Bentley
Advancing Infrastructure

Project Summary

Organization
Hatch

Solution
Water and Wastewater Treatment Plants

Owner/Client
City of Toronto (Toronto Water)

Location
Toronto, Ontario, Canada

Project Objectives

- To design a new tunneled outfall to send treated wastewater plant effluent into Lake Ontario.
- To plan construction of a shaft adjacent to the shoreline and mining through rock directly beneath the lakebed.

Project Playbook
Microstation®, OpenBuildings® Designer, OpenRoads™, ProjectWise®, STAAD®

Fast Facts

- Located along Lake Ontario, Ashbridges Bay Treatment Plant is one of Canada's largest and oldest wastewater treatment plants.
- Its existing outfall had insufficient hydraulic capacity and was nearing the end of its service life.
- Hatch realized early on that they needed to combine computer-aided design with engineering analysis for success.

ROI

- By using Bentley applications, Hatch delivered a 3,500-meter-long tunnel design to their client ahead of schedule.
- With MicroStation 3D models used for review workshops, 100% of issued for tender submissions were delivered a week in advance, saving CAD$ 25,000.
- Hatch could employ one full-time and two part-time team members, reducing staff hours by 2,000 hours and resulting in CAD$ 50,000 savings.

Hatch Designs a Complex 3,500-meter-long Tunnel Under Lake Ontario to Replace Aging Outfall

Bentley Applications Helped Deliver Ashbridges Bay Treatment Plant Outfall for the City of Toronto on Time and within Budget

Designing an Underwater Treatment Plant Outfall

Located east of downtown Toronto on the shore of Lake Ontario, the city's Ashbridges Bay Treatment Plant Outfall (ABTPO) project needed an upgrade. The treatment plant is one of Canada's largest and oldest wastewater treatment plants, built in 1910 and operational in 1917. It is the largest of Toronto's four sewage plants, with a peak hydraulic capacity of 3,300 megaliters of wastewater per day. However, the existing outfall had insufficient capacity for discharging treated effluent into the lake, as it was constructed in 1947. The outfall was also nearing the end of its service life.

With team members in Canada, Hatch was responsible for the design and construction of a new tunneled outfall that will send treated wastewater from the treatment plant into Lake Ontario. The CAD$ 300 million project included sinking a shaft adjacent to the shoreline and then mining a tunnel through rock directly beneath the lakebed. "To put the shaft and tunnel dimension into perspective, we're effectively building a shaft which is a football field deep into the ground, a tunnel that is approximately three times the length of the Golden Gate Bridge, and a tunnel dimeter that that is the size of an average two-story house," explained Kevin Waher, senior project manager, tunnels at Hatch. The treated effluent would then flow by gravity from the plant through connecting conduits to the shaft and tunnel out into the lake. The location, complexity, and scale of the project all presented major challenges.

Improving Wastewater Treatment for City of Toronto

Hatch realized early on that they needed software that combined computer-aided design with engineering analysis to ensure the success of this project. Besides overcoming the multiple, complex challenges around the project's construction, they also needed to minimize costs while considering the underwater soil and environmental features. Also, as the treatment plant services about 1.6 million residents, the final result needed to ensure an enhanced quality of life for the community, as well as any future residents as the city grows and expands.

ProjectWise's collaborative environment improved efficiencies and enabled Hatch to complete the detailed design on time and within budget.

They determined that traditional engineering delivery methods would be insufficient in the case of this project. In addition to the work surrounding the construction of the tunnel, Hatch also needed to build 50 vertical in-line diffuser risers to connect the top of the tunnel to the lakebed along the last 1,000 meters of the tunnel to help convey flows to the lake. Tunnel operations would have to be supported from the onshore shaft while risers would be drilled from over-water barges. Coordination would be key to ensuring the successful delivery of this project; and with the team scattered throughout various offices, they would need to develop digital collaboration workflows for efficient communication.

Bringing Team Together for Improved Engineering Analysis

Hatch was already familiar with Bentley, having used the software during this project's initial design phase in 2015. Therefore, Bentley applications were ideal for this next phase of the project. Using Bentley's OpenRoads, Hatch's engineers created surfaces from borehole logs, including the lake's water level and the anticipated tunnel invert. This approach enabled the prediction of geological boundary conditions below the lake to steer significant design decisions. They discovered the most efficient depth of the shaft,

"Bentley's suite of software was implemented on the ABTPO project to build practical solutions that solve unique engineering challenges, to facilitate a connected and collaborative work environment, and to deliver a cost effective and efficient project."

– Kevin Waher, Senior Project Manager Tunnels, Hatch

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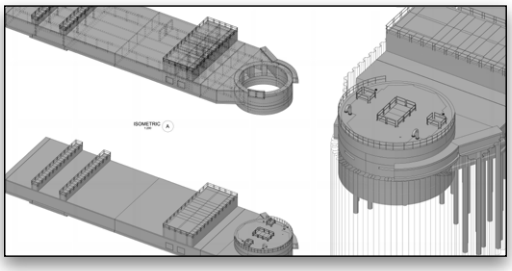
mitigating potential risks of tunnel inundation from the lake. They created a circular profile around the shaft in OpenRoads to confirm soil conditions throughout, which helped determine the appropriate types of excavation. With MicroStation, Hatch modeled all elements of the shaft and tunnel, allowing them to complete the tunnel rings and determine the proper rotation of each ring to help with possible connection problems. The 3D model provided a clear picture of the complex geometry, helping the engineering team prepare a simplified reinforcement plan. They also modeled the excavation for the shaft, accounting for the depth of the structures, varying conditions of the soil and rock, and varying types of structures to ensure that their excavation plan would proceed on time and without any unforeseen delays.

Hatch also used ProjectWise's connected data environment so that the team could collaborate across several time zones, ensuring that the project was on time and under budget. They coordinated all CAD work, engineering analysis, and design in the platform, allowing the team to continue working on CAD drawings while PDFs were created on a separate server. "Bentley's suite of software was implemented on the ABTPO project to build practical solutions that solve unique engineering challenges, to facilitate a connected and collaborative work environment, and to deliver a cost-effective and efficient project," stated Waher.



With MicroStation 3D models used for review workshops, 100% of issued for tender submissions were delivered a week in advance, saving CAD$ 25,000.

Exceeding Client Expectations while Saving Significant Cost

By using Bentley applications for this project, Hatch delivered a high-quality design to their client ahead of schedule. The software's advanced CAD capabilities allowed them to employ one full-time and two part-time team members, reducing staff hours by 2,000 hours and resulting in CAD$ 350,000 savings. With 3D models used for technical peer and constructability review workshops, 100% of issued for tender submissions were delivered to the client a week in advance, saving CAD$ 25,000 in CAD staff hours. Also, because the project was paperless due to the use of ProjectWise's connected data environment for sharing all documents and information, Hatch saved over CAD$ 35,000 in paper and printing costs. ProjectWise's collaborative environment also ensured connectivity across time zones, improving team efficiencies and enabling Hatch to complete the detailed design on time and within budget.

These results were recognized by the client. Alison Barlow, the manager of the Ashbridges Bay Treatment Plant projects, stated, "On time and under budget, what more can I say?" Additionally, Justyna Teper, the City of Toronto's outfall project manager, stated that, "The outfall design phase was completed to the city's satisfaction, on time and under budget, which is commendable." The new outfall is a critical element of the city's improvements to the plant's hydraulic capacity, and it is anticipated that the ABTPO project will help improve the city's shoreline and beaches, as well as Lake Ontario's water quality. Russell Pye, senior marketing specialist for Hatch stated that, "Hatch sincerely appreciates the opportunity to employ Bentley's suite of software and tools to performed detailed design services. [. . .] We look forward to working with [Bentley] again on future outfall projects across the world." The construction of this project is on track to be completed in 2024.

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