

INTEGRATED STORMWATER MANAGEMENT MASTER PLAN (ISWM-MP)

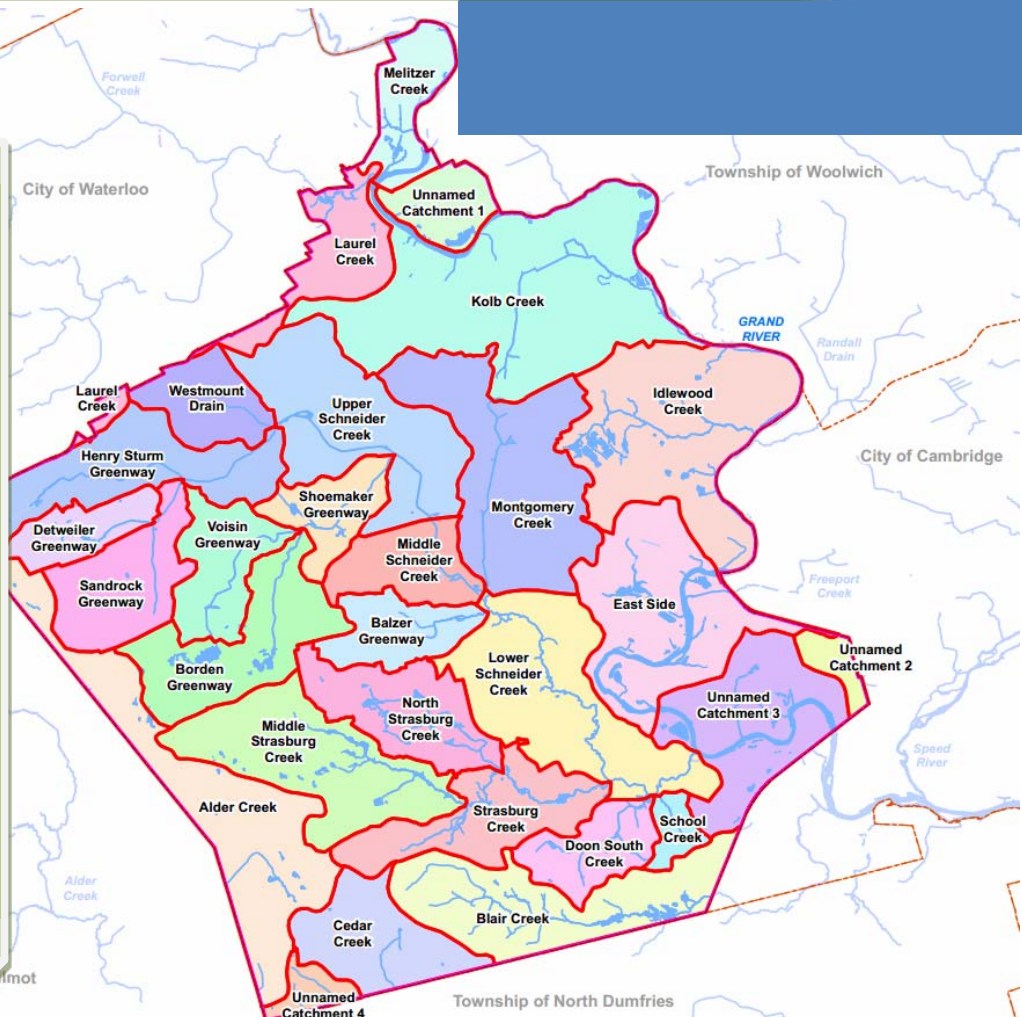
IMPLEMENTATION PLAN



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INTEGRATED SWM-MP

IMPLEMENTATION PLAN

Executive Summary

Following the completion of the Integrated Stormwater Management Master Plan (ISWM-MP) in May 2016 and the required 30-day public review period, an Implementation Plan has been developed which directs the allocation of funding, the prioritization of works and which includes the necessary supporting policies to permit the implementation of the recommended approaches in order to achieve the overall stormwater master plan goals and objectives.

Through a collaborative effort with multiple City departments and staff, an implementation schedule and budget forecast has been developed to guide future works in the immediate, medium and long term from 2017 to 2030. The implementation schedule and associated budget have been distributed over the 14-year implementation period in order to manage staff and equipment requirements, build municipal capacity, align with other municipal projects and programs and ensure that programs and projects can be effectively delivered within existing funding forecasts.

BACKGROUND

The City of Kitchener Integrated Stormwater Management Master Plan (ISWM-MP) was completed in May 2016 and as presented in report INS-16-047 was endorsed by City Council on May 30, 2016. The ISWM-MP was completed in accordance with the requirements for Master Plans under Section 4, Approach #2 of the Municipal Engineers Association Municipal Class Environmental Assessment Act (October 2000, as amended in 2007 & 2011), which is an approved process under the *Ontario Environmental Assessment Act*. The ISWM-MP completed the required 30-day public review period on July 10, 2016 at which point the ISWM-MP was considered final.

OVERVIEW

The next step following the completion of the ISWM-MP was the development of a strategic Implementation Plan for the recommended approaches for the six (6) stormwater management program elements:

- 1) Municipal Pollution Prevention, Operations & Maintenance Practices,
- 2) Market Based Strategies for Private Property (source controls),
- 3) Stormwater for the Capital Roads Program (conveyance controls),
- 4) Stormwater Management Facilities,
- 5) Watercourse and Erosion Restoration, and
- 6) Urban Flood Management & Stormwater Infrastructure.

An Implementation Plan has been developed in order to:

- Prioritize all the works based on the watersheds in the most need and where there are opportunities to maintain and/or improve conditions through the elements of the recommended approach,
- Recommend funding allocation and develop an implementation schedule using existing funding sources, and
- Develop supporting policy.

The ISWM-MP Implementation Plan is a strategic document which outlines how and when each specific program or projects of the recommended approach are to be completed to achieve the project goals and objectives. Through a collaborative effort with multiple City departments and staff, an implementation schedule and budget forecast has been developed to guide future works from 2017 to 2030.

IMPLEMENTATION SCHEDULE AND BUDGET FORECAST

The implementation schedule and budget forecast considers three (3) implementation periods:

- 1) Immediate Term Implementation Priorities which correspond to the 5-year Capital Forecast from 2017-2021;
- 2) Medium Term Implementation Priorities (2022-2025); and
- 3) Long Term Implementation Priorities (2025-2030).

The implementation schedule and budget forecast illustrates the specific program or project elements of the recommended approach as well as the recommended year within which the element is to be completed as well as the estimated costs. **Figure E1** summarizes the implementation schedule and budget forecast. The Implementation Plan has been developed based on the existing 9.2% projected annual stormwater rate increase over the next 10 years and will not add to that projected increase.

The implementation schedule and associated costs have been distributed over the 14-year implementation period in order to manage staff and equipment requirements, build municipal capacity, align with other municipal projects and programs and ensure that projects can be effectively delivered within existing funding forecasts.

Beyond the specified implementation period from 2017 to 2030, some \$40 million in expenditures have been deferred for the replacement of the approximately 14,961m of surcharging pipes identified through the preliminary trunk sewer modelling as well as to address pipe capacity issues outside the modelled trunk sewer system.

Figure E1 - ISWM-MP Implementation Schedule and Budget Forecast

	Immediate Term Implementation Priorities					Medium Term Implementation Priorities				Long Term Implementation Priorities				
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Low Impact Development (LID) AIRP	Implementation of LID Road Standard (\$250,000/year)			LID Road Retrofits as part of AIRP										
Sediment Management Program (Sediment Removal)	8 SWM Facilities (\$633,420)	8 SWM Facilities (\$828,158)	6 SWM Facilities (\$82,774)	7 SWM Facilities (\$205,662)	3 SWM Facilities (\$289,269)	3 SWM Facilities (\$31,533)	8 SWM Facilities (\$620,290)	6 SWM Facilities (\$351,498)	6 SWM Facilities (\$358,528)	6 SWM Facilities (\$365,698)	6 SWM Facilities (\$373,012)	6 SWM Facilities (\$380,473)	6 SWM Facilities (\$388,082)	6 SWM Facilities (\$395,844)
	Sediment Removal 8 OGS Units (\$128,112)	Sediment Removal 8 OGS Units (\$68,874)	City-Wide OGS Sediment Study (\$50,000)	Sediment Removal 6 OGS Units (\$81,182)	Sediment Removal 6 OGS Units (\$82,806)	Sediment Removal 6 OGS Units (\$84,462)	Sediment Removal 6 OGS Units (\$86,151)	Sediment Removal 6 OGS Units (\$87,874)	Sediment Removal 6 OGS Units (\$89,632)	Sediment Removal 6 OGS Units (\$91,425)	Sediment Removal 6 OGS Units (\$93,253)	Sediment Removal 6 OGS Units (\$95,118)	Sediment Removal 6 OGS Units (\$97,020)	Sediment Removal 6 OGS Units (\$98,961)
Drainage Improvements Program	LID Trail Enhancements (\$50,000/year)													
	LID Integration into PARTS (\$50,000/yr)		LID Integration into PARTS (\$100,000/yr)		LID Retrofit of 1 Laneway (\$55,204)	LID Retrofit of 2 Laneways (\$112,616)	LID Retrofit of 2 Laneways (\$114,869)	LID Retrofit of 2 Laneways (\$117,116)	LID Retrofit of 2 Laneways (\$119,509)	LID Retrofit of 2 Laneways (\$121,899)	LID Retrofit of 2 Laneways (\$124,337)	LID Retrofit of 2 Laneways (\$126,824)	LID Retrofit of 2 Laneways (\$129,361)	LID Retrofit of 2 Laneways (\$131,948)
Market Incentive Program	Trillium Pilot Project (\$25,000/year)			Set-Up Market Based Strategy (\$1,270,000)	Market Based Strategy (\$575,000/year)				Maintain Market Based Strategy (\$75,000/year)					
	Continue Stormwater Credit Program and Stormwater Grants													
SWM Infrastructure Maintenance Program	Continue Existing SWM Infrastructure Maintenance Program		Continue Existing SWM Infrastructure Maintenance Program											
			Sediment Removal from 1/5th of Uncontrolled Catch Basins											
			(\$63,672)	(\$64,946)	(\$66,245)	(\$67,570)	(\$68,921)	(\$70,300)	(\$71,706)	(\$73,140)	(\$74,602)	(\$76,095)	(\$77,616)	(\$79,169)
SWM Infrastructure Implementation	Model Purchase, Model Update and Staffing (\$100,000)	LiDAR Data Processing, Integrate HEC-RAS Model, Define Overland Flow Routes (\$30,000)	LiDAR Data Processing, Integrate HEC-RAS Model, Define Overland Flow Routes (\$30,000)	LiDAR Data Processing, Integrate HEC-RAS Model, Define Overland Flow Routes (\$30,000)		Implement Urban Flood Management Recommendations (\$30,000)	Implement Urban Flood Management Recommendations (\$30,000)	Implement Urban Flood Management Recommendations (\$30,000)						
	SWM Pond 61 Outlet Sewer (\$175,000)	SWM Pond 61 Outlet Sewer (\$403,000)	SWM Pond 61 Outlet Sewer (\$608,000)											
Drainage Risk Evaluation Program				Drainage Basin Risk Studies (\$30,000/ year)			Implement Recommendations (\$40,000)	Implement Recommendations (\$200,000)						
SWM Monitoring Program	Continue with Refined SWM Audit (\$80,000)	Continue with Refined SWM Audit (\$80,000)	Updated Water Quality (EMC) and Flow Monitoring Protocol Target Subwatersheds (\$100,000/year)											
	Filsinger DFO Monitoring (\$20,000/ year)			Updated Water Quality (EMC) and Flow Monitoring Protocol to reflect Target Subwatersheds (\$100,000/ year)										
Credit Trading Study			Habitat Banking Study (\$30,000)	SWM Credit Trading Study (\$50,000)	Implement Study Recommendations (\$50,000)									
Watercourse Improvement Program	Idlewood Improvements and MG-1E-F Projects (\$1,282,250)	Idlewood Improvements and MG-1E-F Projects (\$1,282,250)	MG-1E-F Project (\$1,896,300)	SR-2B Erosion Site Project (\$225,146)	SM-2B Restoration Reach Project (\$3,252,622)	Schneider Creek @ Manitou Road Erosion Site- SC-4L Project (\$104,170)	SB-13A Erosion Site Project (\$470,961)	BD-1A Erosion Site (utility and sanitary) Project (\$240,190)	LC-1A-2A Restoration Reach Project (\$4,230,628)	Schneider Creek at Old Carriage Road - Restoration Reach - SC-2B Project (\$2,133,240)				
	VS-1A Restoration Reach Project (\$1,131,142)			Stonegate Creek Erosion Site- ES-GRT61 Project (\$380,080)		BD-1B Erosion Site Project (\$427,311)	BD-1A Erosion Site (water main) Project (\$1,192,749)							
		Balzer Creek Rehab (\$867,000)				SC-4L Erosion Site Project (\$107,976)								
SWM Facility Retrofits Program	Construction 21 & 66 (\$980,500)	Construction 10 & 111 (\$1,759,837)	Construction 16 & 7 (\$347,280)	Construction 65 (\$1,286,760)	Construction 62 (\$248,057)	Construction 61 (\$1,199,969)								
	Design 10, 111 & 65 (\$705,559)	Design 16 and 7 (\$52,092)	Design 65 (\$295,000)	Design 62 (\$137,209)	Design 61 (\$179,954)									
Park SWM Enhancements						Prospect Park (\$1,324,897)	Sandrock Hydro Corridor (\$4,076,708)	Cherry Park (\$1,165,916)	Country Hill Park (\$831,878)	Idlewood Greenway (\$2,133,240)	Victoria Park (\$4,911,329)	Biehn Park (\$9,638,638)	Rosenburg Park (\$5,239,107)	Cameron heights Pool and Kaufman Park (\$13,194,788)
						Country Side Park (\$292,915)		Country Side Park (\$298,773)	Millwood Park (\$304,749)					
ANNUAL TOTALS	\$5,346,841	\$5,299,211	\$3,948,026	\$4,782,047	\$4,979,157	\$4,090,297	\$6,768,187	\$4,473,558	\$6,225,654	\$5,448,391	\$5,801,533	\$10,542,148	\$6,156,186	\$14,125,710

POLICY DEVELOPMENT

The ISWM-MP (May 2016) report including the supporting technical documents included as Appendix A through N and the Implementation Plan replaces the following existing Council Policies:

- I-1135 Stormwater Management Policy (December 10, 2001)
- I-1140 Stormwater Management Review/System (March 29, 1999 as amended July 5, 1999)
- I-1145 Stormwater Management Facilities – Design Principles (September 30, 1996)

One (1) new policy, Stormwater Management, containing three (3) specific component has been prepared as part of the ISWM-MP process and the Implementation Plan in collaboration with city staff, the Region of Waterloo, the GRCA and the Ministry of Environment and Climate Change (MOECC). The three (3) supporting components in the policy include:

- A. Stormwater Infiltration in the Context of Source Protection Planning (October 2016)**
- B. Stormwater Volume Criteria and Targets (October 2016)**
- C. Stormwater Management Fee**

In general, The ISWM-MP (May, 2016), the supporting technical document to the ISWM-MP included as **Appendix A-N** within the May 2016 report and this Implementation Plan shall provide the overarching policy direction for stormwater management with the City of Kitchener

A. Stormwater Infiltration in the Context of Source Protection Planning

This component defines where and how infiltration based stormwater management controls, commonly referred to as Low Impact Development (LID) controls, can safely be planned and constructed in the context of the approved source protection planning policy under the Clean Water Act.

Developed in consultation with the Region of Waterloo staff and the MOECC, this component acknowledges that the use of infiltration practices to reduce runoff and restore natural hydrologic processes is crucial to maintaining and improving the City of Kitchener's natural water systems, maintaining the viability of local stormwater infrastructure, and contributing to climate change adaptation & mitigation strategies. As the implementation of infiltration practices becomes more prevalent, the City of Kitchener has a duty to protect local groundwater resources by implementing a land use-based stormwater infiltration guideline which is developed based on a sound understanding of identified and future risks.

This component identifies high risk site activities which have the potential for high levels of contamination. Sites with high risk activities are generally discouraged from incorporating LID techniques that utilize infiltration as its primary function for risky drainage areas and require the proponent to prepare a Pollution Prevention Plan and/or Risk Management Plans as part of SWM Reporting requirements. Spill prevention and management are a central focus of such plans.

Also identified within this component are the infiltration opportunities and constraints and lists of acceptable practices within various land-uses ranging from Residential, Mixed Use, Commercial, Industrial Employment, Institutional and Open Space and Natural Heritage Conservation as well as local, minor and major roadways within the City of Kitchener.

B. Stormwater Volume Criteria and Targets

This component outlines the newly established minimum stormwater volume criteria and outlines the application of general stormwater management targets as part of:

- New development,
- Redevelopment, reurbanization and residential intensification, and
- Linear projects (roadways, trails and transit infrastructure etc.).

All sites within the City of Kitchener will be required to:

- Continue to control off-site runoff for **flood control and erosion** per the approved watershed, subwatershed, master drainage plans, Environmental Impact Statement (EIS), Provincial Policy and Guidelines or other area specific studies. Special Policy Areas which address known or flood prone areas will remain in effect.
- Continue to achieve infiltration targets to maintain the existing water balance per current approved and future subwatershed plans. Current subwatershed plans include: Blair Creek, Doon South, Idlewood Creek, Strasburg and Upper Strasburg Creeks.
- Control for **water quality** (pollutant loadings) in accordance with current MOECC guidelines to 'Enhanced-Level 1' protection as defined in the 2003 Stormwater Management Planning & Design Manual.
- Retain a minimum of 12.5mm of runoff from the all surfaces on the entire site and enroll in the City of Kitchener Stormwater Utility Credit program. Retention can be a combination of infiltration, evapotranspiration or rain water re-use (also known as rainwater harvesting). All volume retained on-site will be counted towards achieving the flood and erosion control, water quality control as well as towards existing infiltration targets.

In all cases, the targets specified in this component shall be superseded by more stringent targets as developed by the MOECC or through future Watershed Studies, Subwatershed Studies, Master Drainage Plans, Environmental Impact Statement (EIS) and/or other area specific studies such as GRCA Wetland Policy.

Minimum Volume Retention Target - Rationale

A minimum volume retention target is the central alteration to how stormwater is managed within the City of Kitchener. This component was developed to align with the pending MOECC LID Stormwater Management Guidance Manual which is anticipated of release in 2017. The MOECC pending document will likely contain minimum volume targets which will exceed the City's minimum target of 12.5mm and is expected to mandate the use of LID approaches for new development, infill and redevelopment as well as linear projects.

Minimum Volume Retention Target – Application

This component has built in flexibility, outlining the approach for sites with restrictions (constraints) which may prevent them from achieving the minimum volume targets such as sites with shallow bedrock, high groundwater, contaminated soils, as well as high risk sites and other limitations per the Stormwater Infiltration in the Context of Source Protection Planning (October 2016). In such cases, as confirmed by city Development Engineering staff, the sites shall be required to achieve the Maximum Extent Possible or MEP. In this way, the city is asking only what can be technically and reasonably achieved given the identified constraints.

On sites where the proponent cannot implement the required volume control to the Maximum Extent Possible or MEP as confirmed by the City of Kitchener Development Engineering section, the site will be required to contribute to the Stormwater Management Fee (formerly Cash-in-lieu) at the current per hectare rate as defined by the City of Kitchener as amended from time to time.

A. Stormwater Management Fee

A Stormwater Management Fee (formerly Cash-in-lieu) has been established such that a development proponent shall provide a designated financial contribution at the current per hectare rate as defined by the City of Kitchener, as amended from time to time where the requirements of the **Stormwater Infiltration in the Context of Source Protection Planning and the Stormwater Targets and Volume Criteria** are not be fully achieved. This fee will be applied towards off-site stormwater management elsewhere in the city, in conformance with the recommended approaches of the Integrated Stormwater Management Master Plan (ISWM-MP).

Funds will be collected by the City of Kitchener SWM Utility until such time as a suitable project or program is identified for partial or full funding.

IMPLEMENTATION SYNERGIES WITH CITY PLANS AND POLICIES

The recommended approach for City wide stormwater management and implementation on a priority subwatershed basis is not intended to be addressed in isolation as part of the ISWM-MP. The ISWM-MP was developed with full consideration for other Strategic Plans, Subwatershed Studies, Master Plans, Secondary Plans, Environmental Assessments and Policies. More specifically, the elements of the recommended approach represent potential synergies with other studies and plans and should be considered as such.

The ISWM-MP explicitly recommended that Staff, as part of other city initiatives, plans, studies and programs, leverage potential synergies as the opportunities are identified in order to more efficiently achieve overall City goals to increase urban tree canopy, construct new trails and cycle lanes, improve transit and build transit capacity, rehabilitate parks, reconstruct roads as well as improve stormwater management.

Integration across city departments is the corner stone of a modern approach to stormwater management and will be essential for the City of Kitchener in the implementation of the ISWM-MP in order to maintain and improve the condition and health of the City's subwatersheds.

Implementation of the recommended approaches as detailed in this Implementation Plan for ISWM-MP should have regard for the following:

- **Parks Strategic Plan (September 2010)**
- **Multi-Use Pathways and Trails Master Plan (May 2012)**
- **Cycling Master Plan (2010)**
- **Planning Around Rapid Transit (PARTS)**
- **Ecological Restoration Areas and Policies**
- **New Secondary Plan Areas**
- **Grand River Water Management Plan (2014)**
- **Grand River Source Protection Plan (LERSPC 2012, Approved 2015, effective July 1, 2016)**
- **Wastewater**
- **Urban Forestry**

PRIORITY SUBWATERSHEDS

This Implementation Plan prioritizes the works recommended by the ISWM-MP based on priority subwatershed. Prioritization is based on the watersheds in the most need and where there are opportunities to improve conditions through the elements of the recommended approach.

Prioritization is based on a hierarchical approach, beginning with the watersheds that have been designated Priority 1 and applying the identified opportunities (i.e. watercourse restoration and erosion repairs, source control pilot programs, conveyance controls, O&M, SWM facilities, flooding, etc.) as detailed within the Recommended Approach in order to improve overall subwatershed conditions. Subwatersheds are prioritized based on the areas of greatest need and opportunity to maximize the 'net-benefit' to the City, the environment and the community.

Five (5) separate evaluation categories are used to prioritize the twenty-nine (29) subwatersheds within the City of Kitchener. These categories are:

1. Stormwater Management
2. Water Quality
3. Stream Health
4. Aquatics
5. Terrestrial Ecology

Using the five (5) evaluation categories existing conditions subwatershed scores were established. These scores were used to prioritize the twenty-nine (29) subwatersheds within the City of Kitchener.

Five (5) subwatersheds were identified as Priority 1, these are:

- Upper Schneider Creek (Score = 21.5)
- Montgomery Creek (Score = 20.7)
- Shoemaker Creek (Score = 20.3)
- Sandrock Creek (Score = 20.2)
- Voisin Creek (Score = 20.1)

Fourteen (14) subwatersheds were identified as Priority 2, these are:

- Henry Sturm Creek (Score = 19.0)
- Westmount Creek (Score = 18.6)
- Middle Schneider Creek (Score = 18.6)
- Balzer Creek (Score = 18.4)
- Alder Creek (Score = 17.7)
- Borden Creek (Score = 17.5)
- North Strasburg Creek (Score = 17.2)
- Laurel Creek (Score = 16.7)
- Kolb Creek (Score = 16.6)
- Lower Schneider Creek (Score = 16.6)
- Detweiler Creek (Score = 16.4)
- East Side (Score = 15.7)
- Unnamed Catchment 1 (Score = 15.6)
- Idlewood Creek (Score = 15.0)

Five (5) subwatersheds were identified as Priority 3, these are:

- Unnamed Catchment 3 (Score = 14.6)
- School Creek (Score = 14.2)
- Doon South Creek (Score = 13.9)
- Melitzer Creek (Score = 13.4)

Three (3) subwatersheds were identified as Priority 4, these are:

- Middle Strasburg Creek (Score = 9.7)
- Strasburg Creek (Score = 9.1)

- Blair Creek (Score = 8.0)

CULTURAL HERITAGE SCREENING

The study area for the stormwater management master plan was the entirety of City of Kitchener. As a City-wide master plan, it was not feasible to complete the site specific MTCS screening checklist for built heritage resources and cultural heritage landscapes as part of the ISWM-MP.

The City has recently completed a comprehensive review and inventory of cultural heritage resources. This includes completing a review of previously inventoried heritage properties, resulting in the recent addition of 220 properties to the Municipal Heritage Register as non-designated property of cultural heritage value or interest. In April 2015, Kitchener City Council approved the Kitchener Cultural Heritage Landscape Study, which identified and inventoried 55 significant cultural heritage landscapes in the City. Through these efforts, and with consideration given to the Region of Waterloo's Archaeological Potential Model, the City has access to an extensive, up to date and comprehensive inventory of built heritage resources, cultural heritage landscapes and archaeological resources.

The ISWM-MP identifies a number of site specific projects per the recommended approaches. Prior to undertaking any identified project, the City shall review each site for the potential to impact known or potential cultural heritage resources in compliance with the heritage policies of the Kitchener Official Plan as well as other policies and procedures. The City will complete the necessary heritage assessment and studies required to identify and mitigate potential impacts and share such studies with the appropriate officials as required.

RECOMMENDED APPROACH

A report titled "**Integrated Stormwater Management Master Plan (ISWM-MP) Municipal Class Environmental Assessment (May 2016)**" has been prepared and details the existing conditions of stormwater and environmental resources within the City of Kitchener, the Class EA process including the various alternatives, evaluation criteria and the recommended approaches for the six (6) stormwater management program elements of:

- 1) Municipal Pollution Prevention, Operations & Maintenance Practices;
- 2) Market Based Strategies for Private Property (source controls);
- 3) Stormwater for the Capital Roads Program (conveyance controls);
- 4) Stormwater Management (SWM) Facilities;
- 5) Watercourse and Erosion Restoration; and
- 6) Urban Flood Management & Stormwater Infrastructure.

Separate detailed reports were also prepared for each of the program elements detailed above and are included as technical appendices to the ISWM-MP Class EA document. A summary of the six (6) stormwater management program elements which make up the Recommended Approaches are provided below.

RECOMMENDED APPROACHES:**1) Municipal Pollution Prevention, Operations & Maintenance Practices**

Pollution Prevention, Municipal Management and Operational Practices are important to ensure pollutants are prevented from impacting the environment and to ensure existing stormwater infrastructure maintain their effectiveness. The ISWM-MP explored approaches to manage pollutants and sediment within the City's stormwater management infrastructure in the most cost effective manner. The study and resulting recommended approaches have been completed following Schedule A/A+ of the Municipal Class EA process, and therefore, are pre-approved.

Catch Basin Clean-out, Street Sweeping and Leaf Pick-up Program

The ISWM-MP reviewed existing street sweeping and leaf collection programs, as well as completed a detailed assessment of catch-basin sediment quality and loading rates within four (4) representative areas of the City corresponding to a new subdivision, mature and old subdivision (minimum of 10 years and 30 years since development respectively) and an industrial/ commercial area. Recommendations included:

- That the existing street sweeping and leaf collecting programs be further investigated to assess the potential to integrate catch-basin cleaning to increase efficiency and reduce cost.
- That sediment removal from catch-basins within uncontrolled areas (areas without existing stormwater ponds or OGS units) is completed starting with priority subwatersheds as identified in section 4.0 of this Implementation Plan.

Oil and Grit Separator (OGS) Cleanouts

OGS units are designed to capture sediment and oils from the storm sewer network prior to stormwater being discharged. The City of Kitchener is currently responsible for the operation and maintenance of sixty-five (65) OGS units in the City, with new ones often added as part of road reconstruction projects where technically feasible. Maintenance has been completed for fourteen (14) of the most critical units and the remainder have been prioritized based operational status or recommended for additional study within the ISWM-MP. The ISWM-MP evaluated thirty-two (32) units with available information and quantified their overall maintenance requirements and concluded that sixteen (16) OGS units required immediate maintenance, six (6) OGS units were classified as high priority and ten (10) OGS units were classified as moderate and low priority. Ultimately, all of the units will require maintenance service at some point as a condition of the Environmental Compliance Approval for their installation.

2) Market Based Strategies for Private Property (source controls)

In 2011, the City established a stormwater utility fee and credit program in 2012 for up to 45% of the fee to encourage private landowners to implement on-site stormwater mitigation and pollution prevention measures. To support landowners implementing SWM mitigation measures such as rain gardens, bioswales, redirecting downspouts, etc., the City of Kitchener in partnership with Residential Energy Efficiency Project (REEP Green Solutions) provides

information, resources and direct expert guidance to residential and industrial, commercial and institutional (ICI) property owners.

However, the number of applications by residents and businesses received for participating in the Stormwater Utility Credit Policy has decreased in volume recently relative to when the program was introduced in 2012. Overall uptake sits at approximately 6% of all residential and non-residential properties. To increase uptake of SWM and pollution prevention practices, market-based research was undertaken to develop enhancements to current SWM programming. The City of Kitchener undertook an extensive market-based research study to explore and understand the "wants and needs" of residents and businesses in order to support and service those interested in improving stormwater management on their properties. This research included a comprehensive review of leading jurisdictions in Canada and the USA, development of a demographic profile of the residents of the City and Kitchener as well as:

- Interviews with business property owners/managers, builders/developers and service providers (in the fields of landscape design and installation, roofing and building sciences, and porous/permeable surfacing).
- A research session (March 11, 2015) with a demographically representative sample of single-family homeowners in the City.

Based on the results of the market-based research, the recommended approach puts forward that in addition to the existing residential credit program, the City intends to evaluate the opportunity to determine the appropriateness of a variety of incentives and programs to support and service those interested in improving stormwater management on their non-residential properties. Approaches such as various financing options, 'bonusing' strategies, review enhancements, and service charge reductions will be evaluated and appropriate methods will be detailed at a later date. It is proposed that the City try a few selected methods on a pilot project basis and focus on priority watersheds in collaboration with REEP Green Solutions as part of the recently approved 3-year (\$439,500) Trillium 'Grow' funding which is to target 2 neighbourhoods in Kitchener.

The goal of this element of the Recommended Approach for source controls will be to achieve a twenty percent (20%) uptake over a five year period, allowing the City to secure source-level SWM measures at just over 25% of non-residential properties by 2021.

3) Stormwater for the Capital Roads Program (conveyance controls)

As an element of the Recommended Approach, the City has identified stormwater management treatment options (conveyance controls) that can be incorporated into the 10-year Capital Forecast for road right-of-way (ROW) reconstruction (resurfacing) and full reconstruction projects until 2024 for local, minor and major roads as well as laneways. Conveyance controls are linear stormwater transport systems that are generally located adjacent to or within roadways. They encourage infiltration of water into the ground, improve water quality and reduce runoff. They can include traditional curb and gutter systems and techniques such as bioswales, grassed channels and subsurface perforated pipe systems.

The incorporation of a cost-effective ROW retrofit approach using a combination of traditional SWM controls (i.e. Oil and Grit Separator (OGS) and other treatment devices) and Low Impact Development (LID) approaches as part of planned road reconstruction and resurfacing projects presents a significant opportunity to improve SWM control (water quality, water quantity, erosion mitigation and water balance) in a cost effective manner within existing urban areas of the City built prior to the implementation of modern stormwater management practices. In addition, ROW retrofits have the added benefit of providing an opportunity to enhance street aesthetics, mitigate and adapt to climate change conditions and reduce urban heat island effects.

The ISWM-MP evaluated through desktop and field investigations, 203 roadway projects and 22 laneways identified within the 10-year Capital Forecast and developed preferred stormwater alternatives for one-hundred seven (107) roadway projects and twenty-two (22) laneway projects.

To direct the implementation of the Recommended Approach, a decision making framework to select the appropriate SWM treatment options for all Capital ROW projects has been developed and in consultation with the Region of Waterloo Hydrogeology and Sourcewater Protection staff, a document has been developed which defines where and how infiltration of roadway runoff can safely occur in the context of the approved source protection planning policy.

The above has been completed following Schedule A/A+ of the Municipal Class EA process, and therefore, all recommended works are considered pre-approved.

4) Stormwater Management (SWM) Facilities

The Recommended Approach for Stormwater Management Facilities is comprised of three (3) individual elements of:

1. Sediment Removals from Existing SWM Facilities
2. Planned SWM Retrofits
3. Park Rehabilitation and SWM Enhancements

Sediment Removals from Existing SWM Facilities

The City of Kitchener inventory includes one hundred and thirty-two (132) SWM facilities that require regular maintenance (not including natural ponds). The ISWM-MP determined the effect of sediment accumulation on existing SWM facilities and developed a prioritized list of those requiring maintenance based on the amount of sediment within each facility and the effect of this accumulation in terms of loss in storage or decrease in performance. The SWM facilities were grouped according to the facility type (i.e. Dry versus Wet Facilities).

Dry facilities (only have water in them during certain storm events) focus on quantity control and were assessed based on the loss in storage capacity. Wet Facilities are designed to provide quality control via a permanent water pool to allow the accumulation of sediment from stormwater. Wet facility sizing is based on the level of protection to be provided in terms of Total Suspended Solid Removal (TSS). A decrease in performance was represented as a loss in

efficiency/level of protection due to sediment accumulation. Maintenance requirements (i.e. clean-outs) were prioritized accordingly. The ISWM-MP recommendations included:

- Of the thirty-one (31) Dry facilities identified:
 - o Seven (7) were assessed as High Priority (>20% Loss)
 - o Two (2) were assessed as Moderate Priority (11-20% Loss)
 - o Seven (7) were assessed as Low Priority (6 -10% Loss)
- Of the sixty-two (62) Wet facilities that were analyzed:
 - o Twenty-Two (22) were assessed as High Priority
 - o Three (3) were assessed as Moderate Priority
 - o Two (4) were assessed as Low Priority

The above has been completed following Schedule A/A+ of the Municipal Class EA process, and therefore all the recommended works as detailed above are considered pre-approved. Further, the maintenance of SWM facilities is a legislated requirement as a condition of the Environmental Compliance Approval issued for their construction. The City has maintained SWM facilities on a planned basis since 2014.

Planned SWM Retrofits

As part of previous Class Environmental Assessments (EAs) completed in 2001 and 2010 eighteen (18) existing ponds were identified as feasible retrofit locations. Retrofits improve or enhance the water quality, quantity and erosion control performance of existing stormwater management facilities and bring them in-line with current standards.

The City has already completed retrofits at eight (8) facilities from 2005 to 2013. The ten (10) remaining planned retrofits awaiting implementation include Ponds 6 (currently underway as part of Kolb Creek project), 66, 10, 16, 65, 61, 21, 7, 62, and 111.

Park Rehabilitation and SWM Enhancements

To identify locations where new stormwater management facilities could be implemented in combination with park rehabilitations to increase the proportion of SWM controlled drainage areas in the City to improve: water quality and quantity control as well as erosion control, a four (4) phase assessment was conducted.

Phase 1 - GIS/Land Assessment: identified potential locations within the study area. Six (6) screening level assessment criteria were utilized to determine feasible locations.

Phase 2 - Field Reconnaissance/ Impact Assessment: consisted of a much more detailed and thorough assessment of each potential location. This phase used a combination of a field reconnaissance and as well as the assessment of each feasible location for impacts and/or opportunities related to the technical, environmental, and social considerations.

Phase 3- Performance Assessment: evaluated the performance capabilities of each site carried forward using primary and secondary criteria per the Stormwater Management

Planning and Design Manual, MOE (2003). This step also identified conceptual SWM facility alternatives for each location (surface or subsurface storage facility) and developed Class 'C' cost estimates

Phase 4 – Consultation with City Staff: Each potential location was reviewed and (5) sites were eliminated based on identified issues such as high groundwater, soil conditions and future development (i.e. future school site and highway expansions by MTO).

A total of thirty (30) potential sites were screened, of which twelve (12) were deemed feasible as either a surface facility (SWM Pond, wetland etc.) or subsurface facility (underground storage facility) following the four (4) phase process. Preferred alternatives for each location were evaluated in fulfilment of Schedule B Class EA requirements using criteria under the primary categories of:

Physical & Natural Environment Criteria - Water Quality, Stream Geomorphology, Aquatic Habitat, Fisheries, Wildlife and Groundwater Resources

Social & Cultural Criteria - Visual Aesthetics, Recreational Opportunities, Cultural/Heritage Resources and Health & Safety

Technical & Engineering Criteria - Flood Control, Erosion Control, Ease of Implementation and Operations & Maintenance

Economic Criteria - Capital Costs, Operations & Maintenance Cost, Lifecycle Costs and Ability to coordinate with other projects

Alternatives, with higher scores represented the greater fulfilment of the evaluation criteria. The preferred solutions for each of the twelve (12) opportunities were then selected based on highest total score from all of the evaluation criteria across each of the alternative solutions. The twelve (12) sites included within the Recommended Approach for Park Rehabilitation and SWM Enhancements are listed in **Table 1 below**.

Table 1 – Twelve (12) Sites Included in the Recommended Approach for Park Rehabilitation and SWM Enhancements

Map & Site ID	Location Name	Preferred Alternative
2-1	Victoria Park	Subsurface Storage Facility
2-2	Cameron Heights Pool & Kaufman Park	Subsurface Storage Facility
2-3	Cherry Park	Subsurface Storage Facility with Wet Pond
3-4	Roseburg Park	Subsurface Storage Facility
4-2	Idlewood Greenway	Subsurface Storage Facility
4-5	Prospect Park	Wet Pond
5-2	Sandrock Hydro-Corridor	Wet Pond
5-5A	Country Side Park	Wet Pond

Map & Site ID	Location Name	Preferred Alternative
5-5B	Country Side Park	Wet Pond
6-1	Country Hill Park	Subsurface Storage Facility
6-3B	Millwood Park	Wet Pond
7-2	Biehn Park	Subsurface Storage Facility

The above has been completed following Schedule B of the Municipal Class EA process, and therefore, may proceed directly to detailed design subject to the completion of the 30 day review. As this work would be done in collaboration with park improvements, the timing of these projects is budget dependent as detailed in Section 6.4 of this Implementation Plan.

5) Watercourse and Erosion Restoration

The purpose of the stream erosion assessment component of the ISWM-MP was to document the physical health of Kitchener's watercourses and to create an inventory of erosion sites that could potentially be addressed through creek-based restoration works. A technical field scoring methodology was used to assess the levels of risk and environmental opportunity, and to classify the erosion sites (primary and secondary). Stream restoration opportunities, including the identified erosion site and restoration reach opportunities, were also evaluated within the context of the Ecological Restoration Areas identified within the City of Kitchener's Official Plan and the recently Council approved Fish Habitat Banking Arrangement with the Department of Fisheries and Oceans Canada. The primary sites are listed in **Table 2**.

Table 2: Primary Stream Restoration Opportunities in Alphabetical Order

Watercourse, Location	Reach ID	Risk	Preferred Solution
Borden Creek at Concordia Park	BD-1A	Sanitary Sewer	Local Works
Borden Creek at Concordia Park	BD-1A	Water Main	Removal of Risk
Borden Creek downstream of Conestoga Pkwy	BD-1B	Sanitary Sewer	Removal of Risk
Lower Laurel Creek	LC-1A-B, 2A	Sanitary Sewer, Building	Reach Based Works ¹
Montgomery Creek at Vanier	MG-1E-F	Water Main, Culvert	Removal of Risk ²
Sandrock Creek at Westheights	SR-2B	Trail, Storm Sewer Outfalls	Local Works
Schneider Creek at Manitou	SC-4L-5A	Water Main (Abandoned)	Removal of Risk ²
Schneider Creek at Old Carriage	SC-2B-3A	Trails, Private Property	Local Works ¹
Shoemaker Creek	SM-2B-E	Sanitary and Storm Sewers	Reach Based Works
Stonegate (Hofstetter) Creek	ES-GRT6-1	Storm Sewer	Removal of Risk
Strasburg Creek Downstream of Old Huron	SB-13A	Culvert, Sanitary Sewer	Local Works ¹
Voisin Creek at Greenbrook	VS-1A	Road, Sidewalk, Utilities	Reach Based Works

1 – Requires land rights (i.e., acquisition and/or easements) and associated costs have not been included in the EA

2 – Optional works to expand the scope and length of stream restoration have also been identified in the EA

Alternative solutions were assessed for each of the primary stream restoration opportunities to recommend a preferred solution. Four preliminary alternative solutions were evaluated in each case, including:

- **Do Nothing** – No creek-based works to address existing erosion or to mitigate existing risks
- **Local Works** – Selective creek-based works to address local erosion issues and risks, and to improve stream habitat
- **Reach Based Works** – Extensive creek-based works to address erosion issues and risks, and to improve or fully rehabilitate stream habitat
- **Removal of Risk** – Elimination or reduction of the erosion risk within the creek channel by removing, realigning, or redesigning the associated infrastructure, and/or by addressing land rights for properties within the stream corridor and the erosion hazard zone.

Preliminary alternatives for each of the primary stream restoration opportunities were evaluated in fulfilment of Schedule B Class EA requirements based on the evaluation criteria as summarized below:

- **Physical/Natural Environment** - Potential Aquatic Habitat Benefit (Water Temperature), Potential Aquatic Habitat Benefit (Fish Passage), Potential to Reduce Erosion of Public Lands, Potential to Reduce Erosion of Private Lands, Potential to Reduce Stream bank and Stream bed Erosion, Potential to Enhance Groundwater Regime, Potential to Reduce Flooding, Potential to Improve Terrestrial Habitat, Integration with Existing Infrastructure and Integration with Existing Environment.
- **Social/Cultural** - Aesthetic / Recreation, Compatibility with Adjacent Land Use, Community Disruption and Public Health and Safety
- **Economic** - Construction Costs, Operation Maintenance and Infrastructure Protection
- **Technical/Engineering** - Ease of Implementation, Agency Acceptance, Policy/Bylaw Requirements, Technical Feasibility

Alternatives, with higher scores represented the greater fulfilment of the evaluation criteria. The preferred solutions for each of the primary stream restoration opportunities were then selected based on highest total score from all of the evaluation criteria across each of the four alternative solutions.

The prioritization of the stream restoration opportunities (**Table 2**) is integrated within a system-wide evaluation of stormwater management priorities and subwatershed health, and in the context of other City projects.

6) Urban Flood Management & Stormwater Infrastructure

As part of the ISWM-MP, a storm trunk sewer network model was developed for all pipes 600mm and larger (approximately 6,000 pipe segments which represents 33% of the total storm sewer network) in order to assess and identify the capacity of the existing storm sewer network and associated stormwater management ponds under five (5) scenarios:

- **Scenario 1 - Existing Conditions:** Calibrated trunk sewer model based on one-year of monitoring data completed as part of the ISWM-MP. Known flooding locations as reported by the City of Kitchener staff demonstrate good agreement with the calibrated model.
- **Scenario 2 - Climate Change on Existing Conditions:** The 5 year storm was increased by 20% to reflect climate change impacts per the recommendations of the Localized Climate Projections for Waterloo Region (September 2015).
- **Scenario 3 - LID Volume Control on Existing Conditions:** Reflects the application of a 12.5mm volume control target (city wide) to reflect the benefits of LID controls on the existing conditions.
- **Scenario 4 - Climate Change & LID Volume Control:** is a combination of Scenarios 2 and 3, and reflects the benefits of the 12.5mm volume control target (city wide) and the impacts of the predicted climate change conditions.
- **Scenario 5 – Intensification on Existing Conditions:** Reflects the impact of intensification within Priority A and B areas per the City of Kitchener Growth Management Plan on the existing trunk sewer system.

The completed Climate Change assessments of the stormwater trunk sewer system is in keeping with Strategic Priority of Sustainable Environment and Infrastructure, and Strategy #4.5 - strengthen the capability and capacity within the organization to manage all of the City's assets so that they are affordable, dependable and sustainable in the long-term. The Climate Change scenario was developed based on the Localized Climate Projections for Waterloo Region (September 2015) developed by the Interdisciplinary Center on Climate Change (IC3) and the University of Waterloo.

Table 3 summarizes the modelling results of the five (5) scenarios and lists the total length of pipe at capacity and the total length of pipe which is surcharged (flow exceeding the pipe capacity which can result in flooded roads and property).

Table 3 - Summary of Trunk Sewer Model Results: Scenarios 1-5

Scenarios ID	Scenarios Name	Total Length of Pipe at Full Capacity (m)	% Length of Pipe at Full Capacity (%)	Total Length of Surcharged Pipes (m)	% Total Length of Surcharged Pipes (%)
1	Existing Conditions	10,723	4.8%	13,763	6.2%
2	Climate Change on Existing Conditions	13,934	6.3%	19,566	8.8%
3	LID Volume Control on Existing Conditions:	4,585	2.1%	5,842	2.6%
4	Climate Change & LID Volume Control	10,685	4.8%	14,691	6.6%
5	Intensification on Existing Conditions	12,427	5.6%	14,671	6.6%

Following the development of the storm trunk sewer network model, and identification and assessment of the capacity of the existing stormwater management ponds, the Recommended Approach includes expansion of the existing sewer network model into areas to be identified for future study as part of the Implementation Plan. The model expansion will permit the City to evaluate and select the preferred remedial approaches to improve the level of service.

MONITORING PLAN

In order to ensure the goals and objectives of the ISWM-MP are accomplished over time, a refocused stormwater monitoring program has also been established as part of the Implementation Plan. The stormwater monitoring program includes previous monitoring obligations as part of construction permitting processes such as the required monitoring of Filsinger Creek per the DFO requirements.

The stormwater monitoring program has two (2) distinct phases:

Phase 1 - Continuation of a refined SWM Audit monitoring (2017-2018) – to establish baseline monitoring results (existing conditions) for previously established historical monitoring locations through-out the City using the City's existing three (3) autosamplers. Monitoring efforts are focused on previously identified core stations with the addition of Priority 1 and Priority 4 subwatershed.

Priority 1 subwatershed have been included in Phase 1 monitoring efforts as these area have been prioritized for immediate implementation of the ISWM-MP recommended approaches.

Priority 4 subwatershed have been included in Phase 1 monitoring efforts in the recognition that the monitoring and data collection within these watersheds, which currently have the highest health score, will be critical to maintaining the systems in their current state.

Phase 2 - Updated Water Quality and Flow Monitoring (2019 - ongoing) – refined monitoring locations and protocols to align with the implementation approach of prioritizing works based on the watersheds in the most need and where there are opportunities to improve conditions but also recognizes the need to protect existing watershed health. Phase 2 monitoring also focuses on the collection of data within subwatershed that were determined to have insufficient data during the subwatershed prioritization analysis and establishes long-term monitoring sites for the collection of water quality data within Priority 1 subwatersheds.

Subwatershed based monitoring will be undertaken at regular intervals to confirm and/or evaluate the effects of the recommended approaches and refine the Implementation Plan to ensure project and programs are delivering the greatest value-

for-dollar for the residents of Kitchener. Following the completion of the Phase 2 monitoring in 2022, it is recommended that watershed health be reassessed following the protocol outlined within the ISWM-MP and that monitoring priorities be re-prioritize based on implementation status of the recommended approaches and revised watershed health scores.

NEXT STEPS AND RECOMMENDATIONS

- 1) The following next steps and recommendations have been developed to guide future works, studies and mechanisms related to the implementation of the City of Kitchener Integrated Stormwater Management Master Plan (ISWM-MP). Prior to undertaking any identified project, the City shall review each site specific project for the potential to impact known or potential cultural heritage resources in compliance with the heritage policies of the Kitchener Official Plan as well as other policies and procedures using noted resources within **Section 5.0**. The City will complete the necessary heritage assessment and studies required to identify and mitigate potential impacts and share such studies with the appropriate officials as required.
- 2) The City of Kitchener's **Site Alteration bylaw** is used to control site alteration activities within the city, such as the placing or dumping of fill; the removal of topsoil; and the alteration of the grade of land. A **Site Alteration Permit** is required for all properties 0.405 hectares or greater. Site alteration permits are not required for:
 - The installation of a swimming pool provided a pool permit is obtained.
 - Minor grading or landscaping projects.
 - Normal farm practices.
 - Development that is undertaken with the appropriate planning approvals and building permits.

Through discussion with City of Kitchener Engineering and Planning staff, it is recommended **that the minimum property area for review should be reduced from 0.405 to 0.1 hectares**. This reduction will more accurately reflect the lot sizes in the City of Kitchener and allow for more comprehensive implementation of volume control policy.

- 3) In light of continuing redevelopment pressures in the City's downtown core, it is recommended that the City of Kitchener **review the existing Downtown Exemption Area** for opportunities to improve the uptake of source control features such as permeable pavement, rainwater harvesting and green roofs to the maximum extent possible (MEP) subject to the City of Kitchener Infiltration Policy and site constraints.
- 4) It is recommended that before final Engineering sign-off, the applicant meet a **certification clause verifying the property has been registered in the City's Stormwater Credit Program**.
- 5) Within the province several manuals and guides have been developed to assist in the design and implementation of LID features. It is recommended that the City of Kitchener direct proponents of development, redevelopment, reurbanization and residential intensification to the **LID reference documents** listed in **Stormwater Infiltration in the Context of Source Protection Planning** see Attachment A.
- 6) It is recommendation that the **City incorporate Low Impact Development design guidelines** per the Low Impact Development Stormwater Planning and Design Guide

(V1.0, 2010 or as amended from time to time) into the City standards and specifications in **2017**.

- 7) Per **Section 6.3** of the **ISWM-MP Report** a review of the existing erosion and sediment controls program as part of the development process should be undertaken to bring municipal policy in line with agency and provincial direction. This review is recommended such that new policies and standards capture the evolution in erosion and Sediment Controls (ESC), from a single approach for sediment management to ESC control methodologies and approaches that utilizes a hierarchical strategy of elimination or reduction of erosion then control of sediment releases. Amended E&SC approaches should be integrated into the City standards and specifications.
- 8) It is recommended that the City **update standard road cross section drawings** as well as relevant sections in the Development Manual to reflect the Recommended Approaches as identified within the ISWM-MP.
- 9) It is recommended that the **City of Kitchener develop a Pollution Prevention Plan checklist** or minimum requirements in consultation with the Region of Waterloo's Risk Management Plans per the Source Protection Plan and Policies.
- 10) That in the future when LID conveyance controls within the right-of-way constitute a significant portion of the City's stormwater infrastructure, it is recommended that the **City staff explore the development of a "Green Streets Fund"** which would allow for the application of a fee based system on all road cut permits where fees are equal to a nominal percentage of total capital (actual or estimated) construction budget. Collected fees would be primarily allocated to verification of appropriate rectification post construction as well as to future municipal ROW retrofit projects and operation and maintenance activities.
- 11) That City staff **explore collaborative funding partnerships with local municipalities, agencies and government** to reduce urban non-point source pollution as specified in the Grand River Watershed Water Management Plan. It is further recommended that City staff be directed to explore the development of a market for the collection and sale of urban non-point source pollution 'credits' as a future stormwater funding source.
- 12) It is recommended that the City of Kitchener **investigate through the completion of a comprehensive market analysis, consultation with MOECC and the development of an administrative framework under the Stormwater Utility, the establishment of a Stormwater Volume Retention Credit (SVRC) program**. Through this future program, development projects can implement "over control" (Over control" is a method of balancing the amount of water retained in multiple areas) to retain more than the required minimum runoff volume in one area and less in another. Projects which can

demonstrate ‘over control’ to the satisfaction of the City would qualify for the credits. Such credit may be tradable, saleable or exchangeable.

- 13) It is recommended that the **City of Kitchener investigate** through the completion of a comprehensive assessment and the development of an administrative framework under the Stormwater Utility, the establishment of a policy to permit **“Aggregated or Shared BMP”** amongst multiple properties of the same owner. The administrative framework should at a minimum require that:
 - the proponent be the owner of both subject properties,
 - both properties are enrolled within the Stormwater Credit Program and
 - the facilities are registered on title with appropriate operations and maintenance conditions to the satisfaction of the City of Kitchener.
- 14) The ISWM-MP did not analyze the impact of modified street-sweeping and leaf collection programs on catch basin operation. It is recommended that the City of Kitchener **investigate potential efficiencies of the existing street sweeping and leaf collecting programs and the potential to integrate catch-basin cleaning.**
- 15) It is recommended that an Environmental Technology Verification (ETV) certified catch basin (e.g. CB Shield™ or equivalent) be installed for use as a pilot project in uncontrolled drainage areas where other opportunities do not exist.
- 16) In order to achieve the goals of the ISWM-MP, it is recommended that the City’s permanent staff resources are expanded by **one Design & Construction Project Manager and one Engineering Technologist**. These two positions have previously been filled on a contract basis, but are required permanently based on the findings of the ISWM-MP. The work to be undertaken by the two new positions includes:
 - Development of municipal pollution prevention, operations & maintenance programs.
 - Create market based strategies and pilot programs to incentivize stormwater management practices on private properties.
 - Provide design support for the implementation of low impact development techniques within the municipal right-of-way projects in the AIRP and create new design standards and specifications.
 - Manage stormwater management pond rehabilitation projects.
 - Manage watercourse rehabilitation and erosion control projects.
 - Develop the urban flood management strategy and further refine the hydraulic modelling to identify constraints in stormwater infrastructure.



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List of Terms, Definitions and Acronyms

AEM	Adaptive Environmental Management
ANSI	Area of Natural and Scientific Interest
AMA	Adaptive Management Approach
BMP	Best Management Practice
CofA	Certificate of Authorization
Cms	Cubic Metres per Second
DFO	Department of Fisheries and Oceans
EA	Environmental Assessment
ECA	Environmental Compliance Approval
EMC	Event Mean Concentration
EOP	End-of-Pipe
ERA	Ecological Restoration Areas
ESPA	Environmentally Sensitive Policy Area
GI	Green 'Stormwater' Infrastructure
GIS	Geographical Information Systems
GRCA	Grand River Conservation Authority
GRWMP	Grand River Water Management Plan
GWCS	Ground Water Collection Systems
ICA	Issue Contributing Area
ISWM-MP	Integrated Stormwater Master Plan
LID	Low Impact Development
LOS	Level of Service
MEA	Municipal Class Environmental Assessment
NHS	Natural Heritage System
MNRF	Ministry of Natural Resources and Forestry
MOECC	Ministry of the Environment and Climate Change
NPS	Urban Non-point Source
OGS	Oil and Grit Separator
OWRA	<i>Ontario Water Resources Act</i>
OP	Official Plan
PICP	Permeable Interlock Concrete Paver
PPS	Provincial Policy Statement
PWQO	Provincial Water Quality Objectives
ROP	Regional Official Plan
RMOW	Regional Municipality of Waterloo
SARA	<i>Species at Risk Act</i>
SFU	Single Family Unit
SPP	Source Protection Plan
SWM	Stormwater Management
SWMPDM	Stormwater Planning and Design Manual (MOECC 2003)
SWS	Subwatershed Study
WEMP	Water Efficiency Master Plan
WHPA	Well Head Protection Area
WRS	Water Resource Sustainability
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

1.0 INTRODUCTION

The City of Kitchener Integrated Stormwater Management Master Plan (ISWM-MP) was completed in May 2016 and as laid out in report INS-16-047 was by endorsed by City Council on May 30, 2016. The ISWM-MP was completed in accordance with the requirements for Master Plans under **Section 4, Approach #2** of the Municipal Engineers Association Municipal Class Environmental Assessment Act (October 2000, as amended in 2007 & 2011), which is an approved process under the *Ontario Environmental Assessment Act*.

Following the completion of the ISWM-MP, an Implementation Plan was needed to prioritize all the works based on priority subwatershed as well as recommend funding allocation and policy development. Prioritization has been based on the watersheds in the most need and where there are opportunities to improve conditions through the elements of the recommended approach using existing projected stormwater budgets.

The following report details the Implementation Plan in support of the completed ISWM-MP.

The ISWM-MP Implementation Plan is intended to be read in conjunction with the ISWM-MP Report (May 2016) and the supporting technical document to the ISWM-MP included as **Appendix A-N** within the May 2016 report.

1.1 ISWM-MP Background

The City of Kitchener's Integrated Stormwater Management Master Plan (ISWM-MP) continued the 'state-of-the-art' approach to managing stormwater first established in 2001 as part of the City's previous Master Plan and continued in 2010 and 2012 with the formation of the City's Stormwater Utility and Credit Program. The ISWM-MP updated the 2001 Study and serves as a decision support tool, providing direction for the prioritization of projects. The ISWM-MP also served as a transparent citizen engagement process by which the City can establish stormwater management guidelines and policies for the next 15 years.

The six (6) elements of the ISWM-MP included:

- 1) Municipal Pollution Prevention, Operations & Maintenance Practices,
- 2) Market Based Strategies for Private Property (source controls),
- 3) Stormwater for the Capital Roads Program (conveyance controls),
- 4) Stormwater Management Facilities,
- 5) Watercourse and Erosion Restoration, and
- 6) Urban Flood Management & Stormwater Infrastructure.

The ISWM-MP was developed with an emphasis on integration. The identified projects are intended to be completed as part of existing and planned City initiatives to better serve the residents of Kitchener and reduce overall costs. In this way, the City goals to increase urban

tree canopy, construct new trails and cycle lanes, improve transit, rehabilitate parks and reconstruct City roads can also serve to improve stormwater management leveraging economies of scale. At its core the ISWM-MP is a strategy for the City to better allocate existing funding to projects and areas most in need and which stand to show the greatest improvement.

1.2 ISWM-MP Goals

The ISWM-MP integrated water resources in the context of stormwater, water and wastewater, with the natural environment and associated wildlife habitats, as part of existing and future policies, land planning, concepts of open space & trails, operation and maintenance, asset management, climate change and community engagement and marketing.

The study goals and objectives for the City of Kitchener ISWM-MP were informed by key documents including:

1. The Grand River Water Management Plan (2014)
2. Best Practices Guide for Reducing Urban Non-point Source (NPS) Pollution in the Grand River Watershed (2014)
3. City of Kitchener Strategic Plan for the Environment (2015-2018)
4. Previous watershed and subwatershed studies (various dates)

These documents have received support from City staff and Council and should be viewed as guiding documents, representing established commitments by the City of Kitchener for the management of surface and ground water resources in the Grand River Watershed to 2031.

The goals of the City of Kitchener ISWM-MP were developed in keeping with the goals and objectives of the key guiding documents listed above and in compliance with existing guidance, acts and regulations. The study goals included:

- Direct infill and redevelopment requirements in regard to stormwater management criteria tied to the recommended Master Plan approaches,
- Fill gaps in existing subwatershed studies and stormwater master plans,
- Holistically integrate erosion and stream restoration requirements with areas identified as Ecological Restoration Areas (ERAs) in the City's OP,
- Maintain existing funding and forecast future funding requirements to implement the preferred stormwater approaches,
- Enhance existing incentive programs, increase the uptake rate of credit applications, and examine the monetary value of rebates and the method by which the credits are given,
- Improve community stormwater management education resources and programs,
- Develop an integrated city-wide approach for water quality, water quantity, erosion control, preservation of hydrologic process through water budgets and the preservation and enhancement of the natural environment,
- Aid in the development of a 'level-of-service' (LOS) for stormwater management with the City,

- Inventory and address stormwater infrastructure issues as part of the City’s overall asset management program,
- Direct future acquisition of lands, easements, “rights-to-enter”, and maintenance agreements for stream corridors and other functional elements of the drainage system,
- Direct future SWM monitoring in compliance with the plan’s goals, targets and objectives which acknowledges the adaptive environmental management (AEM) process,
- Evaluate the current Cash-in-lieu Program,
- Develop a new SWM policy for the City, and
- Develop an implementation plan to direct the safe and effective management of stormwater runoff from the City’s urban areas while improving the ecosystem health and ecological sustainability of the receiving watersheds.

1.3 ISWM-MP Objectives

The City of Kitchener ISWM-MP considered flood and erosion control, groundwater and surface water quality management, natural heritage and environment management as well as infrastructure, all in an integrated manner as part of an overall water sustainability plan. In addition, the ISWM-MP integrated existing policies, regulations, acts and guidelines and where appropriate laid out the framework for the development of new policy. The objectives of the City of Kitchener ISWM-MP included the following:

Water Quality

- Maintain or improve surface water and groundwater quality.
- Minimize sediment loading to surface water and groundwater.
- Maintain or enhance the quality of drinking water sources
- Maintain existing thermal watercourse regimes and enhance cool/coldwater regimes where possible.

Water Quantity

- Preserve and re-establish the natural hydrologic process to protect, restore and replenish surface water and groundwater resources.
- Minimize the threat to life and property from flooding.
- Maintain or enhance groundwater supplies through infiltration while minimizing the risks from future land uses and activities.

Erosion Control

- Maintain existing erosion rates or reduce the impacts of excessive erosion on aquatic and terrestrial habitat and property.
- Integrate stream erosion within a master planning process.

Natural Environment

- Protect, enhance and restore natural features and functions such as wetlands, riparian and ecological corridors as well as identified linkages.

- Maintain or improve warmwater, coolwater and coldwater fisheries if appropriate.
- Control or reduce invasive species.

Water Resource Sustainability

- Holistically integrate goals, objectives and targets for water resources (water, sanitary and storm).
- Improve stormwater infrastructure resiliency and adaptation in the context of climate change.

Infrastructure

- Provide a level of service for stormwater management which is consistent with municipal and agency standards.
- Continue to ensure effective functioning of stormwater infrastructure.
- Encourage the implementation of innovative solutions including Low Impact Development (LID) and Green 'Stormwater' Infrastructure (GI) to mitigate stormwater runoff as part of the development of sustainable infrastructure solutions.

Policy and Implementation

- Reflect the acts, policies and regulation developed or amended after 2001.
- Integration of Asset Management Plans for Stormwater which includes long-range forecast and planning direction for many of the specific policy items and recommendations (i.e. ponds, OGS and stream rehabilitation).
- Fundamentally integrate the Level of Service (LOS) model as detailed within the existing Asset Management Report.

2.0 STORMWATER POLICIES

The following section describes existing and new policy developed to support the implementation of the recommended approach of the ISWM-MP.

In general, The ISWM-MP (May 2016), the supporting technical documents to the ISWM-MP included as **Appendix A-N** within the May 2016 report and this Implementation Plan shall provide the overarching policy direction for stormwater management with the City of Kitchener. Individual policy development is detailed below.

2.1 Existing Policies

The ISWM-MP (May, 2016), the supporting technical document to the ISWM-MP included as **Appendix A-N** within the May 2016 report and this Implementation Plan shall replace the following existing Council Policies:

- **I-1135 (December 10, 2001)**
- **I-1140 (March 29, 1999 as amended July 5, 1999)**
- **I-1445 (September 30, 1996)**

2.2 New Policy

One (1) new policy, Stormwater Management, containing three (3) specific components has been prepared as part of the ISWM-MP process and the Implementation Plan in collaboration with city staff, the Region of Waterloo, the GRCA and the Ministry of Environment and Climate Change (MOECC). The three (3) supporting components in the policy are:

- A. **Stormwater Infiltration in the Context of Source Protection Planning (October 2016)**
- B. **Stormwater Volume Criteria and Targets (October 2016)**
- C. **Stormwater Management Fee**

2.2.1 Stormwater Infiltration in the Context of Source Protection Planning

This policy component defines where and how infiltration based stormwater management controls, commonly referred to as Low Impact Development (LID) controls, can safely be planned and constructed in the context of the approved source protection planning policy.

A detailed report which outlines this policy component including all mapping is included as **Attachment A**.

2.2.1.1 Component Summary

Developed in consultation with the Region of Waterloo staff and the MOECC, this policy component acknowledges that the use of infiltration practices to reduce runoff and restore natural hydrologic processes is crucial to maintaining and improving the City of Kitchener's natural water systems, maintaining the viability of local stormwater infrastructure, and contributing to climate change adaptation & mitigation strategies. As the implementation of infiltration practices becomes more prevalent, the City of Kitchener has a duty to protect local groundwater resources by implementing a land use-based stormwater infiltration policy which has been developed based on a sound understanding of identified and future risks.

This policy component identifies high risk site activities which have the potential for high levels of contamination. Sites with high risk activities are generally discouraged from incorporating LID techniques that utilize infiltration as its primary function for risky drainage areas within a site and requires the proponent to prepare a Pollution Prevention Plan and/or Risk Management Plans as part of SWM Reporting requirements. Spill prevention and management are a central focus of such plans.

Also identified within this component are the infiltration opportunities and constraints as well as the acceptable practices within various land-uses ranging from Residential, Mixed Use, Commercial, Industrial Employment, Institutional and Open Space and Natural Heritage Conservation as well as local, minor and major roadways within the City of Kitchener.

2.2.2 Stormwater Targets and Volume Criteria

This policy component outlines the newly established minimum stormwater volume criteria as well as outlines the application of general stormwater management targets as part of:

- New development,
- Redevelopment, reurbanization and residential intensification, and
- Linear projects (roadways, trails and transit infrastructure etc.)

A detailed report which outlines this policy component including all mapping is included as **Attachment B**.

2.2.2.1 Component Summary

As part of this policy component, all sites within the City of Kitchener are required to:

- Continue to control off-site runoff for **flood control and erosion** per the approved watershed, subwatershed, master drainage plans, Environmental Impact Statement (EIS), Provincial Policy and Guidelines or other area specific studies. Special Policy Areas which address known or flood prone areas would remain in effect.
- Continue to achieve **infiltration targets** to maintain the existing water balance per current approved and future subwatershed plans. Current subwatershed plans include: Blair Creek, Doon South, Idelwood Creek, Strasburg and Upper Strasburg Creeks.
- Control for **water quality** (pollutant loadings) in accordance with current MOECC guidelines to 'Enhanced-Level 1' protection as defined in the 2003 Stormwater Management Planning & Design Manual. This requirement standardizes water quality control across the City.
- **Retain** a minimum of 12.5mm of runoff from the all surfaces on the entire site and to enroll in the City of Kitchener Stormwater Utility Credit program. Retention can be a combination of infiltration, evapotranspiration or rain water re-use (also known as rainwater harvesting). All volume retained on-site will be counted towards achieving the flood and erosion control, water quality control as well as towards existing infiltration targets.

In all cases, the targets as specified in this policy component shall be superseded by more stringent targets as developed by the MOECC or through existing/future Watershed Studies, Subwatershed Studies, Master Drainage Plans, Environmental Impact Statement (EIS) and/or other area specific studies and or policies such as GRCA Wetland Policy.

2.2.2.2 Minimum Volume Retention Target - Rationale

A minimum volume retention target is the central modification to how stormwater is managed within the City of Kitchener.

This policy component was developed to align with the pending MOECC LID Stormwater Management Guidance Manual which is anticipated of release in 2017. The pending MOECC document will contain minimum volume targets which will exceed the City's minimum target of 12.5mm and is expected to mandate the use of LID approaches for new development, infill and redevelopment as well as linear projects.

The MOECC is following over 20 American and 9 Canadian Jurisdictions who have implemented minimum volume targets. Compliance with the upcoming MOECC Low Impact Development Stormwater Management Guidance Manual was an important consideration for the City of Kitchener in the development of the ISWM-MP and supporting policies, in order to ensure the master plan remains consistent with future provincial requirements to avoid prematurely outdated implementation strategies and policies. By developing a plan that is consistent with the direction of the MOECC's future requirements, it ensures that costly study updates can be avoided and that the City as well as the development industry stays ahead of future development approval requirements.

This policy component was also developed to address issues identified through the ISWM-MP Class EA process such as:

- Decreases in performance of end-of-pipe stormwater ponds due to changes to the amount of drainage they receive (i.e. catchment area and or contributing impervious surfaces) resulting from such causes as property redevelopment, infill and intensifications projects, building additions including new structures as well as outdoor landscaping.
- Impacts from Climate Change per the Localized Climate Projections for Waterloo Region (September 2015). Through the analysis of the Climate Change impacts to the City's existing storm trunk sewer network, an additional 6,000m of surcharged trunk sewer pipe was identified. By applying a 12.5mm volume retention target, the existing level of service can be maintained and more than \$5.6 million in sewer repairs were shown to have the potential to be deferred.

2.2.2.3 Minimum Volume Retention Target – Application

This policy component recognizes sites may have restrictions (constraints) which may prevent them from achieving the minimum volume targets such as sites with shallow bedrock, high groundwater, contaminated soils, as well as high risk sites and other limitations per the Stormwater Infiltration in the Context of Source Protection Planning (October 2016). In such cases, as confirmed by City Development Engineering staff, the sites shall be required to achieve the Maximum Extent Possible or MEP. In this way, the City is asking only what can be technically and reasonably achieved given the identified constraints.

On sites where the proponent cannot implement the required volume control to the Maximum Extent Possible or MEP as confirmed by the City of Kitchener Development Engineering, the site will be required to contribute to the Stormwater Management Fee (formerly Cash-in-lieu) at the current per hectare rate as defined by the City of Kitchener as amended from time to time.

2.2.3 SWM Management Fee

A Stormwater Management Fee (formerly Cash-in-lieu) has been established such that a development proponent shall provide a designated financial contribution at the current per hectare rate as defined by the City of Kitchener, as amended from time to time, towards the off-site stormwater management, in conformance with the recommended approaches of the Integrated Stormwater Management Master Plan (ISWM-MP), elsewhere in the City in lieu of providing on-site stormwater management should the requirements of the **Stormwater Infiltration in the Context of Source Protection Planning and the Stormwater Targets and Volume Criteria** not be fully achieved.

The Stormwater Management Fee will not be collected within the existing City of Kitchener downtown core exemption area, pending further review.

Funds will be collected by the City of Kitchener SWM Utility until such time as a suitable project or program is identified for partial or full funding.

In addition to the three (3) Stormwater Management policy components, three (3) additional components have been developed to permit the implementation of the ISWM-MP. These requirements relate to Watercourse Works on Private Property, the acquisition of Environmental Compliance Approvals (ECA) from the MOECC, and Stormwater Monitoring and Compliance Monitoring.

2.2.4 Watercourse Works on Private Property

The City of Kitchener will not undertake watercourse works; defined as construction, rehabilitation, repair and other such activities; with the exception of emergency works, on private property unless:

- a) The land owner willingly and without reservations grants a free, uninterrupted, non-exclusive and unobstructed permanent easement including any and all permanent access requirements in gross to the City of Kitchener, its employees, contractors, agents and workmen and all their necessary equipment, machinery, vehicles and materials, with respect to the subject lands for the purpose of permitting them to enter upon, under, along and across the Permanent Easement Lands with 48 hours' notice to the Transferor from time to time and at any time thereafter deemed requisite for the purpose of carrying out maintenance activities and work to maintain and to construct, rehabilitate and/or repair embankments, gabions, retaining walls and other such works as the City of Kitchener shall determine to be necessary or desirable to. The Permanent Easement shall only terminate at such time at the City of Kitchener no longer requires

the Permanent Easement Lands for the purposes of the Permanent Easement and provides notice to the owner of the Permanent Easement Lands that the said lands are no longer required for this purpose, and/or

- b) The land owner willingly and without reservations agrees to the purchase of the necessary lands by the City of Kitchener including any and all lands required to allow permanent access for a nominal sum.

Should the above conditions be satisfied, the City of Kitchener shall assume all responsibility to the continual management, capital costs and maintenance of the works and lands subject to the relevant agency policies and guidelines in perpetuity.

Emergency works shall be considered any works required to maintain existing infrastructure that is at immediate risk of failure or other public safety concerns. Emergency works are defined as situations where there is deemed an imminent threat of injury to persons, loss of life or loss of property and are unexpected occurrences.

2.2.5 Environmental Compliance Approvals

The City of Kitchener will require proponents to acquire an Environmental Compliance Approval (ECA) from the Ontario Ministry of the Environment and Climate Change (MOECC) for all sites constructing on-site stormwater controls pursuant to the *Ontario Water Resources Act* (OWRA) O.Reg 525/98 with the following exemptions:

Approval Exemption, last amendment O.Reg. 396/0, Section 3, Subsection 53(1) and (3) of the Act do not apply to the establishment, alteration, extension or replacement of or a change in a stormwater management facility that,

- a) Is designed to service one lot or parcel of land;
- b) Discharges into a storm sewer that is not a combined sewer;
- c) Does not service industrial land or a structure located on industrial land; and
- d) Is not located on industrial land O. Reg 525/98, s. 3.

As such, an ECA will be required by the City of Kitchener for the establishment, alteration, extension or replacement of or a change in a stormwater management facility for:

- Industrial lands or facilities servicing industrial lands as designated within the City of Kitchener Official Plan, as amended from time to time,
- Facilities servicing more than one lot or parcel of land, including facilities that service the municipal right-of-way, and
- Sites that discharge directly to a watercourse or wetland feature, notwithstanding any required approvals from other agency(ies).

2.2.6 Stormwater Monitoring & Compliance Monitoring

To optimize City monitoring efforts, reduce overall costs of compliance monitoring and ensure all data is compatible and integrated into the annual Stormwater Monitoring Program, the City

of Kitchener will, where feasible, integrate all stormwater or watercourse compliance monitoring resulting from permitting or agency approvals as they strictly relate to municipal projects, regardless of municipal department. Non-municipal projects shall be the responsibility of the individual proponent. It shall be the responsibility of the respective municipal department which is charged with the compliance monitoring to fund the required monitoring. The program shall be administered by the Stormwater Utility through the Annual Stormwater Monitoring Program.

Where possible non-municipal projects should be encouraged to monitor using the City standard monitoring program procedures and protocols as amended from time to time and share the monitoring results with the City of Kitchener.

3.0 IMPLEMENTATION SYNERGIES WITH CITY PLANS AND POLICIES

The recommended approach for City-wide stormwater management and implementation on a priority subwatershed basis (discussed in **Section 4.0**) is not intended to be addressed in isolation as part of the ISWM-MP. The ISWM-MP was developed with full consideration for other Strategic Plans, Subwatershed Studies, Master Plans, Secondary Plans, Environmental Assessments and Policies. More specifically, the elements of the recommended approach represent potential synergies with other studies and plans and should be considered as such.

The ISWM-MP explicitly recommended that staff, as part of other city initiatives, plans, studies and programs, leverage potential synergies as the opportunities are identified in order to more efficiently achieve overall City goals to increase urban tree canopy, construct new trails and cycle lanes, improve transit and build transit capacity, rehabilitate parks, reconstruct roads as well as improve stormwater management.

Integration across city departments is the corner stone of a modern approach to stormwater management and will be essential for the City of Kitchener in the implementation of the ISWM-MP in order to maintain and improve the condition and health of the City's subwatersheds. This Implementation Plan has been developed as such.

Implementation of the recommended approaches as detailed in this Implementation Plan for ISWM-MP has regard for the following:

- **Parks Strategic Plan (September 2010)** which directs the City's investment and initiatives in the future planning, design, acquisition, improvement, management, programming and use of City parks. Of particular relevant to the ISWM-MP are the identified neighbourhood Parkland Gaps and New/ Planned Neighbourhood Park Development areas as well as the associated rehabilitation plans.
- **Multi-Use Pathways and Trails Master Plan (May 2012)** – which builds upon past and current trail development efforts, and is intended as a blueprint to guide the development and operation of multi-use pathways throughout Kitchener in the short, medium and long term. The plan identifies a strategy for development of a primarily off-road, city-wide multi-use pathways network linking neighborhoods, parks and natural areas, public open spaces, schools, shopping areas and other important destinations. Of particular relevant to the ISWM-MP is the integration of existing or future trail networks with identified SWM opportunity locations.
- **Cycling Master Plan (2010)** - aims to install over 100 kilometers of bikeways in the city to encourage cycling among Kitchener residents of all ages, backgrounds, and abilities. The Cycling Master Plan presents both a network of bikeways to be implemented over time, policies to support making Kitchener a bicycle-friendly City, and related practices and programs to further those policies into action. Stormwater infrastructure is

commonly integrated with proposed cycling infrastructure throughout North America and as such it is recommended that future bikeway projects consider the objectives and approaches as outlined within the ISWM-MP.

- **Planning Around Rapid Transit (PARTS)** – this represents the comprehensive planning of the area around rapid transit station stops as part of the Grand River Transit (GRT) system. Having completed the identification of recommended station study areas and the compilation of background information; the City of Kitchener is currently developing Station Study Areas Plans for five station study areas: Central Station Study Area; Midtown Station Study Area; Rockway Stations Study Area; Fairway Station Study Area and Block Line Station Study Area. The ISWM-MP and the recommended approaches should have regard for PARTS and recognize the future use and proximity of proposed SWM opportunities to future stations. It is recommended that the opportunity for source and conveyance control SWM practices be integrated into Station Area Plans where feasible in order to mitigate the hydrologic and water quality impact of urbanization. In addition, the Station Area Plans should be viewed as an opportunity to provide SWM control within areas of the City which currently lack SWM control.
- **Ecological Restoration Areas and Policies** – lands and waters that have the potential to be enhanced, improved or restored to a more natural state, contributing to the overall diversity and connectivity of the Natural Heritage System per Section 7, Part C and Map 6 of the City of Kitchener Official Plan (7.C.2.34 to 7.C.2.43). The approaches of the ISWM-MP represent an opportunity in regards to areas designated for restoration.
- **New Secondary Plan Areas** - the City has received approval of the Rosenberg Secondary Plan, which implements the Community Master Plan for the South West Urban Area. The Rosenberg Community is comprised of 430 hectares located in the southwest portion of the city along Fischer Hallman Road between Bleams Road to the north and Huron Road to the south. The area has been comprehensively planned for approximately 20,000 persons and will be a complete community that is transit supportable, walkable and respects the natural environment with a third of the lands protected from development.ⁱ
- **Grand River Water Management Plan (2014)** - addresses the issues faced by the Grand River watershed. The goals of the plan are to: improve water quality to maintain river health and reduce the impact of the Grand River on Lake Erie; ensure water supplies for communities and ecosystems, reduce flood damage potential, and increase resiliency to deal with climate change. Many agencies share the responsibility for managing water resources. In 2009, they agreed to develop a new plan to address today's most important issues: population growth, climate change and the impacts of extensive agriculture. The plan was developed through a collaborative process. It is

based on "best value solutions" - the most effective and efficient ways to meet the goals.ⁱⁱ

- **Grand River Source Protection Plan (LERSPC 2012, Approved 2015, effective July 1, 2016)** – Drinking water source protection plans identify the risks to municipal water quality and water supplies, and the policies and programs that will reduce the risks. Volume II of the Grand River Source Protection Plan covers the Region of Waterloo including the City of Kitchener. Specific policies relating to Stormwater Management within Wellhead Protection Areas (WHPA) and Intake Protection Zones (IPZs) can be found from policy **RW-MC-15** through **RW-CW-20.1**. In 2000, the WHPAs were incorporated in the Regional Official Policies Plan (ROPP).
- **Wastewater** – As part of the Assessment of Future Water Quality Conditions in the Grand and Speed Rivers (2012), a number of water management scenarios were developed which incorporated wastewater treatment plant upgrades in current municipal wastewater master plans, wastewater treatment plant optimized performance targets and, most relevant to the City of Kitchener ISWM-MP, rural / agricultural and urban non-point source load reductions ranging from 20% to 40%. The report notes the need for integration of watershed resources as it relates to wastewater and stormwater. The ISWM-MP provides insight, options and management approaches to address the above noted needs and deficiencies.
- **Urban Forestry** - The City of Kitchener's Strategic Plan identified managing and enhancing urban forest as one of the top priorities through 2018. The objectives of the Strategic Plan related to urban forestry and the objective of this ISWM-MP can be considered 'twin objectives'. Trees provide many benefits to communities, such as lowering summer temperatures, reducing energy use in buildings, reducing air pollution, enhancing property values, improving human health, and providing wildlife habitat as well as aesthetic benefits while also improving water quality and reducing stormwater runoff.

Throughout the ISWM-MP (May 2016) supporting technical document to the ISWM-MP included as **Appendix A-N** within the May 2016 report, the potential synergies with the above noted plans and policies are noted and the methods and approaches for integration with the objectives of this master plan are discussed. **Section 6.0** of this document provides further direction for each element of the recommended approach as relevant.

4.0 PRIORITY SUBWATERSHEDS

This Implementation Plan prioritizes the works recommended by the ISWM-MP based on priority subwatershed as well as recommend funding allocation and policy development. Prioritization is based on the watersheds in the most need and where there are opportunities to improve conditions through the elements of the recommended approach.

Prioritization is based on a hierarchical approach, beginning with the watersheds that have been designated Priority 1 and applying the identified opportunities (i.e. watercourse restoration and erosion repairs, source control pilot programs, conveyance controls, O&M, SWM facilities, flooding, etc.) as detailed within the Recommended Approach in order to improve overall subwatershed conditions. Subwatersheds are prioritized based on the areas of greatest need and opportunity to maximize the ‘net-benefit’ to the City, the environment and the community.

Per the ISWM-MP, five (5) separate evaluation categories are used to prioritize the twenty-nine (29) subwatersheds within the City of Kitchener. These categories are:

1. **Stormwater Management:** This evaluation category reflects the age of stormwater infrastructure within the City. The percentage of each subwatershed with stormwater quality and stormwater quantity control are metrics used in this category as are subwatershed impervious percentage, incidents of urban flooding and stormwater credit uptake rate.
2. **Water Quality:** Long-term water quality data were used as an evaluation category because degraded water quality can result in a loss of biodiversity and impact the way Kitchener residents interact with local streams and rivers. Parameters given equal weighting in the water quality analysis are chloride, E. coli, nitrate, copper, lead, zinc, total phosphorus, dissolved phosphorus, and total suspended solids.
3. **Stream Health:** 2016 in-field channel assessments form the basis for this evaluation category. The tree metrics given equal weighting in this category are erosion stream health, aquatic stream health, and riparian stream health.
4. **Aquatics:** Historical aquatic ecology studies form the basis of this evaluation category. Species richness, the presence of species intolerant of disturbance and habitat sensitivity are metrics used in this evaluation category.
5. **Terrestrial Ecology:** In order to properly assess existing natural heritage features, a desktop analysis using existing natural heritage studies and GIS data was undertaken. This metrics used in this evaluation category are wetland habitat, riparian habitat, forest habitat, natural cover, and connectivity.

Using the five (5) evaluation categories described above, existing conditions subwatershed scores were established. These scores were used to prioritize the twenty-nine (29) subwatersheds within the City of Kitchener.

Priority Subwatersheds 1 to 4 with associated scoring are graphically presented in **Figure 4.0**.

Figure 4.1 geographically presents the prioritization of subwatersheds in the City of Kitchener. As expected, the highest priority watersheds are located in the urban core as a result of higher density development built before the advent of centralized stormwater management facilities.

Table 4.0 summarizes the priority subwatersheds in the context of identified projects per the ISWM-MP recommended approaches relating to erosion sites, pond retrofits, wet pond sediment removal, dry pond sediment removal, new facility opportunities and OGS sediment removals.

4.1 Priority 1 Subwatersheds

Those subwatersheds with scores of 20 or greater are classified as **Priority 1 Subwatersheds**. In order to improve the environmental conditions in these subwatersheds, municipal stormwater projects including source control initiatives, conveyance control works, end-of-pipe retrofits and in stream/riparian rehabilitation should receive high priority. Five (5) subwatersheds were identified as Priority 1, these are:

- Upper Schneider Creek (Score = 21.5)
- Montgomery Creek (Score = 20.7)
- Shoemaker Creek (Score = 20.3)
- Sandrock Creek (Score = 20.2)
- Voisin Creek (Score = 20.1)

4.2 Priority 2 Subwatersheds

Those subwatersheds with scores between 15 and 20 are classified as **Priority 2 Subwatersheds**. In order to improve the environmental conditions in these subwatersheds, municipal stormwater projects including source control initiatives, conveyance control works, end-of-pipe retrofits and in stream/riparian rehabilitation should receive moderate priority. Fourteen (14) subwatersheds were identified as Priority 2, these are:

- Henry Sturm Creek (Score = 19.0)
- Westmount Creek (Score = 18.6)
- Middle Schneider Creek (Score = 18.6)
- Balzer Creek (Score = 18.4)
- Alder Creek (Score = 17.7)
- Borden Creek (Score = 17.5)
- North Strasburg Creek (Score = 17.2)
- Laurel Creek (Score = 16.7)
- Kolb Creek (Score = 16.6)
- Lower Schneider Creek (Score = 16.6)

- Detweiler Creek (Score = 16.4)
- East Side (Score = 15.7)
- Unnamed Catchment 1 (Score = 15.6)
- Idlewood Creek (Score = 15.0)

4.3 Priority 3 Subwatersheds

Those subwatersheds with scores between 10 and 15 are classified as **Priority 3 Subwatersheds**. In order to improve the environmental conditions in these subwatersheds, municipal stormwater projects including source control initiatives, conveyance control works, end-of-pipe retrofits and in stream/riparian rehabilitation should receive low priority. Five (5) subwatersheds were identified as Priority 3, these are:

- Unnamed Catchment 3 (Score = 14.6)
- School Creek (Score = 14.2)
- Doon South Creek (Score = 13.9)
- Melitzer Creek (Score = 13.4)

4.4 Priority 4 Subwatersheds

Those subwatersheds with scores between 5 and 10 are classified as **Priority 4 Subwatersheds**. These subwatersheds are the closest to natural environmental conditions of the subwatersheds in the City of Kitchener. In order to sustain the environmental conditions in these subwatersheds, development and intensification should focus on providing sufficient buffers and maintaining the natural hydrologic cycle through source control initiatives, conveyance control works, and end-of-pipe facilities. Three (3) subwatersheds were identified as Priority 4, these are:

- Middle Strasburg Creek (Score = 9.7)
- Strasburg Creek (Score = 9.1)
- Blair Creek (Score = 8.0)

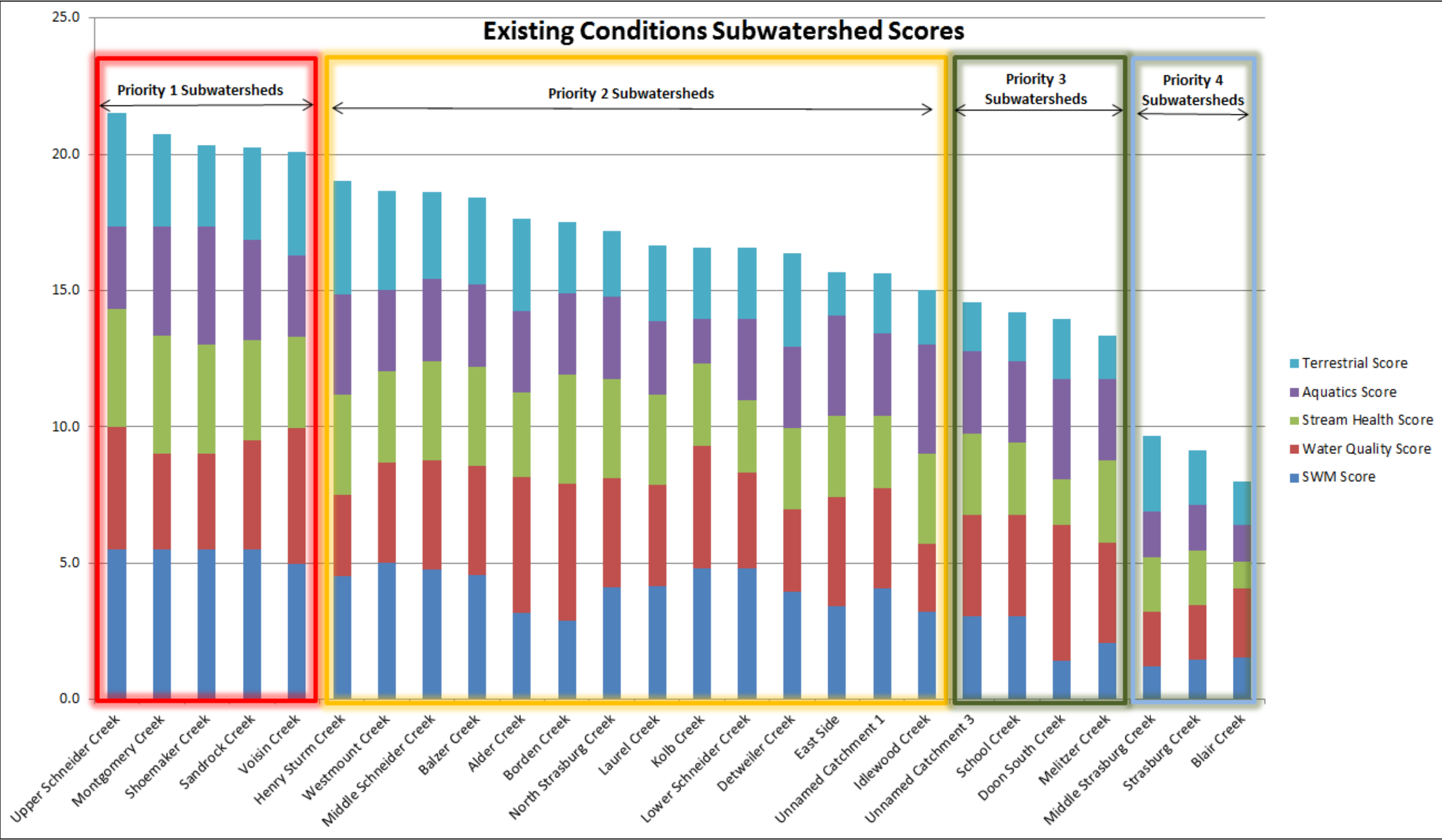


Figure 4.0: Evaluation of Existing Conditions Priority Rating



City of Kitchener Stormwater Management Master Plan

Legend

- Study Area
- Municipal Boundary
- Watercourses
- Subwatershed Boundary
- Overall Subwatershed Rank
 - Priority 1
 - Priority 2
 - Priority 3
 - Priority 4
 - Insufficient Data

Source: City of Kitchener

Figure 4.1

Subwatershed Ranking
Overall Priority

0 0.5 1 2 3 Km



Date: May 2016

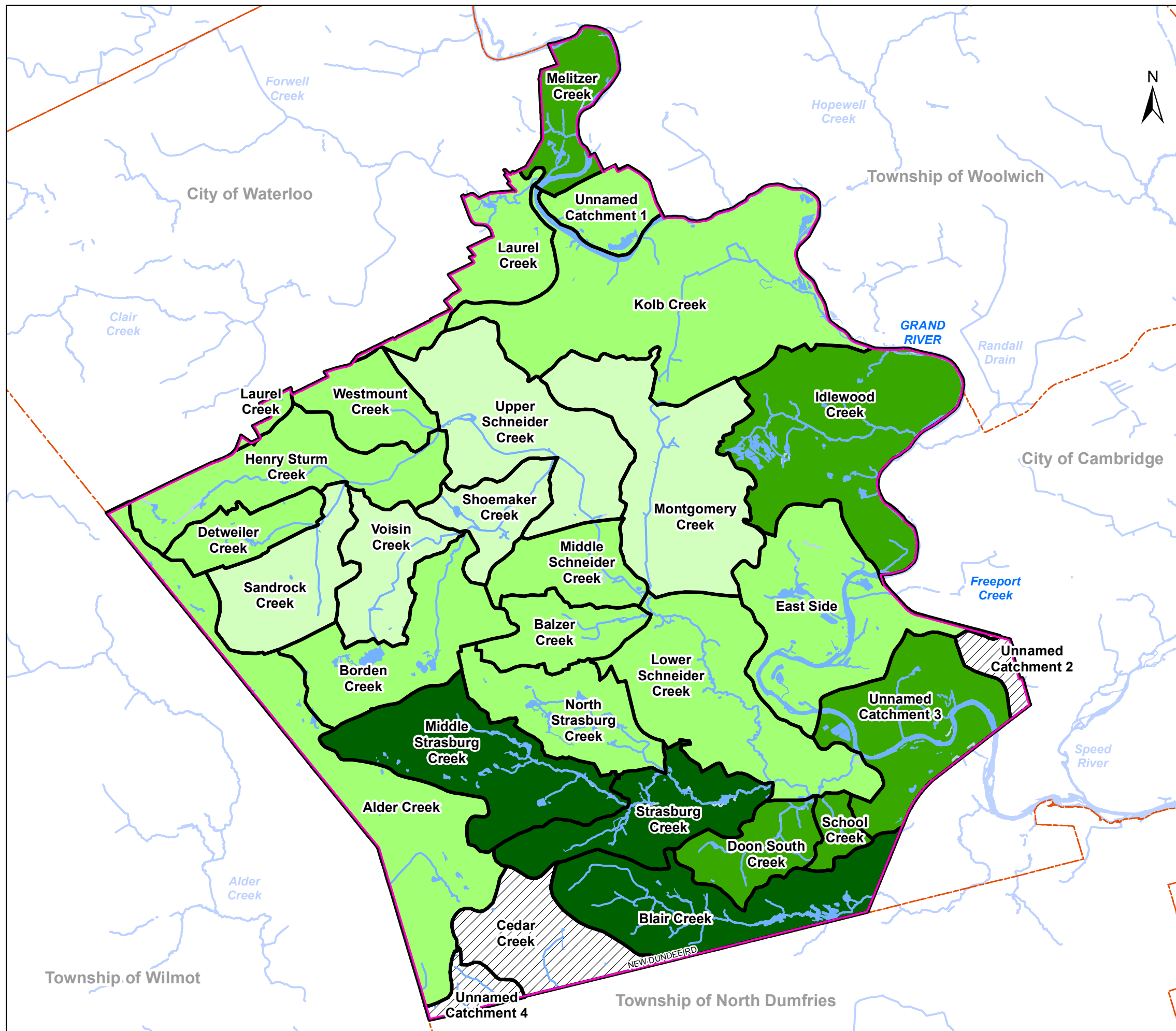


Table 4.0: Watershed Prioritization and Number of Identified Projects

Subwatershed	Priority						
		Erosion Site ¹	Pond Retrofit	Wet Pond Sediment Removal	Dry Pond Sediment Removal	New Facility Opportunity	OGS Sediment Removal
Upper Schneider Creek	Priority 1					3	5
Montgomery Creek		3				1	1
Shoemaker Creek		1					
Sandrock Creek		2				1	
Voisin Creek		1		1	1		
Henry Sturm Creek	Priority 2	2					
Westmount Creek						1	1
Middle Schneider Creek		2					
Balzer Creek		2				3	
Alder Creek			1				
Borden Creek		3		4	1		2
North Strasburg Creek		1	5	1	4		
Laurel Creek		1					
Kolb Creek		1	1	1	1	1	2
Lower Schneider Creek		7				3	1
Detweiler Creek				4	2		1
East Side		4		1			
Unnamed Catchment 1							
Idlewood Creek		2	2	4	4	1	1
Unnamed Catchment 3	Priority 3	1		1			1
School Creek		1		1	1		
Doon South Creek				9			
Melitzer Creek		1					
Middle Strasburg Creek	Priority 4			1			
Strasburg Creek		1	1		3		1
Blair Creek				1			
Cedar Creek	Insufficient Data						
Unnamed Catchment 2							
Unnamed Catchment 4							

¹ includes Erosion Site Opportunities, Erosion Site Monitoring, Restoration Reaches, Projects within Existing Studies, and Private Property Opportunities

5.0 CULTURAL HERITAGE SCREENING

The City has recently completed a comprehensive review and inventory of cultural heritage resources. This includes completing a review of previously inventoried heritage properties, resulting in the recent addition of 220 properties to the Municipal Heritage Register as non-designated property of cultural heritage value or interest. In April 2015, Kitchener City Council approved the Kitchener Cultural Heritage Landscape Study, which identified and inventoried 55 significant cultural heritage landscapes in the City. Through these efforts, and with consideration given to the Region of Waterloo's Archaeological Potential Model, the City has access to an extensive, up to date and comprehensive inventory of built heritage resources, cultural heritage landscapes and archaeological resources.

The study area for the stormwater management master plan was the entirety of City of Kitchener. As a City-wide master plan, it was not feasible to complete the site specific MTCS screening checklist for built heritage resources and cultural heritage landscapes as part of the ISWM-MP.

5.1 Cultural Heritage Screening Implementation

The ISWM-MP identifies a number of site specific projects per the recommended approaches. Prior to undertaking any identified project, the City shall review each site for the potential to impact known or potential cultural heritage resources in compliance with the heritage policies of the Kitchener Official Plan as well as other policies and procedures using the above noted resources. The City will complete the necessary heritage assessment and studies required to identify and mitigate potential impacts and share such studies with the appropriate officials as required. The MTCS screening checklist has been included as **Attachment C**.

6.0 RECOMMENDED APPROACH

6.1 Pollution Prevention/ Municipal Management/Operational Practices

Pollution Prevention, Municipal Management and Operational Practices are important to ensure pollutants are prevented from impacting the environment and to ensure stormwater infrastructure maintain their effectiveness.

The City of Kitchener's ISWM-MP focuses on three (3) measures that fall under this category, these are:

- 1. Catch Basin Programs** – The removal and off-site disposal of sediment from end-of-pipe (EOP) facilities are the most substantial costs associated with maintaining such facilities. As such, the development of a catch basin clean-out program within the City of Kitchener was believed to represent a significant reduction in sediment within EOP facilities, reduce total maintenance costs and extend their required performance for a longer period. In order to understand the effect of a catch basin clean-out program on final sediment removal and disposal cost, when compared to EOP facilities clean-outs for the City of Kitchener a report entitled “**ISWM-MP Municipal Class EA - Catch Basins Clean-out Analysis Memo (May, 2016)**” was prepared and included as **Appendix D of the ISWM-MP Report**.
- 2. Sediment Removal from Oil and Grit Separators** – OGS units use hydrodynamic separation to remove sediment and hydrocarbons from urban runoff. These units require regular inspection and maintenance in order to function as designed. According to the City of Kitchener's GIS database, a hundred and fifty eight (158) OGS units have been installed within the City of Kitchener. The City is responsible for the operation and maintenance of sixty-five (65) of these units per the conditions of the respective MOECC Environmental Compliance Approval (ECA). The ISWM-MP explored approaches to manage pollutants and sediment within the City's OGS units in the most cost effective manner. The recommended works follow Schedule A/A+ of the Municipal Class EA process, and therefore, are pre-approved. In order to understand the impact of sediment accumulation within City of Kitchener OGS units, a report titled “**ISWM-MP Municipal Class EA- Sediment Analysis Memo: SWM Facilities and OGS Units (May, 2016)**” was prepared and included as **Appendix E of the ISWM-MP Report**. Locations are depicted in **Figure 6.1**.
- 3. Erosion and Sediment Control** - The City of Kitchener currently has an erosion and sediment controls program as part of the normal development process. However, to promote better housekeeping, enhanced protection of the environment and recognizing the agency and provincial direction to move towards a the use of a Treatment Train Approach to stormwater management which utilizes LID approaches, it is recommended within **Section 6.3 of the ISWM-MP Report** that the City of Kitchener review the existing erosion and sediment controls program as part of the normal development process.



City of Kitchener Stormwater Management Master Plan

Legend

- Study Area
- Municipal Boundary
- Watercourses

OGS Structures with Maintenance Priority

- High Priority
- Moderate Priority
- Low Priority

Source: City of Kitchener

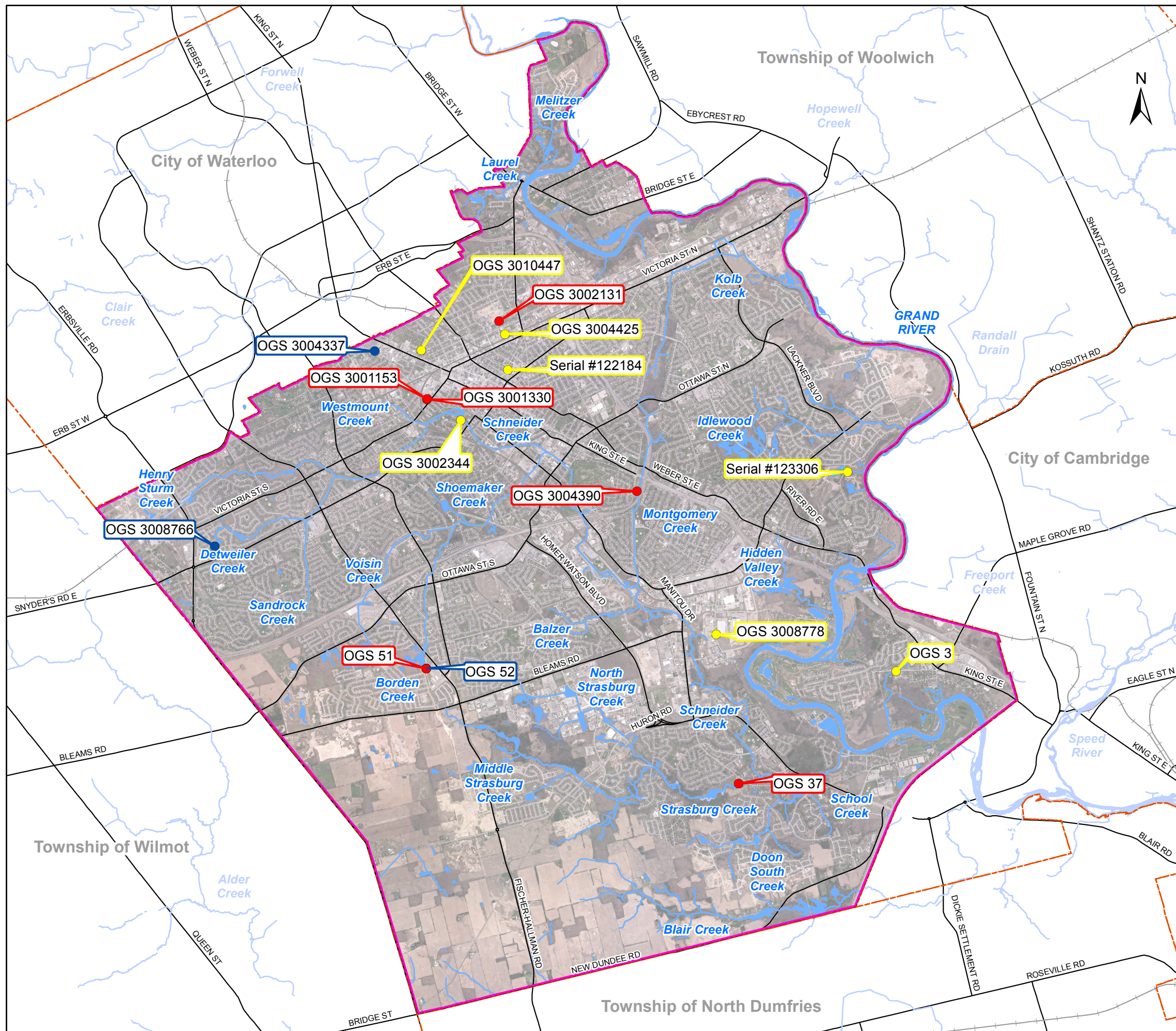
Figure 6.1

OGS Structures with Maintenance Priority

0 0.5 1 2 3 Km



Date: May 2016



6.1.1 Key Next Steps

Catch Basin Program

Sediment removal from catch basins within uncontrolled areas (without end-of-pipe ponds or OGS units) is recommended to improve water quality within the ultimate receiving watercourse. To be most cost-effective clean-outs are to occur once catch basins reach full capacity. Based on the analysis undertaken per the Catch Basin Clean-out Analysis Memo, the required catch basin clean-out frequency in the City of Kitchener ranged from 3.1 to 9.1 years. The average required clean-out frequency was found to be 5.4 years. A catch basin sediment removal program will be implemented for the 6,364 city-owned catch basins in uncontrolled sewersheds. The clean-out program will begin by removing sediment from one-fifth ($1/5^{\text{th}}$) of these catch basins in 2019 with subsequent years each covering another one-fifth ($1/5^{\text{th}}$) of the 6,364 catch basins. Using this removal frequency, each uncontrolled, city-owned catch basin receives a full clean-out every five (5) years.

Sediment Removal from Oil and Grit Separators

The City is responsible for the operation and maintenance of sixty-five (65) OGS units per the conditions of the respective MOECC Environmental Compliance Approval (ECA). Data availability allowed for the analysis of thirty-two (32) of the sixty-five (65) units. Calculated losses in sediment storage capacity were used to determine which OGS units were in need of sediment removal. Sixteen (16) OGS units were determined to need sediment removal. The OGS sediment removal program will begin in the 2017 with eight (8) sediment removals. Sediment will be removed from the remaining eight (8) priority OGS units in 2018. In 2019 a City-Wide OGS Sediment Removal Study will be undertaken on the forty-nine (49) OGS units on which sediment removal was not undertaken in 2017 and 2018. Six (6) OGS units per year have been budgeted for between 2020 and 2030.

Erosion and Sediment Control

A review of the existing erosion and sediment controls program as part of the development process should be undertaken to bring municipal policy in line with agency and provincial direction. This review is recommended such that new policies and standards capture the evolution in erosion and Sediment Controls (ESC), from a single approach for sediment management to ESC control methodologies and approaches that utilizes a hierarchical strategy of elimination or reduction of erosion then control of sediment releases.

6.1.2 Future Studies

Catch Basin Program

The ISWM-MP did not analyze the impact of modified street-sweeping and leaf collection programs on catch basin operation. It is recommended that the City of Kitchener investigate potential efficiencies of the existing street sweeping and leaf collecting programs and the potential to integrate catch-basin cleaning.

Sediment Removal from Oil and Grit Separators

In 2019 a City-Wide OGS Sediment Removal Study will be undertaken on the forty-nine (49) OGS units for which sediment removal was not undertaken in 2017 and 2018. This study will follow a similar approach to the **ISWM-MP Municipal Class EA- Sediment Analysis Memo: SWM Facilities and OGS Units (May, 2016)**, and will prioritize sediment removal from OGS units from 2020 through 2030. The study will analyze OGS units based solely on their loss in storage capacity compared to manufacturers' specifications. This will require sediment depth measurements to be taken at the forty-nine (49) OGS units in the spring of 2019.

In addition to the above, the City-Wide OGS Sediment Removal Study should provide identification of sediment capacities of all city-owned OGS units as the following units were found to lack design specification at the time of the analysis undertaken for the ISWM-MP:

- OGS Structures number 2, 3, 20, 36, 39 and 40

It is important to conduct the appropriate identification of these units in order to determine their current operational conditions relative to the manufacturer specifications.

6.1.3 Approvals, Policy, By-law or Design Standards Consideration

Erosion and Sediment Control policy for development should be updated to consider a hierarchical strategy. Using the hierarchical strategy, the development of subject site eliminates the erosion of soils during construction, reduces the reliance on sediment controls to reduce releases and thereby more completely protects the receiving watercourse from sediment releases. The previous focus on sediment control fails to deal with the root cause of the problem- the erosion. In this regard, it is important to note the following:

- Sediment control does not control erosion, but erosion control does minimize sediment; and
- Sediment control BMPs does not removal all suspended sediment found runoff water.

The basic principles of any ESC plan strategy should include:

- A multi-barrier approach which begins with erosion controls, followed by sediment controls and avoids reliance on a single control point for sediment
- Retain existing vegetation to the greatest extent possible for as long as possible
- Minimizes land disturbance areas
- Reduces runoff velocities and detains runoff to promote settling
- Diverts runoff from problem area
- Minimizes slope length and gradient of disturbed areas
- Maintains overland sheets flow and avoids concentrated flows
- Stores and stockpiles soils away from watercourse, drainage features and top-of-slope

- The acknowledgment that ESC plans are dynamic and require application of the Adaptive Management Approach (AMA) whereby the ESC plan is continually updated as a result of site inspections

6.1.4 Cost

Catch Basin Program

Based on analysis undertaken in the Catch Basin Clean-out Analysis Memo, a cost of \$156.65/Tonne is estimated for catch basin clean-outs in the City of Kitchener. Clean-out of all city-owned catch basins within uncontrolled areas is estimated to cost approximately \$300,000. Each year that the program is run, a cost of \$60,000 (2016 dollars) is incurred. Allocating for 2% inflation, **Table 6.1.4.1** indicates the budget required for the sediment removal program.

Table 6.1.4.1: Annual Catch Basin Sediment Removal Costs

Year	Allocated Budget (\$)
2019	63,672
2020	64,946
2021	66,245
2022	67,570
2023	68,921
2024	70,300
2025	71,706
2026	73,140
2027	74,602
2028	76,095
2029	77,616
2030	79,169

The cost of installing a CB Shield™ or equivalent Environmental Technology Verification (ETV) certified catch basin insert is approximately \$1,250/CB and is recommended for use as a pilot project in uncontrolled drainage areas where other opportunities do not exist. It should be noted that the CB Shield™ or equivalent can be relocated to other uncontrolled drainage areas when no longer required.

Sediment Removal from Oil and Grit Separators

The cost analysis was based tendered values provided by the City of Kitchener, containing the cost of maintenance for the fourteen (14) units cleaned out in 2015. The cost for the removal of liquid material was considered as being \$0.08 / litre, as informed by the City of Kitchener. A cost of cleanout was calculated as \$725 / tonne for the removal and disposal of non-impacted solid material based on a 14 OGS unit average provided in a City of Kitchener. These values are the basis of developing cost estimates within this report. Extra expenses were assumed considering the potential need of soil management for contaminated materials in three (3) different levels. In addition, 25% provisional cost was added to the final price in order to consider other services such as traffic control, implementation of the health a safety plan, removal of contaminated groundwater, removal and replacement of existing damaged structures, supply of materials and other potential construction needs. **Table 6.1.4.2**

indicates the budget required for priority OGS sediment removals and program components beyond 2018. An annual inflation rate of 2% has been added to the average 2016 cost of 6 OGS sediment removals from 2020 through 2030.

Table 6.1.4.2: OGS Removal Costs

Program Component	Year	Allocated Budget (\$)
OGS ID 3004390 (sediment removal)	2017	8,364
OGS ID 3001330 (sediment removal)	2017	27,540
OGS ID 3001153 (sediment removal)	2017	36,210
OGS ID 3002344 (sediment removal)	2017	3,978
OGS ID 123306 (sediment removal)	2017	714
OGS ID 3010447 (sediment removal)	2017	8,466
OGS ID 51 (sediment removal)	2017	22,338
OGS ID 3002131 (sediment removal)	2017	20,502
OGS ID 3008778 (sediment removal)	2018	4,058
OGS ID 3004425 (sediment removal)	2018	8,323
OGS ID 52 (sediment removal)	2018	3,954
OGS ID 3008766 (sediment removal)	2018	6,659
OGS ID 3 (sediment removal)	2018	14,253
OGS ID 122184 (sediment removal)	2018	9,884
OGS ID 37 (sediment removal)	2018	14,774
OGS ID 3004337 (sediment removal)	2018	6,971
City-Wide OGS Sediment Removal Study	2019	50,000
OGS Sediment Removal – 6 Units	2020	81,182
OGS Sediment Removal – 6 Units	2021	82,806
OGS Sediment Removal – 6 Units	2022	84,462
OGS Sediment Removal – 6 Units	2023	86,151
OGS Sediment Removal – 6 Units	2024	87,874
OGS Sediment Removal – 6 Units	2025	89,632
OGS Sediment Removal – 6 Units	2026	91,425
OGS Sediment Removal – 6 Units	2027	93,253
OGS Sediment Removal – 6 Units	2028	95,118
OGS Sediment Removal – 6 Units	2029	97,020
OGS Sediment Removal – 6 Units	2030	98,691

6.1.5 Funding

Catch Basin Program

All funds for the catch basin program will come from the general Stormwater Utility Revenue. No one-time funding sources or external funding sources will be used for this program.

Sediment Removal from Oil and Grit Separators

All funds for the OGS program will come from the general Stormwater Utility Revenue. No one-time funding sources or external funding sources will be used for this program.

Erosion and Sediment Control

No funds have been allocated to the review of existing sediment controls program requirements. This task will be integrated with regular updates to City standards per the respective City timelines.

6.1.6 Timeframe

Catch Basin Program

Generally, the clean-out frequencies directly corresponded to the capacities of the representative area catch basins and loading rates. The clean-out program will begin by removing sediment from one-fifth (1/5th) of these catch basins in **2019** with subsequent years each covering another one-fifth (1/5th) of the 6,364 catch basins. Sediment removal from catch basins will occur **each spring after street sweeping has occurred**. The program is intended continue for perpetuity or until new SWM facilities or new OGS units have been implemented downstream of the current priority catch basins (existing uncontrolled catchments).

Sediment Removal from Oil and Grit Separators

Sediment removal from priority OGS units will begin in the spring of 2017 with eight (8) units. Sediment will be removed from another eight (8) priority units in the spring of 2018. In both instances sediment removal will occur after street sweeping operations are conducted. After the City-Wide OGS Sediment Removal Study identifies new OGS prioritization in 2019, spring sediment removal from six (6) units will be undertaken annually.

Erosion and Sediment Control

Review of existing sediment controls program requirements is anticipated to be completed in 2017.

6.1.7 Recommendations

Catch Basin Program

The follow summarizes the recommendations in the **ISWM-MP Municipal Class EA - Catch Basins Clean-out Analysis Memo (May, 2016)**.

- It is recommended that the City investigate potential efficiencies of the existing street sweeping and leaf collecting programs and the potential to integrate catch-basin cleaning.
- To improve the capture efficiency of each catch-basin within uncontrolled areas, the retrofit of existing catch basins with a an ETV certified catch basin insert can significantly improve performance. A recent study by the University of Toronto found that an existing catch basins

retrofit of with a CB Shield™ captured 47 times more sediment than the unshielded unit, presenting the capture of 38kg vs .8kg of sediment respectively (**Appendix D**). The cost of installing a CB Shield™ or equivalent is approximately \$1,250/CB and is recommended for use as a pilot project in uncontrolled drainage areas where other opportunities do not exist. It should be noted that the CB Shield™ or equivalent can be relocated to other uncontrolled drainage areas when no longer required. Greater sediment capture efficiency at catch basins may influence sediment loading rates and clean-out frequencies.

- It is recommended that the City of Kitchener undertake an annual sediment removal program from city-owned catch basins that are in uncontrolled catchments.

Sediment Removal from Oil and Grit Separators

The follow summarizes the OGS recommendations in the **ISWM-MP Municipal Class EA - Sediment Analysis Memo: SWM Facilities and OGS Units (May, 2016)**.

- Based on ISWM-MP criteria, sixteen (16) OGS units currently need maintenance, six (6) of which have more than 50% of their volume compromised due to sediment accumulation. It is recommended that sediment is removed from these sixteen (16) units by 2018.
- It is recommended that the City of Kitchener undertake a City-Wide OGS Sediment Removal to prioritize sediment removal from OGS units from 2020 through 2030.

Erosion and Sediment Control

The following **Erosion and Sediment Control** considerations should be integrated into updated development policy:

1. Currently typical ESC Plans require the placement of topsoil and seed for all areas not schedule for immediate development following site grading (by June 1 of the following year) for winter conditions. It is suggested that “immediate development” be clarified as “immediate development within 30 days following the completion of site grading” and that “where winter grading prevents the use of topsoil and seed, that alternative *Erosion Control Methods (ECMs)* listed in **Table 6.3.1** be utilized”.
2. All ESC plans focus on Erosion Control using the Erosion Control BMPs and ECMs listed in **Table 6.3.1** in addition to those listed in within the *Erosion and Sediment Control Guidelines for Urban Development*.
3. All ESC plans implement a multi-barrier approach which begins with erosion controls, followed by sediment controls and avoid reliance on a single control point for sediment control
4. That all development areas retain a full-time certified Inspector of Sediment and Erosion Control (CISEC) who has completed and is accredited through the CISEC program. To qualify for admission into the CISEC certification program, applicant must meet the following minimum criteria:
 - o 2+ years of construction site field experience involving erosion and sediment
 - o Through understanding of erosion and sedimentation process and how they impact the environment

- o Complete understanding of key federal, provincial and local regulations
 - o Ability to read and interpret ESC plans
5. Complete site inspections be completed according to the following frequency:
- i. On a weekly basis
 - ii. After every rainfall event
 - iii. After significant snowfall event
 - iv. Daily during extended rain or snowmelt periods
 - v. During inactive construction periods where the site is left unattended for 30-days or longer, a monthly inspection should be conducted.
6. The site inspector shall maintain an inspection log-book.
7. ESC reports be prepared for submission to the contractor/ developer in advance of each meeting and that all records be kept for period of 2 year following construction. Reports should be provided to the City of Kitchener on a weekly basis per standards City requirements. Reports should details, a minimum of:
- o Site location and boundaries
 - o Permitting or approval information
 - o Inspector name and qualification
 - o Rational for inspection (see inspection frequency i.e. weekly, following precipitation etc.)
 - o Observations/ findings relating to the inspection (both positive and negative) including:
 - Written,
 - Annotated ESC plans
 - Photographic using a GIS/ coordinate enabled camera (date stamped)
 - o Person(s) informed/ notified of findings and or observations
 - o Actions required
 - o Follow up on 'actions required' from previous reports.
8. All sediment releases and spills outside the designated control area (development limits) be recorded and reported to the City and GRCA within 24 hours.
9. The acknowledgment that ESC plans are dynamic and require application of the Adaptive Management Approach (AMA) whereby the ESC plan is continually updated as a result of site inspections.

6.2 Market Based Strategies for Private Properties

Source control measures are small-scale stormwater management techniques located at the beginning of a drainage system where stormwater is captured and treated on-site or close to where the rainfall lands. Due to the relatively small area treated by an individual measure, source controls must be well distributed to treat stormwater runoff effectively. Source control measures are generally installed on private property within residential, commercial, industrial and institutional land uses.

Source control measures fall outside of the Municipal Class EA process, since they are to be constructed on private property, often by the individual land owner as a retrofit or during development/ redevelopment (i.e. the City is not the proponent).

To increase uptake of SWM and pollution prevention practices as part of the ISWM-MP, market-based research was undertaken with residential as well as business property owners/managers, builders/developers and service providers to develop enhancements to current SWM programming within City of Kitchener. Results of the market-based research are detailed within a series of three (3) reports were prepared and included as **Appendix F of the ISWM-MP Report**, entitled:

- **ISWM-MP Municipal Class EA: Market-based Strategy: Securing Uptake of at-source Stormwater Management Practices on Private Property (Oct 2015)**
- **ISWM-MP Municipal Class EA: Residential Market Research Summary (April 2015)**
- **Leading Jurisdictions Report (May 12, 2015)**

Through the above noted reports the City has identified new drivers to help promote development and to encourage innovative stormwater management controls on sites, such measures are detailed in **Table 6.2**.

Table 6.2 – Potential Identified Development Drivers to Encourage Innovative Stormwater Management Controls

Approach	Description
MARKET-BASED APPROACH	• A market-based approach employs or stimulates the marketplace to deliver/support SWM initiatives with the ultimate goal of generating transformative, sustained changed. • Two key elements of a market-based approach to municipal SWM are the use of external market drivers and development of strategic joint venture opportunities. • Examples of such external drivers would include, grants, financing and subsidy programs, promotional initiatives, recognition/award programs, etc. • Identifying potential synergies with external organizations and business and developing joint venture agreements for delivery of complementary programs is an effective means of securing higher uptake and leveraging of resources.

Approach	Description
DENSITY & FLOOR AREA RATIO BONUS	• The cost of enhanced SWM measures such as rain gardens, bioswales, exfiltration systems, eco-/green roofs, rain water harvesting, porous paving, etc., results in their limited application in new development. • In leading SWM jurisdictions, increases in allotment of single-detached homes, increases in building height or the floor area ratio are the types of density bonuses made available to builders/developers.
AGGREGATING PROPERTIES INCENTIVE	• A grant or low/no-interest financing initiative in conjunction with credit banking or exchange would encourage non-residential property owners/managers to develop and implement SWM practices to address multiple properties in a drainage area. • Allowing for the aggregation of properties/Grid Low Impact Development (Grid LID) has the potential to bring payback periods down to justifiable investment levels for business property owners. • In addition to grants, bankable and tradable SWM credits based on the value of the loading reduction to the City's SWM system would serve as an added financial incentive for property owners.
SERVICE PROVIDER INCENTIVE	• Incentivizing the landscaping service industry to design and install transitional landscapes that incorporate rain gardens and enhanced permeable areas, and require little or no supplemental irrigation would be the most effective mechanism for driving uptake of on-site SWM landscaping practices and lowering peak water demand amongst single-detached and industrial/commercial property owners. • To qualify for the incentive, landscaping service companies would have to complete training and certification through Landscape Ontario (LO), the professional and industry recognized association of the landscaping industry.
TARGETED HOMEOWNER CAMPAIGN	• Targeted marketing must focus on the beauty of transitional SWM landscapes – it's about creating a new landscape paradigm based on a composite of lot-level best practices that homeowners will desire and seek to obtain. • The focus of the campaign should be a transitional landscape aesthetic for single-detached residential properties, municipal properties and eventually, by extension, multi-unit residential, commercial and industrial properties throughout Kitchener

6.2.1 Key Next Steps

The first step in applying source controls to private properties is the RAIN-Ready Neighbourhood Action Plan to which the City of Kitchener is contributing \$25,000 per year from 2017 through 2019. The bulk of the funding for this project is external to the City through the Trillium “Grow” Grant program.

The RAIN-Ready Neighbourhood Action Plan will create a neighbourhood-level stormwater action planning model that is intended to dramatically increase uptake of stormwater management best practices in wto Kitchener neighbourhoods. The focus will be on neighbourhoods that are at highest risk of flooding during extreme weather events and should be slected based on the recommendatiojns contained with **Section 6.6** and **Figure 6.6**. The project will collect accurate baseline data to determine the barriers to adopting stormwater management practices and work with neighbours to co-create and execute a community engagement plan to match their specific needs.

Over the course of 3 years, the project will result in:

- 4 RAIN-Ready Home demonstration projects
- 450 RAIN-Ready Home Upgrades
- 450 RAIN-Ready Rebates and Stormwater Credits
- 3 hands-on workshops
- Neighbourhood tour for community

Direct installations will continue to reduce the volume and pollution in rainwater reaching local waterways for years to come and will also create a toolkit outlining the approaches used, results achieved, and templates needed to replicate the approach. This will enable the City to spur high levels of on-site stormwater management actions in prioritized neighbourhoods, and to spend limited dollars in a cost-effective way that addresses their most critical needs first.

6.2.2 Future Studies

In order to generate uptake of at-source SWM and pollution prevention practices and measures by residential and industrial/commercial property owners, a “made in Kitchener” market-strategy needs to be developed. This strategy involves three (3) specific implementation categories. These are:

1. **Governance & Administration:** As part of this component the City is to undertake an Integrated Water Management (IWM) planning process starting with the implementation of the Market-Based strategy in 2022. Additionally, a Water Innovation Hub should be established or existing hubs should be used to facilitate market transformation.
1. **Municipal Functions & Operations:** As part of this component the City is to review the current stormwater utility fee structure and establish an incentive and administrative mechanisms to enable incentivize the implementation of private stormwater controls as part of the Stormwater Utility Credit Program within prioritized subwatersheds for the Industrial, Commercial and Institutional (ICI) as well as multi-residential land uses within the City

2. **Market-Based Programming:** As part of this component the City is to establish a service provider incentive program for landscape design and/or installation contractors. It is also recommended that the City undertake a targeted promotional initiative to re-position SWM and SWM-related programming in the marketplace. Additionally, a marketing and promotional initiative program targeting the Industrial, Commercial and Industrial (ICI) land-use and focused on transitional landscapes for lot-level SWM should be developed.

6.2.3 Approvals, Policy, By-law or Design Standards Consideration

It is recommended that policy and by-law considerations, be considered and developed as part of future studies detailed above. Furthermore, it is recommendation that the City incorporate Low Impact Development design guidelines per the Low Impact Development Stormwater Planning and Design Guide (V1.0, 2010 or as amended from time to time) into the City standards and specifications in 2017.

6.2.4 Facilitators and Contributors

In order to support landowners implementing stormwater mitigation measures such as rain gardens, bioswales and downspout disconnections, the City of Kitchener has formed a partnership with Residential Energy Efficiency Project (REEP Green Solutions) in order to provide the public with information, resources and direct expert guidance to residential and industrial, commercial and institutional (ICI) property owners. Other strategic ventures may include partnerships with the Region and energy utilities to deliver a comprehensive energy-water-stormwater DSM program.

In collaboration with REEP Green Solutions, it is recommended that the City attempt a few selected methods on a pilot project basis and focus on priority 1 watersheds.

In order to facilitate the IWM planning process, the City, in conjunction with the Region of Waterloo and the Grand River Conservation Authority (GRCA), will establish an IWM Steering Committee and /or utilize the existing Grand River Water Management Plan working groups.

6.2.5 Mechanisms for Implementation

Mechanisms and approaches to drive uptake of on-site stormwater management measures include:

- Integrated Water Management (IWM) Planning;
- Market-based approach to planning and decision-making;
- Water Innovation Hub;
- Review and Update of Stormwater Utility Fee Structure;
- Aggregated Property Incentives:
- Expedited Approval Process for enhanced and innovative SWM measures;
- Service Provider Incentives for SWM landscaping projects;
- Targeted promotional initiative to re-position SWM in the marketplace; and
- Targeted Homeowner Campaigns focused on the beauty of transitional SWM landscapes.

6.2.6 Development Requirements

Market-based strategies primarily target retrofits that are undertaken voluntarily by property owners; however the new volume-based stormwater management capture targets (**Section 2.2.2**) will require projects that create significant new impervious meet onsite capture criteria.

6.2.7 Cost

Table 6.2.7 provides a cost estimate for a 5-year period for the Preferred Market Based Strategy (MBI Scenario 2). The estimated costs reflects resource requirements including staffing, overhead expenses, consulting services, advertising and promotion, and miscellaneous program related expenses. The dollar value used for “Person Hours” is \$70.00. This amount reflects Statistics Canada’s unadjusted average union salary for employees in Ontario at \$30.66 per hour in 2015 plus an additional overhead cost of \$39.34 per hour.

In order to maintain the programs outlined in the Market-Based Strategy, \$75,000 annually has been allocated from 2025 through 2030.

Table 6.2.7: Cost Estimate for Preferred Market Based Strategy (MBI Scenario 2)

DESCRIPTION	PERSON HOURS	COSTS (\$) YEAR 1†	COSTS (\$) YEARS 2 – 5†
Set up and administration of financing program ¹	10,400	328,000	400,000
On-line application process	715	25,000	25,000
Set-up of incentive program for new ICI development	10,400	300,000	428,000
Administration of incentive program	9,360	164,000	491,000
Set up and administration of site consultation visits and support	6,240	87,000	349,000
Site visits and support for both programs	2,928	41,000	164,000
Advertising and promotional materials for both programs	n/a	100,000	80,000
Advertising and promotion for both programs	n/a	150,000	225,000
Miscellaneous	n/a	75,000	150,000
<i>Sub-Total</i>	<i>40,043</i>	<i>1,270,000</i>	<i>2,313,000</i>
TOTAL COST – MBI SCENARIO 2			3,583,010

† Class “C” Cost estimate, all values in 2016 CDN dollars.

6.2.8 Funding

The RAIN-Ready Neighbourhood Action Plan (2017 through 2019) will receive \$25,000 per year allocated from the Stormwater Management Fee. All other funding associated with the market-based strategy will be allocated from the general stormwater utility fee revenue.

¹ IBID

6.2.9 Timeframe

The RAIN-Ready Neighbourhood Action Plan will span the first three years of implementation. In 2020, \$1.27 million is budgeted for the development of the Market Based Strategy (Year 1 of the market-based strategy items indicated in **Table 6.2.7**). From 2021 through 2024, \$575,000 per year is budgeted for the implementation of the market-based strategy.

6.2.10 Integration

Selection of the RAIN-Ready Neighbourhood Action Plan is intended to be based primarily on neighbourhoods that are at highest risk of flooding during extreme weather events and should be selected based on the recommendations contained with **Section 6.6** and **Figure 6.6** as well as Scenario 2 of the **ISWM-MP Municipal Class EA - Storm Sewer Capacity Report (May, 2016)**” included as **Appendix J of the ISWM-MP Report**.

Integration of City policies and programming across water management and related portfolios provides an opportunity for co-operation; economies of scale; risk management; enhancing program effectiveness (business decisions are not made in isolation with benefits to one portfolio coming at the expense of another); and ultimately, integration enables greater organizational responsiveness and adaptability.

Given the Region of Waterloo’s mandate for water management and the linkages with the City’s SWM objectives, integration with Regional programming and identification of opportunities for coordinated delivery and joint ventures would magnify the reach, efficiency and cost effectiveness of City SWM undertakings.

Specific municipal programs that provide opportunities for integration with the market-based strategy are:

- Parks Strategic Plan (September 2010)
- Multi-Use Pathways and Trails Master Plan (May 2012)
- Cycling Master Plan (2010)
- Planning Around Rapid Transit (PARTS)
- Ecological Restoration Areas and Policies
- New Secondary Plan Areas
- Grand River Water Management Plan (2014)
- Grand River Source Protection Plan (LERSPC 2012, Approved 2015, effective July 1, 2016)
- Wastewater
- Urban Forestry

6.2.11 Prioritization

It is proposed that the City focus on Priority 1 (and potentially Priority 2) subwatersheds leading to full implementation of the market-based strategy. These priority subwatersheds are primarily located in

the urban core. During the market-based strategy set-up year (2020), it is recommended that key neighbourhoods in priority subwatershed be targeted.

6.2.12 Operation and Maintenance

The public willingness to maintain landscape-based stormwater infrastructure is far more realistic when simple source control features that share maintenance regiments with conventional landscape features are implemented. Maintenance of bioretention practices (rain gardens) generally involves maintenance of the vegetative cover similar to a garden bed. Pilot projects such as the Lakeview Neighborhood ROW Retrofit project in Mississauga identified that area private landowners were willing to participate in regular maintenance activities. It suggests that the willingness of homeowners and businesses to take ownership of LID measures is possible if the stormwater measures speak to the vision of the public and /or the business. Given homeowner and business motivations for the design and maintenance of their landscape are based on a deeply held, traditional aesthetic perception of what makes a beautiful landscape, the marketing program must first address this perceptual constraint before lot-level SWM modifications will be voluntarily undertaken.

6.2.13 Recommendations

The City of Kitchener has taken a progressive approach to SWM programming. This market-strategy continues this progressive approach and positions the City as a leader and innovator in stormwater management.

For ease of reference, recommendations are divided into the following three categories: Governance & Administration, Municipal Functions & Operations, and Market-based Programming. The following provides a summary of the recommendations:

Governance & Administration:

- As SWM program moves forward with the ISWM-MP, it is recommended that the City undertake an IWM planning process to identify project and program related efficiencies that will foster implementation.
- It is recommended that the City apply a market-based approach to planning and decision-making processes pertaining to, or impacting, SWM practices by private property owners.
- It is recommended the City, in conjunction with the Region of Waterloo and the Grand River Conservation Authority (GRCA), establish an IWM Steering Committee and /or utilize the existing Grand River Water Management Plan working groups.
- It is recommended that a Water Innovation Hub be established or that the City participate in existing ‘Hubs’.

Municipal Functions & Operations:

- It is recommended that the City review the current stormwater utility fee structure and evaluate the potential to modify the structure for non-residential and multi-residential property owners.
- It is recommended the City establish an incentive and administrative mechanisms to enable the aggregation of non-residential and multi-residential privately-owned properties for a SWM utility credit.

- Based on the results of the market-based research, the recommended that the City evaluate the opportunity to determine the appropriateness of a variety of incentives and programs to support and service those interested in improving stormwater management on their non-residential properties. Approaches such as various: financing options, 'bonusing' strategies, review enhancements, and service charge reductions will be evaluated and appropriate methods should be considered at a later date.
- It is recommended that the City attempt a few selected methods on a pilot project basis and focus on priority watersheds in collaboration with REEP Green Solutions as part of the recently approved 3-year (\$439,500) Trillium 'Grow' funding which is to target two neighbourhoods in Kitchener.
- It is recommended the City establish a SWM infrastructure right-of-way policy and program.
- From feedback received through PIC No. 2, it is further recommended that the City utilize neighbourhood design charrettes at the earliest possible stage of planning for SWM in the municipal ROW and public parks. Early and on-going participation of residents in the design and planning of SWM projects on public lands results in projects that reflect the values and aesthetics of local neighbourhoods and builds support amongst area residents and businesses."
- It is recommended the City implement a SWM reporting framework involving a performance indicators and scorecard management mechanism.

Market-Based Programming

- It is recommended that City staff responsible for SWM investigate the opportunity for strategic joint ventures with the Region and energy utilities to deliver a comprehensive energy-water-stormwater DSM program.
- It is recommended the City establish a service provider incentive program for landscape design and/or installation contractors.
- It is recommended that the City undertake a targeted promotional initiative to re-position SWM and SWM-related programming in the marketplace.
- It is recommended that City SWM staff undertake a marketing and promotional initiative targeting single detached dwellings and focused on transitional landscapes for lot-level SWM.

6.3 Stormwater for the Capital Roads Program

Targeting roads for municipal SWM improvements is an important method of mitigating the stormwater impact of urban development. The incorporation of a cost-effective right-of-way (ROW) retrofit approach using a combination of traditional SWM controls (OGS and proprietary stormwater treatment devices) and Low Impact Development (LID) approaches as part of road reconstruction and resurfacing projects presents a significant opportunity to improve SWM control (water quality, water quantity, erosion mitigation, water balance) within the City of Kitchener.

ROW retrofits using traditional SWM controls and LID has the ability to most significantly improve stormwater quality by reducing the pollutant loading from uncontrolled urban catchments because of the large volume of sediment and other pollutants that wash off of these surfaces on an annual basis, as well reducing runoff volumes and reducing thermal impacts to receiving waters. In addition, ROW retrofits have the added benefit of providing an opportunity to enhance street aesthetics, mitigate and adapt to climate change and reduce heat island effects.

6.3.1 Key Next Steps

In years 2017 through 2019, the City of Kitchener will focus on the implementation of a LID Design Standard for municipal road right-of-ways. In order to complete this, there are two important steps that must be taken, these are:

- a) A review and update of cross-section drawings in the City's Development Manual to reflect the following LID practices:
 - Bioretention Bump-Outs (Curb Extensions)
 - Boulevard Bioretention
 - Bioretention Planters
 - Bioswales
 - Perforated Pipe
 - Permeable Pavement
 - Proprietary Stormwater Quality Treatment Devices
- b) In order to ensure the City assumes only LID practices that are viable in the short and long-term; the City's maintenance period for all ROW LID approaches should be reviewed in the context of standard City of Kitchener tender and special provisions. Of importance are the requirement for extended contractor maintenance periods and enhanced guarantees.

6.3.2 Future Studies

In order to facilitate the implementation of conveyance controls within municipal right-of ways, the following studies are recommended:

Integration of Conveyance Controls with Rapid Transit Study

At the City-Level, the implementation of conveyance controls as part of the City's Planning Around Rapid Transit Stations (PARTS) should be studied. As Station Study Area Plans are prepared through 2018, there is an opportunity to enhance the urban core with green infrastructure that is both highly

aesthetic and provides stormwater benefits. A study that identifies potential LID projects that complement the goals and objectives of PARTS, notably to “enhance the rapid transit system green infrastructure, designs, materials and technologies that encourage sustainability” is recommended.

Project Specific Groundwater Impact Analysis Studies

Per the policy considerations outlined in the **Integrated Stormwater Management Master Plan – Municipal ROW (Conveyance Control) Retrofit Assessment Opportunities Report** (May, 2016) included as **Appendix G of the ISWM-MP Report**, infiltration-based LIDs can only be implemented in Major Roads provided a project specific Groundwater Impact Analysis study is undertaken to demonstrate that groundwater contamination (especially from salt loading) is minimal, not likely or can be mitigated.

6.3.3 Approvals, Policy, By-law or Design Standards Consideration

Infiltration Policy

As part of the City of Kitchener’s *Integrated Stormwater Management Master Plan*, a **Stormwater Infiltration in the Context of Source Protection Planning Policy memo (Oct 10, 2016)** has been developed (**Attachment A**) and reviewed by both the MOECC and the Regional Municipality of Waterloo (RMOW). This report identifies existing policies related to the infiltration of stormwater runoff and contains recommendations for land-use based policies to identify site specific opportunities, constraints and approaches. The policies outlined in the report are intended to be utilized to identify, manage, and implement infiltration based stormwater management controls, commonly referred to as Low Impact Development (LID) controls while ensuring the protection of local groundwater resources from contamination. The policies outlined in the report outline constraints have been placed on the use of infiltration based practices to treat runoff from road ROWs within:

- Issue Contributing Areas and
- Wellhead Protection Areas with Adjusted Vulnerability Scores equal to or greater than 8.

The permitted use of infiltration-based relates directly to the City of Kitchener’s road classification system.

Municipal By-Laws

The long-term viability of conveyance control practices such as bioswales and bioretention facilities depend on adherence to grading and planting plans. It is recommended that a review of City of Kitchener Property standards (665) by-law, weed control (695) by-law be conducted to ensure wording allows for the use of plant growth within the ROW and unconventional grading which permit the ‘temporary ponding’ of water.

Design Standards

City of Kitchener design standards as outlined in the Development Manual (April, 2015) for road works will need to be updated to reflect the incorporation of LID features. It is recommended that the design specifications within the CVC/TRCA Low Impact Development Stormwater Management Planning and Design Guide (2010, v1.0 or most recent) be used to update design standards in 2017. An additional resource is CVC’s Low Impact Development Road Retrofits guide (2013). A full list of resources are included in **Attachment B**.

Utilities Agreements

Access agreements with utilities (i.e., Bell, Rogers, etc.) may need to be altered to ensure that the constructed LIDs are restored or consider implementing enhanced road cut permits which include rectification bonds. Implementation of a “Green Streets Fund” would allow for application of a fee based system on all road cut permits where fees are equal to a nominal percentage of total capital (actual or estimated) construction budget. Collected fees would be primarily allocated to verification of appropriate rectification post construction as well as to future municipal ROW retrofit projects and operation and maintenance activities.

6.3.4 Mechanisms for Implementation

Per the recommendations of the **City of Kitchener ISWM-MP Environmental Assessment Report** (May, 2016) included as **Appendix G of the ISWM-MP Report**, conveyance controls will be integrated into roads by proceeding with ‘multiple objectives’ at the detailed design stage for all capital roads project such that the project can incorporate new SWM infrastructure to achieve SWM objectives.

All conveyance control projects incorporated into roads will be implemented as components of capital roads projects through the Accelerated Infrastructure Replacement Program (AIRP) except for Laneway Retrofits which will be partially funded through the Stormwater Management Fee to the amount of \$100,000 annually starting in 2021. As part of the **Integrated Stormwater Management Master Plan – Municipal ROW (Conveyance Control) Retrofit Assessment Opportunities Report** (May, 2016), preferred conveyance control alternatives were selected for 203 roads of which:

- 17 are laneways,
- 151 are local roads,
- 18 are collectors, and
- 17 are arterial roads.

For roads that have not been assigned a preferred conveyance control alternative, a decision framework has been outlined in the **Integrated Stormwater Management Master Plan – Municipal ROW (Conveyance Control) Retrofit Assessment Opportunities Report** (May, 2016) and are reproduced as **Figures 6.3.1 to 6.3.5** for Local Roads, Minor Roads, Major Roads, Laneways and Sidewalks & Trails respectively.

The decision framework directs the user to a preferred alternative(s) for each roadway based on policy and desired roadway characteristics. However prior to detailed design pre-design activities such as infiltration testing, geotechnical and groundwater investigations are typically required as detailed in the Grey to Green Road Retrofit Guide (CVC, 2013) and the LID Stormwater Planning and Design Guide (2010, v1.0 or most recent) to confirm suite specific constraints or opportunities.

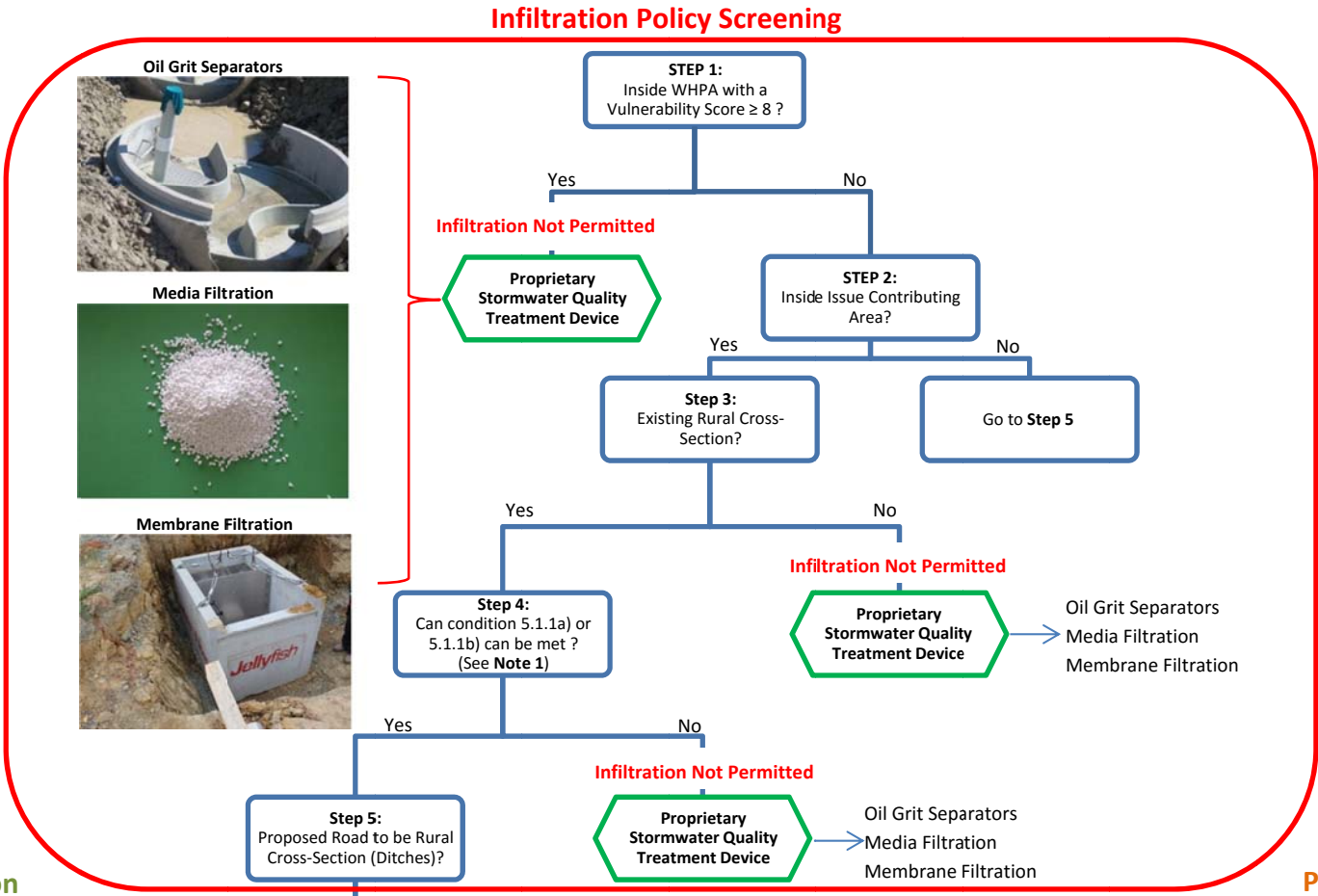
Figure 6.3.1: Local Road Retrofit Decision Making Process

Legend

Preferred Stormwater Treatment Option

Process Step

Ancillary Process for Cul-de-sacs



NOTE 1) 5.1.1 Local Rural Cross-section Roads within ICAs – Exemption

Local roads with existing rural-cross-sections already contribute to chloride loading (though significantly less than minor and major roads per unit length) and it is unlikely that directing runoff from existing grassed ditches to infiltration practices will exacerbate the issue or increase the threat, provided:

- a) The proposed infiltration facility footprint is no larger than the existing ditch footprint;
- or
- b) The proposed annual infiltration volume is not increased as compared to the existing condition (ditch) annual infiltration volume based on the characterization of the limiting in-situ native soils [i.e. infiltration rate(s) per the LID Stormwater Planning and Design Guide (2C10 V1.0 or most recent).

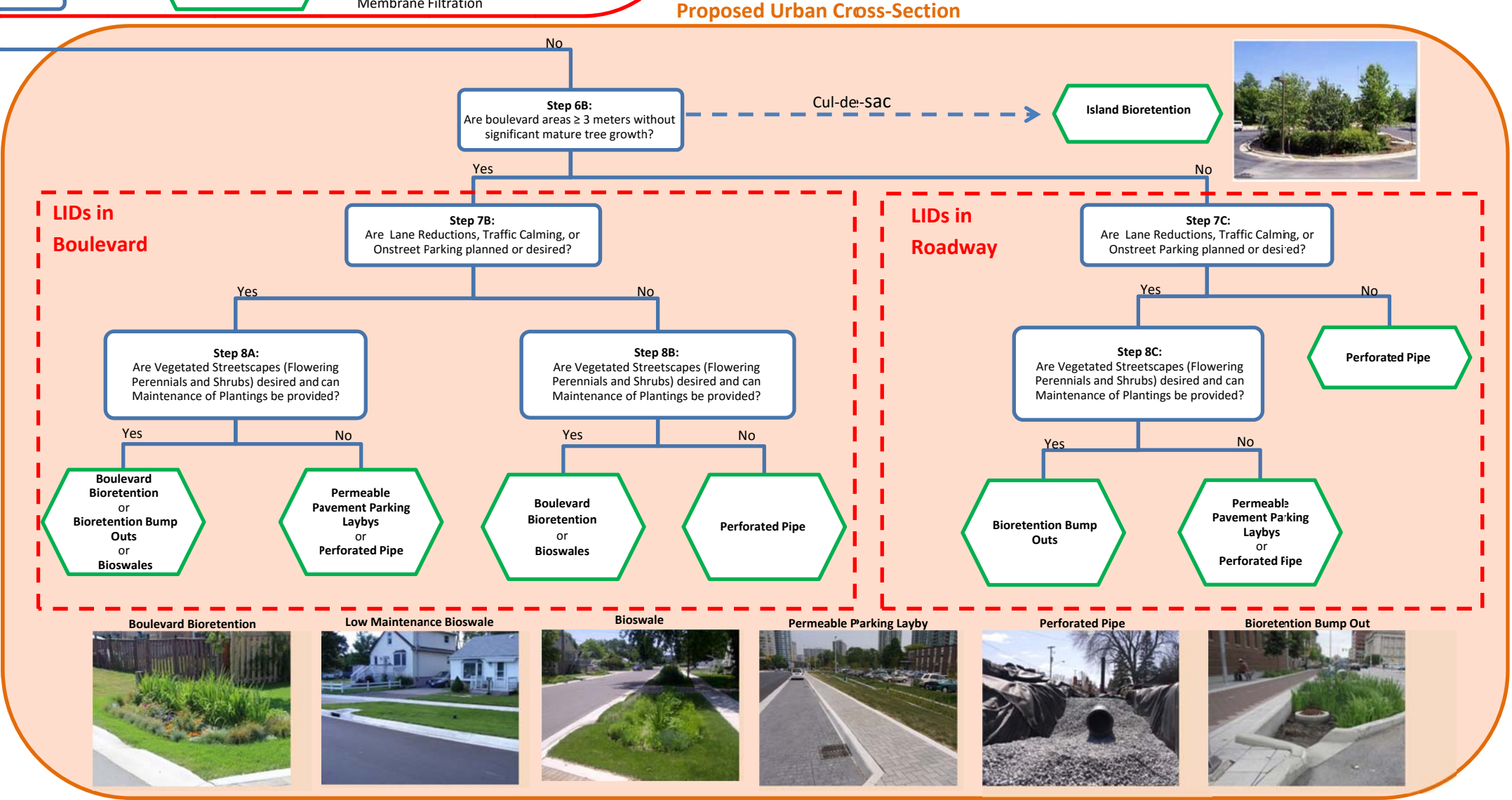
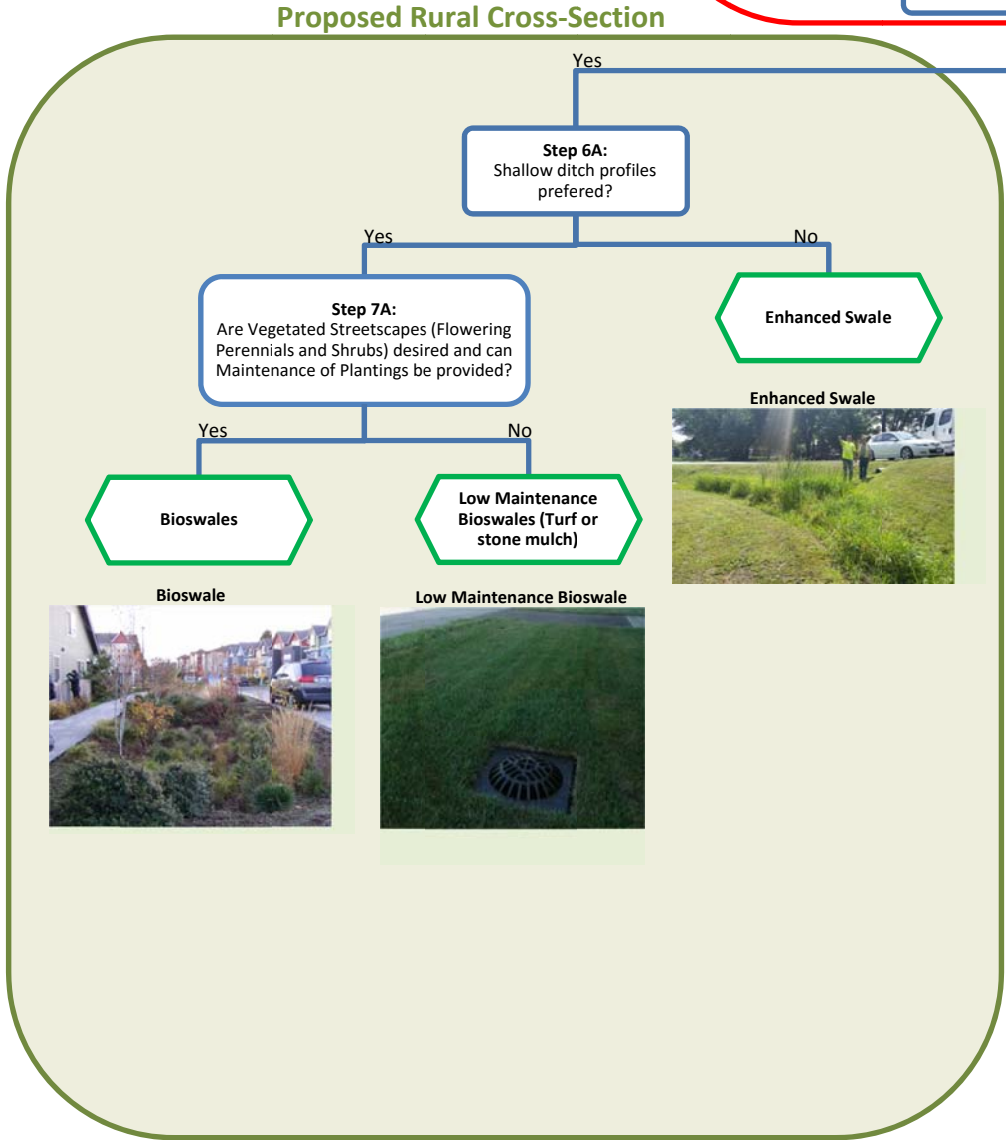


Figure 6.3.2: Minor Road Retrofit Decision Making Process

Legend

Preferred Stormwater Treatment Option

Process Step

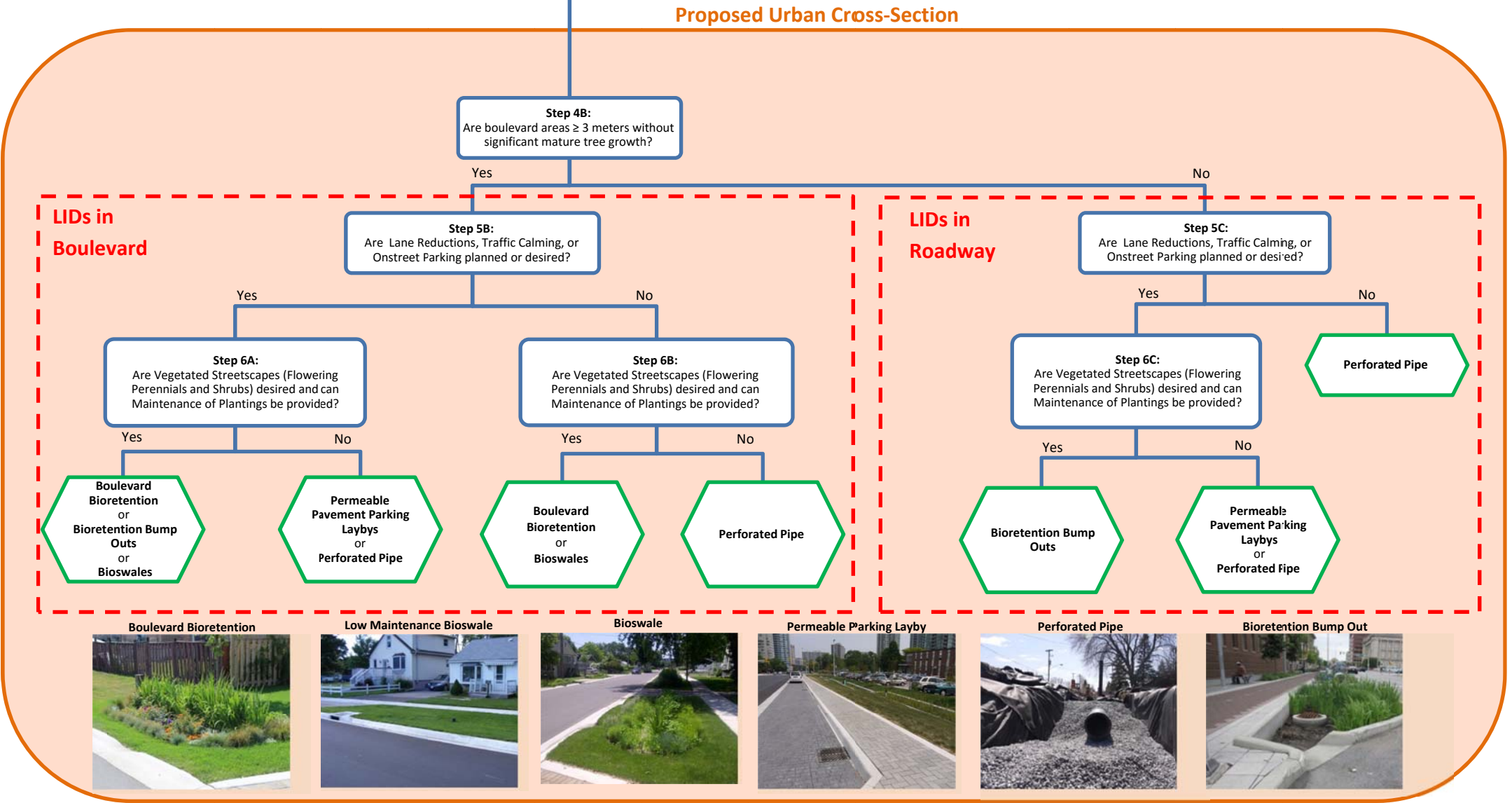
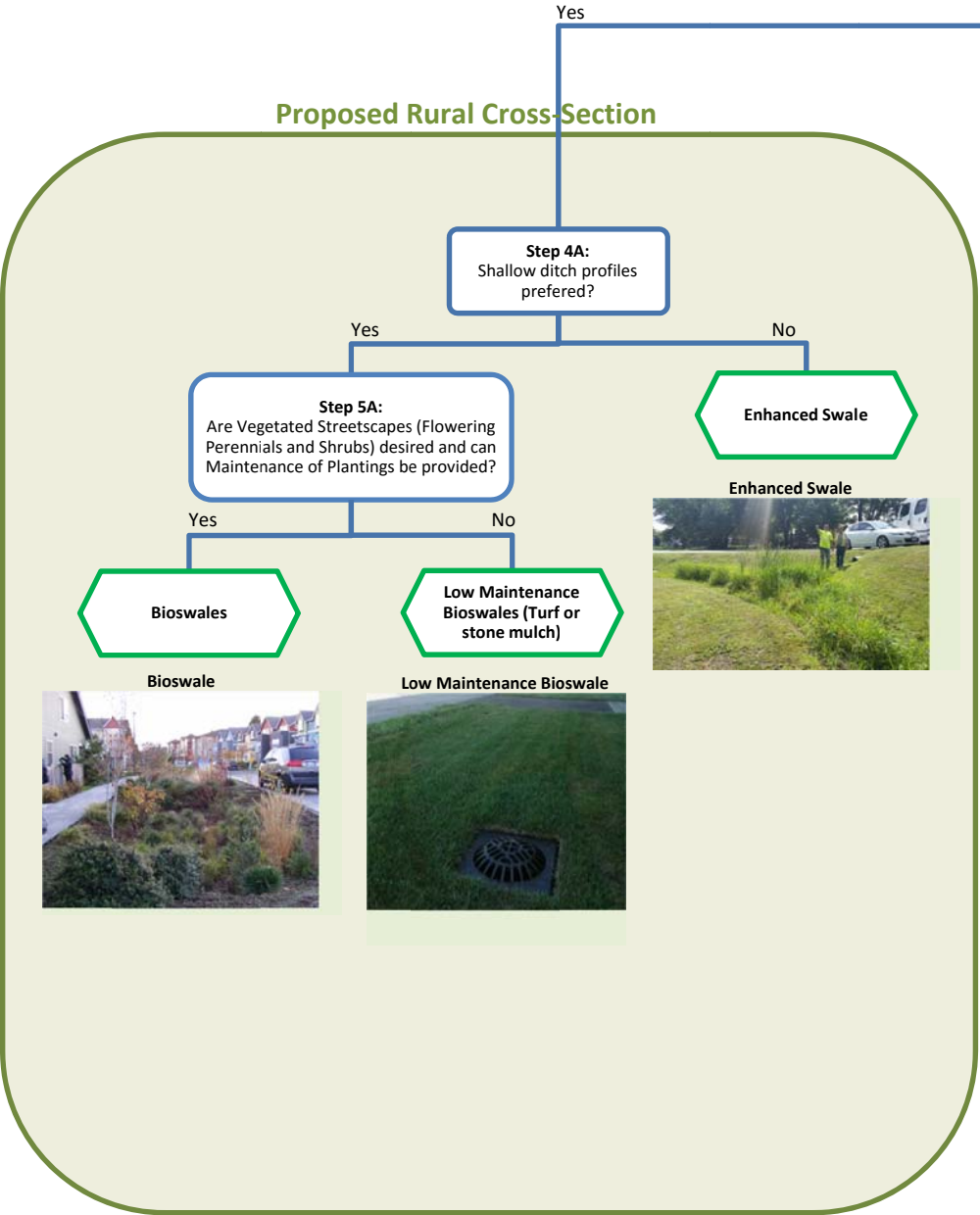
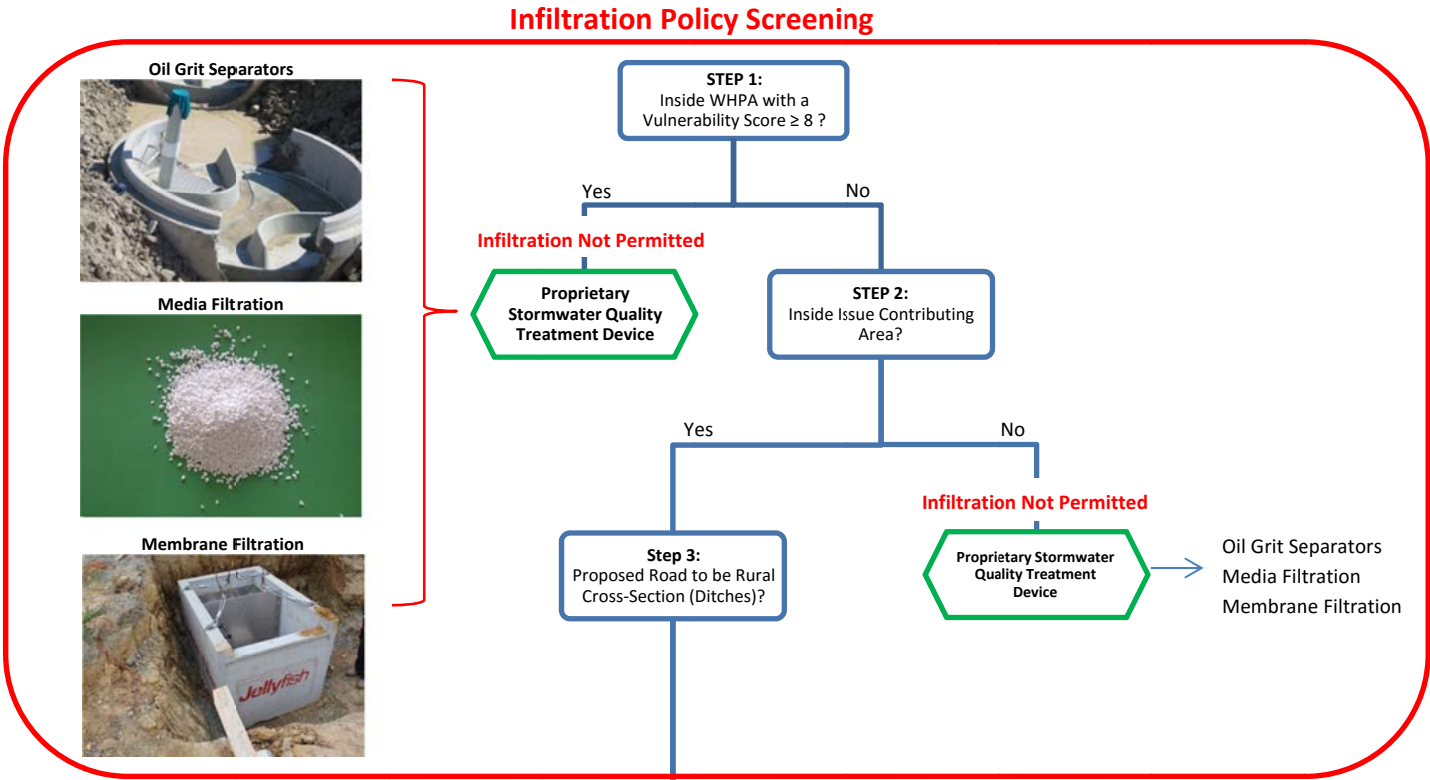
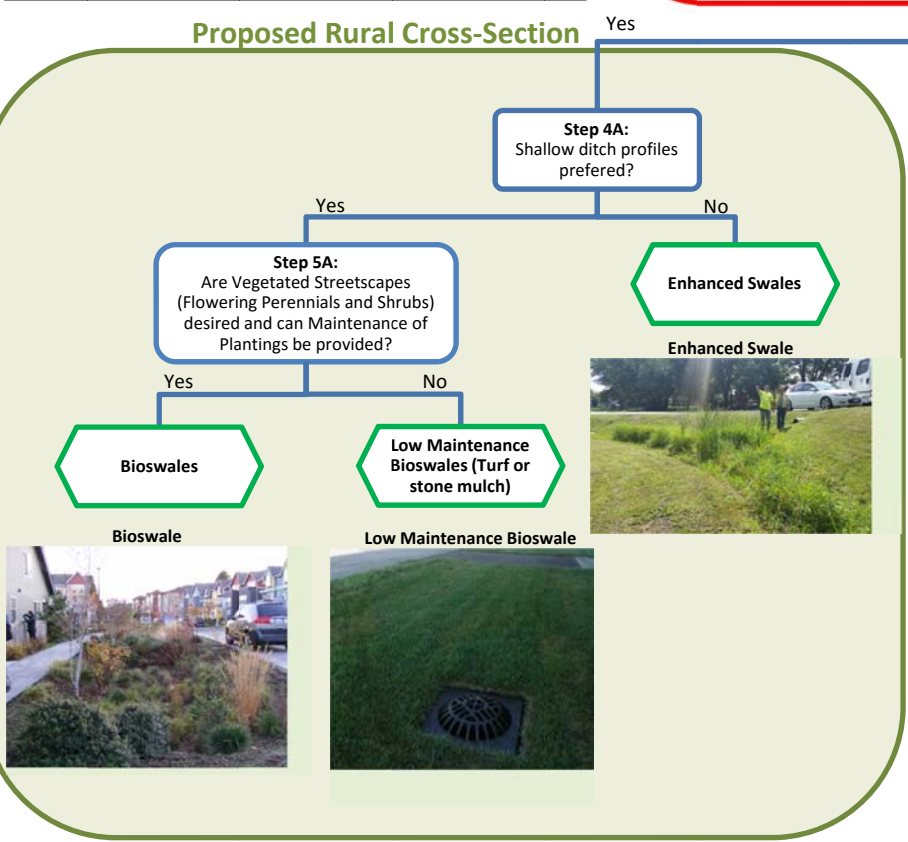
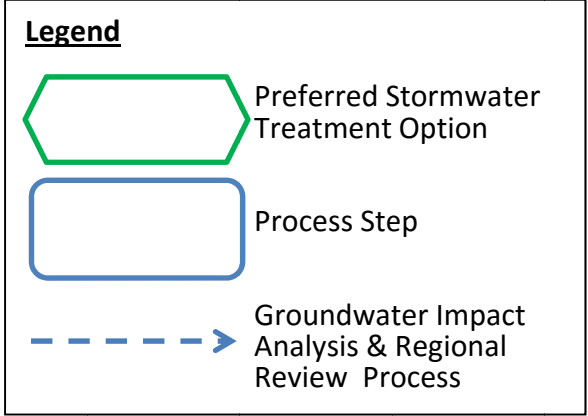
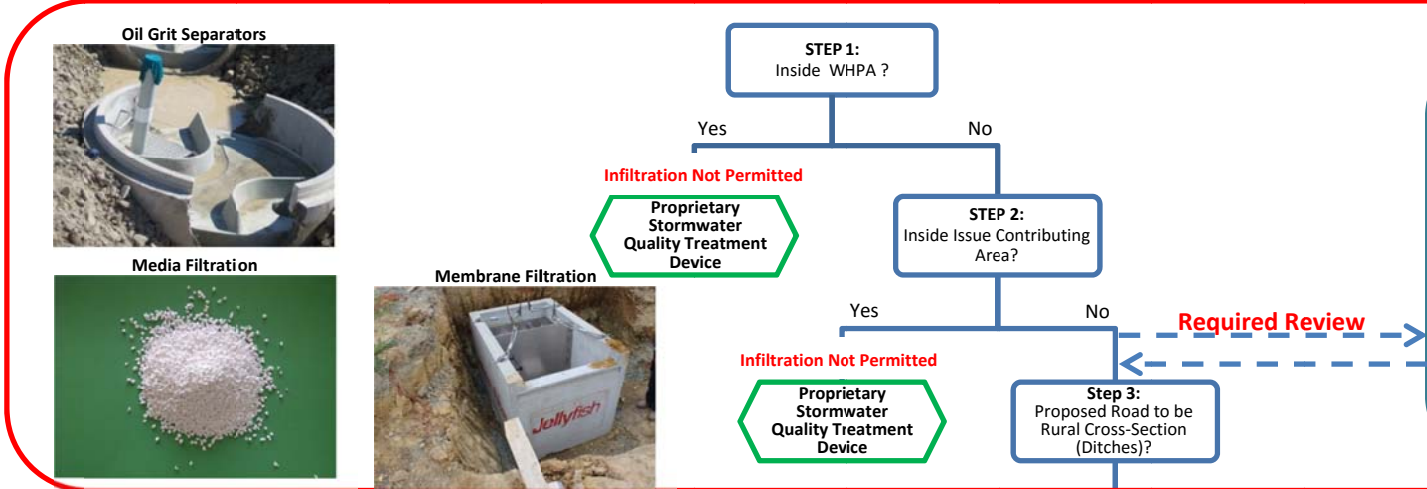


Figure 6.3.3: Major Road Retrofit Decision Making Process



Infiltration Policy Screening



Groundwater Impact Analysis & Regional Review Process

MAJOR ROADS - In order to use infiltration based LIDs on major roads in the City of Kitchener, an analysis of potential impacts to groundwater especially those relating to chloride loading must be undertaken. This analysis should identify the average chloride load expected from the road segment, the receiver characteristics and may suggest mitigation measures such as impervious kill strips, recued chloride application rates or alternate de-icers etc. Those projects that do not satisfy Region of Waterloo Groundwater Impact Analysis requirements should not utilize infiltration based LID practices but may use Proprietary Stormwater Quality Treatment Devices.

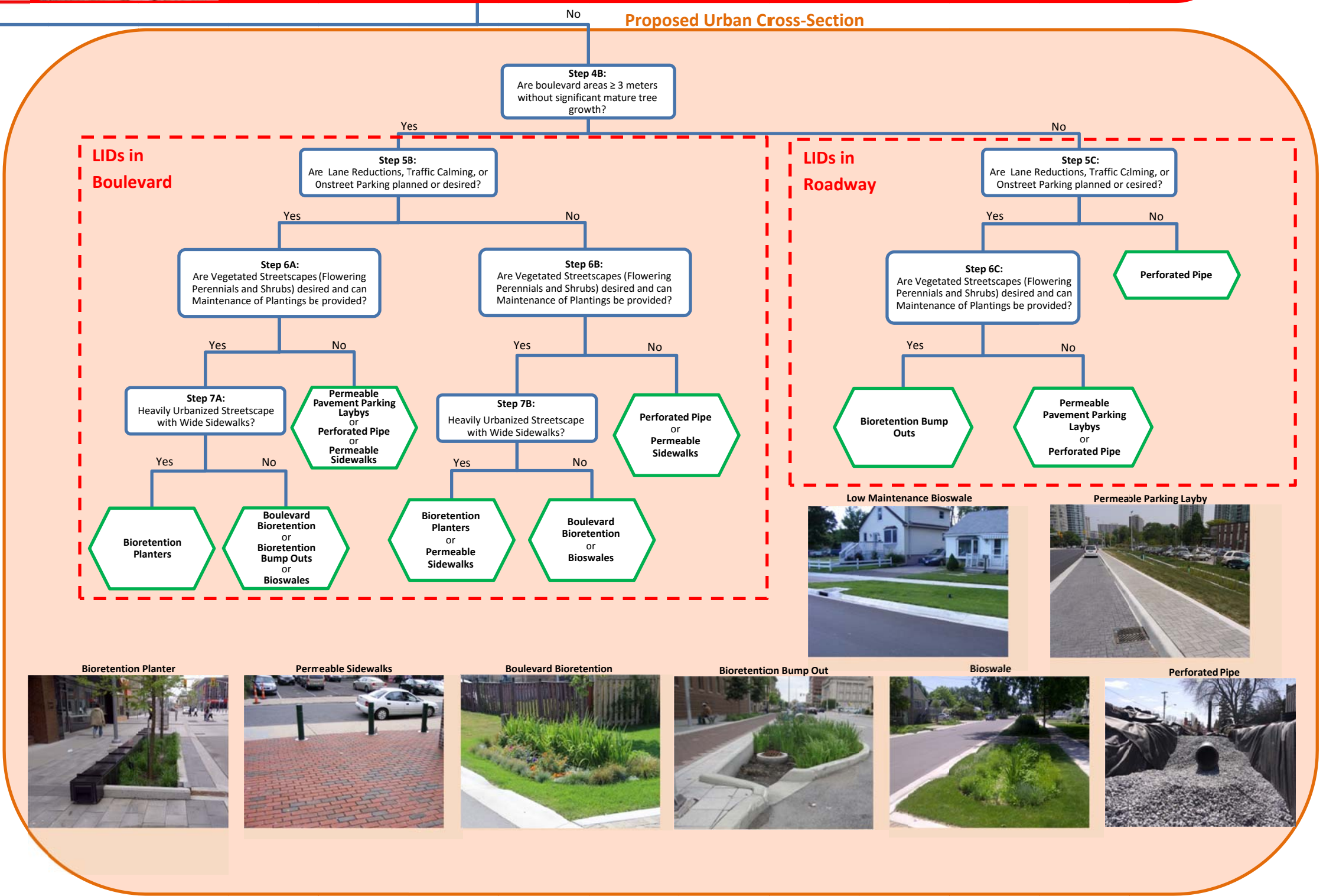
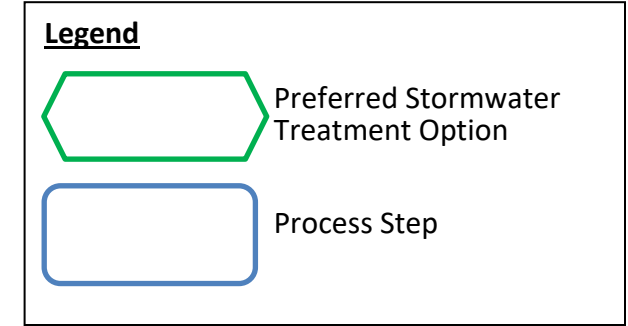


Figure 6.3.4: Laneway Retrofit Decision Making Process



Proprietary Stormwater Quality Treatment Devices

Oil Grit Separators



Media Filtration



Membrane Filtration

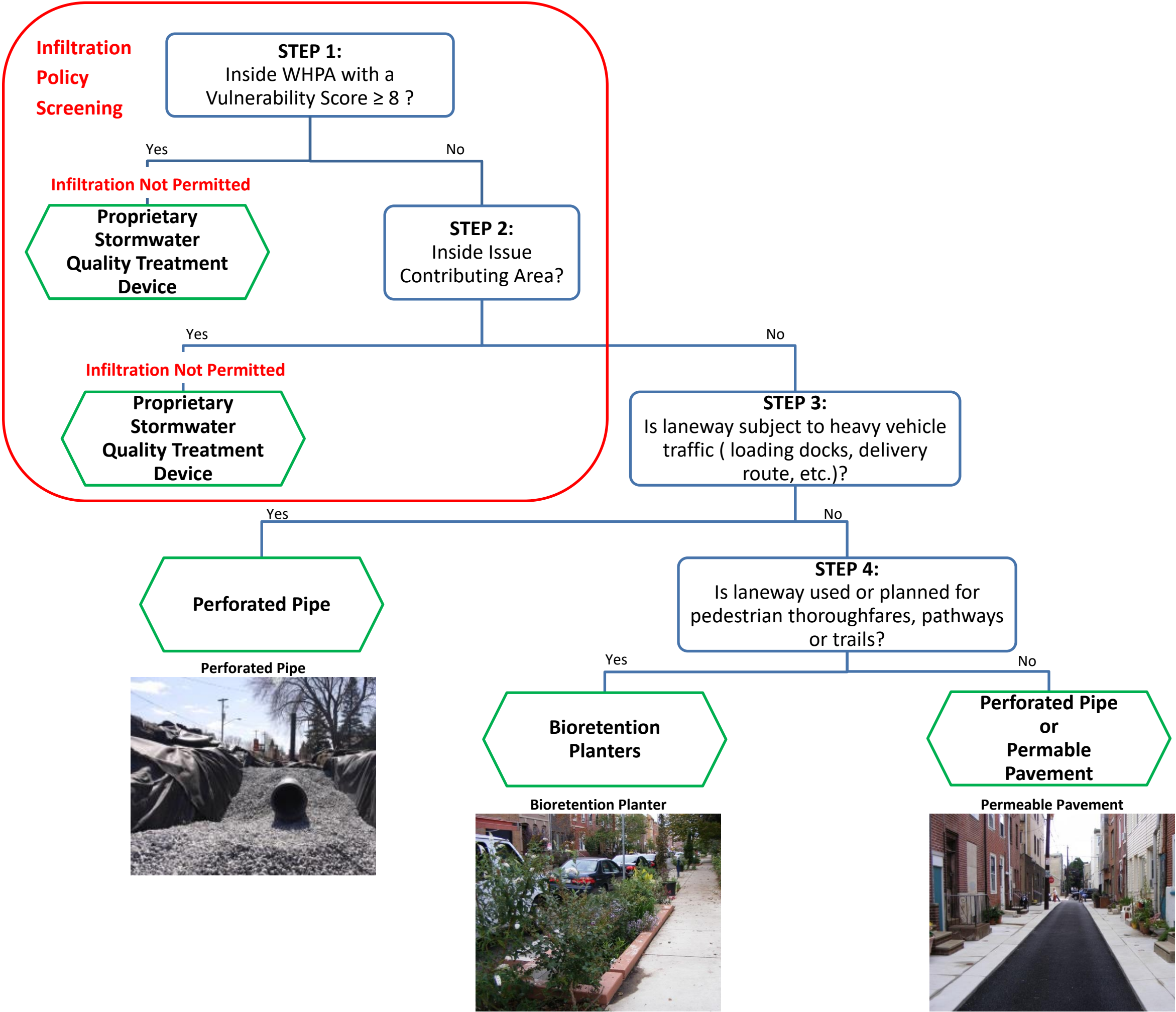
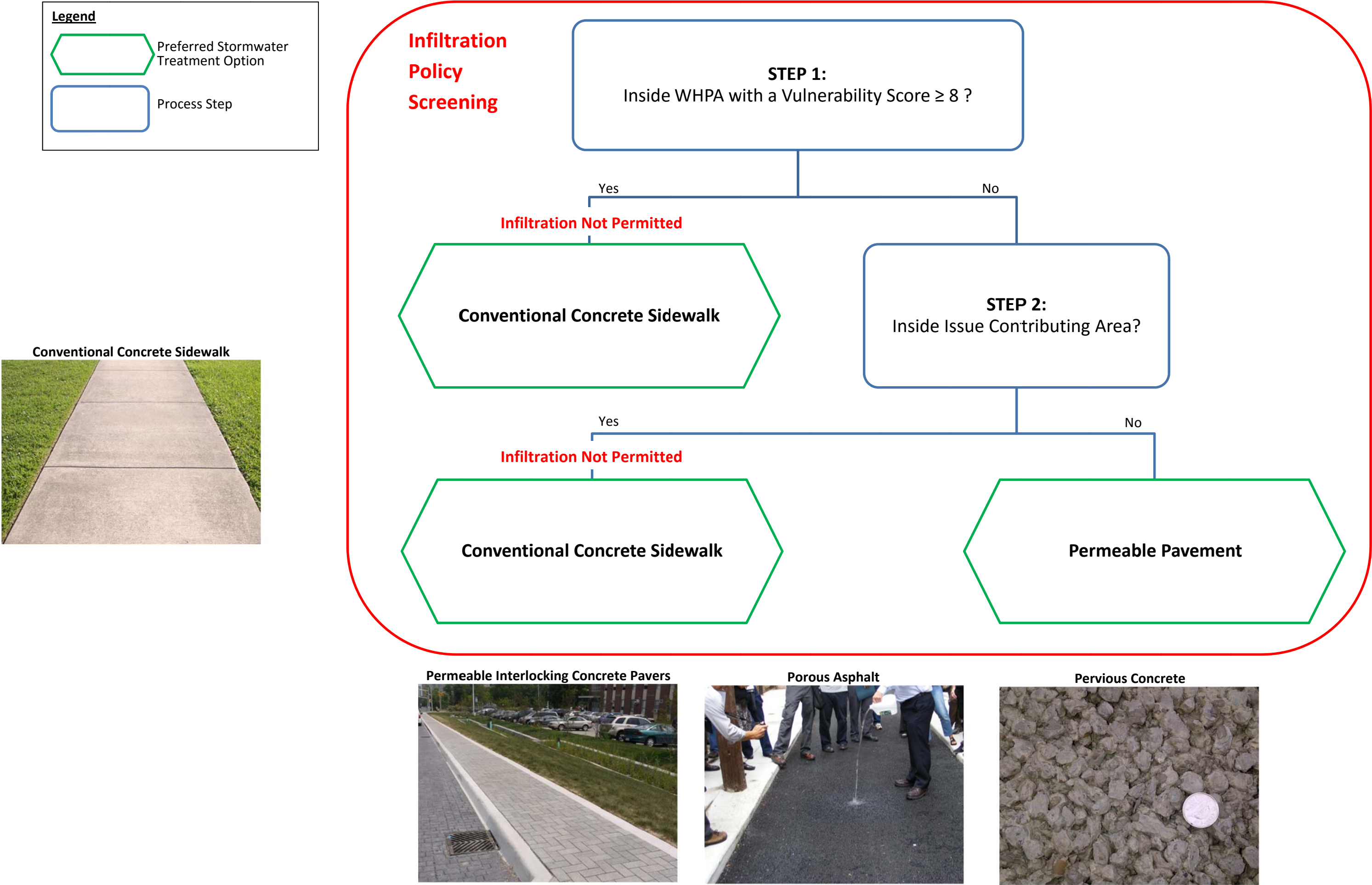


Figure 6.3.5: Sidewalk and Trails Retrofit Decision Making Process



6.3.5 Development Requirements

The **Stormwater Targets and Volume Criteria** document (**Attachment B**) developed as part of the City's ISWM-MP specifically outlines volume requirements for linear development including road reconstruction and road resurfacing projects. The criteria for linear projects states that:

- a) New linear projects without restrictions and subject to the City of Kitchener Infiltration Policy, that create 0.5 or greater hectares of new and/or fully reconstructed impervious surfaces, shall capture and retain the larger of the following:
 - I. The first 6.25 mm of runoff from the new and fully reconstructed impervious surfaces on the site
 - II. The first 12.5 mm of runoff from the net increase in impervious area on the site
- b) Roadway reconstruction, mill and overlay and other resurfacing activities are not considered new linear projects and shall achieve volume reduction to the maximum extent possible (MEP) subject to the City of Kitchener Infiltration Policy.

6.3.6 Cost

Over the first three (3) years of the study an annual budget of \$250,000 has been allocated for the development of LID road standards and specifications and implementation of priority pilot projects. Integrating LID into road reconstruction projects will be absorbed by the Accelerated Infrastructure Renewal Program (AIRP) as a core engineering standard as of the year 2020.

There is also an increase in road replacement costs when LID features are incorporated into the design. The City will require an additional \$1.9 to \$11.1 million in funding for turf and highly vegetated streetscaping options, respectively compared to the road replacements without conveyance controls. This \$1.9 to \$11.1 Million includes all 203 evaluated capital roads projects.

Laneway implementation would require an additional \$1.7 million in funding or result in a savings of \$330,000 for permeable pavements versus perforated pipe respectively. Individual project cost for each of the evaluated roads and t and laneway projects are included in the **Integrated Stormwater Management Master Plan – Municipal ROW (Conveyance Control) Retrofit Assessment Opportunities Report** (May, 2016) included as **Appendix G of the ISWM-MP Report**.

6.3.7 Timeframe

The conveyance control implementation schedule can be broken into two (2) phases.

Phase 1 takes place from 2017 through 2019 and includes the development of LID road standards and specifications and implementation of priority pilot projects. During this phase the City's Development Manual will be updated to reflect LID practices and the City's maintenance period for all ROW LID approaches will be reviewed in the context of standard City of Kitchener tender and special provisions. The City will also begin to implement conveyance control practices on roads that have been given a preferred alternative in the **Integrated Stormwater Management Master Plan – Municipal ROW (Conveyance Control) Retrofit Assessment Opportunities Report** (May, 2016) included as **Appendix G of the ISWM-MP Report**.

Phase 2 takes place from 2020 through 2030 and involves an aggressive retrofit schedule. In this phase, additional capital roads projects with preferred alternatives are retrofitted with LIDs and select capital roads projects that do not have preferred alternatives are evaluated via the conveyance control decision framework (**Figures 6.3.1 to 6.3.5** for Local Roads, Minor Roads, Major Roads, Laneways and Sidewalks & Trails respectively) to determine opportunities for further conveyance control implementation.

6.3.8 Integration

Public transportation, active transportation, and the urban forestry are all components of the municipal ROW. Road reconstruction projects, including those that incorporate LID features into the ROW, should be designed with consideration of these systems.

The **Integrated Stormwater Management Master Plan – Municipal ROW (Conveyance Control) Retrofit Assessment Opportunities Report** (May, 2016) outlines how the implementation of conveyance controls will be integrated with the following municipal programs and priorities:

- a) **Public Transportation:** Station Area Plans should be viewed as an opportunity to provide SWM control within areas of the City which currently lack SWM control. It is recommended that the opportunity for source and conveyance control SWM practices be integrated into Station Area Plans where feasible in order to mitigate the hydrologic and water quality impact of urbanization.
- b) **Active Transportation:** There are several ways that LID practices can be integrated into active transportation systems. It is recommended that where possible source and conveyance control SWM practices be integrated into new active transportation infrastructure.
- c) **Urban Forestry:** At the detailed design stage for each capital roads project, the project is recommended to proceed with ‘twin objectives’ such that the project can incorporate new SWM infrastructure to achieve SWM objectives as well as achieving Urban Forestry objectives. As noted above these ‘twin objectives’ are one-in-the-same from a stormwater perspective, as trees reduce stormwater impacts, flows and volumes.

Other municipal programs that provide opportunities for integration with the conveyance control strategy are:

- Multi-Use Pathways and Trails Master Plan (May 2012)
- Cycling Master Plan (2010)
- New Secondary Plan Areas
- Grand River Water Management Plan (2014)
- Grand River Source Protection Plan (LERSPC 2012, Approved 2015, effective July 1, 2016)
- Wastewater

6.3.9 Prioritization

It is important to note that implementation of conveyance controls within the municipal ROW is opportunistic in that they are incorporated into planned road reconstruction projects. When deciding between funding conveyance control retrofits of equal feasibility, subwatershed prioritization (**Section 4.0**) should be used to determine retrofit priority.

6.3.10 Operation and Maintenance

The following steps should be followed to develop an operation and maintenance program for LID practices implemented within the municipal ROW.

Step 1: Establish an Operations and Maintenance (O&M)- approach which determines the level of maintenance assumed by the municipality and/or undertaken by private land owners.

Step 2: Develop a “Level of Service Model” which details the maintenance program activities and efforts based on the selected maintenance approach. Evaluation of the maintenance requirements of individual LID practices is required at this stage.

In general there are three (3) O&M approaches for LID measures implemented within municipal ROWs.

- **Approach 1:** Private Owner Maintenance – private property owners are responsible for performing ongoing stormwater facility maintenance with municipal guidance and oversight.
- **Approach 2:** Municipal Maintenance – the municipality is responsible for performing ongoing on-site LID maintenance.
- **Approach 3:** Hybrid – a combination of Approach 1 and 2 with clearly defined roles

Table 6.3.10.1 summarizes the requirements/ steps associated with each approach and the advantages and disadvantages to each.

Table 6.3.10.1: O&M Approaches for LID Measures with Municipal ROWs

Maintenance Approach	Typical Requirements /Steps	Advantages	Disadvantages
1. Private Owner Maintenance	1. Develop/ adopt program documents 2. Mandatory maintenance plan for site plan approval 3. Develop homeowner outreach program and materials 4. Develop Inspection Procedures 5. Establish tracking system 6. Compliance enforcement procedures	Reduced costs to the municipality	Municipality required to undertake steps 3-6 Policy and by-law revision required
2. Municipal Maintenance	1. Collect a detailed inventory of all LID controls 2. Establish maintenance policies 3. Mandatory easement requirement for site plan approval (new development) 4. Train inspectors and approvals staff 5. Develop tracking system 6. Perform and document maintenance activities	Avoidance of enforcement issues, and increased control over maintenance frequency May utilized contractors to performance maintenance to reduce costs	High costs, extensive staffing requirements and administrative burden
3. Hybrid	Combination of Approaches 1 & 2	Provides maximum flexibility. Ability to shift some (typically more frequent) maintenance to the landowner.	

There are advantages and disadvantages to each operation and maintenance approach. Adequate training and assembly of maintenance program documents is strongly advised to provide the necessary knowledge required to properly maintain LID practices.

Maintenance requirements for most conveyance control technologies have little difference from most turf, landscaped, or natural areas and do not typically require new or specialized equipment. LID techniques are green 'infrastructure' and do therefore provide a necessary function in communities. The relative importance of this function requires that maintenance personnel and inspectors are well versed in the design, intended function and maintenance requirements of each system. Just as contractor education is critical to ensure proper post-construction function, the education and training of the individuals servicing LID facilities is vital to their long continued operation

Section 10 of the Integrated Stormwater Management Master Plan – Municipal ROW (Conveyance Control) Retrofit Assessment Opportunities Report (May, 2016) included as **Appendix G of the ISWM-MP Report** provides detailed description of operation and maintenance (O&M) activities including inspection and maintenance requirements as well as detailed O&M costs for the approaches of bioretention and bioswales, perforated pipes and permeable pavements.

6.3.11 Recommendations

The following summarizes the recommendations in the **Integrated Stormwater Management Master Plan – Municipal ROW (Conveyance Control) Retrofit Assessment Opportunities Report** (May, 2016) included as **Appendix G of the ISWM-MP Report**.

- It is recommended that the City update road cross section drawings as well as relevant sections in the Development Manual to reflect LID opportunities as identified in this report.
- It is recommended that the City investigate whether access agreements with other utilities (i.e., Bell, Rogers, etc.) may need to be altered to ensure that the installed LIDs are restored or consider implementing enhanced road cut permits which include rectification bonds. Implementation of a “Green Streets Fund” would allow for application of a fee based system on all road cut permits where fees are equal to a nominal percentage of total capital (actual or estimated) construction budget. Collected fees would be primarily allocated to verification of appropriate rectification post construction as well as to future municipal ROW retrofit projects and operation and maintenance activities.
- Maintenance period for all ROW LID approaches should be reviewed in the context of standard City of Kitchener tender and special provisions, specifically the requirement for extended contractor maintenance periods and enhanced guarantees.
- It is further recommended that the City integrate source and conveyance control SWM practices (as detailed in this report) as part of into the Station Area Plans, where feasible, to mitigate the hydrologic and water quality impact of urbanization.
- It is recommended that at the detailed design stage for each capital roads project, that the project proceed with ‘twin objectives’ such that the project can incorporate new SWM infrastructure to achieve SWM objectives as well as achieving Urban Forestry objectives. These ‘twin objectives’ are one-in-the-same from a stormwater perspective, as trees reduce stormwater impacts, flows and volumes. The various LIDs which include soil media as outlined within this report are capable of supporting trees provided adequate soils volume and depth is provided as part of detailed design per Grey to Green Road Retrofit Guide (CVC, 2013) and the LID Stormwater Planning and Design Guide (2010, v1.0 or most recent) and City standards. Consideration during detailed design should also be given to situations where trees are proposed as part of the current project as well as the potential for future tree planning within the same area. Provisions for future tree plantings as part of ROW Retrofit design is also therefore recommended.

6.4 Stormwater Management Facilities

Stormwater management (SWM) facilities are an important component of the City of Kitchener's current stormwater assets. The management of existing facilities and the construction of new SWM facilities is critical to ensure stormwater infrastructure maintain their effectiveness and that pollutants are prevented from impacting the environment. One-hundred and forty-two (142) active SWM facilities are owned and operated by the City.

In order to understand the existing drainage areas contributing to each SWM facility, to assess sediment accumulation within existing SWM facilities and identify opportunities for new SWM facilities a series of three (3) technical reports have been prepared in support of the ISWM-MP. These technical reports are included within the ISWM-MP appendices and are summarized in the following sections and include:

- **"ISWM-MP Municipal Class EA - Stormwater Management Facilities Catchment Report (May, 2016)" included as Appendix H of the ISWM-MP Report.**
- **SWM-MP Municipal Class EA - Sediment Analysis Memo: SWM Facilities and OGS Units (May, 2016)" included as Appendix E of the ISWM-MP Report.**
- **SWM-MP Municipal Class EA - End-of-Pipe SWM Facility Opportunities Report (New Facilities) (April, 2016) included as Appendix I of the ISWM-MP Report.**

Based on the analysis undertaken in the above noted reports there are four (4) general approaches to improving the City of Kitchener's end-of-pipe stormwater treatment network, these are:

1. Retrofit existing to improve water quality treatment where feasible;
2. Remove sediment from existing facilities that have water quality and water quality control significantly impacted by sediment accumulation;
3. Construct new SWM facilities in urban areas of opportunity which are typically associated with public parks and trails; and
4. Enhance SWM catchment areas with conveyance and source controls to mitigate the impact of infill development and intensification on existing end-of-pipe facilities and the natural environment

6.4.1 Key Next Steps

Planned Retrofits

At the time the development of the City of Kitchener ISWM-MP, ten (10) SWM facilities were scheduled for retrofit and had satisfied their respective Class EA requirements. Further evaluation as part of the ISWM-MP was therefore not warranted. The ten (10) SWM facilities scheduled for retrofit can proceed directly to detailed design and implementation per the updated prioritization identified in **Table 6.4.1**. Locations are illustrated within **Figure 6.4.1**.

Table 6.4.1 - SWM Facilities Scheduled for Retrofit

Priority	Retrofit Year	SWM Pond #	Year of Construction	Facility Type	Control Type	Drainage Area (ha)
1 (Retrofit Underway)	2016	6 ¹	1982	Dry Pond	Quantity	6.18
2	2017	66 ²	1963	Wet Pond	Quantity	17.1
3	2017	21 ³	1990	Wetland	Quantity	31.4
4	2018	10 ³	1991	Dry Pond	Quantity	59.6
5	2018	111 ⁴	*	Wet Pond	Quantity	25.8
6	2019	16 ³	1987	Dry Pond	Quantity	5.9
7	2019	7 ³	1986	Wetland	Quantity	17.2
8	2020	65 ²	1963	Wet Pond / Dry Pond	Quantity	53.6
9	2021	62 ⁴	1963	Wetland	*	0
10	2022	61 ²	1963	Wet Pond	Quantity	42

1 -Schedule B: Municipal Class EA Report - Kolb Creek (Aquafor Beech Ltd., 2013)

2- Municipal Class EA, Schedule B: Strasburg Creek (North Branch) Ponds 65, 66 & 61 (Aquafor Beech Ltd., 2011)

3- City of Kitchener Stormwater Management Facility Retrofit, Class EA and Preliminary Design Brief (Aquafor Beech, 2010)

4 –SWM Audit (2002-2010). Note: SWM Facility 62 - recent sediment removals completed in 2015. Additional review may be required prior to undertaking retrofit activities.

* - Unavailable data



City of Kitchener Stormwater Management Master Plan

Legend

- Study Area
- Municipal Boundary
- Watercourses

Planned Retrofits

- 6
- 7
- 10
- 16
- 21
- 61
- 62
- 65
- 66
- 111

Previously Retrofit

- 4
- 22
- 30
- 54
- 107
- 144
- 151
- 152

Not Feasible Retrofits

- 18
- 109

Source: City of Kitchener

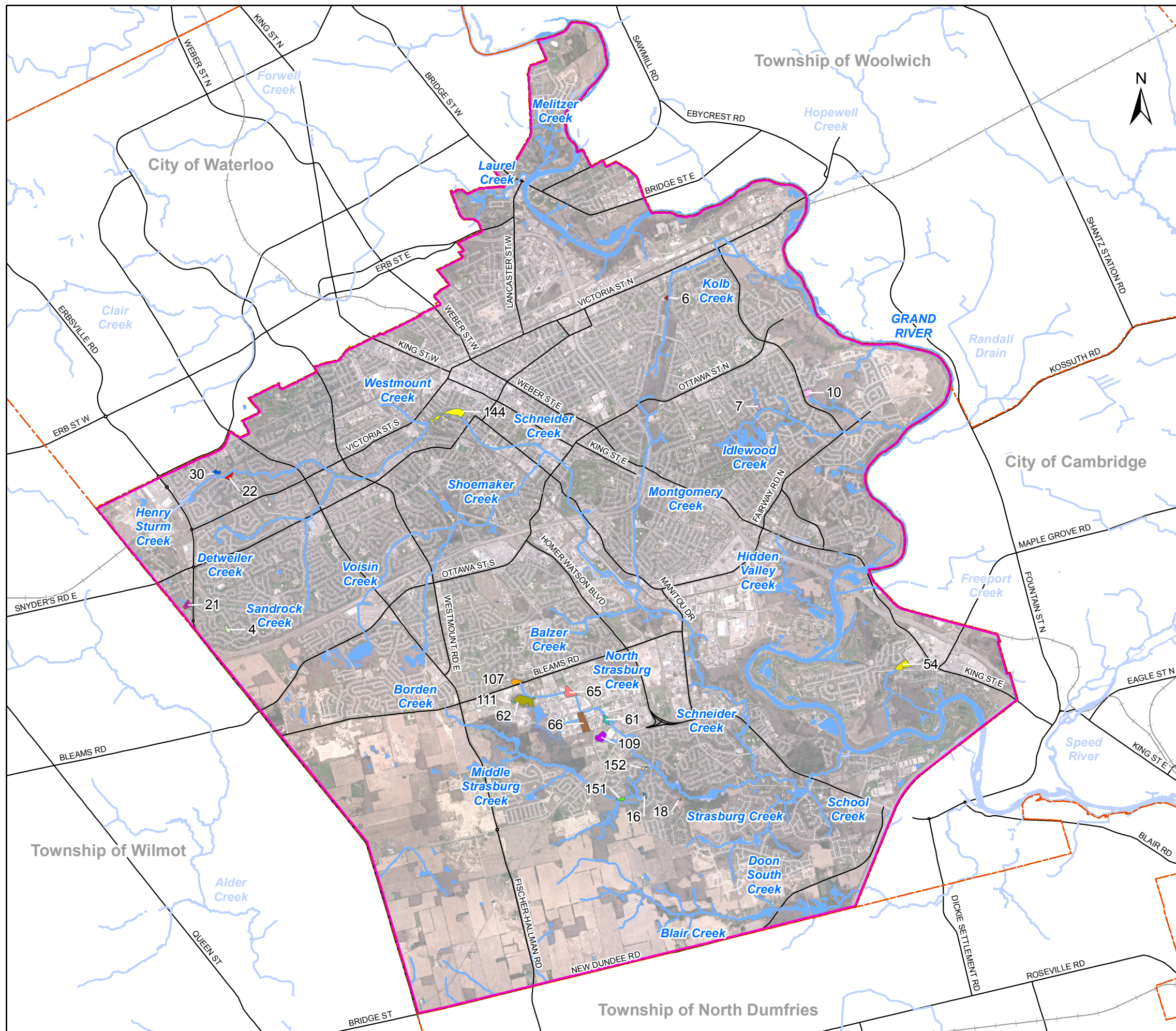
Figure 6.4.1

Stormwater Management Facility Retrofits

0 0.5 1 2 3 Km



Date: May 2016



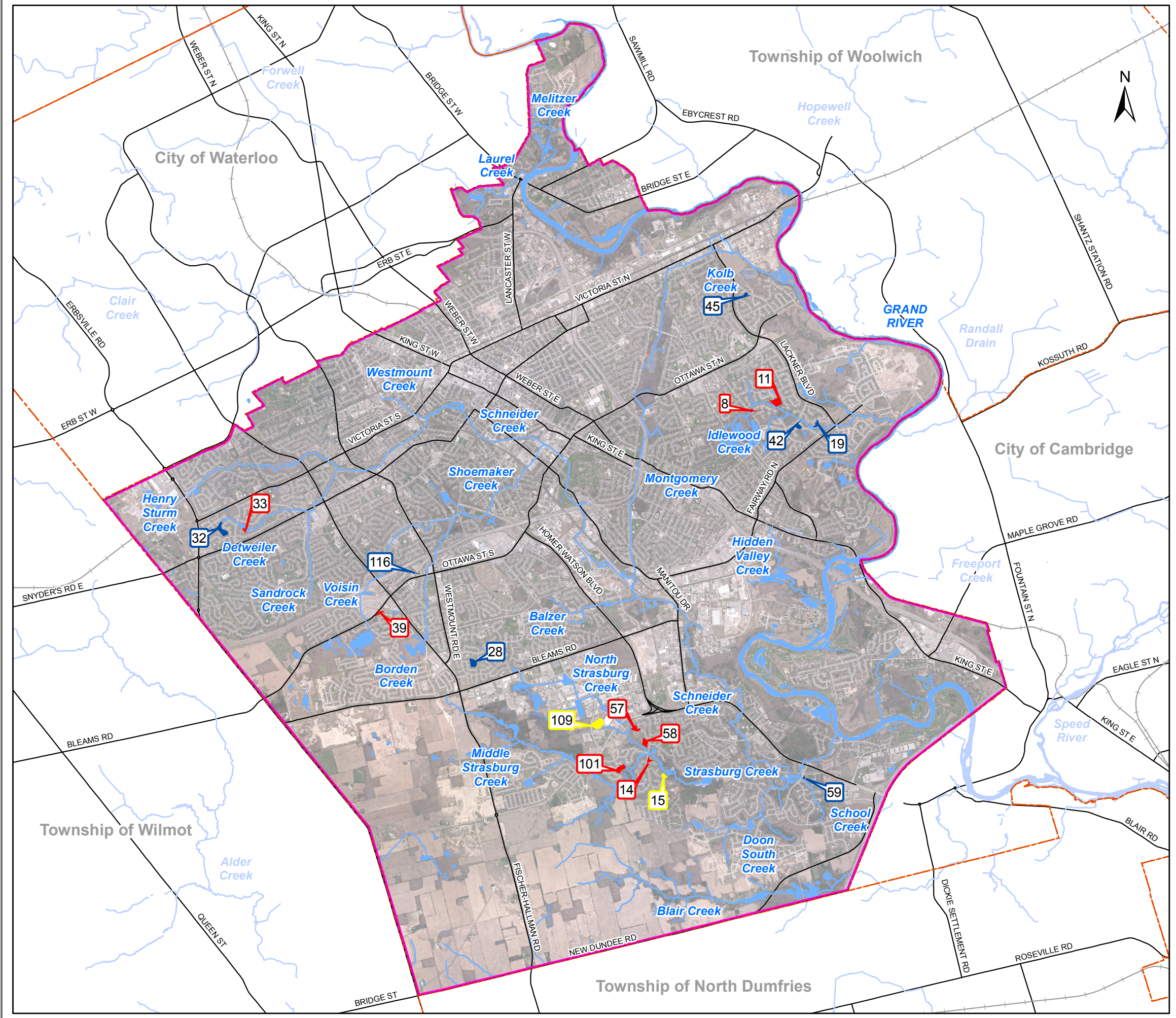
Sediment Removals

In order to ensure long-term operational effectiveness of SWM facilities, it is crucial to remove accumulated sediment periodically per the conditions of the respective MOECC Environmental Compliance Approval (ECA). The maintenance frequency depends on several aspects, such as type of facility, design storage volume, characteristics of the catchment area and municipal practices. Sediment accumulation compromises the effective storage volume and the long-term efficiency of suspended solids retention.

The ISWM-MP explored approaches to manage pollutants and sediment within the City's SWM facilities in the most cost effective manner. The sediment study has been completed following Schedule A/A+ of the Municipal Class EA process, and therefore the associated works are pre-approved.

The locations of Dry Ponds (without permanent pools) that were identified as requiring sediment removal are identified in **Figure 6.4.2**

The locations of Wet Ponds (with permanent pools) that were identified as requiring sediment removal are identified in **Figure 6.4.3**.

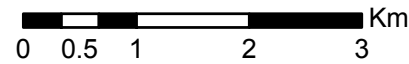


City of Kitchener Stormwater Management Master Plan

- Legend**
- Study Area
 - Municipal Boundary
 - Watercourses
- Dry SWM Facilities with Maintenance Priority**
- High Priority
 - Moderate Priority
 - Low Priority

Source: City of Kitchener

Figure 6.4.2
Dry SWM Facilities with Maintenance Priority



Date: May 2016



City of Kitchener Stormwater Management Master Plan

Legend

- Study Area
- Municipal Boundary
- Watercourses

Priority Wet Pond SWM Facilities

- High Priority
- Moderate Priority
- Low Priority

Source: City of Kitchener

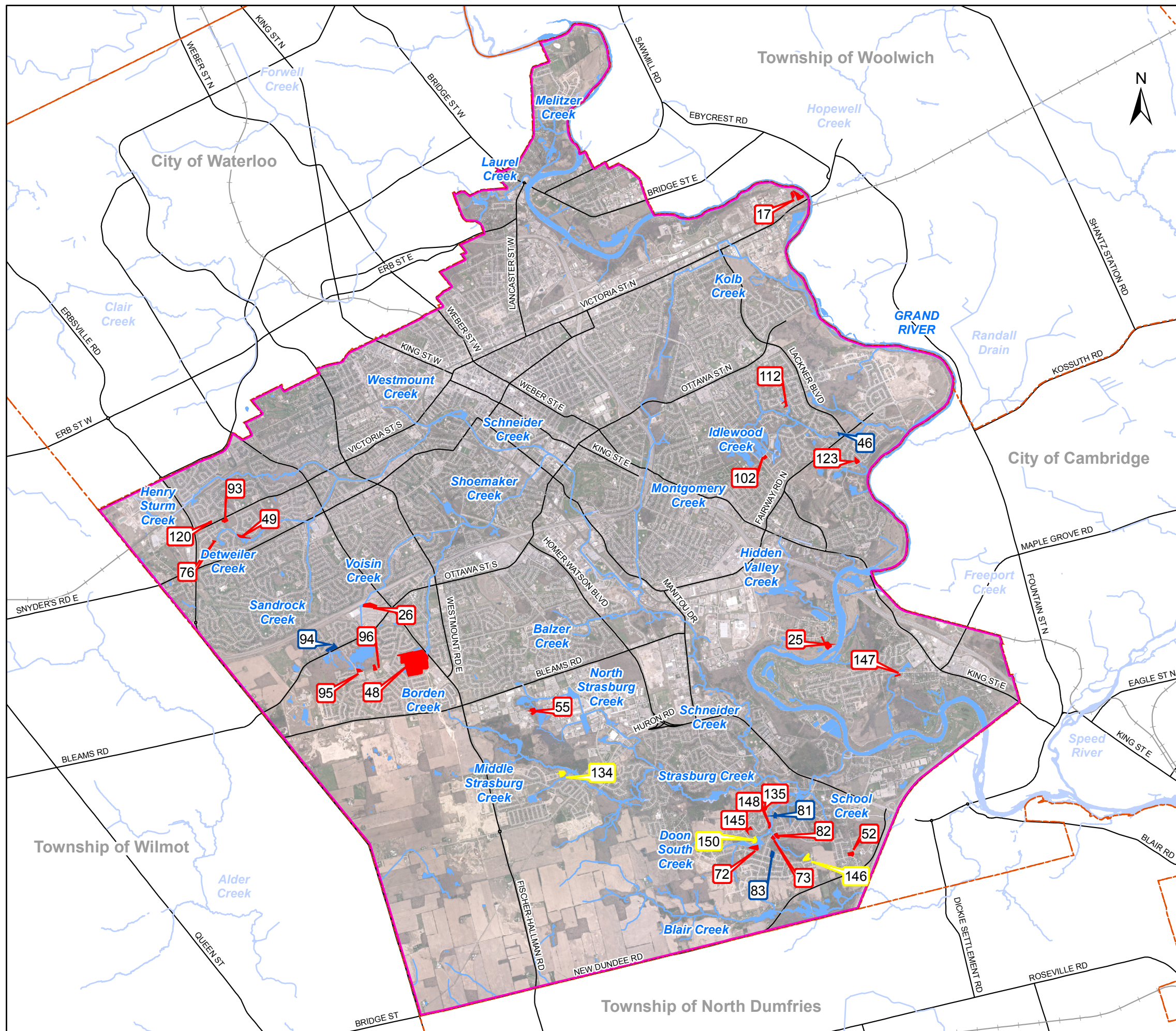
Figure 6.4.3

Wet SWM Facilities with Maintenance Priority

0 0.5 1 2 3 Km



Date: May 2016



Park Rehabilitation and SWM Enhancements (New SWM Facilities)

New end-of-pipe stormwater management facilities are to be constructed in parks within existing urban areas of the City without stormwater control to increase the proportion of SWM controlled drainage areas in the City to improve:

- Water quality control
- Water quantity control
- Erosion control

The recommended approach includes the construction of twelve (12) new stormwater management facilities as part of park rehabilitations. Details including preliminary design and associated sizing are available in the ISWM-MP **End-of-Pipe SWM Facility Opportunities Report** (April, 2016).

The location and preferred alternatives for each the twelve (12) SWM opportunities are illustrated within **Figure 6.4.4**.



City of Kitchener Stormwater Management Master Plan

Legend

- Study Area
- Municipal Boundary
- Watercourses
- Potential SWM Facility

Source: City of Kitchener

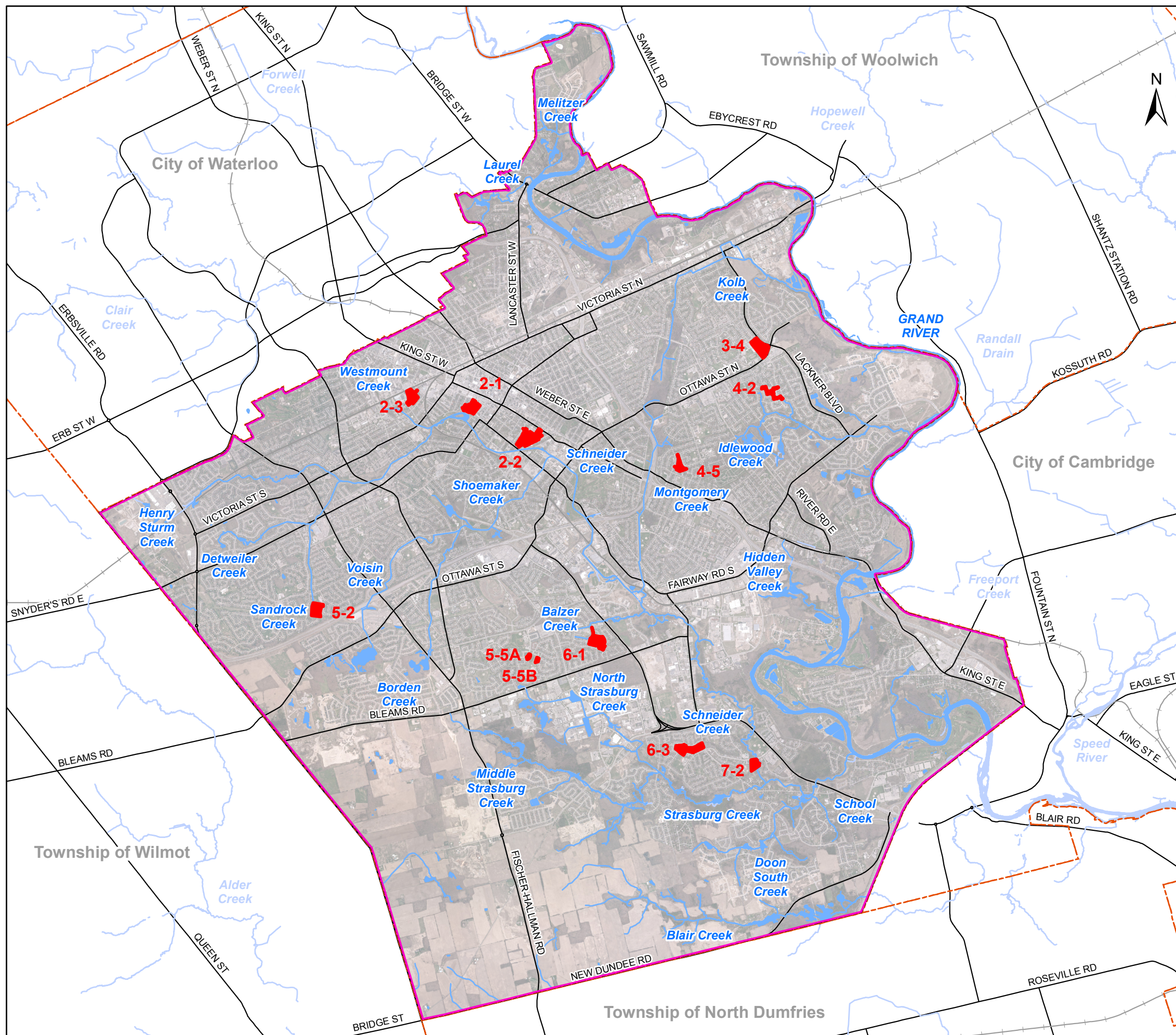
Figure 6.4.4

Potential Stormwater Facility Locations

0 0.5 1 2 3 Km



Date: May 2016



6.4.2 Future Studies

Priority Catchment Studies

SWM facility catchment analysis has indicated that changes to the catchment areas including directing unplanned subcatchments to SWM facilities and increases in the imperviousness of the catchment areas has resulted in some City of Kitchener SWM facilities no longer being able to provide the designed level of quality control. Based on the risk classification undertaken in the **ISWM-MP Municipal Class EA**, the following SWM facilities are at a high risk of failing to meet the original design objectives are **Facilities 70, 2, 76, 44, 1, 119, 19, 12 and 25**. The results of this analysis can be used as the foundation for further study and the development of new strategies targeting these catchment areas for SWM facility retrofits and LID implementation.

Studies to Address SWM Facility Data Gaps

Based on the data gap analysis conducted for the Sediment Analysis Memo, the report recommends the development of studies to gather structural and operational data at the following facilities:

- **SWM Facilities number 5, 41, 63, 64, 75, 105, 106, 108, 124, 129 and 156**

Sediment data also seemed to be inconsistent and did not exist for most of the facilities. To fill in this data gap it is recommended that the City undertake a more complete SWM facility bathymetry study as a mean of collecting more accurate and complete sediment data for all facilities.

6.4.3 Approvals, Policy, By-law or Design Standards Consideration

SWM Facility Retrofits

The study and resulting recommended retrofit works have been completed following Schedule B of the Municipal Class EA process and therefore can proceed directly to detailed design and implementation.

MOECC Environmental Compliance Approval (ECA) per Section 53 of the Ontario Water Resources act / Application for Approval of Municipal and Private Sewage works will be required prior to retrofit construction.

MNRF permits will only be required where projects may impact Species at Risk. Under the Endangered Species Act, the Ministry of Natural Resources can grant permits or other authorizations for activities that would otherwise not be allowed, with conditions that are aimed at protecting and recovering species at risk.

DFO administers development requirements relating to aquatic habitat under the Fisheries Act. This applies to work being conducted in or near waterbodies that support fish that are part of or that support a commercial, recreational or Aboriginal fishery. It is not anticipated that DFO approval will be required for any of the retrofits.

A permit under Ontario regulation 150/06 - Development, Interference with Wetlands and alterations to Shoreline Watercourse will be required through the GRCA any facilities within regulations limits that

is an on-line facility, impacts a wetland or requires the establishment of an outlet. Permits for the maintenance of SWM facility blocks are not generally required from GRCA.

SWM Facility Sediment Removal

Public consultation is not required for sediment removal projects, instead public notice will be issued prior to these activities. In cases where facilities are within habitat of species at risk, MNRF permitting under the Endangered Species Act will be required.

Park Rehabilitation and SWM Enhancements (New SWM Facilities)

The study and resulting recommended works for new SWM facilities have been completed following Schedule B of the Municipal Class EA process and therefore can proceed directly to detailed design and implementation. The City has however acknowledged that Public Consultation will still be undertaken as each new facility is implemented.

MOECC Environmental Compliance Approval (ECA) per Section 53 of the Ontario Water Resources act / Application for Approval of Municipal and Private Sewage works will be required prior to the construction of all new SWM facilities.

MNRF permits will only be required where projects may impact Species at Risk. Under the Endangered Species Act, the Ministry of Natural Resources can grant different types of permits or other authorizations for activities that would otherwise not be allowed, with conditions that are aimed at protecting and recovering species at risk.

DFO administers development requirements relating to aquatic habitat under the Fisheries Act. This applies to work being conducted in or near waterbodies that support fish that are part of or that support a commercial, recreational or Aboriginal fishery. To protect fish and fish habitat, efforts should be made to avoid, mitigate and/or offset harm. A self-assessment will need to be undertaken for new park projects involving works in wetlands and watercourses.

A permit under Ontario regulation 150/06 - Development, Interference with Wetlands and alterations to Shoreline Watercourse will be required through the GRCA for new facilities within regulations limits that impacts a wetland or requires the establishment of an outlet.

6.4.4 Cost

SWM Facility Retrofits

The overall cost of SWM facilities retrofits that are scheduled to occur from 2017 through 2022 is \$7,152,767. **Table 6.4.4.1** identifies the cost of each retrofit project. When allocating funds for these projects in the implementation plan, fifteen percent (15%) of the project budget was allocated to the year before construction for design and eight five percent (85%) was allocated for the construction year. For SWM facility 65, the large scope and associated budget required thirty five percent (35%) to be spent prior to the construction year. For all projects a 2% increase in cost was applied on an annual basis from 2016 in order to account for inflation.

Table 6.4.4.1: Sediment Removal Project Costs

Construction Year	SWM Facility	Type	Subwatershed	Project Cost (\$)
2017	21	Wetland	Alder Creek	280,500
2017	66	Wet Pond	North Strasburg Creek	700,000
2018	10	Dry Pond	Idlewood Creek	1,238,076
2018	111	Wet Pond	North Strasburg Creek	893,183
2019	16	Dry Pond	Strasburg Creek	285,266
2019	7	Wetland	Idlewood Creek	114,106
2020	65	Wet Pond / Dry Pond	North Strasburg Creek	1,976,760
2021	62	Wetland	North Strasburg Creek	285,226
2022	61	Wet Pond	North Strasburg Creek	1,379,650

SWM Facility Sediment Removal

The overall cost of sediment removal from SWM facilities that have been identified as requiring sediment removal as a result of losses in sediment storage capacity is \$2,722,497. Sediment removal is scheduled to begin in 2017 with eight (8) high priority facilities. In total, forty-four (44) facilities are scheduled to undergo sediment removal by 2023. The project costs for sediment removals indicated in **Table 6.4.4.2** are based on unitary costs of \$88/tonne or \$220/tonne. For those facilities where the drainage area was calculated to be less than 30 ha it was assumed that the City would undertake the works and the lower unitary value was used. For facilities where the drainage area was calculated to be at least 30 ha, it was assumed that the sediment removal services would be contracted out and the higher unitary value was used. For all projects a 2% increase in cost was applied on an annual basis from 2016 in order to account for inflation.

Table 6.4.4.2: Sediment Removal Project Costs

Year	SWM Facility	Type	Subwatershed	Project Cost (\$)
2017	39	Dry	Voisin Creek	61,200
2017	26	Wet	Voisin Creek	186,660
2017	109	Dry	North Strasburg Creek	214,200
2017	57	Dry	North Strasburg Creek	2,040
2017	58	Dry	North Strasburg Creek	16,320
2017	33	Dry	Detweiler Creek	56,100
2017	55	Wet	North Strasburg Creek	27,540
2017	48	Wet	Borden Creek	69,360
2018	120	Wet	Detweiler Creek	11,444
2018	76	Wet	Detweiler Creek	2,081
2018	49	Wet	Detweiler Creek	82,192
2018	93	Wet	Detweiler Creek	15,606
2018	25	Wet	East Side	107,161
2018	17	Wet	Kolb Creek	502,513
2018	8	Dry	Idlewood Creek	9,364
2018	11	Dry	Idlewood Creek	97,798
2019	146	Wet	School Creek	14,857
2019	73	Wet	Doon South Creek	7,428
2019	145	Wet	Doon South Creek	15,918
2019	148	Wet	Doon South Creek	15,918
2019	135	Wet	Doon South Creek	11,673
2019	147	Wet	Unnamed Catchment 3	16,979
2020	123	Wet	Idlewood Creek	69,276
2020	102	Wet	Idlewood Creek	28,143
2020	15	Dry	Strasburg Creek	6,495
2020	72	Wet	Doon South Creek	40,050
2020	82	Wet	Doon South Creek	19,484
2020	52	Wet	Blair Creek	42,215
2020	112	Wet	Idlewood Creek	31,391
2021	101	Dry	Strasburg Creek	140,218
2021	14	Dry	Strasburg Creek	35,331
2021	134	Wet	Middle Strasburg Creek	113,720
2022	81	Wet	Doon South Creek	9,009
2022	116	Dry	Borden Creek	4,505
2022	32	Dry	Detweiler Creek	4,505
2022	45	Dry	Kolb Creek	13,514
2023	94	Wet	Borden Creek	118,315
2023	59	Dry	School Creek	50,542
2023	42	Dry	Idlewood Creek	109,125
2023	19	Dry	Idlewood Creek	28,717
2023	150	Wet	Doon South Creek	18,379
2023	83	Wet	Doon South Creek	16,082
2023	46	Wet	Idlewood Creek	14,933
2023	28	Dry	North Strasburg Creek	264,198

Park Rehabilitation and SWM Enhancements (New SWM Facilities)

The implementation of the proposed SWM facility opportunities as part of park rehabilitations is estimated to cost \$43.4 million plus an additional \$4.3 – 8.1 million required for park rehabilitation. Implementation costs for each feasible SWM facility opportunity are summarized in **Table 6.4.4.3**. All of the projects identified are preferred alternatives. For some projects, secondary alternatives are identified in the **ISWM-MP Municipal Class EA** along with associated costs. For all projects a 2% increase in cost was applied on an annual basis from 2016 in order to account for inflation.

Table 6.4.4.3: SWM Facility Opportunities Costs

Construction Year	Location	Recommended Facility Type	Drainage Area (ha)	Estimated Construction Cost (\$) (millions)†
2022	Prospect Park	Surface facility	37	1,325,000
2023	Sandrock Hydro-Corridor	Surface facility	125	4,077,000
2024	Cherry Park	Surface facility	29	1,166,000
2024	Country Side Park	Surface facility	4.7	293,000
2025	Country Side Park	Subsurface facility	4.3	299,000
2025	Country Hill Park	Surface facility	24	832,000
2026	Idelwood Greenway	Subsurface facility	19	2,133,000
2026	Millwood Park	Surface facility	8	305,000
2027	Common areas at Victoria Park	Subsurface facility	27	4,911,000
2028	Biehn Park	Subsurface facility	80	9,637,000
2029	Roseburg Park	Subsurface facility	43	5,239,000
2030	Cameron Heights Pool & Kaufman Park	Subsurface facility	77	13,195,000
†Class 'C' cost estimate				

6.4.5 Funding

In 2017, the existing Stormwater Infrastructure Implementation funds totaling \$1.13 Million will be used along with funds the general Stormwater Utility Revenue for the SWM facility retrofit program along with the SWM facility sediment removal program. In subsequent years, all funding for the retrofits, sediment removals and implementation of new facilities in municipal parks will be allocated from the general Stormwater Utility Revenue.

6.4.6 Timeframe

SWM facility retrofits are scheduled to be completed by 2022.

The SWM facility sediment removals that have been prioritized based on sediment accumulation analysis are scheduled to be conducted from 2017 through 2023. Starting in 2024 and continuing through 2030, six (6) facilities per year are scheduled to undergo sediment removal based on updated sediment accumulation records.

New facility construction in municipal parks is scheduled to start in 2022. All of the identified new SWM facility opportunities will be constructed by 2030.

6.4.7 Integration

SWM facilities are often in or adjacent to public open spaces such as parks and trail networks. As a result there is a potential synergy with parks rehabilitation and enhancements within many SWM facility projects. It has been shown through previous Master Plans for other Ontario municipalities that 'broader community benefits' are required when implementing new SWM facilities in established neighbourhoods in order to gain community support and ensure the project success.

The recommended end-of-pipe SWM works outlined in the ISWM-MP should be integrated with other city initiatives, plans, studies and programs to leverage potential synergies as the opportunities are identified in order to more efficiently achieve overall City goals to increase urban tree canopy, construct new trails and cycle lanes, improve transit and build transit capacity, rehabilitate parks, reconstruct roads as well as improve stormwater management.

During the detailed design of the new SWM facilities located in parks, surface constraints such as impacts to active and passive use of parks and park features, sport fields and trails can be overcome via re-configuration or the implementation of subsurface facilities.

The retrofit of existing SWM facilities and design of new SWM facilities should respect the objective of the following plans:

- **Parks Strategic Plan (September 2010)** which directs the City's investment and initiatives in the future planning, design, acquisition, improvement, management, programming and use of City parks. Of particular relevant to the ISWM-MP are the identified neighbourhood

Parkland Gaps and New/ Planned Neighbourhood Park Development areas as well as the associated rehabilitation plans.

- **Multi-Use Pathways and Trails Master Plan (May 2012)** – which builds upon past and current trail development efforts, and is intended as a blueprint to guide the development and operation of multi-use pathways throughout Kitchener in the short, medium and long term. The plan identifies a strategy for development of a primarily off-road, city-wide multi-use pathways network linking neighborhoods, parks and natural areas, public open spaces, schools, shopping areas and other important destinations. Of particular relevant to the ISWM-MP is the integration of existing or future trail networks with identified SWM opportunity locations.

Additional municipal programs that provide opportunities for integration with the stormwater management facility strategy are:

- Cycling Master Plan (2010)
- Ecological Restoration Areas and Policies
- New Secondary Plan Areas
- Grand River Water Management Plan (2014)
- Grand River Source Protection Plan (LERSPC 2012, Approved 2015, effective July 1, 2016)
- Wastewater
- Urban Forestry

6.4.8 Prioritization

SWM Facility Retrofits

Projects already initiated by the City (Facilities 21 and 66) were scheduled as high priority projects. In general the sequencing of the remaining SWM facility retrofits was prioritized based on subwatershed priority. Some changes to sequencing were undertaken in order to allow funding through the general Stormwater Utility Revenue.

SWM Facility Sediment Removal

Sediment removal projects were prioritized based on the percentage of sediment storage capacity remaining compared to the design storage capacity. Subwatershed prioritization was then used as a secondary method of assigning projects construction years. Some changes to sequencing were undertaken in order to allow funding through the Stormwater Utility Revenue.

Park Rehabilitation and SWM Enhancements (New SWM Facilities)

Where feasible, new facilities were prioritized based on the priority of the subwatersheds that they are in. Due to the large budgets of the construction of new facilities, some projects were re-prioritized based on annual available funding.

6.5 Watercourse Improvement Strategies

Within the City of Kitchener over 80 km of stream systems extend through at least 20 distinct sub-watersheds or catchment areas. Overall most erosion issues within the City of Kitchener were not considered urgent, thus do not require immediate mitigation. Of the forty-three (43) erosion sites, four of the high to moderate risk sites were already identified for mitigation within existing studies on Schneider and Balzer creeks. Further, many sites were identified that will require collaboration with other stakeholders and/or land acquisition to properly remediate the erosion issues. Four erosion sites were considered to be completely within private property (Melitzer, Hidden Valley, Kolb, and Lower Strasburg). The remaining, erosion sites were clustered into primary opportunities and secondary opportunities based generally field interpretations and the technical scoring. Some of the primary erosion site opportunities were combined to include multiple erosion sites together, and in a few cases restoration reach opportunities were identified for reach-scale erosion mitigation.

6.5.1 Key Next Steps

The **Integrated Stormwater Management Master Plan Erosion Assessment Report** (May, 2016) included as **Appendix K of the ISWM-MP EA Report**, specifically contributes a list of twelve (12) primary erosion site and reach restoration opportunities. The evaluation of the preliminary alternatives, the selection of the preferred solution, and the development of the preliminary conceptual designs (including cost estimates) for each of the primary erosion site opportunities are provided in the Erosion Assessment Report. The primary erosion sites are identified in **Table 6.5.1** and geographically on **Figure 6.5.1**.

Table 6.5.1: Primary Erosion Assessment Opportunities

Watercourse and Location	Reach ID	Field ID#	Date Assessed	Length	Risk	Infrastructure Exposed	Collaboration Recommended	Land Acquisition Required	Identified within Other Scope of Studies	Erosion Risk Index (/70)	Environmental Opportunity (/30)	Technical Score (/100)
Erosion Site Opportunities												
Stonegate (Hofstetter) Creek	ES-GRT6-1	42	09-Oct-15	50 m	Storm sewer, DICBs	Yes	-	[9]	-	63	25	88
Sandrock at Westheights	SR-2B	13	08-Jul-15	40 m	Trail, storm outfalls	-	[3]	-	-	62	20	82
Montgomery at Vanier	MG-1E-F	19	15-Jul-15	100 m	Water main, flooding	Yes	-	-	-	56	25	81
Strasburg downstream of Old Huron	SB-13A	29	30-Jul-15	100 m	Culvert, private property, sewer	-	-	Yes	Yes	55	25	80
Borden downstream of Conestoga Pkwy	BD-1B	8	04-Jun-15	100 m	Sanitary Sewer	Yes	-	-	-	58	20	78
Borden at Concordia Park	BD-1A	6 and 7	04-Jun-15	100 m	Sanitary Sewer, Water Main	Yes	-	-	-	64	10	74
Schneider at Manitou	SC-4L	22 and 21	21-Jul-15	120 m	Private property, abandoned pipe	Yes	Yes	-	-	48	25	73
Restoration Reach Opportunities												
Lower Laurel Creek	LC-1A-B, 2A	31 and 32	24-Aug-15	1000 m	Private property, building, sanitary sewer, habitat	-	Yes	Yes	-	65	20	85
Shoemaker Creek	SM-2B	1, 2, and 3	21-May-15	1000 m	Sanitary sewer, storm outfall, habitat	-	-	-	-	59	25	84
Voisin at Greenbrook	VS-1A	4	21-May-15	250 m	Road, sidewalk, habitat	-	-	-	-	54	20	74
Schneider at Old Carriage	SC-2B-C	15 and 16	09-Jul-15	500 m	Private property, trails, habitat	-	Yes	-	-	57	15	72



City of Kitchener Stormwater Management Master Plan

Legend

- Study Area
- Municipal Boundary
- Watercourses

Erosion Sites

- Erosion Site Opportunities
- Restoration Reaches

Source: City of Kitchener

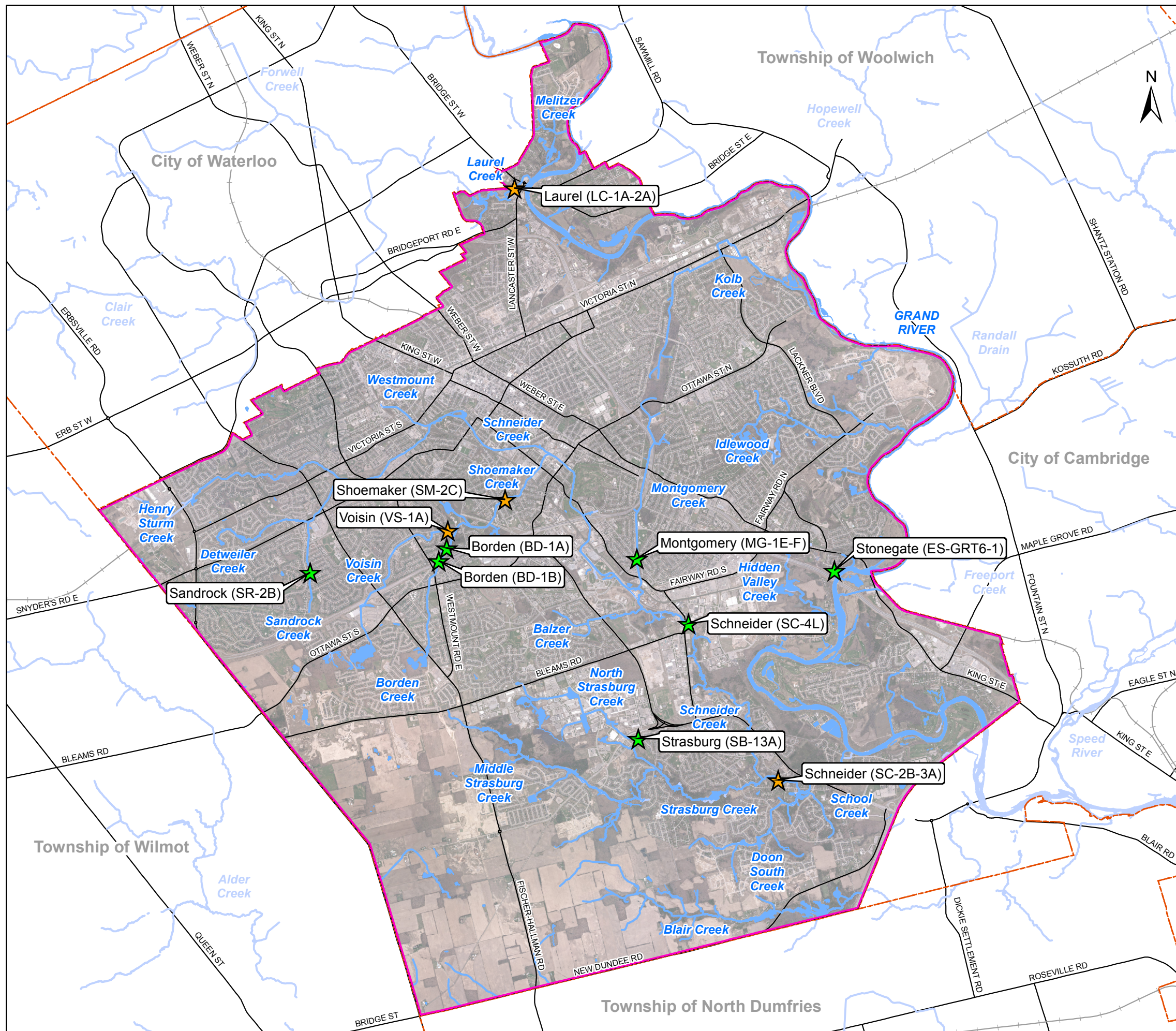
Figure 6.5.1

Erosion Assessment
Primary Opportunities

0 0.5 1 2 3 Km



Date: May 2016



6.5.2 Policy, By-law or Design Standards Consideration

Section 2.2.3 details the relevant policy relating to **Watercourse Works on Private Property**.

The study and resulting recommended retrofit works have been completed following Schedule B of the Municipal Class EA process and therefore can proceed directly to detailed design and implementation. The City will consult with landowners where works on private property are required.

MNRF permits will only be required where projects may impact Species at Risk. Under the Endangered Species Act, the Ministry of Natural Resources can grant different types of permits or other authorizations for activities that would otherwise not be allowed, with conditions that are aimed at protecting and recovering species at risk.

DFO administers development requirements relating to aquatic habitat under the Fisheries Act. This applies to work being conducted in or near waterbodies that support fish that are part of or that support a commercial, recreational or Aboriginal fishery. DFO approval will be required for works at all primary erosion sites.

A permit under Ontario regulation 150/06 - Development, Interference with Wetlands and alterations to Shoreline Watercourse will be required through the GRCA for in-water works.

6.5.3 Cost and Timeframe

The implementation cost and timeframes associated with each primary erosion site project are identified in **Table 6.5.3**.

Table 6.5.3 – Implementation Schedule and Budget for Primary Erosion Site Projects

Year	Watercourse Improvement Program		
2017	Idlewood Improvements and MG-1E-F Projects (\$1,282,250)	Balzer Creek Rehab (\$867,000)	
2018	Idlewood Improvements and MG-1E-F Projects (\$1,282,250)		
2019	MG-1E-F Project (\$1,896,300)		
2020	SR-2B Erosion Site Project (\$225,146)	VS-1A Restoration Reach Project (\$1,131,142)	
2021	SM-2B Restoration Reach Project (\$3,252,622)		
2022	Schneider Creek @ Manitou Road Erosion Site- SC-4L Project (\$104,170)	Stonegate Creek Erosion Site- ES-GRT61 Project (\$380,080)	
2023	SB-13A Erosion Site Project (\$470,961)	BD-1B Erosion Site Project (\$427,311)	SC-4L Erosion Site Project (\$107,976)
2024	BD-1A Erosion Site (utility and sanitary) Project (\$240,190)	BD-1A Erosion Site (water main) Project (\$1,192,749)	
2025	LC-1A-2A Restoration Reach Project (\$4,230,628)		
2026	Schneider Creek at Old Carriage Road - Restoration Reach - SC-2B Project (\$2,133,240)		

6.5.4 Funding

The majority of funding for the Watercourse Improvement Program comes from the general stormwater utility fee revenue. Additional funding for this program is allocated from:

- The Stormwater Management Fee
- The Watercourse Improvement Program Fund (Development Charge)
- The Drainage Improvement Program Fund

6.5.5 Integration

While the erosion site opportunities may themselves be identified as stream restoration projects, the intention of the ISWM-MP is to integrate multiple management layers to develop a system-wide prioritization and implementation plan. The erosion assessment, including identified erosion site and restoration reach opportunities, will ultimately need to consider potential projects which align with the Ecological Restoration Areas identified within the City of Kitchener's Official Plan and with the Council approved Fish Habitat Banking Arrangement with the Department of Fisheries and Oceans Canada (DFO). Specific municipal programs that provide opportunities for integration with the Watercourse Improvement Program are:

- Parks Strategic Plan (September 2010)
- Multi-Use Pathways and Trails Master Plan (May 2012)
- Ecological Restoration Areas and Policies
- New Secondary Plan Areas
- Grand River Water Management Plan (2014)
- Urban Forestry

6.5.6 Prioritization

The erosion sites have been identified and are grouped into first-order classifications to guide their consideration in subsequent stages of the ISWM-MP study. It is intended that the primary erosion assessment opportunities be considered directly for integration within the system-wide prioritization and implementation plan, but most primary erosion site opportunities do not require immediate action and can be monitored and addressed in fullness of time. Secondary erosion assessment opportunities have been documented for the City to monitor, and may be considered for integration into other projects, but are not recommended for direct consideration in this ISWM-MP Implementation Plan.

6.5.7 Recommendations

It is recommended that twelve (12) primary erosion site and reach restoration opportunities are implemented via the Watercourse Improvement Strategies outlined in the Integrated Stormwater Management Master Plan Erosion Assessment Report by the end of 2026. It is also recommended that the City monitor the secondary erosion assessment opportunities and integrate associated solutions where project synergies allow.

6.6 Urban Flood Management & Storm Sewer Infrastructure

As part of the ISWM-MP, in order to understand and assess the capacity of the existing municipal storm sewers and stormwater management ponds, the environmental benefits, as well as technical and financial implications relating to urban flooding within the City of Kitchener a report titled “**ISWM-MP Municipal Class EA - Storm Sewer Capacity Report (May, 2016)**” and included as **Appendix J of the ISWM-MP EA Report** was prepared.

The City of Kitchener has experienced several basement flooding events in the last decade as a result of storm events overwhelming the existing storm sewers and potential cross connections to the sanitary sewer system which caused over 100 reports of basement flooding due to backup of water through the floor drains or plumbing, etc. This component of the ISWM-MP addresses urban flooding (overwhelming of the municipal storm sewer system).

6.6.1 Key Next Steps

The Storm Sewer Capacity analysis component of the ISWM-MP addresses only addresses Phase 1 of the EA process (problem Identification and Opportunity). Phase 2 works will be completed as part of separate studies which will further the technical work that was undertaken in this study, identify alternatives and select the preferred alternative. The studies will specifically:

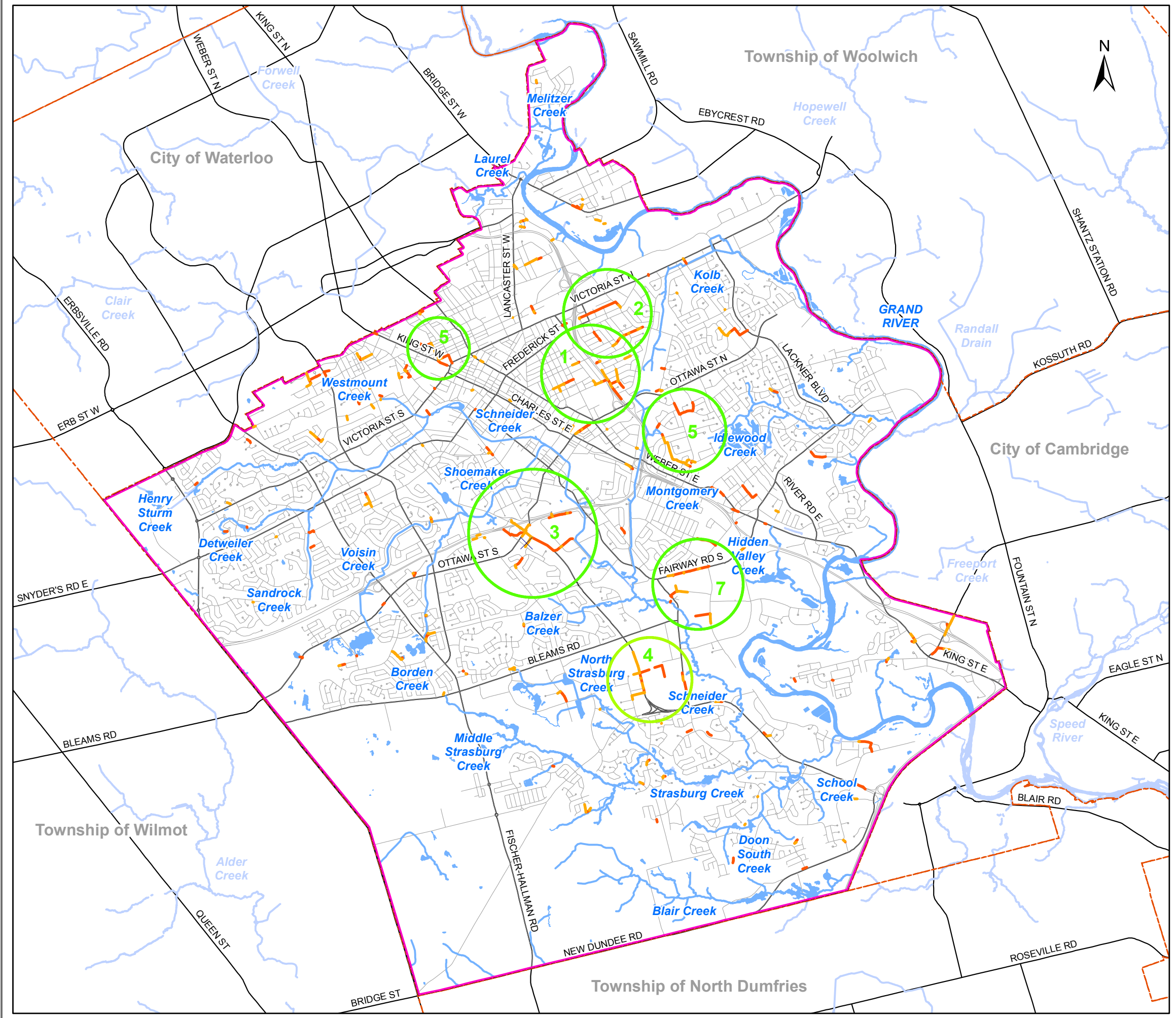
- Use updated LiDAR and HEC-RAS to define the overland flow routes associated with major urban flooding events; and
- Where results dictate, run higher resolution pipe model (storm sewers less than 600mm).

In order to facilitate these project components, model purchase, model updates and one (1) additional staff will be required in 2017. In 2018, 2019 and 2020 LiDAR data processing, and the integration of HEC-RAS modeling will be undertaken to define overland flow routes.

6.6.2 Prioritization

Seven (7) target areas have been identified as priorities in the established and modelling of higher resolution pipe model (storm sewers less than 600mm). The target areas were selected based on known flooding locations as well as the relative concentration of storm sewers at capacity and surcharged during the 5-year event in the exiting conditions state. **Figure 6.6** illustrates the seven (7) target areas.

Where possible and when greater efficiencies can be achieves, target areas may be combined. This is particularly relevant for target areas 1 and 2 which chare bordering sewersheds.

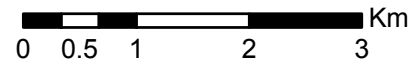


City of Kitchener Stormwater Management Master Plan

- Legend**
- FullCap2
 - Surcharge
 - Study Area
 - Municipal Boundary
 - Watercourses
 - Priority Area

Source: City of Kitchener

Figure 6.6
Priority Storm Sewer Assessment Areas
(Model Build-Out)



Date: October 2016

6.6.3 Cost and Timeframe

At the onset of the program, \$100,000 is allocated for model purchase, model updates and staffing requirements. \$30,000 is allocated to the program annually from 2018 through 2020 for LiDAR data processing, and the integration of HEC-RAS modeling. From 2022 through 2024 a total of \$90,000 is allocated for implementation of the urban flood management recommendations.

6.6.4 Funding

All funding for the Urban Flood Management & Storm Sewer Infrastructure program comes from the general Stormwater Utility fee revenue.

6.6.5 Recommendations

It is recommended that following the established and modelling of higher resolution pipe model (storm sewers less than 600mm) for the seven (7) target areas, the following action be taken:

- Assess the benefits of targets SWM retrofits as part of road reconstruction project and/or the Market Based Strategies (see **Section 6.2**) including targeted incentives with the goal of deferring infrastructure replacement and reducing the overall life-cycle cost to the City of Kitchener while maintaining the required level-of-service.
- Assess the level of mandated volume control required to deferring infrastructure replacement
- Assess the potential predicted Climate Change Impacts following the procedure and methodology as detailed in the “**ISWM-MP Municipal Class EA - Storm Sewer Capacity Report (May, 2016)**” included as **Appendix J of the ISWM-MP Report**
- Reassess the priority of road reconstruction project as required.

7.0 IMPLEMENTATION SCHEDULE AND BUDGET

Program: Within the proposed stormwater budget forecast, a program requires perpetual or long-term annual funding to sustain an acceptable level of service. Programs may have defined start dates and projected program periods; however it is expected that these programs will continue until program components are integrated into new programs or replaced by more efficient strategies.

Project: Within the proposed stormwater budget forecast, a project requires a short-term capital expenditure typically for construction. A goal of the stormwater budget forecast is to allocate start and completion dates for these projects that take into consideration budget opportunities and constraints as well as watershed prioritization.

There are twelve (12) programs that will be implemented as identified in the ISWM-MP. These programs are:

- 1) **Low Impact Development Accelerated Infrastructure Replacement Program (LID AIRP):** This program is being developed for the conveyance control projects within the municipal ROW. This program includes the development of LID roads standards and the construction of pilot projects from 2017 through 2019, followed by implementation of conveyance controls as part of the updated roads program through 2030.
- 2) **Sediment Management Program (Sediment Removal):** This program is being implemented in order to facilitate sediment removal from SWM facilities and OGS units. It should be noted that these are legislative requirements as noted in MOECC issued ECAs and this are mandatory municipal responsibilities that must be planned for in sustainable level-of-service models.
- 3) **Drainage Improvements Program:** This program covers the integration of LID practices into municipal trails (LID trail enhancements), the integration of LID practices into the City's Planning Around Rapid Transit Stations (PARTS) project, and the retrofit of municipal laneways with LID practices.
- 4) **Market Incentive Program:** This program includes all projects that are intended to increase the uptake of LID source controls on provide property. Projects within this program include the RAIN-Ready Neighbourhood Action Plan, the proposed Market-Based Strategy, and the continued funding of stormwater credits and stormwater grants.
- 5) **Stormwater Management Infrastructure Maintenance Program:** This program covers all existing stormwater maintenance works plus the removal of sediment from catch basins in uncontrolled catchments on a regular basis.

- 6) **Stormwater Infrastructure Implementation:** This program includes tasks associated with enhanced urban flood modelling. This program also includes the project works associated with the SWM Pond X outlet (snow storage facility).
- 7) **Drainage Risk Evaluation Program:** This program is being created to study and implement solutions to priority catchment areas that have been flagged for impervious area or catchment area increases beyond the design limits of their end-of-pipe facilities.
- 8) **Stormwater Management Monitoring Program:** This program includes all SWM monitoring and outlines the transition from the existing SWM Audit program to the Updated Water Quality (EMC) and Flow Monitoring Protocol for Target Subwatersheds. The Filsinger DFO Monitoring project is also included under this program.
- 9) **Credit Trading Study:** This program is being established to study the benefits and requirements associated with implementing a SWM credit trading system within the existing SWM marketplace.
- 10) **Watercourse Improvement Program:** This program cover four (4) restoration reach projects and twelve (12) creek improvement projects that are to be completed between 2017 and the end of 2026.
- 11) **Stormwater Management Facility Retrofits Program:** This program consists of ten (10) stormwater management facility retrofits that are to be undertaken from 2017 through 2022 in order to improve water quality conditions in downstream receivers.
- 12) **Park Stormwater Management Enhancements Program:** This program consists of the detailed design and construction of twelve (12) new SWM facilities in existing parks and corridors. New SWM facilities include subsurface and surface facilities.

The implementation schedule and budget forecast considers three (3) implementation periods:

- 1) Immediate Term Implementation Priorities which correspond to the 5-year Capital Forecast from 2017-2021;
- 2) Medium Term Implementation Priorities (2022-2025); and
- 3) Long Term Implementation Priorities (2025-2030).

The implementation schedule and budget forecast illustrates the specific program or project elements of the recommended approach as well as the recommended year within which the element is to be completed as well as the estimated costs. **Figure 7.1** summarizes the implementation schedule and budget forecast.

The implementation schedule and associated costs have been distributed over the 14-year implementation period in order to manage staff and equipment requirements, build municipal

capacity, align with other municipal projects and programs and ensure that projects can be effectively delivered within existing funding forecasts.

Beyond the specified implementation period from 2017 to 2030, some \$40 million in expenditures have been differed for the replacement of the approximately 14,961m of surcharging pipe identified through the preliminary trunk sewer modelling as well as to address pipe capacity issues outside the modelled trunk sewer system.

Figure 7.1 - ISWM-MP Implementation Schedule and Budget Forecast

	Immediate Term Implementation Priorities					Medium Term Implementation Priorities				Long Term Implementation Priorities				
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Low Impact Development (LID) AIRP	Implementation of LID Road Standard (\$250,000/year)			LID Road Retrofits as part of AIRP										
Sediment Management Program (Sediment Removal)	8 SWM Facilities (\$633,420)	8 SWM Facilities (\$828,158)	6 SWM Facilities (\$82,774)	7 SWM Facilities (\$205,662)	3 SWM Facilities (\$289,269)	3 SWM Facilities (\$31,533)	8 SWM Facilities (\$620,290)	6 SWM Facilities (\$351,498)	6 SWM Facilities (\$358,528)	6 SWM Facilities (\$365,698)	6 SWM Facilities (\$373,012)	6 SWM Facilities (\$380,473)	6 SWM Facilities (\$388,082)	6 SWM Facilities (\$395,844)
	Sediment Removal 8 OGS Units (\$128,112)	Sediment Removal 8 OGS Units (\$68,874)	City-Wide OGS Sediment Study (\$50,000)	Sediment Removal 6 OGS Units (\$81,182)	Sediment Removal 6 OGS Units (\$82,806)	Sediment Removal 6 OGS Units (\$84,462)	Sediment Removal 6 OGS Units (\$86,151)	Sediment Removal 6 OGS Units (\$87,874)	Sediment Removal 6 OGS Units (\$89,632)	Sediment Removal 6 OGS Units (\$91,425)	Sediment Removal 6 OGS Units (\$93,253)	Sediment Removal 6 OGS Units (\$95,118)	Sediment Removal 6 OGS Units (\$97,020)	Sediment Removal 6 OGS Units (\$98,961)
Drainage Improvements Program	LID Trail Enhancements (\$50,000/year)													
	LID Integration into PARTS (\$50,000/yr)		LID Integration into PARTS (\$100,000/yr)		LID Retrofit of 1 Laneway (\$55,204)	LID Retrofit of 2 Laneways (\$112,616)	LID Retrofit of 2 Laneways (\$114,869)	LID Retrofit of 2 Laneways (\$117,116)	LID Retrofit of 2 Laneways (\$119,509)	LID Retrofit of 2 Laneways (\$121,899)	LID Retrofit of 2 Laneways (\$124,337)	LID Retrofit of 2 Laneways (\$126,824)	LID Retrofit of 2 Laneways (\$129,361)	LID Retrofit of 2 Laneways (\$131,948)
Market Incentive Program	Trillium Pilot Project (\$25,000/year)			Set-Up Market Based Strategy (\$1,270,000)	Market Based Strategy (\$575,000/year)				Maintain Market Based Strategy (\$75,000/year)					
	Continue Stormwater Credit Program and Stormwater Grants													
SWM Infrastructure Maintenance Program	Continue Existing SWM Infrastructure Maintenance Program		Continue Existing SWM Infrastructure Maintenance Program											
			Sediment Removal from 1/5th of Uncontrolled Catch Basins											
			(\$63,672)	(\$64,946)	(\$66,245)	(\$67,570)	(\$68,921)	(\$70,300)	(\$71,706)	(\$73,140)	(\$74,602)	(\$76,095)	(\$77,616)	(\$79,169)
SWM Infrastructure Implementation	Model Purchase, Model Update and Staffing (\$100,000)	LiDAR Data Processing, Integrate HEC-RAS Model, Define Overland Flow Routes (\$30,000)	LiDAR Data Processing, Integrate HEC-RAS Model, Define Overland Flow Routes (\$30,000)	LiDAR Data Processing, Integrate HEC-RAS Model, Define Overland Flow Routes (\$30,000)		Implement Urban Flood Management Recommendations (\$30,000)	Implement Urban Flood Management Recommendations (\$30,000)	Implement Urban Flood Management Recommendations (\$30,000)						
	SWM Pond 61 Outlet Sewer (\$175,000)	SWM Pond 61 Outlet Sewer (\$403,000)	SWM Pond 61 Outlet Sewer (\$608,000)											
Drainage Risk Evaluation Program				Drainage Basin Risk Studies (\$30,000/ year)			Implement Recommendations (\$40,000)	Implement Recommendations (\$200,000)						
SWM Monitoring Program	Continue with Refined SWM Audit (\$80,000)	Continue with Refined SWM Audit (\$80,000)	Updated Water Quality (EMC) and Flow Monitoring Protocol Target Subwatersheds (\$100,000/year)											
	Filsinger DFO Monitoring (\$20,000/ year)				Updated Water Quality (EMC) and Flow Monitoring Protocol to reflect Target Subwatersheds (\$100,000/ year)									
Credit Trading Study			Habitat Banking Study (\$30,000)	SWM Credit Trading Study (\$50,000)	Implement Study Recommendations (\$50,000)									
Watercourse Improvement Program	Idlewood Improvements and MG-1E-F Projects (\$1,282,250)	Idlewood Improvements and MG-1E-F Projects (\$1,282,250)	MG-1E-F Project (\$1,896,300)	SR-2B Erosion Site Project (\$225,146)	SM-2B Restoration Reach Project (\$3,252,622)	Schneider Creek @ Manitou Road Erosion Site- SC-4L Project (\$104,170)	SB-13A Erosion Site Project (\$470,961)	BD-1A Erosion Site (utility and sanitary) Project (\$240,190)	LC-1A-2A Restoration Reach Project (\$4,230,628)	Schneider Creek at Old Carriage Road - Restoration Reach - SC-2B Project (\$2,133,240)				
	VS-1A Restoration Reach Project (\$1,131,142)			Stonegate Creek Erosion Site- ES-GRT61 Project (\$380,080)		BD-1B Erosion Site Project (\$427,311)	BD-1A Erosion Site (water main) Project (\$1,192,749)							
						SC-4L Erosion Site Project (\$107,976)								
SWM Facility Retrofits Program	Construction 21 & 66 (\$980,500)	Construction 10 & 111 (\$1,759,837)	Construction 16 & 7 (\$347,280)	Construction 65 (\$1,286,760)	Construction 62 (\$248,057)	Construction 61 (\$1,199,969)								
	Design 10, 111 & 65 (\$705,559)	Design 16 and 7 (\$52,092)	Design 65 (\$295,000)	Design 62 (\$137,209)	Design 61 (\$179,954)									
Park SWM Enhancements						Prospect Park (\$1,324,897)	Sandrock Hydro Corridor (\$4,076,708)	Cherry Park (\$1,165,916)	Country Hill Park (\$831,878)	Idlewood Greenway (\$2,133,240)	Victoria Park (\$4,911,329)	Biehn Park (\$9,638,638)	Rosenburg Park (\$5,239,107)	Cameron heights Pool and Kaufman Park (\$13,194,788)
					Country Side Park (\$292,915)			Country Side Park (\$298,773)	Millwood Park (\$304,749)					
ANNUAL TOTALS	\$5,346,841	\$5,299,211	\$3,948,026	\$4,782,047	\$4,979,157	\$4,090,297	\$6,768,187	\$4,473,558	\$6,225,654	\$5,448,391	\$5,801,533	\$10,542,148	\$6,156,186	\$14,125,710

8.0 ANNUAL STORMWATER MONITORING PLAN

8.1 Introduction

In order to ensure the goals and objectives of the ISWM-MP are accomplished over time, a refocused stormwater monitoring program has also been established as part of this Implementation Plan. The monitoring plan has been developed in keeping with the Adaptive Environmental Management (AEM) process whereby “A systematic process for continually improving management policies and practices by learning from the outcomes of operational programs. Its most effective form - “active” environmental management - employs management programs that are designed to experimentally compare selected policies or practices, by evaluating alternative hypotheses about the system being managed.”

Numerous definitions of the AEM exist in the literature, but the process can be described as a risk management strategy utilizing a “learning-by-doing” and “revising-as-appropriate” approach. The primary benefit of an AEM compared to the standard approach is the opportunity to modify the approach by introducing an adjustment step where monitoring program can be adjusted to better meet the needs of the subwatershed.

8.2 Background

As part of the recommendations of the 2001 Stormwater Management Policy, a city-wide monitoring program was recommended to ensure that the implementation of the Stormwater Master Plan was proceeding and to ensure there was a “net gain” to the municipal SWM system. The city-wide monitoring program (audit) has been conducted annually since 2001.

Since 2001 the monitoring program focused on surface water quality (chemical and bacteriological) and invertebrate and fish community sampling (biological) to identify and monitor the impact of the SWM Policy Implementation. Per the 2001 Policy (6xi to 6xii), the SWM audit required the following:

1. Monitoring and reporting by an independent consultant which was to include the review of retrofits, new ponds, and OGS; creek rehabilitations, accounting of re-development and infill area within the City and review of in-stream monitoring results.
2. In stream monitoring – seven (7) stations monitored annually, 5 core stations and 2 non-core stations per **Table 8.1** below.

Table 6.1 Previous Parameters Sampling & Sampling Procedure (2001-2012)

Parameters	Per 2001 SWM Policy	
	Sampling Procedure/Type	Timing
Chloride	Grab	• 6 times/year, • 3 season (spring – fall) • 1 wet and 1 dry/season
E.coli	Grab	
Nitrate	Grab	
Copper	Grab	
Lead	Grab	
Zinc	Grab	
Total & Dissolved Phosphorous	Grab	
Total Suspended Solids (TSS)	Grab	
Hardness (as CaCO ₃)	Grab	
Temperature	Field Measurement	Monthly from May to Sept
Dissolved Oxygen	Field Measurement	
Invertebrates	n/a	Annually
Fisheries	n/a	Annually

3. Formation of an Implementation Committee consisting of the City, the Grand River Conservation Authority (GRCA), the Region of Waterloo and the Independent consultant. The committee is to review all recommendations and reporting.

The SWM Audit continued relatively unchanged until 2012, when the sampling of heavy metals for the seven stations, continuous water temperature, flow monitoring at two (2) for the seven station annually as well as winter water quality sampling was added. Since its inception, sampling stations within the City have expanded to more than 25 stations, including the 5 core stations.

Per the recommendations of the 2012 SWM Audit Technical Memorandum, the 2013 SWM Audit program was revised to provide improved water quality data through the use of flow proportionate water quality sampling to develop Event Mean Concentrations (EMCs) using automated water quality sampling procedures and equipment. The invertebrate and fish community sampling (biological) remained unchanged. In 2013, the monitoring of 33 stormwater facilities located within source protection areas per the Region of Waterloo's draft policy for the protection plan (Ontario Clean Water Act) were included in the program. In addition, in 2013, water quality analysis was performed by an accredited independent laboratory.

The recommendations of the 2012 SWM Audit proposed the continuation and expansion of flow proportionate water quality sampling to develop Event Mean Concentrations (EMCs) for all Kitchener sampling stations in order to establish baseline conditions and define the benefits of SWM. The current SWM Audit sampling program since 2013 is detailed below in **Table 6.2**.

Table 6.2 Parameters Sampling & Sampling Procedure (2013- 2016)

Parameters	2012 SWM Audit Program	
	Sampling Procedure/Type	Timing
Chloride	Flow Proportionate Automated Sampling (EMC) 3 Dry event grab samples	• 8 events/ year • 4 season • 2 samples/ season • dry event samples – spring to fall
E.coli		
Nitrate		
Copper		
Lead		
Zinc		
Total & Dissolved Phosphorous		
Total Suspended Solids (TSS)		
Hardness (as CaCO ₃)		
pH		
Temperature	Continuous	May- September
Dissolved Oxygen	Field Measurement	May- September
Conductivity	Field Measurement	May- September
Invertebrates	OBBN (Jones, 2007)	Annually
Fisheries	OSAP, Version 8, 2010 (Stanfield, 2010)	Annually

8.3 Proposed Monitoring Plan Overview

The stormwater monitoring program has two (2) distinct phases. Monitoring has been phased to permit City staff to build capacity with the municipality, vet the proposed monitoring program with partner agencies (specifically the GRCA and MROW) and permit the alignment of future budgets with the revised program needs. The two (2) distinct phases include:

Phase 1 - Continuation of a refined SWM Audit monitoring (2017-2018) – to establish baseline monitoring results (existing conditions) for previously established historical monitoring locations through-out the City using the City's existing three (3) autosamplers. Monitoring efforts are focused on previously identified core stations with the addition of Priority 1 and Priority 4 subwatershed.

Phase 2 - Updated Water Quality and Flow Monitoring (2019 - ongoing) – refined monitoring locations and protocols to align with the implementation approach of prioritizing works based on the watersheds in the most need and where there are opportunities to improve conditions but also recognizes the need to protect existing watershed health. Phase 2 monitoring also focuses on the collection of data within subwatershed that were determined to have insufficient data during the subwatershed prioritization analysis and established long-term monitoring sites for the collection of water quality data within Priority 1 subwatersheds.

Other Monitoring Obligations

In addition, the stormwater monitoring program is recommended to include previous monitoring obligations including but not limited to:

- As part of construction permitting processes such as the required monitoring of Filsinger Creek per the DFO requirements.
- That pursuant to Region of Waterloo SPP Policy No. RM-MC-19, as per the recommendations of the ISWM-MP, the City work collaboratively with the Region of Waterloo to assess (as required) the identified thirty-three (33) existing SWM facilities within Source Protection Areas that are considered potential threats to drinking water sources as a result of chlorides from road de-icers applied during winter maintenance operations. These facilities include: SWMF #: 13, 15, 24, 26, 33, 34, 39, 40, 47, 49, 50, 51, 61, 65, 66, 75, 88, 94, 95, 96, 97, 100, 108, 109, 115, 116, 121, 129, 133, 136, 138 & 157.
- ECA compliance monitoring for stormwater management facilities.
- Other permit compliance monitoring as directed by the GRCA, MNRF, DFO or MOECC. To be identified on a case-by- case basis.

Table 8.1 summarizes the proposed monitoring schedule for Phases 1 and 2 from 2017 to 2023.

Figure 8.1 illustrates the recommended monitoring locations.

Table 8.1 – Recommended Monitoring Program Schedule and Priorities

Monitoring Phases				Phase 1		Phase 2 (No. of Samplers)					
Recommended Locations (See Figure 8.1)	Description	Subwatershed Priority	EMC Completed	2017	2018	2019 (5)	2020 (7)	2021 (9)	2022 (11)	2023	
Core Stations											
Henry Sturm 1 (HS1)	Previous Core Station	Priority 2	2015	DW&B						Re-assess Watershed Health. Re-prioritize Based on Implementation Status & Health	
Kolb Creek 1 (KD1)	Previous Core Station	Priority 2	2014	DW&B							
Montgomery 1 (MG1)	Previous Core Station	Priority 1	2014	DW&B		Long Term EMC Station					
North Strasburg 2 (SB2)	Previous Core Station	Priority 2	2015	DW&B							
Lower Schneider 1 (SC1)	New Core Station	Priority 2		EMC							
Sandrock 2 (SR2)	Previous Core Station	Priority 1	2016	DW&B		Long Term EMC Station					
Shoemaker 1 (SM1)	Previous Core Station	Priority 1	2016		DW&B		Long Term EMC Station				
Upper Schneider (SC-9)	New Core Station	Priority 1†		EMC	DW&B		Long Term EMC Station				
Voisin Creek (VS-1)	New Core Station	Priority 1 ³		EMC	DW&B		Long Term EMC Station				
Middle Strasburg (SB7)	New Core Station	Priority 4			EMC						
Strasburg (SB1)	New Core Station	Priority 4			EMC						
Blair Creek (BBB-F6 or 2414044)	New Core Station	Priority 4	BBB-F6 (GRCA Station) 241044 - Completed through Upper Blair SWS								
Non-Core Stations											
Idlewood 1 (IW1)	Prev. Non-Core Station	Priority 2			EMC					Re-assess Watershed Health. Re-prioritize Based on Implementation Status & Watershed Health	
Balzer Creek (BZ-1)	New Non-Core Station	Priority 2 ³	2016		DW&B						
Laurel Creek (LC-1)	New Non-Core Station	Priority 2 ¹				EMC					
Borden Creek (BD-1)	New Non-Core Station	Priority 2 ³						EMC			
Unnamed Catchment 1	New Non-Core Station	Priority 2 ^{1,3}				EMC					
Middle Schneider (MS-1)	New Non-Core Station	Priority 2						EMC			
Detweiler Creek (DW-1(b))	New Non-Core Station	Priority 2 ^{2,3}				DW&B			EMC		
Westmount Creek - WD1 (WM-1(a))	New Non-Core Station	Priority 2 ^{1,3}				DW&B	EMC				
East Side Creek (ES-1)	New Non-Core Station	Priority 2 ²							EMC		
North Strasburg 13a (SB13a)	Prev. Non-Core Station	n/a	2013								
School Creek (SCH-1)	New Non-Core Station	Priority 3 ^{1,3}				DW&B		EMC			
Melitzer Creek (MZ-1)	New Non-Core Station	Priority 3 ^{1,3}				DW&B	EMC				
Doon South (DS-1)	New Non-Core Station	Priority 3 ²							EMC		
Unnamed Catchment 3	New Non-Core Station	Priority 3 ^{1,3}				DW&B		EMC			
Cedar Creek (CC-1)	New Non-Core Station	n/a ¹	Monitoring not recommended. No watercourses within City Limits (MNRF)								
Alder Creek (AC-1)	New Non-Core Station	Priority 2 ²									
Unnamed Catchment 2	New Non-Core Station	n/a ¹									
Unnamed Catchment 4	New Non-Core Station	n/a ¹									
EMC - Flow Proportionate WQ Sampling, Dry Weather Sampling, Flow & Temperature Monitoring Completed, Biological and Fisheries Sampling DW&B - Dry Weather Sampling and Biological sampling (Benthic) Watershed Health Analysis: 1) Insufficient WQ Data; 2) Assumed WQ Score; 3) Insufficient Biological Data											

SWM Audit Monitoring Programs

2002
Chemical Sampling: SR2, HS1, SC4, SC2, SB2, SB11, SB1, KD4, KD1, MG1
Biological Sampling: SR2, HS1, SC9, SC4, SC2, SB13, SB7, SB2, SB11, SB1, KD4, KD2, KD1, MG2, MG1
Temperature / Flow: SB7

2003
Chemical Sampling: MG1, KD1, HS1, SC4, SC2, SB2, HS3
Biological Sampling: MG1, KD1, HS1, SC4, SC2, SB2, HS3
Temperature / Flow: SB7

2004
Chemical Sampling: HS1, SC2, SB1, MG1, KD1, NW1, BL1
Biological Sampling: HS1, SC2, SB1, MG1, KD1, NW1, BL1
Temperature / Flow: SB7

2005
Chemical Sampling: HS1, SC2, SB2, MG1, KD1, NW1, BL1, VS1
Biological Sampling: HS1, SC2, SB2, MG1, KD1, NW1, BL1, VS1
Temperature / Flow: SB7

2006
Chemical Sampling: HS1, SC2, SB2, SB1, MG1, KD1, IW1, VL
Biological Sampling: HS1, SC2, SB2, SB1, MG1, KD1, IW1
Temperature: VL, HS1, VLW
Depth: VLW

2007
Chemical Sampling: HS3, VL, IW3, SB3, SB8, VS4, HS1, KD1
Biological Sampling: HS3, IW3, SB3, SB8, VS4, KD1, HS1
Temperature: HS1, VLW, VL, KD1, WM1(WM-1(a))
Depth: VLW
Additional Chemical Data Available: PQWMN: LC1, SC1

2008
Chemical Sampling: HS1, SR2, KD1, KD2, KD4, MG1, SB2, SB13, SC2, BBB-11, SC1
Biological Sampling: HS1, SR2, KD1, KD2, MG1, SB2, SB13, SC2
Temperature: KD1, KD2, KD4, SB13
Depth: KD1
Additional Chemical Data Available: PQWMN: LC1

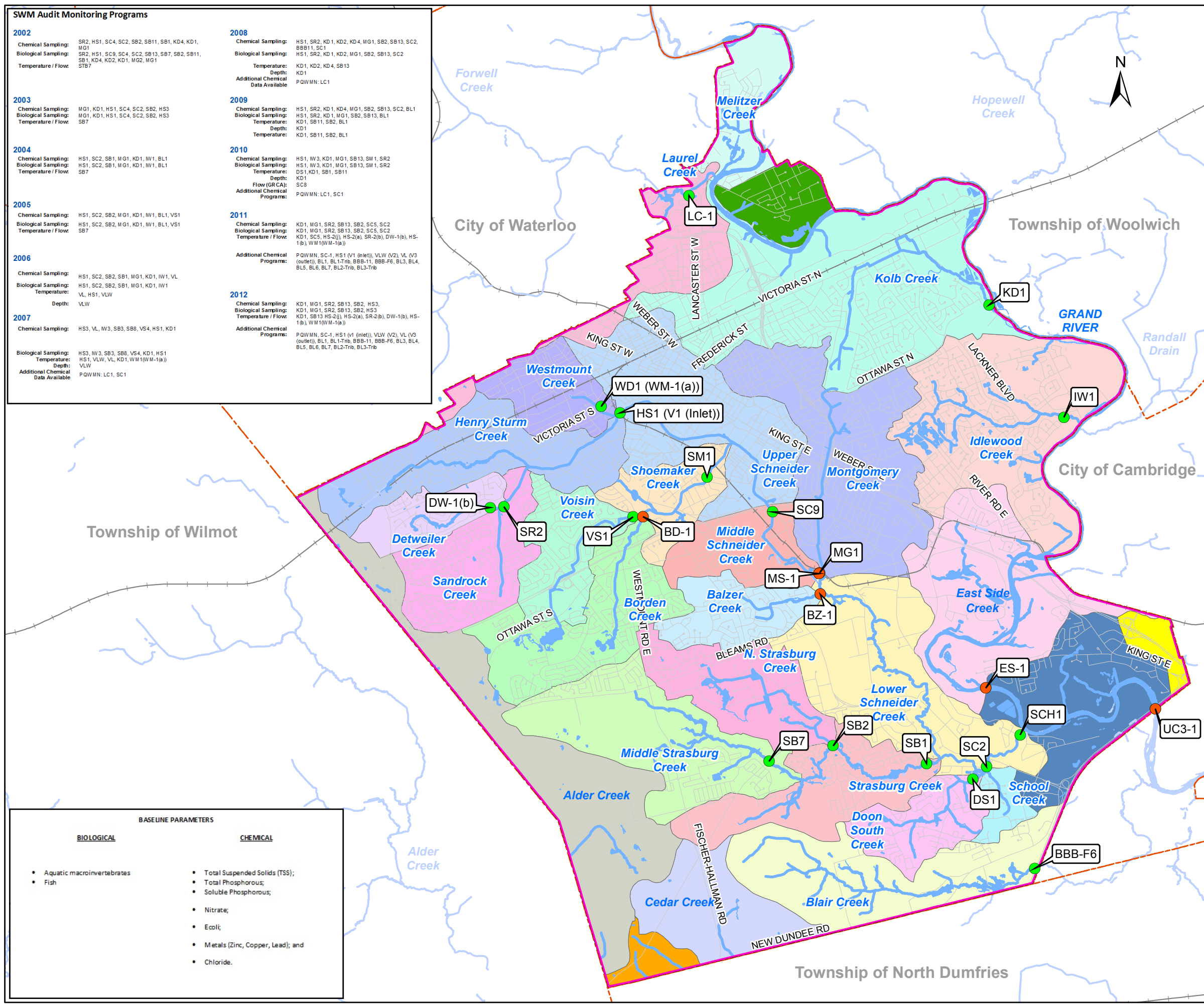
2009
Chemical Sampling: HS1, SR2, KD1, KD4, MG1, SB2, SB13, SC2, BL1
Biological Sampling: HS1, SR2, KD1, MG1, SB2, SB13, BL1
Temperature: KD1, SB11, SB2, BL1
Depth: KD1
Temperature: KD1, SB11, SB2, BL1

2010
Chemical Sampling: HS1, W3, KD1, MG1, SB13, SM1, SR2
Biological Sampling: HS1, W3, KD1, MG1, SB13, SM1, SR2
Temperature: DS1, KD1, SB1, SB11
Depth: KD1
Flow (SR-CA): SC8
Additional Chemical Programs: PQWMN: LC1, SC1

2011
Chemical Sampling: KD1, MG1, SR2, SB13, SB2, SC5, SC2
Biological Sampling: KD1, MG1, SR2, SB13, SB2, SC5, SC2
Temperature / Flow: KD1, SC5, HS-2(a), HS-2(b), SR-2(b), DW-1(b), HS-1(b), WM1(WM-1(a))
Additional Chemical Programs: PQWMN, SC-1, HS1 (V1 (inlet)), VLW (V2), VL (V3 (outlet)), BL1, BL1-Trib, BBB-11, BBB-F6, BL3, BL4, BL5, BL6, BL7, BL2-Trib, BL3-Trib

2012
Chemical Sampling: KD1, MG1, SR2, SB13, SB2, HS3
Biological Sampling: KD1, MG1, SR2, SB13, SB2, HS3
Temperature / Flow: KD1, SB13 HS-2(a), HS-2(b), SR-2(b), DW-1(b), HS-1(b), WM1(WM-1(a))
Additional Chemical Programs: PQWMN, SC-1, HS1 (V1 (inlet)), VLW (V2), VL (V3 (outlet)), BL1, BL1-Trib, BBB-11, BBB-F6, BL3, BL4, BL5, BL6, BL7, BL2-Trib, BL3-Trib

BASELINE PARAMETERS	
BIOLOGICAL	CHEMICAL
- Aquatic macroinvertebrates - Fish	- Total Suspended Solids (TSS); - Total Phosphorous; - Soluble Phosphorous; - Nitrate; - Ecoli; - Metals (Zinc, Copper, Lead); and - Chloride.

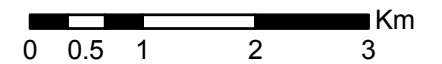


City of Kitchener Stormwater Management Master Plan

- Legend**
- Study Area
 - Municipal Boundary
 - Watercourses
 - Recommended (New) Subwatershed Monitoring Locations
 - Proposed Subwatershed Monitoring Locations
- Subwatershed**
- Alder Creek
 - Balzer Creek
 - Blair Creek
 - Borden Creek
 - Cedar Creek
 - Detweiler Creek
 - Doon South Creek
 - East Side
 - Henry Sturm Creek
 - Idlewood Creek
 - Kolb Creek
 - Laurel Creek
 - Lower Schneider Creek
 - Melitzer Creek
 - Middle Schneider Creek
 - Middle Strasburg Creek
 - Montgomery Creek
 - North Strasburg Creek
 - Sandrock Creek
 - School Creek
 - Shoemaker Creek
 - Strasburg Creek
 - Unnamed Catchment 1
 - Unnamed Catchment 2
 - Unnamed Catchment 3
 - Unnamed Catchment 4
 - Upper Schneider Creek
 - Voisin Creek
 - Westmount Creek

Source: City of Kitchener

Figure 8.1
Recommended Monitoring Locations



Date: October 2016



8.4 Phase 1 - Continuation of a refined SWM Audit monitoring (2017-2018)

As part of Phase 1, a refinement to the existing SWM Audit program has been developed with the goal of establishing baseline monitoring results (existing conditions) for previously established historical monitoring locations through-out the City. The focus of Phase 1 monitoring are the identified core stations, which consist of previously identified core stations consistent with the SWM Audit (2013-2016), previously completed monitoring sites in addition to the addition of Priority 1 and Priority 4 subwatershed.

Priority 1 subwatershed have been included in Phase 1 monitoring efforts as these area have been prioritized for immediate implementation of the ISWM-MP recommended approaches. Baseline data for each Priority 1 subwatershed will provide a benchmark against which future stormwater management efforts can be compared.

Priority 4 subwatershed have been included in Phase 1 monitoring efforts in the recognition that the monitoring and data collection within these watersheds, which currently have the highest health score, will be critical to maintaining the systems in their current state. Management actions can be undertaken if adverse changes to watershed health are recorded.

The Phase 1 program is recommended to include the following. Monitoring program procedures and protocols are detailed in **Attachment D**.

- **Water Quality** - flow proportionate water quality sampling using automated water quality sampling procedures and equipment to develop Event Mean Concentrations (EMCs) using the City's existing three (3) automated water quality sampling units. It is recommended that future water quality sampling be revised to include:
 - Flow proportionate water quality sampling for three (3) stations annually using automated water quality sampling procedures and equipment to develop EMCs. EMCs will provide the City with the ability to better quantify in-stream water quality in regards to Provincial Water Quality Objectives (PWQO) for various representative pollutants. Station locations are recommended to rotate annually to include all core stations by 2018. This recommendation would reduce the overall sampling effort (reduced number of analyzed samples) while providing improved data resolution and comparative analysis.
 - All grab sampling should be eliminated from the Phase 1 program, with the exception dry weather grab sampling of three (3) events for 5 core stations in 2017 and the remaining 6 core stations in 2018 to identify spills and illicit discharges.

Grab samples provide only an instantaneous concentration during an event period and does not provide an indication of pollutant loadings. Grab samples are also difficult to develop accurate comparisons between watercourses and

from year-to-year. By eliminating grab sampling from the program this recommendation would reduce the overall sampling effort (reduced number of analyzed samples). The level of effort for dry weather sampling would remain unchanged from previous years.

- o Collected water quality samples shall be submitted to a private accredited laboratory for analysis.
- **Water Quantity** – continuous flow monitoring for three (3) stations annually corresponding to the flow proportionate water quality sampling stations. The level of sampling effort would remain unchanged from previous years.
- **Temperature Monitoring** - continuous temperature monitoring for two (2) stations annually corresponding to the flow proportionate water quality sampling stations. Station locations are recommended to rotate annually to include all core stations, followed by non-core stations. The level of effort would remain unchanged from previous years.
- **Invertebrate Community Sampling** – Benthic macroinvertebrate monitoring should be continued on an annual basis for at each continuous flow monitoring station and dry weather sampling station. The benthic community composition can change very quickly if habitat quality changes (benthics have limited mobility and a short life span), therefore monitoring is best conducted frequently. The results would continue to be compared to previous years, to track changes over time. Results provide a measure of how the benthic community has changed over time and are an excellent indication of in-stream conditions. The level of effort would remain unchanged from previous years.
- **Fish Community Sampling** - For each sampling station, it is recommended that annual data be collected for a minimum of two (2) years to establish baseline conditions at each station beginning with Core Stations followed by Non-Core Stations. Fish community sampling is not recommended for stations with a significant sampling history from previous years that includes more than 1 year of fisheries data.

After baseline conditions have been established for all station, monitoring shall be can be conducted per the following:

- o Stations with no identified sensitive species – sampling may be conducted at a reduced frequency (bi-annual or longer). Station locations are recommended to rotate annually per the recommendations of the external consultant and the Implementation Committee.
- o Stations where sensitive species have been identified, monitoring may be conducted at an increased frequency (annual basis). If sensitive species are found at a station where no sensitive species have been previously identified, monitoring should be conducted at an increased frequency for subsequent years.

This recommendation has the potential to reduce the overall sampling effort (reduced number of analyzed samples) but more importantly focuses sampling effort and budget on a priority basis relating to those stations with sensitive species.

- **Compliance Monitoring: Permit, Construction and ECA** – where possible, it is recommended that compliance monitoring be integrated into the annual stormwater monitoring program.

8.5 Phase 2 - Updated Water Quality and Flow Monitoring (2019 - ongoing)

As part of Phase 2, monitoring locations and protocols have been refined to align with the implementation approach of prioritizing works based on the watersheds in the most need and where there are opportunities to improve conditions but also recognizes the need to protect existing watershed health. Phase 2 monitoring also focuses on the collection of data within subwatershed that were determined to have insufficient data during the subwatershed prioritization analysis and established long-term monitoring sites for the collection of water quality data within Priority 1 subwatersheds.

Subwatershed based monitoring will be undertaken at regular intervals to confirm and/or evaluate the effects of the recommended approaches and refine the Implementation Plan to ensure project and programs are delivering the greatest value-for-dollar for the residents of Kitchener. Following the completion of the Phase 2 monitoring in 2022, it is recommended that watershed health be reassessed following the protocol outlined within the ISWM-MP and that monitoring priorities be re-prioritize based on implementation status of the recommended approaches and revised watershed health scores.

The Phase 2 program is recommended to include the following. Monitoring program procedures and protocols are detailed in **Attachment D**.

- **Water Quality** - flow proportionate water quality sampling using automated water quality sampling procedures and equipment to develop Event Mean Concentrations (EMCs) using the City's existing three (3) automated water quality sampling units and the purchase of two (2) additional units per year, with the ultimate goal of acquiring a total of twelve (12) automated units by 2023. It is recommended that future water quality sampling be revised to include:
 - Flow proportionate water quality sampling for using automated water quality sampling procedures and equipment to develop EMCs per the locations detailed in **Table 8.1**. EMCs will provide the City with the ability to better quantify in-stream water quality in regards to Provincial Water Quality Objectives (PWQO) for various representative pollutants. Beginning in 2019, per the recommendations of the 2015 SWM Audit, autosamplers shall be strategically located at Core Station within Priority 1 watershed with the aim at producing

long-term continuous data (rather than at 5-year cycles) at a limited number of stations. It is recommended that a minimum of 10 consecutive years of data be collected at each long-term station in order to establish trends. As more autosamplers become available following the completion of EMC monitoring at non-core stations per **Table 8.1**, the program should be extended to other stations based on the recommendations of the external consultant and the Stormwater Monitoring Program Implementation Committee (City of Kitchener, GRCA and MROW).

- All grab sampling should be eliminated from the Phase 2 program, with the exception dry weather grab sampling of three (3) events for the locations detailed in **Table 8.1** to identify spills and illicit discharges.
 - Collected water quality samples will continue to be submitted to a private accredited laboratory for analysis.
- **Water Quantity** – continuous flow monitoring for five (5) to eleven (11) stations annually per the locations detailed in **Table 8.1** and corresponding to the flow proportionate water quality sampling stations.
- **Temperature Monitoring** - continuous temperature monitoring for five (5) to eleven (11) stations annually per the locations detailed in **Table 8.1** corresponding to the flow proportionate water quality sampling stations.
- **Invertebrate Community Sampling** – Benthic macroinvertebrate monitoring should be continued on an annual basis for at each continuous flow monitoring station and dry weather sampling station. The benthic community composition can change very quickly if habitat quality changes (benthics have limited mobility and a short life span), therefore monitoring is best conducted frequently. The results would continue to be compared to previous years, to track changes over time. Results provide a measure of how the benthic community has changed over time and are an excellent indication of in-stream conditions. The level of effort would remain unchanged from previous years.
- **Fish Community Sampling** – Continuing from Phase 1, for each sampling station, it is recommended that annual data be collected for a minimum of two (2) years to establish baseline conditions at each station beginning with Core Stations followed by Non-Core Stations. Fish community sampling is not recommended for stations with a significant sampling history from previous years that includes more than 1 year of fisheries data.

After baseline conditions have been established for all station, monitoring shall be can be conducted per the following:

- Stations with no identified sensitive species – sampling may be conducted at a reduced frequency (bi-annual or longer). Station locations are recommended to

rotate annually per the recommendations of the external consultant and the Implementation Committee.

- o Stations where sensitive species have been identified, monitoring may be conducted at an increased frequency (annual basis). If sensitive species are found at a station where no sensitive species have been previously identified, monitoring should be conducted at an increased frequency for subsequent years.

This recommendation focuses sampling effort and budget on a priority basis relating to those stations with sensitive species.

- **Compliance Monitoring: Permit, Construction and ECA** – where possible, it is recommended that compliance monitoring be integrated into the annual stormwater monitoring program.

8.6 AEM approach for Stormwater Monitoring Program

It is recommended that on a 5 year basis the City of Kitchener in consultation with the Stormwater Monitoring Program Implementation Committee (City of Kitchener, GRCA and MROW) review and refine the overall stormwater monitoring program. Monitoring program refinements should be in keeping with the goals and objectives of the ISWM-MP.

9.0 NEXT STEPS AND RECOMMENDATIONS

The following next steps and recommendations have been developed to guide future works, studies and mechanisms related to the implementation of the City of Kitchener Integrated Stormwater Management Master Plan (ISWM-MP).

- 17) Prior to undertaking any identified project, the City shall review each site specific project for the potential to impact known or potential cultural heritage resources in compliance with the heritage policies of the Kitchener Official Plan as well as other policies and procedures using noted resources within **Section 5.0**. The City will complete the necessary heritage assessment and studies required to identify and mitigate potential impacts and share such studies with the appropriate officials as required.
- 18) The City of Kitchener's **Site Alteration bylaw** is used to control site alteration activities within the city, such as the placing or dumping of fill; the removal of topsoil; and the alteration of the grade of land. A **Site Alteration Permit** is required for all properties 0.405 hectares or greater. Site alteration permits are not required for:
 - The installation of a swimming pool provided a pool permit is obtained.
 - Minor grading or landscaping projects.
 - Normal farm practices.
 - Development that is undertaken with the appropriate planning approvals and building permits.

Through discussion with City of Kitchener Engineering and Planning staff, it is recommended **that the minimum property area for review should be reduced from 0.405 to 0.1 hectares**. This reduction will more accurately reflect the lot sizes in the City of Kitchener and allow for more comprehensive implementation of volume control policy.

- 19) In light of continuing redevelopment pressures in the City's downtown core, it is recommended that the City of Kitchener **review the existing Downtown Exemption Area** for opportunities to improve the uptake of source control features such as permeable pavement, rainwater harvesting and green roofs to the maximum extent possible (MEP) subject to the City of Kitchener Infiltration Policy and site constraints.
- 20) It is recommended that before final Engineering sign-off, the applicant meet a **certification clause verifying the property has been registered in the City's Stormwater Credit Program**.
- 21) Within the province several manuals and guides have been developed to assist in the design and implementation of LID features. It is recommended that the City of Kitchener direct proponents of development, redevelopment, reurbanization and residential intensification to the **LID reference documents** listed in **Stormwater Infiltration in the Context of Source Protection Planning see Attachment A**.

- 22) It is recommendation that the **City incorporate Low Impact Development design guidelines** per the Low Impact Development Stormwater Planning and Design Guide (V1.0, 2010 or as amended from time to time) into the City standards and specifications in **2017**.
- 23) Per **Section 6.3** of the **ISWM-MP Report** a review of the existing erosion and sediment controls program as part of the development process should be undertaken to bring municipal policy in line with agency and provincial direction. This review is recommended such that new policies and standards capture the evolution in erosion and Sediment Controls (ESC), from a single approach for sediment management to ESC control methodologies and approaches that utilizes a hierarchical strategy of elimination or reduction of erosion then control of sediment releases. Amended E&SC approaches should be integrated into the City standards and specifications.
- 24) It is recommended that the City **update standard road cross section drawings** as well as relevant sections in the Development Manual to reflect the Recommended Approaches as identified within the ISWM-MP.
- 25) It is recommended that the **City of Kitchener develop a Pollution Prevention Plan checklist** or minimum requirements in consultation with the Region of Waterloo's Risk Management Plans per the Source Protection Plan and Policies.
- 26) That in the future when LID conveyance controls within the right-of-way constitute a significant portion of the City's stormwater infrastructure, it is recommended that the **City staff explore the development of a "Green Streets Fund"** which would allow for the application of a fee based system on all road cut permits where fees are equal to a nominal percentage of total capital (actual or estimated) construction budget. Collected fees would be primarily allocated to verification of appropriate rectification post construction as well as to future municipal ROW retrofit projects and operation and maintenance activities.
- 27) That City staff **explore collaborative funding partnerships with local municipalities, agencies and government** to reduce urban non-point source pollution as specified in the Grand River Watershed Water Management Plan. It is further recommended that City staff be directed to explore the development of a market for the collection and sale of urban non-point source pollution 'credits' as a future stormwater funding source.
- 28) It is recommended that the City of Kitchener **investigate through the completion of a comprehensive market analysis, consultation with MOECC and the development of an administrative framework under the Stormwater Utility, the establishment of a Stormwater Volume Retention Credit (SVRC) program**. Through this future program, development projects can implement "over control" (Over control" is a method of balancing the amount of water retained in multiple areas) to retain more than the

required minimum runoff volume in one area and less in another. Projects which can demonstrate 'over control' to the satisfaction of the City would qualify for the credits. Such credit may be tradable, saleable or exchangeable.

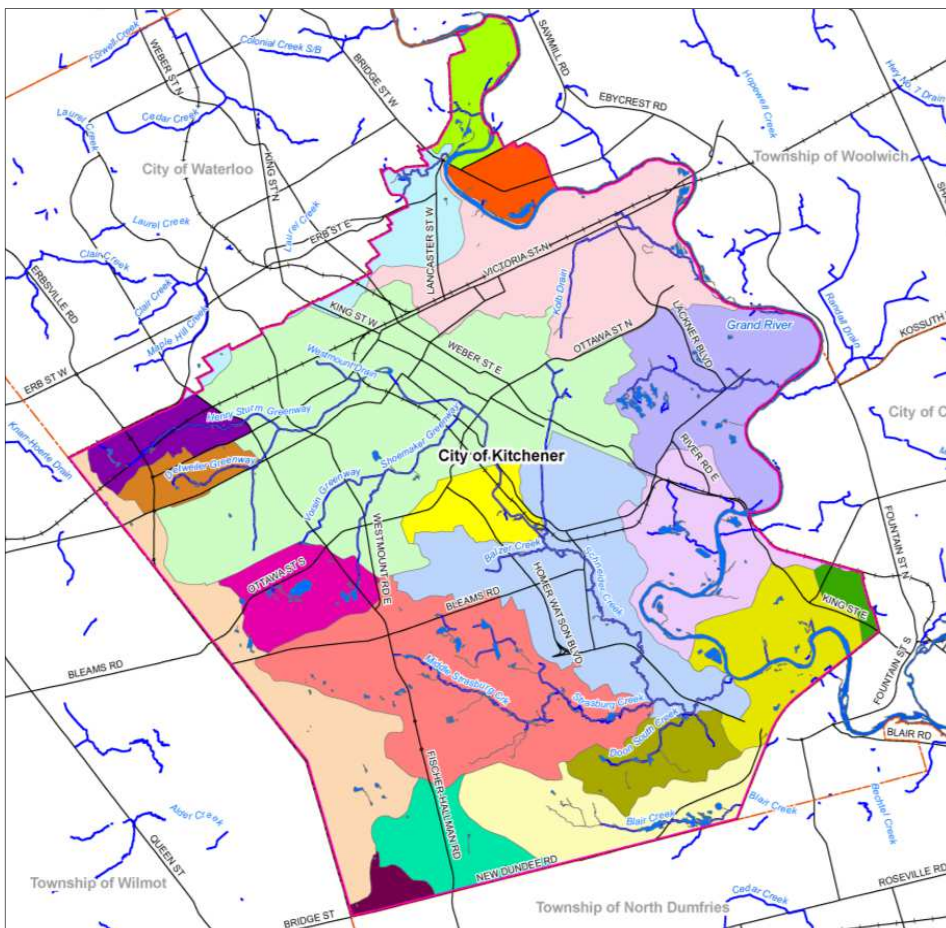
- 29) It is recommended that the **City of Kitchener investigate** through the completion of a comprehensive assessment and the development of an administrative framework under the Stormwater Utility, the establishment of a policy to permit **"Aggregated or Shared BMP"** amongst multiple properties of the same owner. The administrative framework should at a minimum require that:
- the proponent be the owner of both subject properties,
 - both properties are enrolled within the Stormwater Credit Program and
 - the facilities are registered on title with appropriate operations and maintenance conditions to the satisfaction of the City of Kitchener.
- 30) The ISWM-MP did not analyze the impact of modified street-sweeping and leaf collection programs on catch basin operation. It is recommended that the City of Kitchener **investigate potential efficiencies of the existing street sweeping and leaf collecting programs and the potential to integrate catch-basin cleaning.**
- 31) It is recommended that an Environmental Technology Verification (ETV) certified catch basin (e.g. CB Shield™ or equivalent) be installed for use as a pilot project in uncontrolled drainage areas where other opportunities do not exist.
- 32) In order to achieve the goals of the ISWM-MP, it is recommended that the City's permanent staff resources are expanded by **one Design & Construction Project Manager and one Engineering Technologist**. These two positions have previously been filled on a contract basis, but are required permanently based on the findings of the ISWM-MP. The work to be undertaken by the two new positions includes:
- Development of municipal pollution prevention, operations & maintenance programs.
 - Create market based strategies and pilot programs to incentivize stormwater management practices on private properties.
 - Provide design support for the implementation of low impact development techniques within the municipal right-of-way projects in the AIRP and create new design standards and specifications.
 - Manage stormwater management pond rehabilitation projects.
 - Manage watercourse rehabilitation and erosion control projects.
 - Develop the urban flood management strategy and further refine the hydraulic modelling to identify constraints in stormwater infrastructure.

Attachment A - Stormwater Infiltration in the Context of Source Protection Planning (October 2016)

Prepared for:
The City of Kitchener

INTEGRATED STORMWATER MANAGEMENT MASTER PLAN (ISWM-MP) MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT

Stormwater Infiltration in the Context of Source Protection Planning



55 Regal Road, Unit 3
Guelph, ON
N1K 1B6

October 2016
FINAL

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1.0 Introduction

The use of infiltration practices to reduce runoff and restore natural hydrologic processes is crucial to improving the City of Kitchener's natural water systems, maintaining the viability of local stormwater infrastructure, and contributing to climate change adaptation & mitigation strategies. While the City has already been successful in facilitating the implementation of rain gardens, permeable pavers and other infiltration practices via the Stormwater Credit program, few credits have been issued outside of residential neighbourhoods. As the implementation of infiltration practices becomes more prevalent, the City of Kitchener has a duty to protect local groundwater resources by implementing a land use-based stormwater infiltration guideline which is developed based on a sound understanding of identified and future risks.

2.0 Purpose

This document identifies existing policies related to the infiltration of stormwater runoff and contains land-use based policies to identify site specific opportunities, constraints and approaches. The following shall be applied as part of the City of Kitchener Integrated Stormwater Management Master Plan (ISWM-MP) and utilized to identify, manage, and implement infiltration based stormwater management controls, commonly referred to as Low Impact Development (LID) controls.

The infiltration requirements outlined in this document are primarily intended to be used for retrofit opportunities and/or the redevelopment of land within the City's current built up area. Where an implementation strategy has been developed through a Subwatershed Study, Master Drainage Plan, Secondary Plan or other planning study the infiltration recommendations contained within these detailed studies will supersede. In all cases, the most stringent policy and/or requirements shall apply.

The identification of site specific opportunities, constraints and approaches discussed in this document relates directly to the protection of local groundwater resources and not the identification of opportunities to maximize groundwater recharge. The approach described below can be used as a framework for the maintenance of the pre-development onsite water balance and can be used in conjunction with mapping prepared for the City of Kitchener ISWM-MP which identifies soil types, surficial geology and significant recharge areas.

The following shall be read in conjunction with the **Stormwater Volume Criteria and Targets (October 2016)** as prepared for the Integrated Stormwater Management Master Plan (ISWM-MP).

The application of this document shall be effective January 1, 2017.

3.0 Existing Policy

Several existing policies provide a framework for the development of land-use based infiltration guidelines within the City of Kitchener. It is recognized that as new policies are developed and technical studies are completed by planning authorities, the guidelines outlined in this document will adapt to changes as part of an adaptive management approach. Existing policies that provide a framework include:

1) Provincial Policy Statement (MMAH, 2014)

The Provincial Policy Statement (PPS) provides policy direction on matters of provincial interest related to land use planning and development. Section 1.6.6.7 of the PPS states that planning for stormwater management shall:

- a) Minimize, or, where possible, prevent increases in contaminant loads;
- b) Minimize changes in water balance and erosion;
- c) Not increase risk to human health and safety and property damage;
- d) Maximize the extent and function of vegetative and pervious surfaces; and
- e) Promote stormwater management best practices, including stormwater attenuation and re-use, and low impact development.

Stormwater management is also discussed in the PPS under section 2.2.1 water wherein it is stated that Planning authorities shall protect, improve or restore the quality and quantity of water by:

- h) Ensuring stormwater management practices minimize stormwater volumes and contaminant loads, and maintain or increase the extent of vegetative and pervious surfaces.

2) Stormwater Management Planning and Design Manual (MOE, 2003)

The Stormwater Management Planning and Design Manual (SWMPDM) provides technical and procedural guidance for the planning, design, and review of stormwater management practices. A companion document to the 2003 SWMPDM is currently under development. This companion document will include volumetric stormwater management targets and recommendations on the implementation of infiltration practices. The 2003 SWMPDM recognizes that lot level and conveyance controls are “required to maintain the natural hydrologic cycle to the greatest extent possible”. Appendix G of the 2003 SWMPDM manual discusses methodology for the retrofitting of existing infrastructure to achieve water balance, water quantity, water quality, and erosion and flood control goals.

3) Grand River Watershed Water Management Plan (GRCA, 2014)

The Water Management Plan addresses the management of surface and ground water resources in the Grand River watershed to 2031. The Watershed Plan pulls together plans such as forestry, fisheries, natural heritage, drinking water source protection, recreation and other planning processes so that linkages can be made for larger scale watershed planning. Section 5.2.1.3.2 of the Grand River Watershed Water Management Plan references covers Urban Stormwater. MOE’s 2003 SWMPDM for design and performance guidance and states that municipalities within the GRCA jurisdiction are collaborating to compose a list of best practices for stormwater control for both new and existing developments.

4) City of Kitchener Official Plan (City of Kitchener, 2014)

The City of Kitchener Official Plan is used to direct growth and provide policy framework and guidance to the development of the City. The official plan promotes the use of infiltration practices as part of the source water protection objectives outlined in section **7.C.1**. These objectives are:

7.1.1. To protect existing and future sources of drinking water from incompatible land-uses.

7.1.2. To maintain and, wherever feasible, enhance the quantity and quality of water infiltration and recharge to groundwater aquifers.

7.1.3. To minimize the potential for contamination, including potential contamination from de-icing salts, on sources of municipal drinking-water.

7.1.4. To promote informed stewardship of Source Water Protection Areas.

In the City of Kitchener Official Plan an infiltration specific stormwater policy can be found in section:

14.C.1.28 “Stormwater management designs will be encouraged to use appropriate on-site infiltration measures to the maximum extent feasible in areas where soil types permit.”

5) Regional Official Plan (Region of Waterloo, 2015)

The Region of Waterloo Official Plan is used to direct growth and change within the Region while conforming to existing policy framework in order to further the sustainability and livability of the community. Specific policies within the Regional Official Plan that relate to the infiltration of stormwater are **8.A.5** and **8.A.11**.

Section 8.A.5 for Development applications within all Source Water Protection Area designations will comply with the following:

“employment uses that would direct infiltration of stormwater run-off without pre-treatment through the use of drywells or artificial/enhanced recharge will not be permitted”

Section 8.A.11 Within the WPSA 1 designation:

“new individual wastewater treatment systems, private wells, pipelines sewers, stormwater management ponds (or other ponds) and the direct infiltration of stormwater run-off without pre-treatment will not be permitted”

6) Grand River Source Protection Plan (LERSPC 2012, Approved 2015, effective July 1, 2016)

Drinking water source protection plans identify the risks to municipal water quality and water supplies, and the policies and programs that will reduce the risks. Volume II of the Grand River Source Protection Plan covers the Region of Waterloo including the City of Kitchener. Specific policies relating to Stormwater Management within Wellhead Protection Areas (WHPA) and Intake Protection Zones (IPZs) can be found from policy **RW-MC-15** through **RW-CW-20.1**.

RW-MC-15: For existing discharge of stormwater from a stormwater management facility within vulnerable areas where this activity is a significant drinking water threat, the Ministry of the Environment, in consultation with the owner of the stormwater management facility and following the completion of the assessment identified in policy RW-CW-19, shall ensure that the Environmental Compliance Approval that governs the stormwater management facility includes appropriate terms and conditions to ensure that the activity ceases to be a significant drinking water threat in the following vulnerable areas:

- i. In Wellhead Protection Areas A and B where the vulnerability is equal to ten(10);
- ii. In Wellhead Protection Area E where the vulnerability is greater than or equal to eight (8);
- iii. In Intake Protection Zone Three (3) where the vulnerability is equal to eight(8);
- iv. In Intake Protection Zone One (1);
- v. Where a Nitrate and/or Chloride Issue has been identified, in all Issue Contributing Areas.

RW-MC-16: To ensure the new discharge of stormwater from a stormwater management facility does not become a significant drinking water threat within vulnerable areas where this activity would be a significant drinking water threat:

- a. The Ministry of the Environment shall prohibit the new discharge of stormwater from a stormwater management facility within the Environmental Compliance Approvals process in the following areas as appropriate.
 - i. In Wellhead Protection Area A;
 - ii. In Intake Protection Zone One (1).
- b. The Ministry of the Environment shall ensure that the Environmental Compliance Approval that governs the new discharge of stormwater from a stormwater management facility includes appropriate terms and conditions to ensure the activity does not become a significant drinking water threat when permitted in the following areas as appropriate:
 - i. In Wellhead Protection Area B where the vulnerability is equal to ten (10);
 - ii. In Wellhead Protection Area E where the vulnerability is greater than or equal to eight (8);
 - iii. In Intake Protection Zone Three (3) where the vulnerability is equal to eight (8);
 - iv. Where a Nitrate and/or Chloride Issue has been identified, in all Issue Contributing Areas except Wellhead Protection Area A.

The Environmental Compliance Approval should include, as minimum, water quality monitoring measures and reporting annually to the Ministry of the Environment, as appropriate. Where there is a Nitrate, and/or Chloride Issue, groundwater and/or surface water quality shall be monitored for Nitrate and Chloride, respectively.

RW-MC-17: The Regional Municipality of Waterloo and the Area Municipalities shall review and, if necessary, amend their Official Plans and Zoning By-laws to reflect policy RW-MC-16 as it relates to stormwater management in the following areas to ensure these activities never become significant drinking water threats:

- i. In Wellhead Protection Area A;
- ii. In Intake Protection Zone One (1).

RW-MC-18: The Regional Municipality of Waterloo and Area Municipalities shall review and, if necessary, amend their Official Plans to require any development proposals for new stormwater management facilities shall be subject to a study to assess impact and mitigation measures in accordance with the

Regional Implementation Guideline for Source Water Protection Studies to the satisfaction of the Regional Municipality of Waterloo within the following areas:

- i. In Wellhead Protection Area B where the vulnerability is equal to ten (10);
- ii. In Wellhead Protection Area E where the vulnerability is greater than eight (8);
- iii. In Intake Protection Zone Three (3) where the vulnerability is greater than eight (8);
- iv. Where a Chloride and/or Nitrate Issue has been identified, in all Issue Contributing Areas except Wellhead Protection Area A.

Where a proposed stormwater management pond is located within 500 metres of a Drinking Water System that obtains water from a bedrock aquifer, the study shall, as a minimum, assess changes in classification of the municipal supply well and or changes in hydrogeological conditions that could affect the pathogen vulnerability to the well.

RW-CW-19: The Area Municipalities, in collaboration with the Regional Municipality of Waterloo and the Ministry of Environment, shall undertake an assessment of stormwater management facilities to determine appropriate scope and type of measures to protect drinking water sources within two (2) years from the date the Source Protection Plan takes effect to ensure that this activity ceases to be a significant drinking water threat in the following areas:

- i. In Wellhead Protection Area A and B where the vulnerability is equal to ten (10);
- ii. In Wellhead Protection Area E where the vulnerability is greater than eight (8);
- iii. In Intake Protection Zone Three (3) where the vulnerability is equal to eight (8);
- iv. Where a Chloride and/or Nitrate Issue has been identified, in all Issue Contributing Areas.

RW-CW-20: To ensure the existing and future discharge of stormwater from a stormwater management facility exempt from Environmental Compliance Approvals does not become or ceases to be a significant drinking water threat:

- a. The future discharge of stormwater from a stormwater management facility within vulnerable areas where this activity would be a significant drinking water threat is designated for the purpose of Section 57 of the Clean Water Act, 2006 and is prohibited within the following vulnerable areas where there is or would be a significant drinking water threat:
 - i. In Wellhead Protection Area A;
 - ii. In Intake Protection Zone One (1).
- b. The discharge of stormwater from a stormwater management facility shall be designated for the purpose of Section 58 of the Clean Water Act, 2006 and a Risk Management Plan shall be required with the persons or agencies engaging or proposing to engage in the following areas:
 - a) Existing:
 - i. In Wellhead Protection Area A and B where the vulnerability is equal to ten (10);
 - ii. In Wellhead Protection Area E where the vulnerability is greater than or equal to eight (8);
 - iii. In Intake Protection Zone One (1);
 - iv. In Intake Protection Zone Three (3) where the vulnerability is equal to eight (8);
 - v. Where a Nitrate and/or Chloride Issue has been identified, in all Issue contributing Areas except in Wellhead Protection Area A.
 - b) Future:
 - i. In Wellhead Protection Area B where the vulnerability is equal to ten (10);

- ii. In Wellhead Protection Area E where the vulnerability is greater than or equal to eight (8);
- iii. In Intake Protection Zone Three (3) where the vulnerability is equal to eight (8); and
- iv. Where a Nitrate and/or Chloride Issue has been identified, in all Issue Contributing Areas except Wellhead Protection Area A.

The Risk Management Plan shall include, as a minimum, water quality monitoring and reporting to the Risk Management Official. Where there is a Nitrate and/or Chloride Issue, the Risk Management Plan shall also include water quality monitoring for nitrate or chloride, respectively.

RW-CW-20.1: To promote best management practices and to provide guidance about the importance of source water protection, the Regional Municipality of Waterloo shall develop and implement an incentive program for persons engaging in the existing discharge of stormwater from a stormwater management facility exempt from Environmental Compliance Approvals in the following areas:

- i. In Wellhead Protection Area A and B where the vulnerability is equal to ten (10);
- ii. In Wellhead Protection Area E where the vulnerability is greater than or equal to eight (8);
- iii. In Intake Protection Zone One (1);
- iv. In Intake Protection Zone Three (3) where the vulnerability is equal to eight (8);
- v. Where a Nitrate and/or Chloride Issue has been identified, in all Issue Contributing Areas except in Wellhead Protection Area A.

Additional to the above policies related to stormwater management, the SPP stipulates the following regarding road works:

RW-CW/NB-40: The Regional Municipality of Waterloo and Area Municipalities and the Ontario Ministry of Transportation shall enhance road design measures in Environmental Assessments to modify, widen or expand existing roads and/or design/develop new roads to minimize the impact from any application of salt on roadways related to the development of new roads in the following areas:

- i. In Wellhead Protection Area B where the vulnerability is equal to ten (10);
- ii. Where a Chloride and/or a Sodium Issue has been identified, and in all Wellhead Protection Areas where the vulnerability is greater than or is equal to six (6). The assessment should make recommendation for enhancement measures to protect drinking water sources to be carried through detailed design and construction of the road.

WHPAs where the adjusted vulnerability score is equal to or greater than 8

Of specific concern are WHPAs where the adjusted vulnerability score is equal to or greater than 8. Travel times to the wellhead within these areas are short and it is within the best interest of the City of Kitchener to avoid the implementation of infiltration practices from paved surfaces within these areas. WHPAs with adjusted vulnerability scores equal to or greater than 8 are shown on Figure 1.0 along with WHPAs with adjusted vulnerability scores from 2 through 6.

The Ontario Clean Water Act, 2006, defines a Drinking Water Threat as “an activity or condition that adversely affects or has the potential to adversely affect the quality or quantity of any water that is or may be used as a source of drinking water, and includes an activity or condition that is prescribed by the regulation as a drinking water threat.”

Within the City of Kitchener, issues relating to drinking water quality were identified for the following well fields as described in **Table 3.0**.

Table 3.0 – Identified Issues for Kitchener Well Fields

Well Field	Wells	Identified Issue & Associated Threat
Manheim East	K21, K25 and K29	Nitrate
Manheim west	K91, K92, K93, and K94	
Manheim Peaking	K22A, K23, K24 and K26	
Manheim ASR (Aquifer Storage & Recovery)	Wells ASR01, ASR02, ASR03 ASR04, RCW1 and RCW2	
Greenbrook	K01, K02, K04B, K05A, and K08	Chloride - increasing concentrations of chloride since at least 1973
Strange Street	K10A, K11A, K13, K18 and K19	Chloride (K10A) - increasing concentrations of chloride since at least 1973
Parkway	K31, K32 and K33.	Sodium & chloride - increasing chloride concentrations since at least 1992
Wilmot Centre	K50 and K51	Nitrate

Issue Contributing Areas (ICAs) have been developed in response to the identified issues for each of the aforementioned wells and well fields. The corresponding ICAs are illustrated in **Figure 1**. Due to the risk of groundwater contamination associated with infiltration of stormwater in these areas, it is recommended that stormwater infiltration practices in ICAs be limited to runoff originating from relatively clean sources of water such as landscaped areas (front, side or rear yards), rooftops (see **Section 4.0**) and local roads with rural cross-sections (see **Section 5.0**).



City of Kitchener Stormwater Management Master Plan

Legend

- Study Area
- Municipal Boundary
- Watercourses
- City of Kitchener Wells
- Issue Contributing Areas (CWA) - CHL
- Issue Contributing Areas (CWA) - NIT
- Vulnerability Score 8 - 10
- Vulnerability Scores 2 - 6
- WHPA-E
- Intake Protection Zone**
 - IPZ-1
 - IPZ-2

Source: City of Kitchener

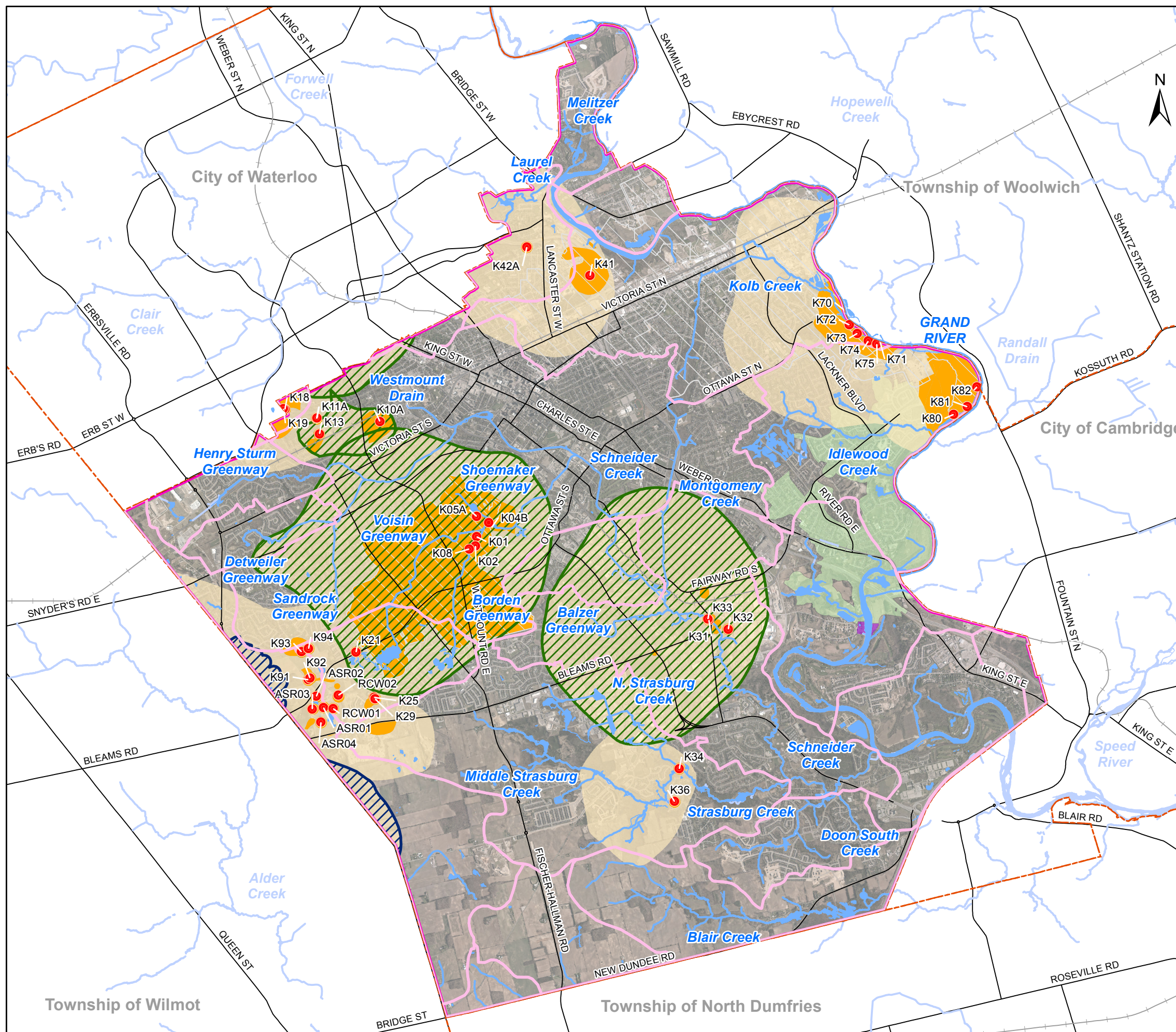
Figure 1

Stormwater Infiltration Constraint Areas

0 0.5 1 2 3 Km



Date: March 2016



4.0 Land Use Based Infiltration Plan

General land use categories are identified below along with stormwater infiltration opportunities and constraints. The general goal of this land use based approach is to provide an effective way of identifying infiltration opportunities while protecting local groundwater resources from contamination, specifically for identified issues and threats (**Table 3.0**). Land use within the City of Kitchener is identified in **Figure 2**.

4.1 High Risk Site Activities

For all sites, infiltration practices should not accept runoff from drainage areas within the site itself which are associated with higher risks such as fueling operations, waste disposal areas, vehicle washing stations, salt storage areas, stockpiling areas, outdoor storage areas and shipping and receiving areas etc. Instead pollution prevention practices in the form of administrative and engineering controls should be applied in these areas.

Table 4.0 identifies individual high risk site activities. High risk site activities are defined as those with the potential for high levels of contamination such as hydrocarbons, metals, organic and inorganic compounds, sediments and chlorides. While it may be difficult to predict the ultimate activities of individual sites; **Table 4.0** can be used as a screening framework for identifying portions of each site where additional focus and review is needed to where infiltration practices (i.e. LIDs) should be discouraged, due to risk associated with the specific uses.

Drainage areas within each site with high risk activities (**Table 4.0**) will be generally discouraged from incorporating LID techniques that utilize infiltration as its primary function within the identified catchment because of the associated risk to groundwater contamination. However high risk site activities do not preclude the use of those LID techniques that utilize filtration, evapotranspiration (ET) or re-use as the primary processes. Additionally, the infiltration of rainwater from catchments not directly impacted by the respective high risk site activities such as rainwater emanating from rooftops, employee parking facilities or directly falling on permeable surfaces is generally considered relatively 'clean' and should not be excluded from infiltration.

Pollution Prevention Plans and/or Risk Management Plans are required to be submitted as part of SWM Reports for sites containing activities identified as having high risks as listed in **Table 4.0** and/or supplemented by high risk sites as identified by the Region of Waterloo's Source Protection Policies.

Pollution Prevention Plans are guiding documents that outline the use of processes, practices, materials, products, substances or energy that avoid or minimize the creation of pollutants and waste, and reduce the overall risk to the environment and human health. A typical pollution prevention plans (see Stormwater Pollution Prevention Handbook, 2001) can include details not limited to:

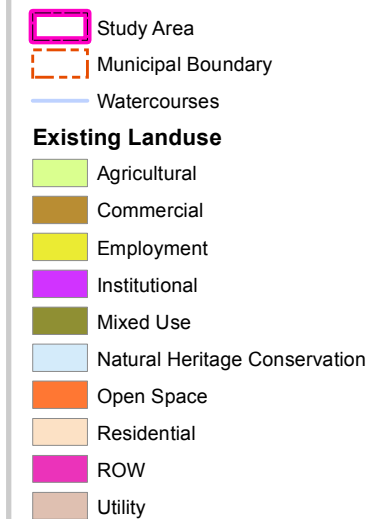
- Spill containment procedure and systems
- Material and waste storage including dumpster and grease management
- Outdoor storage including chemicals and raw as well as finished materials
- Parking lot and building maintenance activities
- Landscaping and grounds care
- Protection and designation of buffer and drainage areas
- Vehicle and fleet maintenance and repair
- Fueling stations and fuel storage
- Snow and Ice management

Table 4.0 - High Risk Site Activities

Uses within the site boundaries which would preclude infiltration for the identified catchment where the High Risk use is taking place. (Infiltration of roof water is not limited by high risk site use)	
1. Airports 2. Snow Storage Areas and Facilities 3. Disposal, Storage and Transfer - Storage of hazardous wastes or liquid industrial wastes - Landfills, waste transfer stations, & putrescible waste disposal - Lagoons for sewage treatment - Bulk liquid trucking - Warehousing, bulk storage or retail sale of: - Petroleum fuels, oils, chlorinated solvents, - Household or industrial cleaning products - Agricultural pesticides, herbicides, fungicides & fertilizers 4. Contracting Operations: - Roofing Siding and Sheet Metal Contractors 5. Metal finishing operations - Electroplating, Electro Coating, Galvanizing, Painting, Application of Baked Enamel - Electroplating Plating, Polishing, Anodizing and Colouring - Powder Metallurgy Part Manufacturing - Metal Coating Engraving except Jewellery and Silverware and Allied Services to - Manufacturers - Non-ferrous Metal except Copper and Aluminium Rolling Drawing and Extruding - Metal Heat Treating - Motor Vehicle Stamping - Metal Stamping	9. Manufacturing of: - Metal Household Furniture Manufacturing - Miscellaneous Fabricated Metal Product Manufacturing - Electrometallurgical Ferroalloy Product Manufacturing - Metal Can Manufacturing and Other Metal Container Manufacturing - Unfinished Fabricated Metal Products Manufacturing - Other Metal Valve and Pipe Fitting Manufacturing - Enameled Iron and Metal Sanitary Ware Manufacturing - Fabricated Structural Metal Manufacturing - Metal Window and Door Manufacturing - Metal Tank (Heavy Gauge) Manufacturing - Sheet Metal Work Manufacturing - Ornamental and Architectural Metal Work Manufacturing - Prefabricated Metal Building and Component Manufacturing - Fabricated Structural Metal Manufacturing - Machine Tool Metal Cutting Types Manufacturing - Machine Tool Metal Forming Types Manufacturing - Other Metalworking Machinery Manufacturing - Bare Printed Circuit Board Manufacturers - Electronic Coil Transformer and Other Inductor Manufacturing - Printing Ink Manufacturing - All Other Basic Inorganic Chemical Manufacturing - Gum and Wood Chemical Manufacturing - Petrochemical Manufacturing - All Other Basic Organic Chemical Manufacturing - Pesticide and Other Agricultural Chemical Manufacturing - All Other Miscellaneous Chemical Product and Preparation Manufacturing - Photographic Film Paper Plate and Chemical Manufacturing

6. Automotive Services • Auto Wrecking & Salvage Yards • Gasoline Stations • Automotive Body Paint and Interior Repair and Maintenance • Automotive Exhaust System Repair • All Other Automotive Repair and Maintenance • Automotive Transmission Repair • General Automotive Repair • Other Automotive Mechanical, Electrical Repair & Maintenance • Automotive Oil Change and Lubrication Shops 7. Other Services • Metals Service Centres and Offices • Jewellery Watch Precious Stone and Precious Metal Wholesalers • Photofinishing Laboratories • Dentist Offices • General Medical and Surgical Hospitals • Psychiatric and Substance Abuse Hospitals • Speciality Hospitals • Medical Laboratories • Dental Laboratories • Testing Laboratories • Commercial or Industrial Dry Cleaning of Textiles and Laundry Services (except coin operated) • Books Printing • Quick Printing • Other Commercial Printing • Commercial Lithographic Printing • Commercial Gravure Printing • Commercial Flexographic Printing • Commercial Screen Printing • Other Commercial Printing • Manifold Business Forms Printing	• Other Chemical and Allied Products Wholesalers • Plastics Material and Resin Manufacturing • Soap and Other Detergent Manufacturing • Pharmaceutical Preparation Manufacturing • Paint and Coating Manufacturing • Petroleum Lubricating Oil and Grease Manufacturing • All Other Petroleum and Coal Products Manufacturing • Asphalt Paving Mixture and Block Manufacturing • Asphalt Shingle and Coating Materials Manufacturing • Plastics Bottle Manufacturing • Plastics Plumbing Fixture Manufacturing • All Other Plastics Product Manufacturing • Leather and Hide Tanning and Finishing • All Other Leather Goods Manufacturing • Wood & Wood Product Preservation & Treatment Manufacturing • Petroleum Products or Asphalt Batching (including processing) Manufacturing • Motor Vehicles, Trucks, & Bus Bodies Manufacturing • Aircraft & Aircraft Parts Manufacturing • Rail Cars Manufacturing • Mobile Homes Manufacturing • Ships & Boats Manufacturing • Industrial Chemicals Manufacturing • Adhesives Manufacturing • Small Electrical Appliances Manufacturing • Electric Lamps Manufacturing • Wet Batteries Manufacturing • Dry Electrical Industrial Equipment Manufacturing • Vehicle Engines Manufacturing • Cable & Wire Manufacturing • Paints & Varnishes Manufacturing • Major Electric Appliances Manufacturing • Plastics & Synthetic Resins Manufacturing
---	--

8. Transportation Services • Support Activities for Rail Transportation • All Other Transit and Ground Passenger Transportation • School and Employee Bus Transportation • Interurban and Rural Bus Transportation • School and Employee Bus Transportation • Other Support Activities for Road Transportation	• Lighting Fixtures Manufacturing • Wet Electrical Equipment Manufacturing • Steering & Suspension Parts Manufacturing • Motor Vehicle Wiring Manufacturing • Reinforced Fiberglass Manufacturing • Electronic Components (semiconductors, printed circuit boards, cathode ray tubes) Manufacturing • Wheels & Brakes Manufacturing
Source: Amended from LID Stormwater Management Manual (TRCA & CVC, Draft 2008), East Side Lands Master Drainage Plan (Nov 2013) and Stormwater Management Policy Development Implementation Procedure for Development Updated 2008 - Schedule A * For sites with unknown activities (i.e. units with multiple and/ or unspecified tenants) at the time of application, the City shall apply most stringent requirements.	



Existing Landuse by Official Plan



Date: February 2016

4.2 ICAs and WHPAs

For all sites within ICAs and/or WHPAs with adjusted vulnerability scores equal to or greater than 8, paved surfaces (roads, sidewalks and parking surfaces) should not be treated with stormwater infiltration practices. This is to prevent groundwater from salt based deicers commonly used on these surfaces in the winter.

4.3 Land Use Infiltration Guidelines

The following outlines the infiltration guidelines for various land-uses, including:

- | | |
|----------------|---|
| 1. Residential | 4. Industrial Employment |
| 2. Mixed Use | 5. Institutional |
| 3. Commercial | 6. Open Space and Natural Heritage Conservation |

There is less risk of groundwater contamination associated with the infiltration of runoff from pervious surfaces and relatively clean impervious surfaces such as roof tops and should be considered a priority for infiltration followed by:

- Landscaped areas
- Paved surfaces
- Roadways

There is however a need to infiltrate runoff from other impervious surfaces in order to reduce runoff and restore natural hydrologic processes. Taking these objectives and constraints into consideration, the guidelines outlined in Section 4.3 take a tiered risk-based approach. The guidelines take into consideration both the source of runoff and groundwater vulnerability. The guidelines impose greater restriction on infiltration practices within ICAs and WHPAs. **Table 4.1** summarizes the respective guidelines for the various land-uses and outlines the potential LID infiltration controls that are acceptable for implementation.

1) *Residential*

a. Single Family Residential

Within Single Family Residential areas (excluding new development), infiltration practices shall be encouraged for runoff origination from landscaped areas (front, side or rear yards), driveways and rooftops.

For Single Family Residential areas within **ICAs and/or WHPAs with a vulnerability score equal to or greater than 8**, infiltration practices shall be encouraged only for runoff origination from landscaped areas (front, side or rear yards) and rooftops.

b. Low, Medium Rise & High Rise Residential

Within Low Rise, Medium Rise and High Rise Residential areas, infiltration practices are generally encouraged for runoff origination from landscaped areas (front, side or rear yards), paved surfaces and rooftops.

For Low Rise, Medium Rise and High Rise Residential areas within **WHPAs with a vulnerability score of 2 to 6 inclusive**, infiltration practices are encouraged for runoff origination from landscaped areas (front, side or rear yards), rooftops and paved surfaces less than 200 m². For paved surfaces between 200 to 2000 m², infiltration practices are encouraged only if a Salt

Management Plan (SMP) is completed for the subject property. Infiltration practices are discouraged for runoff originating from paved surfaces in excess of 2000m².

For Low Rise, Medium Rise and High Rise Residential areas within **ICAs and/or WHPAs with a vulnerability score equal to or greater than 8**, infiltration practices are encouraged only for runoff origination from landscaped areas (front, side or rear yards) and rooftops.

2) Mixed Use

Within Mixed Use areas (mix of commercial and residential), infiltration practices are generally encouraged for runoff origination from landscaped areas (front, side or rear yards), paved surfaces and rooftops.

For Mixed Use Areas within **WHPAs with a vulnerability score of 2 to 6 inclusive**, infiltration practices are encouraged for runoff originating from landscaped areas (front, side or rear yards), rooftops and paved surfaces less than 200 m². For paved surfaces between 200 to 2000 m², infiltration practices are encouraged only if a Salt Management Plan (SMP) is completed for the subject property. Infiltration practices are discouraged for runoff originating from paved surfaces in excess of 2000m².

For Mixed Use areas within **ICAs and/or WHPAs with a vulnerability score equal to or greater than 8**, infiltration practices are encouraged only for runoff origination from landscaped areas (front, side or rear yards) and rooftops.

Infiltration practices should not receive runoff from paved surfaces on Mixed Use areas where spills can cause damage to the infiltration practices and contamination of groundwater, these areas include, but are not limited to the following and those listed in **Table 4.0**:

- Fueling stations
- Waste disposal areas
- Vehicle washing stations
- Salt storage areas
- Stockpiling areas (soils, aggregate, landscape products, etc.)
- Shipping and receiving areas

3) Commercial

Within Commercial areas, infiltration practices are generally encouraged for runoff origination from landscaped areas (front, side or rear yards), paved surfaces and rooftops.

For Commercial areas **WHPAs with a vulnerability score of 2 to 6 inclusive**, infiltration practices are encouraged for runoff origination from landscaped areas (front, side or rear yards), rooftops and paved surfaces less than 200 m². For paved surfaces between 200 to 2000 m², infiltration practices are encouraged only if a Salt Management Plan (SMP) is completed for the subject property. Infiltration practices are discouraged for runoff originating from paved surfaces in excess of 2000m².

Additionally, for commercial areas within **ICAs and/or WHPAs with a vulnerability score equal to or greater than 8**, infiltration practices are encouraged only for runoff origination from

landscaped areas (front, side or rear yards) and rooftops. Infiltration practices should also be avoided for areas zoned as Gas Stations (C-7).

Infiltration practices should not receive runoff from site areas where spills can cause damage to the infiltration practices and contamination of groundwater, these areas include, but are not limited to the following and those listed in **Table 4.0**:

- Fueling stations
- Waste disposal areas
- Vehicle washing stations
- Salt storage areas
- Stockpiling areas (soils, aggregate, landscape products, etc.)
- Shipping and receiving areas

4) Industrial Employment

Within Industrial Employment areas, infiltration practices are generally encouraged for runoff origination from landscaped areas (front, side or rear yards) and rooftops. Infiltration practices should not receive runoff from paved surfaces at Industrial sites. This applies both outside of and within the **ICAs and/or WHPAs with a vulnerability score equal to or greater than 8**.

With respect to the infiltration of roof runoff from lands zoned as Industrial Employment, the City of Kitchener acknowledges the potential for contamination especially from damaged or improperly maintained rooftop industrial scrubbers. It is the City's intent to use a risk-based approach on these properties. As part the site plan review process, City Staff will prohibit the infiltration of stormwater from industrial roofs with scrubbers and/or that house scrubber waste including all liquid solutions, solids, pastes and powder waste products.

The City has taken to take this approach due to the large number of properties within the City that are zoned as Industrial Employment but do not contain rooftop high risk activities. The roof tops of these sites are ideal candidates as sources of stormwater to be routed to infiltration practices due to their large impervious surfaces. The roofs at these sites pose a substantially lesser risk of groundwater contamination than onsite ground-level paved surfaces which are salted throughout the winter.

5) Institutional

Within Institutional areas, infiltration practices are generally encouraged for runoff origination from landscaped areas (front, side or rear yards), paved surfaces and rooftops. Infiltration practices should not receive runoff from site areas where spills can cause damage to the infiltration practices and or contamination of groundwater (see **Table 4.0** and the bulleted list under commercial land use).

For Institutional areas within **WHPAs with a vulnerability score of 2 to 6 inclusive**, infiltration practices are encouraged for runoff origination from landscaped areas (front, side or rear yards), rooftops and paved surfaces less than 200 m². For paved surfaces between 200 to 2000 m², infiltration practices are encouraged only if a Salt Management Plan (SMP) is completed for the subject property. Infiltration practices are discouraged for runoff originating from paved surfaces in excess of 2000m².

For Institutional areas within **ICAs and/or WHPAs with a vulnerability score equal to or greater than 8**, infiltration practices are encouraged only for runoff origination from landscaped areas (front, side or rear yards) and rooftops.

6) Open Space and Natural Heritage Conservation

Within Open Space and Natural Heritage Conservation areas (including parks and trail systems), infiltration practices shall be encouraged for runoff origination from landscaped areas, paved surfaces and rooftops (as applicable).

For Open Space and Natural Heritage Conservation areas within **WHPAs with a vulnerability score of 2 to 6 inclusive**, infiltration practices are encouraged for runoff origination from landscaped areas (front, side or rear yards), rooftops and paved surfaces less than 200 m². For paved surfaces between 200 to 2000 m², infiltration practices are encouraged only if a Salt Management Plan (SMP) is completed for the subject property. Infiltration practices are discouraged for runoff originating from paved surfaces in excess of 2000m² unless the paved surface receives no salt applications or is closed/ not maintained during winter months.

For Open Space and Natural Heritage Conservation areas within **ICAs and/or WHPAs with a vulnerability score equal to or greater than 8**, infiltration practices shall be encouraged only for runoff origination from landscaped areas and rooftops (as applicable).



Table 4.1: Land Use- Infiltration Guideline: Opportunities and Constraints

Land Use	Inside ICAs and/or WHPAs with Adjusted Vulnerability Scores equal to or greater than 8			Outside ICAs but within WHPAs with Adjusted Vulnerability Scores from 2 through 6			Outside ICAs and Outside WHPAs		
	Opportunities	Constraints	Acceptable Infiltration Practices	Opportunities	Constraints	Acceptable Infiltration Practices	Opportunities	Constraints	Acceptable Infiltration Practices
Residential	Landscaped Areas and Rooftops	Paved Surfaces	Soakaways, Infiltration Trenches and Chambers; Downspout Disconnection & Bioretention (Rain Gardens)	Landscaped Areas, Driveways and Rooftops	None	Soakaways, Infiltration Trenches and Chambers; Downspout Disconnection & Bioretention (Rain Gardens)	Landscaped Areas, Driveways and Rooftops	None	Soakaways, Infiltration Trenches and Chambers; Downspout Disconnection & Bioretention (Rain Gardens)
Mixed Use	Landscaped Areas and Rooftops	Paved Surfaces	Soakaways, Infiltration Trenches and Chambers; Downspout Disconnection & Bioretention	Landscaped Areas, Paved Surfaces (less than 2000m ²) and Rooftops	Paved Surfaces (larger than 2000m ²)	Soakaways, Infiltration Trenches and Chambers; Downspout Disconnection & Bioretention	Landscaped Areas, Paved Surfaces and Rooftops	None	Soakaways, Infiltration Trenches and Chambers; Downspout Disconnection; Bioretention & Permeable Pavements
Commercial	Landscaped Areas and Rooftops	Paved Surfaces, Fueling Stations, Waste Disposal Areas, Vehicle Washing Stations, Salt Storage Areas, and Stockpiling Areas		Landscaped Areas, Paved Surfaces (less than 2000m ²) and Rooftops	Paved Surfaces (larger than 2000m ²), Fueling Stations, Waste Disposal Areas, Vehicle Washing Stations, Salt Storage Areas, and Stockpiling Areas		Landscaped Areas, Paved Surfaces and Rooftops	Fueling Stations, Waste Disposal Areas, Vehicle Washing Stations, Salt Storage Areas, Stockpiling Areas, Shipping and Receiving Areas	
Industrial Employment	Landscaped Areas and Rooftops	Paved Surfaces, Fueling Stations, Waste Disposal Areas, Vehicle Washing Stations, Salt Storage Areas, and Stockpiling Areas	Soakaways, Infiltration Trenches and Chambers; Downspout Disconnection & Bioretention	Landscaped Areas and Rooftops	Paved Surfaces, Fueling Stations, Waste Disposal Areas, Vehicle Washing Stations, Salt Storage Areas, and Stockpiling Areas	Soakaways, Infiltration Trenches and Chambers; Downspout Disconnection & Bioretention	Landscaped Areas and Rooftops	Paved Surfaces, Fueling Stations, Waste Disposal Areas, Vehicle Washing Stations, Salt Storage Areas, Stockpiling Areas, Shipping and Receiving Areas	Soakaways, Infiltration Trenches and Chambers; Downspout Disconnection & Bioretention
Institutional	Landscaped Areas and Rooftops	Paved Surfaces, Waste Disposal Areas and Salt Storage Areas	Soakaways, Infiltration Trenches and Chambers; Downspout Disconnection & Bioretention	Landscaped Areas, Paved Surfaces (less than 2000m ²) and Rooftops	Paved Surfaces (larger than 2000m ²), Waste Disposal Areas and Salt Storage Areas	Soakaways, Infiltration Trenches and Chambers; Downspout Disconnection; Bioretention & Permeable Pavements	Landscaped Areas, Paved Surfaces and Rooftops	Waste Disposal Areas and Salt Storage Areas	Soakaways, Infiltration Trenches and Chambers; Downspout Disconnection; Bioretention & Permeable Pavements
Open Space & Natural Heritage Conservation	Landscaped Areas and Rooftops	Paved Surfaces		Landscaped Areas, Paved Surfaces (less than 2000m ²) and Rooftops	Paved Surfaces (larger than 2000m ²) unless the paved surface receives no salt applications or is closed/ not maintained during winter months.		Landscaped Areas, Paved Surfaces and Rooftops	None	

5.0 Infiltration Plan for Municipal Roads

Roads segments often bisect multiple land uses and as such require their own infiltration guidelines. Based on the City of Kitchener's road classification system, roads can be classified as:

- Alleyway/Laneways;
- Cul-de-Sacs;
- Local Streets;
- Collectors; or
- Arterials

The City of Kitchener's road classification system includes a subcategory for roads based on vehicle traffic. This subcategory will be the basis for infiltration guidelines. City roads fall into one of the following categories:

Local Roads: Includes all Alleyways/Laneways, Cul-de-Sacs, and Local Streets.

Minor Roads: Includes less frequently used collector roads. Examples are Guelph St, Union St and Wilson Ave.

Major Roads: Includes frequently used collector roads and all arterial roads. Examples are Fredrick St (Collector), Glasgow St (Collector), Wellington St N (Collector), Highland Rd E (Arterial), and Queens Blvd. (Arterial).

Section 5.1 through 5.3 recommend specific infiltration policies based on road type, local groundwater vulnerability and groundwater issues identified in the SPP. Where a street falls into **more than one category** (e.g. within WHPA Adjusted Vulnerability Score of 8 and within ICA) the more stringent constraints on infiltration practices are to apply. **Table 5.0** summarizes the respective guidelines for the various road classifications and outlines the potential LID controls that are acceptable for implementation.

5.1 Roads within ICAs

To avoid contamination from road deicers, in general runoff **from all road segments within ICAs should not be conveyed to infiltration practices**. This prohibition includes the use of flexible liners and or gated/closeable inlets to prevent infiltration of runoff due to the potential for punctures and or winter by-pass, respectively. Should 'permanent' and or 'hardened' impermeable closed bottom structure be used (i.e. plastic or concrete tanks, vaults, or chambers) be proposed, explicit approval from the Region of Waterloo shall be obtained.

These roads should alternatively be treated using conventional stormwater management controls such as ponds, wetlands and hybrid facilities as well as hydrodynamic separators (OGS units) and or non-infiltrating membrane filtration units (i.e. Jellyfish filters).

5.1.1 Local Rural Cross-section Roads within ICAs - Exemption

One exception for roads within ICAs is for **local roads with existing rural-cross-sections**. These roads already contribute to chloride loading (though significantly less than minor and major roads per unit length) and it is unlikely that directing runoff from existing grassed ditches to infiltration practices will exacerbate the issue or increase the threat, provided:

- a) The proposed infiltration facility footprint is no larger than the existing ditch footprint;
- or

- b) The proposed annual infiltration volume is not increased as compared to the existing condition (ditch) annual infiltration volume based on the characterization of the limiting in-situ native soils (i.e. infiltration rate(s) per the LID Stormwater Planning and Design Guide (2010 V1.0 or most recent).

Local roads meeting the above exemption clauses should be subject to further salt reduction/salt management measures (including no salting, if possible) which should be considered as part of detailed design recommendations. These measures are to be integrated in the City-Wide Salt Management Strategy as required.

5.2 Roads within WHPAs

Where the **Adjusted Vulnerability Rating is 8 to 10**, infiltration practices are not recommended for any road type. This is due to the short travel times to the wells and associated risk of groundwater contamination.

Within a WHPA where there the **Adjusted Vulnerability Rating is less than 8** (i.e. the Vulnerability Rating is 2 to 6, inclusive), infiltration practices are recommended for **Local Roads only**. Local roads have less intensive winter deicer application as a result of lower usage and posted speed limits.

5.3 Roads outside of ICAs and WHPAs

Outside of ICAs and WHPAs, road runoff can be conveyed to infiltration practices from **Local and Minor** roads. Runoff originating from **Major** roads can only be directed to infiltration practices provided a project specific Groundwater Impact Analysis study is undertaken to demonstrate that groundwater contamination (especially from salt loading) is minimal, not likely or can be mitigated.

For all road types, it is important to review land use within the area serviced by each road before implementing infiltration practices. Runoff from road segments that services high risk activities especially those where spills of hazardous materials are more likely should include a spill capture plan/ structures or not conveyed to infiltration practices.



Table 5.0: Road Classification Based Infiltration Guidelines and Acceptable Practices

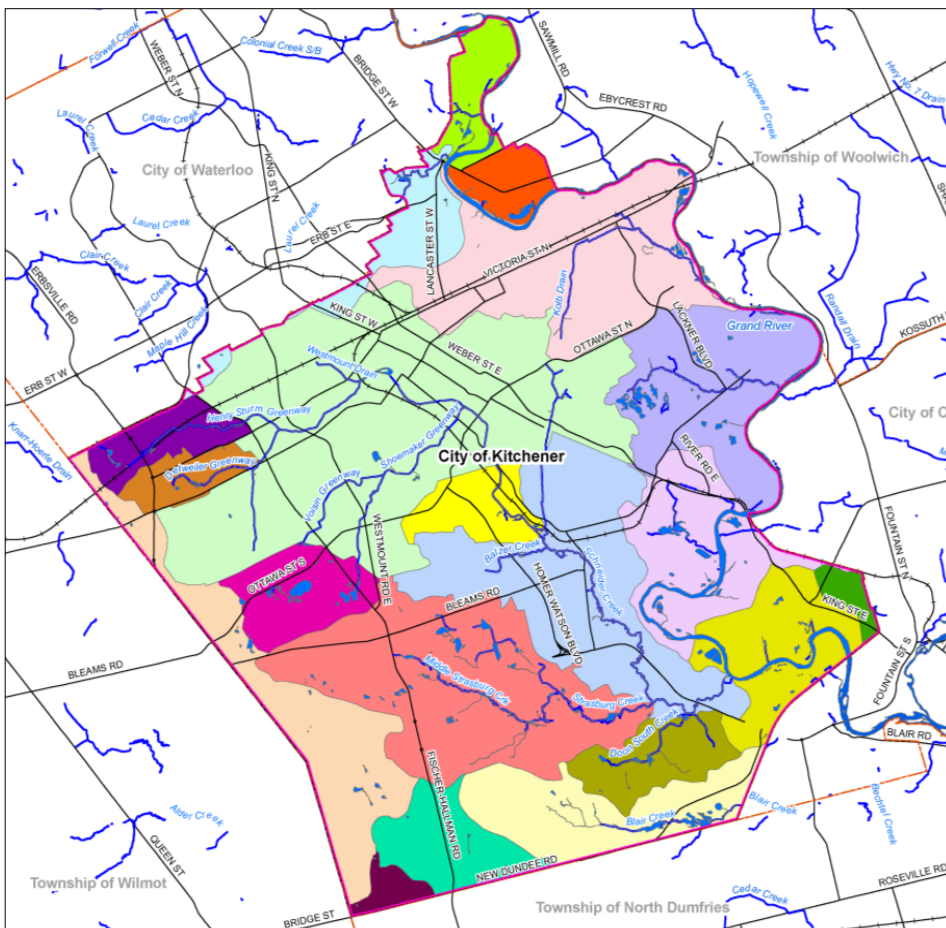
Road Classification	Cross- Section	Inside ICAs		Inside WHPAs with Adjusted Vulnerability Scores equal to or greater than 8		Inside WHPAs with Adjusted Vulnerability Scores from 2 through 6		Outside ICAs and Outside WHPAs	
		Requirement	Acceptable Practices	Requirement	Acceptable Practices	Requirement	Acceptable Practices	Requirement	Acceptable Practices
Local Road (Alleyways/ Laneways, Cul- de-Sacs, and Local Streets)	Urban Cross Section (i.e. Curb and Gutter)	Not to be conveyed or treated using infiltration based practices.	Convey to downstream SWM facility or Hydrodynamic separators (OGS units) and or membrane filtration units	Not to be conveyed or treated using infiltration based controls.	Convey to downstream SWM facility or Hydrodynamic separators (OGS units) and or membrane filtration units	Permissible to conveyed or treated using infiltration based practices.	Bioretention (Dry Swales/ Bioswale, Boulevard units & Bump-outs), Perforated Pipes, Permeable Pavements & Enhanced Swales	Permissible to conveyed or treated using infiltration based practices.	Bioretention (Dry Swales/ Bioswale, Boulevard units & Bump-outs), Perforated Pipes, Permeable Pavements & Enhanced Swales
	Rural Cross Section (i.e. Ditched)	Permissible to conveyed or treated using infiltration based practices provided condition 5.1.1a) or 5.1.1b) can be met.	Bioretention (Dry Swales/ Bioswale, Boulevard units & Bump-outs), Perforated Pipes, Permeable Pavements & Enhanced Swales						
Minor Roads (Includes less frequently used collector roads)	Urban & Rural Cross Section	Not to be conveyed or treated using infiltration based practices .	Convey to downstream SWM facility or Hydrodynamic separators (OGS units) and or membrane filtration units	Not to be conveyed or treated using infiltration based controls.	Convey to downstream SWM facility or Hydrodynamic separators (OGS units) and or membrane filtration units	Not to be conveyed or treated using infiltration based practices.	Convey to downstream SWM facility or Hydrodynamic separators (OGS units) and or membrane filtration units	Permissible to conveyed or treated using infiltration based practices.	Bioretention (Dry Swales/ Bioswale, Boulevard units & Bump-outs), Perforated Pipes, Permeable Pavements & Enhanced Swales
Major Roads (Includes frequently used collector roads and all arterial roads)	Urban & Rural Cross Section	Not to be conveyed or treated using infiltration based practices .	Convey to downstream SWM facility or Hydrodynamic separators (OGS units) and or membrane filtration units	Not to be conveyed or treated using infiltration based controls.	Convey to downstream SWM facility or Hydrodynamic separators (OGS units) and or membrane filtration units	Not to be conveyed or treated using infiltration based practices.	Convey to downstream SWM facility or Hydrodynamic separators (OGS units) and or membrane filtration units	Permissible to conveyed or treated using infiltration based practices provided a project specific Groundwater Impact Analysis study is undertaken to demonstrate that groundwater contamination (especially from salt loading) is minimal, not likely or can be mitigated	Bioretention (Dry Swales/ Bioswale, Boulevard units & Bump-outs), Perforated Pipes, Permeable Pavements & Enhanced Swales

Attachment B - Stormwater Targets and Volume Criteria (October 2016)

Prepared for:
The City of Kitchener

INTEGRATED STORMWATER MANAGEMENT MASTER PLAN (ISWM-MP) MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT

Stormwater Volume Criteria and Targets



55 Regal Road, Unit 3
Guelph, ON
N1K 1B6

October 2016
FINAL

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Appendix A - High Risk Site Activities

Appendix B - Stormwater, Pollution Prevention and Low Impact Development Resource

1.0 Purpose

The purpose of this document is to outline the newly established minimum stormwater volume criteria as well as outline the application of the general stormwater management targets for implementation as part of the City of Kitchener Integrated Stormwater Management Master Plan (ISWM-MP) for new development, redevelopment, reurbanization and residential intensification as well as linear projects.

The following shall be read in conjunction with the **Stormwater Infiltration in the Context of Source Protection Planning (October 2016)** as prepared for the Integrated Stormwater Management Master Plan (ISWM-MP).

The specified minimum targets contained within this document do not preclude the proponent from achieving the required stormwater quantity, quality, erosion control and water balance requirements as identified through watershed, subwatershed, master drainage plans, Environmental Impact Statement (EIS), Provincial Policy and Guidelines or other area specific studies; nor does it preclude the proponent from the requirement to prepare appropriate pollution prevention plans per the Canadian Environmental Protection Act, or Risk Management Plans per the Region of Waterloo or City of Kitchener requirements (see Stormwater Infiltration in the Context of Source Protection Planning and **Appendix B**). In all cases, the most stringent policy and/or requirement shall apply.

The application of the specified stormwater targets contained herein shall be effective January 1, 2017.

2.0 Key Definitions

Throughout this document the following terminology shall be applied.

Stormwater refers to rainwater and melted snow that flows over roads, parking lots, lawn and other sites in rural and urban areas.

Stormwater Management refers to practices which help to minimize the impact of polluted runoff flowing into watercourses, control the rate at which, or prevent, flooding from occurring and reduces the strain that stormwater places on municipal infrastructure.

Low Impact Development is an innovative stormwater management approach with a basic principle that is modeled after nature: manage rainfall at the source using uniformly distributed decentralized micro-scale controls.

Criteria is defined as numerical targets or management principles given to practitioners for stormwater control to be defined and outlined in local by-laws set by the City of Kitchener.

Volume Retention Criteria has been described by others as “volume reduction”, “permanent interception”, “zero discharge” and/or an “infiltration target”. For the purpose of the City of Kitchener, the Stormwater Volume Criteria and Target shall be described as a Volume Retention target. The retained volume shall be ultimately infiltrated, evapotranspired or re-used, as such the specified volume shall not later be discharged to the municipal sewer networks or surface waters and does not therefore become runoff.

Infiltration is the downward entry of water into the surface of the soil, as contrasted with percolation which is movement of water through soil layers. Infiltration shall be defined as the temporary storage in the upper soil layers prior to evapotranspiration; or water that percolates down to local aquifers (shallow and deep aquifers).

Evapotranspiration is the combination of evaporation and transpiration of water into the atmosphere from living plants, the water surface and soil.

Re-use includes storing stormwater runoff and then using it as a source of water for internal and external uses. Re-use is also referred to as rainwater harvesting.

Pre-Development Conditions - is defined as current conditions present in the field the date the application is made or the least urbanized condition (i.e. lowest total impervious percentage for the site) prior to the date the application whichever is most stringent.

*Development*ⁱ - (New Development) the creation of a new lot, a change in land use, the construction of buildings and structures or an addition or alteration to a building or structure that substantially increases the size or usability of the site, requiring approval under the Planning Act, but does not include:

- a) activities that create or maintain infrastructure authorized under an environmental assessment process; and,
- b) works subject to the Drainage Act

*Redevelopment*ⁱ - the creation of new units, uses or lots on previously developed land in existing communities, including brownfield and greyfield sites. It may also involve the partial or full demolition of a building and/or structure and the assembly of lands for development.

- Brownfields are underutilized or derelict properties believed to contain some form of contamination; and
- Greyfield are previously developed sites that are not contaminated.

*Residential Intensification*ⁱ – intensification of a property, site or area which results in a net increase in residential units or accommodation and includes:

- a) redevelopment, including the redevelopment of brownfield sites;
- b) the development of vacant or underutilized lots within previously developed areas;
- a) infill development - new development on formerly vacant land;
- c) the conversion or expansion of existing industrial, commercial and institutional buildings for residential use; and
- d) the conversion or expansion of existing residential buildings to create new residential units or accommodation, including accessory apartments, second dwelling units and rooming houses.

*Reurbanization*ⁱ - describes four distinct types of activity, all of which serve to increase the residential or employment density on sites located within the existing, Built-Up Area. The four types of activity captured under the definition of reurbanization include:

- b) infill: new development on formerly vacant land;
- c) intensification: an expansion in the use of an existing structure or structures that serves to increase the density on a site

- d) adaptive re-use: a change in the use of a building or structure, typically from commercial/industrial to residential, that results in greater density; and,
- e) redevelopment: the wholesale change or conversion of an area, often involving some form of land assembly and/or demolition, which results in significantly higher density than existed previously.

Linear Projects - Construction or reconstruction of roads, trails, sidewalks, rail lines and transit infrastructure that are not part of a common plan of development or sale.

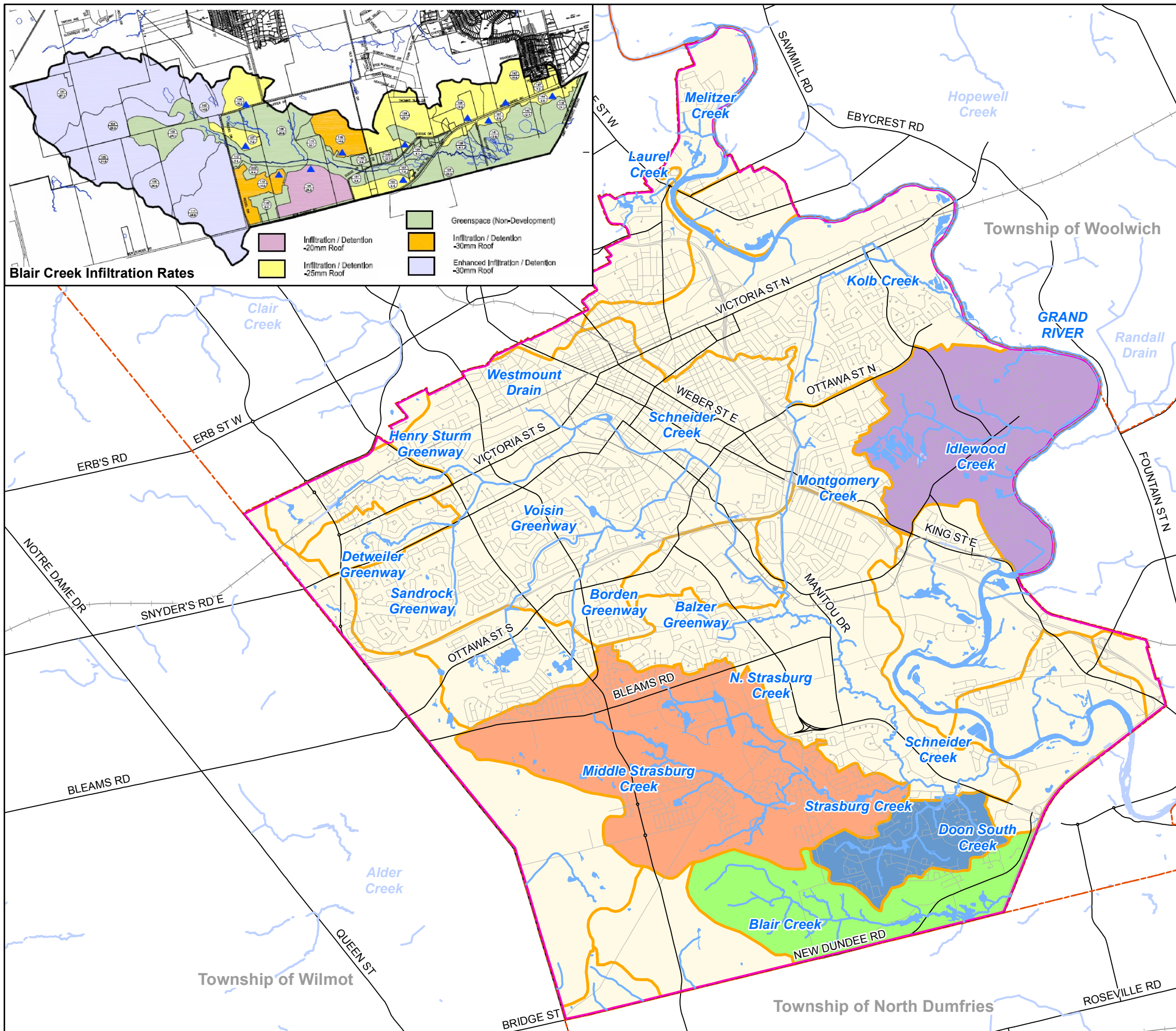
3.0 Existing Infiltration Targets

Within the City of Kitchener existing infiltration targets are governed by five (5) distinct subwatershed plans. These targets were outlined in the Stormwater Management Policy Development Implementation Procedure for Development (AECOM 2008). **Table 3.0** identifies existing infiltration targets within the City of Kitchener.

Table 3.0: Existing Infiltration Targets

Subwatershed	Infiltration Target	Source
Blair	Maintain existing conditions or increase infiltration, design targets for specific subcatchments (Stantec, 2009) vary from 20-30 mm.	Upper Blair Creek Functional Drainage Study Final Report (Stantec, March 2009)
Doon South	Maintain existing conditions or increase infiltration.	Doon South Creek Subwatershed Plan (Paragon Engineering Limited, 1993)
Idlewood	Maintain existing conditions or increase infiltration. At-source infiltration of 12 mm from impervious land uses, and with drainage within four days, inception of runoff generated by 25 mm in two hours (for both infiltration and extended detention).	Idlewood Creek Master Drainage Plan (MacLaren Engineers, 1992)
Strasburg Creek	Maintain existing conditions or increase infiltration	Strasburg Creek Master Watershed Plan Implementation Report, Revised Edition by the City of Kitchener (Paragon Engineering Limited, September 1996)
Upper Strasburg Creek	Maintain existing conditions or increase infiltration	Upper Strasburg Creek Subwatershed Plan Updated Report (CH2M Hill, January 2008)

Existing infiltration targets are illustrated in **Figure 3.1**. The infiltration targets identified in **Table 3.0** will be superseded by the proposed volume criteria and targets outlined in **Section 5.1** of this document in all areas of the city except for the Blair Creek Subwatershed. For Blair Creek, the infiltration targets as outlined in the Upper Blair Creek (Kitchener) Functional Drainage Study Final Report (Stantec, March 2009) and confirmed in the Upper Blair State of the Watershed Study (Aquafor Beech, 2016) supersede those volume targets as identified in **Section 5.1**, as they are more stringent.



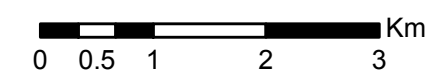
City of Kitchener Stormwater Management Master Plan

Legend

- Study Area
 - Municipal Boundary
 - Watercourses
 - Subwatershed Boundary
- Current Required Subwatershed Infiltration Rates**
- Blair Creek - See inset (Figure 14, Stantec, 2009)
 - Doon South Creek - Maintain existing conditions or increase infiltration
 - Idlewood Creek - At-source infiltration of 12mm from impervious land uses
 - Strasburg/Upper Strasburg Creek - Maintain existing conditions or increase infiltration
 - All Other Subwatersheds - 25mm from on-site rooftop surfaces

Source: City of Kitchener

Figure 3.1
Current Required Subwatershed Infiltration Rates



Date: April 2016

4.0 Volume Target Rationale

The general rationale for the development of the Volume Retention Criteria and targets includes but is not limited to:

- Less variable pollution control over Volume Capture and Treatment criteria, as pollutant loads to receivers are reduced through infiltration, evapotranspiration and re-use. Additional water quality benefits result from treatment process of filtration, adsorption and sedimentation;
- Urban flood prevention of the municipal sewer network through increased sewer capacity by reduced volume and peak flows, as well as delayed time-to-peak;
- Maintenance of pre-development groundwater recharge or hydrologic cycle preservation through infiltration and evaporation;
- Contribution to stream baseflow and mitigation of thermal impacts to urban streams; and
- Preservation of groundwater quantity and levels.

4.1 Provincial Direction

The Ministry of the Environment and Climate Change (MOECC) released in February 2015 an **Interpretation Bulletin – Expectations Re: Stormwater Management** which detailed the Ministry's position, specifically that:

- "The natural hydrologic cycle should be maintained to the greatest extent possible."
- "Too often, preservation of the natural hydrologic cycle is not sufficiently addressed in stormwater management plans submitted to the Ministry for an Environmental Compliance Approval (ECA)."
- "Low Impact Development (LID) is relevant for all forms of development, including urban intensification and retrofit."
- "LID can be less costly than conventional stormwater practices."
- "Going forward the Ministry expects that stormwater management plans will reflect the findings of the watershed, subwatershed, and environmental management plans, and will employ LID in order to maintain the natural hydrologic cycle to the greatest extent possible. "

The Interpretation Bulletin was a precursor to the release of the terms-of-reference for the development of the Ministry of the Environment and Climate Change (MOECC) Low Impact Development Guidance Manual, a companion document to the 2003 MOE Stormwater Planning and Design Guidance Manual (SWMPD). The pending Low Impact Development Stormwater Management Guidance Manual is anticipated of release in 2017 and will contain minimum volume targets which will exceed the City's minimum target of 12.5mm and is expected to mandate the use of LID approaches for new development, infill and redevelopment as well as linear projects.

The MOECC is following over 20 American and 9 Canadian Jurisdictions who have implemented minimum volume targets. Compliance with the upcoming MOECC Low Impact Development Stormwater Management Guidance Manual was an important consideration for the City of Kitchener in the development of the ISWM-MP and supporting policies, in order to ensure the master plan remains consistent with future provincial requirements to avoid prematurely outdated implementation strategies and policies. By developing a plan that is consistent with the direction of the MOECC's future requirements, ensures that costly study updates can be avoided and that the City as well as the development industry stay ahead of future development approval requirements.

While the MOECC LID Guidance Manual is still under development and a volume targets has not been selected for Ontario, the following figures summarize the existing volume control targets for both US (**Figure 4.1**) and Canadian Jurisdictions (**Figure 4.2**) which provide context and insight into the volume targets currently in place in other jurisdictions.

In general, the vast majority of US and Canadian jurisdictions currently have stormwater volume control targets within the 14-24mm range, and many have targets of 25mm or greater.

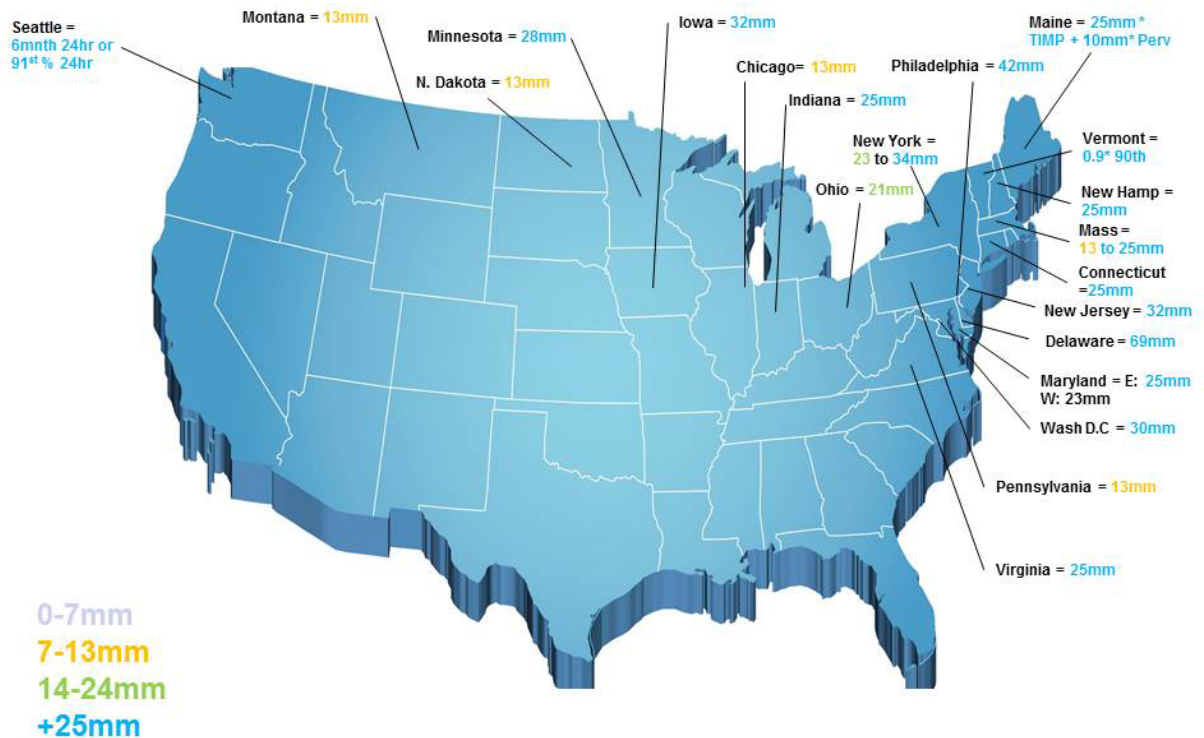


Figure 4.1 - Summary of Existing US Stormwater Volume Targets

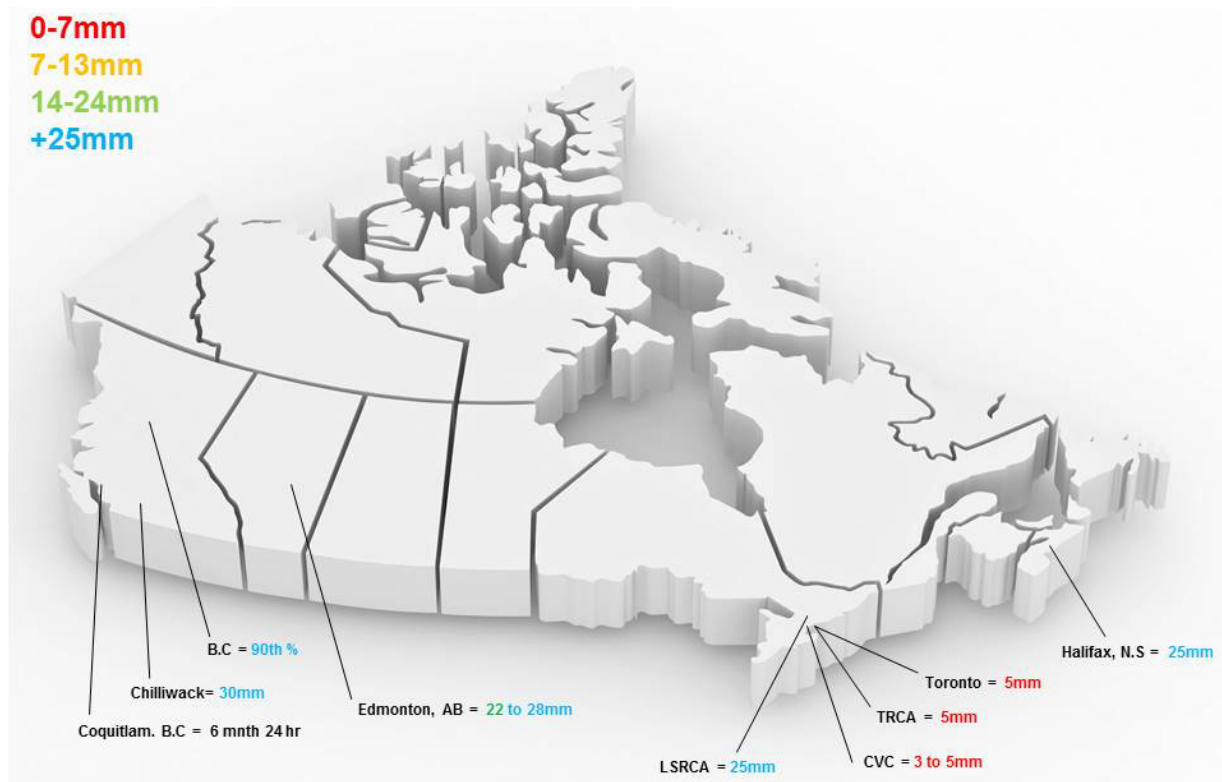


Figure 4.2 - Summary of Existing Canadian Stormwater Volume Targets

4.2 Need within Existing Areas

The following describes the need for volume control targets for the City of Kitchener from the perspective of existing stormwater facilities and stormwater piping systems in the light of predicted climate change scenarios.

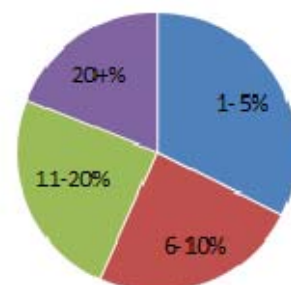
Existing Stormwater Infrastructure

The performance of end-of-pipe stormwater management (SWM) facilities and stormwater piping systems are affected by changes to their catchment area and or contributing impervious surfaces. SWM infrastructure are designed based on the surface area of the catchment, catchment impervious percentage and the required level of conveyance, water quality and water quantity control.

A review of catchment areas and impervious percentages contributing to existing City stormwater facilities (original design vs. current condition) found that:

- A total of 37 SWM facilities were found to have a higher percentage of impervious surfaces than was specified in their original design reports. Of these SWM facilities that showed increases in impervious percentage, sixteen (16) were found to have significant increases of 10% or more.
- A total of 53 SWM facilities were found to have catchments that were larger in surface area than was specified in their

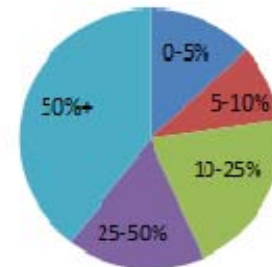
SWM Facility Impervious % Increases



original design reports. Of these SWM facilities, 41 were found to have increases in catchment area that were larger than 10% of the original design area.

Within a stormwater management facility, the permanent pool is the deeper portion that continuously retains water. This area is critical to water quality improvements because it facilitates settlement of suspended solids. The required permanent pool volume of a SWM facility is calculated via MOECC's SWM Planning and Design Manual (2003) and is based on a prescribed level of water quality control, the surface area of the catchment and catchment impervious percentage. Based on analysis of existing catchment conditions and stormwater quality targets, 26 SWM facilities may have insufficient permanent pool volumes.

SWM Facility Catchment Area Increases



Increase in Contributing Impervious Percentage and Drainage Area

Development and/or redevelopment within an the catchment of a Built-up Area can increase the impervious percentage resulting in reduced facility performance, in terms of both flood prevention and pollutant removal, due to greater runoff volumes reaching the facility and increasing the pollutants suspended in the water column. To mitigate the reduction in facility performance, volume retention criteria and targets are required.

This increase in impervious surfaces can result from typical redevelopment, reurbanization and residential intensification activities within the Built-Up Area and is an identified phenomenon in many Ontario municipalities. **Figure 4.3** illustrates the permit acquisition data for the City of Kitchener from 2010 to 2014, which is a contributor to increases in impervious surfaces contributing to existing SWM ponds.

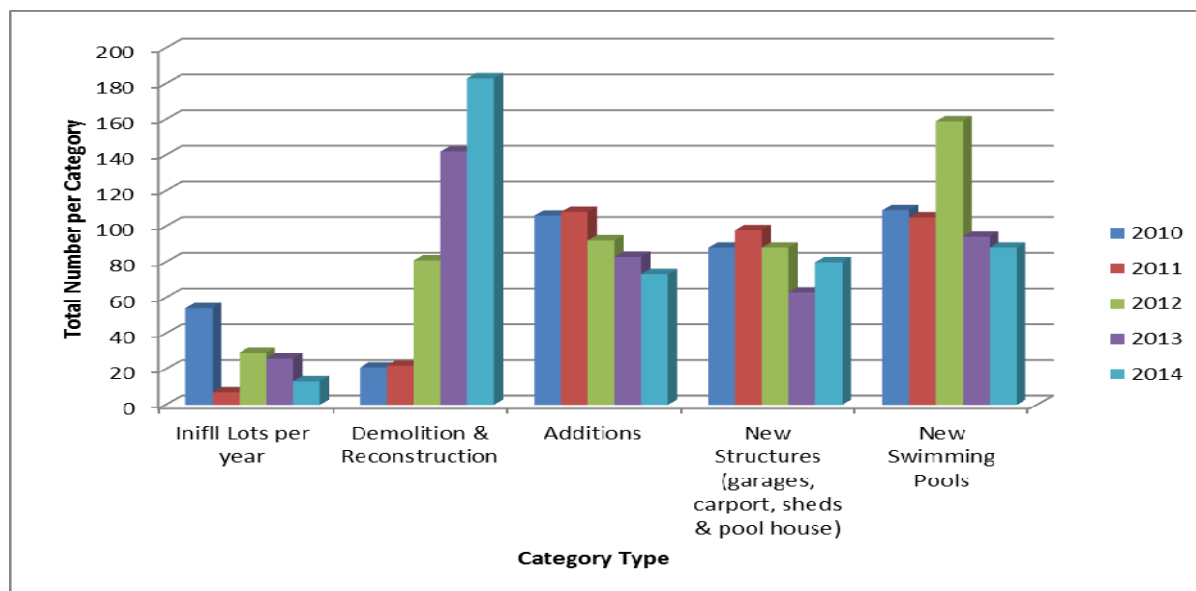


Figure 4.3 - Permit Acquisition Data by Category (2010 to 2014)

Increases in the contributing drainage areas beyond the original catchment delineation can have a similar effect as increases in impervious area on existing stormwater facilities performance and conveyance capacity of the stormwater piping systems. An analysis of the City's existing storm trunk sewer network found more than 13,500m of surcharged pipe during the 5-year event. Applying climate change projections per the recommendations of the Localized Climate Projections for Waterloo Region (September 2015), an additional 6,000m of surcharged pipe during the 5-year event is predicted, totaling more than 19,500m and significantly increase the risk of urban flooding. To mitigate the predicted climate change impacts, volume retention criteria and targets are required.

5.0 City of Kitchener Stormwater Targets

In light of the pending MOECC LID Volume control targets, the identified issues relating to increases in impervious surfaces and drainage area contributing to existing stormwater facilities, conveyance capacity of the stormwater piping systems and in light of predicted climate change impacts, for the purposes of the City of Kitchener ISWM-MP, an interim minimum Volume Retention Target of **12.5mm** has been established. The geographical coverage of this volume target is depicted in **Figure 5.1**.

The volume target is to be applied as a minimum target. This minimum target, like all other noted targets for water quantity, quality, erosion control and water balance shall be superseded by more stringent targets as developed by the MOECC or through future Watershed Studies, Subwatershed Studies, Master Drainage Plans, Environmental Impact Statement (EIS) and/or other area specific studies, including those related to the GRCA Wetland Policy.

This interim target will ensure that the implementation mechanisms and policies within the ISWM-MP are in place while not pre-supposing the pending targets from the MOECC. This approach is considered a moderate approach with consideration for the Municipal interests as well as the interests of the broader development community.

5.1 Stormwater Volume Retention Targets

Any works that results in site disturbance or create new impervious surface on sites that are 0.1 or greater must meet all of the following stormwater performance goals:

'New' Development Volume Control

For new nonlinear development on sites of 0.1 hectares or greater, without restrictions, stormwater runoff volumes will be controlled and the post-construction runoff volume shall be retained on site for runoff that is generated from the first 12.5 mm of rainfall from all surfaces on the entire site. The subject site shall be required to enroll in the City of Kitchener Stormwater Utility Credit program.

Redevelopment, Reurbanization and Residential Intensification Volume Control

For redevelopment, reurbanization and residential intensification on sites of 0.1 hectares or greater, without restrictions, stormwater runoff volumes will be controlled and the post-construction runoff volume shall be retained on site for runoff that is generated from the first 12.5 mm of rainfall from all surfaces on the entire site. The subject site shall be required to enroll in the City of Kitchener Stormwater Utility Credit program.

Linear Development Volume Control

- a) New linear projects without restrictions and subject to the **Stormwater Infiltration in the Context of Source Protection Planning (October 2016)**, that create 0.5 or greater hectares of new and/or fully reconstructed impervious surfaces, shall capture and retain the larger of the following:
 - I. The first 6.25 mm of runoff from the new and fully reconstructed impervious surfaces on the site
 - II. The first 12.5 mm of runoff from the net increase in impervious area on the site

- b) Roadway reconstruction, mill and overlay and other resurfacing activities are not considered new linear projects and shall achieve volume reduction to the maximum extent possible (MEP) subject to the **Stormwater Infiltration in the Context of Source Protection Planning (October 2016)**.

Sites with Restrictions

For all sites regardless of perceived constraints, the proponent shall be required to fully comply with the appropriate volume control targets described above. Should pre-consultation with City of Kitchener engineering staff and/or pre-design investigation by the proponent and reviewed by the City identify that volume targets are not achievable; the proponent must consider and present the merits of relocating project elements to address varying soil conditions and other constraints. Site constraints which may result in the City permitting alternatives to the above prescribed volume targets include:

- i. Shallow bedrock[†],
- ii. High groundwater[†],
- iii. Contaminated soils (i.e. Brownfields)

Per the **Stormwater Infiltration in the Context of Source Protection Planning (October 2016)**:

- iv. High Risk Site Activities – See **Appendix A**
- v. Prohibitions: Issue Contributing Areas (ICA) and or WHPAs with a vulnerability score equal to or greater than 8
- vi. Restrictions: including WHPAs with a vulnerability score of 2 to 6 inclusive

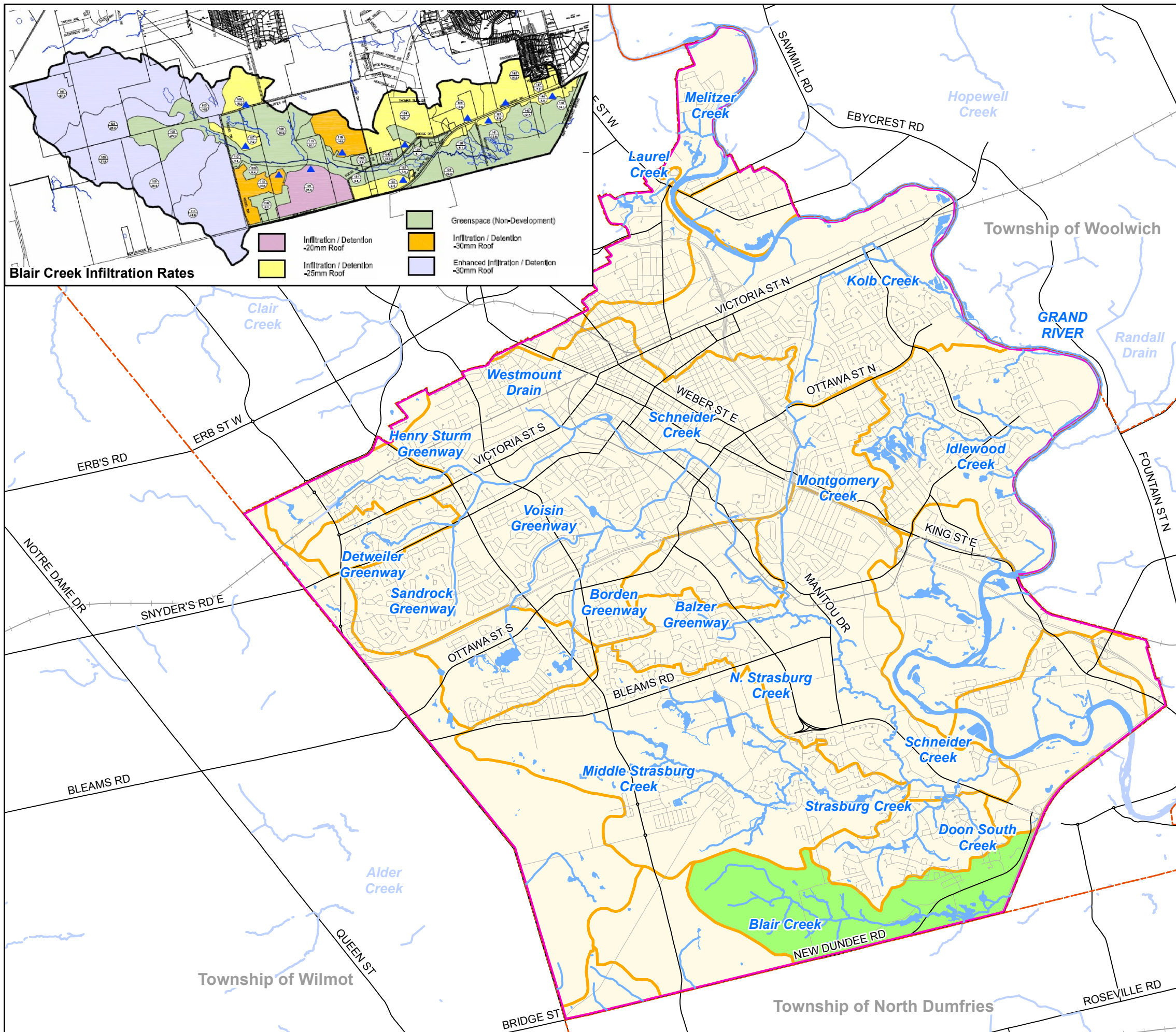
[†] May limit infiltration capabilities if within 1m of the proposed facility invert per Table 3.4.1 of the LID Stormwater Planning and Design Guide (2010, V1.0 or most recent). Detailed assessment or studies are required to demonstrate infiltration effects within 1.0m and results may permit relaxation of the minimum offset as approved by City of Kitchener Development Engineering.

Maximum Extent Possible (MEP)

In cases where the City of Kitchener Development Engineering has confirmed that site constraints exist which cannot be overcome, the proponent shall be required to implement volume controls to the MEP or “maximum extent possible”. City of Kitchener Development Engineering shall define the MEP based on techniques outlined in the CVC LID Planning and Design Guide (V1.0, 2010 as amended from time to time).

Stormwater Management Fee

On sites where the proponent cannot to implement the required volume control to the MEP or “maximum extent possible” as confirmed by the City of Kitchener Development Engineering the proponent shall contribute to the Stormwater Management Fee (formerly Cash-in-lieu) corresponding to all uncontrolled areas at the current per hectare rate as defined by the City of Kitchener as amended from time to time.



City of Kitchener Stormwater Management Master Plan

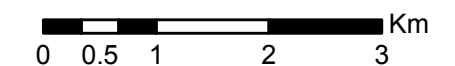
Legend

- Study Area
 - Municipal Boundary
 - Watercourses
 - Subwatershed Boundary
- Proposed Subwatershed Infiltration Rates**
- Blair Creek - See inset (Figure 14, Stantec, 2009)
 - All Other Subwatersheds - 12.5mm of volume control for the entire site, where there are no restrictions

Source: City of Kitchener

Figure 5.1

Proposed Subwatershed Infiltration Rates



Date: April 2016

5.2 Water Quality Requirements

Where more stringent targets do not apply, stormwater quality strategies shall control pollutant loadings in accordance with current MOE guidelines to 'Enhanced-Level 1' protection as defined in the 2003 Stormwater Management Planning & Design Manual within the City of Kitchener (**Table 5.1**).

Enhanced-Level 1 protection is the reduction of average long-term annual load of suspended sediment by 80% or greater. Per the MOE guide "any stormwater management practice that can be demonstrated to approval agencies to meet the required long-term suspended solids removal for the selected levels under the conditions of the site is acceptable for water quality objectives." For LIDs implemented in Ontario, the industry standard to achieve an Enhanced-Level 1 protection is to design for runoff resulting from a 25 mm rainfall depth event. This is because the vast majority (approximately 90%) of rainfall events in Southern Ontario result in less than 25 mm of precipitation. Treating the runoff from one hundred percent of rainfall events of 25 mm or less and the first 25 mm of all events larger than 25 mm provides a high level of pollutant load reduction, which equates to roughly a 90% reduction in the long-term annual load of suspended sediment. The City of Kitchener is enforcing volume targets to reduce the loading of pollutants into stormwater management facilities, watercourses and ecological restoration areas.

Where proponents of development, redevelopment, reurbanization or residential intensification projects are able to achieve the volume targets described above, this pollutant load reduction will be acknowledged during the review of a stormwater management plan. The complete control of runoff that is generated from the first 12.5 mm of rainfall from all surfaces on the entire site through a combination of reuse, evapotranspiration and infiltration practices will be considered by the City of Kitchener to be achieving half of the sites required Enhanced-Level 1 water quality treatment.

As such, in order to achieve the prescribed water quality target of 25mm (Enhanced-Level 1 protection) the proponent may design other onsite stormwater quality best management practices (source, conveyance, end-of-pipe, or proprietary water quality devices) to treat the remaining runoff or may be required to contribute to the Stormwater Management Fee. Development engineering will determine through the requirements of existing and future Watershed Studies, Subwatershed Studies, Master Drainage Plans, Environmental Impact Statement (EIS), Provincial SWM Policy and/or other area specific studies, including those related to the GRCA Wetland Policy and/or site condition the means and methods by which the remainder of the 25 mm (Enhanced-Level 1 protection) will be achieved i.e. through on-site control or via the Stormwater Management Fee.

For sites which are within the catchment of a stormwater management facility that has been determined by the City of Kitchener to be deficient in water quality control for the prescribed drainage area or impervious cover, the proponent shall be required to provide on-site water quality control equivalent to 'Enhanced-Level 1' control. Deficient stormwater management facility catchments will be defined by the City of Kitchener through future studies as detailed in the ISWM-MP Implementation Plan.

5.3 Water Quantity Requirements

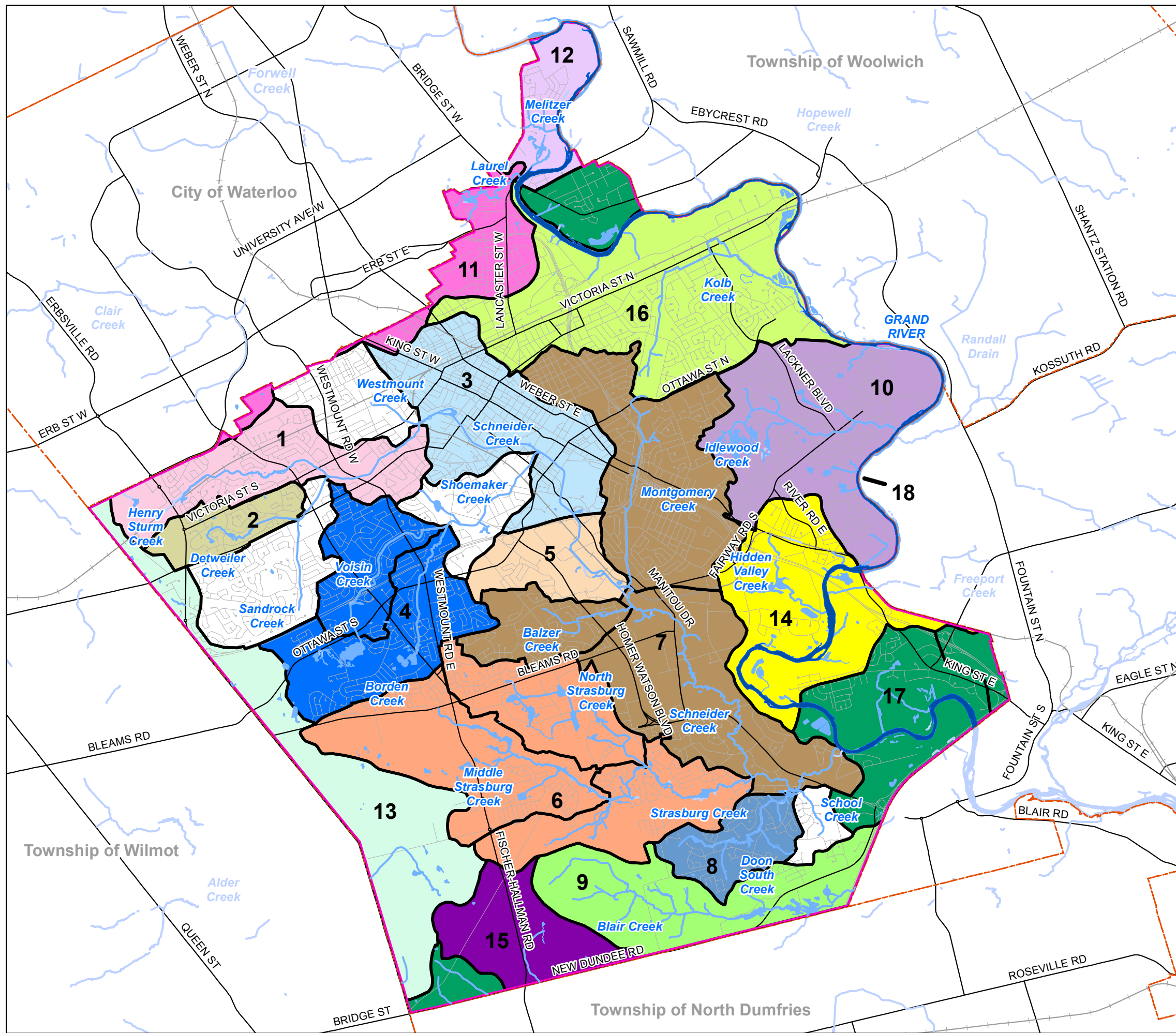
Different areas of the City of Kitchener have different water quantity criteria based on the sensitivity of the watershed and the receiving watercourse, as directed through MOECC and GRCA approved studies. Every site in the City is at a minimum required to meet post-to-pre development runoff rates for different storm frequencies based on the subwatershed criteria (i.e. 2yr, 5yr, 10yr, 25yr, 50yr, 100yr, or regional storm event - Hurricane Hazel) as listed in **Table 5.1** and illustrated within **Figure 5.2**.

Areas of the City are more prone to flooding and erosion impacts and in those locations, Special Policy Provisions apply for quantity control on the entire site, specifically Henry Sturm and Middle Strasburg (See **Table 5.1**).

The City of Kitchener is enforcing volume targets to achieve stormwater control improvements. **Water quantity** targets including the restriction of post-development peak flows to pre-development peak flows as well as area weighted flow values as prescribed in appropriate planning documents (Subwatershed Plan, Master Drainage Plan, etc.) shall remain in effect.

However, peak flow reductions that are achieved as a result of achieving the specified volume control targets will contribute to the site's water quantity requirements. The proponent shall demonstrate through calculations or hydrologic modelling the peak flow reductions associated with incorporating the required volume controls into a development, redevelopment, reurbanization or residential intensification project.

For sites which are within the catchment of a stormwater management facility that has been determined by the City of Kitchener to be deficient in flood control for the prescribed drainage area or impervious cover, the proponent shall be required to provide on-site pre-to post volume control as directed by the City of Kitchener Development Engineering. Deficient stormwater management facility catchments will be defined by the City of Kitchener through future studies as detailed in the ISWM-MP Implementation Plan.



City of Kitchener Stormwater Management Master Plan

Legend

- Study Area
- Municipal Boundary
- Subwatershed Boundary
- Watercourses

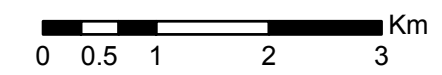
Policy Area

- 1 - Henry Sturm Creek
- 2 - Detweiler Creek
- 3 - Upper Schneider Creek
- 4 - Upper Voisin/Upper Borden Creek
- 5 - Middle Schneider Creek
- 6 - Strasburg Creek
- 7 - Lower Schneider/Balzar/Lower Montgomery Creek
- 8 - Doon South Creek
- 9 - Blair/Bechtel/Bauman Creek
- 10 - Idlewood Creek
- 11 - Laurel Creek
- 12 - Melitzer Creek
- 13 - Alder Creek
- 14 - East Side
- 15 - Cedar Creek
- 16 - Kolb Creek
- 17 - Unnamed Catchments
- 18 - Grand River

Source: City of Kitchener

Figure 5-2

Stormwater Control Criteria



Date: October 2016





Table 5.1 – Existing Stormwater Targets: Water Quality and Quantity

Policy Area	Watercourse/ Catchment Areas	Quality	Quantity	Other
1	Henry Sturm	Enhanced level, 80% TSS removal	- No 25 year control 100 year site control to 0.04m³/s/ha - No regional storm control	Special Policy Area (SPA) Flood Control
2	Detweiler	Enhanced level, 80% TSS removal	- No 25 year control 100 year control as per the Detweiler Drainage Study - No regional storm control	
3	Upper Schneider	Enhanced level, 80% TSS removal	- No 25 year control 5 and 100 year post to pre site control - No regional storm control	
4	Upper Voisin, Upper Borden	Enhanced level, 80% TSS removal	25 and 100 year post to pre site control - Regional storm control as per the Laurentian West Master Drainage Plan	
5	Middle Schneider	Enhanced level, 80% TSS removal	- No 25 year control 100 year site control to 0.04m³/s/ha - No regional storm control	Special Policy Area (SPA) Flood Control
6	Strasburg	Enhanced level, 80% TSS removal	25 year, 100 year, Regional storm controls as per the Strasburg Creek Master Watershed Plan (Map 13 and 8)	
7	Lower Schneider / Balzer /Lower Montgomery	Enhanced level, 80% TSS removal	- No 25 year control - No 100 year control - No regional storm control 5 year post to pre site control	
8	Doon South	Enhanced level, 80% TSS removal	- No 25 year control - No 100 year control - No regional storm control 5 year post to pre site control	
9	Blair, Bechtel and Bauman Creeks	Cold-water fishery enhanced level, 80% TSS removal	Land Use Assumed % Imp <i>Industrial/Commercial</i> 65% <i>Institutional</i> 40% <i>Low Density Residential</i> 35% <i>Limited Service Residential</i> 25% <i>Trailer Park</i> 25% The property must maintain the existing % Imp. allowed on the site *note that the water quality ponds were conservatively sized*	- An Environmental Impact Study is required to assess the potential impacts on major Environmental function - A water balance is required - The temperature of the water leaving the site must meet the temperatures approved in the report
10	Idlewood Creek	Cold-water fishery enhanced level, 80% TSS removal	2, 5 and 100 year post to pre is required	- An Environmental Impact Study is required to assess the potential impacts on major environmental functions - A water balance is required - The temperature of the water leaving the site must meet the temperatures approved in the report
11	Laurel Creek	Portions of the creek is a cold-water fishery enhanced level, 80% TSS removal	2, 5 and 100 year post to pre is required	- A water balance is required - The temperature of the water leaving the site must meet the temperatures approved in the report

12	Melitzer Creek	If outletting to the Grand River then enhanced level, 80% TSS removal, normal level If outletting to a creek in this watershed then 80% TSS removal, enhanced level	5 and 100 year post to pre is required	A water balance is required
13	Alder Creek	Enhanced level, 80% TSS removal	5 and 100 year post to pre is required	- An Environmental Impact Study is required to assess the potential impacts on major environmental functions - A water balance is required
14	East Side	Cool water creek enhanced level, 80% TSS removal	5 and 100 year post to pre is required	A water balance is required
15	Cedar	Cool water creek enhanced level, 80% TSS removal	5 and 100 year post to pre is required	- A water balance is required - The temperature of the water leaving the site must meet the temperatures approved in the report
16	Kolb Creek	Cold water creek enhanced level, 80% TSS removal	5 and 100 year post to pre is required	The temperature of the water leaving the site must meet the temperatures approved in the report
17	Un-named Catchments (these catchments are not associated with a larger creek therefore the City of Kitchener applies the most strict criteria to ensure no creek degradation is occurring within these smaller tributaries)	Enhanced level, 80% TSS removal	100 year post to 0.04m³/s/ha	A water balance is required
18	Grand River	Enhanced level, 80% TSS removal	5 year post to pre is required	
All Others	Sandrock Creek, Shoemaker Creek, Westmount Creek & School Creek	Enhanced level, 80% TSS removal	As prescribed by City of Kitchener Development Engineering	As prescribed by City of Kitchener Development Engineering

5.4 Direct Discharge of Stormwater to Watercourses

Sites located in close proximity to watercourses present unique challenges for stormwater practitioners. The reduction of pollutant loads is essential before stormwater is discharged to these features in order to preserve or enhance ecological habitat.

Sites that discharge via private or municipal conveyance systems to a watercourse that is **within 1,000m of the site**: The proponent will ensure the site achieves complete water quality control of runoff that is generated from all surfaces on the entire site by:

Achieving Enhanced-Level 1 protection by designing for the treatment of the runoff resulting from a 25 mm rainfall depth event (See **Section 5.2**), including the adherence to the volume targets as described in **Section 5.1**.

For sites that discharge via private or municipal conveyance systems to a watercourse that is **within 1,000m of the site** contribution to the Stormwater Management Fee will not be considered.

5.5 Downtown Exemption Area

The downtown core presents challenges for the implementation of convention stormwater management practices due to the lack of available area for facilities. The City of Kitchener's stormwater management policy respects this by enforcing only minimum quantity control measures within the Downtown Exemption Area as identified in the City's Stormwater Management Policy Development Implementation Procedure for Development (AECOM, 2008). The City of Kitchener's proposed volume targets acknowledges that volume control may still be achievable within the downtown core via source control measures such as rainwater harvesting, permeable pavement and green roofs.

As such, within the Downtown Exemption Areas, sites shall achieve volume reduction to best efforts subject to the **Stormwater Infiltration in the Context of Source Protection Planning (October 2016)** and site constraints, in keeping with the goals and objectives of the ISWM-MP.

6.0 Future Considerations

Aggregated or Shared BMPs

The City of Kitchener may choose in the future to establish a system or policy to permit the sharing of BMPs amongst multiple properties of the same owner. Projects can thus achieve on-site retention with a “Aggregated or Shared BMP” that is off-site if:

- the proponent is the owner of both subject properties,
- both properties are enrolled within the Stormwater Credit Program and
- the facilities are registered on title with appropriate operations and maintenance conditions to the satisfaction of the City of Kitchener.

Credit Trading Program

The City of Kitchener may choose in the future to establish a Stormwater Volume Retention Credit (SVRC) program. Through this future program, development projects can implement “over control” (Over control” is a method of balancing the amount of water retained in multiple areas) to retain more than the required 12.5mm of runoff volume in one area and less in another. Projects which can demonstrate ‘over control’ to the satisfaction of the City could qualify for the credits.

Future studies are recommended in this regard.

7.0 Implementation of the Volume Targets

In order for the City of Kitchener to implement the stormwater criteria and targets specified herein for development or redevelopment, reurbanization and residential intensification, the review process will need to be integrated into existing planning processes.

The specified stormwater criteria and targets will be enforced through the following planning application processes:

A. **Plan of Subdivision**- This process is required for a parcel of land to be legally divided to establish public streets and to divide lands into two or more parcels in order to sell one or more parcels. Subdivision can be infill development or in new development areas.

B. **Site Plan**- Projects that require full site plan approval include:

- Constructing new buildings or additions;
- Undertaking major building renovations which substantially increase the size or usability of a building or structure;
- Establishing a commercial parking lot; and
- Altering to an already approved site plan.

Site plan applications are not required for the construction of a:

- Single-family dwelling;
- Semi-detached dwelling;
- Duplex; or
- Farm building.

For these Site Plan exemptions, stormwater criteria and targets will be implemented through the **Building Permit** application process.

C. **Stamp Plan A**- This type of application requires a less detailed submission and less intensive review by the City. Projects that fall into this category include:

- A minor building or structure addition;
- Minor building renovations such as those associated with a change of use that includes site works;
- A street fronting townhouse block that is part of a registered subdivision;
- The construction of model homes prior to registration of a Plan of Subdivision; and
- A temporary sales centre.

D. **Plan of Condominium**- A new build condominium is required to proceed through the site plan process. Proponents proposing a standard condominium, a common elements condominium or a condominium conversion are required to proceed through the Plan of Condominium process.

For all sites a Pollution Prevention Plans and/or Risk Management Plans shall be required to be submitted as part of SWM Reports for sites containing developments identified as having high risk sites activities as listed in **Table 4.0** of the **Stormwater Infiltration in the Context of Source Protection Planning (October 2016)** include as **Attachment A** and/or supplemented by high risk sites as identified by the Region of Waterloo's Source Protection Policies.

The following planning application processes do not directly result in the construction or reconstruction of impervious surfaces on a site. As such the specified stormwater criteria and targets will not be enforced during these processes. Instead where new lots are created, the monthly property charges billed by the City through the Stormwater Utility system are to be updated to reflect runoff conditions of the subject property.

- A. **Committee of Adjustment-** The Planning Act gives a city council-appointed committee the authority to:
- Grant minor variances from the city's zoning bylaw;
 - Allow changes to legal non-conforming uses which the current zoning does not permit.
 - Give consent for land severance to divide a parcel of land into more than one lot or as lot additions to abutting properties.
- B. **Part-Lot Control-** This type of application is undertaken to subdivide a residential lot or a block fronting on existing or dedicated road for the purpose of selling, conveying, leasing or mortgaging.
- C. **Stamp Plan B-** This type of application requires a minimal submission by the applicant due to the minor nature of the project. Projects that go through the Stamp B application process include:
- Housekeeping/as-built revision of a minor nature (e.g. red-line revisions);
 - Minor changes are required to the approved Site Plan to maintain in compliance with the Development Agreement;
 - Plans to recognize parking layout for an existing developed site; and
 - Existing building conversions that require minimal site works (such as adding an additional dwelling unit to an existing building).

8.0 Recommendations

In addition to the aforementioned in **Section 1.0** through **Section 7.0**, the following recommendations are noted:

1) The City of Kitchener's **Site Alteration bylaw** is used to control site alteration activities within the city, such as the placing or dumping of fill; the removal of topsoil; and the alteration of the grade of land. A **Site Alteration Permit** is required for all properties 0.405 hectares or greater. Site alteration permits are not required for:

- The installation of a swimming pool provided a pool permit is obtained.
- Minor grading or landscaping projects.
- Normal farm practices.
- Development that is undertaken with the appropriate planning approvals and building permits.

Through discussion with City of Kitchener Engineering and Planning staff, it is recommended **that the minimum property area for review should be reduced from 0.405 to 0.1 hectares**. This reduction will more accurately reflect the lot sizes in the City of Kitchener and allow for more comprehensive implementation of the City's stormwater criteria and targets.

2) In light of continuing redevelopment pressures in the City's downtown core, it is recommended that the City of Kitchener **review the existing Downtown Exemption Area** for opportunities to improve the uptake of source control features such as permeable pavement, rainwater harvesting and green roofs to the maximum extent possible (MEP) subject to the **Stormwater Infiltration in the Context of Source Protection Planning (October 2016)** and site constraints.

3) It is recommended that before final Engineering sign-off, the applicant meet a **certification clause verifying the property has been registered in the City's Stormwater Credit Program**.

4) Within the province several manuals and guides have been developed to assist in the design and implementation of LID features. It is recommended that the City of Kitchener direct proponents of development, redevelopment, reurbanization and residential intensification to the **LID reference documents** listed in **Attachment B**.

5) It is recommended that the City of Kitchener **update their policy regarding the requirement for MOECC Environmental Compliance Approval (ECA)**. Updates should reflect ECA exemptions – specifically, Pursuant to the Ontario Water Resources Act (OWRA) O.Reg 525/98, all water quality controls must receive an ECA. Per O.Reg 525/98, subsection 53(1) and (3) O. Reg. 525/98 – Approval Exemption, last amendment O.Reg. 396/0, Section 3, Subsection 53(1) and (3) of the Act do not apply to the establishment, alteration, extension or replacement of or a change in a stormwater management facility that,

- a) Is designed to service one lot or parcel of land;
- b) Discharges into a storm sewer that is not a combined sewer;
- c) Does not service industrial land or a structure located on industrial land; and
- d) Is not located on industrial land O. Reg 525/98, s. 3.

6) It is recommendation that the City incorporate Low Impact Development design guidelines per the Low Impact Development Stormwater Planning and Design Guide (V1.0, 2010 or as amended from time to time) into the City standards and specifications in 2017.

7) It is recommended that the City of Kitchener develop a Pollution Prevention Plans and/or Risk Management Plans checklist or minimum requirements in consultation with the Region of Waterloo's Risk Management Plans per the Source Protection Plan and Policies.

8) It is recommended that the City of Kitchener identify deficient stormwater management facility catchments (water quality and quantity) through future studies as detailed in the ISWM-MP Implementation Plan.

Attachment A – High Risk Site Activities

High Risk Site Activities

Uses within the site boundaries which would preclude infiltration for the identified catchment where the High Risk use is taking place. (Infiltration of roof water is not limited by high risk site use)	
1. Airports 2. Snow Storage Areas and Facilities 3. Disposal, Storage and Transfer - Storage of hazardous wastes or liquid industrial wastes - Landfills, waste transfer stations, & putrescible waste disposal - Lagoons for sewage treatment - Bulk liquid trucking - Warehousing, bulk storage or retail sale of: - Petroleum fuels, oils, chlorinated solvents, - Household or industrial cleaning products - Agricultural pesticides, herbicides, fungicides & fertilizers 4. Contracting Operations: - Roofing Siding and Sheet Metal Contractors 5. Metal finishing operations - Electroplating, Electro Coating, Galvanizing, Painting, Application of Baked Enamel - Electroplating Plating, Polishing, Anodizing and Colouring - Powder Metallurgy Part Manufacturing - Metal Coating Engraving except Jewellery and Silverware and Allied Services to - Manufacturers - Non-ferrous Metal except Copper and Aluminium Rolling Drawing and Extruding - Metal Heat Treating - Motor Vehicle Stamping - Metal Stamping	9. Manufacturing of: - Metal Household Furniture Manufacturing - Miscellaneous Fabricated Metal Product Manufacturing - Electrometallurgical Ferroalloy Product Manufacturing - Metal Can Manufacturing and Other Metal Container Manufacturing - Unfinished Fabricated Metal Products Manufacturing - Other Metal Valve and Pipe Fitting Manufacturing - Enameled Iron and Metal Sanitary Ware Manufacturing - Fabricated Structural Metal Manufacturing - Metal Window and Door Manufacturing - Metal Tank (Heavy Gauge) Manufacturing - Sheet Metal Work Manufacturing - Ornamental and Architectural Metal Work Manufacturing - Prefabricated Metal Building and Component Manufacturing - Fabricated Structural Metal Manufacturing - Machine Tool Metal Cutting Types Manufacturing - Machine Tool Metal Forming Types Manufacturing - Other Metalworking Machinery Manufacturing - Bare Printed Circuit Board Manufacturers - Electronic Coil Transformer and Other Inductor Manufacturing - Printing Ink Manufacturing - All Other Basic Inorganic Chemical Manufacturing - Gum and Wood Chemical Manufacturing - Petrochemical Manufacturing - All Other Basic Organic Chemical Manufacturing - Pesticide and Other Agricultural Chemical Manufacturing - All Other Miscellaneous Chemical Product and Preparation Manufacturing - Photographic Film Paper Plate and Chemical Manufacturing

6. Automotive Services

- Auto Wrecking & Salvage Yards
- Gasoline Stations
- Automotive Body Paint and Interior Repair and Maintenance
- Automotive Exhaust System Repair
- All Other Automotive Repair and Maintenance
- Automotive Transmission Repair
- General Automotive Repair
- Other Automotive Mechanical, Electrical Repair & Maintenance
- Automotive Oil Change and Lubrication Shops

7. Other Services

- Metals Service Centres and Offices
- Jewellery Watch Precious Stone and Precious Metal Wholesalers
- Photofinishing Laboratories
- Dentist Offices
- General Medical and Surgical Hospitals
- Psychiatric and Substance Abuse Hospitals
- Speciality Hospitals
- Medical Laboratories
- Dental Laboratories
- Testing Laboratories
- Commercial or Industrial Dry Cleaning of Textiles and Laundry Services (except coin operated)
- Books Printing
- Quick Printing
- Other Commercial Printing
- Commercial Lithographic Printing
- Commercial Gravure Printing
- Commercial Flexographic Printing
- Commercial Screen Printing

- Other Chemical and Allied Products Wholesalers
- Plastics Material and Resin Manufacturing
- Soap and Other Detergent Manufacturing
- Pharmaceutical Preparation Manufacturing
- Paint and Coating Manufacturing
- Petroleum Lubricating Oil and Grease Manufacturing
- All Other Petroleum and Coal Products Manufacturing
- Asphalt Paving Mixture and Block Manufacturing
- Asphalt Shingle and Coating Materials Manufacturing
- Plastics Bottle Manufacturing
- Plastics Plumbing Fixture Manufacturing
- All Other Plastics Product Manufacturing
- Leather and Hide Tanning and Finishing
- All Other Leather Goods Manufacturing
- Wood & Wood Product Preservation & Treatment Manufacturing
- Petroleum Products or Asphalt Batching (including processing) Manufacturing
- Motor Vehicles, Trucks, & Bus Bodies Manufacturing
- Aircraft & Aircraft Parts Manufacturing
- Rail Cars Manufacturing
- Mobile Homes Manufacturing
- Ships & Boats Manufacturing
- Industrial Chemicals Manufacturing
- Adhesives Manufacturing
- Small Electrical Appliances Manufacturing
- Electric Lamps Manufacturing
- Wet Batteries Manufacturing
- Dry Electrical Industrial Equipment Manufacturing
- Vehicle Engines Manufacturing
- Cable & Wire Manufacturing
- Paints & Varnishes Manufacturing
- Major Electric Appliances Manufacturing

• Other Commercial Printing • Manifold Business Forms Printing 8. Transportation Services • Support Activities for Rail Transportation • All Other Transit and Ground Passenger Transportation • School and Employee Bus Transportation • Interurban and Rural Bus Transportation • School and Employee Bus Transportation • Other Support Activities for Road Transportation	• Plastics & Synthetic Resins Manufacturing • Lighting Fixtures Manufacturing • Wet Electrical Equipment Manufacturing • Steering & Suspension Parts Manufacturing • Motor Vehicle Wiring Manufacturing • Reinforced Fiberglass Manufacturing • Electronic Components (semiconductors, printed circuit boards, cathode ray tubes) Manufacturing • Wheels & Brakes Manufacturing
Source: Amended from LID Stormwater Management Manual (TRCA & CVC, Draft 2008), East Side Lands Master Drainage Plan (Nov 2013) and Stormwater Management Policy Development Implementation Procedure for Development Updated 2008 - Schedule A * For sites with unknown activities (i.e. units with multiple and/ or unspecified tenants) at the time of application, the City shall apply most stringent requirements.	

Attachment B – Stormwater, Pollution Prevention and Low Impact Development Resources

Resources:

Low Impact Development Stormwater Planning and Design Guide (2010, v1.0)

- <http://www.creditvalleyca.ca/low-impact-development/low-impact-development-support/stormwater-management-lid-guidance-documents/low-impact-development-stormwater-management-planning-and-design-guide/>

Low Impact Development Stormwater Management Planning and Design Guide, including Fact Sheets:

www.sustainabletechnologies.ca/portal/alias_Rainbow/lang_en/tabID_578/DesktopDefault.aspx

Construction Guide for Low Impact Development Version 1.0 – 2012

<http://www.creditvalleyca.ca/low-impact-development/low-impact-development-support/stormwater-management-lid-guidance-documents/designers-guide-for-low-impact-development-construction-draft/>

Landscape Design Guide for Low Impact Development – Version 1.0 June 2010

<http://www.creditvalleyca.ca/low-impact-development/low-impact-development-support/stormwater-management-lid-guidance-documents/andscape-design-guide-for-low-impact-development-version-1-0-june-2010/>

Rain Water Harvesting Design and Costing Tool

www.sustainabletechnologies.ca/portal/alias_Rainbow/lang_en/tabID_595/Default.aspx

LID Retrofit Guides - <http://www.creditvalleyca.ca/low-impact-development/low-impact-development-support/stormwater-management-lid-guidance-documents/>

- Low Impact Development Road Retrofits
- Low Impact Development Business and Multi-Residential Retrofits
- Low Impact Development Public Lands Retrofits
- Low Impact Development Residential Retrofits

[LID Studies and Research](#)

Sustainable Technologies Evaluation Program (STEP): www.sustainabletechnologies.ca/

Pollution Prevention Plans

<https://archive.org/details/std01076383.ome>

ⁱ *The following definitions are per the City of Kitchener Official Plan*
http://www.kitchener.ca/en/insidcityhall/official_plan_review.asp

Attachment C - MTCS screening checklist

Screening for Impacts to Built Heritage and Cultural Heritage Landscapes

This checklist is intended to help proponents determine whether their project could affect known or potential cultural heritage resources. The completed checklist should be returned to the appropriate Heritage Planner or Heritage Advisor at the Ministry of Tourism and Culture.

Step 1 – Screening for Recognized Cultural Heritage Value

YES	NO	Unknown	
☐	☐	☐	1. Is the subject property designated or adjacent* to a property designated under the <i>Ontario Heritage Act</i> ?
☐	☐	☐	2. Is the subject property listed on the municipal heritage register or a provincial register/list? (e.g. Ontario Heritage Bridge List)
☐	☐	☐	3. Is the subject property within or adjacent to a Heritage Conservation District?
☐	☐	☐	4. Does the subject property have an Ontario Heritage Trust easement or is it adjacent to such a property?
☐	☐	☐	5. Is there a provincial or federal plaque on or near the subject property?
☐	☐	☐	6. Is the subject property a National Historic Site?
☐	☐	☐	7. Is the subject property recognized or valued by an Aboriginal community?

Step 2 – Screening Potential Resources

YES	NO	Unknown	
☐	☐	☐	Built heritage resources
☐	☐	☐	1. Does the subject property or an adjacent property contain any buildings or structures over forty years old [†] that are:
☐	☐	☐	▪ Residential structures (e.g. house, apartment building, shanty or trap line shelter)
☐	☐	☐	▪ Farm buildings (e.g. barns, outbuildings, silos, windmills)
☐	☐	☐	▪ Industrial, commercial or institutional buildings (e.g. a factory, school, etc.)
☐	☐	☐	▪ Engineering works (e.g. bridges, water or communications towers, roads, water/sewer systems, dams, earthworks, etc.)
☐	☐	☐	▪ Monuments or Landmark Features (e.g. cairns, statues, obelisks, fountains, reflecting pools, retaining walls, boundary or claim markers, etc.)
☐	☐	☐	2. Is the subject property or an adjacent property associated with a known architect or builder?
☐	☐	☐	3. Is the subject property or an adjacent property associated with a person or event of historic interest?
☐	☐	☐	4. When the municipal heritage planner was contacted regarding potential cultural heritage value of the subject property, did they express interest or concern?
☐	☐	☐	Cultural heritage landscapes
☐	☐	☐	5. Does the subject property contain landscape features such as:
☐	☐	☐	▪ Burial sites and/or cemeteries
☐	☐	☐	▪ Parks or gardens
☐	☐	☐	▪ Quarries, mining, industrial or farming operations
☐	☐	☐	▪ Canals
☐	☐	☐	▪ Prominent natural features that could have special value to people (such as waterfalls, rocky outcrops, large specimen trees, caves, etc.)
☐	☐	☐	▪ Evidence of other human-made alterations to the natural landscape (such as trails, boundary or way-finding markers, mounds, earthworks, cultivation, non-native species, etc.)
☐	☐	☐	6. Is the subject property within a Canadian Heritage River watershed?
☐	☐	☐	7. Is the subject property near the Rideau Canal Corridor UNESCO World Heritage Site?
☐	☐	☐	8. Is there any evidence from documentary sources (e.g., local histories, a local recognition program, research studies, previous heritage impact assessment reports, etc.) or local knowledge or Aboriginal oral history, associating the subject property/ area with historic events, activities or persons?

Note:

If the answer is "yes" to any question in Step 1, proceed to Step 3.

The following resources can assist in answering questions in Step 1:

Municipal Clerk or Planning Department – Information on properties designated under the Ontario Heritage Act (individual properties or Heritage Conservation Districts) and properties listed on a Municipal Heritage register.

Ontario Heritage Trust – Contact the OHT directly regarding easement properties. A list of OHT plaques can be found on the website: [Ontario Heritage Trust](#)

Parks Canada – A list of National Historic Sites can be found on the website: [Parks Canada](#)

Ministry of Tourism and Culture – The Ontario Heritage Properties Database includes close to 8000 identified heritage properties. Note while this database is a valuable resource, it has not been updated since 2005, and therefore is not comprehensive or exhaustive. [Ontario Heritage Properties Database](#)

Local or Provincial archives

Local heritage organizations, such as the municipal heritage committee, historical society, local branch of the Architectural Conservancy of Ontario, etc.

Consideration should also be given to obtaining oral evidence of CHRs. For example, in many Aboriginal communities, an important means of maintaining knowledge of cultural heritage resources is through oral tradition.

If the answer is "yes" to any question in Step 2, an evaluation of cultural heritage value is required. If cultural heritage resources are identified, proceed to Step 3.

If the answer to any question in Step 1 or to questions 2-4, 6-8 in Step 2, is "unknown", further research is required.

If the answer is "yes" to any of the questions in Step 3, a heritage impact assessment is required.

If uncertainty exists at any point, the services of a qualified person should be retained to assist in completing this checklist. All cultural heritage evaluation reports and heritage impact assessment reports must be prepared by a qualified person. Qualified persons means individuals (professional engineers, architects, archaeologists, etc.) having relevant, recent experience in the identification and conservation of cultural heritage resources. Appropriate evaluation involves gathering and recording information about the property sufficient to understand and substantiate its heritage value; determining cultural heritage value or interest based on the advice of qualified persons and with appropriate community input. If the property meets the criteria in Ontario Regulation 9/06 under the Ontario Heritage Act, it is a cultural heritage resource.

[†] The 40 year old threshold is an indicator of potential when conducting a preliminary survey for identification of cultural heritage resources. While the presence of a built feature that is 40 or more years old does not automatically signify cultural heritage value, it does make it more likely that the property could have cultural heritage value or interest. Similarly, if all the built features on a property are less than 40 years old, this does not automatically mean the property has no cultural heritage value. Note that age is not a criterion for designation under the *Ontario Heritage Act*.

Step 3 – Screening for Potential Impacts

YES	NO	Will the proposed undertaking/project involve or result in any of the following potential impacts to the subject property or an adjacent* property?
☐	☐	Destruction, removal or relocation of any, or part of any, heritage attribute or feature.
☐	☐	Alteration (which means a change in any manner and includes restoration, renovation, repair or disturbance).
☐	☐	Shadows created that alter the appearance of a heritage attribute or change the exposure or visibility of a natural feature or plantings, such as a garden.
☐	☐	Isolation of a heritage attribute from its surrounding environment, context or a significant relationship.
☐	☐	Direct or indirect obstruction of significant views or vistas from, within, or to a built or natural heritage feature.
☐	☐	A change in land use such as rezoning a battlefield from open space to residential use, allowing new development or site alteration to fill in the formerly open spaces.
☐	☐	Soil disturbance such as a change in grade, or an alteration of the drainage pattern, or excavation, etc.

* For the purposes of evaluating potential impacts of development and site alteration "adjacent" means: contiguous properties as well as properties that are separated from a heritage property by narrow strip of land used as a public or private road, highway, street, lane, trail, right-of way, walkway, green space, park, and/or easement or as otherwise defined in the municipal official plan.

Attachment D – Monitoring Program Procedures and Protocols

Autosampling Stations

At each autosampler station, water quality monitoring shall be conducted using automated flow proportionate sampling in order to produce Event Mean Concentrations (EMCs) for selected constituents and therefore enable calculation of pollutant mass loadings into receiving waters. Monitoring activities at the flow proportionate sites would include the following:

- 1) Installation of an automated sampling device at the selected sites. A flow meter compatible with the selected automated sampling device would be utilized to trigger sampling as flow rates change. Flow meters would record continuous flow data in order to develop the EMC. Recording water levels every 15 minutes is suitable for developing EMCs.
 - A minimum of eight (8) sampling events per year should be undertaken, with two (2) events per season (i.e. Spring, Summer, Fall, and Winter) to ensure statistical significance.
 - Undertaking a minimum of five (5) single discrete flow measurements and installation of a staff gauge is recommended in order to develop a rating curve (i.e. depth versus flow relationship). Continuously recorded depth values are translated to flow rates per the relationship developed by the corresponding rating curve.
 - Continuous temperature monitoring is recommended at the automated flow proportionate sampling locations in order to establish baseline thermal regimes at the respective sampling location. Data should be recorded every 15 minutes.
 - A minimum of three (3) dry weather sampling events should be conducted at each sampling location with one event in each of spring, summer and fall season. Dry weather sampling consists of grab samples which are analyzed to provide an indication of failing infrastructure or contamination due to spills upstream. Dry weather sampling shall be limited to days without rain events and is not conducted within 48 hours of a significant storm event.
 - Sampled parameters shall be consistent with **Table D1**. Laboratory sampling methodology and detection limits should be consistent with the previous sampling efforts (beginning with 2015) to ensure consistency amongst past datasets.

Table D-1: Water Quality Parameters Sampling & Sampling Procedure

Parameters	Sampling Procedure/ Dry Weather Sites	Sampling Procedure/Type Flow Proportionate Sites
Chloride	Grab	Automated
E.coli	Grab	Automated
Nitrate	Grab	Automated
Copper	Grab	Automated
Lead	Grab	Automated
Zinc	Grab	Automated
Total and Dissolved Phosphorous	Grab	Automated
Total Suspended Solids (TSS)	Grab	Automated
Hardness (as CaCO ₃)	Grab	Automated
Additional Water Quality Parameters Sampled		
pH	Field Measurement – collected at time of sample retrieval	
Temperature	Field Measurement – collected at time of sample retrieval	
Dissolved Oxygen	Field Measurement – collected at time of sample retrieval	
Conductivity	Field Measurement – collected at time of sample retrieval	

Water Quantity

Continuous measurements shall be uniform in terms of frequency and representative of the flow regime. Therefore, it is recommended that a 15-min interval be employed.

Biological Monitoring

Fisheries Monitoring

A Single Pass Backpack Electrofishing Survey will be conducted annually in spring (second week in March), summer (third week in July) and fall (last week of September) at the sampling station using OSAP Section 3: Module 1. This approach is used to produce a comprehensive fish species inventory within a site, characterizing the fish community, spawning activity and providing a qualitative assessment of species abundance. Species identification, number of fish, individual length and weight will be recorded.

Benthic Macroinvertebrate Sampling

Standard sampling protocols should be followed including the Ontario Benthos Biomonitoring Network Protocol (OBBN) (Jones, 2007) and Ontario Stream Assessment Protocol (OSAP). Benthic samples should be analysed using a multimetric approach to summarize the condition.

In addition to richness (e.g. total number of taxa) and composition metrics (e.g. % Diptera), macroinvertebrate can also be classified according to:

- functional feeding groups (e.g., % Collector-Filterers, % Scrapers, % Shredders)
- habit/behavior characteristics (e.g., % Clingers)

Functional feeding groups provide an indication of food web relationships. Habitat and behaviour characteristics indicate the functionality of the organism (e.g., the way it moves or searches for food).

The samples will be analysed using a multi-metric approach to summarize the condition of the watercourse using the following indices:

- Taxa Richness
- % EPT (Ephemeroptera, Plecoptera and Trichoptera)
- # EPT Taxa
- % Oligochaeta
- % Diptera
- % Chironomidae
- % Collector-filterer
- % Collector-gatherer
- % Scraper
- % Shredder
- % Clinger
- Shannon's Diversity Index
- Hilsenhoff's Biotic Index

Water Quality Database Submission Requirements

The following is the minimum data requirements for laboratory submissions. The data submitted to the consultant must include, but not be limited to the following fields.

<u>Field Name</u>	<u>Description</u>	<u>Type</u>	<u>Size</u>
Source:	Name of the laboratory	Text	32
ID:	Unique sample number	Long	9
STATION ID:	Name of sampling site	Text	11
PARAMETER DESCRIPTION:	Full description of parameter	Text	50
SAMPLE DATE:	Date of sampling event	Text	12
SAMPLE TIME:	Time of sample event	Text	9
SAMPLE MATRIX:	The medium of the sample (water)	Text	20
RESULT:	Result value	Double	8
UNITS:	Abbreviated form of result unit	Text	28
METHOD DETECTION LIMIT:	The detection limit of the associated method	Double	8
METHOD:	Description of test method	Text	50
SAMPLE TYPE:	Grab, spike, duplicate	Text	20
EQUIPMENT:	Used for continuous sampling	Text	20
EASTING:	UTM Coordinate of sampling site	Double	20
NORTHING:	UTM Coordinate of sampling site	Double	20
MONITORING PROGRAM NAME:	Name of monitoring program	Text	16

Other information that must be provided is the full address and contact information of the laboratory. This data must be delivered as a digital file (.xls, .xlsx, .dbf, .csv).

ⁱ Rosenberg Secondary Plan / Southwest Urban Area Studies Community Master Plan
<https://www.kitchener.ca/en/insidecityhall/opreviewdocs.asp>

ⁱⁱ Grand River Water Management Plan (2014) <https://www.grandriver.ca/en/our-watershed/Water-management-plan.aspx>