Downtown Urban Centre and Burlington GO Major Transit Station Area Flood Hazard and Scoped SWM Assessment
Phase 2 Terms of Reference and Scope of Work (DRAFT)

PURPOSE

The purpose of Phase 2 study is to verify through model simulation that there will be no increased creek peak flows for the full range of the updated City of Burlington design storms and Hurricane Hazel. This modelling will reflect maximum potential impervious levels permitted by the proposed Zoning, or in the case of the area within the Downtown Urban Centre the Official Plan policies of the new Official Plan[1]. The Phase 2 study will refine modeling from the Phase 1 study to map flood susceptible areas using latest modelling tools. The Phase 2 report will outline sources of information, modeling approaches, assumptions, model refinements, etc. and shall include summary tables of model results demonstrating no increased flooding or flood risk. The study is expected to provide sufficient information to support the evaluation of development applications and to support the development of planning studies (Burlington GO MTSA). The findings of the Phase 2 study will also determine if any amendments are required to the Official Plan in the Downtown Urban Center. Deliverables include five hard copies of the study report as well as a digital copy and digital copies of all models, drawings and figures.

The scope of work set outlined below may be further refined or adjusted to reflect any evolving requirements that could impact the study.

New policy approved by the Region of Halton in the City's new Official Plan, with respect to lands within the Downtown Urban Centre, states in subsection 8.1.1(3.16.1) e):

> The City will undertake a Phase 2 Flood Hazard Study using more detailed topographical survey data to facilitate future development applications. Amendments to this Plan may be required to implement the findings of the study, as determined by the City, in consultation with Conservation Halton.

[1] On Nov. 30, 2020, the Region of Halton issued a Notice of Decision approving the new Burlington Official Plan. Section 17(27) of the Planning Act (R.S.O. 1990, as amended) sets out that all parts of an approved official plan that are not the subject of an appeal will come into effect on the day after the last date for filing a notice of appeal- that date being Dec. 22, 2020 for the new Burlington Official Plan. The appeal record submitted to the Local Planning Appeal Tribunal (LPAT) by the Region of Halton indicates that a total of 48 appeals to various parts of the new Burlington Official Plan were received during the appeal period.

1. Hydrologic Input Data Refinement

a. Update hydrologic modelling for Roseland Creek to use the City's current IDF parameters (with climate change allowance). Generate inflow hydrographs for Roseland Creek upstream of the QEW enclosure for frequency design storms and Hurricane Hazel. Hydrographs are to be used to assess potential for spill from Roseland to East Rambo Creek at QEW, refer to b. below.

b. Prepare an unsteady state 2D hydraulic model to map potential spill from Roseland Creek at the QEW to the downstream receiving system(s) (i.e., East Rambo Creek, etc.). Identify and quantify any spill(s) which may contribute to the Hager/Rambo system. Prepare mapping identifying inundation limits, spill points, etc. Discuss findings within reporting and add spill flows into hydrologic modelling for Hager/Rambo Creeks as appropriate.

c. Update the Phase I Study's hydrologic modelling to use the City's current IDF parameters (with climate change allowance), revised Flood Control Facility rating curves, consideration for partially blocked outlets where appropriate, and considerate of any inflows expected from spills. Update peak flows and inflow hydrographs as required for associated hydraulic model updates. Complete analysis for two scenarios; one with flood control facilities included and one with flood control facilities removed.

d. Complete a hydrologic assessment of the future land use condition. Future land use must consider maximum imperviousness permitted under proposed Zoning and/or the new Official Plan for study area catchments. Compare findings to existing conditions and verify there will be no increased creek peak flows for the full range of design storms and Hurricane Hazel.

BURLINGTON GO MAJOR TRANSIT STATION AREA

2. West Rambo Creek - Hydraulics

a. Flows to be based on "Scenario 1" only (East Rambo Flood Control Facility (FCF) spills as per existing conditions), premised on CH support of "low tech memo" with respect to infeasibility of retrofitting East Rambo Creek FCF.

b. Prepare unsteady state 2D hydraulic model(s) to map spill from the East Rambo FCF to the downstream receiving system(s) (i.e., Hager Rambo Diversion Channel, etc.). Modelling must use HEC-RAS 2D or PCSWMM 2D. CH has identified a preference for HEC-RAS 2D. Define which modelling platform will be used within the proposal. Include a cost estimate for using HEC-RAS 2D if use of PCSWMM was envisioned.

Modelling will need to comply with the underlying principle that attenuation and/or flood storage caused by bridges/culverts cannot be credited in downstream flood risk

mapping. Assume reach-based analysis will be required where mapping uses unsteady state analysis.

c. Hydraulic modelling shall make use of the best available topographic data, including detailed LiDAR/DEM data (Fall 2018) as appropriate.

d. Verify in the field the connection point and related elevations of West Rambo Creek with the Hager Rambo (HR) Diversion Channel.

e. Re-assess anticipated spill flows from the Brant Street underpass to Fairview Street/Brant Street (and to Downtown Urban Centre) from 2D modelling to support separate 2D modelling of Downtown Urban Centre.

f. Update 1D HEC-RAS geometry using best available topographic data (e.g., LiDAR/DEM data). Re-assess coding for ineffective flow areas and lateral structures. Detailed review and refinement of modelling upstream of Fairview Street is required.

g. Generate 1D floodplain mapping for remaining areas based on best available topographic data and modelling updates. Mapping sheets shall be prepared at a maximum 1:2000 scale. Generate updated flood risk mapping where 2D modelling is applied. Mapping sheets shall be prepared at a maximum 1:2000 scale. Mapping products (digital files) to be prepared include flood depth, flood velocity, flood depth velocity product, and flood risk data (MNR risk guidelines).

h. Map both existing and proposed conditions where flood condition change (existing versus proposed)

3. East Rambo Creek - Hydraulics

a. Flows to be based on "Scenario 1" only (East Rambo FCF spills as per existing conditions), premised on CH support of "low tech memo" with respect to infeasibility of retrofitting East Rambo Creek Flood Control Facility.

b. Update 1D HEC-RAS geometry using best available topographic data (e.g., LiDAR/DEM data).

c. Re-assess and adjust coding for ineffective flow areas as required.

d. Incorporate 1D-2D spill integration for spill at Lateral Structure 3 (CNR track area), to better define floodplain extents (potentially assess separately from 2D modelling for West Rambo Creek). Confirm if spill across CNR tracks is still expected.

e. Generate 1D floodplain mapping for remaining areas based on best available topographic data and modelling updates. Mapping sheets shall be prepared at a maximum 1:2000 scale.

f. Generate updated flood risk mapping where 2D modelling is applied. Mapping sheets shall be prepared at a maximum 1:2000 scale. Mapping products (digital files) to be present include flood depth, flood velocity, flood depth velocity product and flood risk data (MNR risk guidelines)

g. Map both existing and proposed conditions where flood condition change (existing versus proposed)

4. Hager-Rambo Diversion Channel - Hydraulics

a. Flows to be based on "Scenario 1" only (East Rambo FCF spills as per existing conditions), premised on CH support of "low tech memo" with respect to infeasibility of retrofitting East Rambo Creek Flood Control Facility.

b. Update 1D HEC-RAS geometry using best available topographic data (e.g., LiDAR/DEM data).

c. Review simulated drop in flood elevations in the vicinity of Thorpe Road, update and refine modelling as necessary to ensure that model reflects a reasonable result with no greater than a 0.5 m drop in water surface elevation between cross sections. Re-generate floodplain mapping in this area as required.

d. Generate 1D floodplain mapping for remaining areas based on best available topographic data and modelling updates. Mapping sheets shall be prepared at a maximum 1:2000 scale.

e. Re-assess spill flows at lateral structures 1 and 2 and overtopping of Fairview Street from 1D HEC-RAS modelling to support separate 2D modelling of these spill areas, include assessment of optimizing lateral structures on an individual basis.

f. Generate updated flood risk mapping where 2D modelling is applied. Mapping sheets shall be prepared at a maximum 1:2000 scale. Mapping products (digital files) to be present include flood depth, flood velocity, flood depth velocity product and flood risk data (MNR risk guidelines)

g. Map both existing and proposed conditions where flood condition change (existing versus proposed)

5. Hager Creek at CNR - Hydraulics

a. Update HEC-RAS geometry using best available topographic data (e.g., LiDAR/DEM data).

b. Re-assess and adjust coding for ineffective flow areas as required. Ensure proper alignment of the culverts and embankments

c. Implement a lateral structure at expected spill point to the east, however do not include any further 2D modelling components or assessments given that spill flows would not be expected to impact study limits, based on findings from February 2019 report provided the findings are still valid following the 2-D modelling/spill analysis.

6. Impacts of filling on floodplain and/or spill

Assess sensitivity of 2D modelling results to filling of future development sites. The assessment shall include at least three scenarios, including:

a. Scenario 1: All lands scheduled for intensification are filled/raised above the flood hazard, whilst all Roads/ROWs remain unchanged.

b. Scenario 2: Assume 80 percent of all lands scheduled for intensification which reside within flood risk areas are filled/raised above the flood hazard, whilst all Roads/ROWs remain unchanged. Appropriate lot line setbacks shall be established in consultation with the City and CH.

c. Scenario 3: Additional Scenario to be determined in conjunction with the study team pending results of Scenario's 1 and 2. It is expected that the study team will make recommendations for the scenarios to be evaluated.

Reporting must document findings and discuss results of with respect to potential impacts of each scenario. Recommendations as to what filling may be permissible versus what must be avoided shall be included.

DOWNTOWN URBAN CENTRE

2. Lower Hager Creek - Hydraulics

a. Update 1D HEC-RAS geometry using best available topographic data (e.g., LiDAR/DEM data).

b. Implement a lateral structure at expected spill point near Caroline Street, however do not include any further 2D modelling components or assessments given that spill flows would not be expected to impact study limits, based on findings from February 2019 report.

c. Generate 1D floodplain mapping for remaining areas based on best available topographic data and modelling updates. Mapping sheets shall be prepared at a maximum 1:2000 scale.

3. Lower Rambo Creek - Hydraulics

a. Update 1D HEC-RAS geometry using best available topographic data (e.g., LiDAR/DEM data).

b. Update flows as required based on updated spill assessment from Burlington GO Major Transit Station Area. Include modelling of the "with" and "without" spill flows from upstream areas, consistent with previous assessment.

c. Generate 1D floodplain mapping for remaining areas based on best available topographic data and modelling updates. Mapping sheets shall be prepared at a maximum 1:2000 scale.

d. Asses potential spill at Caroline Street. Prepare a 2D hydraulic model(s) to map spill as required (limits: Upstream of Caroline Street to Lake Ontario).

4. Impacts of filling on floodplain and/or spill

Assess sensitivity of 2D modelling results to filling of future development sites. The assessment shall include at least three scenarios, including:

a. Scenario 1: All lands scheduled for intensification are filled/raised above the flood hazard, whilst all Roads/ROWs remain unchanged.

b. Scenario 2: Assume 80 percent of all lands scheduled for intensification which reside within flood risk areas are filled/raised above the flood hazard, whilst all Roads/ROWs remain unchanged. Appropriate lot line setbacks shall be established in consultation with the City and CH.

c. Scenario 3: Additional Scenario to be determined in conjunction with the study team pending results of Scenario's 1 and 2. It is expected that the study team will make recommendations for the scenarios to be evaluated.

Reporting must document findings and discuss results of with respect to potential impacts of each scenario. Recommendations as to what filling may be permissible versus what must be avoided shall be included.