

4.6 Natural Heritage Features

Natural heritage features within the Mid-Spencer/Greenville Subwatershed study area were characterized using a combination of primary and secondary information sources. The results of this baseline assessment were used to characterize the Natural Heritage System (NHS), as described in **Section 4.7**.

4.6.1 Introduction

Aquafor Beech Limited obtained background information on the study area of the Greenville Creek Subwatershed Study from the City of Hamilton, Hamilton Conservation Authority and the Guelph MNR Office. Sources of background information reviewed by Aquafor Beech Limited include the following:

- City of Hamilton Rural Official Plan (City of Hamilton 2012)
- City of Hamilton Urban Official Plan (City of Hamilton 2013)
- Natural Heritage Information Centre (NHIC) database records of significant species and natural areas
- Hamilton Natural Areas Inventory Project, 3rd Edition (Schwetz 2014)
- Nature Counts Project: Hamilton Natural Areas Inventory (Dwyer 2003)
- Species lists from the City of Hamilton's Natural Heritage Database for the areas defined by Dwyer (2003) and Schwetz (2014) as:
 - Dundas Valley (DUND-14);
 - Hayesland Alvar (FLAM-32);
 - Donald Farm Complex (FLAM-33);
 - Christie Stream Valley (FLAM-34);
 - Hayesland Swamp (FLAM-35); and
 - Spencer Gorge (FLAM-41)
- Species accounts and checklists within the 3rd Edition of the Hamilton NAI (Schwetz 2014), including:
 - The Herpetofauna of Hamilton, Ontario (Zammit 2014);
 - The Fishes of Hamilton, Ontario (Coker 2014);The Vascular Plants of Hamilton, Ontario (Goodban 2014);
 - The Vegetation Communities of Hamilton, Ontario (Goodban 2014);
 - The Butterflies of Hamilton, Ontario (Van Ryswyk 2014) ;
 - The Mammals of Hamilton, Ontario (Schwetz 2014); and
 - The Breeding Birds of Hamilton, Ontario (Smith 2014).
- Birds of Hamilton and Surrounding Areas (Curry 2006)

4.6.2 Fieldwork Supporting the Characterization of the Subwatershed

In addition to the use of the background resources listed above, existing conditions in the subwatershed study area were characterized through field investigations occurring between 2006 and 2014. Biological field surveys conducted from 2006-2011 occurred throughout the subwatershed study area, but in general fieldwork focused on the characterization of natural heritage features within the subwatershed that were not already located within the preliminary NHS (i.e. the NHS as identified by the City of Hamilton).

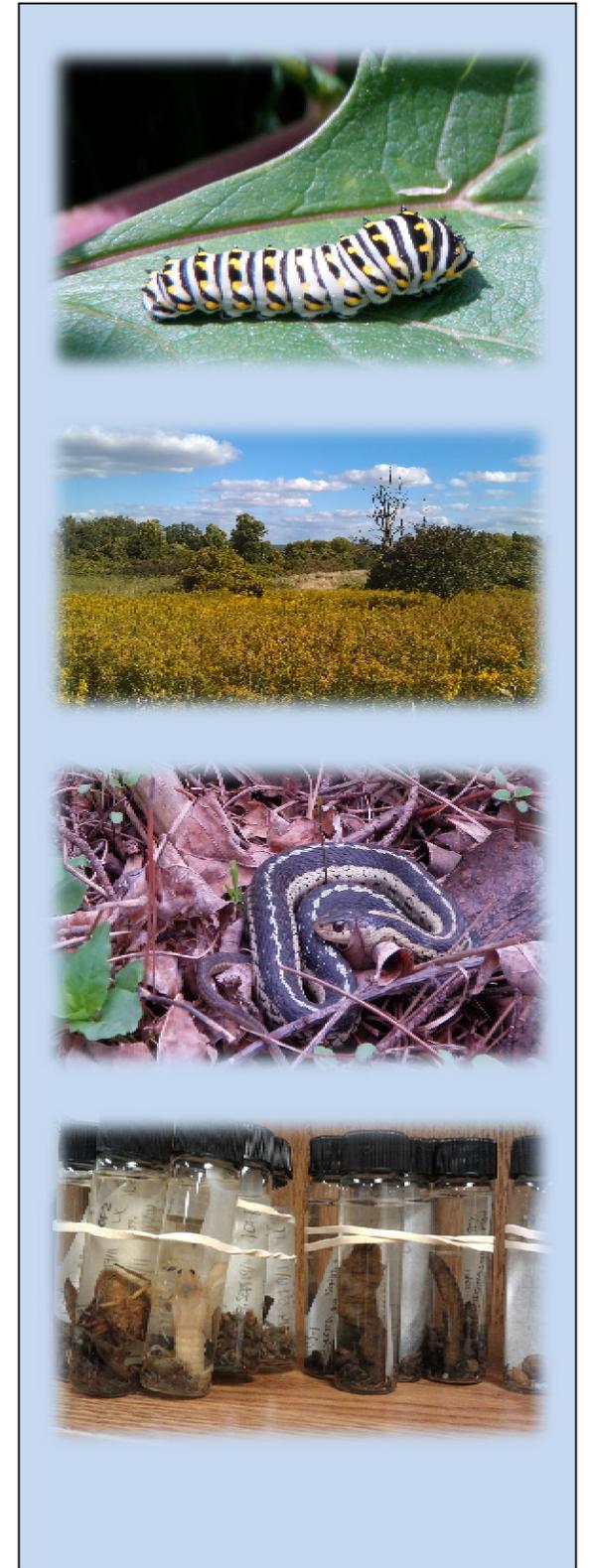
Aquafor Beech Limited staff conducted supplemental reconnaissance-level fieldwork on September 20, 2011 to confirm existing conditions and characterization of features assessed prior to 2011. In 2014, field surveys were conducted within the Rural Settlement Area (RSA) only, as this is the only area in the subwatershed slated for development in the near future. The intent of the 2014 surveys was to update outdated biological survey data for areas within the RSA that are outside of the preliminary NHS.

During field surveys, incidental wildlife observations were recorded and representative site photographs were taken. For ease of reference, a list of species recorded from the study area of the Greensville Subwatershed Study during surveys from 2006-2011 is located in **Appendix F**.

A summary of the field studies completed as part of this study is contained within **Table 4.6.1**, below. **Appendix G** contains the 2006 Faunal Inventories Report completed by Ecoplans Limited. More recent natural heritage data, collected from 2011 to 2014, is presented below in **Sections 4.6.2.1 to 4.6.2.5**.

Table 4.6.1: Summary of Ecological Field Surveys, 2006-2014.

Survey Type	Location	Date(s)	Surveyor/Authority
Site Reconnaissance	Unknown, presumably throughout subwatershed.	2006: April 13	EcoPlans Ltd.
Amphibian Calling Surveys	60 Call Station Locations throughout subwatershed; see Ecoplans Report in Appendix G	2006: April 13, 20; May 24, 25; June 21, 22.	
Migratory Bird Survey & Avian Habitat Assessment	25 Wildlife Survey Units throughout subwatershed; see Ecoplans Report in Appendix G	2006: April 27 & May 10.	
Breeding Bird Surveys		2006: May 17, 19, 24; June 1, 6, 20, 22; July 13, 31.	
Hawk & Owl Surveys		Took place during other bird surveys in 2006.	
Ecological Land Classification	Greater subwatershed: SW & SE of Conc. 4 and Brock Rd; NE corner of Conc. 5 and Brock Rd.; Copetown Rd Racetrack east of Hwy 52; Flamborough Downs racetrack; Rendering Plant; Sugar Bush (NE of Conc. 6 & Brock Rd.); wetland (SE of Hwy 8 & Middletown Road). Within the RSA: House on Hill (Hauser); Weirs Road (Zimmerman); Marshboro Rd (east of Zimmerman, west of Hauser near Kew Crt).	2006: October 17	Collaborative effort between Ecometrix and Aquafor Beech Ltd.
Ecological Land Classification	Weirs Road (Zimmerman), Marshboro Road	2007: September 12	Natural Resource Solutions Inc.
Benthic Invertebrates	Middle Spencer Creek at: <ul style="list-style-type: none"> • Hwy 5; • Crook's Hollow Road; • Dundas Market Street Bridge. 	2008	Aquafor Beech Ltd.
Ecological Land Classification	Throughout the subwatershed in areas not already in the City of Hamilton's NHS or covered by ELC studies completed in 2006 & 2007.	2001: August 11, 12, 15, & 16	Natural Resource Solutions Inc.
Fish	Varies: Information available throughout the subwatershed. See Table 4.6.21 for details.	Varies: Information spanning 1970-2011 was used to characterize fish habitat.	Ministry of Natural Resources and Forestry & Hamilton Conservation Authority

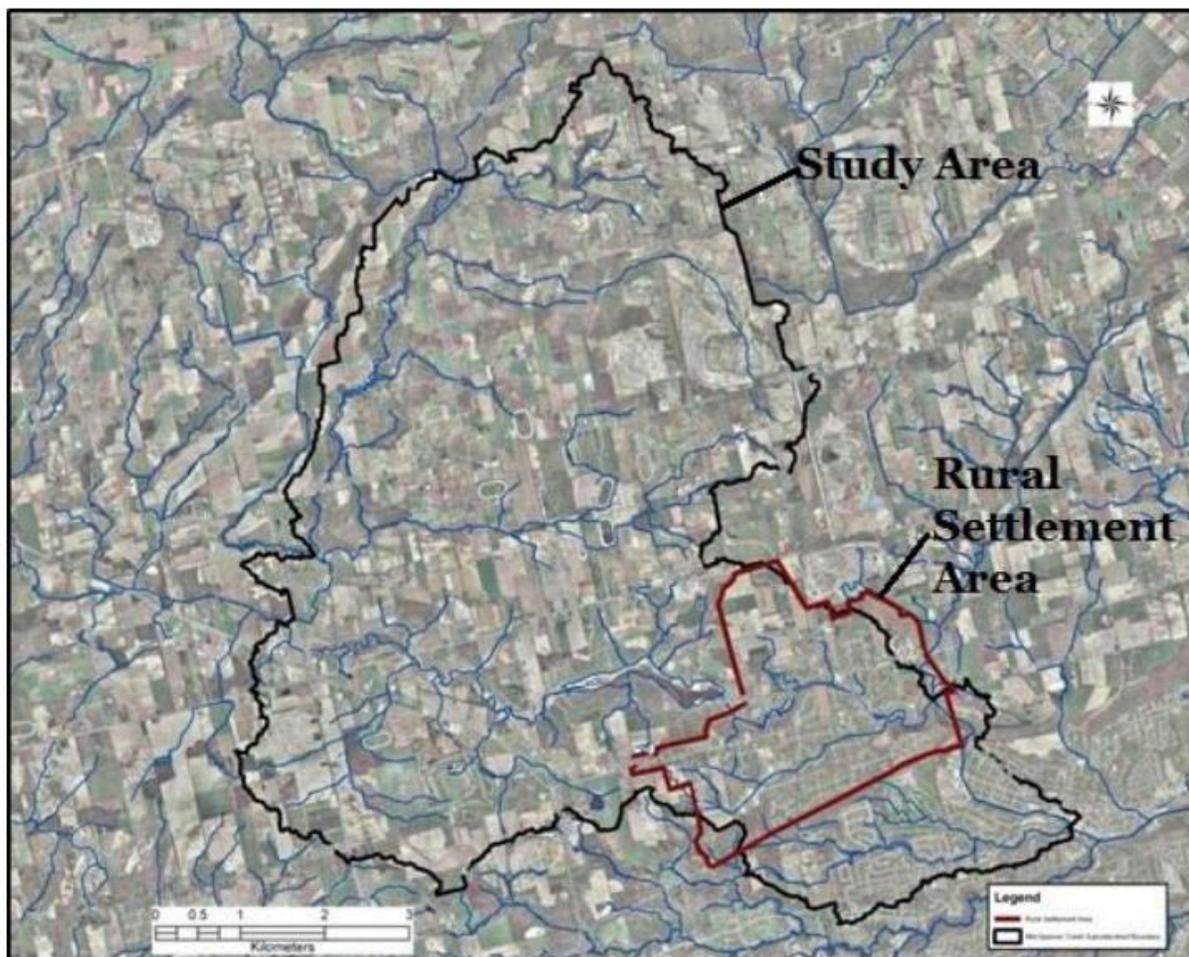


Survey Type	Location	Date(s)	Surveyor/Authority
Benthic Invertebrates	Middle Spencer Creek	2011	Hamilton Conservation Authority
Benthic Invertebrates	Middle Spencer Creek at Crook's Hollow Road.	2014: May 21	Aquafor Beech Limited
Amphibian Calling Surveys	Multiple locations throughout and immediately adjacent to the RSA (includes survey stations 3, 48a, 48b, 48c, 49, 50, & 53-56).	2014: April 24; May 28; & June 25	
Breeding Bird Surveys	Multiple locations throughout the RSA.	2014: June 9 & 23	
Ecological Land Classification	Multiple locaitons throughout the RSA.	2014: August 13 & 22; Sept 16	



Biological Fieldwork

As mentioned above, the Mid-Spencer/Greenville Subwatershed Study commenced in 2006. During that same year and the years following, biological fieldwork was conducted in support of the SWS. The Study Area (pictured below) is divided into two sections: the greater SWS Study Area, as defined by the subwatershed boundary and outlined in black below, and the Rural Settlement Area (RSA), outlined in red. Due to servicing/groundwater limitations, development is only proposed within the RSA. Accordingly, though the entire SWS Area was studied, the RSA was surveyed in greater detail.



During a March 21 2014 meeting between Aquafor Beech Limited and the City of Hamilton, City staff indicated that biological field work over five (5) years old required updating. Given that only the RSA is slated to be developed, it was agreed that only field studies in areas within and immediately adjacent to the RSA would require updating.

As listed above in **Table 4.6.1**, the 2014 field program included the following biological surveys:

- a) Vegetation Community Classification;
- b) Amphibian calling surveys;
- c) Breeding bird surveys; and
- d) Benthic invertebrate sampling.

Details of the methodology and results of biological survey items a) through c) are provided below. Benthic invertebrate sampling results have been incorporated into **Section 4.6.2.5**.

4.6.2.1 Vegetation Community Classification and Flora

Vegetation communities within and directly adjacent to the RSA that were surveyed in 2006 and 2007 were resurveyed in 2014, with the exception of one site that has since been developed (i.e. Weir's Road, WSU 11). Survey methodology followed that of the *Ecological Land Classification for Southern Ontario: First Approximation and Its Application* (Lee et al., 1998).

The results of the 2014 vegetation community classification surveys are illustrated below in **Figure 4.6.1**. Field sheets are included in **Appendix H**.

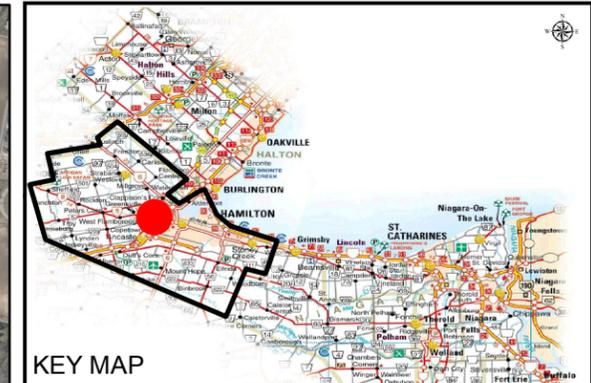
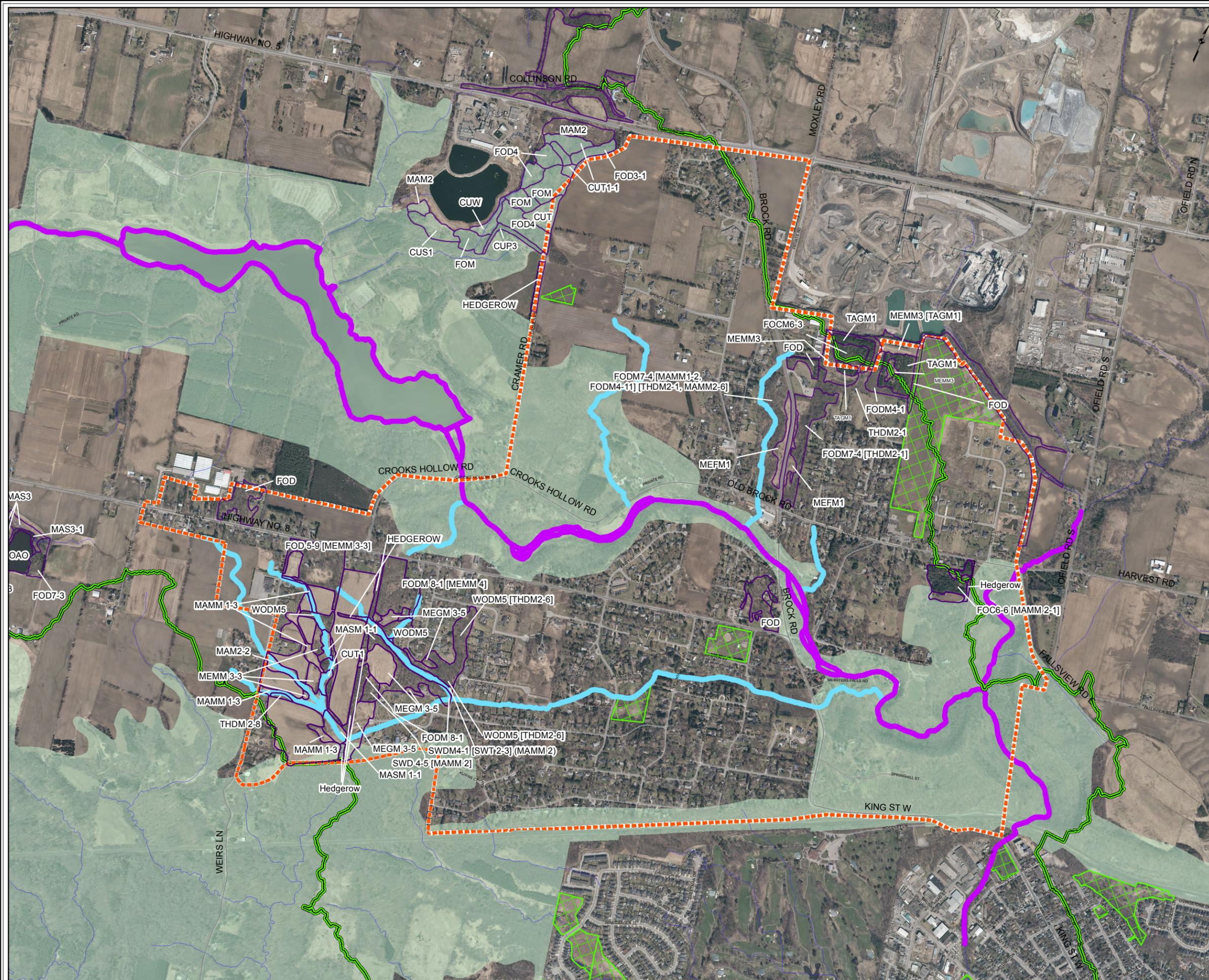
Rare vegetation communities were not recorded during surveys.

Flora

The majority of species recorded during vegetation community classification fieldwork are common and widespread species. One (1) nationally and provincially Endangered species, Butternut (*Juglans cinerea*) was recorded in 2011 at one location. This species is further discussed in **Section 4.6.3**. Four (4) species rare to Hamilton were recorded during fieldwork:

- Black Bulrush (*Scirpus atrovirens*);
- Blue Beech (*Carpinus caroliniana*);
- Downy Willow-herb (*Epilobium strictum*); and
- Tulip Tree (*Liriodendron tulipifera*).

An annotated list of flora recorded during vegetation community classification fieldwork is contained within **Appendix F**.



KEY MAP

LEGEND:

- Mid-Spencer Creek Subwatershed Boundary
- Rural Settlement Area
- Watercourse
- Parks
- Preliminary Natural Heritage System

Revised Natural Heritage System

- FishHabitat
- Direct Fish Habitat
- Indirect (Contributing) Fish Habitat

NOTES:
All watercourses are considered Core Areas

Meters



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**GREENSVILLE
SUBWATERSHED STUDY**

Vegetation Communities within
the Rural Settlement Area

FIGURE: 4.6.1

DATE: February 2016

4.6.2.2 Amphibian Calling Surveys

Methodology

Twelve (12) amphibian calling survey stations within the Greenville RSA established in 2006 by Ecoplans Ltd. were surveyed by Aquafor Beech Limited in 2014 using the protocols of the Marsh Monitoring Program (MMP) (Bird Studies Canada, 2012). The locations of the survey stations were reviewed and approved by the City of Hamilton and the HCA prior to the commencement of 2014 surveys.

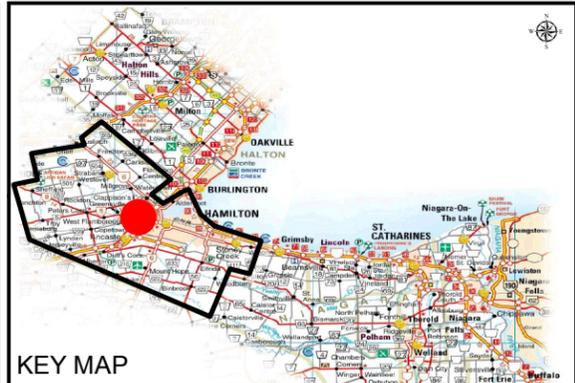
All stations were visited on the evenings of April 24th, May 28th, and June 25th 2014, with the exception of the HCA Pond that was visited only on May 28th and June 25th 2014. The location, survey direction, wind, cloud cover, and air temperature for each station are summarized in **Table 4.6.2**. Survey stations within the RSA are illustrated in **Figure 4.6.2**. Note that survey station numbering for the 2014 surveys follows the survey station numbering scheme used for surveys completed in 2006.

In addition to the twelve (12) survey stations upon the direction of Hamilton Conservation Authority ecology staff a survey station was added to the field program after the first round of site visits had been completed. As such, records for the thirteenth (13th) amphibian calling survey site are comprised of mid- and late-season surveys only. The HCA was interested in having possible amphibian breeding activity at a recently-discovered woodland pond east of Cramer Road accounted for in the subwatershed study. In recognition of the request of the HCA and by virtue of the thirteenth survey site's location on land owned by the HCA, this survey site is herein referred to as the *HCA Pond*.

Results

Calling amphibians were heard from a total of seven (7) stations in the Greenville RSA. Over the course of three site visits, Spring Peeper (*Pseudacris crucifer*), Northern Leopard Frog (*Lithobates pipiens*), Western Chorus Frog (*Pseudacris triseriata*), Wood Frog (*Rana sylvatica*), American Toad (*Bufo americanus*), Green Frog (*Lithobates clamitans*, inset photo), and Gray Treefrog (*Hyla versicolor*) calls were heard. The species name, call code (1-individual calls; 2-individual and small groups; 3-full chorus) and number of individuals were recorded and summarized in **Table 4.6.3**.





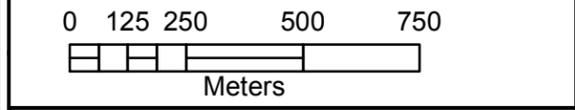
KEY MAP

LEGEND:

- Mid-Spencer Creek Subwatershed Boundary
- Rural Settlement Area
- Amphibian Monitoring Station

NOTES:

Wetlands shown on this map are outside of the Preliminary Natural Heritage System




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**GREENSVILLE
SUBWATERSHED STUDY**

Amphibian Monitoring Stations
Within the Rural Settlement Area

FIGURE: 4.6.2

DATE: February 2016

All seven frog species recorded during 2014 surveys are considered common and widely distributed throughout the watershed. With the exception of wood frog and western chorus frog, these species are generally tolerant of minor urbanization provided that floodplain water features and watercourses are maintained. Neither the Committee on the Status of Species at Risk in Ontario (COSSARO) nor the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has assessed the status of the Spring Peeper, Wood Frog, Gray Treefrog, Green Frog or American Toad. The Northern Leopard Frog is currently listed as Not at Risk under the Ontario Endangered Species Act (2007) and the Ontario population as Not at Risk under the Federal Species at Risk Act. COSSARO lists the Western Chorus Frog as Not at Risk. COSEWIC lists the Western Chorus Frog Great Lakes / St. Lawrence – Canadian Shield population as Threatened (2008). The International Union for Conservation of Nature (IUCN) lists the global status of all seven species as Least Concern (2014). All species are listed with stable population trends, with the exception of the Northern Leopard Frog and Western Chorus Frog, which have decreasing populations.

HCA Pond

Frog calls were not heard at the HCA Pond during mid- and late season amphibian calling surveys conducted in 2014. As mentioned above, the HCA Pond site was added to the survey after the early survey timing window. Thus, it is possible that early breeding amphibian species were missed in the survey. Accordingly, it is recommended that early spring amphibian calling surveys be conducted at the HCA Pond as part of future studies in order to fully characterize extant amphibian habitat at the site.

Table 4.6.2. Calling Amphibian Survey Station Locations and Environmental Conditions, 2014.

Station	Location				Environmental Conditions During Surveys		
	Zone	Easting	Northing	Bearing (°)	Beaufort Wind Scale	Cloud Cover (10ths)	Air Temp.
1	17T	580976	4791098	220	0	10	8°C
					3	7	13°C
					1	10	21°C
2	17T	580226	4790828	11	0	10	8°C
					3	7	13°C
					1	10	21°C
3	17T	580151	4791160	46	0	10	8°C
					3	7	12°C
					1	10	21°C
48a	17T	581691	4793089	56	1	9	12°C
					6	2	12°C
					2	10	22°C
48b	17T	581782	4792727	256	1	10	10°C
					5	2	13°C
					1	10	21°C

Station	Location				Environmental Conditions During Surveys		
	Zone	Easting	Northing	Bearing (°)	Beaufort Wind Scale	Cloud Cover (10ths)	Air Temp.
48c	17T	582816	4792804	108	1	6	11°C
					6	2	12°C
					1	10	20°C
49	17T	580579	4793589	170	0	9	16°C
					6	2	13°C
					1	10	21°C
50	17T	579739	4793450	160	0	9	16°C
					6	2	13°C
					5	10	21°C
53	17T	581317	4790399	143	0	4	7°C
					5	2	13°C
					0	10	20°C
54	17T	581120	4790536	148	1	4	10°C
					5	2	13°C
					0	10	21°C
55	17T	581199	4791300	140	0	10	8°C

Station	Location				Environmental Conditions During Surveys		
	Zone	Easting	Northing	Bearing (°)	Beaufort Wind Scale	Cloud Cover (10ths)	Air Temp.
					2	7	13°C
					1	10	21°C
56	17T	580695	4790901	240	0	10	8°C
					3	7	13°C
					1	10	21°C
HCA Pond	17T	580879	4792564	131	4	2	13°C
					1	10	22°C

Table 4.6.3. Amphibians heard using MMP Protocols (2014)

Date	Station	Species	Number of Individuals	Call Code (1-3)
4/24/14	2	Spring Peeper	-	3
	3	Spring Peeper	4	1
	48a	Northern Leopard Frog	1	1
	48b	Spring Peeper	1	1
	48c	Spring Peeper	-	3
		Western Chorus Frog	1	1
	50	Spring Peeper	-	3
	55	Spring Peeper	5	2
		Western Chorus Frog	1	1
		Wood Frog	1	1
5/28/14	2	American Toad	1	1
		Spring Peeper	2	1
	48c	Green Frog	4	1
	50	Spring Peeper	1	1
	55	American Toad	1	1

Date	Station	Species	Number of Individuals	Call Code (1-3)
		Gray Treefrog	5	2
		Spring Peeper	-	3
		Green Frog	1	1
6/25/14	3	Gray Treefrog	2	1
	48a	Green Frog	2	1
	48c	Gray Treefrog	3	1
		Green Frog	6	1
	55	Gray Treefrog	2	1
		Green Frog	2	1

4.6.2.3 Breeding Bird Surveys

Methodology

Breeding bird surveys of the Mid-Spencer Creek Subwatershed were first completed in 2006 by Ecoplans Limited. Of the many Wildlife Survey Units (WSUs) present within the greater subwatershed, a total of ten (10) are located within the RSA. In 2014 staff of Fieldlife Environmental Consultants & Ecological Services, under subcontract to Aquafor Beech Limited, performed breeding bird surveys in ten WSUs within the RSA, as well as four Open Country Breeding Bird (OCBB) areas not surveyed previously. These OCBB areas were added to the 2014 field program to account for the potential presence of open meadow breeding birds utilizing these habitats. Breeding bird survey areas surveyed in 2014 are illustrated in Figure 4.6.3, below.

Two protocols were used to complete breeding bird surveys in all WSUs and OCBBs. First, point counts were conducted following the Canadian Wildlife Service Forest Bird Monitoring Program (FBMP), a long-term monitoring project designed to provide estimates of breeding bird numbers that are comparable across time. FBMP methodology can be summarized briefly as follows:

- Ten-minute point counts are conducted at permanent stations no more than 250 m apart in forest habitat and no more than 500 m apart in open habitat;
- All birds seen and heard within the 10 minute point count are recorded, with birds singing within a radius of 100 m from the surveyor recorded as near and birds singing outside the 100 m radius as far. A standard FBMP datasheet was used for each visit to each Point Count Station (**Appendix I**).
- Surveys are conducted during two periods, an early period and a late period during the breeding season. The recommended period for early surveys is May 24 – June 15 and June 10 – July 10 for late surveys. Surveys are conducted at least 10 days apart to obtain information on breeding birds for both early and late periods.
- Surveys are conducted in weather without substantial rain, with wind speeds less than Beaufort Scale 3, at times between dawn and approximately 9:30 to 10:00 am, depending on the degree of bird activity.

To facilitate maximum survey coverage within the Mid-Spencer Creek Subwatershed, area searches were also conducted. Area searches are recommended by Bird Studies Canada (BSC) to assess species presence/absence and to document breeding evidence. BSC recommends two site visits/survey area because two visits permit data to be collected for both the early and late breeding period. Two visits also allow for information on territoriality to be obtained. If a bird is heard singing in the same territory twice, it increases the certainty that it is breeding from “possible” to “probable”.

Point Count stations within the Mid-Spencer Creek Subwatershed were selected at the approximate centres, or edges accessible by road, of ten WSUs and four OCBBs as defined by the Aquafor Beech Ltd. Mid-Spencer Creek Subwatershed Study: Biological Field Study April, 2014 Update document reviewed and approved by the City of Hamilton and the Hamilton Conservation Authority. In this report, the WSU numbering scheme follows that of the 2006 Ecoplans Report. As such, the WSUs surveyed in 2014 include WSU numbers 8a, 8b, 9, 10, 12, 13, 14, 26, 29, and 31.

During each of two visits to the Mid-Spencer Creek lands in 2014, Fieldlife Environmental Consultants & Ecological Services staff conducted one 10-minute point count at each of the fourteen Point Count stations according to FBMP Point Count protocols. Birds heard or seen within the WSU or OCBB of each Point Count station were differentiated from those outside of the unit, but all species seen or heard were recorded unless they appeared to be entirely outside of the lands subject to the Mid-Spencer Creek Breeding Bird Survey Monitoring Program (e.g. south of the rail road tracks near Weirs Lane). Point counts in OCBB units 3 & 4 were conducted later in the morning because these two Units are not forested, covered with annual row crops such as Wheat (*Triticum* spp.) or Corn (*Zea mays*). Thusly, these areas are considered a lower priority for breeding bird surveys. Following Point Counts, Fieldlife staff conducted area searches of each of the fourteen WSUs and OCBBs, specifically WSU Units 8a, 8b, 9, 10, 12, 13, 14, 26, 29, and 31 as well as OCBB Units 1, 2, 3 and 4. During area searches, Fieldlife staff recorded (i) all birds, including any observed birds that were not previously heard or seen during the Point Count surveys and (ii) any observed evidence of breeding.

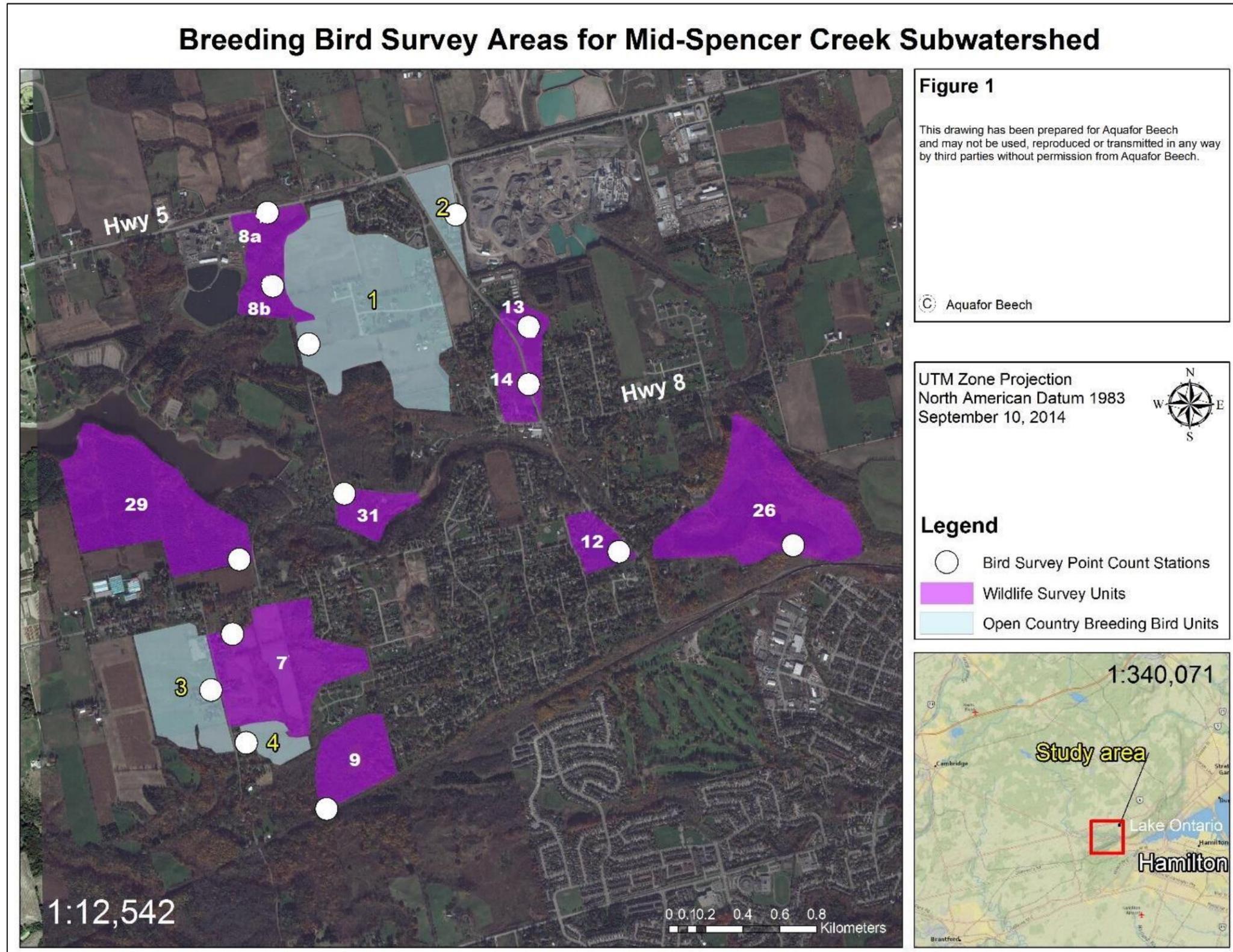


Figure 4.6.3: Breeding Bird Survey Locations, 2014.

Breeding bird surveys of the Mid-Spencer Creek Subwatershed lands were conducted on June 9 and 23, 2014. **Figure 4.6.3** (above) displays the 10 WSUs and 4 OCBBs within the study area. Photos of the WSUs and OCBBs are located along with field datasheets in **Appendix I**. Both visits were conducted between 5:00 am and 1:00 pm in clear to partially cloudy weather. During the first visit, there was light drizzle but no rain heavy enough to affect bird activity, with wind speeds of 0-2 on the Beaufort Wind Scale. Bird activity was moderate to high during both visits. Times for point counts conducted in each WSU are provided below in **Table 4.6.4**. One species, Common Raven (*Corus corax*), was observed during visit 1 within OCBB2.

Table 4.6.4: Start time of 10-minute point counts in each Wildlife Survey Unit and Open Country Breeding Bird Unit. Units are listed in the order that point counts were conducted; earlier visits were conducted in primarily forested units.

Wildlife Survey Unit	Start Time of Point Count Surveys	
	Visit 1	Visit 2
OCBB 2	5:45 AM	5:22 AM
13	6:15 AM	6:05 AM
14	6:35 AM	6:45 AM
12	7:05 AM	6:39 AM
26	7:43 AM	7:12 AM
31	8:30 AM	8:10 AM
OCBB 1	9:24 AM	8:34 AM
8b	9:48 AM	9:09 AM
8a	10:19 AM	5:45 AM
29	10:57 AM	7:48 AM
OCBB 3	11:21 AM	10:03 AM
OCBB 4	11:40 AM	10:21 AM
9	11:59 AM	10:53 AM
7	12:46 PM	9:46 AM

Results

A total of fifty one (51) species were heard or observed during 2014 surveys (**Table 4.6.20**) Most of the recorded species are common forest generalists that inhabit large and small forest blocks and successional areas in southern Ontario. Three species recorded during surveys are considered Species at Risk (SAR) in Canada and Ontario: Eastern Meadowlark (*Sturnella magna*, provincially and federally threatened), Barn Swallow (*Hirundo rustica*, provincially and federally threatened), and Wood Thrush (*Hylocichla mustelina*, federally threatened and of special concern provincially) (MNR 2014, COSEWIC 2014).

- Eastern Meadowlark was observed singing adjacent to OCBB survey unit #2 on June 3rd.
- A Barn Swallow was observed singing and foraging within OCBB survey unit #3 on June 3rd. With the proximity to residential housing and other buildings it is possible that these structures may provide suitable habitat for Barn swallow nesting, but no nests were observed or confirmed during breeding bird surveys.
- Wood Thrush was observed in WSU 8b and 26 on June 23rd during scheduled point counts and random area searches.

Eastern Meadowlark is an open country breeding bird and, although observed, very little suitable breeding habitat was found. The OCBB survey unit #2 is a corn field. The only potential breeding habitat for this species is OCBB survey unit #1, which is largely composed of cultural meadows and is > 30 ha in size (MNR Draft Ecoregion Criteria Schedule 7E 2012), but it is not clear whether this field has been abandoned or left inactive for > 5 years. However, open country breeding birds were not detected in this survey unit during either survey period.

According to the 2007 Environment Canada publication *Area Sensitive Forest Birds in Urban Areas*, two of the species recorded during surveys are considered area sensitive breeders in the Greater Toronto Area (GTA): Pileated Woodpecker (*Dryocopus pileatus*) and Wood Thrush. Pileated Woodpecker is dependent on coniferous and deciduous forests, but may also inhabit younger woodlands provided there is adequate habitat structure (e.g. snags). Wood Thrush, typically inhabits second-growth and mature deciduous and mixed forest habitats with well-developed understory layers. Both species were mainly noted in WSUs 8b and 29.

Summaries of the findings at each WSU or OCCB survey unit are found below. Note that in the proceeding tables, Breeding Evidence codes are as follows: *PO* = possible, and *PR* = probable. Proximity refers to estimated distance from the Point Count station; with *near* = within a 100 m radius, and *far* = beyond a 100 m radius.

Wildlife Survey Unit 8a

Unit 8a consists of a mid-successional thicket dominated by dense Staghorn Sumac (*Rhus typhina*) and Grey Dogwood (*Cornus racemosa*) surrounded by mature Maple hardwood forest. There is a hydro corridor running through the central portion of the unit in a north-south axis which accounts for the majority of disturbance and introduced plant species such as Garlic Mustard (*Alliaria petiolata*). The unit is bounded by Kerns Road to the east, open fields and a parking lot to the north, and mature deciduous forest to the west and south. Sixteen species were noted in this unit (**Table 4.6.5**). Birds noted in this habitat included generalist species of both upland and wetland successional habitat and woodland edges such as Yellow Warbler (*Dendroica petechia*) and Rose-breasted grosbeak (*Pheucticus ludovicianus*), but also included species specifically dependent on thicket habitat such as Gray Catbird (*Dumetella carolinensis*). Additional species observed during the random area search within this unit include an area sensitive breeding bird for the GTA, American Redstart (*Setophaga ruticilla*), and another forest generalist, Red eyed Vireo (*Vireo olivaceus*). Both of these birds were observed on June 9th.

Table 4.6.5: Birds recorded in Wildlife Survey Unit 8a.

Common Name	Highest Breeding Evidence	Proximity	Numbers of Birds Recorded		
			Visit 1	Visit 2	Random area search
Turkey Vulture	PO	Near	1		
Red-winged Blackbird	PO	Near	3		3
Yellow Warbler	PO	Near	1		1
Gray Catbird	PO	Near	1		
Mourning Dove	PO	Near	1		
Tree Swallow	PO	Near	1		
Rose-breasted Grosbeak	PO	Near	1		
American Goldfinch	PO	Near	2		
Ring-billed Gull	PO	Near		30	
Yellow Warbler	PO	Near		2	
Red-winged Blackbird	PO	Near		2	
Song Sparrow	PO	Near		1	
Brown-headed Cowbird	PO	Near		1	
European Starling	PO	Near		1	
American Robin	PO	Near		2	
Gray Catbird	PO	Near		1	
Red eyed Vireo	PO	Near			1
American Redstart	PO	Near			1
Eastern Kingbird	PO	Near			1

Wildlife Survey Unit 8b

Unit 8b consists of a closed-canopy deciduous forest dominated by Red Oak (*Quercus rubra*) and Sugar Maple (*Acer saccharum*) with occasional White elm (*Ulmus americana*). It is bounded by fields and meadow pasture to the north, east and north-west, and contiguous forest to the south and south-west. The unit is relatively small, so some species could be heard from the adjacent fields (WSU units 8a and OCBB 1). Eighteen species were noted in this unit (**Table 4.6.6**). Off road ATV trails bisect the southern half of this unit providing disturbance and open areas for generalists such as Brown-headed Cowbird. A few bird species recorded are generalist forest species found in large and small woodland patches in southern Ontario. Additional species were noted during the random area search, largely accumulated from hiking the trail system, including area sensitive American Redstart and Wood Thrush.

Table 4.6.6: Birds recorded in Wildlife Survey Unit 8b

Common Name	Highest Breeding Evidence	Proximity	Numbers of Birds Recorded		
			Visit 1	Visit 2	Random area search
Gray Catbird	PO	Near	1		
Song Sparrow	PO	Near	1		
Yellow Warbler	PO	Near	1		1
American Goldfinch	PO	Near	1		1
Common Grackle	PO	Far	1		
European Starling	PO	Near	1		
Red-tailed Hawk	PO	Near	1		
Red-winged Blackbird	PO	Near	1		
Song Sparrow	PO	Far	1		
Wood Thrush	PO	Near		1	1
Common Yellowthroat	PO	Near		1	
Song Sparrow	PO	Near		2	
Ring-billed Gull	PO	Near		1	
Mourning Dove	PO	Near		1	
Brown-headed Cowbird	PO	Near		1	
Herring Gull	PO	Near		1	
Gray Catbird	PO	Near		1	
Red eyed Vireo	PO	Near			1
American Robin	PO	Near			1
American Redstart	PO	Near			1
Northern Cardinal	PO	Near			1

Wildlife Survey Unit 9

Unit 9 consists of a patch of forest dominated by Sassafras (*Sassafras albidum*) and Red Oak. It is bounded on the south by the CN Rail tracks and surrounded by residential housing on the north and east.

All birds noted in Unit 9 (**Table 4.6.7**) are common generalist species of small forest patches except Red-winged Blackbird (*Agelaius phoeniceus*), which inhabits small wetlands. This species is not found in smaller grassland patches in urban habitats. A total of eight species were observed in this unit. Additional species that emerged during random area searches include Scarlet Tanager (*Piranga olivacea*), Veery (*Catharus fuscescens*), both area sensitive breeder within the GTA, and American Goldfinch.

Table 4.6.7: Birds recorded in Wildlife Survey Unit 9.

Common Name	Highest Breeding Evidence	Proximity	Numbers of Birds Recorded		
			Visit 1	Visit 2	Random area search
Great Crested Flycatcher	PO	Near	1		
Red-winged Blackbird	PO	Near	1		
Blue Jay	PO	Near		1	
Red-eyed Vireo	PO	Near		1	
Indigo Bunting	PO	Near			1
Veery	PO	Near			1
American Goldfinch	PO	Near			1
Scarlet Tanager	PO	Near			1

Wildlife Survey Unit 10

Unit 10 consists of Soya bean (*Glycine max*) fields surrounded by deciduous woodland dominated by Sugar Maple interspersed with meadow marshes dominated by Reed Canary Grass (*Phalaris arundinacea*). A total of ten species were recorded (**Table 4.6.8**). Killdeer (*Charadrius vociferous*) was observed during random area searches.

Table 4.6.8: Birds recorded in Wildlife Survey Unit 10.

Common Name	Highest Breeding Evidence	Proximity	Numbers of Birds Recorded		
			Visit 1	Visit 2	Random area search
Baltimore Oriole	PO	Near	1		
American Crow	PO	Near	1		
Song Sparrow	PR	Near	2		
Red-tailed Hawk	PO	Near	1		

Song Sparrow	PO	Near	1		
Northern Cardinal	PO	Near	1		
Indigo Bunting	PO	Near		1	
House Wren	PO	Near		1	
Red-tailed Hawk	PO	Near		1	
Northern Cardinal	PO	Near		1	
Baltimore Oriole	PO	Near		1	
Killdeer	PO	Near			1

Wildlife Survey Unit 12

Like Unit 14, WSU 12 is relatively narrow, consisting of mature Black Walnut dominated woodland. It is bounded to the north, west and south by residential housing. On the east it is bounded by Brock Road. Eleven species were observed within this unit (see **Table 4.6.9**). White-breasted Nuthatch (*Sitta carolinensis*), observed during the first field visit, is an area sensitive breeding bird in the GTA.

Table 4.6.9: Birds recorded in Wildlife Survey Unit 12.

Common Name	Highest Breeding Evidence	Proximity	Numbers of Birds Recorded		
			Visit 1	Visit 2	Random area search
Red-eyed Vireo	PO	Near	1		
American Robin	PO	Far	1		
Northern Cardinal	PO	Far	1		
Northern Flicker	PO	Far	1		
White-breasted Nuthatch	PO	Near	1		1
Blue Jay	PO	Near		1	1
Red-wing Blackbird	PO	Near		1	
Song Sparrow	PO	Near		1	
European Starling	PO	Near		1	
American Robin	PO	Near		1	
American Crow	PO	Near		1	

Wildlife Survey Unit 13

Unit 13 consists of a narrow patch of mature deciduous forest dominated by Red Oak and Shagbark Hickory (*Carya ovata*). It is bounded to the north and east by cropland, to the west by a large open field and to the south by shrubby fields and contiguous forest. Twelve species were noted within this unit (**Table 4.6.10**). Most species recorded are generalists of small forest

patches and forest edges. Three additional species was identified during random area searches, Brown-headed Cowbird (*Molothrus ater*), American Crow (*Corvus brachyrhynchos*) and European Starling (*Sturnus vulgaris*).

Table 4.6.10: Birds recorded in Wildlife Survey Unit 13.

Common Name	Highest Breeding Evidence	Proximity	Numbers of Birds Recorded		
			Visit 1	Visit 2	Random area search
American Robin	PO	Near	1		
Northern Cardinal	PO	Near	1		
European Starling	PO	Near	5		
American Crow	PO	Near	1		3
Ruby-throated Hummingbird	PO	Near	1		
Gray Catbird	PO	Near	1		
American Robin	PO	Near		1	
House Wren	PO	Near		1	
European Starling	PO	Far		1	2
European Starling	PO	Near		1	
Ring-billed Gull	PO	Far		1	
House Sparrow	PO	Near		1	
Indigo Bunting	PO	Near		1	
Tree Swallow	PO	Near		1	
Brown-headed Cowbird	PO	Near			1

Wildlife Survey Unit 14

Unit 14 is a meadow marsh dominated by grasses and small forbs such as Meadow Fescue (*Festuca elatior*) and Orchard Grass (*Dactylis glomerata*). It is bounded to the north and west by cropland and to the south and east by mature deciduous forest and thicket.

Eleven species were noted during point counts in this unit (**Table 4.6.11**). No additional species were heard or observed from random area searches. Birds noted in this unit are mainly generalist species of shrubby habitat and forest edges.

Table 4.6.11: Birds recorded in Wildlife Survey Unit 14

Common Name	Highest Breeding Evidence	Proximity	Numbers of Birds Recorded		
			Visit 1	Visit 2	Random area search
Northern Cardinal	PO	Near	2		
Red-winged Blackbird	PO	Near	1		

Great Crested Flycatcher	PO	Near	1		
Common Grackle	PO	Near	1		
American Robin	PO	Near	1		
Rose-breasted Grosbeak	PO	Near	1		
European Starling	PO	Near	1		
Brown-headed Cowbird	PO	Near	1		
American Crow	PO	Near		2	
Song Sparrow	PO	Near		1	
Blue Jay	PO	Near		1	

Wildlife Survey Unit 26

Wildlife Survey Unit 26 is a large Sugar Maple, Red Oak hardwood deciduous forest unit that is bounded by Webster Falls to the north, residential housing to the west, the CN rail tracks to the south and contiguous forest immediately east. Sixteen (16) birds were heard or observed, including the locally rare Carolina Wren (*Thryothorus ludovicianus*) and Wood Thrush, a Species at Risk (**Table 4.6.12**). Additional birds that arose during random area searches include Red-bellied Woodpecker (*Melanerpes carolinus*), an area sensitive breeder within the GTA and is considered uncommon in Hamilton (Curry, 2003). The presence Brown Thrasher (*Toxostoma rufum*) is indicative of early successional edge habitat adjacent to the forest parcel suitable for breeding by this species.

Table 4.6.12: Birds recorded in Wildlife Survey Unit 26.

Common Name	Highest Breeding Evidence	Proximity	Numbers of Birds Recorded		
			Visit 1	Visit 2	Random area search
Indigo Bunting	PO	Near	2		
Ovenbird	PO	Far	1		
American Goldfinch	PO	Near	1		1
Blue Jay	PO	Near	2		
Northern Cardinal	PO	Near	1		1
Chipping Sparrow	PO	Near	1		
Song Sparrow	PO	Near	1		
Brown Thrasher	PO	Near	1		
Carolina Wren	PO	Near	1		1
Baltimore Oriole	PO	Near	1		
American Robin	PO	Near		1	1
Blue Jay	PO	Near		1	2
Wood Thrush	PO	Near		1	1
Northern Flicker	PO	Near			1
Red eyed Vireo	PO	Near			1

Red-bellied Woodpecker	PO	Near			1
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Wildlife Survey Unit 29

Unit 29 is largely dominated by an extensive > 30 year old Red Pine (*Pinus resinosa*) plantation that has naturalized with Celandine (*Chelodinium majus*) as the dominant ground cover. It is bounded on the west and south by agricultural corn fields and on the north by a deciduous forest surrounding Christie Lake. Eleven species were observed or heard in this unit (see **Table 4.6.13**). Pileated Woodpecker (*Drycopus pileatus*) is an area sensitive breeding bird within the GTA. No additional bird species were recorded during random area searches.

Table 4.6.13: Birds recorded in Wildlife Survey Unit V

Common Name	Highest Breeding Evidence	Proximity	Numbers of Birds Recorded		
			Visit 1	Visit 2	Random area search
Indigo Bunting	PO	Near	2		1
Turkey Vulture	PO	Near	2		
Turkey Vulture	PO	Far	1		
House Wren	PO	Far	1		
Song Sparrow	PR	Near	2		
American Crow	PO	Near	1		1
Blue Jay	PO	Far	1		
American Crow	PO	Near		3	
Pileated Woodpecker	PO	Far		1	1
Song Sparrow	PO	Near		2	
Blue Jay	PO	Far		1	
Northern Cardinal	PO	Near		1	
Blue Jay	PO	Near		1	
American Robin	PO	Near			1
Baltimore Oriole	PO	Near			1

Wildlife Survey Unit 31

Habitats within Wildlife Survey Unit 31 consist of mature deciduous forest dominated by riparian vegetation such as Green Ash (*Fraxinus pennsylvanica* var. *sub integerrima*) and Black Walnut (*Juglans nigra*), with a denser understory than that noted in Unit 8b. The unit is surrounded to the north by fields and cropland, to the west by cropland, and to the south by late successional thicket and contiguous forest.

Fifteen species were noted within this habitat (**Table 4.6.14**). Recorded species are mainly generalists of small forest patches and forest edges. Additional species noted during random area searches include Common Yellowthroat (*Geothlypis trichas*) observed on June 9th, 2014.

Table 4.6.14: Birds recorded in Wildlife Survey Unit 31.

Common Name	Highest Breeding Evidence	Proximity	Numbers of Birds Recorded		
			Visit 1	Visit 2	Random area search
Song Sparrow	PO	Far	1		
Song Sparrow	PO	Near	2		
House Wren	PO	Near	1		
House Wren	PO	Far	1		
Brown-headed Cowbird	PO	Near	1		
American Crow	PO	Near	1		
Rose-breasted Grosbeak	PO	Near	1		1
Red-eyed Vireo	PO	Near	1		
Red-winged Blackbird	PO	Near	1		
Cedar Waxwing	PO	Near	1		1
American Robin	PO	Near		1	
Common Grackle	PO	Near		1	
Ring-billed Gull	PO	Near		1	
Northern Cardinal	PO	Near		1	
Song Sparrow	PO	Near		1	1
Wild Turkey	PO	Near			4
Blue Jay	PO	Near			1
Red winged Blackbird	PO	Near			2
Common Yellowthroat	PO	Near			1
Baltimore Oriole	PO	Near			1

Open Country Breeding Bird Unit 1

OCBB Unit 1 is predominantly open meadow or field with active corn fields. It is bounded on the west by deciduous forest, including WSUs 8a and 8b and on the south by mixed deciduous forest with a large proportion of White Pine (*Pinus strobus*). Twenty four species of birds were recorded during breeding surveys (Table 4.6.15). One species, Great Blue Heron (*Ardea herodias*) is significant if found nesting in a heronry. This bird observed on June 23rd and was moving between foraging areas and thus is not considered a significant observation. Eleven species were observed during random area searches.

Table 4.6.15: Birds recorded in Open Country Breeding Bird Unit 1.

Common Name	Highest Breeding Evidence	Proximity	Numbers of Birds Recorded		
			Visit 1	Visit 2	Random area search
Field Sparrow	PO	Near	1		
Song Sparrow	PO	Near	2		
House Wren	PO	Near	2		1
Tree Swallow	PO	Near	1		
Song Sparrow	PO	Far	1		
Yellow Warbler	PO	Near	1		1
Red-winged Blackbird	PO	Near	1		
American Goldfinch	PO	Near	1		
Indigo Bunting	PO	Far	1		
Savannah Sparrow	PO	Near	1		1
Gray Catbird	PR	Near		1	4
Song Sparrow	PR	Near		1	1
Red-tailed Hawk	PO	Far		1	
American Robin	PO	Near		1	
American Robin	PO	Far		1	
Ring-billed Gull	PO	Near		1	
Northern Cardinal	PO	Near		1	
Eastern Kingbird	PO	Near		1	
Great Blue Heron	PO	Near		1	
American Goldfinch	PO	Near		2	
Baltimore Oriole	PO	Near		2	
American Robin	PR	Near		1	
Indigo Bunting	PO	Near		1	1
Blue Jay	PO	Near		1	
Rose-breasted Grosbeak	PO	Near			1
European Starling	PO	Near			6

Common Name	Highest Breeding Evidence	Proximity	Numbers of Birds Recorded		
			Visit 1	Visit 2	Random area search
Brown-headed Cowbird	PO	Near			3
Northern Flicker	PO	Near			1
Turkey Vulture	PO	Near			1

Open Country Breeding Bird Unit 2

OCBB Unit 2 consists of a corn field bounded to the north by Highway 5, to the west by Brock Road, and to the east by the Lafarge quarry. Ten (10) species were observed during bird surveys, including a Species at Risk, the Eastern Meadowlark (**Table 4.6.16**). However, the habitat is not suitable to provide breeding habitat for this Species at Risk. According to the MNR 2013 General Habitat Description guidance document and 2013 recovery strategy, Eastern Meadowlark requires a variety of natural grassland habitat types including remnant prairies, savannahs and alvar grasslands. The bird observed, therefore, was likely a migrant moving between breeding areas which may or may not be within the study area. Birds observed during random area searches include the locally rare Common Raven (*Corvus corax*) on June 9th.

Table 4.6.16: Birds recorded in Open Country Breeding Bird Unit 2.

Common Name	Highest Breeding Evidence	Proximity	Numbers of Birds Recorded		
			Visit 1	Visit 2	Random area search
Chipping Sparrow	PR	Near	2		
Eastern Meadowlark	PO	Far	1		
Common Grackle	PO	Far	1		
American Robin	PO	Near		1	
European Starling	PO	Near		2	
Northern Cardinal	PO	Far		1	
American Goldfinch	PO	Near		1	
Brown-headed Cowbird	PO	Near		1	
Ring-billed Gull	PO	Near		1	
American Crow	PO	Near		1	
Common Raven	PO	Near			1

Open Country Breeding Bird Unit 3

OCBB Unit 3 is dominated by active agricultural uses consisting of corn field in the southern portion of the Unit and wheat in the north (**Figure 4.6.4**). The survey unit is bounded Weirs Lane and WSU 10 to the east and Highway 8 to the north. Within this Unit, ten (10) species were observed during breeding bird surveys (**Table 4.6.17**). Significant species observed in this unit include Barn Swallow. Within the study area suitable breeding habitat for this Species at Risk does exist, but is not associated directly with this unit since there were no visible abandoned buildings or other structures which provide the necessary cover to carry out the reproductive cycle (MNR 2013, 2014). On June 23rd, House Finch and Barn Swallow were observed during random area searches.

Table 4.6.17: Birds recorded in Open Country Breeding Bird Unit 3.

Common Name	Highest Breeding Evidence	Proximity	Numbers of Birds Recorded		
			Visit 1	Visit 2	Random area search
House Finch	PO	Near	1		1
Chipping Sparrow	PO	Near	1		
Barn Swallow	PO	Near	1		1
Killdeer	PO	Near	1		
Song Sparrow	PO	Near	1		
American Robin	PO	Near	2		
Song Sparrow	PO	Near		1	
Chipping Sparrow	PO	Near		1	
European Starling	PO	Near		3	
Common Yellowthroat	PO	Near		1	
Red-winged Blackbird	PO	Near		1	
Brown-headed Cowbird	PO	Near		1	



Figure 4.6.4: Corn (left) and wheat (right) in OCBB Survey Unit 3.

Open Country Breeding Bird Unit 4

Habitat types within OCBB Unit 4 consist of a corn field in the south and wheat in the west bounded by Weirs Lane and WSU 10 on the north and contiguous forest with WSU 9 on the south. Twelve species were observed during bird surveys (**Table 4.6.18**). No additional birds were detected during random area searches.

Table 4.6.18: Birds recorded in Open Country Breeding Bird Unit 4.

Common Name	Highest Breeding Evidence	Proximity	Numbers of Birds Recorded		
			Visit 1	Visit 2	Random area search
Red-winged Blackbird	PO	Near	1		
Song Sparrow	PO	Near	1		
European Starling	PO	Near	1		
Northern Flicker	PO	Near	1		
Tree Swallow	PO	Near	1		
American Robin	PO	Near		3	
Wild Turkey	PO	Far		4	
Indigo Bunting	PO	Near		1	
Chipping Sparrow	PO	Near		1	
American Robin	PO	Far		1	
Killdeer	PO	Near		1	
American Goldfinch	PO	Near		1	
Gray Catbird	PO	Near		1	

Species Observed and Territories within the Rural Settlement Area

Table 4.6.19 provides the results of breeding bird surveys completed in the 2014 Monitoring Program. Each cell of **Table 4.6.19** indicates the largest number of individuals recorded through point counts and/or area searches and the highest observed breeding evidence. On the following page, **Table 4.6.20** provides a summary of the numbers of species and territories estimated in each Survey Unit during each of the two breeding bird surveys.

Table 4.6.19: Numbers of species and territories recorded in the Survey Units of the Greenville RSA during breeding bird surveys completed during 2014.

Wildlife Survey Unit	Number of Species Observed	Number of Territories Observed
8a	16	20
8b	18	18
9	8	8
10	10	13
12	11	13
13	12	21
14	11	13
26	16	25
29	11	19
31	15	25
OCBB1	24	40
OCBB2	11	15
OCBB3	10	21
OCBB4	12	20

LEGEND

1. G-rank: Global ranks are assigned by a consensus of the network of Conservation Data Centres, scientific experts and The Nature Conservancy to designate a rarity rank based on the range-wide status of a species, subspecies or variety.

G1 - Extremely rare; usually 5 or fewer occurrences in the overall range or very few remaining individuals; or because of some factor(s) making it especially vulnerable to extinction.
G2 - Very rare; usually between 5 and 20 occurrences in the overall range or with many individuals in fewer occurrences; or because of some factor(s) making it vulnerable to extinction.
G3 - Rare to uncommon; usually between 20 and 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.
G4 - Common; usually more than 100 occurrences; usually not susceptible to immediate threats.
G5 - Very common; demonstrably secure under present conditions.

2. S-rank: Provincial (or Subnational) rank by the MNR Natural Heritage Information Centre (NHIC) to set protection priorities for rare species and natural communities.

S1 - Critically Imperiled - Critically imperiled in the state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.
S2 - Imperiled - Imperiled in the province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the province.
S3 - Vulnerable - Vulnerable in the province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation
S4 - Apparently Secure - Uncommon but not rare; some cause for long-term concern due to declines or other factors.
S5 - Secure - Common, widespread, and abundant in the province.

3. COSEWIC Status. COSEWIC (Committee on the Status of Endangered Wildlife in Canada) assigns a federal status ranking for all species that it assesses. Ranking definitions are as follows:

Endangered (END) - A wildlife species facing imminent extirpation or extinction.
Threatened (THR) - A wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.
Special Concern (SC) - A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.
Not at Risk (NAR) - A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

4. COSSARO Status. COSSARO (Committee on the Status of Species at Risk in Ontario) assigns a provincial status ranking for all species that it assesses. Ranking definitions are as follows:

Extinct – the species no longer lives anywhere in the world.
Extirpated – the species lives somewhere in the world, and at one time it lived in the wild in Ontario, but it no longer lives in the wild in Ontario.
Endangered – the species lives in the wild in Ontario but is facing imminent extinction or extirpation.
Threatened – the species lives in the wild in Ontario, is not endangered, but is likely to become endangered if steps are not taken to address factors threatening it.
Special Concern – the species lives in the wild in Ontario, is not endangered or threatened, but may become threatened or endangered due to a combination of biological characteristics and identified threats.

5. Status in the City of Hamilton as defined by the Hamilton Natural Areas Inventory (Smith in Schwetz 2014)

R – Rare in the City of Hamilton (1-20 breeding pairs).
U – Uncommon in the City of Hamilton (21-200 breeding pairs).
C – Common in the City of Hamilton (201-1000 breeding pairs).
A – Abundant in the City of Hamilton (>1000 breeding pairs).
EXLMTL – Extralimital. Breeding well outside the recognised breeding range with no evidence that it represents a general expansion of the breeding range and with no expectation that it will reoccur.
I – Interruptive. A species that has adapted to breeding where a suitable and sufficient food supply is available. This may include locations outside their normal breeding range.
EXTR – Extirpated. No longer breeding in the City of Hamilton.

Discussion of Results

Of the 386 bird species in the Hamilton area (Checklist of the Birds of the Hamilton Area, 2006), the following 22 species are confirmed breeders within the RSA:

- House Wren;
- American Robin;
- Gray Catbird;
- European Starling;
- Yellow Warbler;
- American Redstart;
- Chipping Sparrow;
- Field Sparrow;
- Savannah Sparrow;
- Song Sparrow;
- Red-tailed Hawk;
- Eastern Kingbird;
- Turkey Vulture;
- Red-winged Blackbird;
- Red-eyed Vireo;
- Brown-headed Cowbird;
- Baltimore Oriole;
- Blue Jay;
- American Crow;
- American Goldfinch;
- House Finch; and
- Tree Swallow.

Although breeding bird surveys were conducted 14 days apart during the peak breeding period, little to no evidence for confirmed breeding was obtained. However, given the frequency of observations of some species it can be assumed that if they were observed more than once during surveys they were likely breeding.

The most commonly observed bird was Song Sparrow, showing up in WSU 8b, 31, 29, as well as OCBB units 1 and 3 during both survey dates (i.e., June 9th and 23rd). Thusly, following the BSC survey protocol and guidelines it can be assumed that Song Sparrow is breeding in these units, although noted as a possible breeder in the Tables. Other birds that can be assumed to be breeding, but listed as possible breeders include Red-winged Blackbird in WSU 8a, American Robin in WSU 31, 12, and OCBB 4. These birds tend to be habitat generalist rather than forest breeders, however. Six species observed or heard during bird surveys were area sensitive breeders requiring suitable interior breeding bird habitat (NHAG 2014); Wood Thrush, Red-bellied Woodpecker, Pileated Woodpecker, Veery, White-breasted Nuthatch and American Redstart; but these were not observed more than once during both survey periods.

Avifaunal Species at Risk

The number and diversity of Species at Risk birds within the study area is reflective of the type of habitat available for breeding. With an extensive amount of forest cover, the Niagara Escarpment, and agricultural cropland bisecting the area; the three avian Species at Risk detected during bird surveys had a representative array of habitats to choose from in order to carry out breeding.

The presence of suitable habitat for Eastern Meadowlark, however was not evident due to the size and nature of the agricultural areas located within the Greensville RSA. The bird observed within OCBB 2 on June 9th was likely flying over the census area toward more suitable areas.

In addition, the amount of suitable interior breeding habitat for Wood Thrush within WSU 26 (Spencer Gorge) is 18 ha compared to 0.2 ha within WSU 8b. Thus, WSU 26 provides excellent forest cover and habitat for Wood Thrush and these birds are likely breeding in this unit.

As discussed previously, Barn Swallow may be using the residential buildings or barn structures within the agricultural cropland areas as suitable habitat within the Greensville RSA.

4.6.2.4 Fish

Fish are effective biological indicators: They occur in a wide variety of habitats which are widely studied. In addition, Ontario fishes exhibit a wide range of tolerances to many disturbances and are easy to identify to species level.

This subsection focuses on the characterization of aquatic habitat (i.e. fish habitat) within the RSA. The Middle Spencer Creek Subwatershed is the largest subwatershed in the Spencer Creek system and is comprised of thirteen (13) subcatchments (HCA 2011). Westover Creek, Spring Creek, Flamborough Creek, Logie's Creek and the Greensville Tributary all converge with Middle Spencer Creek upstream of the confluence with Lower Spencer Creek. Logie's Creek and the Greensville Tributary descend over the escarpment upstream of their confluence with Middle Spencer Creek (HCA 2011). Logie's Creek descends over Tew's Falls, the Greensville Tributary waterfall is unnamed, and the main channel of Middle Spencer Creek descends 22 m over Webster's Falls into Spencer Gorge. The Greensville Tributary and a small section of Logie's Creek fall within the RSA (HCA 2011).

Groundwater discharge within the Middle Spencer Creek Subwatershed is much less than that of the Upper Spencer Creek Subwatershed (HCA 2011). Although some groundwater recharge is received from wetlands, recharge is primarily surface water driven. The main channel of Middle Spencer Creek is within the Christie Stream Valley ESA. Upstream of the RSA, Spencer Creek is a meandering channel with a moderately-developed floodplain (HCA 2011).

In 1971, the Christie Dam and Reservoir was constructed on the main channel of Mid Spencer Creek by the Hamilton Conservation Authority as a flood control structure (HCA 2011). Water flowing into the reservoir is classified as cool, and water flowing out of the reservoir is classified as warm (HCA 2011).

Fish Communities Upstream of the Rural Settlement Area (General Assessment)

Middle Spencer Creek upstream of the RSA includes the Christie Reservoir. Upstream of the reservoir, the main channel of Middle Spencer Creek is classified as coolwater habitat (HCA 2011) and contains presence/absence data for fish species found upstream of the RSA (fish records were obtained from the HCA on October 24, 2011 and MNR on October 4, 2011).

In general, Middle Spencer Creek upstream of the RSA contains a mix of moderately tolerant cool and warmwater species. Data collected from HCA and MNR shows that a total of thirty (30) species have been collected through various studies. A single Black Redhorse (*Moxostoma duquesnei*), a Threatened species, was collected from the Christie Reservoir in 1998. Such a collection is likely an anomaly and it is unlikely that this species would be found again in the watershed (HCA 2011).

Fish Communities Downstream of RSA (General Assessment)

Contains presence/absence of fish species found downstream of the RSA. Fish records were obtained from the HCA and MNR.

Areas downstream of the RSA are classified as warmwater fish habitat (HCA 2011). Spring Creek converges with the main channel of Middle Spencer Creek near the confluence with Lower Spencer Creek (HCA 2011). Data from the MNR and HCA show that the fish community downstream of the RSA is less diverse than upstream of the RSA but included fish species that were not detected upstream. MNR and HCA fish collection records show that ten (10) species have been captured downstream of the RSA. Similar to upstream of the RSA, a mix of cool and warmwater species were captured.

The Greenville Tributary, a small section of Logie's Creek, and Middle Spencer Creek (spanning from downstream of the Christie Reservoir to downstream of the confluence with Logie's Creek, below the escarpment) all fall within the RSA. The fish communities within each watercourse are described below.

Middle Spencer Creek

The main channel of Middle Spencer Creek within the RSA is classified as warmwater habitat (HCA 2011). Fish records obtained from the HCA and MNR indicate that upstream of Crooks Hollow Road, sixteen (16) species have been captured. Downstream of Crooks Hollow Road, eleven (11) species have been captured. Both sampling areas included a mix of coolwater and warmwater species. All tributaries to Middle Spencer Creek within the RSA are likely intermittent (HCA 2011), and no fisheries data exists.

Within the RSA, there are two barriers to fish movement in Middle Spencer Creek: The Christie Dam (HCA 2011). The second barrier is the Niagara Escarpment. Additionally, HCA identified

thirty seven (37) areas with insufficient riparian buffer along Middle Spencer Creek within the RSA (HCA 2011).

In May of 2012, the Hamilton Conservaiton Authority completed the removal of the Crook's Hollow dam. Dam removal efforts involved natural channel design, wetland creation, riparian plantings and other restoration measures. Previously identified as a barrier to fish passage (HCA 2011), the removal of the dam and reservoir will likely improve fish habitat within the immediate area and downstream.

There are four online ponds along the creek and its tributaries within the RSA, which most likely contribute to warming of the creek (HCA 2011). A storm sewer outfall located approximately 50 m downstream of the small dam may affect water quality and temperature (HCA 2011). Additionally, the park at Webster's Falls, within the natural corridor of Middle Spencer Creek may be degrading the natural features of the area and affecting water quality (HCA 2011).

Greenville Tributary

The Greenville Tributary originates in the wetlands near Weirs Lane and flows east through a number of grassy swales and undefined channels with very little riparian vegetation. From here, the Tributary is piped under the westernmost extent of Oak Avenue before outletting from a culvert at the 90° corner on Oak Avenue. Further downstream, the channel passes through a series of backyards, and becomes very narrow, shallow and undefined and has been mowed through. The creek then passes under Brock Road, where it descends over the Escarpment before converging with Middle Spencer Creek. MNR fish records show that sampling was conducted along the Greenville Tributary in 2005 and 2006, at five (5) stations upstream of Brock Road. No fish were captured or observed. Therefore, Aquafor Beech Limited did not conduct fish sampling along the Greenville Tributary.

A combination of the Escarpment acting as a fish barrier, minimal fish habitat in some areas, and the intermittent nature of the creek are likely the reasons for the lack of a fish community. Fourty two (42) areas with insufficient riparian buffer were identified along the Greenville Tributary by the HCA (HCA 2011).

Logie's Creek

Within the RSA, Logie's Creek crosses beneath Harvest Road before descending over (Figure 4.6.5). Finescale Dace (*Chrosomus neogaeus*), Northern Pearl Dace (*Margariscus nachtriebi*) and Northern Redbelly Dace (*C. eos*), which are all common coolwater species and moderately tolerant of pollution, have been observed in Logie's Creek immediately above the Escarpment in 1991 (HCA 2009). In addition, Aquafor Beech Limited staff observed fish upstream of Harvest Road in October, 2011.



Figure 4.6.5: Logie's Creek descending 41 metres over Tew's Falls

Table 4.6.21: Fish species found within the Middle Spencer Creek Subwatershed

Common Name	Species Name	Thermal Regime	Upstream of RSA				Within RSA				Downstream of RSA	
			Christie Reservoir	Upstream of Hwy 5	Downstream of Westover Rd.	Between 5 th Concession Rd and Middletown Road	Upstream of Crooks Hollow Rd	Downstream of Crooks Hollow Rd	Greenville Tributary (No Fish Captured)	Logie's Creek, just upstream of Escarpment	Downstream of Confluence with Logie's Creek	Spring Creek
			2005-2011	2006	1998	1973, 1984, 1993	1970-2011	1993, 1998	2005, 2006	1991	1991, 2011	1996, 2003
Black Crappie	<i>Pomoxis nigromaculatus</i>	Coolwater	ü									
Black Redhorse	<i>Moxostoma duquesnei</i>	Warmwater	ü									
Blacknose Dace	<i>Rhinichthys atratulus</i>	Coolwater				ü	ü	ü			ü	ü
Blacknose Shiner	<i>Notropis heterolepis</i>	Coolwater	ü		ü							
Blackside Darter	<i>Percina maculata</i>	Coolwater			ü		ü	ü				
Bluegill	<i>Lepomis machochirus</i>	Warmwater					ü					
Bluntnose Minnow	<i>Pimephales notatus</i>	Warmwater	ü	ü	ü		ü	ü				
Brook Stickleback	<i>Culaea inconstans</i>	Coolwater									ü	
Brown Bullhead	<i>Ameiurus nebulosus</i>	Warmwater	ü	ü			ü					
Common Carp	<i>Cyprinus carpio</i>	Warmwater	ü	ü			ü	ü				
Common Shiner	<i>Luxilus cornutus</i>	Coolwater			ü	ü	ü	ü				
Creek Chub	<i>Semotilus atromaculatus</i>	Coolwater		ü	ü	ü	ü				ü	ü
Emerald Shiner	<i>Notropis atherinoides</i>	Coolwater	ü									
Fathead Minnow	<i>Pimephales promelas</i>	Warmwater	ü		ü		ü	ü			ü	
Finescale Dace	<i>Chrosomus neogaeus</i>	Coolwater						ü		ü		
Golden Shiner	<i>Notemigonus crysoleucas</i>	Coolwater	ü									

Hornyhead Chub	<i>Nocomis biguttatus</i>	Coolwater									ü	
Johnny Darter	<i>Etheostoma nigrum</i>	Coolwater	ü	ü	ü			ü				
Largemouth Bass	<i>Micropterus salmoides</i>	Warmwater	ü	ü		ü	ü				ü	
Longnose Dace	<i>Rhinichthys cataractae</i>	Coolwater				ü	ü	ü			ü	
Mimic Shiner	<i>Notropis volucellus</i>	Warmwater				ü						
Northern Hog Sucker	<i>Hypentelium nigricans</i>	Warmwater				ü						
Northern Pearl Dace	<i>Margariscus nachtriebi</i>	Coolwater								ü	ü	
Northern Pike	<i>Esox lucius</i>	Coolwater	ü									
Northern Redbelly Dace	<i>Chrosomus eos</i>	Coolwater					ü			ü		
Pumpkinseed	<i>Lepomis gibbosus</i>	Warmwater	ü	ü			ü	ü				
Rainbow Darter	<i>Etheostoma caeruleum</i>	Coolwater		ü	ü						ü	
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Coldwater					ü					
River Chub	<i>Nocomis micropogon</i>	Coolwater				ü	ü					
Rosyface Shiner	<i>Notropis rubellus</i>	Warmwater			ü							
Smallmouth Bass	<i>Micropterus dolomieu</i>	Warmwater				ü					ü	
Spotfin Shiner	<i>Cyprinella spiloptera</i>	Warmwater			ü							
Striped Shiner	<i>Luxilus chrysocephalus</i>	Coolwater			ü							
White Sucker	<i>Catostomus commersonii</i>	Coolwater	ü	ü	ü	ü	ü	ü				
White Crappie	<i>Pomoxis annularis</i>	Warmwater	ü									
Yellow Perch	<i>Perca flavescens</i>	Coolwater	ü									

4.6.2.5 Benthic Invertebrates

Benthic macroinvertebrates are commonly used as indicators to assess the water quality, health and integrity of aquatic ecosystems because:

- a) They are highly sensitive to environmental changes which make them excellent indicators of water quality;
- b) They are abundant in nearly all watercourses, living on or in the substrate;
- c) They can be easily and inexpensively collected and easily quantified;
- d) They are easily identified; and
- e) They have restricted mobility and specific habitat preferences, and therefore cannot simply move away from environmental stresses occurring at a site. (Griffiths, 1999)



Benthic invertebrate samples, sorted and labelled

Water quality can be assessed using multiple indices, or metrics, that are easy to calculate and produce a single score. Multiple indices could relate to specific impacts, making it necessary to use many metrics to detect impacts (TRCA 2000).

The HCA describes the benthic community of Middle Spencer Creek in Middle Spencer Creek Subwatershed Stewardship Action Plan (HCA 2011). Benthic fauna in the upper reaches of the Middle Spencer Subwatershed suggests impaired water quality (HCA 2011), including records of species indicative of organic and nutrient enrichment. After passing through wetlands as the creek approaches Highway 5, increased benthic diversity and richness indicates an improvement in water quality. Downstream of Highway 5 the benthic community suggests water quality impairment as indicated by increased numbers of tolerant taxa and decreased numbers of intolerant taxa (HCA 2011).

Downstream of the Christie Reservoir, as a result of siltation and organic accumulation coming from the reservoir the benthic community suggests impaired water quality. However, a few taxa which prefer cooler water temperatures have been collected at this location, suggesting a small amount of groundwater input (HCA 2011).

Immediately upstream of Webster's Falls, water quality conditions improve due to groundwater inputs originating from the Niagara Escarpment. However, benthic fauna still indicates organic debris and the thermal effects of a lack of shade (HCA 2011).



In 2008, Aquafor Beech conducted benthic macroinvertebrate surveys at the following crossings of Middle Spencer Creek:

- Highway 5;
- Crook's Hollow Road; and
- Dundas Market Street Bridge.

Aquafor Beech Limited's 2008 benthic macroinvertebrate data results are similar to the results of benthic surveys conducted by the HCA in 2011. Survey results indicate that the quality of the benthic community decreased from the Highway 5 station to downstream of the Christie Dam at the Crook's Hollow station (slightly less richness, slightly less intolerant taxa, and more tolerant taxa. Results from the sampling site at the Dundas Market Street bridge indicated the most impaired water quality, with a much lower number of intolerant taxa and a much higher number of tolerant taxa.

Aquafor Beech Limited's 2014 benthic macroinvertebrate data results at Crook's Hollow Road are slightly different than the 2008 results from the same site. In 2014, more intolerant organisms (Oligochaeta, Simuliidae, Chironomidae) were collected, and less Ephemeroptera, Plecoptera and Tricoptera (EPT). The differences can be accounted for as a result of seasonal differences. The 2014 surveys could not be completed at the beginning of spring, due to a late spring freshet. Extremely high flows made it too dangerous to complete surveys until May 21, 2014. In addition, it is possible that many EPT taxa would have already emerged before that date.

The indices calculated as a result of these surveys are contained within **Table 4.6.22** below. Raw data is located in **Appendix I**.

Table 4.6.22: : Results of Benthic Macroinvertebrate Survey Conducted by Aquafor Beech Limited in 2008 and 2014.

Indices	2008			2014
	Hwy 5	Crook's Hollow	Dundas Market Street Bridge Hydro Station	Crook's Hollow
Total Number of Organisms	730	3538	2239	345
Taxa Richness	29	28	40	23
% Chironomidae	4.38	4.30	7.15	37.68
% EPT	75.62	74.39	24.25	34.49
% Oligochaetes & Diptera	8.63	9.72	34.97	63.19
Shannon-Weiner Diversity	1.80	1.94	2.79	2.22

4.6.3 Species at Risk and Species of Conservation Concern

For the purpose of this Study, Species at Risk are defined as species listed as Endangered, Threatened, or of Special Concern by the Committee on the Status of Species at Risk in Ontario (COSSARO). Species of Conservation Concern are defined as species listed as Endangered, Threatened, or of Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC); species with Global ranks of G1 – G3; species with Sub-national/Provincial ranks of S1-S3; and species rare within the City of Hamilton.

Aquafor Beech Limited consulted a number of primary and secondary information sources to assess the presence of Species at Risk and species of conservation concern within the study area. These sources include:

- NHIC Biodiversity Explorer (1km square search completed in 2012 for the entire Greensville Subwatershed Study Area)
- Field observations from ELC, breeding bird, and amphibian surveys completed by Aquafor Beech Limited (2014)
- Field observations from ELC work completed by Natural Resource Solutions Incorporated (2007 & 2011)
- Mid-Spencer/Greensville Subwatershed Study Faunal Inventories Report (Ecoplans, 2006)
- City of Hamilton Natural Areas Inventory (Dwyer et al., 2003; and Schwetz, 2014) (Species at Risk and S-Ranked species only)
 - Hayesland Swamp (ESA 13)
 - Hayesland Alvar (ESA 28)
 - Donald Farm Complex (ESA 29)
 - Spencer Gorge (ESA 30)
 - Christie Stream Valley (ESA 31)
 - Dundas Valley (ESA 41)

A total of sixty four (64) Species at Risk and species of conservation concern have previously been recorded within or adjacent to the Mid-Spencer/Greensville Subwatershed study area (**Table 4.6.23**). Extirpated and historical records from the NHIC biodiversity database search were excluded from the list unless there was a reasonable possibility that these species could occur within the study area.

Incidental wildlife sightings recorded outside of the RSA by Natural Resource Solutions Incorporated during Ecological Land Classification surveys (2007 and 2011) yielded records of Species of Conservation Concern. These records are included in **Table 4.6.23** along with other Species of Conservation Concern records and are illustrated in **Figure 4.6.6**. All incidental wildlife records have been incorporated into final species lists (**Appendix F**). Known locations of Species at Risk documented within the RSA during surveys completed by Ecoplans Limited

are summarized in **Table 4.6.24** and are discussed in detail in **Appendix G**. Depending on species at risk status updates, some species not previously identified as Species at Risk by Ecoplans Limited (e.g. Bobolink) were included in the list while others were excluded (e.g. Mulberry Wing) as appropriate. One species of Special Concern, Monarch (*Danaus plexippus*), and one S3 species, Giant Swallowtail (*Papilio cresphontes*), were not included in as the two species were so common during field investigations conducted in the year 2006 that specific location data was not recorded.

Endangered, Threatened, and Special Concern Species

The potential occurrence of species listed as Endangered, Threatened, or of Special Concern by COSARRO within the RSA is addressed in **Section 4.6.3**.

In Consideration of Monarch



Since 2006, the status of the Monarch butterfly (inset photos) has changed significantly. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has recently published a proposed species at risk management plan for the Monarch in Canada. Monarch populations have declined dramatically over the past 15-20 years. Most recently (2013-2014 overwintering period), the Monarch population in Eastern Canada occupied only 0.67 ha of overwintering habitat, compared with a 1994-2014 average of 6.39 ha. The primary threats facing Monarchs in Eastern Canada include the degradation and loss of overwintering habitat in Mexico, the widespread use of pesticides and herbicides throughout their breeding grounds, climate change, severe weather events, succession and/or conversion of breeding and nectaring habitat, and the impacts of Bark Beetles on overwintering habitat (Environment Canada, 2014).

Due to the recent concern over Monarch populations, biological field surveys conducted in 2012 and 2014 recorded location data for incidental observations of this species. Surveys in 2012 and 2014 did not include targeted surveys for lepidopterans, including Monarch butterfly.

Table 4.6.23: Consolidated list of Species at Risk and Species of Conservation Concern within the Greenville Subwatershed Study Area

Species		Status					Source									
Latin Name	Common Name	COSEWIC ¹	COSSARO ²	G Rank ³	S Rank ⁴	Regional	Ecoplans (2006)	ABL (2007, 2014)	NRSI (2007, 2011)	NHIC	City of Hamilton Natural Areas Inventory (2003 & 2014)					
											Hayesland Swamp	Hayesland Alvar	Donald Farm Complex	Spencer Gorge	Christie Stream Valley	Dundas Valley
LEPIDOPTERANS																
<i>Danaus plexippus</i>	Monarch	SC	SC	G5	S2N,S4B	C	*	*	*		*	*	*	*	*	*
<i>Euphyes conspicua</i>	Black Dash	-	-	G4	S3	U	*				*	*	*		*	*
<i>Euphes dion</i>	Dion Skipper	-	-	G4	S3	U					*				*	
<i>Papilio cresphontes</i>	Giant Swallowtail	-	-	G5	S3	U	*		*				*			*
<i>Satyrium caryaevorum</i>	Hickory Hairstreak	-	-	G4	S3	U							*			*
ODONATES																
<i>Argia tibialis</i>	Blue-tipped Dancer	-	-	G5	S3	R									*	
<i>Arigomphus villosipes</i>	Unicorn Clubtail	-	-	G5	S2S3	C					*				*	*
<i>Enallagma anna</i>	River Bluet	-	-	G5	S2	U									*	
<i>Libellula semifasciata</i>	Painted Skimmer	-	-	G5	S2	U										*
<i>Rhionaeschna mutae</i>	Spatterdock Darner	-	-	G4	S2	H										*
HERPTILES																
<i>Ambystoma jeffersonianum</i>	Jefferson Salamander	END	END	G4	S2	R										*
<i>Chelydra serpentina</i>	Snapping Turtle	SC	SC	G5	S5	C					*	*			*	*
<i>Lampropeltis triangulum</i>	Milksnake	SC	SC	G5	S3	U				*	*		*	*	*	*
<i>Pseudacris triseriata</i>	Western Chorus Frog (GLSLCS Population)	THR	NAR	G5	S4	C		*								
<i>Thamnophis sauritus</i>	Ribbonsnake	SC	SC	G5	S3	R										*
BIRDS																
<i>Cardellina canadensis (C. pusilla)</i>	Canada Warbler	THR	SC	G5	S4B	R						*			*	
<i>Caprimulgus vociferous</i>	Whip-poor-will	THR	THR	G5	S4B	R						*	*			

Species		Status					Source									
Latin Name	Common Name	COSEWIC ¹	COSSARO ²	G Rank ³	S Rank ⁴	Regional	Ecoplans (2006)	ABL (2007, 2014)	NRSI (2007, 2011)	NHIC	City of Hamilton Natural Areas Inventory (2003 & 2014)					
											Hayesland	Hayesland	Donald Farm	Spencer	Christie	Dundas
<i>Chaetura pelagica</i>	Chimney Swift	THR	THR	G5	S4B,S4N	U	*		*							
<i>Contopus virens</i>	Eastern Wood-Pewee	SC	SC	G5	S4B	C	*		*							
<i>Corvus corax</i>	Common Raven	-	-	G5	S5	R		*								
<i>Dendroica cerulea</i>	Cerulean Warbler	END	THR	G4	S3B	R, H				*	*					*
<i>Dolichonyx oryzivorus</i>	Bobolink	THR	THR	G5	S4B	C	*		*			*	*		*	*
<i>Empidonax virescens</i>	Acadian Flycatcher	END	END	G5	S2S3B	R					*					*
<i>Hirundo rustica</i>	Barn Swallow	THR	THR	G5	S4B	C/U	*	*	*				*			*
<i>Hylocichla mustelina</i>	Wood Thrush	THR	SC	G5	S4B	C	*	*								
<i>Ixobrychus exilis</i>	Least Bittern	THR	THR	G5	S4B	R, H					*					
<i>Melanerpes erythrocephalus</i>	Red-headed Woodpecker	THR	SC	G5	S4B	R	*									
<i>Nycticorax nycticorax</i>	Black-crowned Night-Heron	-	-	G5	S3B	U										*
<i>Riparia riparia</i>	Bank Swallow	THR	SC	G5	S4B	U	*		*		*	*			*	*
<i>Seiurus motacilla</i>	Louisiana Waterthrush	SC	SC	G5	S3B	R, H	*			*				*		*
<i>Sturnella magna</i>	Eastern Meadowlark	THR	THR	G5	S4B	C	*	*	*			*	*			*
<i>Thryothorus ludovicianus</i>	Carolina Wren	-	-	G5	S4	R		*						*		*
<i>Vermivora chrysoptera</i>	Golden-Winged Warbler	THR	SC	G4	S4B	R, H	*									*
MAMMALS																
<i>Myotis lucifugus</i>	Little Brown Bat	-	END	G5	S4	uncertain									*	*
PLANTS																
<i>Arisaema dracontium</i>	Green Dragon	SC	SC	G5	S3	H								*	*	
<i>Aureolaria virginica</i>	Downy Yellow False Foxglove	-	-	G5	S1	H				*				*		
<i>Carex albicans</i> var. <i>albicans</i>	White-tinged Sedge	-	-	G5T4T5	S3	H								*		*
<i>Carex oligocarpa</i>	Eastern Few-fruited Sedge	-	-	G4	S3	H				*						

Species		Status					Source									
Latin Name	Common Name	COSEWIC ¹	COSSARO ²	G Rank ³	S Rank ⁴	Regional	Ecoplans (2006)	ABL (2007, 2014)	NRSI (2007, 2011)	NHIC	City of Hamilton Natural Areas Inventory (2003 & 2014)					
											Hayesland	Hayesland	Donald Farm	Spencer	Christie	Dundas
<i>Carex formosa</i>	Handsome Sedge	-	-	G4	S3S4	H						*				
<i>Carex x subviridula</i>	A Sedge	-	-	GNA	S2	-					*					
<i>Carex virescens</i>	Ribbed Sedge	-	-	G5	S3	H										*
<i>Carpinus caroliniana</i>	Blue Beech	-	-	G5	S5	H										
<i>Carya glabra</i>	Sweet Pignut Hickory	-	-	G5	S3	U			*							*
<i>Castanea dentata</i>	American Chestnut	END	END	G4	S2	h				*				*	*	*
<i>Cirsium discolor</i>	Field Thistle	-	-	G5	S3	H										*
<i>Cornus florida</i>	Eastern Flowering Dogwood	END	END	G5	S2?	U										*
<i>Crataegus dissona</i>	Northern Hawthorn	-	-	G4G5	S3	H										*
<i>Epilobium strictum</i>	Downy Willow-herb	-	-	G5?	S5	H			*							
<i>Hieracium paniculatum</i>	Panicled Hawkweed	-	-	G5	S2?	H										*
<i>Hybanthus concolor</i>	Green Violet	-	-	G5	S2	h										*
<i>Juglans cinerea</i>	Butternut	END	END	G4	S3?	C		*						*	*	*
<i>Liriodendron tulipifera</i>	Tulip Tree (planted)	-	-	G5	S4	H			*							
<i>Morus rubra</i>	Red Mulberry	END	END	G5	S2	H								*		*
<i>Muhlenbergia tenuiflora</i>	Slim-flowered Muhly	-	-	G5	S2	H								*		
<i>Panax quinquefolius</i>	Ginseng	END	END	G3G4	S2	H										*
<i>Phegopteris hexagonoptera</i>	Broad Beech Fern	SC	SC	G5	S3	H										*
<i>Populus x jackii</i>	Jack's Hybrid Poplar	-	-	GNA	S2	-								*		
<i>Ranunculus hispidus</i> var. <i>hispidus</i>	Bristly Buttercup	-	-	G5T5	S3	H								*		
<i>Scirpus atrovirens</i>	Black Bulrush	-	-	G5?	S5	H			*							
<i>Thalictrum thalictroides</i>	Rue Anemone	-	-	G5	S3	H								*		
<i>Uvularia perfoliata</i>	Perfoliate Bellwort	-	-	G5	S1	H				*				*		
FISH																

Species		Status					Source									
Latin Name	Common Name	COSEWIC ¹	COSSARO ²	G Rank ³	S Rank ⁴	Regional	Ecoplans (2006)	ABL (2007, 2014)	NRSI (2007, 2011)	NHIC	City of Hamilton Natural Areas Inventory (2003 & 2014)					
											Hayesland	Hayesland	Donald Farm	Spencer	Christie	Dundas
<i>Clinostomus elongatus</i>	Redside Dace	END	END	G3G4	S2	R, H				*	*		*			
<i>Lampetra appendix</i>	American Brook Lamprey	-	-	G4	S3	R									*	
<i>Moxostoma duquesnei</i>	Black Redhorse	THR	THR	G5	S2	R, H								*		

¹**COSEWIC (Committee on the Status of Endangered Wildlife in Canada)**

EXT Extinct - A species that no longer exists.

EXP Extirpated - A species no longer existing in the wild in Canada, but occurring elsewhere.

END Endangered - A species facing imminent extirpation or extinction.

THR Threatened - A species likely to become endangered if limiting factors are not reversed.

SC Special Concern - A species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

²**COSSARO (Committee on the Status of Species at Risk in Ontario):** The provincial review process is implemented by the MNR's Committee on the Status of Species at Risk in Ontario (COSSARO).

EXT Extinct—A species that no longer exists anywhere.

EXP Extirpated—A species that no longer exists in the wild in Ontario but still occurs elsewhere.

END Endangered - A species facing imminent extinction or extirpation in Ontario which is a candidate for regulation under Ontario's Endangered Species Act (ESA).

THR Threatened—A species that is at risk of becoming endangered in Ontario if limiting factors are not reversed.

SC Special Concern —A species with characteristics that make it sensitive to human activities or natural events.

³**G-Rank (global):** Global ranks are assigned by a consensus of the network of Conservation Data Centres (CDCs), scientific experts, and the Nature Conservancy to designate a rarity rank based on the range-wide status of a species, subspecies, or variety.

G1 Extremely rare—usually 5 or fewer occurrences in the overall range or very few remaining individuals; or because of some factor(s) making it especially vulnerable to extinction.

G2 Very rare—usually between 5 and 20 occurrences in the overall range or with many individuals in fewer occurrences; or because of some factor(s) making it vulnerable to extinction.

G3 Rare to uncommon—usually between 20 and 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.

G4 Common—usually more than 100 occurrences; usually not susceptible to immediate threats.

G5 Very common—demonstrably secure under present conditions.

⁴**S-Ranks (provincial):** Provincial (or Subnational) ranks are used by the Natural Heritage Information Centre (NHIC) to set protection priorities for rare species and natural communities. These ranks are not legal designations. Provincial ranks are assigned in a manner similar to that described for global ranks, but consider only those factors within the political boundaries of Ontario.

S1 Critically Imperiled—Critically imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.

S2 Imperiled—Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.

S3 Vulnerable—Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

S4 Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 Secure—Common, widespread, and abundant in the nation or state/province.

S#S# Range Rank —A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community. Ranges cannot skip more than one rank (e.g., SU is used rather than S1S4).

LEGEND - Regional Ranks, following Dwyer et al. 2014			
Lepidoptera	Breeding Birds	Fish	Herpetofauna
C = common, present at > 30 stations	A = abundant, > 1000 pairs	A = abundant, found in 60% of stations/watershed	A = abundant, > HHA squares
U = uncommon, present at 11–30 stations	C = common, 201 - 1000 pairs	C = common, 40% of stations/watershed	C = common, 26-200 HHA squares
R = rare, present at ≤ 10 stations	U = uncommon, 21 - 200 pairs	U = uncommon, ≤ 25% of stations/watershed	U = uncommon, 11 -25 stations H = locally significant
Flora	R = rare, 1-20 pairs	R = rare, ≤ 10% of stations/watershed	R = rare, 1 -10 stations h = moderately significant
C = common, known from > 10 sites	ex = extirpated	H = locally significant	ex = extirpated, no records from 1984-2002
h = uncommon, known from 6 - 10 sites		h = moderately significant	
H = rare, known from ≤ 5 sites			

³G-Rank (global)

Global ranks are assigned by a consensus of the network of Conservation Data Centres (CDCs), scientific experts, and the Nature Conservancy to designate a rarity rank based on the range-wide status of a species, subspecies, or variety.

G1 Extremely rare—usually 5 or fewer occurrences in the overall range or very few remaining individuals; or because of some factor(s) making it especially vulnerable to extinction.

G2 Very rare—usually between 5 and 20 occurrences in the overall range or with many individuals in fewer occurrences; or because of some factor(s) making it vulnerable to extinction.

G3 Rare to uncommon—usually between 20 and 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.

G4 Common—usually more than 100 occurrences; usually not susceptible to immediate threats.

G5 Very common—demonstrably secure under present conditions.

⁴S-Ranks (provincial)

Provincial (or Subnational) ranks are used by the Natural Heritage Information Centre (NHIC) to set protection priorities for rare species and natural communities. These ranks are not legal designations. Provincial ranks are assigned in a manner similar to that described for global ranks, but consider only those factors within the political boundaries of Ontario.

S1 Critically Imperiled—Critically imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.

S2 Imperiled—Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.

S3 Vulnerable—Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

S4 Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.

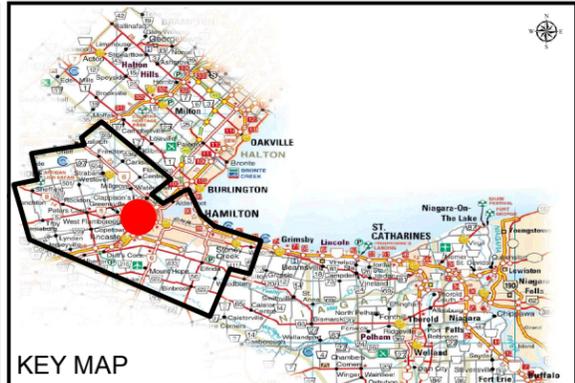
S5 Secure—Common, widespread, and abundant in the nation or state/province.

S#S# Range Rank —A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community. Ranges cannot skip more than one rank (e.g., SU is used rather than S1S4).

LEGEND - Regional Ranks, following Dwyer et al. 2014		
Breeding Birds		Lepidoptera
A = abundant, > 1000 pairs	H = locally significant	C = common, present at > 30 stations
C = common, 201 - 1000 pairs	h = moderately significant	U = uncommon, present at 11 - 30 stations
U = uncommon, 21 - 200 pairs		R = rare, present at ≤ 10 stations
R = rare, 1-20 pairs		
ex = extirpated		* = present
m = migratory bird survey		
B = breeding bird survey		



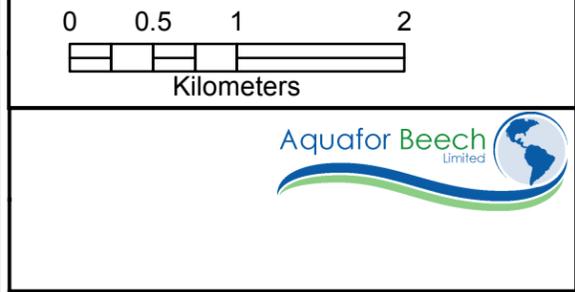
- Legend**
- Mid-Spencer Creek Subwatershed Boundary
 - Rural Settlement Area
 - New Development Areas
- Species At Risk**
- Bank Swallow (2011)
 - Barn Swallow (2011)
 - Barn Swallow (2014)
 - Black Bulrush (2007)
 - Black Bulrush (2011)
 - Blue Beech (2011)
 - Bobolink (2011)
 - Butternut (2007)
 - Carolina Wren (2014)
 - Chimney Swift (2011)
 - Chorus Frog (2014)
 - Downy Willow-herb (2011)
 - Eastern Meadowlark (2011)
 - Eastern Meadowlark (2014)
 - Eastern Wood-pewee (2011)
 - Tulip Tree (2011)
 - Wood Thrush (2014)



KEY MAP

LEGEND:

NOTES:
 To be read in conjunction with Natural Heritage maps and reports provided by Ecoplans (2006).



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**GREENSVILLE
 SUBWATERSHED STUDY**

Species at Risk and Species of Conservation Concern Recorded by NRSI (2007 & 2011) and Aquafor Beech Limited (2014)

FIGURE: 4.6.6

DATE: February 2016

4.7 Natural Heritage System

The following subsections outline the NHS policy framework as well as the NHS identification and development undertaken for the Mid-Spencer Subwatershed Study Area.

Provincial Context

The 2014 Provincial Policy Statement (PPS), promulgated under the Planning Act, directs municipal land-use planning activities related to matters of provincial interest. Section 2.1.2 of the Provincial Policy Statement (PPS) states that:

the diversity and connectivity of natural features in an area, and the long-term ecological function and biodiversity of natural heritage systems, should be maintained, restored or, where possible, improved, recognizing linkages between and among natural heritage features and areas, surface water features and ground water features (Ministry of Municipal Affairs and Housing, 2014).

The PPS supports not only the protection of individual natural heritage features (woodlands, wetlands, valleylands, wildlife habitat, etc.) but also the linkages that connect them into a broader Natural Heritage System (NHS). The NHS approach is effective because it acknowledges that natural heritage features have strong functional ties to one another, and this functionality may be compromised when such features become isolated within a predominately agricultural or urban matrix. Accordingly, a key objective of the Greenville Subwatershed Study is to provide a framework to guide the development of the lands so that their ecological processes, functions and significant natural features are protected, maintained and enhanced (City of Hamilton 2012, 2014).

The Province of Ontario provides technical guidance to implement the natural heritage policies of the PPS through the Natural Heritage Reference Manual (NHRM). The first iteration of the NHRM, issued by the Ministry of Natural Resources and Forestry (MNRF) in 1999, recognizes the development of a natural heritage system as a comprehensive approach to defining and protecting natural heritage features and areas. The most recent edition of the NHRM, issued in 2010, places greater emphasis on planning for natural heritage systems and providing connectivity among natural heritage features and areas (MNRF 2010). The NHRM itself is an advisory document outlining what planning authorities (e.g. municipalities, conservation authorities) should consider when reviewing development proposals for impacts on natural heritage features.

The PPS defines a Natural Heritage System as:

a system made up of natural heritage features and areas, and linkages intended to provide connectivity (at the regional and site level) and support natural processes

which are necessary to maintain biological and geological diversity, natural functions, viable populations of indigenous species and ecosystems. These systems can include natural heritage features and areas, federal and provincial parks and conservation reserves, other natural heritage features, lands that have been restored and areas with the potential to be restored to a natural state, areas that support hydrologic functions, and working landscapes that enable ecological functions to continue (Ministry of Municipal Affairs and Housing, 2014).

The NHS approach is a useful method for the protection of natural heritage features and areas because it reinforces an understanding that the elements of the system have strong ecological ties to each other, as well as to other physical features and areas in the overall landscape. The NHS approach also addresses a number of important land use planning concerns, including biodiversity decline, landscape fragmentation and the maintenance of ecosystem health. The NHRM describes these planning concerns in greater detail and outlines the potential benefits of a NHS (MNR 2010).

The majority of the study area is within the Greenbelt Planning Area and is thus subject to the provisions of the 2005 Greenbelt Act.

Local Context

The Mid-Spencer Creek Subwatershed contains a number of Natural Heritage Features. Within the greater Subwatershed Area, Natural Heritage Features include:

- Woodlands
- Wetlands
 - Swamp
 - Marsh
- Environmentally Sensitive Areas
 - Christie Stream Valley
 - Hayesland Alvar
 - Donald Farm Complex
 - Spencer Gorge
 - Dundas Valley
 - Hayesland Swamp
- Areas of Natural and Scientific Interest
 - Spencer Gorge
 - Guelph Rockport Formation
 - Guelph Amabel Formation
 - Dundas Valley
- Forests
- Watercourses
- Meadows
- Thickets
- Alvars

Specific to the Greensville Rural Settlement Area (RSA), Natural Heritage Resources include:

- Watercourses
 - Swamp
- Woodlands
- Thickets
- Wetlands
 - Marsh
- Meadows
- Forests
- Environmentally Sensitive Areas
 - Dundas Valley

- Christie Stream Valley
- Spencer Gorge

Together, the above mentioned Natural Heritage Features compliment one another in the context of the greater Natural Heritage System (NHS).

The City of Hamilton has taken a nested approach to natural heritage system planning: the NHS is comprised of Core Areas and Linkages, as illustrated below in **Figure 4.7.1**. The City of Hamilton (2012, 2013) defines Core Areas as *Key Natural Heritage Features*, *Key Hydrologic Features*, and *Local Natural Areas*.

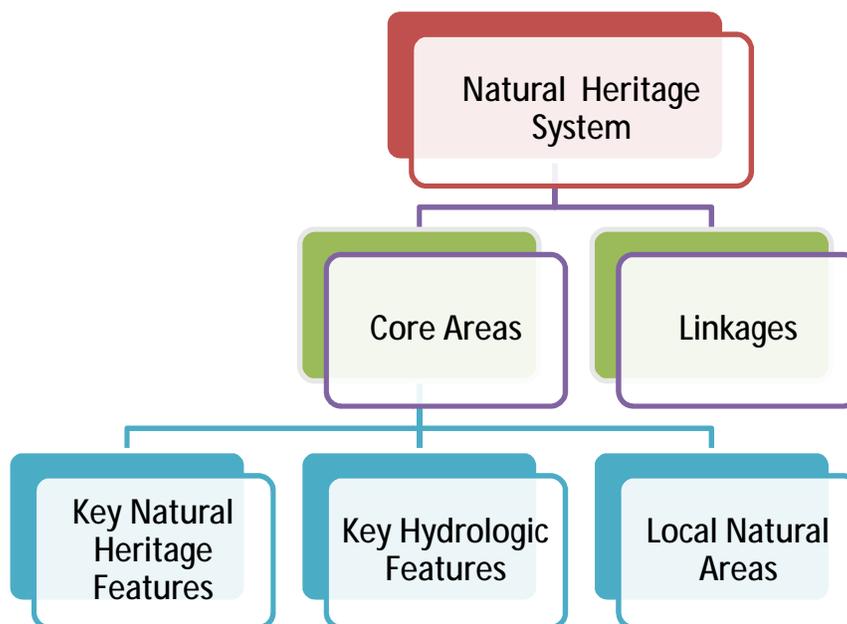


Figure 4.7.1: The City of Hamilton's Approach to Natural Heritage Planning

Applicable Definitions

During the preparation of its new Rural and Urban Official Plans (completed in 2012 and 2013, respectively), the City of Hamilton identified the components of a municipal Natural Heritage System (NHS) consisting of Core Areas and Linkages. In developing the Recommended NHS, Aquafor Beech Limited relied on applicable definitions from the City of Hamilton's Rural and Urban Official Plans, as follows:

The City of Hamilton (2012, 2013) defines **Key Natural Heritage Features** as:

- Significant habitat of endangered, threatened, and special concern species;
- Fish habitat;
- Wetlands;
- Life Science Areas of Natural and Scientific Interest (ANSIs);
- Significant valleylands;

- Significant woodlands;
- Significant wildlife habitat;
- Sand barrens, savannahs, and tallgrass prairies; and
- Alvars.

The City of Hamilton (2012, 2014) defines **Key Hydrologic Features** as:

- Permanent and intermittent streams;
- Lakes (and their littoral zones);
- Seepage areas and springs; and,
- Wetlands.

The City of Hamilton (2012, 2014) defines **Local Natural Areas** as:

- Environmentally Significant Areas as identified by the City of Hamilton;
- Unevaluated wetlands; and
- Earth Science Areas of Natural and Scientific Interest.

The City of Hamilton (2012, 2014) defines **Linkages** as landscape areas that connect natural areas. Linkages may include the following:

- Woodland linkages (e.g. small woodlands);
- Other natural vegetation types (e.g. meadows, old field, thickets); and
- Streams and watercourses that connect Core Areas.

A more thorough definition of Linkages, as provided by the City of Hamilton, is:

Linkages are ... landscape areas that connect natural areas. Linkages are also important natural features, either in their own right or through restoration activities. They are avenues along which plants and animals can propagate, genetic interchange can occur, populations can move in response to environmental changes and life cycle requirements, and species can be replenished from other natural areas. Conserving linkages also protects and enhances Core Areas.

The City of Hamilton's definitions of (i) woodland linkages and (ii) other natural vegetation types vary between the Urban and Rural Official Plans (**Table 4.7.1**). The primary difference between the two being that the Rural Official Plan does not specify the minimum size criteria for linkages. However, because 0.5 ha is the minimum size for vegetation units on OP maps, despite the specified difference between the two, the definitions are essentially the same because the mapping uses the same minimum designable unit size.

Table 4.7.1: City of Hamilton definitions of woodland linkages and other natural vegetation types.

Term	Definition – Urban Official Plan	Definition – Rural Official Plan
Woodland linkage	Any natural or planted wooded area of any size or composition of 0.5 ha or more in size that either connects or lies within 100 m of a Core Area.	Any natural or planted wooded area of any size or composition that either connects or lies within 100 m of a Core Area.
Other natural vegetation types	Any meadow, thicket, or old field at least 0.5 ha in size that connects Core Areas or is situated within 100 m of a Core Area.	Any meadow, thicket, or old field that connects Core Areas or is situated within 100 m of a Core Area.

4.7.1 Methodology

Aquafor Beech Limited used a systems approach to identify a recommended NHS for the study area of the Greenville Subwatershed Study. The systems approach identifies a NHS that includes core areas while ensuring that smaller, less significant natural areas or degraded lands between these areas are maintained or restored to provide a connected system of natural areas (City of Hamilton 2012, 2013). Briefly, the approach used by Aquafor Beech Limited involved the following steps:

- (1) A preliminary NHS for the study area of the Greenville/Mid-Spencer Subwatershed Study was identified based on Core Areas as mapped by the City of Hamilton (2012, 2013).
- (2) Data from existing information sources and supplemental fieldwork was used to characterize the existing conditions of the study area of the Greenville/Mid-Spencer Creek Subwatershed with a particular emphasis on areas of land within the Minor Urban Area of Greenville (Primary Study Area), referred to herein as the Rural Settlement Area (RSA). Outside of the RSA, natural heritage features outside of the preliminary NHS were classified based on scoped field visits and air photo interpretation. Within the RSA, natural heritage features outside of the preliminary NHS were subject to detailed field investigations.
- (3) The preliminary NHS was refined through further assessment based on the definitions provided in the City of Hamilton’s Official Plan (2012, 2013). For ease of mapping, the Mid-Spencer Subwatershed Study Area was split into three sections: Zone A, Zone B, and Zone C.

The Recommended NHS builds upon the (pre-existing) Preliminary NHS identified by the City of Hamilton. The Recommended NHS includes the Preliminary NHS and the following three (3) features:

- 1) Core Areas and Linkages as defined by the City of Hamilton (2012, 2013);
- 2) Vegetation protection zones consistent with the minimum requirements of the City of Hamilton (City of Hamilton 2012, 2013); and
- 3) Opportunities to enhance the attributes of Core Areas and Linkages.

The proceeding section details the results of the assessment of Core Areas and Linkages outside of the Preliminary NHS. Vegetation Protection Zones, and enhancement areas on lands outside of the Preliminary NHS are discussed in **Sections 4.7.5** and **9.3.5**, respectively. For ease of reference, corresponding definitions for each element of the NHS are provided within each subsection. **Section 4.8** details the inclusion of the above three Natural Heritage Features within the Recommended NHS, as applicable.

4.7.2 Review and Refinement of Core Areas within the Rural Settlement Area

In developing the Recommended NHS, Aquafor Beech Limited reviewed and refined the Preliminary NHS for the study area of the Greenville Subwatershed Study to incorporate Key Natural Heritage Features, Key Hydrologic Features, Local Natural Areas, and their associated vegetation protection zones (City of Hamilton 2013, 2014) as defined below. Per the project's terms of reference, particular emphasis was placed on the Rural Settlement Area (RSA), as this is the only area within the subwatershed where development is expected to occur.

Core Areas included within the Recommended NHS satisfy the definitions associated with each component of Core Areas, as outlined below:

4.7.2.1 Key Natural Heritage Features

4.7.2.1.1 Significant Habitat of Endangered, Threatened and Special Concern Species

The City of Hamilton (2012, 2013) defines the Significant Habitat of Endangered, Threatened, and Special Concern Species as follows:

the habitat, as approved by the Ministry of Natural Resources, that is necessary for the maintenance survival and/or recovery of naturally occurring or reintroduced populations of species at risk and where those areas of occurrence are occupied or habitually occupied by the species during all or any part(s) of its life cycle.

Within the RSA, the Preliminary NHS was reviewed to address the protection afforded the habitat of species designated as Endangered, Threatened or Special Concern by the Committee on the Status of Species at Risk in Ontario (COSSARO) including:

- the habitat of COSSARO-designated species protected by the Ontario Endangered Species Act (2007).

- the significant habitat of species designated Endangered, Threatened or Special Concern by COSSARO. By definition, such habitat constitutes a Key Natural Heritage Feature and a Core Area as established by the City of Hamilton’s Urban Official Plan (City of Hamilton 2012).

For each of the twenty one (21) COSSARO-designated species at risk known or suspected to occur in the Greenville Subwatershed Study Area, Aquafor Beech Limited used background information and the results of previous studies to determine: (i) the habitat requirements of the species, (ii) the availability of potentially suitable habitat for the species in the RSA, (iii) whether lands within the RSA has been surveyed for the species per MNR-specified protocols, and (iv) whether the species has been recorded within or adjacent to the RSA. Based on this information, Aquafor Beech Limited developed seven (7) categories to characterize the occurrence in the RSA of each of the twenty one (21) COSSARO-designated species (**Table 4.7.2**).

Table 4.7.2: Categories of occurrence assigned to COSSARO-designated species.

Occurrence Category	Definition
1	The species is known to occur in the RSA.
2	The species does not occur in the RSA because all available evidence suggests that the RSA is located well beyond the distribution of the species.
3	The species does not occur in the RSA because suitable habitat is not present.
4	The species does not occur in the RSA – potentially suitable habitat was located but no specimens were observed during surveys completed per MNR-specified protocols.
5	The species does not occur in the RSA - no potentially suitable habitat was located and no specimens were observed during surveys completed per MNR-specified protocols.
6	The presence of the species in the RSA has not been assessed per MNR-specified protocols; specific surveys are not recommended because any potentially suitable habitat for the species is incorporated in the recommended NHS.
7	The presence of the species in the RSA has not been assessed per MNR-specified protocols; future surveys for the species are recommended to guide implementation of the recommended NHS.

Table 4.7.3 lists thirty two (32) COSSARO-designated species at risk known or suspected to occur in the Greenville Subwatershed Study Area and the occurrence category of each as assessed by Aquafor Beech Limited, Ecoplans Limited, and Natural Resource Solutions Incorporated (NRSI).

In refining the preliminary NHS, Aquafor Beech Limited considered only the habitat requirements of COSSARO-designated species known to occur in the RSA (i.e. Category 1 species). No further consideration was given to the habitat requirements of those species that do not occur in Zone B (i.e. Category 2, 3, 4 and 5 species) or those whose habitat (e.g. wetlands) the City of Hamilton has already identified as a component of the municipal NHS (i.e. Category 6 species). Additional surveys at subsequent planning stages are recommended for COSSARO-designated species whose presence in the RSA has not been assessed per MNR-specified protocols (i.e. Category 7 species) and for select species that do occur in the RSA (e.g. category 1 species) but can potentially occupy habitats outside of surveyed areas; survey results may require future refinement to the recommended NHS.

Table 4.7.3: Categories of 31 COSSARO-designated Species at Risk known or Suspected to Occur in the Greensville Rural Settlement Area

Taxon	COSSARO Status ¹	Common Name	Scientific Name	Occurrence Category	Comments
Plants	Endangered	American Chestnut	<i>Castanea dentata</i>	1	<p>COSEWIC (2004) states the following regarding American Chestnut habitat:</p> <p>Typical habitat is an upland deciduous forest on acid to neutral, sandy soil. Common associates, in order of highest frequency, are red oak, black cherry, sugar maple, American beech, white ash, white oak, red maple and sassafras. White pine, hemlock, shagbark hickory and black oak are occasional associates.</p> <p>Deposits of sandy soils (Grimsby sandy loam) exist within the northern portion of the RSA; no individuals were found during surveys completed by Ecoplans Limited (2006), Aquafor Beech Limited (2006) and NRSI (2011). The majority of potential American Chestnut habitat in the RSA is incorporated in the NHS, though individuals may present on residential properties or in hedgerows. Additional surveys for American Chestnut at subsequent planning stages are recommended.</p>
		Eastern Flowering Dogwood	<i>Cornus florida</i>	6	<p>Eastern Flowering Dogwood is a showy woodland understory species. Its distribution in Ontario is restricted to the Carolinian Zone (e.g. southwestern Ontario). It grows in a variety of mid-aged to mature forests, including open dry-mesic hickory woodlands, mesic maple-beech deciduous forest and mixed forest (Bickerton and Thompson-Black 2010). It prefers coarser soils, in particular acidic sandy-loams. A recovery strategy (Bickerton and Thompson-Black 2010) and habitat regulation have been developed for this species. The habitat regulation applies to counties and regional municipalities where this species has been previously observed or may be expected, including the Regional Municipality of Hamilton. The entire ELC vegetation type polygon in which flowering dogwood is observed is considered habitat, as well as the “terrestrial area” 20 metres around the stem (for individuals near a polygon edge or within hedgerows).</p> <p>Eastern Flowering Dogwood has previously been recorded in the Dundas Valley ESA. There are no known records of the species within the Greensville RSA.</p>
		Butternut	<i>Juglans cinerea</i>	1	<p>The Butternut Recovery Strategy (Environment Canada 2010) states the following:</p> <p>Butternut can tolerate a large range of soil types. It typically grows best on rich, moist, well-drained loams often found along stream banks but can also be found on well-drained gravelly sites, especially of limestone origin. Butternut is intolerant of shade and competition, requiring sunlight from above to survive but it has the ability to maintain itself as a minor component of forests in later successional stages. As a result, the species is typically scattered throughout a stand and occasionally, groups of butternuts can be found along forest roads, forest edges or anywhere sunlight is adequate to support regeneration through seed.</p> <p>Butternut was located within the “Marshborough Road ELC survey site” by Aquafor Beech Limited in 2006 and NRSI in 2007. The aforementioned area (located north of woodland 5) has been significantly modified since 2006 and it is not known if any butternut persist on the property. Surveys completed by Dillon Consulting Limited (2010) and NRSI (2010 & 2007) did not cover all potential Butternut habitat in detail; individual Butternut trees could be present in remnant hedgerows, forest edges, etc. Additional surveys for Butternut at subsequent planning stages are recommended.</p>

Taxon	COSSARO Status ¹	Common Name	Scientific Name	Occurrence Category	Comments
		Red Mulberry	<i>Morus rubra</i>	6	The Red Mulberry Recovery Strategy (Parks Canada 2011) describes Red Mulberry habitat as fresh to moist, well-drained, forested habitats, including floodplains, bottomlands, the slopes and ravines along the southern portion of the Niagara Escarpment and in swales on some western Lake Erie sand spits. Critical habitat for Red Mulberry as defined by Parks Canada (2011) is found only on Pelee Island. Red Mulberry was previously recorded in the Spencer Gorge and Dundas Valley ESAs. All potential habitat in the RSA is incorporated in the NHS.
		American Ginseng	<i>Panax quinquefolius</i>	6	In southwestern Ontario, American Ginseng typically grows in rich, moist, but well-drained, and relatively mature, deciduous woods dominated by Sugar Maple (<i>Acer saccharum</i>), White Ash (<i>Fraxinus americana</i>) and American Basswood (<i>Tilia americana</i>). It also occur in treed swamps, though to a lesser degree. It usually grows in deep, nutrient rich soil over limestone or marble bedrock. Abundant shade is critical for the species (MNRF 2013 ⁵). The habitat of American Ginseng is protected under the ESA (2007). Category 1 habitat is described as “the area occupied by American Ginseng and the area of forest or treed swamp ELC community classes within 100 m of the occupied area”. Furthermore, Category 2 habitat is described as “the area of forest or treed swamp ELC community classes between 100 m and 150 m of the occupied area, and contiguous with Category 1” (MNRF 2013 ⁵). Given the habitat requirements of this species, it is the opinion of Aquafor Beech Limited that all potentially suitable habitat for the species within the RSA has been included within the NHS.
	Special Concern	Broad Beech Fern	<i>Phegopteris hexagonoptera</i>	6	The habitat of Broad Beech Fern is described as shady moist areas of maple and beech forests (http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=244). The species occurs in Hamilton according to Riley (1989) and Oldham (2009). All potential Broad Beech Fern habitat in the RSA is incorporated in the NHS.
		Green Dragon	<i>Arisaema dracontium</i>	6	Green Dragon was recorded in 2011 during fieldwork conducted in support of the 2014 Hamilton NAI. This plant typically grows in moist to wet deciduous forests, most often along streams (http://www.ontario.ca/environment-and-energy/green-dragon). All potential habitat for Green Dragon within the RSA has been incorporated into the NHS.
Mammals	Endangered	Little Brown Bat	<i>Myotis lucifugus</i>	7	Little Brown Bat roost in trees and buildings during the summer months, after which they move to more humid places that remain above freezing such as caves, basements of century homes, etc. for hibernation during the late fall through to early spring. Little Brown Bat has previously been recorded in the Christie Valley and Dundas Valley ESAs (Schwetz 2014). Specific surveys for bats have not been completed as part of this study. Due to the availability of potential habitat throughout the RSA, further surveys for this and other bat species are recommended. Surveys should be undertaken in accordance with the MNRF Guelph District’s bat survey protocol.
		Northern Long-eared Bat	<i>Myotis septentrionalis</i>	7	Northern Long-eared Bat typically roosts in trees from spring to autumn. In the winter months, they hibernate in areas such as caves or mines.

Taxon	COSSARO Status ¹	Common Name	Scientific Name	Occurrence Category	Comments
					Northern Long-eared Bat are known to occur within Hamilton, though there are no specific records for the Greensville RSA. Given the presence of forests and the Niagara Escarpment, it is possible that this species may be present in the area. As such, future surveys for this and other bat species are recommended. Surveys should be undertaken in accordance with the MNRF Guelph District's bat survey protocol.
		Eastern Small-footed Bat	<i>Myotis leibii</i>	7	<p>Eastern Small-footed Bat roost in a variety of habitats, including and not necessarily limited to tree cavities, mines, caves, under rocks, rocky outcrops, in buildings, and under bridges. With the exception of mines, all of the aforementioned habitat types exists either within or adjacent to the Greensville RSA. This species hibernates in caves and mines.</p> <p>Eastern Small-footed Bat are known to occur within Hamilton, though there are no specific records for the Greensville RSA. Given the presence of potential roosting and hibernation sites within the RSA and adjacent lands, it is possible that this species may be present in the area. As such, future surveys for this and other bat species are recommended. Surveys should be undertaken in accordance with the MNRF Guelph District's bat survey protocol.</p>
Birds	Endangered	Acadian Flycatcher	<i>Empidonax virescens</i>	5	Acadian Flycatcher has been recorded in the Dundas Valley ESA. The Acadian Flycatcher Recovery Strategy recognises the south-west Dundas Valley as an area of critical habitat (Environment Canada 2012); this area is outside of the Greensville Subwatershed Study Area.

Taxon	COSSARO Status ¹	Common Name	Scientific Name	Occurrence Category	Comments
Birds	Threatened	Barn Swallow	<i>Hirundo rustica</i>	1	<p>Barn Swallow nesting sites are most often found in association with human structures, with nests being found on “a variety of artificial structures that provide either a horizontal nesting surface (e.g., a ledge) or a vertical face, often with some sort of overhang that provides shelter. Nests are most commonly located in and around open barns, garages, sheds, boat houses, bridges, road culverts, verandahs [sic] and wharfs” (COSEWIC 2011¹). Nesting sites and foraging areas are typically found close to open habitats such as farmland, meadows, parks and wetlands (COSEWIC 2011¹). As Barn Swallow nests are constructed of mud pellets, a nearby source of mud (such as a wetland, creek, or ditch) is an important component of habitat selection. Barn Swallow habitat is protected under the Endangered Species Act (2007) and includes the nest and areas up to a 200m radius of the nest (MNR 2013⁴).</p> <p>Suitable nesting and foraging habitat for Barn Swallow exists throughout the Greensville Subwatershed Study Area, including the RSA. Within the RSA, Barn Swallow was recorded in Habitat Units 9, 10, 13, 14, 15, and 26 by Ecoplans Limited in 2006; and in Open Country Breeding Bird Unit 3 by Aquafor Beech Limited in 2014. The ubiquity of this species necessitates additional surveys at future planning stages (e.g. as part of an EIS).</p>
		Bobolink	<i>Dolichonyx oryzivorus</i>	1	<p>Bobolink require open country habitats consisting of natural and semi-natural grassland (including but not limited to tallgrass prairie, alvar grasslands, beaver meadows, and grassy peatlands), hayfields, pastures, grassland habitat restoration sites, and abandoned fields where the species has been confirmed to breed or probably bred during the current or previous three years. Furthermore, the recovery strategy recommends that annual row crops (e.g., winter wheat and rye) be excluded from the habitat (MNR 2013¹).</p> <p>Bobolink receives habitat protection under the Endangered Species Act (2007); up to 300m from a nest or defended territory is considered regulated habitat for the species, provided the habitat in that area is suitable (MNR 2013²). Bobolink has previously been recorded in the Christie Stream Valley, though exact location data is unknown to the study team at this time. This species was not recorded during breeding bird surveys within the RSA conducted in 2014.</p>
		Cerulean Warbler	<i>Dendroica cerulea</i>	4	<p>Cerulean Warbler habitat is protected under the Endangered Species Act (2007) based on the Act’s general definition of habitat. The 2010¹ COSEWIC status report states the following:</p> <p style="padding-left: 40px;">Primary breeding habitat for this species is most often described as large, mature deciduous forest, typified by structurally mature hardwood species in mesic or floodplain conditions containing a closed or semi-open canopy...In Ontario, Cerulean Warblers favour mature deciduous stands dominated by oak-maple, often in association with swampy bottomlands.</p> <p>Oak and maple-dominated woodlands exist within the Spencer Gorge ESA, though Cerulean Warblers were not found during NAI surveys (Dwyer et al. 2003).</p>
		Chimney Swift	<i>Chaetura pelagica</i>	7	<p>Chimney Swift habitat is protected under the Endangered Species Act (2007) based on the Act’s general definition of habitat. MNR is currently developing a Recovery Strategy and a species-specific habitat regulation for the species (MNR 2009). Chimney Swifts were found Habitat Units 10, 29, and 31 (within and adjacent to the RSA) in surveys conducted by Ecoplans Limited in 2006. They were also observed in open areas along Brock Rd between Woodlands 6 & 7 by NRSI in 2011. Additional surveys for Chimney Swift roosting and nesting sites at subsequent planning stages are recommended. Surveys in 2014 did not result in Chimney Swift</p>

Taxon	COSSARO Status ¹	Common Name	Scientific Name	Occurrence Category	Comments
					records.
		Eastern Meadowlark	<i>Sturnella magna</i>	1	<p>Eastern Meadowlark occupies open habitat such as grasslands, pastures and savannahs that, generally, are a minimum of 5 ha in size (COSEWIC 2011²). “It also uses a wide variety of other anthropogenic grassland habitats, including hayfields, weedy meadows, young orchards, golf courses, restored surface mines, grassy roadside verges, young oak plantations, grain fields, herbaceous fencerows, and grassy airfields” (COSEWIC 2011²). The habitat of Eastern Meadowlark is protected under the ESA (2007). The MNRF defines the habitat of the species as an area of continuous suitable habitat up to 300m from the nest or approximate centre of the defended territory (MNRF 2013³).</p> <p>Breeding evidence in Habitat Unit 15 recorded by Ecoplans Limited in 2006 can no longer be considered viable due to land use changes (e.g. residential development) within and adjacent to Habitat Unit 15 since 2006. Breeding bird surveys within the RSA conducted in 2014 by Aquafor Beech Limited noted possible breeding activity in lands adjacent to Open Country Breeding Bird Habitat Unit 2. The ubiquity of this species necessitates additional surveys at future planning stages (e.g. as part of an EIS).</p>
		Least Bittern	<i>Ixobrychus exilis</i>	1	<p>The Least Bittern recovery strategy describes the main breeding habitat as permanent wetlands consisting of freshwater and brackish marshes with dense, tall, persistent emerging plants (mainly cattail <i>Typha</i> spp), interspersed with open water and occasionally clumps of shrubby vegetation (Environment Canada 2011¹).</p> <p>Critical breeding habitat for Least Bittern has not been identified within the RSA. However, as the species is reliant on wetlands, all potential habitat in the RSA has been incorporated into the Greensville NHS.</p>
	Special Concern	Bank Swallow	<i>Riparia riparia</i>	1	<p>The COSEWIC status report on Bank Swallow describes their habitat as follows:</p> <p>The Bank Swallow breeds in a wide variety of natural and artificial sites with vertical banks, including riverbanks, lake and ocean bluffs, aggregate pits, road cuts, and stock piles of soil. Sand-silt substrates are preferred for excavating nest burrows. Breeding sites tend to be somewhat ephemeral due to the dynamic nature of bank erosion. Breeding sites are often situated near open terrestrial habitat used for aerial foraging (e.g., grasslands, meadows, pastures, and agricultural cropland). Large wetlands are used as communal nocturnal roost sites during post-breeding, migration, and wintering periods. (COSEWIC 2013)</p> <p>Within the RSA, Bank Swallow has previously been recorded within the Christie Stream Valley ESA. Bank Swallow was not recorded during breeding bird surveys conducted in 2014. It is therefore presumed that presently, within the RSA suitable habitat for this species is present within the Christie Stream Valley ESA only.</p>
		Canada Warbler	<i>Cardellina canadensis</i> (a.k.a. <i>C. pusillaa</i>)	6	<p>Canada Warbler breeds in mixed and deciduous forests with well-developed, dense shrubby understories (Peck and James, 1987) with diverse habitat structure near and on the ground layer (http://www.ontario.ca/environment-and-energy/canada-warbler).</p> <p>Canada Warbler was recorded in the Christie Stream Valley ESA between 2011 and 2013 during field studies supporting the 2014 Hamilton NAI. All areas of potential habitat for this species within the RSA has been</p>

Taxon	COSSARO Status ¹	Common Name	Scientific Name	Occurrence Category	Comments
					incorporated into the NHS.
		Eastern Wood-pewee	<i>Contopus virens</i>	1	<p>Eastern Wood-pewee is a small, inconspicuous member of the tyrant flycatcher family (<i>Tyrannidae</i>). The species typically breeds in deciduous and mixed woods, with a preference for open space near the nest provided by forest edges, clearings, roadways, and water (Peck and James, 1987).</p> <p>Within the RSA, Ecoplans (2006) previously recorded Eastern Wood-pewee breeding evidence within Wildlife Habitat Units 9, 12, 26 and 29 (Spencer Gorge ESA).</p>
		Golden-winged Warbler	<i>Vermivora chrysoptera</i>	4	<p>Golden-winged Warbler requires early successional scrub habitat with an abundance of herbaceous cover (COSEWIC 2006).</p> <p>Golden-winged Warbler has been located in the Dundas Valley ESA and within Habitat Unit 20 (Ecoplans 2006). Both of these areas are outside of the Greenville Subwatershed Study Area.</p>
		Louisiana Waterthrush	<i>Seiurus motacilla</i>	1	<p>The Management Plan for the Louisiana Waterthrush describes the species as an area-sensitive forest bird, found in riparian zones in mature tracts of deciduous-mixed forests, and it shows a preference for streams below steep-sided slopes in forests containing deciduous trees, often with a hemlock component. Nest sites are found along stream banks, under mossy logs, and in roots of fallen trees...Clear headwater streams and associated wetlands are preferred sites, but this species will also inhabit heavily-wooded swamps most often frequented by Northern Waterthrush (Environment Canada 2011²).</p> <p>Louisiana Waterthrush was recorded in the Spencer Gorge during NAI field studies (Dwyer et al. 2003) and by Ecoplans Limited (2006). Within the RSA, suitable habitat for the species does not exist outside of the Spencer Gorge, and is protected as part of the NHS.</p>
		Red-Headed Woodpecker	<i>Melanerpes erythrocephalus</i>	4	<p>The Government of Canada species profile webpage (2010) describes Red-headed Woodpecker as occurring in:</p> <p>a wide variety of habitats, including open oak and beech forests, grasslands, forest edges, orchards, pastures, riparian forests, roadsides, urban parks, golf courses, cemeteries, as well as along beaver ponds and brooks. The open areas favoured by this species usually contain a high density of dead or unhealthy trees for roosting, and where holes can easily be made for nesting. In winter, the Red-headed Woodpecker occurs mainly in open, mature woodlands, such as oak stands, oak-hickory stands, maple stands, ash stands and beechwoods. The presence of this species in these various stands correlates with the abundance of acorns and beechnuts.</p> <p>Though suitable habitat exists in the NHS within the RSA, Red-headed Woodpecker was not found during NAI surveys or surveys completed by Ecoplans Limited (2006).</p>
		Wood Thrush	<i>Hylocichla mustelina</i>	1	<p>Wood thrush is a medium sized migratory songbird in the thrush family (<i>Turdidae</i>) that is widely distributed in deciduous and mixed forests in southern Ontario (Cadman et al., 2007). Sibley et al. (2001) further refines the description of the habitat requirements of the wood thrush to include undisturbed moist mature deciduous or</p>

Taxon	COSSARO Status ¹	Common Name	Scientific Name	Occurrence Category	Comments
					<p>mixed forest with deciduous sapling growth often near a pond or swamp; as well as hardwood forest edges; the forest must have some trees higher than 12 m.</p> <p>Within the RSA, Wood Thrush breeding evidence was recorded in Habitat Units 8b, and 9 by Ecoplans Limited in 2006. Breeding bird surveys conducted within the RSA by Aquafor Beech Limited in 2014 note that the species is possibly breeding in two territories within Wildlife Survey Unit 8b and two territories within Wildlife Survey Unit 26.</p>

Taxon	COSSARO Status ¹	Common Name	Scientific Name	Occurrence Category	Comments
Reptiles and Amphibians	Endangered	Jefferson Salamander	<i>Ambystoma jeffersonianum</i>	7	<p>Jefferson Salamander is associated with deciduous or mixed woodlands. Terrestrial habitat must contain suitable microhabitat (e.g. leaf litter, downed woody debris, tree stumps and rodent burrows) for foraging and overwintering. Breeding occurs in ponds located in or in proximity to woodlands. Breeding ponds generally consist of vernal pools but other types of wetlands may be used. Some individuals migrate up to 1 km, but 90% of adults reside in suitable habitat within 300 m of their breeding pond. Migratory movements to and from breeding ponds may occur through a variety of habitats, including woodlands, plantations, agricultural fields and early successional areas (MNR 2010).</p> <p>Jefferson Salamander habitat is protected under the Endangered Species Act (2007). For the purposes of the Act, Section 28 of Ontario Regulation 242/06 defines Jefferson Salamander habitat as follows:</p> <p>In the City of Hamilton, the counties of Brant, Dufferin, Elgin, Grey, Haldimand, Norfolk and Wellington and the regional municipalities of Halton, Niagara, Peel, Waterloo and York,</p> <ul style="list-style-type: none"> i. a wetland, pond or vernal or other temporary pool that is being used by a Jefferson salamander or Jefferson dominated polyploid or was used by a Jefferson salamander or Jefferson dominated polyploid at any time during the previous five years, ii. an area that is within 300 metres of a wetland, pond or vernal or other temporary pool described in subparagraph i and that provides suitable foraging, dispersal, migration or hibernation conditions for Jefferson salamanders or Jefferson dominated polyploids, iii. a wetland, pond or vernal or other temporary pool that, <ul style="list-style-type: none"> A. would provide suitable breeding conditions for Jefferson salamanders or Jefferson dominated polyploids, B. is within one kilometre of an area described in subparagraph i, and C. is connected to the area described in subparagraph i by an area described in subparagraph iv, and iv. an area that provides suitable conditions for Jefferson salamanders or Jefferson dominated polyploids to disperse and is within one kilometre of an area described in subparagraph i. <p>The Hamilton Conservation Authority is currently undertaking salamander monitoring activities within the Greenville RSA. Monitoring is expected to continue into 2016 and 2017, but may be extended should survey conditions in those years not be favorable. At the end of the third successful survey year, it will be known if the area surveyed supports Jefferson Salamander and, if applicable, the extent of regulated habitat.</p>
	Special Concern	Snapping Turtle	<i>Chelydra serpentina</i>	6	<p>Snapping Turtles are aquatic and generally occur in habitats that provide slow-moving water, a soft mud bottom and dense aquatic vegetation such as ponds, sloughs, shallow bays and slow streams. Some individuals persist in heavily urbanized water bodies such as golf course ponds and irrigation canals. Females generally nest on sand and gravel banks along waterways, but may also use muskrat houses, abandoned beaver lodges and anthropogenic features such as road shoulders, railway embankments and gardens. Snapping turtles hibernate</p>

Taxon	COSSARO Status ¹	Common Name	Scientific Name	Occurrence Category	Comments
					under water in lakes, marshes or small, continuously flowing streams (COSEWIC, 2008). All areas of potential habitat for this species within the RSA has been incorporated into the NHS.
		Eastern Milksnake	<i>Lampropeltis triangulum</i>	7	The Eastern Milk Snake is widespread in the City of Hamilton and several records occur from within the study area of the Greenville Subwatershed Study, with relative abundance in the “alvar habitats of central Flamborough” (Lamond 1994). The species is difficult to locate because of their secretive behaviour (COSEWIC 2002). Consequently, although no individuals were encountered incidentally during surveys completed by Ecoplans Limited (2006) and NRSI (2007 & 2011) it is premature to conclude that the species is not extant in the RSA. Accordingly, additional surveys for Eastern Milksnake at subsequent planning stages are recommended.
		Eastern Ribbonsnake	<i>Thamnophis sauritus</i>	6	Eastern Ribbonsnake is semi-aquatic and is most often found along the edges of shallow ponds, streams, marshes and other wetlands bordered by dense vegetation (Smith 2002). In Hamilton the species is characteristic of wetlands that are associated with large wooded areas; the Eastern Ribbon Snake record nearest to the RSA is from a site located in the Dundas Valley ESA, south of the RSA (Lamond 1994). In the opinion of Aquafor Beech Limited, it is highly unlikely that the few small, disjunct wetlands remaining in the RSA function as Eastern Ribbonsnake habitat.
Fish	Endangered	Redside Dace	<i>Clinostomus elongatus</i>	6	Redside Dace are small, insectivorous fish that rely on visual search of prey at the water’s surface, and are therefore sensitive to siltation and changes in water turbidity (Redside Dace Recovery Team 2010). Redside Dace require cool, clear flowing water with riffle-pool sequences and overhanging streamside vegetation (Redside Dace Recovery Team 2010). The Redside Dace record nearest to the RSA is within Spencer Creek, approximately 8 km upstream, north of Concession 6 W (HCA 1998). Middle Spencer Creek is classified as a warmwater watercourse within the RSA. In the opinion of Aquafor Beech Limited, it is highly unlikely that the available aquatic habitat within the RSA functions as Redside Dace habitat.
	Threatened	Black Redhorse	<i>Moxostoma duquesnei</i>	6	A single Black Redhorse was captured adjacent to the RSA in 1998, in the Christie Reservoir (HCA 1998). The habitat within the Christie Reservoir is not ideal and this species had not been previously recorded east of the Grand River Watershed (HCA 1998). The HCA (1998) states that it is unlikely that <i>M. duquesnei</i> would be found elsewhere in the watershed, which includes the RSA.
Insects	Special Concern	Monarch	<i>Danaus plexippus</i>	1	Monarch butterfly habitat consists of open areas that support its larval host plant Milkweed (<i>Asclepias</i> spp.) and other wildflowers (COSEWIC, 2010 ²). Such habitat is common in Southern Ontario and includes cultural meadows, gardens, roadsides, and other disturbed lands. Accordingly, the designation of Monarch as Special Concern mainly reflects its vulnerability to the loss of overwintering areas in Mexico rather than habitat-related concerns in Ontario (COSEWIC 2010 ²). As mentioned in Section 4.6.3 , Monarch was so common during field surveys in 2006, specific location data was not recorded. Monarch observations were recorded during field work completed in 2012 and 2014. Incidental observations from fieldwork completed in 2012 and 2014 are as follows:

Taxon	COSSARO Status ¹	Common Name	Scientific Name	Occurrence Category	Comments
					<ul style="list-style-type: none"> ○ 2012 ELC surveys completed by NRSI note observations of Monarch at Brock Rd and Conc. 4: ELC Polygons C & E; Brock Rd. and Harvest Rd.: ELC Polygons A & F; Brock Rd. and Conc. 5: ELC Polygons C & D. ○ 2014 ELC surveys completed by Aquafor Beech Limited in 2014 note observations of Monarch in ELC Polygons 4 & 17.

¹**COSSARO (Committee on the Status of Species at Risk in Ontario)**

The provincial review process is implemented by the MNR's Committee on the Status of Species at Risk in Ontario (COSSARO).

EXT Extinct—A species that no longer exists anywhere.

EXP Extirpated—A species that no longer exists in the wild in Ontario but still occurs elsewhere.

END Endangered - A species facing imminent extinction or extirpation in Ontario which is a candidate for regulation under Ontario's Endangered Species Act (ESA).

THR Threatened—A species that is at risk of becoming endangered in Ontario if limiting factors are not reversed.

SC Special Concern —A species with characteristics that make it sensitive to human activities or natural events.

4.7.2.1.2 Fish Habitat

The City of Hamilton (2012, 2014), in keeping with the definition provided by the Provincial Policy Statement (2014), as follows:

As defined in the *Fisheries Act*, [fish habitat] means spawning grounds and any other areas, including nursery, rearing, food supply, and migration areas on which *fish* depend directly or indirectly in order to carry out their life processes.

Within the study area of the Greenville Subwatershed Study, the Preliminary NHS was reviewed to confirm the inclusion of fish habitat as defined by the City of Hamilton (2012, 2014). Sections 4.6.2.4 and 4.6.2.5 summarize the fish species identified in the RSA and the results of benthic macroinvertebrate surveys, respectively.

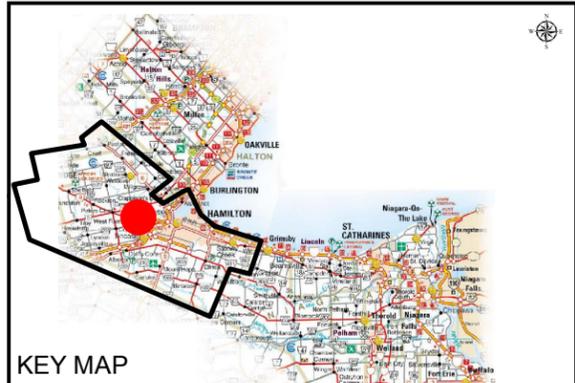
Fish Habitat Classification of Watercourses

Within the study area of the Greenville Subwatershed Study, the preliminary NHS was reviewed to confirm the inclusion of fish habitat. As mentioned previously, the City of Hamilton (2013) defines fish habitat as “the spawning grounds and nursery, rearing, food supply, and migration areas on which fish depend on directly or indirectly in order to carry out their life processes”. As all watercourses within study area are classified as either direct (i.e. fish present) or indirect (i.e. contributing to downstream populations) fish habitat, all watercourses in the study area meet the definition of fish habitat according to the City of Hamilton (2013). Accordingly, all watercourses in the study area are designated as Core Natural Areas within the revised NHS. Fish habitat classifications are listed in (Table 4.7.4) and illustrated in Figure 4.7.2, below.



Table 4.7.4: Fish Habitat Classification of Watercourses within the Greenville Subwatershed Study Area

Watercourse	Watercourse Fisheries Classification
Logie’s Creek	Direct Fish Habitat
Middle Spencer Creek	Direct Fish Habitat
Tributaries to Middle Spencer Creek	Indirect (Contributing) Fish Habitat
Unnamed Watercourse	Indirect (Contributing) Fish Habitat

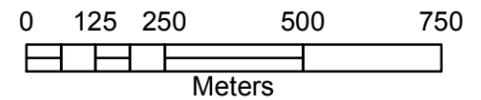


KEY MAP

LEGEND:

- - - Rural Settlement Area
- Mid-Spencer Creek Subwatershed Boundary
- Direct Fish Habitat
- Indirect (Contributing) Fish Habitat
- Watercourse

NOTES:



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**GREENSVILLE
SUBWATERSHED STUDY**
Fish Habitat Classification Within
Greensville Rural Settlement Area

FIGURE: 4.7.2

DATE: February 2016

4.7.2.1.3 Wetlands

Within the Greensville Subwatershed Study Area, the preliminary NHS was reviewed to confirm the inclusion of wetlands as defined by the City of Hamilton (2009, 2011):

Land such as swamp, marsh, bog, or fen (not including land that is being used for agricultural purposes and no longer exhibits wetland characteristics) that:

- (a) is seasonally or permanently covered with shallow water or has the water table close to or at the surface;
- (b) has hydric soils and vegetation dominated by water-tolerant plants; and
- (c) has been further identified according to evaluation procedures established by the Ministry of Natural Resources, as amended from time to time.
- (d) This includes provincially and locally significant wetlands (definition in accordance with the Greenbelt Plan, 2005).

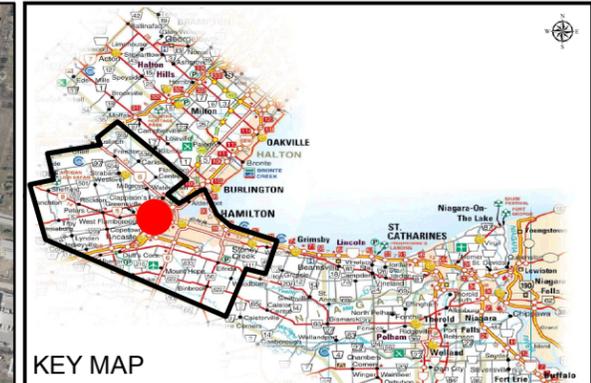
Aquafor Beech Limited revised the Preliminary NHS within the Greensville Subwatershed Study Area to incorporate any wetland not previously mapped as a Core Area. Within the RSA of the Greensville Subwatershed Study Area, Aquafor Beech Limited (2006, 2011, 2014) identified ten (10) vegetation units characterized by the Ecological Land Classification System for Southern Ontario as swamp or marsh (

Figure 4.7.4) that were not within the existing NHS. These units include eight (8) discrete wetland areas (Wetlands 1 – 8). Note that at the time of the 2006 fieldwork, Wetland 2 was not included in the City of Hamilton’s NHS mapping. The City of Hamilton’s mapping has since been updated to include a portion of Wetland 2 in the preliminary NHS.

Wetlands 1 – 8 are included as Core Natural Areas in the Greenville NHS. It is important to confirm the boundaries of NHS features such as wetlands at future development planning stages/the detailed design phase in coordination with the HCA and the City of Hamilton, as it is at this stage where the features will be identified, studied further, and firm boundaries established.



Figure 4.7.3: Wetland 4, located within the south west portion of the Greenville RSA

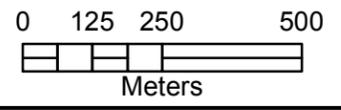


KEY MAP

LEGEND:

-  Mid-Spencer Creek Subwatershed Boundary
-  Rural Settlement Area
-  Wetland
-  City of Hamilton unevaluated wetlands

NOTES:




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**GREENSVILLE
SUBWATERSHED STUDY**
Wetlands Within The Rural
Settlement Area

FIGURE: 4.7.4

DATE: February 2016

4.7.2.1.4 Life Science Areas of Natural and Scientific Interest (ANSI)

The Preliminary NHS was reviewed to confirm the inclusion of Life Science Areas of Natural and Scientific Interest (ANSI) as defined by the City of Hamilton (2012, 2013):

Lands and waters containing natural landscapes or features that are important for natural heritage protection, appreciation, scientific study, or education. Life Science ANSIs are identified by MNR using evaluation procedures established by that Ministry, as amended from time to time (Greenbelt Plan, 2005).

Life Science ANSIs within the Mid-Spencer Creek/Greenville Subwatershed include the provincially significant Spencer Gorge Escarpment Valley Life Science ANSI. This ANSI overlaps with the Spencer Creek Bedrock Gorge Earth Science ANSI. These ANSIs are located in the eastern portion of the Rural Settlement Area, and are encompassed within the boundaries of the Spencer Gorge Environmentally Significant Area (ESA) and are included within the Preliminary NHS.

4.7.2.1.5 Significant Valleylands

The Preliminary NHS was reviewed to confirm the inclusion of Significant Valleylands as defined by the City of Hamilton (2012, 2013):

A natural area that occurs in a valley or other landform depression that has water flowing through or standing for some period of the year which is ecologically important in terms of features, functions, representation, or amount, and contributes to the quality and diversity of an identifiable geographic area or natural heritage system. (PPS, 2005).

Significant Valleylands constitute Key Natural Heritage Features of Core natural Areas in the City of Hamilton's NHS. Significant Valleylands are designated by the Province and by the City of Hamilton. According to Official Plans and data provided to Aquafor Beech Limited by the City of Hamilton, Significant Valleylands are not present within the Greenville Subwatershed Study Area. However, the City has not yet identified criteria or mapping for significant valleylands and as such these features may be present within the study area. However, it is assumed that they are protected as part of other Core Area features (e.g. ESAs, watercourses).

4.7.2.1.6 Significant Woodlands

Within the RSA, the Preliminary NHS was reviewed to confirm the inclusion of significant woodlands as defined by the City of Hamilton (2012, 2014). The City of Hamilton defines *woodlands* as follows:

Treed areas that provide environmental and economic benefits to both the private landowners and the general public, such as erosion prevention, hydrological and nutrient cycling, provision of clean air and the long-term storage of carbon, provision of wildlife habitat, outdoor recreational opportunities, and the sustainable harvest of a wide range of woodland products. Woodlands include treed areas, woodlots or forested areas.

The City of Hamilton, in keeping with the definition provided by the PPS (2014), defines *woodlands* and *woodland linkages* as:

Woodlands: means treed areas that provide environmental and economic benefits to both the private landowner and the general public, such as erosion prevention, hydrological and nutrient cycling, provision of clean air and the long-term storage of carbon, provision of wildlife habitat, outdoor recreational opportunities, and the sustainable harvest of a wide range of woodland products. Woodlands include treed areas, woodlots or forested areas.

The City of Hamilton (2012, 2013) defines *significant woodlands* as follows:

An area which is ecologically important in terms of:

- (a) Features such as species composition, age of trees, stand history;
- (b) Functionally important due to its contribution to the broader landscape because of its location, size, or due to the amount of forest cover in the planning area; and
- (c) Economically important due to site quality, species composition or past management history.

In Hamilton, significant woodlands are wooded areas that meet two (2) or more of the following criteria:

Criterion	Description												
Size	All woodlands that meet the minimum size criteria (below) are significant.												
	<table border="1"> <thead> <tr> <th>Forest Cover (By Planning Unit)</th> <th>Minimum Patch Size for Significance</th> </tr> </thead> <tbody> <tr> <td>< 5%</td> <td>1 ha</td> </tr> <tr> <td>5-10%</td> <td>2 ha</td> </tr> <tr> <td>11-15%</td> <td>4 ha</td> </tr> <tr> <td>16-20%</td> <td>10 ha</td> </tr> <tr> <td>21-30%</td> <td>15 ha</td> </tr> </tbody> </table>	Forest Cover (By Planning Unit)	Minimum Patch Size for Significance	< 5%	1 ha	5-10%	2 ha	11-15%	4 ha	16-20%	10 ha	21-30%	15 ha
	Forest Cover (By Planning Unit)	Minimum Patch Size for Significance											
	< 5%	1 ha											
	5-10%	2 ha											
	11-15%	4 ha											
	16-20%	10 ha											
21-30%	15 ha												
Interior Forest	Any woodland with interior forest habitat (100 metres from edge) is considered significant.												
Proximity / Connectivity	Woodlands that are located within 50 metres of a significant natural area, (defined as wetlands 0.5 hectares or greater in size, ESAs, PSWs, and Life Science ANSIs) are significant.												
Proximity to Water	Woodlands are considered significant if any portion is within 30 metres of any hydrological feature, including all streams, headwater areas, wetlands, and lakes.												
Age	Woodlands with trees of 100 years or more in age are significant. Age will be determined initially using FRI mapping and can be verified during the EIS.												
Rare Species	Any woodland containing Threatened, Endangered, Special Concern, provincially or locally rare plant or wildlife species is significant.												

Significant woodlands shown in the Rural and Urban Official Plan Areas have been incorporated into Core Natural Areas mapping as part of the Greensville NHS. Additional woodlands within and outside of the RSA meeting the woodland definition contained within the Hamilton Official Plans were also included in the NHS. **Table 4.7.5** details the significant woodland analysis completed for woodlands within the RSA. Woodlands listed in this table are illustrated in **Figure 4.7.5**.

With 12.58% forest cover (Hamilton Conservation Authority, 2011), the minimum size criteria for woodlands within the Greensville Subwatershed is 4 hectares (City of Hamilton, 2011; City of Hamilton, 2012).

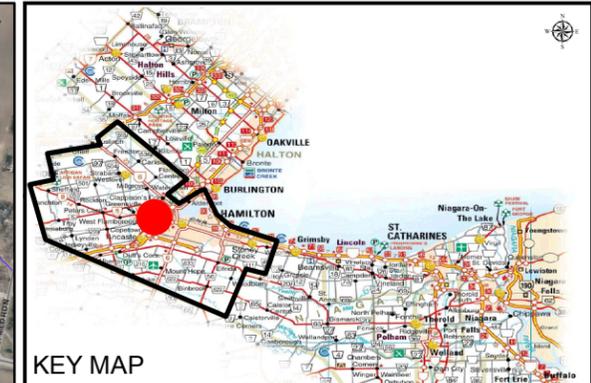
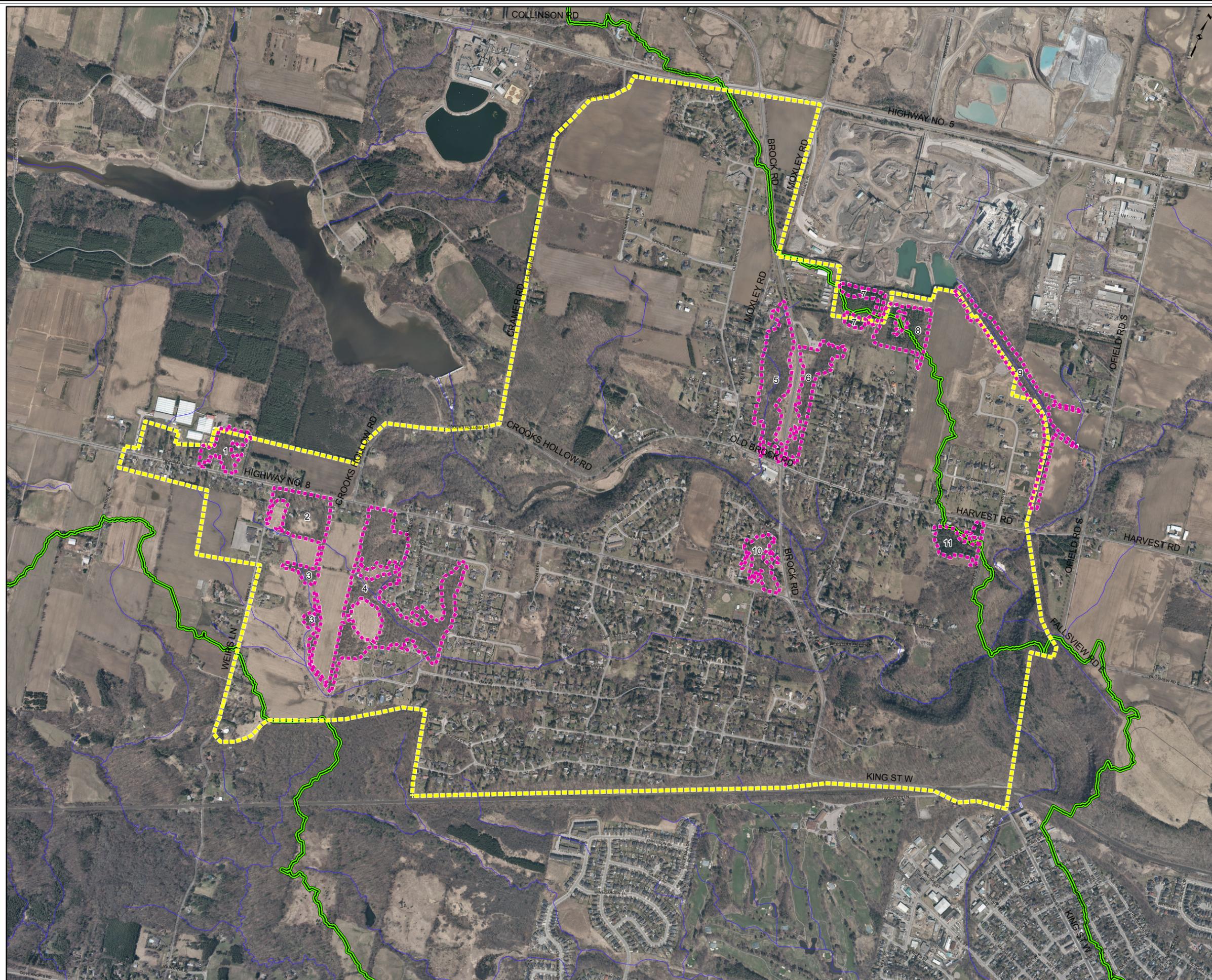
Within the RSA of the Greensville Subwatershed Study Area, Aquafor Beech Limited (2006, 2011) identified twelve (12) vegetation units characterized by the Ecological Land Classification System for Southern Ontario as woodland, plantation or deciduous forest (**Figure 4.7.5**). These units form eight (8) discrete woodland blocks (Woodlands 1 – 4 and Woodlands 9 – 11); Woodlands 3, 4, 5, 7, 8, 9, 10, and 11 are considered significant because they satisfy two or more City of Hamilton criteria for significance (**Table 4.7.5**).

Within the RSA of the Greensville Subwatershed Study Area, Natural Resources Solutions Incorporated (2007, 2011) identified twenty three (23) vegetation units characterized by the Ecological Land Classification System for Southern Ontario as plantation or deciduous forest. These units form four (4) discrete woodland blocks (Woodlands 5 – 8) (**Figure 4.7.5**); Woodlands 3, 4, 5, 7, 8, 9, 10 and 11 are considered significant because they satisfy two or more City of Hamilton criteria for significance (**Table 4.7.5**). In the case of Woodlands 7 and 8, proximity to a wetland satisfied two of the criteria for significance.

Table 4.7.5: Significant Woodland Analysis for Greenville Rural Settlement Area

Woodland	Criteria under Regional Official Plans						Status
	Size (> 4 ha)	Interior Forest	Proximity/ Connectivity	Proximity to Water	Age	Rare Species	
Woodland 1			*				-
Woodland 2				*			-
Woodland 3			*	*		*	Significant
Woodland 4	*		*	*		*	Significant
Woodland 5	*			*			Significant
Woodland 6						*	-
Woodland 7			*	*		*	Significant
Woodland 8			*	*		*	Significant
Woodland 9	*			*			Significant
Woodland 10*	*		*				Significant
Woodland 11*			*				Significant

* ELC Polygon is part of a larger contiguous woodland area, and so qualifies as significant woodland.



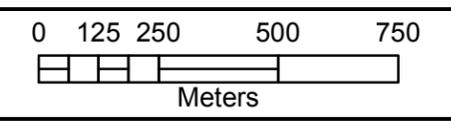
KEY MAP

LEGEND:

-  Mid-Spencer Creek Subwatershed Boundary
-  Rural Settlement Area
-  Woodland

NOTES:

Woodlands shown on this map are outside of the Preliminary Natural Heritage System.



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**GREENSVILLE
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Woodlands Within The Rural
Settlement Area

FIGURE: 4.7.5

DATE: February 2016

4.7.2.1.7 Significant Wildlife Habitat

Within the RSA, the preliminary NHS was reviewed to confirm the inclusion of Significant Wildlife Habitat as defined by the City of Hamilton (2012, 2014):

Areas where plants, animals and other organisms live and find adequate amounts of food, water, shelter and space needed to sustain their populations. Wildlife habitat is significant where it is ecologically important in terms of features, functions, representation, or amount and contributes to the quality and diversity of a Natural Heritage System. Significant wildlife habitat areas are defined as consisting of one or more of the following:

- (a) Critical habitat areas that provide for seasonal concentrations of animals;
- (b) Wildlife movement corridors;
- (c) Rare vegetation communities or specialized habitats for wildlife; and/or
- (d) Habitats for species of conservation concern including provincially and federally threatened, endangered, special concern species, and locally rare species.
- (e) MNR identifies criteria, as amended from time to time for the foregoing.

The RSA has limited potential to function as Significant Wildlife Habitat as it is dominated by residential land use and common culturally influenced habitats (including agriculture). The NHIC has no records of Significant Wildlife Habitat from within the Greenville RSA (or the Greenville Subwatershed Study Area) and none was identified within the RSA by Ecoplans Limited (2006) or Natural Resources Solutions Incorporated (2007, 2011) during field surveys.

Within the RSA, Significant Wildlife Habitat is most likely located within the Core Areas of the preliminary NHS as revised above. However, to ensure the inclusion of Significant Wildlife Habitat in the refined NHS (e.g. lands outside of the preliminary NHS), Aquafor Beech Limited further assessed the potential presence in the RSA of Significant Wildlife Habitat as defined by MNR (2000). In the opinion of Aquafor Beech Limited, the following eight (8) types of Significant Wildlife Habitat are potentially present in the RSA:

- Habitat for area sensitive species;
- Forests providing a high diversity of habitats;
- Foraging areas with abundant mast;
- Old growth or mature forest stands;
- Cliffs;
- Seeps and springs;
- Amphibian woodland breeding ponds; and
- Habitats for species of conservation concern.

Each of these eight (8) types of Significant Wildlife Habitat is discussed in greater detail below.

The Mid-Spencer Creek/Greenville Subwatershed Study Faunal Inventories Report completed by Ecoplans Limited (**Appendix G**) contains supplemental information on Significant Wildlife Habitat for the greater Greenville Subwatershed Study Area.

Habitat for Area Sensitive Species

The MNR (2000) describes habitat for area sensitive species as follows:

Some wildlife species require large areas of suitable habitat for their long-term survival. This seems to be particularly true for larger mammalian carnivores such as gray wolf, lynx, and fisher. On a smaller scale, many birds require substantial areas of suitable habitat for successful breeding and their populations decline when habitat becomes fragmented and reduced in size. Over time, competitive species, predators, and nest parasites (primarily the brown-headed cowbird) reduce productivity of these birds...

The larger and least fragmented forest stands within a planning area will support the most significant populations of forest-area sensitive birds. Forests should cover about 30% of the regional landscape to provide minimal conditions for these species and there should be several large woodlands (30 to 100+ ha) present to provide enough suitable forest-interior bird nesting habitat. Forests comprised of a mainly closed canopy of large trees and a variety of vegetation layers tend to support a greater diversity of species because of the broader range of habitats they provide...

For area-sensitive grassland bird species, large grassland areas are required as they are more likely to be buffered from disturbance, more likely to increase the distance of nesting habitat to woody edges (thereby reducing nest predation and parasitism), and provide more opportunities for nesting. An endangered species in Ontario, the Henslow's sparrow, appears to prefer tall-grass fields of at least 30 ha. Sufficient habitat is required for several breeding pairs before the habitat will be used, although one pair of birds may only use an area of 1 to 2 ha in size. Even more common grassland species such as bobolinks, savannah sparrows, and grasshopper sparrows are more abundant as breeding birds in grasslands of at least 10 ha. Grasslands with a variety of vegetation structure, density, and composition tend to support a greater diversity of grassland nesting birds because different species require different nesting habitat.

Protecting significant woodlands as suggested in the Natural Heritage Section of the Provincial Policy Statement, will also maintain some critical habitat for area-sensitive forest species. The significant woodland component is closely linked to this important significant wildlife habitat. The largest, least-disturbed grasslands might also be identified for their value to area-sensitive grassland species and provision of further landscape diversity. Each planning area should protect representative examples of these habitats.

Seven (7) species recorded by Ecoplans Limited (2006) from the RSA are considered by the MNR (2000) to be area sensitive. The majority of these species were recorded in Habitat Unit 11, which has subsequently been developed and is unlikely to support these species at present. The remaining species were found in the Spencer Gorge ESA (which contains interior forest habitat as measured 100m from the forest edge) and in Crook's Hollow (part of the Christie Stream Valley ESA). These area sensitive species and the Habitat Units they occupy are further discussed in the Mid-Spencer Creek / Greenville Subwatershed Study Faunal Inventories Report (Ecoplans 2006) in **Appendix G**.

Forests Providing a High Diversity of Habitats

The MNR (2000) describes forests providing a high diversity of habitats as follows:

Forests with a variety of vegetation communities and dominant tree cover are most likely to have the highest diversity of plant and wildlife species. Complexes of upland and wetland habitats also may have high diversity.

Many species of wildlife such as squirrels, and cavity-nesting birds like pileated woodpeckers, barred owls, and wood ducks use large trees with hollow cavities to bear and raise young. These trees can also provide resting or loafing habitat for mammals like raccoon and porcupine. Older forest stands usually have more cavity trees and support a higher diversity of species than young stands. Best sites contain a mix of large and small tree cavities. Cavities in living trees are generally better than those in dead trees because they last longer. Some tree species make better cavity trees than others do. For example, species such as red pine or white birch break down very quickly and are of limited use for cavities.

Very tall trees, such as white pine, that grow above the main canopy (supercanopy trees), provide important habitat for birds of prey, that may use these trees for nests, roosts, and hunting perches.

Forests with numerous vertical layers of vegetation also contribute greatly to site diversity because of the many microhabitats they provide for wildlife. In addition, an abundance of ground structure such as large fallen logs and leaf litter further enhances a site's ability to support wildlife. Fallen logs are essential habitat for some salamanders, members of the weasel family, certain woodpeckers, and many invertebrate species.

The NHS as revised above incorporates as Core Natural Heritage Features eight (8) of the thirteen (13) forested areas within the RSA because they constitute Significant Woodlands as defined by the City of Hamilton (2012). Three (3) of the five (5) remaining woodlands identified in the RSA (i.e. Woodlands 5 south, 7, and 12) are included as Core Natural Heritage Features of the NHS under other criteria (e.g. habitat of Endangered, Threatened, or Special Concern species). The remaining two (2) woodlands, Woodlands 1 and 2, are highly influenced by

human activity and do not provide a high diversity of habitats for wildlife. These woodlands, located in the western portion of the RSA, are included in the revised NHS as Linkages. In summary, all woodlands within the RSA are included within the NHS.

Foraging Areas with Abundant Mast

The MNR (2000) describes foraging areas with abundant mast as follows:

Over 75 species of birds and mammals consume fruit and nuts within the Great Lakes-St. Lawrence forest region and abundant supplies can enhance their survival and productivity. In summer and fall, black bears search for areas of abundant food. The most important areas are forests containing numerous large beech and red oak trees that supply the energy-rich beechnuts and acorns that bears prefer. These sites are especially important in the fall because the animals are building fat reserves for hibernation. Other animals such as white-tailed deer that remain active throughout winter may also rely on supplies of nuts to build fat reserves. In summer, in more open areas, large patches of berry-producing shrubs (blueberries, raspberries, huckleberries) provide important feeding habitat for a variety of animals and birds. Black cherry, mountain ash, and apple trees also may attract wildlife. If these food sources are unavailable or drastically reduced, bears may wander into human communities in search of food.

Within the RSA, candidate foraging areas with abundant mast are located within the preliminary NHS. ELC community data from Dwyer et al. (2003) indicates that mast-producing species such as oaks (*Quercus* spp.), black cherry (*Prunus serotina*), choke cherry (*P. virginiana*), serviceberry (*Amelanchier* spp.) and raspberries (*Rubus* spp.) are present within the Spencer Gorge ESA (ELC polygons 1 [CUT1-5 complex], 2, 3, 4, 5, and 10), the Christie Stream Valley ESA (ELC Polygons 11, 14, 21, 23, 26, F7-2, and F8-1), and the Dundas Valley ESA (general vegetation community information indicates that beech (*Fagus grandifolia*), black cherry and oaks are present). Within areas outside of the preliminary NHS (including areas within the revised NHS), significantly sized mast-producing forest stands and extensive patches of berry-producing shrubs are not present.

Old Growth or Mature Forest Stands

The MNR (2000) describes old growth or mature forest stands as follows:

Although definitions of old-growth forest vary depending on tree species, generally these sites are characterised by having a large proportion of trees in older age classes, many of them over 120 to 140 years old. Other features include: a broad spectrum of tree sizes with some very tall trees, an uneven canopy with scattered gaps due to fallen trees and large limbs, and abundant fallen logs in various stages of decomposition. These older,

relatively undisturbed forests usually support a high diversity of wildlife species. Old-growth forest stands are rare throughout the province, particularly in southern Ontario, largely due to past logging practices. Most candidate sites will likely be small stands that have experienced little or no forestry management.

Within the RSA, old growth or mature forest stands are entirely located within the preliminary NHS. ELC community data from Dwyer et al. (2003) indicates that one old growth and several mature forest communities are present within the Christie Stream Valley ESA (ELC polygons 7, 14, 16, 18, 20, 21, 22, 23 [old growth], 26, F7-2, and F8-1) and Spencer Creek ESA (ELC polygons 2, 3, 4, 7, 10, 11, 12, 13, and 14).

Cliffs

The MNR (2000) describes cliffs as follows:

Cliffs are dominated by bedrock with sharp or variably broken edges and a vertical relief greater than three meters. Average soil depth is usually less than 15 cm and restricted to places where organic debris and mineral material can accumulate such as in cracks, hollows, and along the upper rim.

Many cliffs may be locally significant because of their value as specialised habitat for wildlife such as nesting peregrine falcons or rare plants such as purple-stemmed cliff brake. During summer, large numbers of turkey vultures may roost on secluded cliff faces.

Many cliffs have areas where groundwater seepage creates a thin film of water running over the rock surfaces. Often unique floral and insect species are associated with these specialised habitats. Some surfaces contain a diverse assemblage of algae and fungi that live within the crystalline structure of the rock.

Cliffs composed of limestone, dolostone and/or sandstone are most prevalent along the Niagara Escarpment, from Manitoulin Island to near Niagara-on-the-Lake. Granite cliffs are more widespread in the province, but metamorphic/granitic cliffs are only found on the Frontenac axis in Site Region 6E.

Cliffs within the RSA are contained within the Spencer Gorge ESA and the Christie Stream Valley ESA (which contains a seepage area, as described in the succeeding subsection), and are included as a Core Natural Heritage Feature of the preliminary NHS. There are no cliffs outside of the preliminary NHS within the Greensville Subwatershed Study Area, including that within the RSA.

Seeps and Springs

The MNR (2000) describes seeps and springs as follows:

Seepage areas, springs, and small intermittent streams provide habitat for numerous uncommon species such as northern two-lined salamander and ginseng. In winter, wild turkey and white-tailed deer also forage in these areas because of the lack of snow on the ground. Often these areas support a high diversity of plant species. Many of the most important seeps are in forested areas where the canopy maintains cool, shaded conditions.

The refined NHS incorporates as Core Areas most forested areas within the RSA. As such, the most important seeps and springs will be included within the RSA and therefore protected. During the decommissioning of the Crook's Hollow Dam, construction crews uncovered a seepage/spring during the construction of a bypass channel. This feature has since been incorporated into the rehabilitation design of the decommissioned dam, as seen below in . This seepage area is within the preliminary NHS, and is therefore included in the revised NHS. In addition, a small seep was observed within Woodland 12 during vegetation community surveys conducted by Aquafor Beech Limited in 2014. Woodland 12 is considered a significant woodland and is included as a Core Area within the NHS.



Figure 4.7.6: Seepage area uncovered within the decommissioned Crook's Hollow Dam site. (photo courtesy of the Hamilton Conservation Authority)

Amphibian Woodland Breeding Ponds

The MNR (2000) describes amphibian woodland breeding ponds as follows:

These ponds are used for breeding by several species of frogs and salamanders. Such water bodies may be small and ephemeral but nevertheless, important to local amphibian populations, especially if they provide the only suitable habitat in the area.

The best breeding ponds are unpolluted, and contain a variety of vegetation structure, both in and around the edge of the pond, for egg-laying and calling by frogs. The best adjacent habitats are closed-canopy woodlands with rather dense undergrowth that maintains a damp environment. Moist fallen logs are another important habitat component required by salamanders. Sites with several ponds and/or ponds close to creeks are especially valuable.

As noted above, the refined NHS incorporates as Core Areas most forested areas within the RSA. Amphibian calling surveys undertaken by Ecoplans Limited indicate that amphibians were present in Woodlands 4, 5, and 6 in 2006. Later amphibian calling surveys conducted in 2014 by Aquafor Beech Limited indicate that amphibians are present in Woodlands 5, and 6. A brief overview of each woodland under consideration is provided below:

Woodland 4

In 2006, Spring Peeper (*Pseudacris crucifer*) was recorded at Amphibian Monitoring Station 1, at the southernmost extent of Woodland 4. Small shallow ponds are present in the north east portion of this woodland, and may serve as habitat for amphibians outside of dry years. This woodland also contains wetland habitats (see

Figure 4.7.4). Woodland 4 is included as part of the revised NHS due to its proximity/connectivity to a significant natural area, proximity to water, and presence of rare species (i.e. Butternut); accordingly, this woodland is protected.

Woodland 5

In 2006, Spring Peeper and American Toad (*Bufo americanus*) were recorded at Amphibian Monitoring Station 55, in the south lobe of Woodland 5. As there are no ponds in Woodland 5, it is likely that these frogs were using the semi-permanent watercourse as a breeding site. Since 2006, lands within and north of this woodland have been developed. Presently, potential habitat for amphibians consist of the aforementioned watercourse and a SWM pond. During 2014 surveys, spring peeper, American toad, western chorus frog (*Pseudacris triseriata*), wood frog (*Lithobates sylvaticus*), green frog (*Lithobates clamitans*), and gray treefrog (*Hyla versicolor*) were recorded (Station 55).

Woodland 6

In 2006, Spring Peeper and Green Frog were recorded at Amphibian Monitoring Station 48b, within Woodland 6. Spring Peeper was recorded at the same station in 2014. Woodland 6 contains a small pond feature (**Figure 4.7.7**), as confirmed by field work conducted by Natural Resource Solutions Incorporated (2011), that support amphibian breeding. Due to the low numbers of species and low calling code recorded in this area, it is the opinion of Aquafor Beech Limited that Woodland 6 is not a significant breeding site for anurans. Based on its size and proximity to water, Woodland 6 is considered a Significant Woodland and is accordingly protected as a Core Natural Heritage Feature of the revised NHS.



Figure 4.7.7: Small wetland feature within Woodland 6

Within the RSA, amphibian woodland breeding ponds located in woodlands outside of those included in the revised NHS are not present. Based on the limited amount of amphibians found calling during monitoring, it is highly unlikely that the three locations described above would be considered significant in the planning area. For further discussion on amphibian calling surveys completed in 2006, see **Appendix G**. For surveys completed in 2014, see **Section 4.6.2.2**.

Habitats for Species of Conservation Concern

According to the Significant Wildlife Habitat Technical Guide (MNR 2000), Species of Conservation Concern are defined as those listed as Special Concern by the Committee on the Status of Species at Risk in Ontario (COSSARO); species listed as Endangered, Threatened, or of Special Concern by COSEWIC; species with Global ranks of G1 – G3; species with Sub-national/Provincial ranks of S1-S3; or locally rare species (i.e., species that are rare within the City of Hamilton).

Analysis of Species of Conservation Concern within the RSA

The first step in identifying habitat for species of conservation concern is to determine which species are present in the area. **Section 4.6.3** lists the sixty four (64) Species at Risk and Species of Conservation Concern recorded within the Greenville Subwatershed Study Area, including the RSA, per the above-listed sources. Of the forty eight (48) species of conservation concern known or suspected to occur within the Mid-Spencer/Greenville Subwatershed study area (listed in **Table 4.6.23** of **Section 4.6.3**), nineteen (19) species of conservation concern have previously been recorded within or adjacent to the RSA. In addition, one (1) national Species at Risk, and one (1) locally rare species have been identified through primary field investigations within the RSA.

Note: A number of provincially rare species previously recorded from the Greenville RSA are also designated Endangered, Threatened or Special Concern by COSSARO. These species are not considered further as their habitat is addressed by Aquafor Beech Limited under recommendations for COSSARO-designated species at risk, Table 4.7.3.

However, the extent to which the revised NHS incorporates this habitat, and the availability of other areas of potentially suitable habitat beyond the RSA, varies from species to species. Accordingly, twenty one (21) species of conservation concern can be divided into the following three categories, as detailed below.

As specific locality data is unavailable for some of these species records, Aquafor Beech Limited used background information and the results of previous studies to determine (i) the habitat requirements of these species and (ii) the availability of potentially suitable habitat for these species in the RSA. **Table 4.7.6** summarizes the results of this assessment.

Category 1 – the revised NHS incorporates most of the vegetation communities in the RSA that provide potentially suitable habitat for these species. It is unlikely that this species occurs outside of the revised NHS.

Category 2 – the revised NHS incorporates some of the vegetation communities in the RSA that provide potentially suitable habitat for these species; however, potential habitat for this species also occurs outside of the revised NHS. Accordingly, surveys at subsequent planning stages are recommended.

Category 3 – the revised NHS incorporates some of the vegetation communities in the RSA that provide potentially suitable habitat for these species; however, the same vegetation communities occur in the greater Greenville Subwatershed Study Area and immediately adjacent lands and have similar or greater potential to function as habitat for these species.

As mentioned previously, the majority of the RSA is occupied by residential development. The highest quality habitats within the RSA are contained within the preliminary NHS. It is unlikely that majority of the provincially rare flora listed below occur in the disturbed natural and semi-natural habitats outside of the preliminary NHS. However, most of the potential habitat for the below mentioned provincially rare flora is contained within the revised NHS. One of the provincially rare insect listed below (i.e. Monarch) is confirmed within the RSA, however specific habitat recommendations for all provincially rare insects listed below are not required due to the ubiquity of foraging habitat within the Greenville Subwatershed Study Area and the City of Hamilton as a whole.

Table 4.7.6: Assessment of Species of Conservation Concern Previously Recorded within the Greensville Rural Settlement Area

Taxon	Species	Conservation Rank	Habitat Requirements	Availability of Potentially Suitable Habitat in the RSA	Category
Plants	Downy Yellow False Foxglove <i>Aureolaria virginica</i>	S1	Occurs in dry, open, deciduous woods (MNR 2000); grows best as a hemi-parasite on members of the white oak group (King 1989).	The preliminary NHS incorporates all oak woodlands identified in the RSA (limited to ESAs). The revised NHS incorporates all other deciduous woodlands as Core Natural Heritage Features except for Woodlands 1 and 2, which are considered woodland linkages. Woodlands 1 and 2 do not likely provide habitat for Downy Yellow False Foxglove as they are maple-dominated and highly disturbed. Downy Yellow False Foxglove was not found in 2011 surveys completed by Natural Resource Solutions Incorporated.	1
	White-tinged Sedge <i>Carex albicans</i> var. <i>albicans</i>	S3	Occurs in open sandy or rocky woods (MNR 2000).	Within the RSA, sandy-loam soils are present under Woodlands 6, 7, and 8. Woodland 8, a naturalizing coniferous plantation, does not provide suitable habitat for White-tinged Sedge. Woodlands 6 and 8 are also unlikely candidates for White-tinged Sedge habitat due to the degree of disturbance present. All three woodlands were surveyed by Natural Resource Solutions Incorporated in 2011; White-tinged Sedge was not found. This species was previously recorded within the Spencer Gorge ESA.	1
	Eastern Few-fruited Sedge <i>Carex oligocarpa</i>	S3	Occurs in dry deciduous woods, woodland edges, banks, and alvar woodlands (MNR 2000); usually in calcium-rich loams on rocky slopes above streams. Sensitive to disturbance. (http://labs1.eol.org/pages/1123782?category_id=17)	The revised NHS incorporates the largest, least disturbed deciduous woodlands near streams in the RSA. Woodlands 1 and 2, included in the NHS as linkages, occur on loam soils and are highly disturbed; accordingly these woodlands likely do not provide habitat for this disturbance-sensitive sedge.	1
	Ribbed Sedge <i>Carex virescens</i>	S3	Occurs in dry and mesic hardwood forests and forest edges (MNR 2000).	Previously located in the Dundas Valley ESA (Dwyer et al. 2003), it is unlikely that Ribbed Sedge is present in the revised NHS due to the disturbed nature of Woodlands 1 through 11. However, it would be prudent to include spring botanical surveys as part of development applications adjacent to deciduous woodlands within the RSA.	2
	Northern Hawthorn <i>Crataegus dissona</i>	S3	Occurs in old fields, poorly managed pastures, fencelines and roadsides (MNR 2000).	All suitable habitats within the RSA have not been surveyed for Northern Hawthorn. It is recommended that suitable habitat (e.g. hedgerows) be surveyed for this species at subsequent planning stages.	2
	Green Violet <i>Hybanthus concolor</i>	S2	Occurs in rich, wet-mesic floodplain forests and mesic forests over limestone (MNR 2000).	The preliminary NHS incorporates all high-quality wet-mesic and floodplain forests. Marginal habitat (e.g. Woodland 5) was surveyed by Natural Resource Solutions Incorporated (2011) and did not result in Green Violet sightings.	1
	Tulip Tree <i>Liriodendron tulipifera</i>	Locally Rare	Typically occurs in deep, rich, moist soils.	One tulip tree was located in Woodland 6 by Natural Resource Solutions Incorporated in 2011. As the species was planted, it is the opinion of Aquafor Beech Limited that this observation is not considered significant in the context of the NHS.	n/a
	Slim-flowered Muhly <i>Muhlenbergia tenuiflora</i>	S2	Occurs in rich deciduous forest and riparian areas, often on rocky or sandy soil (MNR 2000).	The revised NHS incorporates all rich deciduous woodlands and riparian areas.	1
	Jack's Hybrid Poplar <i>Populus x jackii</i>	S2	A hybrid between <i>P. deltoides</i> and <i>P. balsamifera</i> , <i>P. x jackii</i> is typically found in floodplains, riparian areas, and other wet places (Farrar 1995).	The revised NHS incorporates all floodplains, wetlands and riparian areas.	1

Taxon	Species	Conservation Rank	Habitat Requirements	Availability of Potentially Suitable Habitat in the RSA	Category
	Bristly Buttercup <i>Ranunculus hispidus</i> var. <i>hispidus</i>	S3	Occurs in dry, open sandy woods, savannahs (MNR 2000).	Within the RSA, sandy-loam soils are present under Woodlands 6, 7, and 8. All three woodlands were surveyed by Natural Resource Solutions Incorporated in 2011; no occurrences of Bristly Buttercup were observed.	1
	Black Bulrush <i>Scirpus atrovirens</i>	Locally Rare	Occurs in wetland habitats, including riparian areas.	This species was identified in several locations within Wetland 2 by Natural Resource Solutions Incorporated in 2011. Wetland 2 has been incorporated into the NHS as a core area. It is possible that this species exists in wetlands, including riparian areas, elsewhere in the RSA.	2
	Rue Anemone <i>Thalictrum thalictroides</i>	S3	Occurs in deciduous woods and rocky outcroppings (MNR 2000).	Previously located in the Spencer Gorge ESA (Dwyer et al. 2003), it is unlikely that Rue Anemone is present in the revised NHS due to the disturbed nature of Woodlands 1 through 11. However, it is recommended that spring botanical surveys be required as part of development applications adjacent to deciduous woodlands within the RSA to ensure development does not impact this sensitive species.	2
	Perfoliate Bellwort <i>Uvularia perfoliata</i>	S1	Perfoliate Bellwort occurs in deciduous forests and thickets with acid-neutral soils (Flora North America Vol. 26 Pages 148, 150). Perfoliate Bellwort also occurs in rich, mesic woodlands; dry oak-pine woods, and thickets (MNR 2000).	Nature Counts surveys (Dwyer et al. 2003) did not locate Perfoliate Bellwort within the RSA. The revised NHS incorporates most of the woodland and thicket communities in the RSA. Similarly, surveys conducted by Natural Resource Solutions Incorporated (2007 and 2011) did not result in documented occurrences of this species. Due to the disturbed nature of the woodlands and thickets outside of the preliminary NHS, it is highly unlikely that Perfoliate Bellwort is present within the revised NHS.	1
Birds	Carolina Wren <i>Thryothorus ludovicianus</i>	Locally Rare	Carolina Wren is a Carolinian species which nests in residential areas, buildings in wooded areas, and deciduous woodlands (Peck and James 1987).	Smith (2014) lists Carolina Wren as rare and local in Hamilton. Carolina Wren was recorded within the Spencer Gorge ESA as part of the Nature Counts NAI (Schwetz 2014). The species was also recorded in the same area by Aquafor Beech Limited in 2014 (WSU 26). This species was not recorded elsewhere in the RSA. Given the habitat requirements for this species, it is possible that Carolina Wren occurs outside of the NHS.	2
Amphibians	Western Chorus Frog <i>Pseudacris triseriata</i>	S3; nationally Threatened	Western Chorus Frog habitat consists of forest openings around woodland ponds, and also damp meadows, marshes, bottomland swamps, as well as temporary ponds in open areas including on occasion urban ponds. In order to breed successfully, ponds must have at least 10cm of water and be devoid of predatory fish (Bolton 2013).	COSEWIC considers the Great Lakes-St. Lawrence population of Western Chorus Frog to be a Threatened species nationally. This species is not listed as at risk under the Ontario ESA. Western Chorus Frog was recorded in 2014 at amphibian monitoring stations 48c and 55. At both of these monitoring stations, frogs were heard calling from within or on lands directly adjacent to storm water management ponds. Due to the anthropogenic nature of these features, Aquafor Beech Limited did not include them within the NHS. However, it is recommended that context-appropriate surveys and, if necessary, temporary relocation efforts take place prior to SWM pond maintenance. For this reason, these SWM ponds are illustrated in Figure 9.2.3 .	2
Insects	Blue-tipped Dancer <i>Argia tibialis</i>	S3	The Blue-tipped Dancer inhabits small wooded sandy stream with slow to moderate current, less often larger rivers. The presence of stream riffles is unimportant to this species. This species is more often found in forested streams, but is also found in urban degraded streams (Paulson 2011).	According to the 2014 Hamilton NAI (Curry 2014), this species is severely restricted in Hamilton, occurring only on Spencer Creek just upstream of the Christie Reservoir. The entire Christie Stream Valleys is included within the NHS within the RSA, as are all watercourses. Accordingly, future surveys for this species are not recommended.	1
	Unicorn Clubtail <i>Argomphus villisipes</i>	S2S3	Unicorn Clubtail occurs at vegetated and unvegetated mud-bottomed lakes and ponds, including beaver ponds and ponds in rural and urban areas, such as farm ponds and storm water management ponds (Curry 2014; Paulson 2011).	According to the 2014 Hamilton NAI this species' range and abundance has increased dramatically, and it "can be expected at almost any farm dugout or storm water management pond in Hamilton" (Curry 2014). While all wetlands within the RSA have been included within the NHS, storm water management ponds within the RSA have not. It rests upon the City of Hamilton to determine whether SWM ponds supporting this species can be included within the NHS.	2

Taxon	Species	Conservation Rank	Habitat Requirements	Availability of Potentially Suitable Habitat in the RSA	Category
	River Bluet <i>Enallagma anna</i>	S2	As its name suggests, the River Bluet occupies streams and small rivers mostly in open country but also with wooded riparian borders (Paulson 2011).	River Bluet was previously recorded in the Christie Stream Valley. This species' continental range is expanding and it may become more common. All watercourses have been included within the NHS. Accordingly, specific management recommendations for this species are not required at this time.	1
	Dion Skipper <i>Euphes dion</i>	S3	The Dion Skipper habitat consists of marshes dominated by sedges. Only a few sedge species are known foodplants; in Hamilton, Lake Sedge (<i>Carex lacustris</i>) is likely the usual foodplant (Van Ryswyk 2014).	Dion Skipper was recorded in the Christie Stream Valley during Nature Counts surveys (Schwetz 2014). Within the RSA, suitable habitat for this species (i.e. sedge marshes) are not present outside of the preliminary NHS. All wetlands are included within the recommended NHS within and outside of the RSA. Accordingly, specific management recommendations for this species are not required at this time.	1
	Giant Swallowtail <i>Papilio cresphontes</i>	S3	Adults are often found in open woodlands and nearby fields. In Ontario, larvae are found on Hop Tree (<i>Ptelea trifoliata</i>) and Northern Prickly-ash (<i>Zanthoxylum americanum</i>) (Wormington and Lamond 2003; Layberry et al. 1998).	Natural Resource Solutions Incorporated (2011) recorded one Giant Swallowtail in Woodland 8. This species has also been recorded within the Dundas Valley ESA in 1989 (Wormington and Lamond 2003), and in multiple Habitat Units surveyed by Ecoplans Limited (2006). Wormington and Lamond site the recent recolonization of the Hamilton Area as part of a northern expansion of this Carolinian species. Host plant Northern Prickly-ash is common and widespread throughout Hamilton, while Hop Tree has only been recorded in Cootes Paradise (Goodban 2003). Foraging habitat for this species is present throughout the Greensville Subwatershed Study Area and Hamilton. Accordingly, specific management recommendations are not required at this time.	3
	Hickory Hairstreak <i>Satyrium caryaevorum</i>	S3	Adults are usually associated with deciduous woodlands, where it is easiest to find on milkweeds and White Sweet Clover alongside the woods. In Ontario, larvae are primarily reared on Hickory species (<i>Carya</i> spp), but also on Walnut species (<i>Juglans</i> spp.), Red Oak (<i>Quercus rubra</i>), White Ash (<i>Fraxinus americana</i>), and Hawthorn species (<i>Crataegus</i> sp.) (Wormington and Lamond 2003; Layberry et al. 1998).	Hickory Hairstreak was previously recorded in the Dundas Valley ESA (Dwyer 2003) and more recently in the Spencer Gorge ESA and Christie Stream Valley ESA (Schwetz 2014). Suitable habitat for this species is present throughout the Greensville Subwatershed Study Area. As foraging and host plants are common and widespread throughout the Greensville Subwatershed Study Area and Hamilton, no specific management recommendations are required at this time.	3

¹S-Ranks (provincial)

Provincial (or Subnational) ranks are used by the Natural Heritage Information Centre (NHIC) to set protection priorities for rare species and natural communities. These ranks are not legal designations. Provincial ranks are assigned in a manner similar to that described for global ranks, but consider only those factors within the political boundaries of Ontario.

S1 Critically Imperiled—Critically imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.

S2 Imperiled—Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.

S3 Vulnerable—Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

S4 Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 Secure—Common, widespread, and abundant in the nation or state/province.

S#S# Range Rank —A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community. Ranges cannot skip more than one rank (e.g., SU is used rather than S1S4).

4.7.2.1.8 Sand Barrens, Savannahs, and Tallgrass Prairie

Sand barrens, savannahs (with the exception of cultural savannahs), and tallgrass prairies are provincially rare vegetation communities that constitute Key natural Heritage Features of Core Natural Areas in the City of Hamilton's NHS. The City of Hamilton (2012, 2013) defines these vegetation communities as follows:

Sand Barrens: means land (not including land that is being used for agricultural purposes or no longer exhibits *sand barrens* characteristics) that:

- a) Has sparse or patchy vegetation that is dominated by plants that are:
 - i. Adapted to severe drought and low nutrient levels; and
 - ii. Maintained by severe environmental limitations as drought, low nutrient levels and periodic disturbances such as fire;
- b) Has less than 25 per cent tree cover;
- c) Has sandy soils (other than shorelines) exposed by natural erosion, depositional process or both; and
- d) Has been further identified, by the Ministry of Natural Resources or by any other person, according to evaluation procedures established by the Ministry of Natural Resources, as amended from time to time (Greenbelt Plan, 2005).

Savannah: means land (not including land that is being used for agricultural purposes or no longer exhibits *savannah* characteristics) that:

- a) Has vegetation with a significant component of non-woody plants, including tallgrass prairie species that are maintained by seasonal drought, periodic disturbances including fire, or both;
- b) Has from 25 per cent to 60 per cent tree cover;
- c) Has mineral soils; and
- d) Has been further identified, by the Ministry of Natural Resources or by any other person according to evaluation procedures established by the Ministry of Natural Resources, as amended from time to time (Greenbelt Plan, 2005).

Tallgrass Prairies: means land (not including land that is being used for agricultural purposes or no longer exhibits tallgrass prairie characteristics) that:

- a) Has vegetation dominated by non-woody plants, including tallgrass prairie species that are maintained by seasonal drought, periodic disturbances such as fire, or both;
- b) Has less than 25 percent tree cover;
- c) Has mineral soils; and
- d) Has been further identified, by the Minister of Natural Resources or by any other person, according to evaluation procedures established by the Ministry of Natural Resources, as amended from time to time (Greenbelt Plan, 2005).

Within the RSA, the preliminary NHS was reviewed to confirm the inclusion of the above three vegetation communities. Cultural savannahs were not included as Core Natural Heritage Features in the NHS because: a) tallgrass prairie species are absent in cultural savannahs within the Greenville Subwatershed Study Area, and b) cultural savannahs are the result of human disturbance and do not reflect a naturally-occurring vegetation type. Sand barrens, savannahs, and tallgrass prairies are absent from the Greenville Subwatershed Study Area.

4.7.2.1.9 Alvars

Within the Greenville Subwatershed Study Area (including the RSA), the preliminary NHS was reviewed to confirm the inclusion of alvars as defined by the City of Hamilton (2013):

Naturally open areas of thin or no soil over essentially flat limestone, dolostone, or marble rock, supporting a sparse vegetation cover of mostly shrubs and herbs (Greenbelt Plan, 2005).

Alvars constitute Key Natural Heritage Features of Core natural Areas in the City of Hamilton's NHS. Several alvar vegetation communities are present within the Greenville Subwatershed Study Area. Most are included within ESAs (e.g. Donald Farm Complex (Dwyer, 2003), Hayesland Alvar (Dwyer, 2003 and Ecoplans, 2006), Christie Stream Valley (Ecoplans, 2006)) and are protected within the NHS.

Two (2) alvars containing four (4) alvar/rock barren community types were identified by Natural Resource Solutions Incorporated in 2011 and include:

1) RBSA1 – Alvar Shrub Rock Barren (inset photo)

This community is located on the northwest corner of Middletown Road and Concession 4 West, and has been included as a Core Natural Heritage Feature in the Greenville NHS. This community was also identified as an alvar by Ecoplans (2006) (Wildlife Survey Unit #2).



2) RBTB2 – Non-calcareous Treed Rock Barren, with RBO – Open Rock Barren and MEMR2 – Dry-Fresh Non-Calcareous Bedrock Mixed Meadow inclusions (inset photo, foreground).



These rock barren communities are located on the northwest corner of Brock Road and Concession 4 West, and have been included as a Core Natural Heritage Feature in the Greenville NHS. These communities were also identified as an alvar by Ecoplans (2006) (Wildlife Survey Unit #18).

Wildlife survey work completed by Ecoplans (2006) noted that Wildlife Survey Units 1, 2, 7, 16, 17, 18, 20, and 21 contain alvar habitat either partially or wholly. Wildlife Survey Units 2 and 18 were classified using ELC by NRSI in 2011, as described above. Wildlife Survey Units 20, 21, and 22 are contained within the Hayesland Alvar ESA, while Wildlife Unit 7 is contained within the Christie Stream Valley ESA. Accordingly, these four units are included in the Greenville NHS as Core Natural Heritage Features by virtue of their designation as ESAs. Wildlife Survey Units 16, and 17 were classified by Aquafor Beech Limited in 2006 as Cultural Thicket vegetation communities. Alvar habitat types identified in Ecoplans' Wildlife Survey Unit 1 were classified by Aquafor Beech Limited in 2006 as Cultural Meadow and Cultural Thicket vegetation communities. Accordingly, these units were included in the Greenville Natural Heritage System as Linkages.

Alvars are not present within the RSA.

4.7.2.2 Key Hydrologic Features

4.7.2.2.1 Permanent and Intermittent Streams

The City of Hamilton (2012, 2013), in keeping with the definitions provided by the Greenbelt Plan (2005), defines permanent and intermittent streams as follows:

Permanent Stream: means a stream that continually flows in an average year.

Intermittent Streams: means stream-related watercourses that contain water or are dry at times of the year and are more or less predictable, generally flowing during wet seasons of the year but not the entire year, and where the water table is above the stream bottom during parts of the year.

As both permanent and intermittent streams receive the same level of protection under the City of Hamilton Official Plans (2012, 2013), differentiation between the two types of streams is not contained within this report. Streams are discussed in **Section 4.5**, and mapped in **Figure 4.5.1–Figure 4.5.3** and **Figure 4.7.2**.

4.7.2.2.2 Lakes and their Littoral Zones

The City of Hamilton (2012, 2013) defines lakes and littoral zones as follows:

Lake means any inland body of standing water, usually fresh water, larger than a pool or pond or a body of water filling a depression in the earth's surface (Greenbelt Plan, 2005).

Littoral Zones means the shallow water areas surrounding the outer boundary of a *lake*, which is usually a highly productive zone.

Definitions for pools and ponds are not provided in the City of Hamilton Official Plans (2012, 2013). For the purposes of this study, Aquafor Beech Limited defines ponds and pools as:

a permanent standing body of water that is sufficiently shallow to allow light penetration to the bottom sediments adequate to potentially support photosynthesis of higher aquatic plants over the entire bottom (Wetzel, 2001).

Aquafor Beech Limited also recognises that the above definition for ponds and pools would, in some cases, meet the definition of a marsh according to the Ontario Wetland Evaluation System (MNR, 1993) and the Ecological Land Classification for Southern Ontario (ELC) (Lee et al., 1998). Furthermore, under the ELC, a pond or pool could also meet the definition of a Shallow Water ecosite, while a lake meets the definition of an Open Water ecosite.

Lakes and their littoral zones were not found within the Mid-Spencer/Greenville Subwatershed outside of the Preliminary Natural Heritage System and accordingly are not discussed further in the report.

4.7.2.2.3 Seepage Areas and Springs

The City of Hamilton (2012), in keeping with the definition provided by the Greenbelt Plan (2005), defines seepage areas as follows:

sites of emergence of groundwater where the water table is present at the ground surface.

Seepage areas are discussed under Significant Wildlife Habitat, **Section 4.7.2.1.7**.

4.7.2.2.4 Wetlands

Wetlands located within the Mid-Spencer/Greenville Subwatershed study area were incorporated into the NHS. As previously stated, vegetation communities within the RSA were investigated in detail and vegetation communities outside of the RSA were classified using a combination of air photo interpretation, reconnaissance site visits (including roadside assessments), and detailed investigations. Wetlands within the RSA are discussed above under **Section 4.7.2.1.3**.

4.7.2.3 Local Natural Areas Within the Rural Settlement Area

4.7.2.3.1 Environmentally Significant Areas (ESA)

The Preliminary NHS was reviewed to confirm the inclusion of Environmentally Significant Areas (ESA) as defined by the City of Hamilton (2012, 2013):

Locally significant areas that meet any one of the following criteria:

- a) The area is a good representative of a biotic community characteristic of the natural landscapes of the City and not adequately represented in existing protected areas or the area is a good representative of pre-settlement biotic community;
- b) There are biotic communities that are rare in the City, Province, or Canada;
- c) The area is a large natural area (20 hectares or more in size); it may be sufficiently large to provide habitat for species requiring large habitat areas;

- d) There is habitat for species considered significant in the City, Province, or Canada;
- e) The site fulfills a significant hydrological function (groundwater recharge or discharge, ground or surface water quality, or flood attenuation);
- f) The site contains a significant earth science feature (distinctive and unusual landform);
- g) There is a high diversity of native species or biotic communities;
- h) The area provides *essential* habitat for the continuation of species; for example, significant areas of species concentrations, areas *essential* for certain stage of the life cycle, source areas for species;
- i) There are significant seasonal concentrations of wildlife;
- j) The area acts as a link between natural areas or functions as a corridor for wildlife;
- k) The area is in good natural condition, with few non-native species, particularly invasive non-natives; or
- l) The area contains significant *fish habitat*.

ESAs within the Greensville Subwatershed Study Area falling either wholly or partially under the Rural Official Plan (2012) area include:

- o Hayesland Swamp (ESA #13)
- o Hayesland Alvar (ESA #28)
- o Donald Farm Complex (ESA #29)
- o Spencer Gorge (ESA #30)
- o Christie Stream Valley (ESA #31)
- o Dundas Valley (ESA #41)

ESAs within the Greensville Subwatershed Study Area falling either wholly or partially under the Urban Official Plan (2013) area include:

- o Spencer Gorge (ESA #30)
- o Christie Stream Valley (ESA #31)
- o Dundas Valley (ESA #41)

Of these, the Dundas Valley ESA, Spencer Gorge ESA, and Christie Stream Valley ESA are located within the Greensville Rural Settlement Area.

All of the above ESAs have been included in Core Natural Areas mapping as part of the Greensville NHS. It is noted that significant portions of the Hayesland Alvar contain active aggregate extraction operations.

4.7.2.3.2 Unevaluated wetlands

Wetlands located within the Mid-Spencer/Greensville Subwatershed study area were incorporated into the NHS. As previously stated, vegetation communities within the RSA were investigated in detail and vegetation communities outside of the RSA were classified using a combination of air photo interpretation, reconnaissance site visits (including roadside assessments), and detailed investigations. Wetlands within the RSA are discussed above under **Section 4.7.2.1.3**.

4.7.2.3.3 Earth Science Areas of Natural and Scientific Interest

According to Hamilton's Rural Official Plan, two (2) Earth Science ANSIs are present within the Greensville Subwatershed Study Area.

The Spencer Creek Bedrock Gorge Earth Science ANSI, which overlaps with the Provincially Significant Spencer Gorge Escarpment Valley Life Science ANSI, is located in the eastern portion of the Rural Settlement Area, and is encompassed within the boundaries of the Spencer Gorge Environmentally Significant Area (ESA).

An additional Regionally Significant Earth Science ANSI is present within the Greensville Subwatershed Study Area: The Guelph and Rockport Formation ANSI is located north of Crook's Hollow Road within the Christie Stream Valley ESA. It is noted that the Guelph Amabel Formations ANSI, located to the north east of the RSA within an active aggregate extraction area (**Figure 7.2.1**, has recently had its ANSI designation removed (C. Plosz, personal communication). Accordingly, it is not included in the NHS.

The Spencer Creek Bedrock Gorge and Guelph and Rockport Formation ANSIs are included as Local Natural Areas under Core Natural Heritage Features of the NHS.

4.7.3 Review and Refinement of Linkages within the Rural Settlement Area

The City of Hamilton (2012, 2013) defines linkages as landscape areas that connect natural areas. Linkages may include the following:

- Woodland linkages (e.g. small woodlands);
- Other natural vegetation types (e.g. meadows, old field, thickets); and
- Streams and watercourses that connect Core Areas.

The City of Hamilton’s definitions of (i) woodland linkages and (ii) other natural vegetation types vary between the Urban and Rural Official Plans (**Table 4.7.7**).

Table 4.7.7: City of Hamilton definitions of woodland linkages and other natural vegetation types.

Term	Definition – Urban Official Plan	Definition – Rural Official Plan
Woodland linkage	Any natural or planted wooded area of any size or composition of 0.5 ha or more in size that either connects or lies within 100 m of a Core Area.	Any natural or planted wooded area of any size or composition that either connects or lies within 100 m of a Core Area.
Other natural vegetation types	Any meadow, thicket, or old field at least 0.5 ha in size that connects Core Areas or is situated within 100 m of a Core Area.	Any meadow, thicket, or old field that connects Core Areas or is situated within 100 m of a Core Area.

In concert with applying the definitions above, Aquafor Beech Limited used the Core Areas and Linkages identified by the City of Hamilton (i.e. the Preliminary NHS) and those identified by Aquafor Beech Limited as described above as a baseline reference for informing the potential candidacy of linkages within the study area. As stated previously, the Greenville RSA received a greater level of detailed field studies and analysis than the greater subwatershed study area. The following linkage analysis focuses on lands within the RSA.

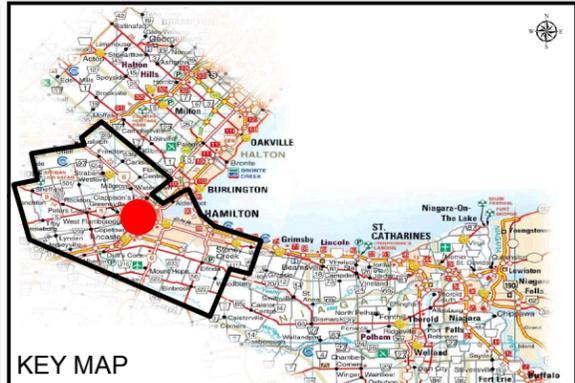
Aquafor Beech Limited reviewed vegetation communities characterized by Aquafor Beech Limited (2006, 2014) and Natural Resources Solutions Incorporated (2007, 2011), identifying five (5) Woodland Linkages (as illustrated in **Figure 4.7.8**) and nine (9) Linkages of Other Natural Vegetation Types not previously mapped by the City of Hamilton. **Figure 4.7.8** illustrates these Linkages.

The incorporation of Woodland Linkages 1, 2, 3, and 4; and nine (9) Linkages of Other Natural Vegetation Types in the refined NHS was reviewed based on the City of Hamilton's definitions, as outlined in **Table 4.7.7**. **Table 4.7.8** describes the extent to which the thirteen (13) Woodland Linkages and Linkages of other natural vegetation types were incorporated in the refined NHS.

Streams and watercourses within the RSA were excluded from the linkage analysis because they qualify as Core Areas.

Table 4.7.8: Linkage Assessment for the Greensville Rural Settlement Area.

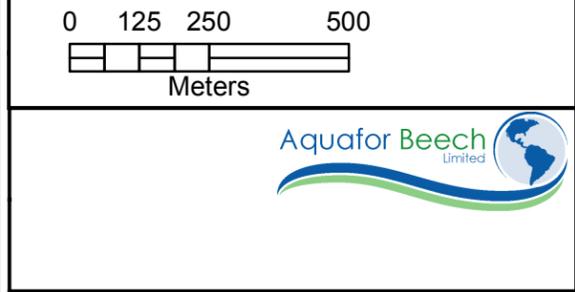
Designation	Composition	Incorporated in Refined NHS?	Rationale	
			Located within 100m of a Core Area?	Comments
Woodland Linkages				
Woodland Linkage 1	Deciduous Hedgerow	Yes	Yes	Provides a linkage between two Core Natural Heritage Features.
Woodland Linkage 2	Cultural Woodland (CUW)	Yes	Yes	Adjacent to a Core Natural Heritage Feature.
Woodland Linkage 3	Dry-Fresh Sugar Maple Deciduous Forest (FOD5)	Yes	Yes	Located within 100 m of a Core Natural Heritage Feature (Wetland 1).
Woodland Linkage 4	Dry-Fresh Oak-Maple-Hickory Deciduous Forest (FOD2)	Yes	Yes	Part of a habitat matrix comprised of woodlands and thickets. Habitat to the south of the existing nearby dwelling has been altered as a result of present development.
Other Natural Vegetation Types (ONVT)				
ONVT Linkage 1	Dry-Moist Old Field Meadow (CUM1-1)	Yes	Yes	Part of a habitat matrix comprised of wetlands, woodlands, and meadows.
ONVT Linkage 2	Dry-Moist Old Field Meadow (CUM1-1)	Yes	Yes	Part of a habitat matrix comprised of wetlands, woodlands, and meadows.
ONVT Linkage 3	Dry-Moist Old Field Meadow (CUM1-1)	Yes	Yes	Located between Woodland 4 and residential development; functions as a buffer to Wetland 4 and Woodland 4.
ONVT Linkage 4	Dry-Moist Old Field Meadow (CUM1-1)	Yes	Yes	Surrounded by Woodland 4; provides opportunities for wildlife movement. Likely contributes to the habitat value of Woodland 4.
ONVT Linkage 5	Dry-Moist Old Field Meadow (CUM1-1)	Yes	Yes	Surrounded by Woodland 4; provides opportunities for wildlife movement. Likely contributes to the habitat value of Woodland 4. Functions as a buffer to Wetland 4.
ONVT Linkage 6	Dry-Moist Old Field Meadow (CUM1-1)	Yes	Yes	Surrounded by Woodland 4; provides opportunities for wildlife movement. Likely contributes to the habitat value of Woodland 4.
ONVT Linkage 7	Staghorn Sumac Thicket (THDM2-1)	Yes	Yes	Functions as a linkage between four (4) Core Natural Heritage Features (Woodlands 7, 8, and 9; Wetland 6).
ONVT Linkage 8	Dry-Fresh Forb Meadow (MEFM1)	Yes	Yes	Functions as a buffer between Brock Road and Woodland 6.
ONVT Linkage 9	Dry-Fresh Forb Meadow (MEFM1)	Yes	Yes	Functions as a buffer between Brock Road and Woodland 7.



- KEY MAP**
- LEGEND:**
- Rural Settlement Area
 - Mid-Spencer Creek Subwatershed Boundary
 - Linkage
 - Woodland Linkage
 - Other Natural Vegetation Type

NOTES:

Woodlands shown on this map are outside of the Preliminary Natural Heritage System.



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**GREENSVILLE
SUBWATERSHED STUDY**

Linkages Assessment Within The Greensville
Rural Settlement Area

FIGURE: 4.7.8

DATE: February 2016

4.7.4 Summary of Core Natural Heritage Features and Linkages within the Revised Natural Heritage System

This section brings together the results of the assessment of Core Natural Heritage Features and Linkages as characterized above in **Sections 4.7.2** and **4.7.3**. Detailed illustrations of the Core Natural Heritage Features and Linkages within the greater Mid-Spencer/Greenville Subwatershed study area and the RSA are provided below.

Study Zones

Due to the large size of the greater Mid-Spencer/Greenville Subwatershed study area, in order to provide detailed figures the study area was divided into three Zones: Zone A, Zone B, and Zone C. These Zones are described below and are illustrated in **Figure 4.7.9**. The descriptions below also provide a brief policy overview.

Zone A consists of the lands north of Concession 4 West. Much of Zone A is dedicated to agricultural land uses. Aggregate extraction is also prominent on the landscape. Zone A contains significant natural heritage features and areas; moreover, existing land uses provide opportunities for ecological restoration (see **Section 9.3.5**). The entirety of Zone A is subject to the provisions of the Greenbelt Plan, Protected Countryside policies (see brief explanation under Zone C, below) (2005).

Zone B consists of the lands between Concession 4 West and Highway 5. The majority of the Zone B lands consist of agricultural land uses. Natural heritage features are most prominent in the western portion of Zone B, as represented by the Donald Farm Complex ESA and the Christie Stream Valley ESA. The entirety of Zone B is subject to the provisions of the Greenbelt Plan, Protected Countryside policies (see brief explanation under Zone C, below) (2005).

Zone C consists of the lands south of Highway 5 and includes the Greenville RSA. Lands within Zone C fall under a number of Provincial plans* including:

- Niagara Escarpment Plan: Escarpment Protection Area (EPA). the policies aim to maintain the most natural Escarpment features, cultural heritage features and enhance the landscape quality of Escarpment features. Compatible recreation, conservation and educational activities are encouraged in this designation (Niagara Escarpment Plan 2005).
- Niagara Escarpment Plan: Escarpment Natural Area. The policies for this designation aim to maintain the most natural Escarpment features, cultural heritage features and enhance the landscape quality of Escarpment features. Compatible recreation, conservation and educational activities are encouraged in this designation. (Niagara Escarpment Plan 2005).
- Niagara Escarpment Plan: Escarpment Rural Area. The policies for this designation state that Escarpment Rural Areas provide a buffer to the more ecologically sensitive

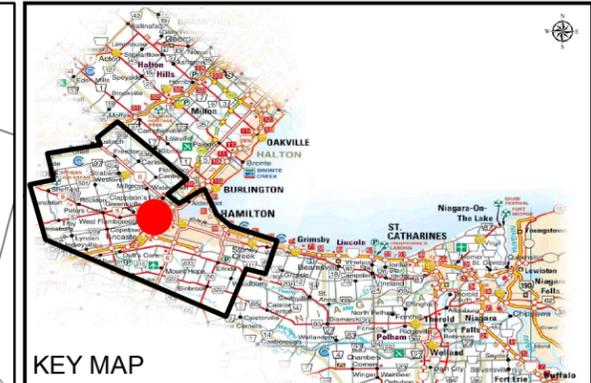
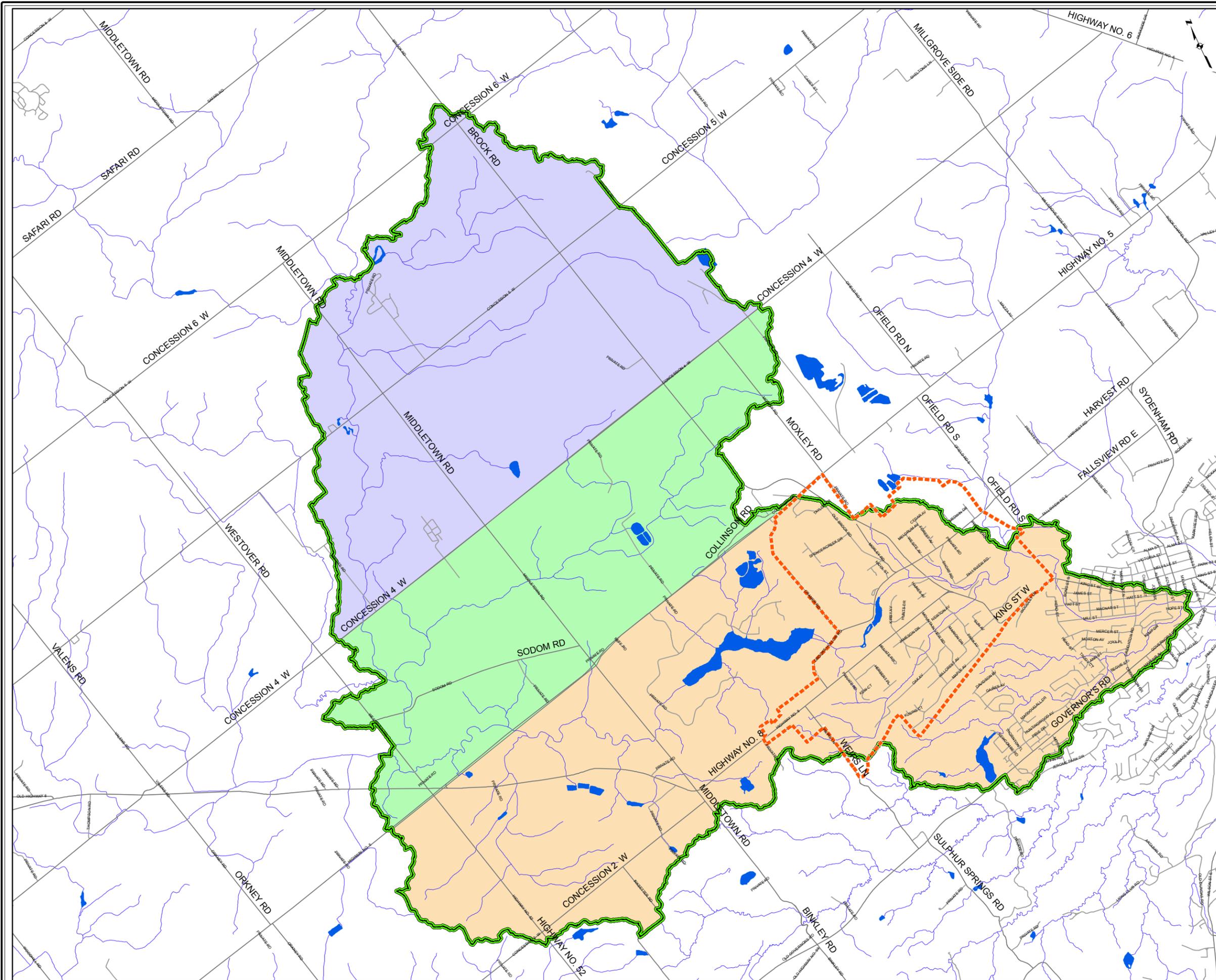
area of the Escarpment. Here the objectives seek to maintain scenic values of lands in the vicinity of the Escarpment and maintain the open landscape character by encouraging the conservation of traditional cultural heritage features. Agriculture, forestry and compatible rural land uses are supported in this designation (Niagara Escarpment Plan 2005).

- Niagara Escarpment Plan: Escarpment Minor Urban Centre. Policies associated with the Escarpment Minor Urban Centre aim to recognize, maintain, and enhance the character, function, and needs of existing minor urban areas in a way that is sustainable for the Escarpment Minor Urban Centre and the surrounding environment (Niagara Escarpment Plan 2005).
- Greenbelt Plan: Protected Countryside. Policies associated with the Greenbelt Protected Countryside aim to protect against the loss and fragmentation of agricultural lands and to permanently protect against the loss of natural heritage features while providing for a wide range of economic and social activities associated with the abovementioned features (Greenbelt Plan, 2005).

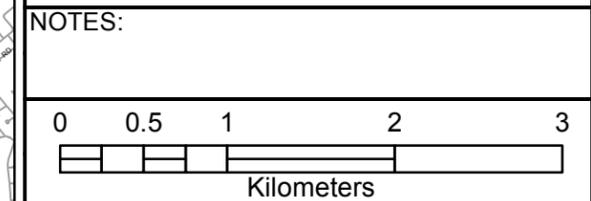
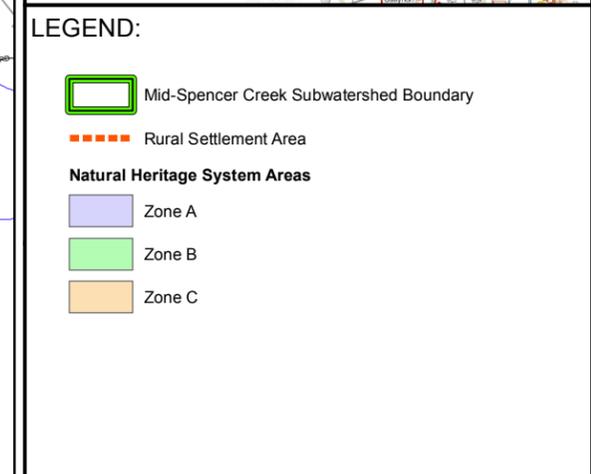
*Please note that as part of the Co-ordinated Provincial Plan Review, revisions to the current policies of the NEP and the Greenbelt Plan may be considered.

The details of the Revised NHS are illustrated as follows:

- Locations of Natural Heritage System Areas A – C, **Figure 4.7.9.**
- Details of the Revised Natural Heritage System: Zone A, **Figure 4.7.10.**
- Details of the Revised Natural Heritage System: Zone B, **Figure 4.7.11.**
- Details of the Revised Natural Heritage System: Zone C, **Figure 4.7.12.**
- Details of the Revised Natural Heritage System: Rural Settlement Area, **Figure 4.7.13**



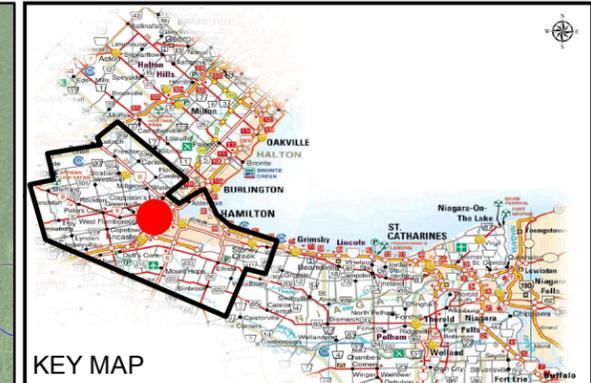
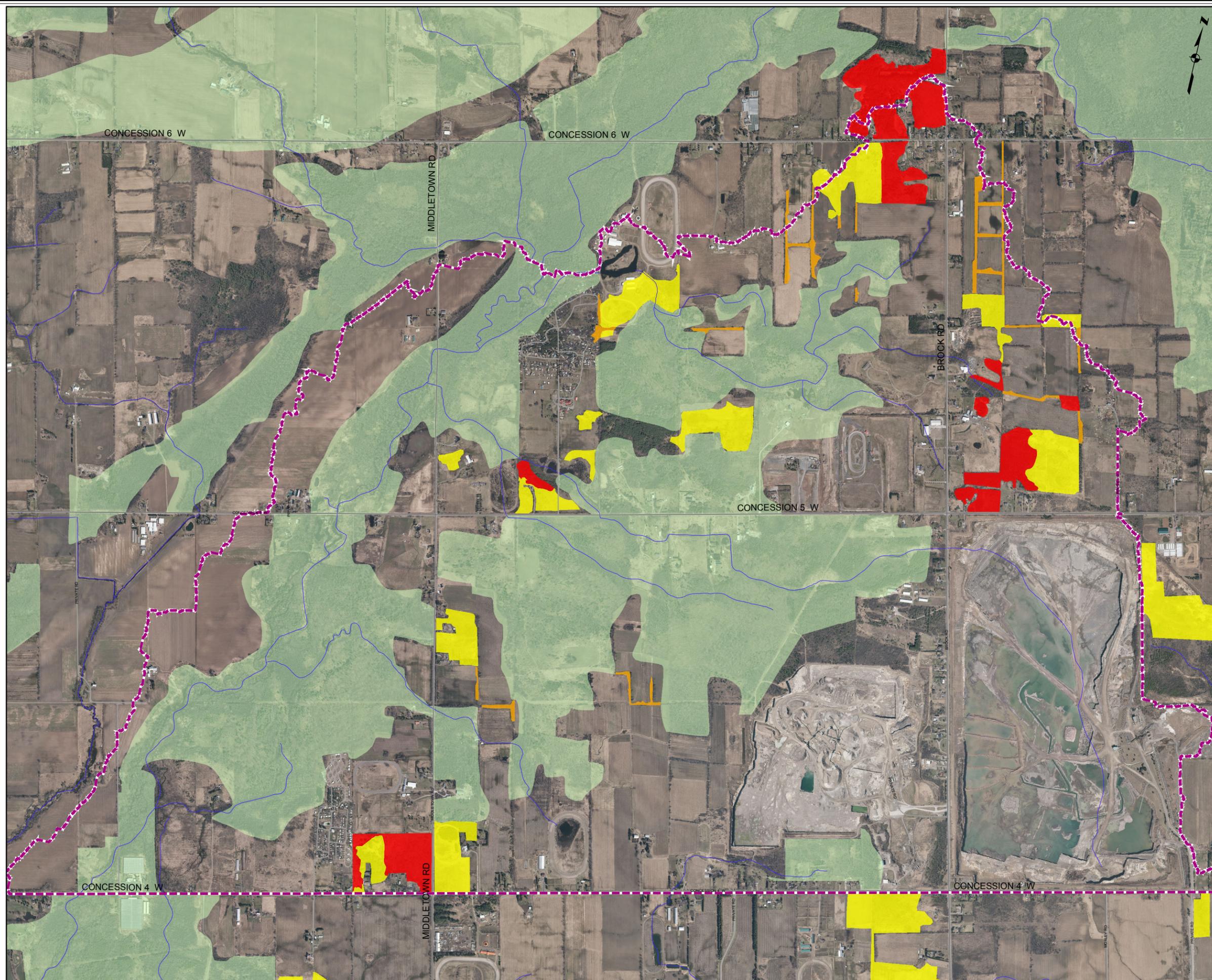
KEY MAP



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**GREENSVILLE
SUBWATERSHED STUDY**
Revised Natural Heritage System:
Zones A, B & C

FIGURE: 4.7.9
DATE: February 2016



KEY MAP

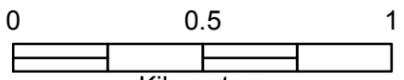
LEGEND:

-  Zone A
-  Watercourse
-  Preliminary Natural Heritage System

Revised Natural Heritage System

-  Core Areas
-  Linkages
-  Hedgerow

NOTES:
All watercourses are Core Areas



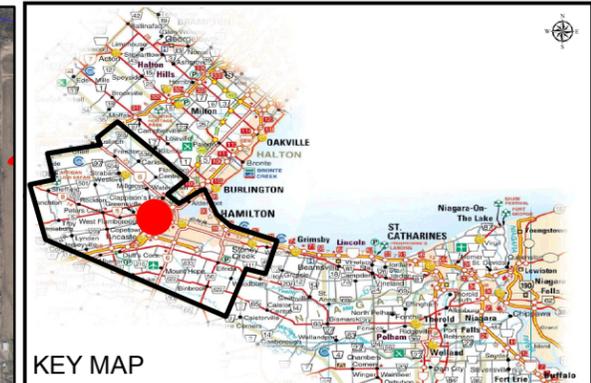
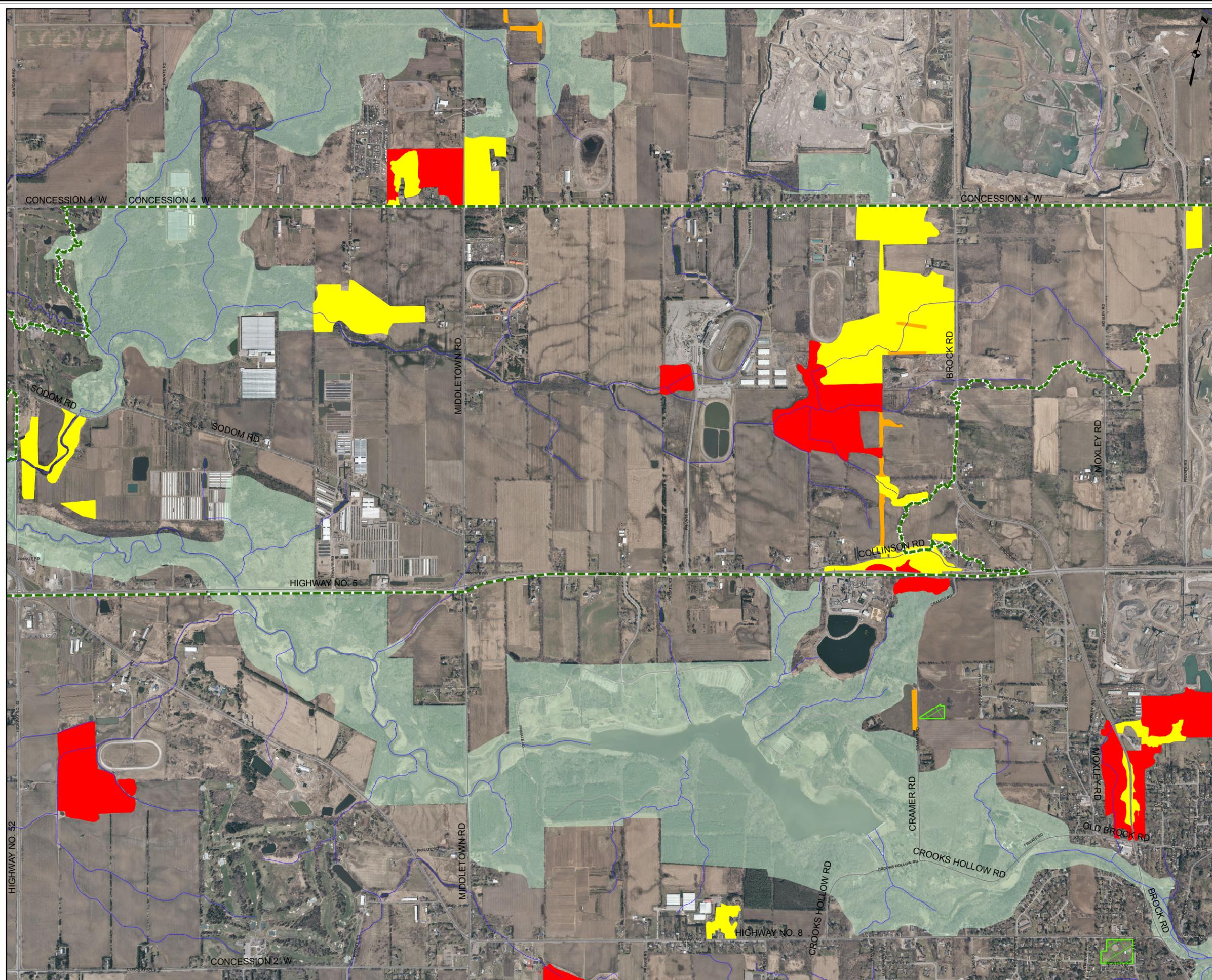


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**GREENSVILLE
SUBWATERSHED STUDY**
Revised Natural Heritage System:
Zone A

FIGURE: 4.7.10

DATE: February 2016



KEY MAP

LEGEND:

- Zone B
- Watercourse
- Parks
- Preliminary Natural Heritage System

Revised Natural Heritage System

- Core Areas
- Linkages
- Hedgerow

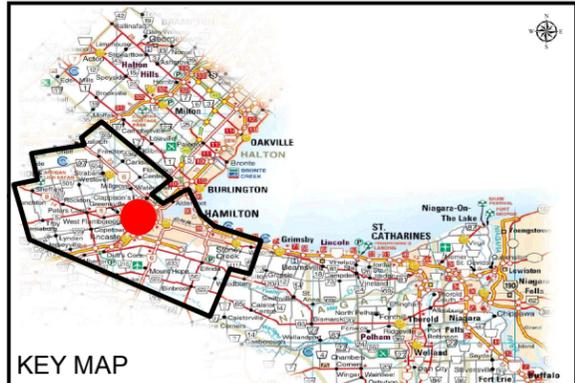
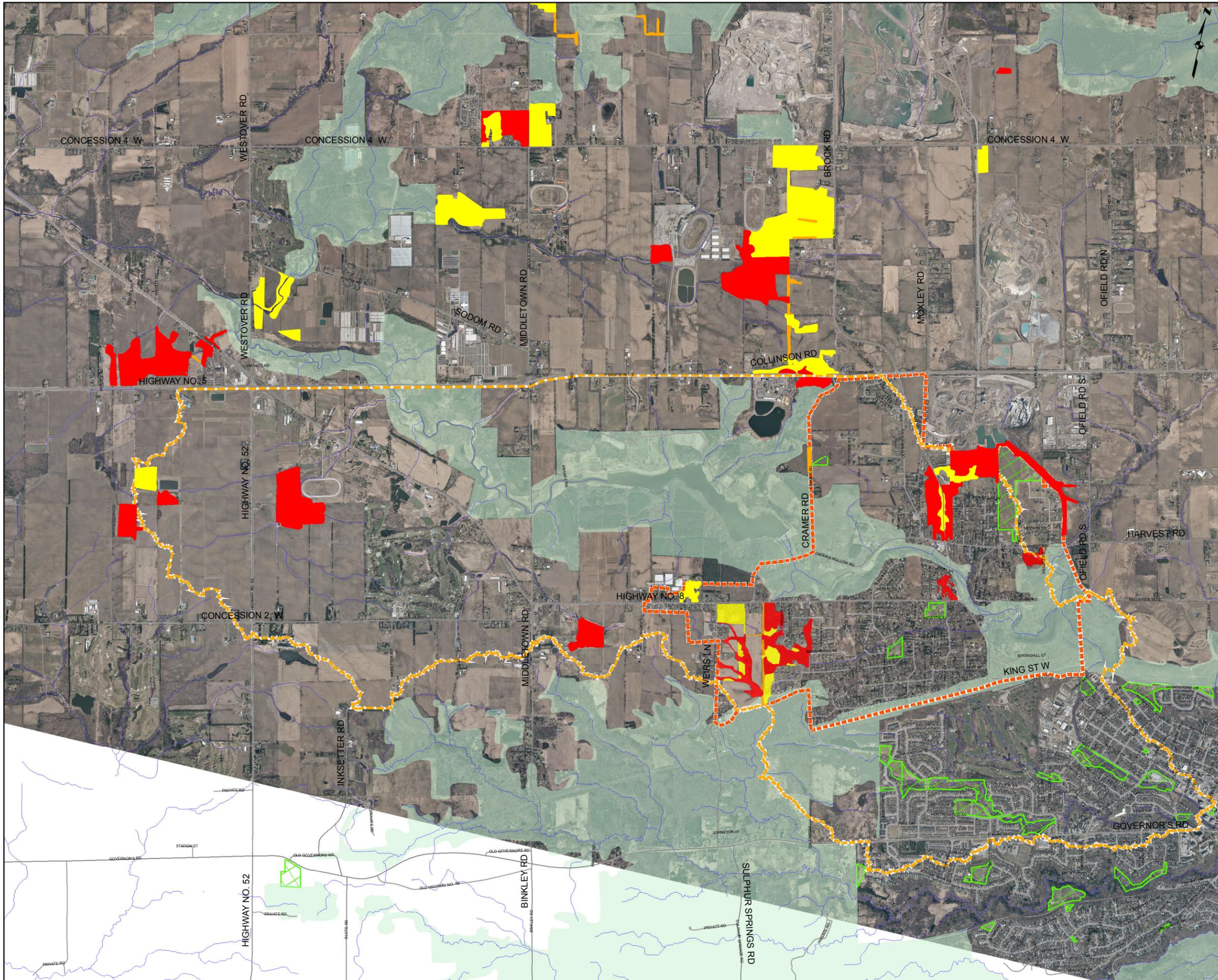
NOTES:
All watercourses are Core Areas



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**GREENSVILLE
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Revised Natural Heritage System:
Zone B

FIGURE: 4.7.11
DATE: February 2016



KEY MAP

LEGEND:

- Zone C
- Rural Settlement Area
- Watercourse
- Parks
- Preliminary Natural Heritage System

Revised Natural Heritage System

- Core Areas
- Linkages
- Hedgerow

NOTES:
All watercourses are Core Areas

0 0.5 1

 Kilometers

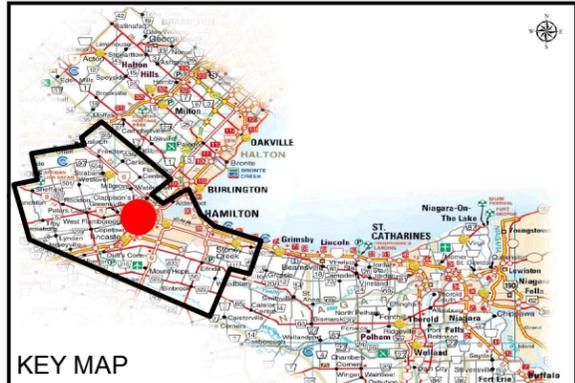
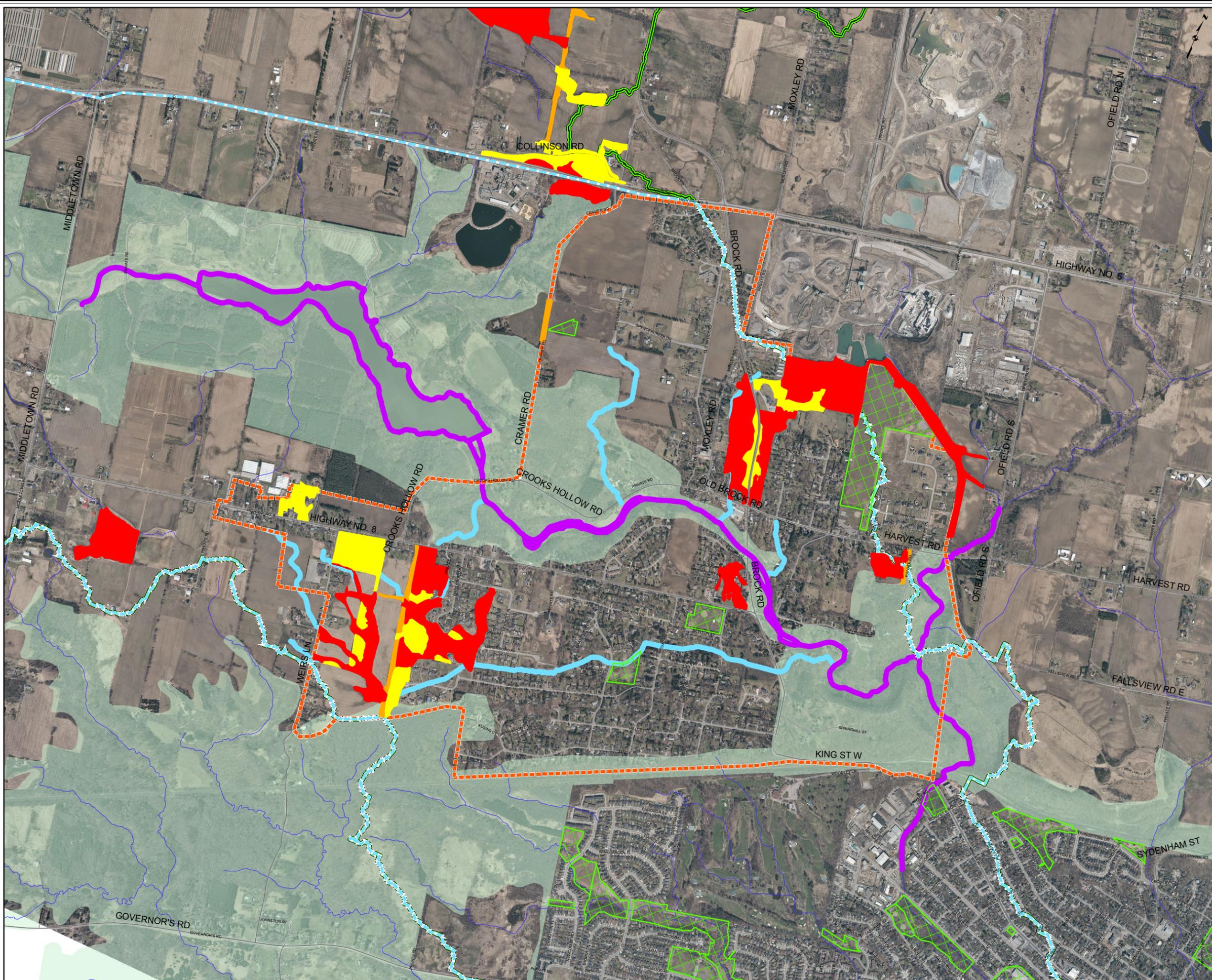


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**GREENSVILLE
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 Revised Natural Heritage System:
 Zone C

FIGURE: 4.7.12

DATE: February 2016



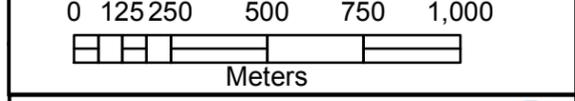
KEY MAP

LEGEND:

- Mid-Spencer Creek Subwatershed Boundary
- Rural Settlement Area
- Watercourse
- Parks
- Preliminary Natural Heritage System
- Revised Natural Heritage System**
 - Core Areas
 - Linkages
 - Hedgerow
- FishHabitat**
 - Direct Fish Habitat
 - Indirect (Contributing) Fish Habitat

NOTES:

All watercourses are considered Core Areas



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**GREENSVILLE
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Vegetation Communities within
the Rural Settlement Area

FIGURE: 4.7.13

DATE: February 2016

4.7.5 Vegetation Protection Zones

Vegetation protection zones (VPZs), sometimes referred to as buffers, are required to aid in mitigating potential adverse environmental impacts to natural features and habitats resulting from development and/or site alteration. VPZs are vegetated physical separations between natural features and development areas intended to preserve the ecological integrity of natural features and their associated processes (MNR 2010). VPZ recommendations for Core natural Heritage Features are discussed below in a general sense given the absence of a final land use plan for each developable area in the RSA. Context is of paramount importance: it is recommended that the VPZ widths and planting prescriptions outlined in this report be revisited as new information regarding potential land use becomes available. Once VPZs are determined, they become part of the NHS. VPZs are to be imposed only where new development and/or site alteration is to occur but will not affect lands which are within the study area but not being proposed for development and/or site alteration.



Many species, including Wood Frog (pictured above), rely on different habitat types throughout the year. Buffer recommendations resulting from detailed studies (i.e. an EIS) should be context-sensitive and address the habitat requirements of flora and fauna within the NHS.

Within the Greenville Subwatershed Study Area, the revised NHS was refined to incorporate preliminary vegetation protection zones consistent with the minimum requirements of the City of Hamilton's Urban and Rural Official Plans (**Table 4.7.9** and **Table 4.7.10**). At this stage in the planning process the recommended NHS, the elements of which are detailed in **Section 4.7**, are subject to the minimum VPZ requirements as defined by the City of Hamilton. The widths of these preliminary VPZ are to be reviewed at a subsequent planning stage and may be augmented (i.e. increased or decreased) based on the recommendations of an approved Environmental Impact Statement (EIS) per Policies 2.4.10 to 2.4.14 of the City's Rural Official Plan (2014).

Per the definitions provided by the City of Hamilton, VPZs are included in Natural Heritage Systems. However, in order to keep Natural Heritage maps readable, the preliminary minimum vegetation protection zones widths listed below have been excluded from maps within **Section 4.7**. However, VPZs are included in the constraints mapping contained within **Section 4.8**, below.

The 37-acre City-owned property east of Woodland 8 is currently proposed for development. The proposed Johnson Tew Park and Arboretum does not encroach into revised NHS. The park plan uses mostly native tree species and preserves the original topography, with all trails within the park are outside of the revised NHS. Immediately adjacent to Woodland 8, a native wildflower meadow is proposed. Given the low-impact nature of the proposed park, the adjacent native plantings (meadow and trees), and the timing of the project, it is recommended that the minimum VPZ requirements below be augmented/ possibly lessened in the case of Johnson Tew Park and Arboretum, subject to the completion of an appropriate study such as an EIS.

Table 4.7.9: Minimum Vegetation Protection Zone Requirements for Urban Areas as Required by the City of Hamilton (adapted from City of Hamilton 2013)

Core Natural Heritage Feature	Minimum Vegetation Protection Zone (VPZ) Requirements
Coldwater Watercourses and Critical Fish Habitat	30 m VPZ on each side of the watercourse, measured from the bankfull channel.
Warmwater Watercourse and Important and Marginal Fish Habitat	15 m VPZ on each side of the watercourse, measured from the bankfull channel.
Provincially Significant Wetlands	30 m VPZ, measured from the boundary of the wetland, as approved by the Conservation Authority or MNRF.
Locally Significant Wetlands and Unevaluated Wetlands	15 m VPZ, measured from the boundary of the wetland, as approved by the Conservation Authority or MNRF, unless an EIS recommends a more appropriate VPZ.
Woodlands	10 m VPZ, measured from the edge (drip line) of the woodland.
Significant Woodlands	15 m VPZ, measured from the edge (drip line) of the significant woodland.
ANSIs	Areas of Natural and Scientific Interest require a 15 m VPZ.
Designated Valleylands	As required by the Conservation Authority.
Significant Habitat of Threatened or Endangered Species and Significant Wildlife Habitat	The VPZ shall be determined through an EIS, dependent on the sensitivity of the feature.

Table 4.7.10: Minimum Vegetation Protection Zone Requirements for Rural Areas as Required by the City of Hamilton (adapted from City of Hamilton 2012)

Core Natural Heritage Feature	Minimum Vegetation Protection Zone (VPZ) Requirements
Permanent and Intermittent Streams	30 m VPZ on each side of the watercourse, measured from the bankfull channel.
Fish Habitat	30 m VPZ measured from either side of the top of bank or meanderbelt allowance.
Wetlands	30 m VPZ, measured from the boundary of the wetland.
Woodlands	15 m VPZ, measured from the edge (drip line) of the woodland.
Significant Woodlands	30 m VPZ, measured from the edge (drip line) of the significant woodland.
ANSIs	Areas of Natural and Scientific Interest require a 30 m VPZ.
Designated Valleylands	15 m VPZ, measured from the top of bank.

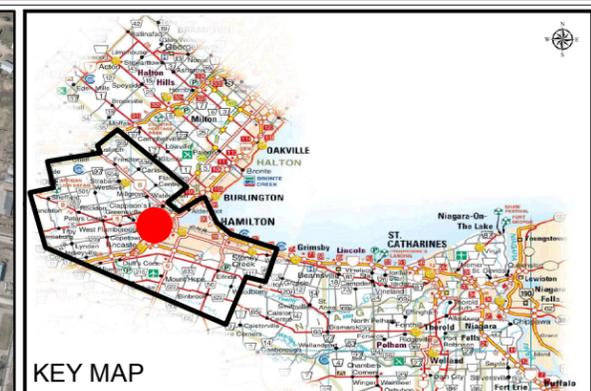
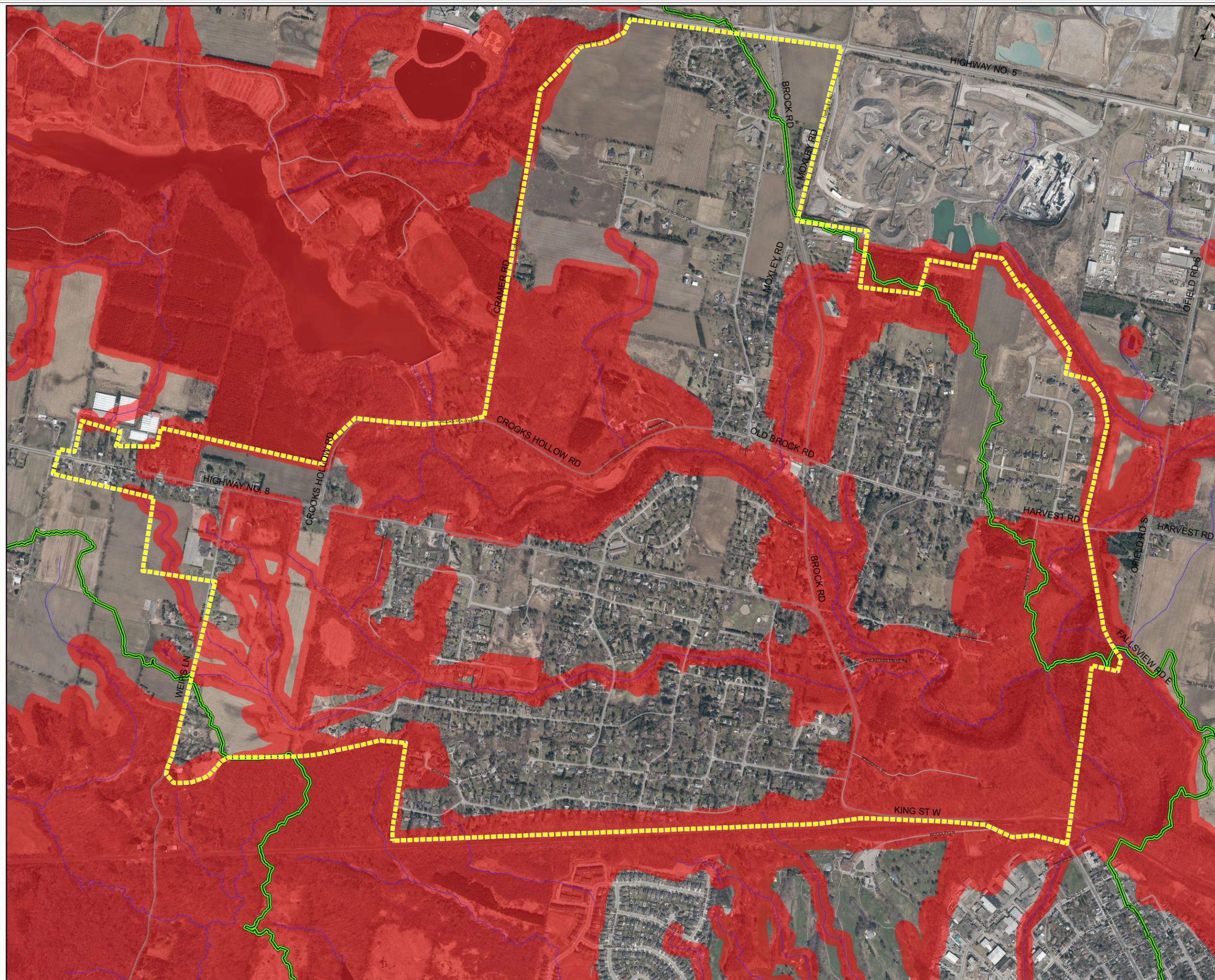
4.8 Opportunities and Constraints to Development

Constraints to development include features, functions and or policy designations that preclude, limit or shape the development of an area. The level of constraint can vary from prohibition of development to a requirement of a specific management practice(s) or remediation measures to be undertaken during implementation. At the lowest level of constraint, the application of appropriate management practices may be sufficient to allow development to proceed.

Constraints to development identified in the Mid-Spencer/Greensville Subwatershed study area consist of the Revised Natural Heritage System, its associated vegetation protection zones, and hazard lands. Hazard lands, as defined by Hamilton Conservation Authority (2011), include (i) lands within the flood plain of the Regulatory Flood as determined by Aquafor Beech Limited and (ii) lands within the erosion hazard limit. Within the RSA, hazard lands (i.e. floodplain) was identified along the Greensville Tributary from approximately the westernmost extent of Marshboro Avenue downstream to west of Hamilton Road 8. Hazard land constraints on lands outside of the RSA were not identified as part of this study and will presumably be investigated as the need arises.

Through the process of identifying the Revised Natural Heritage System, associated vegetation protection zones, and hazard lands; Aquafor Beech Limited has also identified areas within the Mid-Spencer/Greensville Subwatershed study area available to development.

Opportunities and Constraints mapping is shown in **Figure 4.8.1** and **Figure 4.8.2**, below.

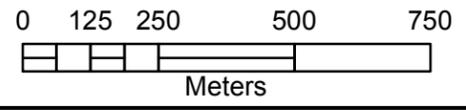


KEY MAP

LEGEND:

-  Mid-Spencer Creek Subwatershed Boundary
-  Rural Settlement Area
-  Constraints

NOTES:



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**GREENSVILLE
SUBWATERSHED STUDY**
Opportunity & Constraints to Development:
Greenville Rural Settlement Area

FIGURE: 4.8.1

DATE: February 2016

Mid-Spencer Creek /
Greenville Rural
Settlement Area
Subwatershed Study

Legend

- Watercourses
- Floodline Mapping (Aquafor Beech)
- Catchment
- Constraints
- New Development Areas

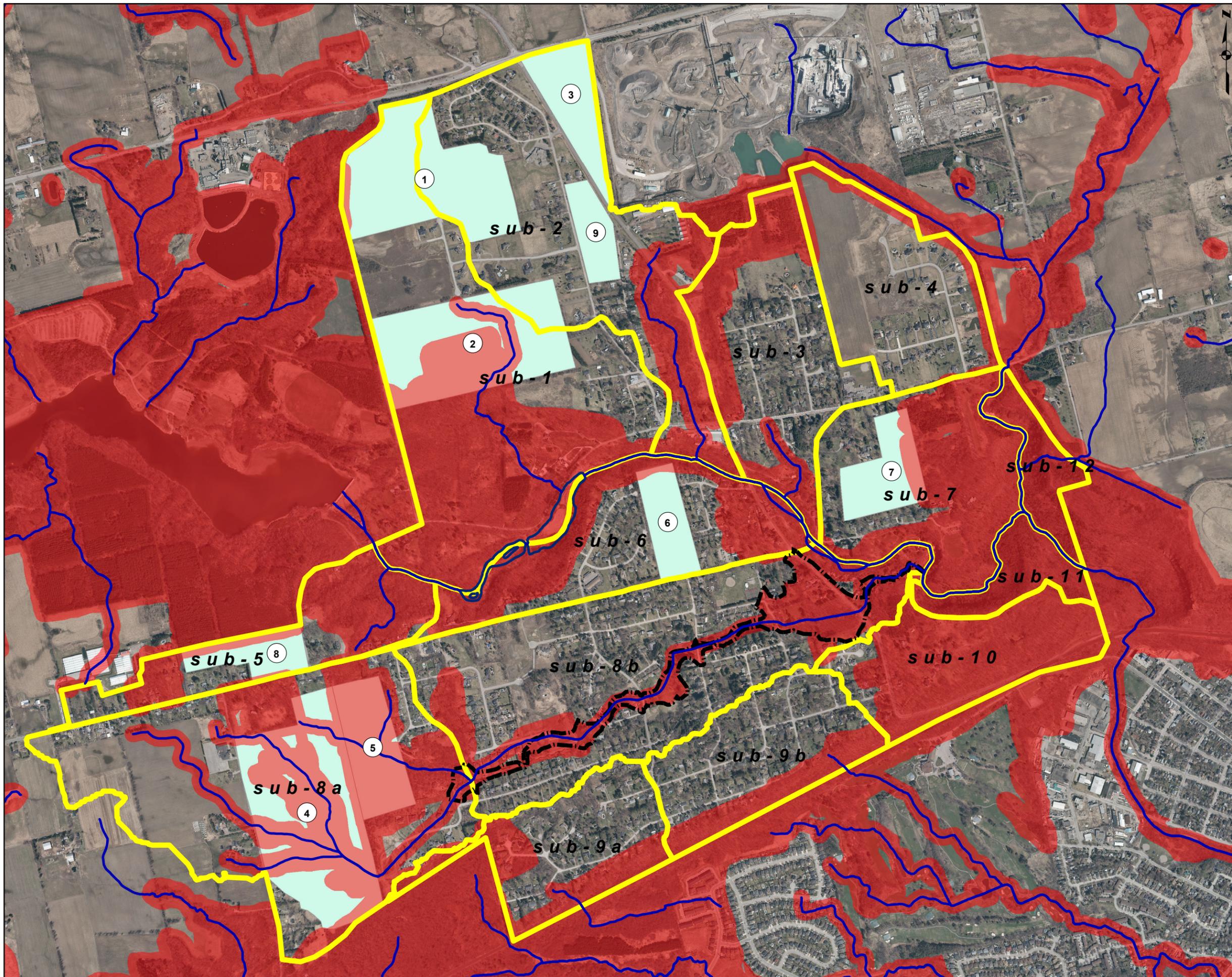


FIGURE 4.8.2

Rural Settlement Area
(New Development
and Constraints)

5 FIRST PUBLIC INFORMATION CENTRE

The first public meeting was held at the Christ Church on November 21, 2007. The public open house included:

- Presentations by the consulting team, Hamilton-Halton Watershed Stewardship Program (HHWSP) and the Ontario Rural Wastewater Centre
- A series of poster boards which defined
 - The study areas
 - Study goal, objectives and key tasks
 - The municipal Class Environmental Assessment process
 - Existing environmental conditions
 - Key findings
- Circulation of Workshop Participant Workbook.

A workshop was also held after the presentations. In the workshop individuals formed small groups and discussed the questions that were posed in the Workshop participant Workbook as noted above.

In total approximately 160 people attended the open house including City staff, members of the project team, members of the local community groups and members of the general public.

A detailed synopsis of the participant feedback, general questions, comments and concerns, response to workshop booklet questions and additional comments is provided in **Appendix M**. Provided below is an overview as to the content of the public input as well as the response to the questionnaire.

Participant Feedback

- City staff were asked if future development was going to be put on hold (including current applications). A City planner responded that he was not aware of any current applications and that this study is not a precursor to a planned development. Rather, it is a study to develop a preferred management strategy for the area, with the interest of protecting water resources to the extent possible.
- The HHWSP representative was asked why funding only applies to homes near municipal wells. It was noted that this is the first year of the program and funding is limited. The decision was therefore made to start with those residences.
- One homeowner asked how you know when your septic system is ready to be pumped. It was noted, in response, that septic systems should be pumped when they are 1/3rd full and pumped on average every 2-5 years. Other signs include sewage backing up into the basement, odour near the leaching bed or when you see wet, mushy areas near the bed.

Workshop Booklet Questions

- The features or resources that were valued the most varied and included the rural setting, birds, animals and nature in general, natural features of the Niagara Escarpment and the wells and well water
- The potential issues that were identified most frequently include quality of water for domestic consumption, quantity of water for domestic consumption, development impacts to well water quantity and quality
- Recommendations to address the key issues included development control, an open process (between the City and the community), access and recording of data, promotion of water conservation measures and assistance with respect to water cisterns and wells.
- Participants noted that they would be willing to implement (or participate in) a community liaison committee, upgrading their septic system, drill a deeper well, provide information for tracking purposes and install water conservation measures.
- Barriers to implementation included politics, cost, urban sprawl, lack of professional help and lack of regulations and inspections.
- The priority tools or information that residents would like to see included information about drilling wells, further understanding of groundwater quality and general municipal assistance

6 IMPACT ASSESSMENT

Existing environmental conditions were defined in Section 4. This Section considers the impact of future development, specifically within the Greenville RSA, where an additional 300+ units are envisaged, in addition to the 925 units already established.

The impacts will be considered without controls or measures that are considered Best Management Practices (BMP). A Best Management Practice is defined as a pro-active measure that will protect, restore, or enhance desirable environmental features. Most of these features are directly related to the sustainability of groundwater quantity and water quality.

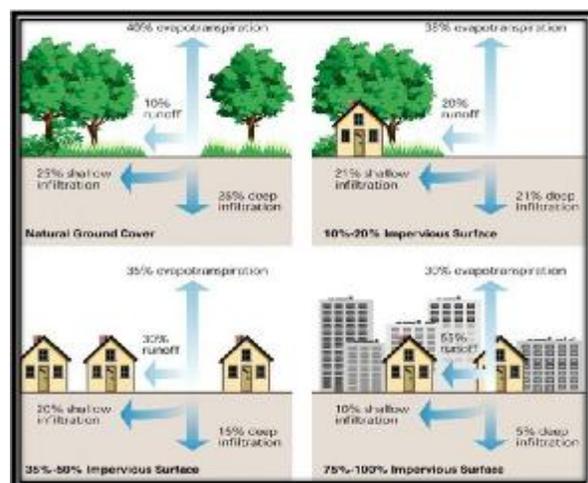
The primary drivers for impact analysis within the Greenville RSA are water quantity (problems with wells running dry) and water quality (problems related to bacteria and/or nitrates that have been documented for 30 years). There is concern that further development pressures may aggravate these problems. It is important to document the nature and causes of these potential problems before alternative strategies can be developed. These alternatives will be considered in Section 7.

6.1 Surface Water Assessment

6.1.1 Problems

As part of land use change and development, pervious land surfaces are converted to impervious surfaces. Runoff from impervious surfaces, including building rooftops, roadways, sidewalks, parking surfaces etc. reduce the volume of precipitation lost to the natural hydrologic pathways such as infiltration and evapotranspiration.

As a result, runoff volumes and peak flows are increased during precipitation events, hydrologic response times to precipitation events are reduced, base flow conditions are impaired, ground water recharge is reduced, and the fluvial geomorphic processes of erosion and deposition are altered. Watersheds with significant development are more prone to both erosion and flooding which can lead to degraded riparian habitat and infrastructure damage. The accompanying figure illustrates representative changes in the proportion of precipitation entering different flow pathways, when land use changes from native vegetation to an urban



landscape. In general, for a given storm event, the total volume of stormwater runoff reaching a stream increases 3 to 5 fold compared to rural or forested watersheds, accompanied with an increase in magnitude and duration of peak runoff and a significant decrease (greater than 50%) in infiltration.

Implications of these impacts include flooding issues, property and infrastructure damage, water quality issues resulting from surface runoff picking pollutants from land surfaces, and modifications in stream morphology due to excessive erosion and/or sedimentation. Accordingly, areas of concern under future development scenarios include:

1. **Water Balance** - The increase in impervious surfaces within the new development areas will result in the reduction in infiltration and evapotranspiration due to the reduction in permeable surfaces and natural soil and vegetation cover. Reduction in baseflow contribution to watercourses is also anticipated with specific concern in headwater and first order reaches (Discussion about infiltration deficit is included in **Section 9.2.1.1**);
2. **Water Quality** – impacts are anticipated as a result of increasing imperviousness, and changing landuse types. Among expected changes are:
 - a. Changes in pollutant loadings: including phosphorus loadings, and Total Suspended Sediment loading, and
 - b. Changes in thermal regime in receiving watercourses, consequently affecting cool water fish species;
3. **Water Quantity:**
 - a. **Flooding** – larger runoff volumes and increased peak flows are anticipated as pervious land surfaces are converted to impervious surfaces.
 - b. **Erosion** – without mitigation, the fluvial geomorphic processes of erosion and deposition will be altered and increased rates of erosion can be anticipated.

6.1.2 Surface Water Impact Assessment

Nine (9) areas were identified by the City of Hamilton for new development in conformance with the Secondary Plan Areas reported in the Official Plan. **Figure 6.1.1** shows the location of the new development areas within each subcatchment. The constraints and opportunities map (**Figure 4.8.2**) shows areas where new development is constrained because of the presence of natural heritage features including woodlots, wetlands and floodplain areas. **Figure 6.1.2** shows where the constraints are within the Rural Settlement Area.

In order to evaluate the impacts of proposed development on surface water hydrology within the study area, the SWMHYMO model was run using the characteristics of the new development including location within existing subcatchments, connection to surface water features, the increase in imperviousness. In addition, the constraints identified earlier to account for natural heritage features and floodlines were overlain to account for available space for development. **Table 6.1.1** shows coverage areas of new development within existing subcatchments.

Table 6.1.1: New Development Areas within the Rural Settlement Area*

New Development	Total Area (ha)	Area in subcatchment		
		Subcatchment	Total Area (ha)	Area outside Constraints area
1	23.8	1	11.8	10.9
		2	10.9	10.9
2	23.7	1	20.8	10.5
		2	2.9	2.9
3	8.3	2	8.3	8.3
4	29.4	8	29.4	11.7
5	9.5	8	9.5	0.1
6	6.1	6	6.1	5.7
7	7.8	7	7.8	6.1
8	5.5	5	5.5	3.8
9	4.6	2	4.6	4.6

*The land base outside of areas of the identified constraints area(s) is a preliminary assessment, subject to site-specific boundary staking and the finalization of VPZ limits.

The modelling steps used in the impact assessment hydrological analysis are summarized below:

- The hydrological model for existing conditions was updated to include new development areas (**Table 6.1.1**);
- The model was then adjusted to include proposed future development characteristics;
- Surface runoff rates were summarised (**Table 6.1.2**)

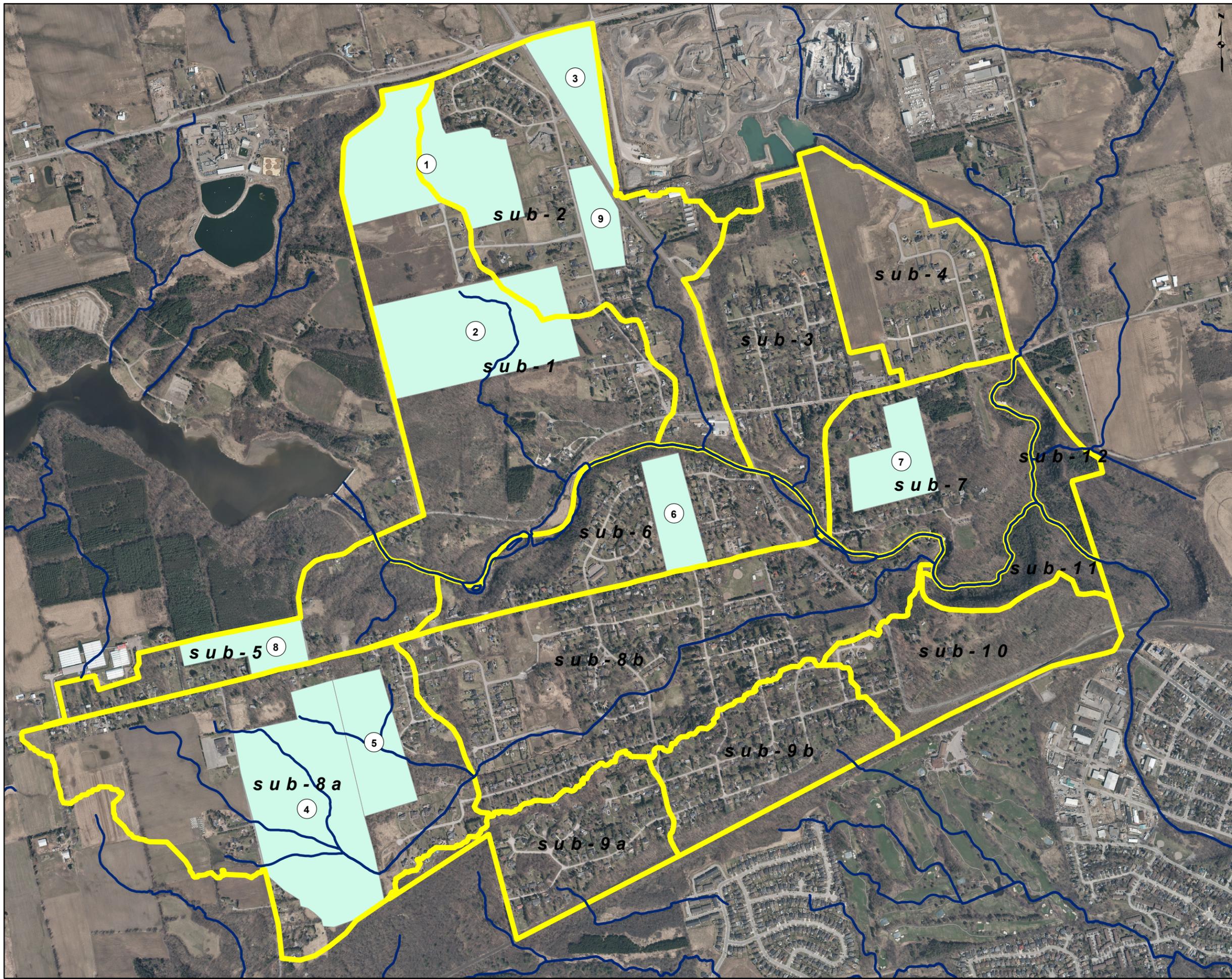
The modeling results presented in **Table 6.1.1** show an increase in surface runoff in all catchments that include future development (Catchments 1,2,5,6,7,8a) and Catchment 8b located downstream of Catchment 8a (highlighted in **Table 6.2.2**). Without control, issues related to water balance (infiltration deficit), water quantity (flood and erosion), and water quality (changes in pollutant loadings and thermal regime) are expected.

Chapter 7 and **Chapter 9** discuss potential list of control measures (alternatives) and the recommended approach, respectively.

Table 6.1.2: Surface Runoff Rates under Existing and Future Conditions (No Control)

Catchment	Drainage Area	Flow (cms) under Existing Conditions							Flow (cms) under Future Conditions						
		2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	Regional	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	Regional
1	101.05	0.42	0.90	1.31	1.90	2.40	2.93	10.01	1.19	2.08	2.79	3.93	4.74	5.79	10.09
2	81.20	0.97	1.65	2.19	3.06	3.67	4.44	7.59	1.99	3.42	4.53	6.13	7.54	9.16	8.51
3	46.90	1.38	2.49	3.35	4.60	5.72	6.73	5.77	1.38	2.49	3.35	4.60	5.72	6.73	5.77
4	38.01	0.42	0.76	1.04	1.45	1.81	2.14	3.99	0.42	0.76	1.04	1.45	1.81	2.14	3.99
5	29.60	0.44	0.84	1.16	1.63	1.96	2.31	3.16	0.71	1.34	1.84	2.55	3.06	3.58	3.25
6	44.25	1.22	2.34	3.23	4.52	5.43	6.52	5.75	1.42	2.71	3.74	5.21	6.25	7.34	5.84
7	45.61	1.19	2.48	3.33	4.59	5.66	6.69	6.34	1.36	2.71	3.78	5.29	6.35	7.49	6.35
8a	102.05	1.29	2.51	3.47	4.87	5.88	6.95	10.71	1.75	3.30	4.49	6.27	7.83	9.23	10.73
8b	95.59	3.19	6.01	8.83	12.81	15.79	18.22	20.21	3.39	6.82	9.89	13.63	17.06	19.67	20.65
9a	28.75	1.31	2.47	3.38	4.68	5.58	6.83	4.01	1.31	2.47	3.38	4.68	5.58	6.83	4.01
9b	32.20	1.47	2.79	3.82	5.30	6.32	7.72	4.49	1.47	2.79	3.82	5.30	6.32	7.72	4.49
10	31.83	0.58	1.23	1.72	2.38	2.90	3.44	4.21	0.58	1.23	1.72	2.38	2.90	3.44	4.21
11	10.40	0.73	1.39	1.86	2.48	2.95	3.42	1.51	0.73	1.39	1.86	2.48	2.95	3.42	1.51
12	9.68	0.65	1.25	1.68	2.24	2.66	3.09	1.41	0.65	1.25	1.68	2.24	2.66	3.09	1.41

Mid-Spencer Creek /
Greenville Rural
Settlement Area
Subwatershed Study



Legend

- Watercourses
- Catchment
- New Development Areas

FIGURE 6.1.1

Rural Settlement Area
Subcatchments
(New Development)

Mid-Spencer Creek /
Greenville Rural
Settlement Area
Subwatershed Study

Legend

- Watercourses
- Floodline Mapping (Aquafor Beech)
- Catchment
- Constraints
- New Development Areas

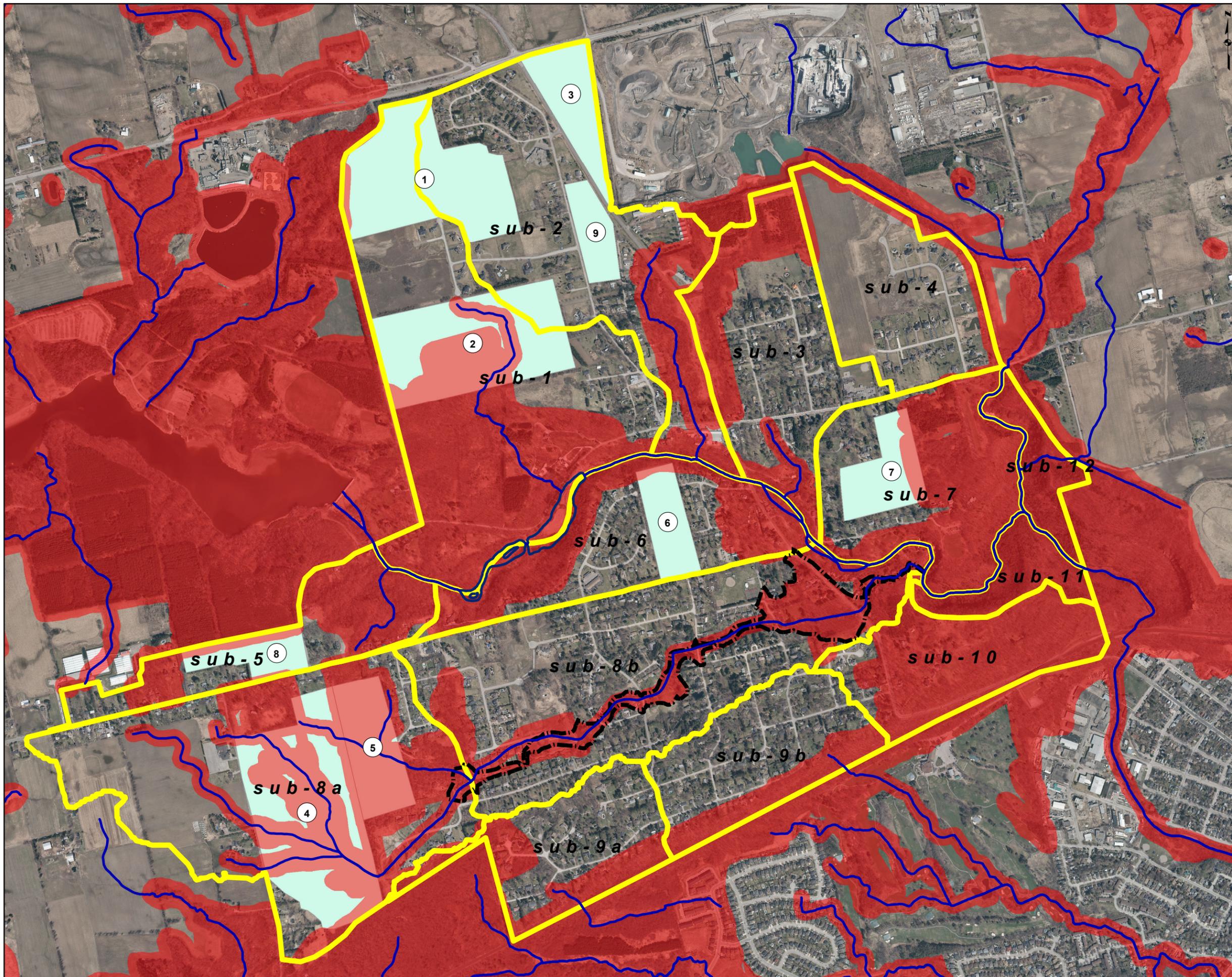


FIGURE 6.1.2

Rural Settlement Area
(New Development
and Constraints)

6.2 Groundwater Impact Assessment

6.2.1 Groundwater Quantity

Groundwater is the sole source of drinking water in the Mid-Spencer Subwatershed and in the Greenville RSA. The hydrogeology of the Greenville RSA indicate that there are two aquifers that provide drinking water to the majority of residents, namely an overburden aquifer in thick accumulations of sand and gravel, and a bedrock aquifer that is most commonly exploited in the uppermost 5 metres of weathered rock.

Water quantity problems have been noted by many residents, most recently in 2007 when a number of wells ran dry.

The existing conditions led to the following conclusions:

- There is evidence that both the overburden aquifers and the shallow bedrock aquifer are hydraulically connected and often share the same problems of quantity and quality.
- Domestic water demand constitutes less than 1% of the total permitted groundwater withdrawals and 2% of the actual average of the permitted withdrawals, mainly from the dewatering of the Lafarge and Flamboro quarries.
- More than half of the groundwater recharge occurs within the RSA itself, the remainder occurring from groundwater inflows from the north of the RSA.
- Existing groundwater extraction for domestic purposes by 2,525 residents represents 9% of the estimated total groundwater available.
- Approximately 85% of the extracted groundwater is returned to the ground through septic systems.
- Water quantity complaints in 2007 occurred in a year where annual precipitation was less than 75% of its long-term average and half that of the following year.

The impact assessment of proposed future development on water quantity was examined by Earthfx (2010b, 2014, 2015). A 3-dimensional model of the Greenville RSA was constructed and calibrated using the numerical MODFLOW code. The model included potential demands from PTTW in quarry dewatering and aggregate washing north of the RSA.

Three scenarios were considered. First, under existing conditions, 950 wells were included. In the second scenario, an additional 317 wells were modeled to account for proposed future development (total of 1267 wells) pumping at a rate of 1,173.5 litres/day (which is the quantity required by a family of four). Finally, the third scenario considered drought conditions, defined as 6 months, one year and two years of zero recharge to groundwater. The distribution of existing and proposed wells is shown in **Figure 6.2.1** for reference.

The approach used by Earthfx was to calculate the times-of-travel (ToT), whereby virtual water particles are tracked backwards in time using the hydraulic conductivity and porosity of the aquifers and aquitards back to the point of recharge. The ToT values for 2 years, 5 years and 25 years are shown under existing conditions in **Figure 6.2.2**.

What is apparent from the model is that most of the water extracted under existing conditions in the Greensville RSA is replenished within a period of 2 years from recharge occurring from the west and north, but mainly within the Greensville RSA itself.

When the additional 317 wells are added to the model, a similar pattern and extent of source water provenance is observed. (**Figure 6.2.3**).

The areas contributing the bulk of recharge to drinking water aquifers is shown in **Figure 6.2.4** under a build-out condition, with a total of 1,217 wells pumping simultaneously.

The drawdowns (i.e. the long-term drop in the water level) were calculated and the results are summarized in **Table 6.2.1**.

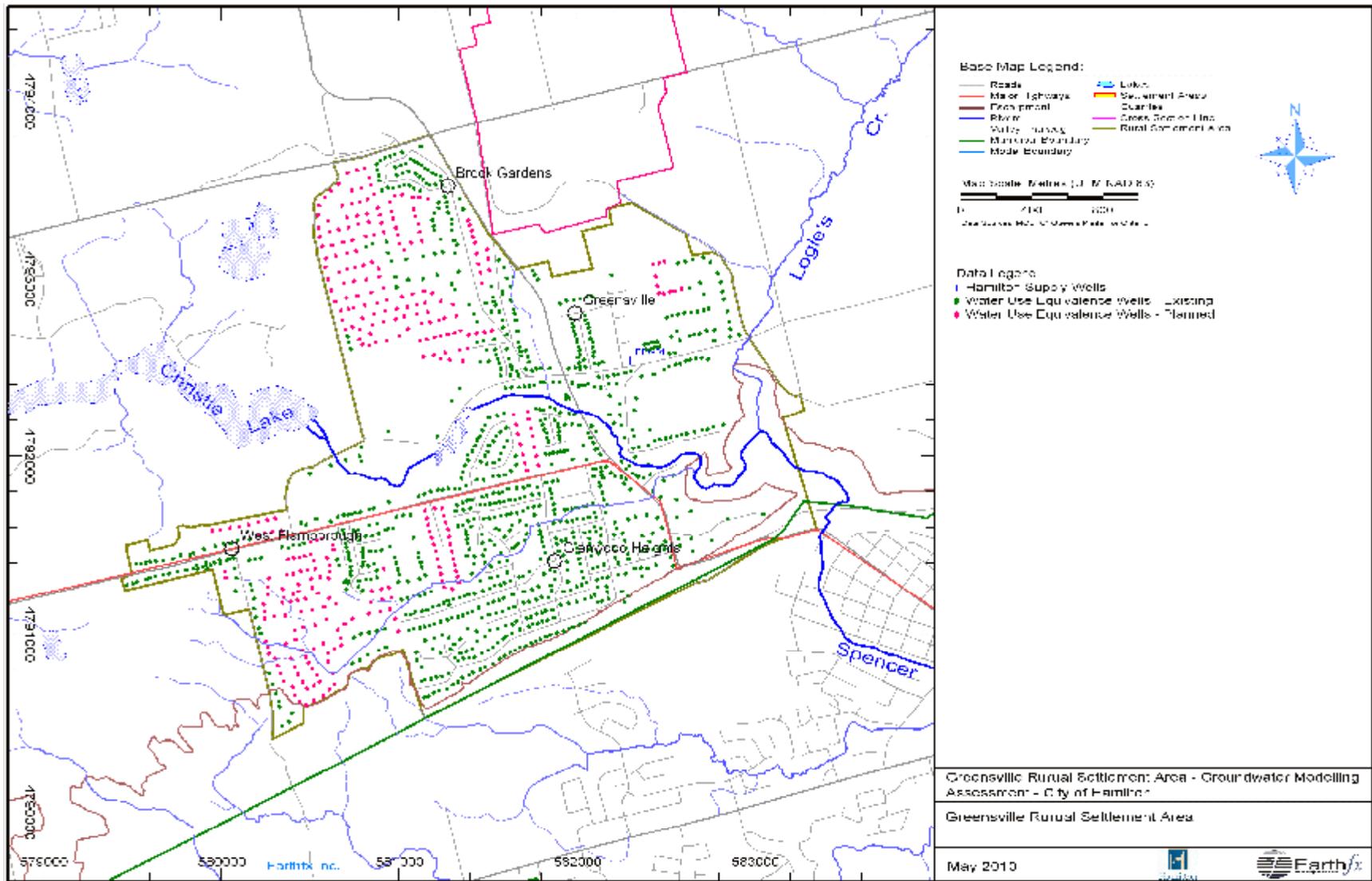


Figure 6.2.1: Existing and Proposed Wells in the Greenville RSA Used in the Earthfx Model

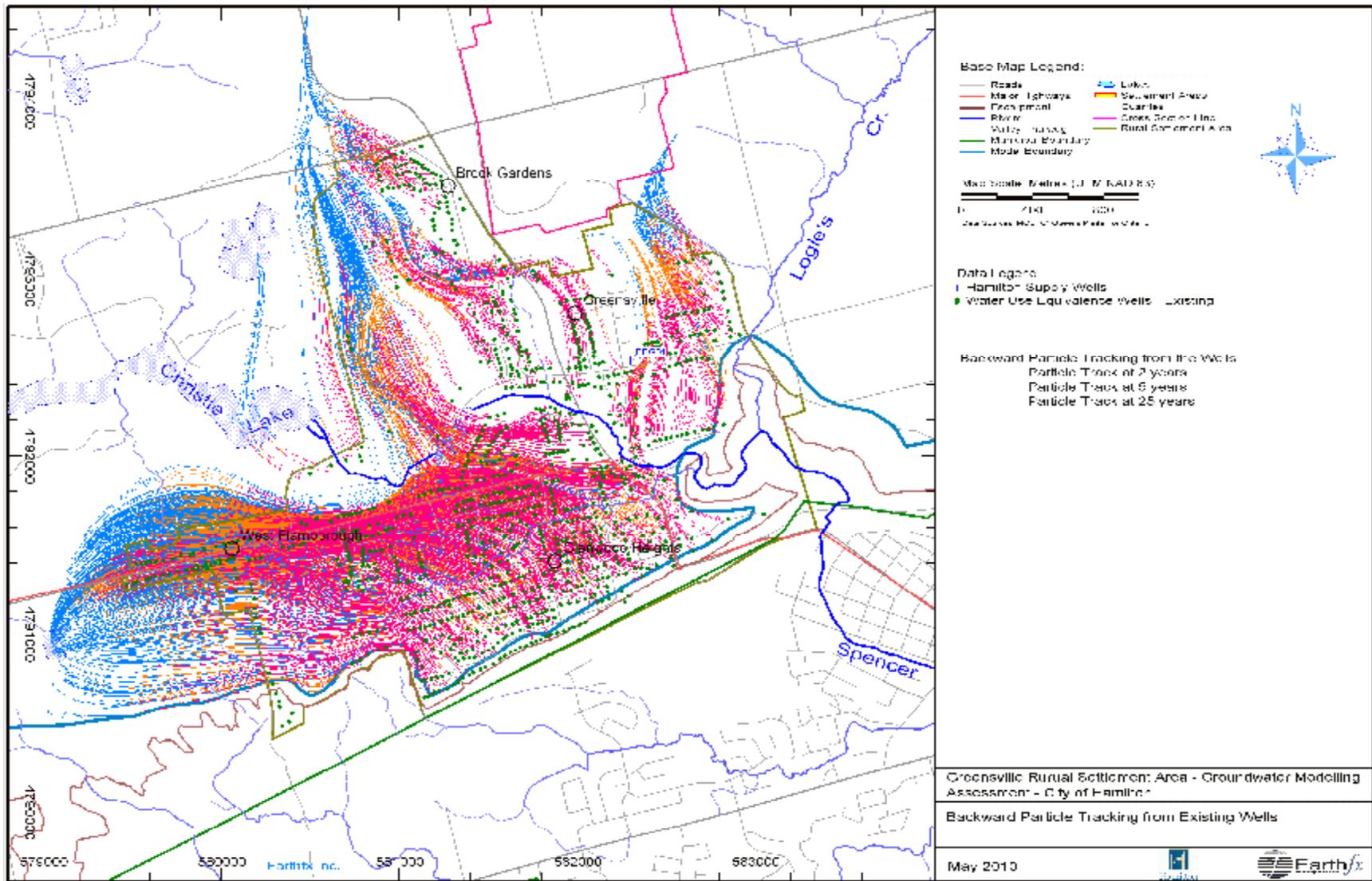


Figure 6.2.2: Times-of-Travel of Groundwater from Point of Recharge to Existing Water Wells

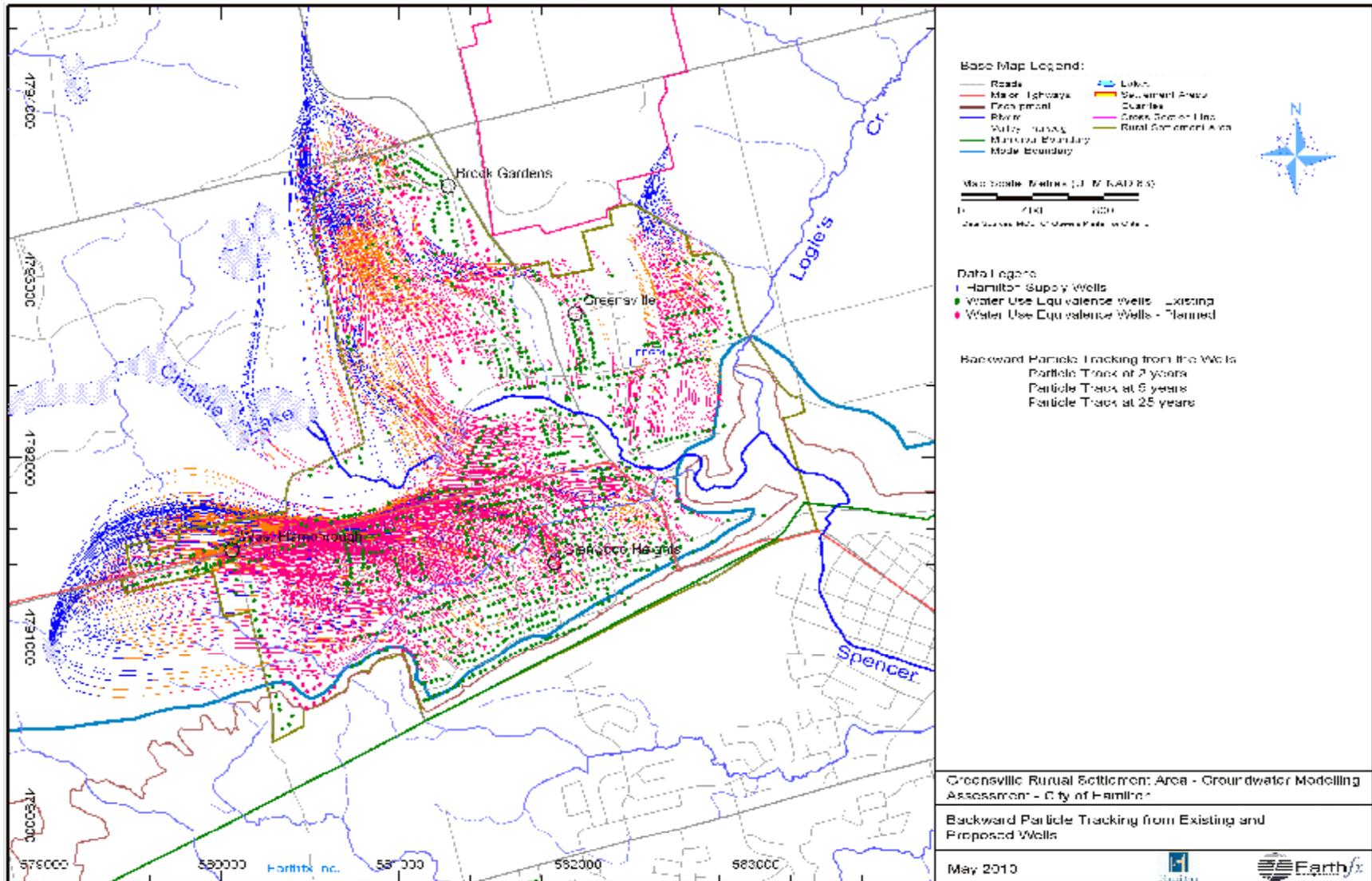


Figure 6.2.3: Times-of-Travel of Groundwater from Point of Recharge to Existing and Proposed Water Wells

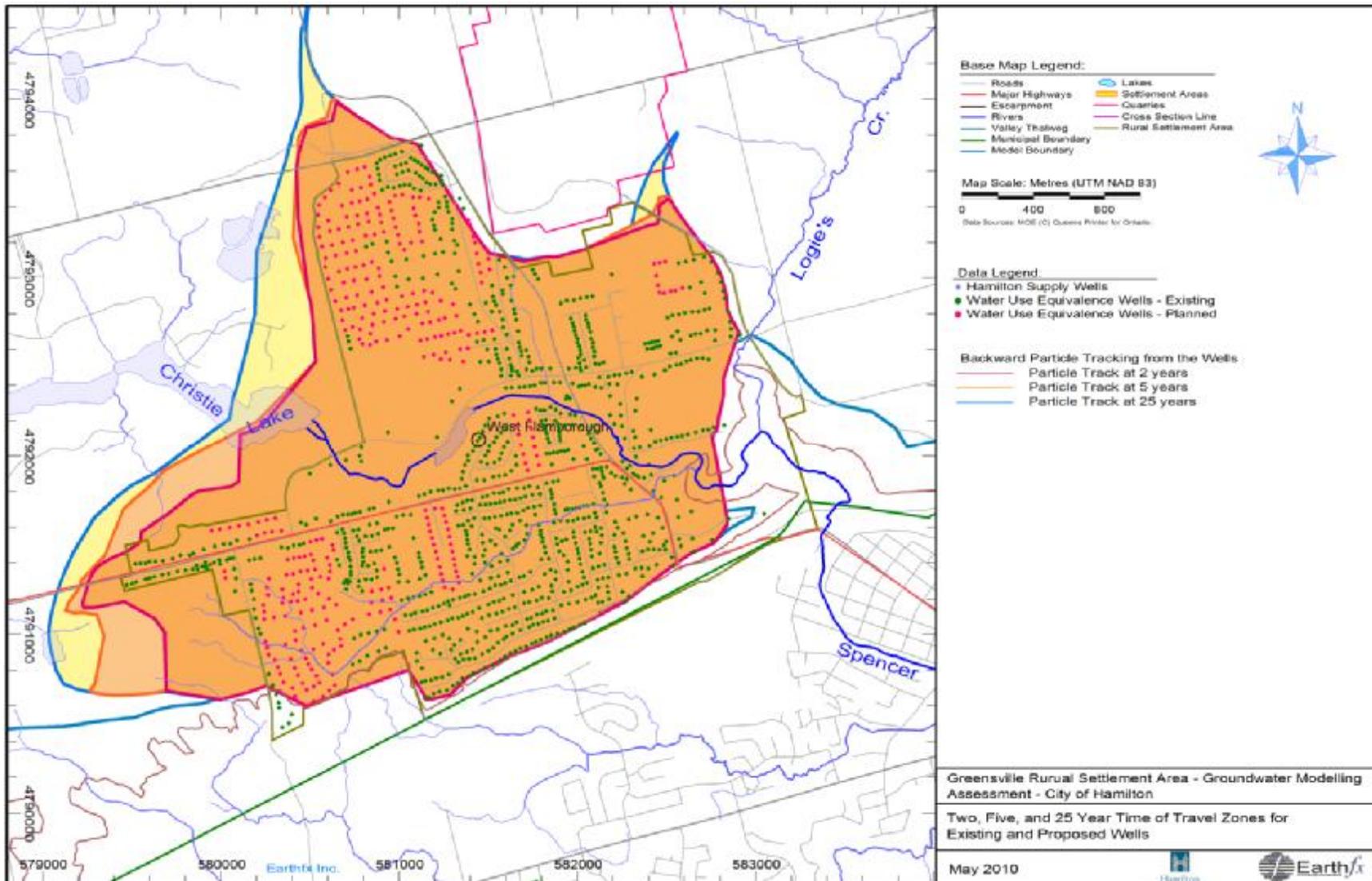


Figure 6.2.4: Area of Groundwater Recharge for 2 to 25 Year ToT for Existing and Proposed Wells

Table 6.2.1: Summary of Water Level Drawdowns Under Existing and Proposed Development for the Greensville RSA

Aquifer	Description	Scenario 1 - Existing Wells Only (950 wells)	Scenario 2 - Existing and Proposed Wells (1,217 wells)	Comments
Layer 4	Shallow bedrock aquifer at depths <4 metres, connected to the overburden aquifer	0.5 metre	0.5 metre	Increased area of drawdown in the north part of the RD+SA, west of Brock Road due to additional development
Layer 7	Bedrock aquifer at depths >5 metres	0.1 metre	0.1 metre	

Under both existing conditions and proposed build-out development, the maximum drawdown due to well demand remains less than 0.5 metre (less than 2 feet).

A third scenario was examined by Earthfx to assess drought conditions, defined as periods of 6 months, 1 year and 3 years of zero groundwater recharge (**Table 6.2.2**)

Table 6.2.2: Water Level Drawdowns in the Greensville RSA Under Drought Conditions

Aquifer	Description	Drawdown after 6 months of drought	Drawdown after 1 year of drought	Drawdown after 2 years of drought	Affected Areas
Layer 4	Shallow bedrock aquifer at depths <5 metres, connected to the overburden aquifer	3 metres	3 – 5 metres	5 metres	Highest in north-central RSA (Brock Gardens), Lowest south of Harvest Road
Layer 7	Bedrock aquifer at depths >5 metres	<1 - 4 metres	1 - 6 metres	2 – 7 metres	Highest in Wesite/Meldrum and Village Green areas. And north of Hwy 5

The model demonstrates that even a 6-month drought causes a 10-fold drop in water levels when compared to a full build-out condition with an additional 317 water wells. It is concluded that drought conditions lead to more severe impacts than additional development. This model confirms the effect noted in **Chapter 4**, where one year (2007) with a 25% reduction in normal precipitation led to a surge of complaints of wells running dry.

The second conclusion from the model is that the times-of-travel and their directions do not extend to the Lafarge South and North Quarries, where large quantities of groundwater are pumped out for de-watering.

6.2.2 Groundwater Quality

In terms of water quality, the following was observed:

- Bacteria present in well water is a chronic problem documented in 1983, 2005 and 2008. At least one out of ten wells is considered unsafe to drink. Bacteria has also affected the Briencrest communal well which serves 26 residences.
- In 2008, several residents complained that they experience seasonal flooding that may affect their wells.
- Nitrate (and sodium) is often elevated in well water, although the frequency of concentrations above the drinking water standard of 10 mg/L has decreased from 18% of wells in 1983 to zero in 2008. Much of the nitrate appears to be derived from septic system infiltration, given that more than half the septic systems in the RSA are older than 25 years. Furthermore, most of the contributing agricultural areas area to the north of the RSA is not intensively farmed, having nutrient units (NU) less than 1. Groundwater entering the RSA from the north boundary records nitrate concentrations between 0.7 and 2.4 mg/L. The long-term concentration of nitrate in the Greensville municipal well has been steady mainly under 6 mg/litre in recent years.

An additional 317 residences will require an additional 317 private septic systems, which will have an impact on groundwater quality. Based on the conservative Ministry of the Environment guidelines, each residence is assumed to discharge 1000 litres of wastewater per day and 40 grams of nitrogen (as nitrate) to the septic tile bed.

The impact of existing and proposed septic systems on groundwater quality was calculated as a mass balance load, with each residence infiltrating 1000 litres/day through their septic tile bed with 40 mg/litre nitrate. The resulting concentration of nitrate in groundwater is expressed graphically for a range of annual infiltration of precipitation infiltrated within the RSA (assuming that precipitation contains zero nitrate). The resulting calculation for existing and proposed conditions is shown in **Figure 6.2.5**.

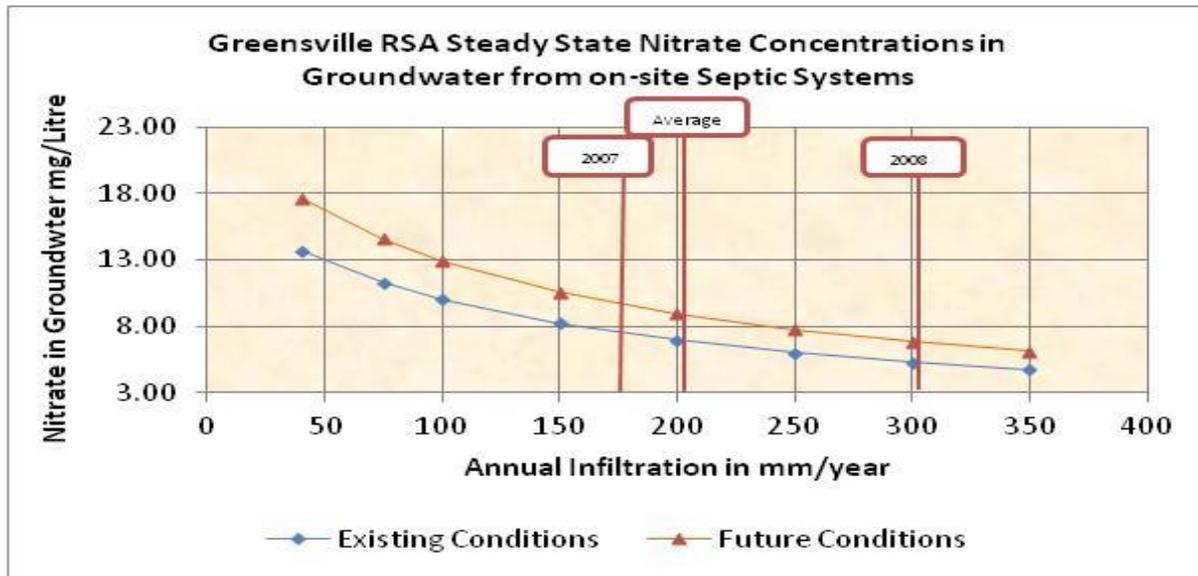


Figure 6.2.5: Total Nitrate Concentration in Groundwater in Greenville from Existing and Proposed Septic Systems (with infiltration average, in 2007 and 2008).

This calculation demonstrate that adding 317 homes will contribute an additional 2 mg/litre of nitrate to the groundwater across the entire 655 hectares of the Greenville RSA. This increase can, in part, be attenuated by increasing the overall annual infiltration.

This loading does not represent a justification for advancing with the proposed developments, which are subject to the pertinent Ministry of the Environment (MOE) and the City of Hamilton municipal policies and guideline. The pertinent guidelines include:

- City of Hamilton Guidelines for Hydrogeological Studies and Technical Standards for Private Services, November 2013.
- Guideline D5 – Planning for Sewage and water Services, Procedure D-5-4: Technical Guideline for Individual On-Site Sewage Systems: Water Quality Impact Risk Assessment (which includes a consideration on lot sizes);
- Guideline B-7: Incorporation of the Reasonable use Concept in MOE Groundwater Management Activities, Procedure B-7-1: Determination of Contaminant Limits and Attenuation Zones (which includes a method of calculating nitrate impacts on adjoining properties).
- Procedure D-5-5: Technical Guideline for Private Wells: Water Supply Assessment (which includes a section on well interference)

6.3 Natural Heritage

Proposed land use changes (i.e., a change from agricultural to residential and commercial/industrial) have the potential to impact natural heritage features and functions within and adjacent to the Greenville RSA. Impacts may result from direct activities (e.g. construction activities such as clearing grading, infrastructure such as road, water and waste water servicing) or indirect activities (e.g. occupancy issues such as dumping of waste material, creation of indiscriminate trails etc.).

The following subsections provide a general assessment of the potential impacts development within the Greenville Rural Settlement Area may have on terrestrial and aquatic natural heritage features and functions, herein included in the term Natural Heritage System (NHS), with respect to the following general environmental categories:

- Woodlands
- Wetlands
- Aquatic Habitat
- Aquatic Fauna
- Terrestrial Fauna
- Flora
- Wildlife Linkages

In preparing a list of potential impacts to the NHS, Aquafor Beech Limited organized potential impacts into three (3) temporal categories: immediate, short-term, and long-term impacts, and an additional category for cumulative impacts. Impacts can be either positive or negative in relation to the NHS. These impacts and their associated recommended mitigation measures, as applicable, are detailed below in an easy-to-reference chart (**Table 6.3.1**). Recommendations specific to vegetation protection zones, or buffers, are presented below in **Section 4.7.5 and Section 10.4.4**.

(Note: The following examples contained in this paragraph are provided for contextual purposes and are not necessarily related to the proposed development areas or the study area referenced in this report.)

Immediate impacts are those that will occur during or immediately after the development construction phase. One example of an immediate impact could include direct loss of habitat for flora and/or fauna. *Short-term impacts* include those that occur shortly after construction is complete and buildings are occupied. An example of a short-term impact could include edge effects on newly-created woodland edges, or unauthorized dumping. *Long-term impacts* are impacts that occur long after house occupancy, and are generally realized after the 15-year mark. An example of a long term impact could include a decrease in local avian populations due to predation by domestic cats. *Cumulative impacts* are those caused by the combination of past, present, and reasonably foreseeable future impacts. Cumulative impacts are often realized in the long-term, but are not necessarily restricted to that timeframe. An example of a cumulative impact could include the loss of wetland cover due to land clearing during settlement (c.a. 150 years ago), urbanization (present), and potential future changes in hydrology or climate.

Table 6.3.1: Summary of Potential Impacts to the Natural Heritage System

Potential Impacts	Affected Element of the NHS	Temporal Category				Details and Recommended Mitigation Measures
		Immediate	Short Term	Long Term	Cumulative	
Fragmentation or reduction in size of an element of the NHS	<ul style="list-style-type: none"> • Woodlands • Wetlands • Aquatic Habitat • Wildlife Linkages 					New development and site alteration are not permitted within Provincially Significant Wetlands. New development and site alteration are not permitted within or adjacent to other Core Areas, unless it can be shown, through an approved EIS, that there will be no negative impact on the ecological features or functions of the Core Area. It is recommended that any approved area reduction in Core Areas and/or Linkages be subject to compensation (e.g. restoration), provided the ecological function is not significantly impacted through the reduction. Restoration of wildlife linkages/corridors may be a suitable mitigation and/or improvement strategy in some cases.
Loss of successional habitat	<ul style="list-style-type: none"> • Woodlands • Wetlands • Terrestrial Fauna • Flora • Wildlife Linkages 					New development and site alteration are not permitted within Provincially Significant Wetlands. New development and site alteration are not permitted within or adjacent to other Core Areas, unless it can be shown, through an approved EIS, that there will be no negative impact on the ecological features or functions of the Core Area. Often, successional habitats such as meadows are perceived to have less ecological value in comparison to other elements of the NHS such as woodlands and wetlands. However, many species (e.g. Monarch) require successional habitats in order carry out their life processes. Accordingly, as part of future studies it is recommended that the ecological function of extant successional habitat be fully evaluated and, if applicable, mitigated through compensation plantings on a net gain (as opposed to a no net loss) basis.
Edge effects	<ul style="list-style-type: none"> • Woodlands • Wetlands 					Given the relatively linear edges of existing woodlands abutting lands suitable for development, it is not anticipated or recommended that new woodland edges be created. It is recommended that edge effects (e.g. drying due to increased solar radiation, wind throw, changes in hydrology, changes in forest microclimate, etc.) be mitigated through: a) an edge management plan which could include measures such as pre-stressing trees and successional plantings, and b) appropriate plantings adjacent to natural features.
Increased potential for the introduction of invasive non-native species	<ul style="list-style-type: none"> • Woodlands • Wetlands • Aquatic Habitat • Aquatic Fauna • Terrestrial Fauna • Flora • Wildlife Linkages 					Multiple factors can contribute to the increased potential for the introduction of invasive non-native species, including but not limited to: changes in hydrologic regime, accidental or intentional introduction by humans (e.g. fuel wood movement, horticultural practices, recreational fishing bait, etc.), nutrient loading, and habitat alteration. Measures recommended to mitigate the introduction and spread of invasive species include the prevention of disturbances within and adjacent to the NHS, monitoring of natural areas to detect infestations, effective buffer plantings, landowner outreach programs, and effective trail planning.
Encroachment into the NHS	<ul style="list-style-type: none"> • Woodlands • Wetlands • Aquatic Habitat • Aquatic Fauna • Terrestrial Fauna • Flora • Wildlife Linkages 					Rear lot encroachment, dumping, vandalism, camping, and unauthorized trails can be mitigated through the construction of rear lot fencing (installed before homes are occupied) and the use of thorny plant species within planting areas adjacent to residential lots. Landowner outreach (e.g. information pamphlets, community info sessions, etc.) may also be useful.

Light and noise	<ul style="list-style-type: none"> • Terrestrial Fauna 					Light and noise have the potential to impact amphibians breeding behavior and the behavior of mammals, especially forest-dwelling birds. Possible light and noise impacts to species within natural areas adjacent to development can be minimized through the installation of dense evergreen plantings and fencing between natural features and proposed development, and well as the use of directional lighting.
Habitat alteration	<ul style="list-style-type: none"> • Woodlands • Wetlands • Aquatic Habitat • Aquatic Fauna • Terrestrial Fauna • Flora • Wildlife Linkages 					<p>Impacts could include:</p> <ul style="list-style-type: none"> • Rear lot encroachment, dumping, vandalism, camping, and unauthorized trails can be mitigated through the construction of appropriate rear lot fencing and the use of thorny woody plant species within planting areas. • Stream length can be reduced due to development-related activities such as watercourse diversions, road crossings, etc. <p>Due to the myriad potential damaging effects of habitat alteration, it is not recommended that significant habitat alteration (e.g., alterations that could negatively affect the form and/or function of the NHS) occur. The City of Hamilton’s Rural and Urban official plans do not allow “alterations that could negatively affect the form and/or function of the NHS”.</p>
Reductions in the populations or reproductive capacity of significant species	<ul style="list-style-type: none"> • Aquatic Fauna • Terrestrial Fauna • Flora 					Multiple factors, including but not limited to impacts listed here, have the potential to contribute to reductions in populations and/or fecundity of significant species within and adjacent to the Greenville NHS. Accordingly, it is recommended that future studies (e.g. EISs) comprehensively address potential stressors and impacts to significant species and related mitigation measures.
Changes in hydrologic regime (e.g. water quantity, quality, hydroperiod, direction of flow, etc.)	<ul style="list-style-type: none"> • Woodlands • Wetlands • Aquatic Habitat • Aquatic Fauna • Terrestrial Fauna • Flora 					Surface and ground water regime has a regulating effect on ecosystems. Accordingly, alteration to the hydrologic regime has the likely potential to affect both terrestrial and aquatic ecosystems. It is therefore recommended that extant hydrologic regime(s) be maintained. As part of the efforts to maintain extant hydrologic regimes, it is recommended that water balances and topography be considered as part of futures studies (e.g. EISs) which examine the potential impacts of development and site alteration on natural features such as woodlands and wetlands.
Increased Nutrient Loading	<ul style="list-style-type: none"> • Woodlands • Wetlands • Aquatic Habitat • Aquatic Fauna • Flora 					Increased nutrient loading can result from human activities such as fertilizer application and improper septic tank maintenance. Nutrient loading, especially that of nitrogen and phosphorus, can lead to degraded water quality and ecosystem health. In addition, increased nitrogen levels often provide opportunities for non-native plant colonization. Heavily vegetated buffers, especially those densely planted with grasses, can reduce nutrient loading into adjacent natural heritage features. Another mitigation measure could include educating home owners about the potential impacts of nutrient loading, and recommendations for reducing impacts such as the use of low-input lawn grass species, decreasing fertilizer dosage and frequency, using slow-release fertilizers, and using fertilizer with low concentrations of N-P-K; for example.
Salt Contamination	<ul style="list-style-type: none"> • Woodlands • Wetlands • Aquatic Habitat • Aquatic Fauna • Terrestrial Fauna • Flora 					Salt contamination has the potential to change vegetation community assemblages, increase available habitat for invasive and/or non-native flora, and negatively impact both aquatic and terrestrial fauna (e.g. amphibians). Mitigation options include implementing a salt management plan for the Greenville RSA, which includes a resident education and outreach plan.

Silt deposition	<ul style="list-style-type: none"> • Woodlands • Wetlands • Aquatic Habitat • Aquatic Fauna • Flora 					Silt deposition can result from improper erosion control practices during construction, and can be avoided through implementation of a proper erosion and sediment management control plan.
Domestic pet predation	<ul style="list-style-type: none"> • Terrestrial Fauna 					If allowed to roam free, domestic pets (e.g. cats) can have detrimental effects on local wildlife populations, particularly birds and small mammals. In order to mitigate the effects of predation, it is recommended that residential lots be fully fenced and homeowners educated on the potential effects domestic wildlife may have on local wildlife.
Road mortality	<ul style="list-style-type: none"> • Terrestrial Fauna 					Increased road traffic and construction of additional residential roads increases the potential for road mortality. Potential mitigation measures include appropriate road planning, reduction in traffic speeds, signage, and the construction of wildlife crossings.
Increased wildlife persecution by humans	<ul style="list-style-type: none"> • Terrestrial Fauna 					Some wildlife taxa, such as snakes, experience human persecution due to (false) perceptions about snakes' danger to humans, pets, and livestock as well as superstitious/folk beliefs. Possible mitigation measures include public outreach and education.
Dumping and rubbish	<ul style="list-style-type: none"> • Woodlands • Wetlands • Aquatic Habitat • Aquatic Fauna • Terrestrial Fauna • Flora • Wildlife Linkages 					Dumping and rubbish have the potential to pollute surface and ground water resources and pose a threat to wildlife. Dumping and the deposition of rubbish can be mitigated through the construction of appropriate rear lot fencing, the use of thorny woody plant species within buffer (VPZ) planting areas, and through public education and stewardship activities (e.g. trash cleanup days).

7 EVALUATION OF ALTERNATIVES

7.1 General

This chapter will:

- provide a general description of the types of alternative solutions that were considered in order to address the key constraints as defined in **Chapter 4** and potential impacts as summarized in **Chapter 6**;
- provide a description of the criteria that were used to screen the alternative solutions;
- provide an evaluation of the effectiveness of the alternative solutions; and
- discuss the rationale for selecting the preferred solution.

The approach that has been used is outlined as follows:

- establish a long list of alternatives;
- screen the alternatives to determine feasibility and acceptance; and
- undertake a more comprehensive assessment for alternatives that are found to be feasible.

There are several items that need to be considered in evaluating the alternatives. These items have been summarized below:

1. There are two study areas that are under consideration (the Rural Settlement Area (RSA) and the larger Mid Spencer Creek Subwatershed Area). Consistent with other components of this study a more detailed assessment is being undertaken for the RSA.
2. The alternatives must address a wide range of environmental issues relating to groundwater, flooding, erosion, water quality, terrestrial and aquatic ecology. A wide range of general measures should therefore be considered initially.
3. Other initiatives including studies for Source Protection and stewardship have been completed by agencies such as the City and Conservation Authority. These initiatives need to be considered as part of the evaluation.
4. Implementation of the alternatives will take place using a variety of mechanisms and stakeholders. For example, some measures will be implemented by homeowners as part of stewardship programs while other measures will be implemented as part of the planning process. Some of the alternatives may be subject to the Environmental Assessment Act which requires a defined evaluation and selection process. In this regard Approach #1 of the Master Planning process in the MEA Municipal Class EA document has been used.

7.2 Long List of Alternatives – Mid-Spencer Subwatershed

A long list of alternatives or management actions has been identified for the Mid Spencer subwatershed. The list, together with a description of each alternative, is provided below. At the subwatershed level a wide variety of alternatives needs to be considered to address the range of existing land uses and environmental resources. As the focus of the technical work for this study is limited to defining existing conditions and defining general strategies at a subwatershed level the evaluation of the alternatives will be generalized. Implementation of proposed measures will be based on general recommendations made for this study together with the findings/recommendations of other studies.

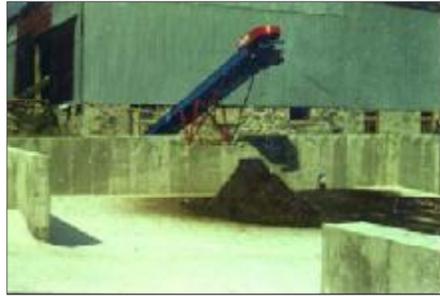
The broad range of management actions recommended for the Mid-Spencer Subwatershed area are summarized below:

- Structural Best Management Practices for Rural Areas
- Non-structural BMPs for Rural Areas
- Measures for Rural Estates
- Stream Restoration Programs
- Aquatic Habitat / Fish Community Enhancement Programs
- Terrestrial Habitat Enhancement
- Groundwater Protection
- Aggregate Extraction
- Stormwater Management Alternatives

7.2.1 Structural Best Management Practices for Rural Areas

Applying Best Management Practices technologies to rural lands offers significant benefits both to the environment and farm productivity, while providing the opportunity to restore agricultural streams.

Structural BMP's for Rural Areas include manure storage, feedlot runoff control, constructed wetlands, tile drain outlet controls, nutrient management, and irrigation ponds/water conservation. These programs will include incentives for Rural BMP's, and recognizing the community benefits of the resulting water quality improvements.



Manure/Feedlot Storage

7.2.2 Non-structural BMPs for Rural Areas

Structural BMP's for Rural Areas include livestock access control, nutrient management, cover crops, buffer strips, reduced livestock densities, wildlife management and conservation tillage and would be applied to all existing rural areas. These programs will include Community Education and Outreach Components.



Conservation Tillage



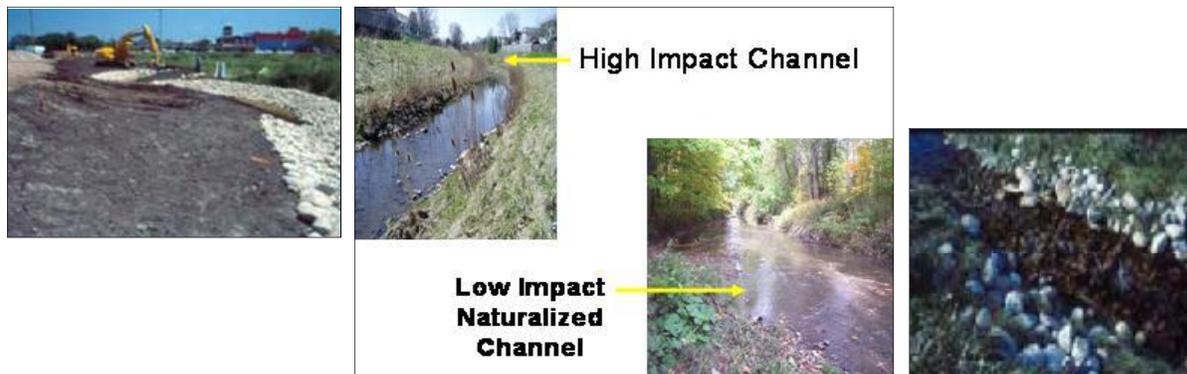
Livestock fencing

7.2.3 Measures for Rural Estates

Rural Estate BMP's include septic system replacement and inspection programs, inspection and review programs for Permits to Take Water, landscaping, and fertilizer and pesticide reduction programs. These programs will include Community Education and Outreach Components.

7.2.4 Stream Restoration Programs

Stream restoration will be implemented on a reach basis to address stream instability, wildlife habitat, and erosion concerns. A natural channel design approach should be implemented on priority reaches to address instability, erosion and sedimentation problems. Other measures include protection of riparian zone, riparian plantings, and reconnection of floodplains. The following inset photos show examples of natural channel design projects:



Natural Channel Design

7.2.5 Aquatic Habitat / Fish Community Enhancement Programs

Aquatic habitat enhancement projects would focus on barrier removal and enhancement of instream habitats associated with the erosion projects outlined in **Section 7.2.4**, as well as select riparian rehabilitation opportunities discussed in **Section 7.4**. Instream habitat enhancement could include a range of measures including creating pool: riffle morphology, increasing instream cover including woody debris, enhancement of spawning habitat and improving habitat conditions for target species such as rainbow darter (*Etheostoma caeruleum*), a sensitive indicator species (Scott and Crossman, 1973).

Stewardship efforts aimed at riparian landowners are considered key to the success of any enhancement program within areas of privately-owned land. Landowners identified as having insufficient riparian buffers should be made aware of available funding and technical assistance for establishing buffers (HCA 2011). Workshops, information sessions, literature, websites, public service announcements, interpretive signage and direct landowner contact can be implemented to promote healthy streams and the creation of larger riparian buffers (HCA 2011). At a minimum, riparian buffer widths should be in accordance with the 30 metre minimum Vegetation Protection Zone widths specified by the City of Hamilton (2013) (**see Section 6.3**).

Existing initiatives are underway through the Middle Spencer Creek Subwatershed Stewardship Action Plan and the future Fisheries Management Plan (currently being finalized). Key components include repair/mitigation/removal of dams, increasing the amount of woody debris in the system, habitat improvement, sediment management and headwater protection. The Middle Spencer Creek Subwatershed Stewardship Action Plan indicates that a feasibility and prioritization study may be undertaken for the removal of dams. Existing initiatives are underway through the efforts of the Hamilton Conservation Authority (e.g. the Crook's Hollow Dam removal project, summary in **Appendix L**). The following inset photos shows examples of instream habitat improvement:



7.2.6 Terrestrial Habitat Enhancement

Priorities for terrestrial habitat enhancement will focus on restoration measures that will increase forest cover within the Subwatershed and establish connections between Natural Heritage Features. Additional terrestrial habitat enhancement opportunities discussed in this report include the following:

- Rubbish removal;
- Floodplain plantings;
- Invasive species management;
- Filling in forest canopy gaps;
- Establishment of wildlife corridors;
- Creation of connections between woodlands;
- Creation of connections between ESAs;
- Wetland enhancements; and
- Wetland creation through online pond removal.

Wetland rehabilitation includes the concept of diversifying the habitat types surrounding wetlands in an effort to provide varied habitat for native species, manage flooding, improve water quality. On a larger scale, reforestation is another important measure, not only for increasing terrestrial habitat but also for carbon sequestering, increasing evapotranspiration, improving local microclimates, and increasing opportunities for wildlife movement.

For a detailed discussion of rehabilitation and enhancement in the Mid-Spencer Creek Subwatershed, including areas within the Greenville Rural Settlement Area, see **Section 7.4**.

7.2.7 Vegetation Protection Outside of the NHS

It is recommended that vegetation outside the boundaries of the NHS be protected and incorporated into development/lot design where possible. Compensation plantings *in appropriate locations* to account for *natural features* that cannot be retained is encouraged at a minimum ratio of 3:1. That is, compensations plantings should account for three times the amount of the natural feature(s) lost.

It is anticipated that some tree loss will occur in order to accommodate development. That is, treed areas not included as part of the NHS (e.g. hedgerows) may be removed to accommodate the proposed large-lot industrial/commercial development parcels. As many hedgerows are located along lot lines, it is probable that hedgerows can be retained post-development. Retention of these hedgerows will likely benefit wildlife, and will also benefit development by providing shade to buildings, employee picnic areas, and/or parking lots.

While it is the opinion of the Study Team that the preservation of trees is favourable, it is not recommended that invasive species within hedgerows be retained. Exotic invasive species such as European buckthorn (present throughout), should be removed so that the threat of these species spreading to valuable retained natural areas within the NHS is greatly reduced.

7.2.8 Woodland Edge Management

Woodland edge management plans are often required when development or site alteration is required near or within an existing woodland edge. The majority of woodlands within the subwatershed study area are included within the NHS and are protected by buffers. Expanding upon the potential impacts listed above in **Table 6.3.1**, typical impacts to remaining woodland communities may include, but are not limited to:

- Direct loss of floral and faunal habitat;
- Trees along the ‘new’ edge may be susceptible to windthrow;
- Reduced species richness and abundance;
- Decreased biodiversity;
- Reduced stability of landforms composed of unconsolidated material;
- Regrading/fill placement along forest edges can impact root systems of retained trees, resulting in root stress/tree decline;
- Loss of canopy cover/shade, resulting in an increase in sunlight penetration;
- Some trees with thinner bark (e.g. Beech) can be susceptible to sunscald and frost cracking due to changes in light penetration. This can weaken the tree's defences, particularly to pathogens.

- Changes in microclimates (increased temperatures, decreased soil moisture) resulting in desiccation;
- Site may be more susceptible to invasion by non-native species, pathogens, etc.;
- Soil compaction resulting from unrestricted vehicle and machinery operations; and,
- Loss of native seed bank.
(TRCA, 2004)

The potential impacts listed above can be avoided in part or entirely through adherence to the Vegetation Protection Zone guidelines in this document (see **Section 4.7.5**). A selection of possible mitigation measures are listed below:

- Direct development activities away from significant and/or sensitive natural heritage features;
- Prevent or reduce construction staging areas adjacent to natural heritage features;
- Install sturdy, well-marked tree protection fencing at an appropriate distance past the dripline of retainable trees and include provisions for tree protection on design drawings;
- Retain native shrubs and groundcover wherever possible;
- Replanting of removed vegetation at a minimum 3:1 ratio in appropriate locations which serve to enhance the configuration or linkage of existing natural areas;
- Retain stumps within 5 m of the new edge to allow for vegetative regeneration from the existing seed bank;
- Plant salt-tolerant species along the edges of parking lots, roads, etc to mitigate the effects of salt spray and runoff on existing natural vegetation, with a preference towards native species;
- Restrict grading and other development activities to areas outside of the VPZ;
- Retain natural drainage patterns;
- Retention of dead or dying trees for wildlife benefit, providing there is no potential for property damage or threats to human safety;
- Prune shallow-rooted trees to avoid windthrow;
- Removal of problem exotics such as European buckthorn;
- Plant early-successional species along woodland edges to provide protection to woodland edges; and,
- Monitoring of edge plantings to ensure effectiveness and survivorship.
(adapted from TRCA, 2004)

As mentioned above, woodlands (significant or otherwise) within the areas proposed for development are not subject to planned direct modification (i.e. subject to cutting) under the MESP. That is, linear infrastructure and servicing has been placed outside of existing woodland

boundaries. Additionally, all woodlands have buffer widths ascribed to them as a means of protection. Proposed future commercial/industrial development should not occur within buffers.

7.2.9 Fencing

Permanent rear lot/development fencing should be considered to prevent uncontrolled access and encroachment into adjacent natural areas. Hard barriers should be considered between commercial/industrial areas and the NHS. Opportunities for wildlife passage should be considered at appropriate locations when incorporating hard barriers adjacent to natural areas, and live fencing should be encouraged where feasible. It is recommended that species selection for live fencing include woody species with thorns (e.g *Crataegus* spp, *Rubus* spp, *Rosa* spp, *Zanthoxylum americanum*) to discourage encroachment into natural areas. The final recommendations regarding the type of fencing and potential offsetting of the fence onto public lands to preclude fence alterations/gate installation should be developed during subsequent planning stages.

7.2.10 Groundwater Protection

Groundwater is the sole source of drinking water for the Mid-Spencer Creek Subwatershed (population 11,829) and of the Greenville RSA (population 2,525). As reviewed in Chapter 4, there are continuing problems with water quality and quantity within the RSA. Groundwater discharge to Middle Spencer Creek contributes more than 50% of the total annual flow and continued groundwater recharge and discharge is essential to preserve the ecological functions of Middle Spencer Creek. The protection and management of groundwater resources within the subwatershed was identified as a concern under existing conditions. The recent Tier 1, Tier 2 and Tier 3 Water Quality Stress Assessment (WQSA) identified the Mid-Spencer Creek as being under moderate stress. The Assessment Report for the Hamilton Region Source Protection Area included the Well Head Protection Area (WHPA) for the Greenville municipal well and the its vulnerability. Phase 1 and 2 of the Tier 3 Water Budget and Local Risk Assessment for the Greenville Municipal System (Earthfx, 2014) refined the hydrostratigraphy, water demand from quarries and assessed transient water levels and groundwater pumping data to provide a solid foundation for subsequent assessment tasks.

Groundwater protection should address the following objectives

- Protect natural features overlying identified groundwater recharge areas;
- Maintain the water balance at a subwatershed level;
- Implement Well Head Protection policies around the Greenville municipal well;
- Restrict and monitor land uses within highly vulnerable areas associated with the WHPA

- Encourage the maintenance, repair or replacement of failing private septic systems;
- Encourage the maintenance, repair, replacement and proper abandonment of water wells susceptible to bacterial contamination from surface;
- Preserve or enhance the pre-development water budget through policies that promote infiltration at the lot level;
- Consolidate stewardship and regulatory programs that are presently delivered through multiple agencies into a more seamless program to provide sustainable program delivery in terms of staff resources and incentive funding, and to achieve higher degrees of voluntary participation and compliance by citizens;
- Educate staff and elected representatives on state-of-the-art technologies for stormwater management and urban development standards, to build support for incorporating these technologies into infrastructure master plans, new development and redevelopment projects; and
- Increase the combined efforts of all agencies in the area of public education, community outreach and stewardship of tributaries, shorelines and riparian zones to encourage landowners to develop a conservation ethic in the treatment and rehabilitation of these resources and to improve public and agency relations.

7.2.11 Aggregate Extraction

There is one operating quarry in the Mid-Spencer Creek Subwatershed, the Lafarge North Quarry, located 1500 metres north of the RSA Boundary. The Lafarge North Quarry has a Permit to Take Water (PTTW) for quarry dewatering for up to 18,398,207 cubic metres per year. The Lafarge South Quarry (**Figure 7.2.1**) is contiguous to the Greenville RSA and is used for aggregate washing and processing. The Lafarge North and South Quarries have PTTWs for a maximum of 30,548,310 cubic metres per year, although average pumping rates are less than 32% of the permitted rates. It is understood that the water from the North Quarry is directed to the South Quarry for aggregate washing and processing, and then subsequently discharged to a tributary of Logie's Creek in the Logie's Creek Subwatershed.

As such, the quarry dewatering is outside the scope of the present study and is dealt with in the Assessment Report of the Hamilton Region Source Protection Area and the Tier 3 Risk Assessment Report (Earthfx, 2014).

Partnership opportunities to promote progressive rehabilitation and appropriate after-uses supportive of the restoration of the natural environment could be investigated by the City of Hamilton, NEC, HCA, and the Management of Abandoned Aggregate Properties Program of the Ontario Aggregate Resources Corporation, for example.



Figure 7.2.1: The Lafarge South Quarry Retention Pond, viewed from the RSA (2011).

7.2.12 Policy Development

As of March 7, 2012, the Rural Hamilton Official Plan is no longer under appeal and is in full force except for 2 sections. First, a section on Surplus Farm Dwelling Severances (Chapter F1.14.2.2 c ii); and the Hamilton Airport Expansion Area (Volume 3, Special Policy Area “C”).

The Greenville Secondary Plan was prepared in 1992 as an Official Plan Amendment (OPA 13) to the Official Plan of the (former) Town of Flamborough. OPA 13 outlines land use policies, guideline for developments, growth patterns and servicing requirements.

The following policies are considered in addition to OPA 13:

- The Greenbelt Plan (2005)
- The Niagara Escarpment Plan (2005)
- Provincial Policy Statement (2014)
- Source Protection Plans (under the Clean Water Act, 2006)
- City of Hamilton Water and Wastewater Master Policy Plan (2005)
- City of Hamilton Guidelines for Hydrogeological Studies and Technical Standards for Private Services (2013)

7.3 Long List of Alternatives – Rural Settlement Area

The Secondary Plan for Greenville (1992) sets out requirements for storm water drainage and hydrogeology studies to be completed prior to new development within the Greenville Settlement Area. This study will, therefore provide alternatives related to drainage and groundwater protection for new developments. In addition, as noted in Chapter 6, impacts associated with new development will impact both surface and groundwater flows.

Chapter 4 of the Secondary Plan for Greenville summarized a variety of issues related to environmental features within the Rural Settlement Area. This would suggest that restorative measures, to be undertaken by homeowners or agencies, are also required.

Lastly, with respect to groundwater, a range of alternatives to protect or enhance groundwater quantity and quality, need to be considered. Several of these alternatives may include works or undertakings that are subject to the Environmental Assessment Act.

In summary, the alternatives that are to be considered for the Rural Settlement Area will have to address a variety of environmental resources and may be generally grouped under the following four categories.

- **Alternatives that are subject to the Environmental Assessment Act:** These alternatives will be subject to an evaluation process within this study.
- **Alternatives that fall under the Planning Act:** These measures will be identified and screened through this study. Refinement and approvals of the proposed measures will be subject to further studies.
- **Alternative that fall under the Niagara Escarpment Planning and Development Act:** These measures will be identified and screened through this study. Refinement and approvals of the proposed measures will be subject to further studies.
- **Alternatives that are classified as Operations and Maintenance undertaken by the City of Hamilton:** These measures are currently undertaken on a regular basis by various City departments.
- **Alternatives that are considered to be Stewardship projects:** These measures will be identified as part of this study and are generally not subject to further approvals. The measures are usually undertaken by homeowners or landowners and are voluntarily (therefore not subject to further approvals).

Provided below (**Table 7.4.1**) is a long list of alternatives that are to be considered for the Rural Settlement Area. Also provided with the list is a brief description of alternative together with the category for which the alternative (or group of alternatives) generally falls under (Environmental Assessment, Planning Act, City Operations and Maintenance, or Stewardship).

The alternatives which fall under the Planning Act or Stewardship will be further discussed in **Chapters 9 and 10**. The process for screening and evaluating alternatives subject to the Environmental Assessment process will be described in subsequent sections of this chapter.

7.4 Alternatives Subject to the Environmental Assessment Process

As noted in **Table 7.4.1** there are several items which are described under the general heading ‘Servicing Alternatives’. One of the objectives of the subwatershed study is to identify constraints and opportunities and investigate all alternative solutions. In this regard the subwatershed planning process may make recommendations which lead to undertakings that are subject to the Environmental Assessment Act. As noted previously, in order to meet the intent of the Act, the subwatershed study will be conducted as a Master Plan (Approach #1) and satisfy Phases 1 and 2 of the Municipal Engineer’s Association (MEA) Class Environmental Assessment process, in accordance with the established principles for Master Planning. The Master Plan will then become the basis for, and used in support of, future investigations for any specific Schedule B and C projects identified within it.

Provided below is a description of the screening and evaluation process, together with the selection of a preferred alternative for various alternatives that were considered under the general heading of ‘Servicing Alternatives’ and Stormwater Management.

Table 7.4.1: Long List of Alternatives for Rural Settlement Area

Alternative	Description	Category
Stormwater Management Measures for New Development	<ul style="list-style-type: none"> • Conventional stormwater facilities to control flooding, erosion, water quality • Low Impact Development measures to meet water balance requirements 	Environmental Assessment / Planning Act
Measures for Existing Homes	<ul style="list-style-type: none"> • Replacement of septic systems • Replacement of existing wells • Septic system inspection programs • Reduce fertilizer use 	Stewardship
Servicing Alternatives	<ul style="list-style-type: none"> • Bring up municipal water • Provide more communal wells • Control/limit development • Provide back up for existing municipal well 	Environmental Assessment
Municipal Operation & Maintenance Practices	<ul style="list-style-type: none"> • Reduce use of road salt • Reduce fertilizer use in parks 	City Operations and Maintenance
Policies	<ul style="list-style-type: none"> • Control/limit development • Enforce existing policies (e.g. lawn watering) • Implement wellhead protection policies 	Planning Act Source Protection Act
Stewardship	<ul style="list-style-type: none"> • Encourage source control (lot level) programs for homeowners to increase infiltration • Self-assessment through the “Landowner Stewardship Guide for the Ontario Landscape” from www.stewardshipmanual.ca 	Stewardship
Habitat Enhancement	<ul style="list-style-type: none"> • Stream restoration • Aquatic habitat • Terrestrial habitat 	Stewardship

7.5 Servicing Alternatives

Provided below is a description of each of the alternative solutions that were considered for servicing existing and new growth.

7.5.1 “Do nothing” – Maintain Status Quo

This alternative is traditionally carried forward as a benchmark in the Environmental Assessment process. For the purpose of this study the ‘Do-nothing’ alternative would essentially equate to

maintaining status quo. This would include continuing the use of the existing municipal well including the necessary on-going operation and maintenance practices.

7.5.2 Control / Limit Community Growth

This alternative would generally consist of limiting growth to within existing system capacities and would therefore negate new development including infills. This alternative would also include continuing the use of the existing municipal well and necessary on-going operation and maintenance practices.

7.5.3 Bring up municipal water

This alternative would involve extending the City's municipal water supply from Dundas up the escarpment to Greenville. Potable water, for part or all the Greenville would ultimately be provided from the Woodward Avenue Water Treatment Plant.

7.5.4 Provide more communal wells

There is currently one communal well, the Briencrest well, which services 26 homes. The well and pumphouse is located on the west side of Haines Avenue, between Briencrest and Kirby Avenues (see location in **Figure 4.4.8**). The well is currently owned by Infrastructure Ontario (formerly Ontario Realty Corporation) and is operated by the Ontario Clean Water Agency (OCWA). For this alternative new, or existing dwellings would be serviced by communal wells.

7.5.5 Maintain status Quo – Add Backup well

This alternative is similar to the Maintain Status Quo alternative with the exception that a backup well would be planned for in the case issues arose at the existing well.

7.6 Description of the Evaluation Criteria

The alternative solutions identified in the previous section were evaluated to select a preferred solution. **Table 7.6.2** presents the evaluation criteria used in the valuation process. The criteria, and approach used to evaluate the servicing alternatives is similar to the approach used in the City of Hamilton Water and Wastewater Master Plan Class Environmental Assessment Report (**Table 7.6.1**).

Table 7.6.1: Information Matrix For Servicing Alternatives

Evaluation Criteria	Do Nothing – Maintain Status Quo	Control – Limit Community Growth	Bring Up Municipal Water	Provide More Communal Wells	Status Quo – Add Back-up Well
Natural Environment	<ul style="list-style-type: none"> Minimal impact to natural environment as ongoing activities are limited. Ecological processes likely to maintain current trajectory. 	<ul style="list-style-type: none"> Minimal impact as further construction activities would be halted 	<ul style="list-style-type: none"> Significant impact associated with crossing of existing streams and potential impact on the Natural Heritage System 	<ul style="list-style-type: none"> Moderate potential impact as a result of stream crossings, local impacts to vegetation and wildlife 	<ul style="list-style-type: none"> Minimal impact to natural environment as ongoing and proposed activities are limited
Socio-Economic	<ul style="list-style-type: none"> Impact on existing and proposed development, recreational areas and utilities limited 	<ul style="list-style-type: none"> Neutral impact as reduction in construction activities would be offset by economic impact 	<ul style="list-style-type: none"> Significant impacts due to construction including traffic disruption, noise 	<ul style="list-style-type: none"> Significant localized impacts due to construction noise, traffic disruption 	<ul style="list-style-type: none"> Impact on existing and proposed development, recreational areas and utilities limited
Legal–Jurisdictional	<ul style="list-style-type: none"> This alternative is consistent with existing municipal and provincial policies 	<ul style="list-style-type: none"> This alternative is not consistent with existing growth policies for the city 	<ul style="list-style-type: none"> This alternative is not consistent with Provincial or Municipal policy This would require review by the Niagara Escarpment Commission 	<ul style="list-style-type: none"> This alternative is not consistent with Municipal policy and the Greenville RSA Plan on partial servicing This alternative is prohibited by the Greenbelt Plan and the Provincial Policy Statement or the Rural Official Plan 	<ul style="list-style-type: none"> This alternative is consistent with provincial policy and preferred by municipal policy requirements
Technical	<ul style="list-style-type: none"> Level of service is adequate <p>Alternative is technically feasible</p> <ul style="list-style-type: none"> Issues will arise if existing well malfunctions 	<ul style="list-style-type: none"> Level of service for existing homes is adequate 	<ul style="list-style-type: none"> Technical assessment would need to be confirmed as part of Regional assessment of water distribution system 	<ul style="list-style-type: none"> Technical assessment would be confirmed as part of subsequent, more detailed assessment 	<ul style="list-style-type: none"> Reliability of service for existing dwellings serviced by municipal well FDG01 would be improved Alternative is technically feasible <p>Two wells installed in Johnson Tew Park have required flows for backup</p>
Financial	<ul style="list-style-type: none"> Ongoing costs for operation and maintenance are quite low Future development costs borne by developer / landowner 	<ul style="list-style-type: none"> Ongoing costs for operation and maintenance are quite low 	<ul style="list-style-type: none"> This alternative would be significantly more costly than any of the other alternatives 	<ul style="list-style-type: none"> This alternative would be more costly than others, except the <i>Bring-up Municipal Water</i> alternative 	<ul style="list-style-type: none"> Ongoing costs for operation and maintenance are quite low Future development costs borne by developer / landowner Cost for back-up well tied into existing system is of moderate cost
Overall Alternative Rank					

Most Preferred      Least Preferred

Table 7.6.2: Listing of Evaluation Criteria

Physical and Natural Environment

- Impact on vegetation, fish and wildlife; surface drainage and groundwater; soil and geology
- Impact on areas of natural and scientific interest, and environmentally-sensitive areas
- Disruption of topographical features

Social, Economic, and Cultural Environment

- Impact on existing and proposed development
- Impact on archaeological and historic sites
- Impact on agricultural resources
- Impact on recreational areas
- Impact on other utilities
- Coordination with proposed roadway development

Technical Factors

- Level of service
- Security and reliability
- Impact on existing infrastructure
- Constructability
- Impact on operations and maintenance
- Meeting legislated criteria and regulations

Financial Factors

- Construction, operation and maintenance (life-cycle) costs
- Best use of existing infrastructure
- Flexibility for scheduling works

Legal and Jurisdictional Factors

- Provincial Policy Statement
- Greenbelt Plan
- Niagara Escarpment Commission
- City Water and Wastewater Policy Land Acquisition

7.7 Summary of Evaluation Process For Servicing Alternatives

7.7.1 “Do-nothing”

This alternative is traditionally carried forward as a benchmark in the Environmental Assessment process. For the purpose of this study the ‘Do-nothing’ alternative would essentially equate to maintaining status quo. This would include continuing the use of the existing municipal well (FDG01) which services 34 dwellings (approximately 108 people) and the necessary on-going operation and maintenance practices. The well is located north of Harvest Road, between the Greensville Public School and Forest Avenue (see **Figure 4.4.8**), The Briencrest communal well which services 26 homes would also be maintained. The remaining Dwellings would be serviced by individual wells

Impact Assessment

The potential for impacts associated with the “Do-nothing” alternative was assessed and options for mitigation of these impacts were reviewed. Details on the assessment are included in the following paragraphs.

Natural Environment Factors:

Construction activities would be limited to periodic maintenance activities at the existing municipal well and activities associated with drilling private wells for new development. The potential impact to aquatic, terrestrial, surface drainage and groundwater would therefore be minimal.

Socio-Economic Factors:

The impact on existing and proposed development, recreational areas or other utilities would not be significant. Ongoing issues with the existing Briencrest well would not be resolved.

Legal-Jurisdictional Factors:

This alternative is consistent with existing municipal and provincial policies.

Partial servicing is not permitted under the Greenbelt Plan, the Provincial Policy Statement (1.6.4.5) and the City's Water and Wastewater Master Plan (2005). The creation of new communal wells is permitted in the Greenville RSA if approved by the City (Rural Official Plan, 3.5.12). Under provisions of the Clean Water Act, the future Source Protection Plan will also prevail in the event of a conflict between an official plan, zoning by-law or policies under Section 3 of the Planning Act.

Technical Factors:

The level of service for the dwellings serviced by the municipal well would be adequate although issues may arise if significant operational problems arise at the well.

Financial Factors:

The estimated costs to operate and maintain the existing well are quite low relative to the cost of adding a back-up well. The cost to drill wells for new development are borne by the developer and/or homeowner.

There will be financial costs to the City to provide the residents in the 36 homes supplied by the municipal well with alternate sources of water when it is taken off-line for maintenance and repairs.

7.7.2 Control / limit community growth

This alternative would generally consist of limiting growth to within existing system capacities and would therefore negate new development including infills. This alternative would also include continuing the use of the existing municipal well and necessary on-going operation and maintenance practices.

Impact Assessment

The potential for impacts associated with the control / limit alternative was assessed and options for mitigation of these impacts were reviewed. Details on the assessment are included in the following paragraphs.

Natural Environment Factors:

The impact on the natural environment would be negligible as further construction activities would be halted.

Socio-Economic Factors:

The impact on existing development would likely be neutral as impacts associated with construction activities and associated with new development would likely be offset by the loss

in revenue associated with new development and the application of those funds to recreational areas and to local commerce.

Legal-Jurisdictional Factors:

Under Places to Grow the City is required to plan for future residential and employment growth. This growth and the goals and objectives of the GRIDS process and VISION 2020 would not be met. This alternative is therefore not consistent with existing jurisdictional factors.

Technical Factors:

The level of service for existing homes would be adequate.

Financial Factors:

The cost for this alternative would be limited to operating and maintaining the existing municipal well.

7.7.3 Bring up Municipal Water

This alternative would require extending the existing municipal potable water supply system from Dundas up to the Greenville Area and providing local municipal water mains to service the 900 plus residential units and commercial sites.

Because the Greenville area lands lie at a higher elevation than is currently serviceable through the existing Pressure District #21 in Dundas, a second Dundas Pressure District would need to be created. Creating this district would also require the following:

- Construction of a new booster pumping station
- Construction of a feeder main from Dundas to the Greenville area
- Construction of an elevated storage tank to meet peak flow and fire requirements
- Construction of local water mains to service individual dwellings and commercial/industrial sites.

Impact Assessment

The potential for impacts associated with the bringing up municipal water alternative was assessed and options for mitigation of these impacts were reviewed. Details on the assessment are included in the following paragraphs.

Natural Environment Factors:

Construction activities associated with constructing a booster station, constructing a feeder main from Dundas to Greenville, construction of an elevated tank and associated local water mains would be considerable. These activities would likely require crossings of existing

streams and may impact sensitive environmental features. Dewatering (depending on soil conditions) may also be required which would impact existing wells.

Socio-Economic Factors:

Constructing a booster station, feeder main, and local water mains will result in significant construction noise, and will likely cause traffic disruptions.

The elevated storage tank would likely be constructed within a current undeveloped area, allowing the exact siting of the tank to be within a compatible land use.

Legal-Jurisdictional Factors:

This alternative is not consistent with the Provincial Policy Statement, The Greenbelt Plan nor with the City's Official Plan. In any case, such an alternative, if allowed, would be subject to review by the Niagara Escarpment Commission.

Technical Factors:

Providing all of the servicing requirements as noted above through the existing Pressure District #21 may be somewhat limiting and would have to be confirmed as part of a larger Regional assessment on a City-wide basis. Furthermore, issues relating to twinning the feeder main to ensure a reliable supply would have to be considered.

Financial Factors:

Approximate costs for this alternative were established using unit rates as provided in the City of Hamilton Water and wastewater Master Plan Class Environmental Assessment Report (the unit costs were updated from 2005 to 2012 costs). An estimated cost, based on 1275 residential units is \$40 million.

7.7.4 Provide More Communal Wells

There is currently one communal well, the Briencrest well, which services 26 homes. For this alternative new, or existing dwellings would be serviced by communal wells.

Impact Assessment

The potential for impacts associated with the providing more communal wells alternative was assessed and options for mitigation of these impacts were reviewed. Details on the assessment are included in the following paragraphs.

Natural Environment Factors:

The impact on aquatic or terrestrial resources, surface drainage or groundwater would be dependent upon where the communal wells were constructed. Typical impacts could include those associated with watercourse crossings and local impacts to vegetation and wildlife.

Socio-Economic Factors:

Activities associated with construction of communal wells would generally result in significant construction noise, traffic disruption as well as impacts associated with dwellings adjacent to the proposed communal wells.

Legal-Jurisdictional Factors:

This alternative is not consistent with existing municipal and provincial policies.

Partial servicing is not permitted under the Greenbelt Plan, the Provincial Policy Statement (1.6.4.5) and the City's Water and Wastewater Master Plan. Under provisions of the Clean Water Act, the future Source Protection Plan will also prevail in the event of a conflict between an official plan, zoning by-law or policies under Section 3 of the Planning Act.

Technical Factors:

Assessment of the technical factors would also be site dependent. The level of service as well as security may improve if existing wells are subject to supply or quality problems. The impact of long term communal wells with respect to reliability and/or impact on operations and maintenance would generally offset these benefits dependent upon the expertise of those who look after the systems. As mentioned earlier, the sole communal well (Briencrest) not owned by the City is presently owned by Infrastructure Ontario and operated by the Ontario Clean Water Agency (OCWA). Although the well and pumphouse are operating in conformity with requirements of the Safe Drinking Water Act, the distribution system is owned by the individual residents where it lies on their properties and is not owned or managed by Infrastructure Ontario.

Bottled water is also brought in to residents due to the poor quality of the well water.

Financial Factors:

Costs for this alternative are difficult to assess as they would be site dependent, particularly in the case of Briencrest where the distribution system remains under private ownership. Typically this alternative would result in unit costs (cost/dwelling) which are lower than the alternative Bring up Municipal Water, but higher than the other alternatives.

7.7.5 Maintain Status Quo – Add Back Up Well

This alternative is similar to the Maintain Status Quo alternative with the exception that a back up well would be planned for in the case issues arose at the existing municipal well.

Impact Assessment

The potential for impacts associated with the Add Back Up Well alternative was assessed and options for mitigation of these impacts were reviewed. Details on the assessment are included in the following paragraphs.

Natural Environment Factors:

Construction activities would be limited to periodic maintenance activities at the existing municipal well and activities associated with drilling wells for new development as well as for the back-up well. The potential impact to aquatic, terrestrial, surface drainage and groundwater would therefore be minimal.

Socio-Economic Factors:

The impact on existing and proposed development, recreational areas or other utilities would not be significant. Ongoing issues with, and ownership of, the existing Briencrest communal well would not be resolved.

Legal-Jurisdictional Factors:

This alternative is consistent with existing municipal and provincial policies. This alternative is consistent with the City's Water and Wastewater Master Plan Policy Paper, Policy W.04 that states "The City of Hamilton shall provide reliability and security throughout the water distribution system".

Three test wells were installed in Johnson Tew Park, a 14.2 hectare park near Harvest and Brock Roads in February 2013 (Stantec, 2014). Two of the wells were found to provide equivalent maximum day taking and peak hour taking as the existing Greenville well FDG01. The consensus within the Hamilton Water Division is that the new wells be fitted with an independent treatment system to provide full redundancy to the Greenville backup system. The treatment system would be near Cedar Avenue.

Technical Factors:

The level of service for the dwellings serviced by the municipal well would be improved over the Do-nothing alternative as the back-up well would provide a fully-redundant secondary source of water should problems arise at the existing well.

Financial Factors:

The estimated costs to operate and maintain the existing well are quite low, estimated to be \$31,100 annually (City of Hamilton staff). The cost to drill wells for new development are borne by the developer and/or homeowner. The estimated cost to bring the two existing backup wells with a separate treatment system on line is \$1,000,000.

7.8 Stormwater Alternatives

This section reviews and evaluates stormwater management alternative measures, referred to as Best Management Practices (BMPs), to mitigate the potential development impacts (Chapter 6) and meet the selected objectives. The term Best Management Practice, which includes Low Impact Development measures (LIDs), is defined as a measure that, when implemented will assist in protecting, enhancing, or restoring the environmental features.

In keeping with the Environmental Assessment process, several alternative techniques have been identified to address the potential environmental impacts resulting from the proposed future development lands within the Rural Settlement Area (RSA):

1. Do nothing;
2. Traditional Measures;
3. Low Impact Development (LID) Measures;
4. Low Impact Development (LID) Measures and Traditional Measures

The above alternative measures focus primarily on the development of a stormwater management strategy, which is the key component of an overall Subwatershed Strategy. A description of each of the above options is discussed in more detail below.

1. Do Nothing

This measure involves developing the RSA lands without stormwater management. This alternative would result in a substantial increase in runoff, flooding, erosion and also water quality degradation both within the future development lands and the lands downstream.

2. Traditional Measures

Traditional measures are practices that are typically designed and implemented within the study area. Accordingly, these measures are:

- End-of-pipe controls including wet ponds, wetlands, and dry ponds;
- Traditional Source Control Measures including oil-grit separators and other lot level measurements such as oversized storm sewers, rooftop storage and parking lot storage

End-of-pipe measures involve addressing stormwater management using conventional stormwater facilities such as wet ponds, wetlands and dry ponds at the end of the flow conveyance system (**Figure 7.8.1**). These facilities may be utilized for any combination of erosion, water quantity and quality control applications.



Figure 7.8.1: Example End-of-Pipe Controls (clockwise from top left: Constructed Wetland, Dry Pond, Wet Pond)

Traditional Source Control Measures (**Figure 7.8.2**) are typically used at the “lot-level” within high-density forms of development such as commercial or industrial landuses. Rooftops, parking lots, or oversized storm sewers can be used to temporarily store rainfall from large storm events. The storm runoff is then released at controlled rates to avoid increased rates of erosion and flooding in the receiving streams. In terms of water quality control, oil-grit separator devices are commonly used to remove some pollutants and improve water quality before runoff is released from industrial or commercial development sites.



Figure 7.8.2: Traditional Source Controls (Clockwise, from top left: Rooftop Storage, Parking Lot Storage, Oil-Grit Separator)

3. Low Impact Development (LID) Measures

According to EPA (2007), Low Impact Development (LID) is a stormwater management strategy that seeks to mitigate the impacts of increased runoff and stormwater pollution. LID comprises a set of site design approaches and small scale stormwater practices that promote the use of natural systems for infiltration, evapotranspiration, and reuse of rainwater. These practices can effectively remove nutrients, pathogens and metals from stormwater, and they reduce the volume and intensity of stormwater flows.

LID measures include two main categories; Source Control measures, and Conveyance Control Measures. Both categories include a suite of measures as follows:

- **Source Control Measures (Figure 7.8.3)** encourage the infiltration of water into the ground and reduce stormwater runoff. These measures can be integrated into the design of future urban developments and may include:
 - Rainwater Harvesting;
 - Green Roofs;
 - Downspout Disconnection;
 - Soakaway Pits,
 - Bioretention and Special Bioretention:
 - Compost Amendments;
 - Tree Clusters;
 - Filter Strips;
 - Permeable Pavement



Figure 7.8.3: Example LID Source Controls (from L to R: Bioretention, Downspout Disconnection, Permeable Pavement, Green Roofs)

- **Conveyance Control Measures:** Conveyance controls (**Figure 7.8.4**) are linear stormwater transport systems that are often located within the road right-of-way. LID conveyance controls not only provide a conveyance function, but also encourage infiltration of water into the ground, improve water quality and reduce runoff volume. They can include bio-swales, grassed channels and subsurface perforated pipe systems. These measures include:
 - Subsurface Perforated Pipes;
 - Bio-swales;
 - Bioretention units (Bump-outs)



Figure 7.8.4: Example LID Conveyance Controls (From L to R: Vegetated Channel, Subsurface Perforated Pipe, Bio-swale, Grass Channel)

LID practices are considered at the earliest stage of site design, are installed during construction and sustained in the future as a low maintenance natural system. Each LID practice incrementally reduces the volume of stormwater on its way to the stream. In doing so, LID practices can be applied to meet stormwater management targets for water quality, geomorphic and water balance objectives.

4. Low Impact Development (LID) Measures and Traditional Measures

LID practices, together with traditional stormwater BMP's can be applied to achieve an overall stormwater management system which provides better performance, is more cost effective, has lower maintenance burdens, and is more protective during extreme storms than conventional stormwater practices alone. Several LID practices may be needed on each site to get all the required storage and attenuation.

LID techniques plus traditional measures such as ponds, oil-grit separators, and lot-level storage mimic natural systems as rain travels from the roof to the stream by applying a series of practices across the entire development site before discharge to receiving water body. Integrating the two categories would provide a 'treatment train' approach to provide integrated treatment of runoff from development sites.

7.9 Evaluation of Alternative Measures

In order to ensure a transparent selection process (as part of the EA) that considers all possible alternatives, a two-phased evaluation process has been used to assess the alternative measures discussed in the previous Section. The two-phased approach (**Figure 7.9.1**) is composed of:

1. Screening level assessment; followed by a
2. Detailed assessment.

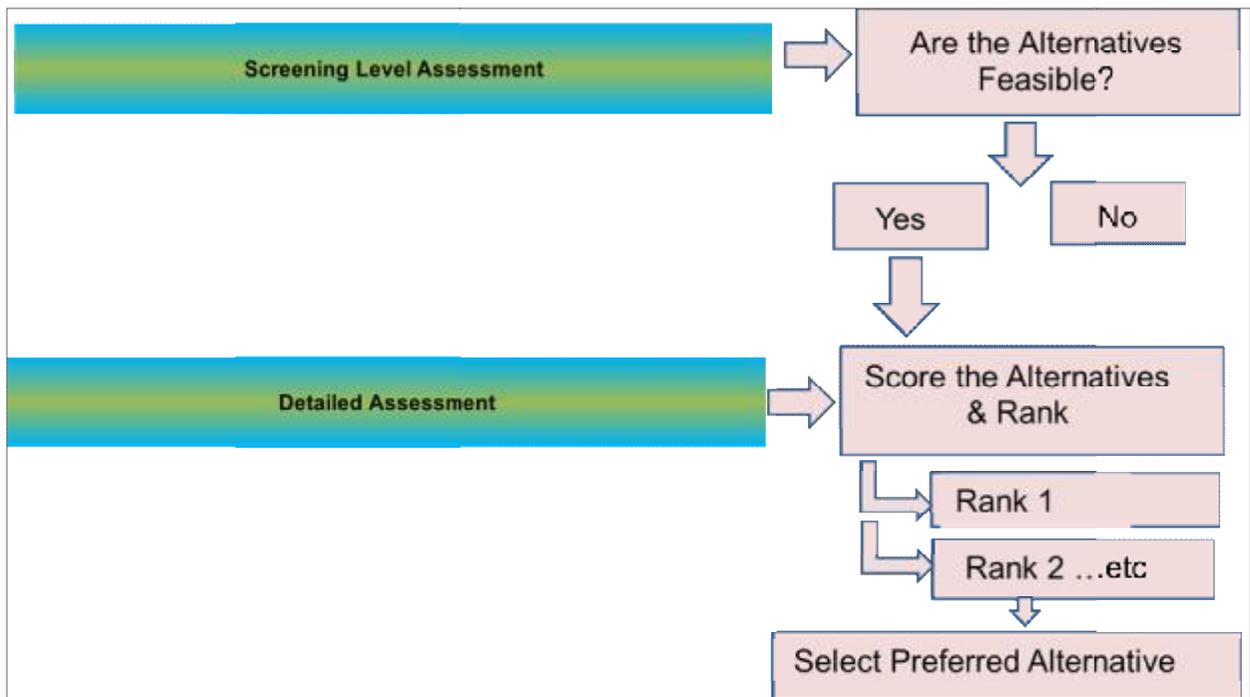


Figure 7.9.1: The Evaluation Process

7.9.1 Screening Level Assessment

The screening level assessment is intended as a coarse screening tool, used to review the stormwater measures that are feasible (and infeasible) for use within the Rural Settlement Area (RSA). To this end, nine (9) screening level assessment criteria have been utilized to determine which stormwater alternatives are to be carried forward to the more detailed assessment phase. The primary criteria include:

- 1) Technical feasibility;
- 2) Ability to meet targets for flooding,
- 3) Ability to meet targets for water quality,
- 4) Ability to meet targets for erosion and
- 5) Ability to meet targets for water balance;
- 6) Cost effectiveness;
- 7) Land requirements;
- 8) Public acceptance; and
- 9) Regulatory agency approval.

Table 7.9.1 describes the screening level assessment criteria and measures for assessment. **Table 7.9.2** presents the results of the screening level assessment. As shown in **Table 7.9.2**, the “Do Nothing” option does not meet flooding, water quality, erosion, or water balance objectives and would also not be acceptable to regulatory agencies. Traditional measures including End-of-Pipe measures tend to be inconsistent with higher-density urban settings due to the relatively large land area requirements, while dry ponds rank poorly in several categories and are not generally favoured by the public or regulatory agencies. These techniques, together with the “Do Nothing” option, were not carried forward to the second, detailed assessment phase.

Table 7.9.1: Primary Criteria used in Screening Level Assessment (Phase 1)

Criteria	Description of Criteria	Measures for Assessment
Technical feasibility	<ul style="list-style-type: none"> Ability of the SWM technique to be constructed given the known constraints. 	<p>The assessment of the individual stormwater control measures ranges from Excellent to Poor in its ability to meet the identified criteria.</p> <p>Stormwater management techniques that fail to meet primary criteria will be deemed to be an unacceptable option and will <u>not</u> be carried forward to the detailed assessment (scored NA – Not acceptable).</p>
Ability to meet targets for flooding	<ul style="list-style-type: none"> Ability of the SWM technique to meet flood control criteria. Technique must control peak outflows for the site to pre-development rates for design storms with return period up to 100yrs. Cannot increase flooding risks to infrastructure and private property. 	
Ability to meet targets for water quality	<ul style="list-style-type: none"> Ability of the SWM technique to meet water quality criteria as per Table 3.2 of the 2003 MOE Stormwater Management Manual. 	
Ability to meet targets for erosion	<ul style="list-style-type: none"> Ability of the SWM technique to control water course erosion in accordance with the 2003 MOE Stormwater Management Manual. 	
Ability to meet targets for water balance	<ul style="list-style-type: none"> Ability of the SWM technique to maintain the pre-development water balance and prevent adverse changes to site hydrology. 	
Cost effectiveness	<ul style="list-style-type: none"> Cost effectiveness of the SWM technique in relation to the overall benefit and the collective criteria. 	
Land requirements	<ul style="list-style-type: none"> A measure of the amount of land required to construct the SWM technique in relation to the overall benefit. 	
Public acceptance	<ul style="list-style-type: none"> General public acceptance of the individual stormwater management technique. 	
Regulatory agency approval	<ul style="list-style-type: none"> Ability of the SWM to meet the requirements of Municipal, Provincial, Federal agencies and the respective Conservation Authorities. 	

Table 7.9.2: Phase 1 Screening-Level Evaluation Matrix

Stormwater Alternatives	Technical Feasibility	Flooding	Water Quality	Erosion	Water Balance	Cost Effectiveness	Land Requirements	Public Acceptance	Regulatory Agency Approval	Overall
Do Nothing	E	NA	NA	NA	NA	E	E	NA	NA	NA
LID Measures										
LID Source Control (infiltration / filtration)	E	P	E	E	E	P	F	G	E	G
LID Conveyance (infiltration / filtration)	E	F	G	G	G	G	G	G	G	G
Traditional Measures										
Traditional Source Control (storage)	E	E	P	G	P	G	G	G	F	G
Wet pond	E	E	G	F	P	G	F	E	E	G
Wetland	E	E	E	G	P	P	NA	G	G	NA
Dry Pond	E	E	P	G	P	G	F	NA	P	NA
	E=Excellent, G= Good, F = Fair, P=Poor, NA = Not Acceptable									

7.9.2 Detailed Assessment

The stormwater management techniques carried forward from screening level assessment were:

- LID Measures (Source control and Conveyance control), and
- Traditional Measures (Traditional source control and Wet ponds)

Both categories were investigated further. A category that combines LID measures and Traditional measures was added to evaluate if implementing both categories would achieve higher score than that achieved by implementing each of them individually. Accordingly, there are seven (7) alternatives that could be classified under the two categories mentioned above (LID measures and Traditional measures). They are:

1. Traditional Measures – Traditional Source Control;
2. Traditional Measures – Wet ponds;
3. Traditional Measures - Traditional Source Control and Wet ponds;
4. Low Impact Development (LID) Measures – Source Control
5. Low Impact Development (LID) Measures _ Conveyance Control;
6. Low Impact Development (LID) Measures – Source Control and Conveyance Control;
7. Low Impact Development (LID) Measures and Traditional Measures

The Detailed Assessment is a much more rigorous and thorough assessment of each alternative, and is based on a set of 19 evaluation criteria under 4 groupings, as described below:

Physical and Natural Environment Criteria

- Ability to meet targets for water balance and mitigate impacts to groundwater recharge and runoff volumes;
- Ability to meet criteria for flooding,
- Ability to meet water quality criteria;
- Ability to meet erosion criteria;
- Impact on terrestrial and aquatic habitat.

Social, Economic and Cultural Environment Criteria

- Impact on existing and proposed development;
- Aesthetic value;
- Potential benefit to the community and public acceptance;
- Coordination with infrastructure design

Technical Criteria

- Level of service and proven effectiveness;
- Regulatory agency acceptance (Municipal, Provincial, Federal and Conservation Authority);
- Impact on existing infrastructure;
- Constructability; and
- Maintenance requirements.

Financial Criteria

- Capital costs;
- Operation and maintenance costs;
- Land requirements;
- Impact on property value; and
- Phasing considerations.

Description of the Detailed Assessment criteria and measures for assessment is provided in

Table 7.9.3. As shown, each stormwater management alternative is given a score of 1 (poor) to 4 (excellent) for each of the evaluation criteria. These scores are then applied and an aggregate score is assigned to each alternative. A matrix illustrating the results of the detailed assessment for each of the three (3) stormwater management alternatives is presented in **Table 7.9.7.**

Table 7.9.3: Description of the Physical and Natural Environment Criteria used in the Detailed Assessment

Criteria	Description of Criteria	Measures for Assessment
Ability to meet targets for Water balance	<ul style="list-style-type: none"> Ability of the SWM alternative to mitigate undesired impacts to the pre-development water balance and prevent adverse changes to site hydrology (surface drainage, groundwater recharge, soils and geology). 	Scoring ranges from 4 if the potential to mitigate changes to the pre-development is high, to 1 if the potential to mitigate water balance changes are low and post-development changes are anticipated.
Ability to meet targets for Flooding	<ul style="list-style-type: none"> Ability of the SWM alternative to meet flood control criteria. Alternative must control peak outflows for the site to pre-development rates for design storms with return period up to 100yrs. Cannot increase flooding risks to infrastructure and private property. 	Scoring ranges from 4 if the potential to meet flooding criteria is high, to 1 if the potential is low and downstream flooding is anticipated.
Ability to meet targets for Water quality	<ul style="list-style-type: none"> Ability of the SWM alternative to meet water quality criteria as per Table 3.2 of the 2003 MOE Stormwater Management Manual. 	Scoring ranges from 4 if the potential to meet water quality criteria is high, to 1 if the potential is low and water quality impacts are anticipated.
Ability to meet targets for Erosion	<ul style="list-style-type: none"> Ability of the SWM alternative to control water course erosion in accordance with the 2003 MOE Stormwater Management Manual. 	Scoring ranges from 4 if the potential to erosion criteria is high, to 1 if the potential is low and erosion impacts are anticipated.
Impact on terrestrial and aquatic habitat: Connectivity, Diversity and Sustainability	<ul style="list-style-type: none"> Potential for the SWM alternative to mitigate impacts to terrestrial and aquatic habitat. Ability for the SWM alternative to provide opportunities for connectivity, diversity and sustainability for terrestrial and aquatic habitats. 	Scoring ranges from 4 if the potential to mitigate impacts to terrestrial and aquatic habitat and provide additional opportunities for connectivity, diversity and sustainability is high, to 1 if the potential is low and impacts are anticipated.

Table 7.9.4: Description of the Social and Cultural Environment Criteria used in the Detailed Assessment

Criteria	Description of Criteria	Measures for Assessment
Impact on existing and proposed development	<ul style="list-style-type: none"> Potential for the SWM alternative to be integrated with the existing and proposed land uses within the study area. 	Scoring ranges from 4 if the potential for land use integration is high, to 1 if the potential is low.
Aesthetic value	<ul style="list-style-type: none"> Potential for the SWM alternative to provide an aesthetic benefit to the existing and proposed community. 	Scoring ranges from 4 if the SWM alternative has potential aesthetic value, to 1 if the potential is low.
Potential benefit to community and public acceptance;	<ul style="list-style-type: none"> Potential benefit to the community with respect to integration into natural areas, passive use areas, trails, as well as general public acceptance of the SWM alternatives. 	Scoring ranges from 4 if the potential for integration in public areas and public acceptance is high, to 1 if the potential for integration and public acceptance is low.
Coordination with proposed roadway design	<ul style="list-style-type: none"> Potential for the proposed SWM alternative to be integrated into the proposed standard roadway cross-sections. 	Scoring ranges from 4 if the potential for integration with the proposed roadway design is high, to 1 if the potential for integration is low.

Table 7.9.5: Description of the Technical Criteria used in Detailed Assessment

Criteria	Description of Criteria	Measures for Assessment
Level of service and proven effectiveness	<ul style="list-style-type: none"> Degree to which the SWM alternative has been proven effective through scientific literature and long-term implementation and monitoring. 	Scoring ranges from 4 if the SWM alternative has been proven effective, to 1 if the alternative is unproven.
Regulatory agency acceptance	<ul style="list-style-type: none"> General level of acceptance of the SWM alternative by the various regulatory agencies (Municipal, Provincial, Federal and CA) 	Scoring ranges from 4 if the SWM alternative is generally accepted by the various regulatory agencies, to 1 if the alternative is generally not accepted.
Impact on existing infrastructure	<ul style="list-style-type: none"> Potential disruption to existing infrastructure (services, roads, etc) 	Scoring ranges from 4 if the potential for disruption is low, to 1 if the potential for disruption is high.
Constructability	<ul style="list-style-type: none"> Degree of difficulty in constructing the SWM alternative given the existing site conditions and constraints. 	Scoring ranges from 4 if the general constructability is high, to 1 if it is low.
Maintenance Requirements	<ul style="list-style-type: none"> Degree of anticipated future effort required to maintain the SWM alternative in good working order. 	Scoring ranges from 4 if the level of anticipated future maintenance is low, to 1 if the alternative requires extensive future maintenance.

Table 7.9.6: Description of the Financial Criteria used in the Detailed Assessment

Criteria	Description of Criteria	Measures for Assessment
Capital costs	<ul style="list-style-type: none"> The relative cost of constructing the SWM alternative. 	Scoring ranges from 4 if the relative cost is low, to 1 if the relative cost is high.
Operations and Maintenance Costs	<ul style="list-style-type: none"> The relative cost of operating and maintaining the SWM alternative 	Scoring ranges from 4 if the relative cost of maintenance is low, to 1 if the relative cost is high.
Impacts on property value	<ul style="list-style-type: none"> Potential impacts (positive or negative) to local property value, based on aesthetic benefits, potential land-use synergies and general economic incentives. 	Scoring ranges from 4 if the potential benefit to property value is high, to 1 if the potential benefit is low.
Phasing Considerations	<ul style="list-style-type: none"> Degree to which the SWM alternative can be effectively implemented as per the proposed construction phasing plan. 	Scoring ranges from 4 if the potential to implement to SWM alternative as per the construction phasing plan is high, to 1 if the potential is low

Table 7.9.7: Detailed Assessment Matrix for Selecting the Preferred Alternative

Alternative #	Alternative Description	Physical and Natural Environment					Social and Cultural Environment				Technical Criteria					Financial Criteria					Aggregate Score
		Water Balance	Flooding	Surface Water Quality	Erosion	Terrestrial and Aquatic Habitat	Existing Land Uses	Aesthetic Value	Benefit to Community and Public Acceptance	Coordination with Infrastructure Design	Proven Effectiveness	Regulatory Agency Acceptance	Impact on Existing Infrastructure	Constructability	Maintenance Requirements	Capital Costs	Operation and Maintenance Costs	Land Requirements	Impacts on Property Values	Phasing Considerations	
Traditional Measures																					
1	Traditional Measures – Traditional Source Control Only	1	3	1	3	1	2	1	1	3	3	3	3	3	3	3	4	4	1	4	47
2	Traditional Measures – Wet Ponds Only	1	4	3	3	2	3	3	3	4	4	4	3	4	3	2	3	1	3	2	55
3	Traditional Measures - Traditional Source Control and Wet Ponds	1	4	3	3	2	3	3	3	4	4	4	3	4	3	3	3	2	2	3	57
Low Impact Development (LID) Measures																					
4	LID Measures – Source Control Only	3	1	3	2	3	3	3	3	3	3	2	2	3	2	3	2	3	3	4	51
5	LID Measures _ Conveyance Control Only	2	1	2	2	3	2	2	2	2	3	2	2	2	2	3	2	3	2	2	41
6	LID Measures – Source Control and Conveyance Control;	4	1	3	2	3	3	3	3	2	3	2	2	2	2	2	2	3	3	2	47
7	LID Source Control and Traditional Measures	4	4	4	4	4	3	4	4	4	4	3	3	2	2	2	2	1	3	2	59*

*The preferred alternative for the RSA study area is Alternative 7 – LID Source Control Measures and Traditional Measures

7.10 Selection of the Preferred Alternative

As shown in **Table 7.9.7**, the preferred alternative for the Rural Settlement Area is Alternative 7, which consists of LID source control measures combined with Traditional measures, which include end-of-pipe wet ponds and oil and grit separators. This alternative ranks highly under the physical and natural environment criteria, and the social-cultural criteria. It also ranks relatively well under the technical criteria. The higher score of the LID source control measures compared to the score of the combined LID (source and conveyance) measures was the reason it was selected to be combined with the traditional measures.

In terms of stormwater management objectives, the use of LID source controls as part of this strategy would provide water balance, water quality, and erosion benefits. And the use of wet ponds as part of the strategy would provide further water quality, erosion and flood control benefits.

It should be noted that the feasibility of an end-of-pipe stormwater pond is constrained somewhat by the size of the area it services. In general, the MOE Stormwater Management Planning Manual (MOE, 2003) suggests that the service area for a stormwater pond should preferably be at least 10 hectares, and not less than 5 hectares. Through a review of the location of future development lands together with drainage patterns, it is understood that some future development sites may not be large enough to be serviced by a stormwater pond. In this case, LID source controls in addition to oil and grit separators would provide the desired water quantity and quality benefits. Accordingly, the following recommendations would be appropriate for the study area.

Preferred Stormwater Management Strategy (for sites > 5ha):

- LID source controls;
- End-of-pipe wet ponds

Alternate Stormwater Management Strategy (for sites < 5ha):

- Traditional source controls (i.e. surface storage and Oil/Grit separators);
- LID source controls

8 COMMUNITY LIAISON COMMITTEE AND SECOND PUBLIC INFORMATION CENTRE

Two Community Liaison Committee Meetings (CLC) and a second Public Information Centre were held.

The first CLC meeting was held on October 08, 2008 while the second was held on January 14, 2009. Both meetings were held at the Flamborough Christ Church. The second public meeting was held at the Christ Church on January 22, 2015.

Provided below is a summary of the objectives and findings for each of these events. Further information is provided in **Appendix M**.

Community Liaison Committee #1

Eight members of the community in addition to City and consultant staff attended the meeting. The objectives of the meeting were to review the findings of the first PIC, discuss issues and concerns and to review and comment on several presentations. The alternatives with respect to providing potable water were also discussed.

A presentation regarding water balance was given. Committee members asked questions pertaining to the value of digging a deeper well, the importance of topography, and the impact of adjacent quarries.

An overview of a well testing program that was carried out in 2008 was given as was an overview as to the alternatives for providing potable water. A list of recommendations from the CLC include increasing by-law enforcement, monitoring quarry activity, providing consistent guidelines for hydrogeologic assessments, education about stewardship measures, and the development of sustainable practices for new and existing homeowners. The City and consultant team were asked to further explore opportunities and frameworks for the second CLC.

Community Liaison Committee #2

Eight members of the community in addition to City and consultant staff attended the meeting. The objectives of the meeting were to review the findings of the first CLC, discuss concepts and development of programs that could be initiated within the Greenville area and to introduce the friends of Greenville Creek group.

The City provided an overview of ongoing incentive programs that relate to water conservation, septic systems or replacement of existing wells. Two concepts for involving the community in programs which may improve groundwater quality or quantity were also presented. The first involves a passive approach whereby residents are directed to programs

via mail outs. The second involves a more active approach whereby focus groups and workshops are initiated by the City and directed by professionals with an objective to develop long term stakeholder engagement in the community. Several residents supported the more active approach but noted that the program could be led by local residents (or a resident group).

The Friends of Greenville Creek group provided background on their initiative and their desire to coordinate activities amongst homeowners in order to improve water quality, natural functions and habitat within the area.

City staff closed the meeting by stating they would take the ideas that were generated to further develop policy and recommendations for public review.

Second Public Information Centre

The second public meeting was held at the Christ Church on January 22, 2015. Approximately 40 people attended. The public open house included:

- A series of poster boards which defined
 - The study areas
 - Study goal, objectives and key tasks
 - The Municipal Class Environmental Assessment process
 - A description of the preliminary natural heritage, stormwater and groundwater systems
 - The evaluation process and preliminary preferred stormwater management strategy
 - The evaluation process and preliminary preferred domestic water supply alternative
- Circulation of Workshop Participant Workbook.

Verbal comments were received from many of the participants and requests for data or digital versions of the poster boards were responded to. Only four participant workbooks were submitted. The responses were in agreement with the selection of the preferred stormwater and domestic water supply alternatives. With respect to the stewardship initiatives two people expressed an interest with respect to implementing stewardship measures and thought that City or Conservation Authority assistance with respect to technical support, financial assistance or provision of brochures or pamphlets would be of value.