URBANTECH®

FUNCTIONAL SERVICING REPORT

MACVILLE SECONDARY PLAN

MACVILLE

TOWN OF CALEDON

REGION OF PEEL

PREPARED FOR
BOLTON OPTION 3 LANDOWNERS GROUP

Urbantech File No.: 15-458

1ST SUBMISSION – FEBRUARY 2021

DISCLAIMER

The content in this document as it relates to areas outside of the Macville Secondary Plan (MVSP) area, is provided for contextual purposes and shall not predetermine the design or form of development within the other expansion areas. The consideration of land uses outside of the MVSP is beyond the scope of this report and is subject to the completion of additional studies and review.

No commitment or guarantee in the timing for parties to undertake or participate in processes outside of the MVSP is implied by this report.

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1.0 INTRODUCTION

1.1 Study Purpose

Urbantech Consulting represents the Bolton Option 3 Landowners Group in connection with seeking the necessary approvals required to permit the development of the Macville Community lands for urban development including residential, commercial, mixed uses, community uses and related servicing and infrastructure. The lands subject to this proposal are part of the Macville Secondary Plan (MVSP) area and are herein referred to as the "MVSP lands". The MVSP lands consist of approximately 182 hectares (450 acres) of land and are generally located north of King Street, east of The Gore Road and west of the CP Railway tracks. Refer to **Drawing 101** for location of the MVSP lands and landownership map.

The eastern portion of the MVSP lands, consisting of lands on both sides of Humber Station Road, north of King Street, have been the subject of Regional Official Plan Amendment 30 (ROPA 30) which was recently approved by the Local Planning Appeal Tribunal (LPAT) and succeeds in bringing these lands into the Bolton Rural Service Centre Settlement Area Boundary. Accordingly, the eastern portion of these lands are designated "Urban Area" in the Region of Peel Official Plan. The western portion of the MVSP lands, consisting of lands north of King Street and east of The Gore Road are currently designated "Rural Area" within the Region of Peel's Rural System in the Region of Peel Official Plan and "Prime Agricultural Area" in the Town of Caledon's Official Plan. It is recognized that the western portion of the MVSP lands are currently located outside of the Settlement Area Boundary of the Bolton Rural Service Centre and accordingly, in order to permit development of these lands for urban-related land uses, these lands will need to be brought into the Bolton Rural Service Centre Settlement Area Boundary. This review is currently underway at the Region of Peel through the Region's 2051 Municipal Comprehensive Review of the Region's Official Plan and it is currently proposed by the Region that the balance of the Macville Community will be brought into the "Urban Area" through the final Regional adoption of the new Regional Official Plan will occur before the end of 2021. Further, a local Official Plan Amendment is required to assign urban land use designations to all of the MVSP lands.

This Functional Servicing Report (FSR) is prepared in support of a local Official Plan Amendment to establish the Macville Secondary Plan in Bolton. This MVSP will facilitate the development of these lands for residential and mixed-use development with related complimentary uses, such as open spaces, parks, trails, commercial uses, the Bolton GO Station, the Environmental Policy Area (EPA), and stormwater management (SWM) facilities.

This FSR is intended to synchronize the environmental objectives described in the Comprehensive Environmental Impact Study and Management Plan (CEISMP) with the grading/servicing approach for the MVSP lands in support of the **Preliminary Framework Plan** as illustrated on **Drawing 102**.

This FSR is a community-wide, high level document intended to identify the development constraints, SWM targets and site serviceability, while providing guidance to the future Draft Plans and supporting studies. As such, this FSR will not be further revised to address potential minor revisions to the local road networks that may arise from the review of the individual Draft Plans. It will be the responsibility of the individual landowners to comply with the overall *intent* of the grading and servicing presented herein. Should individual Draft Plans deviate considerably from the road network presented herein, documentation will be provided to demonstrate how they will adhere to and respect the overall development constraints and servicing targets.

It was agreed with the Town of Caledon, Region of Peel, and TRCA staff that a comprehensive Functional Servicing Report coordinated with the CEISMP would be acceptable to support the Draft Plan applications within the MVSP lands. This FSR is intended to demonstrate how the Draft Plans in MVSP will be developed to meet the requirements of the Secondary Plan and supporting studies. It has been also acknowledged by the Region, Town and Agencies that external infrastructure (outside of MVSP limit) will be required to support the entire MVSP development, as well as future growth within neighbouring development areas. This infrastructure consists of SWM Ponds 1 and 2, and relevant storm, sanitary and watermain services located within the future Bolton Residential Expansion Study area 4 (BRES4) development located immediately south of King Street. External reference plans will be prepared and easements within the participating BRES4 landowner's properties will be conveyed to the Town and Region for the external infrastructure maintenance prior to the development of the BRES4 lands. It is acknowledged that a separate community wide FSR will be required for the BRES4 community, at the time when the BRES4 Draft Plan applications processed. The MVSP **Preliminary Framework Plan** is attached to this section of the report.

As shown in the **Preliminary Framework Plan** on **Drawing 102**, the MVSP lands are approximately 182 hectares (450 acres). They include approximately 10.52 hectares (25.99 acres) of environmental policy areas (EPAs) and 1.43 hectares (3.53 acres) of proposed road widenings (not including internal roads). The net developable area is approximately 170 hectares.

This FSR includes the following information:

- Discussion on the existing drainage conditions.
- Proposed engineering of how the MVSP lands will join the Macville community, specifically the adaption of the **Preliminary Framework Plan** with development limits and CEISMP Environmental Policy Areas (EPAs), into the surrounding environment.
- Proposed grading, storm and stormwater management (SWM) design, and sanitary / water servicing for MVSP, with consideration for future development.

The CEISMP document has been coordinated with this FSR and it describes the environmental components/constraint mapping, impact assessments, mitigation strategies, and adaptive management / monitoring plan. While both documents are required in support of Draft Plan approval, they have been written such that they can be reviewed independently. The FSR and CEISMP documents have been informed, and iteratively re-designed by the preceding background studies that specified land-use patterns, a transportation network and an EPA. The goal of these studies has been to achieve superior, efficient, orderly and ecologically responsible urban development. The overall design follows applicable policies, guidelines and design criteria. Further, it set out the planning controls to be used in implementing these policies. This FSR is prepared in conformance with the requirements of the Municipal Class Environmental Assessment.

1.2 Study Area

The MVSP study area boundaries and land ownership are shown on **Drawing 101**.

The MVSP lands are located within two watersheds as set out on **Drawing 201**.

- West Humber River - The majority of the MVSP lands west of Humber Station Road are within this watershed.
- Main Humber River – The majority of the MVSP lands east of Humber Station Road are within this watershed. A portion located west of Humber Station Road toward the north end of MVSP is also located within the Main Humber River.

1.3 Preliminary Framework Plan

The MVSP Land Use Schedule provided in **Drawing 102, Preliminary Framework Plan,** (Gerrard Design, January 12, 2021) has been updated by the landowners to reflect the latest development proposals. The CEISMP and FSR documents are based on this plan. The plan is supported by these studies and it is recognized that through the agency review of the CEISMP and FSR, additional revisions to future individual Draft Plans may be required.

As illustrated on **Drawing 102**, a number of major structural elements define the MVSP community, including:

- Development of the Caledon GO station on the east flank of the community will be the centerpiece of the community's transit infrastructure, as well as a focus for active transportation modes. The station will support:
  - GO bus services such as the existing Bolton service, from the on-site bus terminal;
  - Future GO Rail service determined to be feasible by Metrolink in their report, "Bolton Commuter Rail Service Feasibility Study";
  - Anticipated additional bus connections established by Brampton Transit, as the community develops; and
  - Opportunity for the Town of Caledon to establish local bus service.

- A logical hierarchy of collector and local roads the provide:
  - Internal movement in a manner that is supportive of non automobile modes of transportation;
  - Appropriate connectivity to the existing higher order road network;
  - Convenient access to the significant transit facilities centred on the future GO station.

- Key features of the above transportation hierarchy include:
  - A Multi-Modal Mobility Ring Road providing direct access to the GO station transit hub and carrying automobiles, internal transit vehicles and including a dedicated 2-way cycle track and double sidewalks;
  - An east-west Central Promenade connected to the GO station transit hub taking the form of a green corridor including a central active transportation spine with support for road cycling in shared lanes and providing a one-way single lane traffic loop; and
  - An east-west collector connection proposed to connect the community to Emil Kolb Parkway.

- An Environmental Policy Area (EPA) that identifies, protects, restores and enhances the diversity and connectivity of natural areas and features;

- A variety of housing types and densities, including commercial and institutional developments in strategic locations;

- Commercial - Mixed-use node located near proposed GO station, adding support for compact urban forms of housing, retail, commercial, office, as well as live-work units; and,

- Community uses and features including an elementary school, a secondary school and a community park.

1.4 Background Studies

The CEISMP and FSR are intended to provide a further level of detail to implement findings and recommendations of several background studies listed below. In this instance, this FSR addresses findings and recommendations from the following studies and guidelines:

- **Ministry of the Environment, Conservation and Parks** (MECP, formerly Ministry of the Environment, MOE), Stormwater Management Practices, Planning and Design Manual, March 2003.
- **Paradigm Transportation Solutions Limited**, Bolton Residential Expansion, Evaluation of Alternative Growth Areas - Transportation, June 2014.
- **Region of Peel** and **Blue Plan Engineering**, 2020 Water & Wastewater Master Plan for the Lake-Based System, Volumes 1 to 5.
- **Region of Peel, Public Works**, Design, Specifications and Procedures Manual, July 2009.
- **R.J. Burnside & Associates Limited**, Technical Memorandum, Bolton Option 3 Lands Preliminary Water Modelling, June 1 2020.
- **SPL Consultants Limited**, Phase One Environmental Site Assessment, 14275 The Gore Road, Bolton, Ontario, August 13, 2014.
- **SPL Consultants Limited**, Preliminary Geotechnical Investigation, Proposed Subdivision Development, 14275 The Gore Road, Town of Caledon, Ontario, August 25, 2014.

- **SPL Consultants Limited**, Preliminary Geotechnical Investigation, Proposed Subdivision Development, Cook Property, Town of Caledon, Ontario, September 17, 2014.
- **Toronto and Region Conservation Authority (TRCA)** and **Civica Infrastructure Inc.**, Final Report, Humber River Hydrology Update, April 2018.
- **Toronto and Region Conservation Authority (TRCA)**, Humber River Watershed Plan, Pathways to a Healthy Humber, June 2008.
- **Toronto and Region Conservation Authority (TRCA)**, Stormwater Management Criteria, August 2012.
- **Town of Caledon**, Development Standards Manual, Version 5.0, 2019.

1.5 Study Team

Members of the study team involved in the preparation of the CEISMP/FSR documents and their respective disciplines are listed below:

Beacon Environmental Limited	Ecology Fluvial Geomorphology	CEISMP
DS Consultants Ltd.	Geotechnical Hydrogeology	FSR
Gerrard Design	Land Use Design	FSR
R.J Burnside & Associates Ltd.	Water Distribution	FSR
Glenn Schnarr & Associates Inc.	Planning	CEISMP/FSR
NAK Design Strategies	Land Use Design	FSR
Urbantech Consulting	Municipal Design Water Resources Group Engineering	FSR

2.0 EXISTING CONDITIONS

2.1 Comprehensive Environmental Impact Study and Management Plan

A detailed characterization of the existing conditions has been addressed in the Comprehensive Environmental Impact Study and Management Plan (CEISMP). The purpose of the CEISMP is to provide a detailed description and background review of the physical and ecological characteristics of the environmental policy area features from the subject lands including their functions, significance and sensitivity. The CEISMP addresses potential impacts to these features and outlines how impacts can be minimized or mitigated.

The CEISMP includes discussion on the following with respect to existing conditions:

- Landform / topography
- Soils / Geology
- Existing erosion sites
- Hydrogeology
- Characterization of surface drainage features and associated geomorphology
- Vegetation assessment
- Wildlife / Terrestrial and Aquatic resources
- Species at Risk and Species of Concern
- Areas of Natural and Scientific Interest / Environmentally Significant Areas
- Provincially Significant Wetlands
- Biophysical environment analysis including evaluation of significant and sensitive features and functions and feature-based water budgets.

The CEISMP document has been submitted under separate cover.

2.2 Existing Drainage

The MVSP lands are situated at the approximate drainage divide between the West Humber River and Main Humber River watersheds. **Drawing 201** illustrates existing drainage patterns and subcatchments within the MVSP and immediate surrounding area. It is noted that the pre-development conditions provided by TRCA, including the subcatchment drainage boundaries within the West Humber and Main Humber watersheds intersected by MVSP, have been refined on **Drawing 201** from recent topographic surveys carried out locally to clarify flow paths, drainage boundaries and outlets.

The majority of the MVSP lands consisting of the west, central and southeast portions is within the West Humber River watershed. These portions consist mainly of some minor headwater features that convey runoff from various West Humber subcatchments that intersect the study area toward culverts along King Street and Humber Station Road. A group of unevaluated wetlands is located just northeast of the intersection of King Street West and The Gore Road.

The northeast portion of the MVSP lands is located within the Main Humber River watershed. This portion consists mainly of some minor headwater features that convey runoff from the intersected Main Humber headwater subcatchments toward the CPR line.

CEISMP **Figures 3.2.5.2a/b** illustrate the drainage features and CEISMP **Figure 4.8.1** illustrates the constraints and opportunities, within the study area.

The land use with the MVSP limits is predominantly agricultural, which has led to modification of the headwater features by farming activities. In general, the headwater features are poorly defined with ephemeral or intermittent flow.

Table 2-1 identifies the existing drainage outlets for the MVSP study area represented on **Drawing 201** and the respective contributing drainage areas.

Table 2-1 Existing MVSP Drainage Outlets

Outlet	Existing Drainage Area [ha]
West Humber River Outlet / Flow Node	
Node E3, 3.50m Wide Concrete Box Culvert at The Gore Road	562.34
Total West Humber River Drainage Area at The Gore Road Crossing	**562.34**
Main Humber River Outlets	
Node 6, 800mm Concrete Box Culvert Across CPR	18.80
Node 7, Culvert Across CPR	2.78
Node 8, 700mm Concrete Box Culvert Across CPR	19.00
Total Main Humber Drainage Area Within MVSP	**40.58**

Under proposed conditions, southeasterly drainage within MVSP, west of Humber Station Road, will be consolidated to a single outlet at the existing Humber Station Road crossing at Node 5. The consolidation to Node 5 includes drainage that contributes to Node 4 under existing conditions, from private property within the MVSP lands. Consolidation is not proposed for three (3) King Street crossings at the southwest of MVSP (i.e. Nodes 1, 2 and 3), in order to maintain drainage conditions for the unevaluated wetland features.

There are three (3) minor headwater reaches within the Main Humber River consisting of three (3) culverts across the Canadian Pacific Railway (CPR) line. The existing and proposed conditions to each culvert have been evaluated in Section 6.

Refer to **Section 5** for the discussion regarding existing versus proposed drainage outlets.

External Drainage

In terms of external drainage, an 79ha area within the West Humber River watershed north of the MVSP lands drains from northwest to southeast via an ephemeral swale into the MVSP lands as shown on **Drawing 201**. This external area is represented by Catchments 37.12A, 37.12B, 37.12C and 37.12D draining to Node 9. This includes drainage beginning from west of The Gore Road.

2.3 Headwater Drainage Feature Assessment

The MVSP lands are situated in the headwaters of the West Humber River and the Main Humber River and supports a number of surface drainage features, as shown in **Figure 3.2.5.2a**, prepared by Beacon Environmental. Beacon has identified and assessed headwater drainage features (HDFs) in accordance with TRCA policies. The identification and assessment methods are further described in the CEISMP.

Figure 3.2.5.2b prepared by Beacon Environmental illustrates HDF assessment reaches and associated management recommendations. The following sections summarize the CEISMP HDF reaches by management classification.

No Management Required

The majority of the HDF reaches assessed within the Subject Lands were characterized as actively farmed, poorly defined features. These reaches provide limited hydrologic functions and do not provide aquatic or terrestrial habitat. In accordance with the TRCA (2014) Guidelines, these reaches have been identified as ‘No Management Required’.

Mitigation

All of the HDF reaches assessed east of Humber Station Road (draining to the main Humber River) were classified as mitigation. These features were characterized as providing surface drainage to downstream fish habitat, with meadow vegetation within riparian communities.

HDF assessment results for Reach WHT6-D determined that, given the enclosed (historical tile drainage) nature of this feature, it currently functions to provide surface drainage (valued hydrology) to downstream reaches. Similarly, WHT6-G and WHT6-H were presumed to have been subject to historical tile drainage. In accordance with the TRCA (2014) Guidelines, these reaches have been identified as ‘Mitigation”.

Conservation

Reaches WHT1-A through WHT1-F, WHT2-A, WHT2-B and WHT2-F, WHT3-A and WHT3-B, WHT6-B and WHT6-C all had valued or contributing hydrology with wetland riparian vegetation. Breeding amphibians were recorded in the WHT2-A meadow marsh. A management classification of “Conservation” is recommended for these reaches (marshes with amphibian breeding habitat).

Protection

Reach WHT6-A was identified as “Protection” based on the presence of flow during the June 8, 2020 sample event (important hydrology), presence of breeding amphibian habitat and wetland riparian vegetation (Appendix X - Photo 1).

Geomorphologic Considerations

The CEISMP has confirmed that all the hydrologic features within the MVSP lands are HDFs and most would not be considered watercourses due to the absence of a defined channel. The few HDFs that do exhibit a channel form lack the regular flows that could result in lateral channel migration. Consequently, it is our opinion that a fluvial geomorphic assessment of stream bank erosion, aggradation and channel migration is not warranted and that the HDF assessment has effectively characterized the relationship between hydrology, geomorphology and aquatic resources for the purposes of this study.

Meander Belt Considerations

In general, watercourses with drainage areas less than one square kilometer (100 hectares) do not generate sufficient hydraulic energy to initiate migration and the associated risk of potential erosion for property and infrastructure (TRCA 2015). Typically, these watercourses are vegetation controlled. Due to the poorly defined, vegetated nature of the HDFs within the MVSP lands, and overall lack of evidence of active geomorphic processes (i.e., erosion, aggradation or migration), it is our opinion that the regulatory floodline represents a more appropriate tool for delineating the watercourse hazard limit for applicable hydrologic features within the Study Area.

2.4 Existing Flood Mapping

The existing HEC-RAS model geometry for the West Humber and Main Humber Rivers was established in the Humber River Hydrology Update prepared by TRCA and Civica Infrastructure (April 2018). The model geometry for the existing conditions was updated with detailed LIDAR / site survey information in several locations, with a focus on the more significant crossings of Humber Station Road, the CPR line and King Street. The HEC-RAS model was also refined using the updated flows from the existing hydrologic model created based on the pre-development drainage plan. Refer to **Drawing 202** for the existing Regional flood mapping drawing and **Appendix 2** for the hydraulic and hydrologic model results.

The majority of drainage features within MVSP are considered to be headwater features and do not require flood mapping due to their small corresponding drainage areas (less than 50 hectares), with the exception of West Humber River Tributary (WHT) 6, which is proposed to be realigned, all headwater features will be removed during development.

APPENDIX 2

Correspondence Regarding Existing Humber River Hydrology and Flood Mapping (TRCA)

3.0 PROPOSED GRADING & ROADS

3.1 Grading Constraints and Objectives

The following grading constraints were taken into consideration in the development of the grading plans for the MVSP lands.

- The existing grades of King Street, a portion of Humber Station Road, The Gore Road and the CPR line establish the boundaries of the overall development grading.
- Accommodation of existing drainage patterns for lands north of MVSP.
- Compatibility of future road extensions into lands north of the MVSP.
- Maintenance of existing ground elevations in the vicinity of natural features that are to be preserved to provide appropriate buffering.

The site grading has been designed in consideration of the following objectives:

- Match existing boundary grading conditions/constraints.
- Conform to Town standards (where feasible).
- Maintain drainage patterns in / out of the natural areas.
- Maintain the overall West Humber River and Main Humber River watershed drainage boundaries, where possible.
- Provide overland flow conveyance for major storm conditions.
- Minimize cut and fill operations and work towards a balanced site.
- Maintain appropriate cover over buried utilities.
- Accommodate the proposed lot grading based on preliminary land use concepts in accordance with the Town standards.

3.2 Preliminary Grading Design

The preliminary grading design for the MVSP lands is depicted on **Drawings 301 to 304**. The grading plans present proposed road centerline elevation and slopes, existing surface contours, and the direction of overland flow paths. Lot specific grading is not presented at this point. The following sections describe critical elements of the grading design.

Compatibility with EPAs

The site is constrained by various natural wetland features as depicted on **DWG 303.** The wetlands are to be maintained and are subject to a 10.0 m buffer. Grading adjacent to the wetlands will generally be designed to match existing elevations at the buffer limits. In some circumstances, grading within the buffer is proposed to blend lot/street grades with natural elevations to avoid retaining walls adjacent to buffers. Where grading in the buffers is proposed, appropriate measures will be undertaken to restore any disturbed buffers to a natural state.

It should also be recognized that infrastructure may cross or encroach on buffers. Where infrastructure impacts buffers, restorative measures will be undertaken.

Lot grading adjacent to buffers will be designed to promote the discharge of clean roof and rear yard runoff to the wetland features to aid in satisfying feature-based water balance objectives.

Road Centerline Gradients

For the most part, the preliminary grading design conforms to the Town design standard of maintaining a minimum of 0.75% centerline road gradient with a few noteworthy exceptions.

Of the ~ 40,000 m of new road to be constructed, 6250 m (16%) have been designed with road centerline gradients ranging from 0.5% to 0.75%. This was deemed necessary to deliver reasonable road elevations and to avoid excessive fills within lands situated north of the MVSP area.

In addition, road gradients were flattened in the vicinity of SWM ponds to be compatible with SWM pond operating levels that are constrained by available drainage outlets.

Cul-De-Sacs

Streets TA and QZ shown on **Drawing 303** are surrounded by wetland areas. To minimize grading encroachments into the wetland buffers, the two streets have been designed to follow the lie of the land which necessitates road centerline gradients between 3.0% and 4.0%

Channel Corridor

The MVSP includes an open space channel situated in the south eastern portion of the plan as shown on **Drawing 304**. The channel has the following characteristics.

- Max 3:1 side slopes.
- 5.0m wide flat shelf at the east side for a trail.
- Provides Regional flood conveyance.
- Provides an outlet for CWC pipe that drains land north of the MVSP area.
- Sized to provide wetland compensation.

Ponds

The proposed SWM facilities impose boundary conditions on the grading design. The permanent pool elevations for the SWM facilities were fixed based on the receiving outlet elevations as follows:

- SWM Pond 1 –(PP=262.75) The anticipated elevation (262.65) of the receiving watercourse/infrastructure immediately downstream of Humber Station Road.

- SWM Pond 2(PP262.50) – The existing inlet elevation (260.90) of an 800 mm culvert situated on the north side of King Street 72m west of Pond 2.

Starting storm sewer inverts have been set at permanent pool elevations. Refer to pond **Drawings 601** and **602** for detailed pond grading.

Overland and Emergency Flow Routes

The roads have been graded (where practical) to ensure positive drainage of major system flows towards the SWM facilities. In general, the major system drainage is directed overland to the SWM ponds. The major system will operate in the event of a minor system blockage or when the minor system capacity is exceeded in extreme rainfall events.

Additionally, each pond has been designed with an emergency spillway that will operate in the event of an outlet blockage or in the Regional storm event. The emergency outlets for the ponds are as follows:

- Pond 1: Open space channel
- Pond 2: King Road Right of Way

100 Year Capture

Four areas of 100-year capture are contemplated in the MVSP. The 100-year capture areas are intended to maximize the post development drainage areas that are treated within the ponds. The areas are depicted on **Drawings 502** and **503**. 100-year capture is proposed where grading constraints (EPA and boundary roads) preclude a surface overland flow outlet to the pond. Areas of 100-year capture will be refined as the draft plans develop.

Uncontrolled Flows

Portions of site cannot practically be served by the proposed SWM ponds due to grading constraints and will be released uncontrolled as follows:

- Cul-de-sacs TA and QZ
- Any rear yards adjacent to Natural Areas or the New Open space channel.
- All development lands in the extreme south west corner of the development

The storm drainage designed outlined in **Section 5.0** accounts for the release of uncontrolled flows from the above areas.

3.3 Cut / Fill Analysis

A preliminary cut/fill analysis was conducted for the overall study area based on the FSR grading plan to determine the locations requiring cut and fill. **Drawing 305** illustrates the cut/fill areas including the non-participating properties.

As noted above, the objective of the cut/fill analysis is to ensure that the grading plan achieves a balance in earthworks quantities such that import and export of material offsite is limited.

As draft plans are advanced, the grading will be further refined to achieve a theoretical balance. It is likely that no single parcel of land will balance, as such, collaboration between landowners will be required to share cuts and fills.

Through the subsequent preparation of the development staging / phasing plans, the cut-fill areas will be further discretized to coordinate the earthworks program between individual owners.

3.4 Roads

The internal road design and proposed Right-of-Way (ROW) widths are shown on **Drawing 102**. The alternative ROW design package has been prepared by NAK. The Preliminary Road Hierarchy Plan is shown on **Drawing 306** and the preliminary ROW cross sections are illustrated on **Drawings 307-313.**

The community will be structured by a well-ordered and fine grain street hierarchy that will appropriately integrate transit connections, various densities and building types, support an expansive walking and cycling network throughout the community and achieve efficient block development.

The character of the streets will vary depending on the function and adjacent land uses proposed in Macville. Minimum street ROW widths are reinforced and alternative road standards are considered to ensure the best response to balancing pedestrian, cycling, transit and vehicular use and promoting easy circulation within the community. Design influences from shared streets or 'woonerfs' will be encouraged, where appropriate, to reinforce pedestrian comfort, provide unique streetscape opportunities, and achieve a reduction in ROW widths.

4.0 Environmental Policy Areas

The Preliminary Framework Plan**, Drawing 102,** has provided Environmental Policy Areas (EPAs) to protect the environmental features identified in the CEISMP. The CEISMP document describes the proposed EPA restoration and ecological / fluvial geomorphologic design considerations.

4.1 Southern Natural Heritage System

The southern natural heritage system is anchored by three tributary systems of the West Humber River (WHT1, WHT2 and WHT3). Associated with these tributaries are a complex of wetland communities W1 to W6). These wetlands are comprised mainly of mineral soil-based reed canary grass and cattail marshes, shallow aquatic wetlands associated with a dug pond, and a couple organic soil-based marsh and swamp communities. Most of these wetland communities are sustained by surface water, however there is evidence to suggest that some are seasonally sustained by groundwater discharge. These groundwater inputs contribute to baseflows along Tributary WHT1 and contribute to more perennial flows and cooler stream temperatures. For this reason, this tributary and its associated wetlands have been identified as fish habitat as well as potential contributing habitat for endangered Redside Dace that are known to occur downstream of the study area.

Protection of EPA features and their ecological functions can be achieved by:

- Prohibiting development and site alteration within the EPA features except where alteration may benefit the ecological function of the features;
- Maintaining the existing water balances of the EPA features to the extent feasible, by implementing the recommendations in the SWM Management Plan and LID Management Plan;
- Applying an appropriate buffer to the limits of the staked wetland features; and
- Designating the features and associated buffers as EPAs.

Maintenance and enhancement of the ecological integrity of the EPA features and their ecological functions is further described in the CEISMP. The feature-based water balance assessment for the EPAs is provided in Section 7.

4.2 Tributary WHT6 Enhanced Corridor / Greenway

A conceptual plan was developed for the WHT6 tributary corridor/greenway to confirm that the corridor has been sized appropriately on the Land Use Plan and Preliminary Framework Plan and can meet the following design objectives:

- Conveyance of the Regional Storm.
- Sinuous low flow channel.
- Run, riffle, and pool habitats.
- Low gradient profile to promote wetland establishment.
- Wetland habitat area equivalent to that of wetlands removed.
- 2.5H:1V – 3H:1V (horizontal to vertical) side slopes.

- 2-3 m wide trail system between the top-of-slope and the corridor boundary, on one side.

As the proposed Tributary WHT6 corridor/greenway will be newly created, the protection requirements applied to it are different from that applied to existing natural heritage features and systems. For example, buffers are typically applied to existing natural heritage features to mitigate the effects of intruding new land uses or new stressors to adjacent lands, however in this case, the corridor is being constructed at the same time as the rest of the development and therefore does not necessitate a buffer as no new land uses or stressors are being introduced. Therefore, the focus of protection efforts has focused on measures that can be applied to retaining the biodiversity of the existing wetland features that will be relocated within the new corridor.

The methodology of the Tributary WHT6 corridor design for achieving protection, maintenance and enhancement of habitats, biodiversity and ecological functions is further described in the CEISMP.

Typical channel cross sections for the Tributary WHT6 Enhanced Corridor / Greenway are provided on **Drawing 401**.

4.3 Proposed Road Crossings of EPAs

This Section addresses future road crossing locations and provides design guidance for these road crossings of the EPAs. As presented on the **Preliminary Framework Plan**, there are two (2) proposed road crossings of the EPAs. Refer to **Drawing 402** for typical road crossing detail.

- One crossing of the proposed realigned section of WHT6, connected to Humber Station Road. A 1500 mm diameter, closed-bottom, concrete box culvert partially buried to allow natural channel conveyance is proposed.

- Once crossing within the southwest wetland complex across Wetland W4. The crossing will consist of a 1500 mm diameter, closed-bottom, concrete box culvert partially buried to allow for continuous natural conditions from upstream to downstream.

5.0 STORM DRAINAGE

The existing storm drainage patterns for the MVSP lands is described in **Section 2.1**. This section describes the storm drainage / related infrastructure design, and proposed LID measures.

5.1 Proposed Stormwater Drainage System and Drainage Area Exchange

The major and minor drainage systems for the MVSP lands have been designed to convey storm runoff to the proposed SWM facilities prior to discharge to the outlets at the receiving drainage features.

Drawing 501 illustrates the overall drainage areas to both SWM facilities and existing flow nodes. **Table 5-1** summarizes the proposed catchment areas and their respective nodes.

Table 5-1 Proposed Catchment Areas and Receiving Flow Nodes

Proposed Catchment ID	Watershed	Receiving Flow Node
101	Main Humber	8
102	Main Humber	7
103	Main Humber	6
104	West Humber	1/2/3
105A/B	West Humber	2/3
106A/B	West Humber	5
107	West Humber	E5

Drawings 502 illustrates the minor system drainage plan. The provided level of detail includes:

- The discretization of drainage areas to individual storm sewers within the overall catchments areas that were delineated on **Drawing 501**;
- Identification of storm maintenance holes (STM MHs) with proposed grades for top and invert elevations; and
- Identification of connecting storm sewer pipes with proposed length, diameter and slope gradients.

Drawing 503 illustrates the major system flow paths within the overall catchments areas that were delineated on Drawing 501 and includes the following elements:

- Proposed overland flow route direction arrows; and
- Proposed primary flow collection routes through ROWs

In the event of total catchbasin blockage at low points, the flows will drain overland via emergency overland flow routes such as boundary roads and major system spillway routes into the SWM facilities. In locations where overland flow is directed to the outlet between lots, the designated overland flow blocks will be required to accommodate the major system flow path. In addition to the major system conveyance capacity requirements, the blocks will be sized according to the Town's recommended widths based on pipe size and depth where applicable.

The storm sewer system inverts were established based on the permanent pool elevation of the end-of-pipe SWM facilities, minimum cover requirements, and the minimum storm sewer slopes permitted by the Town standards. Trunk design details and major system capacity calculations are included in **Appendix 5**.

Drainage Area Exchange

The delineation of the proposed catchment areas has endeavoured to follow, as closely as possible, the existing drainage divide between the West Humber and Main Humber watersheds through the MVSP lands. As shown on **Drawing 501**, the separation between the existing drainage divide and proposed catchment boundaries has minimized the small areas of drainage exchanged between the two watersheds. It is expected that the refined drainage divide will have little to no impact on either watershed.

5.2 Clean Water Pipe and Roof Drain Collector Systems

The existing external area north of MVSP will be directed to the proposed realigned channel west of Humber Station Road via a clean water pipe (CWP) as shown by the horizontal alignment on **Drawing 502** and vertical profile on **Drawing 504**. The extent of the external drainage area capture to the clean water pipe is illustrated on **Drawing 501.** As per grading details shown on **Drawings 301** and **302**, the temporary grade transition and stabilized interceptor swales are proposed along the north limit of the MVSP boundary to direct the external pre-development drainage to the clean water pipe via a headwall structure. The clean water pipe is sized to convey the 100-year flows from the external area. The internal CWP alignment has been chosen as the shortest route through the future development to convey external drainage to the proposed channel, and the CWP will be accommodated within different ROW cross sections. Refer to **Drawing 504** for typical CWP trench details.

It should be noted that, due to the grading constraints associated with the existing upstream WHT6 drainage feature and existing Humber Station Road 1350mm diameter culvert invert at the downstream end of the proposed channel, the clean water pipe is proposed at 0.35% in order to address the grading constraints. This slope is slightly lower than the Town's minimum slope of 0.4%; however, the flow in this large 1350mm diameter concrete pipe will be sufficient to maintain self-cleaning velocities.

The Roof Drain Collector (RDC) system is a future third pipe located within the municipal ROWs that collects clean roof runoff. The RDC system will be required in Catchments 104 and 105, identified on **Drawing 501,** to direct clean roof drainage to the existing wetland complex located northeast of King Street and The Gore Road to mitigate the reduction in drainage area resulting from development. Refer to Section 7 for details of the feature-based water balance and **Drawing 702** for the post-development drainage contribution to the existing wetlands. The RDC design will be finalized at a later date following field confirmation of the wetland water balance requirements.

The assessment of the existing drainage paths is included in the CEISMP, and based on the background review and field investigations in June of 2020, Beacon has confirmed that all drainage features in the MVSP lands are headwater drainage features (HDFs) and are not considered watercourses. Therefore, the HDFs will be removed, and there is an opportunity to consolidate these features and replicate their functions within an enhanced EPA corridor. In addition, the LIDs and rear yard swales could be also considered as compensation for loss of existing HDFs.

5.3 Low Impact Development

A description of potential Low Impact Development (LID) measures as mitigation regarding feature-based and site water balance is included in the CEIMSP and discussed further in **Section 7.3**. Once chosen through future studies, potential LID methods will be applied throughout the plan and integrated into the various components (e.g. EPA, buffers, private lots etc.). The details of maintenance and ownership will be determined at the detailed design stage in order to achieve successful implementation.

APPENDIX 5

Storm Sewer Design Calculations

100-year Capture Calculations

6.0 STORMWATER MANAGEMENT PLAN

6.1 SWM Strategy

The SWM strategy maintains the approximate pre-development watershed divide between the West Humber River and Humber River as well as the individual subcatchments/outlets within each watershed as described in **Section 5.1**. This approach ensures that, with appropriate SWM controls, minimizes change to the overall drainage patterns and sources of drainage to each outlet aside from that associated with increased imperviousness.

Two (2) end-of-pipe stormwater management facilities (wet ponds) are proposed to treat the post-development drainage areas within the West Humber watershed illustrated in **Drawing 501**. It is noted that while quantity controls are not required within the Main Humber River watershed, water quality controls will be provided within these lands, as required.

Pond 1 is situated northwest of the intersection of King Street & Humber Station Road as it abuts King Street to the south and Humber Station Road to the east. Pond 2 is situated in the southwest of the MVSP lands, east of the EPA. Preliminary sizing of these facilities is provided herein.

Other SWM facility types (dry ponds, wetlands, etc.) were not considered for this development. Wet ponds were determined to be more appropriate in terms of meeting the quality and quantity control requirements for the subject lands.

The SWM facilities have been situated in the proposed locations for the following reasons:

- to make use of existing/natural low points in terrain to minimize earthworks/cut and fill operations and maintain existing drainage patterns as much as possible;
- to maintain a permanent pool and drain into the receiving channels / existing / planned storm sewer outlets;
- to locate SWM facilities adjacent to the EPA and maintain flow input locations along the receiving channels where possible;
- to minimize storm sewer infrastructure size and avoid potential servicing crossing conflicts; the contributing areas to the SWM facilities are generally limited to 60 ha;
- to optimize land use by maximizing tableland and serviceable area.

As shown on **Drawings 501-503**, the SWM facilities are located at the proposed drainage outlets along King Street and are linked to a proposed EPA corridor (Pond 1) and existing EPA lands (Pond 2). These locations represent the low areas within the West Humber subcatchments intersected by MVSP.

This section of the FSR identifies the SWM targets and design criteria, as well as the individual SWM facility requirements and LID measures/designs. The hydrologic modelling of pre-development conditions is based on refinements to the hydrologic model in the 2018 Humber River Hydrology Update prepared by TRCA. The subcatchments within the West Humber and Main Humber watersheds intersected by MVSP have been refined from topographic surveys carried out locally to clarify drainage boundaries and outlets.

The TRCA SWM Criteria (2012) provided the unit flow relationships for the 2-year to 100-year storm events within the West Humber. Runoff characteristics for the 25mm and Regional Storm events have been determined by passing these storm events through the hydrologic model.

Table 6-1 provides the results for calibration of existing flow rates of TRCA-defined subcatchments within the West Humber River watershed in the vicinity of the MVSP.

Table 6-1 Calibration of Existing Flow Rates for TRCA-Defined West Humber River Subcatchments

Calibration of Existing Flow Rates for TRCA-Defined West Humber River Subcatchments										
	37.12		37.11		37.10		37.02		J45	
	TRCA	UT	TRCA	UT	TRCA	UT	TRCA	UT	TRCA	UT
AES 6hr										
2	0.10	0.11	0.19	0.20	0.14	0.15	0.05	0.06	0.41	0.47
5	0.19	0.21	0.36	0.37	0.27	0.29	0.10	0.12	0.79	0.91
10	2.18	2.31	3.98	4.31	2.87	3.18	0.88	1.12	8.38	8.96
25	2.79	2.96	5.06	5.47	3.68	4.15	1.15	1.48	10.70	11.59
50	3.24	3.46	5.87	6.35	4.29	4.84	1.37	1.75	12.46	13.57
100	3.70	3.97	6.68	7.22	4.89	5.54	1.58	2.03	14.23	15.55
AES 12hr										
2	0.14	0.16	0.26	0.26	0.19	0.20	0.07	0.08	0.57	0.64
5	0.24	0.26	0.44	0.46	0.33	0.35	0.12	0.14	1.01	1.12
10	2.39	2.53	4.06	4.33	2.89	3.16	0.83	1.07	8.72	9.14
25	2.98	3.16	5.05	5.39	3.62	4.02	1.07	1.37	10.85	11.54
50	3.43	3.64	5.78	6.17	4.16	4.62	1.25	1.60	12.47	13.33
100	3.87	4.13	6.52	6.96	4.71	5.24	1.43	1.83	14.13	15.17
Regional	10.61	11.13	14.84	15.86	10.58	11.44	2.95	3.76	36.31	40.16

6.2 SWM Targets & Design Criteria

The SWM targets / sizing criteria for the MVSP lands were established based on the TRCA SWM Criteria (2012) and the TRCA pre-development hydrologic model presented in the Humber River Hydrology Update (2018).

These studies involved hydrologic modelling for pre- and post-development conditions, resulting in SWM design criteria to control the post-development drainage areas to pre-development flow rates, in addition to meeting the following requirements:

- Ensure that existing flow rates downstream of the subject lands are not exceeded under post-development conditions, thereby providing flood protection for properties downstream of the MVSP area;
- Provide adequate drawdown time / erosion control to protect the form and function of watercourses downstream of the SWM facilities.
- Ensure that the MECP-recommended stormwater quality treatment of runoff is provided;
- Maintain recharge volumes through the use of low impact development and other practices as required based on hydrogeological assessments;
- Maintain water balance to wetland features (refer to Section 7 for further details)

The following specific SWM criteria were established:

Permanent Pool Volume - each stormwater management facility within MVSP must meet the Enhanced (Level 1) criteria as per the MOE SWM Planning and Design Manual (March 2003).

Extended Detention / Erosion Control – The extended detention volume for erosion control is based on detention of the 25mm storm event from 48 hours to 72 hours for controlled release from the SWM ponds, as indicated below.

Pond 1	0.060 m^3/s
Pond 2	0.030 m^3/s

Quantity Control – Table E.1: Summary of Unit Flow Relationships, Humber River Watershed in the TRCA SWM Criteria (2012) provided the equations to determine the quantity control unit flow rates for the 2-year to 100-year storm events within the West Humber River watershed. The unit flow rates determined from these relationships are given below for Ponds 1 and 2 in **Table 6-2**.

Table 6-2 SWM Facility Target Release Rates

Return Period	Pond 1 Drainage Area = 83.92 ha		Pond 2 Drainage Area = 50.15 ha	
	Unit Flow Rate (m^3/s/ha)	Target Release Rate (m^3/s)	Unit Flow Rate (m^3/s/ha)	Target Release Rate (m^3/s)
2-Year	0.0063	0.530	0.0067	0.336
5-Year	0.0096	0.808	0.0102	0.512
10-Year	0.0119	0.997	0.0126	0.631
25-Year	0.0149	1.253	0.0158	0.794
50-Year	0.0173	1.455	0.0184	0.924
100-Year	0.0197	1.649	0.0208	1.045

A Visual OTTHYMO 6.2 (VO6) model was prepared to calculate the storage requirements for the SWM facilities to achieve the target release rates. The evaluation analyzed the 6-hour and 12-hour AES storm distributions. The more conservative results between these two storm distributions have been used.

Regional Control – control post-development flow rates to pre-development levels, as evaluated at a common downstream location.

Regional storm control is required as per email correspondence with TRCA dated April 17, 2020.

SWM Facility Design Criteria - Through a consultation process with the Town of Caledon and review of the Town and MECP design criteria, the following SWM pond design criteria have been established and summarized in **Table 6.3**. Facilities will be designed accordingly to meet the criteria in Section 4.2.1 of the TRCA's Approaches to Manage Regulatory Event Flow Increases resulting from Urban Development (TRCA, 2016), where applicable.

Table 6-3 SWM Pond Design Criteria and Standards

SWM Pond Design Criteria	SWM Design Standards
Maintenance Access Road	A paved / concrete maintenance access road with a width of 5.0m and cross slope of 2% into the pond shall be provided on at least two sides of the pond to access the inlet and outlet structures, forebay, and wet cell. The maintenance access road shall be configured such that two points of entry are provided (where possible). The access road shall be situated in a manner that allows trucks to drive around the pond without having to turn around, or incorporate a turning circle (minimum radius 12.0m) where two access points cannot be provided. Access shall be provided to the bottom of the pond forebay and main cell with 12:1 (horizontal: vertical) slopes. Trails will be combined with the maintenance access roads in locations where the trail alignment passes through the SWM pond block.
Side Slopes	A 7:1 slope centered on the normal water level for 3.5m on either side is proposed. Internal side slopes of 4:1 (H:V) will be provided in all other locations including transition grading above the high water level. The use of armor stone retaining wall is to be considered above the high-water level if required. All other Town criteria for maximum side slopes (3:1) shall be used on the outer side of the pond blocks where necessary.
Sediment Drying / By-Pass Storm Sewer for Pond Maintenance	The Town has separate criteria for sediment removal in dry conditions and in wet conditions: All of the MVSP facilities are designed to be cleaned in the wet. According to the Town criteria for cleaning in wet conditions, sediment drying areas have been provided above the high-water level to dewater the excavated sediment. Alternative methods for dredging the SWM facilities can be explored, including: • winter sediment removal in which the sediment is frozen and easier to haul off site with less dewatering. • on-site filtering methods which involve pumping / pressing with minimal disturbance to the pond.

6.3 Proposed SWM Facility Design

As noted in the preceding section, the SWM targets established in the subwatershed study are based on the drainage area and imperviousness serviced by each SWM pond. The proposed drainage areas to each facility are noted in **Table 6-4** and correspond to **Drawing 501 and 600 series (SWM Pond) drawings**.

Table 6-4 SWM Facility Drainage Areas

SWM Facility	Total Area to Pond Inlet [ha]	Total Area (including pond block and rear yards) [ha]	Imperviousness %
1	78.8	83.92	78
2	47.0	50.15	68

The catchment imperviousness values were approximated based on the Town of Caledon's standard runoff coefficient values as listed in **Table 6-5** for various land uses, converted to imperviousness using the formula:

$$\%IMP = 100 \times (c - 0.2) / 0.7$$

These values were then compared to the %IMP values suggested by TRCA. The more conservative values were applied.

Table 6-5 Runoff Coefficients & Imperviousness for Various Land Uses

<table>
<tr><th>Land Use</th><th>Town Runoff Coefficient (-)</th><th>Town Percent Impervious* (%)</th><th>TRCA Percent Impervious (%)</th><th>Selected Impervious Values (%)</th></tr>
<tr><td>Commercial</td><td>0.90</td><td>100</td><td>95</td><td>100</td></tr>
<tr><td>Industrial – Downtown</td><td>0.90</td><td>100</td><td rowspan="2">95</td><td>100</td></tr>
<tr><td>Industrial – Suburban</td><td>0.75</td><td>79</td><td>95</td></tr>
<tr><td>Apartments</td><td>0.75</td><td>79</td><td>80%</td><td>80</td></tr>
<tr><td>ROW dwellings / Townhouses</td><td>0.70</td><td>71</td><td>75</td><td>75</td></tr>
<tr><td>Duplex</td><td>0.70</td><td>71</td><td>75</td><td>75</td></tr>
<tr><td>Semi-detached (downtown)</td><td>0.60</td><td>57</td><td>60</td><td>60</td></tr>
<tr><td>Single family (downtown)</td><td>0.40</td><td>29</td><td>60</td><td>60</td></tr>
<tr><td>Semi-detached (suburban)</td><td>0.50</td><td>43</td><td>55</td><td>55</td></tr>
<tr><td>Single family (suburban)</td><td>0.40</td><td>29</td><td>40</td><td>40</td></tr>
<tr><td>Schools / Institutional</td><td>0.75</td><td>79</td><td>80</td><td>80**</td></tr>
<tr><td>SWM Facilities</td><td>-</td><td>50</td><td>80-100</td><td>100</td></tr>
<tr><td>Parks / Open space over 4 hectares</td><td>0.20</td><td rowspan="2">7</td><td rowspan="2">10</td><td>10</td></tr>
<tr><td>Parks / Open space under 4 hectares</td><td>0.25</td><td>10</td></tr>
</table>

*Note – values include ROW areas; converted from Town runoff coefficients using C=0.7I+0.2
**It is recommended that the imperviousness for school blocks be reviewed on a site-by-site basis. Typical values of school block imperviousness, based on aerial imagery, range from 50% to 60%.

Based on the contributing drainage areas and imperviousness values and unit rates / targets shown in **Section 6.2**, stage-storage-discharge relationships have been established for each SWM facility. These results are included in **Appendix 6-1**. The provided volumes are based on the preliminary pond grading designs presented in **Drawing 601** and **Drawing 602**.

SWM pond outlets have been designed to ensure that post-development peak flow rates for the 2-year to 100-year storm events do not exceed the pre-development conditions at each Flow Node location. As with the pre-development conditions, post-development peak flow rates were also modelled using VO6 with the summary parameters and output results included in **Appendix 6-2**. The drainage areas and pre- and post-development flow rates at each Flow Node are summarized in **Table 6-6**, for West Humber River Tributary 6, and **Table 6-7**, for West Humber River Tributary 2.

The target release rates for each SWM pond were determined in Table 6-1 from the TRCA unit flow relationships and the contributing drainage area to each SWM pond. Proposed drainage areas for the ponds include the SWM blocks. A complete summary of flow rates at SWM pond discharge points is provided in **Table 6-8** for SWM Pond 1 discharging to WHT6 Node 5 and in **Table 6-9** for SWM Pond 2 discharging to WHT2 Nodes 2/3.

Table 6-6 Existing and Post-Development Flow Rates along West Humber River Tributary 6 from North Limit of MVSP to The Gore Road

	West Humber River Tributary 6									
	Node 9		Node 5		Node E5		Node E6		Node E4	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
NHYD	3	3	18	122	35	35	56	56	49	49
Drainage Areas (ha)	78.77	75.57	163.59	162.53	170.05	170.47	194.43	194.85	562.34	558.62
25 mm	0.03	0.02	0.06	0.14	0.06	0.99	0.07	0.39	0.27	0.40
2	0.12	0.06	0.22	0.15	0.22	0.85	0.25	0.57	0.97	1.31
5	0.20	0.11	0.38	0.33	0.39	1.17	0.43	0.89	1.71	2.15
10	1.19	1.14	2.21	1.52	2.27	2.03	2.53	2.29	9.08	8.49
25	1.47	1.41	2.76	2.01	2.84	2.53	3.16	2.84	11.43	10.77
50	1.69	1.62	3.18	2.40	3.28	2.95	3.64	3.29	13.37	12.63
100	1.90	1.83	3.61	2.79	3.73	3.35	4.13	3.73	15.33	14.46
Regional	4.95	4.73	9.71	8.79	10.12	9.55	11.29	10.60	40.43	40.02

Table 6-7 Existing and Post-Development Flow Rates along West Humber River Tributary 2 from Upstream of King Street to The Gore Road

	West Humber River Tributary 2					
	Node 2/3		Node 10		Node E3	
	Pre	Post	Pre	Pre	Pre	Post
NHYD	11/12	11/12	90	90	49	49
Drainage Areas (ha)	54.92	60.12	117.73	120.69	562.3	558.62
25 mm	0.04	0.32	0.08	0.19	0.3	0.40
2	0.13	0.48	0.28	0.43	1.0	1.31
5	0.23	0.75	0.49	0.72	1.7	2.15
10	1.42	1.01	2.83	2.11	9.1	8.49
25	1.83	1.31	3.69	2.74	11.4	10.77
50	2.13	1.54	4.30	3.22	13.4	12.63
100	2.43	1.76	4.92	3.67	15.3	14.46
Regional	4.96	5.35	10.54	10.44	40.4	40.02

Table 6-8 SWM Pond 1 Release Rate Summary

	West Humber Tributary 6				
	SWM Pond 1 to Node 5				
	Pre	Unit Flow Rate	Target Release Rate	Pond 1 Release Rate	Post
NHYD	18				122
Drainage Areas (ha)	163.59				162.66
25 mm	0.057	-	0.060	0.055	0.143
2	0.215	0.006	0.530	0.488	0.151
5	0.376	0.010	0.808	0.764	0.331
10	2.209	0.012	0.997	0.941	1.516
25	2.762	0.015	1.253	1.191	2.006
50	3.181	0.017	1.455	1.411	2.4
100	3.609	0.020	1.649	1.604	2.792
Regional	9.710	0.059	4.981	4.888	8.778

Table 6-9 SWM Pond 2 Release Rate Summary

	West Humber Tributary 2				
	SWM Pond 2 to Node 10				
	Pre	Unit Flow Rate	Target Release Rate	Pond 1 Release Rate	Post
NHYD	90				90
Drainage Areas (ha)	117.73				120.69
25 mm	0.08	-	0.030	0.028	0.19
2	0.28	0.007	0.336	0.284	0.43
5	0.49	0.010	0.512	0.464	0.72
10	2.83	0.013	0.631	0.578	2.11
25	3.69	0.016	0.794	0.735	2.74
50	4.30	0.018	0.924	0.850	3.22
100	4.92	0.021	1.045	0.955	3.67
Regional	10.54	0.089	4.480	4.383	10.44

Pond Inlets & Forebays

The size of the inlet pipes will be minimized where possible; however, box culverts are preferred as they can provide greater conveyance capacity with less pipe depth in locations where cover is limited. The inlets will generally convey minor system flows, while an overland spillway into the facility will convey flows above the 10-year return period into the facility. The inlet pipe size was determined via storm sewer design calculations (i.e., conveyance capacity based on Manning's equation and Rational Method peak storm flows; refer to **Appendix 5** for the storm trunk design sheets).

All forebays have been designed according to the settling and dispersion length equations provided in Section 4.6.2 of the MOE SWM Planning and Design Manual (2003). Forebay calculations are included in **Appendix 6-1**.

Pond Outlets

Both facilities will have multiple outlet controls including an extended detention outlet, quantity control, emergency spillway and a maintenance sump. The extended detention pipe will consist of a reverse-slope pipe extending from 0.5m from bottom of the permanent pool to an orifice plate on the control structure at the normal water level. The submerged end-of-pipe will be fitted with a perforated pipe section of sufficient open area and will be protected with riprap and filter fabric. The orifice plate will be sized to meet the required extended detention flows and required drawdown time (i.e. minimum 48 hours) under approximately 0.5m to 1m of head (i.e., extended detention level). The orifice plate will be bolted onto the outlet structure with the invert set at the permanent pool level. To prevent potential blockage by debris, etc., a minimum orifice size of at least 100mm is recommended.

Preliminary orifice dimensions and the corresponding target and recommended release rates and drawdown times for both facilities have been calculated and are indicated in **Table 6-10**.

By providing a minimum 48-hour drawdown time for the 25mm event, the erosive effects of increased runoff volume should be adequately mitigated.

Table 6-10 Preliminary Extended Detention Orifice Dimensions

SWM Pond	Target Extended Detention Flow (m^3/s)	Minimum Preliminary Orifice Diameter required to match target (mm)	Preliminary Drawdown Time (hr)
1	0.060	100	48 - 72
2	0.030	100	48 - 72

A series of orifices or a compound weir knock-out will be designed for the outlet control structure to achieve the 2-year to 100 year / Regional target flows where applicable. The preliminary stage-storage-discharge relationships for the ponds are indicated in **Appendix 6-1** are subject to change based on the outlet structure design for each facility. However, the target discharge will be maintained. The detailed outlet structure will be determined at the detailed design stage. A tailwater assessment will confirm the performance of the outlet works relative to the downstream receiving channel.

Both facilities will have an emergency spillway located above the high year water level to manage overflows in the event that all outlet structures are blocked. The spillway will be suitably protected and landscaped to prevent erosion and could be integrated into a restoration design. If it is determined at a future design stage that additional emergency flow conveyance is required, the top of the outlet control structure could be fitted with an emergency overflow grate, to augment the total emergency conveyance capacity or to reduce the emergency spillway dimensions. The emergency flow capacity is the greater of the Regional Storm or 100- year flow in the event of a blockage of the primary outlets.

6.4 SWM Facility Outfalls

The proposed pond outfall locations are illustrated on **Drawings 601** and **602** and have been coordinated with and evaluated by the ecological study team members. The TRCA SWM criteria documents provide guidelines on outfall design and placement. In general, the facility outfalls have been placed:

- outside of the 25-year floodline, where possible;
- outside of the 100-year erosion limit, where possible; and
- outside of the meander belt, where possible.
- outlets into the watercourse to be angled at 45 degrees to reduce erosion impacts where possible.

The extent of the proposed outfall works is governed by the permanent pool elevations, which in turn are constrained by the low points along the development limits. Therefore, outfall channel works within EPA may be required since raising the permanent pool would prevent the low portions of the site from draining into the SWM facilities. The preliminary outfall works are illustrated on **Drawings 601** and **602** and will be further developed at future design stages.

Table 6-11 indicates the proposed SWM facilities outfall locations and associated works involved to ensure flows are conveyed safely to the receiving watercourse.

Table 6-11 SWM Facility Outfall Works

SWM Facility	Outfall Location	Required works
Pond 1	Proposed EPA created by realigned channel upstream of Humber Station Road via 1500 mm concrete storm pipe	Completion of proposed realigned channel and installation of outfall pipe and associated erosion protection including a stone core wetland at the outfall
Pond 2	North side of King Street at east side of Wetland W6 in southwest of MVSP via 1200 mm concrete storm pipe	Installation of outfall pipe and associated erosion protection

At detail design stage, all SWM facility outfalls will be provided with the erosion protection details to prevent scour.

SWM Control for Catchment 104 Areas Unable to Drain to SWM Pond 2

Table 6-12 provides a summary of preliminary OGS sizing for catchment areas that will not drain to SWM Pond 2 due to grading constraints. The recommended OGS are Stormceptor EF series or approved equivalent. The preliminary OGS sizing is provided in **Appendix 6-3**.

Table 6-12 Preliminary OGS Sizing in Catchment 104

Catchment Area	OGS ID	Provided TSS Removal (%)	Stormceptor Model
104-1	OGS-1	84	EF8
104-2	OGS-2	82	EF8
104-3	OGS-3	80	EF4
104-4	OGS-4	85	EF4

Drainage Within Main Humber River Watershed

In accordance with TRCA SWM criteria, no quantity control is required within the Main Humber River watershed.

Table 6-13 provides a comparison of existing and proposed flow rates to the three culverts (Nodes 6 to 8) crossing the CPR at the east side of the MVSP within the Main Humber River watershed.

Table 6-13 Main Humber River Drainage to Nodes at CPR Culverts

	Main Humber River					
	Node 6		Node 7		Node 8	
	Pre	Post	Pre	Post	Pre	Post
NHYD	26	123	28	125	33	118
Drainage Areas (ha)	18.80	8.30	2.78	13.70	19.00	13.25
25 mm	0.14	0.71	0.02	1.42	0.18	1.34
2	0.52	0.96	0.09	1.15	0.74	1.07
5	0.97	1.13	0.16	1.57	1.32	1.49
10	1.29	1.33	0.21	1.84	1.72	1.75
25	1.70	1.49	0.28	2.20	2.22	2.09
50	2.01	1.65	0.32	2.45	2.60	2.35
100	2.32	1.22	0.37	2.71	2.98	2.60
Regional	2.67	1.22	0.40	2.01	2.76	1.95

To provide water quality control and promote groundwater recharge, several low impact development (LID) techniques are being considered for implementation in the MVSP lands draining to the Main Humber River.

The following LID techniques are contemplated for treatment of runoff from public rights-of-way. Lot level techniques are discussed further in **Section 7.3**.

Bioswales: Bioswales are enhanced vegetated swales with an infiltration component. They are vegetated open channels designed to convey, treat and attenuate stormwater runoff. Their implementation is subject to development density, topography and depth to the water table. Bioswales enhance the treatment functionality of a basic grass-lined channel by incorporating modified geometry and flow checks to reduce runoff and enhance contaminant removal. Flow checks can create temporary ponding areas that allow sedimentation, filtration through the root zone and soil matrix, evapotranspiration, and infiltration into the underlying native soil. Bioswales are intended to treat first flush flows which ultimately discharge into the storm sewer system via overflows. Bioswales can be implemented in right-of-ways with or without curb and gutter to reduce impervious cover and add to the natural landscape.

Perforated Pipe Systems: Perforated pipe systems are underground stormwater conveyance systems that allow for infiltration thereby attenuating runoff and reducing contaminant loads to downstream receiving systems. The perforated pipes are installed in gently sloping granular stone beds lined with geotextile fabric. Stormwater runoff infiltrates from the pipes into the gravel bed and underlying native soil as it is being conveyed from source areas to the receiving system. Installation is subject to topography, water table depth and runoff quality. Perforated pipe systems can be used to augment, and occasionally take the place of, conventional storm sewer pipes in order to treat runoff from roofs, walkways, parking lots and low-to-medium traffic roads, with adequate pre-treatment. A design variation can include perforated catchbasins, where the catchbasin sump is perforated to allow runoff to infiltrate into the underlying native soil. Perforated pipe systems are often installed as part of bio-swale systems.

Extended Tree Pits: Extended tree pits are a form of bioretention. They are enlarged planting areas located typically in a row, within the ROW and take advantage of the landscaped space between the sidewalk and the street. They can be designed to take runoff from the sidewalk or street. Stormwater is diverted into the expanded tree pit using curb cuts or trench drains. They are typically designed to be offline, that is when they are full the stormwater will bypass the practice and flow to the downstream street inlet. If large mature canopy trees are desired, then additional soil volume should be provided in the tree pit.

As a form of bioretention, extended tree pits can be considered wherever water can be conveyed to a landscaped area. They are installed close to the impervious area that generates the runoff and can be installed within various forms of development including commercial, institutional, and residential sites in spaces that are traditionally pervious and landscaped. Extended tree pits are able to fit into ultra-urban development contexts.

The opportunities for LIDs within ROWs are to be further explored following the Town's review of the alternative ROW design standards presented in the Urban Design Guidelines.

6.5 Proposed Floodplain

Hydraulic Modeling Objectives

The following are the primary objectives of the hydraulic modelling. The hydraulic modelling results presented herein describe the channel hydraulics of the proposed realignment of West Humber Tributary 6 reaches 6-A, 6-B and 6-C.

- **Flood Mapping**
  - Determine flood elevations for the existing tributaries
  - Determine flood elevations for the proposed watercourse under proposed scenario

- **Riparian Storage**
  - For both tributaries, determine existing riparian storage volume targets for the range of return period events and the Regional Storm;
  - Ensure riparian storage in the proposed channels matches or exceeds existing riparian storage.

The hydraulic modelling was completed with GeoHECRAS. GeoHECRAS was developed by CivilGEO Inc. and is based on the U.S. Army Corps of Engineers' Hydrologic Engineering Center - River Analysis System (HEC-RAS). The post-development floodmapping is illustrated on **Drawings 603A and 603B**.

Objective 1 – Flood Mapping

The HEC-RAS hydraulic model describing the existing conditions was obtained from TRCA on August 21, 2020. The existing model extends along WHT6 to the west side of Humber Station Road and the upstream limit coincides with the upstream limit of Reach 6-C at the south limit of the tile drainage area. Refer to **Drawing 202** for details.

The existing model geometry was imported into GeoHECRAS. A digital terrain model (DTM) to describe the existing conditions was created from information contained in the following topographic surveys performed by JD Barnes:

- Topographic Survey of Part of Lot 12, Concession 4, (Geographic Township of Albion), Town of Caledon, Regional Municipality of Peel, Survey Completed on April 15, 2020.
- Humber Station and Macville Culvert Data, July 30, 2020, with updates on August 4, 2020 and August 21, 2020 (electronic file dates).
- Topographic Survey of Part of Lots 11, 12 and 13, Concession 5, (Geographic Township of Albion), Town of Caledon, Regional Municipality of Peel, Survey Completed on October 14, 2020.

The model contains cross-section information extracted from the above surveys (herein referred to as the “OG surface”).

The characteristics and dimensions of the existing culverts downstream of WHT6, in the vicinity of the MVSP are included in **Table 6-14**. It should be noted that the existing model provided by TRCA did not include these road crossings.

Table 6-14 Existing Culverts Downstream of WHT6

ID#	Right-of-Way | Node ID	Type	Opening Dimension	Length (m)	U/S Invert (m)	D/S Invert (m)
HS5	Humber Station Road | Node 5	CSP	1350mm Dia.	18.9	262.83	262.65
K8	King Street West | Node E5	CSP	1800mm Dia.	23.0	262.28	262.30
HS7	Humber Station Road | Node E6	Twin PVC	2 x 750mm Dia.	14.8	256.68, 256.67	256.67, 256.63
G3	The Gore Road | Node E4	Conc. Box	3.5m Wide	38.9	245.82	245.89

Boundary Flow Conditions

Flows used in the existing model were based on the Visual OTTHYMO 6.2 (VO6) hydrology modelling outlined in **Appendix 6-2** of this report. **Table 6-15** summarizes the flows and contributing areas to each cross-section for the existing and proposed conditions.

Table 6-15 Existing vs. Proposed Boundary Flow Conditions

HEC RAS XS ID	VO6 ID | Node ID	Cond	Drainage Area [ha]	Flow (m^3/s)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	Reg.
5139	**NYHD 96/66 | Node E1**	Ex.	44.04	0.09	0.16	0.90	1.12	1.30	1.48	3.39
		Prop.	40.84	0.05	0.08	0.78	0.97	1.11	1.26	3.06
4397 .62	**NHYD 3 | Node 9**	Ex.	78.77	0.12	0.20	1.19	1.47	1.69	1.90	4.95
		Prop.	75.57	0.06	0.11	1.14	1.41	1.62	1.83	4.73
3459 .49	**NHYD 79/80 | Node 5-2**	Ex.	135.77	0.17	0.30	1.79	2.23	2.56	2.89	7.76
		Prop.	75.57	0.06	0.11	1.12	1.40	1.60	1.81	4.71
3129 .04	**NYHYD 106/- | Node 5-1**	Ex.	145.27	0.19	0.32	1.91	2.39	2.75	3.11	8.44
		Prop.	75.57	0.06	0.11	1.12	1.40	1.60	1.81	4.71
3022 .08	**NHYD 18/122 | Node 5**	Ex.	163.59	0.22	0.38	2.21	2.76	3.18	3.61	9.71
		Prop.	162.53	0.15	0.33	1.52	2.01	2.40	2.79	8.79
2721 .34	**NHYD 35 | Node E5**	Ex.	170.05	0.22	0.39	2.27	2.84	3.28	3.73	10.12
		Prop.	170.47	0.85	1.17	2.03	2.53	2.95	3.35	9.55
2027	**NHYD 56 | Node E6**	Ex.	194.43	0.25	0.43	2.53	3.16	3.64	4.13	11.29
		Prop.	194.85	0.57	0.89	2.29	2.84	3.29	3.73	10.60
1610 .08	**NHYD 86 | Node 13**	Ex.	209.86	0.25	0.45	2.61	3.27	3.77	4.29	12.00
		Prop.	210.28	0.60	0.96	2.38	2.98	3.44	3.91	11.67

1257.87	**NHYD 55 | Node 12**	Ex.	325.72	0.47	0.83	4.42	5.61	6.48	7.37	20.72
		Prop.	319.04	0.72	1.17	4.22	5.36	6.24	7.06	20.10
751	**NHYD 54 | Node 11**	Ex.	528.10	0.90	1.58	8.54	10.73	12.52	14.36	37.60
		Prop.	524.38	1.23	2.01	7.89	9.92	11.60	13.28	36.89
199	**NYHD 49 | 37.30 (J45) - Node E4**	Ex.	562.34	0.97	1.71	9.08	11.43	13.37	15.33	40.43
		Prop.	558.62	1.31	2.15	8.49	10.77	12.63	14.46	40.02

Table 6-16 summarizes the existing and proposed water levels, for the realigned WHT6 downstream to The Gore Road as detailed in **Appendix 6-4**. Minor increases in water elevation are within the tolerance of the model and will not have any impact on the overall system or adjacent properties. The proposed channel design contains the Regional Storm with sufficient freeboard to private property (minimum 0.30 m).

Table 6-16 Existing and Proposed Water Surface Elevations

Ex RS	Prop RS	Existing Reg. W.S. Elev. (m)	Prop. Reg. W.S. Elev. (m)	∆ Reg. W.S. Elev. (Prop. – Ex.) (m)
5139	5139	276.3	276.28	-0.02
5080	5080	275.4	275.39	-0.01
5045	5045	274.83	274.82	-0.01
5008	5008	274.56	274.55	-0.01
4946.01	4946.01	274.01	274	-0.01
4885.21	4885.21	273.43	273.42	-0.01
4831.92	4831.92	273.07	273.06	-0.01
4800.81	4800.81	272.78	272.77	-0.01
4749.98	4749.98	272.54	272.53	-0.01
4701.43	4701.43	272.46	272.45	-0.01
4651.75	4651.75	272.31	272.29	-0.02
4602.06	4602.06	272.09	272.07	-0.02
4559.74	4559.74	271.64	271.62	-0.02
4492.85	4492.85	271.08	271.07	-0.01
4460.53	4460.53	270.91	270.9	-0.01
4397.62	4397.62	270.54	270.54	0
4359	CWC	270.22	CWC	-
4304.29		270.01		-
4270.06		269.8		-
4228.93		269.67		-
4207.18		269.62		-
4168.63		269.25		-
4122.96		269.08		-
4045.6		268.8		-

Ex RS	Prop RS	Existing Reg. W.S. Elev. (m)	Prop. Reg. W.S. Elev. (m)	∆ Reg. W.S. Elev. (Prop. – Ex.) (m)
4008.8		268.66		-
3962.04		268.49		-
3890.7		268.06		-
3844.66		267.77		-
3805.35		267.54		-
3761.64		267.3		-
3713.08		267.14		-
3662.17		266.94		-
3608.28		266.76		-
3558.59		266.54		-
3508.9		266.41		-
3459.49	3459.49	266.04	265.87	-0.17
3410	3410	265.97	265.87	-0.1
3359.83	3359.83	265.96	265.87	-0.09
3310.14	3310.14	265.95	265.87	-0.08
3260	3260	265.95	265.87	-0.08
3210.77	3210.77	265.95	265.87	-0.08
3165.68	3165.68	265.95	265.87	-0.08
3155.05	3160	265.95	265.87	-0.08
3152.41	3138	265.94		
3143.25		Culvert 7 (Ex. Only)		
3133.99		264.98		
3129.04		265		
-	3122	-	265.22	-
3111.39	3111.39	265.01	265.22	0.21
3061.7	3061.7	265.02	265.22	0.20
-	3041	-	265.22	-
3022.08	3022.08	265.02	265.21	0.19
3011.93	2998.53	265.02		
2998.53		Culvert HS5 | Node 5		
2934.09	2934.09	263.87	263.81	-0.06
2912.72	2912.72	263.64	263.59	-0.05
2855.23	2855.23	263.34	263.18	-0.16
2813.79	2813.79	263.34	263.17	-0.17
2764.7	2764.7	263.34	263.17	-0.17
2721.34	2721.34	263.34	263.17	-0.17
2678.01	2678.01	263.31	263.14	-0.17

Ex RS	Prop RS	Existing Reg. W.S. Elev. (m)	Prop. Reg. W.S. Elev. (m)	∆ Reg. W.S. Elev. (Prop. – Ex.) (m)
2664.39	2664.39	Culvert K8 | Node E5		
2644.21	2644.21	261.08	261.07	-0.01
2614.5	2614.5	260.8	260.79	-0.01
2564.81	2564.81	260.63	260.62	-0.01
2515.12	2515.12	260.62	260.61	-0.01
2493	2493	260.61	260.61	0
2474	2474	260.61	260.61	0
2454	2454	Culvert E3		
2429	2429	260.04	260	-0.04
2380	2380	259.89	259.86	-0.03
2364.8	2364.8	259.85	259.82	-0.03
2314	2314	259.44	259.42	-0.02
2264.17	2264.17	258.76	258.75	-0.01
2213.86	2213.86	258.53	258.52	-0.01
2163.54	2163.54	258.27	258.27	0
2113	2113	258.22	258.22	0
2063	2063	258.22	258.21	-0.01
2027	2027	258.21	258.21	0
2010	2010	258.16	258.17	0.01
1992	1992	Culvert HS7 | Node E6		
1979	1979	257.72	257.69	-0.03
1959	1959	257.49	257.47	-0.02
1911.97	1911.97	257.17	257.15	-0.02
1861.65	1861.65	256.76	256.75	-0.01
1811.34	1811.34	256.61	256.59	-0.02
1761.02	1761.02	256.44	256.42	-0.02
1710.71	1710.71	256.22	256.21	-0.01
1660.39	1660.39	255.99	255.98	-0.01
1610.08	1610.08	255.82	255.82	0
1559	1559	255.67	255.66	-0.01
1509	1509	255.34	255.33	-0.01
1459	1459	255.11	255.1	-0.01
1408.82	1408.82	254.77	254.77	0
1358.5	1358.5	254.46	254.45	-0.01
1308.19	1308.19	254.34	254.33	-0.01
1257.87	1257.87	253.96	253.95	-0.01
1207.56	1207.56	253.58	253.57	-0.01

Ex RS	Prop RS	Existing Reg. W.S. Elev. (m)	Prop. Reg. W.S. Elev. (m)	∆ Reg. W.S. Elev. (Prop. – Ex.) (m)
1157.24	1157.24	253.14	253.13	-0.01
1107	1107	252.87	252.86	-0.01
1057	1057	252.61	252.6	-0.01
1007	1007	252.4	252.39	-0.01
955.98	955.98	252.22	252.2	-0.02
906	906	252.01	251.94	-0.07
855.35	855.35	251.92	251.82	-0.1
805.04	805.04	251.9	251.79	-0.11
751	751	251.85	251.78	-0.07
704.41	704.41	251.82	251.74	-0.08
654	654	251.8	251.73	-0.07
603.78	603.78	251.8	251.72	-0.08
554	554	251.8	251.72	-0.08
503.15	503.15	251.8	251.72	-0.08
453	453	251.8	251.72	-0.08
403	403	251.79	251.72	-0.07
353	353	251.79	251.72	-0.07
301.89	301.89	251.79	251.72	-0.07
251.57	251.57	251.79	251.72	-0.07
199	199	251.79	251.71	-0.08
191	191	251.79	251.68	-0.11
170	170	Culvert G4 | Node E4		
146	146	247.04	247.03	-0.01
119	119	246.74	246.74	0
93	93	246.51	246.51	0
50.31	50.31	245.48	245.49	0.01
0	0	244.94	244.93	-0.01

Objective 2 – Riparian Storage

In order to ensure the proposed channel grading provides sufficient storage volume to convey flows, riparian storage analysis was conducted for all storm events. The riparian storage provided by the existing channel was set to be the riparian storage target for the proposed channel.

The riparian storage analysis was conducted by running the existing and proposed steady-state geometries with all crossings removed for each return period event. The volume of water contained with the channel for each event (i.e. riparian storage) was extracted from the model output for both scenarios in order to compare the riparian storage provided before and after development.

The existing condition flows were applied to the existing and proposed condition models for the riparian storage scenarios. The existing flows were applied to the proposed condition model at locations approximately equal to the existing model flow nodes.

The same boundary conditions applied in the “man-made” models with culverts were adopted in the riparian models. The downstream boundary conditions for both the existing and proposed riparian storage models were based on the existing water surface elevation boundary conditions downstream of The Gore Road. It is assumed that the existing downstream water levels were calculated with culverts in place and are therefore higher than the “riparian” downstream water levels would be due to backwater effects.

Table 6-17 summarizes the existing riparian storage targets and the post-development riparian storage volume for Tributary WHT6. The results are provided for the entire reach beginning from downstream of The Gore Road to upstream of the MVSP lands and for the portion of the reach within the MVSP lands.

The detailed riparian storage results are included in **Appendix 6-4**.

The post-development riparian condition model demonstrates that the existing riparian storage volumes are generally maintained across the range of storm events. Note that this analysis does not consider flood plain storage in the proposed features such as the pools, wetland pockets, and off-line stormwater management ponds.

Note that these results will be updated as part of the detailed ultimate channel design particularly as the ultimate channel grading will be finalized in the next design stage.

Table 6-17 Existing and Proposed Riparian Storage

West Humber River Tributary 6 (WHT6)	Existing			Proposed			
	Storm Profile	Channel Range	Riparian Storage (x1000m³)	Storm Profile	Channel Range	Riparian Storage (x1000m³)	Difference (x1000m³)*
System	2-year	5139 (North of MVSP) to 0 (downstream of The Gore Rd crossing)	3.77	2-year	5139 to 4397.62 (North of MVSP) & 3459.49 (Node 5-2, Upstream Channel Extents) to 0 (downstream of The Gore Road crossing)	3.76	0.02
	5-year		5.88	5-year		5.87	0.04
	10-year		24.95	10-year		24.08	-0.39
	25-year		29.82	25-year		28.79	-0.43
	50-year		33.46	50-year		32.33	-0.44
	100-year		37.24	100-year		35.91	-0.55
	Regional		82.01	Regional		77.54	-2.10**
Site Only (BRES3)	2-year	4397.62 (Node 9) to 3011.93 (Node 5, upstream of Humber Station Rd crossing)	0.82	2-year	3459.49 (Node 5-2, Upstream Channel Extents) to 3011.93 (Node 5, upstream of Humber Station Rd crossing)	0.83	0.04
	5-year		1.24	5-year		1.24	0.05
	10-year		4.80	10-year		4.36	0.04
	25-year		5.70	25-year		5.18	0.08
	50-year		6.32	50-year		5.78	0.15
	100-year		7.00	100-year		6.38	0.16
	Regional		16.50	Regional		14.13	0.00**

*Includes clean water collector storage in both system & site only (BRES3) for all storm profiles
**Clean water collector storage inclusive of surcharge capacity during the regional storm event as hydraulically disconnected from proposed development

APPENDIX 6

Appendix 6-1

Pond Design - Drainage Areas – Pond 1
Pond Design - Drainage Areas – Pond 2
Pond Design – Input Summary – Pond 1
Pond Design – Input Summary – Pond 2

Appendix 6-2

Visual OTTHYMO (VO6) Hydrologic Modelling

Appendix 6-3

Preliminary OGS Sizing

Appendix 6-4

HECRAS Summary Output Tables

7.0 WATER BALANCE AND LOW IMPACT DEVELOPMENT

7.1 Overall Site Water Balance

In addition to meeting the quality, erosion control, and quantity control targets, one of the SWM strategy objectives is to address the overall water balance requirements for the site in order to mimic as closely as possible the pre-development water balance including infiltration (recharge) and evapotranspiration volumes.

While end of pipe facilities provide the minimum required SWM controls, the use of LID stormwater management measures that reduce the amount of runoff by increasing on site retention, infiltration and evapotranspiration, improve the overall SWM performance. The use of LIDs in a "treatment-train" approach has long been endorsed by the TRCA.

The water balance / recharge targets were established in the Preliminary Hydrogeological Investigation by DS Consultants (January 2021), by examining the average annual infiltration volumes that occur under existing conditions. The overall site water balance for the MVSP lands is shown in **Table 7-1**.

Table 7-1 MVSP Overall Water Balance

Site	Existing Drainage Area (ha)	Proposed Drainage Area (ha)	Change in Drainage Area (%)	Existing Infiltration Volume (m^3)	Post-Dev. Infiltration Volume, Prior to Mitigation (m^3)	Post-Dev. Infiltration Deficit (m^3)	Existing Runoff Volume (m^3)	Post-Dev. Runoff Volume, Prior to Mitigation (m^3)	Post-Dev. Runoff Surplus (m^3)
MVSP	181.7	181.7	0	158,426	46,976	111,450	312,260	954,144	641,884

7.2 Wetland, Feature-Based Water Balance

Drawings 701 and **702** illustrate the existing and proposed surface drainage areas, respectively, contributing to the various wetland features within the MVSP lands. These drawings indicate the staked wetland limits. The existing drainage areas and drainage patterns to each wetland were identified from topographic mapping and site reconnaissance. The wetlands were characterized in the CEISMP document in terms of ecology, surface drainage and groundwater contributions and overall form and function.

A portion of the existing wetland drainage areas fall within the **Preliminary Framework Plan** development limit. To aid in determining the level of risk and evaluation requirements for the study, an assessment was completed using the Wetland Water Balance Risk Evaluation guidelines provided by the Toronto and Region Conservation Authority (TRCA, Nov 2017), as part of the Preliminary Hydrogeological Investigation. The guideline provides criteria used to evaluate the magnitude of potential hydrological impact on a wetland. The criteria for evaluating the changes in catchment area imperviousness and the size of the catchment include:

- The proportion of impervious cover in the catchment of the wetland that would result from the proposed development;
- The degree of change in the size of the wetland catchment;
- Water taking from, or discharge to, surface water bodies or aquifers directly connected to the wetland, and;
- The impact on locally significant recharge areas.

The effects of the above potential changes include

- reductions in infiltration and baseflow and/or interflow contributions to the wetland; and
- increased runoff with associated risk of flooding and increased stormwater sediment and contaminant loading.

The Impervious Cover Score (S) was calculated for each of the catchments. The equation defining S is as follows:

$$S = \frac{IC \cdot Cdev}{C}$$

where,

- IC is the proportion of impervious cover proposed within the specific catchment (as a percentage between 0 and 100);
- C dev is the total proposed development area within the catchment (in ha); and
- C is the size of the wetland's catchment (in ha).

Results of the calculation are provided in **Table 7-2** and show that wetland catchment W1 to W6 are presented with low risk based on the calculated S.

Table 7-2 Impervious Cover Score - Probability and Magnitude of Hydrological Change

Subcatchment Area Name	Pre-Development Catchment Size (m^2)	Proposed Impervious Cover (m^2)	Impervious Cover Score (S) (%)	Sensitive Feature	Magnitude of Hydrological Change
Wetland 1 (W1)	13,402	85	0. 6	Wetland	Low
Wetland 2 (W2)	50,784	1,615	3.2	Wetland	Low
Wetland 3 (W3)	225,600	1,785	0.8	Wetland	Low
Wetland 4 (W4)	62,040	2,083	3.4	Wetland	Low
Wetland 5 (W5)	74,225	1,062	1.4	Wetland	Low
Wetland 6 (W6)	47,447	1,020	2.1	Wetland	Low

As a result of the proposed grading and drainage design, the existing drainage area to some of the existing wetlands will be modified and will require a water balance analysis to determine the potential impact to the form and function of the feature and the associated mitigation requirements.

An analysis of the hydrological change has been prepared by DS Consultants and the results provided in Appendix B of the **CEISMP**. The analysis completed demonstrates that there is a low magnitude of hydrological change as a result of Impervious Cover Score referred to in Table 7-2 and a high magnitude of hydrological change as a result of Change to Catchment Size for each wetland units as illustrated & tabulated (existing vs. proposed wetland drainage areas) on **Drawing 702**.

The proposed drainage plan was designed to promote drainage of clean sources of water (vegetated areas and roof drainage) towards the wetlands. In particular, all lots backing onto the wetland features have been designed to drain clean flows from half of the rooftop and half of the yards towards the adjacent wetland area as illustrated on **Drawing 702**.

The overall wetland risk rankings provided in **CEISMP Section 4.1.3.2**, in summary of the above findings herein in **Section 7.2**, necessitates additional feature-based water balance analysis in the form of a continuous model to refine a mitigation strategy that addresses potential deficits or surpluses. In the case of mitigating for runoff volume deficits, LID measures are discussed in **Section 7.3**. These measures are applicable for mitigation of deficits in the overall site water balance and in the wetland feature-based water balance.

7.3 Low Impact Development

The hydrogeological / water balance work in the CEISMP addresses the recharge requirements and mitigation measures in detail.

To achieve the water balance targets noted in the preceding section, the SWM strategy must incorporate measures to direct the excess runoff from impervious surface into pervious areas or Low Impact Development (LID) measures to promote attenuation / infiltration.

TRCA have endorsed the use of LID measures, particularly in a “treatment-train” approach involving consecutive stormwater management / LID measures in series to enhance the overall performance, reliability, and effluent water quality. The LID measures most feasible for application in the MVSP lands include:

Downspout Disconnection: Roof leader discharge to pervious surfaces such as lawns or to LID measures provides a source of clean water that can be infiltrated. This is a low / no maintenance, lot-level control that is typically implemented by default.

Additional Topsoil Depth: Coupled with downspout disconnection, an additional depth of topsoil beyond the minimum requirements provides additional storage volume at the lot-level which reduces runoff volume and promotes filtration / infiltration. This is a low / no maintenance practice.

Swales: Swales will be required in the MVSP lands to convey surface flows and have the added benefit of encouraging infiltration as well as peak flow / velocity reduction and improvements to water quality. Suggested swale locations include:

- Swales in Greenland corridors
- Swales in Parks and Schools (public ownership);
- Swales downstream of stormwater management outfalls
- Swales adjacent to rear lots located within buffers.
- Overland flow easements
- Side Yard / Rear Yard swales (private ownership).

Infiltration Facilities: Dedicated infiltration facilities involve construction below grade and their performance is subject to the groundwater table elevations and infiltration rates of the native material. Infiltration facilities should be designed with an emergency overflow spillway to the storm sewer system to prevent infiltration trenches from being fully saturated.

Rain Gardens: Rain gardens are landscape elements that are designed to receive and attenuate / infiltrate runoff, usually from nearby roof areas. Rain gardens require some maintenance and are typically situated on private property. The longevity of these features is subject to the homeowner.

Rainwater Harvesting: Rainwater harvesting typically consists of the use of rain barrels within private property to attenuate stormwater for later use for irrigation. This measure is not guaranteed to remain in place over the long-term, as their longevity is subject to the homeowner. However, it is recommended that rainwater harvesting be considered on a larger scale to supplement the municipal supply to irrigate park / open space areas.

Roof Drainage Collector (RDC) System: This approach would be targeted toward mitigation of the infiltration deficit to the individual wetlands. An RDC system would consist of a “third pipe” within the proposed ROW collecting clean roof water drainage, as well as drainage from rear lot pervious areas. It will be confirmed that the cross sections of the receiving ROWs can accommodate the RDC system. **Drawing 702** provides a typical detail for a cross section of the conceptual RDC pipe within the 18.0m ROW. In order to maintain the feasibility of implementing the RDC system, specifically in terms of scope and cost, the system would be proposed in conjunction with additional selected LID measures.

Additional geotechnical / hydrogeological studies may be required prior to finalizing and confirming the selection of LID techniques. The selected LID techniques will be based on the land use concept shown in the **Preliminary Framework Plan** and on the preliminary site grading. Selection of LID techniques should consider the maintenance requirements, as some of the locations for installation may be privately-owned and operated, while others may be in public ownership and operated and maintained by the municipality.

8.0 SANITARY SERVICING

The proposed MVSP development is tributary to the South Peel Wastewater System. As confirmed by the Bolton Residential Expansion Area Servicing Study, prepared by the Region of Peel, dated September 24, 2020, the proposed conveyance system for the sanitary flow from the MVSP lands (a.k.a Option 3 lands) is the existing trunk sewer on Coleraine Drive. The excerpt from the Peel Region study is included in **Appendix 8**. Sanitary flow is treated ultimately at the G.E. Booth Wastewater Treatment Plant.

8.1 Existing Sanitary infrastructure

The existing sanitary outfall intended to service the MVSP lands is shown on **Drawing 801**. The Bolton Residential Expansion Study (BRES) indicates that both the Options 3 and 4 lands are to be serviced by gravity by connecting a new trunk sewer to the existing 750mm diameter sanitary trunk on Coleraine Drive at manhole 38 located approximately 700m north of George Bolton Parkway.

8.2 Sanitary Sewer Design Criteria

The proposed sanitary sewer infrastructure within the MVSP lands was designed according to the Region of Peel's Sanitary Sewer Design Criteria (July 2009). The Region's criteria for population density for the land uses are summarized in **Table 8-1**.

Table 8-1 Population Density

Density	Persons/Hectare
Single family (greater than 10m frontage)	50
Single family (less than 10m frontage)	70
Semi detached	70
Row dwellings	175
Apartments	475
Light industrial	70
Commercial	50
Schools	600 (Junior Public School) 900 (Senior Public School) 1,500 (Secondary School)

Based on the calculated populations contributing to each sewer, the peak sanitary flows and pipe sizes in **Appendix 8** were determined using the Region's design standards for flow generation rates (302.8 L/c/d), sanitary flow peaking factors (based on Harmon Formula) and infiltration/inflow rate (0.2 L/s/ha) as per the Region's Standard Drawing 2-5-2.

The Region's sanitary sewer design criteria specifies a minimum grade of 0.40% for pipes 250mm in diameter, 0.35% for pipes 300mm in diameter, and 0.30% for pipes larger than 300mm in diameter. The starting legs for local sanitary sewers have been designed at a minimum grade of 1.00%. The minimum velocity recommended by the Region is 0.75m/s.

8.3 Proposed Sanitary Sewer Design

Based on the **Preliminary Framework Plan** presented on **Drawing 102**, the proposed MVSP sanitary drainage system illustrated on **Drawing 802** is designed to service the internal drainage area of 161.5ha and projected population of 24,400 (residential and non-residential). Refer to sanitary design sheets in **Appendix 8**.

The estimated MVSP population numbers exceed the Town of Caledon Option 3 targets which in turn may affect the available capacity in the downstream Coleraine Drive sanitary trunk. However, due to the existing grading constraints, the Coleraine Drive trunk sewer can only accommodate a gravity outfall for a portion of the Option 4 lands which may allow additional Option 3 flows to be utilized within the Coleraine Drive trunk sanitary. Preliminary external sanitary drainage plan is shown on **Drawing 801.**

While it is anticipated that the existing Coleraine Drive trunk sanitary has enough capacity to service all phases of the MVSP development, further coordination with the Region of Peel infrastructure planning group will be required to confirm the ultimate Option 4 drainage boundary and whether additional flows from the lands north of MSVP could be also accommodated in the downstream system. **Drawings 801** and **802** identify the potential external drainage areas that could be accommodated in the MVSP sanitary sewer system by gravity, but the internal pipe oversizing has not been captured until further consultation with the Peel Region staff has taken place.

The preferred alignments of the sanitary sub-trunk sewers within the MVSP development area, as shown on **Drawing 802**, were based on the following criteria provided by the Region of Peel:

- Utilize major internal roads for sub-trunk sewers.
- Where possible, avoid the use of external boundary roads for the sanitary sewer alignments to reduce costs associated with potential tunneling.

Drawings 801 and **802** illustrate the external trunk sewers and internal MVSP local and sub-trunk sanitary sewer alignments including the contributing area and population. The proposed pipe inverts and anticipated ground elevations are shown to demonstrate that sufficient cover has been provided. Only the critical sewer alignments for the local sewers have been designed at this time (that is, sewers which are impacted by grading constraints and crossings).

The sanitary sewers greater than or equal to 375mm will be considered as Development Charge (DC) infrastructure and will be confirmed by Region of Peel prior to approval of the MVSP FSR.

The design calculations in **Appendix 8** demonstrate the peak sanitary flows generated in the MVSP lands with and without potential external drainage area. **Table 8-2** indicates the proposed sanitary flows at each MVSP outlet along King Street. The discharge from the King Street outlets will be directed to the future external trunk sewer.

Table 8-2 Proposed MVSP Sanitary Outlets and Flows

Outlet	Location	Description	Area, Population & Flow (excluding external drainage north of MVSP)	Area, Population & Flow (including external drainage north of MVSP)
1A	King Street	250mm diameter sanitary sewer on Street P	7.3 ha 365 pp 14.5 L/s	7.3 ha 365 pp 14.5 L/s
2A	King Street	450mm diameter sanitary sewer on Street ZC	55.1 ha 4,178 pp 59.6 L/s	55.1 ha 4,178 pp 59.6 L/s
3A	King Street	450mm diameter sanitary sewer on Street X	69.7 ha 10,269 pp 119.9 L/s	69.7 ha 10,269 pp 119.9 L/s
ER5A	King Street/ Humber Station Road	375mm diameter sanitary sewer on Street P	168.5 ha 24,430 pp 253.4 L/s	265.5 ha 30,250 pp 315.3 L/s

The Region of Peel Bolton Residential Expansion Area Servicing Study identified the future trunk sewer along King Street and Coleraine Drive as the ultimate servicing outlet for the MVSP lands (Option 3). High level details of the external trunk alignment are shown in **Appendix 8.** The Region study has considered separate servicing solutions for each Residential Expansion Options, but this FSR recommends combining the sanitary outlet for Option 3 and a portion of Option 4 and 5 lands by rerouting the external trunk sewer as illustrated on **Drawing 801**.

Compared to the Region of Peel proposal, the proposed trunk sewer alignment by MVSP would slightly reduce the length of the external infrastructure and minimize the potential servicing issues associated with the utility conflicts and traffic management along King Street and Coleraine Drive. In addition, the suggested trunk alignment provides an accessible outlet for future development Option 4 and 5 areas. It is noted that further consultation with Peel Region and Town of Caledon will be required regarding the external trunk sewer alignment and necessary EA requirements for the external infrastructure.

Drawings 803 and 804 present a preliminary plan and profile for the external trunk sewer segments between the downstream end of MVSP lands and existing manhole 38 on Coleraine Drive are described in **Table 8-3**.

Table 8-3 External Trunk Sewer

Trunk Sewer Segment	Description	Size (mm)	Length (meters)
1	New gravity sewer along Humber Station Road, south from the Humber Station Road / King Street, intersection	675	1905
2	New gravity sewer from Humber Station Road to the Coleraine Drive / Holland Drive intersection	750	1360
3	New gravity sewer along Coleraine Drive from the Coleraine Drive / Holland Drive intersection to existing manhole 38	750	2130

APPENDIX 8

Excerpt from the Bolton Residential Expansion Area Options by Peel Region, dated September 24, 2020;
Sanitary design calculations;

9.0 WATER SERVICING

As determined in the Bolton Residential Expansion Study (Region of Peel, September 24, 2020) the MVSP lands (a.k.a. Option 3 lands) are generally outside of the range of elevations associated with Pressure Zone 6 of the existing water distribution infrastructure in Bolton. As such, ultimate development of the Option 3 lands will require the addition of Pressure Zone 7. Previous studies completed in support of BRES identified a new Zone 7 booster pumping station at King Street and Coleraine Drive. Ultimately, floating storage is proposed in the form of an elevated tank (ET) to provide storage for flow equalization, fire demands and emergencies. The ET is to be situated in the vicinity of the northwest corner of the Option 3 lands. The excerpt from the Peel Region study is included in **Appendix 9**.

A technical memorandum (June 1, 2020) has been prepared by R.J. Burnside & Associates Limited on behalf of the Bolton Option 3 Landowners Group to provide water distribution servicing recommendations in support of interim and ultimate development of the MVSP lands. This section provides a summary of the memorandum including recommendations based on the results of the hydraulic modeling included therein. The complete memorandum is provided in **Appendix 9**.

Preliminary modelling was performed by Burnside to determine interim alternative water servicing arrangements that could leverage the existing Zone 6 water supply to allow some portion of the Option 3 lands to be developed prior to the design and construction of the ultimate Zone 7 servicing solution. Water supply to the zone in the interim scenario would be principally through a new Zone 7 booster pumping station. The investigation included options to provide water supply to meet fire demands on an interim basis through pumped, as opposed to floating, storage.

Bolton receives water supply from the Tullamore Pumping Station and Reservoir, through a transmission main along Mayfield Road and Coleraine Drive. Bolton's water distribution system is serviced in two pressure zones, Zone 5 and Zone 6. Zone 5 is serviced through Zone 6 by pressure reducing valves at the Bolton Zone 5 Standpipes. The Standpipes have a high-water level (HWL) of 274.1 m. Storage for Zone 6 is supplied by the Bolton ET and the North Bolton ET. The HWL of both ET's is 297.2 m.

The existing ground elevations within the Option 3 lands range from approximately 262 m to 280 m. These elevations fall outside of the range of elevations capable of being serviced by Zone 6 while maintaining adequate operating pressures within the system. The Region of Peel reports operating pressure issues within an existing residential subdivision fronting on King Street in close proximity to the Option 3 lands.

A new pressure Zone 7 with an elevated tower having a HWL of 327.7 m would adequately service all of the Option 3 lands, as well as address existing operating pressure issues for some existing residents.

As per the Region of Peel 2013 Water and Wastewater Master Plan for the Lake-Based Systems, Volume III - Water Master Plan, prepared by BluePlan and AECOM, dated March 31, 2014, a minimum operating pressure of 40 psi and a maximum operating pressure of 100 psi shall be maintained within the water distribution system under maximum day demand and a minimum operating pressure of 40 psi shall be maintained under peak hour demand. The allowable operating pressure during fire flow conditions is a minimum of 20 psi.

The population for the Option 3 lands is based on population targets set in Town of Caledon Official Plan Amendment 226 arising from the completion of the Bolton Residential Expansion Study. The targets for residential and employment are 10,348 persons and 2,250 jobs, respectively. The per capita demands for residential and employment are 270 L/cap/d and 250 L/cap/d, respectively.

The following water demands were determined in the Burnside Technical Memorandum:

- Average Day Demand (ADD) = 38.8 L/s
- Maximum Day Demand (MDD) = 67.3L/s
- Peak Hour Demand (PHD) = 116.5L/s

For the purposes of the preliminary design, the demands have been assumed to have an even distribution across the proposed development at an average density of approximately 69 residents and jobs per hectare. As the detailed design progresses, it is anticipated that future MVSP land-use plans will establish refined density targets to update the watermain modelling.

The required fire flow for the Option 3 lands is 220 L/s while maintaining a minimum system operating pressure of 20 psi, as per Bolton Residential Expansion Study Infrastructure Report, prepared by GM BluePlan dated June 16, 2014.

Water servicing can be provided for the entire MVSP lands with the following provisions:

- a new Booster Pumping Station is constructed in the vicinity of Coleraine Drive and King Street and the diameter of the proposed trunk watermain from the Booster Pumping Station to a point approximately 1200 m southwest is increased to 600 mm, from the currently proposed 400 mm diameter required for the ultimate build out condition;
- the Booster Pumping Station will require appropriately sized booster pumps to provide the ADD, MDD and PHD within the 40 psi to 100 psi pressure range; and
- the Booster Pumping Station will also require a fire pump to provide the MVSP lands with 220 L/s of fire flow.

It is noted that further consultation with Peel Region and Town of Caledon will be required regarding the external watermain alignment and necessary EA requirements for the external infrastructure. The specific arrangement of the Booster Pumping Station would be determined during detailed design.

The existing and planned water distribution infrastructure is illustrated on **Drawing 901.** Based on the preliminary water modeling by Burnside, the external trunk watermain size is increased from 400mm diameter (recommended by Bolton Residential Expansion Area Study) to 600mm diameter to address the future potential population density increase.

APPENDIX 9

Excerpt from the Bolton Residential Expansion Area Options by Peel Region, dated September 24, 2020;
Bolton Option 3 Preliminary Water Modeling by RJ Burnside, dated June 1, 2020;

10.0 IMPLEMENTATION

The successful delivery of various components of the MVSP EPA (Environmental Policy Area) and development areas requires an implementation plan that considers the following items:

- maintaining the environmental integrity of the existing EPA throughout development
- sequencing of site works to deliver the EPA and the development / infrastructure in a timely manner
- erosion and sediment prevention and control including stabilization of open spaces;
- co-operation amongst the developers, consultants and approval agencies; and,
- creativity and flexibility in solving implementation challenges.

This section provides general information on various implementation aspects of the design, construction and conveyance of the EPA and surrounding developments.

Design and Approvals

Ideally, the design of the MVSP development projects would occur for all works in each subcatchment at once; however, this will not be possible in all cases due to non-participating ownerships and different development timing.

As such, concurrent with the preparation of detailed designs, construction staging and sequencing plans will be provided prior to construction approvals to demonstrate when/where/how works will be implemented.

The detailed design will include a construction monitoring program that will be issued under separate cover for discussion with the Agencies prior to implementation.

Numerous approvals are required for the construction of components of the EPA and surrounding developments. Depending upon the specific works, permits / approvals may be required from the Town, TRCA, Region and MECP. The CEISMP and FSR will serve as key guiding documents for the detailed design of the EPA and elements of subdivision design.

Construction Considerations

Construction of the MVSP development, including channelization and road crossings, will be phased. Development phasing is to be determined through detailed design; these submissions should consider participating ownership, development phasing, relationship to earthworks program(s), and required timing of delivery of roads.

The proposed channel realignment is almost entirely off-line from the existing channel, therefore the need for diversion is mostly limited to the overlapping area immediately upstream of the existing Humber Station Road crossing. Where diversion is required, the diversion channels will convey flows until the low-flow channel of the ultimate channel is stabilized. At that point in time, flows will be redirected from the diversion channels into the ultimate channel and the diversion channels will be removed. The location of diversion channels required should consider objectives to:

- minimize disruption of existing drainage patterns;
- minimize the area of disturbance (cut/fill stripping of topsoil);
- locate diversion channels an adequate distance away from the ultimate channel to allow for its construction and close enough for the reconnection of flows;
- minimize the number of temporary construction crossings.

The construction of municipal services and road crossings of the EPA will be completed in the dry, prior to redirecting flows from the diversion channels to the ultimate channel. This would avoid the need to enter the natural channel system to install these services after its construction and restoration have been completed.

Detailed soil investigations along the channel alignments, deep trunk sewers, and in areas adjacent to the wetlands will be required to assess the potential for encountering layers of high hydraulic conductivity sediments. An assessment of the dewatering requirements for construction will be made based on the detailed construction plans. Management and mitigation plans will be developed to address groundwater control as well as the potential for long-term water table lowering. A temporary Permit to Take Water (PTTW) may be required from the MECP depending on the anticipated quantity of dewatering required during construction.

Rigorous erosion and sediment control measures will be designed, implemented and maintained throughout the construction period. At detailed design, an Erosion and Sediment Control Plan will be prepared and designed in conformance with the Town and Conservation Authority guidelines. Erosion and sediment control will be implemented for all construction activities including topsoil stripping, earthworks, foundation excavation and stockpiling of materials and will remain in place and functional until bare surfaces are stabilized.

The following erosion and sediment control measures should be considered for use during construction:

- Natural features will be staked and temporary fencing provided to keep machinery out of sensitive areas;
- Sediment control fence and snow fence will be placed prior to earthworks;
- Logistics/construction plan will be implemented to limit the size of disturbed areas, minimizing the non-essential clearing and grading areas;
- Temporary sediment ponds;
- Rock check-dams and cut-off swales will be provided, where required, in order to control, slow down and direct runoff to sediment basins;
- Sediment traps will be provided;
- Gravel mud mats will be installed at construction vehicle access points to minimize off-site tracking of sediments;
- All temporary erosion and sediment control measures will be routinely inspected / monitored and repaired during construction. Temporary controls will not be removed until the areas they serve are restored and stable; and,
- The "multiple barrier approach" will be applied to all construction stages to ensure erosion is prevented rather than reduced. Recommended measures are to be installed prior to the initiation of the earthworks and grading.

Reference will be made to the *Guidelines for Erosion and Sediment Control for Urban Construction Sites* prepared by the Greater Toronto Conservation Authorities (2020) when preparing Erosion and Sediment Control Plans.

Practical measures for the maintenance of water levels in wetlands and watercourses during construction, as well as monitoring requirements, must be identified and implemented, where feasible.

The construction and conveyance of the projects to public ownership will be implemented through agreements between the landowners and the Town. These agreements will address extent of works, construction phasing, securities requirements, conveyance mechanisms, etc.

The agencies have suggested the use of a single third-party erosion and sediment control monitoring consultant to facilitate monitoring during joint earthworks operations. However, this is only feasible to the extent that the various landowners will coordinate earthworks together, as they have the right to proceed independently and utilize the monitoring consultant of their choice.

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