INFORMATION REPORT

TO:	Chair and Members Public Works Committee
COMMITTEE DATE:	November 1, 2021
SUBJECT/REPORT NO:	Hamilton Water Leak Detection Program (PW21063) (City Wide)
WARD(S) AFFECTED:	City Wide
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COUNCIL DIRECTION

Not Applicable

INFORMATION

Introduction

The City of Hamilton's (City) water system is one of Canada's oldest and most complex. It includes six (6) water distribution systems, 2,031 kms of water mains, 13,425 hydrants, 16,115 valves, and 154,964 service connections.

Public drinking water utilities treat and distribute billions of litres of safe drinking water every day. Ideally the total volume of water produced by each utility would be equal to the volume of water that reaches (and is accurately billed) to the consumers, but this is never the case.

Drinking water that has been produced by the City that is lost before it reaches the customer is called non-revenue water (NRW). NRW can occur through physical losses (leaking and broken pipes), from unbilled authorized consumption (including water used by Hamilton Water for operational purposes such as watermain flushing), and from water used for firefighting. NRW can also come from water meter inaccuracies, data

handling errors, illegal connections and theft. A significant contributor to the City's NRW is leaking and broken watermains. On average, from 2012 to 2020, the City experienced over 300 watermain breaks per year. Due to Hamilton's unique geography and often rocky porous ground there are many watermain leaks and breaks that do not surface and have the potential to remain undetected for years. These hidden leaks account for a large amount of NRW and can be far more damaging to the pipe network, with erosion of pipe bedding leading to major pipe breaks, damage to foundations of roads and possibly even damage to bridges, buildings, etc.

Currently, NRW represents about 26% of the water produced or imported by the City, which is significantly higher than the industry standard of 15%. The table below shows the percentage of NRW in each of the City's water distribution systems from 2018 to 2020.

System	2018	2019	2020
Carlisle	12%	8%	12%
Fifty Road	45%	43%	31%
Freelton	26%	31%	23%
Greensville	36%	35%	33%
Lynden	33%	47%	42%
Woodward	28%	27%	26%
OVERALL	28%	29%	26%

The financial consequences of NRW are multiple and include:

- Lost Water, Wastewater and Storm Rate revenue from unbilled consumption and theft; and,
- Unnecessary operational costs to produce and distribute drinking water (treatment chemicals, energy, etc.).

Staff estimate that $820,000.00 in annual savings can be achieved by reducing NRW to industry standards.

Hamilton Water's Leak Detection Program Pre-2021

Historically, Hamilton Water's programs to control NRW included:

- a residential water meter replacement program (lifecycle replacement);
- a robust water meter maintenance program; and,
- a reactive leak detection program.

Reactive leak detection means that leaks are identified and repaired after receiving a call or complaint related to low water pressure, noise in pipes, or a visual water leak. Hamilton Water did not have a robust proactive leak detection program with dedicated staff, formal processes, and appropriate technology. Any proactive leak detection was 'filler work' completed when staff had available time, using the basic equipment that was available, and generated inconsistent results. A combination of factors often resulted in the excavation of dry holes (holes where there are no leaks to repair), which added unnecessary costs to annual maintenance programs.

Leak Detection Pilot Projects

Beginning in 2019, Hamilton Water initiated pilot projects for proactive leak detection using leading-edge leak detection technology. The pilots allowed Hamilton Water to test the technology in the field, and to develop a cost/benefit analysis to support the procurement of technology and implementation of a formal proactive leak detection program.

The pilot areas covered approximately 400km of water main and were aligned with geographical areas of concern (where water leaks often do not typically surface due to subsurface rock and porous soil). The pilot projects resulted in 185 potential leaks being found. After further investigation, 177 of the 185 potential leaks were verified as true leaks that required action. 153 leaks were on City infrastructure (water mains, valves, water service lines), and 24 leaks were on private infrastructure (water service lines). The accuracy of the piloted technology was greater than 95%. Repairs have been completed for all of the leaks on City infrastructure, and 11 of the private leaks.

Year	# of Potential Leaks	# of Verified Leaks	# of Public Leaks	# of Private Leaks	% Accuracy
2019	114	110	96	14	96.5%
2020	71	67	57	10	94.4%
Total	185	177	153	24	95.7%

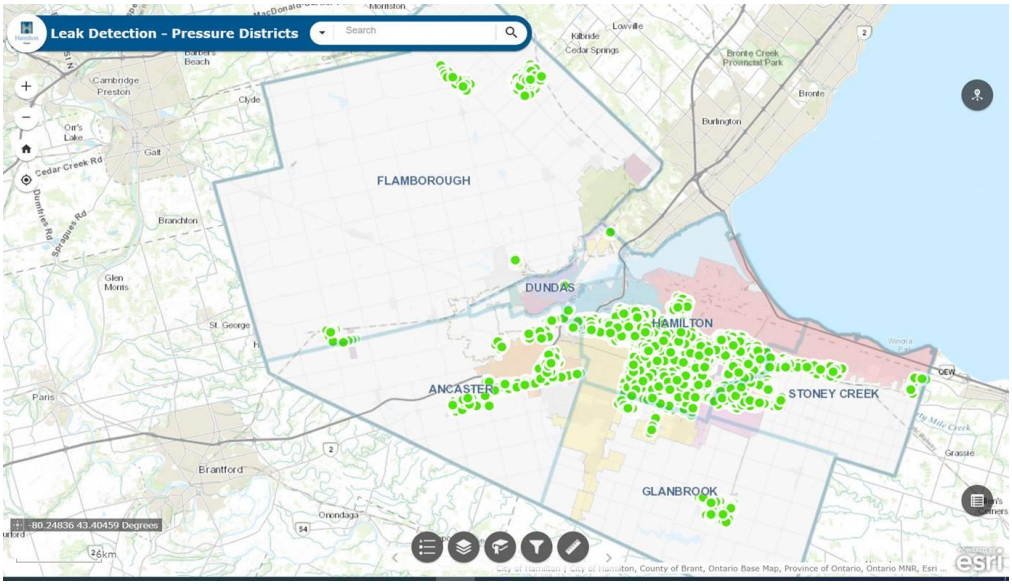
Hamilton Water's New Proactive Leak Detection Program

Based on the success of the pilot projects, Hamilton Water issued a request for proposals in July 2020 for the procurement of leak detecting equipment, which includes 100 correlating data loggers, a hand-held probe, and the associated software. This equipment was purchased in December 2020 and Hamilton Water began designing an in-house water leak detection program. The new program was launched as a trial in early 2021, with the goal of assessing leaks across the City's entire water system by the end of the year. The program was resourced by temporarily reallocating 1.65 full time

equivalents (FTE) from business units within the Water Distribution and Wastewater Collection Section.

During a typical deployment approximately 80 loggers are installed in a defined area by magnetically attaching them to fire hydrants and isolation valves. This allows each logger to listen for and record leak noise approximately 100 metres in each direction. The loggers are programmed to correlate at three (3) different times between 2:00 a.m. to 4:00 a.m., when water usage and traffic noise are typically minimal resulting in less interference and more accurate readings. The loggers are removed the next day and the data collected by the loggers is downloaded to the software application. The software application then identifies locations with potential leaks, which are programmed for focused field investigations by staff. These field investigations identify the leaking infrastructure (e.g. watermain, public portion water service, private portion water service), and pinpoint the exact leak location.

As of September 1, 2021, the loggers have been deployed at 4,200 locations with 78 potential leaks identified. Of the 78 potential leaks, 75 have been verified as true leaks (62 on City infrastructure and 13 on private infrastructure), resulting in an accuracy of 96.2%. Repairs have been completed for all of the leaks on City infrastructure, and five (5) of the private leaks. The following map shows where the leak detection program has been active across the City, as of September 1st, 2021.



Map showing the locations of the Leak Detection Deployment

Climate Change

On March 27, 2019, the City unanimously declared a climate emergency. Hamilton Water is a key stakeholder on the Corporate Climate Change Task Force and is one of the largest energy users in the City. In 2020, Hamilton Water produced 77,575,890 m3 of water. Hamilton Water worked with the Energy, Fleet and Facilities Division to determine that the energy required to produce 1 m3 of water is approximately 0.2 kWh. A robust proactive water leak detection program will reduce energy consumption at the water treatment plant and outstations.

Return on Investment

Return on investment (ROI) is a widely used measure to compare the effectiveness of a purchase or project. The proactive leak detection program utilizes the following resources:

- 1.4 FTE – Two (2) Water Distribution Operators (annual cost)
- 0.25 FTE – One (1) Water Distribution Supervisor (annual cost)
- Proactive Leak Detection Equipment (one-time cost)

Based on the resources utilized, the 2021 Proactive Leak Detection Program cost is $288,000.

Expense	Costs
Leak Detection Equipment	$123,000.00
1.65 FTE / year	$165,000.00
Total Costs	$288,000.00

To determine the ROI, Hamilton Water leverages a watermain leak calculator that accounts for several factors. Hamilton Water has determined that on average 1 – 6” watermain leak will result in 500 m3 of NRW per day. Based on the public watermain leaks that have been repaired in 2021 (as of September 1), the ROI for the Proactive Leak Detection Program was eight (8) months.

Average NRW per watermain leak	500 m3 / day
Cost of NRW	$0.10 / m3
Daily cost of NRW	$50.00
Total watermain leaks repaired	61
Total volume of NRW eliminated	3,403,500 m3
Estimated NRW saved to September 1, 2021	$340,350.00
Return on Investment	8 months (August 2021)

Moving forward, the projected annual cost of the Proactive Leak Detection Program cost is $165,000 based on staffing costs.

Issues/Challenges

Private water service line leaks are detected using the leak detection technology. Private leaks usually occur between the water shut off (at property line) and the water meter. These leaks are considered NRW because the leaking water is not registered by the water meter, and not billed to the property owner. To date, most of the verified private leaks have been on substandard (lead) water service lines.

The identification of a private leak can be challenging as residents are not generally impacted by the leak since there is no visible water pooling or leaking into their property, and there is usually no noticeable reduction in water pressure. Generally, the repair of private side leaks can be costly, and the property owner may be unwilling to incur the cost to repair or replace their service line since the repair does not provide a direct benefit to them. The average cost to completely replace a private water service line ranges from $2,000 to $4,000 depending on the length of the private water service line and the type of soil on the property.

A formal process for communicating private side leaks was created to support the proactive leak detection program. Once a potential private leak has been identified, a letter is mailed to the property owner to notify them of the potential leak with the recommendation to schedule an on-site meeting with Water Distribution staff to locate the leak. If a private leak has been verified, another letter is mailed to the property owner to advise them of the process and timeline for the repair to be completed.

As of September 1, 2021, only 16 of the 37 (43.2%) verified private leaks have been repaired by the property owner. All of these repairs involved the complete replacement of a lead water service line. To date, Hamilton Water has focused on educating property owners where private leaks have been verified and no enforcement action has been taken.

Hamilton Water does have some enforcement tools available in existing by-laws including provisions in the Property Standards By-law 10-221, Sec 14(1) where a property owner can be compelled to complete the repairs. If repairs are required and they are not completed in a timely manner, an investigation by Municipal By-law Enforcement could result in a Property Standards Order. Where there is non-compliance with a Property Standards Order, the City has the ability to complete the work on private property and add the costs to the property’s tax bill.

In some circumstances, the Property Standards By-law also allows Hamilton Water to turn off the water service for a property (notably where there are concerns about health and safety or property damage resulting from a water leak).

Next Steps

The following list of next steps are planned to support the proactive water leak detection program, pending available resources:

- A request for two (2) permanent FTEs to provide full time program support has been included in the 2022 Water, Wastewater, & Storm Rate Budget for consideration by Council;
- Annual proactive leak detection scan across the entire City;
- Identify, investigate, and eliminate other sources of non-revenue water (water meter inaccuracies, data handling errors, illegal connections and theft);
- Complete a process improvement project to identify, improve, and control the proactive leak detection program; and,
- Determine an appropriate enforcement / incentive strategy for private leaks that are not repaired in a timely manner.

APPENDICES AND SCHEDULES ATTACHED

None