



2020 Canadian Consulting Engineering Awards

# LOWER SIMCOE STREET (YORK-BAY-YONGE) OFF RAMP

TRANSPORTATION



ASSOCIATION OF CONSULTING  
ENGINEERING COMPANIES | CANADA



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*The ramp (left) during construction, with Rogers Centre and CN Tower in the background*

## ABOUT THE PROJECT

The City of Toronto is committed to remaking waterfront streets as “places” with high quality amenities for pedestrians and cyclists and designated parks to enrich the waterfront communities. These goals are embodied in the first principle of the City’s Central Waterfront Secondary Plan: Remove barriers and reconnect the City with Lake Ontario.

One barrier that the City had struggled to mitigate was the Gardiner Expressway ramp terminals. In 2013, the City commissioned WSP (formerly MMM Group) to complete an Environmental Study to evaluate alternatives for the reconfiguration of the F. G. Gardiner Expressway York-Bay-Yonge eastbound off ramp. Recommendations in that report included constructing a new eastbound off ramp terminating at Lower Simcoe Street and widening Harbour Street between Lower Simcoe and Bay Streets.

In 2015, the City retained WSP to design a new off ramp to replace the existing York-Bay-Yonge off ramp. The existing off ramp was 700 m long and terminated at Bay Street. The new one was to terminate at Lower Simcoe Street and be 500 m shorter. WSP undertook design and overall project management for preliminary and detailed design of the new bridge structure. The structure was completed in 2018.

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*The City of Toronto wanted to create a more vibrant downtown development by replacing the ageing ramp with one that opened up the Harbour Street cross section to accommodate another lane of traffic, wider sidewalks, treed boulevards, and a 3-m wide paved multi-use trail.*

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*Looking west from Lower Simcoe Street:  
Before, with the existing ramp overhead*



*After, at the termination of the new, shorter ramp*

## INNOVATION

The new F. G. Gardiner Expressway Lower Simcoe Street (York-Bay-Yonge) Off Ramp is a concrete slab on steel plate girder bridge that conveys traffic from the Eastbound Gardiner Expressway into downtown Toronto. It is curved in plan, superelevated, and tapers from two lanes plus shoulder to three lanes plus shoulder. The structure comprises seven spans, ranging in length from 14.0 to 19.5 m. The bridge is supported by four existing bents which also support the mainline Gardiner Expressway plus three new piers and an abutment. From the abutment, the ramp continues east on a 70 m long retained soil system to where it meets existing grade at Lower Simcoe Street. The bridge carries new streetlighting, new advanced traffic management system hardware, and a fixed automated anti-icing spray technology (FAAST) system that includes a weather station.

The FAAST system was incorporated into the ramp to maximize safety on the ramp and eliminate response times during storm/icing events. This system includes a weather station fixed to the barrier wall, sensors within the ground and pavement, and 20 “sprinkler” heads embedded in the pavement to spray anti-icing chemical onto the pavement in advance of icing events. The FAAST system required a pumphouse to house the associated hardware and 20,000 L anti-icing chemical tanks. WSP’s design successfully incorporated this structure into the abutment itself, rather than leaving it as a separate structure, so that it could be made as secure as possible in a downtown environment.

The many site problems and obstacles presented opportunities for WSP to innovate. For example: the abutment of the ramp at its east termination at Lower Simcoe Street sits atop a 100-year-old concrete storm sewer outfall that had to be bridged without subjecting it to any additional stress. To accommodate this, WSP consulted with several ground improvement experts but found their solutions were too costly, too time consuming, and resulted in too much ground settlement. WSP designed an innovative solution that provided a rigid (zero settlement) support for the abutment for \$600,000 less than the other solutions: an 85 x 16 m buried concrete slab supported by 585 small-diameter helical piles advanced to bedrock (not a typical use for such piles). The entire 4 m high, 70 m long retained soil system abutment sits on this “slab on stilts” and imparts no load on the historical storm sewer below. This is a unique and outstanding engineering achievement.

## COMPLEXITY

The quick transition from elevated expressway to at-grade downtown street necessitated a steep ramp. Modifications to the existing bents upstream (west) of the ramp were considered during design to reduce the steepness of the ramp, but these ideas were abandoned given that these bents also carried the mainline Gardiner Expressway above, Lake Shore Boulevard ran underneath them, and any reconstruction would require a significant closure of both roads at the same time. The two roads are the main arteries leading into the downtown area: to close them simultaneously was not an option. Instead, WSP drew on its technical excellence to provide a safe design that included “daps” at the west ends of the 800 mm deep steel girders supporting the start (west end) of the ramp deck, thereby reducing their depth (and lowering the road above) by 470 mm. This allowed for a longer, gentler vertical crest curve leading into the descent down the ramp and improved safety and comfort over what would have been achievable without such an innovation.



*Dapped girder ends at the west end of the ramp allow for a smoother transition to the required steep grade of the ramp*

The existing York-Bay-Yonge ramp was one of three main connections to the downtown core for vehicles entering the City from the west. Closing it meant diverting a large amount of traffic, particularly during the morning rush, to the other ramps at Spadina Avenue and Jarvis Street. One of the most important factors for the successful completion of this project was to minimize the impact on the travelling public and the City’s intent during construction was to minimize the duration of such a closure.



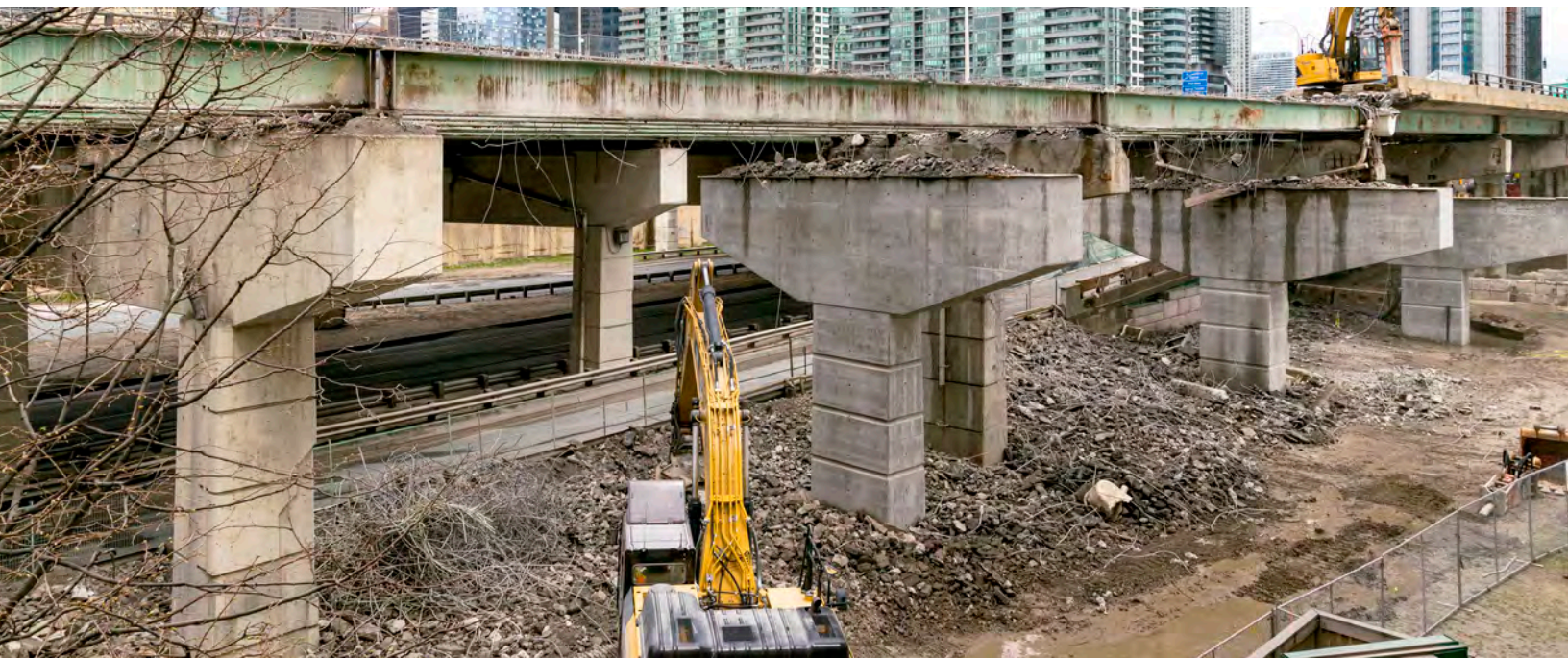
*Construction of the new foundations underneath existing ramp while it stayed open to traffic*

Constructing the foundations often takes up a significant portion of the construction schedule for bridges. On this project, the foundations were designed such that they could be constructed using small equipment entirely under the existing ramp without a need to close it or impact any Gardiner Expressway traffic. **The duration of the ramp closure was thereby shortened by a year.** This engineering feat was made more complex by the fact that the bridge is located in an area of very poor soils (end-dumped spoils to fill in Lake Ontario a century ago) and that caissons had to be advanced to shale bedrock 10 m below the ground surface.





*Demolition of the existing ramp showing close proximity to downtown buildings*



*New piers underneath, ready to accept the new superstructure*

This was a truly multi-disciplinary project requiring the coordination of internal resources, experience, and expertise: in-house structural, municipal, electrical, traffic modelling, and systems engineers; and geotechnical, utility, landscape architecture, and anti-icing sub-consultants. To keep these disciplines working in coordination on schedule and on budget required vigilant, pro-active project management on the part of WSP's structural project manager.

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*Working in this downtown area required that many (sometimes conflicting) client and stakeholder interests be balanced. There was often no precedent for how an agreement should be reached, so WSP had to act as a technical negotiator to ensure that a consensus was reached and the design could proceed on schedule.*

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## SOCIAL AND/OR ECONOMIC BENEFITS

The City wanted a design that would effectively address various planning goals it had established over the preceding decades, best summed up by the first principle of the City's Central Waterfront Secondary Plan: Remove barriers and reconnect the City with Lake Ontario. Also of importance was that the City's waterfront streets be remade as "places" with high quality amenities for pedestrians and cyclists and that parks be designated to enrich waterfront communities. The Gardiner Expressway ramp terminals are one of these barriers that the City has struggled to mitigate.

Completion of the project means that existing parkland within the York Street ramp site can be improved and made visually more accessible to further enrich the waterfront. The new park will have a beneficial effect on the community and meets the City's objective "that parks be designated to enrich waterfront communities." Furthermore, the project allows for the continuation of the Martin Goodman Trail along Harbour Street which accomplishes the City's city building initiative of promoting the creation of pedestrian and cyclist supportive environments.

No project in recent history has had a more profound effect on the community in terms of the City's objective to remove barriers and reconnect Toronto with Lake Ontario. The success of the project, however, would not have been possible without the contribution of WSP's (and their subconsultants') innovative engineers working in a coordinated effort to ensure that the design overcame all of the site constraints, that the steep grade of the ramp could be accommodated in a safe manner, and that impacts to traffic and the community were minimized during construction.



*Looking east down the ramp: A gateway to the City*

## ENVIRONMENTAL BENEFITS

The completed ramp promotes less congestion in downtown Toronto, as described in the 2013 Environmental Study to evaluate alternatives for the reconfiguration of the F. G. Gardiner Expressway York-Bay-Yonge eastbound off ramp. Reduced congestion reduces greenhouse gas emissions from traffic. Above and beyond fulfilling the requirements of the Environmental Study, the innovations introduced by WSP to shorten construction time by one year also significantly helped to reduce congestion. This reduction cannot be understated on the Gardiner Expressway, one of Canada's busiest highways.

The FAAST system incorporated into the ramp minimizes the use of road salt and eliminates the need for snow ploughs on the ramp.

Stainless reinforcing steel in the deck and atmospheric corrosion resistant structural steel not only achieve the 75-year design life for the structure, but also minimize the number of times it will need to be rehabilitated, saving resources and reducing congestion-causing closures during the ramp's service life.

Completing the new ramp meant that land occupied by the previous, longer ramp could be turned over to the City Parks, Forestry, and Recreation department (a very rare occurrence of such an internal land transfer) for incorporation into the adjacent parkland.

# MEETING THE NEEDS OF THE CITY OF TORONTO

The project is a comprehensive solution to the City's requirements in that it improves the public realm yet still maintains the flow of traffic between the Gardiner Expressway, the downtown core, and the waterfront. The project contributes to economic, social and environmental quality of life and works toward goals of the City's Master Plan, the Central Waterfront Secondary Plan, a Municipal Class Environmental Assessment, various Promenade Plans, and the Queens Quay Revitalization Environmental Assessment.

## PROJECT TEAM

**City of Toronto**  
Owner

**WSP**  
Structural, Municipal, Electrical, Traffic Modelling, and  
Advanced Traffic Management Systems Engineering

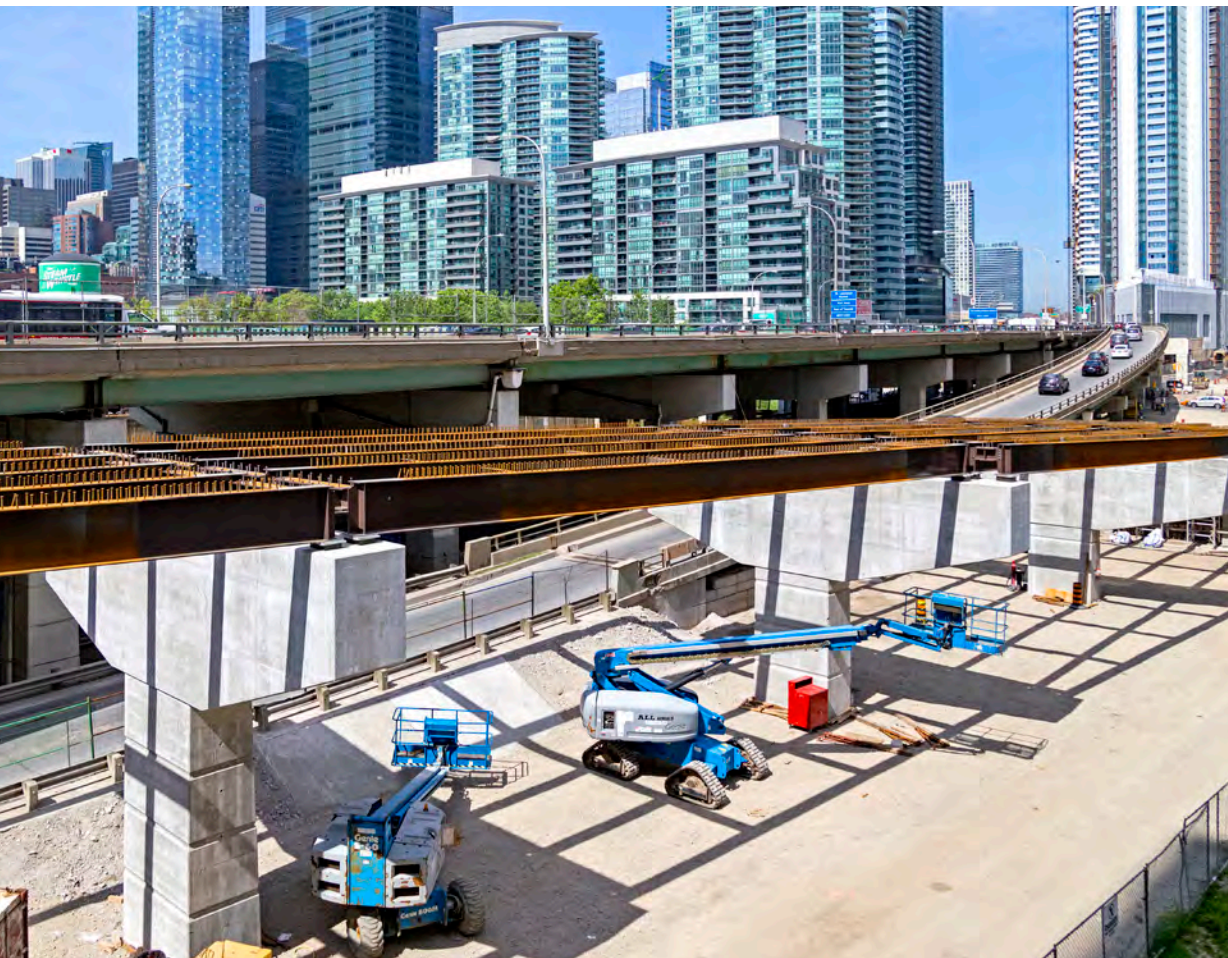
**Intelligent Infrastructure Installations Limited**  
Fixed Automated Anti-Icing Spray Technology

**DTAH**  
Streetscaping

**T2ue**  
Utilities Engineering

**Thurber Engineering Limited**  
Geotechnical Engineering

**Grascan / Torbridge**  
General Contractor



*Looking northeast along the profile of the newly erected girders for the ramp*



## PROJECT SUCCESS

Completion of this project went beyond simply meeting the client's goal of reconnecting the City with its waterfront and creating a new "gateway to the City":

- WSP's design of the new foundations allowed the ramp closure to be shortened by a year;
- WSP designed a unique foundation for the retained soil system abutment, involving an innovative use of helical piles, that will result in zero settlement and saved the City \$600,000; and
- WSP incorporated significant "daps" into the steel girders supporting the west end of the ramp, improving the safety and comfort on the ramp over what would have been achievable without such an innovation.

Such design innovations do more than just meet criteria and "check boxes" for the City of Toronto, they lead to what everyone involved has called a very successful project.



*The new ramp in operation*



As one of the world's leading professional services firms, WSP provides technical expertise and strategic advice to clients in the Transportation & Infrastructure, Property & Buildings, Environment, Industry, Resources (including Mining and Oil & Gas) and Energy sectors, as well as offering project and program delivery and advisory services. Our experts include engineers, advisors, technicians, scientists, architects, planners, surveyors and environmental specialists, as well as other design, program and construction management professionals. With approximately 50,000 talented people in 550 offices across 40 countries—more than 8,000 in Canada and 9,500 in the U.S.—we are uniquely positioned to deliver successful and sustainable projects, wherever our clients need us.