AECOM

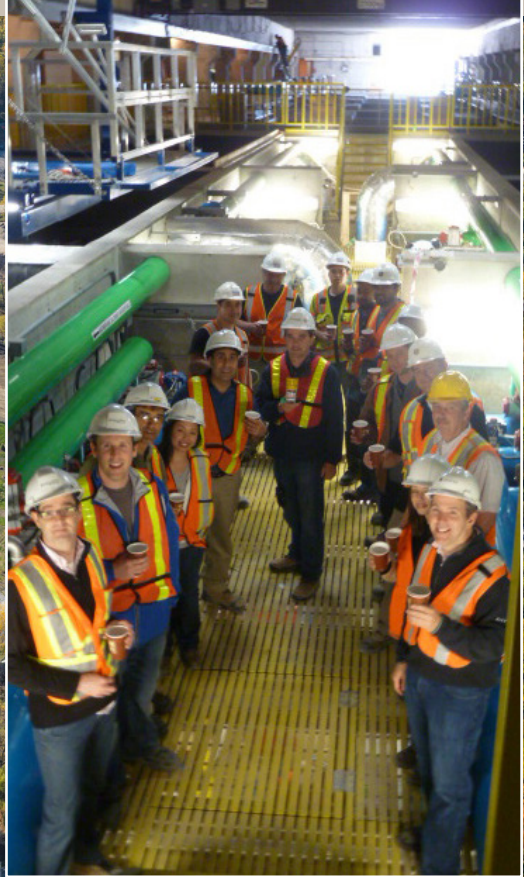
CANADIAN CONSULTING ENGINEERING **AWARDS**

LORNE PARK WATER TREATMENT PLANT EXPANSION

WATER RESOURCES

APRIL **2013**

www.aecom.com
@AECOM



PROJECT **SUMMARY**

Picturesque Jack Darling Memorial Park is located on the north shore of Lake Ontario in the southwest sector of the vibrant City of Mississauga. The park has pedestrian walkways and bicycle paths that wind through the parkland leading to spectacular waterfront trails, picnic areas, tennis courts, playgrounds, splash pads and beaches. The park also has one of the largest and most used leash-free areas for dogs in the Region. A toboggan run starts at the peak of the buried treatment plant and has the best view of Lake Ontario.

The Regional Municipality of Peel commissioned AECOM, in partnership with GENIVAR and other sub-consultants, to design the expansion of the Lorne Park Water Treatment Plant and integrate it into the existing landscape of the park. The project value is in excess of $200 million.

The water treatment plant retrofit design merges older approaches with new technologies to achieve high levels of treatment and expansion capacity in order to service the Region of Peel's projected population growth to the year 2031. With minimum additional footprint, the plant was equipped with a membrane filtration and ultraviolet (UV) light disinfection system. These state-of-the-art processes provide a high level of removal and inactivation of pathogens, and are further supplemented with an UV Advanced Oxidation Process (AOP) to help control taste and odour compounds that occur seasonally. This advanced treatment system ensures extremely high quality water that far exceeds Ontario Drinking Water Quality Standards.

Lorne Park WTP is the largest retrofitted low pressure municipal membrane filtration system in the world and hosts the largest municipal UV advanced oxidation installation for taste and odour removal in North America, and one of the largest in the world. The multiple projects required to deliver this expansion were completed 20 days ahead of schedule.

Effective Consultation and Conceptual Design

In early 2005, following the completion of a Master Planning project, it was determined that the Lorne Park WTP needed to be expanded to 500 ML/d and required additional taste and odour control facilities to be in place by the year 2013.

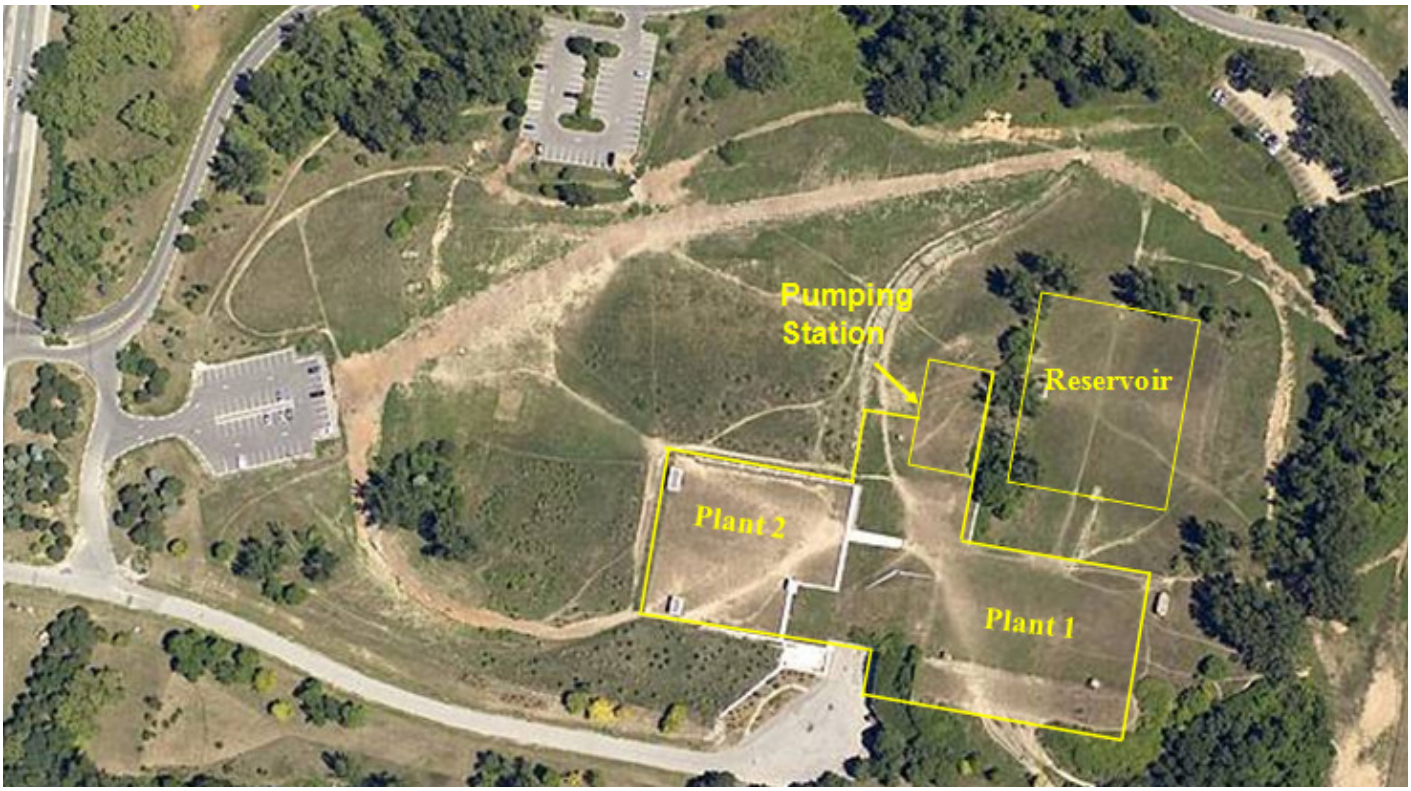
A Schedule C Class Environmental Assessment (EA) was initiated with a public consultation program consisting of two Public Information Centres including meetings with neighbourhood associations managing the leash-free areas for dogs. Efforts to maintain and strengthen communications also included a dedicated website and newsletters.

The preferred conceptual design solution was to retrofit Plant 1 from a 227 ML/d conventional plant to a 380 ML/d membrane plant, with ultraviolet (UV) reactors being installed in both Plants 1 and 2 to provide *Giardia and Cryptosporidium* disinfection, preserving the reservoir to provide virus disinfection as well as distribution water storage. The UV system in Plant 2 was also to be designed as a 380 ML/d UV (200 ML/d in initial phase) advanced oxidation system with hydrogen peroxide being dosed seasonally to provide taste and odour removal when needed.

In May 2005, following the completion of the Class EA, the Region began detailed design work to upgrade and expand the Lorne Park WTP. The main criteria for selecting the preferred treatment strategy included:

- Ensuring that all of the plant's components would continue to meet and exceed the current and foreseen water quality objectives of the Ministry of the Environment's drinking water regulations; and
- Minimizing the construction area and topography changes, while leaving sufficient provisions for future treatment of elevated taste and odour events and possible raw water quality deterioration.

The image below shows the proposed concept of the 500 ML/d expansion, with the new building expansions with landscaping currently undergoing to recreate a leash-free dog park above the plant.



ML/d Lorne Park WTP Buried Below a Leash-free Dog Park (2002)

Design Objectives

The main objectives in designing this plant expansion were to:

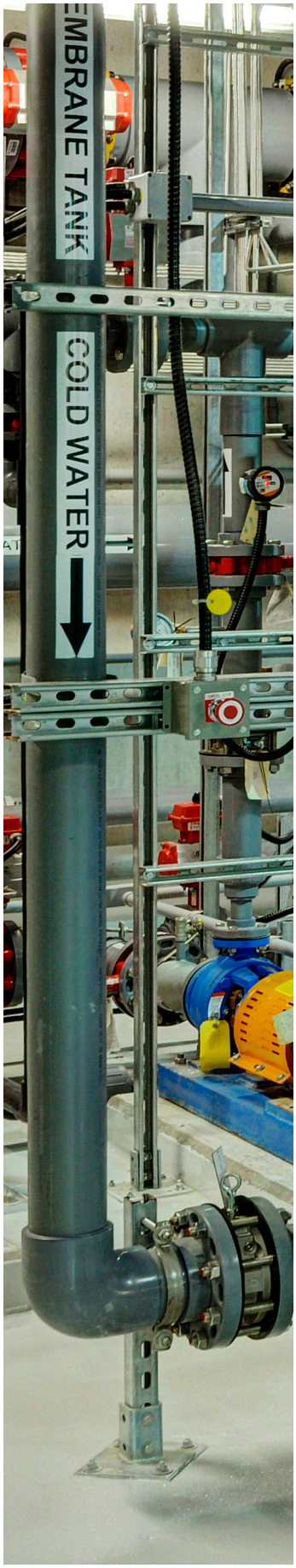
- Provide a design that uses the minimum footprint in this prime location;
- Develop design solutions that allowed new technologies and increased flow to be integrated into the existing plant without allowing major interruptions to the existing plant operations;
- Meet the Region objectives in water quality and allow for provisions to handle raw water quality deterioration;
- Meet the deadline to deliver the water to the Region; and
- Develop design concepts to overcome the weak soil conditions while protecting existing major water retaining structures.

From the earliest stages of the design process, the team worked closely with the Region to develop design criteria and parameters for various elements of the project. Every aspect of the design needed to be evaluated with the following questions:

- Can we design it any other way to reduce the footprint?
- Can we expand the plant capacity in the future?
- Can it be built without interruptions to the water production?

After many reviews, detailed design included the following process changes and expansion conditions:

- Raw Water Supply System — A new low lift pumping station was connected to the existing intake pipe with a new tunnelled pipe. This new pipe was connected to the existing intake pipe while still in operation and flooded with Lake Ontario water while the plant was still producing treated water.
- Membrane Filtration System — Eight sedimentation tanks were retrofitted to hold 16 trains of the membrane filtration system. In order to provide flexibility to the existing operation, flocculation tanks were retrofitted to equalization tanks. This concept was designed to be implemented in two phases to allow a portion of the existing conventional plant to be in operation and meet the demand during construction.
- Taste and Odour Control — The design objectives included meeting threshold limits for taste and odour under various raw water parameters and water demand conditions. The conventional part of the plant continues to have higher taste and odour compound reductions with deep sand GAC filters at 120 ML/d. The membrane filtration part of the plant is equipped with an UV Advanced Oxidation Process (AOP) followed by GAC contactors, which includes specialized catalytic carbon. Blending of these two sections provides excellent levels of reduction in compounds under high spikes in raw water. The operators have flexibility to vary the flow to each part of the plant to obtain higher reductions.



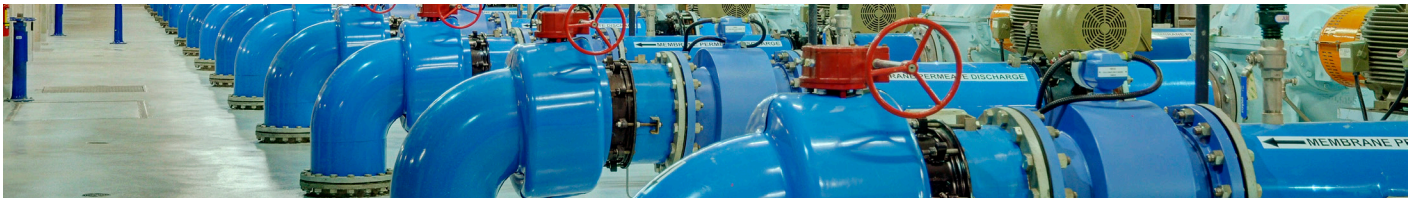
INNOVATIVE SOLUTIONS

Design solutions utilized the least possible footprint for this expansion and allowed space for future expansion in one of the fastest growing regions in Canada. Every challenge was turned into an opportunity in this project. For example, narrowed and steep sloped areas of the new expansion of the building became a gentle path for dogs and their owners. Building a new low-lift pumping station used up the last available space on the east side, but it gave an opportunity to retrofit the existing low lift pumping station and increase the capacity by retrofitting the conventional plant.

Considerations for future expansion of services, ongoing maintenance and operation costs were an integral part of the design. Innovative techniques were used throughout the project in all phases of the design in order to deliver construction cost savings to the Region, while maintaining or improving function, safety and aesthetics. A number of common processes were examined, and innovative interpretations and applications were developed. Some examples included:

- Installed UV disinfection to avoid the construction of an additional reservoir, saving space and money;
- Installed minimum advanced oxidation UV reactors to provide treatment for one plant, so that blending with the treated water from the other plant provides satisfactory water quality;
- Installed dual UV oxidation/disinfection reactors to provide two types of treatment using the retrofitted equipment;
- Retrofitted already engineered filters to provide additional treatment performance requirements;
- Made provisions in the membrane system design to allow for potential deteriorating raw water quality in the future;
- Made provisions in the membrane system design to provide constant and reduced feed and filter flow rates to ease operation and reduce cost of other treatment processes;
- Retrofitted existing residue management processes to provide treatment of new waste; and
- Retrofitted existing chemical rooms for new chemicals.

IN ADDITION TO THE INTEGRATION OF NEW TECHNOLOGIES SUCH AS UV AND MEMBRANE FILTRATION, EVERY SECTION AND EVERY PROCESS OF THE EXISTING PLANT WAS IMPROVED UPON OR EXPANDED TO INCREASE CAPACITY.



LORNE PARK WATER TREATMENT PLANT EXPANSION

HIGH LEVEL OF **COMPLEXITY**

Factors contributing to a high level of complexity for the project included:

- Overall size of the project added to the complexity of it because the expansion was limited to the existing footprint of the plant and could not impede on the Park's environment;
- Schedule requirements were demanding to meet the overall schedule of the Master Plan;
- Coordination of numerous stakeholders and approval authorities such as dog owners, park users and the City of Mississauga;
- Complex transient analyses with various pumping and feedermain options resulted in the installation three surge tanks; and
- Staging of the construction had to be carefully conducted to ensure plant operations at ALL times.

World Class Procurement and Pilot Work

To integrate the state-of-the-art water treatment technologies into the plant expansion, world-class equipment procurements and pilot studies were completed as part of the project. These included:

- A 12-month membrane pilot study on-site that mimicked future processes and tested out potential membrane equipment vendors (Figure 4);
- An 18-month specialized catalytic carbon bench and on-site pilot column studies that reviewed ground-breaking new catalytic carbons from international carbon vendors (Figure 5); and
- Purchasing and competitive equipment procurement of UV Advanced Oxidation (200

SOCIAL AND **ECONOMIC** BENEFITS

All of the contractors involved in the successful delivery of this project were local. In addition, all of the major equipment including membranes provided by GE Water, and UV components provided by Trojan Technologies were sourced from local suppliers.

The Lorne Park Water Treatment Plant design expansion made significant contributions to the economic, social and environmental quality of life for the park, the local community and the larger Region as a whole.

By maintaining the integrity of the Jack Darling Memorial Park while designing the expansion, the Region was able to keep design costs down by using innovative and cost saving techniques to expand the plant with its partners. Ultimately, the benefit is realized from the landscape of the park being upgraded as well as the water treatment plant in an innovative landscape and building design. They both share the landscape while the water treatment plant is virtually unseen by park visitors.

Lorne Park WTP is an Education Facility

The Lorne Park WTP has been the centre of excellence for many tours for industry professionals locally and abroad as far as Hong Kong. It was a key tour facility for the following conferences:

- GE Water Users Group Annual Conference in October 2011
- International UV Association and Ozone Association Joint Conference in November 2011
- Water Quality and Technology Conference in November 2012

The Lorne Park WTP also conducts tours for elementary and secondary school students. In the future, the Region intends to build on this by providing educational stations to enhance the information being provided to both students and industry professionals.

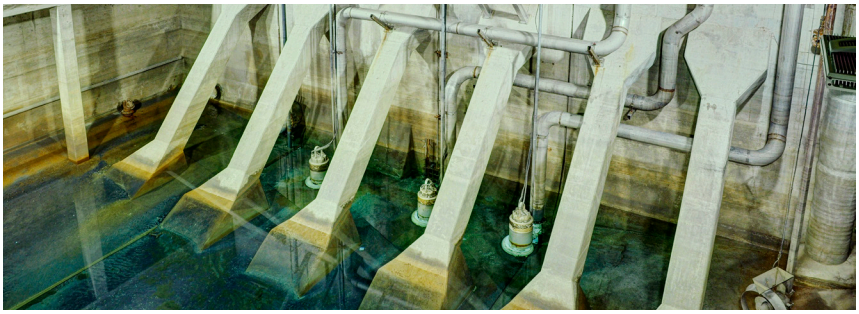
Existing Bexhill Sewage Pumping Station in Rattray Marsh

Public Consultation

To ensure the project's acceptance in the local community, two Public Information Centres were held to explain why the project was necessary and to share information on its overall sustainability. The project team listened and responded to the ideas from the local residents and interested parties. A leash-free dog zone on top and around the plant and a toboggan run on the north east side were established and developed after the plant's original construction and expansion over the years. The addition or upgrade of waterfront trails, picnic areas, tennis courts, playgrounds, splash pads and beaches will enhance the already picturesque parkland and encourage more visitors to the park.

A Truly Local Project

All of the contractors involved in the successful delivery of this project were local. In addition, all of the major equipment including membranes provided by GE Water, and UV components provided by Trojan Technologies were sourced from local suppliers.



ENVIRONMENTAL IMPACTS

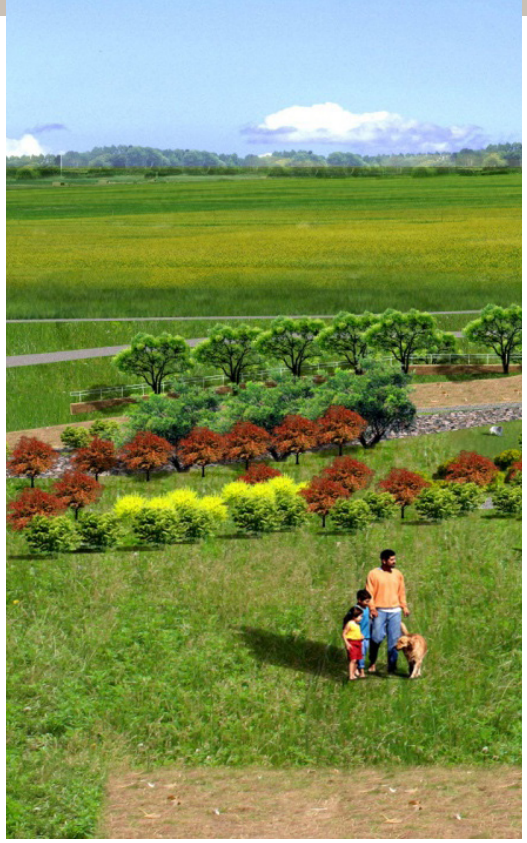
The previous sewage pumping stations were located in Rattray Marsh where overflows could pollute the marsh. The new sewage pumping stations were upsized and located away from this marsh to Jack Darling Park to provide a more reliable sewage transfer in a less sensitive environment in the event of overflows.

The filtration (membrane) and primary disinfection (UV) technologies installed at the Lorne Park WTP to achieve a total plant capacity of 500 ML/d were of a minimal footprint, thus minimizing the amount of site disturbance and excavation required. This included the ability to prevent disruption to the neighbouring wood lot.

The existing plant was already buried underneath Jack Darling Park with landscaping and final grading of the plant expansion being done (Figure 29 and Figure 30) so as to provide the same size park and:

- expose some portions of building walls as possible 'garden walls';
- create better access to the park;
- provide a more comfortable access to the top of the 'plateau' for the dog walkers;
- form a strong connection with existing pathways allowing for a continuous circuit around the parkland; and
- provide a tobogganing run.

Also, a new topographical drainage concept was developed to direct the stormwater runoff to the roots of the trees surrounding the water treatment plant.



Rendering of the Final Grading at Jack Darling Park

MEETING **CLIENT NEEDS**

Lorne Park WTP is the largest retrofitted low pressure municipal membrane filtration system in the world and hosts the largest municipal UV advanced oxidation installation for taste and odour removal in North America, and one of the largest in the world. The multiple projects required to deliver this expansion were completed 20 days ahead of schedule. The client's main design objectives were to:

- implement a design that took the minimum footprint in this prime location;
- develop solutions that allowed new technologies and increased flow to be integrated into the plant without major interruptions to existing operations;
- meet the Region's water quality objectives and allow for provisions to handle raw water quality deterioration; and
- meet the 2013 deadline for increased capacity and taste/odour control.

This retrofit design merges older approaches with new technologies to achieve high levels of treatment and expansion capacity to service the Region of Peel's projected population growth to the year 2031. With minimal additional footprint, the plant is equipped with state-of-the-art technology and processes that provide a high level of removal and inactivation of pathogens, and control taste and odour compounds that occur seasonally. This result is extremely high quality water that exceeds Ontario Drinking Water Quality Standards.

From the earliest stages of the design process, the team worked closely with the Region to develop design criteria and parameters. Every aspect of the design was evaluated and adjusted to minimize its overall impact on footprint, expansion capabilities and potential interruption to water production.