

13.4 Stormwater Management 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

13.4.1 Sediment Removals

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.

As detailed previously, upon review of the available design briefs it was found that many of the SWM facilities that were classified as “wet facilities” lacked an engineered permanent pool. The Dry versus Wet Facilities classification was selected in order to remove uncertainty relating to changes in facility type over time (i.e. facilities that were designed as dry ponds which now appear and have been inappropriately classified as wetlands. It is likely that these facilities are retaining water due to clogging of outlets due to sedimentation or have been misclassified due to the associated colonization by wetland species). For this analysis all facilities that lacked a designed permanent pool based on their available design reports, were classified as ‘dry facilities’. Wet Facilities are defined as those facilities with a permanent pool (per the original design brief), which includes wetlands.

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 that were analyzed:
 - Eight (8) were assessed as High Priority (>20% Loss)
 - Two (2) were assessed as Moderate Priority (11-20% Loss)
 - Seven (7) were assessed as Low Priority (6 -10% Loss)

- Of the sixty-two (61) Wet facilities that were analyzed:
 - Twenty-Two (22) were assessed as High Priority
 - Three (3) were assessed as Moderate Priority
 - Four (4) were assessed as Low Priority

Dry facilities classified as high, moderate and low priority for maintenance and sediment removals are detailed in Table 13.4.1.1.

Wet facilities classified as high, moderate and low priority for maintenance and sediment removals are detailed in Table 13.4.1.2.

**Table 13.4.1.1: Dry Facilities - High, Moderate and Low Maintenance
Priority Sediment Removals**

Priority Ranking	SWM Facility #	Year of Construction	Type of Facility	Decrease in Storage Capacity	Maintenance Priority	Class EA Schedule
1	58	1982	Dry Pond	100%	High Priority	Schedule A/A+
2	57	1985	Dry Pond	100%	High Priority	Schedule A/A+
3	14	1988	Dry Pond	37%	High Priority	Schedule A/A+
4	33	1994	Wetland	32%	High Priority	Schedule A/A+
5	11	1986	Wetland	28%	High Priority	Schedule A/A+
6	101	2003	Wet Pond	28%	High Priority	Schedule A/A+
7	39	1995	Dry Pond	24%	High Priority	Schedule A/A+
8	8	1985	Wetland	21%	High Priority	Schedule A/A+
9	109	2001	Dry Pond	18%	Moderate Priority	Schedule A/A+
10	15	1987	Dry Pond	10%	Moderate Priority	Schedule A/A+
-	19	1987	Dry Pond	9%	Low Priority	Schedule A/A+
-	116	2007	Dry Pond	9%	Low Priority	Schedule A/A+
-	42	1995	Wet Pond	9%	Low Priority	Schedule A/A+
-	32	1994	Wet Pond	8%	Low Priority	Schedule A/A+
-	28	1993	Wetland / Dry Pond	7%	Low Priority	Schedule A/A+
-	59	1989	Dry Pond	6%	Low Priority	Schedule A/A+
-	45	1995	Dry Pond	5%	Low Priority	Schedule A/A+

**Table 13.4.1.2: Wet Facilities - High, Moderate and Low Maintenance
Priority Sediment Removals**

Priority Ranking	SWM Facility #	Year of Construction	Type of Facility	Decrease in Storage Capacity	Maintenance Priority	Class EA Schedule
1	25	1992	Wetland/Dry Pond	80%	High Priority	Schedule A/A+
2	17	1988	Wetland	73%	High Priority	Schedule A/A+
3	112	2000	Wetland	73%	High Priority	Schedule A/A+
4	49	2000	Wetland	69%	High Priority	Schedule A/A+
5	93	1995	Wetland	63%	High Priority	Schedule A/A+
6	145	2002	Wet Pond	61%	High Priority	Schedule A/A+
7	82	2002	Wetland	60%	High Priority	Schedule A/A+
8	48	2002	Wetland	60%	High Priority	Schedule A/A+
9	147	2002	Wet Pond	59%	High Priority	Schedule A/A+
10	55	1998	Wetland	52%	High Priority	Schedule A/A+
11	148	2003	Wetland/Wet Pond	48%	High Priority	Schedule A/A+
12	102	2000	Wetland	48%	High Priority	Schedule A/A+
13	123	2006	Wetland	44%	High Priority	Schedule A/A+
14	52	1998	Wetland	42%	High Priority	Schedule A/A+
15	120	1999	Wet Pond	42%	High Priority	Schedule A/A+
16	26	2003	Wet Pond	41%	High Priority	Schedule A/A+
17	135	2004	Wet Pond	40%	High Priority	Schedule A/A+
18	95	1999	Wet Pond	35%	High Priority	Schedule A/A+
19	96	1999	Wet Pond	28%	High Priority	Schedule A/A+
20	72	2003	Wetland	25%	High Priority	Schedule A/A+
21	73	2003	Wetland	23%	High Priority	Schedule A/A+
22	76	2004	Wetland	20%	High Priority	Schedule A/A+
23	134	2008	Wetland	18%	Moderate Priority	Schedule A/A+
24	150	2004	Wetland	14%	Moderate Priority	Schedule A/A+
25	146	2006	Wet Pond	11%	Moderate Priority	Schedule A/A+
-	94	2002	Wet Pond	7%	Low Priority	Schedule A/A+
-	83	2003	Wetland	10%	Low Priority	Schedule A/A+
-	81	2002	Wetland	7%	Low Priority	Schedule A/A+
-	46	1996	Wetland	10%	Low Priority	Schedule A/A+

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 begun maintaining SWM facilities on a planned basis since 2014.

Refer to Section 14.0 for estimated implementation costs.

13.4.2 Planned Retrofits

The ten (10) remaining SWM facilities are currently scheduled for retrofit (Table 13.4.2). Their status as planned retrofits is based on previously completed Class EA studies, specifically:

- City of Kitchener Stormwater Management Facility Retrofit, Class A+ EA (Aquafor Beech, 2010).
- Municipal Class EA, Schedule B: Strasburg Creek (North Branch) Ponds 65, 66 & 61 (Aquafor Beech Ltd., 2011)
- Schedule B: Municipal Class EA Report - Kolb Creek (Aquafor Beech Ltd., 2013)

The ten (10) remaining SWM facilities which are currently scheduled for retrofit (Table 13.4.2) have satisfied the respective Class EA requirements per the above noted studies. Further evaluation as part of the ISWM-MP is therefore not warranted. The ten (10) SWM facilities scheduled for retrofit can then proceed directly to detailed design and implementation per the identified prioritization.

Table 13.4.2 - SWM Facilities Scheduled for Retrofit

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

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

Refer to Section 14.0 for estimated implementation costs.

13.4.3 Park Rehabilitation and SWM Enhancements (New SWM Facilities)

The ISWM-MP explored and assessed the feasibility of constructing new stormwater management facilities as part of park rehabilitations.

Twelve (12) SWM opportunities were identified as feasible based on the four (4) phase approach, and preferred alternatives for each location were selected as part of the Recommended Approach.

The identification, evaluation and selection of preferred alternatives for the twelve (12) SWM opportunities summarized in Table 13.4.3 below, have been completed following Schedule B of the Municipal Class EA process and therefore can proceed directly to detailed design and implementation.

Table 13.4.3: Park Rehabilitation 12 Feasible SWM Facility Opportunities

Map & Site ID	Location Name	Drainage Area (ha)	Recommended Facility Type (1 - Primary alternative; 2- Secondary alternative)	Preferred Alternative	Class EA Schedule
2-1	Common areas at Victoria Park	27	Subsurface Storage Facility	Subsurface Storage Facility	Schedule B
2-2	Cameron Heights Pool & Kaufman Park	77	Subsurface Storage Facility	Subsurface Storage Facility	Schedule B
2-3	Cherry Park	29	1) Surface facility 2) Subsurface Storage Facility	Subsurface Storage Facility with Wet Pond	Schedule B
3-4	Roseburg Park	43	Subsurface Storage Facility	Subsurface Storage Facility	Schedule B
4-2	Idlewood Greenway	19	Subsurface Storage Facility	Subsurface Storage Facility	Schedule B
4-5	Prospect Park	37	Surface facility	Wet Pond	Schedule B
5-2	Sandrock Hydro-Corridor	125	Surface facility	Wet Pond	Schedule B
5-5A	Country Side Park	4.7	Surface facility	Wet Pond	Schedule B
5-5B	Country Side Park	4.3	Surface facility	Wet Pond	Schedule B
6-1	Country Hill Park	24	1) Surface facility 2) Subsurface Storage Facility	Subsurface Storage Facility	Schedule B
6-3B	Millwood Park	8	Surface facility	Wet Pond	Schedule B
7-2	Biehn Park	80	Subsurface Storage Facility	Subsurface Storage Facility	Schedule B

Refer to Section 14.0 for estimated implementation costs.

13.5 Watercourse and Erosion Restoration

The evaluation process resulted in preferred alternatives that address reach specific erosion concerns at each of the twelve (12) primary erosion sites. Project types include;

- Removal of risk at five (5) locations
- Local works at four (4) locations
- Reach based works at three (3) locations

Table 13.5 identifies the preferred alternative at each site. All projects identified in this table are classified as EA Schedule B projects.

Table 13.5: Preferred Alternatives for Primary Erosion Sites

Watercourse and Reach ID of Erosion Site	Reach ID	Primary Classification	Risk	Preferred Alternative	Class EA Schedule
Borden Creek (downstream of Conestoga Pkwy)	BD-1B	Erosion Site	Sanitary sewer	Removal of Risk	Schedule B
Borden Creek at Concordia Park	BD-1A	Erosion Site	Buried utility, sanitary sewer	Local Works	Schedule B
Borden Creek at Concordia Park	BD-1A	Erosion Site	Water Main	Removal of Risk	Schedule B
Lower Laurel Creek	LC-1A-2A	Restoration Reach	Private property, building, sanitary sewer, habitat	Reach Based Works	Schedule B
Montgomery Creek (at Vanier Road)	MG-1E-F	Erosion Site	Water main, flooding	Removal of Risk*	Schedule B
Sandrock Creek (at Westheights Drive)	SR-2B	Erosion Site	Trail, storm outfalls	Local Works	Schedule B
Schneider Creek (at Manitou Road)	SC-4L	Erosion Site	Private property, abandoned pipe	Removal of Risk	Schedule B
Schneider Creek (at Old Carriage Road)	SC-2B-C	Restoration Reach	Private property, trails, habitat	Local Works	Schedule B
Shoemaker Creek (from Mill Street to Homer Watson Blvd.)	SM-2B	Restoration Reach	Sanitary sewer, storm outfall, habitat	Reach Based Works	Schedule B
Stonegate Creek (Hofstetter Creek) (at the Grand River)	ES-GRT6-1	Erosion Site	Storm sewer, DICBs	Removal of Risk	Schedule B
Strasburg Creek (downstream of Old Huron Road)	SB-13A	Erosion Site	Culvert, private property, sewer	Local Works	Schedule B
Voisin Creek (at Greenbrook Drive)	VS-1A	Restoration Reach	Road, sidewalk, utilities habitat	Reach Based Works	Schedule B

Refer to Section 14.0 for estimated implementation costs.

13.6 Urban Flood Management & Stormwater Infrastructure

As part of the ISWM-MP, development of a calibrated storm sewer trunk system network model and the assessment of various performance scenarios were completed. A total of five (5) scenarios were considered and simulated using the calibrated model, including existing conditions and four other scenarios. The five scenarios were evaluated using the InfoWorks model and then comparing the existing conditions results to each of the other four scenarios.

Through the review of modelling approach and results, the City selected Scenario 4 - Climate Change & LID Volume Control as the preferred modelling scenario and therefore the Recommended Approach to be adopted going forward by the City of Kitchener. Scenario 4 includes both the predicted impacts of climate change as well as the application of a mitigation strategy through the use of and 12.5mm volume control target. In this manner the City has not only assessed potential risks resulting from Climate Change but is proactively taking steps to mitigate the potential risks. While, both the predicted impacts and the full implementation of the 12.5mm volume control target are potentially decades away, Scenario 4 represents an approach that is environmentally, socially and legally as well as fiscally prudent.

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.

The ISWM-MP was carried out following Approach #2 of the Master Plan EA process. The analysis undertaken for this element of the ISWM-MP included the development of a storm trunk sewer network model. This 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. The Storm Sewer Capacity analysis component of the ISWM-MP addresses only addresses Phase 1 of the EA process (problem Identification and Opportunity). As will be outlined in the subsequent Implementation Plan component of the ISWM-MP (under separate cover), 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(s). The following section provides a summary of the study process, analysis, results and conclusions

Refer to Section 14.0 for estimated implementation costs.

14.0 Estimated Costs: Recommended Approach

A summary of the estimated implementation costs for each element of the recommended strategy, as well as future Class EA requirements (Schedule C projects) is provided below and includes a summary of all assumptions.

All program costs as outline below are intended to be implemented within existing and or committed funding allocations per the 2016 City of Kitchener budget process. The Master Plan is intended to allow to the City to prioritize and more efficiently spend the existing and committed budgets to achieve the greatest environmental benefit.

Estimated capital costs estimates for each element of the Recommended Approach are detailed in Table 14.0 below.

Table 14.0 - Recommended Approach – Summary of Capital Cost Estimates†

Recommended Approach Element	Capital Cost Estimate (\$ millions)*
Recommended Approach Element	Capital Cost Estimate (\$ millions)*
1) Municipal Pollution Prevention, Management , Operations & Maintenance Practices	
a. OGS Maintenance (High, Moderate & Low Priority)	\$0.2
b. Sediment Removal for CB in uncontrolled watershed	\$0.3
2) Market Based Strategies for Private Property (source controls): 5 year program costs	\$3.5
3) Stormwater for the Capital Roads Program (conveyance controls)	
a. Roadways	\$1.9 to \$11.1
b. Laneways	\$-0.3 to \$1.7
4) Stormwater Management (SWM) Facilities	
a. Sediment Removals (High, Moderate & Low Priority)	\$2.7
b. Planned Retrofits	\$7.0
c. Park Rehabilitation and SWM Enhancements (new SWM Facilities including park rehabilitation)	\$36.4 – 49.3
5) Watercourse and Erosion Restoration	\$14.0 to \$20.0
6) Urban Flood Management & Stormwater Infrastructure (includes estimated costs for pipes smaller than 600mm which were not modelled)	\$40.0
TOTAL	\$102.2M to \$135.8M
†Class 'C' cost estimate. Note: all values in 2016 CDN dollars	
* Rounded to the nearest \$100,000	

14.1 Est. Costs - Municipal Pollution Prevention, Operations & Maintenance Practices

14.1.1 Estimated Costs: Catch Basin Sediment Removals

A cost analysis was performed in order to determine the unit cost for the catch basin clean-outs. Staff and equipment cost information was obtained from the City of Kitchener work orders issued to complete the clean-outs which included a Vac Truck at a unit cost of \$58.00/hr and a staff cost of \$84.29/hr for two operations staff (including Lead Hand premium).

Sediment disposal costs were estimated based on the SWM Pond Sediment Removal and Disposal Internal Business Case and Decision (2016), developed by the Infrastructure Services Department of the City of Kitchener. The obtained value was \$41.24/Tonne of sediment material disposed. By applying these values, the average service unit costs were estimated as shown in Table 14.1.1

The average service costs presented in Table 14.1.1 are weighted averages, based on volume of sediment or number of catch basins. Phase 1 and 2 cost analysis results are as follows:

Phase 1 (Catch basins assumed Full)

The cost analysis determined an average service cost of \$156.65/Tonne of sediment removed or \$47.13/catch basin serviced.

By extrapolating the cost estimate to all 9,738 catch basins owned by the City of Kitchener, an approximate total cost of \$458,951 would be attributed to the service, whereas the cost to clean-out all catch basins within the City would be approximately \$582,573.

Phase 2

The cost analysis determined an average unit disposal cost of \$684.35/Tonne of sediment removed or \$39.39/catch basin serviced.

Considering the efficiency of catch basins clean-out during both phases were generally equivalent (i.e. 4 catch basins per hour), the Phase 2 results demonstrate the effect of removing less sediment from the catch basins during clean-out operations. The cost per catch basin decreased since less sediment was required to be disposed of; however, the cost per tonne of material increased dramatically.

As such, it is more cost effective to remove sediment from catch basins once they reach full capacity which can be forecasted based on the clean-out frequencies established for each of the four (4) representative areas.

Table 14.1.1 – Catch Basin Clean-out Cost Analysis

Phase	Category	Date	Total Weight of Sediment (kg)	Number of Catch Basins Cleaned	Vac Truck (\$/hr)	Staff Cost (\$/hr)	Disposal Cost (\$/kg)	Total Service Costs (\$)	Service Cost Per CB (\$/CB)	Average Service Cost (\$/CB)	Service Cost (\$/Tonne)	Average Service Cost (\$/Tonne)
1	Mature Residential Subdivision	28-May-15	9440	30	\$58.00	\$84.29	\$0.04	\$1,527.63	\$50.92	\$47.13	\$161.82	\$156.65
	New Residential Subdivision	15-May-15	10190	37				\$1,558.56	\$42.12		\$152.95	
	Industrial/Commercial Subdivision	19-May-15	5560	25				\$1,367.61	\$54.70		\$245.97	
	Old Residential Subdivision	May 22, 26, 2015 & June 1, 2 2015	37690	117				\$5,396.17	\$46.12		\$143.17	
2	Mature Residential Subdivision	22-Mar-16	1210	35	\$58.00	\$84.29	\$0.04	\$1,188.20	\$33.95	\$39.39	\$981.98	\$684.35
	New Residential Subdivision	14-Apr-16	2240	34				\$1,230.68	\$36.20		\$549.41	
	Industrial/Commercial Subdivision	15-Apr-16	1780	25				\$1,211.71	\$48.47		\$680.73	
	Old Residential Subdivision	21-Mar-16	1850	29				\$1,214.59	\$41.88		\$656.54	

Catch Basin versus EOP Facility Clean-outs

The SWM Pond Sediment Removal and Disposal Internal Business Case and Decision (2016), developed by the City of Kitchener, states a unit cost \$88/Tonne for the removal and disposal of sediment from EOP facilities, including inlet and outlet repair, when both City and private forces are combined. This scenario is representative for small facilities due to the City's maintenance capabilities. Larger SWM facilities (i.e. facilities with drainage areas over 30 ha) are expected to have their maintenance completed by a private contractor at an estimated cost of \$220/Tonne. According to the cost analysis results, it is only cost effective to clean-out catch basins (\$156.65/Tonne) within larger drainage areas (over 30 ha) in which EOP facilities are expected to have their maintenance completed by a private contractor at an estimated cost of \$220/Tonne.

According to the City's GIS database, approximately 25% of the City's urban area currently has some level of SWM control, meaning the catch basins within these areas drain to downstream EOP facilities. The remaining catch basins are located in uncontrolled areas and are currently the sole sediment retention mechanism present in these areas. Therefore, sediment collection from catch basins located in uncontrolled areas is an important tool to provide some quality control for stormwater. By excluding the catch basins located in controlled areas, the estimated cost to clean-out all remaining City owned catch basins would be approximately \$300,000.

This represents a significant increase in operation and maintenance costs when added to current annual costs of approximately \$500,000 for street sweeping and \$600,000 for leaf collecting. It is recommended that the City investigate potential efficiencies between the various programs.

14.1.2 Estimated Costs: OGS Units Sediment Removal

Sixteen (16) OGS units require maintenance, six (6) OGS units were classified as high priority (Estimated Cost: \$130,000) and ten (10) OGS units were classified as moderate and low priority (Estimate Cost: \$65,000)

Maintenance costs were estimated for the facilities currently operating at less than acceptable efficiency. The calculations were based on the costs of previous services, specifically the clean out costs for fourteen (14) OGS units as provided 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. This value is 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. Estimated maintenance costs for the OGS units identified as requiring maintenance are outlined in Table 14.1.2.

Table 14.1.2.: Priority OGS Maintenance Costs

Priority Ranking	EE ID ¹	City Unit ID (STMOGSID)	Maintenance Priority	Estimated Maintenance Cost†
1	17	OGS 3001153	High Priority	\$35,500
2	23	OGS 3004390	High Priority	\$8,200
3	5	OGS 37	High Priority	\$14,200
4	18	OGS 3001330	High Priority	\$27,000
5	10	OGS 51	High Priority	\$21,900
6	19	OGS 3002131	High Priority	\$20,100
7	1	OGS 3	Moderate Priority	\$13,700
8	42	Serial #122184*	Moderate Priority	\$9,500
9	34	OGS 3010447	Moderate Priority	\$8,300
10	21	OGS 3002344	Moderate Priority	\$3,900
11	28	OGS 3004425	Moderate Priority	\$8,000
12	32	OGS 3008778	Moderate Priority	\$3,900
13	43	Serial #123306*	Moderate Priority	\$700
14	22	OGS 3004337	Low Priority	\$6,700
15	31	OGS 3008766	Low Priority	\$6,400
16	11	OGS 52	Low Priority	\$3,800
TOTAL				\$ 191,800

¹ Oil/ Grit Separator Inspection Report (Echelon Environmental, 2015)

* City Unit ID unknown

† Based on Estimated Sediment Removal and Disposal Cost at \$725/Tonne + Estimated Liquid Removal and Disposal Cost at \$0.08/L, rounded to the nearest \$100.

14.2 Estimated Costs: Market Based Strategies (source controls)

Table 14.2 below 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.

Table 14.2: 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 ⁶	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 IBID

14.3 Estimated Costs: SWM for the Capital Roads Program (conveyance controls)

Implementation of the preferred approach would utilize the existing stormwater contribution to the AIRP projects, and require an additional \$1.9 to \$11.1 million in funding up to 2024 for turf versus highly vegetated streetscaping options, respectively. 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.

14.4 Estimated Costs: Stormwater Management (SWM) Facilities

The following section summarizes the estimated costs associated the three (3) individual elements which make up the Recommended Approach for Stormwater Management Facilities, specifically:

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

14.4.1 Estimated Costs: Sediment Removals

Maintenance service costs for each facility were estimated based on the City of Kitchener SWM Pond Sediment Removal and Disposal Internal Business Case and Decision, dated January 13th, 2016. According to this study, the most effective approach to meeting the requirements for removal and disposal of sediment from SWM facilities is obtained when the City forces and public tender are combined.

It was observed that when the city provides the complete sediment removal work and publicly tenders the ultimate disposal, the cost, including inlet and outlet repair, is \$88/tonne versus \$220/tonne when the service is completely provided by external contractors. This approach, however, can only be considered for small facilities, due to limitations of the City's maintenance capabilities. Maintenance records show that city forces have cleaned out ponds with drainage areas up to 30ha. As such, maintenance services of ponds with drainage areas larger than 30ha have been evaluated assuming that these facilities would be publicly tendered.

As part of the Recommended Approach, thirty-one (31) Dry facilities and Sixty-two (62) Wet facilities require maintenance activities in the form of sediment removal, specifically:

Of the Thirty-one (31) Dry facilities that were analyzed:

- Eight (8) High Priority
- Two (2) Moderate Priority
- Seven (7) Low Priority

Of the Sixty-one (61) Wet facilities that were analyzed:

- Twenty-Two (22) High Priority
- Three (3) Moderate Priority
- Four (4) Low Priority

Cost estimates for Dry facilities classified as high, moderate and low priority for maintenance and sediment removals are detailed in Table 14.4.1.1.

Cost estimates for Wet facilities classified as high, moderate and low priority for maintenance and sediment removals are detailed in Table 14.4.1.2.

**Table 14.4.1.1: Dry Facilities - High, Moderate and Low Maintenance
Priority Sediment Removals**

Priority Ranking	SWM Facility #	Year of Construction	Type of Facility	Decrease in Storage Capacity	Maintenance Priority	Cost Estimate†
1	58	1982	Dry Pond	100%	High Priority	\$ 16,000
2	57	1985	Dry Pond	100%	High Priority	\$ 2,000
3	14	1988	Dry Pond	37%	High Priority	\$32,000
4	33	1994	Wetland	32%	High Priority	\$55,000
5	11	1986	Wetland	28%	High Priority	\$ 94,000
6	101	2003	Wet Pond	28%	High Priority	\$ 127,000
7	39	1995	Dry Pond	24%	High Priority	\$ 60,000
8	8	1985	Wetland	21%	High Priority	\$ 9,000
9	109	2001	Dry Pond	18%	Moderate Priority	\$ 210,000
10	15	1987	Dry Pond	10%	Moderate Priority	\$6,000
-	19	1987	Dry Pond	9%	Low Priority	\$25,000
-	116	2007	Dry Pond	9%	Low Priority	\$4,000
-	42	1995	Wet Pond	9%	Low Priority	\$ 95,000
-	32	1994	Wet Pond	8%	Low Priority	\$ 4,000
-	28	1993	Wetland / Dry Pond	7%	Low Priority	\$ 230,000
-	59	1989	Dry Pond	6%	Low Priority	\$ 44,000
-	45	1995	Dry Pond	5%	Low Priority	\$ 12,000
TOTAL						\$ 1,025,000

† Class "C" Cost estimate, all values in 2016 CDN dollars. Rounded to the nearest \$1,000 plus 10% contingency.

**Table 14.4.1.2: Wet Facilities - High, Moderate and Low Maintenance
Priority Sediment Removals**

Priority Ranking	SWM Facility #	Year of Construction	Type of Facility	Decrease in Storage Capacity	Maintenance Priority	Cost Estimate†
1	25	1992	Wetland/Dry Pond	80%	High Priority	\$103,000
2	17	1988	Wetland	73%	High Priority	\$483,000
3	112	2000	Wetland	73%	High Priority	\$29,000
4	49	2000	Wetland	69%	High Priority	\$79,000
5	93	1995	Wetland	63%	High Priority	\$15,000
6	145	2002	Wet Pond	61%	High Priority	\$15,000
7	82	2002	Wetland	60%	High Priority	\$18,000
8	48	2002	Wetland	60%	High Priority	\$68,000
9	147	2002	Wet Pond	59%	High Priority	\$16,000
10	55	1998	Wetland	52%	High Priority	\$27,000
11	148	2003	Wetland/Wet Pond	48%	High Priority	\$15,000
12	102	2000	Wetland	48%	High Priority	\$26,000
13	123	2006	Wetland	44%	High Priority	\$64,000
14	52	1998	Wetland	42%	High Priority	\$39,000
15	120	1999	Wet Pond	42%	High Priority	\$11,000
16	26	2003	Wet Pond	41%	High Priority	\$183,000
17	135	2004	Wet Pond	40%	High Priority	\$11,000
18	95	1999	Wet Pond	35%	High Priority	\$103,000
19	96	1999	Wet Pond	28%	High Priority	\$58,000
20	72	2003	Wetland	25%	High Priority	\$37,000
21	73	2003	Wetland	23%	High Priority	\$7,000
22	76	2004	Wetland	20%	High Priority	\$2,000
23	134	2008	Wetland	18%	Moderate Priority	\$103,000
24	150	2004	Wetland	14%	Moderate Priority	\$16,000
25	146	2006	Wet Pond	11%	Moderate Priority	\$14,000
-	94	2002	Wet Pond	7%	Low Priority	\$103,000
-	83	2003	Wetland	10%	Low Priority	\$14,000
-	81	2002	Wetland	7%	Low Priority	\$8,000
-	46	1996	Wetland	10%	Low Priority	\$13,000
TOTAL						\$1,680,000

† Class "C" Cost estimate, all values in 2016 CDN dollars. Rounded to the nearest \$1,000 plus 10% contingency.

14.4.2 Estimated Costs: Planned Retrofits

The ten (10) remaining planned retrofits awaiting implementation include Ponds 6 (currently underway), 66, 10, 16, 65, 61, 21, 7, 62, and 111. Cost estimates developed as part of the previous Class EAs, estimate the implementation costs at \$7.0 million.

The ten (10) remaining SWM facilities are currently scheduled for retrofit. Their status as planned retrofits is based on previously completed Class EA studies, specifically:

- City of Kitchener Stormwater Management Facility Retrofit, Class A+ EA (Aquafor Beech, 2010).
- Municipal Class EA, Schedule B: Strasburg Creek (North Branch) Ponds 65, 66 & 61 (Aquafor Beech Ltd., 2011)
- Schedule B: Municipal Class EA Report - Kolb Creek (Aquafor Beech Ltd., 2013)

Table 14.4.2 - SWM Facilities Scheduled for Retrofit

Priority	SWM Pond #	Year of Construction	Facility Type	Control Type	Drainage Area (ha)	Estimated Costs (\$) [†]
1 (Retrofit Underway)	6	1982	Dry Pond	Quantity	6.18	Underway
2	66	1963	Wet Pond	Quantity	17.1	\$535,000
3	10	1991	Dry Pond	Quantity	59.6	\$1,190,000
4	16	1987	Dry Pond	Quantity	5.9	\$275,000
5	65	1963	Wet Pond / Dry Pond	Quantity	53.6	\$1,900,000
6	61	1963	Wet Pond	Quantity	42	1,330,000
7	21	1990	Wetland	Quantity	31.4	\$275,000
8	7	1986	Wetland	Quantity	17.2	\$110,000
9	62	1963	Wetland	*	0	\$275,000
10	111	*	Wet Pond	Quantity	25.8	\$800,000
TOTAL						\$6,690,000

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)

* - Unavailable data

◇ - Estimated by applying unit rate of \$125/cu.m of perm. pool per City of Kitchener Stormwater Management Facility Retrofit, Class EA and Preliminary Design Brief (Aquafor Beech, 2010)

† Class "C" Cost estimate, all values in 2016 CDN dollars

14.4.3 Estimated Costs: Park Rehabilitation & SWM Enhancements (New SWM Facilities)

The implementation of the proposed SWM facility opportunities as part of park rehabilitations is estimated to cost \$32.1 – 41.2 million with an additional \$4.3 – 8.1 million required for park rehabilitation. The capital construction cost estimates for the surface and subsurface storage facilities were based on the following:

Surface Facilities

1. Previous surface facility construction within the City of Kitchener (Ponds 4, 22, 30 and 107) within the previous eight (8) years. The unit cost ranged from \$150 to 215/m³ (avg. of \$190/m³) of permanent pool volume created. Previous studies in the GTHA^{iv} have utilized a rate of \$100/m³ for excavation required to excavate down to the proposed facility inlet (i.e. pipe depth) and a rate of \$140.00/m³ of permanent pool volume created thereafter. Analysis of this approach revealed an average total unit cost of \$175/m³ of permanent pool volume created. As such a range of \$175/m³ to \$190/m³ has been applied to account for unit cost variability and project uncertainty.
2. A minimum construction cost of \$250,000 per facility was also used for smaller facilities to account for costs associated with mobilization, demobilization, bonding, erosion and sediment control and dewatering etc.

Sub-Surface Facilities

1. Costing for each subsurface storage unit has been based on unit costs of previously constructed facilities in the GTHA, through discussions with several municipalities and product distributors. The unit costs for subsurface facilities ranged from \$450/m³ to \$650/m³ per unit of water quality storage volume provided. Costs include the replacement and/ re-establishment of all existing features to equal or better quality due to the disturbance of the area relating to the construction of the proposed SWM facility.
3. A minimum construction cost of \$350,000 per facility was also used for smaller facilities to account for costs associated with mobilization, demobilization, bonding, erosion and sediment control and dewatering etc.

Parks Rehabilitation

In addition to the above, the cost to rehabilitate the respective park and or park features has been included per the request of City staff. Four (4) levels of park rehabilitation have been assigned:

1. Low Park Rehabilitation (\$50,000 to \$100,000) – represent minor repairs, relocation of existing park features, tree planting and minor improvements to trails.
2. Moderate Park Rehabilitation (\$250,000 to \$500,000) - represent moderate repairs, relocation of existing park features, tree planting and moderate improvements to trails and general construction of new park features.
3. High Park Rehabilitation (\$500,000 to \$1,000,000) - represent reconstruction of high value park features and general construction of new park features (sports fields etc.).
4. Very High (greater than \$1,000,000) – construction of a very high value park features and general construction of new park features (sports fields etc.), typically assigned to District Parks. A cost of \$1,000,000 to \$1,500,000 is allocated in this regard.

It should be noted that park rehabilitation costs are not intended to be funded through the SWM Utility. Rather the SWM Utility would be responsible for replacement and/ re-establishment of all existing features to equal or better quality due to the disturbance of the area relating to the construction of the proposed SWM facility. Park rehabilitation costs would be funded through general tax related funding.

However, the opportunity to coordinate park enhancements and or rehabilitations with proposed SWM facility construction represents an opportunity to reduced overall project costs to the City in both regards as a result of economies of scale, the reduction in design costs and the avoidance of duplication of construction activities (bonding, insurance, mobilization and demobilization, general construction and restoration activities). As such it is recommended that opportunities to coordinate SWM facility construction with park rehabilitation, trail enhancements, park facility upgrades and as part of PARTS planning be investigated as part of the ISWM-MP Implementation Plan to be developed following the approval of the Environmental Assessment.

Implementation costs for each feasible SWM facility opportunity are summarized in Table 14.4.3 below.

Table 14.4.3: Estimated Cost (\$) of the 12 Feasible SWM Facility Opportunities

Map & Site ID	Location Name	Recommended Facility Type (1 - Primary alternative; 2- Secondary alternative)	Drainage Area (ha)	Estimated Construction Cost (\$ (millions)†	Estimated Park Rehabilitation Requirement (\$ (millions)†*
2-1	Common areas at Victoria Park	Subsurface Storage Facility	27	\$ 3.64 – 4.30	\$0.25 – 0.5 (moderate)
2-2	Cameron Heights Pool & Kaufman Park	Subsurface Storage Facility	77	\$ 9.16 – 10.82	\$1.0 – 1.5 (very high)
2-3	Cherry Park	1) Surface facility 2) Subsurface Storage Facility	29	1) \$ 0.97 – 1.06 2) \$ 3.06 – 3.62	\$0.5 – 1.0 (high)
3-4	Roseburg Park	Subsurface Storage Facility	43	\$ 3.69 – 4.37	\$0.5 – 1.0 (high)
4-2	Idlewood Greenway	Subsurface Storage Facility	19	\$ 1.63 – 1.93	\$0.25 – 0.5 (moderate)
4-5	Prospect Park	Surface facility	37	\$ 1.14 - 1.24	\$0.05 – 0.1 (low)
5-2	Sandrock Hydro-Corridor	Surface facility	125	\$ 3.47 – 3.76	\$0.25 – 0.5 (moderate)
5-5A	Country Side Park	Surface facility	4.7	\$ 0.25	\$0.25 – 0.5 (moderate)
5-5B	Country Side Park	Surface facility	4.3	\$ 0.25	\$0.25 – 0.5 (moderate)
6-1	Country Hill Park	1) Surface facility 2) Subsurface Storage Facility	24	1) \$ 0.68 – 0.74 2) \$ 2.15 – 2.54	\$0.25 – 0.5 (moderate)
6-3B	Millwood Park	Surface facility	8	\$ 0.25	\$0.25 – 0.5 (moderate)
7-2	Biehn Park	Subsurface Storage Facility	80	\$ 6.97 – 8.24	\$0.05 – 0.1 (low)
TOTALS			1147	\$32.1 – 41.2	\$4.3 – 8.1
†Class 'C' cost estimate					
*Park rehabilitation costs estimated with input from City Parks Department					
Note: all values in 2016 CDN dollars					

14.5 Est. Costs: Watercourse and Erosion Restoration

Based on the primary list of erosion sites and restoration reach opportunities, \$10.0 – \$15.0 million in stream restoration projects have been considered within the Integrated Stormwater Master Plan. An additional \$4.0 – \$5.0 million in secondary projects have been identified that the City may consider when opportunities arise within other City projects, not including any associated costs for addressing land rights on private property. Stream restoration projects already within existing studies have also been excluded from these cost estimates.

The twelve (12) primary opportunities (erosion sites and restoration reaches) represent the key projects to be considered within system-wide prioritization and implementation plan of the ISWM-MP. The evaluation of alternative solutions was completed for the twelve (12) primary opportunities.

For each of the sites, four (4) preliminary alternative solutions were evaluated using baseline information and a list of evaluation criteria. Scoring of the criteria produced a preferred alternative based on the highest score, which was then developed into a conceptual design. Cost estimates for engineering services (i.e., design, background studies such as geotechnical investigations) and construction costs for each of the preferred alternatives was estimated for each of the preferred alternatives for each site.

The estimated range of costs for the conceptual designs presented in Section 12.4 are presents in Table 14.5 which includes the costs for construction, engineering design and approval and contingency (15%). Cost estimates are exclusive of HST.

A summary of the evaluation of the primary opportunities is presented below in Table 14.5.

Table 14.5: Estimated Cost (\$) Summary of Stream System Opportunities (In Alphabetical Order)

Watercourse and Reach ID of Erosion Site	Field ID#	Reach ID	Primary Classification	Risk	Preferred Alternative(s)	EA Schedule	Estimated Range in Costs for Preferred Alternative
Borden Creek (downstream of Conestoga Pkwy)	8	BD-1B	Erosion Site	Sanitary sewer	Removal of Risk	B	\$312,000 – \$432,000
Borden Creek at Concordia Park	6	BD-1A	Erosion Site	Buried utility, sanitary sewer	Local Works	B	\$175,000 – \$234,000
Borden Creek at Concordia Park	7	BD-1A	Erosion Site	Water Main	Removal of Risk	B	\$829,500 – \$1,206,500
Lower Laurel Creek	31 and 32	LC-1A-2A	Restoration Reach	Private property, building, sanitary sewer, habitat	Reach Based Works	B	\$3,080,000 – \$4,000,500
Montgomery Creek (at Vanier Road)	19	MG-1E-F	Erosion Site	Water main, flooding	Removal of Risk*	B	\$2,924,000 – \$3,032,500
Sandrock Creek (at Westheights Drive)	13	SR-2B	Erosion Site	Trail, storm outfalls	Local Works	B	\$175,000 – \$241,000
Schneider Creek (at Manitou Road)	21 and 22	SC-4L	Erosion Site	Private property, abandoned pipe	Removal of Risk	B	\$85,750 – \$102,250
Schneider Creek (at Old Carriage Road)	15 and 16	SC-2B-C	Restoration Reach	Private property, trails, habitat	Local Works	B	\$1,504,250 – \$2,070,000
Shoemaker Creek (from Mill Street to Homer Watson Blvd.)	1, 2, and 3	SM-2B	Restoration Reach	Sanitary sewer, storm outfall, habitat	Reach Based Works	B	\$2,547,000 – \$3,344,500
Stonegate Creek (Hofstetter Creek) (at the Grand River)	42	ES-GRT6-1	Erosion Site	Storm sewer, DICBs	Removal of Risk	B	\$288,500 – \$385,00
Strasburg Creek (downstream of Old Huron Road)	29	SB-13A	Erosion Site	Culvert, private property, sewer	Local Works	B	\$350,500 – \$470,750
Voisin Creek (at Greenbrook Drive)	4	VS-1A	Restoration Reach	Road, sidewalk, utilities habitat	Reach Based Works	B	\$895,500 – \$1,194,000

14.6 Estimated Costs - Urban Flood Management & Storm Sewer Infrastructure

The modeling results using the 5-year design storm were used to establish preliminary cost implications of incorporating Climate Change or Low Impact Development into the overall ISWM-MP strategy. A unit cost of \$1,150 per linear meter was used to establish the preliminary costs. Table 14.6

Table 14.6: 5-Year Design Storm Assessment Summary – Scenarios 1 - 5

Scenarios ID	Scenarios Name	Total Length of Pipe at Full Capacity (m)	Total Length of Surcharged Pipes (m)	Cost Implications (\$ millions)
1	Existing Conditions	10,723	13,763	\$15.8
2	Climate Change on Existing Conditions	13,934	19,566	\$22.5
3	LID Volume Control on Existing Conditions:	4,585	5,842	\$6.7
4	Climate Change & LID Volume Control	10,685	14,691	\$16.9
5	Intensification on Existing Conditions	12,427	14,671	\$16.9

† Assumes a unit replacement cost of \$1,150/linear meter

Through the review of modelling approach and results, the City selected Scenario 4 - Climate Change & LID Volume Control as the preferred modelling scenario to be adopted going forward by the City of Kitchener. Based on the cost implications of storm sewer replacement associated with Scenarios 1 through 5, it is evident that the implementation of City-wide volume targets is beneficial. Volume targets associated with LID practices will reduce the length of storm sewer pipes at full capacity and surcharging during the 5yr storm event. Table 14.6.1 indicates a \$9.1 million cost savings associated with forgoing critical pipe replacements with the implementation of the LIDs based on existing conditions. Comparing the cost of pipe replacement under Climate Change conditions to Climate Change conditions with volume targets associated with LID practices similarly shows a cost savings of \$5.6 million dollars.

Scenario 4 will therefore be utilized as the basis for the development of financial and budgetary estimates as part of the ISWM-MP.

The anticipated cost to replace the total length of surcharged pipes under Scenario 4 is estimated to be \$16.9 million based on unit cost of \$1,150 per linear meter. This costs represents the capital cost to replace only those pipes which were assessed as part of the calibrated storm sewer trunk system network model (600mm and larger).

The trunk sewer system represents approximately 220,000m or 32.6% of the total storm sewer network in the City of Kitchener. While the trunk sewer system is made up of the largest diameter pipes within the systems, there remains an additional 460,000m or 67.4% of pipes which are 600mm and smaller. To account for the strong probability that additional surcharged pipes will be identified as the model network is expanded beyond the trunk sewer system in areas of previously identified trunk sewer surcharging; it is recommended that the \$16.9 million estimate be increased by an additional \$23 million (factor of 2.4) to a total of \$40 million.

15.0 Recommendations

Consistent with the recommended approach as outlined within this report, the final fifteen (15) study recommendations for the consideration by the City of Kitchener are as follows:

1. That Council approve the City of Kitchener Integrated Stormwater Management Master Plan (ISWM-MP) Class Environmental Assessment Report together with the Recommended Approach;
2. That City staff be directed to file the report with the Ministry of the Environment and Climate Change for the 30 day public review period as required by the *Environmental Assessment Act*;
3. That staff be directed to develop an Implementation Plan (as detailed in Section 16.0), with an operational and maintenance strategy, resource requirements, and supporting policies and by-laws permit the implementation of the Recommended Approach;
4. That City staff be directed to revise the 2017 Capital Budget to reflect and permit the implementation of the Recommended Approach;
5. That per the recommendations of the Market Based Strategy Report (May 2015) that the City of Kitchener apply a market-based approach to planning and decision-making processes pertaining to, or impacting, SWM practices by private property owners. The market based approaches should be designed to increase participation the Stormwater Credit Policy taking into consideration all costs and resource requirements, including staffing, overhead expenses, consulting services, advertising and promotion, and miscellaneous program related expenses;
6. That the City further incentivize the implementation of private stormwater controls as part of the Stormwater Utility Credit Program within prioritized subwatersheds as part of a 'pilot program' and that a focus be placed upon the Industrial, Commercial and Institutional (ICI) as well as multi-residential land uses within the City;
7. That the City explore strategic alignments in regards to the operation and maintenance of City owned stormwater management facilities, specifically, the development of a cost reconciliation mechanism and service level agreement between the Stormwater Utility and Operations to better track allocated O&M funds and direct the allocation of future O&M funding. As well as the creation of an operations unit funded by the Stormwater Utility with a priority focus on the completion of stormwater related operation and maintenance tasks and associated projects as identified through the recommended approach;
8. That the City staff continue to add to the 'credits' of the Habitat Bank created with the Department of Fisheries and Oceans (DFO) through the additional fish habitat

enhancements projects as completed through City projects and the recommended strategy. It is further recommended that City staff be directed to explore the development of a market for the sale of accumulated 'credits' as a future stormwater funding source.

9. That pursuant to Region of Waterloo SPP Policy No. RM-MC-19, 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 and 157.
10. That City staff continue to expand the existing stormwater model within areas to be identified as part of the Implementation Plan including all resource requirements, and staffing. The model expansion will permit the City to evaluate and select the preferred remedial approaches to improve the level of service.
11. That City staff apply the Recommended Approaches of the ISWM-MP as part of 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. It is further recommended that the City integrate source and conveyance control SWM practices per the Recommended Approach as part the Station Area Plans, where feasible, to mitigate the hydrologic and water quality impact of urbanization.
12. That the City update road cross section drawings as well as relevant sections in the Development Manual to reflect the Recommended Approaches as identified in this report.
13. That 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.
14. That City staff explore collaborative funding partnerships with local municipalities, agencies and government to reduce urban non-point source pollution to achieve the specified reductions as part of wastewater treatment plant upgrades as specified in current municipal wastewater master plans. 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.

15. That the City refine existing stormwater monitoring approaches as part of the Implementation Plan to reflect the recommended strategy, and address the lack of financial and staff resources required to:

- Stay current in the review of monitoring reports and data as required by subwatershed plans and other policies;
- The creation of a shared water quality data base (currently underway in partnership with the GRCA);
- Analyze and complete Phase 4 of the adaptive environmental management (AEM) feedback loop of subwatershed plans, environmental studies and other policies. The four (4) phase AEM approach requires Characterization (Phase 1), Impact Assessment (Phase 2), Implementation (Phase 3) as well as Monitoring and Refinement of the management strategy (Phase 4). The analyzed data from the follow-up monitoring is used to test the assumptions made during earlier studies phases to evaluate the performance of the selected management strategies and make necessary adjustments. When all four (4) phases of the AEM process are not completed the process cannot ensure project goals and objectives are being met.

16.0 Implementation Plan

A separate document entitled **Integrated Stormwater Management Master Plan (ISWM-MP) Implementation Plan (2016)** has been prepared and is included under separate cover. The implementation plan will prioritize all the works based on priority subwatershed as well as recommend funding allocation and policy development. Prioritization will be based on the watersheds in the most need and where there are opportunities to improve conditions through the elements of the recommended approach.

The implementation plan has been prepared to provide guidance with respect key next steps, future study considerations, facilitators and contributors, costs and funding considerations, operations and maintenance, integration with other studies, and the prioritization of works based on the identified priority subwatersheds within the City of Kitchener.

The main purpose of the Implementation Plan will be:

- The prioritization of the works based on priority subwatersheds,
- The allocation of the existing and forecasted funding over the next 15 years, and
- The development of supporting policy.

Prioritization will be 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 will be prioritized based on the areas of greatest need and opportunity to maximize the 'net-benefit' to the City, the environment and the community.

The implementation plan will detail:

- The market based approaches designed to increase participation the Stormwater Credit Policy taking into consideration all costs and resource requirements, including staffing, overhead expenses, consulting services, advertising and promotion, and miscellaneous program related expenses;
- How identified works can add to the 'credits' of the Habitat Bank created with the Department of Fisheries and Oceans (DFO) through the additional fish habitat enhancement projects as completed through City projects and the recommended approach. Furthermore, the plan will explore the development of a market for the sale of accumulated 'credits' as a future stormwater funding source;
- Various incentives for property owners who implement private stormwater controls as part of the Stormwater Utility Credit Program within prioritized subwatersheds as part of a 'pilot program' with a focus on the Industrial, Commercial, Institutional (ICI) and multi-residential land uses within the City;

- Strategic alignments in regards to the operation and maintenance of City owned stormwater management facilities, specifically, the development of a cost reconciliation mechanism and service level agreement between the Stormwater Utility and Operations to better track allocated O&M funds and direct the allocation of future O&M funding. As well as the creation of an operations unit funded by the Stormwater Utility with a priority focus on the completion of stormwater related operation and maintenance tasks and associated projects as identified through the recommended approach; and
- Final staffing recommendations in order to implement the recommended approach for Market-based approach implementation (0.5-1.0 FTE), conveyance and End-of-pipe opportunities (1.0-1.5 FTE), InfoWorks Model Technician (1.0 FTE) and Operations and Maintenance (TBD).

Two (2) supporting documents which have been prepared in draft as part of the ISWM-MP process in collaboration with City staff, the Region of Waterloo, the GRCA and the Ministry of Environment and Climate Change, will be finalized as part of the Implementation plan and will form the basis for the development future stormwater policy. “Infiltration in the Context of Source Protection Planning Policy” defines where and how infiltration of runoff can safely occur in the context of the approved source protection planning policy and “Stormwater Volume Criteria and Targets”, outlines the proposed minimum stormwater volume criteria and targets for ‘new’ development, redevelopment, reurbanization and residential intensification as well as linear projects.

In order to ensure the goals and objectives of the Master Plan are accomplished over time, a monitoring program will also be established as part of the Implementation Plan which will address the need for financial and staff resources required to:

- Stay current in the review of monitoring reports and data as required by subwatershed plans and other policies;
- The creation of a shared water quality data base (currently underway in partnership with the GRCA);
- Analyze and complete Phase 4 of the adaptive environmental management (AEM) feedback loop of subwatershed plans, environmental studies and other policies. The four (4) phase AEM approach requires Characterization (Phase 1), Impact Assessment (Phase 2), Implementation (Phase 3) as well as Monitoring and Refinement of the management strategy (Phase 4). The analyzed data from the follow-up monitoring is used to test the assumptions made during earlier study phases to evaluate the performance of the selected management strategies and make necessary adjustments. When all four (4) phases of the AEM process are not completed the process cannot ensure project goals and objectives are being met.