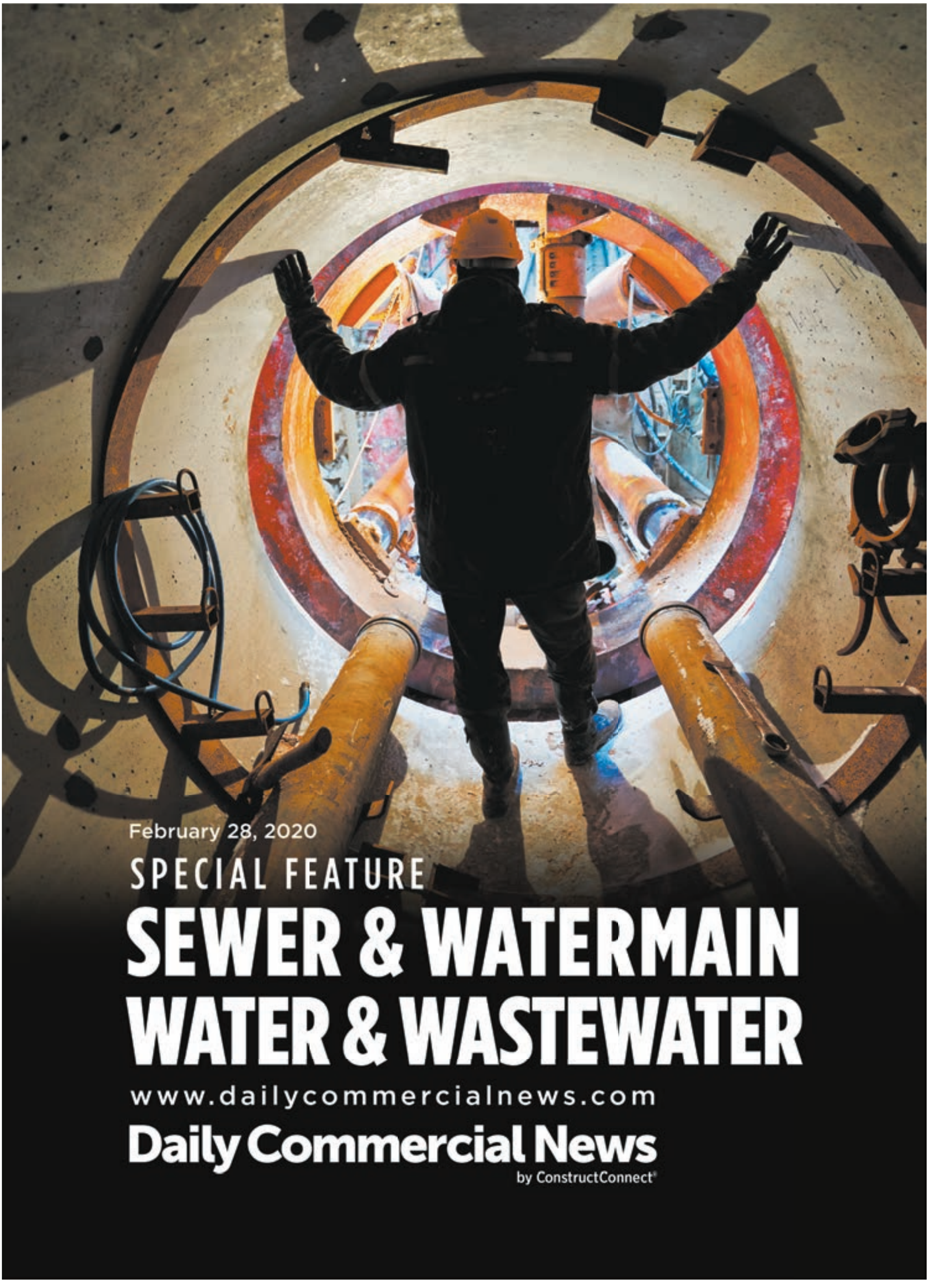

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SPECIAL FEATURE

SEWER & WATERMAIN
WATER & WASTEWATER

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by ConstructConnect®

Waterloo successfully pilots water infrastructure leak detection technology

GRANT CAMERON
CORRESPONDENT

For municipal workers, stopping watermain leaks can be a never-ending battle. Small leaks that are difficult to detect can quickly become big leaks. And, as municipalities know all too well, big leaks can take out a road.

Imagine, then, detecting a leak just as it starts?

A novel, game-changing technology developed by Digital Water Solutions (DWS) can do just that. The company has come up with a monitoring device that fits inside a standard fire hydrant, constantly listening for anything out of the ordinary in the water system to detect a watermain break before it gets worse.

A unit — about the size of a small shoebox — is also attached to the outside of the fire hydrant. The sensors inside the fire hydrant use sound technology to listen for abnormal patterns that may result in leaks. The sensors monitor the drinking water system, providing live data on temperature and pressure.

When noise levels of running water get significantly higher than the established baseline and consistently stay high, it indicates a leak. Cloud-based analytics track the data, sending automatic alerts to managers of any suspicious patterns.

"The whole point is that if you have an ongoing leak the noise level will stay high and you'll hear it," explains Tim Sutherns, head of automation and controls at DWS.

"We track baselines against previous historical data and what we're basically looking for is significant changes in the pattern.

"It's like pattern recognition. If you have an ongoing leak, you'll hear it. By looking for pattern changes, we can identify something that's not normal and, if that's the case, then send out an alert to the municipality."

The technology was tested recently by the City of Waterloo. Forty units were installed on hydrants in the city covering approximately 10 square kilometres. The units cost about $10,000 each. The city obtained funding from the Canadian Water and Wastewater Fund to implement the technology.

Each area was selected because of a history of leaks or breaks and the opportunity to test the units on different pipe materials.

The kit includes both the sensor and the electronics box which is attached to the outside of the fire hydrant. The electronics are on the outside so batteries can be changed easily and the modem can transmit information clearly. Inside, a stainless-steel ball goes on the lower valve assembly of the fire hydrant.

Sutherns says the technology is unique because it senses the pressure below the valve of the fire hydrant so there are no issues with freezing and therefore it allows the hydrants to remain in service year-round.

DIGITAL WATER SOLUTIONS

Here is what a watermain leak detection system looks like which is installed to a fire hydrant. The technology was recently tested by the City of Waterloo in an area of 10 sqaure kilometres.

The sensors constantly collect water column pressure readings — up to 100 times a second to be exact — and do acoustic sampling at 4,000 times a second.

According to a report by Waterloo staff, the results of the test were a success, as the kits enabled the city to monitor pressure, transient pressure, acoustics or leak detection, and water temperature to gain greater visibility into the water distribution system and a deeper understanding of one of the city's largest unseen assets.

"Typically, you don't get to see those assets until there's water flowing down your streets and residents calling in saying, 'What just happened?'" says Sutherns.

The city notes the installed sensors enabled the municipality to identify four events in the system, confirming the validity of the instrumentation and the value of the units.

In two of the events, the sensors detected watermain breaks. One was detected by acoustic sensors during overnight monitoring periods within the area where the units were installed while the other detected a leak that resulted from a pipe being ruptured by a backhoe about six kilometres from the hydrants outfitted with sensors.

The sensors also picked up anomalies when an elevated tank was taken out of service and the instrumentation in the city's system immediately recorded a change in the distribution system pressure.

A fourth event demonstrated the sensitivity of the devices. A small leak was detected using the acoustic data within an area monitored overnight by the units and an investigation discovered the event was an individual filling his swimming pool using a garden hose at a flow rate of up to 25 litres per minute.

"What they've found is that the data they've been receiving has been valuable and they're able to see what's happening in their system," says Sutherns.

"They're able to see everything from their pumps and valves and what's going on and closing, and they're able to see when a leak occurs, and they can pick up watermain breaks. It has been successful in terms of what they were hoping to achieve which is huge."

The technology has also been installed in Guelph, Chatham-Kent and Wellington, as well as the United States and Iceland. DWS also has purchase orders from two more municipalities and is meeting with others.

The kits can be uninstalled and reinstalled in less than two hours.

For the test in Waterloo, kits were installed on every hydrant in a pre-determined area. Based on the success of the first test, the city now plans to widen the coverage area and space them every three to five hydrants.

The city has recently approved an automated water metre reading system so every house will soon be providing data which will provide even more help with watermain leak detection.

Economic Snapshot

Population growth of Canada's major urban areas outpaces the rest of the country

John Clinkard

Approaching the beginning of the third decade of the 21st century, Canada is urbanizing at an unprecedented rate. This observation is based on Statistics Canada's recent release of the nation's sub-provincial population estimates which reported that during the 12 months ending July 1, 2019, the population of Canada's largest urban areas increased by 463,000 (1.75%). To put this growth rate in perspective, over the same period the population of the rest of the country increased by just 68,000 (0.6%). As noted in last year's Snapshot #19, which focused on Canada's total population as of July 1, 2019, almost all the population growth in Canada's large urban centres was fuelled by permanent and temporary immigration.

The subprovincial population estimates highlight four significant aspects of the growth of Canada's CMAs (Census Metro Areas with populations of more than 100,000) over the recent past.

Ontario has the fastest growing CMAs led by Kitchener-Cambridge-Waterloo

For the second consecutive year, Kitchener-Cambridge-Waterloo was the fastest-growing CMA in Canada. After posting growth of 2.6% in 2017-18, it saw its population growth accelerate to 2.8% in 2018/19. Next, London, Ontario posted growth of 2.3% in 2018/19 after a gain of 2.4% the previous year. It is worth noting that both Kitchener-Cambridge-Waterloo and London are home to major universities that serve as a magnet for individuals both inside and more importantly outside the country. The third fastest-growing city in 2018/19 was the Ontario portion of Ottawa/Gatineau which saw its population accelerate from 2.2% in 2017-18 to 2.3% in 2018/19.

Growth of baby boomers in Canada's CMAs is still strong but gradually slowing

Over the past 75 years, the post-war baby boom has had a profound impact on all aspects of Canada's social and economic fabric. While this demographic group is still the fastest growing in Canada's major urban centres, the growth of individuals aged 55 to 75 has steadily slowed from 3.8% to 2.8% over the past nine years. Despite this gradual slowing, this age group continues to expand at an above-average rate of 3.0% in a third of the country's 35 CMAs. Topping the list of the 12 CMAs which experienced the fastest growth of (now aging) baby boomers is Calgary, Alberta with a year-over-year increase of 4.4% in 2018/19. Barrie, Ontario saw growth of 4.3% followed by Saskatoon, Saskatchewan (+4.3%) and Oshawa, Ontario (+3.9%).

Millennials are making an increasing contribution to CMA growth

Approximately one in three (29%) of Canadians currently living in a CMA is a millennial (i.e. an individual aged 20 to 39). entering their prime working and spending year). Over the past 4 years, the growth rate of this age group accelerated from 0.4% to a record 2.5% in 2018/19. Consistent with the fact that it is one of Canada's premier tech hubs, the millennial age group in Kitchener-Cambridge-Waterloo increased by 6.0% in 2018/19 after posting a gain of 4.7% in 2017/18. In Windsor, the number of millennials rose by 4.4% accounting for two-thirds of the CMA's population growth in 2018/19.

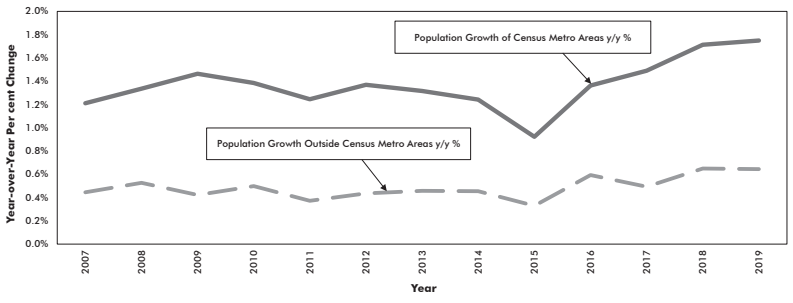
Other CMA's which have experienced above-average growth in the number of millennials include Abbotsford-Mission, British Columbia (+4.0%), London, Ontario (+3.7%), Toronto, Ontario (+3.7%) and Halifax, Nova Scotia (+3.6%). Since they are younger, it is not surprising that the rising concentration of millennials has lowered the median age of Canada's CMAs, currently 39.5 yrs, relative to the rest of country (45.7 yrs).

Suburban population growth particularly strong close to the Toronto CMA

The one final development revealed by the latest population estimates is the evidence of accelerating urban spread — some might say sprawl. This phenomenon is very pronounced in the area on the outskirts of Toronto. Whereas Toronto CMA saw its population increase by 2% in each of the past two years, the municipality of East Gwillimbury to the north saw population growth of 10% in 2018/19 after posting a gain of 12% in 2017/18. To the west, the population of Milton increased by 5.1%, followed by Brampton (+4.7%) and Shelburne (+4%). Given the federal government's plan to admit 340,000 immigrants to Canada in 2020 and since Toronto attracts approximately a third of international migrants, it appears likely that population growth in the municipalities on the edge of Toronto will continue to outpace the whole CMA for the next several years.

John Clinkard has over 35 years' experience as an economist in international, national and regional research and analysis with leading financial institutions and media outlets in Canada.

Growth of Population in Census Metro Areas vs Rest of Country



Data Source: Statistics Canada / Chart: ConstructConnect — CanaData.

constructconnect

Hamilton's Woodward treatment plant upgrades massive in scope

DAN O'REILLY
CORRESPONDENT

The largest single capital investment in Hamilton's history is officially titled: The Woodward Avenue Wastewater Treatment Plant Upgrades.

But that heading doesn't really convey the full scope of an approximately $340-million upgrade of the city's main wastewater treatment plant — the purpose of which is to improve the water quality of Hamilton Harbour.

Preceded by planning, public consultations, and design, the upgrade project is intended to manage wet weather flows, provide better treatment capacity and meet a number of objectives defined by the Hamilton Harbour Remedial Action Plan (HHRAP) — a long term undertaking to restore the harbour.

A major objective of the upgrades is to meet the HHRAP's targets for the reducing the amount of ammonia flowing into the harbour, "as ammonia in high concentrations is toxic to flora and fauna in aquatic ecosystems," says Andrew Grice, director of Hamilton Water.

And attaining that objective is the reason new tanks are being added to Woodward's secondary treatment process — which is comprised of two plants. Work started in 2019 and won't be completed until 2021.

The addition will enable those plants to convert ammonia to less harmful nitrate on a year-round basis. Capacity limitations have hindered that ability with the result HHRAP ammonia reduction targets haven't been met. However, when the new tanks are in service that will all change, says Grice.

"It is estimated that approximately 6,100 tonnes of ammonia will be removed from the aquatic ecosystem over the next 10 years of post-construction."

North America Construction (1993) Ltd. is the general contractor building the tanks and it's also carrying out the parallel construction of a new disk filtration tertiary treatment facility which will also reduce approximately 500 tonnes of phosphorus and 15,000 tonnes of solids during that same 10-year period, says Grice.

At an estimated cost $165-million, the work being conducted by North America Construction is the largest and most expensive of three separate contracts which make up overall Woodward upgrades project. Still, the construction schedule is actually the shortest of those three because of the contractor's parallel work and the fact that the disk filtration tertiary treatment facility is being built on a greenfield site with limited below-ground obstructions is the reason, he says.

CITY OF HAMILTON

Hamilton's new main pumping station at the Woodward Wastewater Treatment Plant will have a wet weather capacity of 1,700 megalitres per day and result in a larger and deeper wet well to mitigate flooding, provide increased system storage and reduce solids building during dry weather flows.

The origins of the Woodward upgrades project dates to 2008 when the City of Hamilton completed an environmental assessment to determine a plan for the upgrades, as well as preparing for future growth.

"But then the 2008/2009 recession hit and there was a decrease in water consumption, so we decided to focus entirely on improving water quality."

In 2016 the first step of plan was put into place with the launch of a long-term monitoring program to measure the impact on the Red Hill Creek. The secondary treatment effluent discharge flows into that creek, but the discharge channel will have to be moved one kilometre to the north when the upgrades program is completed. The monitoring will continue until at least 2031, says Grice.

To provide the necessary power supply to all of Woodward's existing and planned new processes, a major electrical overhaul began in 2017 and will continue until 2021. The existing electrical substations have been in service for over 50 years and are nearing the end of their normal service life. They don't have the sufficient capacity to accommodate the power requirements of the process upgrades.

Alberici Constructors Ltd. is erecting a new power centre consisting of four standby 3,000-KW diesel generators, plus installing a dual 13.8 kV back-up distribution loop right around the entire Woodward site which also includes a water treatment plant.

During the same period, 2017 to 2021, a new 1,700 wastewater MLD wastewater pumping station is being built just upstream of the secondary treatment plants by Maple Reinders.

The Woodward upgrades project is being led by Jacobs, which is the prime consultant, and AECOM, with support from Wood. In addition, there are a number of specialty sub-consultants used for subsurface utility investigations, geotechnical, environmental, and designated substance surveys.

Asked how the planning and co-ordination of a such a lengthy, complicated, and expensive project was and is being carried out, Grice said it involved the creation of a series of separate sub-project teams consisting of both city and consulting staff. The design was undertaken over the course of several years, with key "deliverable milestones" at different stages.

In summarizing the history of the Woodward upgrades, he points out there has been a complete reversal in Hamilton's economic status compared to 2008 and 2009.

"It's now booming," noted Grice.

With that growth, may come an increase in wastewater flows and that is being monitored to determine if a capacity expansion will be required. But that's not anticipated until after 2026, he says.

Although not part of the upgrade's improvements, other construction is also occurring at Woodward including the erection of a new biosolids management facility which is currently on track to open May 1, says Grice.

"This is quite a busy place and, at any one time, there can be 300 workers on site."

CITY OF HAMILTON

The electrical upgrades included in the plant upgrades will ensure sufficient power and for all essential infrastructure at the Woodward Avenue Wastewater Treatment Plant.

$350-million upgrade of Kitchener wastewater treatment plant nears end

DAN O'REILLY
CORRESPONDENT

In a massive undertaking intended to improve the water quality of the Grand River and reduce odours stemming from a lagoon system, the Region of Waterloo has spent millions of dollars and more than 10 years to improve the performance of its large wastewater treatment facility.

> 'The upgrades have significantly improved the plant's reliability, operability and treated water quality,'
>
> Jo-Anne Ing Lagos
> Region of Waterloo

The approximately $350-million upgrade of the Kitchener Wastewater Treatment Plant has gone through three phases — the last of which will come to an end later this year, with a fourth phase now in its early stages.

But that investment is reaping benefits, says Jo-Anne Ing Lagos, the head of the region's environmental engineering division.

Over the past decade those upgrades "have significantly improved the plant's reliability, operability and treated water quality that is returned to the Grand River and have also addressed aesthetic issues including reducing the odours."

REGION OF WATERLOO

Seen here are the new plants being built for secondary wastewater treatment and a new headworks facility that will be completed early this year at the Kitchener Wastewater Treatment Plant.

The upgrades completed in those first three phases transitioned the treatment plant from a conventional secondary treatment plant to a tertiary treatment process capable of meeting stringent effluent criteria.

More complete organic carbon, nitrogen, phosphorus and solids removal as well as improved disinfection have been achieved and studies by the University of Waterloo have shown there has been a marked improvement in the health of the river's fish population, she says.

Conducted from 2008-2012, the first phase upgraded the plant's solids handling process in preparation of for the decommissioning the lagoons and included the construction of a new dewatering centre. The consultant was Tetratech (formerly Hydromantis).

Also starting in 2008 and carrying on into 2013, Phase 2 included improvements to treat centrate and reduce effluent ammonia levels by upgrading the aeration system and the construction of a new aeration building. Other work included the construction of a pumping station and an ultraviolet ultra-disinfection facility. The preliminary and detailed design and services during construction were completed by CH2M Hill.

Commencing in 2010, the third phase included the creation of a facility plan, the conducting of an environmental assessment, the decommissioning of the lagoons, the construction of a new energy centre to provide standby power, and the building of a new headwork's facility, plus a tertiary filtration building and a new outfall. AECOM was the overall consultant and there was a total of six different construction contracts, says Ing Lagos.

Given the scope, complexity and cost of the upgrades program, the region opted for a design-bid-build delivery model. In order accelerate project schedules, however, it also approved a process where the selected design consultants would also provide consulting services during detailed design and construction administration phases, she says.

In the now underway $73-million, 10-year fourth phase there will be multiple projects, some of which are now in progress. They include a twinned influent sewer channel designed by AECOM and being built by W.S. Nichols and the erection of a co-generation facility. The contractor is W.A. Stephenson and the consultant is a team comprised of Jacobs (formerly CH2M Hill) and CIMA. The other projects have not been tendered, although some are in the early design or pre-design stages, says Ing Lagos.

Micro-tunnelling technology key to Newmarket forcemain project

GRANT CAMERON
CORRESPONDENT

A large, yellow crawler crane is in position, poised over a concrete shaft at the pie-shaped worksite near Fairy Lake in Newmarket, Ont. Nearby, an excavator operator is loading dirt onto a waiting dump truck.

Nothing out of the ordinary for your typical construction site, really.

Roughly 12 metres below ground, though, it's a different story. A cigar-shaped, micro-tunnel boring machine is ready to go to work.

The task?

Dig away at the dense underground soil and dirt so concrete pipes can be laid for a 5.1-kilometre-long sewage pipe that will run parallel to an existing 36-year-old forcemain through the heart of Newmarket.

Work on the $110.6-million project, aptly named the York Durham Sewage System Forcemain Twinning Project, is well under way and should be completed by December 2021. The project also includes changes to the Newmarket and Bogart Creek sewage pumping stations to improve the system.

The machine, one of two presently being used on the project, will tunnel west towards Cane Parkway. A second machine will tunnel north from another work area along the route to Newmarket Pumping Station.

The machines will create a tunnel about two metres in diameter. They are pushed by a hydraulic jack and concrete tubes are placed behind.

"At the moment, we're completing our fifth tunnel drive," explains Jose Manalo, project manager, capital planning and delivery, environmental services, for Newmarket. "We're micro-tunnelling the pipe across Newmarket from the north end to the south end.

"Micro-tunnelling is a type of technology where we can do installation of pipe and don't have to open-cut the road and disturb river crossings and whatnot. In total, we have seven micro-tunnel drives. We completed four to date and we are about two weeks away from completing our fifth out of seven drives."

> "It's just amazing. The combination of a laser-guided system and surveying always ensures that they meet the target,"
>
> Jose Manalo
> York Region

The project involves twinning the town's existing forcemain, which will move wastewater from the Newmarket Pumping Station to the Aurora Pumping Station, along with installing 530 metres of pressurized pipe to move wastewater from the Bogart Creek Pumping Station to the new forcemain. Changes will also be made to the Newmarket and Bogart Creek Stations to connect to the new forcemain.

The current forcemain was built around 1983. Presently, Newmarket is the only municipality in the region without a twin forcemain. The plan is to transfer sewage flow to the new pipe and maintain the old one.

The new forcemain will run under 11 river crossings and three railways crossings and below parks and major streets.

TOWN OF NEWMARKET

A look at the cigar-shaped, micro-tunnel boring machines being used on the Newmarket forcemain project.

TOWN OF NEWMARKET

The micro-tunnel boring machines being used for the York Durham Sewage System Forcemain Twinning Project are moved forward using a hydraulic jack. Using the tunnel boring machines reduces the need for open-cut roads.

"It cuts across very dense urban area in Newmarket and we have seven, strategically-placed work areas. Within those work areas we drive the tunnel from point A to point B," says Manalo.

"Right now, we have two machines that are tunnelling in different directions to ensure we finish the project on schedule."

The boring machines are smaller and different than the much larger tunnel-boring machines (TBMs) used on projects like the Metrolinx Eglinton Crosstown light rail line in Toronto. The TBMs are run by an operator inside the machines, whereas the micro-tunnel boring machines are run by an operator above ground.

The micro-tunnel boring machines churn away at the ground and a crane then lowers segments of pipe as it is pushed forward.

It takes a small team of 18 to 20 workers to ensure that the placement and alignment of the machine is correct and that it stays on track.

Contractor for the tunnelling work is Ward & Burke Construction. The company has completed several similar projects in Ontario, including the Burbrook Trunk Sewer Project, a $9.5-million project that involved constructing concrete caissons and two micro-tunnels under rail lines in London, Ont.

As with any tunnel-boring project, the biggest challenge is the soil conditions. The operator adapts as the machine moves along.

"We do our best to try to determine the makeup and the science of the soil conditions so that we can prepare ourselves for what we have to deal with," says Manalo.

"However, you don't always know exactly what soil conditions you're faced with. The main operator needs to be skilled in order to overcome this."

When the machine is boring, the operator is constantly looking at data that is sent back and adjusts the speed and torque of the machine accordingly. Noise is a factor, but engineers have designed the project so that work areas are enclosed as much as possible.

"We've insulated all of our sound-generating equipment," explains Manalo.

"We've housed them off and put insulation blankets around them just to let the vibration and noise from the equipment dissipate."

Original plans called for the forcemain to be installed using an open-cut method, but the amount of trenching required would have been very disruptive to the community and businesses, so the town opted to go with micro-tunnelling in order to ensure less disturbance and to protect the environment.

The machines are incredibly accurate, notes Manalo, and use a laser-guided system so the operator always knows their precise location.

"When they do a breakthrough, they'll draw a circle around where they want it to come through and it's just amazing. The combination of a laser-guided system and surveying always ensures that they meet the target."

TOWN OF NEWMARKET

A section of sewage pipe is lowered into a shaft on the Newmarket forcemain project.