Leak Reduction Initiatives

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Report Summary

This report provides an update on some of the activities that are complete or underway from the Water and Wastewater Task Force in the subject area of leak reduction.

Relationship to the Strategic Plan, Health Impact Assessment and Community Energy & Emissions Plan (CEEP)

This report supports the objectives “Asset Management and Service Excellence”, “Climate Change”, and “Create a Healthier Community” as laid out in the City of Greater Sudbury’s Strategic Plan for 2019-2027. More specifically, these initiatives demonstrate innovation and cost-effective service delivery, and support ecological sustainability.

Financial Implications

There are no Financial Implications associated with this report.

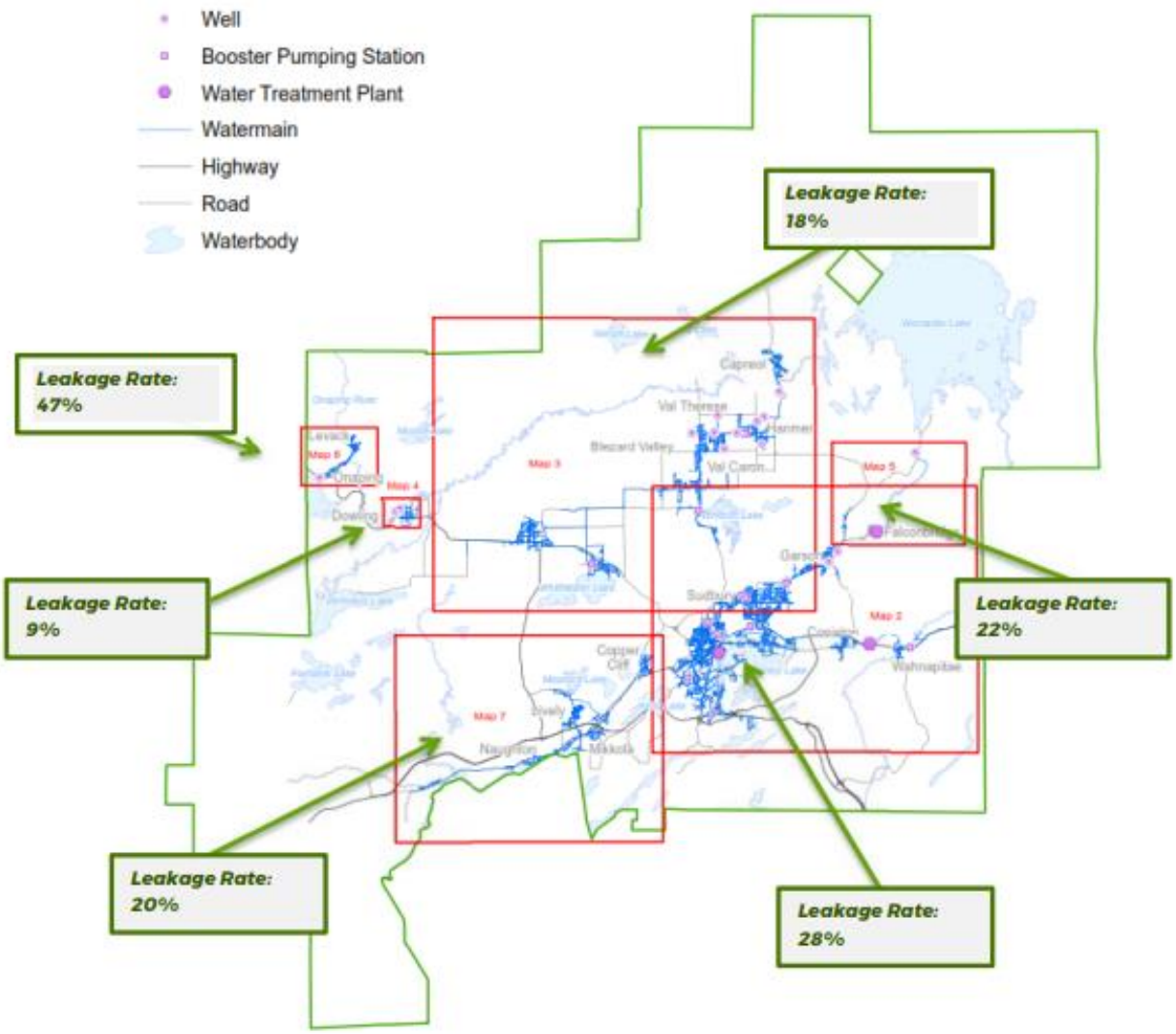
Background

The Water and Wastewater Task Force was created as a temporary 5-year project to implement some of the recommendations arising from the Water and Wastewater Master Plan and Asset Management Plans. Due to the pandemic, there were some delays in the start-up of the project. The 5-year term of the project was officially underway in 2021. This report serves as an update on some of the innovative projects in the areas of leak reduction the Task Force has undertaken.

Leaking water distribution systems are a global problem, which, with decreasing available water and climate change, continues to gain attention and new tools continue to be available on the market to address the issue. Water loss reduction is a cost-effective water management tool. There are many reasons why a water distribution system may experience leaks. Leaks may be a result of aging infrastructure, corrosion, water hammer/pressure surges, frost, ground and soil movement, poor design or inspection, inadequate construction practices, defective or improper valves, fittings, or joints, vibration from road traffic or road rehabilitation, or earthquakes.

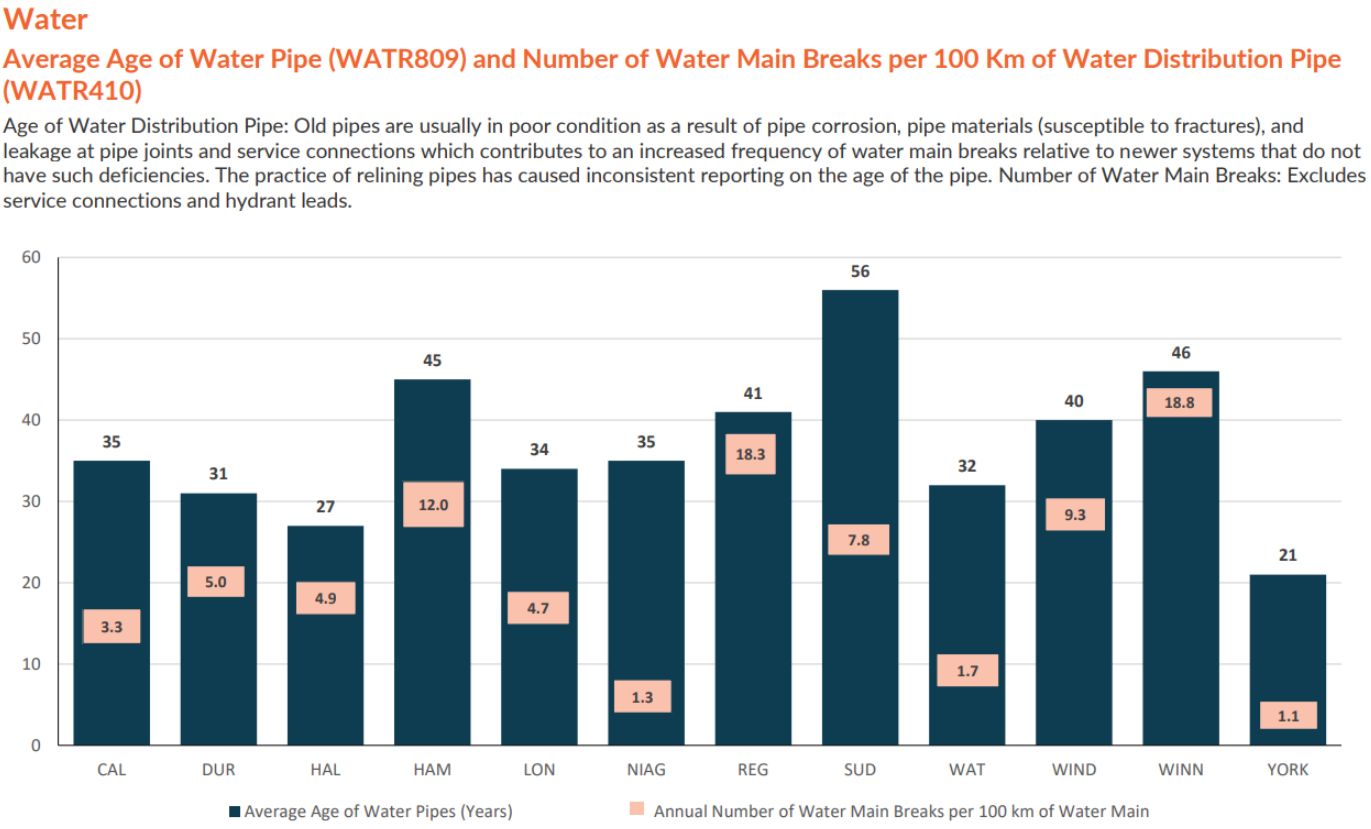
The Water and Wastewater Master Plan detailed the leakage rates across the City's water distribution systems, provided in Figure 1. Please note that some of these rates have changed since the Master Plan was released, most notably a very large leak was found in Levack which was significantly contributing to the elevated leakage rate in that water distribution system. The Water and Wastewater Master Plan stated an aspirational goal of reducing the leakage in each of these systems to 15%. Most industry literature refers to a best practice leakage rate between 15-20%.

Figure 1 – Leakage rates in the City of Greater Sudbury's Water Distribution Systems



To further characterize the City of Greater Sudbury's water distribution systems, please refer to Figure 2, showing the 2021 MBNCan statistics for Sudbury's system age (SUD) and watermain break failure rates. This graph shows that Sudbury is the oldest among participating MBNCan municipalities and is just above the average (7.35) and the median (4.95) watermain break rate for the group. Watermain breaks are a common statistic that is used to understand the condition of the water distribution system and is particularly useful as an indicator to look at where pipes are experiencing stress. While there are many causes for watermain breaks, some breaks begin as leaks that grow making detecting leaks a proactive measure.

Figure 2 – 2021 MBNCan Average Age of Water Pipe and Number Water Main Breaks per 100km of Water Distribution Pipes



What are some strategies for leak reduction in water distributions systems?

There are many tools and techniques available to find leaks, each with its own merits. Traditional leak detection is performed by listening using acoustic devices on metallic pipes, where the operator can hear the pipe leaking, or be able to visually see the noise signal on a meter. On a smaller scale, think of when turning on the water fully in an old home and hearing the pipes scream. This technology has advanced significantly over the last decade and there are now devices on the market using the Internet of Things (IoT) and machine learning. Traditional leak detection has limitations in its application on a large scale, as it is very cumbersome and time consuming, and is often limited to metallic pipes.

AMR/AMI Advanced Water Meter Infrastructure

The AMR/AMI project involves the complete replacement of all water meters with a new technology that allows remote reading of water volume that passes through the meter. The data is loaded to a system within the system that allows staff to compare the amount of water pumped from all the water plants to the amount of water consumed by customers. The difference is an indicator of the total losses in the system including leakage in real time.

District Metered Area (DMA) studies are another important tool in helping to quantify leakage in the distribution system. These studies are undertaken by measuring the flow of water entering and exiting a section of the distribution system. With this information combined with accurate consumption data from individual properties, the amount of water loss or “non-revenue water” can be calculated in a smaller geographic area. These studies would only provide truly accurate and meaningful data with real time metering infrastructure. The City of Greater Sudbury’s AMI project will modernize municipal water delivery technology, upgrade and replace water meters in every home and business. The new technology will connect meters to outdoor transmitters that will send wireless readings directly to Greater Sudbury Utilities. Upon replacement of all meters within an area of the system, a DMA study can be completed.

The benefits to property owners resulting from the AMI project include more accurate and timely information about water consumption, alerts about unexpected high-water consumption and tools that can help track and plan future water usage. The online customer service portal will give customers in-depth information regarding their water usage in real-time and is expected to go live in January 2023**.** Residents who have had their AMI upgrade completed will have access to this modern web portal where they can find detailed information about their household water use, track and compare their water usage over time, as well as be alerted to possible leaks via a continuous flow notification.

Pressure Management and Surges

Another strategy for dealing with leak reduction is pressure management. Pressure management can be an effective tool if there is an area with significant losses and high pressures. This functions to reduce losses as less water will leak through the pipes if pressure is reduced. The reduction in pressure will be less stressful on pipes that are failing and can assist in slowing down the rate of failures. Setting up an area with pressure management is complex and requires to be studied to ensure that the system will continue to adequately function, which makes it not suitable in all circumstances.

Finally, looking at ways to reduce stresses from water hammer and surges in the system can contribute to leak reduction by adding protection to the water distribution system. The City has many large pumps at plants and booster stations that can send pressure waves through the distribution system as they turn on and off. Understanding these dynamics and making sure that the right controls are in place and functioning to minimize the impact of these waves can also be an effective strategy to minimize leaks by ensuring we treat our water distribution system more gently in areas where there are high failure rates. The City's efforts in this area are described in the transients project.

Initiatives led by the Water and Wastewater Task Force for leak reduction

Asset Management

In 2021, the City was able to complete moving the historical watermain break dataset into an updated interactive tool in our Enterprise GIS system using ArcGIS Online and Insights. This new platform allows for direct connection to our work management system, Cityworks, where information from work orders is available in Enterprise GIS as soon as the work order is entered into the Cityworks system as well as access to historical information dating back to the 1980s. There are analytical tools available in Insights that allow staff to filter information by the nature and cause of the break, explore trends over timelines, and to better explore the relationship between timelines of installation and material of installation. This tool is helpful in ensuring that programs can be focused in areas of the highest risk.

Figure 3 – Screen shot from watermain break analytics tool showing a collection of all watermain breaks. This interactive tool shows the pipe material type experiencing watermain breaks and can be filtered by the nature and the cause of the break.

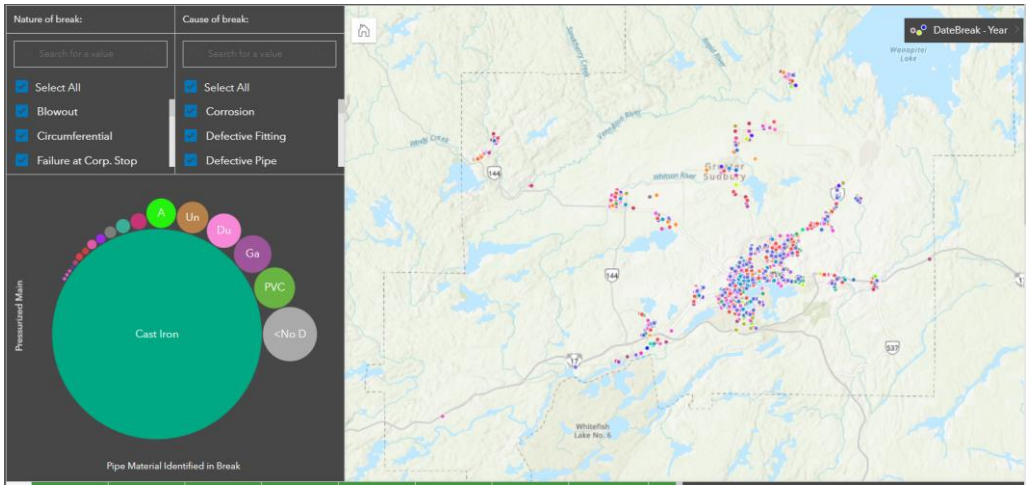


Figure 4 - Screen shot from watermain break analytics tool showing a running total of watermain breaks by month for the past 4 years.

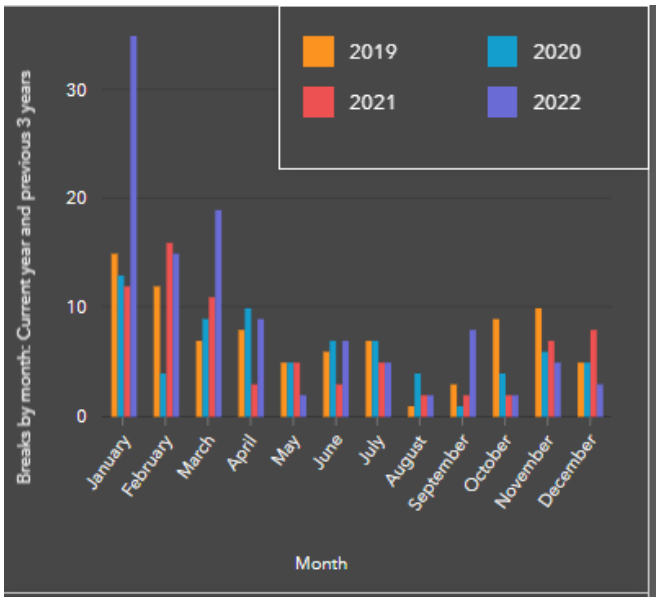
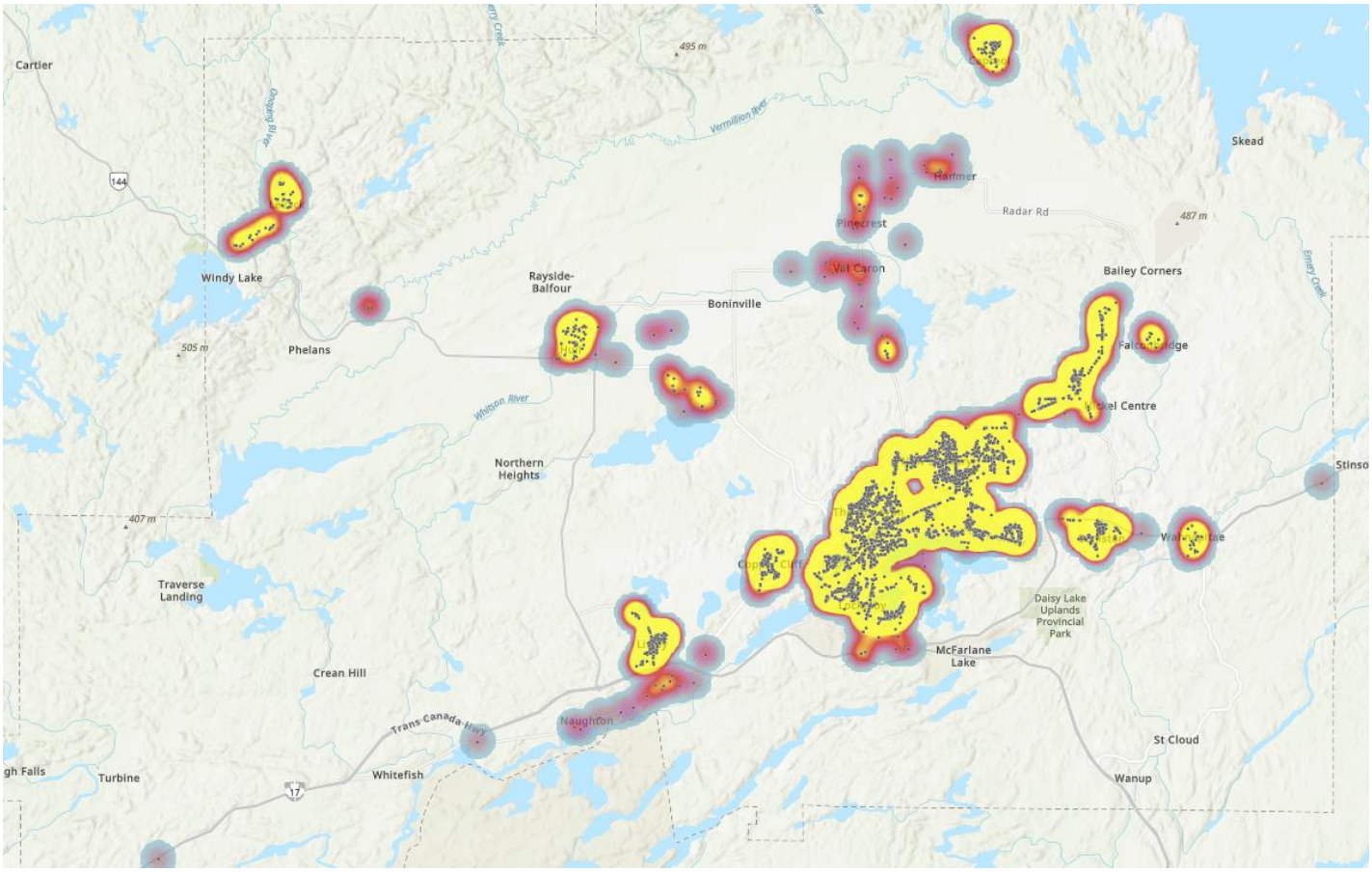


Figure 5 – Screen shot from the watermain breaks tool showing a heat map of all watermain breaks from the1980s to present.



In 2022, the City was able to complete an initial pipe degradation model with CANN Forecast, a company specializing in AI-powered tools for smart water management. There were many inputs into this model, including the upgraded watermain break dataset. This tool can be used to help examine areas with unusual behaviour and help prioritize areas requiring further study, as well as for capital rehabilitation and replacement.

Mobile District Metering

The City was able to be part of an exciting study opportunity throughout 2020 and 2021 where the City was able to complete some district metering in five neighborhoods. This study was completed in partnership with HydraTek, Independent Electricity System Operator (IESO), National Research Council of Canada (NRC), and Natural Sciences and Engineering Research Council of Canada (NSERC). The City participated in this project alongside six other Ontario municipalities. Through this initiative the City has characterized the minimum night flow in these neighborhoods which can be used to calculate water balances with advanced water meter infrastructure data. In one neighborhood, the City found significant leaks, would provide a cost avoidance of $1M over the next 10 years. This was a very successful project where the City learned considerable amounts about these neighborhoods and has resulted in several of spin-off projects. This project won awards by both the Professional Engineers of Ontario, York Region with the Engineering Research Project of the Year Award and by the Ontario Water Works Association with the Water Efficiency Award.

Hydrant monitoring Pilot Projects

Two six-month hydrant pilot projects were launched in the fall of 2022. The first pilot project saw leak detection technology embedded in hydrant caps. This leak detection technology is suitable in neighbourhoods with metallic watermains, which are better at transmitting sound. The listening devices in the hydrant caps are able to notice changes in acoustics that are characteristic of leaks and calculate an approximation of where the location of the leak is between the two instruments. Information is available to staff on the cloud through the Internet of Things (IoT). As of the first week of December 2022, a large leak was found and repaired, and other leaks are under investigation or awaiting repair.

Figure 6 – First leak found using new leak detection technology. 1945, 150mm cast iron watermain.

The neighbourhood chosen to pilot this technology is known to be an area where the ground conditions are representative of leaks or watermain breaks often do not surface. The City most frequently finds breaks when the water is running along the surface of the ground or when there is a service disruption. By using acoustic leak detection technology, the City hopes to find more leaks sooner, and have additional success in reducing our non-revenue water.

A second hydrant technology being piloted in a different priority area began in late 2022. This technology is able to measure the temperature and pressure of the water distribution system at the hydrant. These instruments also transmit the data to a cloud-based platform for staff to access and using machine learning the system is able to convert pressure information into information that can alert staff about watermain breaks or leaks in the area of the system that is being monitored. This information may be helpful beyond simply early detection for background information that is required for the future pressure management study in this area.

Transients Study

When the large pumps turn on and off at the water treatment plants and booster stations, they send enormous amounts of energy through the City's water distribution system. If this energy is not properly managed, it can result in destructive forces causing premature infrastructure failure, often seen as watermain breaks. In 2021, the City invested in a transients study for the Sudbury water system, which included a field study to monitor these transient events throughout the Sudbury system. Some of the recommendations from this study have already been implemented in upgrades at the Wanapitei water treatment plant, while others have been included in the design for the David Street water treatment plant which is scheduled for upgrades in 2023. In addition, these recommendations will be included in work for the trunk main repair project, which is critical infrastructure responsible for water distribution in the Wanapitei system, as well as the decommissioning of the Kingsway booster station. A needs and criticality assessment was also completed to help focus the City's resources on the air release valves that have the greatest potential to reduce watermain breaks and provide the greatest amount of protection to the Sudbury system. As a result, the City can expect to see additional air release valve replacements as these assets have been given a higher priority when reviewing capital projects. Air release valves are most frequently installed at high points in the system to release air. Air is a compressible fluid, so it is very important that this air gets expelled from the system, as air under great pressure can become destructive if not released. These improvements are anticipated to have a positive impact towards leak reduction for the Sudbury system, and reduced watermain breaks as the City continues to invest in infrastructure that will help absorb and release energy that would otherwise create additional stresses on the City's aging pipes.

Water Efficiency Strategy

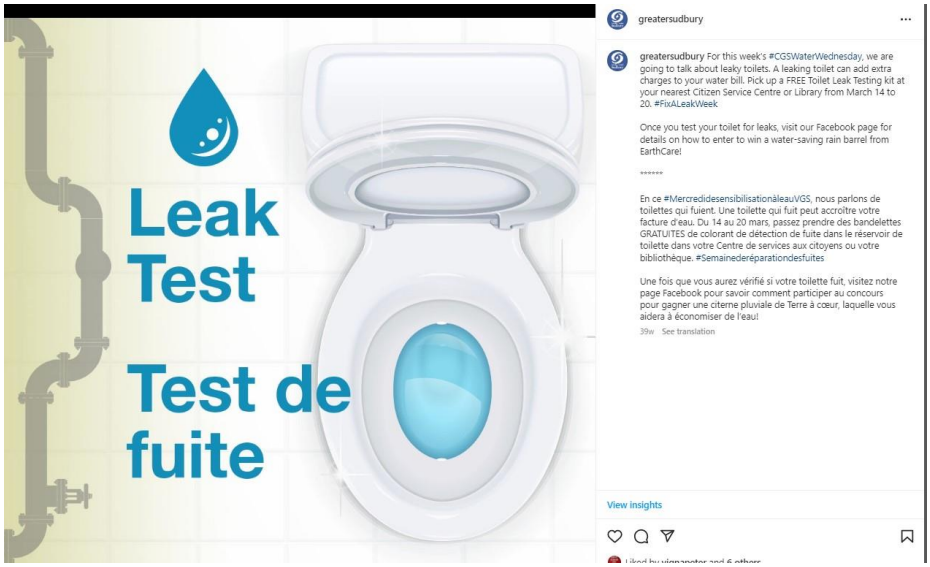
The Water Efficiency strategy was completed at the end of 2021. This report was able to do a deep dive into the residential water use across the City and understand what happens to water after it is produced at the plants. The significant take-aways from this report are:

1) The residential water use is quite efficient, measuring below the provincial average water use per capita per day.
2) There is no justification for significant resources in the way of subsidies/grants to be used for private water efficiency.
3) The report was another confirmation that the non-revenue water is higher than it could be, confirming the importance of the investments that have been made, and the need to continue to target for leak reduction in the water distribution network.
4) Other opportunities to reduce operating costs were recommended, including performing water audits on City owned facilities to ensure that the City was using appropriate water efficient fixtures. This would be beneficial for cost avoidance for the City's operating costs, as well as an opportunity for the City to act as a leader and model for water efficiency to the community. This will be incorporated into future capital projects as the need arises.
5) The best use of resources for water efficiency is through education and outreach. Because of this, #CGSWaterWednesdays were initiated, which were shared on Facebook, Twitter, and Instagram. The City also distributed toilet test strips during fix a leak week in March of 2022 through the libraries.

Education and Outreach

The Water and Wastewater Task Force created education and outreach resources for the theme areas of leak reduction, and water efficiency. In 2022 a new social media campaign, #CGSWaterWednesdays began, where a new water or wastewater message gets posted to the City's social media feeds, Facebook, Twitter, and Instagram, once weekly. Two other special social media campaigns were also run: Hydrant Heroes, which encouraged people to get to know where to find the nearest hydrant was and take a fun selfie while shoveling it out, as well as the previously mentioned Fix-a-leak week. During the Fix-a-leak week campaign, the City partnered with the libraries to distribute toilet test strips so that people could see if they had a leaky toilet valve, which is one of the most common areas to find a leak.

Figure 7 – A post from the #CGSWaterWednesday series



Future Projects

Looking ahead, the Water and Wastewater Task Force will be working through the planning and logistics required to begin installing the priority air release valves that were identified in the transients study. Some of this work requires significant coordination and watermain shutdowns to execute safely and will be done in partnership with the operators in Distribution & Collection.

Other notable leak reduction projects for 2023 include launching a pressure management study for the Sudbury water system, and a study to assist with optimizing blow-offs. Blow-offs are like intentional leaks on our water distribution system and are often installed to help create a demand on the water system to help resolve water quality concerns. The project will explore the possibility of reducing blow-off operating volumes, limiting seasons or duration which these valves are on, and look for opportunities to turn some off where recent capital improvements may have corrected the initial reason why they needed installation.

Resources Cited

1. Water and Wastewater Master Plan https://www.greatersudbury.ca/live/water-and-wastewater-services/projects-plans-reports-and-presentations/water-wastewater-master-plan/
2. Water and Wastewater Asset Management Plan https://www.greatersudbury.ca/city-hall/budget-and-finance/financial-reports-and-plans/pdf-documents/appendix-c4-water-wastewater/