City of Guelph

Stormwater Management Master Plan

Appendix B – Stormwater Management Facilities, OGS and Catchments Report

November 2021

Prepared for:
The City of Guelph

Stormwater Management Master Plan

Appendix B: Stormwater Management Facilities, OGS and Catchments Report

Prepared by:
Aquafor Beech Ltd.

Guelph, Ontario
55 Regal Road
Guelph, ON, N1K 1B6
T. 519-224-3740 ex 236

Reference #: 66636
November 2021
Final Report

Table of Contents

List of Figures

List of Tables

List of Appendices

1 Introduction

Infill development and redevelopment of areas within the City of Guelph's Urban Boundary can have a negative impact on the performance of end-of-pipe storm water management (SWM) facilities. SWM facilities are designed based on the surface area of the catchment, catchment impervious percentage and the required level of water quality and water quantity control. New development and/or redevelopment within an urban catchment can increase the impervious percentage resulting in greater volumes of both runoff and pollutants suspended in the water column. Expanding the area draining to a SWM facility beyond the original catchment delineation can have a similar effect.

This report describes and summarizes the individual elements involved in the sizing of existing SWM facilities within the City of Guelph. The analysis undertaken for this study compares the design basis (level of water quality protection) and catchment characteristics from original design briefs with data gathered using GIS representing existing catchment conditions.

2 Purpose

The purpose of this study is to assess the design and capacity of existing SWM Facilities throughout the City of Guelph and identify facilities that may be under capacity, according to the Ministry of Environment, Conservation and Parks (MECP) water quality design requirements as outlined in the 2003 Stormwater Management Planning and Design Manual (SWMPDM). Results of the assessment completed through this report will be used with other technical memoranda to assess maintenance and retrofit opportunities for SWM facilities and OGS units (associated with Task 2 of the Terms of Reference). A separate report will assess opportunities for new SWM reports.

3 Sources of Information

3.1 SWM Facility and OGS Information

According to the city's GIS database, a total of 123 SWM facilities exist within the City of Guelph. These SWM facilities provide water quality and/or water quantity control. The city provided the information summarized below to accompany many facilities. This information was used to assess the design criteria of each. Information was missing for several facilities such that it was not possible to verify the drainage area, impervious area, or type of treatment provided (water quality, quantity, or both).

The city provided Aquafor with multiple sources of information, including:

- 2014 Stormwater Management Facilities Inventory, Assessment, and Maintenance Needs Study Report;
- GIS layers, including:
    - "Engineering_Data swManagementPond" – This layer, last updated on January 17, 2020, contains records for 123 stormwater facilities, identifying them as wet ponds, dry ponds or greenways.

  - "Engineering_Data swOilandGritSeparator" – This layer, last updated on January 17, 2020, contains records for 192 OGS units, 141 of which are owned by the City of Guelph, 9 are unassumed, and 42 are privately owned. Since January 2020, the 9 unassumed units have been assumed by the City, for a total of 150 owned by the City. The OGS model is identified for 180 units, while the diameter is provided for 138 units.
  - "Engineering_Data swCatchment" – This layer, last updated on January 17, 2020, contains catchment areas for some of the SWM facilities within the city. While 58 catchments are associated with a facility, some facilities have multiple catchments. The remaining 63 catchments in the layer are not associated with a SWM facility.
  - "Guelph_SWM_Catchments" – This layer, last updated on August 20, 2013, was provided as part of the 2008 TSH Stormwater Management Facility Inventory, Assessment and Maintenance Needs Plan. It contains catchment area of SWM Facilities 1-99.
  - Aquafor developed a new layer representing the total impervious areas within the City. Two existing City layers were combined, and an additional analysis of ortho-imagery was completed to add road and sidewalk areas to the two layers listed below:
    - "Guelph_Impervious_Surfaces" – This layer, last updated on May 15, 2020, includes driveways, parking lots, and outbuildings within the City.
    - "IT_Data Buildings" – This layer, last updated on October 28, 2019, includes building rooftops throughout the City.
- City of Guelph Stormwater Management Pond Database – This database was developed as part of the 2008 TSH Stormwater Management Facility Inventory, Assessment and Maintenance Needs Plan, and contains some design details for SWM Facilities 1-99.
- Guelph_SWM_Facility_Inventory_2020 – Spreadsheet summarizing some facility characteristics for SWM Facilities 1-123.
- Stormwater Management Reports and Drawings – Hard copy and electronic reports and drawings as identified through the city's KISS system.
- Other SWM Drawings, Reports, ECAs, and Correspondence – Provided electronic file folders for Facilities 1-123 and hard copy files not included in KISS.
- OGS Master 2020 Spreadsheet – Spreadsheet summarizing OGS characteristics and sediment depths from 2001-2020.

Available information for each facility is summarized in **Appendix A.**

3.2 Redevelopment Information and Relevance

Most Water Quality SWM facilities in the City of Guelph have been designed to one of three (3) levels of water quality protection per the 2003 SWMPDM. Although modern water quality standards prohibit the design of facilities to Level-3 or "Basic" treatment corresponding with a 60 percent long-term average total suspended solids (TSS) reduction, this memo considers Level-3 as the original design criteria as applicable. These levels aim to maintain or enhance

existing aquatic habitat, based on the suspended solids removal performance for the different end-of-pipe stormwater management facilities developed in the continuous simulation modelling. Descriptions of the habitat characteristics corresponding to the three levels of protection from the 2003 SWMPDM are given below.

Level 1: Enhanced Protection – This level (80 percent TSS reduction) or greater should be used when sensitive aquatic habitat will be impacted by end-of-pipe discharge. Generally, this will include receiving waters that have aquatic communities that have adapted to a low suspended solids environment. Conditions where a minimum of enhanced protection should be used include:

- Areas with high permeability soils (i.e., Soil Conservation Service (SCS) hydrologic classes A and B) conducive to infiltration resulting in low suspended solids loadings from the pre development site;
- Habitat sensitive to sediment and siltation (such as gravel bottom used for bass or brook trout spawning);
- High baseflow discharge areas (such as groundwater upwellings important to brook trout);
- Low upstream sediment loads resulting in clear surface water important to maintaining habitat for sight feeding fish species (such as bass, northern pike, lake trout, and brook trout); and
- Low pre development erosion characteristics (such as dense vegetation, or erosion resistant soils).

Level 2: Normal Protection - Normal protection (70 percent TSS reduction) can be considered when conditions for enhanced protection do not exist. Example habitats where normal protection may be appropriate include:

- Areas with moderate, natural upstream sediment loads (such as some walleye feeding habitat)
- Spawning habitat less sensitive to suspended solids loadings (such as aquatic and emergent plant beds used by pike and perch).

Level 3: Basic Protection - Basic protection (60 percent TSS reduction) would only be acceptable where the receiving aquatic habitat is demonstrated to be insensitive to stormwater impacts and has little potential for immediate or long-term rehabilitation. Generally, basic protection may be applied in the following conditions:

- Areas where downstream aquatic habitat has adapted to high suspended solid loadings prior to anthropomorphic changes to the watershed (for example, aquatic habitat conditions that may be found naturally in areas of fine-grained soils)
- Downstream watercourses have been significantly altered (by urbanization or agricultural practices), hardened, or polluted, and there is little short or long-term potential for rehabilitation.

4 SWM Facility Analysis

The catchments of some greenway facilities were grouped together since the applicable SWM report didn't distinguish separate catchments for each facility. These included: 44-48; 58-59; 62-63; 64-65 and 68; 69-71; and 89-90. Storm Water Management Facilities (SWMF) 51 and 52 were excluded from the analysis as they are private facilities. SWMF 16 was also excluded as subsequent retrofits merged it into SWMF 113. With the revisions to the City's SWMF database discussed in **Section 4.1**, a total of 107 catchments were used in the analyses in **Sections 4.3** to **4.6. Appendix A** presents the summary information used in the analysis, while **Appendix B** presents the rankings generated in **Sections 4.3** to **4.6.**

4.1 Proposed Revisions to City's SWMF Database

4.1.1 SWMF 118 and 119

Since their construction and inclusion in the City's SWMF database, SWMF 118 and 119 have been modified to become one SWM facility. The former SWMF 119 does not infiltrate, but is still connected to SWMF 118 which does provide infiltration. SWMF 118/119 has therefore been re-classified as a Wet Facility with Infiltration.

4.1.2 Previously Uncounted SWM Facilities

Three additional SWM facilities were added to the City's database, as these facilities had previously been constructed but not tracked by the City. These facilities were given new ID numbers as follows:

SWMF 127: This is an on-line dry pond on Hadati Creek, just north of the railway tracks. Documentation on this facility can be found in the following locations:

- Stormwater Management Design Report, Draft Plan 23T-96501 and 23T-99501 Martini/Valeriote Subdivision. Gamsby and Mannerow Limited, March 19, 2004.
- Box Culvert Extension under CN Tracks: Design Size Review WRT: Final Stormwater Management Design Report, Southern Hadati Creek Watershed. Schaeffers Consulting Engineers, May 17, 1997.
- Certificate of Approvals 3-0628-97-006 and 2973-5Q5RP8

SWMF 128: This is an on-line dry pond on Hadati Creek, located in an existing wetland just north of Starwood Drive. Documentation on this facility can be found in the following locations:

- Guelph Grangehill Developments Subdivision Stormwater Management Report. Cosburn Patterson Wardman Limited, August 1992.
- Certificate of Approval 3-0514-95-006

SWMF 129: This is an on-line dry pond on Hanlon Creek Tributary B, on the north side of Kortright Road. Documentation on this facility can be found in the following locations:

- February 16, 1984 letter and memo from Cumming-Cockburn & Associates to City of Guelph and GRCA (File No: 16.152.108)
- Drawing G-83 – Sediment & Recharge Pond No. 2 (Kortright Road)
- Drawing 84-03 – Construction Details, University Village Subdivision Phase II

Stormwater facilities 124, 125 and 126 are currently under design or construction and were therefore not included in the analysis.

4.2 Facility Classification

While the city's GIS layers, spreadsheets and database identified three types of SWM facilities (wet pond, dry pond, and greenway), the SWM reports identified two additional types, including infiltration facility and wetland. There were also several facilities that combined a wet or dry pond with an infiltration facility. A total of 36 facilities were re-classified based on the information available within the available design reports, design drawings, and as-built drawings (**Table 4.1**). **Figure 4.1** presents the revised facility classifications in the context of all City facilities.

Table 4.1: Re-Classified SWM Facilities (36 of 123)

SWM Facility	Existing City Classification	2021 Revised Classification per Original Facility Design
1	Dry*	Wetland
2	Dry	Infiltration
3	Dry	Infiltration
4	Wet	Infiltration
5	Dry	On-line Infiltration
6	Dry	On-line Infiltration
7	Dry	Infiltration
8	Dry	Wet
10	Dry	Infiltration
11	Dry	Infiltration
12	Dry	On-line Pond
13	Dry	Infiltration
14	Dry	Infiltration
16	Dry	Wet (merged with 113)
17	Dry	Dry with Infiltration
19	Dry	Wet
20	Dry	Infiltration
22	Dry	Infiltration
24	Dry	Wet
25	Dry	Infiltration
26	Dry	Infiltration
53	Wet	Wetland
73	Wet	Wet with Infiltration Basin

SWM Facility	Existing City Classification	2021 Revised Classification per Original Facility Design
74	Dry	Wet with Infiltration Basin
75	Dry	Wet with Infiltration Basin
76	Dry	Wet
79	Wet	Dry
81	Wet	Dry
98	Dry	Infiltration
100	Wet	Wetland
101	Wet	Wetland
104	Dry	Infiltration
105	Dry	Wet
107	Wet	Wet with Infiltration Basin
108	Wet	Wet with Infiltration Basin
109	Wet	Wet with Infiltration Basin
112	Wet	Hybrid
113	Wet	Hybrid
114	Wet	Hybrid
116	Dry	Infiltration
118/119	Wet	Wet with Infiltration Basin
120	Wet	Infiltration
121	Wet	Infiltration
123	Wet	Dry
127	NA	On-line Pond
128	NA	On-line Pond
129	NA	On-line Pond

* Note: The City's GIS database identified this pond as a dry facility. The design to retrofit SWMF #1 as a wetland was completed in 2017 and the pond was subsequently retrofitted.

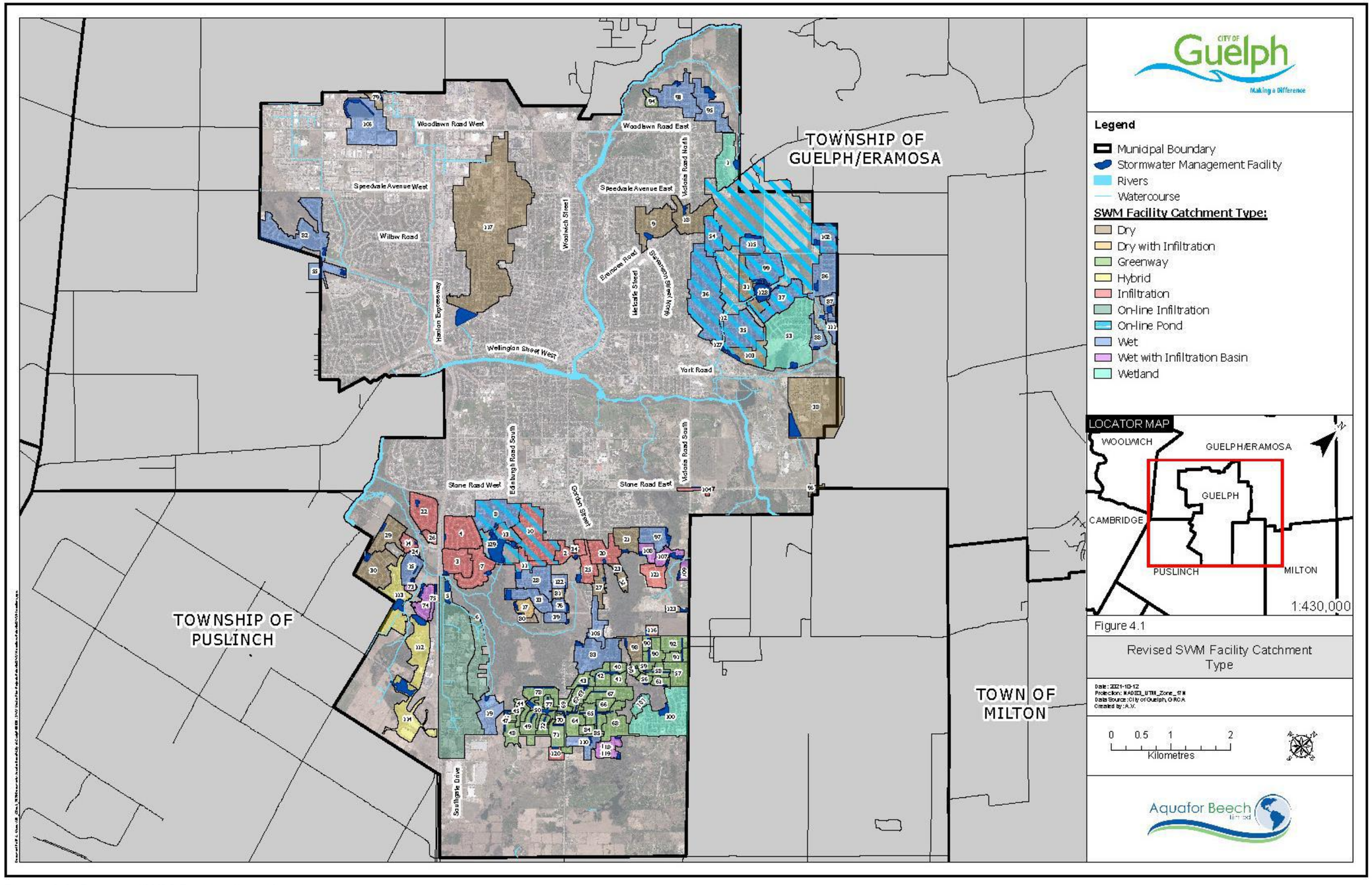

Figure 4.1: Revised SWM Facility Classification

4.3 Catchment Area

Catchment areas for each SWMF were delineated based on the storm sewer network, ground surface elevations, and parcel boundaries. To ensure GIS data was not skewed by catchments that were not fully built out, a visual analysis of aerial photography (2020) and the City of Guelph's parcel fabric was conducted. Through the visual analysis, eight (8) SWM facility catchments were identified as being not fully built out. The SWM facilities that were identified as being not fully built out were excluded from the following analysis. SWM facilities with parcels not fully developed were 1, 95, 112, 113, 114, 120, 121 and 123 (**Figure 4.2**).

The newly delineated catchment areas were compared with the catchment area identified within the applicable SWM report. Of the seventy-eight (78) SWM facilities, or groups of SWM facilities, for which both design and existing catchment areas were available, comparative analysis indicated 21 of the SWM facilities had a smaller catchment area than were indicated in the design briefs while 22 remained approximately the same, and 35 had a larger catchment area than were indicated in the design briefs. **Table 4.2** summarizes the results of the catchment area analysis.

Table 4.2: Catchment Area Comparison

Number of SWM facility catchments analysed*	78
Number of SWM facility catchments with a decrease in area (>5% decrease)	21
Number of SWM facility catchments with no change in area (change < ±5%)	22
Number of SWM facility catchments with an increase in area	35
5% - 10% increase (small increase)	9
11% - 20% increase (moderate increase)	11
21% - 50% increase (large increase)	9
>50% increase (extreme increase)	6
Percentage of SWM facilities analysed that were designed for a smaller catchment area	**44.9%**

*Does not include SWM facilities 1, 95, 112, 113, 114, 120, 121 and 123 which are not fully built out

The catchments of the 15 facilities with large or extreme increases in catchment area (>20%) were examined to determine what caused the significant increase (**Table 4.3** and **Figure 4.3**). For some of the older catchment areas, the increase was sometimes attributable to the construction of subsequent phases of development. **Table 4.3** also presents the results of the 2014 sediment survey, indicating the percent capacity remaining in the pond due to sediment accumulation. Low percent capacity remaining could indicate issues within the catchment or that the facility was overdue for clean-out.

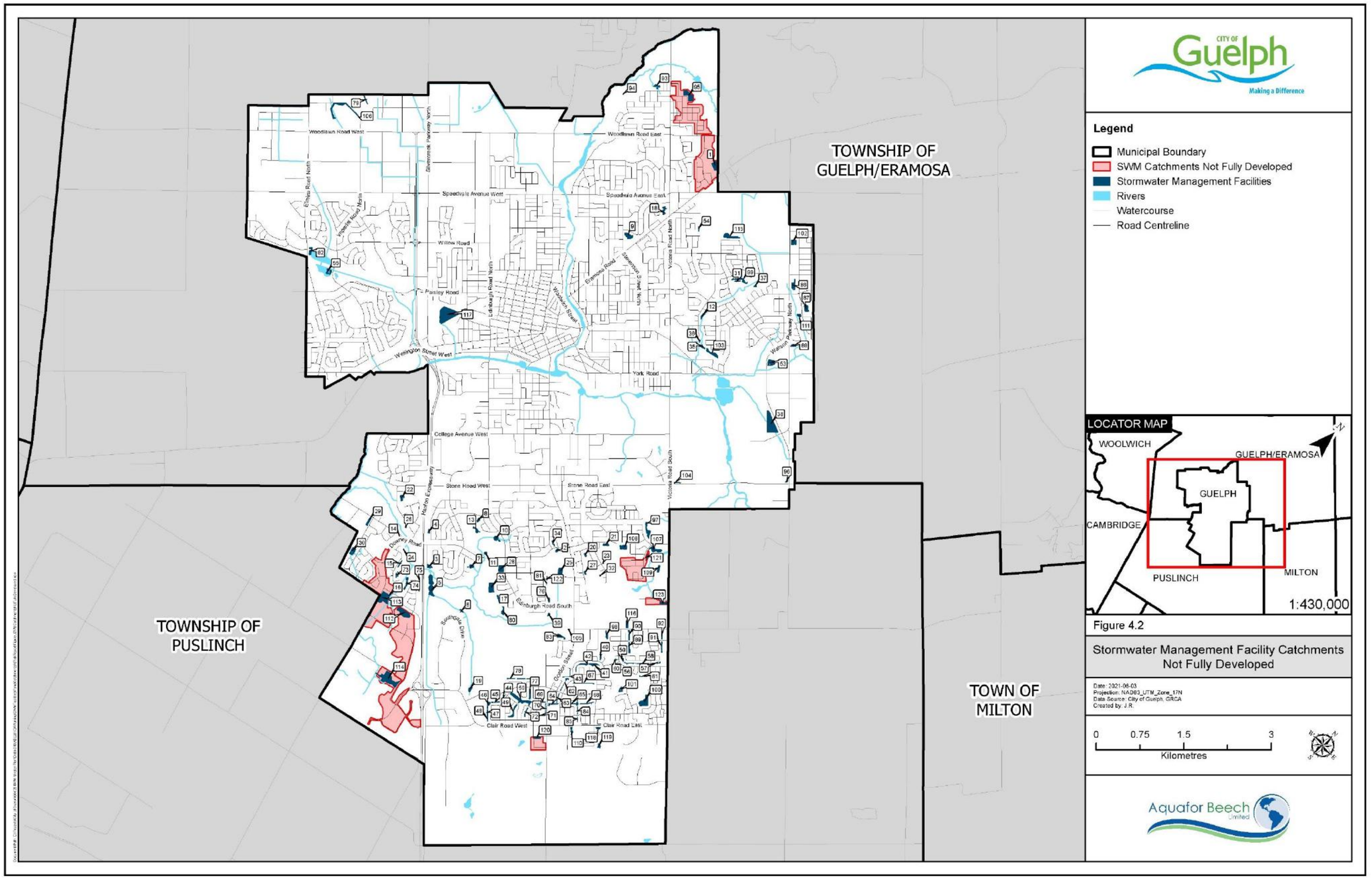

Figure 4.2: SWM Catchments Not Fully Developed

Table 4.3: SWMF Catchment Area – Large or Extreme Increases

SWM Facility	SWM Report Catchment Area (ha)	2021 GIS Catchment Area (ha)	Percent Increase	Comments	2014 Percent Capacity Remaining
15	4.13	14.13	242.1	Discrepancy with SWM report likely due to subsequent phases of development draining to SWMF.	96
20	8.01	19.61	144.9	Discrepancy with SWM report likely due to subsequent phases of development draining to SWMF.	96
27	8.14	10.74	32.0	Drainage from Gatto Subdivision likely added to SWMF at a later date.	-
36	8	36.41	355.1	-	75
43	5.77	7.45	29.16	-	-
44-48	14.729	24.38	65.5	SWM Report doesn't provide separate drainage areas for SWMF 44-48.	-
56	2.48	3.48	40.4	-	-
58	8.13	11.98	47.4	Appears SWM Report drainage areas should be 8.13ha combined for both facilities. Parts of storm sewer network date later than pond installation.	-
59	8.13				-
66	5.01	6.05	20.81	Delineation of boundary between SWMF 66 and 67 may differ from design assumptions.	-
69-72	20.16	31.01	53.8	New developments appear to drain to SWMF 69-72.	100
77	3.11	4.75	52.6	-	-
83	27.85	34.79	24.93	Per “Gordon Street Stormwater Outlet Addendum” (Gamsby	91

SWM Facility	SWM Report Catchment Area (ha)	2021 GIS Catchment Area (ha)	Percent Increase	Comments	2014 Percent Capacity Remaining
				and Mannerow, 2003) a channel was constructed to convey uncontrolled discharge from Gordon Street to the facility.	
87	5.43	8.35	53.8	New road and development appear to drain to facility.	72
111	3.77	6.10	46.7	-	75

Where data are available, catchments have been classified into one of five (5) levels of catchment area increase from “no increase” through “extreme increase” (**Table 4.4**). **Figure 4.4** identifies the SWM facilities and the catchment risk scores.

Table 4.4: Catchment Area Risk Scores

Category	Range of Catchment Area % Change	Score
Extreme Increase	Change ≥ 50%	5
Large Increase	20% ≤ Change < 50%	4
Moderate Increase	10% ≤ Change < 20%	3
Small Increase	5% ≤ Change < 10%	2
Minimal / No Increase	Change < 5%	1

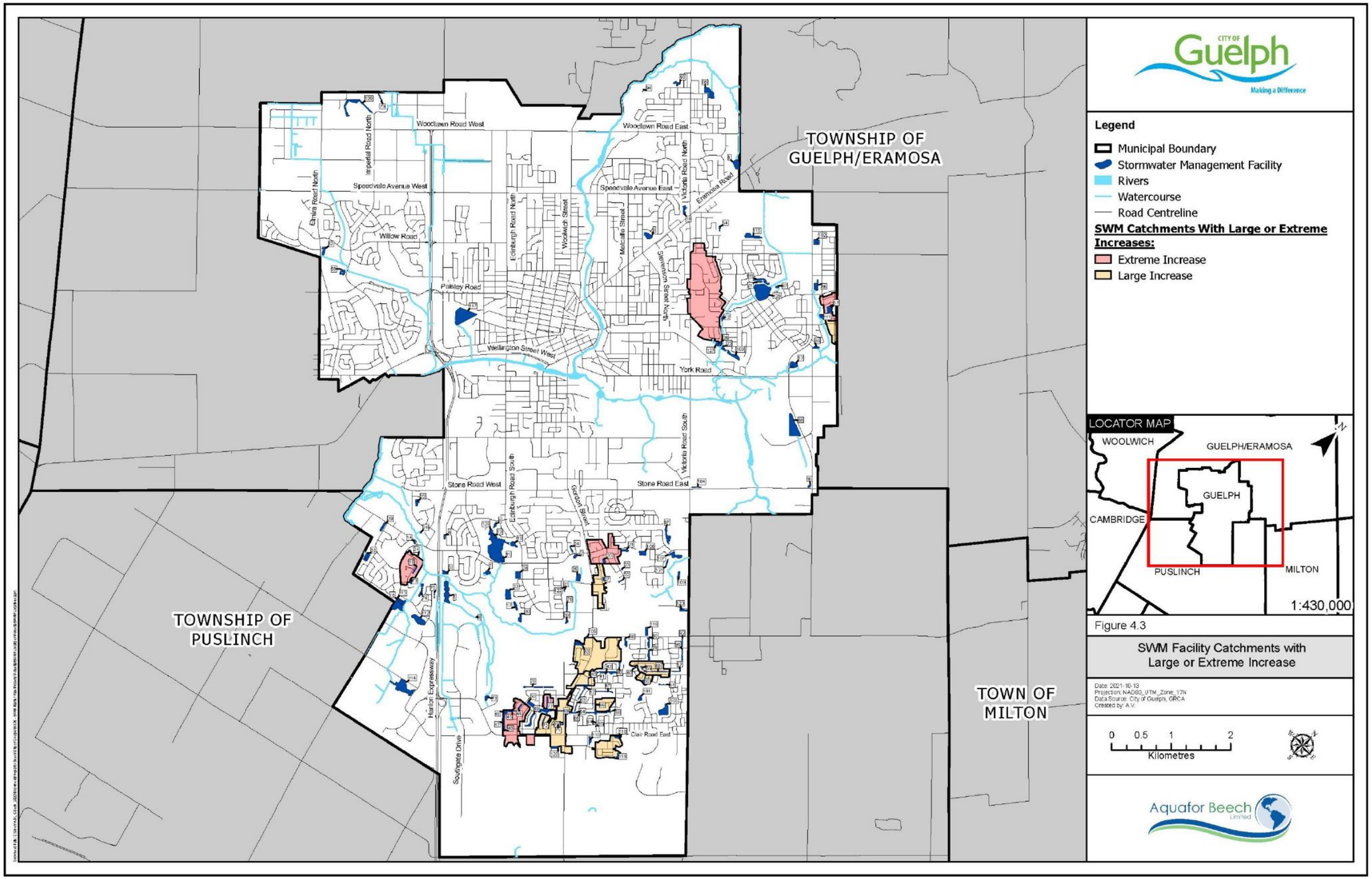

Figure 4.3: Comparison of Existing and Revised SWM Catchments with Large or Extreme Increases

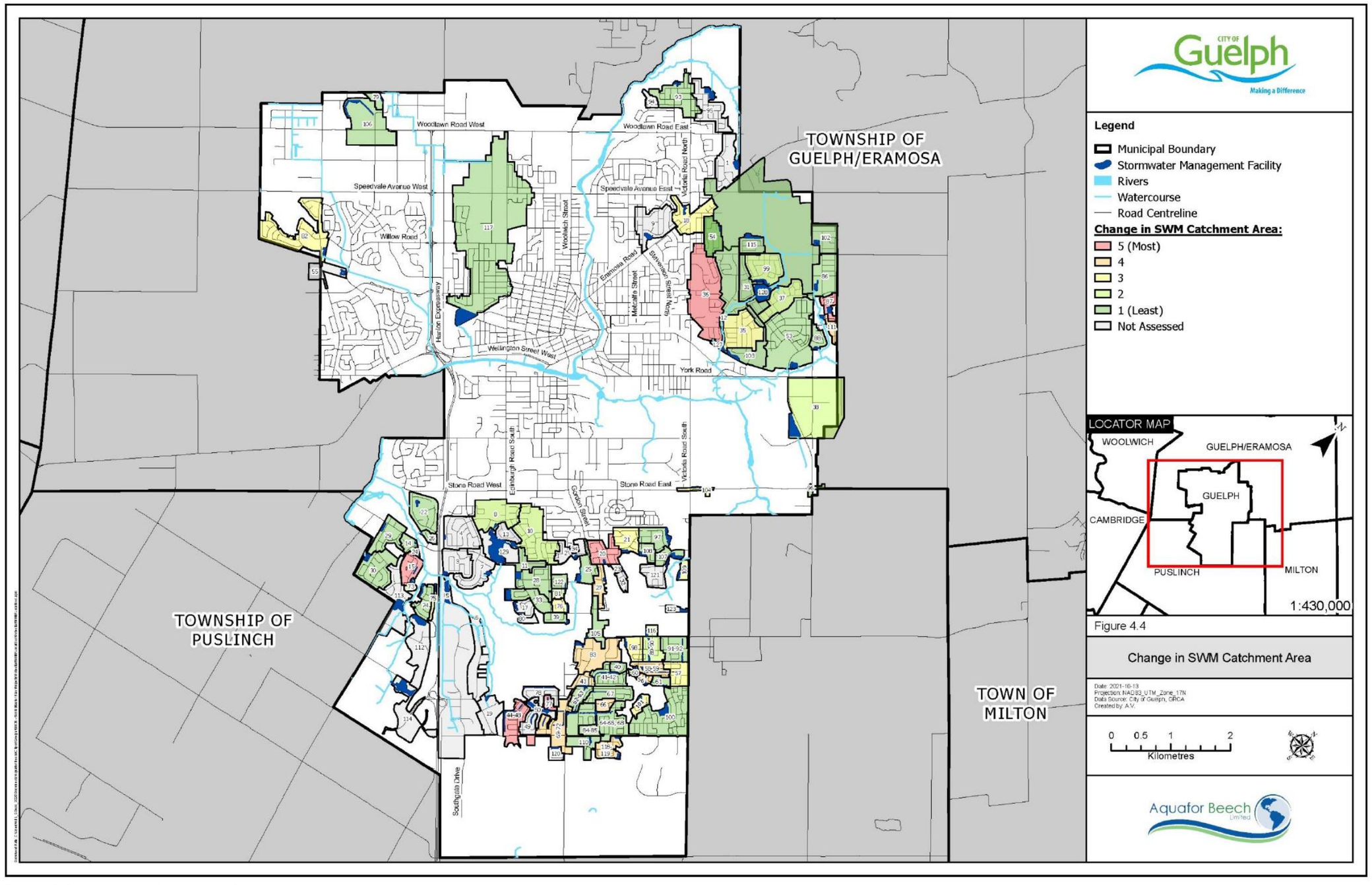

Figure 4.4: Change in Catchment Area

4.4 Impervious Percentage

Where design information was available via design briefs, the as-designed impervious percentage was compared to the impervious percentage based on a GIS analysis of existing conditions.

Upon review of the design reports, design impervious percent could not be obtained for 47 of the SWM facilities. This was due to either missing design or design reports that stated a runoff curve number (CN) but did not specify the design impervious percentage. The SWM facilities for which design impervious percentage could not be obtained were excluded from the following analysis.

To ensure GIS data was not skewed by catchments that were not fully built out, a visual analysis of aerial photography (2020) and the City of Guelph's parcel fabric was conducted. Through the visual analysis, eight (8) SWM facility catchments were identified as being not fully built out. The percent imperviousness of these catchments was found to be 20 percent to 80 percent less than the design imperviousness, and were therefore excluded from the analysis. This included facilities 1, 95, 112, 113 and 114, 120, 121 and 123.

Of the 56 SWM facilities for which both design and existing impervious percentages were available, comparative analysis indicated that 39 of the SWM facilities had a smaller impervious percentage than were indicated in the design briefs and 17 had larger impervious percentages than were indicated in the design briefs. **Table 4.5** summarizes the results of the impervious percentage analysis.

Table 4.5: Impervious Percentage Comparison

Number of SWM facility analysed *	56
Number of SWM facility catchments with a decrease in impervious %	39
Number of SWM facility catchments with an increase in impervious %	17
1% - 5% increase (small increase)	2
5% - 10% increase (moderate increase)	3
10% - 20% increase (large increase)	2
>20% increase (extreme increase)	10
Percentage of SWM facilities analysed that were designed for a smaller impervious percentage	**27%**

*Does not include SWM facility catchments that are not fully built out (1, 95, 112, 113 and 114, 120, 121 and 123)

Many of the largest percent increases are due to the very low design percent impervious. For example, 15 of the 17 catchments with an increase had a design percent impervious below 50%, which is the lowest percent impervious permitted in the City's current Development Engineering Manual, with the exception of park areas.

The catchments of the 12 facilities with large or extreme increases in impervious percentage (>10%) are listed in **Table 4.6**, which also presents the percent capacity remaining in each

facility in 2014 due to sediment accumulation. Low percent capacity remaining could indicate issues within the catchment or that the facility was overdue for clean-out.

Table 4.6: SWMF Impervious Percent Discrepancies

SWM Facility	SWM Report Percent Impervious	2021 GIS Percent Impervious	Percent Increase	2014 Percent Capacity Remaining
84	35	62	77.0	*
85	35	62	77.0	*
64-65,68	35	54	53.2	*
66	35	49	38.6	*
62-63	35	48	36.8	*
26	39	52	32.9	*
25	41	52	27.7	92
55	56	71	27.3	83
54	30	36	21.1	80
29	35	42	20.4	70
110	48	56	16.9	91
74	45	50	10.8	*

* indicates the facility was not surveyed in 2014

Where data are available, catchments have been classified into one of five (5) levels of impervious increase from “no increase” through “extreme increase” (**Table 4.7**). **Figure 4.5** identifies the SWM facilities and impervious percentage risk scores.

Table 4.7: Impervious Percentage Risk Scores

Category	Range of Impervious % Change	Score
Extreme Increase	Change ≥ 20%	5
Large Increase	10% ≤ Change < 20%	4
Moderate Increase	5% ≤ Change < 10%	3
Small Increase	0% < Change < 5%	2
No Increase	Change ≤ 0	1

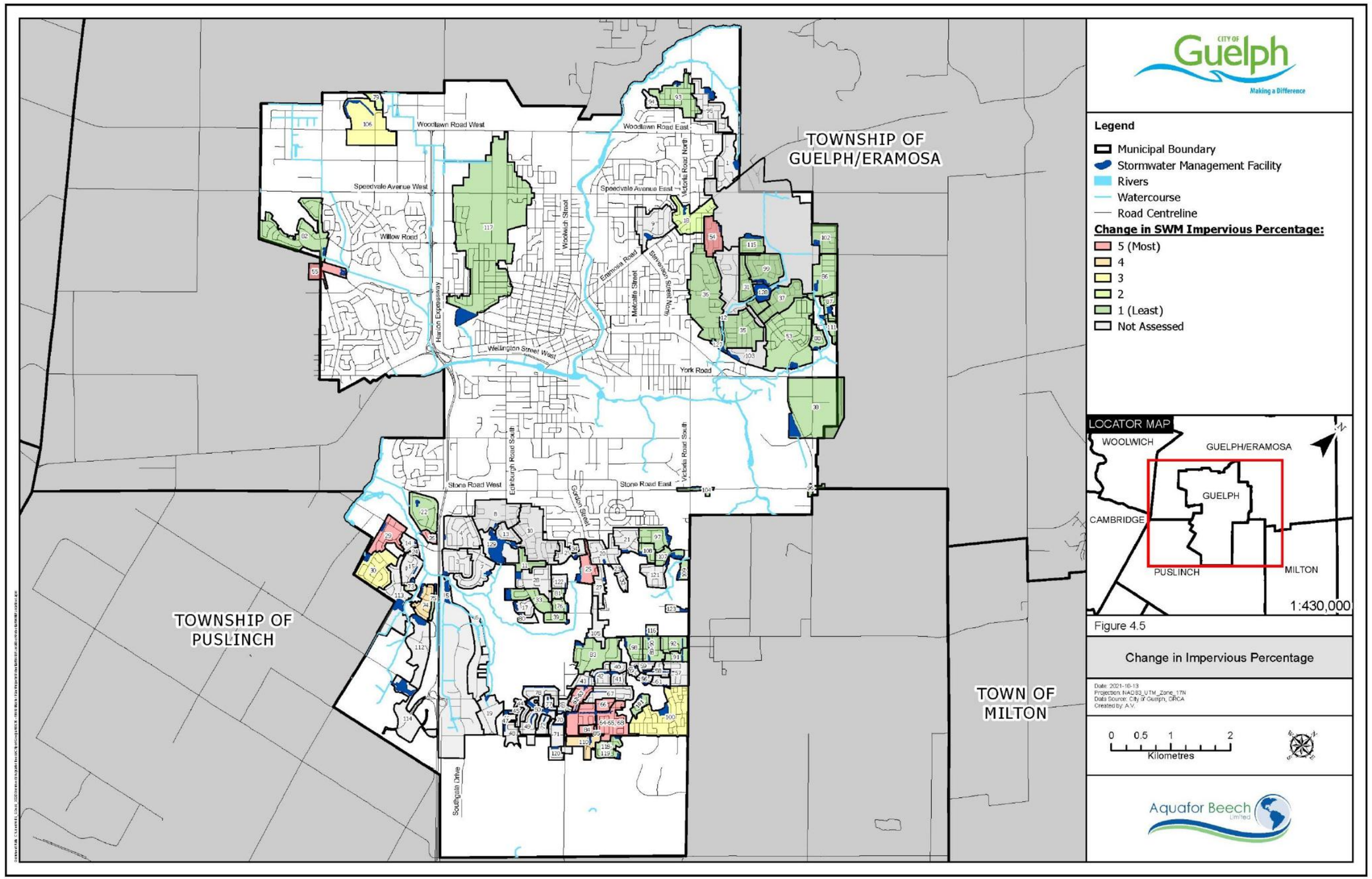

Figure 4.5: Change in Impervious Percentage

4.5 Combined Catchment Risk

Using the catchment area and impervious percentage analysis presented in **Section 4.3** and **4.4**, data were analysed to determine which facilities are most at risk due to the combined effects of impervious percentage increases and catchment area increases. In order to complete this analysis, values were assigned to impervious percentage increase classifications and catchment area increase classifications. **Table 4.4** and **Table 4.7** identify how values were assigned to catchments in order to define combined risk levels.

For all SWM catchments where data was available, impervious percentage risk scores were multiplied with catchment area risk scores. The resulting scores were classified as "combined risk scores". SWM facility catchments with combined scores from one (1) through four (4) were identified as being at low risk. SWM facility catchments with combined scores from five (5) through nine (9) were identified as being at medium risk. SWM facility catchments with combined scores greater than nine (9) were identified as being at high risk. **Table 4.8** summarizes the combined risk score analysis.

Table 4.8: Combined Risk Scores

Number of SWM facilities analysed	53
Number of "low risk" SWM Catchments	43
Number of "medium risk" SWM Catchments	9
Number of "high risk" SWM Catchments	1

Figure 4.6 identifies catchments with low, medium and high combined risk scores. Based on this risk classification, **Table 4.9** identifies SWM facilities are at a high risk of failure to meet design objectives. Sediment survey results from 2014 are also presented, if available. Only five of the facilities at medium or high risk were surveyed in 2014, but three of these facilities were within the 20 facilities with the least percent capacity remaining.

Table 4.9: Facilities at Medium or High Risk of Failure to Meet Design Objectives

SWM Facility	Combined Risk Score	2014 Percent Capacity Remaining
66	20	*
18	6	*
25	5	92
26	5	*
29	5	70
36	5	75
54	5	80
87	5	72
62-63	5	*
64-65,68	5	*

* indicates the facility was not surveyed in 2014

However, only half the facilities had both the design catchment size and impervious percentage, so this ranking should be considered alongside the rankings described in **Sections 4.3** and **4.4** which only considered catchment area or impervious percentage. These rankings have been presented in **Figure 4.7**. Future analyses should also be conducted into the functionality of the remaining facilities, particularly those which were constructed in the 1970s through the 1990s.

Aquafor previously completed a Stormwater Management Facility Maintenance Inspection Summary of 41 SWM facilities. Of the facilities at high risk identified above, only SWMF 18, 25, 26, and 29 were inspected. SWMF 18 was found to be low priority (in good condition), SWMF 25 was high priority (poor condition), and SWMF 26 and 29 were moderate priority (fair condition).

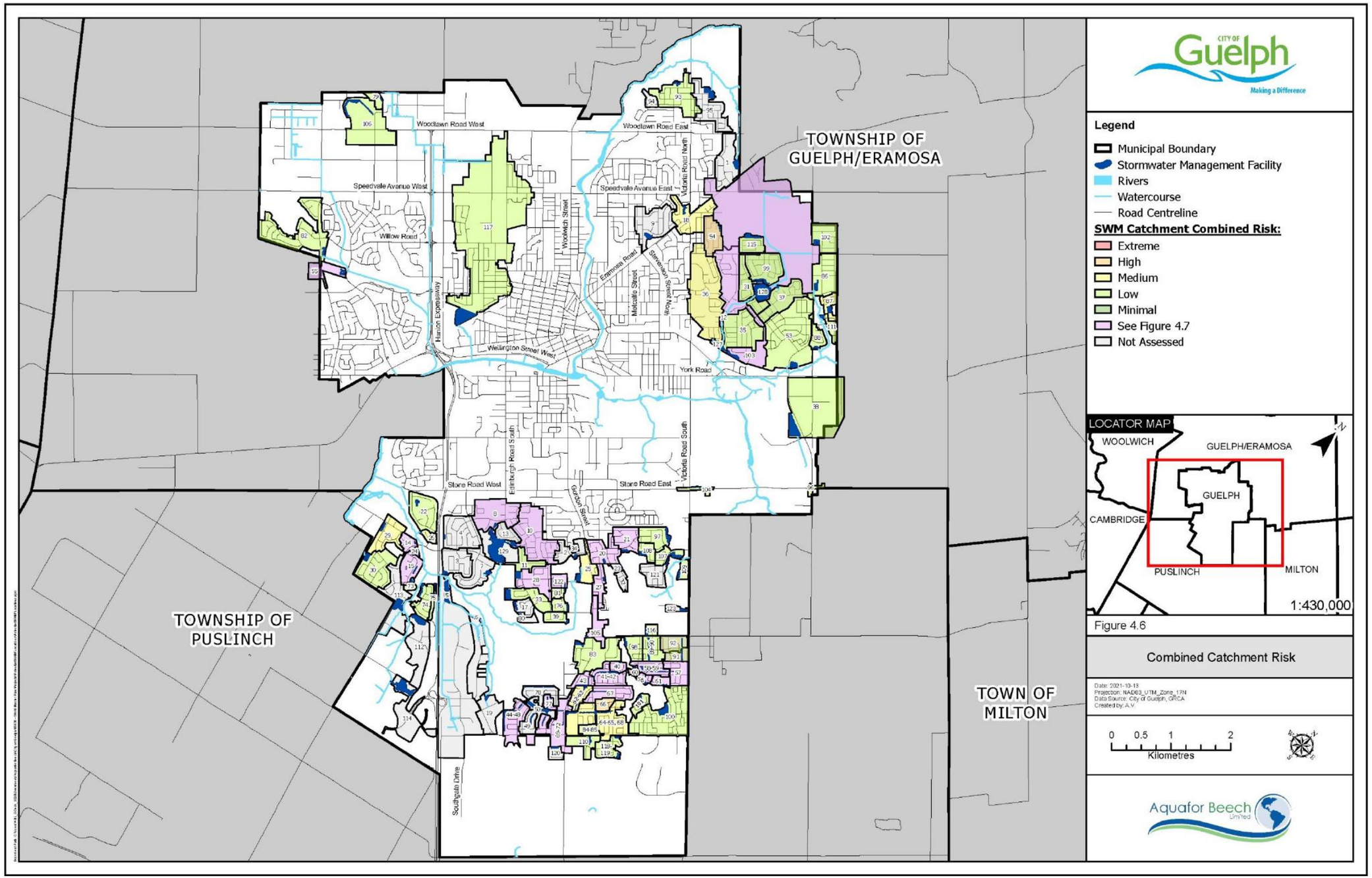

Figure 4.6: Combined Catchment Risk

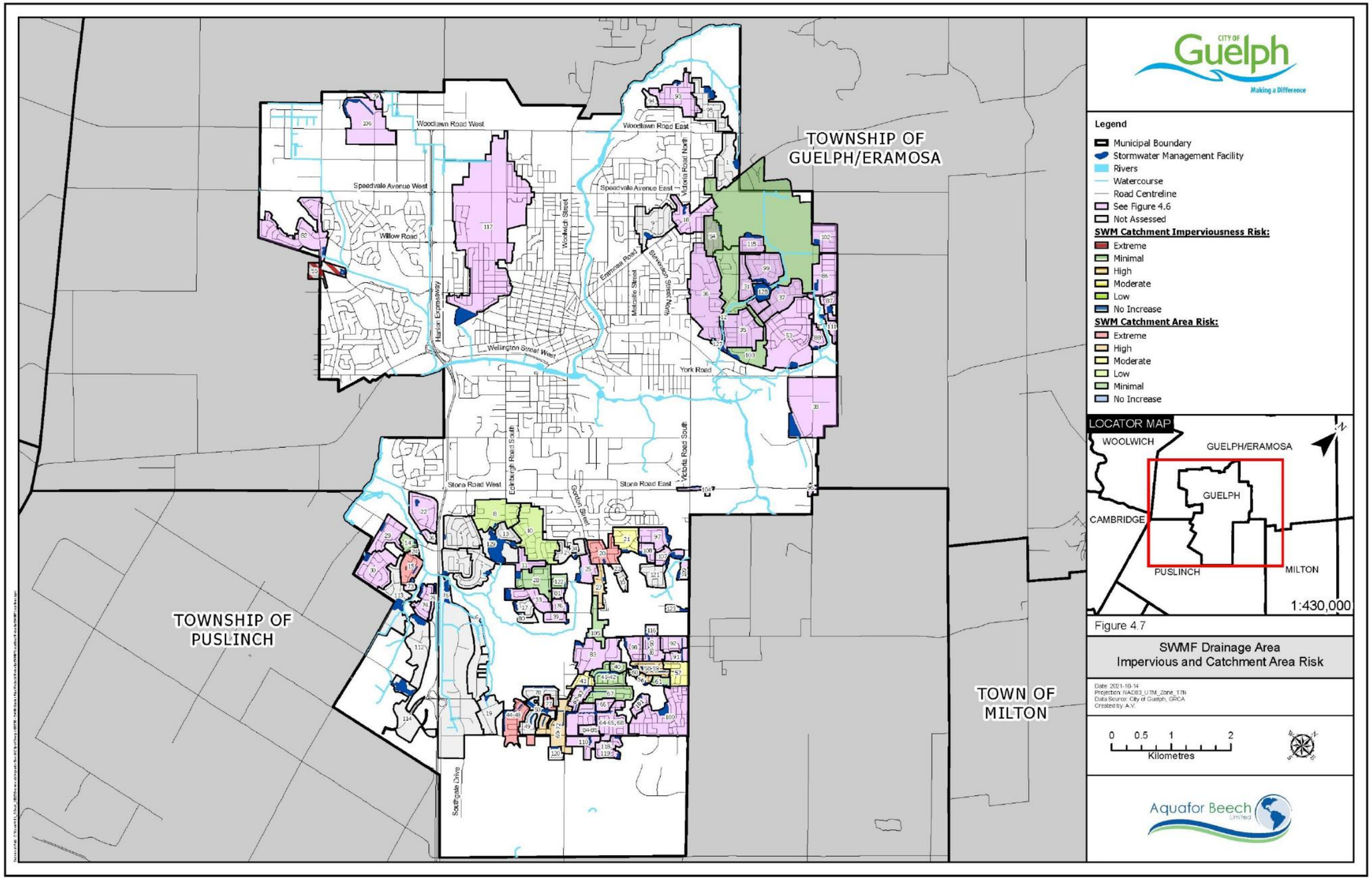

Figure 4.7: SWMF Drainage Area Impervious and Catchment Area Risk

4.6 MECP Water Quality Sizing Criteria

The volumetric water quality criteria are presented in **Table 4.10**. The values are based on a 24-hour drawdown time and a design which conforms to the guidance provided in this manual. Requirements differ with SWMF type to reflect differences in removal efficiencies. Of the specified storage volume for wet facilities, 40 m^3/ha is extended detention, while the remainder represents the permanent pool.

As the City's Development Engineering Manual requires facilities to be constructed to Level-1 or Enhanced treatment, corresponding to an 80 percent long-term average TSS reduction, all facilities were compared to this standard.

Table 4.10: Water Quality Storage Requirements Based on Receiving Waters

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level*			
		35%	55%	70%	85%
Enhanced 80% long-term S.S. removal	Infiltration	25	30	35	40
	Wetlands	80	105	120	140
	Hybrid Wet Pond/Wetland	110	150	175	195
	Wet Pond	140	190	225	250
Normal 70% long-term S.S. removal	Infiltration	20	20	25	30
	Wetlands	60	70	80	90
	Hybrid Wet Pond/Wetland	75	90	105	120
	Wet Pond	90	110	130	150
Basic† 60% long-term S.S. removal	Infiltration	20	20	20	20
	Wetlands	60	60	60	60
	Hybrid Wet Pond/Wetland	60	70	75	80
	Wet Pond	60	75	85	95
	Dry Pond (Continuous Flow)	90	150	200	240

* 40 m^3/ha is extended detention, while the remainder represents the permanent pool
† Modern water quality standards prohibit the design of facilities to "Basic" treatment

Within a wet 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 the 2003 SWMPDM and is based on a prescribed level of water quality control, the surface area of the catchment and catchment impervious percentage. To determine the potential impact of changes to the impervious percentage and catchment area draining to each SWM facility an analysis was completed to determine the required permanent pool and extended detention volumes for each facility based on catchment parameters

extracted from GIS analysis. **Table 4.11** summarizes the permanent pool impact analysis, while **Table 4.12** summarizes the extended detention results. Only 27 wet ponds, wetlands, or wet ponds with infiltration basins were included in the analysis, as the remaining 17 facilities lacked design information or their catchments were not fully built out.

Table 4.11: Summary of Permanent Pool Impacts

Number of SWM facilities with design permanent pool volume available*	27
Number of facilities achieving Enhanced permanent pool volume	17
Number of facilities achieving Normal permanent pool volume	4
Number of facilities achieving Basic permanent pool volume	5
Number of facilities with less than Basic permanent pool volume	1
Percentage of SWM facilities analysed that don't achieve Enhanced volume target	**37%**

*Does not include SWM facilities 1, 95, 112, 113, 114, 120, 121 and 123 which have catchments not fully built out.

Table 4.12: Summary of Extended Detention Impacts

Number of SWM facilities with design extended detention volume available*	27
Number of facilities with sufficient or excess extended detention volume	20
Number of facilities with insufficient extended detention volume	7
Percentage of SWM facilities analysed with insufficient permanent pool volume	**26%**

*Does not include SWM facilities 1, 95, 112, 113, 114, 120, 121 and 123 which have catchments not fully built out.

Figure 4.8 identifies analyzed facilities that have insufficient permanent pool volume for their specified water quality target, while **Figure 4.9** identifies those with insufficient extended detention volume. **Table 4.13** summarizes SWM facilities that have insufficient permanent pool volume based on water quality targets and catchment characteristics, while **Table 4.14** summarizes those with insufficient extended detention volume.

Note that the City's Development Engineering Manual currently requires extended detention of the 4 hour, 25mm Chicago distribution rainfall event for 24 hours, which will be assessed using the City's PCSWMM model.

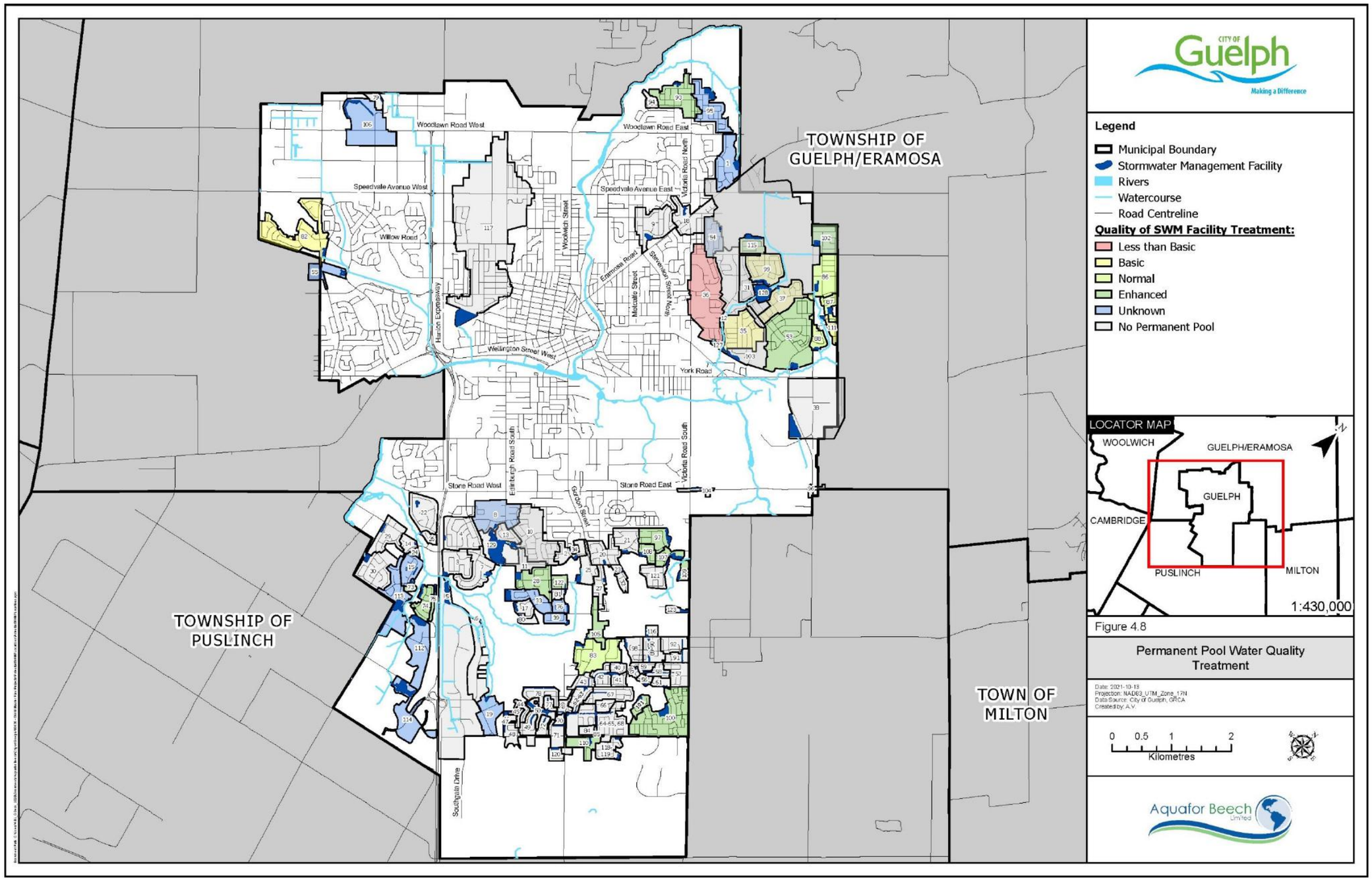

Figure 4.8: Insufficient Permanent Pool Volume

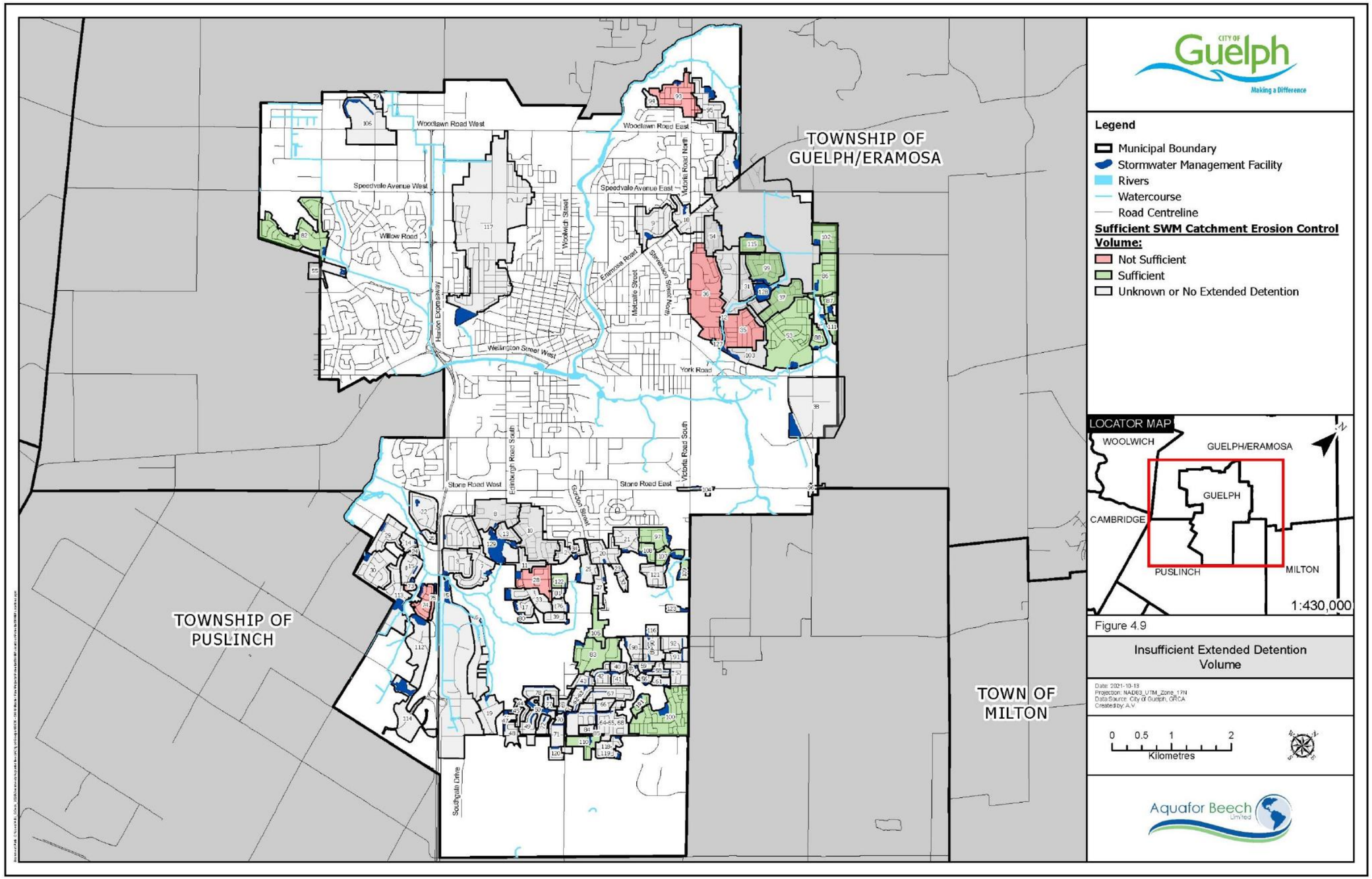

Figure 4.9: Insufficient Extended Detention Volume

Table 4.13: Summary of SWM Facilities with Insufficient Permanent Pool Volume to Achieve Enhanced Water Quality Treatment

SWM Facility #	Year Constructed	Design Permanent Pool Volume (m^3)	Required Permanent Pool Volume per GIS Catchment Characteristics (m^3)	Level of Protection	Facility Type	Additional Volume Required (m^3)
35	1997	1034	4018	Basic	Wet	2984
36	1997	359	4478	Less than Basic	Wet	4119
37	1997	1250	3276	Basic	Wet	2026
82	2001	2400	6103	Basic	Wet	3703
83	2003	2150	3313	Normal	Wet	1163
86	2003	2941	3467	Normal	Wet	526
87	2003	829	1007	Normal	Wet	178
88	2006	745	1155	Normal	Wet	410
99	2005	1572	3649	Basic	Wet	2077
111	2011	326	789	Basic	Wet	463

Table 4.14: Summary of SWM Facilities with Insufficient Extended Detention Volume to meet Design Level of Protection

SWM Facility #	Year Constructed	Facility Type	Design Extended Detention (m^3)	Required Extended Detention (m^3)	Additional Volume Required (m^3)
28	1991	Wet	776.5	936.6	160
35	1997	Wet	1270	1401.0	131
36	1997	Wet	340	1456.5	1116
73	2000	Wet with Infiltration Basin	105.6	111.7	6
74	2001	Wet with Infiltration Basin	531.2	551.6	20
75	2001	Wet with Infiltration Basin	122.8	141.0	18
93	2003	Wet	1264	1310.1	46

4.7 Water Quantity Impacts

Changes to SWM facility catchment areas also have the potential to impact how SWM facilities function during flood events. Most SWM facilities including dry ponds (designed without a permanent pool for water quality) are designed to temporarily detain runoff during flood events and release without exacerbating flooding and erosion on downstream lands. Increases in impervious surfaces and/or catchment areas draining to SWM facilities can overwhelm these facilities with larger volumes and higher peak flowrates entering the facility. Due to the unique stage-storage-discharge relationship at each SWM facility, it is not feasible at this level to identify the flood volume deficit for each SWM facility. It is however, likely that those facilities with the highest combined risk score as identified in **Section 4.5** are the most susceptible to failing their flood control requirements, and should be subject to a subsequent study.

5 Stormwater Management Coverage

The facility classification was used to identify which facilities provide quality control, quantity control or both. Dry ponds are assumed to provide only quantity control, whereas all other classifications described above will provide some kind of quality and quantity control.

5.1 Oil and Grit Separators

Limited information was available regarding the catchments of the Oil and Grit Separators (OGS) throughout the city, so it was not possible to analyze their catchments in a similar

manner to the SWM facilities in **Section 4.** Catchments were generated for each OGS unit based on the storm sewer network and parcel fabric, although some catchments were estimated if there was insufficient detail in these layers (**Figure 5.1** and **Figure 5.2**). Design catchments were only found for six OGS units (#80, 110, 111, 112, 171, 172) so no catchment analyses were completed for OGS units.

There are 150 city-owned and 42 privately-owned OGS units currently in operation throughout the city. Many of these units are located within the catchments of SWM facilities which provide quality control, and therefore act as pre-treatment. However, the remaining OGS units are located in areas with no SWM control or areas with quantity control only, in which case they provide important water quality controls. City-owned OGS units provide standalone water quality treatment to 325 ha while private units provide 30 ha.

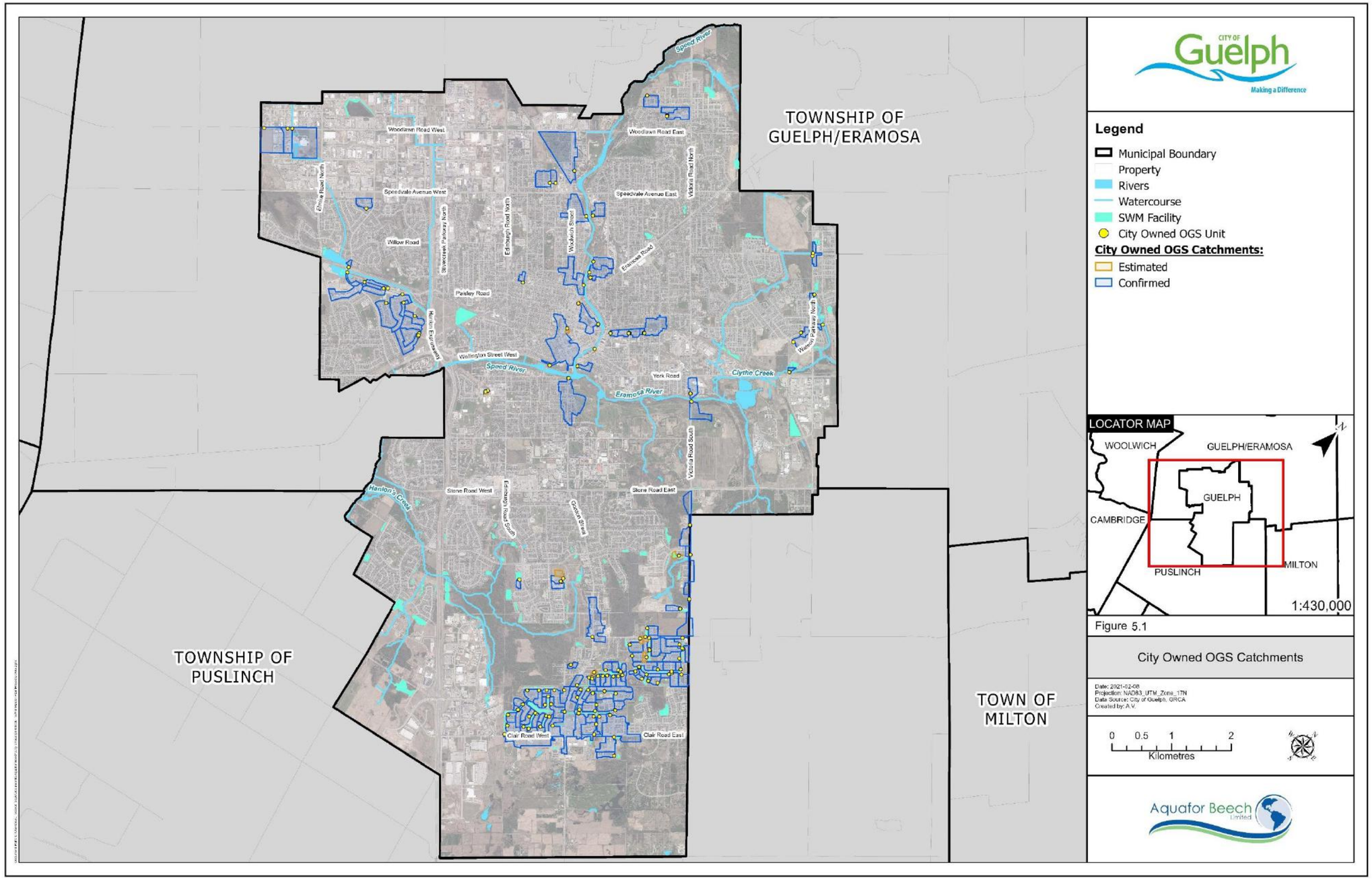

Figure 5.1: City-Owned OGS Units

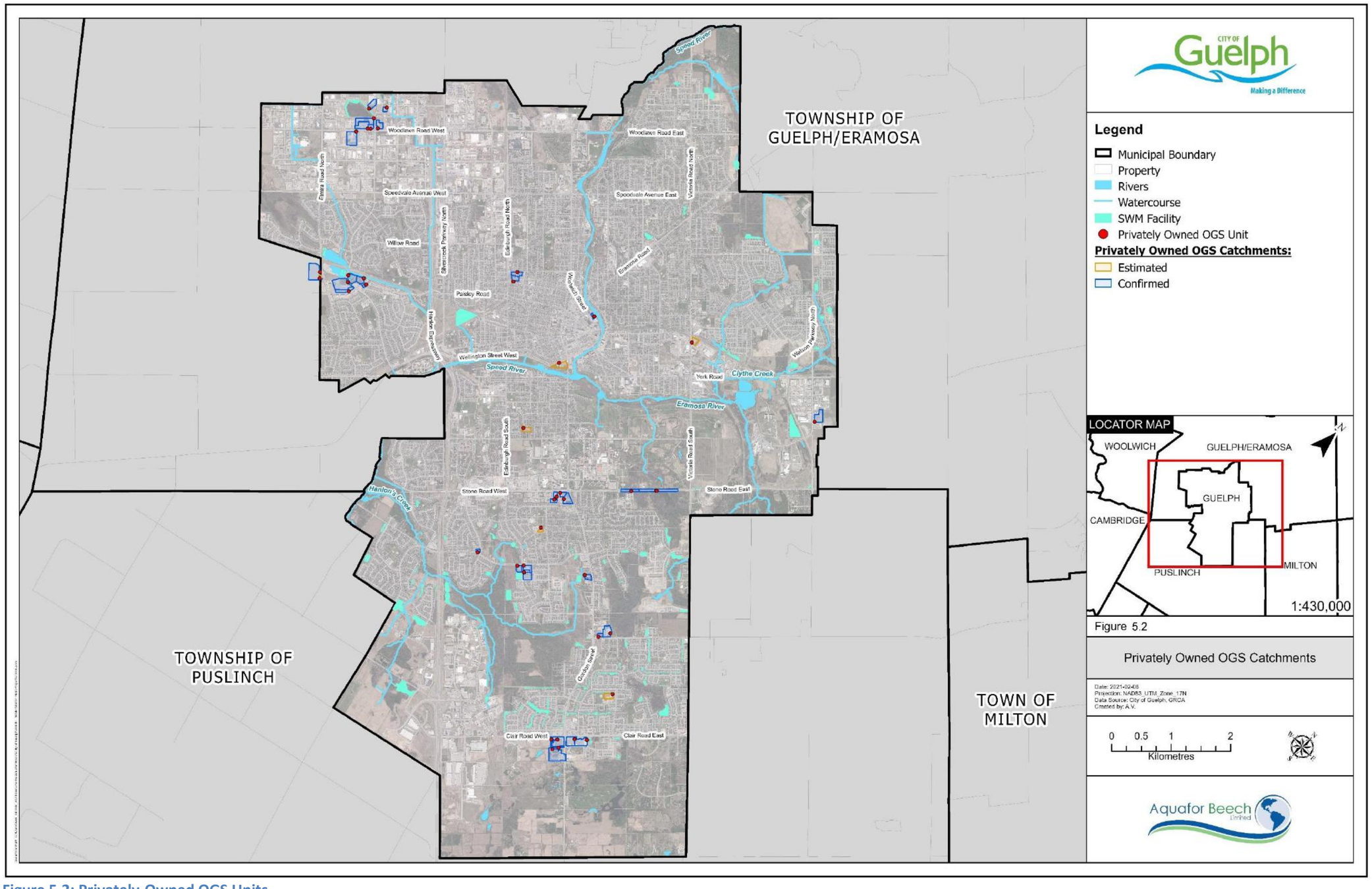

Figure 5.2: Privately-Owned OGS Units

5.2 City-Wide Controls

Currently, approximately 46 percent of the built-up urban area receives some from of stormwater control, whether through surface SWM facilities or OGS units. About 33 percent of the city has water quality control, while 37 percent has quantity control (**Figure 5.3**). From the available data, it is unknown whether some SWM facilities provide quantity control in addition to the known quality control (2 percent of urban area). These values exclude the Natural Heritage System that doesn't currently receive stormwater control, which accounts for approximately 993ha, or 13% of the City's built boundary.

The distribution of SWM and OGS facilities is shown in **Figure 5.4**. As is typical, the older neighbourhoods in the City have poorer coverage, and primarily receive quality control through OGS units installed as retrofits.

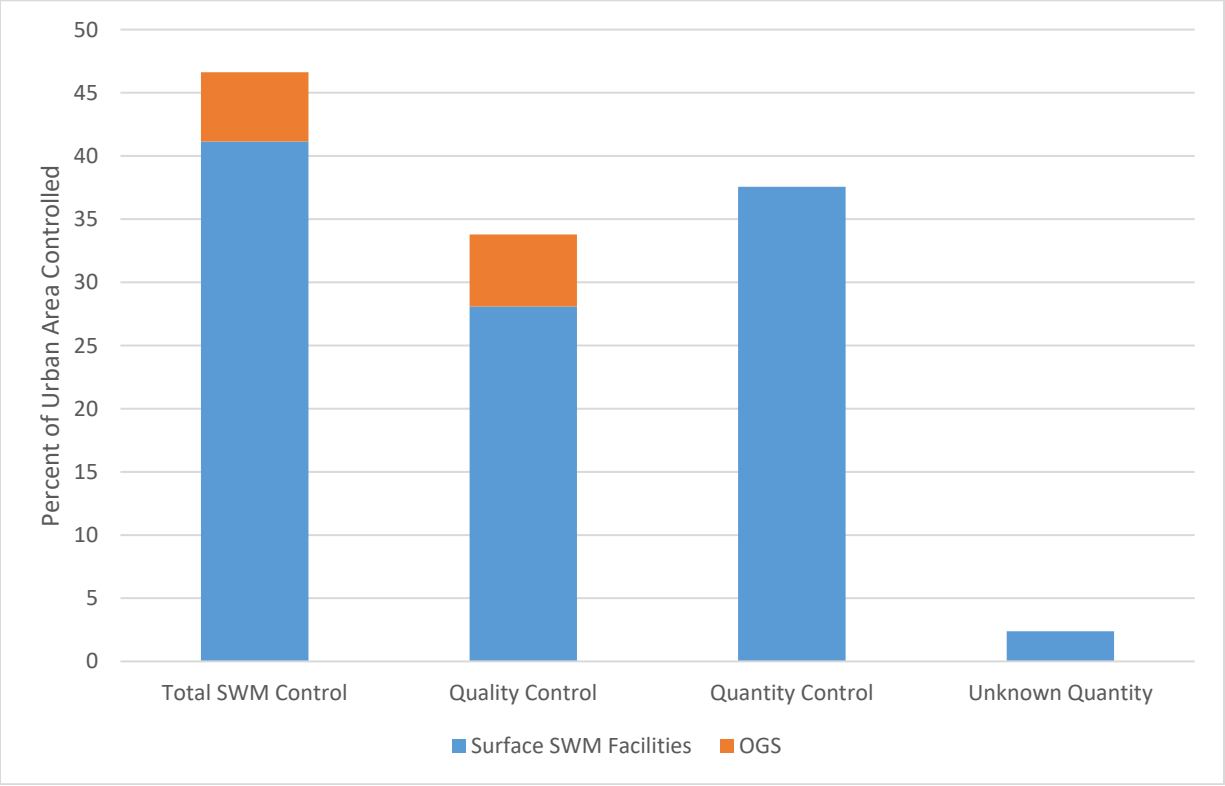

Figure 5.3: City-Wide SWM Controls

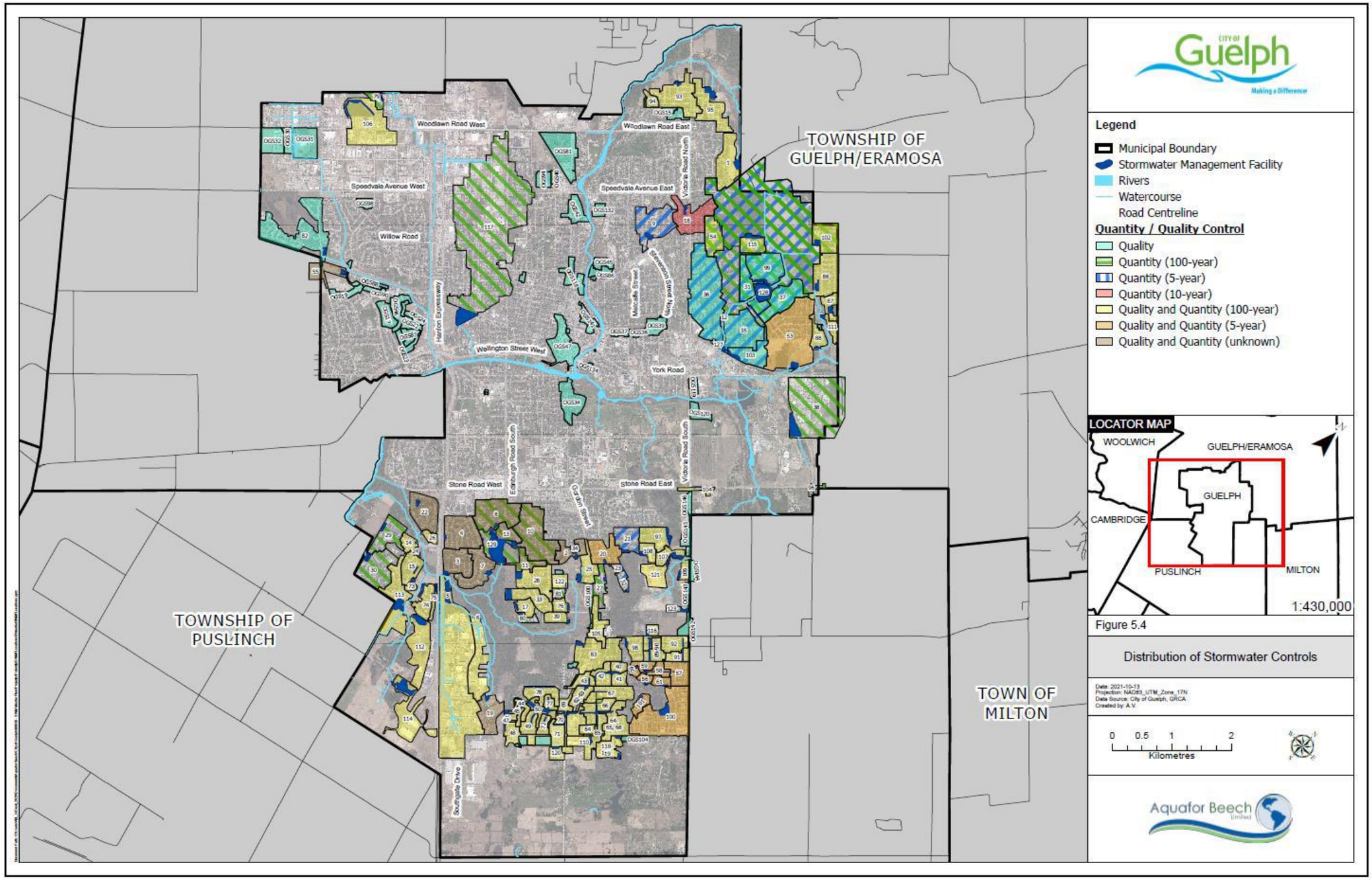

Figure 5.4: Distribution of Stormwater Controls

6 Conclusions and Recommendations

SWM facility catchment analysis has indicted 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 Guelph SWM facilities no longer being able to provide the design level of quality control. This does not take into account the impact of sedimentation which also reduces the efficiency of water quality treatment over time.

6.1 Recommendations for Existing SWM Facilities

a) It is recommended that the City of Guelph further investigate the efficiency of those facilities which have been found to have a **High Risk of Failure** (i.e. High Combined Risk Score; or Extreme or High Catchment Area or Imperviousness Risk Score) and/or **Insufficient Permanent Pool Volume** or **Extended Detention Volume**. It is likely that these facilities are not meeting design water quality objectives as a result of changes to their catchment areas. Conducting water quality sampling, preferably using Event Mean Concentration (EMC) methodology, will help determine the actual efficiency of these facilities. Since the City already has a Stormwater Pond Monitoring program, these high-risk facilities should be considered for inclusion in the program. Retrofit opportunities will be provided during subsequent phases of the SWM-MP.

b) For facilities that were missing either design imperviousness or design catchment area, it is recommended that the City complete further analyses to determine whether these facilities are at risk due to catchment changes. Completing a topographic and bathymetric survey of the facilities without adequate design information allows for the pond capacity to be calculated and compared to the permanent pool and storage volumes required by the 2003 SWMPDM. While a topographic and bathymetric survey was completed in 2014, the permanent pool volume was not estimated at the time.

c) It is recommended that the results of this analysis be used in the development of a new City of Guelph SWM facility retrofit implementation strategy. Those facilities that do not have sufficient permanent pool volume are ideal candidates for wet facility retrofits. Those facilities that were designed to out-dated design standards (i.e. water quantity only or Level-3 Basic treatment) are also potential retrofit targets. It is noted that other factors will play a key role in the prioritization of retrofits. These factors include:

   - Catchment Size
   - Subwatershed Environmental Targets and Existing Conditions
   - Maintenance Requirements (including sedimentation)
   - Feasibility of Source and Conveyance Controls within the Catchment

d) It is recommended that the results of this analysis be used in the development of an LID implementation strategy. The catchment areas of the facilities found to have a **High Risk of Failure** (i.e. High Combined Risk Score) and/or **Insufficient Permanent Pool Volume** should be prioritized for source and conveyance controls in order to reduce peak flows,

inflow volumes and the loading of pollutants from all runoff events. If feasible, these ponds could also be retrofit to increase their capacity.

6.2 Recommendation for Infill Development and Redevelopment

a) Like most Southern Ontario municipalities, future growth is expected to be accommodated throughout the city, however the Growth Plan for the Greater Golden Horseshoe prioritizes intensification within the existing city urban boundaries and establishes a minimum intensification target of 50 percent new residential development to be accommodated within the built-up areas each year. In light of the risks associated with increases in imperviousness of SWM catchments, it is recommended that the City investigate the development of lot-level stormwater retention targets be developed for infill and redevelopment (see separate Stormwater Volume Criteria and Targets Report).

6.3 Recommendation for Expansion of SWM Facility Catchment Areas

a) In light of the risks associated with increases in SWM catchments areas, it is recommended that the City of Guelph prohibit the expansion of SWM facility catchment boundaries beyond the limits described in original designs. Where it is feasible for retrofits to meet Level 1 – Enhanced quality control for the new catchment area, SWM facility catchment areas may be expanded.

6.4 Recommendations for New SWM Facilities

a) It is recommended that the City of Guelph consider constructing new SWM facilities in the areas of the city that currently do not receive any stormwater controls. To ensure future facilities are built to appropriate standards it is recommended that the City of Guelph review the imperviousness of different land use types based on historical development, infill development and redevelopment and incorporate any associated recommendations into future SWM policy for facilities sizing. This is especially critical given that 50 percent of new development in the city is to be accommodated within existing built-up areas, per the Growth Plan of the Greater Golden Horseshoe, which will significantly increase imperviousness and runoff volumes. An alternative that could be considered is oversizing permanent pool areas by a factor of safety to allow for some infill or redevelopment without facility expansion. This factor of safety may also provide some resiliency to climate change. New SWM facilities will be considered as part of the SWM Master Plan under separate cover.

Appendix A: Summary of SWM Facility Data

SWM Pond #	Pond Classification		Drainage Area (ha)		% Impervious			Design Permanent Pool Volume (2008 Database (m3)	Design Permanent Pool Volume (Design Report) (m3)	Design Extended Detention Volume (Design Report) (m3)	Level of Treatment (Design Report)	Level of Quantity Control (Design Report)	Quantity / Quality Status*
	Existing Classification	Design Report Classification	SWM Report	2020 GIS (ABL)	Design (2008 Database)	SWM Report	2020 GIS (ABL)						
1	Dry	Wetland	24.94	27.36	-	62	26.2	-	2831	-	Enhanced	100-year	Quality and Quantity
2	Dry	Infiltration	-	11.98	-	-	47.5	-	-	-	-	-	Quality and Quantity*
3	Dry	Infiltration	-	21.02	-	-	40.1	-	-	-	-	-	Quality and Quantity*
4	Wet	Infiltration	-	31.35	-	-	40.6	-	-	-	-	-	Quality and Quantity*
5	Dry	On-line Infiltration	-	150.95	-	-	46.6	-	-	-	-	-	Quality and Quantity
6	Dry	On-line Infiltration	-	31.18	-	-	52.9	-	-	-	-	-	Quality and Quantity
7	Dry	Infiltration	-	24.23	-	-	42.5	-	-	-	-	-	Quality and Quantity*
8	Dry	Wet	30.815	33.84	-	-	34.1	-	-	-	-	-	Quality and Quantity*
9	Dry	Dry	-	32.58	-	-	41.7	-	-	-	-	-	Quantity (5-year)
10	Dry	Infiltration	43.3	46.76	-	-	39.6	-	-	-	-	-	Quality and Quantity*
11	Dry	Infiltration	10.45	10.93	-	56	54.4	-	-	-	-	-	Quality and Quantity*
12	Dry	On-line Pond	328.26	281.19	-	-	13.8	-	-	-	-	100-year	Quantity
13	Dry	Infiltration	-	9.99	-	-	39.6	-	-	-	-	-	Quality and Quantity*
14	Dry	Infiltration	6.64	6.36	-	-	43.5	-	-	-	-	100-year	Quality and Quantity
15	Wet	Wet	4.13	14.13	-	-	32.3	-	-	-	-	100-year	Quality and Quantity
16	Dry	-	19.372	-	-	44.32	-	2702.5	2702.5	774.8	Level 1	100-year	Quality and Quantity
17	Dry	Dry with Infiltration	-	8.10	-	-	46.0	-	-	-	-	100-year	Quantity and Quality
18	Dry	Dry	25.3	28.06	38	38	39.2	-	-	-	-	10-year	Quantity (10-year)
19	Dry	Wet	-	20.30	-	-	63.3	-	-	-	-	-	Quality and Quantity*
20	Dry	Infiltration	8.01	19.61	-	-	43.7	-	-	-	-	5-year	Quality and Quantity (5-year)
21	Dry	Dry	14.8	16.51	-	-	43.1	-	-	-	-	5-year	Quantity (5-year)
22	Dry	Infiltration	26.695	25.75	-	39	37.7	-	-	-	-	-	Quality and Quantity*
23	Dry	Dry	-	2.30	-	-	50.8	-	-	-	-	5-year	Quantity (5-year)
24	Dry	Wet	1.9	1.65	-	-	32.3	-	-	-	-	100-year	Quality and Quantity
25	Dry	Infiltration	18.59	13.61	-	40.6	51.8	-	-	-	-	100-year	Quality and Quantity
26	Dry	Infiltration	4.63	4.08	-	38.92	51.7	-	-	-	-	100-year	Quality and Quantity
27	Dry	Dry	8.14	10.74	-	-	42.1	-	-	-	-	100-year	Quantity
28	Wet	Wet	27.8	23.41	-	-	49.9	-	6920	776.5	Level 1	100-year	Quality and Quantity
29	Dry	Dry	21.74	20.90	-	34.76	41.8	-	-	-	-	100-year	Quantity
30	Dry	Dry	33.86	30.47	-	43.91	46.5	-	-	-	-	100-year	Quantity
31	Dry	Dry	27	20.51	-	54.3	46.4	-	-	-	-	none	Quality
32	Dry	Dry	-	4.93	-	-	43.7	197	-	-	-	5-year	Quantity (5-year)
33	Wet	Wet	19.42	17.87	-	49.55	43.1	-	-	-	-	100-year	Quality and Quantity
34	Dry	Dry	1.74	1.69	55	55	41.3	-	-	-	Level 2	100-year	Quantity
35	Wet	Wet	31.6	35.02	-	45	40.3	-	1034	1270	Level 3	none	Quality
36	Wet	Wet	7.7	73.05	-	77	42.1	-	359	340	Level 3	none	Quality
37	Wet	Wet	23.98	25.31	55	59.86	46.9	959	1250	1650	Level 2	-	Quality
38	Dry	Dry	87.2	91.77	70	70	32.4	-	-	-	-	100-year	Quantity
39	Wet	Wet	6.803	6.97	-	52.77	50.6	-	-	-	-	100-year	Quality and Quantity

SWM Pond #	Pond Classification		Drainage Area (ha)		% Impervious			Design Permanent Pool Volume (2008 Database (m3)	Design Permanent Pool Volume (Design Report) (m3)	Design Extended Detention Volume (Design Report) (m3)	Level of Treatment (Design Report)	Level of Quantity Control (Design Report)	Quantity / Quality Status*
	Existing Classification	Design Report Classification	SWM Report	2020 GIS (ABL)	Design (2008 Database)	SWM Report	2020 GIS (ABL)						
40	Greenway	Greenway	5.22	4.74	-	-	43.5	-	-	-	Level 1	100-year	Quality and Quantity
41	Greenway	Greenway	17.51	16.01	-	-	48.9	-	-	-	Level 1	100-year	Quality and Quantity
42	Greenway	Greenway			-	-		-	-	-	Level 1	100-year	Quality and Quantity
43	Greenway	Greenway	5.77	7.45	-	-	49.7	-	-	-	Level 1	100-year	Quality and Quantity
44	Greenway	Greenway	14.729	24.38	-	-	52.8	-	-	-	Level 1	100-year	Quality and Quantity
45	Greenway	Greenway			-	-		-	-	-	Level 1	100-year	Quality and Quantity
46	Greenway	Greenway			-	-		-	-	-	Level 1	100-year	Quality and Quantity
47	Greenway	Greenway			-	-		-	-	-	Level 1	100-year	Quality and Quantity
48	Greenway	Greenway			-	-		-	-	-	Level 1	100-year	Quality and Quantity
49	Greenway	Greenway	-	8.99	-	-	52.5	-	-	-	Level 1	100-year	Quality and Quantity
50	Greenway	Greenway	-	8.65	-	-	29.4	-	-	-	Level 1	100-year	Quality and Quantity
53	Wet	Wetland	79	79.39	42	42	27.9	2800	2800	3200	Level 2	5-year	Quality and Quantity (5-year)
54	Wet	Wet	17.5	17.12	30	-	36.3	438	-	-	Level 2	100-year	Quality and Quantity
55	Wet	Wet	-	13.36	56	-	71.3	-	-	-	Level 2	-	Quality and Quantity*
56	Greenway	Greenway	2.48	3.48	-	-	41.0	-	-	-	Level 1	5-year	Quality and Quantity (5-year)
57	Greenway	Greenway	12.59	14.54	-	-	54.8	-	-	-	Level 1	5-year	Quality and Quantity (5-year)
58	Greenway	Greenway	8.13	11.98	-	-	49.7	-	-	-	Level 1	5-year	Quality and Quantity (5-year)
59	Greenway	Greenway	8.13		-	-		-	-	-	Level 1	5-year	Quality and Quantity (5-year)
60	Greenway	Greenway	2.66	2.41	-	-	47.6	-	-	-	Level 1	5-year	Quality and Quantity (5-year)
61	Greenway	Greenway	5.4	4.87	-	-	29.1	-	-	-	Level 1	5-year	Quality and Quantity (5-year)
62	Greenway	Greenway	10.52	9.86	-	35	47.9	-	-	-	Level 1	100-year	Quality and Quantity
63	Greenway	Greenway			-	35		-	-	-	Level 1	100-year	Quality and Quantity
64	Greenway	Greenway	43.57	44.30	-	35	53.6	-	-	-	Level 1	100-year	Quality and Quantity
65	Greenway	Greenway			-	35		-	-	-	Level 1	100-year	Quality and Quantity
66	Greenway	Greenway	5.01	6.05	-	35	48.5	-	-	-	Level 1	100-year	Quality and Quantity
67	Greenway	Greenway	18.26	17.38	-	-	47.3	-	-	-	Level 1	100-year	Quality and Quantity
68	Greenway	Greenway	combined with 64 and 65		-	35		-	-	-	Level 1	100-year	Quality and Quantity
69	Greenway	Greenway	20.16	27.79	-	-	61.7	-	-	-	Level 1	100-year	Quality and Quantity
70	Greenway	Greenway			-	-		-	-	-	Level 1	100-year	Quality and Quantity
71	Greenway	Greenway			-	-		-	-	-	Level 1	100-year	Quality and Quantity
72	Greenway	Greenway			-	-		-	-	-	Level 1	100-year	Quality and Quantity
73	Wet	Wet with Infiltration Basin	2.64	2.79	-	45	36.5	317m	1228.35	105.6	Level 1	100-year	Quality and Quantity
74	Dry	Wet with Infiltration Basin	13.28	13.79	-	45	49.9	2998.65	2998.65	531.2	Level 1	100-year	Quality and Quantity
75	Dry	Wet with Infiltration Basin	3.07	3.53	-	45	44.7	-	616.95	122.8	Level 1	100-year	Quality and Quantity
76	Dry	Wet	5.21	5.77	-	50.3	49.1	-	-	-	Level 1	100-year	Quality and Quantity
77	Greenway	Greenway	3.11	4.75	-	-	49.6	-	-	-	Level 1	100-year	Quality and Quantity
78	Greenway	Greenway	-	13.86	-	-	48.7	-	-	-	Level 1	100-year	Quality and Quantity
79	Wet	Dry	5.17	5.26	-	67.6	69.6	510	-	-	-	100-year	Quantity

SWM Pond #	Pond Classification		Drainage Area (ha)		% Impervious			Design Permanent Pool Volume (2008 Database (m3)	Design Permanent Pool Volume (Design Report) (m3)	Design Extended Detention Volume (Design Report) (m3)	Level of Treatment (Design Report)	Level of Quantity Control (Design Report)	Quantity / Quality Status*
	Existing Classification	Design Report Classification	SWM Report	2020 GIS (ABL)	Design (2008 Database)	SWM Report	2020 GIS (ABL)						
80	Dry	Dry	-	4.02	-	-	49.3	-	-	-	-	100-year	Quantity
81	Wet	Dry	3.59	3.82	-	52	50.4	-	-	-	Level 1	100-year	Quantity
82	Wet	Wet	45.86	54.43	-	57.64	39.2	2400	2400	5700	Level 2	none	Quality
83	Wet	Wet	27.85	34.79	39	-	33.5	2154	2150	5200	Level 1	100-year	Quality and Quantity
84	Greenway	Greenway	6.16	6.38	-	35	61.9	-	-	-	Level 1	100-year	Quality and Quantity
85	Greenway	Greenway			-	35		-	-	-	Level 1	100-year	Quality and Quantity
86	Wet	Wet	30.7	28.42	55	55	43.6	3235	2941	13558	Level 1	100-year	Quality and Quantity
87	Wet	Wet	5.43	8.35	55	55	43.0	829	829	2117	Level 1	100-year	Quality and Quantity
88	Wet	Wet	8.82	9.20	-	55	45.2	326m	745	2137	Enhanced	100-year	Quality and Quantity
89	Greenway	Greenway	12.945	13.88	-	47.7	41.3	-	-	-	Level 1	100-year	Quality and Quantity
90	Greenway	Greenway			-	47.7		-	-	-	Level 1	100-year	Quality and Quantity
91	Greenway	Greenway	18.43	19.00	-	58.47	51.7	-	-	-	Level 1	100-year	Quality and Quantity
92	Greenway	Greenway			-	58.47		-	-	-	Level 1	100-year	Quality and Quantity
93	Wet	Wet	48.72	32.53	58	58	37.3	4793	4906	1264	Level 1	100-year	Quality and Quantity
94	Greenway	Greenway	-	4.77	-	-	39.5	-	-	-	Level 1	100-year	Quality and Quantity
95	Wet	Wet	30.02	28.33	55	55	43.3	1787	2431	2794	Enhanced	100-year	Quality and Quantity
96	Dry	Dry	4.4	2.92	35	35	21.0	-	-	-	Level 3	100-year	Quantity
97	Wet	Wet	16	15.99	-	47	36.8	-	2284	1470	Level 1	100-year	Quality and Quantity
98	Dry	Infiltration	10.01	11.53	-	55	50.1	-	3800	-	Enhanced	100-year	Quality and Quantity
99	Wet	Wet	26.1	27.75	47	-	46.2	1570	1572	1237	Enhanced	none	Quality
100	Wet	Wetland	57	57.84	-	45	47.5	-	5193	3302	Level 1	5-year	Quality and Quantity (5-year)
101	Wet	Wetland	6.1	6.83	-	45	28.9	5193	820	600	Enhanced	5-year	Quality and Quantity (5-year)
102	Wet	Wet	22.9	20.08	-	51	44.5	820	3699	1550	Enhanced	100-year	Quality and Quantity
103	Dry	Dry	33.9	19.22	-	-	13.4	3699	-	-	Level 3	none	Quality
104	Dry	Infiltration	3.61	4.12	-	35	32.3	2370	-	-	Level 1	100-year	Quality and Quantity
105	Dry	Wet	27.85	13.57	-	-	49.2	-	-	-	-	100-year (ECA states major stor	Quality and Quantity
106	Wet	Wet	51.88	51.65	-	47.8	52.4	-	-	-	-	100-year	Quality and Quantity
107	Wet	Wet with Infiltration Basin	19.3	9.17	-	48	33.8	-	3301	1824	Level 1	100-year	Quality and Quantity
108	Wet	Wet with Infiltration Basin	10.4	7.19	-	47	26.2	-	1874	942	Level 1	100-year	Quality and Quantity
109	Wet	Wet with Infiltration Basin	4.4	5.16	-	65	33.5	-	799	551	Level 1	100-year	Quality and Quantity
110	Wet	Wet	12.95	12.45	-	48	56.1	-	1972	576	Level 1	100-year	Quality and Quantity
111	Wet	Wet	4.16	6.10	-	55	46.9	-	326	1088	Level 1	100-year	Quality and Quantity
112	Wet	Hybrid	44.97	32.09	-	85	15.9	-	8680	6743	Enhanced	100-year	Quality and Quantity
113	Wet	Hybrid	65.27	34.77	-	55.1	32.3	-	10315	7252	Enhanced	100-year	Quality and Quantity
114	Wet	Hybrid	79.87	33.31	-	74	41.0	-	24877	10581	Enhanced	100-year	Quality and Quantity
115	Wet	Wet	11.92	12.07	-	54.8	45.6	-	1936	685	Level 1	100-year	Quality and Quantity
116	Dry	Infiltration	3.6	3.79	65.58	67.2	49.9	-	-	-	Enhanced	100-year	Quality and Quantity
117	Dry	Dry	242.3	247.82	61.80	50.3	48.0	-	-	-	-	100-year	Quantity
118/119	Wet	Wet with Infiltration Basin	10.52	12.99	-	64.2	39.0	-	-	-	Level 1	100-year	Quality and Quantity
120	Wet	Infiltration	4.6	5.17	-	67.5	49.6	-	-	2056	Enhanced	100-year	Quality and Quantity
121	Wet	Infiltration	12.61	14.58	-	62.5	21.9	-	-	-	-	100-year	Quantity and Quality
122	Wet	Wet	6.5	6.28	-	-	29.5	-	1234	980	Enhanced	100-year	Quality and Quantity
123	Wet	Dry	3.52	3.13	-	83	47.2	-	-	-	-	100-year	Quantity
127	NA	On-line Pond	-	496.72	-	-	25.4	-	-		-	5-year	Quantity (5-year)
128	NA	On-line Pond	-	342.70	-	-	20.4	-	-		-	100-year	Quantity
129	NA	On-line Pond		124.17			32.7					100-year	Quantity

*Level of quantity control not specified in available reports

Appendix B: SWM Facility Rankings

SWM Pond #	Change in Catchment Area	Change in Impervious Percent	Combined Catchment Risk Score	Combined Catchment Risk	Permanent Pool Volume	Sufficient Extended Detention Volume
1	Catchment not built out					
2					-	-
3					-	-
4					-	-
5					-	-
6					-	-
7					-	-
8	2				Unknown	-
9					-	-
10	2				-	-
11	1	1	1	Low	-	-
12	1				-	-
13					-	-
14	1				-	-
15	5				Unknown	-
17					-	-
18	3	2	6	Medium	-	-
19					Unknown	-
20	5				-	-
21	3				-	-
22	1	1	1	Low	-	-
23					-	-
24	1				Unknown	-
25	1	5	5	Medium	-	-
26	1	5	5	Medium	-	-
27	4				-	-
28	1				Enhanced	Not Sufficient
29	1	5	5	Medium	-	-
30	1	3	3	Low	-	-
31	1	1	1	Low	-	-
32					-	-
33	1	1	1	Low	Unknown	-
34	1	1	1	Low	-	-
35	3	1	3	Low	Basic	Not Sufficient
36	5	1	5	Medium	Less than Basic	Not Sufficient
37	2	1	2	Low	Basic	Sufficient
38	2	1	2	Low	-	-
39	1	1	1	Low	Unknown	-
40	1				-	-
43	4				-	-
49					-	-
50					-	-
53	1	1	1	Low	Enhanced	Sufficient
54	1	5	5	Medium	Unknown	-
55		5			Unknown	-
56	4				-	-
57	3				-	-

SWM Pond #	Change in Catchment Area	Change in Impervious Percent	Combined Catchment Risk Score	Combined Catchment Risk	Permanent Pool Volume	Sufficient Extended Detention Volume
60	1				-	-
61	1				-	-
66	4	5	20	High	-	-
67	1				-	-
73	2	1	2	Low	Enhanced	Not Sufficient
74	1	4	4	Low	Enhanced	Not Sufficient
75	3	1	3	Low	Enhanced	Not Sufficient
76	3	1	3	Low	Unknown	-
77	5				-	-
78					-	-
79	1	2	2	Low	-	-
80					-	-
81	2	1	2	Low	-	-
82	3	1	3	Low	Basic	Sufficient
83	4	1	4	Low	Normal	Sufficient
86	1	1	1	Low	Normal	Sufficient
87	5	1	5	Medium	Normal	Sufficient
88	1	1	1	Low	Normal	Sufficient
93	1	1	1	Low	Enhanced	Not Sufficient
94					-	-
95	Catchment not built out					
96	1	1	1	Low	-	-
97	1	1	1	Low	Enhanced	Sufficient
98	3	1	3	Low	-	-
99	2	1	2	Low	Basic	Sufficient
100	1	3	3	Low	Enhanced	Sufficient
101	3	1	3	Low	Enhanced	Sufficient
102	1	1	1	Low	Enhanced	Sufficient
103	1				-	-
103	1				-	-
104	3	1	3	Low	-	-
104	3	1	3	Low	-	-
105	1				Enhanced	Sufficient
105	1				Enhanced	Sufficient
106	1	3	3	Low	Unknown	-
106	1	3	3	Low	Unknown	-
107	1	1	1	Low	Enhanced	Sufficient
107	1	1	1	Low	Enhanced	Sufficient
108	1	1	1	Low	Enhanced	Sufficient
108	1	1	1	Low	Enhanced	Sufficient
109	3	1	3	Low	Enhanced	Sufficient
109	3	1	3	Low	Enhanced	Sufficient
110	1	4	4	Low	Enhanced	Sufficient
110	1	4	4	Low	Enhanced	Sufficient
111	4	1	4	Low	Basic	Sufficient
111	4	1	4	Low	Basic	Sufficient
112	Catchment not built out					

SWM Pond #	Change in Catchment Area	Change in Impervious Percent	Combined Catchment Risk Score	Combined Catchment Risk	Permanent Pool Volume	Sufficient Extended Detention Volume
113	Catchment not built out					
114	Catchment not built out					
115	1	1	1	Low	Enhanced	Sufficient
115	1	1	1	Low	Enhanced	Sufficient
116	2	1	2	Low	-	-
116	2	1	2	Low	-	-
117	1	1	1	Low	-	-
117	1	1	1	Low	-	-
120	Catchment not built out					
121	Catchment not built out					
122	1				Enhanced	Sufficient
122	1				Enhanced	Sufficient
123	Catchment not built out					
127					-	-
128					-	-
129					-	-
118/119	4	1	4	Low	Unknown	-
41-42	1				-	-
44-48	5				-	-
58-59	4				-	-
62-63	1	5	5	Medium	-	-
64-65,68	1	5	5	Medium	-	-
69-72	4				-	-
84-85	1	5	1	Low	-	-
89-90	2	1	2	Low	-	-
91-92	1	1	1	Low	-	-