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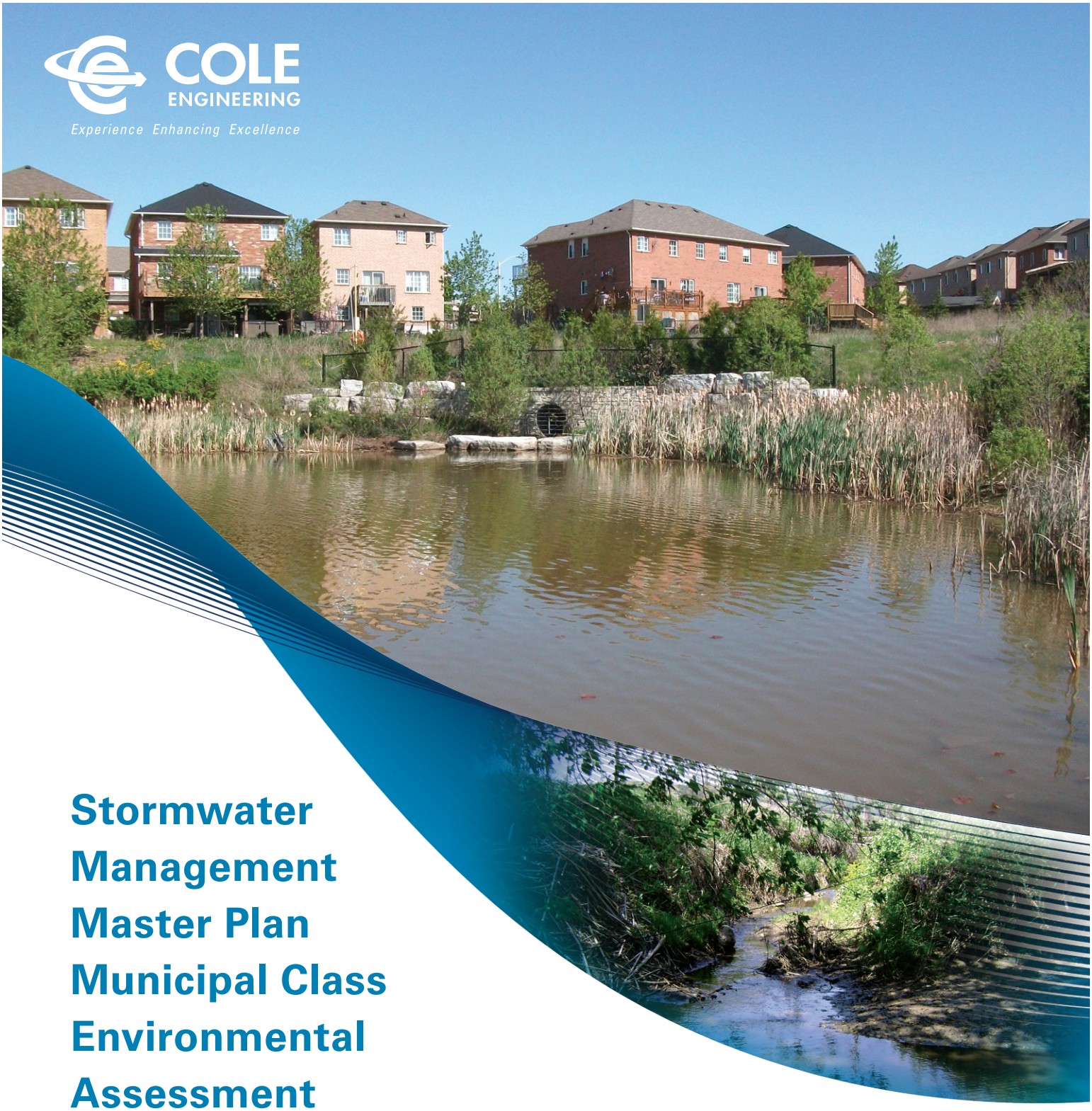

Stormwater Management Master Plan Municipal Class Environmental Assessment

THE CITY OF VAUGHAN

JUNE 2014

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Issues and Revisions Registry

Identification	Date	Description of issued and/or revision
Draft Report	March 2013	For review
Final Report	June 2013	Final submission

Statement of Conditions

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Executive Summary

Introduction

The City of Vaughan (the City) is located in south-western York Region, and is bound by the City of Toronto to the south, the City of Markham and Town of Richmond Hill to the east, the Township of King to the north, and by the City of Brampton and the Town of Caledon to the west. The study area represents the entirety of the City's municipal boundary, and totals approximately 27,400 hectares in size. The City contributes drainage into two (2) major watersheds: 1) The Humber River to the west; and, 2) The Don River to the east.

In its existing condition, development in the City consists largely of low-rise residential areas, along with large tracts of commercial and employment lands located around the Concord and Edgeley neighbourhoods, as well as along the Highway 7 corridor. Lands north of Teston Road are largely undeveloped and are currently used primarily for agricultural purposes.

Study Purpose

The study is split into two (2) main components: 1) The City-Wide Stormwater Management Master Plan (SWMMP) document; and, 2) The Rainbow Creek Master Plan Update (RCMPU) Study. The intent of the SWMMP is to develop a practical and implementable framework for Stormwater Management (SWM) in the areas of expected growth and intensification in the City. Alternatives specific to key growth areas were analysed based on technical merit along with economic, social, and environmental constraints and opportunities.

The RCMPU Study identifies appropriate SWM criteria for the Rainbow Creek subwatershed, based on existing conditions and expected population and employment growth in the area. The subwatershed is located on the west end of the City and is part of the larger Humber River watershed. The Study also assessed existing erosion sites and flood vulnerable sites within the watershed, and provides a list of recommended studies and works for each site.

Problem / Opportunity

The recently-approved 2010 Official Plan Amendment (OPA) has provided direction for growth and intensification within the City, to a planning horizon of 2031. The City has initiated the City-Wide Storm Drainage / SWM MPCEA to complement the OPA by providing a SWM framework for these areas. As part of the overall SWM MPCEA, the City is also undertaking an update study to the Rainbow Creek Master Plan. The TRCA has been working with the City to rehabilitate and enhance the environmental conditions of deteriorated streams in urbanized areas, including the Rainbow Creek watershed. The City is committed to developing and implementing a regeneration plan for the Rainbow Creek watershed.

This project presents the opportunity to prepare a SWM planning and guidance document to support and direct development in compliance with the City's OPA and policies of the TRCA to improve and determine the best management practices for SWM as well as to support future intensification as mandated by the Province of Ontario.

The RCMPU Study presents the opportunity for regeneration that will not only improve the environmental conditions within the creek and valley system, but will provide reasonable protection against accelerated erosion and flooding while protecting municipal infrastructure and property.

SWMMP Objectives

The goal of the SWMMP is to develop a practical and implementable SWM framework for the City. Particular attention was paid to areas that have been identified by the City's OPA as areas of future growth and intensification.

In order to achieve this goal, the objectives of the SWMMP are defined as follows:

- Identify storm drainage and SWM system requirements to support the Vaughan Consolidated Growth Management Strategy;
- Identify appropriate methods of accommodating post-development storm water runoff, water quality, erosion control and water balance for future development lands identified within the new Official Plan and to meet the City's overall growth projections;
- Identify SWM control strategies;
- Identify areas where more detailed sub-watershed studies may be required;
- Establish computer models as required to support the selection of preferred servicing solutions;
- Establish a preferred and complete set of solutions capable of addressing the City's storm drainage and SWM infrastructure needs to the year 2031 and in accordance with the phasing requirements noted above to 2051;
- Identify alternative infrastructure planning strategies by taking into account the treatment approach to stormwater and select the preferred alternative to meet the City's growth needs;
- Review the City's existing design criteria / standards and policies and recommended improvements and/or updates that will provide the basis for future infrastructure planning and design;
- Establish infrastructure phasing requirements / triggers and policies to facilitate each of the required Master Plan horizon years; and
- Undertake a comprehensive consultation program with all necessary stakeholders including public groups / agencies, York Region, TRCA and the development industry.

Alternative Solutions

A range of alternative solutions were developed in order to address the identified problems and opportunities. The alternatives identified for evaluation are summarized in the following categories:

- Do Nothing;
- Lot Level / At Source / Conveyance Controls; and,
- End-of-Pipe Measures.

Recommended Design Criteria

Design Criteria for SWM is dependent on the tributary watershed and the existing infrastructure which conveys runoff to the watercourse. The existing design criteria have been researched for each of the future growth and intensification areas identified in the City's OPA. These criteria were then used to evaluate the technical merit of the alternative solutions. The design criteria for each area are summarized below.

Secondary Plan Areas to be Approved

Yonge-Steeles:

- **Quantity Control:** Peak flow rates for all storms up to and including the 100-year storm (i.e. 2, 5, 10, 25, 50, and 100-year storms) should be controlled to existing levels. The analysis should be completed using a 12 hour SCS storm distribution with the TRCA's IDF information;
- **Quality Control:** All watercourses and waterbodies within the TRCA's jurisdiction are classified as requiring an Enhanced Level of Protection, which equates to 80% TSS removal;
- **Erosion Mitigation:** Provide 5 mm on-site retention;
- **Water Balance:** Provide best efforts to match the site's existing water budget; and,
- **General:** Low Impact Development strategies should be implemented where possible to assist in meeting SWM requirements.

Woodbridge Focus Area:

- **Quantity Control:** As this area outlets to the Main Humber there is no quantity control requirement;
- **Quality Control:** All watercourses and waterbodies within the TRCA's jurisdiction are classified as requiring an Enhanced Level of Protection, which equates to 80% TSS removal;
- **Erosion Mitigation:** provide 5 mm on-site retention;
- **Water Balance:** Provide best efforts to match the site's existing water budget; and,
- **General:** Low Impact Development strategies should be implemented where possible to assist in meeting SWM requirements.

Kleinburg – Nashville Focused Area:

- **Erosion Mitigation:** Provide minimum 5 mm on-site retention for all storm events;
- **Quality Control:** Stormwater is to be treated to Enhanced Protection Levels as defined in the MOE SWM Planning and Design Manual (2003);
- **Water Balance:** Best efforts to maintain existing water balance is expected; and,
- **Quantity Control Criteria:** Will vary depending on the receiving watercourse:
  - Sites discharging to the main branch of the east or Main Humber River requires no quantity control;
  - Sites discharging to Rainbow Creek are to control post-development peak flow rates to the pre-development TRCA unit flow rate targets for Sub-basin 36; and,

  - Sites discharging east across Kipling Avenue to a tributary of the east Humber River are to control post-development peak flow rates to the pre-development TRCA unit flow rate targets for Sub-basin 19A.
- **General:** Low Impact Development strategies should be implemented where possible to assist in meeting SWM requirements.

West Vaughan Employment Area:

- **Quantity Control:** Post-development peak flow rates are to be controlled to the predevelopment unit flow rates for Humber River Sub-Basin 36 (Equation F);
- **Quality Control:** Stormwater is to be treated to Enhanced Protection levels as defined in the MOE SWM Planning and Design Manual (2003);
- **Erosion Control:** 5 mm of on-site retention is to be provided for all storm events for the purpose of erosion control;
- **Water Balance:** Provide best efforts to maintain existing water balance using low impact development practices; and,
- **General:** Low Impact Development strategies should be implemented where possible to assist in meeting SWM requirements.

Intensification Corridors:

As this secondary plan consists of various locations throughout the City which do not have a common outlet there is no common criteria for this secondary plan. Each area has been assigned site specific SWM criteria and these criteria can be found in **Volume 2 – Intensification Corridors**.

Future Secondary Plan Areas

Block 27:

- **Quantity Control:** Post-development peak flow rates are to be controlled to the existing conditions unit flow rates for Humber River Sub-Basin 19A (Equation E) for sites discharging to the Humber River watershed. Sites discharging to the Don River watershed must control post-development peak flow rates to the existing conditions unit flow rates for Don River Sub-Basin 2;
- **Quality Control:** Stormwater is to be treated to Enhanced Protection Levels as defined in the MOE SWM Planning and Design Manual (2003);
- **Erosion Control:** Minimum 5 mm of on-site retention is to be provided for all storm events for the purpose of erosion control;
- **Water Balance:** Provide best efforts to maintain existing water balance using Low Impact Development practices; and,
- **General:** Low Impact Development strategies should be implemented where possible to assist in meeting SWM requirements.

Block 41:

- **Quantity Control:** Post-development peak flow rates are to be controlled to the existing conditions unit flow rates for Humber River Sub-Basin 19A;
- **Quality Control:** Stormwater is to be treated to Enhanced Protection Levels as defined in the MOE SWM Planning and Design Manual (2003);

- **Erosion Control:** Minimum 5 mm of on-site retention is to be provided for all storm events for the purpose of erosion control;
- **Water Balance:** Provide best efforts to maintain existing water balance using low impact development practices; and,
- **General:** Low Impact Development strategies should be implemented where possible to assist in meeting SWM requirements.

Vaughan Mills:

- **Quantity Control:** Sites east of Highway 400 currently discharge to one of three (3) SWM ponds. Runoff under post-development conditions must conform to the SWM Report for the ponds. Sites west of Highway 400 must provide unit flow rate controls for Humber River Sub-basin 46 before discharging to Black Creek;
- **Quality Control:** Stormwater is to be treated to Enhanced Protection levels as defined in the MOE SWM Planning and Design Manual (2003);
- **Erosion Control:** Minimum 5 mm of on-site retention is to be provided for all storm events for the purpose of erosion control;
- **Water Balance:** Provide best efforts to maintain existing water balance using low impact development practices; and,
- **General:** Low Impact Development strategies should be implemented where possible to assist in meeting SWM requirements.

Highway 7 and Weston Road:

- **Quantity Control:** Sites discharging to Pond 80 and 65 are to control discharge from the site to existing level of control. Sites not discharging to these ponds are to meet unit flow rate targets for Humber River Sub-basin 46;
- **Quality Control:** Stormwater is to be treated to Enhanced Protection levels as defined in the MOE SWM Planning and Design Manual (2003);
- **Erosion Control:** Minimum 5 mm of on-site retention is to be provided for all storm events for the purpose of erosion control;
- **Water Balance:** Provide best efforts to maintain existing water balance using Low Impact Development practices; and,
- **General:** Low Impact Development strategies should be implemented where possible to assist in meeting SWM requirements.

Concord Center:

- **Quantity Control:** Post-development peak flow rates are to be controlled to existing conditions peak flow rates for the 2 to-100-year storms, using the 12-hour SCS distribution. Sites larger than 5.0 ha (Catchment 1601) must control post-development peak flow rates to unit flow rate targets specified for the Don River Sub-basin 6;
- **Quality Control:** Stormwater is to be treated to Enhanced Protection Levels as defined in the MOE SWM Planning and Design Manual (2003);
- **Erosion Control:** Minimum 5 mm of on-site retention is to be provided for all storm events for the purpose of erosion control;
- **Water Balance:** Provide best efforts to maintain existing water balance using low impact development practices; and,

- **General:** Low Impact Development strategies should be implemented where possible to assist in meeting SWM requirements.

Vaughan Health Campus of Care (VHCC):

- **Quantity Control:** As the development site is larger than 5 ha, post-development peak flow rates are to be controlled to the unit flow rate targets for Don River Sub-basin 1;
- **Quality Control:** Stormwater is to be treated to Enhanced Protection Levels as defined in the MOE SWM Planning and Design Manual (2003);
- **Erosion Control:** Minimum 5 mm of on-site retention is to be provided for all storm events for the purpose of erosion control;
- **Water Balance:** Provide best efforts to maintain existing water balance using low impact development practices; and,
- **General:** Low Impact Development strategies should be implemented where possible to assist in meeting SWM requirements.

Dufferin Street and Center Street:

- **Quantity Control**: Post-development peak flow rates are to be controlled to pre-development peak flow rates for the 2 to 100-year storms, using the 12-hour SCS distribution;
- **Quality Control:** Stormwater is to be treated to Enhanced Protection Levels as defined in the MOE SWM Planning and Design Manual (2003);
- **Erosion Control:** Minimum 5 mm of on-site retention is to be provided for all storm events for the purpose of erosion control;
- **Water Balance:** Provide best efforts to maintain existing water balance using low impact development practices; and,
- **General:** Low Impact Development strategies should be implemented where possible to assist in meeting SWM requirements.

Promenade Mall:

- **Quantity Control:** Post-development peak flow rates are to be controlled to existing peak flow rates for the 5 to 100-year storms, using the City's IDF curve. Currently, the site discharge to the Clark Avenue west storm sewer at a specified rate of 5.34 m^3/s;
- **Quality Control:** Stormwater is to be treated to Enhanced Protection Levels as defined in the MOE SWM Planning and Design Manual (2003);
- **Erosion Control:** Minimum 5 mm of on-site retention is to be provided for all storm events for the purpose of erosion control;
- **Water Balance:** Provide best efforts to maintain existing water balance using low impact development practices; and,
- **General:** Low Impact Development strategies should be implemented where possible to assist in meeting SWM requirements.

Preferred SWM Strategies

The alternative solutions were evaluated based on four (4) main considerations: 1) Technical merit, 2) Natural environment impacts, 3) Social / cultural impacts; and, 4) Financial impacts. The technical merit consideration generally rules out the "Do Nothing" alternative in all areas, as it does not address the need for SWM to support growth and intensification within the City. Selection of the preferred SWM strategy also takes into consideration the location of the proposed growth or intensification area, proposed changes in land use, existing soils, existing drainage patterns, and existing infrastructure.

The preferred SWM strategies for each specific area are outlined in further detail within the report.

Many of the preferred solutions included recommendations for new SWM ponds which will be assumed by the City. The ponds will require regular inspections and maintenance, such as grass cutting and trash removal, as well as a complete cleanout every 10 – 20 years.

General maintenance requirements are discussed in **Volume 1 – Section 15**, the estimated annual cost for maintaining the SWM facilities for each of the preferred solutions are summarized in **Table 1** below. Areas that are not included in this table do not have new SWM Ponds as a component of their preferred SWM strategy.

Table 1 – Number of SWM Ponds

Secondary Plan Area	Number of Ponds	Tributary Area
Kleinburg – Nashville	7	126 ha
WVEA – Block 59	6	239 ha
WVEA – Blocks 60 & 65	4	107 ha
WVEA – Block 66	5	117 ha
Woodbridge	No municipal ponds are proposed for this area	
Yonge – Steeles	No municipal ponds are proposed for this area	
Intensification corridors	No municipal ponds are proposed for this area	
Future Secondary Plan Areas		
Block 27	6	313 ha
Block 41	6	201.5 ha
Vaughan Mills	-	-
Dufferin Street and Center Street	2	4.1 ha
VHCC	2	34 ha
Concord Center	No municipal ponds are proposed for this area	
Promenade Mall	No municipal ponds are proposed for this area	

Although the preferred SWM strategy has been determined for each of the Secondary Plan Areas and Future Secondary Plan areas these strategies are preliminary. The size and location of SWM facilities and choice of low impact development strategies to be implemented on each site will be refined during different stages in the approval process. Each area will require further studies such as Secondary Plan Design, Master Environmental and Servicing Plans for development blocks, and preliminary and detailed design reports. For each of the stages in development different studies will be required, such as geotechnical / hydro-geotechnical studies, environmental impact studies, and erosion studies. The studies required will be determined for each individual site and the results of these studies may change the requirements for individual developments. Changes may be made to the SWM strategies as more detailed information becomes available. In all cases the criteria for each development will reflect the most recent regulations from the City, the TRCA, the MOE and other approval agencies.

Previously Approved Secondary Plan Areas

Areas which have approved secondary plans and have moved forward in the development process were not evaluated in detail as part of the master plan. A summary of the development plans and design criteria for each of these areas has been included in this report and the design criteria are summarized below.

Carrville District Center Secondary Plan:

The SWM strategy for the Carville District Center should be designed to meet requirements set out be the City and the TRCA as well as requirements from other governing agencies such as the MTO, MOE, and MNR which may have jurisdiction over the site. The current SWM criteria for this site are as follows:

- Quantity Control:
  - Control post-development peak flows to pre-development levels for all storms up to and including the 100-year storm (i.e. 2, 5, 10, 25, 50, and 100-year storms); and,
  - Unit flow rates for Don River Catchments 18 and 8A should be used for sites greater than 5 ha and the analysis should be completed using the 12-hour SCS storm distribution.
- **Quality Control:** All watercourses and waterbodies within the TRCA's jurisdiction are classified as requiring an Enhanced Level of Protection, which equates to 80% TSS removal;
- **Erosion control:** As a minimum requirement the TRCA requires 5 mm on-site retention for areas which do not warrant a detailed analysis. For sites with SWM pond, extended detention of the 25 mm event for a period of 48-hours may also be required; and,
- **Water Balance:** Water balance requirements are site specific and should be determined in consultation with the TRCA.

As the secondary plan for this site has been approved and more detailed work may be underway it is important that any new development remain consistent with the current approved SWM plans for the Development Block.

Employment Lands, Highway 400 North (Blocks 34 and 35)

- Quantity Control:
  - Sites tributary to the Don River: Control post-development peak flows to pre-development levels for all storms up to and including the 100-year storm (i.e. 2, 5, 10, 25, 50, and 100-year storms). Unit flow rates for Don River should be used for sites greater than 5 ha and the analysis should be completed using the 12-hour SCS storm distribution;
  - Sites Tributary to the Humber River: Control post-development peak flows to pre-development levels for all storms up to and including the 100-year storm (i.e. 2, 5, 10, 25, 50, and 100-year storms). Unit flow rates for the Humber River should be used and the analysis should be completed using the 6-hour and 12-hour AES storm distributions; and,
  - Development outside of the approved urban boundary when the hydrology study was finalized may require Regional Storm Protection; proponents should consult with TRCA staff to confirm.
- **Quality Control:** All watercourses and waterbodies within the TRCA's jurisdiction are classified as requiring an Enhanced Level of Protection, which equates to 80% TSS removal;
- **Erosion control:** Extended detention of the 25 mm event for a period of 24-hours;
- **Water Balance:** Don River Watershed: Site water balance following new development shall resemble pre-development conditions to the extent possible, pre-development rate of infiltration should be maintained through one or a combination of on-site measures; and,
- **Humber River Watershed:** Manage water balance, new or improved SWM controls focusing on infiltration where feasible, green roof technologies and rainwater harvesting in areas with clay soils at surface and thick aquitard layers underneath.

As the secondary plan for this site has been approved and more detailed work may be underway it is important that any new development remain consistent with the current approved SWM plans for the Development Block.

Steeles Corridor: Jane to Keele (OPA 620):

- **Criteria taken from:** the Draft Municipal Servicing Master Plan Class EA Study OPA 620 Steeles Corridor: Jane to Keele, Vaughan, by SRM Associates, dated October, 2011
- Quantity Control:
  - On-site quantity control to 180 L/s/ha for all of the OPA 620 area; and,
  - Control post-development peak flows to unit flow rates for the Humber River unit flow rates for all storms up to and including the 100-year storm (i.e. 2, 5, 10, 25, 50, and 100-year storms). The analysis should be completed using the 6-hour and 12-hour AES storm distribution.
- Quality Control:
  - All watercourses and waterbodies within the TRCA's jurisdiction are classified as requiring an Enhanced Level of Protection, which equates to 80% TSS removal; and,
  - Provision of an oil / grit separator (if required) for runoff directed into the BCPV lands south of Steeles Avenue.
- **Erosion control:** Extended detention of the 25 mm event for a period of 48-hours may also be required;

- **Water Balance**:
  - Provision of groundwater recharge, to the best extent possible, with the intent of matching pre-development infiltration levels;
  - On-site capture / re-use / infiltration of 15 mm of rainfall from 50% of the total developments roof areas;
  - On-site capture / infiltration of 7.5 mm of rainfall for the remaining roof and site area; and,
  - Provision of a roof runoff leader to provide "clean" runoff for the BCPV land south of Steeles Avenue.

As the secondary plan for this site has been approved and more detailed work may be underway it is important that any new development remain consistent with the current approved Servicing Strategy Master Plan and any other SWM reports for this area.

Block 40 / 47:

- **Criteria taken from**: SWM Report, Master Environmental / Servicing Plan Blocks 40 /47 – Pine Valley Drive / Teston Road, City of Vaughan, by EMC Group ltd., dated December, 2010;
- **Quantity Control:** Control post-development peak flows to unit flow rates for the Humber River unit flow rates for all storms up to and including the 100-year storm (i.e. 2, 5, 10, 25, 50, and 100-year storms). The analysis should be completed using the 6-hour and 12-hour AES storm distribution;
- **Quality Control:** All watercourses and waterbodies within the TRCA's jurisdiction are classified as requiring an Enhanced Level of Protection, which equates to 80% TSS removal;
- As the receiving watercourse is classified as a cold water fish habitat temperature mitigation will be required;
- **Erosion control:** On-site capture / re-use / infiltration of 5 mm of rainfall and extended detention of the 25 mm event for a period of 48-hours may also be required; and,
- **Water Balance:** Provision of groundwater recharge, through the use of LID practices, with the intent of matching pre-development infiltration levels to the best extent possible.

As the secondary plan for this site has been approved and more detailed work may be underway it is important that any new development remain consistent with the current approved Servicing Strategy Master Plan and any other SWM reports for this area.

Kipling Avenue:

- **General:** Meet the requirements for the TRCA guidelines on erosion and sediment control, 2006;
- **Criteria taken from:** The City's By-law Number 175-2009, OPA 694, June, 2009;
- **Quantity Control:** No quantity control is required as the site is tributary to the Main Humber River. Proponent must verify the capacity of the downstream pipes and overland flow routes from the site to the River;
- **Quality Control:** All watercourses and waterbodies within the TRCA's jurisdiction are classified as requiring an Enhanced Level of Protection, which equates to 80% TSS removal;
- **Erosion Control:** Proponents should contact the TRCA for erosion control criteria for this site; and,

- **Water Balance:** Proponents should contact the TRCA for water balance requirements for this site.

As the secondary plan for this site has been approved and more detailed work may be underway it is important that any new development remain consistent with the current approved Servicing Strategy Master Plan and any other SWM reports for this area.

Block 61 West

- Quantity Control:
  - Control post-development peak flows to unit flow rates for the Humber River unit flow rates for all storms up to and including the 100-year storm (i.e. 2, 5, 10, 25, 50, and 100-year storms). The analysis should be completed using the 6-hour and 12-hour AES storm distribution;
  - It has been agreed upon with the TRCA that additional storage will be provided for events larger than the 100-year storm, this storage will be provided as dry ponds adjacent to the proposed wet ponds;
- **Quality Control:** All watercourses and waterbodies within the TRCA's jurisdiction are classified as requiring an Enhanced Level of Protection, which equates to 80% TSS removal;
- **Erosion Mitigation:** An erosion detention volume will be based on the 25 mm rainfall event released over a 48-hour period, or a recommendation from a geomorphic / erosion threshold study; and,
- **Water Balance**: The volume and aerial distribution of recharge over the site should be maintained to closely match existing conditions.

Recommendations for Future Study

As part of the Master Plan EA process certain aspects of the City's drainage network were recommended for more detailed study, these recommended studies are summarized below in **Table 2**.

Table 2 – Recommended Additional Future Studies

Study Description	Cost
City-wide erosion assessment study	$600,000.00
A total of 20 drainage concern site were identified from reported flooding during the August 19, 2005 event. The City-Wide Drainage and SWM Criteria Study conducted in 2009 identified potential causes of flooding at each of these locations. The City is currently undertaking the second phase of this drainage study and focusing on seven (7) of the 20 previously identified flood vulnerable areas. It is recommended that a similar study be completed for (6) of the remaining 13 flood vulnerable areas which are located within or downstream of Secondary Plan areas to determine the level of service of these areas and provide mitigation recommendations.	$600,000.00
A hydraulic assessment of the existing stormwater network should be conducted in order to determine the system's existing capacity and identify areas that are currently not meeting City criteria.	$500,000.00

RCMPU Objectives

The goal of the RCMPU is to enhance the environmental conditions of the Rainbow Creek subwatershed and identify appropriate SWM criteria for future developments within the subwatershed.

In order to achieve, this goal, the objectives of the RCMPU are as follows:

- Recommend storm drainage plan and SWM criteria for Rainbow Creek and identify improvements required in the existing storm water collection system;
- Conduct necessary field work to identify alternative SWM measures that would cost-effectively improve the storm water runoff quantity, quality, erosion potential and reduce future maintenance requirements and flooding;
- Select the preferred SWM and flood control alternative(s) to be considered for future phased implementation;
- Develop draft policies and SWM criteria to be applied to existing, new development and re-development in the Rainbow Creek sub-watershed to help achieve identified SWM targets;
- Establish / identify major and minor system drainage patterns in areas of future development and identify the number of ponds required and potential pond locations;
- Verify the need to propose flood remediation works for sites on Rainbow Creek as identified in 1989 MDP under existing, interim (2011) and full build out conditions of Rainbow Creek Watershed;
- Identify and evaluate other flood vulnerable sites within the City and make recommendations for flood remediation work;
- Evaluate the impact of upstream development on the existing erosion problems and identify stream restoration where required; and,
- Establish erosion levy to address existing and future erosion problems.

RCMPU Study

The Master Plan Update updated the existing hydrologic and hydraulic modeling to reflect current conditions in the Rainbow Creek subwatershed. As part of the study, erosion assessments were conducted to determine the most effective erosion control criteria. The report also assessed existing flood vulnerable sites and recommended appropriate remedial studies and mitigation work for each site.

After establishing existing hydrologic and hydraulic conditions, future conditions were modeled based on expected growth outlined in the OPA for planning horizons of 2031 and 2051. Impacts of developments were assessed to confirm the effectiveness of existing SWM requirements for the subwatershed.

Recommended SWM Strategy for Rainbow Creek

Based on the updated hydrologic, hydraulic, and erosion modeling for Rainbow Creek, the recommended SWM requirements for the watershed moving forward are as follows:

- Quantity Control:
  - SWM facilities designed to control flows to unit flow rates will result in post-development flows which are less than or equal to pre-development levels within Rainbow Creek for storm events ranging from the 2-year to the 100-year event; and,
  - Block 61 ponds should be updated in the model once the design has been finalised to verify that they are not causing an increase in flows downstream of the site.

- Regional Controls:
  - It is determined that regional controls were not recommended for developments within the Vaughan portion of the Rainbow Creek Sub-watershed; and,
  - More detailed analysis of the impacts of development in Brampton on the subwatershed is recommended to determine impacts to flood risk from the regional regulatory storm event.
- **Erosion Control**: Due to the low erosion thresholds for Rainbow Creek, it is recommended that future developments retain the first 5 mm of runoff on-site. The criteria results in an expected reduction of the duration of the frequent erosive events which contribute to erosion in Rainbow Creek. No extended detention is recommended as the analysis indicated that extended detention within the Rainbow Creek the subwatershed could increase the duration of erosive flows in the creek; and,
- **Flood Susceptible Sites**: The recommended studies and mitigation work outlined in the report should be completed as funding becomes available;

Recommendations for Future Works

As part of the RCMPU recommendations have been made for future study and projects related to flooding and erosion mitigation or correction within the subwatershed. These projects are summarized below in **Table 3** and **Table 4**. For more details on these recommendations please refer to **Volume 3 – Sections 5.4 (Flood Mitigation)** and **Section 5.6 (Erosion Mitigation)**.

Table 3 – Recommended Flood Mitigation Studies

Detailed Survey and Updated Model and Flood Mapping to Determine Frequency and Extent of Flooding		
Location	**EA schedule**	**Cost**
9751 McGillivray Road, north of Rutherford Road and adjacent property	N/A	$10,000
Property adjacent to 9751 McGillivray	N/A	$10,000
7231 Martin Grove Road, north of Highway 407	N/A	$10,000
Woodbridge Foam Factory, on Meeting House Road	N/A	$10,000
Major Mackenzie Drive, west of CP Railway	N/A	$23,000
McGillivray Road, east of Huntington Road	N/A	
CP Railway north of McGillivray Road	N/A	
Houses on south end of Woodcroft Lane and Blossom Court	N/A	$12,000
Culvert under Major Mackenzie Drive, west of CP Rail and south of Block 61	N/A	$10,000
This site includes 10 duplex lots on the south side of Albany Drive	N/A	$10,000
Detailed Survey and Updated Model and Flood Mapping to Determine Frequency and Extent of Flooding, Given that these Building are Located Well Into The Floodplain we are Recommending Flood Proofing of the Buildings		
Small horse barn located at 9290 McGillivray Road	N/A	$16,000
Storage Yard and Small office located at 9441 Huntington Road	N/A	$16,000
Small shed or barn located at 10223 Highway 50, north of Major Mackenzie Drive	N/A	$16,000
Other Flood Mitigation Projects		
McGillivray Road, west of CP Railway – Culvert replacement and channel improvement	Schedule B	$480,000

Table 4 – Recommended Erosion Mitigation Studies

Location	Recommendation	EA schedule	Cost
Erosion occurring under Highway 407 bridge and adjacent to the Highway 407 embankment.	Repair existing erosion protection installation.	Schedule B	$205,000
Upstream of Highway 407 and downstream of Regional Road 7. Terrafix protection has failed at a sanitary crossing downstream of the existing toe protection.	Monitor toe protection behind residential units.	N/A	$10,000
	Repair existing Terrafix installation.	Schedule B	$176,000
High eroding bank upstream of Highway 27, Between Langstaff Road and the upper reach of Main 3, is contributing excess sediment to the stream.	Cut bank back to a more gentle slope and install toe protection.	Schedule B	$88,500
	Re-vegetate eroding bank and monitor site until vegetation is well established.		
Between Langstaff Road and the forested area to the north of Langstaff Road. Old beaver dam is causing local erosion issues. Downstream of the dam the channel is actively migrating and causing bank erosion.	The old beaver dam should be removed if it has been abandoned and the surrounding area should be cleaned up.	Schedule B	Work to be undertaken as part of the Block 59 development.
	Erosion along this reach should be addressed as part of the Block 59 development.		
Between the confluence of the East Humber River and Highway 407. Erosion is	Erosion along this reach should be addressed as part of the Block 59 development.	Schedule B	Work to be undertaken as part of the Block 59 development.

Location	Recommendation	EA schedule	Cost
occurring at various locations within the reach, primarily at outside bends.			
Between Langstaff Road and reach M3, upstream of the confluence with the west branch. Erosion at several locations due to a narrow corridor, moderate channel entrenchment and pedestrian traffic. Bank erosion is also occurring at the old weir downstream of Woodbridge Avenue.	Toe protection at outside bends. Bank stabilization around the weir. Install a pedestrian path and signs to educated the public on foot traffic causing erosion.	Schedule B	$1,605,000

Public and Agency Consultation

In order to fulfill the requirements for a Municipal Class EA, two (2) Public Information Centers (PICs) were held. Notices for the PICs were circulated to stakeholders and review agencies on September 29, 2011 for PIC #1 and on June 7, 2012 for PIC #2. The notices were also posted on the project website (www.vaughaninfrastructure.ca) as well as local newspapers "The Liberal" and "The Citizen".

Materials presented at the two (2) PICs included:

- **PIC #1 – October 13, 2011**: This PIC provided the study objectives, background information, and problem / opportunity statements to the public; and,
- **PIC #2 – June 27, 2012**: This PIC provided a review of the background information, identified alternative solutions, provided the criteria for evaluating the different alternatives, and summarized the preferred alternatives.

At both PICs, members of the public and review agencies were encouraged to provide input for consideration in the project. The comments received by the project team and the responses sent by the project team are included in the report.