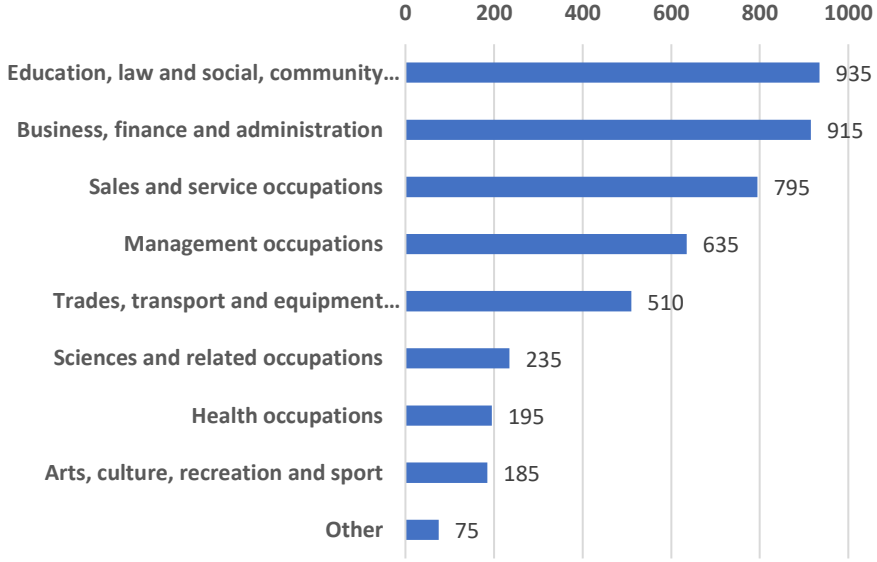


2017 Retail Price Comparison (Government of Nunavut)



Labour Force by Occupation in Iqaluit, 2016

Number employed (Statistics Canada, 2016)



Drinking Water Supply

The City's drinking water is supplied by Lake Geraldine Reservoir, which is fed by the Sylvia Grinnell River Basin and the Apex River Basin. The combined surface area of the two watersheds is approximately 303,950 hectares and can support a population of approximately 8,300. (Trow, 2004)

Reservoir levels rise with spring melt and precipitation, and fall with consumption and evaporation. Water levels range from a maximum of 111.3 m (height of weir) to as low as 107.5 m by the end of winter. The City's 2012 Water License limits withdrawals from the reservoir to 1,100,000 m^3 per year. This limit was exceeded in 2016 and 2017 and contributed to record low reservoir levels. (City, 2018)

In 2018, a temporary license was obtained to pump water from the Niaqunguk River (Apex River) to the reservoir for several weeks to ensure that the volume available at freeze-up would be sufficient for the 2018-2019 winter season. (Nunavut Water Board, 2018) As a back-up measure, the City also approved the purchase of a reverse osmosis filtration system capable of treating sea water for consumption.

Purification and Distribution

The purification plant has a rated Maximum Day capacity of 9,500m^3/day. Assuming gross demand of 400 litres/person/day, the treatment plant can serve a population of approximately 11,300 (Earth Tech, 2002) and the storage facility approximately 10,500 people. Water is conveyed to customers by water trucks and the Utilidor—a 35 km system of buried and exposed insulated pipe, 2 booster stations, and 5 water heating stations.

Customers using hauled water are provided with a daily top-up service, available 8:00 am to 5:00 pm except holidays. Tank top-ups outside those times cost $250.00—a strong incentive to use water wisely.

Customers requiring more than 2,000 litres per day must be connected to the Utilidor, unless approved by council. And, commercial and industrial developments with low water use are discouraged from developing within the Utilidor service area to reserve serviced land for more water intensive land uses.

The City's General Plan encourages intensification of Iqaluit's core and does not support expansion of the Utilidor service area to areas receiving trucked service.

City of Iqaluit General Plan

The *City of Iqaluit General Plan*, 2010 has policies governing Iqaluit's drinking water system, including water efficiency. The following policy excerpts are the most pertinent for development of a water demand strategy:

2.3.2 Ensuring Clean Air, Water, & Land

A clean and adequate water supply will remain a high priority. The City will ensure protection of the Lake Geraldine and Niaqunguk River watersheds for future water supply…

4.2 Watershed Protection Area

No development, including roads or trails, is permitted within the Watershed Protection Area.

5.3.1 General Commercial Policies

All commercial developments with large water use (greater than 2,000 litres per day) shall be serviced by utilidor.

7.3 Water Supply & Treatment

- Until the water supply to the Lake Geraldine reservoir has been increased, the City will not undertake any land development after a population of 8,300.
- The City will approve development applications only when it is satisfied there is sufficient water treatment and treated water storage to service the proposed development.

7.5 Water & Sewer Services: Piped vs. Trucked

- All new residential, commercial and institutional development will be serviced by the Utilidor.
- Development approved by Council shall be limited to single-detached, semi-detached or duplex residential developments, and to small-scale commercial and institutional developments where water use does not exceed 2,000 l/d.
- Council will require water conservation methods, such as the use of low flow water fixtures, to reduce consumption.
- New industrial development may be permitted on trucked services depending on the use(s) being proposed; any use with water demand greater than 2,000 litres per day will require connection to utilidor.

8.7 Lot Development Standards

All buildings shall use water saving devices that meet the following specifications:

- Toilets – water saver or ultra-low flush using 6 litres per flush or less.
- Showerheads – low-flow using 9.8 litres per minute or less at 551 kPa
- Washroom and kitchen faucets - 8.3 litres per minute or less at 413 kPa

Metered Water Use

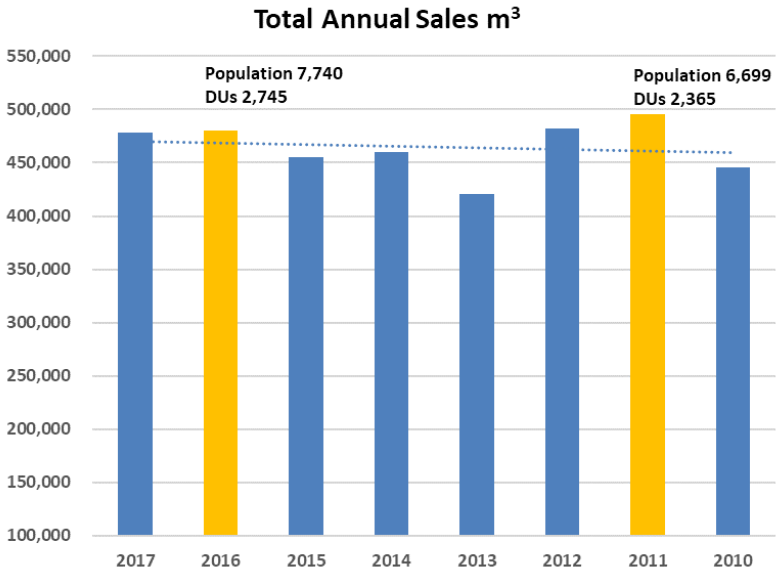
As of October 2018, the City had 1,535 water meter accounts of which 479 received trucked service. (City, 2018)

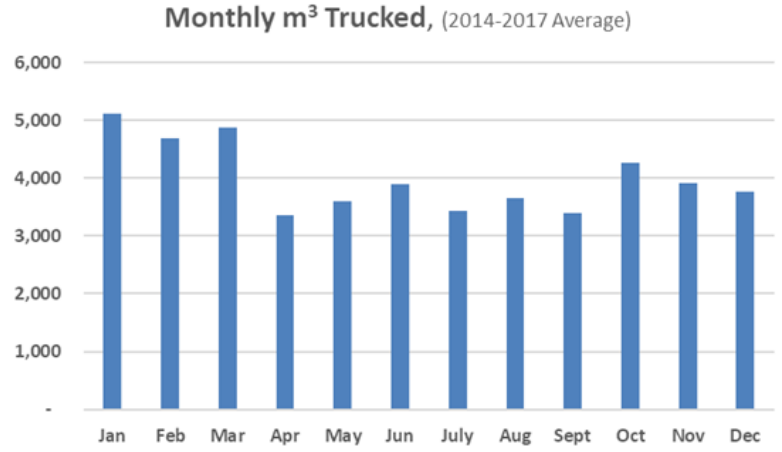
Trends in Sales

Metered water use in Iqaluit has not changed significantly over the past eight years despite a growing population. The graph at right shows a slight upward trend in water use, but not at a rate that matches growth in population and dwelling units.

Seasonal water use patterns are best identified by examining hauled water sales because of daily delivery records. The table at right illustrates that usage is greatest during the winter months, which corresponds to anecdotal information regarding:

- running-water to prevent pipe freezing;
- more laundry and baths associated with winter life; and
- significant number of people go on vacation outside the City during the summer.



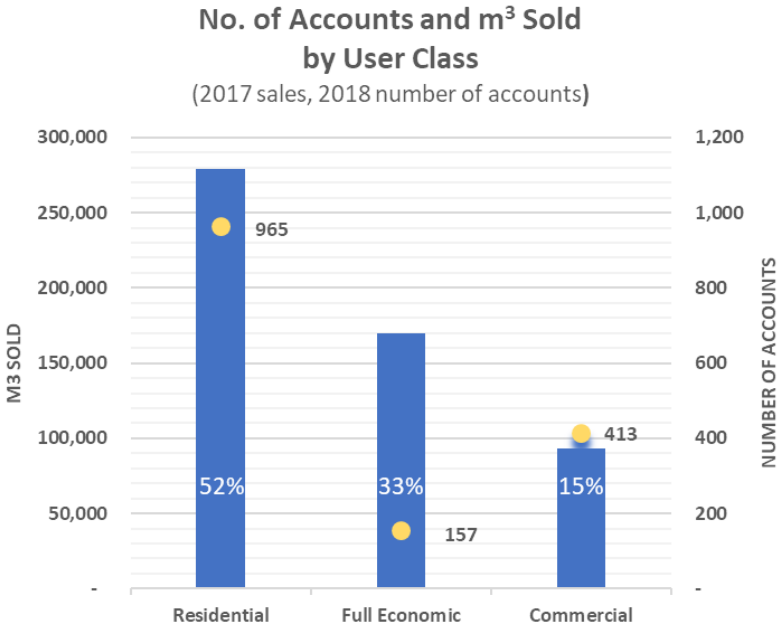


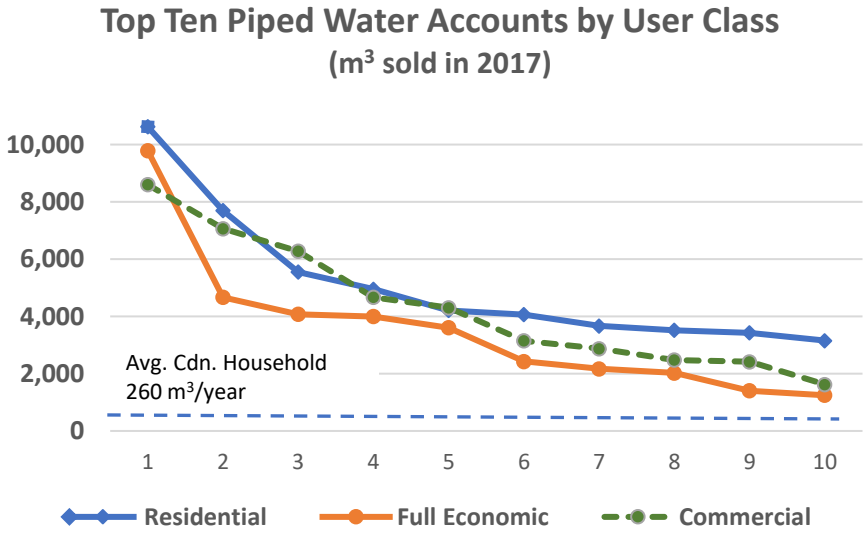
Use by Billing Class & Volume

Most of the City's 1,535 water billing accounts are for residential use, as shown at right. Average residential water use in Canada for a household of three is approximately 260m^3/year. (Environment Canada, 2011)

Large water account holders are referred to as *High Volume Users* (HVUs). Ten apartment buildings and townhouse complexes accounted for approximately 20% of residential water sales in 2017. Combined, the top ten Residential, Commercial and Full Economic accounts (30 buildings) purchased 25% of municipal water sold in 2017. Almost all 30 used more than 2,000 m^3/year. See below illustration.

Six of the top ten Full Economic accounts are residential buildings. Non-residential uses among these top 30 accounts include major public institutions, hotels, and some office buildings.





Several high volume customers were visited in August 2018. Site walk throughs and staff interviews revealed that many of these buildings were built with a high degree of water efficiency, or have undergone water efficiency retrofits. Several have capital or operating accounts used to replace inefficient fixtures and appliances during tenant change-over, building renewal projects, or in accordance with major lease agreements.

Where limited water efficiency action was observed, some property managers indicated that no investments would occur until decisions were made regarding potential demolition and rebuild at the site. And, in a limited number of cases there was a desire to conduct large scale retrofits or appliance change-outs but insufficient funds to do so.

Costs Recovery

The municipality funds water services through a variety of means, but primarily through the water rate. All municipal water customers in Iqaluit have water meters that measure consumption to which a $/litre rate is applied. Water use is metered in the building or on the truck.

Water *rate structures*, the *price* of water, and financial *rebates and incentives* influence how water is used, investments in water efficient fixtures and appliances, and can impact economic development. Care must be taken to use financial tools appropriately as water is an essential resource and the cost of living in Iqaluit is very high.

The 2018 water rate is 2¢/litre ($20.00/$m^3$) with a 1.3¢/litre rebate applied to residential customers for a net charge of $7.00/$m^3$. For comparison purposes, the 2018 summer-time rate charged by the City of Vancouver was $6.30/$m^3$. In both Iqaluit and Vancouver the water rate also pays for wastewater services.

The City receives an annual transfer from the Government of Nunavut, currently just over $1.23 million/year. This amount has not changed significantly in several years. The balance of revenues come from fees for trucked water call-outs, service connections, review of development applications, the sale of water meters, and from interest earned. (City, 2018)

In 2017, the value of rebates issued to Residential account holders was just over $2.9 million—$1.67 million more than it received from the Territory.

The top 10 Residential water accounts in the City are for buildings owned by the private sector. These 10 buildings received rebates valued at just over $660,000 in 2017. (City, 2018) Many of the residential units in those buildings are *leased* to government entities. Residential buildings *owned* by government entities do not qualify for the residential rebate, including Nunavut Housing Corporation.

Regardless of whether a building is leased or owned by the public or private sector, most residential tenants do not pay a water bill as the cost of water is included in monthly rents. (Interviews, August 2018)

Customer Opinion

Most water efficiency measures require the cooperation of residents, business owners, and employees. Understanding user needs, behaviors, and concerns is essential to developing a feasible water demand strategy.

A study of Inuit experience with Iqaluit's municipal water supply found that those interviewed had concerns regarding the following matters (Watson, 2017):

- Taste and smell of chlorine, particularly amongst Elders.
- Discoloured (brown) water, particularly following maintenance of the Utilidor.
- Service interruptions due to infrastructure failure, maintenance activities, or severe weather including frozen water tanks and service lines.

  …we did go through a few blizzards, so three days on one tank. Eight people. It's almost impossible. And if anything I think I do remember we had to gather some snow to melt.
- Depleted water supply when sharing water tanks with multiple people or dwelling units.
- Historic boil water advisories, usually experienced spring and fall due to changing temperatures in Lake Geraldine Reservoir.
- High cost of water, call-out fees to fill a tank, cost to repair or replace a tank and related infrastructure.
- Illness, possibly arising from contaminates entering tanks during water filling or the prolonged use of filters.
- Inconsistent messaging regarding water shut-offs.

Photo source: http://nunatsiaq.com August 10, 2018

Many of these concerns are shared by non-Inuit customers as evidenced by media reports, on-line public forums, and discussions with high volume users. Other matters raised by consumers in recent years include the following:

- Water losses due to poor condition of the distribution system.
- Delays in addressing water losses from visible leaks.
- Leaks from distribution system flooding private property.
- Delays in addressing water shortage.
- Hauling water to high volume customers that use more than 2000 litres/day.
- Use of potable water to fight fires.
- Inequity in levels of service between customers on the Utilidor and those receiving trucked service for the same price per cubic meter.
- Waterless Wednesdays during prior water shortage.

Addressing these concerns is challenging given continued growth, and the impacts of climate change, limited operating and capital costs, and difficulties filling municipal staff vacancies.

Analysis

Gross Demand

Iqaluit is one of the fastest growing communities in Canada, experiencing a 16% increase in population between 2011 and 2016. While raw water withdrawals from Lake Geraldine increased during that time, water sales were relatively stable with an average of 537,926m3/year over that period. This indicates either that:

- Water efficiency practices in recent years are off-setting increases from population growth; or
- Increases in water demand are not being captured and billed.

The impact of past efficiency measures cannot be discounted for the following reasons:

- In 2011, the City implemented a significant rate increase that may have prompted retrofits by major landlords as the cost of water is included in many rental agreements.
- Government of Canada specifications for new builds and leased properties require a high level of water efficiency that is maintained or improved upon over time.
- Approximately 50% of all housing was built since 2001 and likely has water efficient fixtures, e.g. 13 litre flush in the 1990s, 6 litre flush in the 2000s, and with dual flush and auto sensors in the 2010s.
- All commercial, institutional and residential sites visited in August 2018 indicated a medium to high degree of water efficiency.
- In most cases, property managers said that retrofits are being phased-in.

Tenants

Over 70% of residents live in rental accommodation, and most do not pay the water bill. This can lead to inefficient water use and a disregard of leaks. The greater concern expressed by landlords was non-reporting of water problems by tenants, in some cases out of fear of penalty.

For this reason, most landlords interviewed expressed interest in real-time on-line reporting of metered consumption to allow for early identification of broken and leaking infrastructure. Some also expressed interest in submetering to have tenants pay for their water use. All were supportive of the City developing tenant-educational materials for landlord use.

Affordability & the Residential Rebate

While the residential rebate allows the net Residential water rate to be comparable to southern cities, it is unclear whether this “affordability” subsidy trickles down to lessees and renters when provided to commercial landlords. It may be more appropriate to apply the subsidy to government landlords as it is assumed that public sector landlords operate on a cost-recovery basis and are not taking profit.

This is particularly the case for Nunavut Housing Corporation and its agent Iqaluit Housing Association, which could benefit by applying rebated amounts to the implementation of water efficiency measures and improving the supply and condition of affordable housing in the city. (Nunavut Housing Corporation, 2017)

Homeowners and Small Business

While most high volume users interviewed have the budgets required to carry-out water efficient retrofits, the same is not necessarily true for home owners and small businesses that are responsible for paying water bills. The current residential rebate provides affordability relief for homeowners, but does not incent retrofits or water efficiency, and does not address the needs of small businesses.

Many municipalities offer rebate programs to encourage the replacement of inefficient fixtures and appliances. However, most rebate programs occur in communities with much older housing stock, and require administrative support that the City is not resourced to provide. Two alternative approaches are considered more appropriate to the Iqaluit setting:

- Provide people with the tools they need to make informed decisions, and ensure that water efficient goods are available on-hand in the market place.
- Provide site specific subsidies to the few high volume users that lack the budgets required to implement water efficiency measures by using a portion of the Territorial transfer.

Water Service Standard

The service standard gap identified between the City and some of its customers appears to be due, in part, to insufficient resources and business processes to identify and respond to problems in the distribution system in a timely and appropriate manner.

With respect to insufficient resources, it is understood that the Territorial annual transfer was originally intended to be used for system maintenance and renewal. At some point, those funds were allocated towards providing the Residential rebate. (City, 2018) There is a need to reassess how the Territorial transfer is used to ensure that the City is able to provide the service standard expected by rate payers, and recover the moral authority it needs to ask residents and businesses to be more water efficient. Assessment of the value of the annual transfer is also warranted through discussions with the Government of Nunavut.

The credibility gap can also be explained, in part, by cultural differences. Inuit residents who make up roughly 40% of Iqaluit's population have a different lived experience with water, including water-taking from natural sources. Opportunities should be provided to continue this culturally significant practice while at the same time ensuring protection of the watershed and providing education regarding limits in supply and the need for water efficiency.

Metering & Billing

Existing systems used to manage metering data and billing do not provide customers on-line access so that they can monitor use and identify problems in a timely manner. Significant fluctuations in water bills are identified manually at the time of billing, which may be several days or weeks after a problem has occurred.

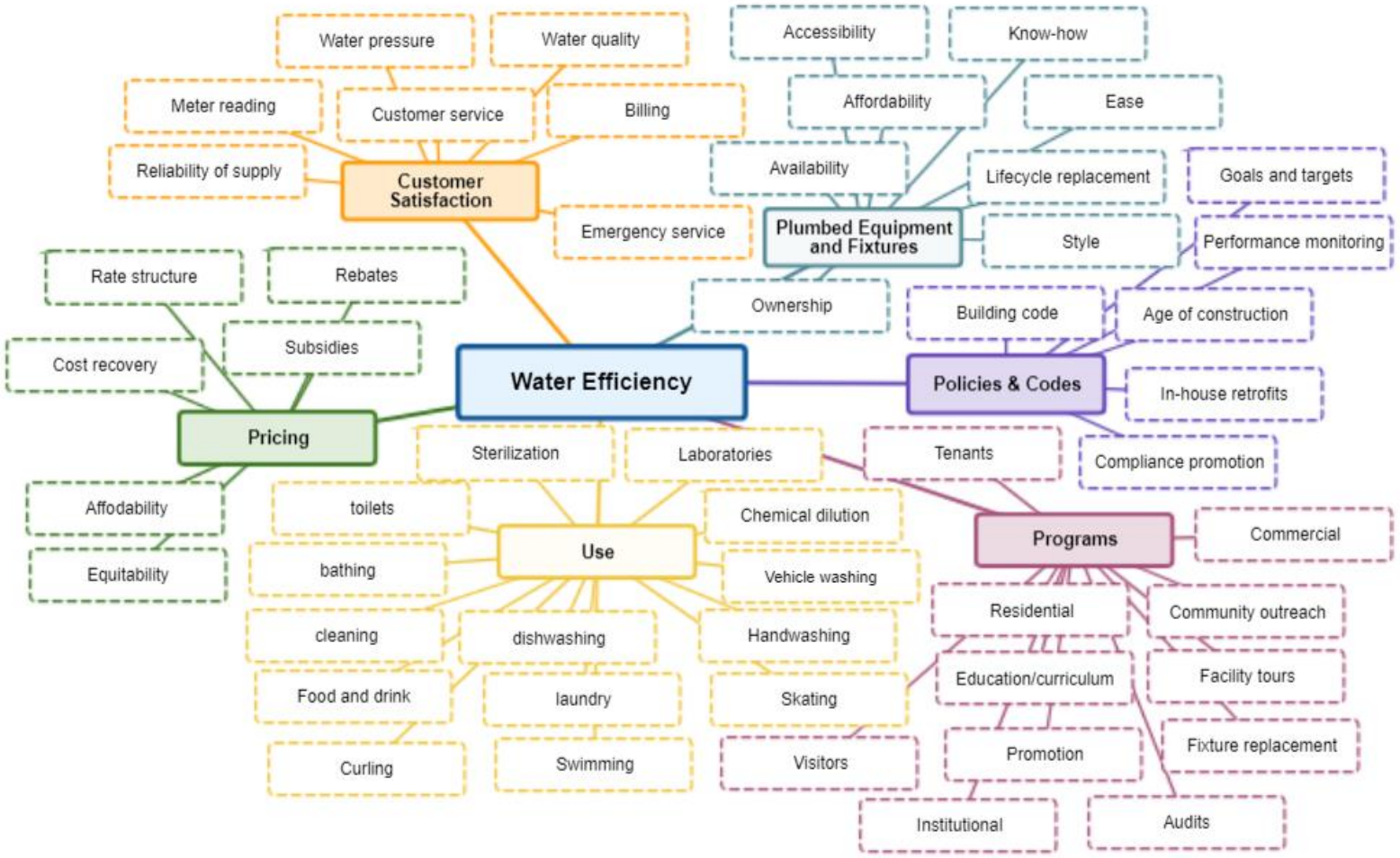
Similarly, data extraction and reporting for city business is time consuming, requiring manual manipulation instead of automatic report generation. Improved reporting functionality and on-line access would ease use and support early identification of leaks on private property.

Opportunities

A water demand strategy can touch on many issues, as illustrated on the following page. This report focuses on matters with the greatest potential for maintaining demand at current levels and mitigating increases over time arising from growth. Accordingly, options in this report are grouped under the following themes:

- Early identification of leaks on private property
- Connecting end-users to the cost of water
- Access to and cost of water efficient appliances
- Attitudes and behaviours

Water efficiency map of issues



Theme 1: Early Identification

Both public and private sector High Volume Users (HVUs) expressed interest in technologies that would allow them to monitor use and identify leaks more frequently than the current monthly bill. Landlords also want to improve tenant reporting of problems, and early identification of misuse. Alternative approaches were identified to improve identification and response to water management problems on private property.

Option	Benefits	Requirements
1. Real-time upload of meter data using a fixed network	• Provides the City with continuous data feed from existing meters served by the Utilidor. • Allows for automated monitoring and reporting of metered use. • Allows for automated email notification of customers of unusual water use. • Allows for identification of illegal bleeds. • Opportunity to combine with electricity supplier.	• Collectors installed at high elevation to pick-up signals from existing meters in Utilidor service area (estimate that four are required.) • Software to translate data feed, monitor use, and provide notifications. • Annual support fee (based upon number collectors and meters served.)
2. On-line customer portal	• Builds on the above and provides customers with the ability to monitor water use on-line. • Opportunity to combine with electricity supplier.	The above, and: • Software that provides secure web portal for customers. • Annual support fee.
3. Monitoring of key equipment or areas	• Allows customers to submeter areas of their operation and monitor online from a computer located within ~300 meters.	• Transmitter installed between meter and register. • Permission from the City to install. • 4-10 mAmp service and 24 Volt DC power supply
4. Pre-formatted communication materials to support the reporting of problems by tenants	• Easily implemented information and tools by landlords and leaseholders. • Consistent look and recognition across the City. • Cost efficient implementation	• Design of templates for fridge magnets, washrooms stickers, common area signs, and key messages for insert into newsletters. • Production and distribution.

Theme 2: User Pay

The Residential Rebate levied on water bills does not encourage water efficiency, and there is no incentive for end-users to be waterwise because lease agreements and monthly rents include water service. Several options were identified to reconnect end users to the cost of service.

Option	Benefits	Requirements
1. Change future lease agreements re: water fixtures, appliances, and payment of water bill.	• Leaseholders incented to engage with their tenants on water efficiency. • Greater transparency of costs and savings associated with water efficiency leasehold improvements.	• Major leaseholders (governments and corporations) agree to pay water charges based upon actual use. • Rents and related terms adjusted. • Payment mechanism (direct or indirect to the City)
2. Submetering and billing of tenants	• End-users are informed of the volume they consume and are charged accordingly.	• Independent supply line to each unit. • Submetering of individual units. • Amendment to Water By-law. • Payment mechanism (direct or indirect to the City)
3. Limit Residential Rebate to the first $24m^3$ consumed per month.	• This assumes 200 litres/capita/day in a four-person household and would encourage efficient use of water by end-users; and water conservation programming by lease-holders and landlords.	• Amendment to Water By-law.
4. Apply Residential Rebate to IHA units and to entire IHA water bill.	• Addresses the higher numbers of occupants typically found in public housing. • Supports improvements to IHA housing stock. • All others customers incented to implement water efficient measures and behaviours.	• Amendment to Water By-law
5. Improve system operations and maintenance.	• Will improve quality of service, customer satisfaction, and system losses. • Will improve customer willingness to “do their bit” when City is seen to be addressing supply-side leaks.	• Document system operations and work instructions • Increase investment in field staff recruitment, training, and retention • Improve business processes to allow for early identification and mitigation of system leaks

Theme 3: Access & Affordability

While high volume users place annual orders for the shipment of water efficient fixtures and appliances, the average homeowner must purchase what is available in local stores when something requires immediate replacement. And, many individuals and organizations lack the capital to carry-out major retrofits.

Option	Benefits	Requirements
1. Ensure that water efficient dishwashers and clothes washers are sold at local stores	• Provides home owners and small businesses with water-efficient choices.	• Basic market research. • Agreement with local stores to stock water efficient appliances. • Appropriate storage.
2. Reallocate portion of Residential Rebate to support purchase of water efficient appliances by individual homeowners.	• Provides homeowners with financial support to make water-wise purchases. • Addresses the challenges of homeowners that have made a commitment to settle in Iqaluit.	The above, and: • Rebate administration/method. • Amendment to Water By-law. • Method for appropriate disposal of old appliances.
3. Reallocate portion of Residential Rebate to IHA for 2 years time to implement retrofit program.	• Accelerated improvements to condition of older housing stock. • Temporary measure would yield sustained savings, reduce operating costs for IHA and allow for allocation of savings to other housing improvements. • All others customers incented to implement water efficient measures and behaviours.	• Agreement with IHA. • Amendment to Water By-law.
4. Minimum water efficient standard for dishwashers and clothes washers supplied by municipal water.	• Stores would stock compliant units only. • Replacement of older units with water efficient units.	• Amendment to Water By-law.
5. On-line water audit tool for use by homeowners and business owners that pay water bill.	• Easily accessible by users and self-directed • Audit tools are available by end-use • Can be coordinated with Item 1	• Obtain and upload existing audit tool(s) • Promotion program • Coordinate with suppliers and plumbers

Theme 4: Attitudes & Behaviours

Water is often wasted without thought. People forget to be waterwise and need regular reminders unless they are receiving hauled service or paying the water bill. Many in Iqaluit are new to the community and are unaware of its water challenges. And, some activities and behaviors considered acceptable elsewhere require adaptation to Iqaluit's situation. However, to change peoples attitudes and behaviours, the City must improve its own credibility on this issue.

Option	Benefits	Requirements
1. Timely response to all visible leaks	• Increased credibility in public eye. • Increased willingness of public to do its part.	• Improved identification and response to leaks in the distribution system.
2. Prohibit Food Waste Disposal units on sinks (e.g. garburators)	• Reduces water use as well as solids entering the city's wastewater system that require treatment and disposal.	• Amendment of Water By-law.
3. Seasonal Public Education Campaign	• Keeps water efficiency in public's mind and addresses transient nature of population.	• Seasonal messaging and campaigns that don't just relate to shortages or breaks.
4. Pre-formatted communication materials to support education of tenants.	• Easily implemented information and tools by landlords and leaseholders. • Consistent look and recognition across the City. • Cost efficient implementation.	• Design of templates for washrooms stickers, common area signs, and key messages for insert into newsletters. • Production and distribution to building owners and managers.
5. Engagement of Inuit Community on traditional water taking	• Increased trust and understanding between the City and Inuit residents on traditional and municipal water supplies.	• Design and implementation of engagement strategy • Consideration of water taking opportunities

Next Steps

The following next steps are recommended:

- City review of this document to ensure that it is accurate, complete, and addresses sensitive issues appropriately.
- Targeted meetings with key stakeholder groups to review options and expand as needed.
- A public engagement strategy to:
    - Review and discuss options
    - Identify potential water efficiency performance measures.
- Discussions with the Government of Nunavut regarding the annual grant.
- Short-list the actions to be carried out this term of Council.
- Hire or retain support to deliver on program delivery.
- Monitor performance and report back to Council.

References

Page	Source
6	Nunavut Land Claims Agreement, as amended 2009. https://qia.ca/wp-content/uploads/2017/02/land_claims_agreement_nunavut.pdf
7	Qikiqtani Truth Commission (QTC), 2010. http://caid.ca/QTCFinRepEN2010.pdf
8	Iqaluit Sustainable Community Plan, 2014. https://www.city.iqaluit.nu.ca/sites/default/files/iqaluit_sustainable_community_plan.pdf
9	Statistic Canada. Census Profile, 2016 Census Iqaluit, Nunavut and Saskatchewan https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E Annual Report on Housing in the North, June 21, 2018. https://www.cmhc-schl.gc.ca
10	Nunavut Food Price Survey, Comparison of Nunavut & Canada CPI Food Price Basket Items, 2017 http://www.stats.gov.nu.ca/en/home.aspx
11	Trow Associates Inc., 2004. City of Iqaluit Raw Water Supply and Storage Review ftp://ftp.nwb-oen.ca Nunavut Water Board. TYPE "A" WATER LICENCE NO. 3AM-IQA1626, 2018 Amendment 1, August 14, 2018 ftp://ftp.nwb-oen.ca/registry
12	Earth Tech Canada Inc., 2002. Municipality of Iqaluit Water Treatment Plan Pre-design Brief ftp://ftp.nwb-oen.ca
13	City of Iqaluit, 2015. Consolidated General Plan. https://www.city.iqaluit.nu.ca
14	City of Iqaluit, Public Works Department, 2018. Statistic Canada. Census Profile, 2016 Census Iqaluit, Nunavut and Saskatchewan https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E
15	Environment Canada, Residential Water Use 2017. https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/residential-water-use.html

References

Page	Source
16	City of Iqaluit, Public Works Department, 2018. City of Iqaluit, Finance Department, 2018. Interviews with several landlords and City staff conducted August 2018.
17	Watson, Victoria. Perceptions of Water among the Inuit Community in Iqaluit, Nunavut, 2018. https://yorkspace.library.yorku.ca Nunatsiaq News, various articles 2009-2018. http://nunatsiaq.com/ Iqaluit Public Service Announcements, various posts 2018.https://www.facebook.com/groups/iqaluitpublicservice/
18	Nunavut Housing Corporation, Annual Report 2016-2017. https://s3.amazonaws.com/nhcweb/publications/annualreport_2016-17_0.pdf
19	2001-2002 Apex Pilot. http://www3.sympatico.ca/rolf/apex.html