Prepared for:

**The Corporation of the City of Hamilton**

**71 Main Street West**
**Hamilton, ON L8P 4Y5**

# Block 2 Servicing Strategy for the Fruitland – Winona Secondary Plan Lands

## Final Report


submitted by:

**Aquafor Beech Ltd.**


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# 1.0 INTRODUCTION

The City of Hamilton is in the process of preparing Block Plans for three areas within the Fruitland-Winona area (see **Figure 1-1**). As shown in **Figure 1-1** there are three (3) blocks included in the Fruitland-Winona Secondary Plan which require a Block Servicing Strategy:

**Block 1**: generally located by Barton Street to the north, Highway 8 to the south, Fruitland Road to the west and east of Jones Road to Stoney Creek, numbered Watercourse 6.
**Block 2**: Generally located by Barton Street to the north, Highway 8 to the south, Watercourse 6 at the west and Glover Road to the east
**Block 3**: Generally located north of Barton Street, Highway 8 to the south, McNeilly Road at the west and east of Lewis Road.

**This study will address the requirements to prepare a Block Servicing Strategy for Block 2.**

## 1.1 Study Area

The study area for Block 2 is shown on **Figure 1-2**. As was noted above the boundaries for the study area are Barton Street to the north, Highway 8 to the south, Watercourse 6 to the west and Glover Road to the east.

## 1.2 Study Purpose

The purpose of this study is to develop a Block Servicing Strategy (BSS) for the Block 2 lands. The RFP/terms of reference for the study, developed by the City of Hamilton, is contained in **Appendix F** (at the request of the City, **Appendix F** also includes a description of the recommendations for further ecological study included in the SCUBE study and the ecological studies completed as part of the Block 2 Servicing Strategy).

The Block Servicing Strategy shall have regard for existing development in accordance with the Fruitland-Winona Secondary Plan by reflecting the general scale and character of the established development pattern in the surrounding area by taking into consideration lot frontages and areas, building height, coverage, mass, setbacks, privacy and overview. All development within the lands identified as “Servicing Strategies Area” in the Fruitland Winona Secondary Plan – Block Servicing Strategy area delineation shall conform to the Block Servicing Strategies.

## 1.3 Report Outline

Provided below is a brief overview of the content of this report:

**Chapter 1** provides an introduction to the report structure and study purpose;
**Chapter 2** provides a summary of key documents which have been completed together with the impact on this study;
**Chapter 3** provides an overview of existing conditions;
**Chapter 4** describes the development of the Concept Plan;
**Chapter 5** describes the Functional Design;
**Chapter 6** describes the Implementation Plan; and,
**Chapter 7** provides Conclusions and Recommendations.

In addition,

**Appendix A** contains Sewer Design Tables and Figures;
**Appendix B** contains the Watermain Hydraulic Report;
**Appendix C** contains the Air Drainage Analysis Report;
**Appendix D** contains Road Functional Designs;
**Appendix E** contains the Environmental Impact Study;
**Appendix F** contains the study RFP and supplemental information requested by the City;
**Appendix G** contains SWM Pond Drawdown Calculations;
**Appendix H** contains the list of City of Hamilton staff members;
**Appendix I** contains the material for public consultation; and
**Appendix J** contains the Letter Report – SCUBE Block 2 Draft Development Constraints – August 2016.

## 1.4 Public Consultation Process

A comprehensive public consultation program (see **Appendix I**) was incorporated into the study and included the following components:

- Stakeholder List – A mailing list was created and maintained throughout the study. It included local community groups, First Nations, external agencies and neighbourhood associations, among others within the study area, as well as members of the public who requested to be added to the list via telephone, email or comment sheets submitted during public consultations.
- Newspaper Notices – Notices were placed in the Stoney Creek News one and two weeks prior to each public meeting, to announce the Landowner Meeting (December 2016) and to publicize each public consultation event and Draft Report Completion throughout the study process (April 2017, June 2017, April 2018). The notices provided a description of the study, invited the public to attend the

consultation event, and identified ways to obtain more information – please see copies of Notices in **Appendix I**.

- Direct Mail – Direct mail was used for notification of all those listed on Stakeholder List, except where otherwise indicated/requested (this includes other City Departments).
- Public Information Centres (PICs) – A total of two (2) PICs were held. The PICs followed an open house format where participants had the opportunity view display boards and speak with members of the project team, Conservation Authority and City staff. Feedback Forms were distributed at each PIC to encourage participants to submit written comments.
- Other Meetings – Numerous meetings were held, and correspondence exchanged, with individuals and various groups of interested land owners/members of the public – as per Appendix I.
- Project Website – A project website (Hamilton.ca/blockservicingstrategies) **Error! Hyperlink reference not valid.**was created to serve as a portal for all project information, updates, and consultation materials throughout the study. The website url was promoted in the Public meetings and each PIC notice.
- Twitter – The City of Hamilton Twitter Account was used to also disseminate notification of all Public Meetings in Stoney Creek area.

Copies of all public consultation materials and meeting summaries can be found in **Appendix I**.

### 1.4.1 Public Notification

Prior to the Public Meeting and each Public Information Centre, a notice was published in the Stoney Creek News – Community Newspaper, one and two weeks prior to each meeting, and sent to those individuals who requested to be added to the study mailing list, as well as other Stakeholder/Agency list members. Each Landowner and PIC notice included a description of the study, invited the public to attend the event, and identified ways to obtain more information. The notice for Study Draft Report Completion encouraged residents to visit the project website to review the Draft Report and provide comments, as needed.

### 1.4.2 Land Owners Meeting #1

The Land Owners Meeting #1 was held on **December 2, 2016 (9;00 am – 12:00 pm)** and **December 7,2016 (1:00 pm – 4:00 pm).** The purpose of the meeting was to:

- Introduce the Block 2 Background information and preliminary development concept plan;

- Provide an overview of the proposed water, sanitary, and stormwater servicing plans;
- Provide an opportunity for affected landowners to comment on the background information and concept plan, and to discuss questions and issues with staff and consulting team.

The format of the meetings consisted of an open house format with display boards.

Members of the project team and City staff were available to answer questions informally and respond to feedback.

Some participants took the opportunity to provide input by completing a Comment Form. Comment Forms were collected either at the meeting or subsequently via email.

The three primary discussion questions were:

1. What is your relationship to the project?
2. What is their interest in the project?
3. Comments regarding the information provided and format used?

A summary of comments can be found in **Appendix I**.

### 1.4.3 Public Information Centre #1

Public Information Centre (PIC) #1 was held on **April 4, 2017 from 3:30-5:00 and 6:00-8:30 pm** at the Stoney Creek Municipal Centre, 777 Highway 8 in Stoney Creek. Information was presented for both Block 1 and Block 2. The purpose of the PIC was to:

- Introduce the Block 2 development concept plan;
- Provide an overview of the proposed /updated water, sanitary, and stormwater servicing plans;
- Provide an opportunity for landowners and the public to comment on the concept plan, and to discuss questions and issues with staff;
- Block 1 Information was presented in a separate portion of the meeting space, with appropriate staff present to answer questions for that study.

This meeting was held in conjunction /coordination with PIC#1 for Block 1 Servicing Strategy and Gordon Dean Avenue Phases 3 & 4 EA to maximize attendee time, and provide cross boundary information for residents and land owners living in the Block Servicing/Stoney Creek area.

The format of the meeting consisted of an open house for the times as noted above Approximately 30 people attended/signed in at the open house, participants were able to

review display boards that focused on various aspects of the project. Members of the project team, Conservation Authority and City staff were available at the open house to answer questions informally and respond to feedback.

During the PIC, many participants took the opportunity to provide input by completing a Comment Form or during the question and answer session. A total of 1 Comment Form was collected, and several follow up e-mails and meetings followed.

A summary of public comments can be found in the PIC #1 summary report in **Appendix I**.

### 1.4.4 Public Information Centre #2

The second PIC was held on **June 8, 2017 from 3:30-5:00 and 6:00-7:30 pm** at the Stoney Creek Municipal Centre, 777 Highway 8 in Stoney Creek. The purpose of the PIC was to:

- Present the updated Block 2 development concept plan;
- Provide further detail of the proposed water, sanitary, and stormwater servicing plans, with some transportation and natural heritage updates;
- Provide an opportunity for landowners and the public to comment on the concept plan, and to discuss questions and issues with staff;
- This PIC was also coordinated with Blocks 1 & 3 Servicing Strategies, with separate information presented and feedback gathered by representatives of the land owners for both studies, within adjoining/shared meeting space.

The PIC format consisted of an open house for the times as noted above. Approximately 39 people participated in the PIC. During the open house, participants had an opportunity to review display boards. Members of the project team, Conservation Authority and City staff were available at the open house to answer questions informally and respond to feedback.

A combined total of 5 Comment Forms were received, which were handed in at the PIC, submitted after the meeting, or completed online.

A summary of public comments can be found in the PIC #2 summary report in **Appendix I**.

### 1.4.5 Notice of Draft Project Report Completion

Notices regarding Project Report completion were sent out to all interested (as indicated during the course of the study) stakeholders, for 3-week public review.

Comments START DATE: Monday, April 9, 2018; END DATE: Monday, April 30, 2018

Hard Copies of the Report were available for review at the following locations:

- Stoney Creek Municipal Service Centre - Library, at 777 Highway 8, Stoney Creek;
- City Hall - 71 Main Street West - City Clerk's Office - 1st Floor;
- City Hall - 71 Main Street West - 6th Floor Front Desk.

Several meetings took place, upon request from larger groups of interested land owners, in an effort to answer questions. E-mail and telephone inquiries were also addressed with individual land owners, and organized groups of land owners, regarding impacts to their properties, questions on the study process and next steps. Comments received and answered are contained in **Appendix I**.

### 1.4.6 Councillor Briefings

City staff met with the local Councillor, Brenda Johnson, to provide briefings on study progress and upcoming public consultation meetings, prior to each public meeting, and separately, as requested by constituents.

### 1.4.7 Website

The project website was used to share all background information related to the study, meeting materials, project updates and staff contact information (*Hamilton.ca/blockservicingstrategies***Error! Hyperlink reference not valid.**

### 1.4.8 Meetings

Several requests were received from area residents to meet with City staff to gain a better understanding of the study approach and recommendations.

This pertains to private citizens – we can only include content and dates, no names of who attended. In addition to meetings, City staff responded to telephone and email inquiries from residents and interested stakeholders throughout the study process.

### 1.4.9 Agency and Indigenous Consultation

List of Indigenous Groups contacted during the course of the study can be found in the Stakeholder List, **Appendix I**.

An Information Report to Council will be submitted, to let Council know about the public consultation process and outcomes of this report. Once accepted by Council the Report will be deemed finalized.

Appendix N
Amendment No. 17
to the Urban Hamilton Official Plan

"Map B.7.4-4 - Fruitland-Winona Secondary Plan - Block Servicing Strategy Area Delineation" to be adopted into the Urban Hamilton Official Plan

| Date: | Revised By: | Reference File No.: |
|---|---|---|
| April 2014 | AM/NB | OPA-U-17(S) |

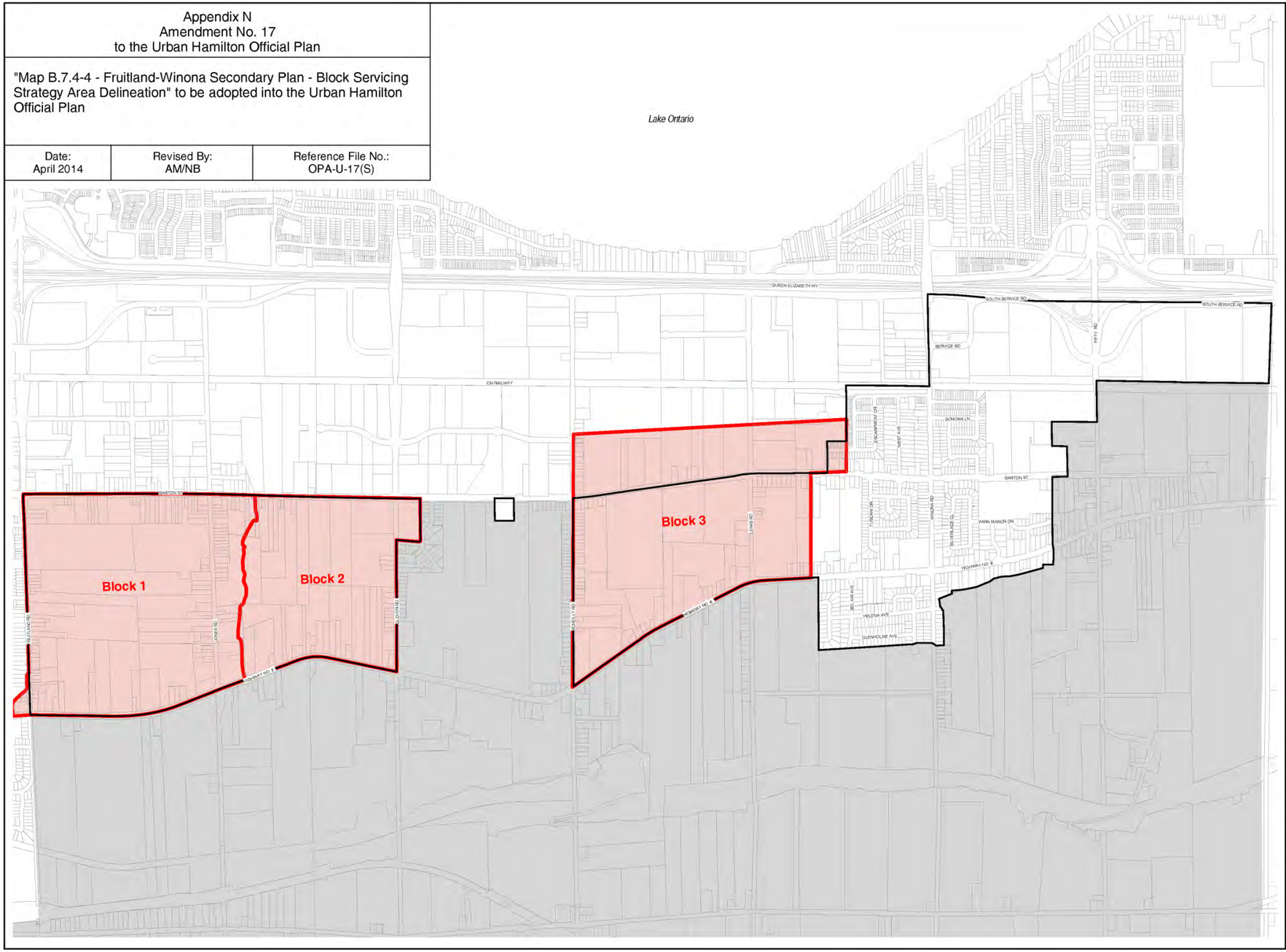


Figure 1.1 – Fruitland–Winona Secondary Plan – Block Servicing Plan Areas

**Figure 1-1 –Fruitland-Winona Secondary Plan – Block Servicing Plan Areas**


**Figure 1-2 – Block 2 Study Area Map**

## 2.0 EXISTING STUDIES

A number of studies or plans have been completed prior to the undertaking of the Block Servicing Study. Provided below is a summary of several of the key studies together with their relevance to this study.

### 2.1 Fruitland Winona Secondary Plan

The Urban Hamilton Official Plan was amended by Amendment No. 17 on May 14, 2014 by City Council to incorporate the Fruitland-Winona Secondary Plan (Secondary Plan) into the Urban Hamilton Official Plan. This Secondary Plan identified land uses, densities, development forms, cultural heritage features and development standards. The Secondary Plan also provided for protection of the natural heritage features. The lands in the Fruitland-Winona Secondary Plan are generally located south of Barton Street, north of Highway No. 8, east of Fruitland Road and west of the City boundary within the former City of Stoney Creek, but exclude most of the lands between Glover Road and McNeilly Road as they are within the Greenbelt Plan.

The Fruitland-Winona Secondary Plan (Secondary Plan) requires a block servicing strategy so that development proceeds in a coordinated and comprehensive manner. The Secondary Plan has been delineated into three Blocks, Block 1, Block 2 and Block 3 for the completion of these servicing strategies (see **Figure 2-1** (Map B.7.4-3 - Block Servicing Strategy Area Delineation)). This study is for the Block 2 Servicing Strategy.

Amendment No. 17 includes the following schedules that relate to Block 2:

- Schedule B - Natural Heritage System
- Schedule B-2 - Detailed Natural Heritage Features Key Natural Heritage Feature Significant Woodlands
- Schedule B-4 - Detailed Natural Heritage Features Key Natural Heritage Feature and Key Hydrologic Feature Wetlands
- Schedule C- Functional Road Classification
- Schedule E-1 - Urban Land Use Designations
- Appendix B - Major Transportation Facilities and Routes
- Map B.7.4-1 - Winona Urban Community Secondary Plan – Land Use Plan (subsequently revised by the Ontario Municipal Board Order dated December 4, 2015 (Block 2 Plan included in this report)
- Map B.7.4-2 - Fruitland-Winona Secondary Plan – Natural Heritage System
- Map B.7.4-3 - Fruitland-Winona Secondary Plan – Transportation Classification Plan
- Map B.7.4-4 – Fruitland-Winona Secondary Plan – Block Servicing Strategy Area Delineation.

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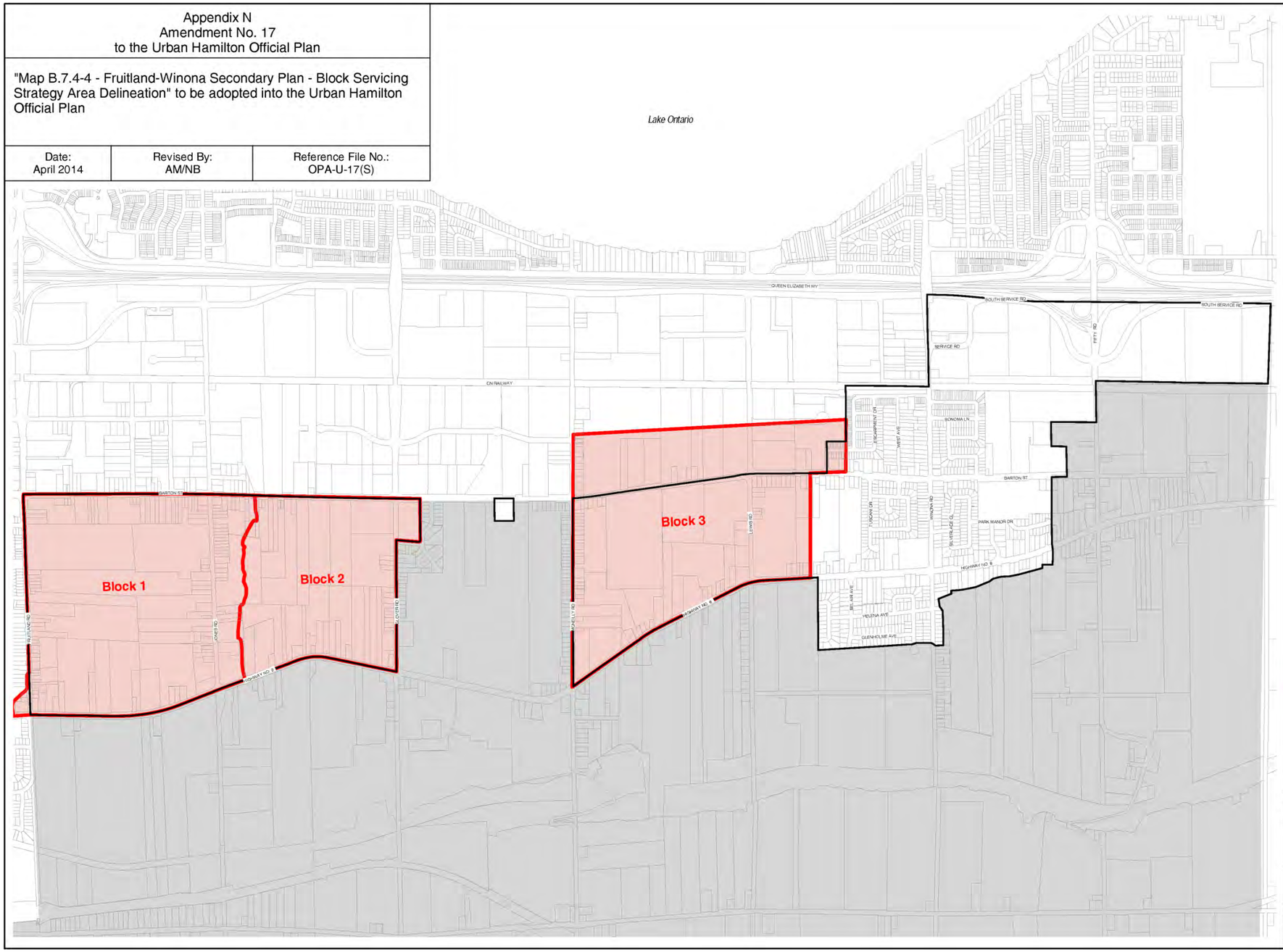



Figure 2.1 – Fruitland–Winona Secondary Plan – Block Servicing Plan Areas

**Figure 2-1 –Fruitland-Winona Secondary Plan – Block Servicing Plan Areas**

The Secondary Plan for Block 2 includes a number of land uses, including low density residential 2 (20 to 40 net units per ha), low density residential 3 (40 to 60 net units per ha), medium density residential 2 (60 to 75 units per ha), arterial and local commercial, a neighbourhood park, natural open space and institutional land uses. The topography for Block 2 is generally flat with natural heritage features including several watercourses (e.g. Watercourses 6.0 and 7.0). The HCA regulated mapping also shows a section of Watercourse 6.1 to be regulated in Block 2. The Fruitland-Winona Sub-Watershed studies are to form the basis of the block servicing strategy. The Block 2 Servicing Strategy is to include:

1) the neighbourhood park as shown in the Fruitland-Winona Secondary Plan;
2) local road pattern and any trail connections;
3) boundaries of the land use designations;
4) meander belt width assessments for watercourses;
5) preliminary grading plan;
6) preferred servicing plan;
7) stormwater management strategy, functional design plan and drainage plans which outline major and minor systems;
8) phasing for the development;
9) a scoped air drainage analysis brief;
10) hydrological investigation;
11) phasing strategy for external road infrastructure;
12) availability of storm and sanitary outlets; and
13) servicing needs for abutting developments.

As part of the Block 2 Servicing Strategy, a process of consultation with the affected landowners is to be undertaken.

The Fruitland-Winona Secondary Plan Transportation Classification Plan is intended to be flexible and may be modified within the Block Servicing Strategy provided that the proposed change does not result in a decrease in the residential density for the Block area or alter the intention and functionality of the collector road system. A north-south collector road is included in the Block 2 Secondary Plan. Any new local road crossings should avoid significant and/or sensitive natural features with roadway drainage infrastructure to provide capacity to pass the Regulatory flood event or meet regulatory flooding depths on roadways.

Stormwater Management facilities were not designated on the land use plan. The size, number and location of the stormwater management facilities are to comply with the City's criteria and guidelines for stormwater infrastructure design and policies, the Fruitland-Winona Sub-watershed Studies and the Block Servicing Strategy. These stormwater management facilities may be identified or relocated through the Block Servicing Strategy. Stormwater management facilities along the Barton Street Pedestrian Promenade are to be designed to promote public safety and, where possible, not be

fenced. Further, passive recreation is to be incorporated in the stormwater management facility if possible.

The Fruitland-Winona Secondary Plan land use figure (**Figure 2-2**) shows a portion of Watercourse 7.0 and designates it as natural open space as the area was identified as a core area. The Natural Heritage map which is part of the Official Plan shows the remainder of the watercourse and the associated vegetation protection zones and linkages. The Block 2 Servicing Strategy is to include a review of existing conditions to confirm the natural heritage systems.

On December 4, 2015, a decision by the Ontario Municipal Board (OMB) to address an appeal by the appellants of Urban Hamilton Official Plan Amendment No. 17 (UHOPA 17) (Fruitland-Winona Secondary Plan) as it pertained to their lands known as 860 and 884 Barton Street was given. As part of the proposed settlement, a Site Specific Policy Area K was established which outlined the land uses for this area and which amended UHOPA 17. The Block 2 Secondary Plan figure (**Figure 2-2**) that is included in this report reflects this OMB decision.


**Figure 2-2 –Secondary Plan Land Use**

## 2.2 SCUBE West Subwatershed Study

The Stoney Creek Urban Boundary Expansion (SCUBE) Subwatershed study was undertaken in support of the Secondary Plan and was completed in three phases. The Subwatershed Study Phase 3 Document combined the findings from the SCUBE West Study (Blocks 1 and 2) and the SCUBE East study (Block 3).

A summary of the three phases is provided below.

**Phase 1:** Investigate and define existing conditions, including environmental constraints and opportunities for development.

**Phase 2:** Evaluate future land use impacts and develop a Subwatershed Strategy, comprised of recommended works and measures to address stormwater management and maintenance, protection and enhancement of the study area's significant natural heritage features and ecological functions.

**Phase 3:** Develop an implementation plan to guide future work by the City of Hamilton and development proponents.

The key findings are provided below:

**Stormwater Management**

The preliminary locations for the stormwater management ponds are shown in **Figure 2-3**. The ponds are designed to provide water quality treatment together with the reduction of downstream erosion and flooding. Low Impact Development measures will also be required to meet water balance requirements. The level of control for water quality was originally set to meet Level 2 but was increased to meet Level 1 at the request of HCA at the conclusion of the SCUBE West study. In an effort to be conservative and to ensure that the subject lands are serviceable from a water quality perspective, the SWM ponds herein have been sized to Level 1. Should Level 2 be deemed an appropriate water quality target in the future, the SWM ponds can be reduced in size.

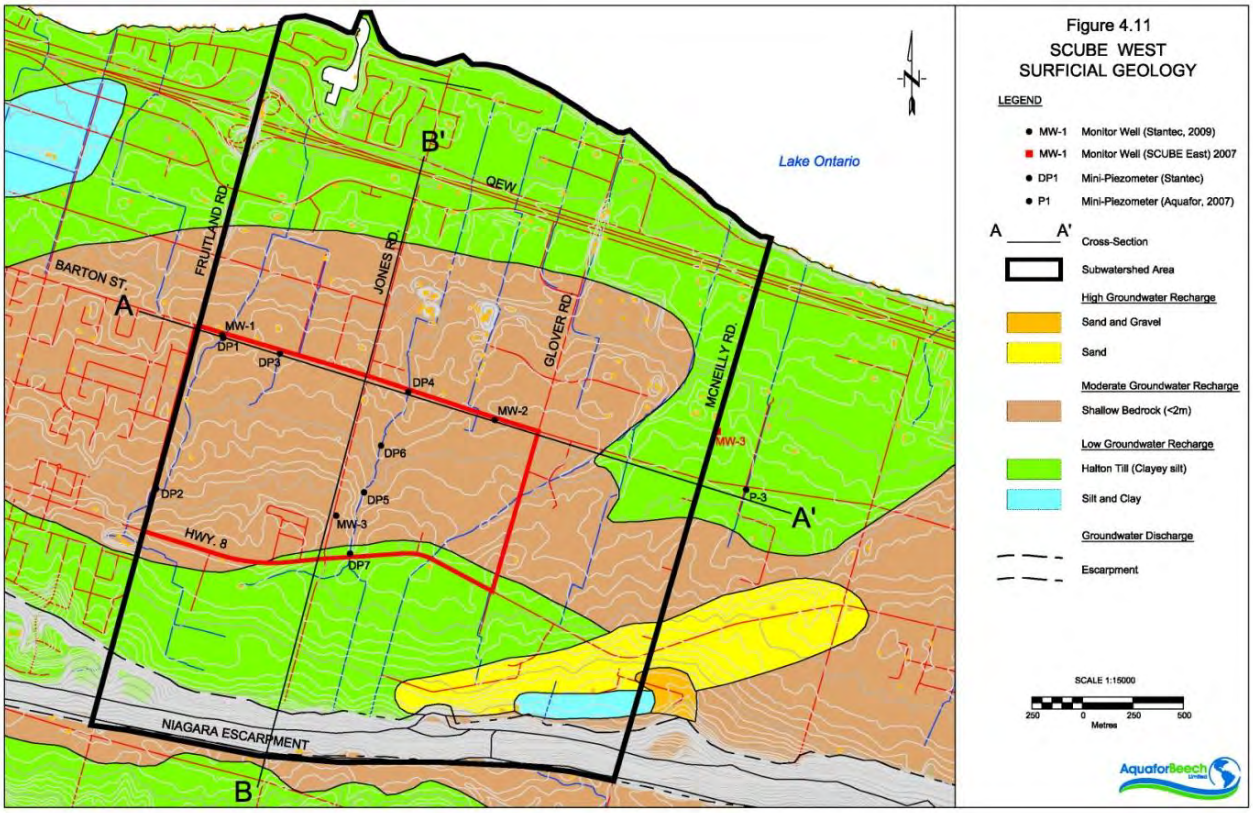
The approximate storage volumes (on a per hectare basis) are 100 $m^3$/ha for erosion and 450 $m^3$/ha for flood control. The location, volume and associated land requirements will be updated as part of the Block Servicing Study and will subsequently be refined at the Functional Design Level and detailed design Level.

**Groundwater Resources**

A review of the geology and hydrogeology of the study area was undertaken to gain an

understanding of the groundwater resources within the study area, including potential groundwater recharge and discharge locations. Water well records, geology and soils maps were reviewed to characterize the groundwater system. In addition, the logs of several monitoring wells and piezometers on this and the contiguous property were provided by the City of Hamilton.

Based on the 2009 boreholes advanced by Stantec, the SCUBE West area is characterized by a relatively low recharge potential and relatively shallow piezometric surface (<5 m below ground surface). In particular, it is noted that the silt till and several metres of the underlying shale bedrock are noted as being dry in the boreholes logs. This observation suggests that the overall recharge potential across SCUBE West is very low. There is a band of sand at the base of the Escarpment where higher infiltration potential is expected, although this represents a small area of the subwatershed. Figure 3.12 from the SCUBE West Study is reproduced below.




**Geology of the SCUBE West study area (after Feenstra, 1985) with Stantec Monitor wells and piezometer locations. Monitor P-3 on SCUBE East from Jagger Hims (2007)**

To better characterize the existing infiltration rates for the study area, a basic water budget was prepared for the existing land use conditions. The estimated annual groundwater

recharge for the silty clay soils over the majority of the study area is approximately 100 mm per year. The remaining 171 mm occurs as overland runoff. The isolated area of sand/gravel deposits near the base of the Niagara Escarpment has a significantly higher annual recharge rate of approximately 200 mm per year. The remaining 85 mm occurs as overland runoff.

In areas of silty clay soils it is recommended that future stormwater management planning should include measures, where feasible, to minimize changes to the existing groundwater recharge rate of approximately 100 mm per year. This will, in turn, help to minimize future increases in runoff rates. The areas with granular soils, situated near the base of the Escarpment represent a zone of high groundwater recharge potential. Given its function as a potential contributor of baseflow to stream reaches to the north, the existing recharge potential of approximately 200 mm per year from this feature should be protected through future source and conveyance control stormwater management measures which promote the infiltration of clean runoff.

Table 5.1 of the SCUBE Watershed Study Phase 3: Implementation Report summarizes the water balance requirements. The water balance requirements vary between 1 to 3 mm per event depending on native soil type. Measures such as disconnection of downspouts, pervious pavements or soakaway pits may be used to meet these requirements.

**Natural Heritage System**

The Recommended Natural Heritage System (NHS) is shown in **Figure 2-4**. As detailed in the EIS completed in support of the Block 2 Servicing Strategy, (the NHS is comprised of Core Areas (Key Natural Heritage Features, Key Hydrologic Features, and Local Natural Areas and their associated Vegetation Protection Zones (VPZs)) collectively with Linkages, comprise the Natural Heritage System (NHS). The NHS, in addition to hazards such as floodplain and erosion hazard lands, constitutes constraints to development. The EIS notes that the floodplain mapping for Watercourse 6.0 should be updated as more accurate, up-to-date topographic mapping becomes available. The floodplain mapping for Watercourse 6.0 will be updated, if needed, as the Hamilton Conservation Authority ongoing study is finalized. It also notes that culvert expansion at Barton Street be considered to see if the floodlines can be reduced.

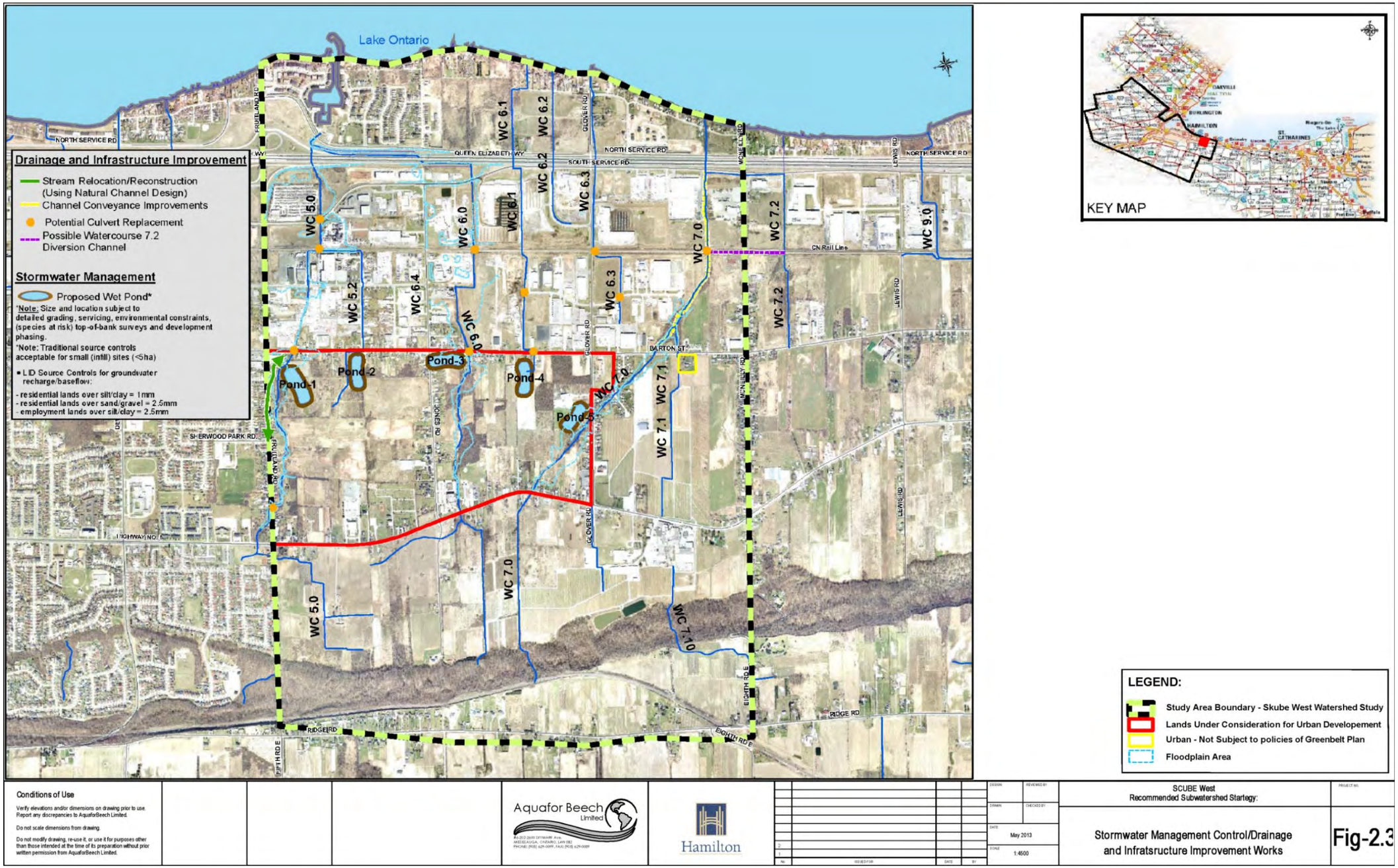



**Figure 2-3 –SCUBE West Stormwater Management Ponds**

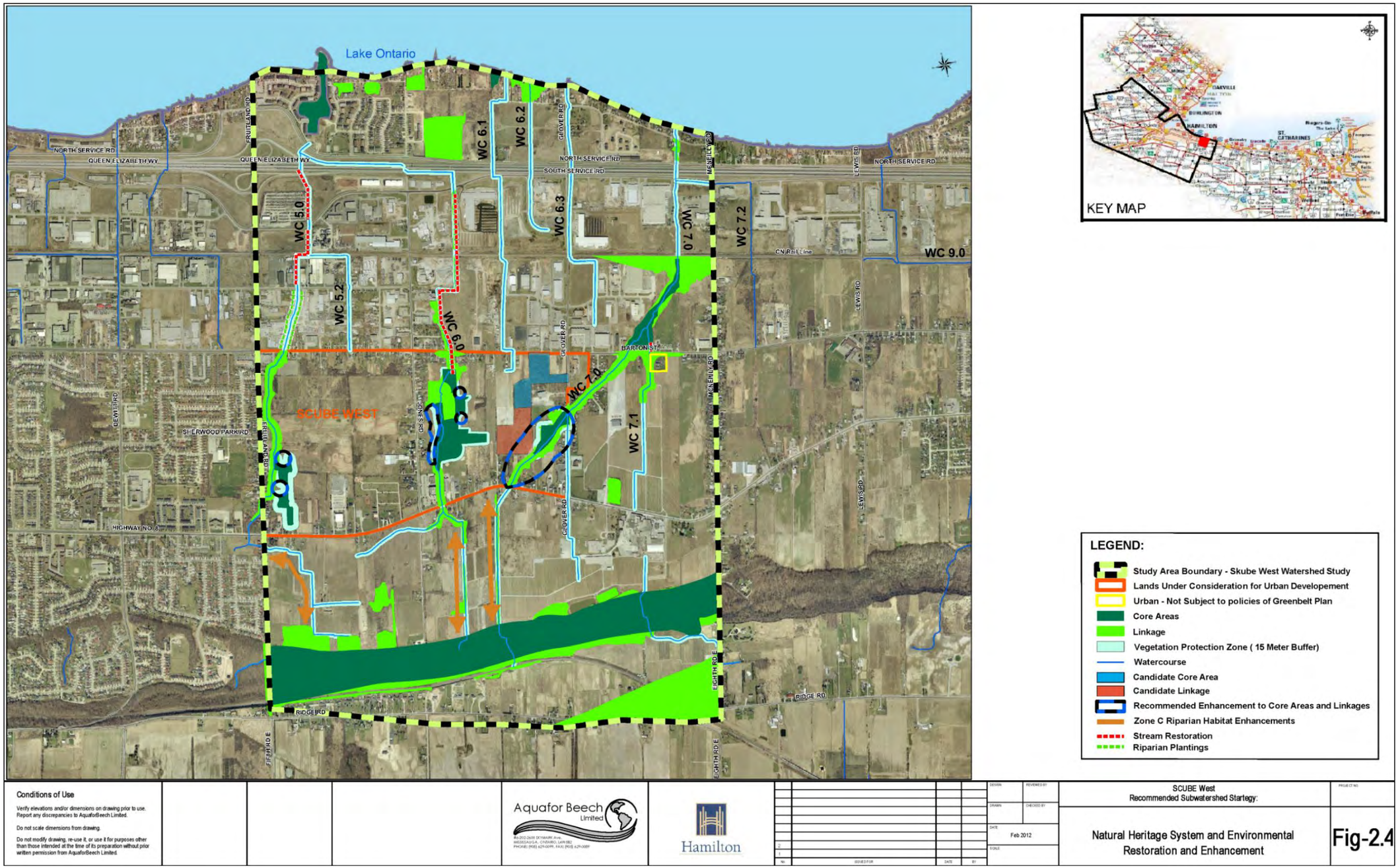



**Figure 2-4 –SCUBE West Natural Heritage Systems**

The EIS also notes that further work to define hazard lands, habitat of species-at-risk (SAR) and other species of conservation concern, and Significant Wildlife Habitat needs to be undertaken at a subsequent planning phase.

Upon filing of the Subwatershed Study (as part of the Environmental Assessment process) a 'Bump Up Request' was filed with respect to a property located on the north east corner of Block 2. As a result, the report was updated to reflect the removal of Woodland 6. Table 4.1 of the SCUBE report was also updated to provide the following statement.

"As mentioned above Woodland 6 was removed subsequent to the completion of Phases 1 and 2 of the SCUBE Subwatershed study. The remaining meadow has not been evaluated to determine whether it qualifies as significant wildlife habitat. As noted in Sections 5.3.2.3.7 and 5.3.2.3.8, the meadow could potentially serve as specialized habitat for wildlife and/or habitat for species of conservation concern. Accordingly, it is recommended that investigation of significant wildlife habitat be conducted by a qualified individual (e.g. ecologist)."

# 3.0 DEVELOPMENT OF EXISTING CONDITIONS

The following sections provide an overview as to how the development of existing environmental features and functions within the Block 2 lands were established.

Defining the current state of the environment, as well as the relationship between each feature is necessary in order to characterize key environmental functions, define opportunities and limitations associated with future development, and to ultimately establish alternative strategies to protect, enhance or restore the environmental features over time.

The following sections will summarize the approach used together with the findings for each of the individual disciplines. **Section 3.5** will then pull together the findings to prepare an overall map illustrating the Natural Hazard and Environmental Limitations to development.

## 3.1 Floodplain Mapping

The floodlines from the SCUBE report were initially used to define the extent of flooding within the study area. The 100-year storm was used to define floodplain limits. During the study discussions were held between Aquafor Beech Limited and Hamilton Conservation Authority (HCA). The discussions pertained to the limitation of the accuracy of the existing topographic information which is used, in part, to establish the floodlines. HCA provided Aquafor with a more accurate set of topographic information from an ongoing study for HCA. This information was used and the floodlines were updated accordingly. The floodlines are shown on **Figure 3-5**.

## 3.2 Meander Belt Assessment

As part of developing environmental constraints, a meander belt assessment was undertaken. A meander belt represents the area that a channel can reasonably be expected to occupy both now and in the future with respect to channel movement and migration. Meander belt delineation is used in conjunction with erosion hazard mapping and is a required buffer adjacent to watercourses since anything situated within a meander belt could, at some time in the future, be subject to erosion by the channel.

The Toronto and Region Conservation Authority (TRCA) (2004) meander belt delineation procedures are generally accepted guidelines for completing river erosion hazard mapping within the TRCA jurisdiction, and these procedures are considered appropriate for most other conservation authority watersheds in southern Ontario. Other relevant guidelines in Ontario for assessment of meander belts and slope erosion hazards include Ministry of Natural Resources Ontario (MNR) (2002) and Conservation Ontario (2005).

The procedures in the report followed the TRCA (2004) protocol. When a channel has been historically altered or straightened, the existing meander pattern does not reflect the potential meander belt that the channel would have had if it had remained unaltered, and in turn empirical relationships may be applied to provide a conservative meander belt which assumes a natural sinuosity of the watercourse returns.

The following relationship based on drainage area, gradient, stream power, and discharge was used to define the meander belts for watercourses 6 (MB = 57.8m) and 7 (MB = 54.3m). In order to allow for erosion access allowances beyond the top of the meander belt, two times the standard deviation of the empirical equation was added to the meander belt.

$$M_b = -14.827 + 8.319 \ln (A_d \times \Omega) + 2(\text{Std. Dev.}) \qquad r^2 = 0.74$$

Where: $M_b$ = Meander Belt; $A_d$ = Drainage Area; $\Omega$ = Stream Power.

A summary table has been included below to define the parameters used in determining the meander belts.

**Table 3.1 Meander Belt Parameters for Watercourses 6 & 7.**

| Watercourse | Discharge (m3/s) | Drainage Area (km2) | Gradient (m/m) | Stream Power (W/m) | Standard Deviation | Meander Belt |
|---|---|---|---|---|---|---|
| 6 | 7.70 | 1.463 | **0.007** | **528.54** | **8.63** | **57.76** |
| 7 | 7 | 1.485 | **0.005** | **343.21** | **8.63** | **54.29** |

### 3.3 Natural Heritage System

The City of Hamilton uses a systems approach to natural heritage system planning: the NHS is comprised of Core Areas and Linkages, as illustrated below in **Figure 3-1**. The City of Hamilton's Urban Official Plan (2012) defines Core Areas as lands comprised of *key hydrologic features, key natural heritage features, and local natural areas.* Linkages are defined as natural areas that within the landscape that ecologically connect Core Areas. These definitions are expanded upon in the EIS (**Appendix E**). Furthermore, within the Fruitland-Winona Secondary Plan, policy B.7.4.11 states that the Natural Heritage System is comprised of Core Areas, Linkages, Vegetation Protection Zones and Restoration Areas.

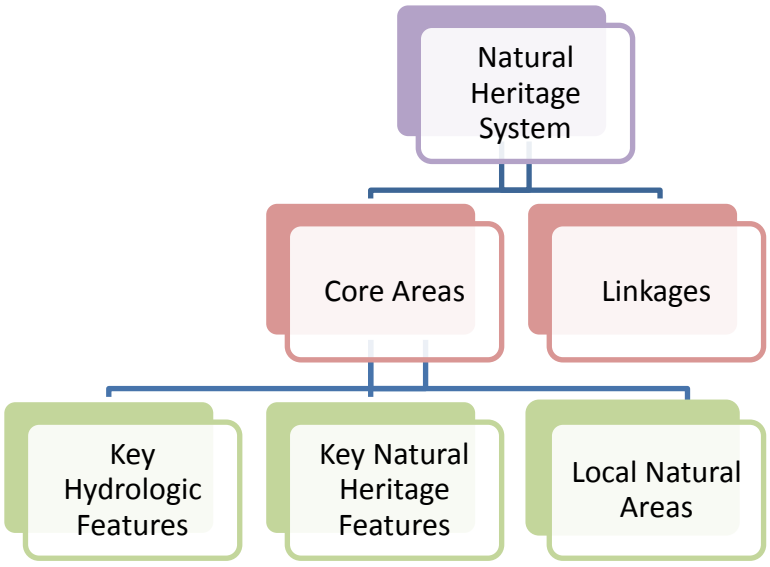



**Figure 3-1 – Overview of the City of Hamilton's approach to natural heritage planning**

The intent of the City's natural heritage policies is to "to preserve and enhance Core Areas and to ensure that any development or site alteration within or adjacent to them shall not negatively impact their natural features or their ecological functions" (UHOP Vol. 1 Policy 2.3). According to the City of Hamilton's Urban Hamilton Official Plan Vol. 1 Policy 2.3.3, "the natural features and ecological functions of Core Areas shall be protected and where possible and deemed feasible to the satisfaction of the City, enhanced. To accomplish this protection and enhancement, vegetation removal and encroachment into Core Areas shall generally not be permitted, and appropriate vegetation protection zones shall be applied to all Core Areas."

To characterize the existing conditions within the Block 2 study area, Aquafor Beech Limited relied upon primary and secondary information sources. The following background information was reviewed and incorporated into the EIS, as applicable:

- City of Hamilton Urban Official Plan (2013);
- The Provincial Policy Statement (2014);
- Hamilton Conservation Authority policies and mapping;
- Hamilton Natural Areas Inventory Species Checklist Document (2014);
- Solicitation of natural heritage data form the Ministry of Natural Resources and Forestry (MNRF);
- Natural Heritage Information Centre (NHIC)/MNRF database (Make-a-Map);
- SCUBE Subwatershed Study, Phases 1 and 2 Final Report (Aquafor Beech Ltd., 2014),

- SCUBE Subwatershed Study, Phase 3; Implementation (Aquafor Beech Ltd., 2013),
- Linkage Assessment of 860 and 884 Barton Street, Stoney Creek (Colville Consulting Inc. 2012); and,
- Historic and current aerial photography.

In addition, the following biophysical studies were completed in 2015:

- Vegetation community classification;
- Summer vegetation inventory;
- Breeding bird surveys;
- Amphibian breeding surveys (anurans);
- Incidental observations of wildlife;
- Updating of the floodplain for Watercourse 6.0; and,
- Delineation of the meander belts on Watercourses 6.0 and 7.0.

As detailed in the EIS (**Appendix E**), Core Areas of the Natural Heritage System within the Block 2 study area consist of wetlands, significant woodlands, significant wildlife habitat, habitat of Endangered and Threatened species, and watercourses. Linkages consist of the northern portion of ELC polygon 1, ELC polygon 10, FODM7-2, and Watercourses 6.0 and 7.0. These features and their NHS designations are summarized in **Table 3.2**, below. A map of vegetation communities (**Figure 3-3**) has been provided for context. Lands shown on this map as "not assessed" were not subject to vegetation community classification because 1) lands had recently been cleared/altered; and, 2) land access permission was not secured. Land access is illustrated at the end of this report in **Figure 7-1**. Lands that were not accessed during 2015 due to lack of access permission were assessed using a combination of air photo interpretation and visual assessments from adjacent lands.

Limitations and opportunities to development, which includes the NHS, are illustrated in **Section 3.4**, **Figure 3-5**.

### 3.3.1 Aquatic Resources

Fish habitat characterization and recommendations for enhancement and restoration are based upon information contained within the SCUBE West Subwatershed Study Phase 1 and Phase 2 Final Report (Aquafor Beech Ltd., 2013) and the SCUBE Subwatershed Study Phase 3 Final Report (Aquafor Beech Ltd., 2014).

Within the study area, Watercourses 6.0 and 7.0 are considered indirect/supporting fish habitat. Downstream of the CN rail track between Glover Road and the QEW, Watercourse 7.0 is considered direct fish habitat. Fish habitat classifications are illustrated in **Figure 3-2** below.


**Figure 3-2 – Fish Habitat Classification**

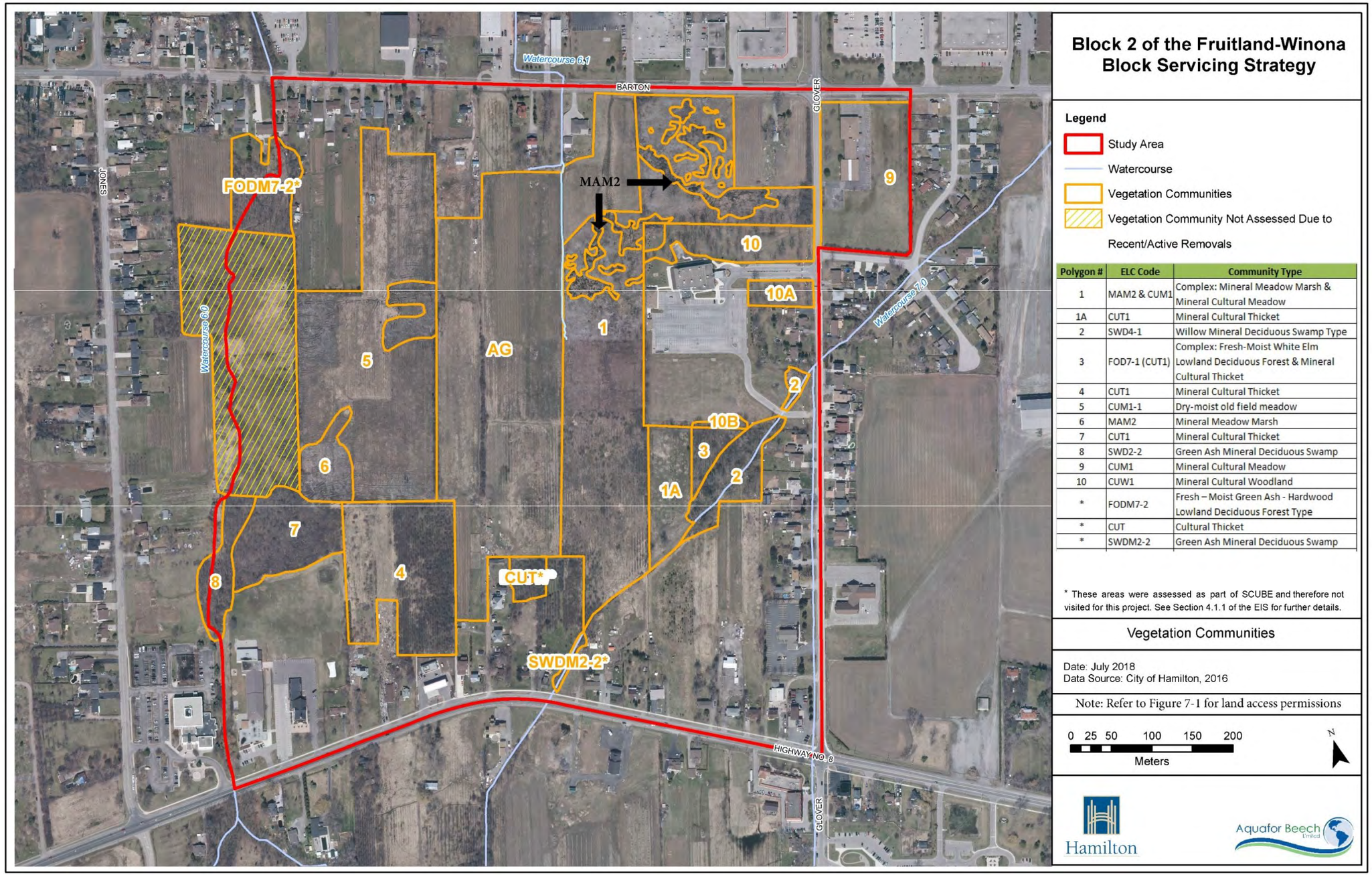
The southern "hockey stick-shaped" portion of Watercourse 6.1, as shown in the SCUBE West Subwatershed Study Phase 1 and Phase 2 Final Report (Aquafor Beech Ltd., 2013), is considered indirect/supporting fish habitat. The portion of the watercourse south of the aforementioned portion of Watercourse 6.1 (not pictured in **Figure 3-2**) was added to the watercourse mapping following a site visit by the Hamilton Conservation Authority on June 9th 2016.

While a seasonally appropriate survey of Watercourse 6.1 has not been completed to date, based on the information available and assessment completed through the current study **Hamilton Conservation Authority staff note that while the feature does contribute to fish habitat downstream it has limited function overall and would not be required to be retained as an open feature when these lands go forward for development.** The drainage contribution of the existing feature to downstream reaches would have to be maintained through the stormwater management design. Furthermore, the status of Watercourse 6.1 as possible fish habitat will have to be screened by the DFO before any land development decisions are made. Fish Habitat Compensation may be required for changes to the feature.

Restoration of the downstream portion of Watercourse 6.0 and all of Watercourse 7.0 is recommended. Furthermore, in recognition of the recent extensive vegetation removals along Watercourse 6.0., it is recommended that riparian areas which were subject to removals be replanted. See **Section 6.5** for further details.

**Table 3.2 – Summary of Core Areas and Linkages within the Natural Heritage System**

| | | | |
|---|---|---|---|
| **Natural Heritage System** | **Core Natural Areas** | **Key Natural Heritage Features** | **Discussion** |
| | | Fish Habitat | All watercourses within the study area provide contributing fish habitat. |
| | | Wetlands | Wetlands within the study area consists of ELC polygons 1 (in part), 2, 5 (in part), 6, and 8. ELC polygons 1 (in part), 5 (in part), and 6 are composed of Mineral Meadow Marshes, while ELC polygons 2 and 8 are deciduous swamps. In addition, a green ash mineral deciduous swamp (SWDM2-2), located at the downstream end of Watercourse 7.0, was identified during the SCUBE study (Aquafor Beech Ltd., 2014) and based on air photo interpretation appears to be extant. As detailed in Section 8 of the EIS, all wetlands except for those complexed within ELC polygon 5 are included in the NHS. |
| | | Significant Woodlands | As detailed in Section 9 of the EIS, Significant Woodlands within the study area include all treed communities with the exception of ELC polygons 10 and 10A, SWDM2-2, and FODM7-2. |
| | | Significant Wildlife Habitat | Confirmed significant wildlife habitat within the study area includes Habitat for Species of Special Concern and Rare Species, consisting of wetlands complexed within ELC polygons 1 and 5, as well as woodland represented by ELC polygon 10B.<br>Potential significant wildlife habitat consists of bat maternity roosts in treed habitats, and snapping turtle habitat within watercourses and stream corridors. Both of these habitats are protected under other natural heritage designations (i.e. significant woodlands, watercourses) and hazard lands (i.e. floodplain, meanderbelt/erosion hazard). |
| | | Significant Habitat of Endangered, Threatened, and Special Concern Species | As detailed in EIS (**Appendix E**), regulated habitat for bobolink and barn swallow is present within the study area. Alteration of regulated habitat will require a permit under the Endangered Species Act, in consultation with the MNRF.<br>As detailed above, potentially suitable habitat for Endangered bats, consisting of treed habitats, are included in the NHS. In addition, potentially suitable habitat for species of special concern; i.e. snapping turtle and West Virginia white, consisting of stream corridors and FODM7-2, respectively; are included in the NHS. |
| | | **Key Hydrologic Features** | **Discussion** |
| | | Permanent and Intermittent Watercourses | Watercourses 6.0 and 7.0 are shown in Schedule B-8 of the City of Hamilton's Urban Official Plan (2013). Based upon observations made in the field and information contained within the SCUBE Phase 1 & 2 report, Watercourse 6.1 and Watercourse 7.0 are intermittent watercourses. Watercourse 6.0 also exhibits characteristics of an intermittent watercourse, with the exception of the lower reach that is located between residential properties fronting on Barton Street. This latter area is considered a permanent watercourse.<br>Regarding potential re-development for the existing residential lots located along the west side of Glover Road to the north of Highway No. 8 adjacent to the tributary to Watercourse 7.0, an assessment of development constraints would be required should re-development be considered at a future planning stage. |
| | | Wetlands | ELC polygons 1, 2, 5, 6, and 8 are wetlands, or are complex communities which include wetlands. ELC polygons 1 (in part), 5 (in part), and 6 represent Mineral Meadow Marshes, while ELC polygons 2 and 8 represent deciduous swamps. In addition, a green ash mineral deciduous swamp (SWDM2-2), located at the downstream end of Watercourse 7.0, was identified during the SCUBE study (Aquafor Beech Ltd., 2014). As detailed in Section 8 of the EIS, all wetlands except for that which is complexed within ELC polygon 5 are included in the NHS. |
| | | **Local Natural Areas** | **Discussion** |
| | | Unevaluated Wetlands | None of the wetlands within the study area were subject to evaluation under the Ontario Wetland Evaluation System (OWES). ELC polygons 1 (in part), 2, 5 (in part), 6, 8 and the green ash mineral deciduous swamp (SWDM2-2) associated with Watercourse 7.0 represent wetlands, or are complex communities composed of wetlands. All wetlands except for those complexed within ELC polygon 5 are included in the NHS (per the direction of the City of Hamilton). |
| | **Linkages** | | **Discussion** |
| | | | As detailed in Section 10 of the EIS, Linkages within the study area consist of ELC Polygon 10 and the portion of cultural meadow in ELC Polygon 1 that surrounds the wetland complex in the northern portion of the vegetation polygon, the forest on the downstream end of Watercourse 6.0 (FODM7-2), and Watercourses 6.0 and 7.0. |
| | **Restoration Areas** | | **Discussion** |
| | | | Per the Fruitland-Winona Secondary Plan, Restoration Areas are included in the NHS. See Section 14.3 of the EIS for details. |




| Polygon # | ELC Code | Community Type |
|---|---|---|
| 1 | MAM2 & CUM1 | Complex: Mineral Meadow Marsh & Mineral Cultural Meadow |
| 1A | CUT1 | Mineral Cultural Thicket |
| 2 | SWD4-1 | Willow Mineral Deciduous Swamp Type |
| 3 | FOD7-1 (CUT1) | Complex: Fresh-Moist White Elm Lowland Deciduous Forest & Mineral Cultural Thicket |
| 4 | CUT1 | Mineral Cultural Thicket |
| 5 | CUM1-1 | Dry-moist old field meadow |
| 6 | MAM2 | Mineral Meadow Marsh |
| 7 | CUT1 | Mineral Cultural Thicket |
| 8 | SWD2-2 | Green Ash Mineral Deciduous Swamp |
| 9 | CUM1 | Mineral Cultural Meadow |
| 10 | CUW1 | Mineral Cultural Woodland |
| * | FODM7-2 | Fresh – Moist Green Ash - Hardwood Lowland Deciduous Forest Type |
| * | CUT | Cultural Thicket |
| * | SWDM2-2 | Green Ash Mineral Deciduous Swamp |



**Figure 3-3 – Vegetation Communities**

## 3.4 Establishment of the Natural Hazards and Environmental Limitations Map

Limitations to development include natural heritage features protected under the City of Hamilton's Urban Official Plan (2013) and the policies of the HCA, VPZs associated with natural heritage features, as well as hazards such as floodplain and erosion hazard lands. Opportunities to development consist of lands outside of constraint areas. Opportunities and constraints to development are illustrated in **Figure 3-5**.

As detailed in the EIS, nesting and foraging habitats for both barn swallow and bobolink (species-at-risk) are present within the study area. Tt is expected that habitat for barn swallow will be compensated for within the study area in a natural area adjacent to open parkland and wetland; habitat for bobolink will be compensated for off-site (to be confirmed through consultation with the MNRF). Accordingly, habitat for these species is not shown as a constraint to development. However, in order to develop, persons owning lands that contain regulated habitat for barn swallow and/or bobolink will need to consult with the MNRF about obtaining a permit under the Endangered Species Act prior to any site alteration.

## 3.5 Properties Warranting Specific Consideration

There are several properties within the Block 2 study area that have undergone significant alteration immediately prior to and/or during the course of this study. These properties were not accessed as part of this study; characterization, where possible, was completed through air photo interpretation, review of background information, and observations made from the property line(s) (refer to **Figure 7-1** for land access permissions). As such, the limitations and constraints to development on these properties will need to be confirmed through the completions of an EIS. The EISs are to be completed by the development proponent(s) in consultation with the City of Hamilton and the Hamilton Conservation Authority at a subsequent planning stage. Suggested site-specific studies to be completed as part of the EISs are contained in **Section 6.4.1**. The development limits for these properties will be determined by the greater of the limits of the natural heritage system and/or hazard lands.

A description of the properties is contained below.

### 3.5.1 860 & 884 Barton Street

As described in previous studies (Aquafor Beech Limited, 2014; Colville Consulting Inc. 2012) a significant portion of the property on the south west corner of Barton Street and Glover Road was forested. The *Linkage Assessment of 860 and 884 Barton Street, Stoney Creek*, prepared by Colville Consulting Inc., describes the contiguous treed community on site as a Dry-Fresh Oak-Hickory Deciduous Forest Fresh-Moist Oak-

Maple-Hickory complex and a Mineral Green Ash Deciduous Swamp (see **Figure 6-1**). The report completed by Colville Consulting Inc. indicates that a provincially rare sedge (*Carex hirsutella*, S3) was located during field work. The habitat of provincially rare species is considered Significant Wildlife Habitat according to the MNRF's Significant Wildlife Habitat Technical Guide (2000). Significant wildlife habitat is protected under the City of Hamilton's Official Plan.

Subsequent to the acceptance of the Colville report and prior to June 2014, the forest on the aforementioned property (known as Woodland 6 in the SCUBE report) was removed in accordance with the tree bylaw in effect at the time.

On December 4, 2015, a decision by the Ontario Municipal Board (OMB) to address an appeal by the appellants of Urban Hamilton Official Plan Amendment No. 17 (UHOPA 17) (Fruitland-Winona Secondary Plan) as it pertained to their lands known as 860 and 884 Barton Street was given. As part of the proposed settlement, a Site Specific Policy Area K was established which outlined the land uses for this area and which amended UHOPA 17. The Block 2 Secondary Plan figure (**Figure 2-2**) that is included in this report reflects this OMB decision.

The Council Approved Fruitland-Winona Secondary Plan (FWSP) policy, specifically Natural Heritage System Map B.7.4-2, indicates that this area is designated as developable. The FWSP also provides policy guidance in Sections 7.4.2.5 and 7.4.11, which are consistent with Urban Hamilton Official Plan, as referenced in FWSP.

Site visits and wildlife surveys conducted from adjacent lands by Aquafor Beech Limited in support of this report, in combination with air photo interpretation, resulted in the identification of several natural heritage features on the property (**Figure 6-2**). Notably, the provincially rare sedge identified by Colville Consulting Inc. persists on site; a complex of wetlands, which provide breeding habitat for amphibians, is present where the forest once stood; and bobolink (Threatened) was recorded on site with a breeding status of 'probable'. In June of 2015, HCA identified an extension of Watercourse 6.1 on adjacent lands to the east. In addition, the habitat of barn swallow, another Threatened species (which is nesting off-site within the study area), overlaps onto the property. Wetlands are protected under the City of Hamilton's Official Plan, as are watercourses, significant wildlife habitat, and the habitat of Endangered and Threatened Species. The habitat of Endangered and Threatened species is also protected under the Endangered Species Act.

### 3.5.2 238 Jones Road

Natural heritage properties along Watercourse 6.0, which were confirmed to be designated by a Council approved FWSP Natural Heritage System Map b.7.4-2 as designated Core Areas, Linkages, Restoration Areas, Vegetation Protection Zone and Watercourses. Per the SCUBE study, natural heritage features present on the property include Watercourse 6.0, wetlands (swamp) and thicket. However, vegetation community assessments are limited by the survey methodology used at the time (i.e. roadside surveys). In 2014/2015, natural areas on 238 Jones Road were cleared.

**Figure 3-4 - Evidence of tree clearing at 238 Jones Road**

Field staff were not given permission to enter this property. An attempt was made to assess vegetation communities from the property line (see **Figure 3-4**). However, due to the recent clearing and grubbing an accurate assessment could not be made. Breeding bird and calling amphibian surveys were conducted adjacent to the property (Breeding bird point location 6 and Amphibian monitoring stations 4 & 5). None of the findings of the wildlife surveys have resulted in limitations to development outside of extant natural areas (i.e. woodlands, riparian corridor, etc.).

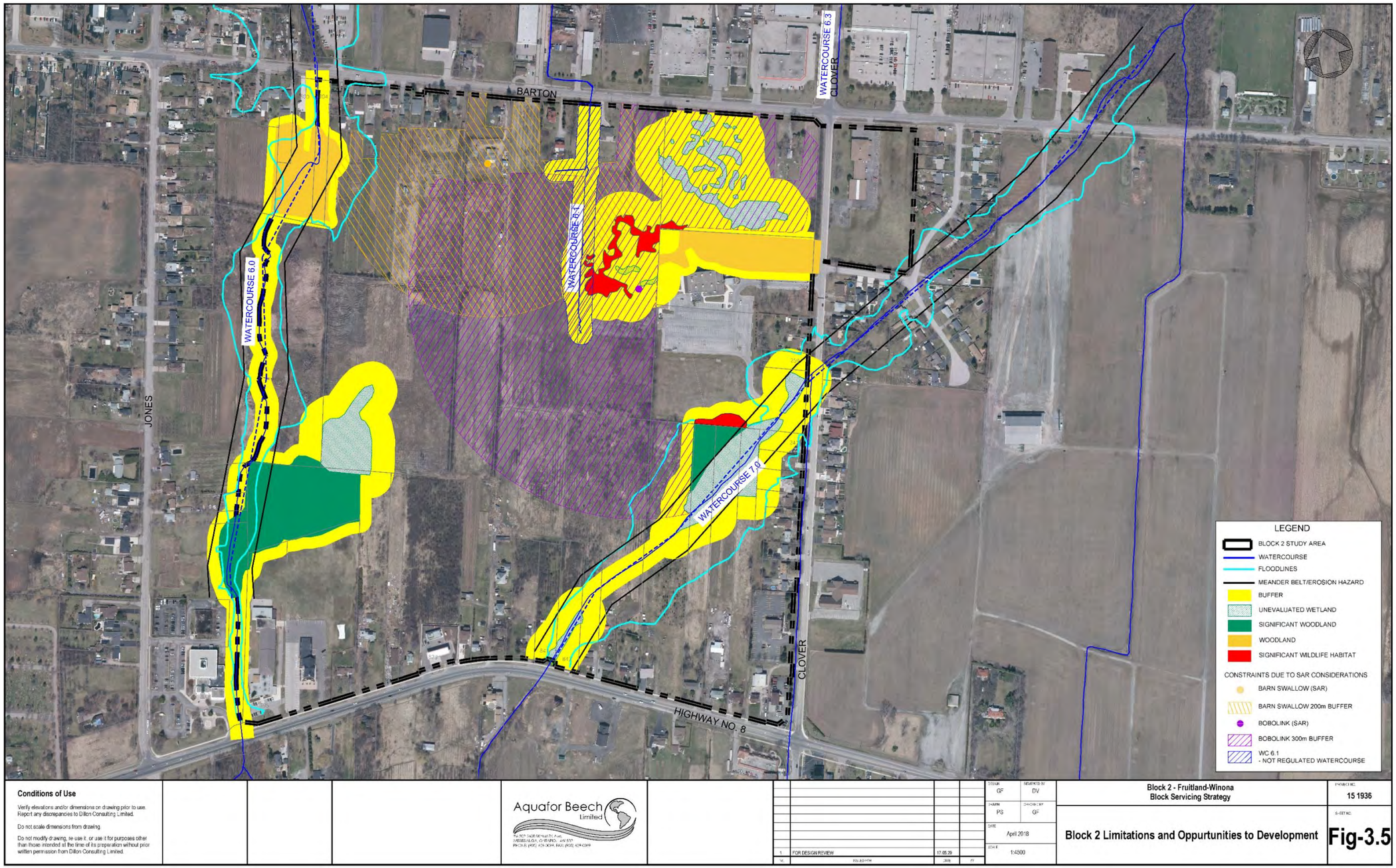



**Figure 3-5 – Limitations and Opportunities to Development**

# 4.0 DEVELOPMENT OF CONCEPT PLAN

## 4.1 General

The development of the Concept Plan starts with the land uses and limitations as defined in the Fruitland-Winona Secondary Plan (Secondary Plan) and then builds upon this with the findings from other studies (e.g. the SCUBE Subwatershed Study) together with the findings from this study. Provided below is an overview as to how the Concept Plan was established.

## 4.2 Concept Plan

### 4.2.1 Considerations

The considerations for the development of the Concept Plan included:

- The land uses that were shown in the Fruitland-Winona Secondary Plan (Hamilton Official Plan Map B.7.4-1).
- The development constraints which included the environmental features and environmental hazards defined through the Aquafor Beech floodplain mapping and erosion analyses. The aggregate of all development constraints for the study area are illustrated in **Figure 3-5**, above, and include:
    - Flood hazards, represented by 100 year floodlines,
    - Meander belt/erosion hazards,
    - NHS features, including wetlands, woodlands, and significant wildlife habitat that were identified through mapping and confirmed through field investigations with HCA and City staff,
    - NHS buffers, as defined by City and HCA policy.

Other considerations in the development of the Concept Plan included:

- Local roads.
- The neighbourhood park location as shown in the Fruitland-Winona Secondary Plan.
- Existing land uses to be preserved which included the Fruitland Christian Reformed Church, Kingdom Hall, John Knox Christian School and the Pioneer Gas Station (823 Highway No. 8).
- Stormwater Management Pond locations.
- Water and Wastewater Infrastructure Servicing.
- Grading.

### 4.2.2 Preliminary Concept Plan

As part of the preliminary concept plan development a road layout was proposed. The Secondary Plan defined the location of the north – south collector road. The proposed road layout was then based on the location of key features including the proposed park and stormwater management pond(s) together with the limitations defined by the natural heritage system.

The Block 2 servicing strategy required a transportation network for local roads that considered the Secondary Plan land use and the identified collector road and infrastructure to support future growth. The proposed local road system provides a road system that services the lands with infrastructure for the lands that require direct frontage onto a municipal road and also for lands that do not require municipal road frontage. As shown in **Figure 4-1**, a preliminary draft of the Concept Plan developed in Sept. 2016 recognized the constraints associated with the potential wetland and Watercourse 6.1 located on 844, 860 and 884 Barton Street. This preliminary concept plan did not include the December 4, 2015 decision by the Ontario Municipal Board (OMB) to address an appeal by the landowners of 860 and 884 Barton Street which established the approved land uses for 860 and 884 Barton Street. The preliminary plan (see **Figure 4-1**) was subsequently revised to assume that the potential wetland and other ecological constraints and significant wildlife habitat including barn swallow and bobolink will be addressed during the development process that follows the completion of the Block Servicing Strategy. This is discussed in subsequent sections of the report.

The road network has been designed to mitigate any negative impacts on the tender fruit areas to the south, by providing a north/south alignment of road corridors. The natural open space corridors and constraint areas also tie directly into the proposed and existing road patterns, to provide the noted desired alignment.

The preliminary concept plan included an east-west connection road from Jones Road to Glover Road to provide additional road access into and from the roads in Block 2. Also, the neighbourhood park was located west of the location in the Secondary Plan to mitigate the location of the park on Winona Vine Estates lands which were unlikely to develop in the near future and also to move the park away from the floodplain of Watercourse 7.0 (see **Figure 4-2**). Since the Secondary Plan did not provide for an east west collector road from Jones Road to Glover Road and established the location of the neighbourhood park. The preliminary concept plan was revised.

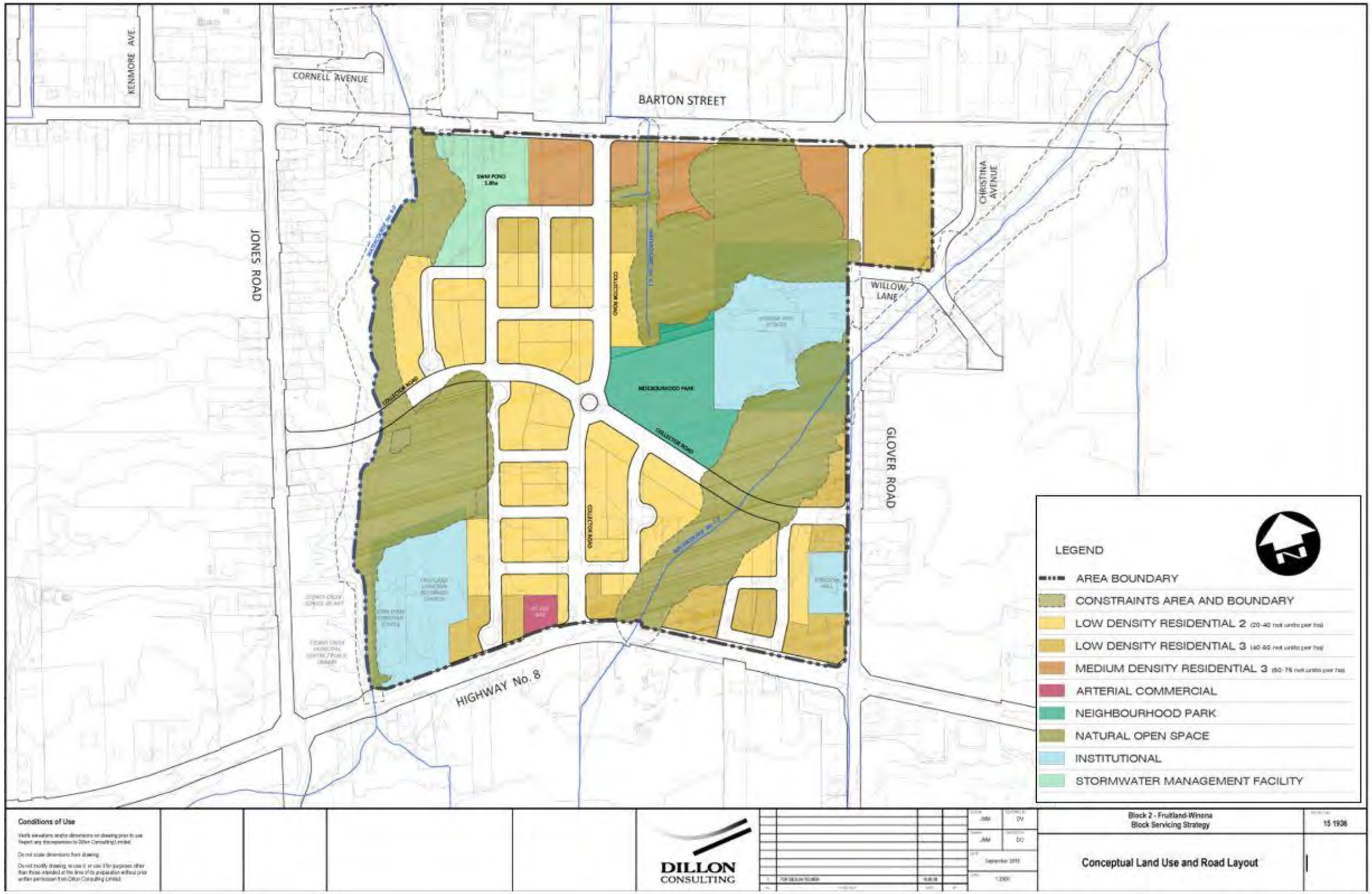



**Figure 4-1 – Preliminary Concept Plan (Sept. 2016)**


**Figure 4-2 – Neighbourhood Park Location Review (Oct 11, 2016)**

### 4.2.3 Concept Plan

The Preliminary Concept Plan was revised to address the issues identified in **Section 4.2.2**. With the inclusion of the lands at 860 and 844 an additional stormwater management pond was needed. The road layout was revised to include the lands at 860 and 844 Barton Street and Winona Vine Estates. The road layout needed to consider minimizing the need for easements for infrastructure. The plan does not include a road layout 288 Glover Road which already has servicing development plans.

The east west collector road from Jones Road to Glover Road was removed but in order to provide additional road access for Block 2 to the external boundary roads a local road connection from the north south collector road to Jones Road and a local road connection to Glover Road was added. The east west collector road from Jones to Glover Roads was originally considered in the transportation plan but was removed due to potential impacts with the Natural Heritage System / natural open space areas. The Block Servicing Strategy Environmental Impact Statement and the road placement have addressed the original concern with an east west collector road across the watercourses and environmental corridors. The location of these local road connections within the watercourse floodplain areas will be confirmed through a required environmental impact statement report following the completion of the Block Servicing Strategy Study and the review of this report is to be to the satisfaction of the City and HCA. A multi-use path from Jones Road to the proposed neighbourhood park is also included in the plan within the

local road connection corridor to Jones Road. The local road connection to Jones Road and the multi-use path align with the east west collector road in Block 1.

An additional road connection to Barton Street was proposed for the north east quadrant of the Block 2 study area (south west quadrant of Barton Street and Glover Road) but due to the potential for this connection to be a bypass for the north south collector road and promote increased traffic movement to this location, this road was removed. There is potential for lands adjacent to Barton Street west of Glover Road to be serviced by an internal road / driveway. A roundabout on the north south collector road has been added which will assist with slowing traffic on the collector road.

A cul de sac is located adjacent to Highway No. 8 to allow for emergency access and to service the lands in this area. With the road connection to Jones Road from the north south collector road, the location of this cul de sac can be reviewed during the detailed design stage with the consideration for relocating the cul de sac northerly away from Highway No. 8. An air drainage review has identified an opening at this location will assist with air drainage but is not required. A roundabout which will assist with slowing traffic on the north south collector road has been added to the plan at the intersection with the proposed local road connection to Jones Road.

The design of the Block 2 collector and local road network has taken into consideration the objectives, general policies and land use designations as identified in the Fruitland-Winona Secondary Plan. The design has been laid out to allow the implementation of the Plan's key objectives, including providing transportation and active transportation linkages for safe and functional residential neighborhoods, and adequate and efficient municipal services. The land use and road network meet the requirements of the general policies and land use designations and also takes advantage of the identified constraints and natural heritage, in providing opportunities for a variety of residential housing types, open space, and parkland (see **Figure 4-3**).

### 4.3 Natural Hazards and Environmental Constraints

The natural hazards and environmental constraints, as noted above, were taken into consideration when establishing the road network. It should be noted that the concept plan as shown, assumes that Watercourse 6.1 and the unevaluated wetland located in the northeast corner of the study area will be developed. As noted in **Section 3.3.1**, it has been confirmed by HCA that **Watercourse 6.1 can be enclosed/piped as long as downstream contributions were maintained**. Further direction with respect to the studies that need to be undertaken prior to confirmation of this assumption is contained within **Section 5.0**.

## 4.4 Stormwater Management Ponds

The Concept Plan shows the location of the two proposed stormwater ponds. These stormwater facility locations were not finalized as part of the Fruitland-Winona Secondary Plan process and will be finalized through the Block Servicing Strategy". Further details with respect to the sizing and functional layout of the facilities is provided in **Sections 5** and **6**. It should also be noted that the area southeast of Watercourse 7.0 cannot be serviced by a traditional stormwater pond due to the small drainage area and the lack of a suitable outlet for a pond. The details for servicing this area and the types of stormwater management to be provided are provided in **Section 5**.


**Figure 4-3 – Concept Plan**

# 5.0 FUNCTIONAL DESIGN

## 5.1 General

Chapter 4 provided the approach to developing the Concept Plan. This chapter will provide further details with respect the functional design of the stormwater management ponds, water, sanitary and storm sewer servicing.

## 5.2 Stormwater Management

Pursuant to the City of Hamilton Comprehensive Development Guidelines and Financial Policies Manual (2016), the following Functional Serving Report (FSR) has been prepared for the two (2) proposed stormwater management ponds intended to service the Block 2 lands of the Stoney Creek Urban Boundary Expansion (SCUBE) West area. The two (2) subject ponds are denoted as Pond 6.0 and Pond 6.1 and outlet to watercourses 6.0 and 6.1 respectively.

Per the City of Hamilton Comprehensive Development Guidelines and Financial Policies Manual (2016), a Functional Stormwater Management Report precedes the Detailed Stormwater Management Report and typically are at a level of detail below the detailed Stormwater Management Reports for any proposed developments with a minimum are of a 5 ha.

The subject Functional Stormwater Management Report (FSR) for Block 2 describes the existing servicing constraints, design criteria, provides a servicing assessment as well as the proposed servicing solution complete with functional designs.

From the SCUBE Subwatershed Study: Phase 3, the preliminary locations for the stormwater management ponds are shown in **Figure 2-3**. The subject ponds (Pond 6.0 and Pond 6.1) are noted as a single pond, Pond 4 in regards to water quality and flood control requirements, however Pond 3 which releases to Watercourse 6.0, provides relevant erosion control criteria and release rates for Pond 6.0. The Phase 3 report summarizes the conceptual stormwater management pond characteristics per the Phase 3 Study which has been updated and revised as part of the FSR.

The ponds were designed to provide water quality treatment together with the reduction of downstream erosion and flooding. Low Impact Development (LID) measures will also be required to meet water balance requirements. The level of control for water quality was originally set to meet Level 2 but was increased to meet Level 1 at the request of Hamilton Conservation Authority (HCA) at the conclusion of the SCUBE West study. In an effort to be conservative and to ensure that the subject lands are serviceable from a water quality

perspective, the SWM ponds herein have been sized to Level 1. Should Level 2 be deemed an appropriate water quality target in the future, the SWM ponds can be reduced in size.

As noted within the Phase 3 study the approximate storage volumes (on a per hectare basis) were 99 to 107 $m^3$/ha for erosion and 423 to 447 $m^3$/ha for flood control. The volume and associated land requirements were noted as 'requiring future updates as part of the Block Servicing Study and subsequently refined at the Functional Design Level, followed by the detailed design level'. In addition, it was noted that the location of the stormwater management ponds, as noted in the Secondary Plan were also subject to refinement.

The use of Low Impact Development (LID) source controls to maintain existing groundwater recharge rates and pre-development water balance is also required. Infiltration targets vary between 1 to 3 mm depending on native soil type. The subject study area has a volumetric infiltration target of 1 mm over the drainage area.

The Phase 3 study noted that the Functional Stormwater Management Reports (FSR) were required for the preliminary design of centralized SWM facilities, specifically in regards to:

- Hydrologic modelling to confirm/refine storage requirements based on updated drainage areas and development densities;
- Preliminary design of SWM Ponds (grading, inlet/outlet, rating curves);

The following section details the Functional Stormwater Management Report (FSR) for Block 2 and describes the existing servicing constraints, design criteria, provides a servicing assessment as well as the proposed servicing solution complete with functional designs.

## 5.3 Block 2 FSR – Low Impact Development Source Controls

As noted previously, the use of Low Impact Development (LID) source controls to maintain existing groundwater recharge rates and pre-development water balance is required. The subject study area has a volumetric infiltration target of 1 mm over the drainage area.

Current Stormwater management practice advocates the consideration of Stormwater Management Practices (SWMP's) on a hierarchical basis, whereby more pro-active techniques are considered first, beginning with:

1. Lot Level Techniques, Source Controls and Alternative Development Standards;
2. Transport or Conveyance Controls; and,
3. End-of-Pipe Controls.

The philosophy behind this hierarchy is that Stormwater management techniques are usually more effective when applied at the source.

The City of Hamilton supports the progressive implementation of a wide range of Stormwater management techniques. This range is expected to increase and change over time, as long-term monitoring results indicating the level of success of various techniques, become available. Per to the City of Hamilton Comprehensive Development Guidelines and Financial Policies Manual (2016), Section G.2.5, Table G.1 and G.2 provide the current perspective of the City of Hamilton regarding available Stormwater management practices, as well as special supporting documentation which is required for implementation of each technique. An amended Table G.1 and G.2 has been prepared below for the subject site.

**Table 5.1 – Amended List of Available LID Controls for Block 2**

| Stormwater Management Technique | City of Hamilton Perspective | Special Supporting Documentation Required to Verify Suitability |
|---|---|---|
| **Lot Level Techniques, Source Controls, and Alternative Development Standards** | | |
| Alternative Development Standards (i.e. Green roofs, biofilters) | On a case-by-case basis | Yes |
| Reduced lot grades | Not currently endorsed (ref. Lot Grading Standard) | N/A |
| Roof leader discharge to surface (Downspout Disconnection) | Encouraged | Address winter icing concerns |
| Roof leader discharge to soakaway pits & Rear yard ponding | Discouraged in residential land use due to maintenance and impacts on use of rear yards, including WNV | Geotechnical and on-site soil assessment |
| Porous pavement | Porous pavement applicable in specialized applications. Subject to proper documentation by the Proponent. | Technical documentation required |
| Pervious pavement | Pervious paving stone applicable in mitigation for thermal impacts; typically, appropriate in low volume areas such as overflow parking | Technical documentation required |

## 5.4 Block 2 FSR – Stormwater Management Ponds

Using the conceptual stormwater management pond characteristics developed as part of the Phase 3 Study as detailed in **Table 5.3**, the subject FSR updates and refines the stormwater management ponds requirements (Ponds 6.0 and 6.1). The subsequent sections detail the existing servicing constraints, design criteria and servicing assessment. It should be noted that the stormwater management ponds (Ponds 6.0 and 6.1) have not been designed to service drainage from the future urbanized Barton Street due to grading constraints as well as location of the ponds relative to the ultimate assumed outlets for the roadway.

### 5.4.1 Alternative Servicing Strategy for Barton Street Urbanization

Should the Barton Street urbanization include a ditched drainage system rather than subsurface piping, it is potentially feasible for the SWM ponds to accept drainage from the south side of Barton Street, however this must be confirmed at the detailed design stage. Alternatively, a servicing strategy (conveyance and quality control) could be established using Low Impact Development (LID) techniques such as bioswale or perforated pipes systems; or conventional approaches such as hydrodynamic separators or SWM filters. Again, this this must be confirmed at the detailed design stage. Quantity control could alternatively be provided by smaller SWM facilities on the south side of Barton Street, through superpipe storage or subsurface storage systems.

## 5.5 Existing Servicing Constraints

### 5.5.1 Imperviousness

A weighted imperviousness has been applied to the subject area which includes Natural Areas and Environmental constraints. The percent Impervious has been calculated for the subject drainage area using proposed GIS layers and C values from the City of Hamilton's 2016 standards. **Table 5.2** summarizes the imperviousness calculations.

**Table 5.2 – Weighted Imperviousness**

| Location/ Pond # | Drainage Area (ha) | Land-use Contributing to SWM Pond | Area | C-Value * | Assumed Imperviousness % |
|---|---|---|---|---|---|
| Pond 6.0 | 27.6 | **Env. Constraint/ Natural Open Space** | **7.69** | **0.15** | **52.9** |
| | | **Institutional** | **2.74** | **0.75** | |
| | | **Low Density Residential 2** | **6.29** | **0.50** | |
| | | **Low Density Residential 3** | **1.16** | **0.55** | |
| | | **Medium Density Residential** | **0.72** | **0.65** | |
| | | **Multi-Use Trail/ Park** | **0.22** | **0.25** | |
| | | **Road/ Arterial Commercial** | **6.61** | **0.90** | |
| | | | | | |
| Pond 6.1 | 16.4 | **Env. Constraint/ Natural Open Space** | **0.00** | **0.15** | **57.4** |
| | | **Institutional** | **0.00** | **0.75** | |
| | | **Low Density Residential 2** | **4.98** | **0.50** | |
| | | **Low Density Residential 3** | **1.22** | **0.55** | |
| | | **Medium Density Residential** | **4.59** | **0.65** | |
| | | **Multi-Use Trail/ Park** | **2.28** | **0.25** | |
| | | **Road/ Arterial Commercial** | **3.11** | **0.90** | |

*Per City of Hamilton's 2016 standards; ** SWM Pond excluded form the calculation

It must be noted that at the detailed design stage, the proponent will be required to reflect the final imperviousness based on the proposed development and update the control targets as required by applying the same methodology as described herein.

### 5.5.2 Hydrology

The Subwatershed Study also identified conceptual stormwater management (SWM) pond locations and catchments in the SCUBE West lands. Further ***catchment-scale*** modelling for these individual SWM ponds was also completed to estimate storage and release rate requirements to control the catchments to pre-development levels.

During the SCUBE West Subwatershed Study, a VISUAL OTTYMO hydrologic model was setup and calibrated to observed rainfall-runoff gauge data. The hydrologic model was used to estimate storage requirements for erosion and flood control for future stormwater management ponds within the SCUBE West development lands south of Barton Street. The Subwatershed Study also identified conceptual stormwater management (SWM) pond locations and catchments in the SCUBE West lands (**Figure 2-3**). The SCUBE West Subwatershed Study also completed further ***catchment-scale*** modelling for these individual SWM ponds was also completed to estimate storage and release rate requirements to control the catchments to pre-development levels.

**Table 5.3** summarizes the release rates and storage volumes requirements for the conceptual stormwater ponds identified in the SCUBE West Subwatershed Study stormwater management ponds requirements. The subject ponds are noted as Ponds 3 and 4. Note: Future phases shall not rely or be permitted to apply the release rates ($m^3/s$) from the SCUBE West SWS. Proponents are directed to apply the release rates as defined within this report:

- Section 5.6.2, Table 5.6
- Section 5.6.3, Table 5.7
- Section 5.7.3.1, Tables 5.10 & 5.11

**Table 5.3** assumes that the total storage volume includes permanent pool storage plus the higher of extended detention storage for water quality or flood control. **Table 5.3** also reports the Estimated Pond Footprint Area, but notes that the actual footprint areas will depend on physical constraints including grading / storm sewer inverts / outlet (creek) elevations, etc. For conceptual purposes, the pond footprint areas were estimated assuming a 3:1 length to width flowpath, maximum water depth of 2.5 m for flood control ponds, 1.5 m for ponds with water quality control only, and included allowances for side slopes, etc.

As noted previously, per the SCUBE West Subwatershed Study, all future stormwater management facilities were required to provide permanent pool and extended detention storage to meet Level 2 water quality control requirements. However, the level of control for water quality was increased to meet Level 1 at the request of Hamilton Conservation Authority (HCA). As such, the previous Level 2 water quality requirements have been removed from **Table 5.3**. The revised Level 1 (Enhanced) water quality requirements are discussed in **Section 3.**

Subsequent sections of this FSR report describe the refinement of the hydrologic estimates from the SCUBE West Subwatershed Study in regards to the subject ponds (Pond 6.0 and Pond 6.1) are noted as a single pond, Pond 4 in regards to water quality and flood control requirements, however Pond 3 which releases to Watercourse 6.0, provides relevant erosion control criteria and release rates for Pond 6.1.

**Table 5.3 – Stormwater Management Pond Characteristics and Requirements per the SCUBE West Subwatershed Study (November 2014)**

| Pond # | Est. DA | Assumed % Imp. | Extended Detention for Erosion Control | | | | Extended Detention for Flood (Quantity) Control | | | | | | | | Total Storage Vol. | Est. Pond Footprint Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Erosion Control | | | | 2-Year Control | | | | 100-Year Control | | | | | |
| | | | Release Rate | | Storage Vol. | | Release Rate | | Storage Vol. | | Release Rate | | Storage Vol. | | | |
| | (ha) | | ($m^3$/s) | (L/s/ha) | ($m^3$) | ($m^3$/ha) | ($m^3$/s) | (L/s/ha) | ($m^3$) | ($m^3$/ha) | ($m^3$/s) | (L/s/ha) | ($m^3$) | ($m^3$/ha) | ($m^3$) | (ha) |
| 1 | 39.8 | 50% | 0.025 | 0.6 | 4,011 | 101 | 0.166 | 4.2 | 5,730 | 144 | 1.143 | 28.7 | 16,830 | 423 | 19,417 | 1.9 |
| 2 | 24.5 | 52% | 0.024 | 1.0 | 2,625 | 107 | 0.159 | 6.5 | 3,750 | 153 | 0.997 | 40.7 | 11,180 | 456 | 12,723 | 1.5 |
| 3 | 26.4 | 48% | 0.026 | 1.0 | 2,611 | 99 | 0.171 | 6.5 | 3,730 | 141 | 1.071* | 40.6 | 11,500 | 436 | 13,216 | 1.5 |
| 4 | 26.5 | 52% | 0.037 | 1.4 | 2,800 | 106 | 0.248 | 9.4 | 4,000 | 151 | 1.477* | 55.7 | 11,850 | 447 | 13,573 | 1.6 |
| 5 | 21.1 | 50% | 0.013 | 0.3 | 2,198 | 104 | 0.084 | 4.0 | 3,140 | 149 | 0.564 | 26.7 | 9,330 | 442 | 10,702 | 1.3 |

* Future phases shall not rely or be permitted to apply the release rates ($m^3$/s) from the SCUBE West SWS. Proponents are directed to apply the release rates as defined within this report:

- Section 5.6.2, Table 5.6
- Section 5.6.3, Table 5.7
- Section 5.7.3.1, Tables 5.10 & 5.11

### 5.5.3 Hydraulics –Floodplain Elevations and Culverts

The following section describes the existing servicing constraints for SWM Pond 6.0 and Pond 6.1 relating to:

a) Floodplain Elevations and
b) Culvert Grades and Capacity

### 5.5.4 Floodplain Elevations

In the SCUBE West Subwatershed Study, a VISUAL OTTYMO hydrologic model was used to estimate flood flows which in turn were used to define flood hazard lands over Watercourse 6 within the study area. Definition of flood hazard lands over Watercourse 6.1 was not required, as such floodplain constraints are not a concern for SWM Pond 6.1.

Floodplain elevations in proximity to SWM Pond 6.0 were extracted from the approved HEC-RAS model from the SCUBE West Subwatershed Study. The 100-yr flood elevation within watercourse 6.0 in proximity to SWM Pond 6.0 ranges from 87.27 to 87.31m. SWM Pond 6.0 must be located outside the 100-yr floodplain elevation to ensure it remains in the offline condition. The SWM ponds must be designed such that they can discharge to the watercourse during the 100-year event or in an emergency condition, given the 100-year water level within the creek.

### 5.5.5 Culverts

Watercourse 6.0 currently has two (2) existing culverts at the Barton Street crossing consisting of 1) a 1900mm x 1300mm concrete box culvert to the east and 2) a 1250mm Ø CSP to the west. Watercourse 6.1 has one (1) existing culvert at the Barton Street crossing consisting of a 600mm Ø CSP. **Table 5.4** summarizes the existing culvert constraints in relation to upstream and downstream culvert invert elevations as well as existing channel inverts.

**Table 5.4 – Summary of Existing Culvert Constraints for Watercourse 6.0 and 6.1**

| | Watercourse 6.0 | | | | Watercourse 6.1 | |
|---|---|---|---|---|---|---|
| | Culvert No. 1 - East (1900 x1300mm Concrete Box Culvert) | | Culvert No. 2 - West (1250mm Ø CSP) | | Culvert No. 3 (600mm Ø CSP) | |
| SWM Pond | Upstream Invert (m) | Downstream invert (m) | Upstream Invert (m) | Downstream invert (m) | Upstream Invert (m) | Downstream invert (m) |
| Pond 6.0 | 84.889 | 84.41 | 84.959 | 84.524 | - | - |
| Pond 6.1 | - | - | - | - | 87.612 | 87.467 |

Hydraulic analysis was completed for all three (3) culverts to determine conveyance capacity of the 100-year pond outflow.

Culverts 1 and 2 were analyzed using the existing 100-year flow of Watercourse 6.0 (10.1$m^3$/s), subtracting the 'No Pond' flow of 1.72$m^3$/s (from **Table 5.9**), and adding the 100-year pond outflow of 1.06$m^3$/s (from **Table 5.9**). For the 100-year storm Culvert 1 (1900 x 1300mm concrete box) and Culvert 2 (1250mm CSP) have insufficient capacity (i.e. coveys the 50-year event under existing conditions, with the 100-year overtopping the road), however the capacity is improved compared for the 100-year event in the proposed conditions. An upgrade to two (2) twin 2400mm x 1200mm concrete box culverts would increase the capacity to convey the entire 100-year storm and pond outflow without overtopping Barton Road.

Culvert 3 (600mm CSP) has sufficient capacity to convey the 10, 25, and 100-year outflow of Pond 6.1 (flows in **Table 5.10**). Without the pond, Culvert 3 overtops Barton Road during a 100-year storm by 0.25m; with the pond it can accommodate the 100-year storm and maintain a freeboard of 0.16m. The resulting Headwater over Diameter of Culvert 3 is 0.53, well below the maximum allowable of 1.5 as outlined in the Ministry of Transportation Design Guidelines.

The SCUBE West Subwatershed Study proposed upgrading of the existing culverts at Watercourse 6.0 at the Barton Street crossing to improve the conveyance capacity of the existing drainage systems and to provide a range of secondary benefits including the provision of warm water habitat, the enhancement of vegetation protection zones adjacent to watercourses, the elimination of barriers to fish passage and/or improved outlet options for future stormwater management facilities. This subject FSR has applied the existing culvert sizing and elevations to the design of SWM Pond 6.0 as the timeline for the culvert upgrade is unknown at this time.

## 5.6 Design Criteria

The following section describes the design criteria relating to quantity control, quality control, erosion and sediment control as well as the major and minor systems design related to SWM Ponds 6.0 and 6.1. The unit area release rates and storage volume targets (i.e. L/s/ha and $m^3$/ha) from **Table 5.3** have been applied to the revised drainage areas for Ponds 6.0 and 6.1 in order to develop the actual release rates and storage volume targets design criteria (i.e. $m^3$/s and $m^3$).

From the SCUBE Subwatershed Study: Phase 3, the preliminary locations for the stormwater management ponds are shown in **Figure 2-3**. The subject ponds (Pond 6.0 and Pond 6.1) are noted as a single pond, Pond 4 in regards to water quality and flood

control requirements, however Pond 3 which releases to Watercourse 6.0, provides relevant erosion control criteria and release rates for Pond 6.0. The Phase 3 report summarizes the conceptual stormwater management pond characteristics per the Phase 3 Study which has been updated and revised as part of the FSR.

### 5.6.1 Quality Control

Per the SCUBE West Subwatershed Study, all future stormwater management facilities will need to provide permanent pool and extended detention storage to meet Level 2 water quality control requirements. However, the level of control for water quality was increased to meet Level 1 at the request of Hamilton Conservation Authority (HCA) – See **Section 5.2**. As such, previous SWM pond requirements were revised to account for the additional permanent pool storage and extended detention requirements in conformance with Level 1 (Enhanced) water quality control per the MOE 2003. **Table 5.5** summarizes the revised water quality control requirements (Level 1).

**Table 5.5 – Level 1 Water Quality Control Requirements for SWM Ponds 6.0 and 6.1**

| Location/ Pond # | Drainage Area (ha) | Land-use | Assumed Imperviousness % | Water Quality Control - Level 1 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Permanent Pool | | Extended Detention | |
| | | | | ($m^3$/ha)* | ($m^3$)* | ($m^3$/ha) | ($m^3$)* |
| Pond 6.0 | 27.6 | Residential | 52% | 141 | 3,891 | 40 | 1,104 |
| Pond 6.1 | 16.4 | Residential | 57% | 150 | 2,460 | 40 | 656 |

### 5.6.2 Quantity Control

Per the SCUBE West Subwatershed Study, all future stormwater management ponds within the Block 2 study area will require post-to-pre flood (quantity) control due to the presence of existing downstream erosion and due to the flood-susceptibility of downstream lands on the receiving streams of Watercourses 6.0 and 6.1. As noted within the Phase 3 study (**Table 5.3**) the water quantity storage volume requirement (on a per hectare basis) for SWM Pond 6.0 and 6.1 is 447 $m^3$/ha for flood control.

It should be noted that, as a result of the change from Level 2 to Level 1 water quality control, the permanent pool requirements for SWM Ponds 6.0 and 6.1 were increased. The increase in water quality control therefore increases the total storage volume requirements (permanent pool + 100-yr storage volume requirement). **Table 5.6** summarizes the quantity control requirements, release rates and revised total storage requirements (*) for SWM Ponds 6.0 and 6.1. Note: at the detailed design stage, it is recommended that consideration be given to the design of the permanent pool elevation

such that it is above the 100-year creek operating elevation to avoid backwater effects which may reduce flood control volume target.

**Table 5.6 – Quantity Control Requirements and Release Rates for SWM Ponds 6.0 and 6.1 per the SCUBE West Subwatershed Study (November 2014) and Revised Total Storage Volume Requirements**

| Pond # | Extended Detention for Flood (Quantity) Control | | | | | | | | Total Storage Vol.* |
|---|---|---|---|---|---|---|---|---|---|
| | 2-Year Control | | | | 100-Year Control | | | | |
| | Release Rate | | Storage Vol. | | Release Rate | | Storage Vol. | | |
| | ($m^3/s$) | (L/s/ha) | ($m^3$) | ($m^3$/ha) | ($m^3/s$) | (L/s/ha) | ($m^3$) | ($m^3$/ha) | ($m^3$) |
| Pond 6.0 | 0.1794 | 6.5 | 4,167 | 151 | 1.537 | 55.7 | 12,337 | 447 | 16,229 |
| Pond 6.1 | 0.1542 | 9.4 | 2,476 | 151 | 0.913 | 55.7 | 7,331 | 447 | 9,643 |

### 5.6.3 Erosion and Sediment

Per the SCUBE West Subwatershed Study, all future stormwater management ponds within Block 2 study area will require extended detention for erosion control due to the presence of existing downstream erosion. As noted within the Phase 3 study (**Table 5.4**) the erosion control requirements (on a per hectare basis) for SWM Pond 6.0 and 6.1 varied between 99 and 106 $m^3$/ha for erosion control. As outlined previously, the subject ponds (Pond 6.0 and Pond 6.1) are noted as a single pond, Pond 4 within **Table 5.3** and **Figure 2-3** in regards to water quality and flood control requirements, however Pond 3 which releases to Watercourse 6.0, provides relevant erosion control criteria and release rates for Pond 6.0. **Table 5.7** summarizes the erosion control requirements, release rates and revised total storage requirements (*) for SWM Ponds 6.0 and 6.1.

**Table 5.7 – Quantity Control Requirements and Release Rates for SWM Ponds 6.0 and 6.1 per the SCUBE West Subwatershed Study (November 2014) and Revised Total Storage Volume Requirements**

| Pond # | Extended Detention for Erosion Control | | | | | | | | Total Storage Vol.* |
|---|---|---|---|---|---|---|---|---|---|
| | Erosion Control | | | | 2-Year Control | | | | |
| | Release Rate | | Storage Vol. | | Release Rate | | Storage Vol. | | |
| | ($m^3/s$) | (L/s/ha) | ($m^3$) | ($m^3$/ha) | ($m^3/s$) | (L/s/ha) | ($m^3$) | ($m^3$/ha) | ($m^3$) |
| Pond 6.0 | 0.0276 | 1.04 | 2,732 | 99 | 0.1794 | 6.5 | 4,167 | 151 | 16,229 |
| Pond 6.1 | 0.0229 | 1.40 | 1,738 | 106 | 0.1542 | 9.4 | 2,476 | 151 | 9,643 |

## 5.7 Servicing Assessment

The following sections describe the servicing assessment for SWM pond 6.0 and 6.1. Conceptual designs are provided in the subsequent figures:

- Pond 6.0 - **Figure 5-1** and **Figure 5-2**
- Pond 6.1 – **Figure 5-3**

### 5.7.1 Volumetric Sizing Requirements

The volumetrically sizing requirements for SWM Ponds 6.0 and 6.1 in regards to the required water quality control, quantity control and erosion control per the SCUBE West Subwatershed Study as detailed within **Section 2.2** are summarized in **Table 5.8**. Note: At the detailed design stage, it is recommended that consideration be given to the design of the permanent pool elevation such that it is above the 100-year creek operating elevation to avoid backwater effects which may reduce flood control volume target.

**Table 5.8 – Volumetric Sizing Requirements**

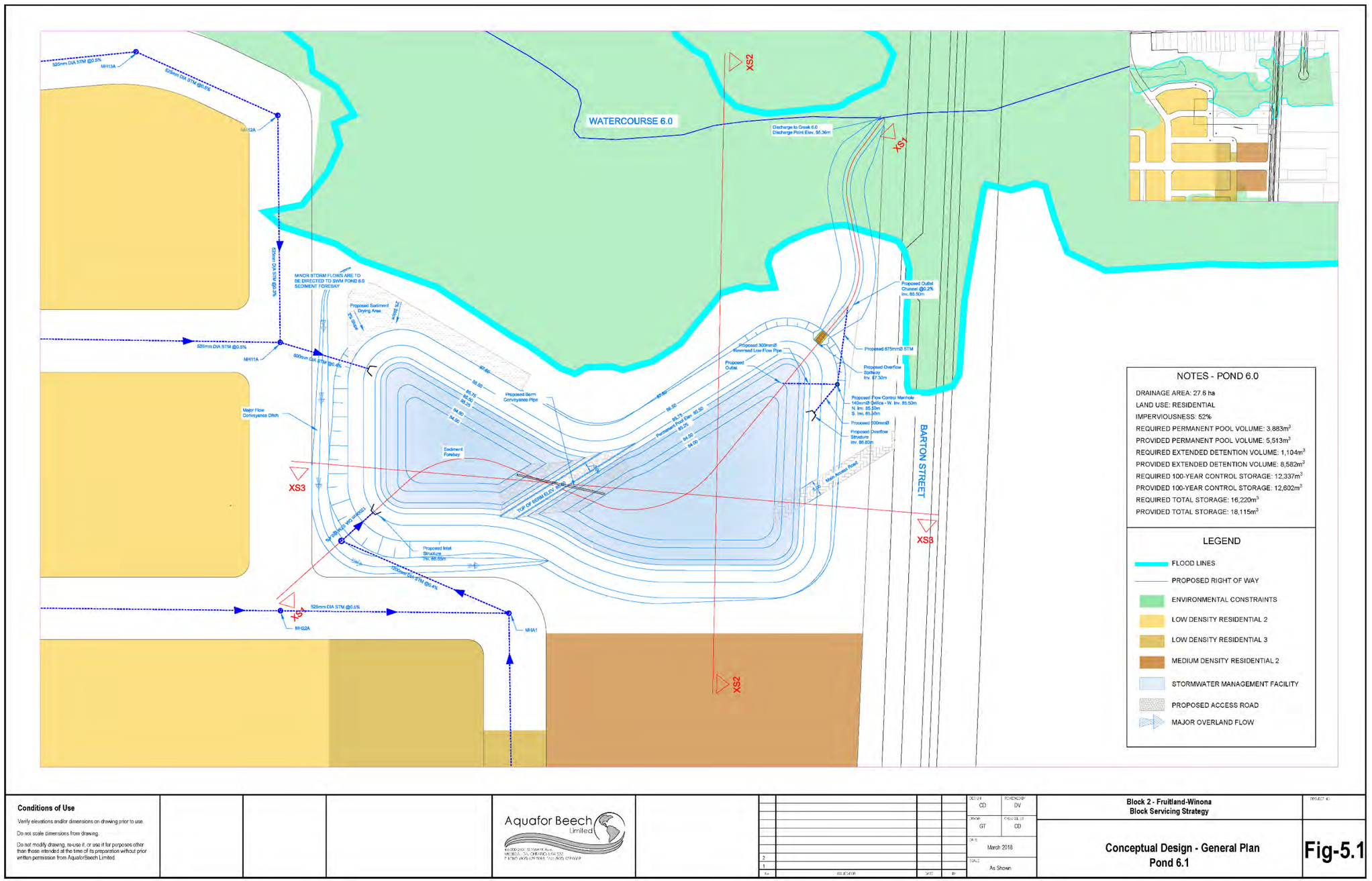
| Pond # | Volumetric Storage Requirements ($m^3$) | | | | |
|---|---|---|---|---|---|
| | Quality | | Quantity | Erosion | Total Storage Vol.* |
| | Permanent Pool | Extended Detention | | | |
| Pond 6.0 | 3,891 | 1,104 | 12,337 | 2,732 | 16,229 |
| Pond 6.1 | 2,460 | 656 | 7,331 | 1,738 | 9,643 |
| *** Total storage volume = permanent pool + quantity control volume.** | | | | | |

### 5.7.2 Volumetric Sizing of Proposed Ponds

The proposed SWM Ponds 6.0 and 6.1 as illustrated within the conceptual designs for Pond 6.0 - **Figure 5-1** and **Figure 5-2** and Pond 6.1 – **Figure 5-3** have been sized volumetrically to provide the required water quality control, quantity control and erosion control per the SCUBE West Subwatershed Study as detailed within **Section 2.2. Figure 5-1** to **Figure 5-3** illustrate the conceptual design of the two (2) SWM ponds, with the explicit intention of demonstrating the feasibility of the achieving the required SWM targets. Detailed design will refine the proposed concepts, but shall be required to adhere to the relevant City of Hamilton Standard. Full-size versions of **Figure 5-1** to **Figure 5-3** have been included at the end of this report. **Table 5.9** compares the volumetric storage requirements with the proposed conceptual designs. Note: At the detailed design stage, it is recommended that consideration be given to the design of the permanent pool elevation such that it is above the 100-year creek operating elevation to avoid backwater effects which may reduce flood control volume target.

**Table 5.9 – Volumetric Sizing Requirements vs. Conceptual Designs**

| Criteria | Pond 6.0 | | Pond 6.1 | |
|---|---|---|---|---|
| | Required ($m^3$) | Provided ($m^3$) | Required ($m^3$) | Provided ($m^3$) |
| Quality – Perm. Pool | 3,891 | 5,513 | 2,460 | 2,675 |
| Quality - Ext Detention | 1,104 | 5,582 | 656 | 5,202 |
| Quantity | 12,337 | 12,602 | 7,331 | 7,656 |
| Erosion | 3,730 | 9,068 | 1,738 | 5,885 |
| Total Storage | 16,229 | 18,115 | 9,643 | 10,331 |




NOTES - POND 6.0

DRAINAGE AREA: 27.6 ha
LAND USE: RESIDENTIAL
IMPERVIOUSNESS: 52%
REQUIRED PERMANENT POOL VOLUME: 3,883m³
PROVIDED PERMANENT POOL VOLUME: 5,513m³
REQUIRED EXTENDED DETENTION VOLUME: 1,104m³
PROVIDED EXTENDED DETENTION VOLUME: 8,582m³
REQUIRED 100-YEAR CONTROL STORAGE: 12,337m³
PROVIDED 100-YEAR CONTROL STORAGE: 12,602m³
REQUIRED TOTAL STORAGE: 16,220m³
PROVIDED TOTAL STORAGE: 18,115m³

LEGEND

- FLOOD LINES
- PROPOSED RIGHT OF WAY
- ENVIRONMENTAL CONSTRAINTS
- LOW DENSITY RESIDENTIAL 2
- LOW DENSITY RESIDENTIAL 3
- MEDIUM DENSITY RESIDENTIAL 2
- STORMWATER MANAGEMENT FACILITY
- PROPOSED ACCESS ROAD
- MAJOR OVERLAND FLOW



Aquafor Beech Limited

| | | | |
|---|---|---|---|
| DESIGN: CD | REVIEWED: DV | | |
| DRAWN: GT | CHECKED: CD | | |
| DATE: March 2018 | | | |
| SCALE: As Shown | | | |

**Block 2 - Fruitland-Winona Block Servicing Strategy**

**Conceptual Design - General Plan Pond 6.1**

**Fig-5.1**

**Figure 5-1 – Pond 6.0 Conceptual Design – Plan View**

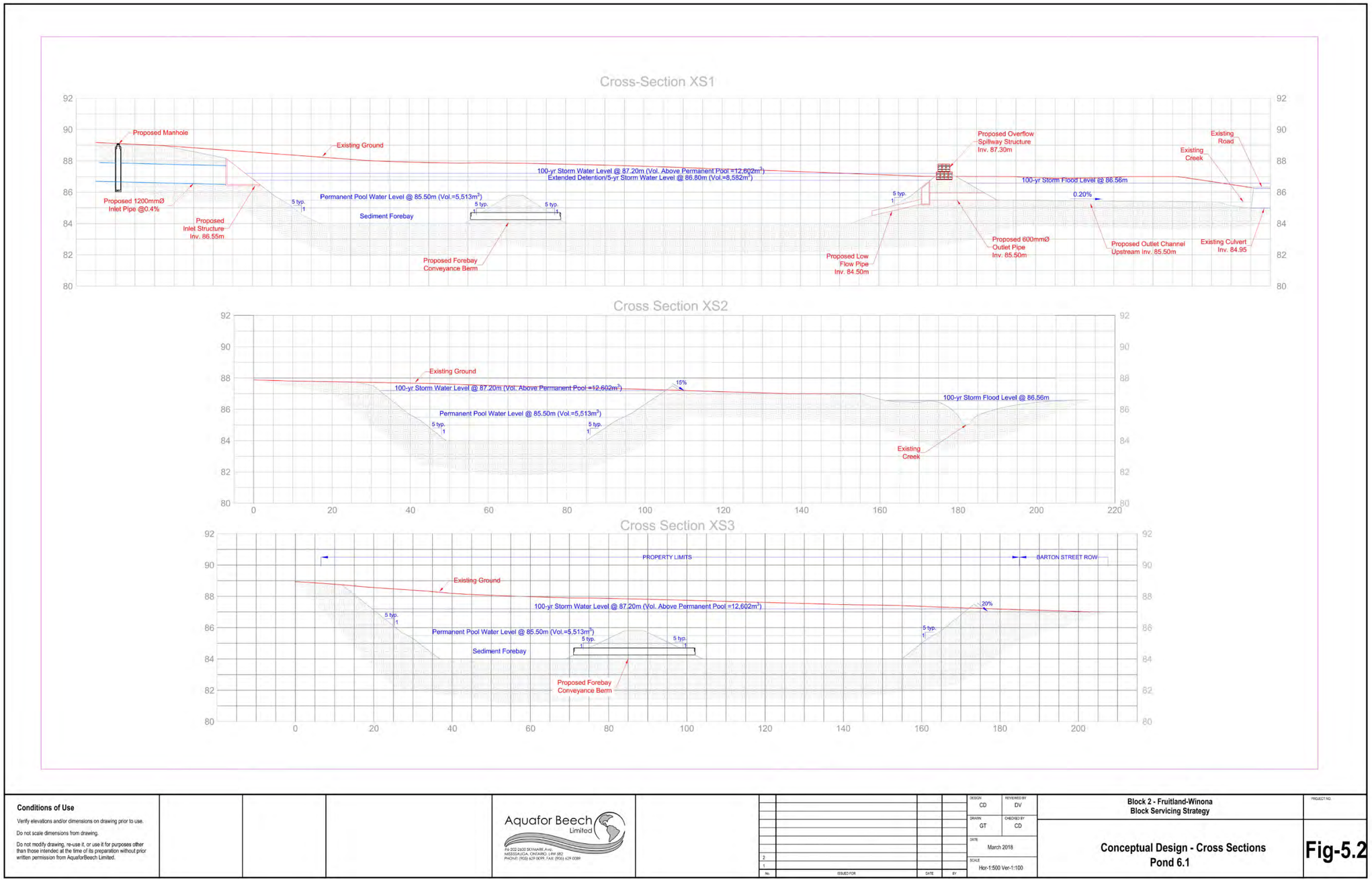



**Figure 5-2 – Pond 6.0 Conceptual Design – Cross-Sections**

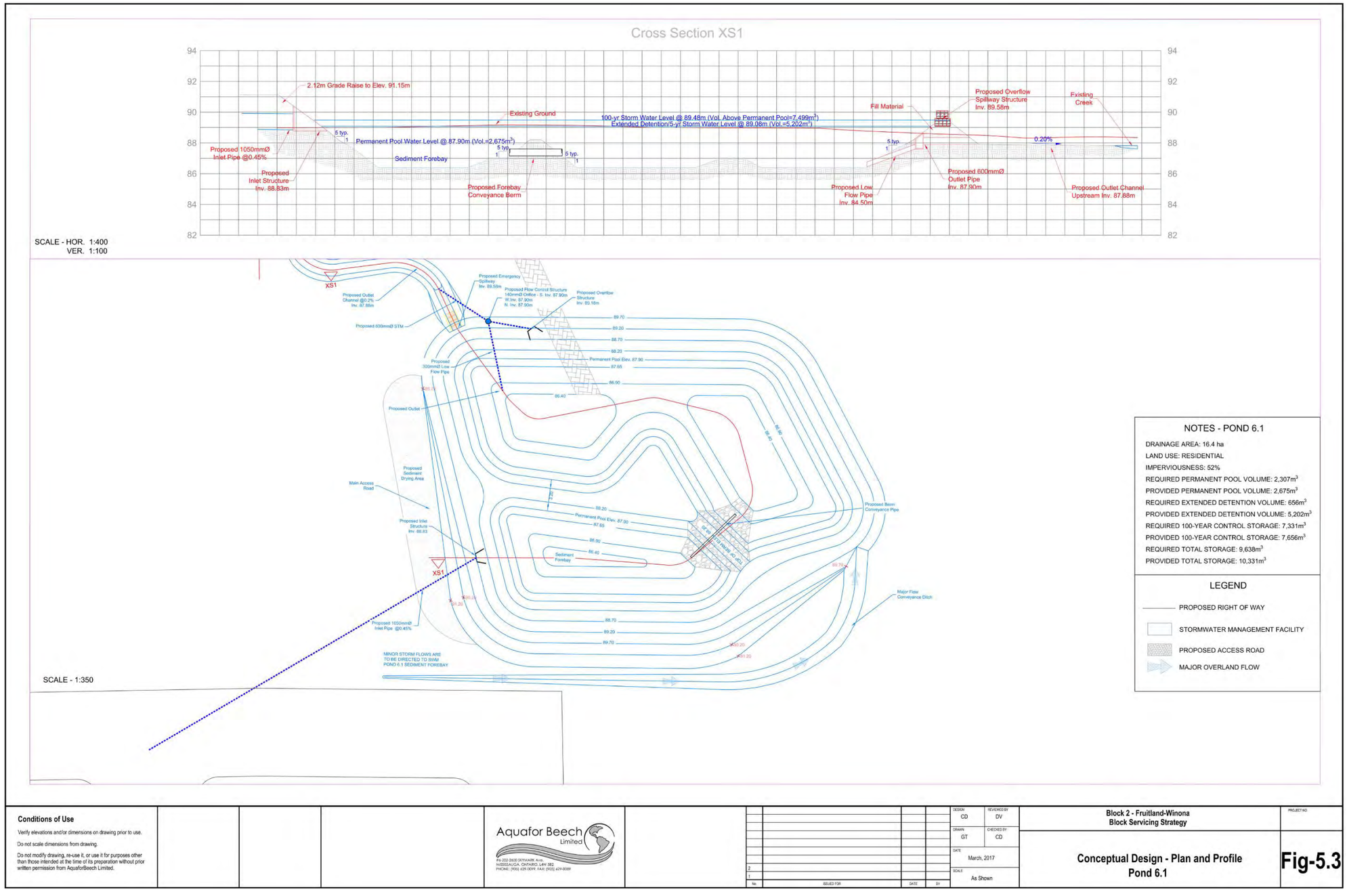



**Figure 5-3 – Pond 6.1 Conceptual Design – Plan and Profile**

### 5.7.3 Modeling for Block 2 Ponds

The following section describes the refined modelling and analysis undertaken to validate the conceptual design for SWM Ponds 6.0 and 6.1. It must be noted that a PCSWMM model has been developed for this FSR and validated by comparison to the SCUBE SWS 2013 Phase 3 SWM Pond modeling results, in order to confirm the accuracy of the resultant peak flows and runoff volumes calculated.

**Background**

A review of previous modeling studies for the study area was undertaken. The Phase 1 and Phase 2 Reports of SCUBE West Subwatershed Studies characterized hydrologic and hydraulic modeling to define flood hazards over different watercourses of the study area including watercourses 6.0 and 6.1. Initially, the MIKE-11 model was selected and the rainfall and streamflow data were used to setup and adjust the model. The Phase 1 and Phase 2 Reports conclude with a recommended Subwatershed Strategy that consists of a series of stormwater management controls to mitigate the impacts from proposed future development. During the Phase 1 and 2 SCUBE West Subwatershed Study, a VISUAL OTTHYMO hydrologic model was setup and calibrated to the observed rainfall-runoff gauge data. The hydrologic model was also used to estimate storage requirements for erosion and flood control for stormwater management ponds within the SCUBE West development lands south of Barton Street as detailed in previous sections.

The exact locations and the size of the ponds were not defined from the previous study. These factors would depend on the location and depth of suitable pond outlets. In this study, further hydrologic modeling investigations will be used to confirm /refine storage requirements based on updated drainage areas and development densities.

**Model Selection**

The hydrologic model selected for application in this study was PCSWMM 2016. PCSWMM 2016 has the capability of using a number of versions of SWMM5 for performing the hydrologic and hydraulic calculations.

PCSWMM is a dynamic rainfall-runoff simulation model that can be used for single event or long-term (continuous) simulation of runoff quantity from primarily urban areas. The input and output data of the model is fully compatible with the EPA Storm Water Management Model (SWMM) a free software platform from the U.S. Environmental Protection Agency (EPA). The runoff component of PCSWMM operates on a collection of catchment areas that receive precipitation and generate runoff. The routing portion of PCSWMM conveys this runoff through a system of pipes, channels, storage/treatment devices, etc. PCSWMM tracks the quantity of runoff generated within each catchment,

and the flow rate and depth in each pipe during a simulation period comprised of multiple time steps.

The use of PCSWMM allows better representation of the actual site runoff conditions because it uses the non-linear reservoir model to generate catchment runoff, which accounts for the net effects of precipitation, evaporation, infiltration, and surface storage for each catchment. The model is also capable of simulating flow in pipes, orifices, weirs and outlets structure commonly included within SWM ponds.

**Representation of the Proposed Development**

The secondary Plan established the types of land uses within the Block 2 lands. Also defined was the location of the neighborhood park as well as which existing land uses were to be preserved (e.g. Christian Reformed Church, Kingdom Hall and John Know Cristian School). The drainage areas for the existing and proposed conditions are 16.4 and 27.6 ha for pond 6.0 and 6.1 respectively.

**Stormwater Management Facilities**

Two SWM facilities are recognized in the study area, they are pond 6.0 and 6.1. These ponds are defined as storage nodes in the model. The data required for the storage node include stage/storage relationships and inlet and outlet configurations with the overall drainage network. Engineering drawings, survey data and background reports were used to facilitate the collection of the modelling data required for the ponds. The stage storage curves for the water quantity of the ponds were based on the conceptual pond designs are presented in **Section 5.7.2.**

The initial water depths in the ponds were set at the permanent pool levels (85.50 m for Pond 6.0 And 87.9 m for Pond 6.1), therefore, when running the design storm events, it was assumed that only the storage above the permanent pool level would be used for quantity control.

#### 5.7.3.1 SWMF Performance

Two model scenarios for existing and proposed land uses were developed in order to analyze the performances of the two ponds. The existing condition represents the current site land use while future condition represents the site conditions as per the Secondary Plan and road layout.

The OTTHYMO model that was developed previously was used as a base model and all the calibrated parameters were setup based on that model. Therefore, the PCSWMM model was then setup in this study with the main objective of evaluating the performance of the proposed ponds. **Figure 5-4** presents the study area for the PCSWMM model.

The design storms were entered into the PCSWMM model to determine the flow rates and storage volumes of the pond under existing and proposed conditions. These include the 2 and 100 years return frequency design storms obtained from the SCUBE West study. The performance of the ponds 6.0 and 6.1 under existing and future conditions was evaluated using the model running rainfall events of 2 and 100-year return period.

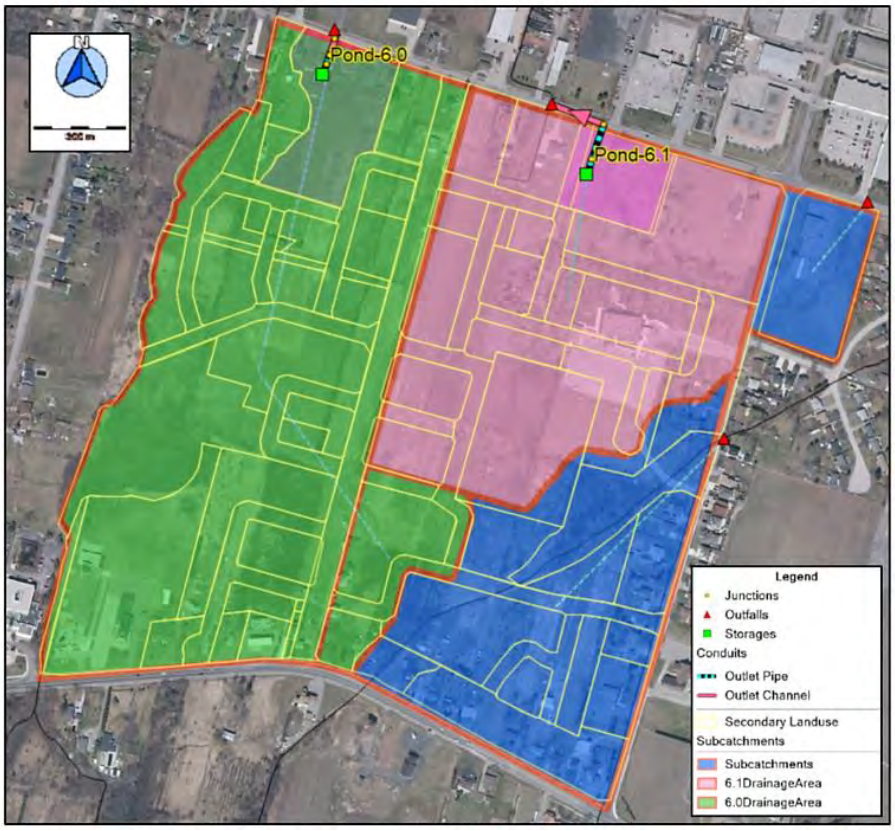



**Figure 5-4 – PCSWMM Modeling Area for SWM Ponds 6.0 and 6.1**

It must be noted that the PCSWMM model developed for this FSR, has been validated by comparison to the SCUBE SWS 2013 Phase 3 SWM Pond modeling results, in order to confirm the accuracy of the resultant peak flows and runoff volumes calculated. The pond water level, volume, and the discharge rates are represented in **Table 5.10** and **Table 5.11**.

**Table 5.10 – Proposed Flow Rates, Volumes and Water Depth (Pond 6.0)**

| Return Period | Existing (No Pond) | | SCUBE | | Proposed Condition | | | | | Targets ($m^3$) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Runoff Volume 1000 ($m^3$) | Flow ($m^3/s$) | Flow ($m^3/s$) | Volume 1000 ($m^3$) | Volume 1000 ($m^3$) | Elevation (m) | Depth (m) | Inflow ($m^3/s$) | Outflow ($m^3/s$) | Max. Erosion Release Rate ($m^3/s$) | Max. 2-yr Release Rate ($m^3/s$) | Max. 100-yr Release Rate ($m^3/s$) |
| 2 | 1.2 | 0.27 | 0.248 | 4.00 | 5.59 | 86.40 | 0.90 | 2.028 | 0.037 | 0.027* | 0.171 | |
| 5 | 2.98 | 0.52 | | | 8.994 | 86.82 | 1.32 | 3.145 | 0.049 | | | |
| 10 | 4.40 | 0.74 | | | 10.144 | 86.96 | 1.46 | 3.938 | 0.417 | | | |
| 25 | 6.56 | 1.08 | | | 10.962 | 87.05 | 1.55 | 4.994 | 0.753 | | | |
| 50 | 8.28 | 1.38 | | | 11.556 | 87.12 | 1.62 | 5.807 | 0.934 | | | |
| 100 | 10.1 | 1.72 | 1.477 | 11.85 | 12.268 | 87.2 | 1.7 | 6.659 | 1.068 | | | 1.537 |

* Max release rate at specified erosion control volume.

**Table 5.11 – Proposed Flow Rates, Volumes and Water Depth (Pond 6.1)**

| Return Period | Existing (No Pond) | | Proposed Condition Pond 6.1 | | | | | Targets ($m^3$) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Runoff Volume ($m^3$) | Flow ($m^3/s$) | Volume 1000($m^3$) | Elevation (m) | Depth (m) | Flow ($m^3/s$) | Outflow ($m^3/s$) | Max. Erosion Release Rate ($m^3/s$)* | Max. 2-yr Release Rate ($m^3/s$) | Max. 100-yr Release Rate ($m^3/s$) |
| 2 | 1,630 | 0.65 | 3.375 | 88.73 | 0.89 | 1.091 | 0.033 | 0.022* | 0.248 | |
| 5 | 2,710 | 0.99 | 5.387 | 89.12 | 1.22 | 1.729 | 0.042 | | | |
| 10 | 3,560 | 1.22 | 6.362 | 89.29 | 1.39 | 2.181 | 0.136 | | | |
| 25 | 4,760 | 1.55 | 6.872 | 89.37 | 1.47 | 2.78 | 0.317 | | | |
| 50 | 5,720 | 1.8 | 7.144 | 89.42 | 1.52 | 3.241 | 0.344 | | | |
| 100 | 6,760 | 2.07 | 7.499 | 89.48 | 1.548 | 3.721 | 0.366 | | | 0.913 |

* Max release rate at specified erosion control volume.

The high-water level (100-yr) for Pond 6.0 and Pond 6.1 are 87.2 and 89.48 m respectively. A review of the modeling results shows that both ponds 6.0 and 6.1 were found to have sufficient storage to handle the runoff generated from the storm events of up to 100-year return period under proposed conditions, without spilling or overtopping.

#### 5.7.3.2 Stage/Storage/Discharge Relationship

From the PCSWMM model, the stage discharge relationships for Ponds 6.0 and Pond 6.1 were defined and are defined in **Table 5.12** and **Table** 5.13 respectively.

**Table 5.12 – Stage – Area - Storage Relationship for SWM Pond 6.0**

| **Elevation (m)** | **Depth (m)** | **Storage ($m^3$)** | Active Storage ($m^3$) | Incremental Active Storage ($m^3$) | **Area ($m^2$)** |
|---|---|---|---|---|---|
| 84.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 84.10 | 0.10 | 243.65 | 0.00 | 0.00 | 2436.50 |
| 84.20 | 0.20 | 497.26 | 0.00 | 0.00 | 2536.10 |
| 84.30 | 0.30 | 766.94 | 0.00 | 0.00 | 2696.80 |
| 84.40 | 0.40 | 1053.27 | 0.00 | 0.00 | 2863.30 |
| 84.50 | 0.50 | 1356.83 | 0.00 | 0.00 | 3035.60 |
| 84.60 | 0.60 | 1677.89 | 0.00 | 0.00 | 3210.60 |
| 84.70 | 0.70 | 2016.67 | 0.00 | 0.00 | 3387.80 |
| 84.80 | 0.80 | 2373.70 | 0.00 | 0.00 | 3570.30 |
| 84.90 | 0.90 | 2749.47 | 0.00 | 0.00 | 3757.70 |
| 85.00 | 1.00 | 3144.49 | 0.00 | 0.00 | 3950.20 |
| 85.10 | 1.10 | 3559.26 | 0.00 | 0.00 | 4147.70 |
| 85.20 | 1.20 | 3994.30 | 0.00 | 0.00 | 4350.40 |
| 85.25 | 1.25 | 4219.57 | 0.00 | 0.00 | 4505.40 |
| 85.30 | 1.30 | 4450.88 | 0.00 | 0.00 | 4626.20 |
| 85.40 | 1.40 | 4934.22 | 0.00 | 0.00 | 4833.40 |
| 85.50 | 1.50 | 5445.78 | 0.00 | 0.00 | 5115.60 |
| 85.60 | 1.60 | 5986.31 | 540.53 | 540.53 | 5405.30 |
| 85.70 | 1.70 | 6556.57 | 1110.79 | 570.26 | 5702.60 |
| 85.72 | 1.72 | 6708.06 | 1262.28 | 151.49 | 7574.50 |
| 85.75 | 1.75 | 6853.09 | 1407.31 | 145.03 | 4834.33 |
| 85.80 | 1.80 | 7156.41 | 1710.63 | 303.32 | 6066.40 |
| 85.90 | 1.90 | 7791.61 | 2345.83 | 635.20 | 6352.00 |
| 86.00 | 2.00 | 8447.33 | 3001.55 | 655.72 | 6557.20 |
| 86.10 | 2.10 | 9123.75 | 3677.97 | 676.42 | 6764.20 |
| 86.20 | 2.20 | 9821.02 | 4375.24 | 697.27 | 6972.70 |
| 86.30 | 2.30 | 10539.31 | 5093.53 | 718.29 | 7182.90 |
| 86.40 | 2.40 | 11278.78 | 5833.00 | 739.47 | 7394.70 |
| 86.50 | 2.50 | 12039.60 | 6593.82 | 760.82 | 7608.20 |
| 86.55 | 2.55 | 12428.06 | 6982.28 | 388.46 | 7769.20 |

| | | | | | |
|---|---|---|---|---|---|
| 86.60 | 2.60 | 12821.93 | 7376.15 | 393.87 | 7877.40 |
| 86.70 | 2.70 | 13626.04 | 8180.26 | 804.11 | 8041.10 |
| 86.80 | 2.80 | 14454.69 | 9008.91 | 828.65 | 8286.50 |
| 86.90 | 2.90 | 15314.50 | 9868.72 | 859.81 | 8598.10 |
| 87.00 | 3.00 | 16213.34 | 10767.56 | 898.84 | 8988.40 |
| 87.10 | 3.10 | 17237.94 | 11792.16 | 1024.60 | 10246.00 |
| 87.15 | 3.15 | 17789.65 | 12343.87 | 551.71 | 11034.20 |
| 87.20 | 3.20 | 18374.07 | 12928.29 | 584.42 | 11688.40 |
| 87.30 | 3.30 | 19663.83 | 14218.05 | 1289.76 | 12897.60 |
| 87.40 | 3.40 | 20014.99 | 14569.21 | 351.16 | 3511.60 |
| 87.50 | 3.50 | 20998.00 | 15552.22 | 983.01 | 9830.10 |

**Table 5.13 – Stage- Area - Storage Relationship for SWM Pond 6.1**

| **Elevation (m)** | **Depth (m)** | **Storage ($m^3$)** | Active Storage (m3) | Incremental Active Storage (m3) | **Area ($m^2$)** |
|---|---|---|---|---|---|
| 86.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 86.50 | 0.10 | 73.82 | 0.00 | 0.00 | 794.15 |
| 86.60 | 0.20 | 158.83 | 0.00 | 0.00 | 910.75 |
| 86.70 | 0.30 | 255.97 | 0.00 | 0.00 | 1036.75 |
| 86.80 | 0.40 | 366.18 | 0.00 | 0.00 | 1172.05 |
| 86.90 | 0.50 | 490.38 | 0.00 | 0.00 | 1357.80 |
| 87.00 | 0.60 | 637.74 | 0.00 | 0.00 | 1546.75 |
| 87.10 | 0.70 | 799.73 | 0.00 | 0.00 | 1695.75 |
| 87.20 | 0.80 | 976.89 | 0.00 | 0.00 | 1850.00 |
| 87.30 | 0.90 | 1169.73 | 0.00 | 0.00 | 2009.40 |
| 87.40 | 1.00 | 1378.77 | 0.00 | 0.00 | 2174.10 |
| 87.50 | 1.10 | 1604.55 | 0.00 | 0.00 | 2343.95 |
| 87.60 | 1.20 | 1847.56 | 0.00 | 0.00 | 2532.50 |
| 87.70 | 1.30 | 2111.05 | 0.00 | 0.00 | 2759.40 |
| 87.80 | 1.40 | 2399.44 | 0.00 | 0.00 | 3003.15 |
| 87.90 | 1.50 | 2711.68 | 0.00 | 0.00 | 3243.25 |
| 88.00 | 1.60 | 3048.09 | 336.41 | 336.41 | 3474.21 |
| 88.09 | 1.69 | 3371.78 | 660.10 | 323.69 | 3608.90 |
| 88.10 | 1.70 | 3408.98 | 697.30 | 37.20 | 3836.09 |
| 88.20 | 1.80 | 3793.75 | 1082.07 | 384.77 | 4076.50 |
| 88.30 | 1.90 | 4224.28 | 1512.60 | 430.53 | 4372.95 |
| 88.40 | 2.00 | 4668.34 | 1956.66 | 444.06 | 4461.00 |
| 88.43 | 2.03 | 4804.21 | 2092.53 | 135.87 | 4576.70 |

| | | | | | |
|---|---|---|---|---|---|
| 88.50 | 2.10 | 5126.01 | 2414.33 | 321.80 | 4665.76 |
| 88.60 | 2.20 | 5597.39 | 2885.71 | 471.38 | 4782.65 |
| 88.70 | 2.30 | 6082.54 | 3370.86 | 485.15 | 4924.35 |
| 88.80 | 2.40 | 6582.26 | 3870.58 | 499.72 | 5073.95 |
| 88.90 | 2.50 | 7097.33 | 4385.65 | 515.07 | 5227.80 |
| 89.00 | 2.60 | 7627.82 | 4916.14 | 530.49 | 5382.30 |
| 89.10 | 2.70 | 8173.79 | 5462.11 | 545.97 | 5537.40 |
| 89.20 | 2.80 | 8735.30 | 6023.62 | 561.51 | 5689.90 |
| 89.30 | 2.90 | 9311.77 | 6600.09 | 576.47 | 5836.75 |
| 89.40 | 3.00 | 9902.65 | 7190.97 | 590.88 | 5930.62 |
| 89.43 | 3.03 | 10082.75 | 7371.07 | 180.10 | 6054.50 |
| 89.50 | 3.10 | 10508.10 | 7796.42 | 425.35 | 6150.06 |
| 89.60 | 3.20 | 11128.26 | 8416.58 | 620.16 | 6275.85 |
| 89.70 | 3.30 | 11763.27 | 9051.59 | 635.01 | 6350.10 |

### 5.7.4 Outlet Control Calculations – Drawdown Time

Considering a continuous outflow rate equal to the peak flow of the 5-year storm event, the drawdown time of the extended detention for pond 6.0 and 6.1 can be defined by:

$$t = \frac{V_{ED}}{Q_5 * 3600}$$

Where: t = Drawdown time (hours)

$Q_5$ = Peak flow for the 5-year return period storm ($m^3/s$)

$V_{ED}$ = Volume of Extended Detention ($m^3$)

The drawdown times of the Extended Detention volumes to meet the specified erosion control release rates for Pond 6.0 and 6.1 are 88 and 72 hours respectively.

### 5.7.5 Forebay Dispersion Length

The dispersion length is the length required to dissipate flows from the inlet pipe such that the flows will disperse to a velocity of ≤0.5m/s. The dispersion length for the forebay has been calculated as follows:

$$\text{Flow Distance (m)} = \frac{8 \times Q}{d \times v^f}$$

Where Q = 5-year inlet flow rate ($m^3/s$)

d = Depth of forebay permanent pool (m)

$v^f$ = Desired velocity = ≤0.5m/s

**Pond 6.0 Forebay Dispersion Length**

**Minimum Flow Distance (m)**

Where Q = 5-year inlet flow rate ($m^3/s$) = 0.52$m^3/s$
d = Depth of forebay permanent pool (m) = 1.55m

$$= \frac{8 \times Q}{d \times v^f}$$

= (8*0.52 $m^3/s$) / (1.55m *0.5 m/s)
= 5.37 m

Forebay flow distance as detailed in **Figure 5-1** and **Figure 5-2** is 85m and will be sufficient to reduce incoming flow velocities to below 0.5m/s.

**Minimum bottom width of the deep zone (m)**

Width = Flow distance / 8 (Equation 4.7)
=5.37m / 8
=0.67m

The bottom width as detailed in **Figure 5-1** and **Figure 5-2** is 70m.

**Erosion Prevention**

The wet pond area as detailed in **Figure 5-1** and **Figure 5-2** has a flow length of 85m, a top width of 108m and a bottom width of 70m. The cross-sectional area of the wet pond is approx. 281$m^2$ and as such the velocity of the flow as it moves through the water column will be as follows:

Velocity =Flow / Cross section area
= 0.52$m^3/s$ / 281$m^2$
= 0.0019 m/s

Therefore, the average velocity through the wet pond will be 0.0019m/s. This velocity is acceptable, as it is less than the permissible 0.5m/s to prevent erosion.

**Pond 6.1 Forebay Dispersion Length**

**Minimum Flow Distance (m)**

Where Q = 5-year inlet flow rate ($m^3/s$) = 0.99 $m^3/s$
d = Depth of forebay permanent pool (m) = 1.50m

$$= \frac{8 \times Q}{d \times v^f}$$

= (8*0.99 $m^3/s$) / (1.50m *0.5 m/s)
= 10.56 m

Forebay flow distance as detailed in **Figure 5-3** is 132m and will be sufficient to reduce incoming flow velocities to below 0.5m/s.

**Minimum bottom width of the deep zone (m)**

Width = Flow distance / 8 (Equation 4.7)
=10.56m / 8
=1.32m

The bottom width as detailed in **Figure 5-3** is 26m.

**Erosion Prevention**

The wet pond area as detailed in **Figure 5-3** has a flow length of 132m, a top width of 54m and a bottom width of 26m. The cross-sectional area of the wet pond is approx. 217$m^2$ and as such the velocity of the flow as it moves through the water column will be as follows:

Velocity =Flow / Cross section area
= 0.99 $m^3/s$ / 217$m^2$
= 0.0045 m/s

Therefore, the average velocity through the wet pond will be 0.0045m/s. This velocity is acceptable, as it is less than the permissible 0.5m/s to prevent erosion.

### 5.7.6 Length/Width Ratios

Per the City of Hamilton Comprehensive Development Guidelines and Financial Policies Manual (2016), the minimum forebay length to width ratio shall be a minimum of 2:1**.** **Table 5.14** summarizes the length to width ratios for SWM Ponds 6.0 and 6.1. The length to width ratio as proposed for Pond 6.1 is below the minimum 2:1 ratio, due to site constraints related to offsets from the 100-yr flood elevation and available land area within the designated pond block. It is expected that the L:W ratio for Pond 6.1 will be optimized during the subsequent detailed design phase.

**Table 5.14 – Summary of Length to Width ratio for SWM Pond 6.0 and 6.1**

| Pond # | Length (m) | Width (m) | Min. L: W Ratio Requirement | Proposed L: W Ratio |
|---|---|---|---|---|
| Pond 6.0 | 123 | 85 | 2 : 1 | 1.4 :1 |
| Pond 6.1 | 132 | 54 | 2 : 1 | 2.4 : 1 |

### 5.7.7 Decanting Area

Per the City of Hamilton Comprehensive Development Guidelines and Financial Policies Manual (2016), sediment decanting areas have been included for both SWM Ponds 6.0 and 6.1 as detailed in **Figure 5-1** and **Figure 5-3**. Decanting areas have been located adjacent to the maintenance access roads for ease of use during dredging operations and for efficiency during off-site sediment transport after dewatering has occurred. Decanting areas characteristics are as follows:

- 420m$^2$ decanting area for SWM Pond 6.0 (**Figure 5-1**)
- 498m$^2$ decanting area for SWM Pond 6.1 (**Figure 5-3**)

### 5.7.8 Maintenance Access Route

Per the City of Hamilton Comprehensive Development Guidelines and Financial Policies Manual (2016), maintenance access roads have been provided for Pond 6.0 (**Figure 5-1**) and Pond 6.1 (**Figure 5-3**) from the City's road allowance to the inlet and outlet structures and forebay areas. Due to constraints related to the available area within the SWM block, looped maintenance access roads are not possible. As such, hammerhead turn arounds, with the minimum 17m width and a 12m centreline turning radius, have been provided. The proposed maintenance access roads have been designed with a roadway width of 5m.

### 5.7.9 Overland Flow Route to Main Pond

Per the City of Hamilton Comprehensive Development Guidelines and Financial Policies Manual (2016), the minor drainage system for the Block 2 study area is proposed to consist of subsurface concrete storm sewers designed to convey the 5-year event. For the purposes of this FSR for SWM Ponds 6.0 and 6.1, the 5-year event is directed to the SWM pond sediment forebay, while flows above the 5-year event bypass the sediment forebay and discharge to the main cell of the respective SWM pond via the overland flow route consisting of the roadway network. Inlet inverts to the proposed SWM ponds are above the corresponding 5-year water level within the respective SWM pond to ensure a free outlet condition.

## 5.8 Storm Sewer Servicing

### 5.8.1 Introduction

The storm servicing for Block 2 (excluding the stormwater management ponds) includes the storm outfalls, major and minor storm systems. The major storm system consists of surface (overland) flow (including roads and ditches) and the minor system consists of storm sewers or ditches. The road location and design is critical to provide an acceptable storm system, drainage plan and grading plans. The study area is generally bounded by Barton Street, Glover Road, Highway No. 8 and Watercourse 6.0. The study area also includes lands on the east side of Glover Road (288 Glover Road), between Barton Street and Willow Lane which already has servicing development plans.

### 5.8.2 Existing Storm Infrastructure and Outfalls

There is limited storm sewer infrastructure on the boundary streets. The infrastructure generally consists of culverts to convey road ditch flow or watercourses. On Highway No. 8, there are road drainage storm sewers on the north side of the road that outlet to Watercourse 6.0 and 7.0. Glover Road has 900 mm and 750 mm diameter driveway culverts and a ditch on the west side of the road that provides drainage from Highway No. 8 northerly. In addition a section of Glover Road drains to the ditch on the west side of Glover Road. A concrete culvert crosses Glover Road for Watercourse 7.0. The ditch on the west side of Glover Road south of this concrete culvert also drains to this location. The culvert also provides drainage for Glover Road from Willow Lane southerly. There are two culvert crossings on Barton Street between Watercourse 6.0 and Glover Road. The Barton Street crossing for Watercourse 6.0 is through a 1900 mm x 1300 mm Corrugated Steel Pipe (CSP) and 1250 mm x 1250 mm box culvert. Watercourse 6.1 crosses Barton Street through a 600 mm CSP. Drainage on Barton Street is by ditches on the north and south sides. The existing infrastructure information noted above was attained from the available City Spider electronic engineering vault system drawings, the Barton Street EA base plans and field measurements of the 900 and 750 mm culverts on the west side of Glover Road.

### 5.8.3 Storm Sewer Network Design

The Concept Plan road layout needed to accommodate the location of the two stormwater management (SWM) ponds on the south side of Barton Street (SWM Pond 6.0 located west of the north south collector road and SWM pond 6.1 located east of the north south collector road). The gradient of the study area is from Highway No. 8 northerly to Barton Street with a section of the study area at the south east quadrant to Watercourse 7.0. The existing drainage is identified on the existing and proposed drainage **Figure 5-5**.

The design criteria that was used as a basis for the storm sewer network design is found in the City of Hamilton Comprehensive Development Guidelines and Financial Policies Manual (2016). This design criteria that, includes minimum sewer sizes, minimum and maximum velocities, design capacity, cover over sewers as well as land use runoff coefficients, was used for the development of the Storm Design Tables (included in Appendix A1) and the Storm Drainage Plan which outlines the catchment area information, storm sewer sizing and slopes (**Figure 5-6**).

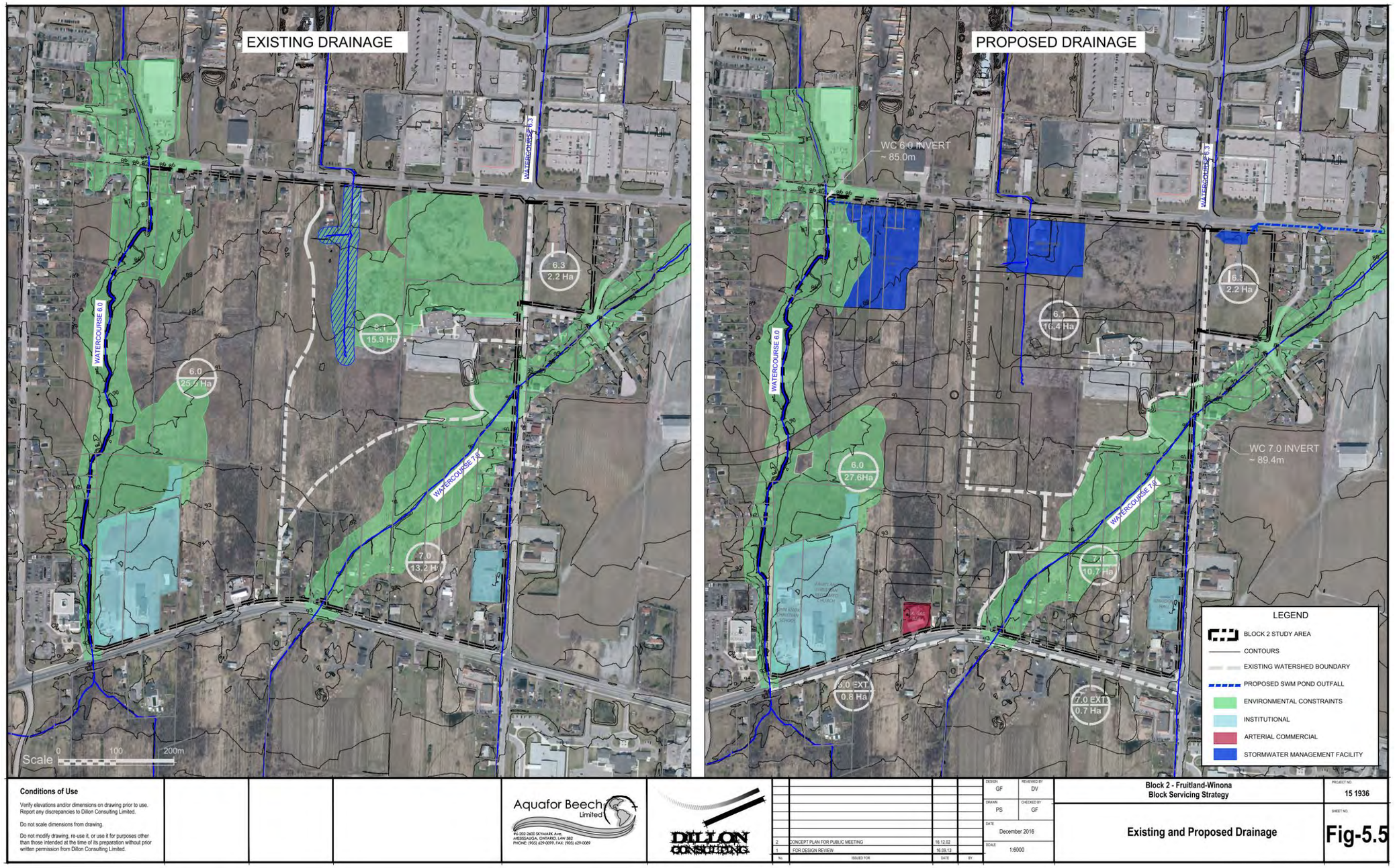



**Figure 5-5 – Stormwater Servicing (Existing and Proposed Drainage)**

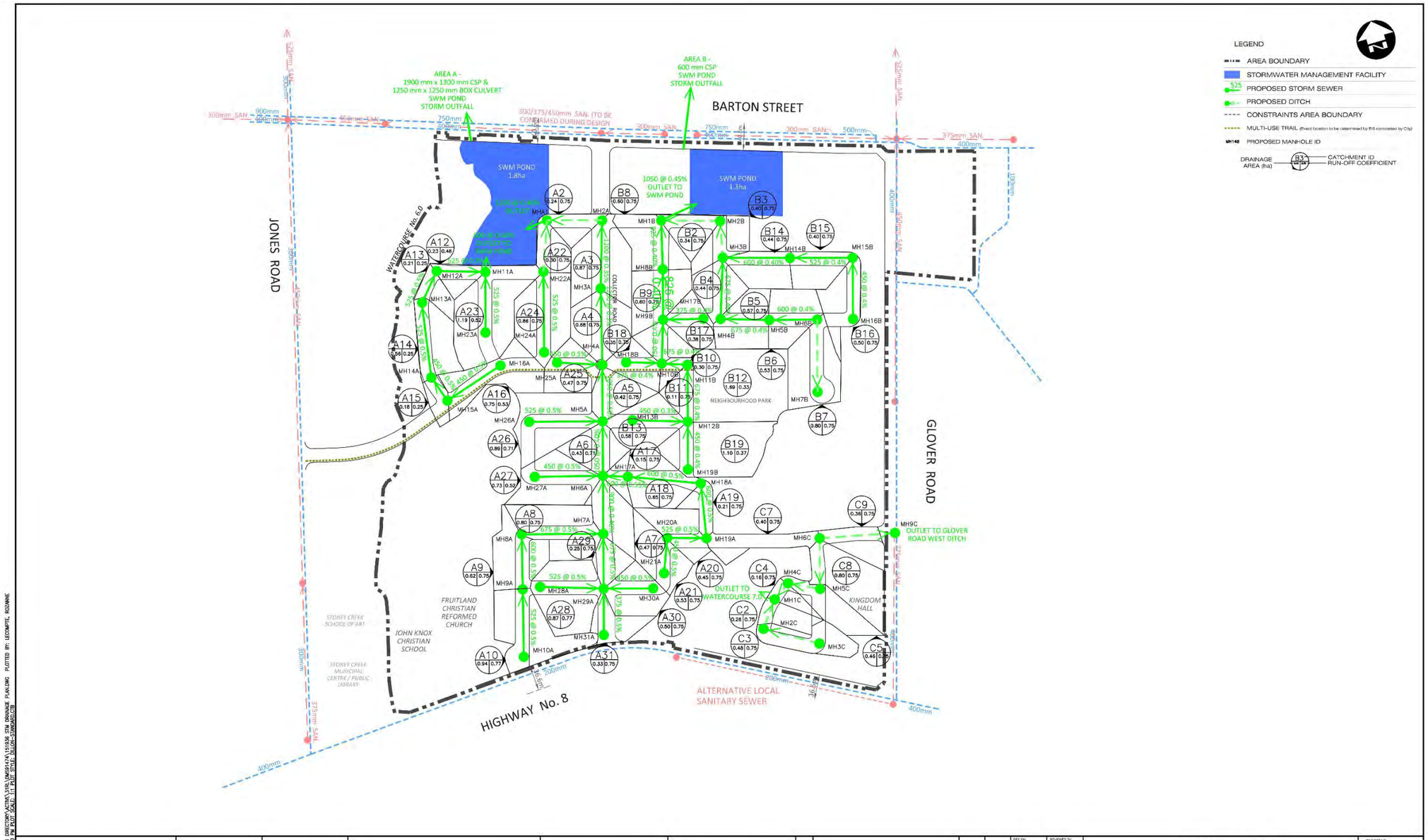



**Figure 5-6 – Storm Drainage Plan**

The SWM pond locations were located at the low ends of the drainage areas noted as A and B on the storm drainage plan and storm design tables that are included as Appendix A1. SWM pond 6.0 is located west of the north south collector road and outlets to the 1900 mm x 1300 mm CSP and 1250 mm concrete culvert that crosses Barton Street at Watercourse 6.0. SWM pond 6.1 is located east of the north south collector road and outlets to the 600 mm CSP that crosses Barton Street at Watercourse 6.1. Area C drains to Watercourse 7.0. The existing grades, elevation of Watercourse 7.0 and available area does not allow for a SWM pond for this area. Stormwater quality will be managed by a proposed ditch system and pre-development to post development will need to be managed through ditch pipe outlets that control the flow to pre-development flows. During the detailed design phase the sizing of the outlet pipes and ditches will need to address this and any stormwater storage needs.

A road grade plan was developed with the Concept Plan road layout and the SWM pond locations. The major overland flow for Areas A and B are directed to SWM ponds 6.0 and 6.1 along the roads with the proposed drainage generally maintaining the existing drainage areas noted on the existing and proposed drainage figure where possible. In a few locations, the major over land flow is to Watercourse 7.0. The major flow figure outlines the major storm flow along the proposed roads or ditches.


**Figure 5-7 – Storm Major System Plan**

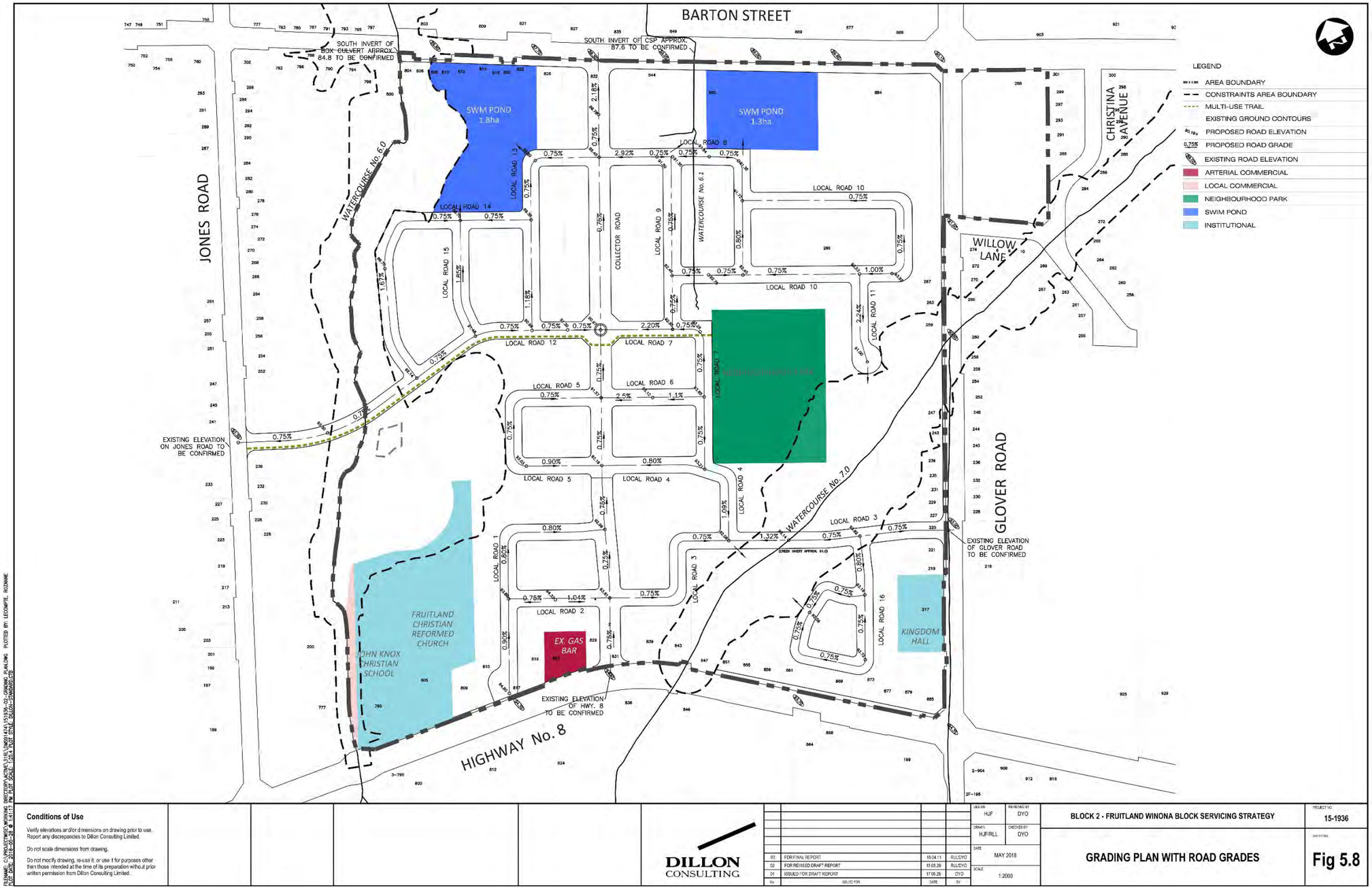


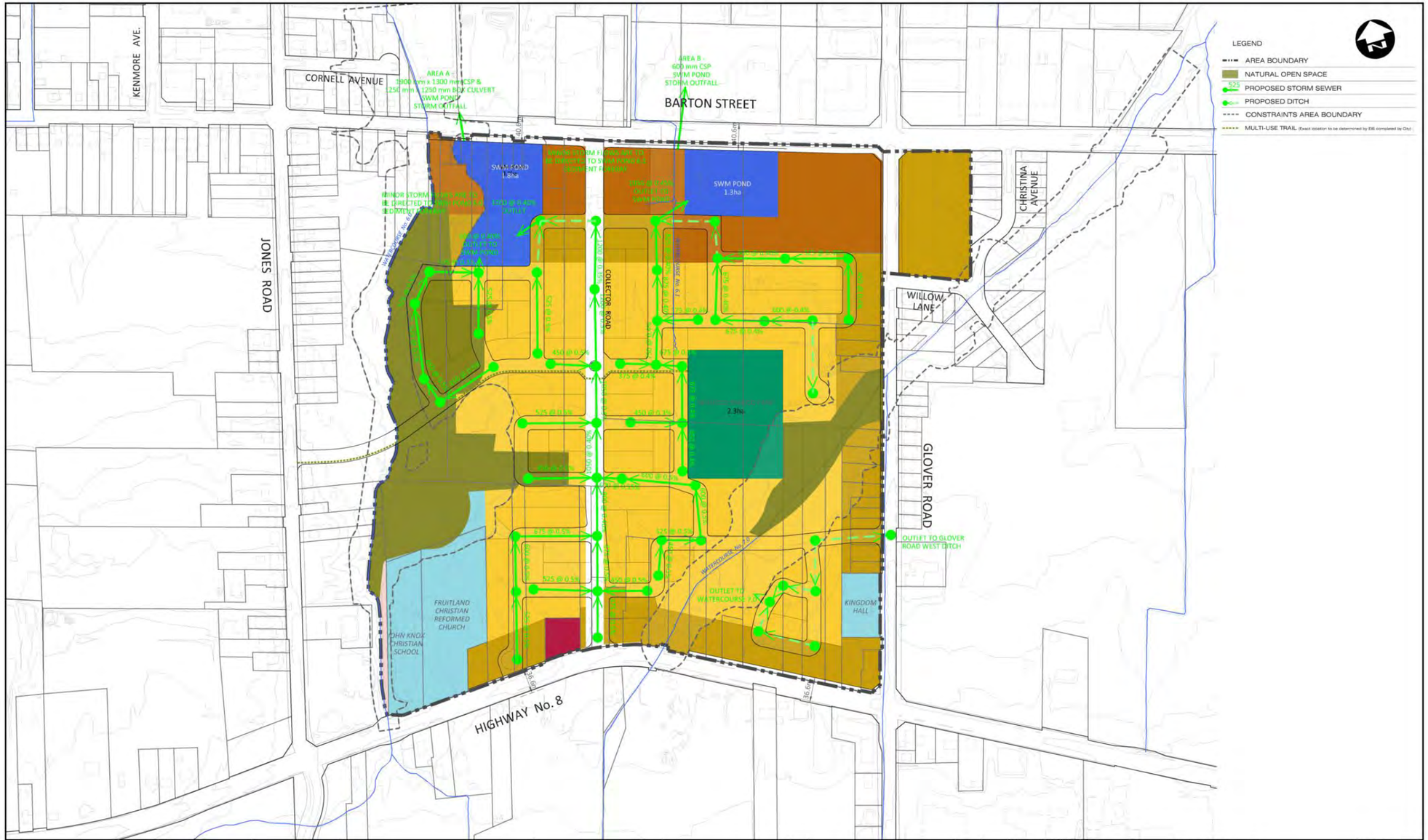

**Figure 5-8 – Grading Plan with Road Grades**

The minor storm system consists of storm sewers and ditches for Areas A and B and ditches for Area C (Outlets to Watercourse 7.0). A design sheet (**Appendix A1**) was prepared for Area C which demonstrates that there is insufficient cover for storm sewers. During detailed design when there is topographical survey information available and a final road layout, then ditch cross sections should be developed. A section of the local road connection to Glover Road drains to the ditch on the west side of Glover Road and Local Road 11 drains to Watercourse 7.0 by ditches as well. The need to drain the minor storm system in places by ditches is associated with reducing the fill that is required for this plan. Where drainage is shown to discharge directly to Watercourse 6.1 or 7.0 appropriate storm water quality and quantity control through the ditches will be required. Major flows from Local Roads 9 and 8 will be required to drain to SWM pond 6.1. The grading plan requires fill in a number of areas to provide drainage to the SWM ponds whose elevations have been set to provide the required storage with the outlet elevations to Watercourses 6.0 and 6.1. In order to reduce the amount of fill that is required to develop Block 2, a minimum cover of 1.2 metres for storm sewers has been used. The City standard cover on storm sewers is 2.75 metres. A depth of 1.2 metres will provide for road catch basin connections only. Where 1.2 metres is not able to be achieved in select areas, ditches are proposed. Where ditches are proposed the right of way width is to be adjusted to allow sufficient road allowance width to accommodate ditches. Where the hydraulic grade line is above the bottom of the ditch invert system (ie where the ditches will hold water) the ditches are to be enclosed (not open) with a shallow pipe or culvert. The lands on the east side of Glover are lower and do not drain to the ditch on the west side of Glover Road as shown on **Figure 5.8**.

Where the local roads in Area C drain to Watercourse 7.0 in addition to the use of ditches for stormwater quality and quantity control Low Impact Design (LID) design measures are to be considered including collection and infiltration systems during the detailed design stage.

Adjusting the site to achieve additional cover is limited by the City standard minimum road grade of 0.75%. The road grade for the north south collector road which carries the major overland flow is 0.75% and the grade at Highway No. 8 needs to be met. The storm sewer design table included in the appendices outlines the maximum cover that can be achieved for the storm sewers. The watercourse culvert crossing sizes and channel design have not been determined at this time and a minimum watercourse road crossing elevation was assumed for the local road connections to Jones and Glover Roads. The desirable cover over the top of the creek crossing culverts is the pavement structure depth of the roads so the culverts are not located within the pavement structure. The minor storm system is shown on the attached figure. The design of the storm sewer sizing and

slopes shown on the Storm Minor System Plan (**Figure 5-9**) are outlined in the Storm Design Table that is included as an appendix (**Appendix A1**) to this report.

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Block 2 - Fruitland-Winona Block Servicing Strategy

Storm Minor System Plan

PROJECT NO. 15 1936

SHEET NO. Fig 5.9

**Figure 5-9 – Storm Minor System Plan**

Following the completion of the Concept Plan, Road Grading Plan, Storm Sewer Network Design (Minor and Major Systems) preliminary lot grading information was added to the Road Grading Plan to indicate how the lots would drain. The lot grading design guidelines can be found in the City of Hamilton Comprehensive Development Guidelines and Financial Policies Manual (2016). The design criteria used for maximum and minimum slopes was a minimum of 2.0 % to allow for back to front drainage and a maximum of 5.0%. Where the lot grading slope exceeds 5.0%, a retaining wall may be needed if, during detailed design, the maximum grades are not maintained at 5.0% or lower. The depth of fill on the lots can be reduced with a minimum 1.0% slope. The grading plan has select areas where slopes have been reduced to 1.0%. During detailed design split lot drainage can be considered providing the proposed road grades are maintained. The existing contours have been included on the drawings as well as the existing grades of the boundary roads which include Barton Street, Glover Road and Highway No. 8. These elevations and contours show how the Block 2 grades tie into the boundary roads and the degree of fill that needs to be placed for this plan. The digital terrain model contours are shown on the grading plans. These contours and the depth of fill that is required for Block 2 will need to be confirmed during the design phase when design level topographical surveying is undertaken. Based on the digital terrain model contours, the John Knox Christian School and the Fruitland Christian Reformed Church lands currently drain to Watercourse 6.0. The plans do not propose redevelopment of these Secondary Plan institutional lands.

Ditch details should be provided during the detailed design stage when the final road grades have been determined along with sidewalk placement. Area C is noted as draining to Watercourse 7.0 and stormwater quality is to be managed by ditches with stormwater pre to post development flows managed by ditch pipe outlets. Details on ditch and pipe outlet sizing are to be developed during the detailed design stage. The preliminary lot grading for Block 2 is shown on **Figure 5-10**. The grading for 826, 844 and 884 is to be adjusted to drain to SWM ponds 6.0 and 6.1 with 884 Barton Street and the eastern part of 844 Barton Street draining to SWM pond 6.1 and 826 and the area east of the north south collector road draining to SWM pond 6.0.

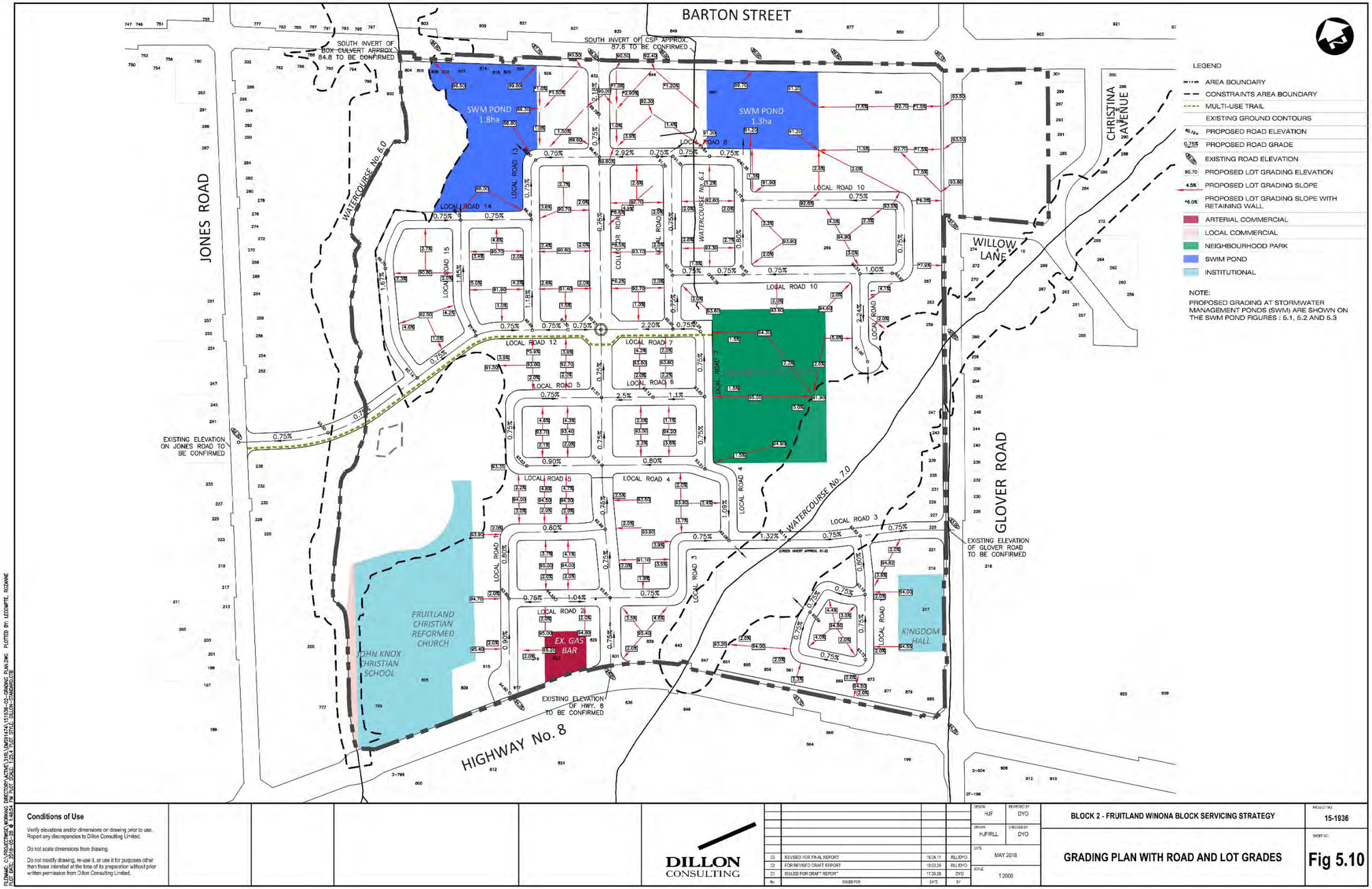


**Figure 5-10 – Grading Plan with Road and Lot Grades**

## 5.9 Water Main Servicing

The proposed water system servicing of Block 2 at a functional design level consistent with the City development guidelines (City of Hamilton, 2016) was completed. The Block 2 study area is bounded in the north and south by Barton Street and Highway No. 8 respectively, and the west and east are bounded by Watercourse 6 and Glover Road respectively.
The existing water distribution network surrounding the study area as potential points of connection include (clockwise from north-west):

- 400 mm on Barton Street between Jones Road and Glover Road;
- 400 mm on Glover Road between Barton Street and Highway No. 8;
- 200 mm on Highway No. 8 between Glover Road and Jones Road; and,
- 300 mm on Jones Road between Highway No. 8 and Barton Street.

This system is further reinforced along the northern segment with interconnection to a 750 mm watermain along Barton Street. The existing watermain infrastructure on the boundary roads are outlined on **Figure 5-11** (Watermain Plan).
The area is predominantly planned for residential use with park and green space. The total serviceable area, based on proposed zoning approach and secondary plan densities, includes an estimated demand population of approximately 3,900 capita equivalent. Existing serviced lands include institutional and arterial commercial already serviced by water systems on Highway No. 8 and Glover Road and are not included in the above capita equivalency estimate. These properties are not considered further in the present analysis, as they do not represent additional projected demands.

### 5.9.1 Domestic Demand

The study area design criteria are established on the basis of existing data as extracted from the hydraulic model provided by the City and the provincial design guidelines. A design basis is established from the more conservative of the available sources and is summarized in the Watermain Hydraulic Report Memo in **Appendix B.**

### 5.9.2 Fire Flow Demand

With regard to fire flow, the typical approach for development servicing is to calculate a flow requirement according to a standard methodology (Fire Underwriters Survey, 1999). The methodology requires detailed knowledge of the architectural design of proposed buildings. This level of detail is not known at this time. Consequently, the alternative approach used in this evaluation is to overlay anticipated available fire flow capacity as observed by hydrants within the development watermain network as calculated within a water system model. Under maximum day plus required fire flows for ultimate build out

conditions, the pressure area bounding the study area and within the study area are expected to maintain service pressures above 140 kPa at ground level. The requirements for Form 1 shall be confirmed and verified at the draft site plan stage.

### 5.9.3 Subdivision Computer Model

The watermain network was modeled using road rights-of-way and a main north-south spine with box-grid services along collector roads. The model assumes Hazen-Williams coefficient of friction (C-Factor) and the resulting C-Factors are 100, 110, and 120 for pipe sizes of 150 mm. 200 mm. and 300 mm respectively. These friction factors are considered conservative versus new PVC pipe with documented long-term C-factors in excess of 140. The water model elevations were set to grade elevation based on topographical contour data. Water demands were applied to the network according to proposed land use and per capita demand. The total build-out demand is 20.7 L/s under average day conditions. The network was simulated under the following future conditions representing year 2031 background system demand within the coarse pipe model provided by the City. The 200 mm east-west lateral through the proposed roundabout and the 300 mm north-south main from Barton Street to the roundabout were both upsized to meet fire flow design basis.

The proposed watermain network is presented with pipe diameters in **Figure 5-11** below. It should be noted that during the detailed design stage when the road grade has been finalized, the watermain profile will need to be lowered to pass under the storm sewer where there is a conflict with maintaining a minimum design cover for the watermain. During detailed design an alternative watermain connection is to be reviewed from Local Road 3 across Watercourse 7.0. The road layout for Area C is subject to the final development arrangement (assembly of lots etc.) which will impact the watermain layout. All dead end street watermains are to be looped.

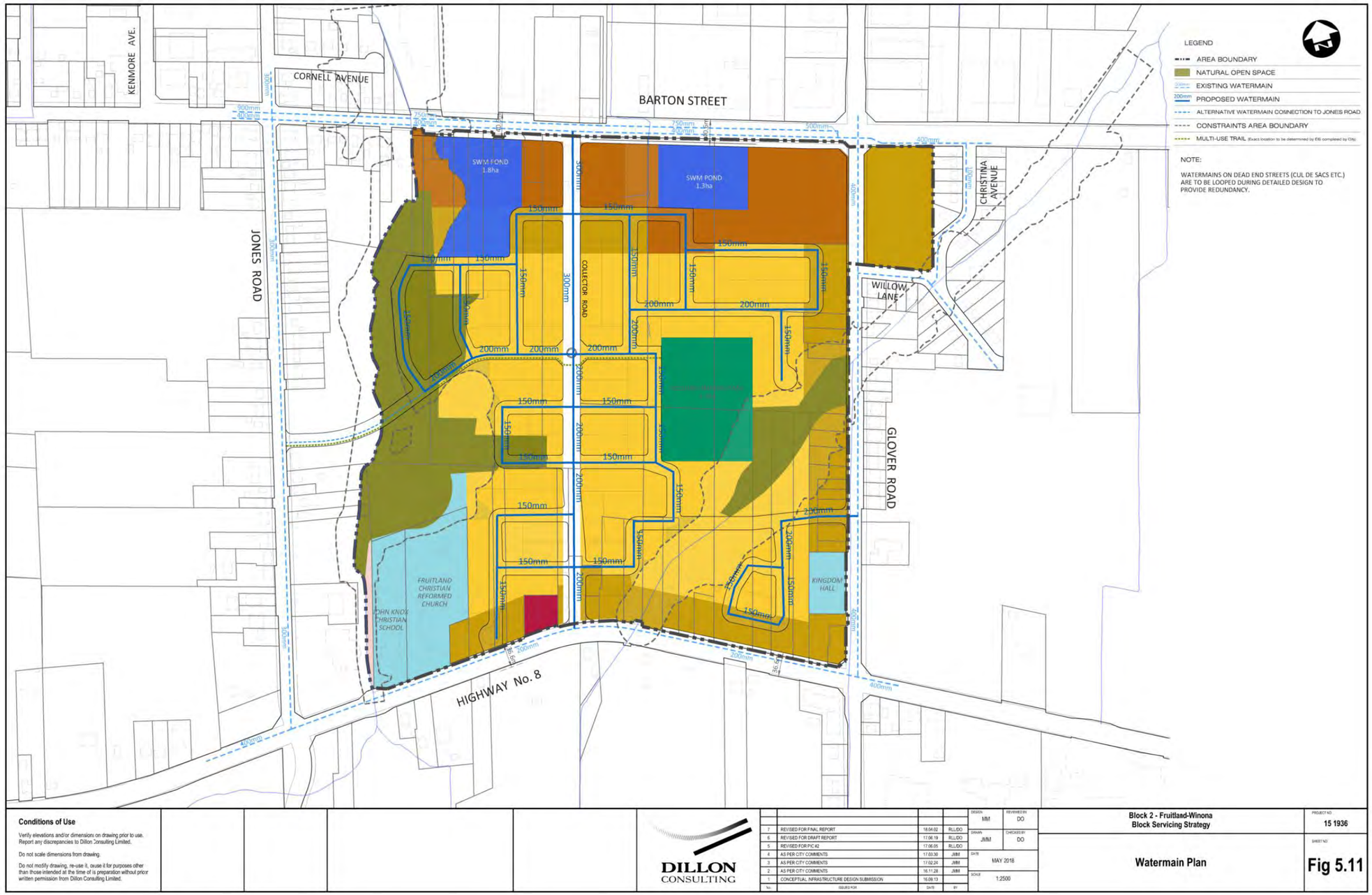


**Figure 5-11 – Watermain Plan**

### 5.9.4 Detailed Design Considerations

#### 5.9.4.1 Transient Pressures

The system is not evaluated for transient pressures at this time as final materials have not been selected. A transient analysis should be performed at the detailed design stage.

#### 5.9.4.2 System Flushing

The system is not evaluated for final flushing arrangement as the location of hydrants and final watermain configuration should be established at detailed design. The proposed configuration includes cul-de-sac locations with potential dead-end connections that will require looping. Developers will be required to maintain an adequate chlorine residual through water quality flushing or other means until adequate chlorine residual is established. The system needs to be evaluated for final flushing arrangement during detailed design when the hydrant placement is being finalized along with alternative connections and valve placement. During detailed design consideration for a connection from the cul de sac west of the north south collector road to Highway No. 8 is to be considered.

#### 5.9.4.3 System Resilience

The block servicing geometry provides for a potential interconnection opportunity to Jones Road. This alternative could be used to reinforce the Highway No. 8 interconnection or possibly defer the connection according to build-out phasing. The hydraulic benefit of the alternative connection should be reviewed during detailed design. The Jones Road connection could be extended under Watercourse 6.0 with a watermain casing to minimize future environmental impacts.

The draft site plan submissions shall comply with City standards for a minimum number of system connections; in particular, for servicing areas with more than 100 units a secondary connection shall be required. A watermain connection on Local Road 3 west of Local Road 16 across Watercourse 7.0 could be considered during detailed design.

#### 5.9.4.4 Fire Flows

The future site-specific development applications would be required to identify actual fire requirements and confirm that the requirements do not exceed the design allowance of this evaluation. The hydraulic modelling demonstrates that the servicing study will meet the requirements of anticipated fire flow including supply pressure greater than or equal to 140 kPa (20 psi) under 2031 maximum day plus fire flow demand and within the limitation of available design detail. Detailed design of the future development shall be

required to demonstrate at the draft site plan stage that alteration and development of the drinking water system will comply with Form 1 requirements.

#### 5.9.4.5 Water Age

Overall impacts to water age were not reviewed, but could be considered during detailed design particularly if development phasing is anticipated to span a long period.

## 5.10 Sanitary Sewer Servicing

The Block 2 sanitary sewer proposed infrastructure to service the Secondary Plan land use and related development was based on the land uses associated with the Secondary Plan. This included the December 4, 2015, decision by the Ontario Municipal Board (OMB) to address an appeal by the landowners of 860 and 884 Barton Street.

### 5.10.1 Existing Infrastructure

Existing sanitary sewer infrastructure exists on Barton Street, Glover Road and Jones Road. This existing infrastructure has been shown on the Sanitary Plan **Figure 5-12** and was identified from the City of Hamilton's Spider Electronic Vault System and from the Barton Street EA base plans. This existing infrastructure that was reviewed for connection opportunities included; (i) 300 mm to 450 mm diameter sanitary sewers on Barton Street, (ii) 375 mm to 450 mm diameter sanitary sewers on Glover Road and (iii) 375 mm and 450 mm diameter sanitary sewers on Jones Road. There are no existing sanitary sewers on Highway No. 8.

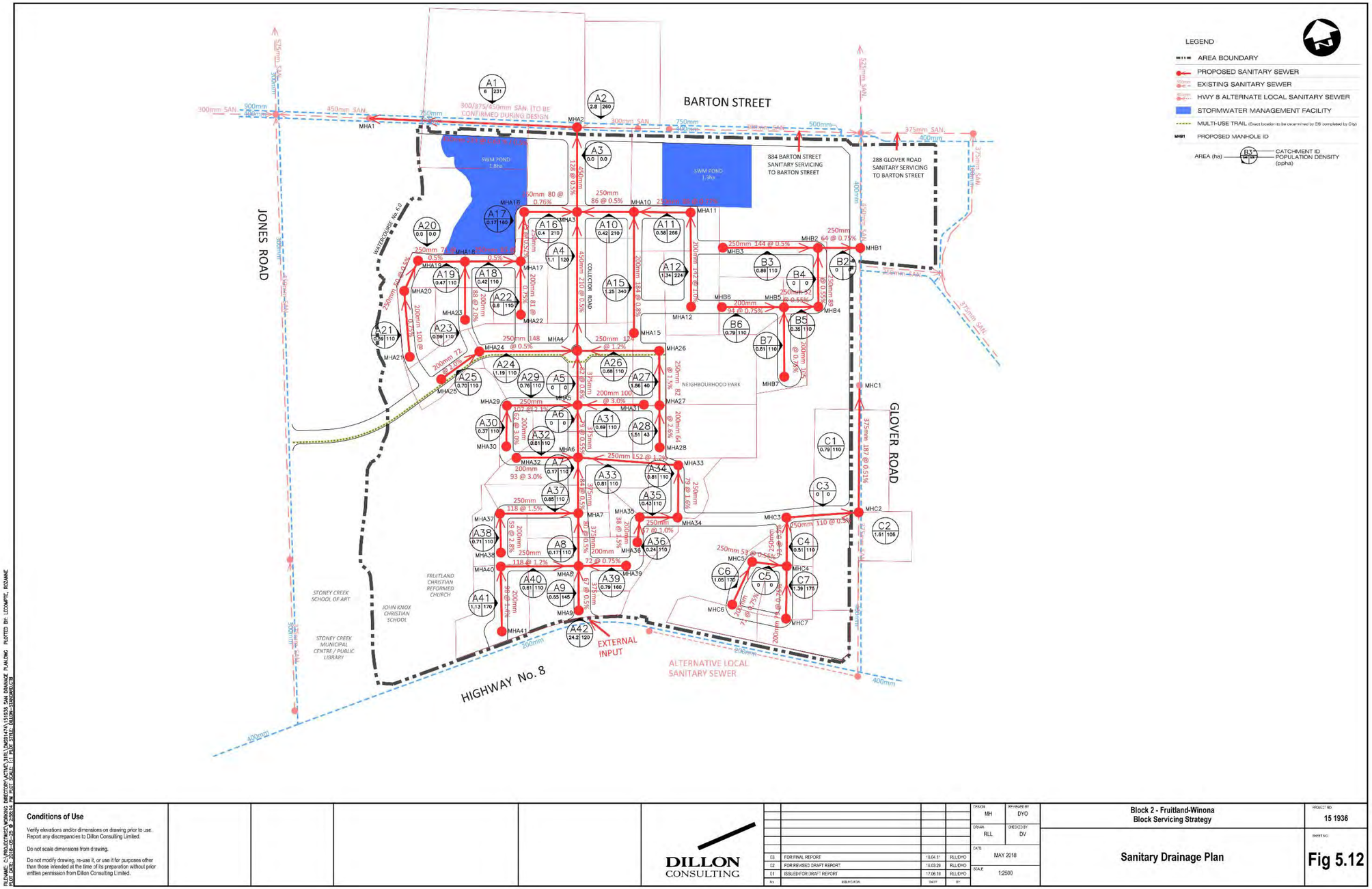


**Figure 5-12 – Sanitary Drainage Plan**

### 5.10.2 Sanitary Sewer Network Design

The proposed sanitary network required connection(s) to the existing infrastructure on the boundary streets and a review of this infrastructure was undertaken to determine which infrastructure was designed to service the Block 2 development area. The land generally falls from Highway No. 8 to Barton Street. Based on an initial review of the depths of the existing infrastructure on the boundary roads along with the catchment design figure provided by the City for the sewers, Glover Road and Barton Street was selected to service the Block 2 area.

Consideration of the external areas for the Barton Street sanitary sewer catchment area south of Highway No. 8 of the study area was also included in the proposed sanitary network as this drainage area needed to be accommodated through the Block 2 study area sanitary sewers. The external area to the study area south of Highway No. 8 that was included in the Glover Road sanitary sewer catchment area would be serviced by the Glover Road sanitary sewer and connected at or in the vicinity of the Glover Road and Highway No. 8 intersection. A review for an alternative local sewer on Highway No. 8 that could service the existing properties on the north side of Highway No. 8 that could be constructed before the balance of the proposed sanitary network in Block 2 was also completed.

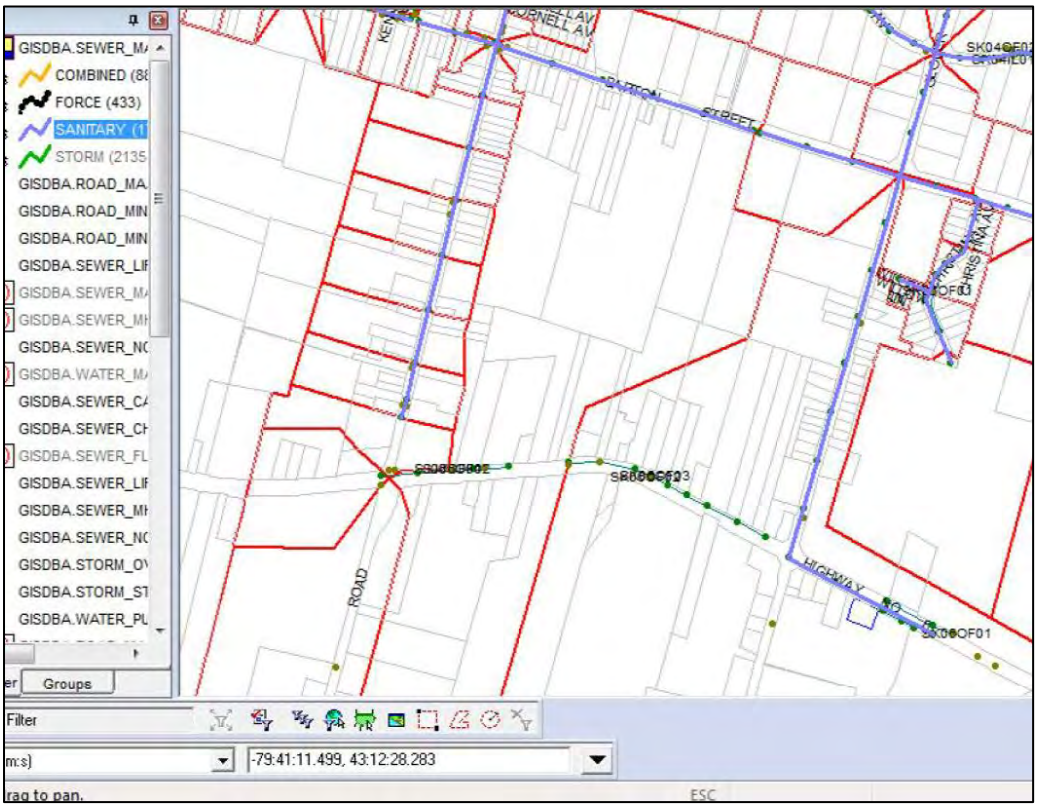


**Figure 5-13 – Sanitary Sewer Catchment Design Figure**

The basis for the sanitary sewer design criteria that was used for the Block 2 proposed sanitary sewer network is located in the City of Hamilton Comprehensive Development Guidelines and Financial Policies Manual (2016). This design criteria that includes minimum sewer sizes, minimum and maximum velocities, design capacity, cover over sewers as well as land use sanitary flows was used for the development of the Sanitary Design Table (included in **Appendix A2**) and the Sanitary Drainage Plan which outlines the catchment area information, sanitary sewer sizing and slopes. The Sanitary Drainage Plan (**Figure 5-12**) and Sanitary Plan (**Figure 5-14**) do not show individual manholes, but manhole node locations for the identified catchment areas.

The Block 2 sanitary sewer network layout does not include a sewer layout for 884 Barton Street. This block of land was reviewed for municipal infrastructure servicing and proposed a sanitary sewer on a local road which connected to Barton Street. Since this road connection was too close to the intersection of Barton Street and Glover Road, this local road connection which would have serviced 884 Barton Street was not included in the Concept Plan road layout and, subsequently, a municipal sanitary sewer was also deleted from the proposed sanitary network. This block of land can be serviced by a sanitary connection to the existing Barton Street sewers which allow for sanitary drainage from this block of land. A sewer connection to Barton Street for 884 Barton Street has been shown on **Figure 5-12** and **Figure 5-14**. The lands on the east and west side of the north south collector road can be serviced with a connection to the existing sanitary sewers east of the north south collector road and to the proposed upgraded sanitary sewers on Barton Street west of the north south collector road.

The proposed sanitary sewer network for Block 2 also does not include a sewer layout of 288 Glover Road which already has servicing development plans. This block of land can be serviced by a sanitary connection to the existing Barton Street sewers which allow for sanitary drainage from this block of land. A sewer connection to Barton Street for 884 Barton Street has been shown on **Figure 5-12** and **Figure 5-14**. Another consideration when completing the Block 2 sanitary sewer plan was the Winona Vine Estates (269 Glover Road). This is a recent development and is not likely to develop in the short term or long term. This parcel of land though was included in the Secondary Plan and therefore a sanitary servicing sewer layout has been shown on the Sanitary Plan (**Figure 5-14**). The sewers which are proposed do not service property outside of this area and will not impact the timing for development of adjacent Block 2 parcels.

The proposed sanitary sewer network is outlined on the **Figure 5-14** Sanitary Plan. The Sanitary Plan was developed in tandem with the Concept Plan Road Layout as the intent was to locate the sanitary sewers on the proposed roads to limit the need for sewer easements. The location of the watercourses, in particular Watercourse 7.0 established

the need to service the south east quadrant of Block 2 with a separate sanitary outlet to Glover Road. In order to use the existing sanitary sewers on Barton Street and Glover Road, sections of these sewers will require lowering and / or upsizing. This has been identified on the Sanitary Plan.

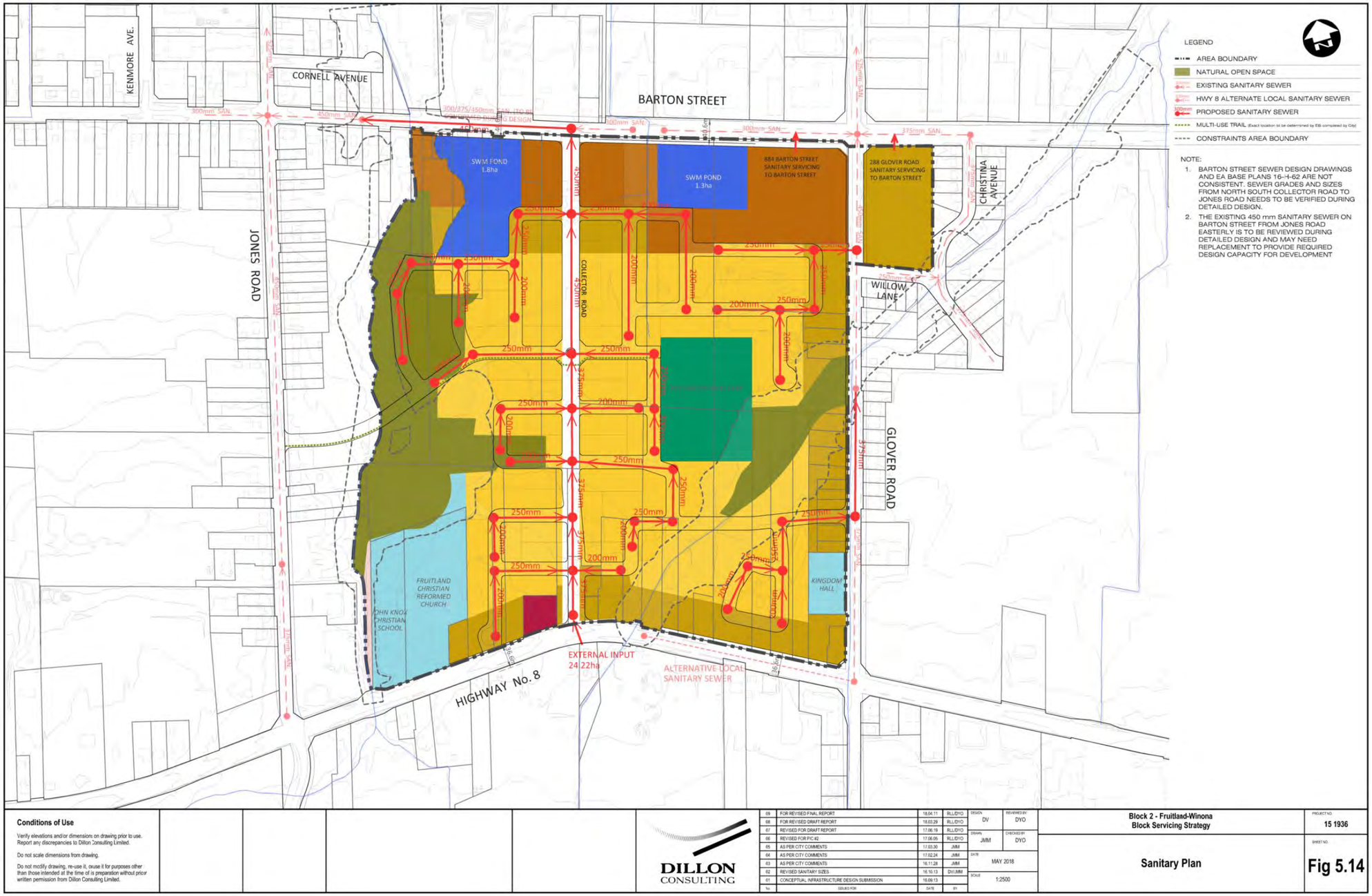


**Figure 5-14 – Sanitary Plan**

There are no existing sewers on Highway 8. Should the institutional properties, 795 and 805 require a sanitary sewer connection, then, these lands would be serviced through a connection to the north south collector sewer. A review of the potential to install an alternative local sewer on Highway No. 8 to service the existing properties on the north side of Highway No. 8 was completed. This review was completed should a need to provide sanitary sewer service on Highway No. 8 prior to the installation of the sanitary sewer system in Block 2 to Highway No. 8 or to Glover Road as shown on the Sanitary Plan be required. An alternative local sewer could be constructed on Highway No. 8 from Watercourse 7.0 to Glover Road but the balance of Highway No. 8 would be difficult to install a sanitary sewer that provided the required cover over the sewer based on the Highway No. 8 topography, the existing sewer grades on Jones Road and Glover Road and crossing of Watercourse 6.0.

Development Phasing requires the completion of the work on the existing infrastructure that the sanitary sewers are to connect to and the construction of the stormwater management ponds provided that the area is to drain to these ponds. The area shown as Area C on the Sanitary Drainage Plan can be developed with the improvements to the Glover Road existing sanitary connection sewers.
The other two areas, Area A and B (exception sanitary sewers servicing 269 Glover Road) drain to the Barton Street sanitary sewers and require the improvements to the existing sanitary connection sewers as well as the stormwater water management pond construction. Providing these are completed, development could proceed in a southerly / easterly / westerly direction along the Collector Road sanitary sewers from Barton Street southerly towards Highway No. 8.

During the detailed design phase the existing infrastructure sizing and grades on Barton Street will need to be confirmed along with the sewer sizing and slopes based on final road layout and catchment areas.

## 5.11 Air Drainage

As part of the Block 2 Servicing Strategy for the Fruitland-Winona Stoney Creek Urban Boundary Expansion, an air drainage analysis was prepared by a qualified environmental engineer, climatologist and an agrologist who are specialized in the field of tender fruit and grape production. The subject lands include the area bounded by Barton Street to the north, Highway 8 to the south, Glover Road to the east, and Watercourse 6.0 to the west. Amec Foster Wheeler and Dr. Kevin Ker were retained by Dillon Consulting to conduct a desktop Air Drainage Analysis for the Block 2 proposed development. The desktop analysis included a review of the area's topography and an analysis of the area's climatology.

New urban developments can alter the natural air flow pattern by blocking and/or affecting the air mixing and turbulences in the area. Such changes can, therefore, affect the micro-climate in that area. To study such effects, it is important to analyze the topography, current air flow, and climate conditions of the area. The area is located between the Niagara Escarpment to the south and Lake Ontario to the north. The area bounded by the Niagara Escarpment is much steeper than the area between the development and Lake Ontario. The ground at the top of the Niagara Escarpment is standing at ~200 m above mean sea level (MSL) and the ground elevation descends steeply northward towards the Block 2 area. The ground elevations within Block 2 range between an average above MSL of 94 m (at Highway 8) to an average of 88 m (at Barton Street).

The objective of the air drainage analysis was to study the effect of the proposed development within the Block 2 Fruitland-Winona Stoney Creek Urban Boundary Expansion to the micro-climate in the region. Included in the review was the impact of the positioning of a proposed cul-de-sac at Highway 8.

There are two types of low temperature injury conditions: advection frost and radiation frost during the growing season and advection freeze and radiation freeze during the dormant period. Advection frost is a regional frost event and it occurs when low temperature air masses, which originate from northern regions, move into the area. This kind of event can be understood through the analysis of climatological data and the topography of the region. Radiation frost is a micro-scale climate event and is generally site specific. Radiation frost is typically caused by cold air accumulation near the ground surface, which can occur in the spring or fall. Low temperature freeze events occur during the winter months when plants are not actively growing, but are in a dormant state to survive winter conditions.

Tender fruit trees and wine grapes can be damaged in the winter due to very low temperatures that go below their acclimation points. The damage often includes cracking of trunks and branches, the death of flower and leaf buds, or total death of trees and vines.

The Block 2 Concept Plan includes low to medium density dwelling units, a neighbourhood park, SWM Ponds, pre-existing institutional land use, and natural open spaces. The developed area is expected to include a new south-north collector road, located approximately in the center of the development in addition to two new east-west aligned roads connecting Jones Road and Glover Road to the collector road.

The analysis of the weather data obtained from the three nearby weather stations (Vineland Weather Station, Burlington Piers Weather Station, and Hamilton Airport Weather Station) suggests the following:

- Prevailing winds are from the west and southwest direction.
- The Vineland area has the most moderate temperatures among the three stations.
- Based on archived observations from the Hamilton Airport Weather Station, the highest fog incidences happened during December and February, with February being the month with the highest number of reported freezing fog events.
- The westerly and south-westerly winds were the dominant direction during fog events whereas north-easterly, south-westerly, and west-southwest winds were the dominant directions during freezing fog events.

Following the desktop analysis of the microclimate and the topography on the area contained by the Block 2 Concept Plan with the proposed road layout, the proposed development is not expected to block the southwesterly-to-northeasterly direction air flow. The new development is not expected to impede the natural air movement and may assist in mixing the boundary air layer (a layer near the ground) by creating eddies (turbulences), thus aid in streaming any cold air descending from the Niagara Escarpment, i.e. preventing air stagnation. The proposed roads, watercourses and the natural open spaces outlined in the Concept Plan will help to channel the air downstream toward Lake Ontario.

The proposed position of the cul-de-sac outlined on the Concept Plan that is adjacent to Highway 8 (to the west of the Collector Road), with its narrow opening on Highway 8, may aid in the air drainage process (south-to-north), but its contribution is expected to be minimal. Relocating the cul-de-sac further north is not expected to affect the overall air drainage process. It is recommended to retain the narrow opening on Highway 8 if the cul-de-sac is to be relocated as the maintenance of a narrow opening along Highway 8 is desirable from an overall air drainage perspective; however, not maintaining the narrow opening is not expected to significantly affect the general air flow.

It is further recommended that the proposed road crossing culverts for Watercourse 6.0 and Watercourse 7.0 are to have as large an opening as practical to allow air drainage flow along the watercourse corridor.

The Air Drainage Analysis Report has been included in **Appendix C**.

## 5.12 North South Collector Road and Glover Road

### North South Collector Road

The North South Collector Road functional design was based on a major collector urban residential road with a pavement width of 11.0 metres and a right of way of 26.0 metres based on the City of Hamilton Comprehensive Development Guidelines and Financial Polies Manual. Curb and gutter, boulevard and sidewalks are proposed on both sides of the road with storm sewers. A minimum gutter grade shall be 0.75% with the grades consistent to allow major overland flow as shown in Figure 5.7, the storm major system plan and Figure 5.8, the grading plan with road grades. The detailed design shall ensure proper drainage to City standards at the roundabout and if minimum gutter grades can not be achieved, then total collection catch basins and storm sewers are to be sized for the 100-year storm rather than use the road as the major overland flow route. During the detailed design stage where a multi-use path is to be considered on one side of the road with sidewalks on the other side, an alternative for 2.0 metre sidewalks may be considered on both sides of the road if there is insufficient room for the multi-use path.

The existing road grades of Barton Street and Highway No. 8 need to be considered along with the proposed road grades of these roads from the Class Environmental Assessments. During the detailed design stage when the road grade is finalized the visibility curves at the sags will need to meet the design guidelines shown in the current version of the Comprehensive Development Guidelines and Financial Policies Manual. During the detailed design stage a traffic impact study will be needed and which will determine lane configurations and intersection details.

The functional design plans have been included in **Appendix D** of this report.

### Glover Road

The Glover Road functional design was based on a minor collector urban residential road with a pavement width of 8.0 metres. As per the City Official Plan, Glover Road is to have a right of way of 26.0 metres. Curb and gutter, ditches and sidewalks are proposed on both sides of the road. No storm sewers are proposed as the outlets for the road drainage are the existing ditches which do not provide sufficient cover to accommodate storm sewers. Catch basins that connect to the proposed and existing ditch on the west side of Glover Road is proposed. A minimum gutter grade shall be 0.75%. The existing road grades of Barton Street and Highway No. 8 need to be considered along with the proposed road grades of these roads from the Class Environmental Assessments. During the detailed design stage when the road grade is finalized the visibility curves at the sags will need to meet the design guidelines shown in the current version of the Comprehensive Development Guidelines and Financial Policies Manual. A sidewalk

exists on the east side of the road and should remain in its current location to minimize impact to existing development as it will be difficult to locate a sidewalk between the curb and ditch without impacts to either property or existing development. Detailed design should consider a multi-use path on the west side of the road or cycling lanes on each side of the road. During the detailed design stage a traffic impact study will be needed and which will determine lane configurations and intersection details.

The functional design plans have been included in **Appendix D** of this report.

# 6.0 IMPLEMENTATION

## 6.1 General

This chapter will describe the key steps that are required to implement the Concept Plan. This will include requirements for future studies, agencies responsible for implementation and approvals and additional design guidance and policy considerations. A separate section has been provided for the following components:

- 6.2 – Floodplain Mapping
- 6.3 – Stormwater Management
- 6.4 – Natural Heritage System
- 6.5 - Restoration & Enhancement
- 6.6 Servicing

## 6.2 Floodplain Delineation

The floodplains as shown in this report were derived from the SCUBE Study or, in the case of Watercourse 6.0 were updated based on mapping provided by HCA.

With respect to the floodplain mapping it should be noted that HCA are currently undertaking a Study entitled Numbered Watercourses Floodline Mapping Study. The purpose of this study is to develop flood plain mapping for each watercourse, in accordance with the HCA Flood Plain Mapping Standards, as stated in the HCA Flood Plain Mapping Review (2010). HCA, the City and Aquafor have worked closely to ensure that the floodlines produced from this study will reasonably reflect those as defined in the ongoing study, however it should be noted that the results from the HCA study will supersede the findings from this study. The anticipated completion date for the study is the end of 2017.

As was noted in the SCUBE Subwatershed study there are constraints along Watercourse 6.0 immediately upstream of Barton Street. The existing culverts would seem to be undersized and could be replaced as part of the ongoing Barton Street Transportation Environmental Assessment Study. Furthermore, the channel between 820 and 824 Barton Street is constrained. This results in an expanded floodplain and will also serve as a constriction for future development (see accompanying photos).

Steps undertaken at the Draft Plan stage should include a hydraulic assessment of the existing Barton Street watercourse crossings as well as the impact of removing one or both of the houses located at 820 and 824 Barton Street.

The floodlines that have been established are not in accordance with the HCA Flood Plain Mapping Standards. At several of the Public Information Centres residents have asked as to whether the floodlines could be reduced (in width) by undertaking a cut and fill balance. This item, in general, will need to be addressed by HCA and will also have to take into consideration other natural heritage features that exist within the floodplain.

It is recommended that restoration of the downstream portion of Watercourse 6.0 and all of Watercourse 7.0 be undertaken. Further details are provided under **Section 6.4** below.

There is one proposed watercourse crossing on each of Watercourses 6.0 and 7.0. The location of the crossings will be refined at the Draft Plan Stage (see **Figure 4-3**). At the Draft Plan phase an EIS will have to be undertaken in order to determine the impact on the watercourse together with remediation measures. The sizing and final location of the

watercourse crossing will also have to be undertaken. Approvals from HCA and the City will be required.

### 6.3 Stormwater Management

Per the City of Hamilton Comprehensive Development Guidelines and Financial Policies Manual (2016), a Functional Stormwater Management Report precedes the Detailed Stormwater Management Report and typically are at a level of detail below the detailed Stormwater Management Reports for any proposed developments with a minimum are of a 5 ha. As such, a Detailed Stormwater Management Report shall be prepared and submitted to the City for review and approval. Section G.8.1.2 – Detailed SWM Report, of the City of Hamilton Comprehensive Development Guidelines and Financial Policies Manual (2016) provides a generic term of reference as follows:

**Plans showing:**

- Lot and road layout with land use;
- Elevations at key points (in a contour map);
- Any surveyed constraint lines (e.g. top of bank, floodlines, wetlands);
- Minor drainage system, with storm sewers, maintenance holes and catch basins;
- Major drainage system with overland flow routes at key points;
- Details of Stormwater management practices, e.g. storage facilities; and,
- Erosion and sediment controls.

**Descriptions of:**

- Receiving system and outlet including confirmation of legal status;
- Classification of site and downstream aquatic habitat per DFO / MNRF / MOE-CC guidelines;
- SWM criteria for quantity, quality, flooding and erosion control;
- Hydraulic analysis, as required, to establish the floodplain for major flow elements;
- Design of SWMPs to meet applicable criteria, polices and guidelines;
- Preliminary erosion and sediment control plan describing existing site conditions, erosion potential, down gradient risk assessment, and anticipated erosion and sediment controls, including staging; and,
- Proposed maintenance and monitoring.

**Tables showing:**

- Targets for water quality, quantity, erosion control and release rates per this FSR and consistent with the SCUBE west study.
- Hydrologic parameters for existing and future land use;
- Pre- and post-development peak flows and volumes at all outlets;

- Post-development flows at all minor system maintenance holes;
- Hydraulic grade line analysis;
- Stage / storage / discharge relationships for SWMPs; and,
- Overland flow depths and velocities at key points on roads and at outfalls.

**Figures / Drawings showing:**

- General location plan;
- Drainage areas for existing and future land use including all external areas;
- Details of overland flow routes;
- Details of SWMP facility appurtenances (inlets and outlets);
- Details of erosion and sediment controls; and,
- Schematic of computer models.

**Approvals**

The Development Proponent is responsible for obtaining all other necessary permits and approvals from some or all of the following agencies (as required):

- Hamilton Conservation Authority;
- Ontario Ministry of Transportation;
- Ontario Ministry of the Environment and Climate Change;
- Ontario Ministry of Natural Resources and Forestry;
- Niagara Escarpment Commission;
- Federal Department of Fisheries and Oceans; and,
- Environment Canada (Federal).

In support of the preparation of Detailed SWM Report, noted below are some general requirements:

**Geotechnical Investigations and Soils Report for SWM Ponds**

Prior to the submission of detailed design two boreholes with nested monitoring wells shall be drilled and monitored for three seasons in the vicinity of each proposed Stormwater management pond. The proponent shall consult with City staff regarding the borehole location and monitoring process. Soil classification and water levels shall be recorded and noted on the plans and profiles submitted.

**Geotechnical Investigations and Soils Report for LIDs**

These studies would be focused on the local soils information gathered through subsurface geotechnical investigations and undertaken for the purposes of the design of LID infiltration techniques.

Geotechnical investigations are necessary to support the design of most LID practices. However, the scope of work will vary depending on the selected LID practice. **Table 6.1** below provides a summary of the geotechnical investigation activities which are necessary for the detailed design of select LID measures.

Boreholes are recommended to be advanced a minimum of 1.5 m below the proposed invert of proposed LID practices. The resolution of the investigation (i.e. quantity and spacing between boreholes) will vary from site to site and between LID practices. Resolution of the borehole investigations should be such that sufficient information is collected for detailed design purposes. Appendix C of the LID Stormwater Planning and Design Guide provides guidance with respect to the recommended number of boreholes.

**Table 6.1 – Geotechnical Investigation Activities for LID Practices Implemented**

| LID Practice | Geotechnical Investigation Activities | | | | |
|---|---|---|---|---|---|
| | Borehole | Piezometers/ Monitoring Wells | Laboratory Soil Testing | Soaked CBR Test | In-Situ Hydraulic Conductivity Testing |
| Porous or Pervious Pavements | ● | ● | ● | ● | ● |
| Bioretention & biofilters | ● | ● | ● | | ● |
| Soakaway Pits | ● | ● | ● | | ● |
| Infiltration Chambers | ● | ● | ● | | ● |
| Downspout Disconnection | ● | | | | |

**Soaked California Bearing Ratio (CBR)**

Soaked CBR is only required for the design of permeable pavement. Geotechnical investigations must include recommendation for base and sub-base requirements and other measures required to ensure adequate structural strength such as compaction or geosynthetic requirements. The Low Impact Development Stormwater Management Planning and Design Guide Version 1.0 (CVC, 2010) provides detailed design requirements for permeable pavement. Furthermore, the American Society of Civil Engineers (ASCE) has developed a guidance manual entitled “Design, Construction and Maintenance of Permeable Interlocking Concrete Pavement” which may also provide valuable design insight and direction to practitioners.

**Geotechnical Laboratory Soil Testing**

Soils samples collected as part of geotechnical investigations characterize the soil properties including natural moisture content, plasticity characteristics, particle size distribution, and analytical results for contaminates. It is beneficial if geotechnical investigations include recommendations regarding soil disposal alternatives.

**Piezometer/monitoring wells**

Monitoring wells typically consist of 50mm diameter piezometers installed to depths of 3.5 to 4.5 meters and encased within an flush mount or above ground, lockable, steel housing. Monitoring wells are installed to determine the pre and post construction seasonal high water table and groundwater flow direction. Monitoring wells may be implemented when available data from background documentation or previous investigation is not available. The Low Impact Development Stormwater Management Planning and Design Guide Version 1.0 (CVC, 2010) has design criteria regarding groundwater clearance requirements for LID practices.

**In-Situ Hydraulic Conductivity Testing**

In–situ infiltration testing characterizes the hydraulic conductivity properties of the existing native material on-site. On-site infiltration testing using the Guelph Permeameter test or other suitable approach to determine the in-situ field saturated hydraulic conductivity and the design infiltration rate per the LID Stormwater Planning and Design Guide (Appendix C) is required. Testing should be performed within the approximate location and invert of proposed LID practices and should include an appropriate safety factor.

## 6.4 Natural Heritage System

Defining the current state of the environment, as well as the relationship between each feature is necessary in order to characterize key environmental functions, define opportunities and constraints associated with future development, and to ultimately establish alternative strategies to protect, enhance or restore the environmental features over time. As detailed in **Section 3.4**, Aquafor Beech Limited characterized the NHS following a series of biophysical field investigations as well as review of available background information. The NHS in the Block 2 study area consists of Core Areas (comprised of Key Natural Heritage Features, Key Hydrologic Features, and Local Natural Areas and their associated Vegetation Protection Zones (VPZs)) and Linkages. The NHS is illustrated in **Figure 3-5.**

The NHS is protected by the City of Hamilton's Official Plan and, in the cases of hazard lands (wetlands, etc.) and the habitat of species-at-risk, protected under Ontario

Regulation 161/06 and the Endangered Species Act, respectively. Works completed in lands regulated by HCA will require a permit under Ontario Regulation 161/06. Similarly, works proposed within habitat of species-at-risk will require further consultation with the MNRF, and potentially will require a permit under the Endangered Species Act from the MRNF.

### 6.4.1 Recommendations for Further Study

The NHS and constraints and opportunities to development shown in **Figure 3-5** may be subject to revision following further studies, including but not necessarily limited to the following:

1. It is recommended that lands not accessed as part of the work completed for the Block 2 study be subject to further study (e.g. an EIS) at the expense of the landowner(s). The EIS is to be completed in accordance with the City's EIS Guidelines, in consultation with the City of Hamilton and the HCA.
    a. The Hamilton Conservation Authority is to determine whether there is a surface water connection between the wetland complex on the corner of Barton Street and Glover Road (ELC polygon 1) in order to determine if the wetland is regulated according to the policies of the Conservation Authority. This determination would be based on ecological inventory/assessment work completed by the future development proponent(s) at this location.
2. To ensure compliance with the Endangered Species Act, the following is recommended:
    a. Treed habitats throughout the study area, but especially those subject to road crossings, should be surveyed for bat maternity roosts in accordance with the Guelph District MNRF's *Survey Protocol for Species at Risk Bats within Treed Habitats: Little Brown Myotis, Northern Myotis & Tri-Colored Bat* (MNRF, 2017).
    b. In order to develop, persons owning lands that contain regulated habitat for barn swallow and/or bobolink should consult with the MNRF about obtaining a permit under the Endangered Species Act prior to any habitat alteration.
    c. The list of species-at-risk in Ontario is updated regularly. In order for future studies to demonstrate compliance with the ESA, the species-at-risk screening exercise in the Block 2 EIS should be updated to reflect species uplisting(s), and/or changes to species' habitat descriptions, as applicable.
3. Furthermore, it is recommended that the Hamilton Conservation Authority update their regulated areas mapping per the findings of this report and the results of item (3), above.

4. Watercourses 6.0 and 7.0, as identified in the SCUBE report and reiterated in this report, are candidates for restoration and revegetation. Accordingly, as development moves forward it is recommended that comprehensive channel and riparian restoration plans be developed for these watercourses. Coordination amongst landowners within Block 2 and, in the case of Watercourse 6.0, in Block 1 will likely be required. It is recommended that the City of Hamilton and the Hamilton Conservation Authority staff be included at the early restoration design stages to identify specific areas of concern. See **Section 6.5** for further information.
5. Opportunities to restore and enhance previously degraded ecosystems (e.g. especially those associated with Watercourse 6.0 and lands on the corner of Barton Street and Glover Road) should be given due consideration.

**Site-specific Direction for Further Study**

As previously mentioned, there are several properties that were not accessed during field studies due to lack of access permission. These properties were assessed using a combination of background information, visual assessments form adjacent lands, and air photo interpretation. One property in particular contains a number of (often overlapping) natural heritage features protected under the City of Hamilton's Official Plan and potentially under HCAs regulation and policies.

**860 & 884 Barton Street**

As described in previous studies (Aquafor Beech Limited, 2014; Colville Consulting Inc. 2012) a significant portion of the property on the south west corner of Barton Street and Glover Road was forested. The *Linkage Assessment of 860 and 884 Barton Street, Stoney Creek*, prepared by Colville Consulting Inc., describes the contiguous treed community on site as a Dry-Fresh Oak-Hickory Deciduous Forest Fresh-Moist Oak-Maple-Hickory complex and a Mineral Green Ash Deciduous Swamp (see **Figure 6-1**). The report completed by Colville Consulting Inc. indicates that a provincially rare sedge (*Carex hirsutella*, S3) was located during field work. The habitat of provincially rare species is considered Significant Wildlife Habitat according to the MNRF's Significant Wildlife Habitat Technical Guide (2000). Significant wildlife habitat is protected under the City of Hamilton's Official Plan.


**Figure 6-1 – Vegetation Community Classification completed by Colville Consulting Inc. (2012)**

Subsequent to the acceptance of the Colville report and prior to June 2014, the forest on the aforementioned property (known as Woodland 6 in the SCUBE report) was legally removed. Site visits and wildlife surveys conducted from adjacent lands by Aquafor Beech Limited in support of this study, in combination with air photo interpretation, resulted in the identification of several natural heritage features on the property (**Figure 6-2**). Notably, the provincially rare sedge identified by Colville Consulting Inc. persists on site; a complex of wetlands, which provide breeding habitat for amphibians, is present where the forest once stood; and bobolink was recorded on site with a breeding status of 'probable'. In June of 2015, HCA identified an extension of Watercourse 6.1 on adjacent lands to the east. In addition, the habitat of barn swallow, another Threatened species (which is nesting off-site within the study area), overlaps onto the property. Wetlands are protected under the City of Hamilton's Official Plan, as are watercourses, significant wildlife habitat, and the habitat of Endangered and Threatened Species. The habitat of Endangered and Threatened species is also protected under the Endangered Species Act.

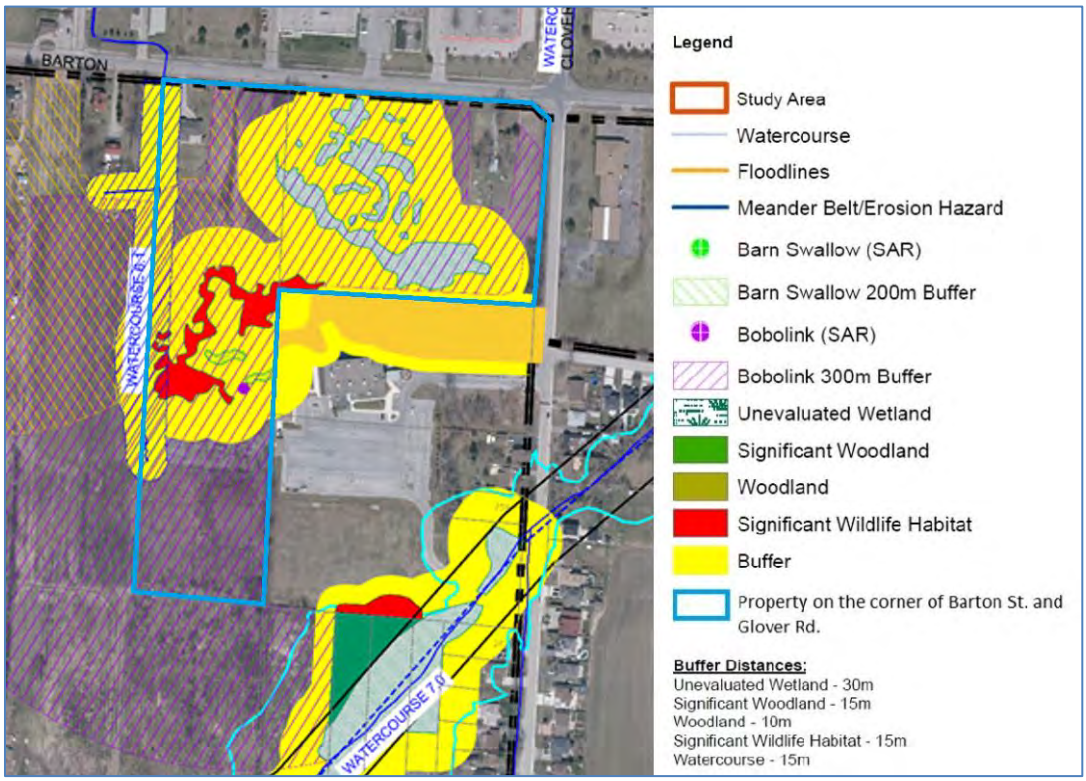


**Figure 6-2 – Natural Heritage Designations on the Property on the Corner of Barton St. and Glover Rd.**

As with all properties within the study area that were not visited during the biophysical surveys conducted in support of the Block 2 Servicing Strategy, for the property located at the south east corner of Glover Road and Barton Street it is recommended that the

findings of this study be confirmed through future study through the completion of an Environmental Impact Statement (EIS). The terms of reference (TOR) for the study should be developed in consultation with the City of Hamilton and HCA and follow the City of Hamilton's EIS Guidelines.

Until such time as the environmental features and functions of the property located on the south east corner of Barton Street and Glover Road are comprehensively studied, it is *recommended* that the natural heritage designations and their accompanying designations and protections under the City of Hamilton's Official Plan and the policies of HCA as detailed in this report remain (note: there are no Natural Heritage designations on this property as per the Fruitland-Winona Secondary Plan mapping (B.7.4-2) or the UHOP Volume 1 Schedule B (Natural Heritage System)). As noted previously, works proposed within lands regulated by HCA will require a permit under Ontario Regulation 161/06. Works proposed within habitat of species-at-risk will require further consultation with the MNRF and potentially a permit under the Endangered Species Act.

**238 Jones Road**

Significant vegetation clearing has recently occurred at 238 Jones Road (see **Figure 3-4**), and the property was not assessed as part of this study. As detailed in **Section 6.5**, it is recommended that aquatic and terrestrial habitats, including and not limited to those that were recently cleared, be subject to ecological restoration. It is further recommended that biophysical studies be completed on the property. The results of these studies will inform the goals of the restoration plan(s) (i.e. will guide restoration to create habitat for target species and/or guilds) and inform limitations and opportunities to development. Limitations and opportunities to development are to be confirmed through future study through the completion of an EIS. The TOR for the study should be developed in consultation with the City of Hamilton and HCA and follow the City of Hamilton's EIS Guidelines.

### 6.4.2 Stewardship

Aquafor Beech Limited recommends that the City of Hamilton consider requiring proponents to develop as part of the (future) planning approvals process, educational materials to encourage local stewardship of the NHS. In particular, Aquafor Beech Limited recommends the preparation of an education brochure to distribute to residents within and adjacent to the Block 2 study area. It is recommended that such brochures:

- Emphasize the importance of conserving retained natural areas in urbanizing landscapes.

- Provide an overview of the significant natural heritage features and functions of the NHS.
- Provide specific recommendations to residents to promote environmental stewardship. Topics to be addressed could include (i) the proper means to dispose of organic and hazardous waste; (ii) recommended measures to avoid recreational impacts (e.g. stay on designated trails), (iii) examples of encroachment and their potential impact on retained natural areas, (iv) the importance of keeping cats indoors and dogs on a leash; (v) the use native species rather than invasive exotics in landscaping; and (vi) the proper use of salt, fertilizers, herbicides, and pesticides.
- Outline the environmental responsibilities of the City of Hamilton, developers, and local residents.
- Promote opportunities for resident participation in the management and restoration of retained natural areas.
- Provide contact information for sources of additional information and support for stewardship efforts, such as the Hamilton-Halton Watershed Stewardship Program and the Hamilton Landowner Stewardship Council.

### *Opportunities to restore and enhance natural areas exist throughout the study area*

In the interest of long-term environmental recovery and sustainability, Aquafor Beech Limited encourages the City of Hamilton, Hamilton Conservation Authority and other relevant agencies to engage communities, organizations and other interest groups in support of Stewardship projects throughout the Subwatershed. It is recommended that oopportunities to engage community partners such as the Hamilton-Wentworth Stewardship Council, ReLeaf Hamilton, the Hamilton Naturalists Club, and the Field and Stream Rescue Team be investigated.

Aquafor Beech Limited has identified three (3) stewardship initiatives that would be beneficial to the recovery, enhancement and long-term sustainability of the NHS:

1) Encourage landowners to avoid cutting grass to the edge of a watercourse and to help maintain naturally vegetated riparian areas. Healthy riparian areas will help maintain aquatic habitat health and water quality while providing habitat for terrestrial animals and birds.
2) Enhance aquatic habitat by eliminating anthropogenic debris, particularly old tires, water barrels, picnic tables and garbage bags from Watercourse 6.0.
3) Requirement, encouragement, and/or facilitation of restoration and enhancements per **Section 6.5**, below.

## 6.5 Restoration and Enhancement

The City of Hamilton may undertake enhancements to Core Areas and Linkages within Block 2 or seek to implement these works as Conditions of Approval through future applications under the Planning Act. The timing of the other restoration and enhancement works is not dependent on any other works or development, but coordination of enhancement activities with other works (e.g. drainage and infrastructure improvements) and/or development may present opportunities to minimize potential disturbance to the NHS and achieve cost savings. Adaptive monitoring of enhancement measures is strongly recommended.

For most of the above restoration works, the Hamilton Conservation Authority and City of Hamilton would be the primary approval agencies, and additional approvals/permits from MNRF and DFO where appropriate. Any watercourse alteration may require DFO review. Opportunities to involve other community organizations in enhancement activities should be investigated. Potential partners include the Hamilton-Wentworth Stewardship Council, ReLeaf Hamilton, the Hamilton Naturalists Club, and the Field and Stream Rescue Team.

Several recommendations for restoration and enhancement measures are contained within the SCUBE reports (Aquafor Beech Ltd., 2012 & 2013). The objectives of the aforementioned enhancement measures include the following:

- naturalize Hazardous Lands (e.g. floodplain) as defined by the Hamilton Conservation Authority;
- decrease the edge-interior ratio of Significant Woodlands and Wetlands;
- provide improved opportunities for wildlife movement;
- buffer Core Areas from future land uses;
- increase habitat diversity; and
- improve water quality.

**Figure 6-4** illustrates the environmental restoration and enhancement works recommended by the Fruitland-Winona Secondary Plan. These works are not directly related to, or expected to benefit the future urban development lands. Rather, these works are generally recommended to address existing environmental issues, or to protect and enhance the Core Areas and Linkages of the recommended NHS. Development proponents are not responsible for any of the recommended restoration and enhancement works at this time. It should be recognized that the City of Hamilton may seek to implement these works as Conditions of Approval through future applications under the Planning Act. Restoration and enhancement works will be reviewed by the City of Hamilton and the Hamilton Conservation Authority. These works include the following:

Watercourse 6.0 Stream Restoration – The following works are recommended to improve the existing aquatic habitat, bank stability and stream shading of the urbanized reaches of Watercourse 6.0 so that it can ultimately function as direct fish habitat

- Secure banks and improve aquatic habitat through woody and herbaceous riparian plantings at erosion points.
- Removal of garbage and debris.
- Assess the feasibility of replacing the deteriorated culvert at Barton Street.
- It is recommended that Hamilton Conservation Authority staff be included at the early restoration design stages to identify specific areas of concern.
- It is recommended that the City of Hamilton explore opportunities to encourage stewardship of watercourses. Potential measures include providing support for the purchase of riparian plantings and facilitating the development/distribution of educational/interpretive materials.

Enhancement of terrestrial features associated with Watercourse 6.0 – A woodland and a swamp, referred to as Woodland 2 and Wetland 2 in the SCUBE reports; once connected ELC Polygons 6, 7, and 8 with the Green Ash Hardwood Deciduous Forest (FODM7-2) to the north. A significant portion of Woodland 2 and Wetland 2 were removed since the completion of the SCUBE studies; presently the results of the related ongoing Ontario Municipal Board (OMB) hearing and the results of charges under the Conservation Authorities Act (CAA) are not known. Accordingly, the applicability of the restoration and enhancement recommendations contained in the SCUBE reports (i.e. reduction of edge-interior ratio of woodlands, enhanced VPZs along Wetland 2) is not known at this time.

From a natural heritage perspective, it is recommended that *at a minimum*, the hazard lands associated with Watercourse 6.0 be subject to reforestation that will re-establish the connection between natural areas located at the northern and southern extent of Watercourse 6.0. For the purposes of establishing constraints and opportunities to development, Aquafor Beech Limited and the City of Hamilton have assumed that the aforementioned minimum area will be restored. It is further recommended that the restored communities reflect extant natural communities present or once present within Block 2 (e.g. oak-hickory lowland deciduous forest). These recommendations are not intended to supersede any decisions made under the OMB process or the charges under the CAA.

Watercourse 7.0 Restoration and Enhancement – The following works are recommended to improve existing aquatic habitat and increase the ecological function of the riparian corridor.

- The existing culvert at the proposed east-west road crossing upstream of Glover Road should be replaced; the use of an open-bottom culvert should be considered to facilitate fish passage.
- It is recommended that the City of Hamilton explore opportunities to encourage stewardship of watercourses. Potential measures include providing support for the purchase of riparian plantings and facilitating the development/distribution of educational/interpretive materials.

Enhancement of terrestrial features associated with Watercourse 7.0 – In keeping with the recommendations of the SCUBE studies, it is recommended that extant natural areas along Watercourse 7.0 (i.e. ELC Polygons 1A, 2, and SWDM2-2) be connected via riparian reforestation efforts (general area shown in **Figure 6-4**, below).

Aquafor Beech Limited recommends enhancement of the floodplain Watercourse 7.0 through the use of site-specific plantings. Enhancement plantings should consist of native trees and shrubs. Specifically, it is recommended that the lands within the floodplain be subject to restoration consisting of forest nucleation cells (**Figure 6-3**) planted in a gradient of concentration from the edge of extant wetlands (higher concentration) outwards to the limits of the floodplain (lower concentration). Such a planting density gradient would mimic patterns of natural succession, providing habitat diversity within the ecotone and enhancing its potential use by wildlife (OMNR, 2000). Recommended riparian plantings would have the added benefit of improving water quality and enhancing aquatic habitat.

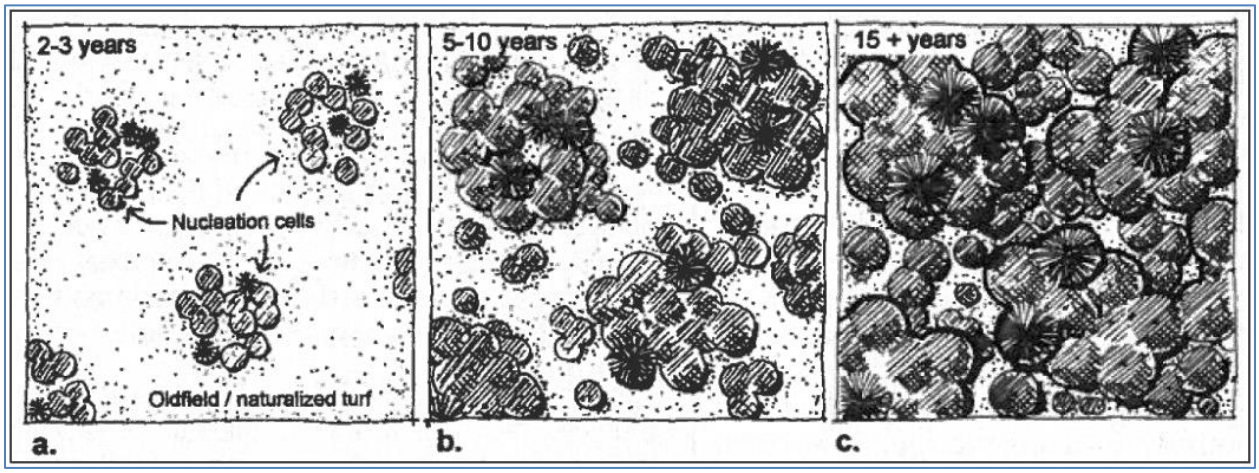


**Figure 6-3 - Gradual expansion of forest nucleation cells over time (from Daigle and Havinga, 1996)**

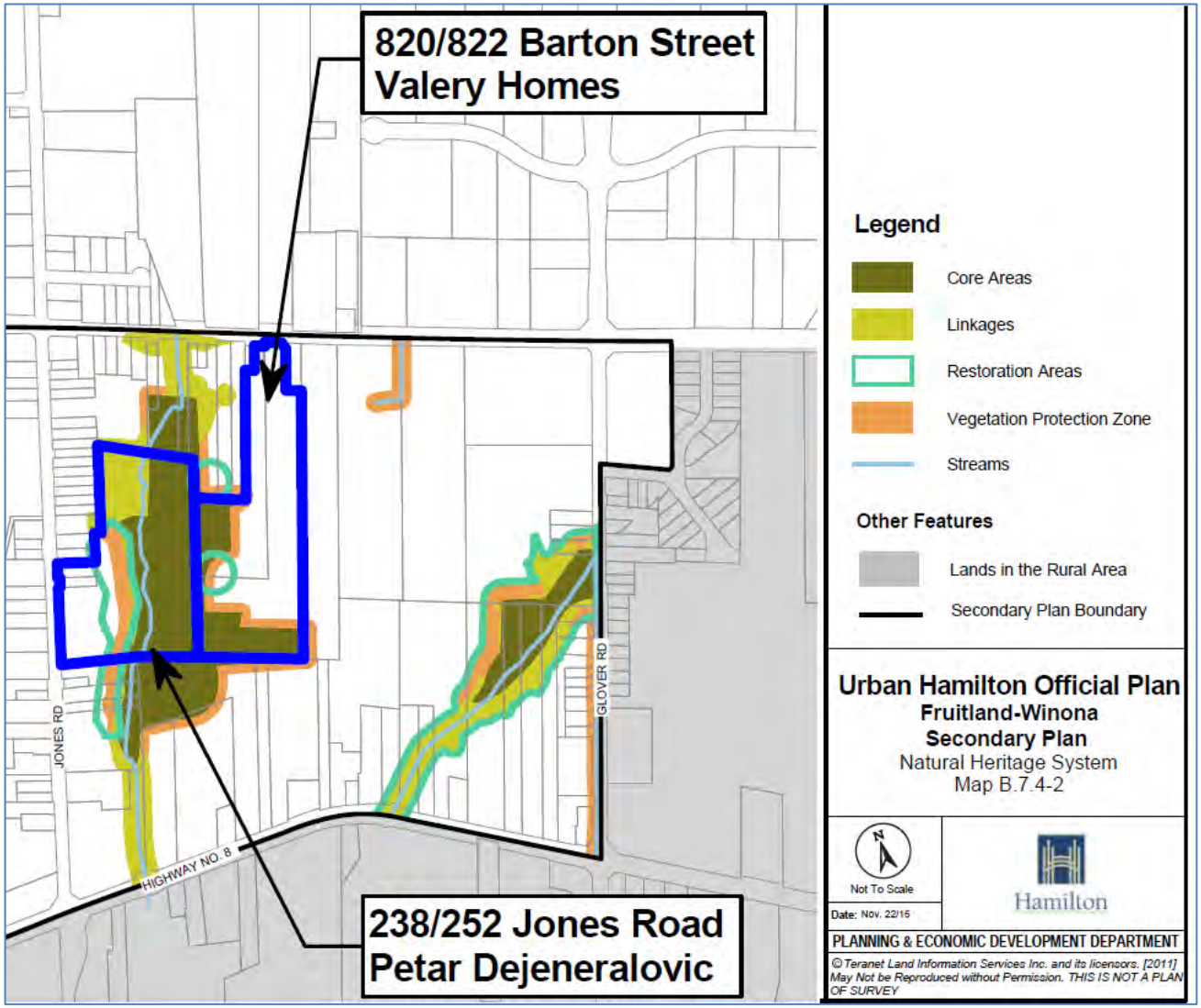


**Figure 6-4 - Natural Heritage System and Areas Recommended for Enhancements per the Fruitland-Winona Secondary Plan**

(Please note that the NHS and enhancements as shown above have been updated as part of this study.)

## 6.6 Servicing

There are a number of servicing area items and approvals that will need to be addressed or acquired during the detailed design phase of the development of Block 2. An outline of these servicing area items follows.

### 6.6.1 Concept Plan

The development constraints which include the environmental features and environmental hazards defined through the Aquafor Beech floodplain mapping and erosion analyses will need to be reviewed with design level topographical surveys and the location of stormwater management ponds confirmed. Development plans will need a traffic impact study to confirm timing for any signal installations on the external road connections as well as lane configuration needs on the collector road. The completion of the Barton Street and Highway No. 8 EA's will identify the vertical and horizontal road improvements including future road grade, road widenings, drainage needs and lane configurations for the north south collector road connections at the intersections with these external roads. A designated cycling lane is shown on Highway No. 8 from Jones Road easterly on the cycling network. Any cycling lane connection needs through Block 2 will need to be confirmed. The Watercourse 6.0 and 7.0 local road crossing locations and multi-use trail will need to be confirmed through environmental reviews including an environmental impact statement. The current north south collector road alignment at Highway No. 8 is located to include MacDonald Lane. This alignment will need to be reviewed at the time of development as well as the cul-de-sac final location west of the north south collector road. Approvals by the Hamilton Conservation Authority (HCA) are needed for all the watercourse road crossings and the development of lands at Watercourse 6.1. Any revisions to Watercourse 6.1 from a natural state will also need to be confirmed by the HCA.

Right of way future widths for Barton Street and Highway No. 8 have been noted on Figure 4.4 and include road widening dedications on Barton Street for a 40.6 metre right of way and on Highway No. 8 for a 36.6 metre right of way which are subject to the ongoing Barton and Fifty Road Phases 3 & 4 EA, and Highway 8 Phases 3 & 4 EA processes. Road widening dedications will also be required for Glover Road to attain a 26.0 metre right of way.

### 6.6.2 Sanitary

Sections of the existing sanitary sewers on Barton Street and Glover Road will require lowering and / or upsizing. This has been identified on the Sanitary Plan. The determination of the scope of this work on the Sanitary Plan was based on the Barton Street EA base plans that do not coincide with the sanitary sewer design plans. The

information on these plans will need to be confirmed during the detailed design phase as well as the as constructed sanitary sewer information on Glover Road. The presence of shale in the Block 2 area is expected. Geotechnical investigation will need to be undertaken during the detailed design phase and a design review completed to minimize cost associated with shale removal. The Sanitary Plan identifies a conceptual sanitary sewer layout based on manhole node locations at intersections. The final detailed design will confirm locations of manholes and apply adjustments in grade at manholes to minimize depth of sanitary sewers and maintain the required depth of cover. High end sewers will require a review of sizing and final slopes to improve cleaning velocities. The Sanitary Plan has used the minimum size sanitary sewers from the City standards which results in minimal velocities since the contributing sanitary drainage areas do not provide adequate flow for optimal cleaning velocities. The final design will require Ministry of the Environment and Climate Change (MOECC) Environmental Compliance Approvals (ECA).

### 6.6.3 Storm

There are minor and major storm discharges to Watercourse 7.0. Pre-development to post-development flows will need to be managed through ditch pipe outlets that control the flow to pre-development flows. During the detailed design phase the sizing of the outlet pipes and ditches will need to address this and any stormwater storage needs. These discharges will require approval from the HCA. The minor storm system generally consists of storm sewers which will provide surface and road drainage through catch basins. The minimum cover for the storm sewers is 1.2 metres to facilitate road drainage. During detailed design storm sewer grades will need to be set at the manholes to provide depth to drain catch basins and provide the 2.75 metre standard sewer cover where possible. An MOECC ECA will be needed for final design of storm infrastructure.

### 6.6.4 Watermain

The system has not been evaluated for transient pressures at this time as final materials have not been selected. A transient analysis should be performed at the detailed design stage. The system will need to be evaluated for final flushing arrangement with the location of hydrants. The final watermain configuration including valve location should be established at detailed design. The proposed configuration includes two cul-de-sac locations with potential dead-end connections that will require consideration. The block servicing geometry provides for a potential interconnection opportunity to Jones Road. This alternative water connection could be used to reinforce and provide redundancy for the Highway No. 8 interconnection and may be required with the phasing of development. Future site-specific development applications should be required to identify actual fire requirements and confirm that the requirements do not exceed the design allowance of this evaluation. Overall impacts to water age were not reviewed with this study but could

be considered during detailed design particularly if development phasing is anticipated to span a long period. A delegated MOECC approval by the City for the watermain infrastructure is required. In addition, if the alternative watermain connection to Jones Road which will cross Watercourse 6.0 is to be constructed, approval from the HCA will be needed.

### 6.6.5 Grading

Topographical surveying is needed to confirm existing grades on site and Highway No. 8 as well as Glover Road and at the local road connection to Jones Road. The City is currently undertaking topographical surveying and producing base plans for Highway No. 8 and Glover Road (Barton Street to Highway No. 8). Following the review of the existing topography and stormwater management pond locations during detailed design, grading should be adjusted to minimize fill. The road grades over the local road watercourse crossings will need to be confirmed following the confirmation of culvert sizes to provide a minimum of 0.60 metres of cover from the roof of the culvert to the road surface.

## 6.7 Phasing of Development

A Phasing Plan, **Figure 6-5** was developed that outlines the phasing scheme for the development of Block 2.

i. Area A (288 Glover Road) on the Phasing Plan has development plans that provide for sanitary, storm and a road / driveway layout and the timing is not impacted by the balance of the development of Block 2 on the west side of Glover. This development will need to address future road grades and widenings on Barton Street as well as future road grades on Glover Road.

ii. Area 1 on the Phasing Plan represents the sanitary replacement sewers on Barton Street and Glover Road as well as Stormwater Management Ponds 6.0 and 6.1 that need to be completed for the balance of development on Block 2 to proceed.

iii. Area 2 and Area 3

- 884 Barton Street can be serviced by a private sanitary connection to the existing Barton Street sewers which allow for sanitary drainage from this block of land. Road access to Barton Street can be provided through local driveway access. The timing for development of 884 Barton Street is dependent on the construction of the SWM pond 6.1 which is needed for water quality and storage. This development will need to address future road grades and widenings on Barton Street.

- The section of Area 2 that is also shown as Area C on the Sanitary Drainage Plan can be developed with the improvements to the Glover Road existing

sanitary connection sewers and with approval from the HCA for the stormwater discharge to Watercourse 7.0. This section of Area 2 (Area C on the Sanitary Drainage Plan) can be developed independent of the balance of Area 2 provided that a single road access to Glover Road is acceptable until the connection to the balance of Area 3 is completed.

- Development of the balance of Area 2 and Area 3 drain to the Barton Street sanitary sewers and require the improvements to the existing sanitary sewers on Barton Street shown on the Sanitary Plan, **Figure 5-14** as well as the stormwater water management pond construction, SWM ponds 6.0 and 6.1. Providing these are completed, development could proceed in a southerly / easterly / westerly direction along the north south collector road sanitary sewers from Barton Street southerly towards Highway No. 8 providing there are a minimum of two road accesses provided.

- The number of lots to be developed will need to be reviewed with the timing for the external road connections to Barton Street, Jones Road and Highway No. 8.

- An alternative local sewer could be constructed on Highway No. 8 from Watercourse 7.0 to Glover Road to provide sanitary sewer service for the properties that front on Highway No. 8 adjacent to this alternative local sewer.


**Figure 6-5 – Phasing Plan**

## 7.0 CONCLUSIONS AND RECOMMENDATIONS

The following key points are provided within this report.

- Chapter 1 – outlines the study area, purpose and report outline
- Chapter 2 – summarizes previous key studies
- Chapter 3 – defines existing conditions
- Chapter 4 – describes the development of the Concept Plan
- Chapter 5 – describes the Functional Plan
- Chapter 6 – describes the Implementation of the document with respect to future studies, design guidance and agency roles

The following conclusions and recommendations based on the information as provided within have been provided.

**Conclusions**

1. The Urban Hamilton Official Plan was amended by Amendment No. 17 on May 14, 2014 by City Council to incorporate the Fruitland-Winona Secondary Plan into the Urban Hamilton Official Plan. This Secondary Plan identified land uses, densities, development forms, cultural heritage features and development standards. The Secondary Plan also provided for protection of the natural heritage features. The lands in the Fruitland-Winona Secondary Plan are generally located south of Barton Street, north of Highway No. 8, east of Fruitland Road and west of the City boundary within the former City of Stoney Creek, but exclude most of the lands between Glover Road and McNeilly Road.
2. The development of the Concept Plan starts with the land uses and constraints as defined in the Secondary Plan and then builds upon this with the findings from other studies (e.g. the SCUBE Subwatershed Study) together with the findings from this study.
3. The primary disciplines that were included as part of developing a Block Servicing Study included:
    - Natural Heritage System including floodplains, meander belts, aquatic and terrestrial features and hydrogeological considerations;
    - Stormwater management including the conceptual design of two stormwater facilities and associated storm sewer system;
    - Municipal servicing including sanitary and watermains;
    - Road network which takes into consideration land uses and environmental constraints; and
    - Air drainage

**Recommendations**

1. The findings from this study will be used as a basis for subsequent studies that will be required at the Draft or Site Plan stage.
2. For future stormwater management design, findings from this study will be used as a basis for subsequent studies that will be required at the Draft or Site Plan stage and that all targets for water quality, quantity, erosion control and release rates be reviewed and verified per this FSR and consistent with the SCUBE west study by the proponent to the satisfaction of the City and the relevant agencies. Future phases shall not rely or be permitted to apply the release rates ($m^3/s$) from the SCUBE West SWS. Proponents are directed to apply the release rates as defined within this report:
    - Section 5.6.2, Table 5.6
    - Section 5.6.3, Table 5.7
    - Section 5.7.3.1, Tables 5.10 & 5.11

    The proposed condition shall reflect the proposed development conditions in regard to drainage area, development type, TIMP and directly connected impervious area etc. In addition,

    a. CA staff shall review and comment on a comparison of the erosion potential of downstream reaches, in relation to the erosion control provided.
    b. Final outlet configuration for the SWM ponds shall be designed such that:
        i. where possible the reverse slope pipe be used as the sole outlet in the water quality and erosion control portion of the facility, and that any outlet chamber can contain openings for flood control and overflow protection,
        ii. where possible the extended detention water level shall be maintained at the elevation of the overflow grate.
    c. At the detailed design stage, it is recommended that consideration be given to the design of the permanent pool elevation such that it is above the 100-year creek operating elevation to avoid backwater effects which may reduce flood control volume target.
3. That an EIS be completed for properties not accessed during the biophysical field work completed as part of this study (see **Figure 7-1: Land Access**). Given the presence of significant natural heritage features on the property located at the south west corner of Barton St. and Glover Rd. and the associated regulatory,

legal, and planning implications; further study is particularly important (see details in **Section 6.4.1**).

4. As stated in **Section 4.2.3**, the locations of local road connections within the watercourse floodplain areas will be confirmed through an EIS following the completion of the Block Servicing Strategy Study the satisfaction of the City and HCA.
5. To ensure compliance with the Endangered Species Act, the following is recommended:
    a. Treed habitats throughout the study area, but especially those subject to road crossings, should be surveyed for bat maternity roosts in accordance with the Guelph District MNRF's *Survey Protocol for Species at Risk Bats within Treed Habitats: Little Brown Myotis, Northern Myotis & Tri-Colored Bat* (MNRF, 2017) or subsequent update.
    b. Prior to site alteration, persons owning lands that contain regulated habitat for barn swallow and/or bobolink should consult with the MNRF about obtaining a permit under the Endangered Species Act prior to any habitat alteration.
6. In addition, the Hamilton Conservation Authority is to assess whether there is a surface water connection between the wetland complex on the corner of Barton Street and Glover Road in order to determine if the wetland is regulated according to the policies of the Conservation Authority. This determination would be based on ecological inventory/assessment work completed by the future development proponent(s) at this location.
7. Furthermore, it is recommended that the Hamilton Conservation Authority update their regulated areas mapping per the findings of this report and the result of (4), above.
8. Watercourses 6.0 and 7.0, as identified in the SCUBE report and reiterated in the EIS prepared in support of this report, are candidates for restoration and revegetation. Accordingly, as development moves forward it is recommended that comprehensive channel and riparian restoration plans be developed for these watercourses in consultation with the City of Hamilton and HCA. Coordination amongst landowners within Block 2 and, in the case of Watercourse 6.0, in Block 1 will likely be required.
9. Opportunities to restore and enhance degraded ecosystems (e.g. especially those associated with Watercourse 6.0 and lands on the corner of Barton St. and Glover Rd.) should be given due consideration at the draft or site plan stages.

10. That further study be undertaken on Watercourse 6.0 to determine if the removal of one or both of properties 820 and 824 Barton street will reduce the extent of the floodplain
11. That further study be undertaken to determine if upgrading the existing Barton Street watercourse crossings will reduce the extent of the floodplain.
12. That restoration of Watercourse 6.0 to improve existing conditions be undertaken.
13. That the final location of the proposed watercourse crossings for Watercourses 6.0 and 7.0 (see **Figure 4-3)** be defined at the Draft Plan stage and that the appropriate EIS and hydraulic analyses (to the satisfaction of HCA and the City) be undertaken.
14. That the final extent of the floodlines for Watercourses 6.0 and 7.0 will be defined as part of an ongoing HCA Floodplain Mapping Study.
15. Should redevelopment of existing residential properties on the west side of Glover Rd. north of Highway 8 be considered, an assessment of the development constraints through the completion of an EIS would be required.

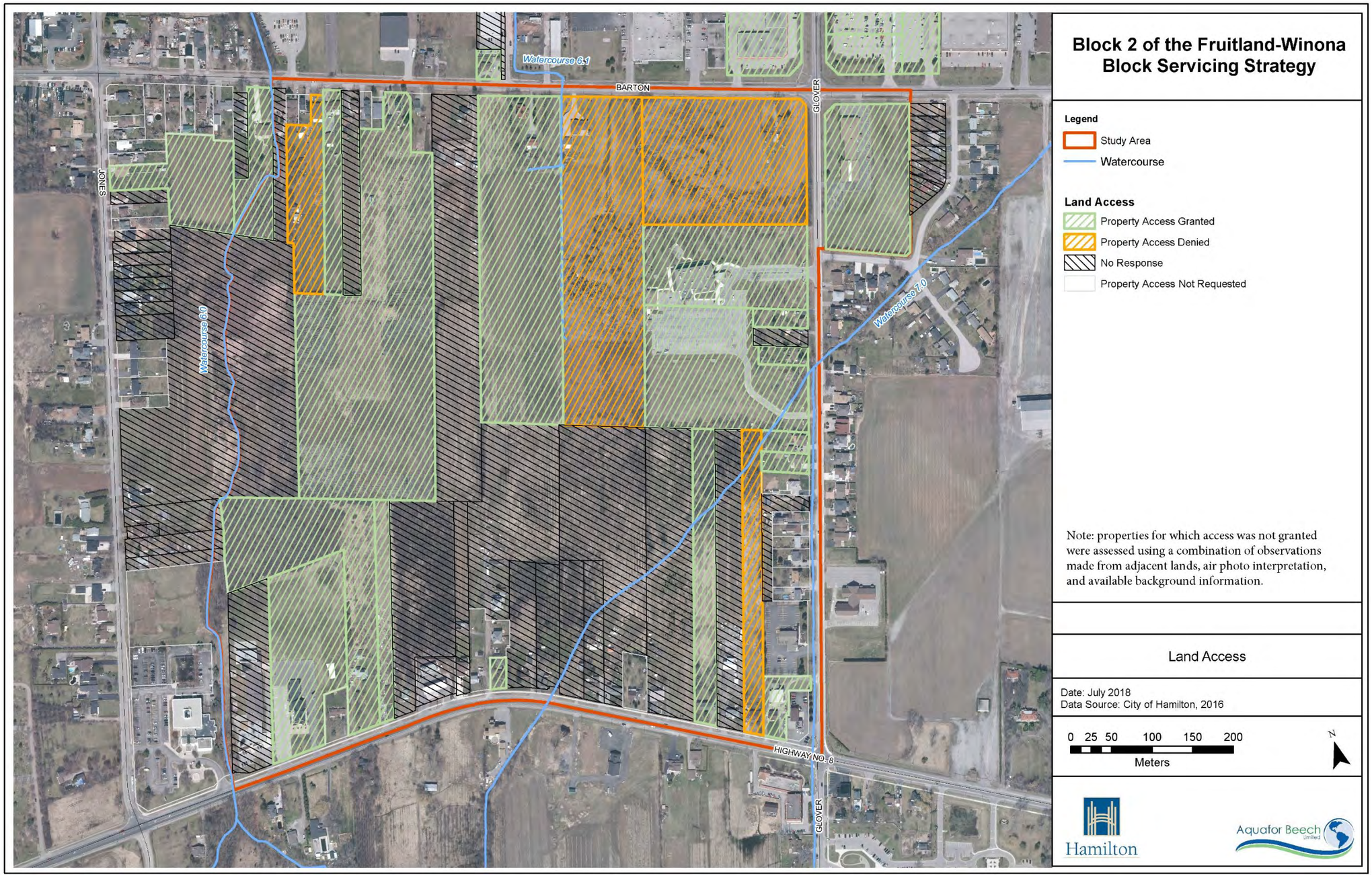


**Figure 7-1: Land Access**

## 8.0 REFERENCES

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