Oakville Water Purification Plant Upgrades

Maximizing the value of existing infrastructure

Oakville, Ontario

ASSOCIATION OF CONSULTING ENGINEERING COMPANIES | CANADA
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REGION OF HALTON

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Executive Summary

The Region of Halton's 100-year-old Oakville Water Purification Plant required upgrades to meet current and projected water demands [Grab your reader's attention with a great quote from the document or use this space to emphasize a key point. To place this text box anywhere on the page, just drag it.]

and updated water quality standards, while considering climate change and emerging contaminant issues. Located in a picturesque community on the shore of Lake Ontario, upgrades to the plant were constrained by neighbouring residents and the waterfront. To deliver the upgrades while minimizing impact to the public and the environment, Associated Engineering developed a two-phased project plan and adopted a sustainable design approach.

The facility's location, age, and limited site required innovative and creative engineering solutions. A high-rate pre-treatment process replaced the conventional pre-treatment system,

Highlights

- Using a sustainable design approach, maximized value from existing infrastructure assets to increase treatment plant capacity
- Retrofitted or repurposed existing infrastructure and optimized treatment processes
- Upgraded treatment plant within constrained site

Exterior of the completed WPP

reducing the footprint of the pre-treatment system by one third. This created space for a new ozone system and chemicals needed for the new pre-treatment process. Ozone provides taste and odour control and primary disinfection.

Upgrades to the Low Lift Pump Station and replacement of the High Lift Pump Station were kept within the existing plant footprint. Pilot testing confirmed filter upgrades could also be achieved in the existing facility footprint; modifications to the filter configuration and underdrain system allowed an increase in the filtration rate. A detailed staging plan ensured ongoing plant production of safe drinking water throughout construction.

This project exemplifies how water utilities can defer large capital expenditures by maximizing value from their existing infrastructure assets to increase treatment plant capacity. Using a sustainable design approach, Associated Engineering maximized opportunities to retrofit or repurpose the existing 100-year-old infrastructure, and optimized treatment processes that were limiting plant capacity. The improvements to the Oakville WPP provide safe drinking water for continued growth and economic development in the Region of Halton for many years to come.

Aerial view of the plant under construction

Introduction

The Oakville Water Purification Plant (WPP) was originally constructed in several stages, beginning in 1908, to meet the needs of a growing community. The plant draws water from Lake Ontario, and the treated drinking water is pumped into Oakvllle's water distribution system, which includes four reservoirs and two water towers.

Project Objectives & Challenges

The 100-year-old Oakville Water Purification Plant was upgraded to meet current and future demands and updated water quality standards. However, the facility's location and age required innovative engineering to deliver upgrades on a constrained site.

Site location and neighbourhood

The WPP's location, in a well-established and developed neighbourhood, limited the space available for the planned upgrades, and meant that the bulk of the work was confined to the existing site footprint. The challenge, therefore, was to replace and improve the existing equipment, and provide for increased water capacity, while being limited to the existing treatment plant site.

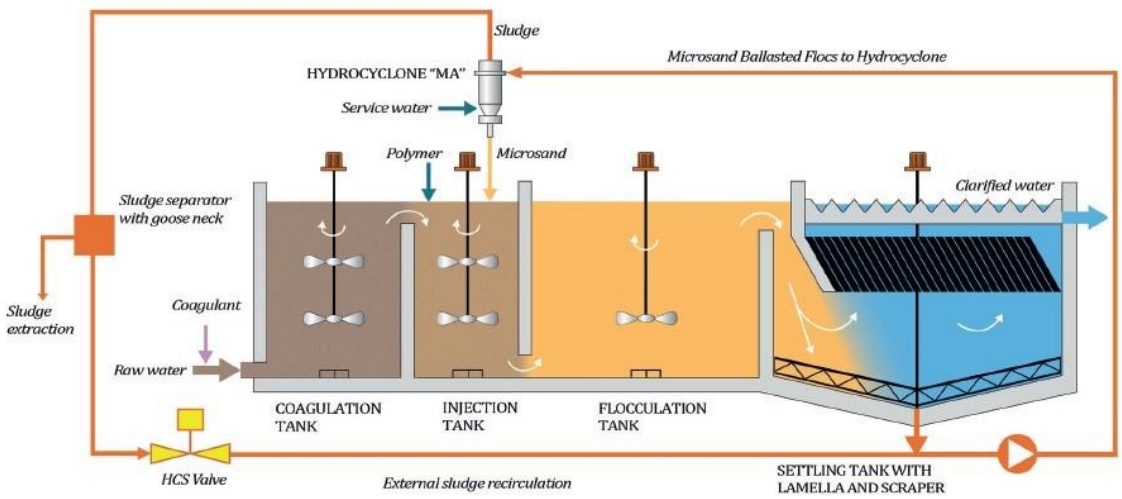
Solution

The physical footprint of the pre-treatment system was reduced by one third by installing a high-rate pre-treatment process (Actiflo®-a ballasted flocculation process) to replace the conventional pre-treatment system. This created space for two new elements. A new ozone system was installed to provide taste and odour control, as well as primary disinfection, and the remaining area houses additional chemicals (alum, polymer and microsand) necessary to operate the new treatment process. Ozone provides the added benefit of its ability to treat emerging contaminants, such as pharaceuticals, should this be necessary in the future.

Water over the weirs

Low Lift Pump Station upgrades were kept within the existing footprint by modifying discharge piping and fittings to improve hydraulics and increasing firm capacity in the future, while eliminating two of the four low lift pumps. Variable frequency drives were also added to the pumps to enhance energy efficiency and allow pumping over a larger range of flows. Architectural modifications, including enhancement to the building cladding, have helped blend the plant with the surrounding residential neighbourhood.

Ozone system



Before work began on the filtration process, a small-scale pilot test was conducted to confirm that upgrades to filter capacity could be achieved within the existing filtration facility footprint. With the optimal filter configuration and maximum design filtration rate determined, the filter underdrain system was replaced with a lower profile system, allowing an increased filter box depth and an increased filter media depth, which provides a higher filtration rate. Significant structural modifications were made including replacement of the filter building roof and rehabilitation of the filter boxes and the structural columns in the filtered water clearwell.

The existing High Lift Pump Station structure and equipment had past its useful life, so a new pump station was required. Keeping with our sustainable design approach, an existing oversized waste holding tank was optimized, modified, and repurposed to accommodate the new High Lift Pump Station. New high lift pumps were installed and sized to meet future capacity requirements, minimizing future upgrade requirements.

A small-scale pilot test was conducted to confirm that upgrades to filter capacity could be achieved within the existing filtration facility footprint out text.

The waste residuals process was optimized to free up valuable real estate that could be repurposed for other treatment upgrades, thereby maximizing the value from the existing infrastructure and minimizing the

constructability impact on the neighbourhood.

High Lift Pump

The water treatment plant upgrades provide 109 million litres per day of drinking water, with the infrastructure to meet a future increase to 130 million litres per day.

The sustainable design approach provided a cost-effective solution that addressed inherent hydraulic constraints with the existing pump station, maximized the value of existing infrastructure, minimized capital costs, and kept upgrades within the existing building footprint.

Innovation

While the upgrades were focused on updating aging equipment, increasing potential capacity of the purification plant for future neighbourhood growth, and improving the treatment process for current water quality regulations, Associated also wanted to ensure that future water quality issues could be addressed. With that in mind, the Oakville plant improvements included an ozone and an advanced oxidation process (AOP), using hydrogen peroxide, as part of the Phase 1 upgrades. Together, these processes can treat emerging contaminants, which could become a concern with water from the Great Lakes basin in the future.

The Oakville plant improvements accommodate treatment of emerging contaminants.

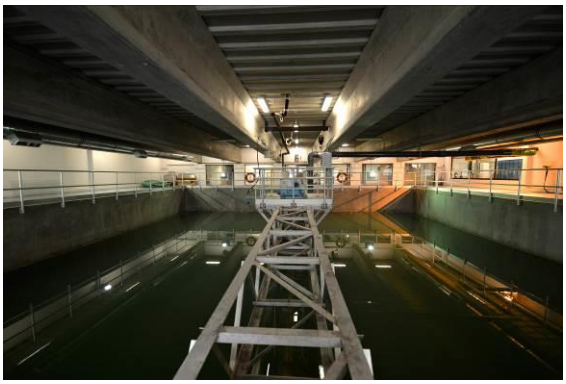
Gravity Thickener

Complexities

The treatment plant's location in a well-established neighbourhood and adjacent to a waterfront trail required the team to consider design and construction activities that minimized or avoided disruptions to the community. In addition, construction had to be staged to maintain drinking water production and distribution to residents and businesses.

Plant site is in an established neighbourhood

Minimizing disruptions to the surrounding neighbourhood was of the utmost importance while successfully completing the major upgrades required at the Oakville WPP. The very tight footprint of the existing facility and proximity to neighbours made this a more complex undertaking than other similar projects. At the outset, a communications plan was developed and implemented to inform, communicate with, and gather input from the community over the course of the multi-year design and construction phases. While some level of disruption was unavoidable, the communications plan helped foster and maintain a positive relationship with the surrounding community.



Capacity maintained during construction

Since the project could only use the existing footprint, maintaining drinking water production during construction also proved to more challenging that would be typically. To address this issue, a staged construction approach and coordinated construction schedule were planned before beginning construction. Since the filter upgrades were identified as having the most impact on production capacity, construction was scheduled to keep the filters on-line during the high-demand summer months. Then construction of the filtration system was phased to maintain a minimum 50% production capacity.

Social & Economic Benefits

A sustainable design philosophy was the cornerstone of the Oakville WPP upgrades, and helped boost the economic benefits of the project. From the beginning, the goal was to maximize the value of the existing infrastructure and defer capital expenditures by re-using existing facilities as much as possible. Using this approach, Associated Engineering maximized opportunities to retrofit and/or repurpose much of the existing 100-year-old infrastructure, and optimized existing individual treatment processes that were limiting overall plant capacity. This project exemplifies how water utilities can defer large capital expenditures by maximizing value from their existing infrastructure assets.

Ozone is an energy effective technology for the multiple treatment objectives that it provides. While the additional treatment processes did result in a net increase to energy consumption, using other energy efficient design techniques as part of our sustainable design approach did reduce the impact on the net energy use.

Socially, the need to maintain the existing treatment plant footprint meant the project followed a staged construction approach to minimize the impact on neighbours and maintain the drinking water supply throughout the upgrades. Regularly informing the public of the status of the upgrades project at the Oakville WPP helped to foster a positive relationship with the neighbouring residents. The improvements to the Oakville WPP provide safe drinking water for residents that meets current and projected demands and treatment requirements and facilitates continued growth and economic development in the Region of Halton for many years to come.

Associated Engineering maximized opportunities to retrofit and/or repurpose much of the existing 100-year-old infrastructure.

Environmental Benefits

Associated's sustainable design approach resulted in significant environmental benefits. For this project, Associated upgraded or re-purposed much of the existing equipment and facilities, thereby reducing the environmental impacts of construction and maximizing the value inherent within the existing infrastructure.

The original sedimentation basins were retrofitted with high-rate treatment process including Actiflo® and ozone providing more robust and advanced treatment within the original treatment plant footprint. Recognizing the historic source water quality variations at the Oakville WPP and being early adopter's of climate change adaptation and mitigation assessments, the Actiflo® process was identified as the preferred pre-treatment technology as it has an inherent ability to withstand severe source water quality variations with minimal impact to operations and more importantly, treatment performance.

The Low Lift Pump Station upgrades were also limited to the existing footprint. By making discharge piping and fitting modifications to improve discharge hydraulics and allow for an increased firm capacity, much of the existing equipment was upgraded instead of replaced, reducing environmental impacts.

The structure and equipment of the existing High Lift Pump Station was well past its useful life. The team decided that a new pump station was required. To reduce environmental impacts and maintain the projects sustainable design philosophy, an existing oversized waste holding tank was optimized, modified, and repurposed to accommodate the new High Lift Pump Station.

High Lift Pump station was built into a re-purposed waste holding tank

New discharge lines from the new High Lift Pump Station were constructed to connect to the water distribution system. The large diameter potable water lines were constructed using micro-tunnelling to minimize the environmental and social impact of construction within the neighbourhood, namely the small local park and waterfront trail.

Meeting Client's Needs

From the start of the project, the Region of Halton had a few key requirements. The project had to be staged carefully to ensure that the treatment plant would remain operational during construction, meet the varying distribution demands, and satisfy all existing regulatory requirements – ultimately, ensuring that the security and safety of the drinking water supply for the Region's residents and businesses. The project also needed to minimize the impact on the local neighbourhood as well as consider regulatory change, climate impact and future capacity increases in establishing the preferred treatment technologies and engineering design solutions.

Associated Engineering and the Region established a two-phase upgrade plan that minimized impact on local residents and users of the waterfront trail, while providing water production and water quality benefits at the end of each phase.

A unique Visioning workshop held early in the Phase 1 design process was critical to understanding the Region's goals and needs. We worked with project stakeholders within the Region to establish their visioning of the overall upgrade requirements at the Oakville WPP.

Subsequently, the team completed an asset assessment and prioritized needs, which informed the staged implementation program that shaped the Phase 1 and Phase 2 upgrades.

An honest, open, and collaborative communication channel between Associated Engineering, the Region as well as the many other internal and external stakeholders contributed to the successful delivery of the project from the initiation of the Phase 1 upgrades to the completion of Phase 2 upgrades in 2015.

Additionally, upgrades included improved HVAC and building systems controls, providing the region with improved control, and reduced energy use. Remote monitoring was also added, allowing the region to see and control all their plants remotely from workstations, tablets, and cellphones, depending on individual responsibility levels.