WWW Linear Infrastructure Performance Review 2024

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Report Summary

This report provides information regarding the performance of the City's Water and Wastewater Linear Infrastructure for 2023.

Relationship to the Strategic Plan, Health Impact Assessment and Climate Action Plans

This report relates to the Asset Management and Service Excellence pillar within the Strategic Plan and has no direct connection to the Community Energy & Emissions Plan.

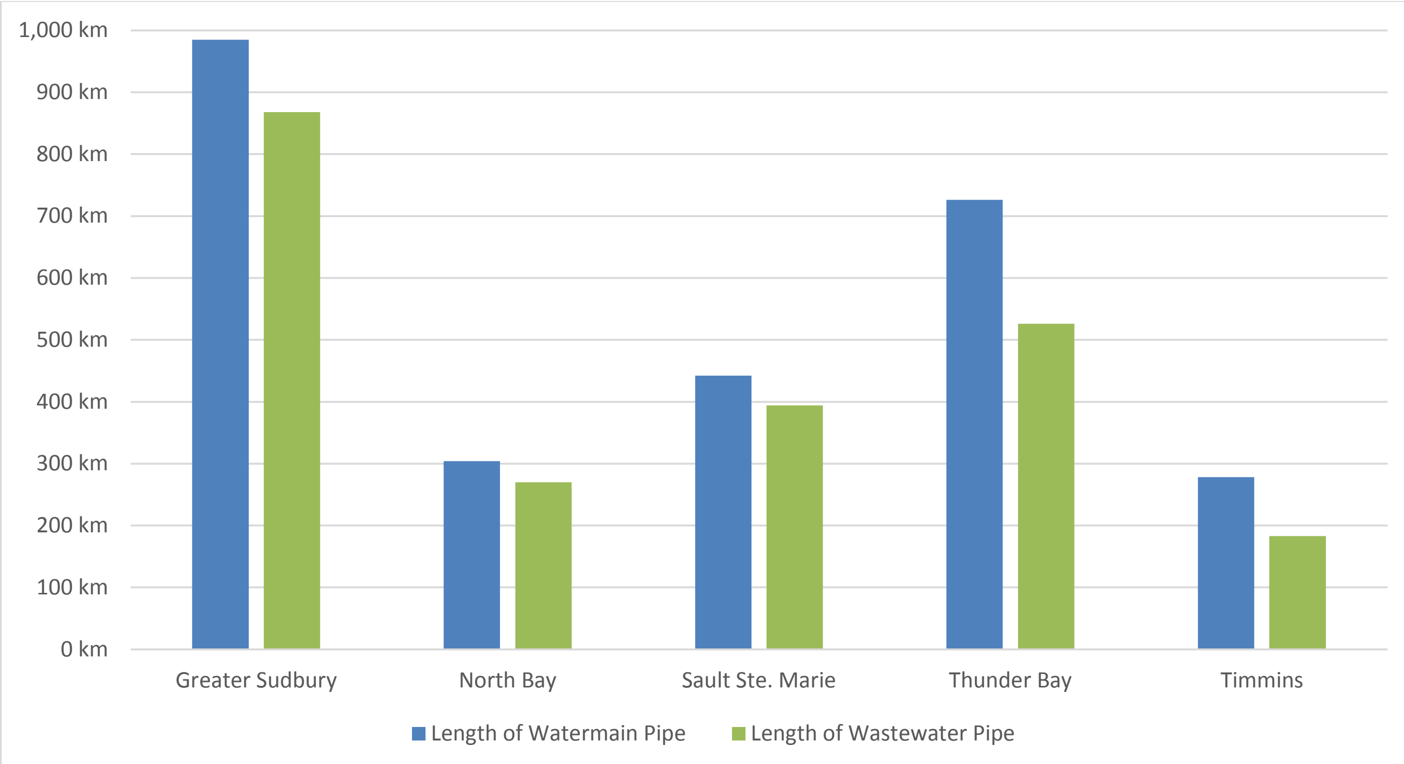
Financial Implications

There are no financial implications associated with this report.

Background

The City of Greater Sudbury provides drinking water and wastewater collection services to approximately 48,000 residential, industrial, commercial, and institutional properties throughout the City. Those services are delivered through water and wastewater (WWW) linear infrastructure composed of approximately 1,000 km of watermain, 800 km of gravity wastewater collection main and 70 km of wastewater force main. Figure 1 provides a comparison of the City's linear pipe network inventory to those of other Northern Ontario communities.

Figure 1 – Northern Ontario Municipal WWW Linear System Inventory



The Distribution and Collection (D&C) Section of Linear Infrastructure Services operates and maintains this infrastructure, including response to 311 inquiries and emergency repairs 24/7, 365 days a year, with support from the Infrastructure Capital Planning division which includes the WWW Condition Assessment and Analytics Section which was made permanent during the 2023 Budget.

Water and Wastewater Pipe Materials

The City's water and wastewater pipe networks were developed incrementally over time as communities were established and grew. Construction materials changed and evolved during that time leaving us with networks comprised of various pipe material types. Pipe materials include metallic (cast iron, ductile iron), non-metallic (polyvinyl chloride, high density polyethylene, asbestos cement, vitrified clay, concrete), and composite (prestressed concrete cylinder pipe). The expected service life of each pipe material can vary depending on manufacturing process and operating conditions (e.g. soil/groundwater properties, subjected pressures/forces) but generally accepted values are provided in Table 1 below.

Table 1 – Water and Wastewater Pipe Expected Service Life (in years)

Pipe Material	Water Pipe	Sewer Pipe
Asbestos Cement (AC)	55	55
Cast Iron (CI)	60	60
Concrete (non-reinforced)	N/A	90
Prestressed Concrete Cylinder Pipe (PCCP)	95	N/A
Ductile iron	60	N/A
High Density Polyethylene (HDPE)	80	80
Poly Vinyl Chloride (PVC)	100	100
Vitrified Clay (VC)	N/A	55

With recent, widely publicized trunk watermain failures in Calgary and Montreal, particular attention is being focused around Prestressed Concrete Cylinder Pipe (PCCP) watermains. There is approximately 56 km of larger diameter (400mm to 900mm) PCCP watermains currently within the City's drinking water network. While service life of PCCP watermain can be beyond 100 years, premature failures, such as those experienced in Calgary and Montreal can occur. Common modes of failure of PCCP include leaks at joints and blowout failures where the barrel of the pipe ruptures. While both failure modes can be costly to repair and result in isolation of key water supply lines, blowout failures can result in immediate and catastrophic release of water from the system. In most cases failure of PCCP is a result of corrosion of the internal steel reinforcement and joints.

The City has experienced a limited number of PCCP breaks primarily resulting from joint/connection failures. Observed failures were generally in areas of shallower pipe installations, which were more heavily trafficked and as a result, prone to higher frost penetration. Pipe movement brought on by frost and ground movement, coupled with the low tolerance of PCCP joints to deflect and rotate is expected to have led to the accelerated deterioration of the joint and ultimate failures.

The City's approach to managing these critical large diameter watermains and associated risks involves four primary strategies which include:

1) Continued monitoring and control of system pressures and pump outputs to ensure undue stress is not applied to the system.
2) Detailed pipe condition assessment studies.
3) Targeted asset renewal/replacement of pipelines identified as a risk due to condition assessments and/or documented failures.
4) Building redundancy in the system by identifying critical, single-feed mains and implementing plans to provide parallel or secondary systems to increase available flow and reduce reliance on a single pipeline.

A prime example of these strategies in practise would be the management of the 13 km of 750 mm diameter PCCP trunk watermain running from the Wanapitei Water Treatment Plant (WTP) to the Sudbury Drinking Water System. To date:

1) Work has been completed at the WTP to better manage and regulate output pressures.
2) A detailed condition assessment of the pipe is underway by AECOM Canada Ltd.
3) Capital works to replace approximately 140 metres of trunk watermain in an area that has experienced multiple joint failures is in progress and will be completed this fall.
4) An Environmental Assessment and preliminary design for future 'twinning' of this watermain to improve redundancy as well as position the drinking water network to better support the City's long-term population and employment growth objectives is underway.

Annual Performance Review

This report is intended to provide an annual performance review of the WWW linear infrastructure systems. This review will utilize performance measurements with benchmark comparisons to municipal peers taken from the Municipal Benchmarking Network Canada (MBNCan) annual performance reporting initiative. Membership in MBNCan provides the City access to shared expertise and data from contributing municipalities from across the country. Where practical, data from multiple years and municipalities may be used to identify trends.

The overall performance of WWW linear infrastructure systems is influenced by factors such as:

- Age of infrastructure
- Historical design/construction methods of existing systems
- Changing climate conditions (e.g. seasonal temperature variations and severe storm events)
- Capital replacement/rehabilitation programs
- Proactive maintenance initiatives

Wastewater Collection System Performance Review

The City of Greater Sudbury owns and operates 13 independent wastewater collection systems, including 69 lift stations, that service the various communities throughout the City. Those independent systems include:

- Onaping - Levack Wastewater System
- Dowling Wastewater System
- Chelmsford Wastewater System
- Valley Wastewater System
- Azilda Wastewater System
- Copper Cliff Wastewater System
- Lively/Walden Wastewater System
- Sudbury Wastewater System
- Coniston Wastewater System
- Wahnapitae Wastewater System
- Garson Wastewater System
- Falconbridge Wastewater System
- Capreol Wastewater System

The three MBNCan Performance Measurements that will be discussed within this review for wastewater collection systems are:

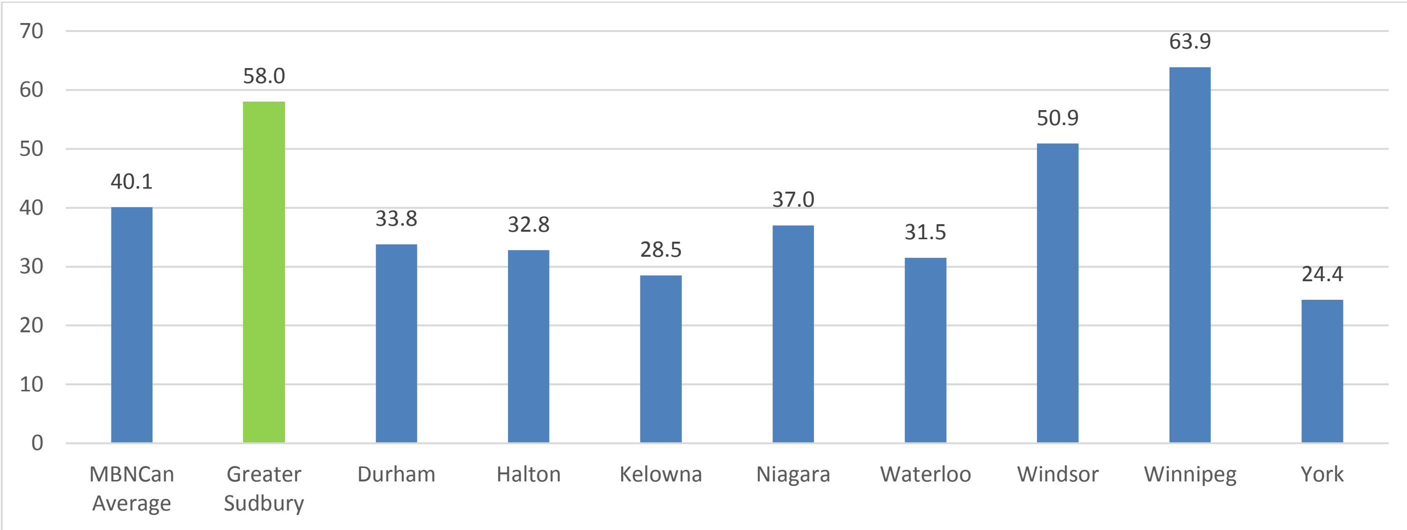
- Average Age of Wastewater Pipe
- Annual Number of Wastewater Main Back-ups per 100 km of Pipe
- Total Cost of Wastewater Collection/Conveyance per km of Pipe

Average Age of Wastewater Pipe

Older wastewater pipes are more susceptible to degradation and can contain cracks, leaking/separated joints and broken/failing pipe sections which can permit the intrusion of debris and roots into the system resulting in blockages and back-ups. Additionally, these deficiencies can also permit the inflow of groundwater into the system potentially increasing flows beyond the pipes capacity, again resulting in a main back-up.

Figure 2 below shows the estimated average age of the City’s collection system with comparisons to municipal peers from the latest MBNCan reporting year of 2023. With an average pipe age of 58 years, the City’s system is among the oldest of the reporting municipalities and approximately 18 years older than the MBNCan average age of 40.1 years. What is not currently represented in this measurement is the inventory of existing wastewater pipes which have been rehabilitated through structural pipe lining. For over 10 years the City has operated a program utilizing trenchless pipe rehabilitation (i.e. structural lining) to extend the service life of aging pipes and reduce the risk of underground failures.

Figure 2 – Average Age of Wastewater Pipes in Years

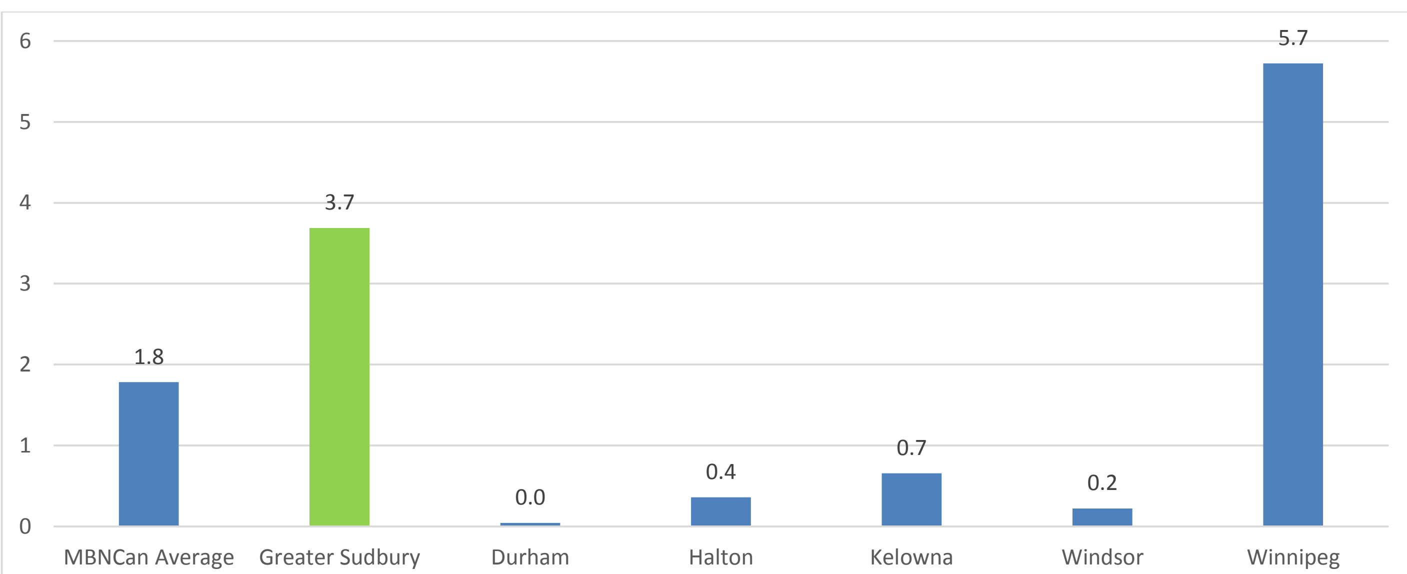


Annual Number of Wastewater Main Back-ups per 100km of Pipe

In addition to pipe age and overall condition, the total number of wastewater system back-ups is also heavily influenced by seasonal variations in precipitation and runoff. Infiltration and inflow of surface runoff and groundwater into the wastewater system during severe storm events or during times of rapid snow melt can contribute to overloading the system leading to wastewater back-ups.

Figure 3 below shows the annual number of wastewater sewer main back-ups per 100 km of pipe in 2023 with comparison to municipal peers (Note: Regional municipalities of Niagara, Waterloo and York do not report on this measure as they do not provide local wastewater collection which is the responsibility of the local municipalities within their boundaries). While back-up rates within Greater Sudbury are higher than the MBNCan average (i.e. 3.7 vs. 1.8 back-ups per 100km of pipe), City initiatives aimed at reducing inflow and infiltration as well as an extensive wastewater pipe flushing program have resulted in a general decreasing trend in recent years.

Figure 3 – Annual Number of Wastewater Sewer Main Back-ups per 100 km of Pipe

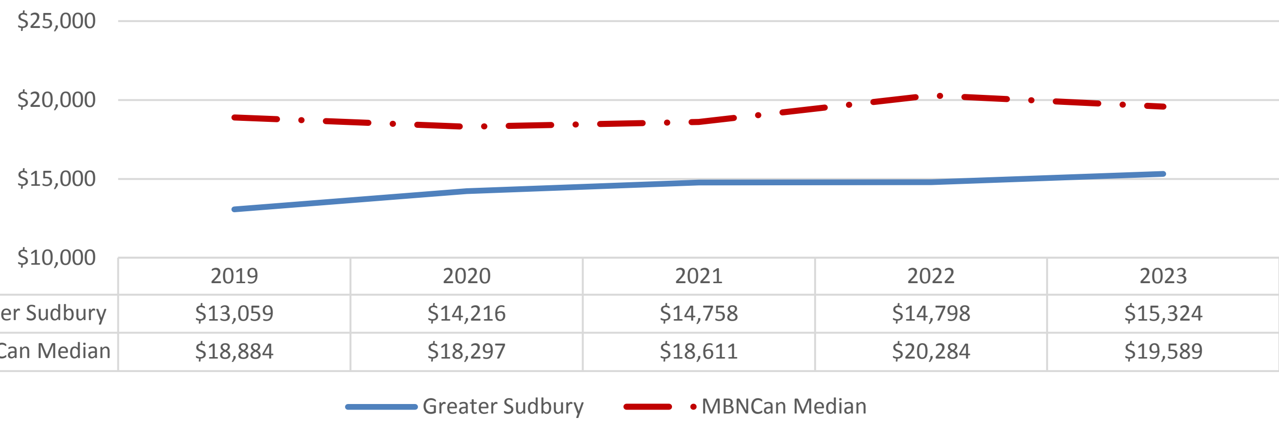


Annual Costs of Wastewater Collection/Conveyance

The MBNCan Performance Measurement for the Total Cost of Wastewater Collection/Conveyance reflects the costs associated with the operation and maintenance of the City's wastewater collection system. Included in these costs is the amortization of the assets which can vary significantly from year to year depending on the type of infrastructure and capital fund expenditures.

Municipalities like Greater Sudbury which provide services over broad geographic areas generally have higher operating costs due to the number of wastewater facilities and pumping stations required. Despite these challenges, the City's operating costs remain below the MBNCan median rate as illustrated by Figure 4.

Figure 4 – Total Cost for Wastewater Collection/Conveyance per km of Pipe



	2019	2020	2021	2022	2023
Greater Sudbury	$13,059	$14,216	$14,758	$14,798	$15,324
MBNCan Median	$18,884	$18,297	$18,611	$20,284	$19,589

Water Distribution System Performance Review

The City of Greater Sudbury owns and operates six distinct municipal drinking water supply systems, including 12 booster stations, spread over a large geographic area servicing the communities throughout the City. The City's Distribution network is made up of the following systems:

- Valley Drinking Water System
- Onaping-Levack Drinking Water System
- Dowling Drinking Water System
- Vermillion Distribution System
- Sudbury Drinking Water System
- Falconbridge Drinking Water System

The three MBNCan Performance Measurements that will be reported on within this review for the drinking water distribution systems are:

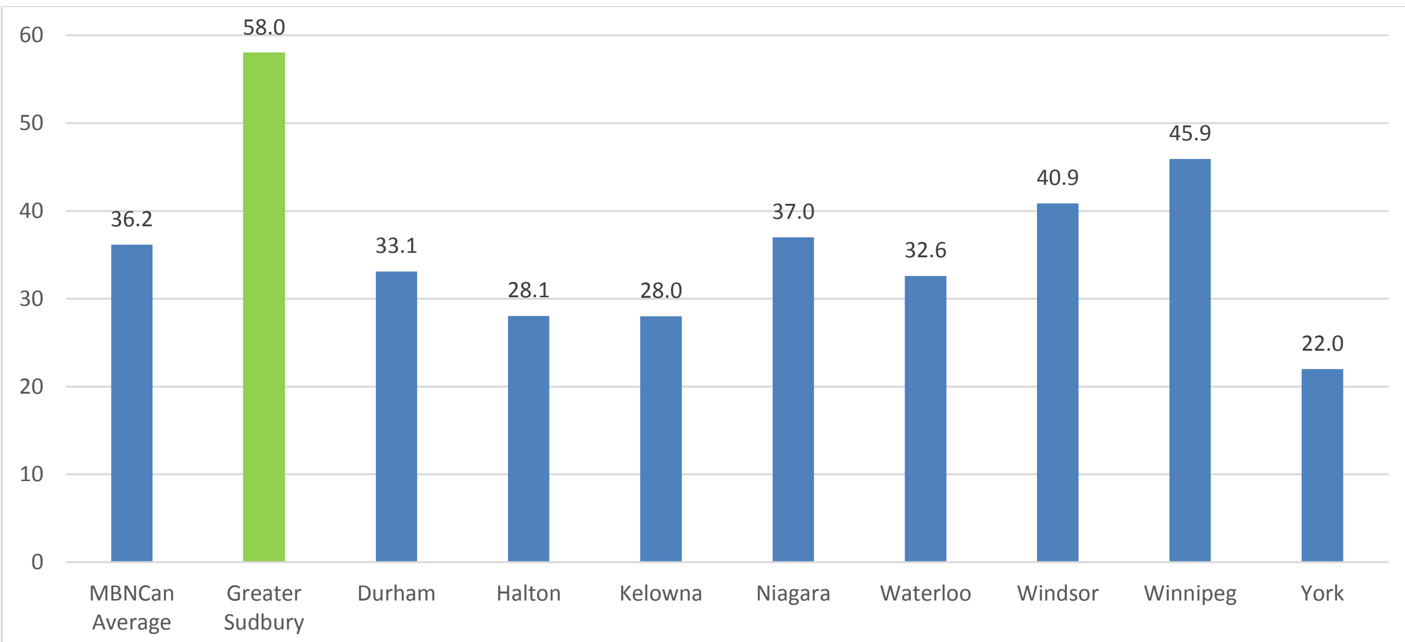
- Average Age of Watermain Pipe
- Annual Number of Watermain Breaks per 100 km of Pipe
- Total Cost for the Distribution/Transmission of Drinking Water per km of Pipe

Average Age of Watermain Pipe

Older watermain pipes, typically those constructed of metallic materials (i.e. cast iron or ductile iron), are susceptible to corrosion, fractures and leakage at pipe joints and service connections which contribute to an increased frequency of watermain breaks relative to newer systems that do not have such deficiencies.

Figure 5 below provides the estimated average age of the City's distribution system with comparisons to MBNCan peers. With an average watermain pipe age of 58 years, the City's system is the oldest of the current reporting municipalities and approximately 22 years older than the MBNCan average of 36.2 years. Similar to the City's lining program for wastewater pipe, the City oversees trenchless pipe rehabilitation (i.e. structural lining) of existing watermains which has been shown to extend the service life and significantly reduce the break frequency of the rehabilitated pipes however, this is not necessarily represented in this performance measure.

Figure 5 – Average Age of Water Main Pipe in Years

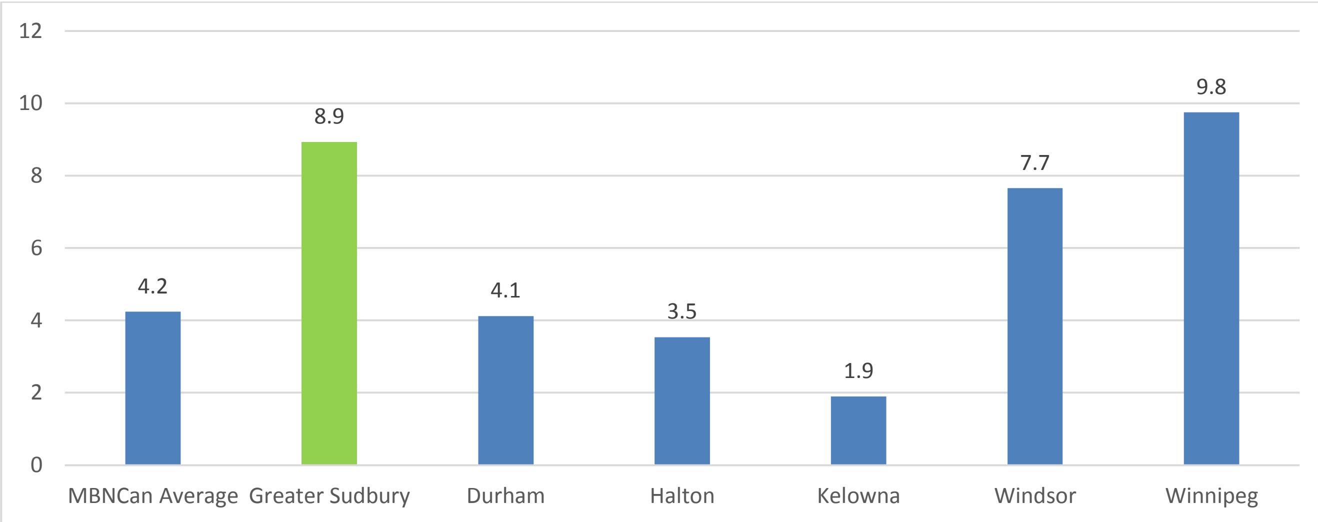


Distribution System Watermain Breaks

Aside from age and general pipe condition, the number of watermain breaks within a particular year is often more significantly impacted by environmental aspects like temperature fluctuations and soil moisture (i.e. groundwater) conditions. Winters with sustained cold temperatures, or those that experience frequent freeze-thaw cycles will result in an increase in the number of watermain breaks within. Colder temperatures lead to deeper frost penetration which in turn produces more soil movement around the pipes. This movement produces additional stresses/strains on the pipe walls which, when coupled with the potentially weakened state due to pipe age, can result in more frequent leaks and breaks.

Figure 6 identifies the annual number of watermain breaks per 100 km of watermain pipe in 2023 with comparison to MBNCan peers (Note: Regional municipalities of Niagara, Waterloo and York do not report on this measure as they do not provide local water distribution which is the responsibility of the local municipalities within their boundaries). The City's watermain break rate per 100 km of pipe lies above the MBNCan average (i.e. 8.9 vs. 4.2 breaks per 100km of pipe) which is likely attributed to the pipe network age and the severity of winter freeze-thaw cycles we experience when compared to our MBNCan peers.

Figure 6 – Annual Number of Watermain Breaks per 100 km of Pipe

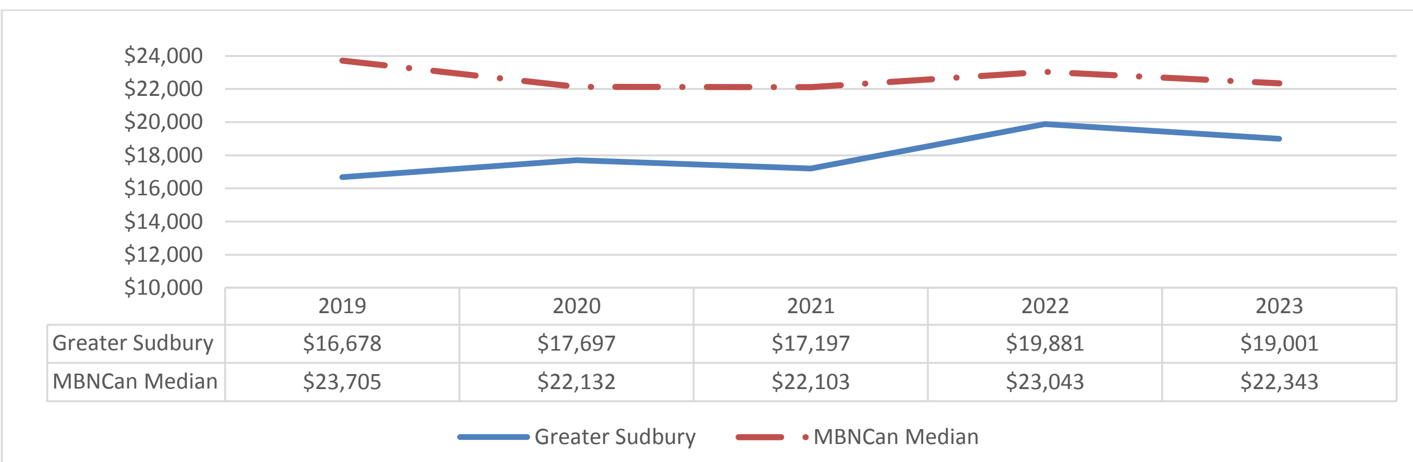


Annual Costs for the Distribution/Transmission of Drinking Water

The MBNCan performance measure for the Total Cost for the Distribution/Transmission of Drinking water reflects the costs associated with the operation and maintenance of the City's distribution system and includes amortization of the assets which can vary significantly from year to year depending on the type of infrastructure and capital fund expenditures.

Similar to wastewater collection systems, municipalities like Greater Sudbury which provide water services over broad geographic areas generally have higher operating costs due to the number of facilities and pressure boosting stations required. Again, the City's total costs per km of pipe remain below the MBNCan median rate of its peers as illustrated by Figure 7.

Figure 7 – Total Cost for Distribution of Drinking Water per km of Watermain



	2019	2020	2021	2022	2023
Greater Sudbury	$16,678	$17,697	$17,197	$19,881	$19,001
MBNCan Median	$23,705	$22,132	$22,103	$23,043	$22,343

WWW Infrastructure Replacement, Rehabilitation and Maintenance Programs

2023 saw continued efforts towards replacement, rehabilitation, and maintenance of the City's WWW linear infrastructure. Capital construction projects involving water and sewer main replacement were undertaken throughout the City including, but not limited to Bancroft Drive, Sparks Street, Struthers Street, Armstrong Street, Loach's Road, Larch Street and Anderson Drive.

In addition to asset replacement works, rehabilitation of the City's pipe network was completed through the structural lining of approximately 1.12 km of watermain and 3.95 km of wastewater main. These methods of trenchless pipe rehabilitation reduce the risk of underground failures and extend the life of aging infrastructure by approximately 60-80 years while minimizing cost and impact to traffic during construction.

Ongoing preventative maintenance programs for the City's WWW linear infrastructure include annual watermain leak detection, water system valve and air release inspections and preventative wastewater pipe flushing and condition assessments.

Summary

The City of Greater Sudbury's wastewater collection system generally experiences above average number of wastewater back-ups and watermain breaks when compared to our MBNCan peers. These results are not unexpected when considering the age our pipe network and climatic and geographic challenges we face. Continued commitment to current and expanded replacement, rehabilitation and maintenance programs will be required to maintain current operating conditions. This is particularly valid when considering the changing weather and climate conditions which are expected in the future.

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