



MEMO

TO: File 16-15113/15M-00267-00
FROM: Bob Koziol, P. Eng.
SUBJECT: Lower Yonge Precinct Drainage Design
DATE: June 28, 2017

Further to previous discussions with respect to the drainage design within the Lower Yonge Precinct, it is anticipated that the detailed design of all roadways within the Precinct will follow the current version of the City of Toronto's Design Criteria for Sewers and Watermains, and will be informed by the current version of the City's Wet Weather Flow Management Guidelines. The first editions of each these documents were issued in November 2009, and November 2006, respectively.

The drainage design for the Lower Yonge Precinct will utilize the existing trunk storm sewer system to the greatest extent possible. Small drainage areas are served by local sewer networks that will discharge to nearby trunk sewers (typically with larger diameter) that serves a number of smaller drainage areas. The trunk storm sewer system conveys stormwater to a watercourse. In the case of the Lower Yonge Precinct, the trunk storm sewers convey stormwater to Lake Ontario. There are existing trunk storm sewers on Lake Shore Boulevard, Harbour Street (west of Yonge Street), Queens Quay East, Bay Street, Yonge Street, Freeland Street, Cooper Street and Lower Jarvis Street.

New trunk storm sewers will be required along Harbour Street between Yonge Street and Lower Jarvis Street and along 'New' Street between Queens Quay East and Lake Shore Boulevard East.

The storm sewer system within the Lower Yonge Precinct will be modelled during detail design using a dynamic model to simulate inflow hydrographs and the effect of storage attenuation. This will ensure that a minor storm with a 2-year return period can be accommodated without storage and confirm that the storm system will not surcharge in the event of a 100-year storm event.

All in-fill development within the Lower Yonge Precinct will be required to meet the City's Wet Weather Flow Management Guidelines. A separate sanitary sewer system will need to be designed and built by the Precinct developers to meet the ultimate requirements for residents and businesses in the Precinct.



It is noted that there is a 3000 mm diameter Combined Sewer Outlet (CSO) within the Precinct that is expected to remain in service. The CSO extends from Church Street north of the Esplanade southerly under the Toronto Parking Authority garage at the end of Church Street, under the Metrolinx rail corridor, and outlets to Lake Ontario at the Lower Jarvis Street slip. The CSO operates as a siphon between Front Street East and Queens Quay East, with invert elevations ranging from 58.3 m to 51.3 m, respectively. The outfall to the slip is at approximately invert 71.0 m according to City archive plans C-416, though it is noted that TWAG model data indicates the discharge elevation at 57.0 m. Though the CSO operates in a surcharged condition it is incumbent upon proponent development teams within the Precinct to demonstrate that the hydraulic grade in the system remains greater than 0.3 m below surface elevation.

The minor system shall be designed to accommodate flow spread within the road allowance without flow storage. Bike lanes are not considered in the calculation of flow spread criteria.

The allowable flow spread is based upon the type of road. Within the Lower Yonge Precinct, there are local, collector, and arterial roads. There are also existing and future road underpasses at Yonge Street, Cooper Street (future), and Lower Jarvis Street crossings of the Metrolinx rail corridor north of the F. G. Gardiner Expressway.

The minor system flow spread shall accommodate the following design criteria:

| Roadway | From | To | Proposed Classification | Minor Storm | Major Storm | Design Criteria |
|---------------------|--------------------|---------------------|-------------------------|-------------|---------------------|-----------------|
| Lake Shore Blvd EB | Yonge Street | Lower Jarvis Street | Major Arterial | 10-year | > 10 up to 100-year | Note 3 |
| Harbour Street | Bay Street | Yonge Street | Major Arterial | 10-year | > 10 up to 100-year | Note 3 |
| Harbour Street | Yonge Street | Jarvis Street | Collector | 5-year | > 2 up to 100-year | Notes 2,5 |
| Bay Street | Queens Quay | Front Street | Minor Arterial | 10-year | > 10 up to 100-year | Note 3 |
| Yonge Street | Queens Quay | Lake Shore Blvd | Major Arterial | 10-year | > 10 up to 100-year | Note 3 |
| Yonge Street | Lake Shore Blvd | Front Street | Major Arterial | 10-year | > 10 up to 100-year | Note 3 |
| Freeland Street | Queens Quay | Lake Shore Blvd EB | Local | 2-year | > 2 up to 100-year | Note 1 |
| Cooper Street | Queens Quay | Lake Shore Blvd EB | Collector | 5-year | > 5 up to 100-year | Note 2 |
| Cooper Street | Lake Shore Blvd EB | The Esplanade | Collector | 25-year | > 25 up to 100-year | Note 3 |
| 'New' Street | Queens Quay | Lake Shore Blvd EB | Local | 2-year | > 2 up to 100-year | Notes 1,4 |
| Lower Jarvis Street | Queens Quay | Lake Shore Blvd EB | Minor Arterial | 10-year | > 10 up to 100-year | Note 3 |

Notes:

1. Minor system constraints: No barrier curb overtopping. Flow spread not to exceed one half of the lane width.
2. Minor system constraints: No barrier curb overtopping. Flow spread must leave at least one lane free of water.
3. Major and Minor system constraints: No barrier curb overtopping. Flow spread must leave at least one lane free of water in each direction.
4. Major system constraints: Maximum depth of flow shall be the lesser of 15 cm above the crown of the road or the water level up to the right-of-way
5. Major System constraints: Maximum depth of flow shall be the lesser of 10 cm above the crown of the road or the water level up to the right-of-way

Source: City of Toronto Design Criteria for Sewers and Watermains, First Edition, November 2009, pages 66 and 67

The trunk storm sewer system must accommodate the increased impervious area for each roadway. In general, trunk storm sewers are designed to accommodate about 90% of the calculated flows to allow for calculation errors in design or future changes to drainage areas. Therefore, if the increase in impervious area from existing conditions to proposed area is within 10%, there should be sufficient capacity in the existing trunk system. Where the impervious area is increased by more than 10%, it can be expected that the trunk storm sewer system will need to be reconstructed. The existing and proposed impervious areas for each road segment are summarized below:

| Roadway | From | To | Existing Impervious Area (m2) | Proposed Impervious Area (m2) | % Increase | Upsize Sewer? |
|---------------------|--------------------|---------------------|-------------------------------|-------------------------------|------------|---------------|
| Lake Shore Blvd EB | Yonge Street | Lower Jarvis Street | 17000 | 17450 | 2.6 | No |
| Harbour Street | Bay Street | Yonge Street | 5570 | 5570 | 0 | No |
| Harbour Street | Yonge Street | Jarvis Street | 0 | 13450 | N/A | See Note 1 |
| Bay Street | Queens Quay | Front Street | N/A | N/A | 0 | No |
| Yonge Street | Queens Quay | Lake Shore Blvd | 7840 | 7840 | 0 | No |
| Yonge Street | Lake Shore Blvd | Rail Corridor | 4030 | 4030 | 0 | No |
| Yonge Street | Rail Corridor | Front Street | 4275 | 4340 | 1.5 | No |
| Freeland Street | Queens Quay | Lake Shore Blvd EB | 5040 | 5190 | 3 | No |
| Cooper Street | Queens Quay | Lake Shore Blvd WB | 3900 | 4670 | 19.7 | Yes |
| Cooper Street | Lake Shore Blvd WB | The Esplanade | 0 | 6010 | N/A | See Note 1 |
| 'New' Street | Queens Quay | Lake Shore Blvd EB | 0 | 3720 | N/A | See Note 1 |
| Lower Jarvis Street | Queens Quay | Lake Shore Blvd EB | 3770 | 3830 | 1.6 | No |

NOTE: 1. New trunk storm sewer required.

As noted above, there may be a need to be new trunk storm sewers on Harbour Street between Yonge Street and Lower Jarvis Street, on 'New' Street between Queens Quay and Lake Shore Boulevard East, and on the Cooper Street extension between Lake Shore Boulevard East and The Esplanade. This will be confirmed during detailed design.

The trunk storm sewer on Harbour Street will be constructed as redevelopment of the Lower Yonge Precinct proceeds. At this time, the phasing of the Harbour Street extension is unknown. The relevant developer will be responsible for the design of the trunk storm sewer along Harbour Street. Each developer will be responsible for ensuring that all on-site drainage is maintained to pre-development levels for quality and quantity. This may be provided through the use of appropriate stormwater control measures. The proposed methodology will be designed and constructed by the developers to meet the City of Toronto, Waterfront Toronto, Toronto Region Conservation Authority and Ministry of Environment and Climate Change approval requirements.

As noted above, the trunk storm sewer on Harbour Street will need to be designed to accommodate the 5 year design storm event and Harbour Street will need to be designed to accommodate the overland flow for the 100 year storm event. The trunk storm sewer may connect to existing trunk storm sewers on side streets (Yonge Street, Freeland Street, Cooper Street, and Lower Jarvis Street) if there is sufficient capacity in these sewers. Alternatively, a new outlet may be required. All new trunk storm sewers will need to be designed in accordance with the current City of Toronto design standards.

The trunk storm sewer on 'New' Street shall be designed to accommodate the 2 year design storm event and 'New' Street will need to be designed to accommodate the overland flow for the 100 year storm event. All new trunk storm sewers will need to be designed in accordance with the current City of Toronto design standards. It should be noted that 'New' Street will likely be constructed in phases as the road allowance straddles the property line between the former LCBO site and the existing Loblaws site. Therefore, the trunk storm sewer should be built on the west side of 'New' Street but designed to accommodate the full build-out of 'New' Street.

There is an increase in impervious area along Cooper Street between Queens Quay and Lake Shore Boulevard of almost 20%. It is likely that the existing trunk storm sewer will need to be replaced with a larger capacity trunk storm sewer as part of the widening and reconstruction of Cooper Street.

It should be noted that the Cooper Street underpass from Lake Shore Boulevard East under the Metrolinx rail corridor requires protection from a minimum minor flow for the 10-year to 25-year storm event due to its classification as a collector; the exact return period is to be specifically evaluated by the City. There is a large CSO immediately below the tunnel that may have capacity to accommodate a larger storm event; this should be further evaluated during the detail design of the tunnel. The storm sewer system for the Cooper Street underpass should be designed to drain to the greatest practical extent by gravity flows and minimize the need for the pumping of stormwater at the tunnel sag. For this reason, it is recommended that the minor storm system be sized to contain the 25-year event without the need for the major system. It will not be possible to meet the aforementioned design criteria solely through a gravity sewer



system; alternative means such as underground storage detention or pumping will have to be considered during detailed design. It is noted that underground storage may not be possible due to high lake levels. A pumping station should be located within the newly acquired right-of-way required for the Cooper Street underpass. The pumping station would include a submersible wet well and a forcemain that would connect to the existing trunk storm sewer along The Esplanade. The final configuration of the pumping station and forcemain will be determined through discussions with the City of Toronto during detailed design of the tunnel.

Most of the Lower Yonge Precinct was previously developed and therefore considered 'brownfield'. However, Harbour Street and the Cooper Street tunnel should be considered to be 'greenfield' developments. The major flow system for these two roads should be designed to accommodate up to the 100-year storm event. The maximum depth of flow on Harbour Street between Yonge Street and Lower Jarvis Street should be designed to be the lesser of 10 cm above the crown of the road or the water level up to the property line.

It is noted that the Yonge Street roadway under the rail corridor will be modestly narrowed to provide a cycle track above the curb (currently on road). In addition, mountable curbs are proposed in this section of Yonge Street, rather than standard height curb and gutter. The existing storm sewer is acceptable for the section of Yonge Street under the rail corridor. Major overland flow runs from north to south through the existing underpass without a sag under the rail corridor.

The existing Lower Yonge Precinct area is characterized by hardscaping and impervious areas, which is also descriptive of the proposed condition, and as such the post-development runoff response will be similar to the existing condition. In order to achieve the design criteria, it may be necessary to implement specific solutions such as:

- Retention of surface water within the road allowance;
- Oversized minor system: sewer system which can contain rarer events than the 2-year storm; or
- Oversized major system: rights-of-way which provide additional drainage capacity by introducing additional depth through steeper road sections.

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