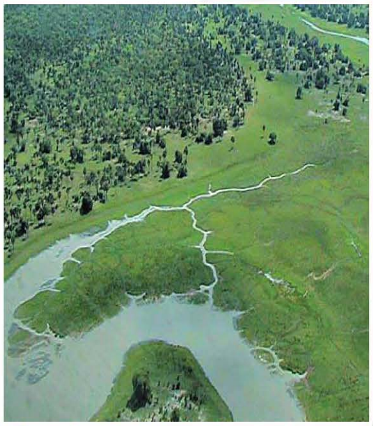
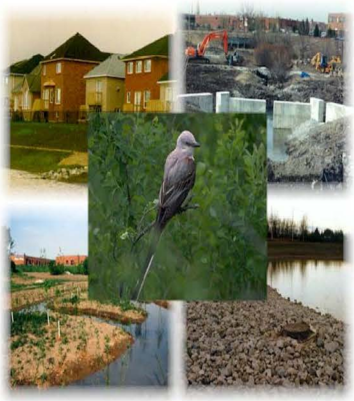
Everett Secondary Plan Master Servicing Plan

Class Environmental Assessment Study Report

VOLUME 2

Background Studies



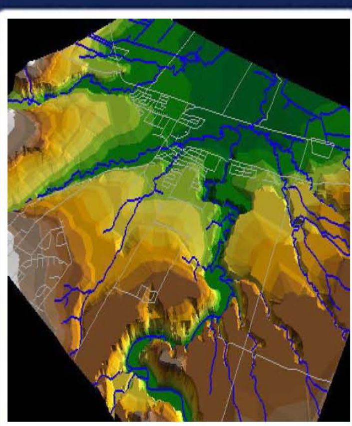


Prepared For:

The Township of

Adjala-Tosorontio

January, 2013



GREENLAND® Consulting Engineers

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120 Hume Street, Collingwood, Ontario, Canada L9Y 1V5

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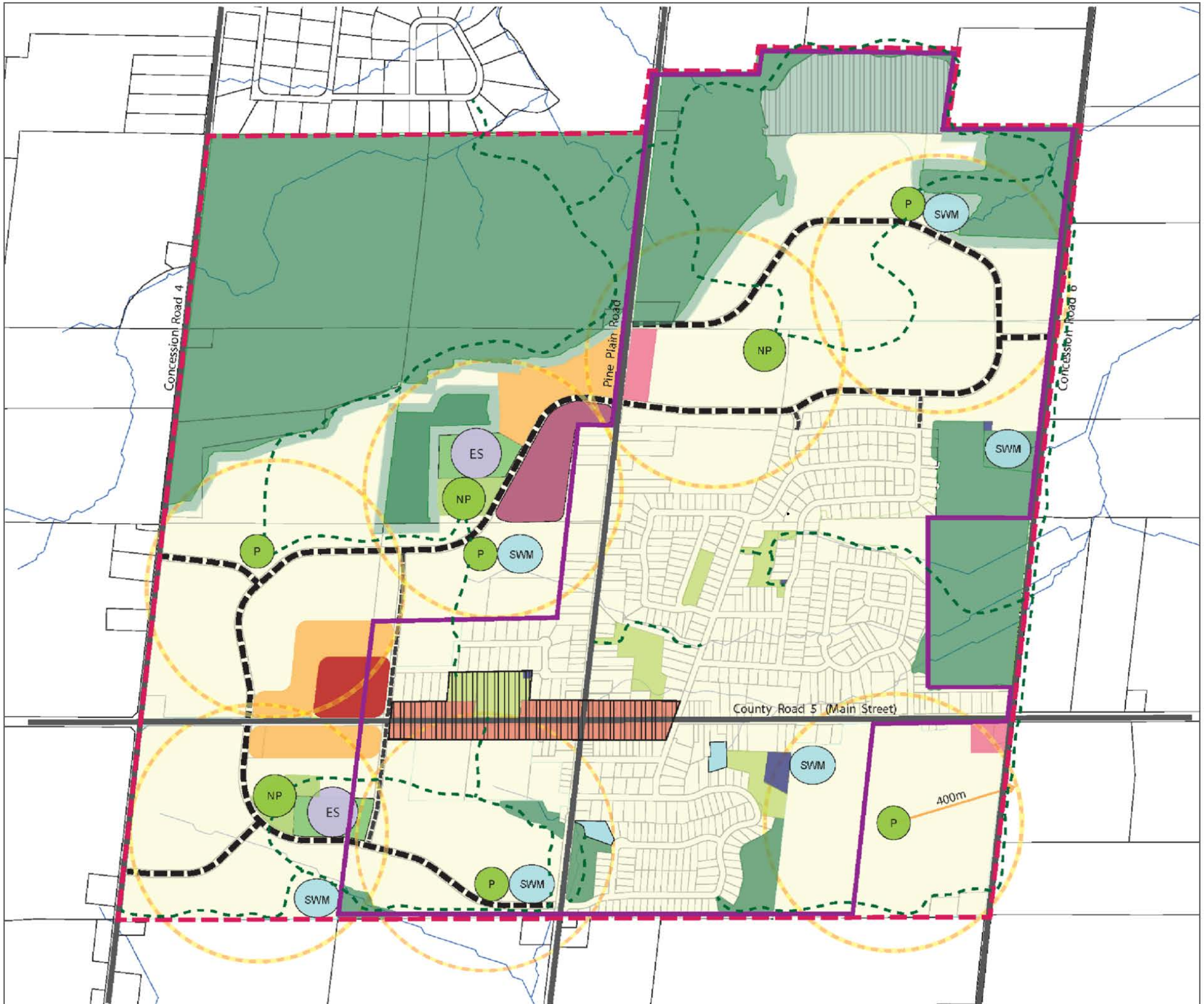
VOLUME 2: BACKGROUND STUDIES
Part 1 – Concept Land Use Plan

FIGURE A-1
Everett Secondary Plan
Township of Adjala-Tosrontio



Conceptual Land Use Legend

- Proposed Secondary Plan Boundary
- Low Density Residential
- Medium Density Residential
- Convenience Commercial
- Main Street
- Neighbourhood Commercial
- Community Centre
- Existing Parks / Open Space
- NP Proposed Neighbourhood Park
- P Proposed Parkette
- ES Proposed Elementary School
- Existing SWM
- SWM Proposed SWM
- Natural Heritage System
- 30.0m buffer
- Lands for further Study
- Proposed Local Road (20.0m)
- Proposed Collector Road (23.0m)
- Utilities
- Community Improvement Areas
- 400m Radius (5 minute walking distance)
- Proposed Trail Network

GREENLAND® consulting engineers

SCALE 1:5000

N

VOLUME 2: BACKGROUND STUDIES

Part 2 – Preliminary Hydrogeological Investigation

GREENLAND®

November 2012

COMMUNITY OF EVERETT CLASS EA: WATER SUPPLY

Preliminary Hydrogeological Investigation

Submitted to:
Township of Adjala - Tosorontio
C/O Greenland Consulting Engineers
120 Hume Street,
Collingwood, ON L9Y 1V5

REPORT

Report Number: 12-1170-0033

Distribution:

2 copies - Greenland Consulting Engineers

1 copy - Golder Associates Ltd.

Golder Associates

Table of Contents

1.0 INTRODUCTION

The purpose of this letter report is to provide a hydrogeological basis for the selection of the preferred alternative for an expansion of the existing groundwater supply in the Community of Everett (Everett). Everett currently obtains potable water supplies from two deep wells located within the Community boundaries. Wastewater servicing is currently via private on-site sewage waste disposal systems. Everett is located approximately four kilometers north west of the Community of Alliston and approximately 20 km south west of the City of Barrie.

Golder Associates Ltd (Golder) has been retained by Greenland Consulting Engineers (Greenland) to provide an assessment of the existing water supply, the potential for additional water supplies, the location of additional water supply wells, and to comment on the Source Water Protection issues.

1.1 Water Supply Requirements

Greenland has prepared an assessment of water supply demand for Everett (Attached in Appendix A). The population of Everett is currently 1,929. Their Maximum Day Demand (MDD) for the past three years was 939 m^3/day and the MDD peaking factor is 2.43 times the Average Day Demand (ADD).

The future water demand is divided into three phases with population thresholds of 3,500, 7,000 and 10,000 people. The future ADD and MDD are as follows:

Phase	Population	ADD (m^3/day)	MDD (m^3/day)
Phase 1	3,500	819	1,829
Phase 2	7,000	1,782	3,755
Phase 3	10,000	2,607	5,214

The MDD is typically required from the water supply source, while the Peak Hour Demand is provided from storage.

2.0 EXISTING WATER SUPPLIES

Everett is currently supplied by three wells constructed in a confined artesian aquifer and are located within the developed area of Everett (Figure 1). Two of the wells are located on Pine Park Blvd (Well 1 and Well 3) and one well is located on Main Street (Well 2). The well records are attached as Figures 2, 3 and 4. The former production wells (PWs 1-78 and 2-78) were constructed in the upper aquifer and have been abandoned due to elevated nitrate concentrations. The shallow aquifer is found in Everett at an elevation range of approximately 220 to 240 masl, which is at a maximum depth of approximately 20 metres below the ground surface.

Well 1 was constructed by Northern Well Drilling (License # 3903) in 1989. The well has a diameter of 254 mm and an overall depth of 62.2 m. The well is equipped with nominal 254 mm diameter telescoping well screen with 16 slot screen installed between 56 and 62.5 mbgl (metres below ground level). The 6.1 m long well screen has a theoretical transmitting capacity of approximately 25 L/sec. Well 1 was originally tested at a rate of 27.3 L/sec for a period of 24 hours, during which time water levels declined from 7.74 mbgl to 35.1 mbgl. A specific capacity of 1.0 L/sec per metre of drawdown is calculated from the original testing.

Testing done in 2011 by Stantec (2011) resulted in a specific capacity of 1.4 L/sec per metre of drawdown. The 2011 testing was done at a rate of 21.1 L/sec which accounts for the slightly higher specific capacity. The recent testing indicates that the performance of the well is similar to that noted during the original testing.

The primary limitations for higher well yields from all of the wells in Everett are the limited aquifer thickness and the relatively fine textured nature of the aquifer. The transmitting capacity of the well screen in Well 1 is relatively low at 25 L/sec. The transmitting capacity of a well screen is the pumping rate at which water passes through the well screen at a velocity of 3 cm/sec under ideal conditions. In naturally developed water wells a significant portion of the well screen is blocked by the aquifer materials; therefore the velocity of water across the well screen is greater than 3 cm/sec. For this reason, many well designers consider the safe yield for a well to be half of the theoretical transmitting capacity of the well screen.

Pumping wells at rates that result in water passing through the screen at velocities higher than 3 cm/sec can cause an increase in the rate of encrustation of the screen by carbonate minerals and an increased rate of corrosion of the well screen. Encrustation of the well screen will result in increased maintenance costs and corrosion of the well screen will reduce the well's useful life. Well 1 is currently operating at 21 L/sec and the well losses are similar to those recorded during the original construction of the well. The current yield of Well 1 is 84% of the maximum theoretical yield for the well screen. The well yield should not be increased over the permitted amount.

Well 2 was constructed by Lunny Well Drilling (License # 3406) in 1990. The well has a diameter of 254 mm and an overall depth of 61.0 m, including a 0.91 m sump at the base of the screen. The well is equipped with nominal 254 mm diameter telescoping well screen with 16, 30 and 50 slot well screen installed between 54.3 and 60.0 mbgl (Figure 3). The 5.5 m long screen has a theoretical transmitting capacity of approximately 30.5 L/sec. The well was originally tested at a rate of 22.7 L/sec for a period of 24 hours, during which time water levels declined from 12.94 m to 39.51 m. A specific capacity of 0.86 L/sec per metre of drawdown was calculated from the original test data.

Well 2 has similar limitations to Well 1, in that the limited aquifer thickness and fine texture of the aquifer limited results in small unit well yields. The transmitting capacity of the screen is approximately 30.5 L/sec and the current yield of Well 2 is 75% of the theoretical transmitting capacity of the well screen. Pumping wells close to or above their theoretical capacities can result in encrustation of the well resulting in increased maintenance and corrosion of the screen results in a shortened well life. Currently Well 2 is operating at approximately 22.7 L/sec, which appears to be acceptable; however the well yield should not be increased over the permitted amount.

Well 3 was constructed as a test well by Snider Well Drilling of Craighurst (License # 4816) in 1978. The well has a diameter of 152 mm and an overall depth of 57.9 m. The well is equipped with nominal 152 mm diameter telescoping well screen with 16 slot screen installed between 56 and 62.5 mbgl. The 4.6 m long well screen has a theoretical transmitting capacity of approximately 11.7 L/sec. The well was originally tested at a rate of 11.2 L/sec for a period of 24 hours, during which time water levels declined from 7.44 mbgl to 18.1 mbgl. A specific capacity of 1.1 L/sec per metre of drawdown is calculated from the original testing.

Well 3 has similar limitations to Wells 1 and 2 with respect to the limited aquifer thickness and fine texture of the aquifer plus the added limitation of a smaller casing diameter than the other two wells. The transmitting capacity of the screen is approximately 12.9 L/sec. Well 3 is currently permitted to take 11 L/sec, which is 85% of the theoretical transmitting capacity of the well screen. Operation of the well at this rate would result in screen entrance velocities in excess of 3 cm/sec, which as described above, could result in an increased rate of encrustation of the screen by carbonate minerals and an increased rate of corrosion of the well screen resulting in a shortened useful life for the well.

2.1 Existing and Future Aquifer Yield

The wells operate under PTTW 93-P-3011 and conditions included in the PTTW include the measuring of non-pumping water levels in production wells on a monthly basis. Golder has reviewed these data for the past three years and compared them to the as-built static water levels. The current non-pumping water levels in the production wells are within 0.5 m of the original water levels during low demand periods and within 2 m of the original static water levels during high water demand periods. It should be recognized that the water level monitoring is done manually and pumps are turned off for a relatively short period of time prior to measuring the static water level. These water levels may represent partially recovered water levels. It is therefore reasonable to conclude that there has been no significant reduction in the static water level in the aquifer at the Everett municipal water supply wells since their construction. The water use at Everett has been 368 to 400 m^3/day over the past three years with maximum day demands of 797 to 1045 m^3/day.

Golder and Waterloo Hydrogeologic conducted well head protection mapping in 2004 (Golder, 2004). This work involved the preparation of a ModFlow 3-D groundwater flow model. This modelling work indicated that an average day water demand of 2,500 m^3/day is available from groundwater resources in the area. The future average day water demand for the area is 2,607 m^3/day, which is expected to be available from the lower aquifer system.

Further work to develop water supplies that will increase the water supply above the current permit to take water maximums will be required. It is expected that this work will include the construction of an additional water supply that will be capable of providing a minimum of 16 L/sec.

3.0 FUTURE WATER SUPPLIES

3.1 Options for water:

There are limited options for additional water supplies in or near Everett. As noted earlier the upper aquifer in the Everett area currently has elevated nitrate concentrations and is unsuitable as a water supply source for municipal purposes. The source of the nitrate is not completely certain, however a combination of the application of agricultural fertilizer and private on-site sewage disposal systems are the likely sources.

The confined artesian aquifer that is being used to supply water to the Everett municipal water distribution system is currently unaffected by the elevated nitrate concentrations in the upper aquifer. This source of water supply continues to be the only viable groundwater source in the area of Everett.

3.2 Groundwater Supply Options

Golder has prepared a series of draft cross sections in the Everett area and two of these have been presented here as Figures 4 and 5. They were prepared using the Ontario Water Well Record database that is compiled and maintained by the Ontario Ministry of the Environment. The database that was used to prepare the maps and cross sections appearing herein was updated at the initiation of this study.

Figure 4 is oriented in an east – west orientation with the line of section along County Road 5 through Everett. The cross section shows the presence of a thick unconfined aquifer in the Everett area. This aquifer was intersected at Everett Wells 1 and 3, where it is approximately 20 m thick. In most areas there is a confined artesian aquifer with a limited thickness that is found at an elevation of approximately 200 metres above sea level (masl) in the Everett area. This aquifer is used by individuals as a source of water supply. The middle aquifer is relatively thin and as a result not useful as a municipal water supply aquifer. The confining layer between the middle and lower aquifer is 5 to 10 m thick in the Everett area.

The Municipal water supply in Everett is likely a lateral equivalent to Regional Aquifer A3 as identified in the Barrie Borden area. This aquifer is generally protected from contamination of surface activities. The area of Everett is similar to other areas in Simcoe County where the Regional A3 Aquifer has little evidence of the impact from surface activities, such as low nitrate concentrations.

The extent of Aquifer A3 is shown on Figures 4 and 5 as the shaded yellow pattern between the elevations of 175 and 190 masl. Aquifer A3 is found throughout the area and to the west of Everett in the Mansfield area Aquifer A3 may be hydraulically connected to Aquifer A2. Aquifer A3 appears to be thicker toward the north and east of Everett.

Figure 6 is a compilation of the well yields of wells within a 10 km radius of Everett. The pumping rates are represented as circles around the water well and are proportional to the yield of the well. High capacity municipal wells are present in Everett, Lisle and Alliston, while high capacity irrigation wells are found between Alliston and Everett, to the east of Everett and to the west of Lisle.

3.3 Future Water Well Drilling

The detailed data from the original testing for Well 1 (Grohal #2) and Well 2 (Ballpark) are not available; however it is clear from the water well records that the wells have similar drawdown and yield characteristics. The interference resulting from the pumping of these wells is not documented in the reports; therefore the Theis equation has been used to estimate the mutual interference among the wells.

The aquifer at Well 1 was intersected between 53.6 and 62.4 mbgl, resulting in 8.9 m of aquifer. The aquifer was relatively uniform and a 16 slot screen was installed in the well. The aquifer at Well 2 was intersected between 55.2 and 61.6 mbgl, resulting in 6.37 m of aquifer, which is 2.5 m thinner than at Well 1. On the basis of a slightly higher specific yield from Well 1 and a greater aquifer thickness, the site of Well 1 has been assessed for a new water supply well with a yield of 15.8 L/sec. Assuming Well 1 and Well 2 each yield 1,964 m^3/day, a well yield of approximately 15.8 L/sec would be required from a third well.

The zone of influenced may be governed by the lateral groundwater flow through the granular soils, based on the reported transmissivity from aquifer testing (Trow, 1990) of 205 m^2/day.

Applying the Theis analytical solution, the lateral extent of groundwater level drawdown can be estimated as follows:

$$s(r,t) = \frac{Q}{4\pi T} W\left(\frac{r^2 S}{4Tt}\right)$$

where $s(r,t)$ = drawdown at distance (r) and time (t) after the start of pumping,

Q = pumping rate required to supply the ADD potable water supply (2,600 m^3/day),

T = aquifer transmissivity (205 m^2/day – based on field study results),

S = aquifer storativity (1×10^{-4} – assumed for confined aquifer conditions), and,

W = Theis well function.

It is assumed that a new well would be constructed 100 m from Well 1 and would yield 15.8 L/sec (approximately 1,300 m^3/day). In combination with Well 1 and Well 3, the MDD well yield would be 5,214 m^3/day and the pumping levels following 90 days of pumping at the wells is calculated to be between 15 and 23 m above the well screens. Under ADD water demand of 2,606 m^3/day for 20 years, the pumping levels in the wells are calculated to be between 19 and 26 m above the well screens. The calculations are shown in Table 2 for both MDD conditions and ADD conditions. These calculations would have to be confirmed with the construction and testing of a 203 mm diameter well.

If an alternative location for a new water supply well is contemplated, sites to the north of Everett would be preferred. The aquifer appears to thicken toward the north and the location of a well offset from the existing wells toward the north would widen the zone of capture for the wells and increase the recharge area for the Everett water supply system. Locating a new well to the south is possible; however the potential for competing for water with the Alliston groundwater supply system increases.

4.0 SOURCE WATER PROTECTION

There are three Storm Water Management (SWM) ponds proposed in Everett (Figure 3). None of the SWM ponds is proposed for lands that fall within an area of high vulnerability or within WHPA-A or WHPA-B, as defined by Burnside (2010). One of the proposed SWM ponds is at the 25 year Time of Travel (ToT), a second pond is on the 10-year ToT, and a third SWM pond is located near between the 2-year and 10-year ToT (Figure 3).

Since the SWM ponds are located outside vulnerable areas in the WHPA for Everett, the potential vulnerability scores for pathogens, or chemical parameters do not represent a significant threat to the water supply system for Everett. If the SWM ponds are expected to hold water they will likely have to be lined, since the surficial soils are sandy and the water table is two to six metres below the ground surface.

5.0 SUMMARY AND CONCLUSION

The existing wells are currently being operated at or near their maximum well yields based on their construction.

A new source of water supply to augment the existing Everett municipal water supply could be obtained from a groundwater source in Everett. The Regional A3 aquifer provides the adequate unit well yields; good quality water, and a source water that is protection from direct contamination from surface activities.

Additional water supplies could be obtained either from twinning one of the existing wells or drilling a new well on a different property. Well construction and testing would be required to confirm the well yield and interference among wells.

The aquifer at Well 1 appears to be a slightly coarser and has a greater thickness than at Well 2. The Well 1 site would be the preferred site for water supply development, barring other site or pump house restrictions.

The construction of SWM ponds at the locations shown on Figure 3 should not pose a significant threat to the on-going operation of municipal water supply wells in Everett.

Report Signature Page

GOLDER ASSOCIATES LTD.

John Easton, M.Sc., P.Geo.
Senior Hydrogeologist, Associate

JAE/plc

6.0 REFERENCES

Burnside Associates, 2010.

Nottawasaga Valley Source Protection Area Approved Assessment Report. Chapter 8: The Township of Adjala -Tosorontio.

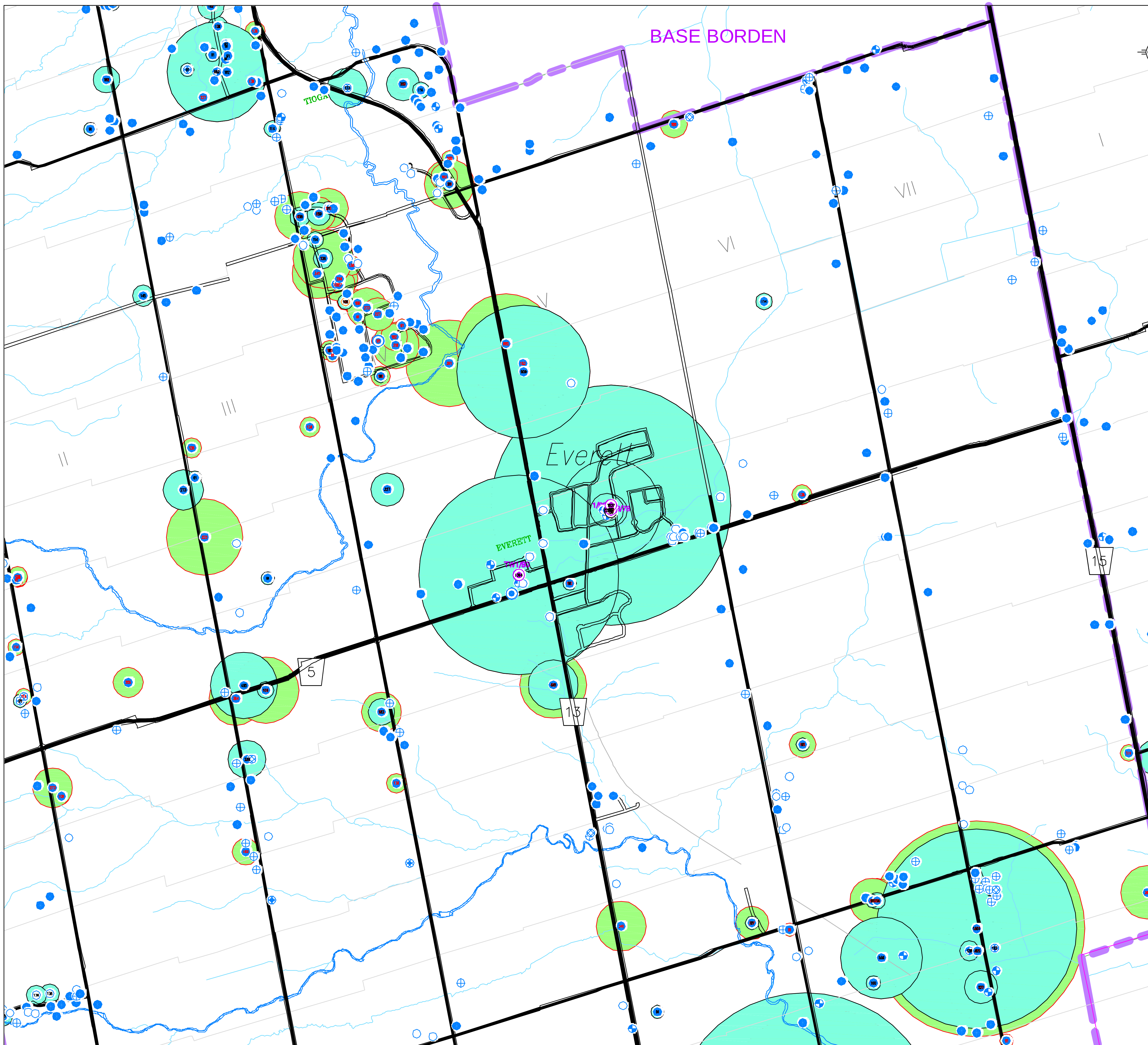
Golder Associates, 2004.

South Simcoe Municipal Groundwater Study. Golder Associates Ltd., Barrie.

Stantec, 2011.

Walton- Everett Phase 1 Lands- PW1/90 Municipal Well Pumping Test. Draft Plan of Subdivision Application – 254 Units, Township of Adjala-Tosorontio, County of Simcoe. Letter to Louise Foster, September 27, 2011, Stantec File: 1606-21773/02.

FIGURES



LEGEND:

Tested Rate (L/min) - Proportional to Recharge

Recommend Rate (L/min)

REFERENCES:

MAPPING BASED ON MOE WATER WELL RECORDS, QUEEN'S PRINTER

DATUM IS UTM NAD 83 ZONE 17

0 250 500 1000 2500

SCALE 1:30000 metres

Plotted Tabloid 11x17

TITLE

PUMPING RATES MAP

EVERETT CLASS EA: WATER SUPPLY

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
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DESIGN	
CAD	J REGIER
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REVIEW	
FILE No.	1211700033ABRATE.dwg
PROJECT No.	12-1170-0033
REV.	
FIGURE	6

PLOT DATE: October 30, 2012
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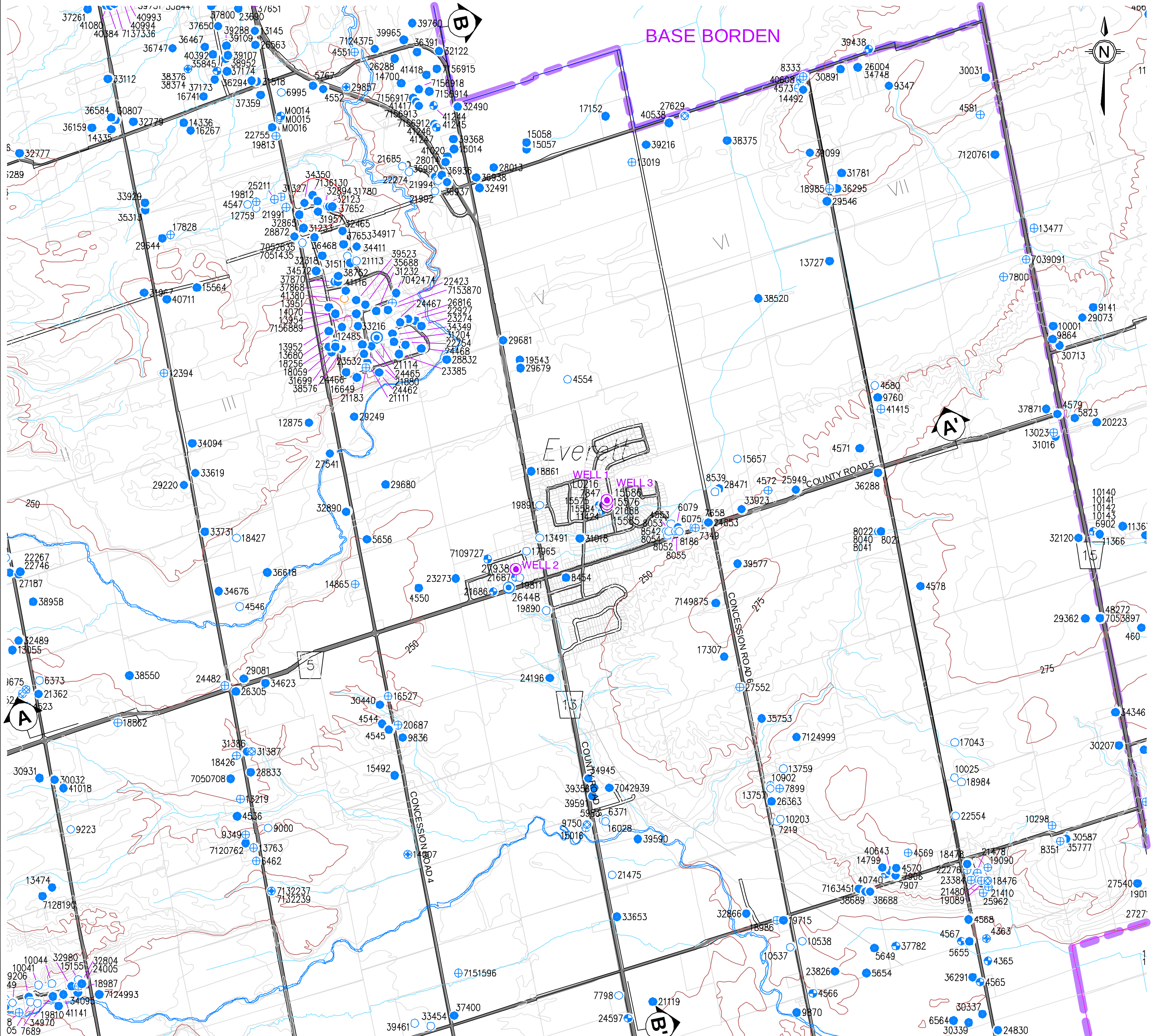

LEGEND:

- Shallow Dug or Bored <10 m
- Deep Bored Well >10 m
- Drilled Overburden Well
- Test or Observation Well
- Drilled Bedrock Well
- Sandpoint
- Municipal / Public Supply

REFERENCES:

MAPPING BASED ON MOE WATER WELL RECORDS, QUEEN'S PRINTER

DATUM IS UTM NAD 83 ZONE 17

0 250 500 1000 2500

SCALE 1:30000 metres

Plotted Tabloid 11x17

TITLE

AREA LOCATION MAP

EVERETT CLASS EA: WATER SUPPLY

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
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CAD	J REGIER
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FIGURE	1

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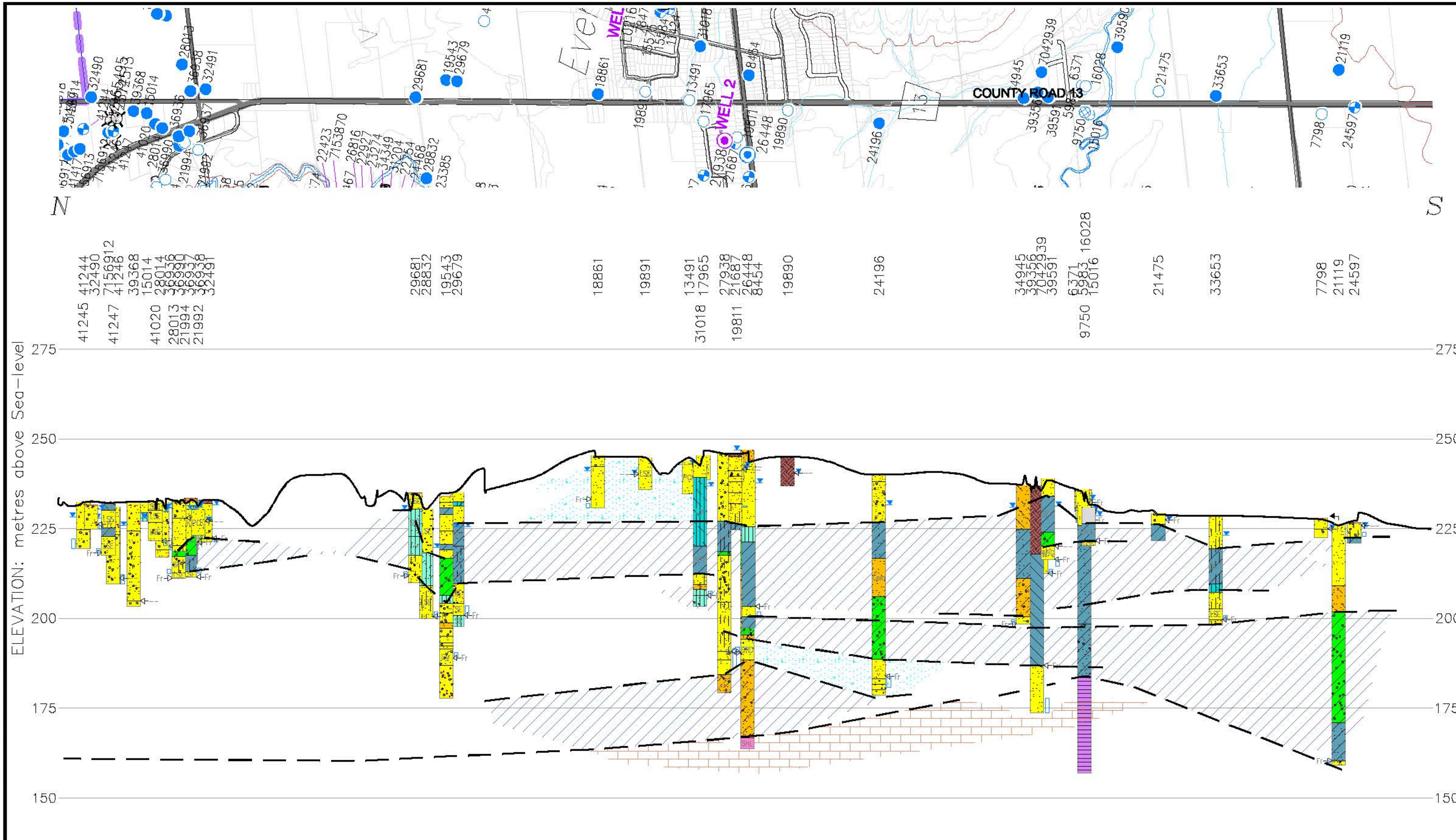

Golder Associates, Barrie, Ontario, Canada	SCALE: AS SHOWN	TITLE	
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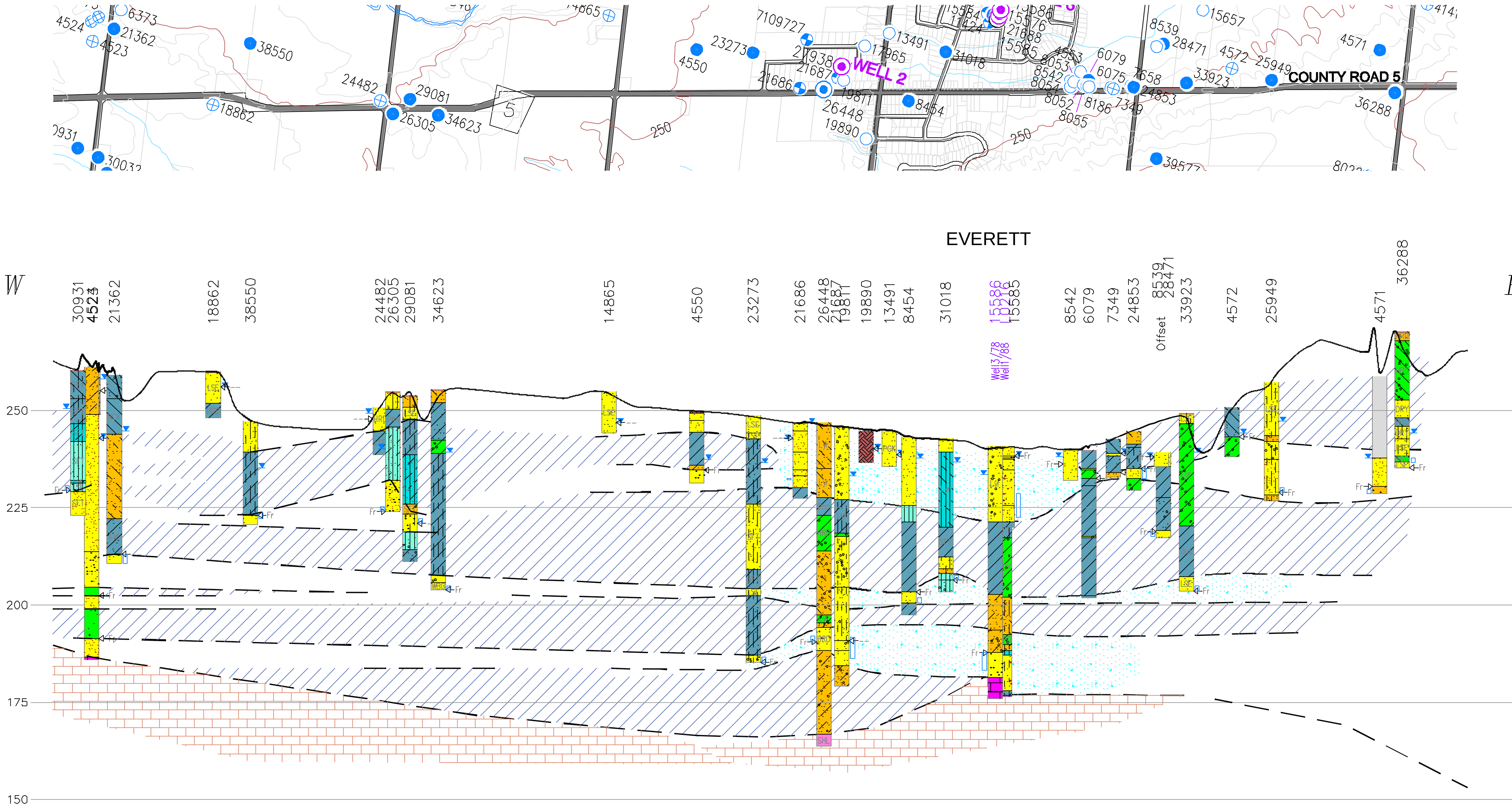
	CAD: J REGIER		
FILE No. 1211700033ABMAP.dwg	CHECK:		
PROJECT No. 12-1170-0033 REV.	REVIEW:	EVERETT CLASS EA: WATER SUPPLY	FIGURE 5



0 100 250 500 1000

SCALE 1:20000 metres

REFER TO FIGURE 7 FOR HYDROGEOLOGICAL SYMBOLS

Golder Associates
Barrie, Ontario, Canada

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REVIEW	
FILE No.	1211700033ABMAP.dwg
PROJECT No.	12-1170-0033
REV.	

TITLE

CROSS-SECTION A - A'

EVERETT CLASS EA: WATER SUPPLY

FIGURE 4

PLOT DATE: October 30, 2012
FILENAME: T:\Projects\2012\12-1170-0033 (Everett, Class EA - Greenland)\-AB-\1211700033ABMAP.dwg

STRATIGRAPHIC PATTERN

- Unoxidized CLAY, Blue, Grey, White, or Undefined CLAY
- Oxidized CLAY, Brown, Red, Yellow
- SILT
- SAND
- GRAVEL
- STONES, Rounded GRAVEL, PEBBLES
- BOULDER
- TILL
- SHALE
- DOLOSTONE
- LIMESTONE
- CRYSTALLINE ROCK

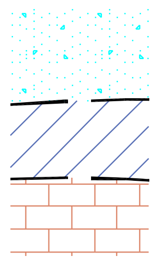
GENERIC MATERIALS

- UNKNOWN OR PREVIOUSLY DUG
- PEAT/LOAM
- SANDS & GRAVELS
- GRANULAR TILL
- SILT
- SILT CLAYEY
- CLAY
- TILL
- LIMESTONES
- SHALES

	SECONDARY/ SOME	TRACE	MINOR	
Clayey				Clay
Silty				Silt
Sandy				Granular

- Screen
- Recorded Static Water Level
- Water Producing Zone
- Flowing Well
- 23453 MOE Recorded Private Well

STRATIGRAPHY (see Notes)



AQUIFER

HYDROSTRATIGRAPHIC CONTACT

CONFINING MATERIAL

BEDROCK
LIMESTONE OR SHALE

MAP SYMBOLS

- Shallow Dug or Bored <10 m
- Deep Bored Well >10 m
- Drilled Overburden Well
- Test or Observation Well
- Test Pit
- Drilled Bedrock Well
- Sandpoint
- Municipal / Public Supply

NOTES

On all sections, boundaries between soil strata have been determined only at well and test well locations. Between the wells and test wells, boundaries are not proven but are assumed from geological evidence.

Wells are located to MOE Water Well Bulletin Data. Locations and elevations are subject to field verification.

Golder Associates
Barrie, Ontario, Canada

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PROJECT No.	12-1170-0033
REV.	
SCALE	AS SHOWN
DATE	30 OCT 2012
DESIGN	
CAD	J REGIER
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REVIEW	

TITLE

HYDROGEOLOGICAL SYMBOLS

EVERETT CLASS EA : WATER SUPPLY

FIGURE 7

PLOT DATE: October 30, 2012
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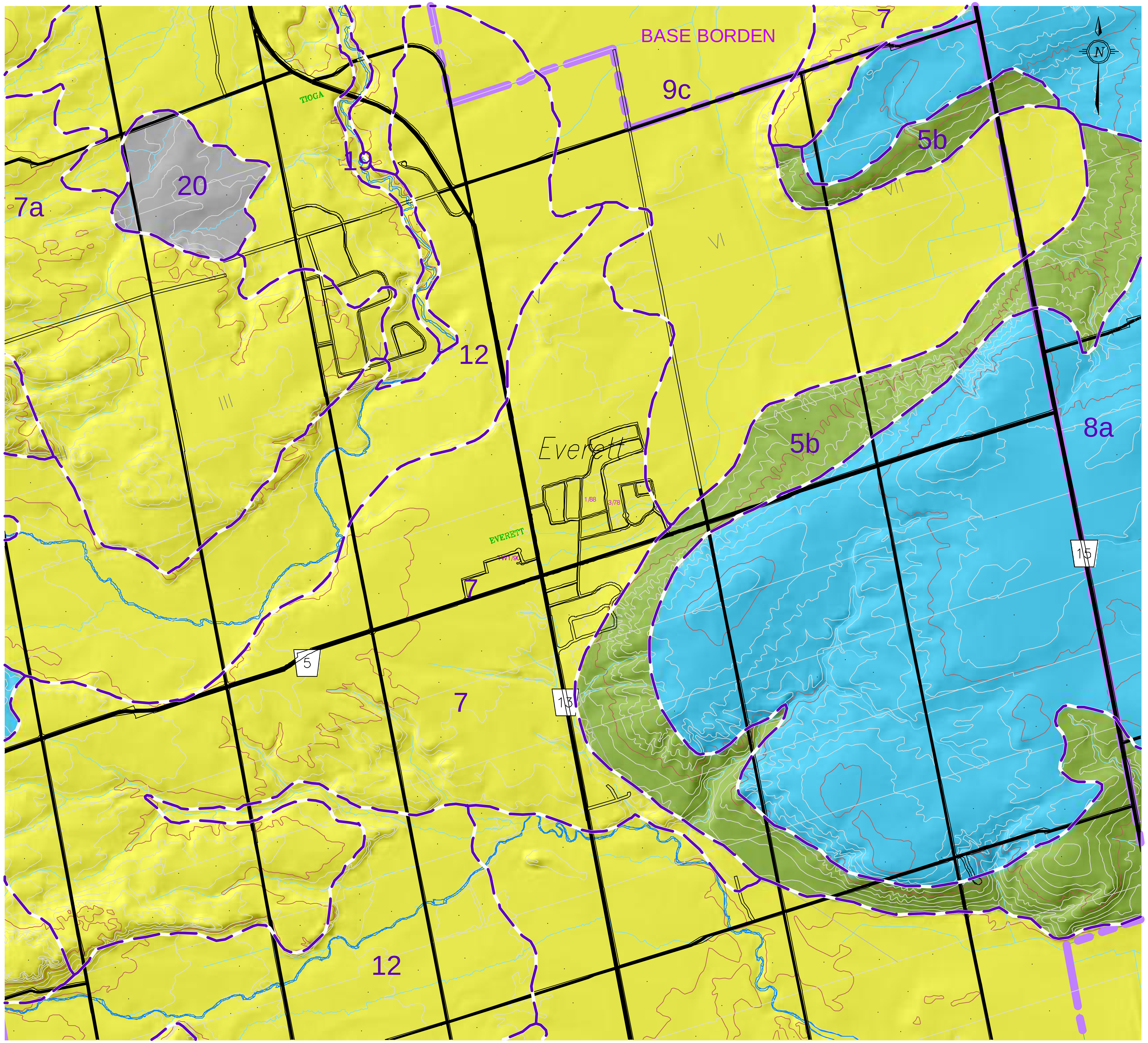

LEGEND:

20	Organic Deposits
19	Fluvial Silt, Sand, Gravel
12	Fluvial Sand
9c	Glaciolacustrine Silt & Sand Deposits
8a	Glaciolacustrine Deep Water Deposits
7	Glaciofluvial Outwash Sand & Gravel
7a	Distal Sand & Gravel
5b	Ablation Till

REFERENCES:

MAPPING BASED 2006 OGS/GSC DIGITAL COMPILATION, QUEEN'S PRINTER

DATUM IS UTM NAD 83 ZONE 17

0 250 500 1000 2500

SCALE 1:30000 metres

Plotted Tabloid 11x17

TITLE

QUATERNARY GEOLOGY MAP

EVERETT CLASS EA: WATER SUPPLY

Barrie, Ontario, Canada

SCALE	AS SHOWN		
DATE	30 OCT 2012		
DESIGN			
CAD	J REGIER		
FILE No. 1211700033ABQUAT.dwg		CHECK	FIGURE
PROJECT No. 12-1170-0033	REV.	REVIEW	2

PLOT DATE: October 30, 2012
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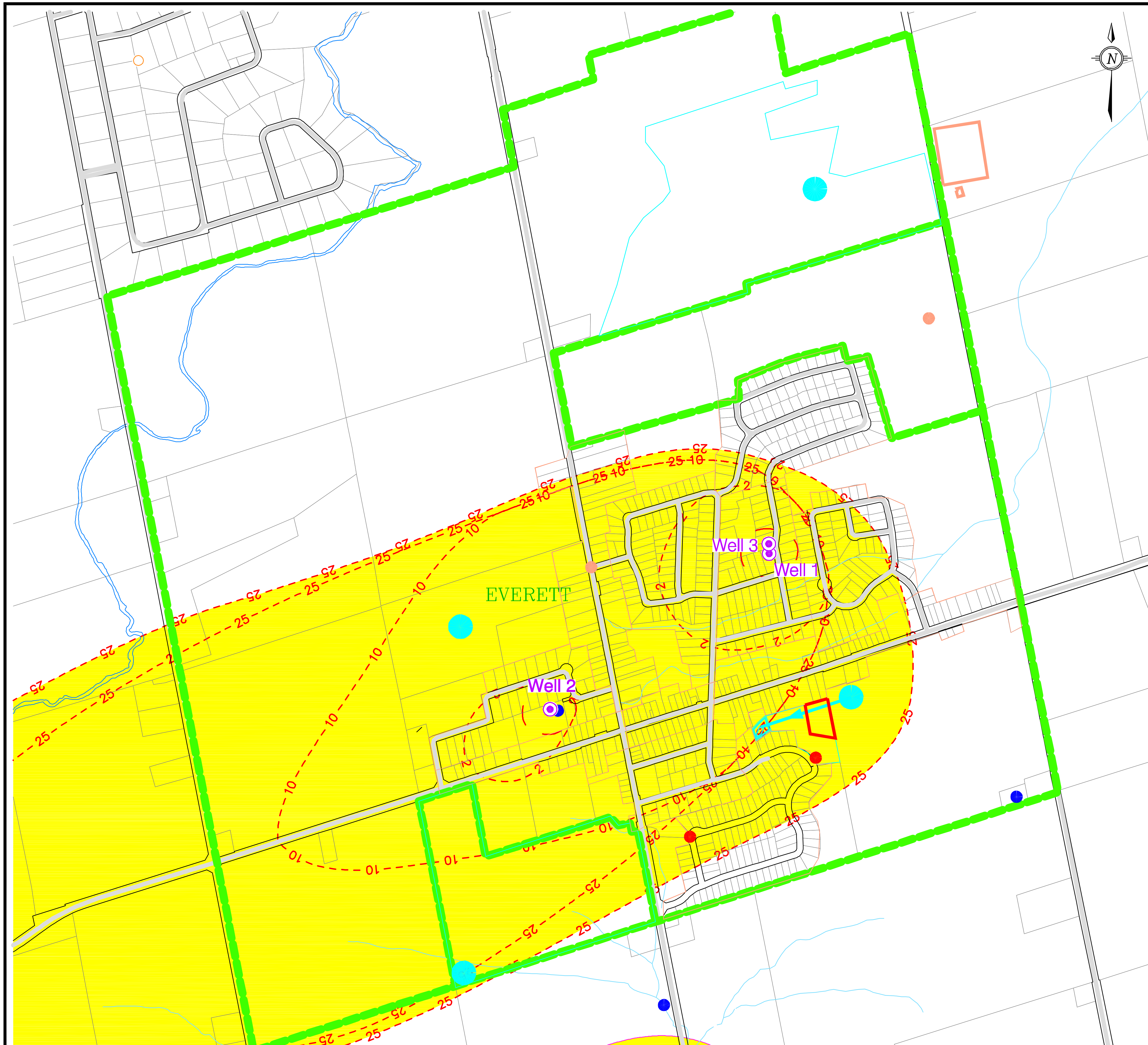

LEGEND:

- Secondary Plan Boundary
- Proposed WWTP & Tile Bed
- Proposed Pumping Station
- Proposed Stormwater Pond
- Existing Municipal Water Well / Infrastructure
- Existing Septic Treatment Infrastructure
- 25 Municipal Water Well Capture Zone, Time of Travel

REFERENCES:

MAPPING BASED ON ESSA TOWNSHIP, PLANNING DEPARTMENT

CAPTURE ZONES, SIMCOE COUNTY GROUNDWATER STUDY, 2005

DATUM IS UTM NAD 83 ZONE 17

0 250 500 1000 2500

SCALE 1:30000 metres

Plotted Tabloid 11x17

TITLE

SITE LOCATION MAP CAPTURE ZONES

EVERETT CLASS EA: WATER SUPPLY

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	30 OCT 2012
DESIGN	
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REVIEW	
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PLOT DATE: November 02, 2012
FILENAME: T:\Projects\2012\12-1170-0033 (Everett, Class EA - Greenland)\-AB-\1211700033ABPLAN.dwg\1211700033ABPLAN.dwg: [Figure 3]

TABLES

Table 2
Township of Adjala - Tosorontio, Everett Water Supply
Combined Interference Among Municipal Well

THEIS EQUATION: s = (Q/(4PIT) LN ((2.25Tt)/(r2S))

Q m3/day	Well discharge	s m	Drawdown at distance r
T m2/day	Aquifer Transmissivity	t days	Time since pumping started or stopped
S	Aquifer storativity	r m	Distance from well

Maxmum Day Demand

Q (m^3/day)	T (m^2/day)	S	t (days)	INTERFERENCE AT RADIUS SHOWN (m) r (m) =	0.3	100	750	1000	2000
Well 1 - (Grohal #1)									
1960	205	1.E-04	90		16.9	8.1	5.0	4.6	3.5
New Well 2 (Grohal #2)									
1294	205	1.E-04	90		11.2	5.3	3.3	3.0	2.3
Well 3 (Ballpark)									
1960	205	1.E-04	90		16.9	8.1	5.0	4.6	3.5

MDD = 5,214 m^3/day	Pumping Level (m)	Interference From Well 1	Well 2	Well 3	Combined interference Pumping Level (m)	Depth to Top of Screen (m)	Pumping Level above Screen (m)
Well 1 - (Grohal #1)	27.4	0	8.1	5.0	40.5	56.0	15.5
New Well 2 (Grohal #2)	18.3	8.1	0	5.0	31.4	54.0	22.6
Well 3 (Ballpark)	26.5	5.0	3.3	0	34.8	56.0	21.2

Average Day Demand

Q (m^3/day)	T (m^2/day)	S	t (days)	INTERFERENCE AT RADIUS SHOWN (m) r (m) =	0.3	100	750	1000	2000
Well 1 - (Grohal #1)									
980	205	1.E-04	3650		9.9	5.5	3.9	3.7	3.2
New Well 2 (Grohal #2)									
647	205	1.E-04	3650		6.5	3.6	2.6	2.4	2.1
Well 3 (Ballpark)									
980	205	1.E-04	3650		9.9	5.5	3.9	3.7	3.2

ADD = 2,606 m^3/day	Pumping Level (m)	Interference From Well 1	Well 2	Well 3	Combined interference Pumping Level (m)	Depth to Top of Screen (m)	Pumping Level above Screen (m)
Well 1 - (Grohal #1)	27.4	0	5.5	3.9	36.8	56.0	19.2
New Well 2 (Grohal #2)	18.3	5.5	0	3.9	27.7	54.0	26.3
Well 3 (Ballpark)	26.5	3.9	2.6	0	33.0	56.0	23.0

Everett Well 1 (PW1-88)

Ministry of the Environment

Ontario

The Ontario Water Resources Act

WATER WELL RECORD

PW1-88 (TW2-88)

P.W.#1---1988.

County or District	Township, Borough, City, Town, Village	Con., Block, Tract, Survey, etc.	Lot
County of Simcoe	Township of Tosorontio(Everett)	Conc # 5	11

Owner	Address	Date Completed
Township of Tosorontio	R.R. # 3 Everett ,Ontario..	Day 31 Mo Jan Yr 89

LOG OF OVERBURDEN AND BEDROCK MATERIALS

General Colour	Most Common Material	Other Materials	General Description	Depth Feet From	To
Brown	sand	clay streaks	layered	0	44
Brown	sand(silty)	clay seams	layered	44	63
Grey	clay	slit	soft	63	76
Grey	clay	stones gravel seams	hardpacked	76	127
Brown	sand(silty)	gravel,clay seams	layered	127	158
Grey	clay	stones	hard	158	167
Grey	sand	silty clay	layered	167	172
Grey	silt	sandy clay	layered	172	176
Brown	sand	fine gravel silt	layered	176	205
Grey	clay(sandy)	silt stones	hardpacked	205	210
Grey	rock	fractured	layered	210	216

K packer +leader 5'-10"

WATER RECORD

Water found at feet	Kind of water
184-204	Fresh

CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth From	To
10	Steel	.375	184	+2.4

SCREEN

Slot No.	Diameter	Length
	9 1/2 inches	20 feet

Material and type: S.S. wire wd — Depth to top of screen: 184 feet

PLUGGING & SEALING RECORD

Depth set at From	To	Material and type
184	91	drill cuttings
91	5	cement grout
5	0	backfill

PUMPING TEST

Pumping test method: Pump. Pumping rate: 360 GPM. Duration of pumping: 24 hrs 0 mins.

Static level: 25.40 feet. Water level end of pumping: 115 feet.

Pump intake set at: 160 feet. Water at end of test: Clear.

Recommended pump type: Deep. Recommended pump setting: 150 feet. Recommended pumping rate: 350 GPM.

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.

50493

FINAL STATUS OF WELL	[X] Water supply
WATER USE	[X] Municipal
METHOD OF CONSTRUCTION	[X] Rotary (conventional)

CONTRACTOR

Name of well contractor: Northern Well Drilling Limited — Well contractor's licence number: 3903

Address: P.O. Box 358 Unionville,Ont.

Name of well technician: Jerry W. Fenwick — Well technician's licence number: T-0001

Signature of technician/contractor — Submission date: 31 Mar. 89

OFFICE USE ONLY

CONTRACTOR'S COPY

FORM NO. 0506 ... MOE FORM 9

Project: Q86-0005B

Trow

TABLE C

Geologic Units at Borehole 5 (Everett Ball Park Well)

Geologic Unit	Depth (m)	Elevation (m a.m.s.l.)	Description
Sand	0-17.1	247.4-230.3	Shallow aquifer
Clay	17.1-22.0	230.3-225.4	
Clayey gravel	22.0-28.1	225.4-219.3	
Sand and gravel	28.1-44.2	219.3-203.2	Middle aquifer
Clay	44.2-47.3	203.2-200.1	
Silty sand	47.3-49.7	200.1-197.7	
Clay	49.7-51.5	197.7-195.9	
Sand	51.5-57.3	195.9-190.1	Deep aquifer
Clay	57.3-58.0	190.1-189.4	
Sand with silt	58.0-69.5	189.4-177.9	Deep aquifer
Clay	69.5-74.7	177.9-172.7	

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

1 PRINT ONLY IN SPACES PROVIDED
2 CHECK ☒ CORRECT BOX WHERE APPLICABLE

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
Simcoe	Tosorontio	V	11

OWNER (SURNAME FIRST)	ADDRESS	DATE COMPLETED
Twp. of Tosorontio	Everett, R. R. #3	DAY 28 MO 08 YR 78

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
	sand	streaks of gravel		0	64
	clay			64	125
	sand	clay		125	155
	sand	gravel, clay		155	174
	course sand			174	195
	limestone		broken	196	207
	limestone			207	213

WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
174-195	☒ FRESH ☐ SULPHUR ☐ SALTY ☐ MINERAL
	☐ FRESH ☐ SULPHUR ☐ SALTY ☐ MINERAL
	☐ FRESH ☐ SULPHUR ☐ SALTY ☐ MINERAL
	☐ FRESH ☐ SULPHUR ☐ SALTY ☐ MINERAL
	☐ FRESH ☐ SULPHUR ☐ SALTY ☐ MINERAL

CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
6	☒ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE	0.188	+ 1	178
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE			
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING	DIAMETER	LENGTH
10ft. x 14 slot 5ft. x 16 slot	6 INCHES	15 FEET
MATERIAL AND TYPE: stainless steel wire wound	DEPTH TO TOP OF SCREEN: packer 174 FEET	

PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

PUMPING TEST

PUMPING TEST METHOD	☒ PUMP ☐ BAILER
PUMPING RATE	148 GPM
DURATION OF PUMPING	24 HOURS
STATIC LEVEL	24.42 FEET
WATER LEVEL END OF PUMPING	59.27 FEET
WATER LEVELS DURING	☒ PUMPING ☐ RECOVERY
15 MINUTES	45.64 FEET
30 MINUTES	46.28 FEET
45 MINUTES	46.56 FEET
60 MINUTES	46.76 FEET
IF FLOWING GIVE RATE	GPM
PUMP INTAKE SET AT	154 FEET
WATER AT END OF TEST	☒ CLEAR ☐ CLOUDY
RECOMMENDED PUMP TYPE	☐ SHALLOW ☒ DEEP
RECOMMENDED PUMP SETTING	100 FEET
RECOMMENDED PUMPING RATE	150 GPM

FINAL STATUS OF WELL

☒ WATER SUPPLY ☐ OBSERVATION WELL ☐ TEST HOLE ☐ RECHARGE WELL ☐ ABANDONED, INSUFFICIENT SUPPLY ☐ ABANDONED, POOR QUALITY ☐ UNFINISHED

WATER USE

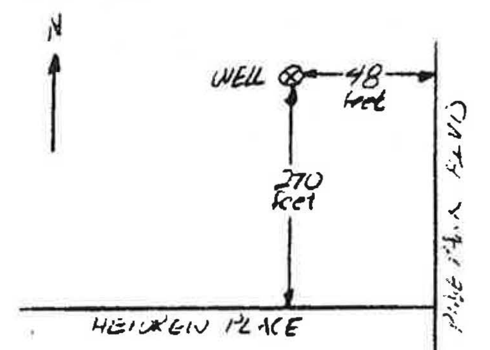
☐ DOMESTIC ☐ STOCK ☐ IRRIGATION ☐ INDUSTRIAL ☐ OTHER ☐ COMMERCIAL ☐ MUNICIPAL ☐ PUBLIC SUPPLY ☐ COOLING OR AIR CONDITIONING ☒ NOT USED

METHOD OF DRILLING

☐ CABLE TOOL ☒ ROTARY (CONVENTIONAL) ☐ ROTARY (REVERSE) ☐ ROTARY (AIR) ☐ AIR PERCUSSION ☐ BORING ☐ DIAMOND ☐ JETTING ☐ DRIVING

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS: PW-3

U2

CONTRACTOR

NAME OF WELL CONTRACTOR: Snider Drilling Limited, LICENCE NUMBER: 4816
ADDRESS: Craighurst, Ontario.
NAME OF DRILLER OR BORER: Phillip Brown. LICENCE NUMBER:
SIGNATURE OF CONTRACTOR: Ralph Snider. SUBMISSION DATE: DAY ___ MO ___ YR ___

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FORM NO. 0506

APPENDIX A

Water and Sewage: Demands/Flows

From Greenland Consulting Engineers, 2012.

Water and Sewage Demands/Flows

A. Historical Water Demands, Peaking Factors and Per Capita Daily Demands

Year	*Average Daily Demand (m^3/d)	*Maximum Daily Demand (m^3/d)	Maximum Daily Demand Peaking Factor	**Peak Hour Peaking Factor (For Population 2,000)
2009	399.50	1,044.90	2.62	3.75
2010	394.20	976.30	2.48	3.75
2011	368.20	796.80	2.16	3.75
Total	1,161.90	2,818.00		
Average	**387.30**	**939.33**	**2.43**	**3.75**
Connections	643.00			
Persons Per Unit	3.00			
Population	1,929.00			
Per Capita Day Demand (L/c/d)	200.78	486.95		

***Source: Burnside Technical Memorandum (16 August 2011) re. R&M Homes Subdivsion Review**
**** Source: Peak Hour Peaking Factor form MOE Guidelines**

B. Historical Sewage Flow

New Horizons is the only Subdivison in Everett with existing muncipal sewage collection/treatment.
Remaining existing areas serviced by septic systems.

Historcial Average Daily Flow	74.00	m^3/d
Service Population	300.00	persons
Average Flow Per Capita	246.67	L/c/d

***Source: County Simcoe Visioning Strategy**

C. Future Water Distribution and Treatment Data

Since the historical per capita average daily demand is low when compared with MOE values,
future development per capita flow is based on the following (for average daily demand)

246.67	L/c/d average sewage flow in New Horizon Sewage Plant
10.00	% Increase for Water Use over Sewage Use
271.33	L/c/d average daily water useage
275.00	L/c/d average daily water useage (rounded)
Varies	Maximum Daily Demand Peaking Factor Per MOE Guidelines

For existing areas the historical average daily demand water data will be used.
As such the following presents water demands for future existing and future growth scenarios:

Average Daily Demand

	Population	Maximum Daily Demand Peaking Factor	Maximum Daily Demand Existing Areas (m^3/d)	Maximum Daily Demand Future Areas (m^3/d)	Total (m^3/d)
Existing	1,929.00	1.00	387.30	0.00	387.30
Phase 1	3,500.00	1.00	387.30	432.03	819.33
Phase 2	7,000.00	1.00	387.30	1,394.53	1,781.83
Phase 3	10,000.00	1.00	387.30	2,219.53	2,606.83

	Population	Maximum Daily Demand Peaking Factor	Maximum Daily Demand Existing Areas (m^3/d)	Maximum Daily Demand Future Areas (m^3/d)	Total (m^3/d)
Maximum Daily Demand					
Existing	1,929.00	2.43	939.33	0.00	939.33
Phase 1	3,500.00	2.23	864.51	964.34	1,828.85
Phase 2	7,000.00	2.11	816.10	2,938.46	3,754.56
Phase 3	10,000.00	2.00	774.60	4,439.05	5,213.65

	Population	Maximum Daily Demand Peaking Factor	Maximum Daily Demand Existing Areas (m^3/d)	Maximum Daily Demand Future Areas (m^3/d)	Total (m^3/d)
Peak Hour Demand					
Existing	1,929.00	3.75	1,452.38	0.00	1,452.38
Phase 1	3,500.00	3.35	1,298.56	1,448.52	2,747.08
Phase 2	7,000.00	3.16	1,224.97	4,410.68	5,635.66
Phase 3	10,000.00	3.00	1,161.90	6,658.58	7,820.48

D. Future Sewage Collection and Treatment Data

Sewage Collection for New and Existing Areas Based Upon		450 L/c/d average daily flow * Harmon Peaking Factor + I/I Allowance
Sewage Treatment	Existing Per Capita Avg. Flow	246 L/c/d average daily flow from New Horizon Subdivsion
		248 L/c/d average daily flow (90% Water Average Daily Demand)
		247 Average L/c/d
		90 L/c/d extraneous flow allowance
		337 Total L/c/d
		340 Total L/c/d - to be used in Study.

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VOLUME 2: BACKGROUND STUDIES
Part 3 – Archaeological Study Report

Stage 1 Archaeological Assessment of
The Everett Secondary Plan and Master Services Class EA
Township of Adjala-Tosorontio
Simcoe County

ORGINAL REPORT

Prepared for:

Township of Adjala-Tosorontio
7855 Sideroad 30, R.R. #1
Alliston, Ontario L9R 1V1
T: 705-434-5055
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Archaeological Licence #P047 (Bruce Welsh)
Ministry of Tourism, Culture and Sport PIF# P047-374-2012
ASI File 12TS-125

25 September, 2012

Archaeological Services Inc.
528 Bathurst St.
Toronto, Ontario
Canada, M5S 2P9
T 416-966-1069
F 416-966-9723
info@iASI.to/www.iASI.to

Stage 1 Archaeological Assessment of
The Everett Secondary Plan and Master Services Class EA
Township of Adjala-Tosorontio
Simcoe County

EXECUTIVE SUMMARY

Archaeological Services Inc. was contracted by the Township of Adjala-Tosorontio, Ontario to undertake a Stage 1 Archaeological Assessment of the Everett Secondary Plan and Master Services Class EA, located in the Township of Adjala-Tosorontio, Simcoe County. The study area is approximately 660 hectares. The study area is generally bordered by Forest Hill Drive to the north, Dekker Street to the south, Concession Road 4 to the west and Concession Road 6 to the east. The study area encompasses an area that includes both urban and rural residential areas, active farm land, wetlands, watercourses, forested lands, municipal parks and active commercial lands.

The background research determined that one archaeological site has been registered within the study area and that no other archaeological sites have been registered within a one kilometre radius. Nineteenth century mapping of the study area illustrated the historical settlement centre of Everett, the Hamilton and North Western Railway and a single dwelling. A review of the general physiographic setting of the study area determined that it is located in both the Simcoe Lowlands and the Peterborough Drumlin Field physiographic regions. The lands of the study area are well drained with multiple watercourses, including the Pine River, as well as multiple tributaries of the Nottawasaga River and the Boyne River. This research has led to the conclusion that there is archaeological potential for the recovery of both pre-contact and Euro-Canadian archaeological resources within the study area.

The detailed Stage 1 field review carried out for this assessment resulted in the following determinations for archaeological potential within the study area:

- All lands that have been fully developed are considered to have no archaeological potential. Likewise, all paved roadways, rail lines, and any parcels of land associated with buried utilities lack any archaeological potential, given the level and severity of land alteration which has occurred in these portions of the study area. This determination is consistent with section 1.3.2 of MTCS's Standards and Guidelines for Consultant Archaeologists.
- The areas of residential development within the Developed Area of Everett are considered to have no remaining archaeological potential. These areas have been subject to severe land alterations which were observed during the field review. This determination is consistent with Section 1.3.2 of MTCS's 2011 *Standards and Guidelines for Consultant Archaeologists*.
- All permanently low and wet areas such as watercourses or wetlands have no archaeological potential. This determination is consistent with standard 2, section 2.1 of MTCS's *2011 Standards and Guidelines for Consultant Archaeologists*.
- A corduroy road was encountered within the unpaved portion of Concession Road 6. Any development within the roadway must be monitored by a licensed archaeologist. This determination is consistent with Standard 4, Section 2.1.7 of MTCS's 2011 *Standards and Guidelines for Consultant Archaeologists*.

- A pond and berm dominated area within the Pine River Block fronting County Road 13 must be subject to a Stage 2 archaeological assessment using a judgmental testpitting strategy. This determination is consistent with Standard 2, Section 2.1.8 of MTCS's 2011 *Standards and Guidelines for Consultant Archaeologists*.
- The balance of the study area, which consists of all active farm lands, woodlots and forested lands, as well as open, unaltered lands and all single residential lot lands as well as all infill lands are considered to have archaeological potential. These lands will require Stage 2 archaeological assessment carried out in accordance with section 2 of the MTCS's 2011 *Standards and Guidelines for Consultant Archaeologists* prior to any development occurring within these lands.

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ARCHAEOLOGICAL SERVICES INC.
PLANNING DIVISION

PROJECT PERSONNEL

Project Manager:	Beverly Garner, Hons. BA, Assistant Manager, Planning
Project Director:	Bruce Welsh, PhD, (P047) Senior Archaeologist
Project Archaeologist:	John Dunlop, Hons. BA, (R261) Staff Archaeologist
Report Preparation:	John Dunlop Jennifer Rose, Hons. BA, (R376) Staff Archaeologist
Report Reviewers:	Beverly Garner Lisa Merritt, MA, (P094) Senior Archaeologist, EA Division

1.0 PROJECT CONTEXT

1.1 Development Context

Archaeological Services Inc. was contracted by the Township of Adjala-Tosorontio, Ontario to undertake a Stage 1 Archaeological Assessment of the Everett Secondary Plan and Master Servicing Municipal Class EA lands, located within the former Geographic Township of Tosorontio, Simcoe County, now in the Township of Adjala-Tosorontio, Simcoe County (Figure 1). The study area is approximately 660 hectares.

This assessment was conducted under the project management of Ms. Bev Garner and project direction of Dr. Bruce Welsh (MTCS PIF P047-374-2012) in accordance with the *Ontario Heritage Act* (R.S.O. 1990) and the Ministry of Tourism, Culture, and Sport's 2011 *Standards and Guidelines for Consultant Archaeologists*. This assessment was carried out prior to the Official Plan amendment for Simcoe County for the acceptance of the Secondary Plan and under the Municipal Class Environmental Assessment process as required by the *Ontario Planning Act* (R.S.O. 1990) and the *Environmental Assessment Act* (R.S.O. 1990) and regulations made under these Acts, and are therefore subject to all associated legislation. This project is being conducted under Schedule B of the Municipal Class Environmental Assessment process. Permission to access the study area and to carry out all activities necessary for the completion of the assessment was granted by the proponent on August 15, 2012.

1.2 Historical Context

The MTCS's *Standards and Guidelines for Consultant Archaeologists* (MTC 2011:18) stipulates that areas of early Euro-Canadian settlement, including places of early military pioneer settlement (pioneer homesteads, isolated cabins, farmstead complexes), early wharf or dock complexes, pioneer churches and early cemeteries, are considered to have archaeological potential. There may be commemorative markers of their history, such as local, provincial, or federal monuments or heritage parks. Early historical transportation routes (trails, passes, roads, railways, portage routes), properties listed on a municipal register or designated under the *Ontario Heritage Act* or a federal, provincial, or municipal historic landmark or site, and properties that local histories or informants have identified with possible archaeological sites, historical events, activities, or occupations are also considered to have archaeological potential.

The study area extends across part of Lots 10, 11, 12 and 13, Concession 4 and Lots 10, 11, 12, 13 and 14, Concession 5, in the Geographic Township of Adjala-Tosorontio, Simcoe County.

1.2.1 Brief History of Adjala-Tosorontio Township, Simcoe County

The Township of Adjala was named after the wife or daughter of Chief Tecumseh, while the Township of Tosorontio was named after the Huron word for "beautiful mountain" (Township of Adjala-Tosorontio website).

Beginning in the 1820s, settlement of the Township began in the south. The Irish Catholics who came to Adjala began naming their communities after their hometowns in Ireland, or after prominent pioneer families who first settled in the area. The sandy soils of Tosorontio's provided habitat for the vast stands of pine trees, which supported as many as seven large sawmills and provided further incentive to come to the area (Township of Adjala-Tosorontio website).

In 1994, the former Township of Adjala and the former Township of Tosorontio were amalgamated into the Township of Adjala-Tosorontio (Township of Adjala-Tosorontio website).

The Hamilton and North Western Railway

Simcoe County was desperate for an alternative to Toronto’s Northern Railway of Canada, as the local residents believed that they did not have proper service to the western portion of the County. The North Railway, recognized this as an issue and decided to form a line from King City through Beeton, Angus and on to Penetanguishene (Cooper 2001). Simcoe County was able to provide municipal aid in the amount of $300,000 in order to ensure the construction of a branch line from Beeton to Collingwood (Cooper 2001). The Hamilton and North Western Railway officially reached Barrie in 1877, and Collingwood in December of 1878, thus passing through such hamlets as Everett, Lisle and Glencairn in Tosorontio Township (Cooper 2001, Township of Adjala-Tosorontio website).

1.2.2 History of the Settlement Area of Everett

The first use of the name Everett is a debated question. There are two competing ideas as to how the community was named. The first of which is that the name was taken after an early settler by the name of Mr. Fisher, who named his farm “Everett,” while the other is after another early settler by the name of Mr. Henry Baycroft, who named the community after his hometown in England (New Tecumseth Public Library).

Everett was originally located one concession east at the intersection of present-day County Road 5 and Concession Road 7. A plaque is now found at this location commemorating the original location of the community (Plate 1). Everett was moved to its current location after the Hamilton and North Western Railway was established in 1878, so that the town could reap the benefits of a local railway station (New Tecumseth Public Library). Soon after its relocation, Everett began to see growth in population and commerce through the late-nineteenth and into the twentieth century.

The first business in Everett was William Lockhart’s general store (JDG 2006). Other early businesses consisted of Pat Hanlan’s blacksmith shop, Edward Anderson’s shoemaker shop, Simpson Jenkin’s carriage shop and John Gallaugher’s hotel (JDG 2006). The local timber industry also proved to be a prosperous commodity for the community (JDG 2006). However, by the mid-twentieth century the general decline of railways in favour of roads led to the demise of the Hamilton and North Western railway and the rail line was dismantled. Everett likewise declined in population and commercial presence.

1.2.3 Review of Nineteenth Century Mapping

A review of the 1881 *Simcoe Supplement in the Illustrated Atlas of the Dominion of Canada* was completed in order to determine if this source depicts any nineteenth-century Euro-Canadian settlement features that may represent potential historical archaeological sites within the study area (Figure 2).

The 1881 *Illustrated Atlas* depicts the historical settlement centre of Everett at the intersection of present-day County Road 5 and County Road 13. Within this intersection, the Everett Post Office is depicted. Immediately adjacent to this settlement centre is the Hamilton and North Western Railway. Lot 11, Concession 4, depicts one additional historical feature of interest; a dwelling owned by A. Wanless. The Pine River is illustrated within Lot 13, Concession 4.

It should be noted that the schematic illustrations of settled areas such as Everett in the *Illustrated Atlas*, do not accurately depict the nature or frequency of any historical features potentially located therein Depicting these smaller settled areas in a schematic manner was a common mapping practice of the nineteenth century.

Jim Hosick, Director of Growth and Development, Township of Adjala-Tosorontio was contacted in order to determine if any properties within the study area had been designated under Part IV of the *Ontario Heritage Act* (R.S.O. 1990) or otherwise listed as having heritage interest by the Township of Adjala-Tosorontio. It was confirmed that there are no designated properties within the study area (Joe Hosick pers. comm. 2012).

Therefore, given the presence of the schematically illustrated settlement area of Everett, the Hamilton and North Western Railway and the dwelling located in Lot 11, Concession 4, there is the potential for the recovery of historical archaeological resources, depending on degree of more recent land alterations.

1.3 Archaeological Context

Understanding the archaeological context of a study area involves research to describe the known and potential archaeological resources within the vicinity of a study area. The background research for such an assessment incorporates a review of previous archaeological research, physiography, and nineteenth-century development for the study area. Background research was completed to identify any archaeological sites within the subject property and to assess its archaeological potential.

1.3.1 Registered Archaeological Sites

In order that an inventory of archaeological resources could be compiled for the study area, three sources of information were consulted: the site record forms for registered sites housed at the Ministry of Tourism, Culture and Sport, published and unpublished documentary sources, and the files of Archaeological Services Inc.

In Ontario, information concerning archaeological sites is stored in the Ontario Archaeological Sites Database (OASD) which is maintained by the Ministry of Tourism, Culture and Sport. This database contains archaeological sites registered within the Borden system. The Borden system was first proposed by Dr. Charles E. Borden and is based on a block of latitude and longitude. Each Borden block measures approximately 13 km east-west by 18.5 km north-south. Each Borden block is referenced by a four-letter designator, and sites within a block are numbered sequentially as they are found. The subject property under review is located within the BbGx Borden block.

One archaeological site has been registered within the study area; however, no other sites have been registered within a one kilometre radius of the study limits. The site consists of an isolated corner-notched projectile point fragment resembling a Middle Woodland Jack's Reef point (BP 1500-1000) (Spence, Pihl and Murphy 1990). The isolated point fragment was encountered by ASI in 2011 (ASI 2011). This type of point is not attributable to any specific cultural complex of the Middle Woodland, having being encountered in association with Point Peninsula, Saugeen and independent complexes (Spence, Pihl and Murphy 1990).

1.3.2 Previously Assessed Lands

Archaeological Services Inc. has previously assessed two large areas within the southwest corner of current study area limits.

The Stage 1 and 2 archaeological assessment of the Everett Community Phase 1 Proposed Residential Subdivision, located within part of Lot 10, Concession 4, took place in October of 2010, under MTCS PIF P049-577-2010. Approximately 28 hectares south of County Road 5 were assessed by means of a pedestrian survey and test pit survey employed at five metre intervals (ASI 2011). No cultural material was encountered during the course of the assessment.

The Stage 1 and 2 archaeological assessment of the Everett Community Phase 2 Proposed Residential Subdivision, located within part of Lot 10, Concession 4, took place in August of 2011, under MTCS PIF P049-578-2010 and P347-079-2011. Approximately 40 hectares south of County Road 5 and east of Concession Road 4 were assessed by means of a pedestrian survey employed at five metre intervals (ASI 2011). During the course of the assessment, pre-contact site BdGx-5 was encountered within a relatively flat portion of the southern half of the property. A single corner-notched projectile point fragment resembling a Middle Woodland Jack's Reef point (BP 1500-1000) manufactured from Onondaga chert was collected (ASI 2011). Due to the isolated nature of the find, no further archaeological assessment was recommended.

Further to the assessments completed by ASI, one additional assessment has been completed within the study area. A Stage 1 and 2 archaeological assessment of the R&M Homes Subdivision Development, located within part of Lot 12, Concession 4, was completed by Archaeological Assessments Ltd. in July of 2011, under MTCS PIF P013-595-2011 (AAL 2011). Approximately 6.96 hectares east of County Road 13 and north of Moore Avenue were assessed by means of a pedestrian survey employed at five metre intervals (AAL 2011). No cultural material was encountered during the course of the assessment.

1.3.3 Review of Physiographic Setting

The majority of the study area is situated within the Simcoe Lowlands physiographic region of southern Ontario; however the southeast corner of the study area is found within the Peterborough Drumlin Field physiographic region of southern Ontario.

The Simcoe Lowlands region occupies approximately 2,849 square km, lying predominately to the east and west of the City of Barrie (Chapman and Putman 1966:299). The lowland surrounding Lake Simcoe, also referred to as the Lake Simcoe basin is situated to the east. While the plains which drain into Nottawasaga Bay, by way of the Nottawasaga River, also referred to as the Nottawasaga basin, is situated to the west. The Nottawasaga basin at one time made up a portion of the glacial Lake Algonquin floor. However, the southern portion of the basin, primarily located in the area of Tecumseh Township represents an area separated from the main bay by moraine uplands. The upper Nottawasaga River and its tributaries have therefore transported large amounts of sand and silt into the area. Shallow streams are present in this area; however drainage is generally poor which in turn has created large bogs (Chapman and Putman 1966:300).

The Peterborough Drumlin Field region occupies an area of approximately 4,523 square km and extends from Hastings County to Simcoe County (Chapman and Putman 1966:280). This belt contains approximately 3,000 drumlins in addition to many drumlinoidal hills and eskers. The drumlins throughout this region are generally composed of highly calcareous till, however this does change locally. While, the eskers in this region are comprised of gravel ridges featuring poor soils. The orientation of the drumlin axes in this field is from northeast to southwest, however within the Lake Simcoe area, the direction of the ice movement seems to have been as much as 60 degrees west of south (Chapman and Putman 1966:282).

The study area is underlain by shales of the Utica formation, which contain layers of calcareous sandstone and sandy shale (Hoffman, Wicklund and Richards 1962:10-11). According to the Soil Survey of Simcoe County Ontario, the surface deposits within the study area are largely comprised of sandy and gravelly glacio-fluvial outwash, however areas within the southwest are found to be comprised of lacustrine clays, silts and sand laid down in glacial lakes. The topography in the southeast is found to feature gentle to moderately steeped slopes (Hoffman, Wicklund and Richards 1962:12-14).

Multiple watercourses are found within the limits of the study area. The largest of which is the Pine River, which flows through the northwest quadrant of the study area. Other watercourses located within the study area include multiple tributaries of the Nottawasaga River. These tributaries are found primarily throughout the east-central portion of the study area, surrounding much of the extant residential area. These tributaries also flow through the northeast corner of the study area. Within the eastern limits of the study area, these watercourses have created wet lands adjacent to Concession Road 6. Finally, the southern portion of the study area features several tributaries of the Boyne River.

The terrain of the study area consists of relatively level lands featuring a gentle northerly slope and is broken only by the Pine River Valley which extends through the northwest corner of the study area. However, the southeastern corner of the property, adjacent to Concession Road 6 and south of County Road 5 is situated approximately 40 metres higher in elevation than the majority of the study area.

A review of the surficial geology mapping of Simcoe County determined that the paleo-shoreline of glacial Lake Algonquin extended through the western extent of the study area (Figure 3). The balance of the study area features inland near shore deposits formed during the initial formation and flooding of glacial Lake Algonquin. The southeast corner of the study area, the highest point of lands, falls within lands classified as the edge of a glacially formed drumlin, which would have acted as a an archipelago during the formation phase of glacial Lake Algonquin. Finally the present-day Pine River valley is classified as a glacial river delta, emptying into the glacial lake.

1.3.4 Pre-and-Post-Contact Period Aboriginal Occupation in Simcoe County

Human occupation of the northwest Simcoe County area extends over the entire breadth of the pre-and-post-contact period of southern Ontario, which is outlined generally in Table 1. There are two specific periods which are particularly significant to northwest Simcoe County; the Paleo-Indian period of occupation and the early-post contact period of the Huron-Wendat.

The paucity of documented sites in the study area may be attributable to the fact that much of the area has not been subject to development or has not been subject to detailed archaeological survey being conducted under the terms of the Planning and Environmental Assessment Acts. It is not a reflection of First Nation settlement or land use prior to Euro-Canadian colonization. Indeed it is known that the environment of the area was rich in resources of particular use to both the Paleo-Indian period and later early-post contact period of the Huron-Wendat. This does not preclude the occupation of the study area throughout the pre-contact period of Southern Ontario.

Table 1: Outline of Southern Ontario Pre-contact and Post-contact Cultures

Period	Archaeological Culture	Date Range	Lifeways/Attributes
PALEO-INDIAN			
Early	Gainey, Barnes, Crowfield	11000 - 10500 BP	Big game hunters
Late	Holcombe, Hi-Lo, Lanceolate	10500 - 9500 BP	Small nomadic groups
ARCHAIC			
Early	Nettling, Bifurcate-base	9800 - 8000 BP	Nomadic hunters and gatherers
Middle	Kirk, Stanly, Brewerton, Laurentian	8000 - 4000 BP	Transition to territorial settlements
Late	Lamoka, Genesee, Crawford Knoll, Innes	4500 - 2500 BP	Polished/ground stone tools (small stemmed)
WOODLAND			
Early	Meadowood	2800 - 2400 BP	Introduction of pottery
Middle	Point Peninsula, Saugeen, Jack's Reef Corner-Notched	2400 -1200 BP	Incipient horticulture
Late	Algonkian, Iroquoian	1200-700 BP	Transition to village life and agriculture
	Algonkian, Iroquoian	700-600 BP	Establishment of large palisaded villages
	Algonkian, Iroquoian	600-400 BP	Tribal differentiation and warfare

Table 1: Outline of Southern Ontario Pre-contact and Post-contact Cultures			
Period	**Archaeological Culture**	**Date Range**	**Lifeways/Attributes**
CONTACT/POST-CONTACT			
Early	Huron, Neutral, Petun, Odawa, Ojibwa	400-350 BP	Tribal displacements
Late	Six Nations Iroquois, Ojibwa, Mississauga	350-200 BP	
	Euro/Canadian	220 BP-Present	Present European settlement

Paleo-Indian Occupation of Simcoe County

The term Paleo-Indian refers to the earliest well documented groups within the Americas dating from approximately 11,500 BP, at the time of the final ice sheets retreat (Ellis and Deller 1990 and Storck 1984). These populations were the first human occupation of the post-glacial landscape of southern Ontario. Archaeological sites dating to this period are rare and are considered to be highly significant archaeological resources. Paleo-Indian groups are defined by their artifact assemblages, site characteristics and the ways in which they subside and exploit their environment (Ellis and Deller 1990). Living in small mobile bands or groups, Paleo-Indians relied on hunting large game rather than hunting and gathering or agriculture, like their later descendants (Ellis and Deller 1990).

Paleo-Indian populations inhabited an environment that may have been similar to present-day Arctic tundra (Ellis and Deller 1990). As such, many sites have been encountered within proximity of the glacial Lake Algonquin Strand, which represents the initial shoreline formed by the glacial lake during the retreat of the ice sheets (Karrow and Warner 1990). The glacial Lake Algonquin Strand extends within general proximity west of the study area (Jackson, Ellis, Morgan, McAndrews 2000). The terrain located within proximity of the strand, both inland and out towards the gradually diminishing glacial Lake Algonquin, provided a habitable environment for Paleo-Indian peoples (Jackson, Ellis, Morgan, McAndrews 2000). As previously noted in section 1.3.3, the paleo-shoreline of glacial Lake Algonquin extends through a portion of the study area. The present-day Pine River valley was also a glacial river delta. Finally, the southeast corner of the study area would have projected into the lake as a high point of land. All of these areas represent potential areas of habitation and activity for Paleo-Indian populations.

It should also be noted that given the path of the paleo-shoreline of glacial Lake Algonquin, the northern and western portions of Simcoe County may have been some of the more densely populated areas by Paleo-Indian people, as reflected by the relative density of known Paleo-Indian sites within this region (Jackson, Ellis, Morgan, McAndrews 2000).

The earliest Paleo-Indians produced distinctive spear or dart points featuring channels or “flutes” located in the centre of the point originating at the base (Ellis and Deller 1990), thus often referred to as fluted projectile points. Within Ontario, Onondaga and Collingwood (Fossil Hill formation) cherts were widely preferred as the raw material of choice. Other Ontario sources such as Haldimand, Selkirk, Ancaster and Kettle Point cherts were available, yet rarely utilized (Ellis and Deller 1990). Therefore, an important indicator in the Paleo-Indian occupation of Simcoe Region is also the known in situ exposure of Fossil Hill chert in the Collingwood area (Storck 1984).

Early Contact/Post-Contact Occupation of Simcoe County

The late sixteenth century witnessed a northward migration of Wendat communities from the north shore of Lake Ontario that resulted in the historical coalescence in Huronia and abandonment of the southern and eastern homelands (Popham and Emerson 1952; Emerson 1959, 1961). Recognizing the existing limitations in archaeological data, researchers considered three main lines of explanation for the migration: ecological factors, socio-economic factors, and socio-political factors (Heidenreich 1963; 1971, Trigger 1962, 1963, 1969, 1979, 1985).

Push and pull factors surrounding northern migration may have stemmed from the attractiveness of Huronia as a settlement area and the looming warfare that may have rendered southern haunts less appealing. However, Trigger (1962; 1963; 1969:24; 1985:157-158) argued that socio-economic incentives were most responsible for the late pre-contact and contact period coalescence of Huron tribes in Huronia. He suggested that trade relations with northern Algonquian peoples, who plied the canoe routes of the upper Great Lakes, were important and longstanding, having been established at least as early as the first Iroquoian settlement of Simcoe County in Middle Iroquoian times.

Indeed, towards the latter part of the fourteenth century, the Barrie region was a primary area of Iroquoian settlement in Simcoe County, but a more diffuse distribution of numerous other apparently late fourteenth century sites throughout southern Simcoe County also attests to an expansion of Middle Iroquoian settlement. Settlements in the Flos Lowlands, together with the sites on the Penetang Peninsula, suggest a western movement into this portion of Simcoe County (Warrick 1990:360-361). Similarly, expansion northwards from the Barrie core area is suggested by relatively isolated middle to late fourteenth century villages located along the rivers flowing north into Severn Sound and along the Sturgeon River watershed. The spread of villages further northward must, in large part, be attributable to the continued migration of new communities into the area, creating a "leapfrog" pattern of village distribution in which less favourable areas were avoided (Sutton 1995:74).

By the end of the sixteenth century, the northward migration that had begun in the thirteenth century approached its final stage, as groups coalesced to form the Huron tribal confederacy in the northern uplands of Simcoe County. The South Slopes Till Plain and the Trent Valley were virtually abandoned at this time, while settlement in southern Simcoe County was considerably reduced.

At the time of contact, the largest nation, the Attignawantan, were historically ensconced on the Penetang Peninsula. The Ataronchonnon were located to their east between Hog Bay and Matchdash Bay. Further east still were the Attingneenongnac and the Arendaronnon, the latter of whom were on the west side of Lake Couchiching. Finally, the Tahontaenrat were located to the south of the Ataronchonnon. They were the smallest nation of the confederacy and were the last group to migrate into Huronia, arriving circa A.D. 1610-1620 (Heidenreich 1971; Trigger 1976).

Overall Pre-and-Post-Contact Period Archaeological Potential

The MTCS's Standards and Guidelines for Consultant Archaeologists (MTC 2011:17) stipulates that primary water sources (lakes, rivers, streams, creeks), secondary water sources (intermittent streams and creeks, springs, marshes, swamps), ancient water sources (glacial lake shorelines indicated by the presence of raised sand or gravel beach ridges, relic river or stream channels indicated by clear dip or swale in the topography, shorelines of drained lakes or marshes, cobble beaches), as well as accessible or inaccessible shorelines (high bluffs, swamp or marsh fields by the edge of a lake, sandbars stretching into marsh) are characteristics that indicate archaeological potential.

Other geographic characteristics that can indicate archaeological potential include: elevated topography (eskers, drumlins, large knolls, plateaux), pockets of well-drained sandy soil, especially near areas of heavy soil or rocky ground, distinctive land formations that might have been special or spiritual places, such as waterfalls, rock outcrops, caverns, mounds, and promontories and their bases. There may be physical indicators of their use, such as burials, structures, offerings, rock paintings or carvings. Resource areas, including; food or medicinal plants (migratory routes, spawning areas, prairie), and scarce raw materials (quartz, copper, ochre, or outcrops of chert) are also considered characteristics that indicate archaeological potential (MTC 2011:18).

An added factor of this pre-contact potential model is the presence of the elevated, well drained lands found within the southeastern corner of the study area. These lands pose as an important indicator in the possibility of encountering potential for the presence of pre-contact archaeological sites.

Therefore, given the presence of the recorded pre-contact archaeological site, the presence of various physiographic determinants such as the Pine River and tributaries of the Boyne and Nottawasaga Rivers, as well as the proximity of the glacial Lake Algonquin Strand and the noted occupation of the Huronia Region, the study area has the potential for the recovery of pre-contact archaeological resources, depending on the degree of more recent land alterations.

1.3.5 Study Area Description

The Stage 1 field review was completed on August 21, 2012 in order to assess the archaeological potential of the property. All field work was conducted under the direction of Mr. John Dunlop (R261). The weather conditions were appropriate for the completion of field work.

The study area consists of the Everett Secondary Plan lands, which is generally bordered by the development boundary approximately extending along Forest Hill Drive to the north, the development boundary approximately extending along Dekker Street to the south, Concession Road 4 to the west and Concession Road 6 to the east. The study area encompasses an area that includes both urban and rural residential areas, active farm land, wetlands, watercourses, municipal parks and active commercial lands. Given the large size, the variety of land uses and physiographic characteristics, the study area was subdivided into eight distinct sections; The Developed Area of Everett, the Southwest Block, the Southeast Block, the Western Block, the Eastern Block, the Pine River Block, the Northern Block, and all Roadways and Right of Ways. The boundaries of these sections are illustrated on Figure 4. The location of the field photos are also depicted on Figure 3.

The Developed Area of Everett

The central portion of the overall study area is dominated by mixed residential and commercial lands comprising the current settlement area of Everett. These lands extend outward from the major intersection of County Road 5/Main Street and County Road 13, in the location of the centre of the historic settlement and the current downtown. County Road 5/Main Street and County Road 13 are dominated by late-nineteenth and early twentieth century structures including houses, store fronts and former churches (Plates 2 and 3). These structures were not depicted on the nineteenth century mapping, but were incorporated into the schematically illustrated Everett as noted on Figure 2. St. David's Anglican Church and cemetery are located on County Road 13, south of Main Street (Plates 4 and 5). The church and cemetery were founded 1880, and neither is noted on the historical mapping.

The northeast, northwest and southeast quadrants of the downtown are the locations of the more recently developed subdivisions. These areas consist of single residential lots, full servicing and utilities, and several municipal parks and were most likely developed within the past thirty years (Plates 6-10). The tributaries of the Nottawasaga River, flow through this portion of the study area (Plate 11). Portions of these tributaries have been modified and incorporated into the municipal water management system.

The Hamilton and Northwestern rail line is noted on the historical mapping as extending north-south on the eastern side of the historic downtown section of Everett. There is currently no evidence of a rail line within this portion of the study area, however, a detailed examination of aerial photography for the study area indicates a treeline and "shadow" outline of the rail line course, extending along the present-day path of Wales Avenue, and further north into agricultural fields in the northern block of the study area (Figure 5).

The Southeast Block

The Southeast Block comprises the portion of the study area which is located within the Peterborough Drumlin Field, and is bordered by the residential development to the west, the study area boundary to the south, Concession Road 6 to the east and the residential lots fronting County Road 5/Main Street. Overall, it lies upon lands which slope up to the north and west, and are generally found to be approximately 40 m above the balance of the study area (Plate 12). This elevated area is a distinct feature when looking across the landscape. The Southeast Block currently consists of agricultural land with a farm complex as well as a separate, single residential lot, both of which front Concession Road 6 (Plates 13 and 14).

The Southwest Block

The Southwest Block is bordered by County Road 5/Main Street to the north, developed lands to the east, Concession Road 4 to the west and the study area boundary to the south. This portion of the study area consists of agricultural lands featuring level terrain, as well as one farm complex, fronting County Road 5/Main Street (Plates 15 and 16). The majority of the lands within the Southwest Block have previously been subjected to archaeological assessments by ASI, as noted in section 1.3.2 (ASI 2011, 2012).

The Western Block

The Western Block is bordered by County Road 5/Main Street to the south, the developed area of Everett to the southeast, County Road 13 to the east, the forested and undeveloped Pine River to the north, and Concession Road 4 to the west. These lands consist of open agricultural lands featuring level terrain

(Plate 17). There are two farm complexes within the Western Block; one fronting County Road 5/Main Street and the other fronting Concession Road 4, as well as a residence at the intersection of the two roads (Plates 18 and 19). The farm complex fronting County Road 5/Main Street is located in the same location as the homestead belonging to A. Wanless, as depicted on the nineteenth century mapping (Figure 2).

The Pine River Block

The Pine River Block consists of lands dominated by the Pine River. These lands consist of forest and open agricultural lands (Plates 20-22). The block is bordered by County Road 13 to the east, the study area boundary to the north, the Western Block to the south and Concession Road 4 to the west. There are several large, single residential lots fronting Concession Road 4 (Plate 23). The eastern portion of the block features an area dominated by ponds and berms indicative of land altering activities in the past (Plates 24 and 25).

The Northern Block

The Northern Block is bordered by County Road 13 to the west, the developed area of Everett to the south, Concession Road 6 to the east, and the study area boundary to the north. These lands consist of open agricultural lands and a woodlot which slopes slightly down to the south (Plates 26-28). There are several single residential lots and one farm complex which front County Road 13 within the lot (Plate 29). Several tributaries of the Nottawasaga River flow through the block, and the Hamilton and North Western rail line shadow extends through several agricultural fields and woodlot (Figure 5). The southernmost fields within the Northern Block have previously been assessed by Archaeological Assessments Limited in 2011 (AAL 2011).

The Eastern Block

The Eastern Block fronts Concession Road 6 and is bordered by the Northern Block and the developed area of Everett. These lands consist primarily of low lying cedar swamp lands, although the low lying wet area ceases as the lands slope upward in the northern portion of the block (Plates 30 and 31). Several tributaries of the Nottawasaga River flow through the block, draining the developed areas to the west (Plate 32).

Roadways and Right of Ways

There are two different types of road which extend through the study area; County and Concession Roads which follow the historical transportation corridors as noted on the nineteenth century mapping and the smaller residential roads which extend through the residential developments in Everett. Typically, rights-of-way (ROW) can be divided into two areas: the disturbed ROW, and ROW lands beyond the disturbed ROW. The typically disturbed ROW extends outwards from either side of the centerline of the traveled lanes, and it includes the traveled lanes and shoulders and extends to the toe of the fill slope, the top of the cut slope, or the outside edge of the drainage ditch, whichever is furthest from the centerline. Subsurface disturbance within these lands may be considered extreme and pervasive, thereby negating any archaeological potential for such lands.

ROW construction disturbance may be found to extend beyond the typical disturbed ROW area, and this generally includes additional grading, cutting and filling, additional drainage ditching, watercourse alteration or channelization, servicing, removals, intensive landscaping, and heavy construction traffic. Areas beyond the typically disturbed ROW generally require archaeological assessment in order to determine archaeological potential relative to the type or scale of disturbances that may have occurred in these zones

The County Roads (County Road 5/Main Street and County Road 13) feature two-lane paved roadways with right of ways which featured buried utilities and services as well as drainage ditches (Plates 33-36). Concession Road 4 consists of a two-lane paved road which features drainage ditches in both right of ways (Plate 37). Concession Road 6 consists of a paved two-lane road south of County Road 5; however, it is an unassumed packed dirt road north of County Road 5 (Plates 38 and 39). Concession Road 6 features a section of a corduroy road within the Eastern Block of the study area (Plates 40 and 41). This corduroy road consists of logs which have been laid lengthwise across the roadway in order to maintain its form through the low lying swampy lands. The logs were noted just below the surface of the packed dirt roadway along a section approximately 200 m in length. The corduroy road is not intact and there are several portions of the roadway which have flooded (Plate 42).

The residential roads which extend through the residential developments within Everett were all found to be two-lane paved roads which feature drainage ditches and buried utilities within the right of ways (Plates 43-45).

2.0 FIELD METHODS

The Stage 1 archaeological assessment was conducted by means of a visual review of the study area that involved spot checking every 40 metres (131 feet) across the study area. Special emphasis was given to locations with high pre-contact archaeological potential and features of historical significance during the field assessment. This strategy is consistent with Section 1.2, Standard 1 of the *Standards and Guidelines for Consultant Archaeologists* (MTC 2011:5).

3.0 ANALYSIS AND CONCLUSION

Archaeological Services Inc. was contracted by the Township of Adjala-Tosorontio, Ontario to undertake a Stage 1 Archaeological Assessment of the Everett Secondary Plan and Master Servicing Municipal Class EA lands, located within the former Geographic Township of Tosorontio, Simcoe County, now in the Township of Adjala-Tosorontio, Simcoe County.

The study area is approximately 660 hectares. The detailed background assessment determined that one archaeological site had been registered within the study area and no other sites have been registered within a one kilometre radius of the study area. A review of the history of the study area determined the settlement area of Everett was originally established one concession road east of its present-day location and that the settlement was moved to accommodate the Hamilton and North Western Railway in the late nineteenth century. A review of the general physiographic setting of the study area determined that it is located in both the Simcoe Lowlands and Peterborough Drumlin Field physiographic regions. The lands of the study area were well drained with multiple watercourses, including Pine River in the northwest quadrant and tributaries of the Nottawasaga and Boyne River in the south and eastern portions of the study area. A review of pre-and-post contact archaeological potential determined that the study area is located within proximity of the glacial Lake Algonquin Strand and is located within a larger area which features a number of Paleo-Indian sites. Furthermore, the study area is located within the traditional lands of what is known as Huronia, the historically occupied lands associated with the Huron/Wendat people.

The study area consists of the Everett Secondary Plan lands, which is generally bordered by Forest Hill Drive to the north, Dekker Street to the south, Concession Road 4 to the west and Concession Road 6 to the east. The study area encompasses an area that includes both urban and rural residential areas, active farm land, wetlands, watercourses, municipal parks and commercial lands (Figures 4 and 6).

Three parcels of land within the study area have been previously subject to archaeological assessments. The recommendations from these assessments have stated that these lands are free of any further archaeological concern (Figure 6).

In order to determine the archaeological potential for the study area, a detailed Stage 1 field review was undertaken, in order to determine the integrity of archaeological potential across the study area.

All lands that have been developed for commercial use are considered to not require further archaeological assessment. Likewise, all paved roadways, rail lines, and any parcels of land associated with buried utilities are considered to lack any archaeological potential. These lands have been altered by the significant disturbance and removal of soils to such a degree that any extant archaeological resources would have been removed. This determination is consistent with section 1.3.2 of MTCS's *Standards and Guidelines for Consultant Archaeologists*. These areas are noted on Figure 6.

All recently built residential developments located inside the Developed Area of Everett are considered to not have remaining archaeological potential. These areas include any parkland which has been notably graded or otherwise impacted during the development process. These areas have been subject to including severe land alterations consistent with current construction techniques which were observed during the field review. This determination is consistent with Section 1.3.2 of MTCS's 2011 *Standards and Guidelines for Consultant Archaeologists*. These areas are noted on Figure 6.

All permanently low and wet areas such as watercourses or wetlands do not have archaeological potential. This determination is consistent with Standard 2, Section 2.1 of MTCS's 2011 *Standards and Guidelines for Consultant Archaeologists*. These areas are noted on Figure 6.

The pond and berm dominated area within the Pine River Block fronting County Road 13 must be subject to a Stage 2 archaeological assessment using a judgmental testpitting strategy. This determination is consistent with Standard 2, Section 2.1.8 of MTCS's 2011 *Standards and Guidelines for Consultant Archaeologists*. This area is noted on Figure 6.

The corduroy road located within Concession Road 6 is potentially representative of a unique historic transportation corridor. Although the visible corduroy road may have been constructed in more recent times, it should be subject to further investigation. Therefore, any development or alteration taking place along the roadway should be monitored by a licensed archaeologist. This determination is consistent with Standard 4, Section 2.1.7 of MTCS's 2011 *Standards and Guidelines for Consultant Archaeologists*.

The balance of the study area, including all active farm lands, woodlots, open, unaltered lands, including and all residential lands excluding the above mentioned current developments and all infill lands within the residential developments where land alterations may not have taken place, are considered to have archaeological potential (Figure 7). There are several factors which were considered in this determination. The extensive forested areas within the Pine River Block and the Northern Block may represent undisturbed forest lands which have the potential for the recovery of insitu archaeological deposits. All active farm lands are considered to have been subject to minimal land alteration (i.e. ploughing). Likewise, any large, single lot residential lands, municipal parks, schoolyards or large scale, mid twentieth century residential lands have likely only been altered in the areas of building footprints or buried utilities. Finally, the majority of these non-agricultural lands are located within the historic settlement area of Everett as noted by the schematically illustrated settlement area on the historical mapping. Given these factors, these lands will require Stage 2 archaeological assessments carried out in accordance with section 2 of the MTCS's 2011 *Standards and Guidelines for Consultant Archaeologists* prior to any development. These lands are identified on Figures 6 and 7.

4.0 RECOMMENDATIONS

In light of these results, the following recommendations are made:

1. Prior to any land-disturbing activities within the subject property, a Stage 2 archaeological assessment must be conducted on the lands as identified in Figures 6 and 7. The Stage 2 assessment must be carried out in accordance with the Ministry of Tourism and Culture's 2011 *Standards and Guidelines for Consultant Archaeologists*.

2. Any development within the Concession Road 6 roadway must be carried out under monitoring of a licensed archaeologist. The archaeologist shall make a thorough inspection of the roadway for any evidence of a historic corduroy road. Any remnant of a historic corduroy road should be fully documented in accordance with the MTCS's 2011 *Standards and Guidelines for Consultant Archaeologists.*

5.0 ADVICE ON COMPLIANCE WITH LEGISLATION

- This report is submitted to the Minister of Tourism, Culture and Sport as a condition of licensing in accordance with Part VI of the Ontario Heritage Act, RSO 1990, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological field work and report recommendations ensure the conservation, preservation and protection of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Ministry of Tourism, Culture and Sport, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.

- It is an offence under Sections 48 and 69 of the Ontario Heritage Act for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological field work on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeology Reports referred to in Section 65.1 of the Ontario Heritage Act.

- Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48 (1) of the Ontario Heritage Act. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with sec. 48 (1) of the Ontario Heritage Act.

- The Cemeteries Act, R.S.O 1990 c. C.4 and the Funeral, Burial and Cremation Services Act, 2002, S.O. 2002. c.33 (when proclaimed in force) require that any person discovering human remains must immediately notify the police or coroner and the Registrar of Cemeteries, Ministry of Consumer Services.

- Archaeological sites recommended for further archaeological fieldwork or protection remain subject to Section 48 (1) of the Ontario Heritage Act and may not be altered, or have artifacts removed from them, except by a person holding an archaeological licence.

The documentation related to this archaeological assessment will be curated by Archaeological Services Inc. until such a time that arrangements for their ultimate transfer to Her Majesty the Queen in right of Ontario, or other public institution, can be made to the satisfaction of the project owner(s), the Ontario Ministry of Tourism, Culture and Sport, and any other legitimate interest groups.

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7.0 PLATES/IMAGES

Plate 1: A Plaque commemorating the original location of Everett.

Plate 2: The late-nineteenth and early twentieth century structures within the settlement area of Everett.

Plate 3: The late-nineteenth and early twentieth century structures within the settlement area of Everett.

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Plate 32: Tributary of the Nottawasaga River flowing through the Eastern Block.


Plate 33: Roadway and right of way of County Road 5.


Plate 34: Roadway and right of way of County Road 5.

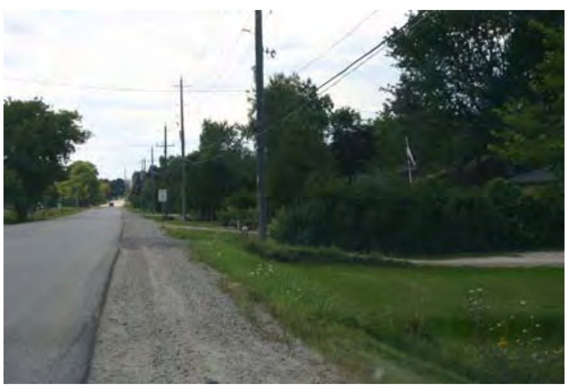
Plate 35: Roadway and right of way of County Road 13.


Plate 36: Roadway and right of way of County Road 13.

Plate 37: Concession Road 4 and right of way.

Plate 38: Concession Road 6, south of County Road 5.

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Plate 43: Typical roadway and right of way within the residential areas.

Plate 44: Roadway and right of way within the residential areas.

Plate 45: Typical utilities encountered in the right of way along the residential roads.

8.0 MAPS

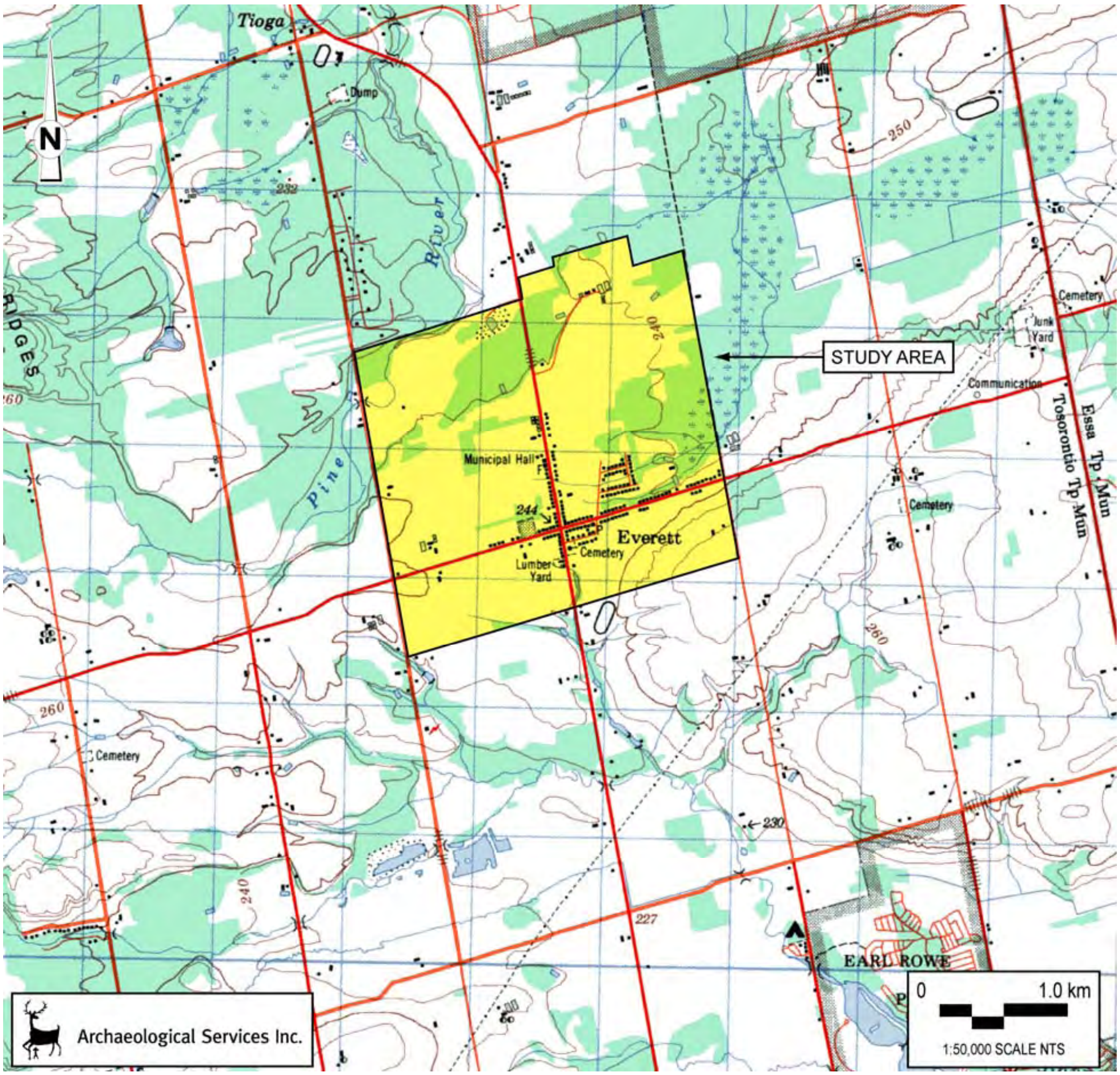


Figure 1: The study area illustrated on the NTS Sheet Alliston 31 D/4, 7th Edition, 1986.

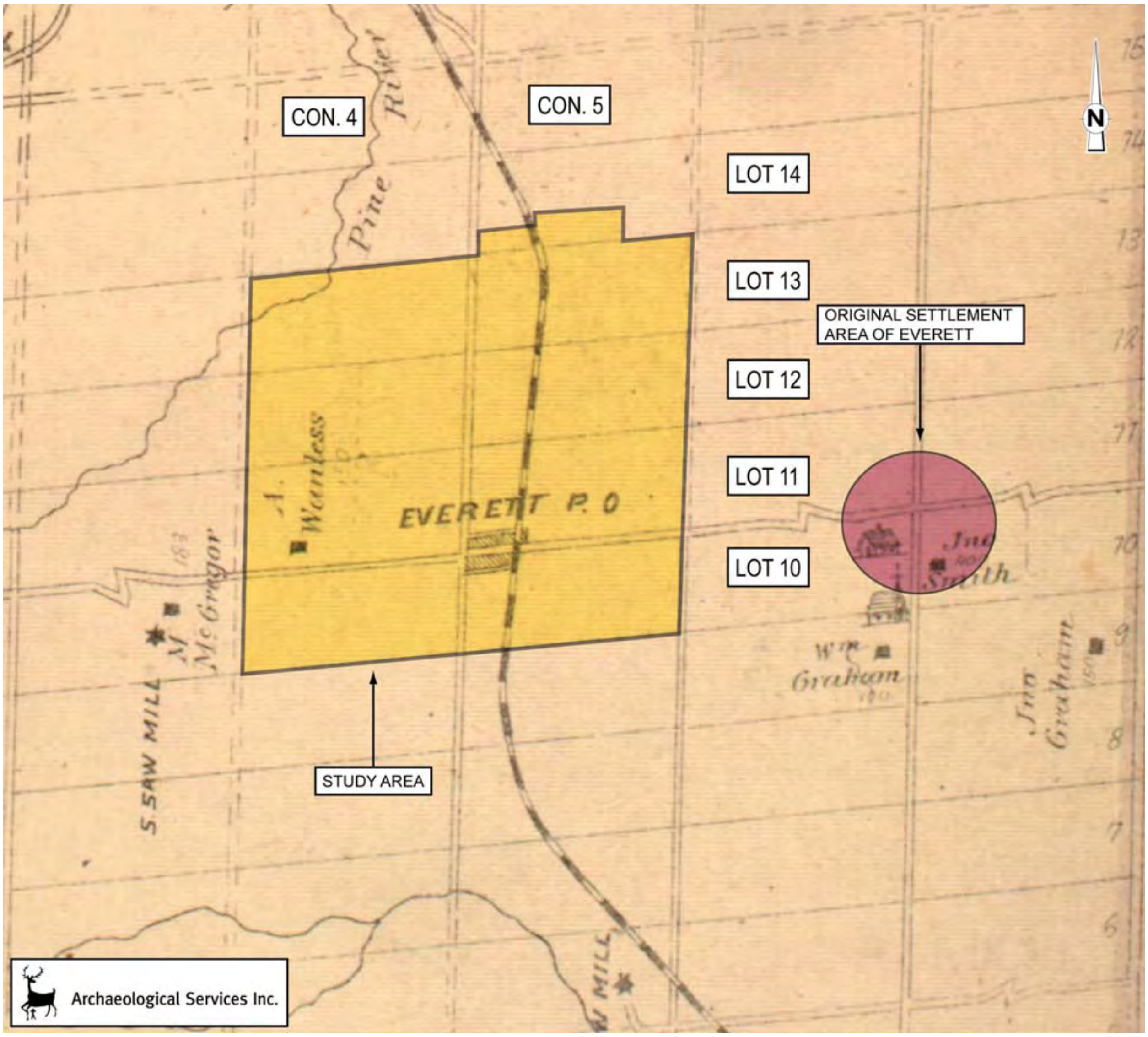
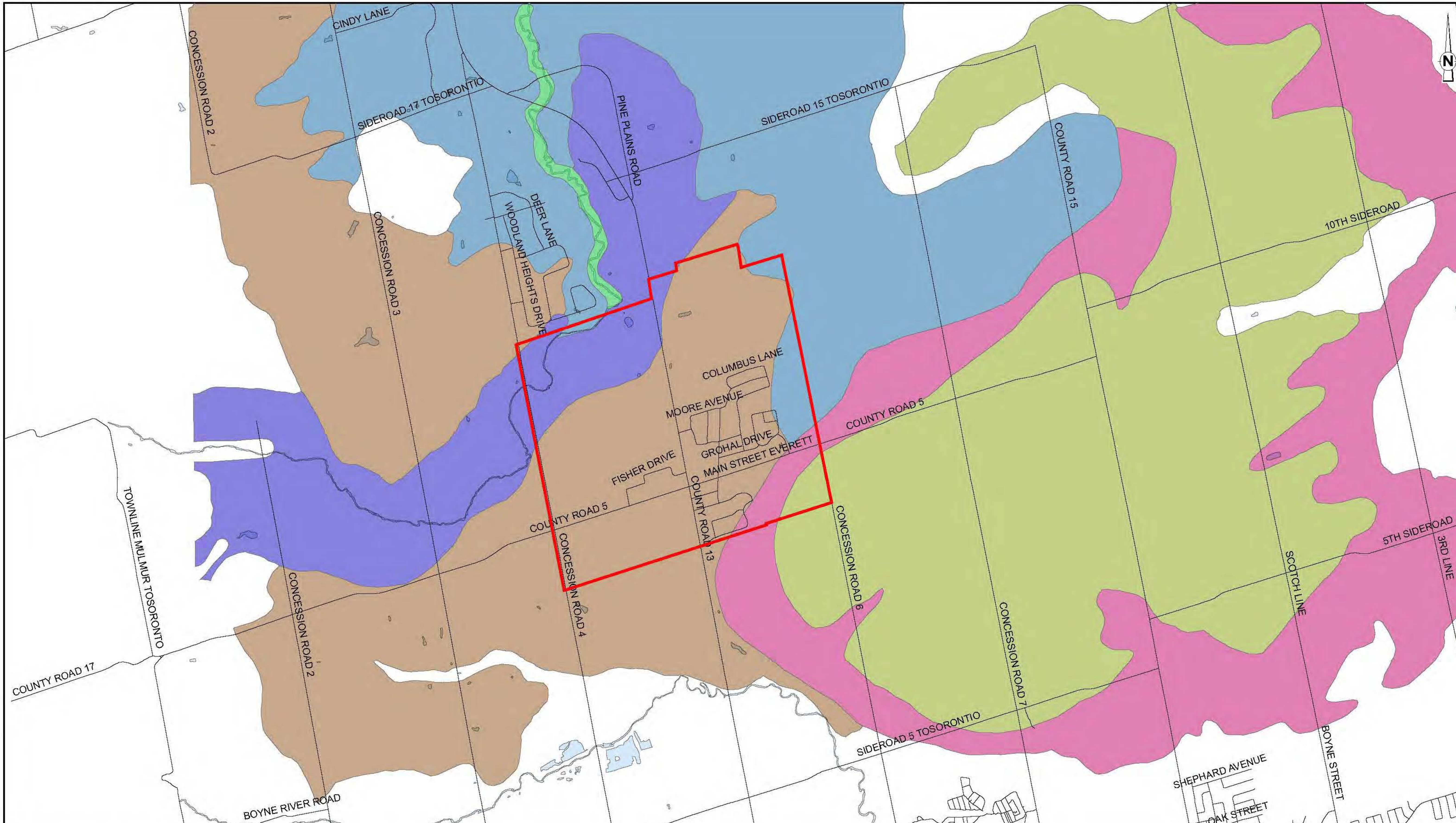


Figure 2: The study area located on the 1881 *Simcoe Supplement in the Illustrated Atlas of the Dominion of Canada.*



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LEGEND
- STUDY AREA BOUNDARY
- GRAVEL, SAND, SILT, CLAY- MODERN FLOODPLAIN
- GRAVEL, SAND, SILT, CLAY- POST-GLACIAL RIVER DELTA
- SAND, SILT, CLAY- GLACIAL NEARSHORE FLATS (LAKE ALGONQUIN)
- SILT AND CLAY GLACIAL DEPOSITS (DRUMLIN)
- SAND AND GRAVEL-NEARSHORE INLAND DEPOSITS
- SANDY SILT TO SAND TILL-STRATIFIED LAKEBEDS

0 2
Kilometers

ASI PROJECT NO.: 12TS-125 DRAWN BY: BWJD
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Figure 3: The Surficial Geology of the Everett Secondary Plan, Township of Adjala-Tosorontio, Simcoe County

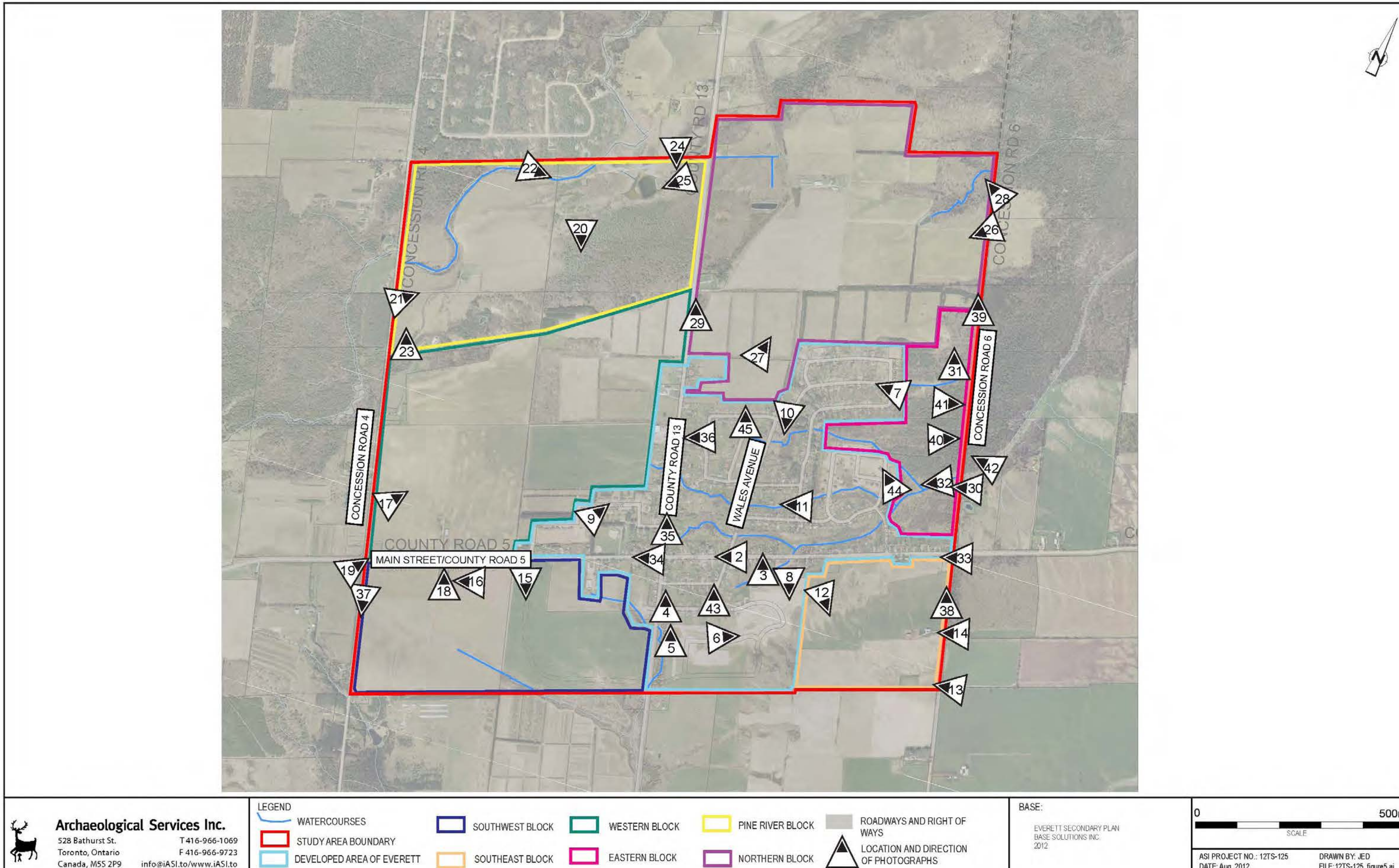

Figure 4: Stage 1 field review outline of the Everett Secondary Plan Lands, Simcoe County.

Figure 5: Aerial image showing the Hamilton and North Western Rail line "shadow" extending through the study area. The shadow line of the rail line is indicated with red arrows.

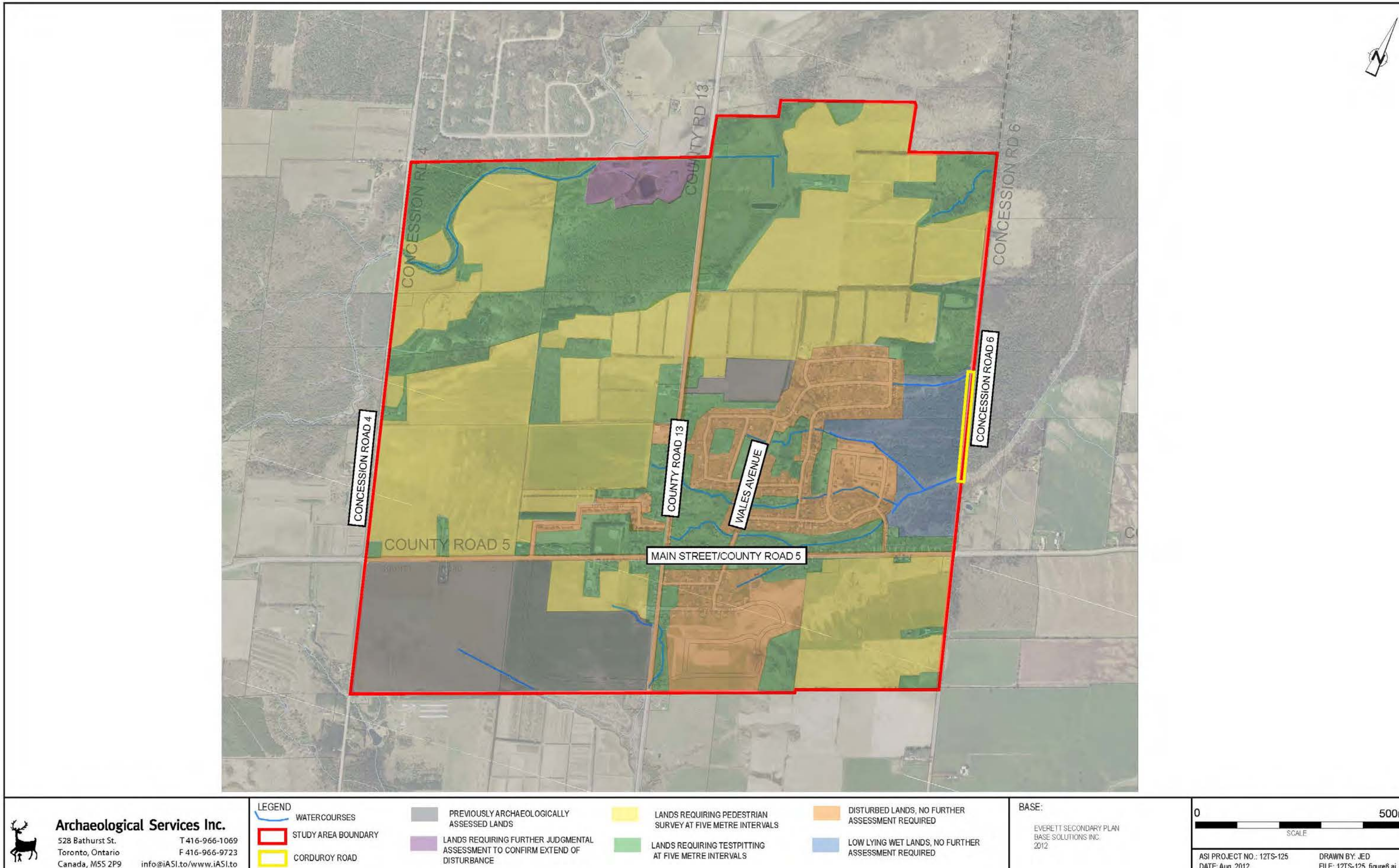

Figure 6: Detailed Stage 1 Field Review of the Everett Secondary Plan Lands, Simcoe County.

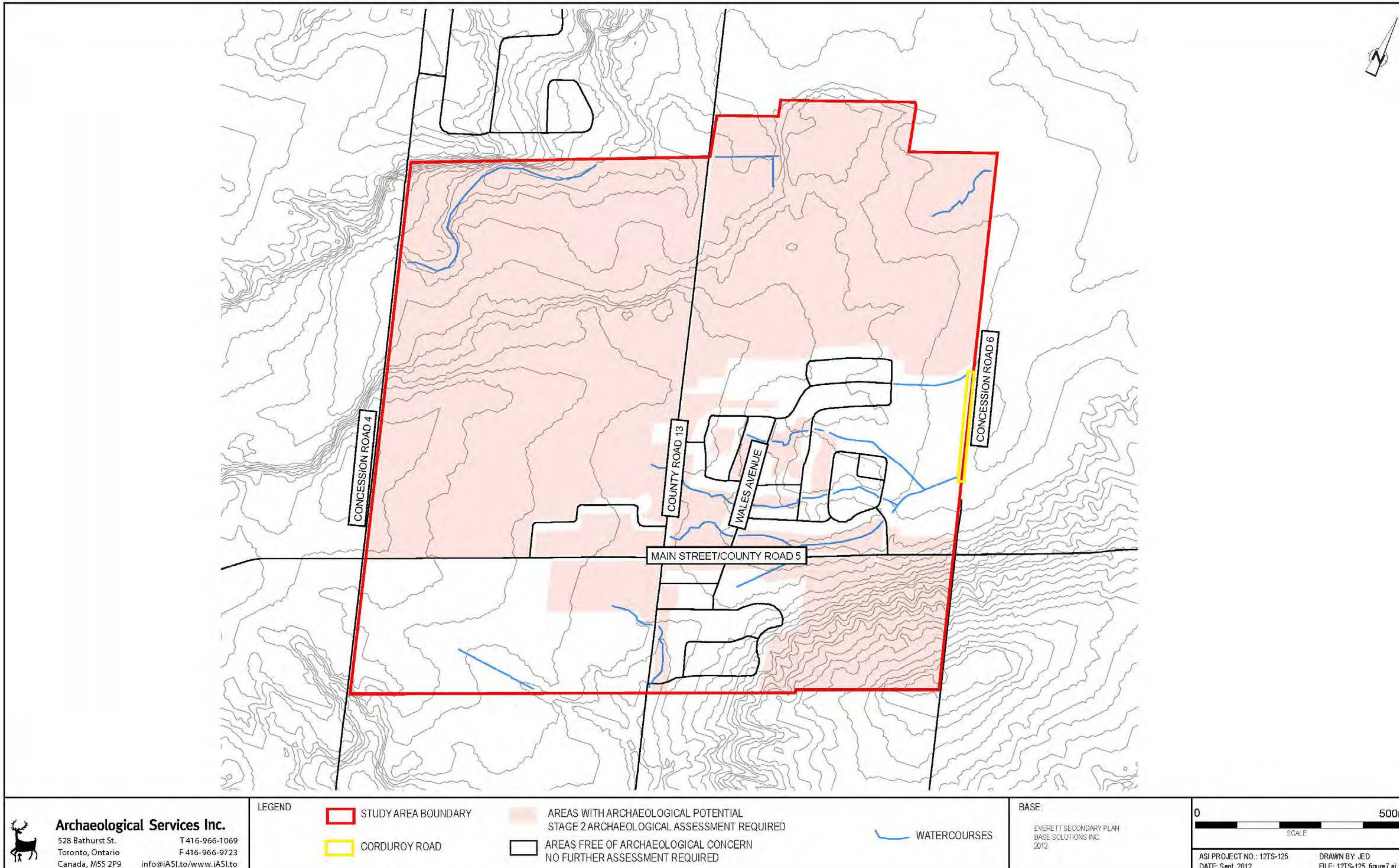

Figure 7: Areas of Archaeological Potential Requiring Further Assessment, Everett Secondary Plan lands, Simcoe County.

VOLUME 2: BACKGROUND STUDIES

Part 4 – Natural Heritage Study Report

Natural Environment – *Draft September 5th, 2012*

Introduction

The following Natural Environment Background Report has been prepared in conjunction with a proposed secondary plan for the Everett Community in the County of Simcoe. The study area encompasses the existing community of Everett and immediately adjacent lands (Figure 1). The background report provides the following information:

- A description and evaluation of the biophysical resource features within the study area based largely on existing background information and mapping;
- Confirmation of natural area boundaries, buffers and linkages through airphoto interpretation and windshield surveys;
- Identification of opportunities/constraints for future development within Everett;
- An evaluation of potential impacts for future development on core natural areas and linkage functions;
- Recommended mitigation/design measures, including buffers/setbacks to reduce development related impacts, protect sensitive environmental features and achieve habitat enhancement; and,
- Additional information, field inventories, and studies required at the development application stage.

The following tasks were completed as part of the analysis:

- Review of background reports and GIS mapping provided by MNR, County of Simcoe and NVCA;
- Consultation with NVCA staff;
- Review of aerial photography, topographic mapping, soils and physiographic mapping; and,
- Windshield survey of study area.

Existing Conditions Overview

The landscape associated with the village of Everett can be described as a mosaic of agricultural land interspersed with mature hedgerows, woodlots, thicket/meadow, and wetlands associated with the Pine River valleylands. The wetlands within the study area are regulated by the Nottawasaga Valley Conservation Authority under their *Development, Interference with Wetlands and Alterations to Shorelines and Watercourses* regulation. They occur in low lying

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areas and floodplains, and consist primarily of mixed swamp communities dominated by a mixture of balsam fir, white spruce, eastern hemlock, eastern white cedar, trembling aspen, balsam poplar, white elm, yellow birch and black ash. Inclusions of cattail and reed canary grass marsh, willow/dogwood thicket swamp, cedar swamp, and deciduous swamp are associated with the mixed swamp features. Adjacent upland habitats support a mixture of mixed and deciduous forest associations. Typical species present include sugar maple, red maple, American beech, white ash, white pine, eastern hemlock, eastern white cedar, black cherry, ironwood, basswood and white birch. A rich, diverse native ground flora comprised of herbaceous plants, sedges/grasses, and ferns are associated with the large, intact wetland and forest blocks.

The upland and wetland communities associated with the Pine River are part of a larger core natural area and corridor that provides an important linkage connection between the Niagara Escarpment core natural areas to the west and the Minesing Swamp and Canadian Shield to the northeast. This provincial scale corridor is considered highly significant due to the connection it provides between major core natural areas within the landscape.

The community of Everett is located within the watersheds of the Pine River and Boyne River systems. The Pine River flows northerly through the northwest corner of the community. A broad floodplain and large expanses of connected forest and wetland habitat are associated with the Pine River, extending both upstream and downstream of the community. A small, intermittent headwater tributary of the Boyne River is located in the southwest corner of the community, in association with cultivated agricultural land. Several small, intermittent tributaries to a tributary of the Pine River are located within the village of Everett and drain easterly through an expansive block of forested wetland (swamp).

The Pine River is a permanent, coldwater stream that supports a variety of fish species, including resident and migratory trout species. Water quality within the Pine River is considered to be good (*NVCA Pine River Subwatershed Report Card*, NVCA 2007). Protection of the groundwater recharge/discharge regime within the community of Everett is of paramount importance to the protection of the ecological integrity and function of the Pine River and its associated wetland features.

Water quality in the Boyne River is rated as poor to fair due to the impacts of agricultural runoff and loss if riparian cover (*NVCA Boyne River Subwatershed Report Card*, NVCA 2007). The Boyne River supports a variety of warmwater and coldwater fish species, including trout.

Existing conditions within the study area are mapped on Figure 1.

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Species-at-Risk

A list of species-at-risk for Simcoe County is presented in Table 1 (attached). The establishment of the natural heritage system for the Everett Community will provide for the protection and enhancement of existing and potential habitat for species-at-risk that may occur within the study area. The key habitat features within the community are primarily associated with the Pine River in the northwest and the large block of wetland and forest to the east. Large blocks of intact wetland and forest habitat occur to the north, south, east and west of Everett.

Wildlife

The large expanses of connected forest and wetland habitat within the community of Everett support a variety of important functions for wildlife including winter habitat for deer (conifer dominated areas), habitat for area sensitive forest interior birds, and dispersal corridor (Pine River, tributary system). Given the size and diversity of habitat conditions present, it is expected that a diverse wildlife community exists within the community of Everett. As noted above, the habitat features within Everett are part of a significant, provincial scale wildlife corridor.

Environmental Policy Areas

The study area contains numerous natural heritage features that are designated as environmental policy areas. These features include:

- Greenlands (County of Simcoe)
- Floodplains, slopes, watercourses and wetlands regulated by the NVCA

From a Provincial Policy Statement and Natural Heritage Reference Manual perspective, the large expanses of forest and wetland within and adjacent to Everett would be considered a “significant” woodland with other natural heritage features/functions associated with it such as significant wildlife habitat, significant valleylands, and significant fish habitat. Habitat for some of the species at risk listed for Simcoe County (refer to Table 1) is likely provided within the large wetland/forest blocks associated with the Pine River corridor. The County of Simcoe Greenlands designation encompasses the forest and wetland features within Everett, as well as the linkage corridor with enhancements.

Environmental policy areas within the study area are shown in Figure 2.

Physiography, Soils and Topography

The study area is primarily flat to gently undulating with relief associated with the Pine River in the northwest and sloping topography in the southeast associated with a remnant shoreline of former Lake Algonquin. From a physiographic standpoint, the study area is located within the Simcoe Lowlands. In the *Physiography of Southern Ontario 3rd Edition*, Chapman and Putnam

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(1984) describe the study area as a gently undulating to flat outwash sand plain formed by glacio-fluvial till deposits.

According to the *Soil Survey of Simcoe County – Report No. 29 of the Ontario Soil Survey* (Hoffman et al., 1962), the soils within the study area are predominantly well drained Tioga sandy loam, Bondhead sandy loam, and Bennington fine sandy loam (Hoffman et al. 1962). Organic muck soils and poorly drained Granby sandy loam soils are associated with the Pine River and wetland areas. The soils of Simcoe County are underlain by rocks of the Ordivician, Silurian and Precambrian ages. Limestones of the Black River, Trenton, Medina, Cataract and Lockport formations and shales of the Utica, Queenston and Richmond formations are present (Hoffman et al., 1962).

The topography of the study area, including slopes and the NVCA Regulation Limit are presented in Figure 2.

Opportunities/Constraints – Natural Heritage System

The study area supports a mosaic of agricultural land interspersed with mature hedgerows, woodlots, and wetlands. Large expanses of forest and wetland (mixed swamp) are located in the northwest and east/northeast section of the study area, in association with the Pine River and tributaries, respectively. The remnant natural areas are primarily associated with valleylands and low-lying depressional areas with poorly drained, organic muck soils. Deciduous/mixed forest and cultural habitat features (thicket, woodland, old field meadow) occur in the upland areas adjacent to the wetlands.

The key natural heritage and hydrologic features within and in proximity to the study area include:

- Pine River – significant valleyland feature, major corridor function, coldwater fishery
- NVCA regulated wetlands – associated with Pine River and headwater tributaries
- Significant woodlands – associated with Pine River and headwater tributaries (Pine River)
- Intermittent headwater tributaries to the Pine River and the Boyne River
- Floodplains
- Habitat for species-at-risk
- Linkage connections among natural features (i.e. both within and in proximity to the study area)
- Simcoe County Greenlands – encompasses the above core natural areas and corridors with buffers/enhancements

Combined, these natural heritage features form the natural heritage system for the community of Everett (Figure 3). The system incorporates the key natural heritage and hydrologic features

Landscape Ecology and Natural Heritage Planning

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noted above plus a minimum 30 m buffer, and enhancements to core area and corridor functions. The County of Simcoe Greenlands, floodplain areas, slopes and meander belt width have also been taken into account in determining the location of the natural heritage system. The application of a minimum 30 m buffer is consistent with current guidelines and policy practices within Southern Ontario, including the adjacent GreenBelt Plan area.

Given the significance and sensitivity of the natural environment features within the study area, appropriate stormwater and groundwater management measures are recommended to maintain and enhance water quality, sustain stream baseflow/temperature and protect wetland hydrology. Low impact development (LID) measures for stormwater management such as bio-swales, at-source infiltration of runoff, wetland storm ponds, and infiltration/cooling trench outlets, are recommended to protect the aquatic and wetland components of the natural heritage system. The predominantly well drained soils across the study area should be suitable for the application of LID stormwater management measures.

Naturalization of the buffers and storm ponds with native species is also recommended to enhance the function and integrity of the natural heritage system and increase its resilience to development of the landscape.

The key elements to be incorporated into the secondary plan with respect to environmental protection are as follows:

- Control of post-development runoff to pre-development levels with Enhanced (former Level 1) stormwater management facilities, constructed as wetland or hybrid type storm ponds;
- Cooling of runoff through a combination of outlet design (e.g. buried stone trench) and shade plantings along the receiving channel;
- Minimizing cut/fill requirements to reduce alterations to surface drainage and infiltration;
- Low Impact Development (LID) stormwater management measures such as landscaped bio-swales, perforated drain tiles, permeable pavement systems, rainwater collection cisterns for irrigation, and minimal or no grade changes within buffer areas;
- Naturalization of buffers and parkland with common, native species indicative of the surrounding landscape and existing site conditions;
- Low level lighting for sports fields and trails adjacent to natural areas;
- Minimal hedgerow tree removal to maintain micro-climate and linkges;

Other urban design criteria to be incorporated into the secondary plan to promote environmental protection include the use of single loaded roads adjacent to natural areas,

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positioning of parkettes and storm ponds between residential areas and features to be protected, large lots to promote at-source infiltration of runoff, and avoidance of areas with steep/sloping topography.

Buffers

As noted above, a 30 m buffer has been applied to the core environmental features within the study area. The secondary plan should be designed to respect the natural heritage features and the buffers. No roads or lots should be permitted within buffer areas.

Compatible uses within buffer areas include stormwater management facilities (provided a minimum 10 m “no touch” buffer is maintained to the feature), trails and passive/active park uses, such as the edges or rear of a sports field.

Larger buffers may be required in certain locations to accommodate areas of seasonal inundation with water (i.e. in the spring), sloping topography, and protection of the natural heritage system. In-season vegetation and wildlife surveys are recommended at the development application stage (EIS) to confirm and refine, where necessary, the buffers to the natural heritage system.

Environmental Protection Strategy

The above noted environmental protection measures are intended to be developed in greater detail as part of the individual EIS’s to be submitted with a development application. Specific details related to the protection of stream baseflow/temperature, water quality, wetland hydrology, and the features/functions of the overall natural heritage system will be provided in the EIS. The environmental protection strategy will be developed in conjunction with the results of the hydrogeological investigation, stormwater management plan, geotechnical studies related to slopes and top of bank, fluvial geomorphological analysis of storm pond outlets and receiving channels. In addition, the EIS will confirm the appropriateness of the proposed buffers and make adjustments, where necessary, to ensure adequate protection is provided to the natural heritage system.

A key element of the EIS will be to provide recommendations for environmental stewardship and awareness for future residents of the Everett community (e.g. through Homeowners Manual, interpretative signage, community involvement in monitoring and enforcement). Recommendations for the naturalization of the buffers, including fencing and signage, will be provided with the goal of augmenting/supplementing existing habitat and deterring public/pedestrian access into sensitive environmental areas. This will be particularly important for the proposed residential areas that abut the natural heritage system as well as the sports fields, and trail connections to natural areas (where appropriate).

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Depending on the results of the in-season field work completed at the EIS stage, refinements to the development concepts may be required to accommodate larger buffers/setbacks to provide long-term protection to the natural heritage system.

Follow-up Studies

The following studies will need to be completed as part of the next phase in the planning approval process for implementing the Secondary Plan (draft plan applications):

- A detailed hydrogeological investigation and water balance analysis will be required to confirm the pre-development pattern/volume of infiltration, impacts of development, and proposed mitigation measures to maintain and/or enhance the groundwater recharge function of the site;
- Detailed stormwater management plans, including outlet cooling design, landscaping plan and performance monitoring program, for proposed storm ponds. Where necessary, a fluvial geomorphological analysis should be completed for the pond outlets to ensure that any downstream erosion concerns are not exacerbated. A key component of this analysis will be to identify and map the locations of tile drain outlets and determine the most appropriate means of maintaining the pre-development contribution to wetland hydrology and stream baseflow;
- In-season field inventories (vegetation, wildlife, fisheries, species-at-risk screening) within the proposed natural heritage system to confirm opportunities/constraints, identify potential impacts and mitigating measures, including buffer/setback requirements and habitat compensation/restoration;
- Naturalization plans for buffer areas, floodplains (formerly farmed) and non-active portions of park uses;
- An EIS will be required for future draft plan of subdivisions. The study should demonstrate how the development plans conform with the environmental protection and enhancement objectives for the Secondary Plan, as outlined in this document;
- Overall environmental monitoring program to measure the effectiveness of the proposed mitigation/enhancement strategy and identify contingency actions (Adaptive Management Plan) to address unforeseen impacts and poor performance;
- Erosion and siltation control plan in accordance with the most stringent standards applied by the NVCAA for protecting the Pine River and Boyne River systems; and,
- Future residents of the community should be informed of the significance/sensitivity of the natural environment and appropriate stewardship behaviour. This can be accomplished through a variety of ways including; interpretative signage at trail heads, homeowners manual, school programs, and trail/nature watch volunteers.

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Servicing

Details related to the master servicing scheme for the community of Everett are provided under separate cover by Greenland International. The environmental characterization and natural heritage system mapping provided in this background report will provide a framework for the stormwater management plan. It will also inform the identification of alternative locations for a sewage treatment facility and the selection of a preferred site, as part of a separate class environmental assessment process. Key environmental considerations with respect to the proposed sewage treatment facility include the following:

- Protection of water quality, baseflow, temperature and natural channel processes within the receiving Pine River;
- Protection of the groundwater regime (quality, quantity, discharge regime/pattern);
- Minimizing or avoiding removal of wetland/forest habitat, including habitat of species-at-risk protected under the *Endangered Species Act*, to accommodate the treatment facility, sewer connections and related infrastructure;
- Compensation for habitat loss/alteration; and,
- Restoration/enhancement of adjacent natural areas including receiving wetlands/watercourse.

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SPECIES AT RISK IN SIMCOE COUNTY

Status for species as per the provincial ****Species at Risk in Ontario (SARO) List - February 2012**.
SARO List - http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/246809.html

END - Endangered, **THR** - Threatened, **SC** - Special Concern

TAXA	SPECIES	STATUS (as of Feb 2012)	DESCRIPTION OF HABITAT USED	HABITAT PROTECTION UNDER ESA**
Amphibian	Jefferson Salamander	THR	woodlands and vernal pools plus adjacent areas primarily along the Niagara Escarpment	Regulated
Bird	Bald Eagle	SC	typically found near the shorelines of lakes and large rivers, may also nest in large open wetlands	N/A
Birds	Barn Swallow	THR	nest on ledges or walls in and outside of barns and other man made structures including buildings and bridges, may also use natural cliffs and caves.	General
Bird	Black Tern	SC	large cattail marshes in wetlands	N/A
Bird	Bobolink	THR	grassland habitats, hayfields and some crop lands	General
Bird	Canada Warbler	SC	deciduous and coniferous forests, usually wet forest types with a well developed, dense shrub layer	N/A
Bird	Cerulean Warbler	SC	forest-interior birds that require large, relatively undisturbed tracts of mature, semi-open deciduous forest.	N/A
Bird	Chimney Swift	THR	in and around urban settlements where they nest and roost in chimneys and other vertical manmade structures, will also use hollow trees or tree cavities in older growth forests, often near water	General

Bird	Common Nighthawk	SC	open areas with little to no ground vegetation, such as forest clearings, rock barrens, peat bogs, lakeshores and logged or burned over areas	N/A
Birds	Eastern Meadowlark	THR	native grasslands, pastures, agricultural fields especially in alfalfa and hay, old fields, meadows	General
Bird	Golden-winged Warbler	SC	areas of early successional vegetation, found primarily on field edges, hydro or utility right-of-ways, or recently logged areas	N/A
Bird	Henslow's Sparrow	END	old fields, pastures and wet meadows, dense, tall grasses, and thatch	General
Bird	Hooded Warbler	SC	interiors of large upland tracts of mature deciduous and mixed forest, and in ravines	N/A
Bird	King Rail	END	shallow, densely vegetated freshwater marshes, marshy riparian shorelines	General
Bird	Least Bittern	THR	large, quiet marshes with cattails	Transition Species
Bird	Loggerhead Shrike	END	Pasture or other grassland with scattered low trees and shrubs. Marginal and abandoned farmlands with scattered hawthorn shrubs and nearby wetlands.	General
Bird	Louisiana Waterthrush	SC	steep, moist, forested ravines with fast flowing streams along Niagara Escarpment	N/A
Bird	Olive-sided Flycatcher	SC	coniferous or mixed forest adjacent to wetlands or rivers	N/A
Bird	Piping Plover	END	wide open beaches along Lake Huron and Southern Georgain Bay shoreline	General
Bird	Red-headed Woodpecker	SC	nests in cavities in dead or mature trees, open woodland and woodland edges, especially in oak savannahs and riparian forest and habitats which contain a high density of dead trees,	N/A
Bird	Short-eared Owl	SC	open areas such as grasslands, marshes, wet meadows, fields and forest clearings	N/A

Bird	Whip-poor-will	THR	open woodlands or openings in mixed forests, rock or sand barrens with scattered trees, savannahs	General
Bird	Yellow Rail	SC	lives deep in the reeds and marshes of shallow wetlands	N/A
Fish	Grass Pickerel	SC	in rivers or wetlands with warm, shallow water and an abundance of aquatic plants	N/A
Fish	Lake Sturgeon	THR	inhabits the bottoms of shallow areas of large freshwater lakes and rivers	General
Fish	Northern Brook Lamprey	SC	small rivers draining into Lake Huron, prefers warm water	N/A
Insect	Hine's Emerald	END	specialist of calcareous wetlands (marshes, sedge meadows and fens) dominated by graminoid vegetation and fed primarily by groundwater from intermittent seeps	General
Insect	Monarch Butterfly	SC	wherever there are milkweed plants and wildflowers, often found in old fields, abandoned farmland and roadsides	N/A
Insect	West Virginia White	SC	moist, deciduous woodlands, with toothwort which is a small, spring-blooming plant of the forest floor	N/A
Plant	*American Ginseng	END	rich, moist, mature deciduous forest	Transition Species
Plant	American Hart's-tongue Fern	SC	mostly on Niagara Escarpment in rocky areas, particularly on limestone rock outcrops in maple-beech forest	N/A
Plant	Butternut	END	found in variety of sites, commonly in forest openings, old fields, hedgerows, on floodplains, stream sides or gradual slopes.	Transition Species
Plant	Eastern Prairie-fringed Orchid	END	wetlands, fens, swamps and tall grass prarie.	Regulated
Plant	Engelmann's Quillwort	END	shallow water in the Severn River	Regulated
Plant	Forked Three-awned Grass	END	Open sand barrens or low sand ridges, sandy forest openings and fallow fields, sandy edges of roads and trails, abandoned sand pits	Transition Species
Plant	Hill's Thistle	THR	open sunny sites, including prairies and woodland alvars.	Transition Species

Plant	Spotted Wintergreen	END	dry, mixed coniferous and deciduous forests	Transition Species
Reptile	Blanding's Turtle	THR	network of lakes, streams, and wetlands, preferring shallow wetland areas with abundant vegetation	Transition Species
Reptile	Eastern Foxsnake (Georgian Bay Population)	THR	found near Georgian Bay shoreline in both marsh and woodland, and often near human habitation	General
Reptile	Eastern Hog-nosed Snake	THR	sandy, well-drained habitats such as beaches and dry woods	Transition Species
Reptile	Eastern Musk Turtle (Stinkpot)	THR	shallow, slow-moving water around Georgian Bay	Transition Species
Reptile	Eastern Ribbonsnake	SC	usually found in vegetated areas close to water bodies, such as marshes, swamps, bogs, ponds, and edges of streams	N/A
Reptile	Five-lined Skink (Georgian Bay Pop.)	SC	rocky outcrops in mixed coniferous and deciduous forests on the southern Shield	N/A
Reptile	Massasauga (Georgian Bay Pop.)	THR	open bedrock outcroppings, conifer swamps/swales	Transition Species
Reptile	Milksnake	SC	wide range of habitats, especially old fields and farm buildings	N/A
Reptile	Northern Map Turtle	SC	large rivers and lakes	N/A
Reptile	Snapping Turtle	SC	very aquatic species, spend most of their lives in water, prefers shallow water in wetland habitats.	N/A
Reptile	*Spotted Turtle	END	ponds, marshes, bogs and fens with an abundant supply of aquatic vegetation	Transition Species
Reptile	*Wood Turtle	END	clear rivers, streams or creeks with a moderate current and sandy or gravelly bottom.	Regulated

IMPORTANT NOTES AND DEFINITIONS:

This list is based on known occurrences of species at risk or species that MNR believes there is a strong likelihood of being present and may therefore not be completely exhaustive.

**Species at Risk in Ontario (SARO) List - This list is subject to change and should therefore be checked periodically for updates.

* Information for these species is provided on a County-wide basis only due to the sensitive nature of the specific locations. For additional information please contact Midhurst District SAR Biologists.

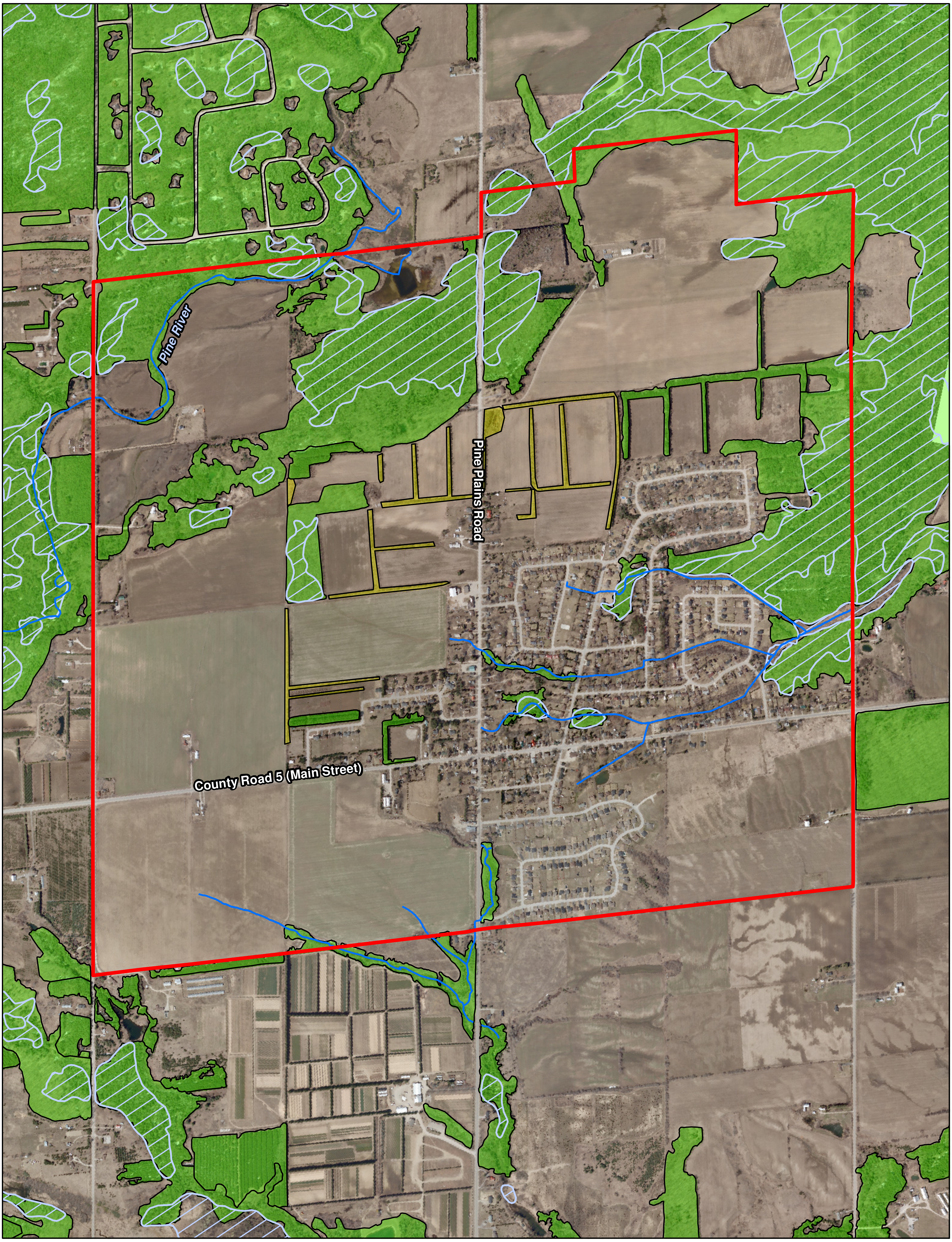
Transition Species - species that will receive general habitat protection in 2013 unless a species specific habitat regulation is developed beforehand.

General Habitat Protection - areas that a species currently depends on to carry out its life processes. These areas may include dens and nests, wetlands, forests and other areas essential for breeding, rearing, feeding, hibernation and migration.

Regulated Habitat - species specific habitat regulations can be found on MNR's Habitat Protection Page at http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/268554.html.

N/A = Habitat protection is not provided for Special Concern species under the *Endangered Species Act* however approval authorities should ensure that Planning Act decisions consider the significant habitat of Special Concern species as potential significant wildlife habitat (as per the Provincial Policy Statement).

**Under the PPS development and site alteration is not permitted in the significant habitat of endangered and threatened species regardless of the habitat provisions provided under the ESA. Planning authorities are required to ensure that Planning Act decisions are consistent with the PPS in this regard.



Legend

- Study Area
- Watercourse NVCA
- Wetland (MNR)
- Woodlands (MNR)
- Hedgerows

N

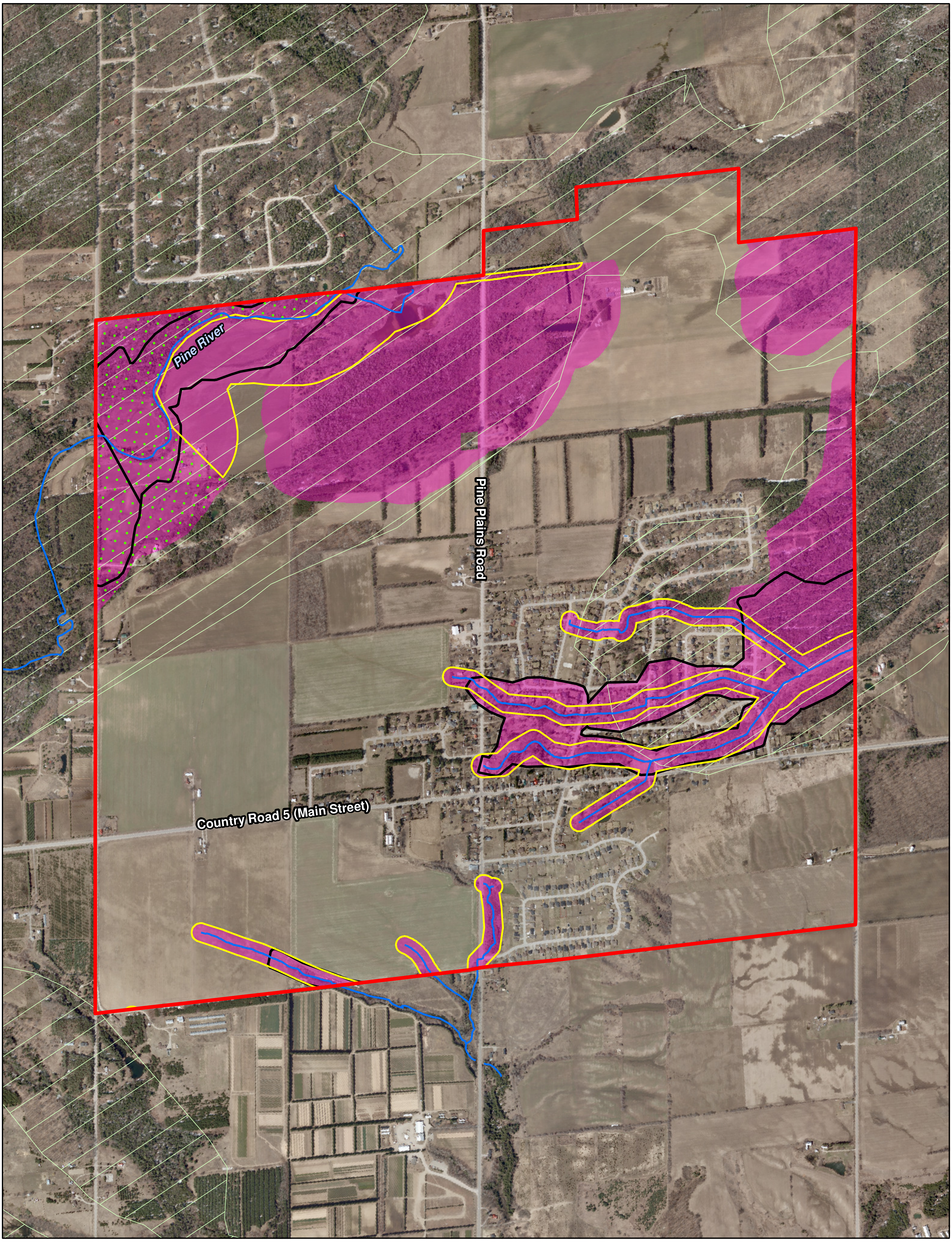
0 100 200 400 600 Meters

PLAN B Natural Heritage
Landscape Ecology & Natural Heritage Planning
176 Fellowes Crescent
Waterdown, ON
L0R 2H3

Everett Secondary Plan

Existing Conditions

Project #	2012-50
Date	May 2012
Scale	1:12,500
Prepared By: JJJ	Reviewed By: BDB
Figure #	1



Legend

- Study Area
- Watercourse (NVCA)
- Meanderbelt (NVCA)
- Flood Lines (NVCA)
- Slope (NVCA)
- Regulated Area (NVCA)
- Greenland (Adjala Township, Simcoe County)

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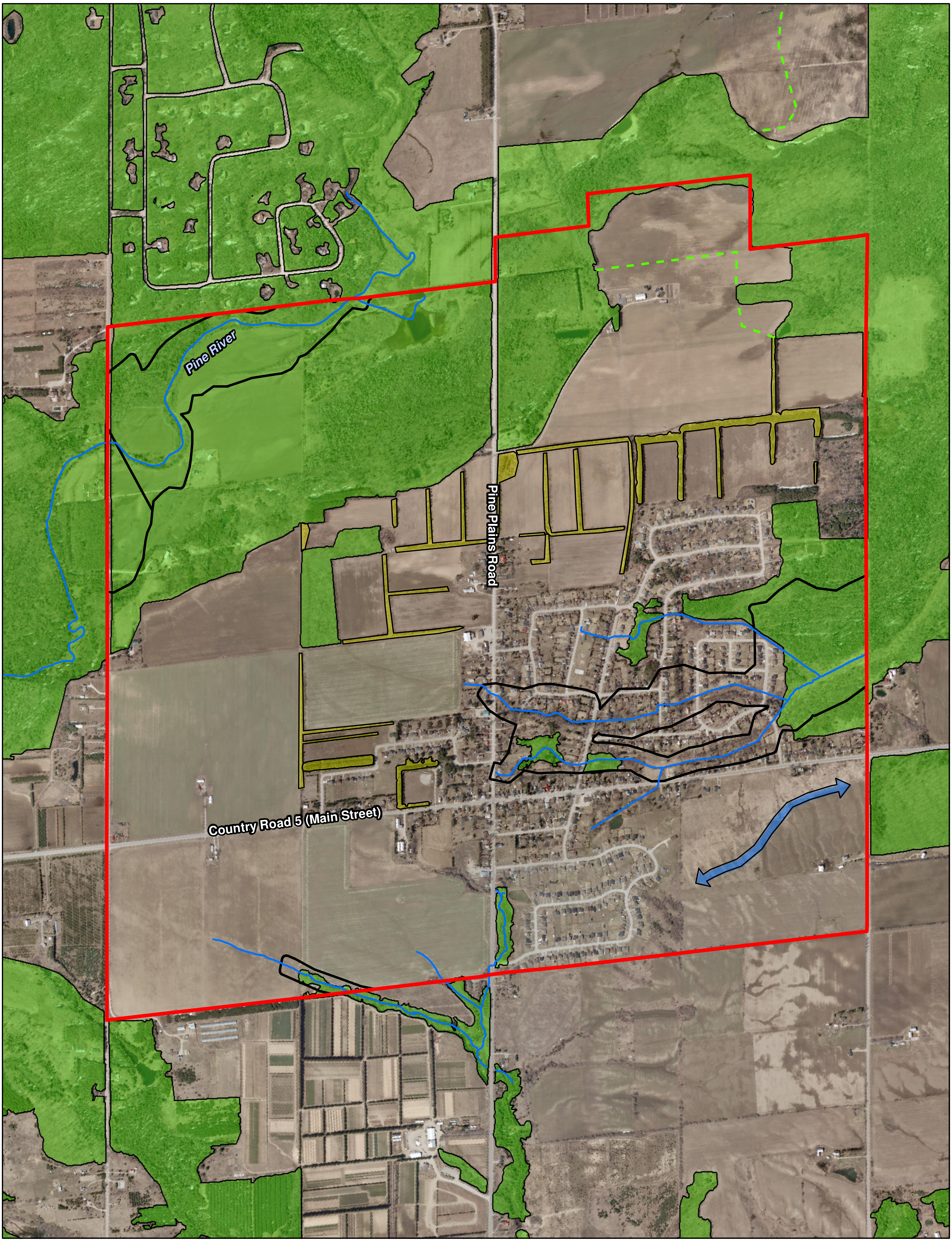
Waterdown, ON
L0R 2H3

Everett Secondary Plan

Environmental Policy Areas

Project #	2012-50	Figure # 2
Date	May 2012	
Scale	1:12,500	
Prepared By: JJJ	Reviewed By: BDB	



Legend

- Study Area
- Watercourse (NVCA)
- Flood Lines (NVCA)
- Corridor Enhancement
- Natural Heritage System*
- Hedgerow (Mature, Planted Conifers)
- Sloping Topography with Ground Water Seepage and Erosion

* Natural Heritage System is comprised of Simcoe County Core Greenlands, NVCA regulated wetlands, woodlands, floodplain/meander belt, and linkages

N

0 105 210 420 630 Meters

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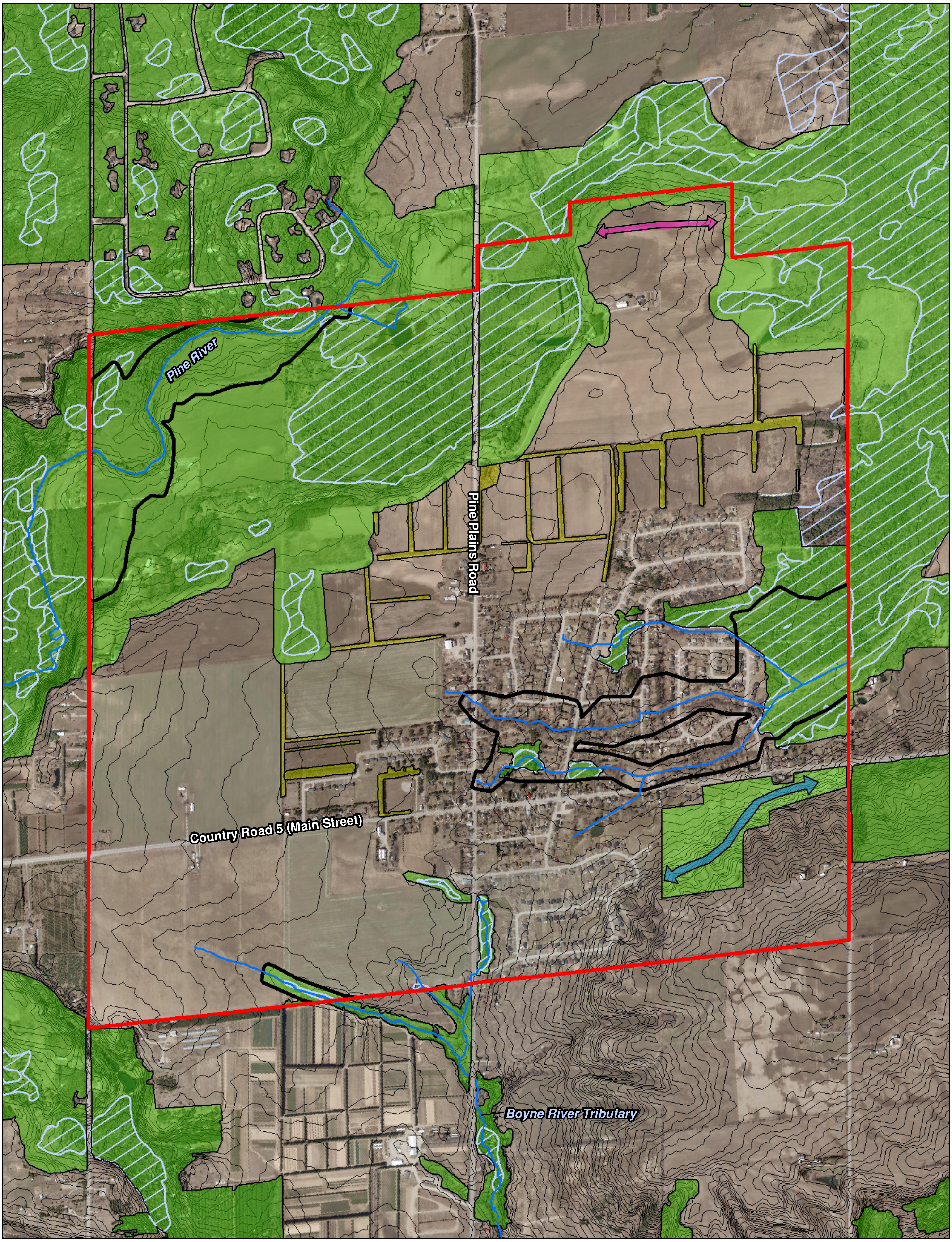
176 Fellowes Crescent
Waterdown, ON
L0R 2H3

Everett Secondary Plan

Natural Heritage System

Project #	2012-50	Figure # 3
Date	May 2012	
Scale	1:12,500	
Prepared By: JJJ	Reviewed By: BDB	



Legend

- Study Area
- Watercourse (NVCA)
- Flood Lines (NVCA)
- Natural Heritage System* (Natural Heritage Feature plus 30 m buffer)
- Hedgerow (Mature, Planted Conifers), retain where feasible
- Sloping Topography with Ground Water Seepage, Wetlands and Erosion
- Corridor Enhancement Opportunity
- Wetlands (NVCA nd MNR))

* Natural Heritage System is comprised of Simcoe County Core Greenlands, NVCA regulated wetlands, woodlands, floodplain/meander belt, and linkages

N

0 95 190 380 570 Meters

PLAN B Natural Heritage
Landscape Ecology & Natural Heritage Planning
176 Fellowes Crescent
Waterdown, ON
L0R 2H3

Everett Secondary Plan

Natural Heritage System

Project #	2012-50	Figure # 3
Date	August 2012	
Scale	1:12,500	
Prepared By: JJJ	Reviewed By: BDB	

VOLUME 2: BACKGROUND STUDIES
Part 5 – Pine River Assimilative Capacity Study

GREENLAND®

20 August 2012

REVISED December 2012

Pine River Assimilative Capacity Study

FINAL REPORT

Prepared for: The Township of Adjala Tosorontio

Submitted by:

Greenland International Consulting Ltd.

Project No. 12-G-2703

Contents

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1. Introduction

The Township of Adjala Tosorontio has an interest in promoting growth in the community of Everett. In order to do so, provision of sanitary servicing is needed to meet the needs of a growing population. One (1) option is to provide a wastewater treatment plant (WWTP) to service the new and existing population in Everett, with a surface water outfall to the nearest major watercourse (i.e. Pine River). In order to add a new wastewater treatment facility with surface water outfall directed to the Pine River, among other requirements, it must first be established that the river has the capacity to receive treated effluent without adversely impacting downstream water quality. The intent of this assimilative capacity study (ACS) is to establish existing conditions in the Pine River with respect to flow and water quality; determine the expected effluent characteristics and estimate the resulting change to in-stream flow and concentration associated with the additional outfall under design flow conditions. The proposed outfall location is on the Pine River north-west of Everett, to the west of County Road 13.

2. Background

2.1 Study Location

Everett is located northwest of Alliston and southwest of Base Borden on Regional Road 5 at the intersection of County Road 13 as shown on Figure 2-1. Everett is close in proximity to the Pine River and Boyne River which are tributaries to the Nottawasaga River. The Pine River is the subject of this study and generally flows east from Highway 124 to Angus.

2.2 Watershed Characteristics

The Pine River watershed is primarily a rural watershed with the majority of land being under forest cover and agriculture. For this study the watershed was divided into 14 catchment areas ranging in size from 220 ha to 6,100 ha with a total drainage area of 33,533 ha

The Nottawasaga Valley Conservation Authority has indicated that the watercourse is a high quality fish habitat with sand and gravel substrate and limited nutrient uptake capacity except in the river banks.

The Pine River currently receives effluent from an existing WWTP at CFB Borden. The WWTP at Angus discharges directly to the Nottawasaga River and will not impact the results of this analysis on the Pine River.

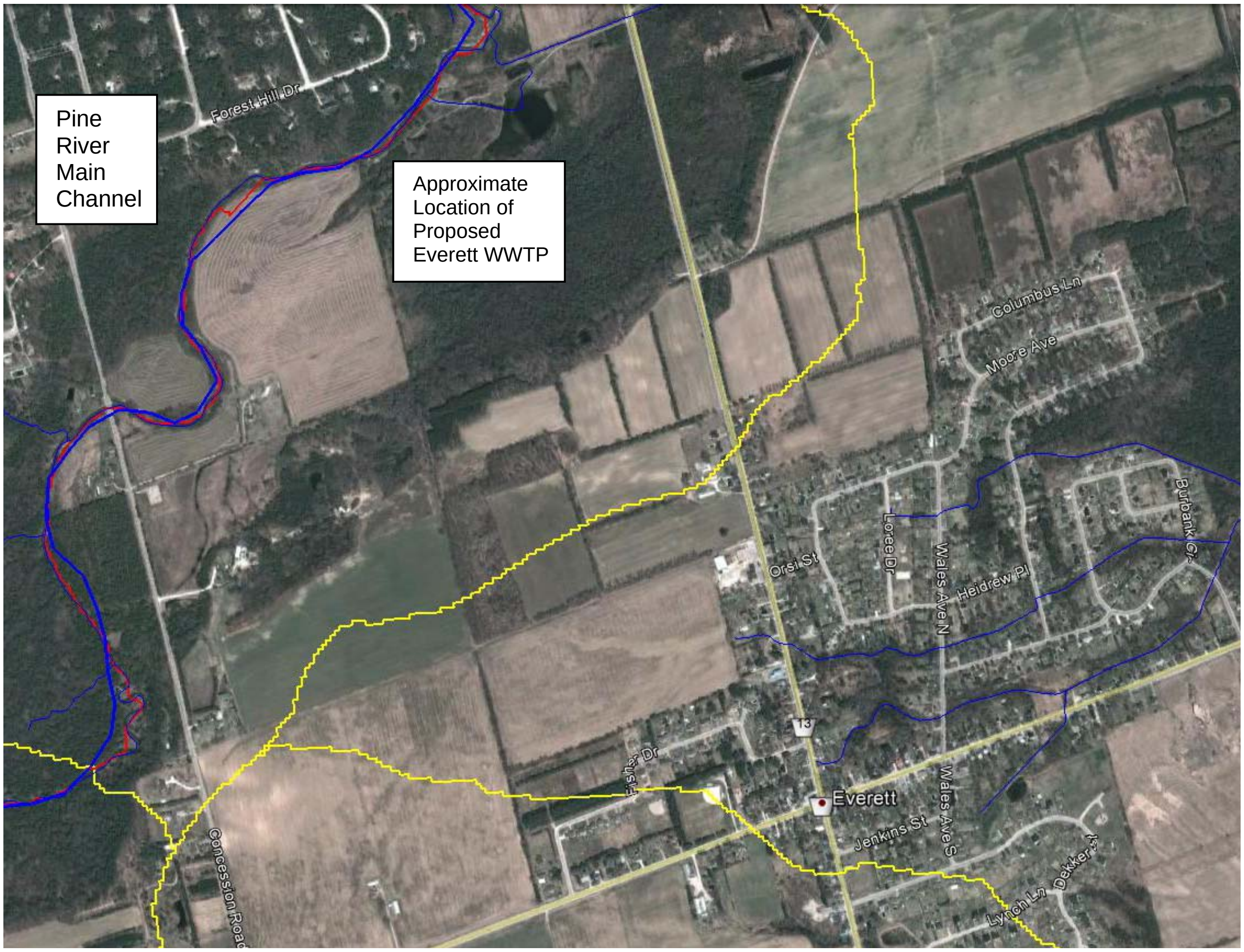


Figure 2-1 Everett location map

3. Study Method

The study was comprised of four (4) main components including: (i) Scenario Development and Applicable Guidelines; (ii) Collection and Analysis of Monitoring Data; (iii) Watershed Water Quality Modeling; and, (iv) Dispersion Modeling

3.1 Scenarios Development and Applicable Guidelines

Four (4) scenarios were considered in the study in order to assess water quality under future conditions of population growth.

Base Scenario: An existing conditions model was calibrated for the 25 year period from 1985 through to 2010. This period represents recent historical conditions with an adequate duration to include wet and dry years and climatic cycles needed to be considered within the lifetime of a new wastewater treatment plant.

Scenario 2: The base model was modified by adding a phased point source at Everett that would service an interim total population of 4,500.

Scenario 3: Includes a final Everett population of 10,000, inclusive of the existing population.

Scenario 4: Represents conditions with the final Everett population and the CFB Borden WWTP operating at full capacity under its current discharge criteria.

Change in concentration and loading under the proposed conditions were compared against existing conditions in order to quantify the level of impact and the level of offsetting that might need to be found from other sources in the watershed.

With respect to existing effluent criteria, the MOE uses the surface water management goals and policies described in MOEE (1994) summarized as follows where the goal is to ensure that the surface waters of the Province are of a quality which is satisfactory for aquatic life and recreation.

***Policy 1**: In areas which have water quality better than the Provincial Water Quality Objective (PWQO), water quality shall be maintained at or above the objective (better than the objective).*

***Policy 2**: Water quality which presently does not meet the PWQOs shall not be further degraded and all practical measures shall be undertaken to upgrade the water quality to the PWQO.*

3.2 Collection and Analysis of Monitoring Data

Review of available monitoring data from the Provincial Water Quality Monitoring Network (PWQMN) and Water Survey of Canada (WSC) found four (4) water quality stations with on-going or historical records and one (1) flow gauge. The flow gauge station (02ED014) located on the Pine River upstream of Everett provides real-time flow data with 43 years of historical data. The Nottawasaga Valley Conservation Authority (NVCA) collects data for the PWQMN and WSC and was able to provide records of available historical monitoring data.

On the recommendation of the NVCA and the Ministry of Environment (MOE) a water quality sampling program collected four (4) sets of grab samples during low to medium flow conditions from May through June 2012. Samples were taken at the Water Survey of Canada station located just upstream of Everett. The monitoring program was needed to confirm that current water quality conditions upstream of Everett remain consistent with historical data.

Monitoring data was processed for use in calibrating the water quality model; for determination of statistical low flow (design constraint) conditions; and to characterize flow and water quality at available positions in the watercourse.

3.3 Watershed In-Stream Water Quality Modeling

CANWET™ 4.2 was used to simulate point and non-point sources and to route flow and concentrations through the Pine River stream network upstream of Angus. The simulation considered sediment, total phosphorus, nitrogen species, dissolved oxygen (DO), biological oxygen demand (BOD), and temperature.

The model simulates one-dimensional continuous daily water balance and non-point source loads from a network of catchments in the watershed. It routes catchment and point source flows and loads at a daily time step and computes in-stream concentrations and flows at nodes within the stream network corresponding with catchment outlets.

The catchment delineation was set up with consideration for the locations of monitoring stations and WWTP locations. In-stream chemical reactions and decay are accounted for in the routed water quality computations.

The simulation used interpolated weather data for the period 1985 through 2003. Weather data from this period is available from Agriculture and Agri-Foods Canada from an application of the ANUSPLIN software to produce continuous historical meteorological data at a 10km resolution grid across Canada. Weather station data was appended for the period of 2004 through to 2010 from the nearest available weather stations in Shanty Bay and Egbert CS. The extended record was needed to simulate up to 2010 in order to take advantage of the most recent flow and water quality monitoring data available.

Constituents of critical importance in the water quality modeling were total phosphorus, dissolved oxygen, and un-ionized ammonia. Total ammonia nitrogen, biologic and sediment oxygen demand, temperature, pH, flow rate, re-aeration rate and a host of decay rate coefficients are part of the determination of critical constituent concentrations.

The base model was calibrated to agree with available monitoring data on a long term annual basis. Scenario results were reported for long term annual and for 7Q20 flow conditions under more restrictive summer temperatures.

3.4 Water Quality Dispersion Modeling

CORMIX version 8 is a 3-dimensional hydrodynamic mixing zone model. It was used in determining the length of the mixing zone downstream of the proposed treatment plant outfall. The physical mixing model provides an estimate of the location where the concentration of the subject constituent becomes fully mixed or below a set threshold both vertically and laterally in the watercourse. The constituent concentration in the plume is modelled at each sub-section of the reach. Results can be compared against PWQO, acute toxicity and background concentrations. This Report presents an analysis of the mixing zone downstream of the proposed WWTP with consideration of un-ionized ammonia which is the only effluent constituent that poses a potential risk in terms of acute toxicity. Other constituents in the effluent are considered in the water quality model but the extent and dimensions of the plume are less critical since toxicity to aquatic life is not the primary concern for these. The following data was used in this mixing zone analysis:

- 7Q20 flow in the Pine River upstream of Everett;
- Estimated average flows from the proposed WWTP; and,
- Ambient upstream and effluent concentrations of un-ionized ammonia

A series of assumptions were made regarding the specific design features of the outfall which will have a direct impact on the shape, length and concentration of the downstream plume. If the actual design is different from those assumptions, the model will need to be updated. However, the interim outfall design used in the model is not particularly aggressive in terms of expediting complete mixing. Diffusers were not used, but rather a single discharge point on the side of the stream channel that discharges below the surface of the channel flow. The final design of the outfall should aim to expedite and achieve complete mixing at a minimum distance downstream of the outfall.

The dispersion model was not calibrated as there is currently no existing outfall with characteristic plume data to compare against.

4. Scenario Development and Applicable Guidelines

Expected effluent concentrations from the proposed WWTP were characterized as shown in **Table 4-1** for the purposes of assessing down-stream water quality resulting from the additional point source. Without better information, the C of A effluent limits from the Angus WWTP were used as a reference.

Table 4-1 WWTP Effluent Expected Concentrations of Governing Constituents

WQ Parameter	Expected Characteristics
Total P	0.1 mg/L considered typical of convention WWTPs
Total Ammonia	Optimized to 1.8 mg/L maximum (summer conditions to achieve 0.02 mg/L un-ionized ammonia in-stream concentration at outfall)
NO3 - N	Assumed NH4 was governing nitrogen constituent as information on WWTP technology and typical concentrations from nearby facilities was not available
TSS	10 mg/L from Angus C of A
BOD	10 mg/L from Angus C of A
DO	Assumed 4.0 mg/L but ultimately dependant on time of year temperature, outfall characteristics and use of aeration prior to release
Temperature	Assumed effluent temperature is equal to ambient in-stream temperature
Total Fecal Coliforms	200 CFU/100 mL allowable limit from Angus C of A

Effluent from the proposed wastewater treatment facility for the Everett Secondary Planning Study was considered using two (2) possible flow scenarios from Everett and a third with CFB Borden WWTP operating at capacity. With a per capita flow rate of 350 L/cap/day, **Table 4-2** shows the resulting flow rates from the proposed treatment facility with phased population growth.

Table 4-2 Annual Average Flow from Proposed Everett WWTP

	4,500 population	10,000 population
Avg. Flow (L/s) @ 350 L/cap/day	18	41

5. Collection and Analysis of Monitoring Data

5.1 Available Monitoring Data

Review of available monitoring data from the Provincial Water Quality Monitoring Network (PWQMN) and Water Survey of Canada (WSC) found four (4) water quality stations with on-going or historical records and one (1) flow gauge (shown in **Figure 5-1** and **Table 5-1**). The proposed discharge location for treated WWTP effluent is north-west of Everett, to the west of County Road 13.

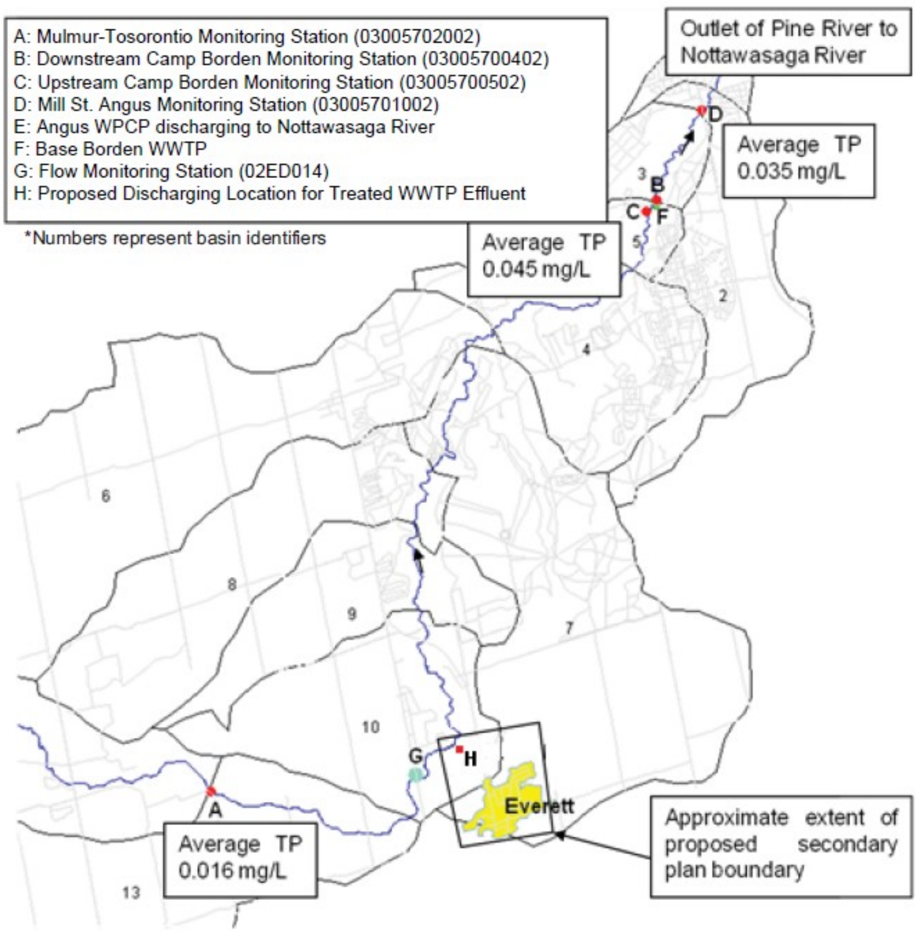


Figure 5-1 Pine River Watershed with Monitoring Stations and Proposed Surface Water Discharge Location

Table 5-1 Water Quality Monitoring Stations on the Pine River

Station	Map Name	Location	Status	First Year	Last Year	Total Years	Missing Years
03005702002 (water quality)	A	Mulmur Tosoronto Townline	Inactive	1975	1996	7	15
03005700402 (water quality)	B	Downstream CFB Borden WWTP	Inactive	1966	1971	6	0
03005700502 (water quality)	C	Upstream CFB Borden WWTP	Inactive	1966	1990	25	0
03005701002 (water quality)	D	Mill Street, Angus	Active	1972	2010	39	0
02ED014 (flow monitoring)	G	Everett	Active	1967	2009	Study used data from 1990-2009	

Note: Data older than 1980 was considered in the study, but was ultimately not used. Location A was found to pre-date current effluent conditions from CFB Borden WWTP.

5.2 Statistical Low Flow Conditions

Statistical low flow conditions were determined from historical flow data at Everett. Standard practice is to use the lowest 7-day consecutive average flow over a 20-year period (7Q20) to establish a “worst case scenario” for dilution of treated effluent. For this analysis the 20-year stream flow record from 1990 through 2009, inclusive, was analyzed. The statistical 7Q20 low flow for the data analyzed was found to occur during the period from 15 to 21 February 2000 with a value of 471 L/sec.

Under historical 7Q20 flow conditions of 471 L/sec for the Pine River at Everett, the effluent from the proposed WWTP facility would account for approximately 8% of the total combined flow for the 10,000 population scenario. Under average annual flow conditions of 1,897 L/sec, between 1990 and 2009, the proportion of stream flow from the Everett facility would be approximately 2% for the same population. The contribution of effluent flow to environmental impact from the proposed facility cannot be considered in isolation without looking at ambient in-stream and effluent constituent concentrations.

5.3 Characterization of Pine River Water Quality

Tables 5-2 and **5-3** provide a statistical summary of water quality data from two (2) locations with relatively recent historical data. There are a comparatively small number of water quality sample points upstream of Everett and a fairly wide range of results from the data downstream at Station D (Mill Street in Angus).

Analysis of available historical water quality data upstream of Everett (Station A, **Figure 5-1**) is based on 13 water quality samples that were taken during periods of low to average flow from 1992 through 1996. Historical water quality data at Station D extends from 1972 to 2010 and provides a much larger sample set to draw conclusions from.

Because the data available from stations B and C, upstream and downstream of CFB Borden, was limited, and the majority more than 20 years old, this data was not included in the analysis.

Further, it is expected that changes have been made to the CFB Borden WWTP that would make these data non-representative of current conditions.

The sampling program undertaken at Station G at the WSC flow gauge upstream of Everett from May and June 2012 provided the results shown in **Table 5-4**. In general, the recently completed monitoring program shows results consistent with historical data.

Trends from upstream to downstream, based on median results, suggest that phosphorus, TKN, fecal coliforms and BOD concentrations increase moving downstream. Ammonia and DO tend to decrease.

Table 5-2 Summary of Historical In-stream Water Quality Data at Everett (Station A)

Parameter	Mean	Median	No. of Samples
TP (mg/L)	0.02	0.01	13
Total Ammonia (mg/L)	0.03	0.03	2
Nitrates (mg/L)	N/A	N/A	N/A
TKN (mg/L)	0.32	0.30	13
BOD (mg/L)	0.85	0.56	13
DO (mg/L)	10.0	10.5	6
Total Fecal Coliforms (CFU/100mL)	N/A	N/A	N/A
Temperature (degrees C)	variable	variable	variable

Table 5-3 Summary of Historical In-stream Water Quality Data at Mill Street (Station D)

Parameter	Average	Median	No. of Samples
TP (mg/L)	0.03	0.02	98
Total Ammonia (mg/L)	0.01	0.01	99
Nitrates (mg/L)	1.4	1.5	22
TKN (mg/L)	0.36	0.33	100
BOD (mg/L)	0.92	0.70	73
DO (mg/L)	10	10	104
Total Fecal Coliforms (CFU/100mL)	125	40	87
Temperature (degrees C)	10	10	105

Table 5-4 Summary of 2012 In-stream Water Quality Data at Station G (WSC Station)

Parameters / Sampling Date and Time	Units	2012-05-07 10:50	2012-05-24 10:07	2012-06-15 12:00	2012-06-20 10:40
Total Ammonia-N	mg/L	ND	ND	0.04	ND
Total Carbonaceous BOD	mg/L	ND	ND	ND	ND
Total Kjeldahl Nitrogen (TKN)	mg/L	0.29	0.42	0.49	0.32
Orthophosphate (P)	mg/L	0.004	0.002	0.003	0.002
Total Phosphorus	mg/L	0.018	0.006	0.003	ND
Total Suspended Solids	mg/L	8	3	3	5
Nitrite (N)	mg/L	ND	ND	NA	NA
Nitrate (N)	mg/L	2.6	2.9	2.6	2.5
Nitrate + Nitrite	mg/L	2.6	2.9	NA	NA
Fecal coliform	CFU/100mL	30	<10	20	250
ND = Not detected					
NA = Not analyzed					

6. Catchment and In-stream Modeling

6.1 Model Calibration Summary

The CANWET™ model was first calibrated for flow at Everett and then for water quality parameters and Station A (upstream of Everett) and at Station D (Mill Street, Angus).

As shown in **Figure 6-1**, the simulated long-term monthly flow agreed well with the stream gauge data with an overall percent difference of 0.5% and Nash—Sutcliff coefficient of 0.96 between 1990 and 2009.

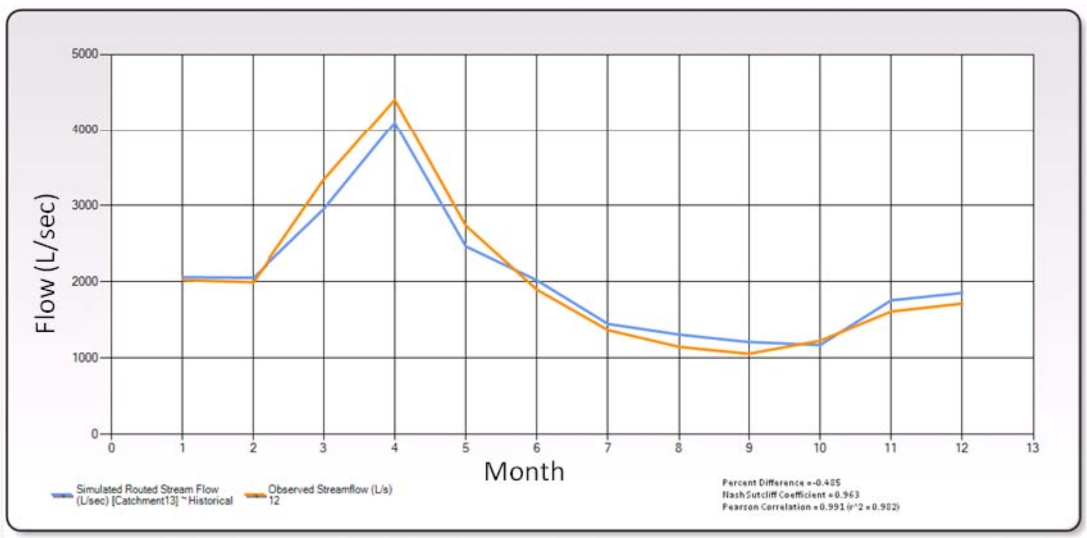


Figure 6-1 Long-term monthly flow simulation and flow gauge data (1990-2009)

For individual days, however, there is some variance between the simulation and the observed data. **Figure 6-2** shows an example of this. For the 7-day period identified for the 7Q20 conditions, the model tended to over predict the flow. Therefore this design flow condition was simulated in isolation using the catchment loading rates simulated for the 7Q20 period, but with a reduced flow equal to that determined from the gauge data from 2000 February 15-21.

The water quality simulation results from the base scenario under average annual flow conditions were all within the 10th and 90th percentiles of the observed concentration data upstream of Everett and downstream at Mill Street with the exception of dissolved oxygen at Mill Street (See summary in **Tables 6-1** and **6-2**). At Mill Street the simulated dissolved oxygen was marginally below the 10th percentile of observed data because the maximum observed stream temperature of 22 degrees was used in this isolated simulation run. This higher temperature was used for consistency with the 7Q20 scenario simulations that were to follow. It was selected in order to add further conservativeness to the approach as it was deemed equally probable that the 7Q20 condition could occur during the summer periods as opposed to the winter when the actual condition was recorded.

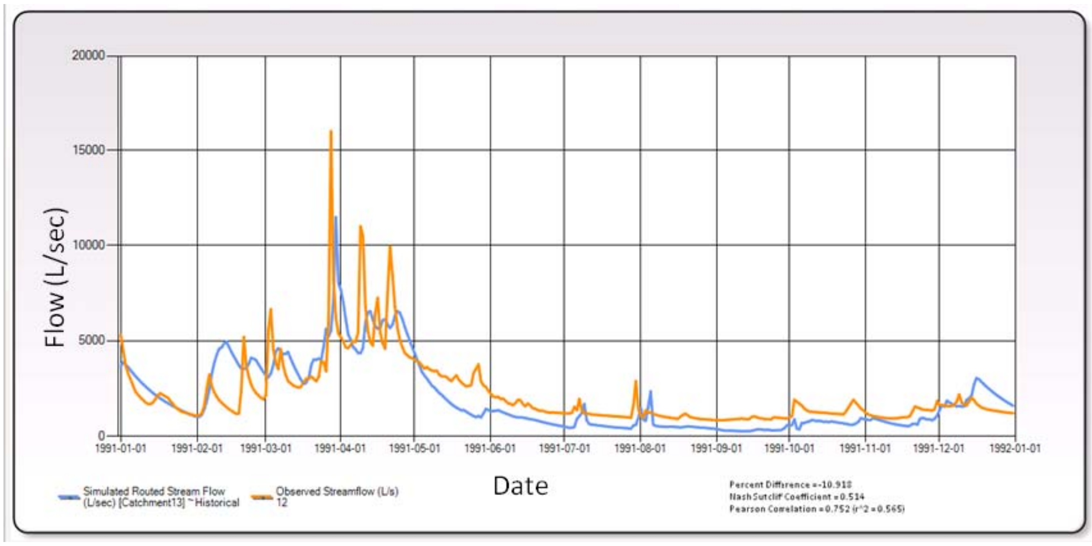


Figure 6-2 Example of daily simulated and measured stream flows (1991)

If the median measured stream temperature of 10 degrees is applied, the dissolved oxygen concentration increases to 10 mg/L at Mill Street. This is consistent with the median dissolved oxygen concentration measured at this location.

Table 6-1 Summary of Historical In-stream Water Quality Data at Everett (Station A)

Parameter	10th Percentile	90th Percentile	No. of Samples	CANWET base scenario
TP (mg/L)	0.00	0.02	13	0.02
Total Ammonia (mg/L)	0.01	0.04	2	0.01
Nitrates (mg/L) (1)	2.5	2.9	4	1.7
TKN (mg/L)	0.20	0.42	13	0.34
BOD (mg/L)	0.22	1.28	13	1.01
DO (mg/L)	8.4	11.0	6	8.1
Total Fecal Coliforms (CFU/100mL) (1)	<10	250	4	118
Temperature (degrees C)	variable	variable	variable	22

Notes:
(1) Historical data was not available; data shown are maximum and minimum values from 2012 monitoring program

Table 6-2 Summary of Historical In-stream Water Quality Data at Mill Street (Station D)

Parameter	10th Percentile	90th Percentile	No. of Samples	CANWET base scenario
TP (mg/L)	0.01	0.06	98	0.02
Total Ammonia (mg/L)	0.00	0.03	99	0.01
Nitrates (mg/L)	1.0	1.7	22	1.3
TKN (mg/L)	0.23	0.52	100	0.24
BOD (mg/L)	0.30	1.78	73	0.66
DO (mg/L)	8	13	104	7
Total Fecal Coliforms (CFU/100mL)	10	253	87	38
Temperature (degrees C)	1	19	105	22

6.2 Scenario Simulations

Plots (**Figure 6-3** to **Figure 6-5**) of critical water quality parameters for which there are Provincial Water Quality Objectives (PWQOs) were generated to investigate the downstream impact of introducing a phased WWTP at Everett and future increase of flow from the CFB Borden facility. Plots show how in-stream concentration is expected to change as flow travels downstream toward Angus due to increased flow, contaminant load, in-stream decay, chemical interactions and re-aeration.

Phosphorus concentrations increase immediately downstream of the two (2) treatment facility outfalls and then begin to decline further downstream due to deposition, plant uptake and dilution from incoming tributaries. The greatest increase in phosphorus concentration occurs immediately downstream of the proposed Everett WWTP with an estimated in-stream concentration increase of 0.006 mg/L under 7Q20 conditions. Immediately downstream of the CFB Borden facility under Scenario 4 the concentration increases by 0.004 mg/L compared with existing conditions. The maximum estimated total phosphorus concentration is just under 0.03 mg/L immediately downstream of the Everett facility under 7Q20 conditions. Therefore all scenarios tested are in compliance with the 0.03 mg/L in-stream PWQO concentration for total phosphorus.

Un-ionized ammonia concentrations increase immediately downstream of the two (2) treatment facility outfalls and then begin a steep decline further downstream due to deposition, plant uptake and dilution from incoming tributaries. The greatest increase in un-ionized ammonia concentration occurs immediately downstream of the proposed Everett WWTP with an estimated maximum in-stream concentration increase to 0.018 mg/L under 7Q20 conditions. For Scenario 4 with 7Q20 flow rates, immediately downstream of the CFB Borden facility, the concentration increases by 0.004 mg/L compared with existing conditions. The maximum estimated un-ionized ammonia concentration is 0.02 mg/L immediately downstream of the Everett facility under 7Q20 conditions, assuming instantaneous complete mixing. The lesser response at the CFB Borden WWTP is due to the higher flow volume in the Pine River at this location which provides a higher level of dilution.

The PWQO for nitrate is 10 mg/L. Although the model accounts for ambient nitrate concentration in-stream, the effluent concentration was unknown and was therefore not evaluated since the un-ionized ammonia was deemed to be the limiting nitrogen species because of its acute toxicity. Ambient water quality samples taken as part of the study were consistent with historical findings showing nitrate concentrations less than 3.0 mg/L suggesting there is adequate capacity within the PWQO and that nitrate is not a limiting consideration.

The simulation predicts that dissolved oxygen concentrations will decline by just over 1 mg/L from the headwaters to the confluence with the Nottawasaga in the base 7Q20 scenario. For Scenario 4 with a 10,000 serviced population at Everett and CFB Borden at capacity, the simulation predicts a further reduction of 0.7 mg/L just above the confluence with the Nottawasaga River. Total in-stream fecal coliform count is estimated to increase by a maximum of 14 CFU/100 mL.under Scenario 4.

A sample of the catchment loading function input parameters for catchment 10 and summary tables for each of the 4 scenarios under average flow conditions and 7Q20 flow conditions are provided in **Appendix A**.

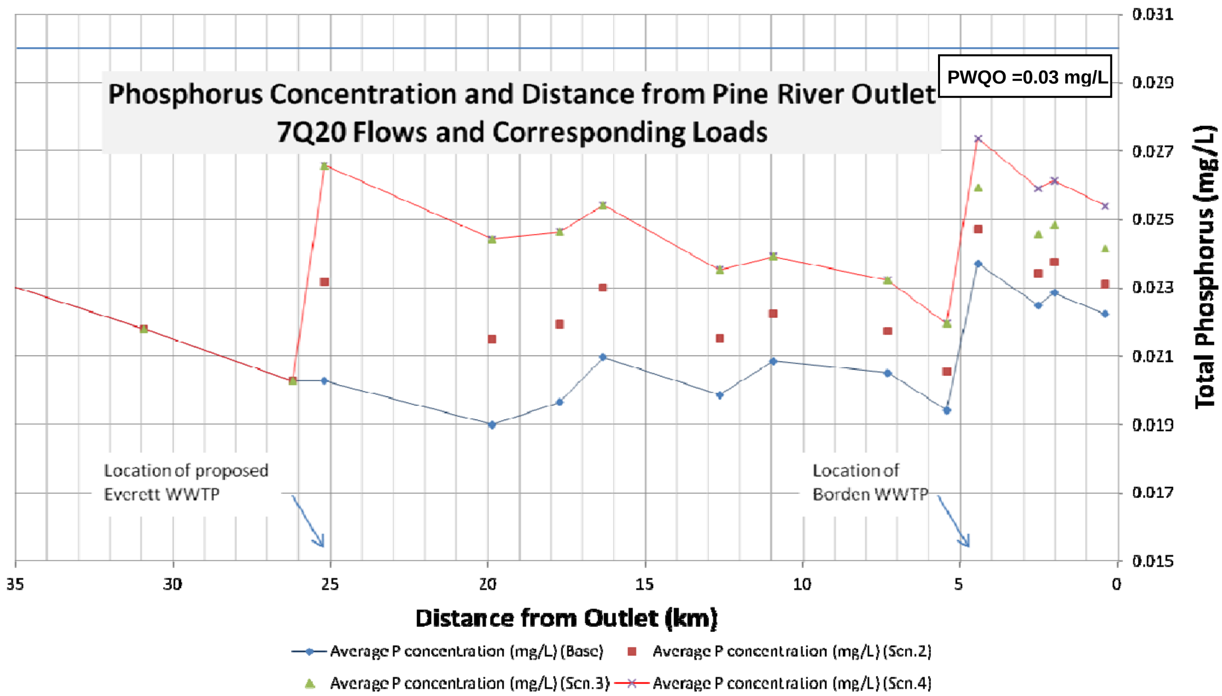


Figure 6-3 Phosphorus concentration and distantance from outlet

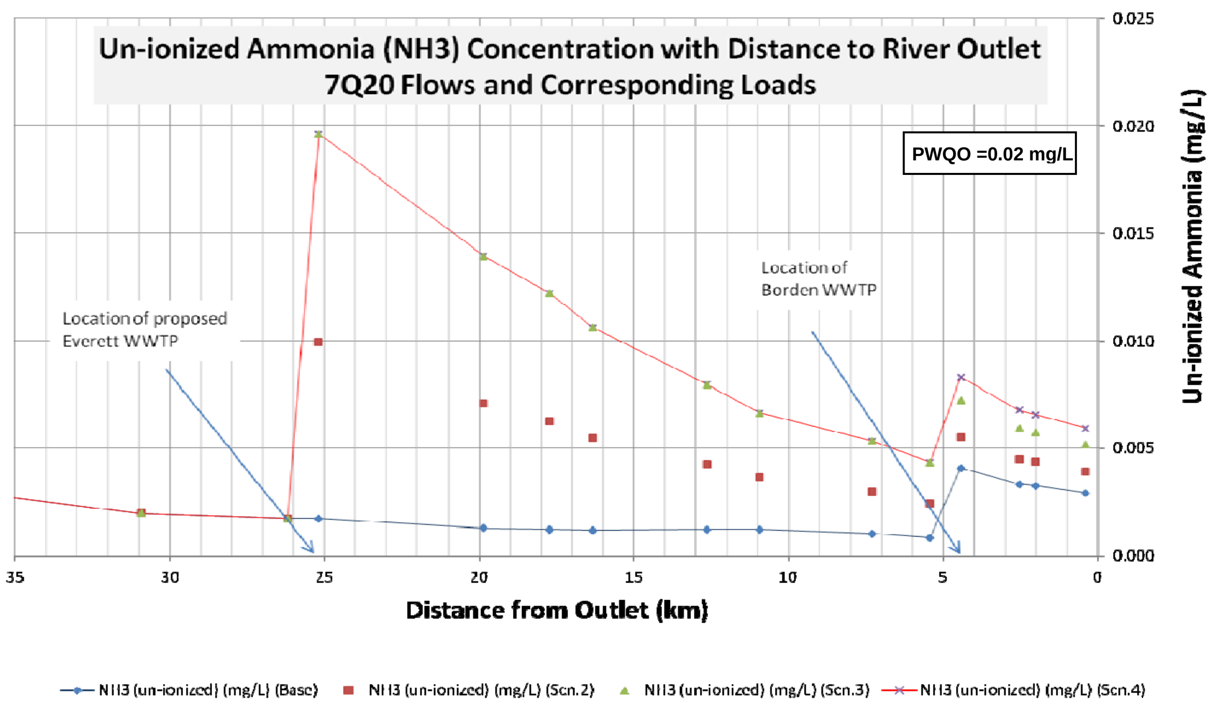


Figure 6-4 Un-ionized ammonia concentration and distantance from outlet

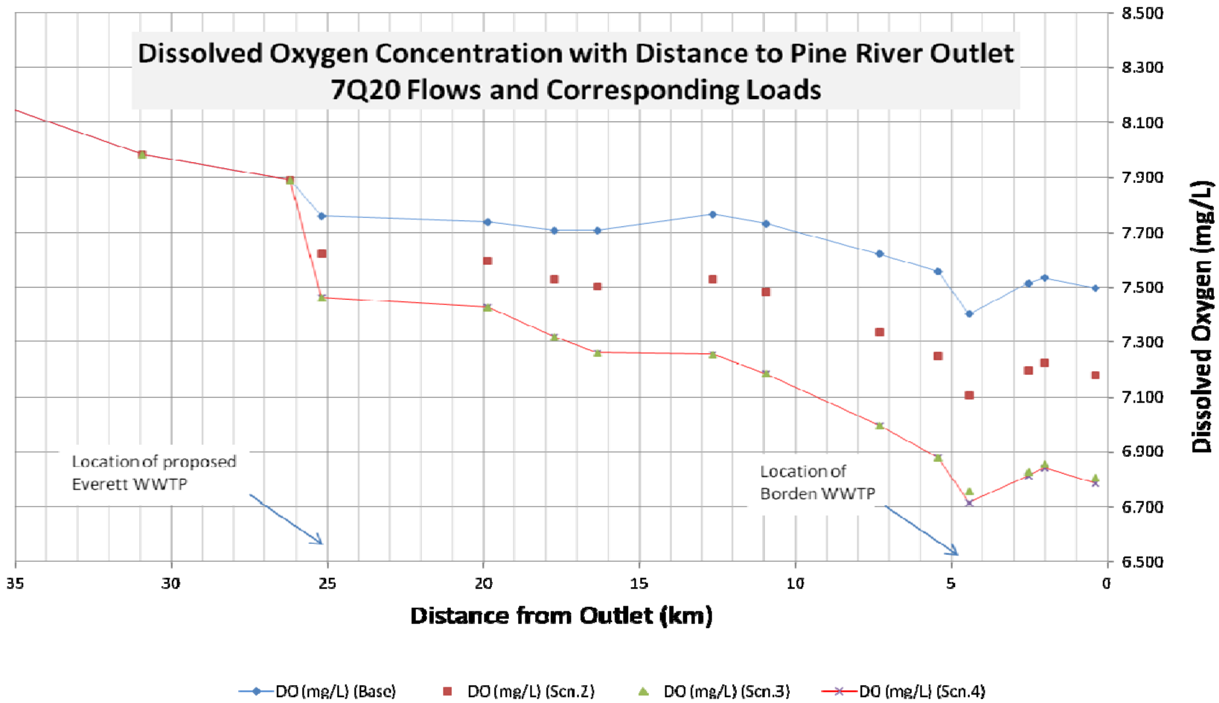


Figure 6-5 Dissolved oxygen concentration and distantance from outlet

7. Dispersion Modeling

The near field mixing zone is most critical for consideration of acute toxicity immediately downstream of the outfall. Un-ionized ammonia was considered a limiting constituent in terms of adherence to PWQO and concerns regarding lethality to aquatic life (acute toxicity).

As the shape and concentration of the downstream plume is highly dependent on the outfall characteristics (i.e. discharge above or below surface, with or without diffusers, velocity, pipe diameter, angle of discharge, temperature, etc.) the results provided herein are a rough estimate, until these design specifications are better known.

A somewhat conservative approach was adopted by assuming a below surface discharge from a single 10 cm diameter pipe 9 cm above the bottom of the stream and 4 m from the nearest bank. The effluent discharges at a rate of 41 L/sec under the 10,000 population condition at an angle parallel to the ambient stream flow. This configuration will take longer and greater downstream distance to achieve complete mixing than multiple pipes with diffusers.

An effluent concentration of un-ionized ammonia of 0.226 mg/L greater than the upstream ambient simulated concentration of 0.002 mg/L was used. At a pH of 8.5 and temperature of 22 degrees, 13% of total ammonia is un-ionized ammonia. Total ammonia in the effluent was determined to have a maximum allowable concentration of 1.8 mg/L using the CANWET model. This value was determined to be the maximum concentration of total ammonia that could be released and achieve a concentration equal to the PWQO for un-ionized ammonia immediately downstream assuming instantaneous complete mixing. The proportion of un-ionized ammonia increases with increased temperature and pH.

Modeling a conservative constituent means that there is no decay or fall out of that constituent as it moves downstream. Given the short travel time and distance during which the plume is expected to exceed the PWQO, this is a reasonable assumption.

The model reports that downstream of the outfall, lateral mixing to a concentration less than the PWQO for un-ionized ammonia of 0.02 mg/L (MOEE, 1994) is achieved at a distance of less than 9 meters downstream after a travel time of less than 9 seconds as shown in **Figure 7-1** and **7-2**. The shape and extent of the plume is sensitive to the angle of discharge. Discharging perpendicular to the ambient flow reduces the distance needed to achieve a similar level of dilution but causes the plume to interact with the left bank of the channel.

The model results note that the effluent velocity is higher than recommended relative to the ambient flow and might be reduced by the addition of multiple pipes or a larger diameter pipe. It is also noted that under 7Q20 flow conditions there is insufficient flow to return the concentration to the ambient upstream concentration in the near field mixing zone.

The model session report is provided in **Appendix B**

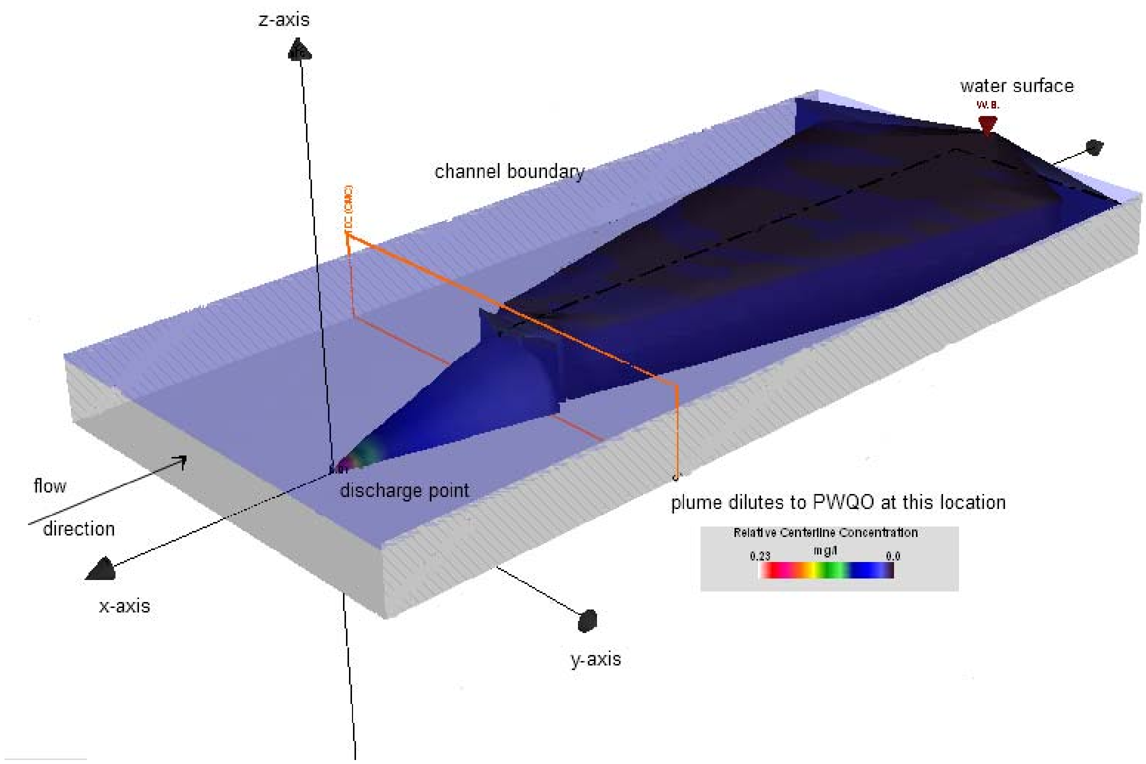


Figure 7-1 Shape of downstream plume

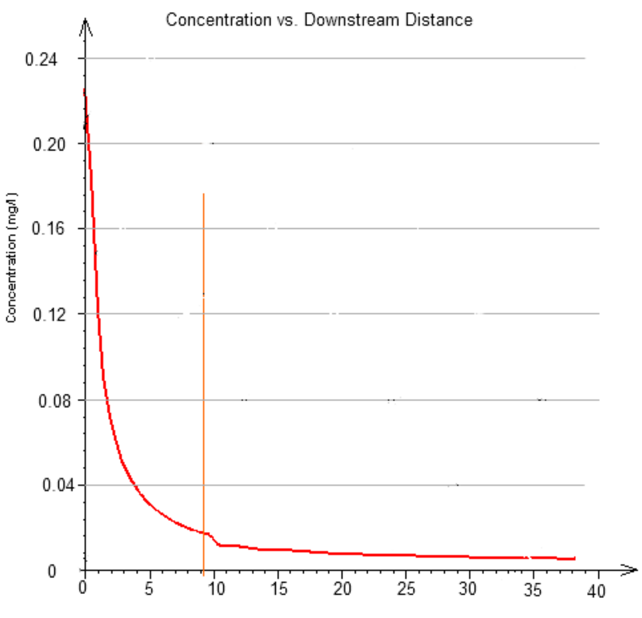


Figure 7-2 Dilution of unionized ammonia in the near field mixing zone

The maximum concentration of un-ionized ammonia in the plume is estimated to be 0.226 mg/L immediately at the outfall.

Unionized ammonia (NH_3) and ammonium (NH_4) exist together in equilibrium in an aqueous solution. MOEE (1994) indicates that the fraction of un-ionized ammonia in an aqueous solution is dependent on temperature and pH according to equation (1) and (2). These equations were applied with an expected summer maximum water temperature of 22 degrees and a pH of 8.5 (consistent with in-stream monitoring results).

$$f = \frac{1}{10^{pKa - pH} + 1} \qquad (1)$$

Where f is the fraction of NH_3 in solution and

$$pKa = 0.09018 + \frac{2729.92}{T + 273.16} \qquad (2)$$

Where T is temperature in degrees Celsius

8. Comparison with In-Stream Water Quality Objectives

In-stream modeling results found the concentrations of total phosphorus, un-ionized ammonia and dissolved oxygen to be within PWQO criteria, as shown in **Table 8-1**. Nitrate loading from WWTPs was not specifically considered due to lack of data, but given that the highest ambient concentrations (simulated and monitored) were less than 3 mg/L, nitrate concentration is not a critical consideration unless the effluent concentration of nitrate is to be greater than 10 mg/L.

Table 8-1 Governing PWQOs and simulated 7Q20 conditions (most limiting reach)

Parameter	Governing PWQO (mg/L)	Critical simulated 7Q20 condition compliant with PWQO?
Dissolved Oxygen (DO)	5 to 8 degrees C (warm water) 4 to 7 degrees C (cold water)	6.7 mg/L; Compliant
Total Phosphorus	0.03	0.03 mg/L; Compliant
Un-ionized Ammonia	0.02	0.02 mg/L; Compliant
Total fecal coliform	200 CFU/100mL	52 CFU/100mL; Compliant

Although there are data points in the historical monitoring record that exceed the PWQO for total phosphorus and total fecal coliforms from the data reviewed, the Pine River is a Policy 1 receiver at Everett based on median concentration data. **The simulation analysis suggests that under average and 7Q20 flow conditions, the PWQO criterion is not exceeded at Everett and the addition of the proposed WWTP with population up to 10,000 will not cause conditions downstream to exceed PWQO under the conditions evaluated.**

9. Conclusions and Recommendations

A Township of Adjala Tosorontio operated treatment facility at Everett with a serviced population of 10,000 will result in increased contaminant loading to the Pine River. Urban growth in Everett will also likely increase the amount of non-point source loading. As a Policy 1 receiver, downstream of Everett, in-stream constituent concentrations must be maintained below PWQOs or better and dissolved oxygen concentrations need to be above specified levels.

The water quality simulations show that under 7Q20 flow conditions that PWQOs for governing water quality constituents are met when effluent is maintained as per the concentrations specified in **Section 4.** However, maximum concentrations of total phosphorus and un-ionized ammonia approach the criteria in reaches immediately downstream of the proposed WWTP. Given that monitoring data suggests concentrations can periodically exceed PWQO criteria, independent of low flow conditions, the Township should consider adding a safety factor to the maximum effluent concentrations identified and/or possibly seek offsetting opportunities downstream or within the Community of Everett. Replacement of older, failing septic systems and better control of nutrient loss from urban and agricultural lands would be possible examples for further investigation.

Offsetting opportunities include any management activities, land use changes, structures or other technologies that would reduce contaminant loading by an amount equivalent to or greater than the anticipated load increase from the proposed Everett WWTP.

The watershed modeling work could be used to assist in identifying the most beneficial locations where offsetting practices might be considered. From our assessment it appears that the rise in phosphorus concentration in the lower reaches of the Pine are at least in part attributable to point and non-point sources within CFB Borden. It is also likely that urban runoff from Angus further increases concentration and loading downstream of the Mill Street monitoring station.

10. References Cited

Ontario Ministry of Environment and Energy (1994) Policies, Guidelines, Provincial Water Quality Objectives, Queen's Printer for Ontario ISBN 0-7778-8473-9 rev

Appendix A

Water Quality Model Input Parameters and Results Summary

Weather Data

Gaps in the weather data used in the water quality model post 2003 were filled in based on a regression equation from matching values between the Shanty Bay and Egbert CS Environment Canada weather stations.

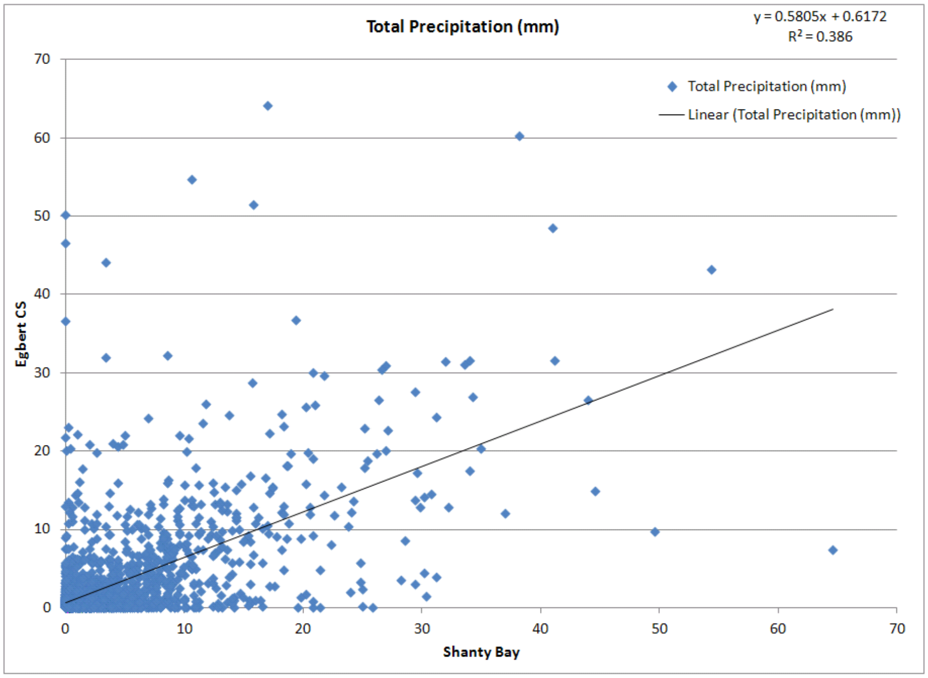


Figure 1: Precipitation Regression: Shanty Bay and Egbert CS Stations

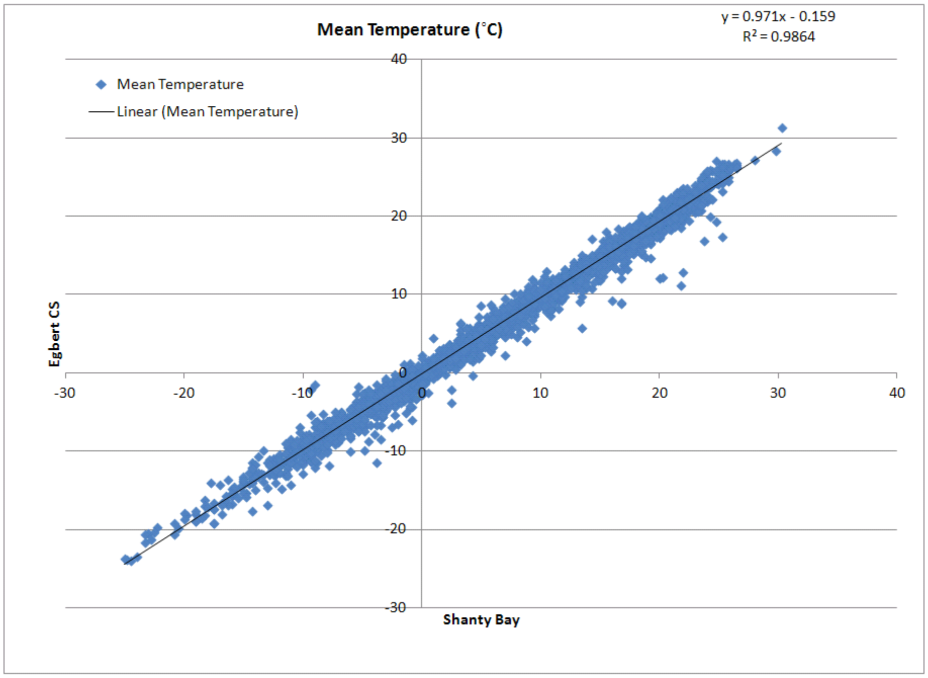


Figure 2: Mean Temperature Regression: Shanty Bay and Egbert CS Stations

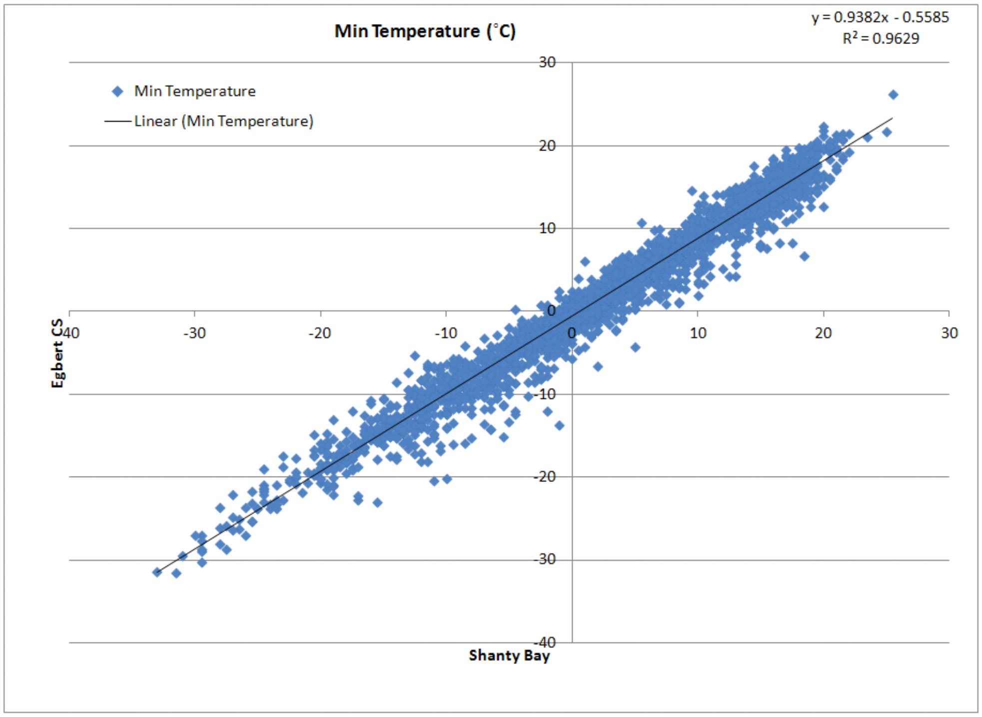


Figure 3: Min Temperature Regression: Shanty Bay and Egbert CS Stations

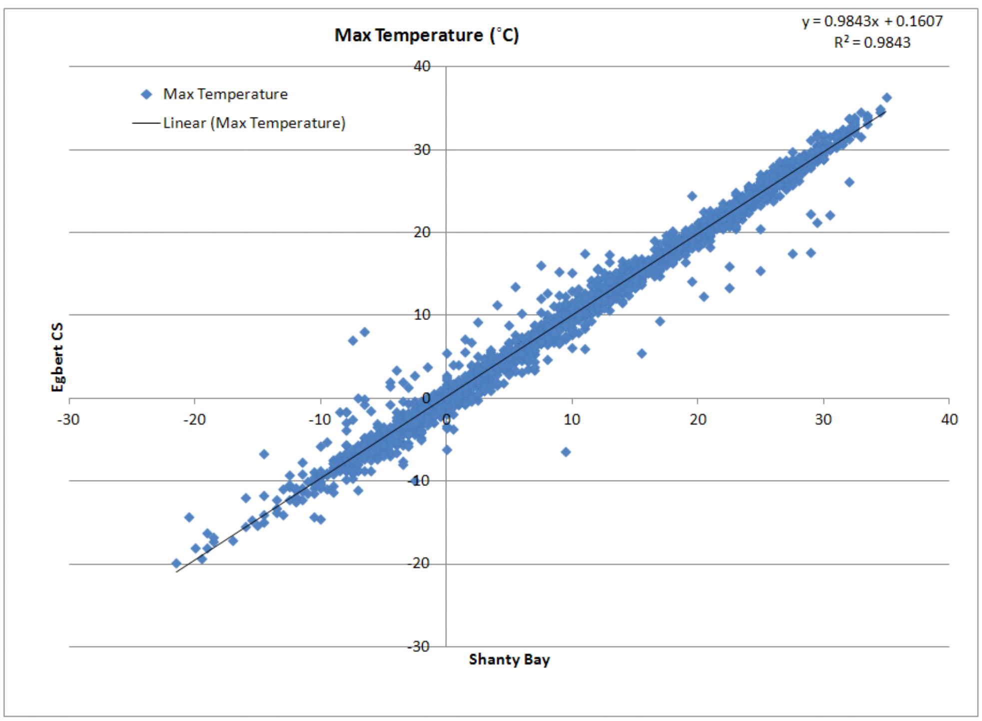
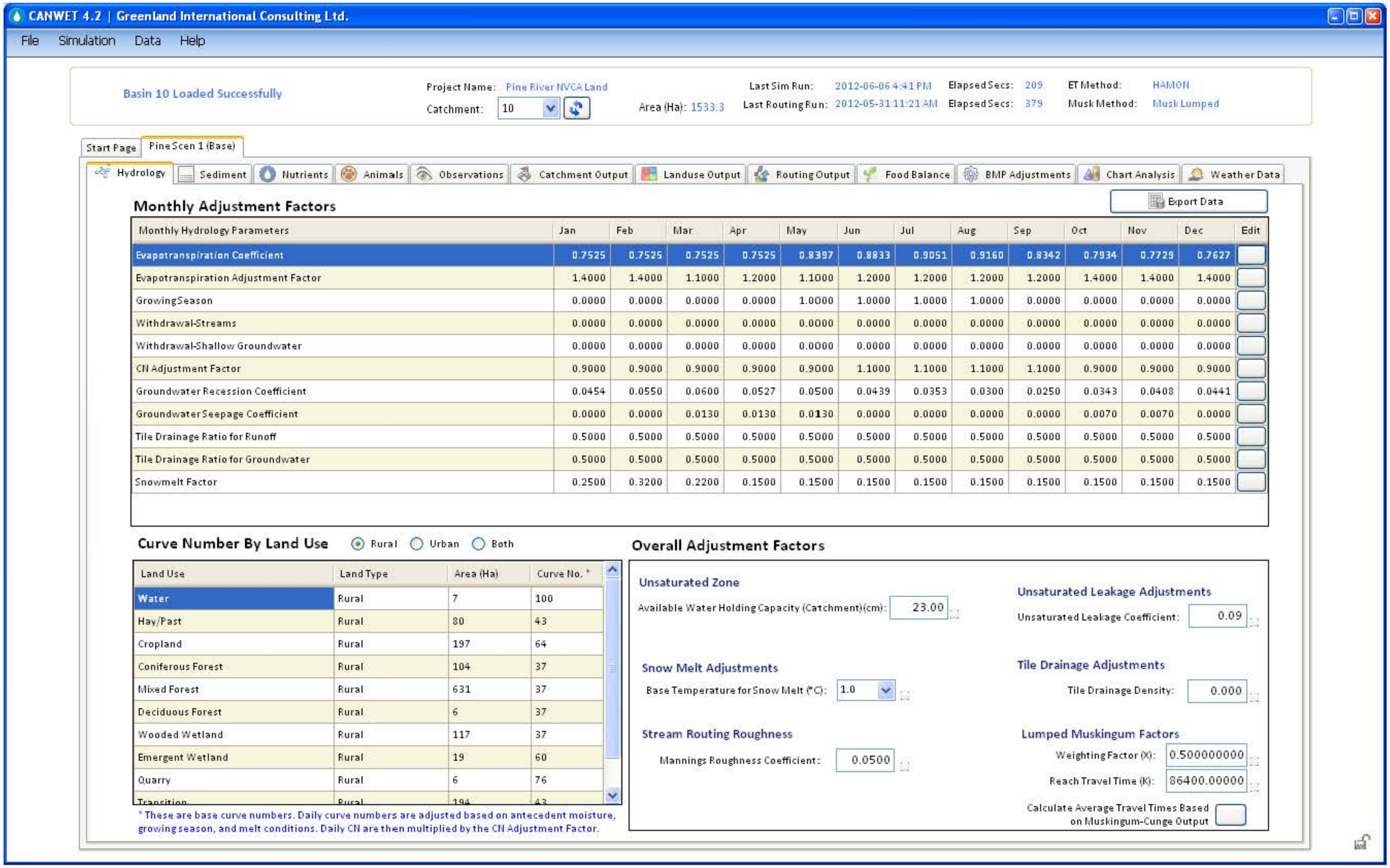


Figure 4: Max Temperature Regression: Shanty Bay and Egbert CS Stations

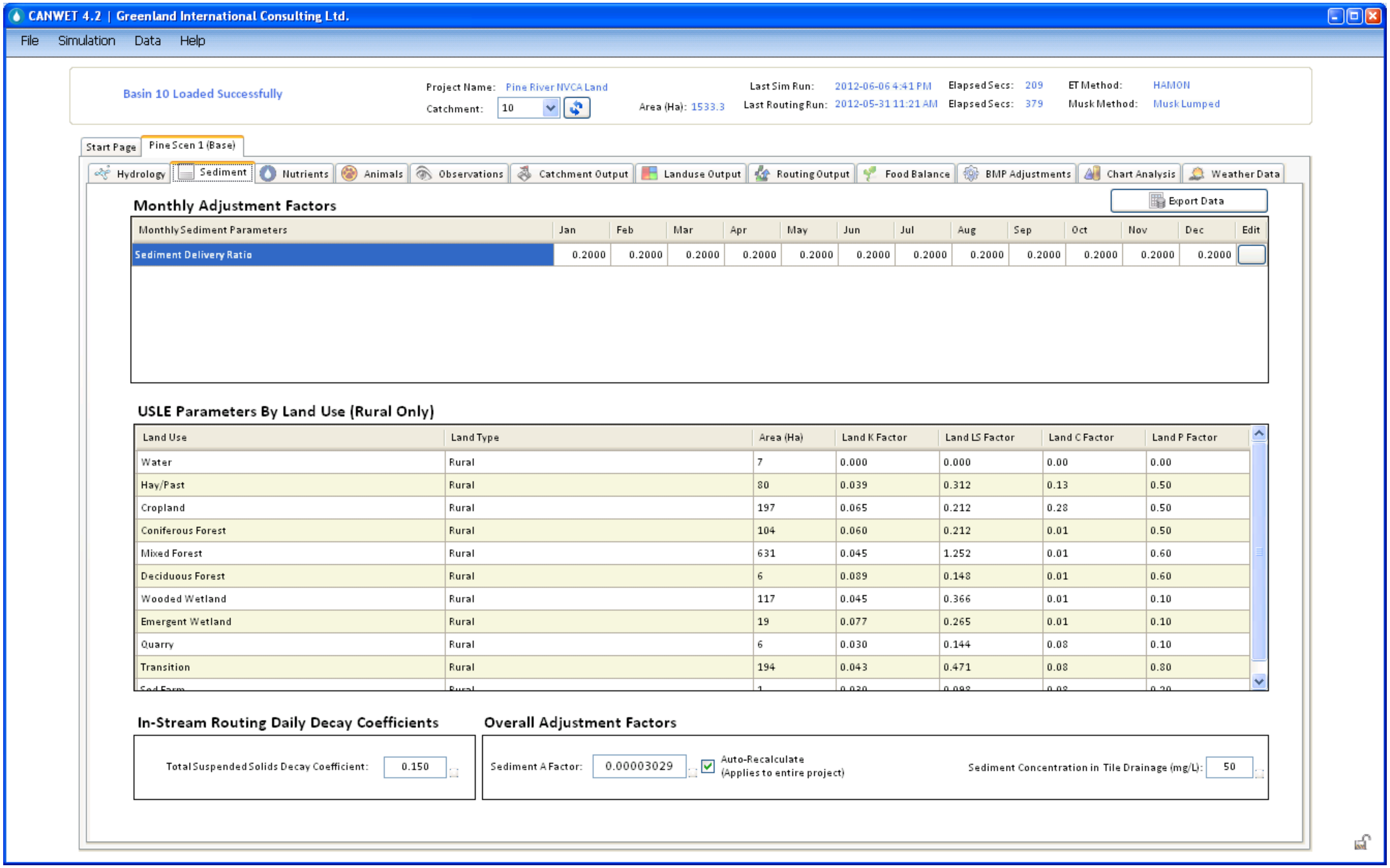
Sample CANWET Input Screens for Catchment 10 Containing Proposed WWTP Everett



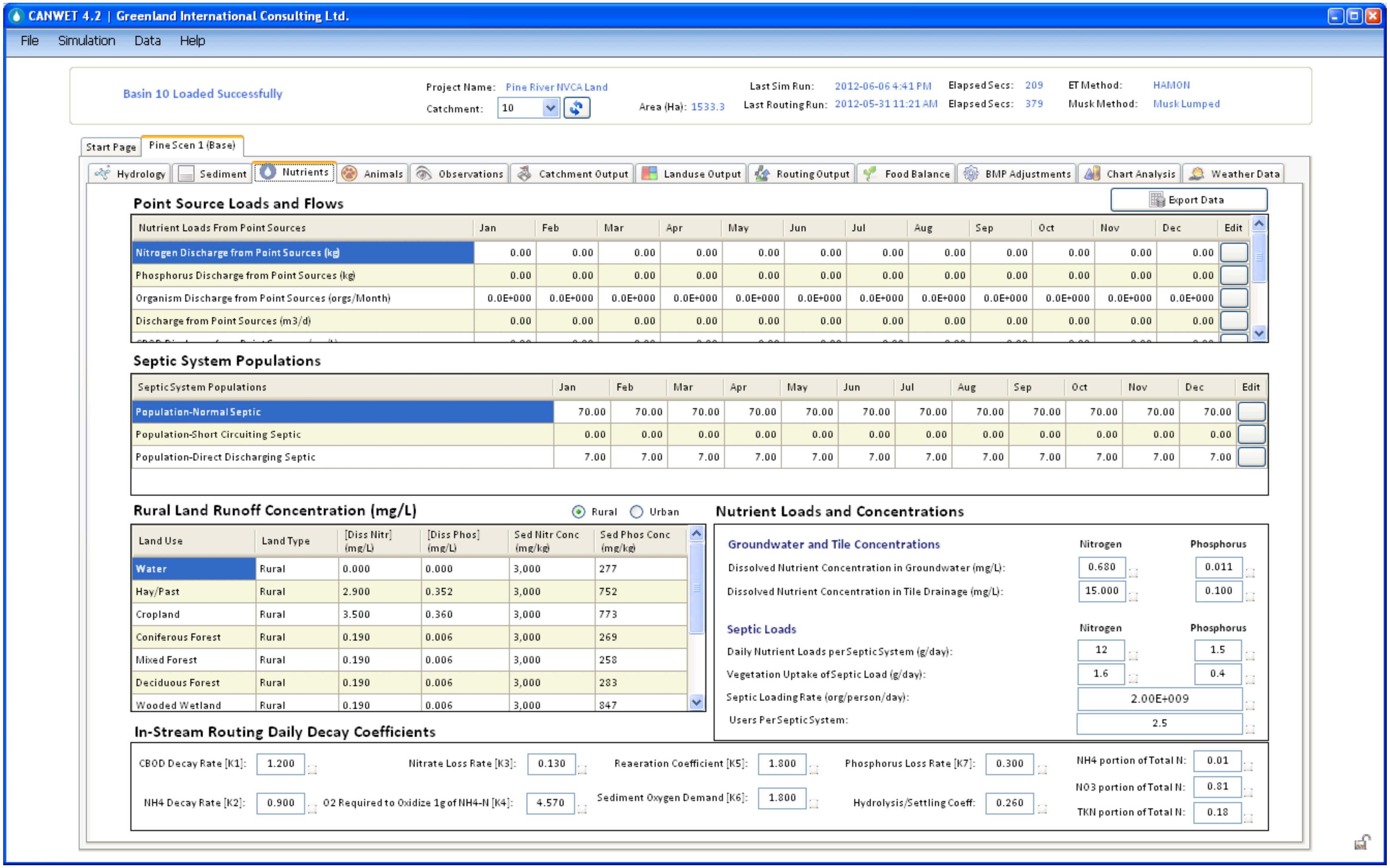
Monthly Hydrology Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Edit
Evapotranspiration Coefficient	0.7525	0.7525	0.7525	0.7525	0.8397	0.8833	0.9051	0.9160	0.8342	0.7934	0.7729	0.7627	
Evapotranspiration Adjustment Factor	1.4000	1.4000	1.1000	1.2000	1.1000	1.2000	1.2000	1.2000	1.2000	1.4000	1.4000	1.4000	
GrowingSeason	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	
Withdrawal-Streams	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Withdrawal-Shallow Groundwater	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
CN Adjustment Factor	0.9000	0.9000	0.9000	0.9000	0.9000	1.1000	1.1000	1.1000	1.1000	0.9000	0.9000	0.9000	
Groundwater Recession Coefficient	0.0454	0.0550	0.0600	0.0527	0.0500	0.0439	0.0353	0.0300	0.0250	0.0343	0.0408	0.0441	
Groundwater Seepage Coefficient	0.0000	0.0000	0.0130	0.0130	0.0130	0.0000	0.0000	0.0000	0.0000	0.0070	0.0070	0.0000	
Tile Drainage Ratio for Runoff	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	
Tile Drainage Ratio for Groundwater	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	
Snowmelt Factor	0.2500	0.3200	0.2200	0.1500	0.1500	0.1500	0.1500	0.1500	0.1500	0.1500	0.1500	0.1500	

Land Use	Land Type	Area (Ha)	Curve No. *
Water	Rural	7	100
Hay/Past	Rural	80	43
Cropland	Rural	197	64
Coniferous Forest	Rural	104	37
Mixed Forest	Rural	631	37
Deciduous Forest	Rural	6	37
Wooded Wetland	Rural	117	37
Emergent Wetland	Rural	19	60
Quarry	Rural	6	76
Transition	Rural	194	43

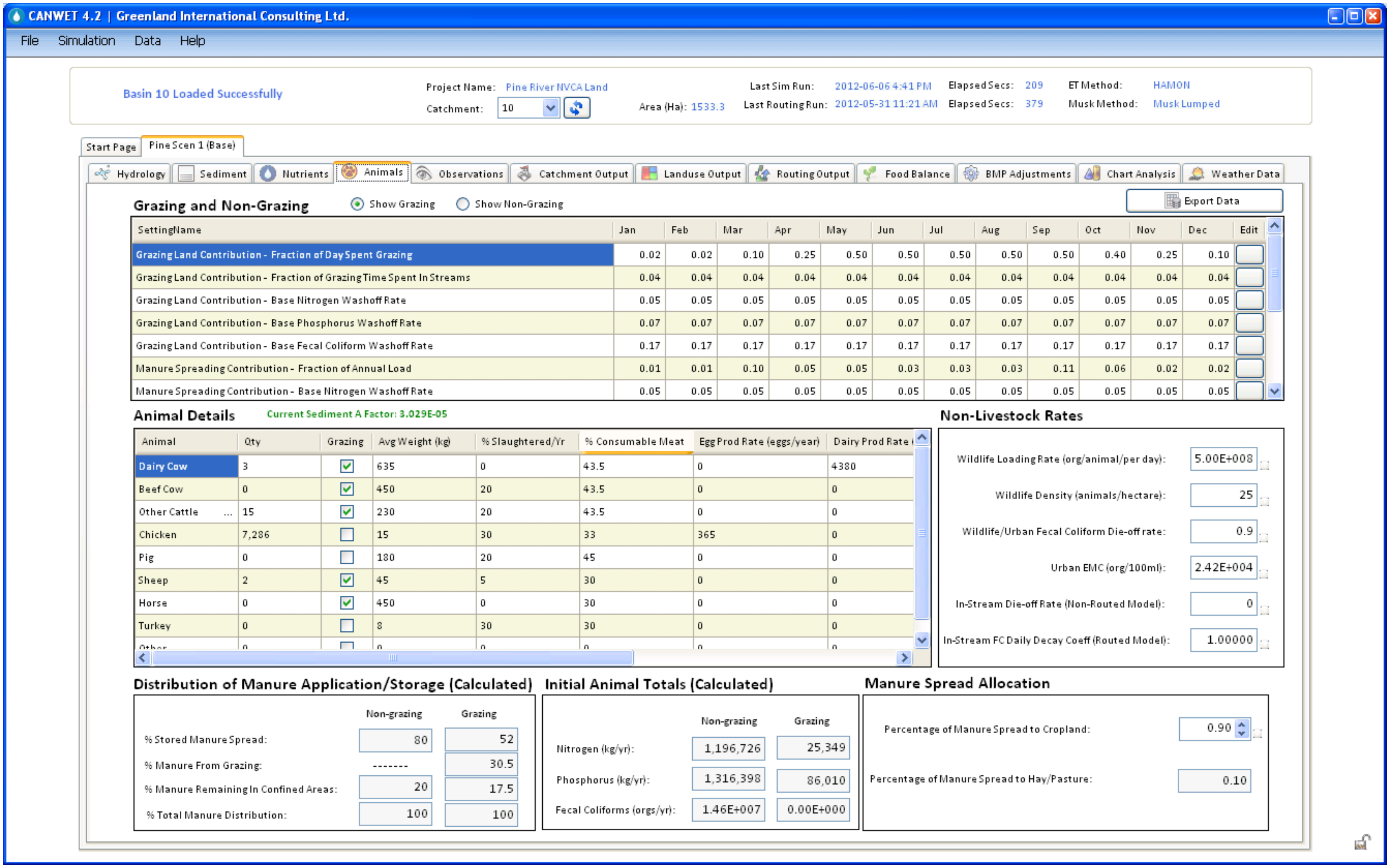
Catchment 10 CANWET hydrology inputs



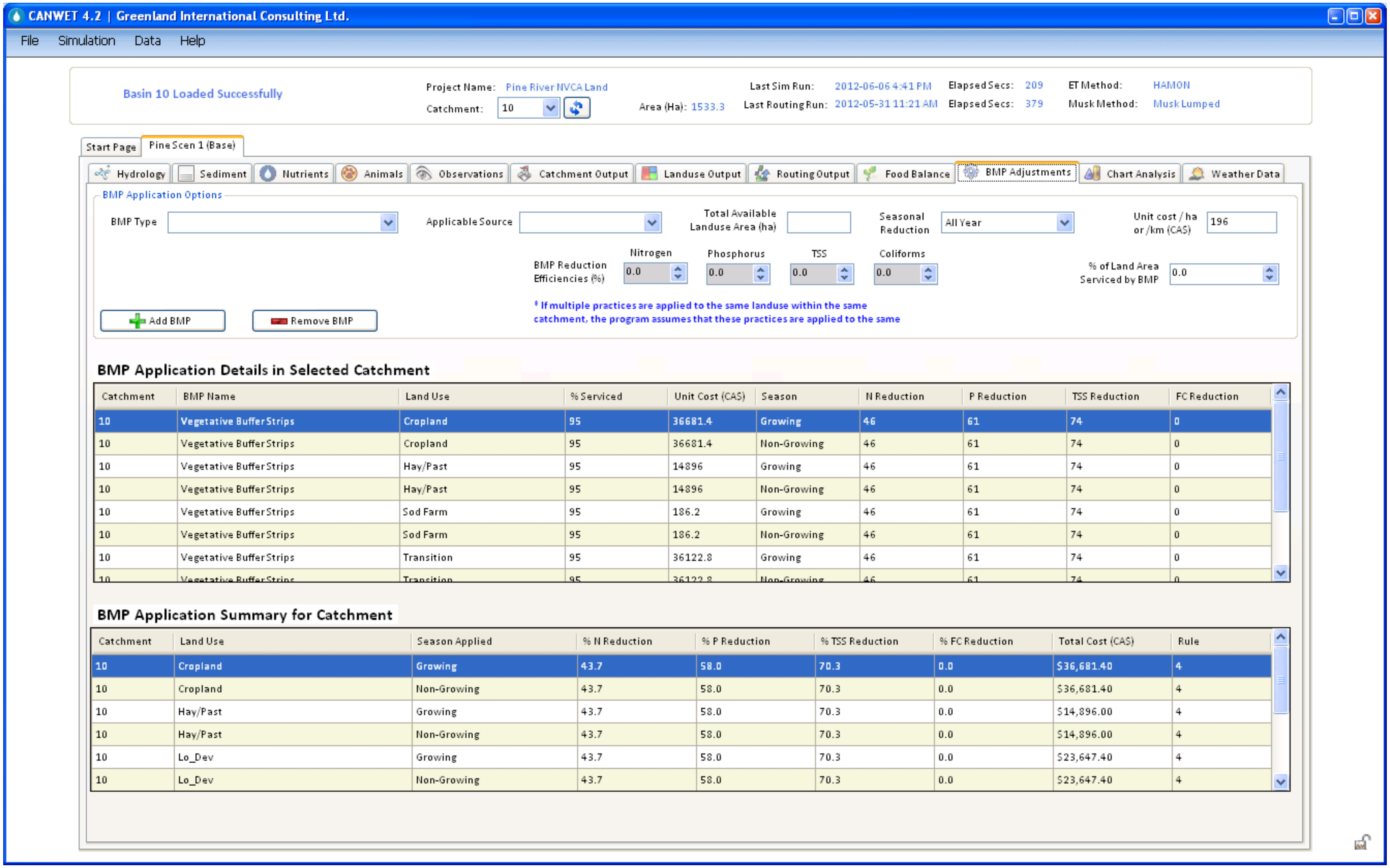
Catchment 10 CANWET sediment inputs



Catchment 10 CANWET nutrient inputs



Catchment 10 CANWET livestock / animal inputs



Catchment 10 CANWET best management practices inputs

Summary of CANWET Results for Average Flow Conditions Isolated

		Base Scenario using Mean Annual Flow									
	Dist. From Outlet (km)	Routed Flow at Node (L/sec) (Base)	Average P concentration (mg/L) (Base)	Average NH3+NH4 concentration (mg/L) (Base)	Average NO2/NO3 concentration (mg/L) (Base)	Average TKN concentration (mg/L) (Base)	NH3 (un-ionized) (mg/L) (Base)	BOD (mg/L) (Base)	DO (mg/L) (Base)	CFU/100 mL (Base)	TSS at reach outlet node (mg/L) (Base)
	52	828	0.027	0.037	3.019	0.671	0.005	1.500	8.626	0.000	0.543
	42	1453	0.022	0.020	2.010	0.427	0.003	1.302	8.432	188.112	0.301
	31	1745	0.020	0.013	1.725	0.344	0.002	1.015	8.069	118.130	0.257
	26	2057	0.020	0.012	1.663	0.328	0.002	0.950	7.952	87.770	0.206
Everett WWTP	25	2057	0.020	0.012	1.663	0.328	0.002	0.950	7.832	87.770	0.000
	20	2179	0.020	0.010	1.576	0.302	0.001	0.836	7.772	72.306	0.039
	18	2272	0.019	0.009	1.537	0.291	0.001	0.796	7.713	65.638	0.028
	16	2411	0.019	0.009	1.498	0.281	0.001	0.774	7.689	60.468	0.046
	13	2787	0.019	0.010	1.509	0.287	0.001	0.815	7.731	51.559	0.160
	11	3159	0.019	0.009	1.442	0.275	0.001	0.836	7.675	46.595	0.094
	7	3306	0.019	0.008	1.386	0.257	0.001	0.737	7.517	39.326	0.133
	5	3319	0.019	0.007	1.368	0.249	0.001	0.678	7.436	36.415	0.026
Borden WWTP	4	3353	0.020	0.013	1.354	0.247	0.002	0.713	7.396	38.089	0.047
	3	3381	0.019	0.012	1.336	0.240	0.002	0.660	7.407	35.274	0.010
	2	3479	0.020	0.012	1.327	0.240	0.002	0.684	7.431	35.825	0.075
	0	3511	0.020	0.011	1.307	0.232	0.001	0.634	7.377	32.932	0.083

		Scenario 2 using Mean Annual Flow									
	Dist. From Outlet (km)	Routed Flow at Node Outlet (L/sec) (Scn.2)	Average P concentration (mg/L) (Scn.2)	Average NH3+NH4 concentration (mg/L) (Scn.2)	Average NO2/NO3 concentration (mg/L) (Scn.2)	Average TKN concentration (mg/L) (Scn.2)	NH3 (un-ionized) (mg/L) (Scn.2)	BOD (mg/L) (Scn.2)	DO (mg/L) (Scn.2)	CFU/100 mL (Scn.2)	TSS at reach outlet node (mg/L) (Scn.2)
	52	828	0.027	0.037	3.019	0.671	0.005	1.500	8.626	0.000	0.543
	42	1453	0.022	0.020	2.010	0.427	0.003	1.302	8.432	188.112	0.301
	31	1745	0.020	0.013	1.725	0.344	0.002	1.015	8.069	118.130	0.257
	26	2057	0.020	0.012	1.663	0.328	0.002	0.950	7.952	87.770	0.206
Everett WWTP	25	2075	0.021	0.027	1.649	0.325	0.003	1.028	7.798	88.744	0.087
	20	2197	0.020	0.022	1.566	0.299	0.003	0.898	7.748	73.110	0.055
	18	2290	0.020	0.019	1.529	0.289	0.002	0.850	7.679	66.359	0.029
	16	2429	0.020	0.017	1.491	0.279	0.002	0.820	7.647	61.096	0.046
	13	2805	0.020	0.017	1.504	0.286	0.002	0.852	7.686	52.088	0.159
	11	3177	0.020	0.015	1.438	0.273	0.002	0.864	7.625	47.032	0.093
	7	3324	0.019	0.012	1.384	0.255	0.002	0.760	7.456	39.684	0.133
	5	3337	0.019	0.011	1.366	0.248	0.001	0.699	7.370	36.744	0.026
Borden WWTP	4	3371	0.020	0.017	1.352	0.246	0.002	0.734	7.331	38.406	0.047
	3	3399	0.020	0.015	1.335	0.239	0.002	0.679	7.339	35.563	0.010
	2	3497	0.020	0.015	1.326	0.238	0.002	0.702	7.364	36.103	0.075
	0	3529	0.020	0.014	1.306	0.231	0.002	0.651	7.307	33.187	0.083

		Scenario 3 using Mean Annual Flow									
	Dist. From Outlet (km)	Routed Flow at Node Outlet (L/sec) (Scn.3)	Average P concentration (mg/L) (Scn.3)	Average NH3+NH4 concentration (mg/L) (Scn.3)	Average NO2/NO3 concentration (mg/L) (Scn.3)	Average TKN concentration (mg/L) (Scn.3)	NH3 (un-ionized) (mg/L) (Scn.3)	BOD (mg/L) (Scn.3)	DO (mg/L) (Scn.3)	CFU/100 mL (Scn.3)	TSS at reach outlet node (mg/L) (Scn.3)
	52	828	0.027	0.037	3.019	0.671	0.005	1.500	8.626	0.000	0.543
	42	1453	0.022	0.020	2.010	0.427	0.003	1.302	8.432	188.112	0.301
	31	1745	0.020	0.013	1.725	0.344	0.002	1.015	8.069	118.130	0.257
	26	2057	0.020	0.012	1.663	0.328	0.002	0.950	7.952	87.770	0.206
Everett WWTP	25	2098	0.022	0.047	1.631	0.321	0.006	1.126	7.757	89.964	0.195
	20	2220	0.021	0.037	1.553	0.296	0.005	0.976	7.718	74.119	0.075
	18	2313	0.021	0.033	1.518	0.286	0.004	0.918	7.637	67.263	0.031
	16	2452	0.020	0.029	1.482	0.277	0.004	0.878	7.595	61.885	0.046
	13	2828	0.020	0.025	1.497	0.283	0.003	0.897	7.630	52.755	0.158
	11	3200	0.020	0.022	1.434	0.271	0.003	0.901	7.562	47.584	0.093
	7	3347	0.020	0.018	1.381	0.254	0.002	0.788	7.380	40.136	0.132
	5	3360	0.019	0.016	1.364	0.246	0.002	0.725	7.287	37.159	0.026
Borden WWTP	4	3394	0.020	0.022	1.350	0.244	0.003	0.759	7.248	38.805	0.047
	3	3422	0.020	0.020	1.333	0.237	0.003	0.702	7.253	35.928	0.010
	2	3520	0.021	0.020	1.324	0.237	0.002	0.724	7.280	36.455	0.074
	0	3552	0.020	0.018	1.305	0.230	0.002	0.671	7.219	33.509	0.082

		Scenario 4 using Mean Annual Flow									
	Dist. From Outlet (km)	Routed Flow at Node Outlet (L/sec) (Scn.4)	Average P concentration (mg/L) (Scn.4)	Average NH3+NH4 concentration (mg/L) (Scn.4)	Average NO2/NO3 concentration (mg/L) (Scn.4)	Average TKN concentration (mg/L) (Scn.4)	NH3 (un-ionized) (mg/L) (Scn.4)	BOD (mg/L) (Scn.4)	DO (mg/L) (Scn.4)	CFU/100 mL (Scn.4)	TSS at reach outlet node (mg/L) (Scn.4)
	52	828	0.027	0.037	3.019	0.671	0.005	1.500	8.626	0.000	0.543
	42	1453	0.022	0.020	2.010	0.427	0.003	1.302	8.432	188.112	0.301
	31	1745	0.020	0.013	1.725	0.344	0.002	1.015	8.069	118.130	0.257
	26	2057	0.020	0.012	1.663	0.328	0.002	0.950	7.952	87.770	0.206
Everett WWTP	25	2098	0.022	0.047	1.631	0.321	0.006	1.126	7.757	89.964	0.195
	20	2220	0.021	0.037	1.553	0.296	0.005	0.976	7.718	74.119	0.075
	18	2313	0.021	0.033	1.518	0.286	0.004	0.918	7.637	67.263	0.031
	16	2452	0.020	0.029	1.482	0.277	0.004	0.878	7.595	61.885	0.046
	13	2828	0.020	0.025	1.497	0.283	0.003	0.897	7.630	52.755	0.158
	11	3200	0.020	0.022	1.434	0.271	0.003	0.901	7.562	47.584	0.093
	7	3347	0.020	0.018	1.381	0.254	0.002	0.788	7.380	40.136	0.132
	5	3360	0.019	0.016	1.364	0.246	0.002	0.725	7.287	37.159	0.026
Borden WWTP	4	3407	0.021	0.024	1.345	0.243	0.003	0.772	7.236	39.423	0.064
	3	3435	0.020	0.022	1.328	0.236	0.003	0.714	7.251	36.493	0.012
	2	3533	0.021	0.022	1.319	0.236	0.003	0.736	7.278	37.002	0.074
	0	3565	0.021	0.019	1.301	0.229	0.002	0.681	7.216	34.011	0.082

Summary of CANWET Results for 7Q20 Flow Conditions Isolated

		Base Scenario using 7Q20 Flow Condition									
	Dist. From Outlet (km)	Routed Flow at Node (L/sec) (Base)	Average P concentration (mg/L) (Base)	Average NH3+NH4 concentration (mg/L) (Base)	Average NO2/NO3 concentration (mg/L) (Base)	Average TKN concentration (mg/L) (Base)	NH3 (un-ionized) (mg/L) (Base)	BOD (mg/L) (Base)	DO (mg/L) (Base)	CFU/100 mL (Base)	TSS at reach outlet node (mg/L) (Base)
	52	192	0.030	0.057	4.650	1.033	0.007	1.500	8.626	0.000	0.151
	42	337	0.025	0.031	3.119	0.663	0.004	1.302	8.433	51.666	0.049
	31	405	0.022	0.015	2.580	0.486	0.002	0.838	7.984	25.457	0.151
	26	477	0.020	0.013	2.405	0.443	0.002	0.774	7.890	17.412	0.089
Everett WWTP	25	477	0.020	0.013	2.405	0.443	0.002	0.774	7.759	17.412	0.000
	20	505	0.019	0.010	2.244	0.395	0.001	0.645	7.738	13.332	0.030
	18	527	0.020	0.010	2.189	0.382	0.001	0.629	7.708	12.186	0.018
	16	559	0.021	0.009	2.133	0.371	0.001	0.629	7.709	11.453	0.045
	13	647	0.020	0.010	2.036	0.355	0.001	0.659	7.763	9.063	0.120
	11	733	0.021	0.010	1.944	0.342	0.001	0.709	7.731	8.294	0.067
	7	767	0.020	0.008	1.864	0.320	0.001	0.635	7.622	6.754	0.081
	5	770	0.019	0.007	1.813	0.301	0.001	0.537	7.558	5.732	0.019
Borden WWTP	4	804	0.024	0.032	1.735	0.288	0.004	0.689	7.402	5.488	0.196
	3	811	0.022	0.026	1.688	0.271	0.003	0.586	7.514	4.639	0.038
	2	833	0.023	0.026	1.669	0.269	0.003	0.605	7.534	4.477	0.005
	0	841	0.022	0.023	1.643	0.261	0.003	0.563	7.497	4.096	0.029

		Scenario 2 using 7Q20 Flow Condition									
	Dist. From Outlet (km)	Routed Flow at Node (L/sec) (Scn.2)	Average P concentration (mg/L) (Scn.2)	Average NH3+NH4 concentration (mg/L) (Scn.2)	Average NO2/NO3 concentration (mg/L) (Scn.2)	Average TKN concentration (mg/L) (Scn.2)	NH3 (un-ionized) (mg/L) (Scn.2)	BOD (mg/L) (Scn.2)	DO (mg/L) (Scn.2)	CFU/100 mL (Scn.2)	TSS at reach outlet node (mg/L) (Scn.2)
	52	192	0.030	0.057	4.650	1.033	0.007	1.500	8.626	0.000	0.151
	42	337	0.025	0.031	3.119	0.663	0.004	1.302	8.433	51.666	0.049
	31	405	0.022	0.015	2.580	0.486	0.002	0.838	7.984	25.457	0.151
	26	477	0.020	0.013	2.405	0.443	0.002	0.774	7.890	17.412	0.089
Everett WWTP	25	495	0.023	0.078	2.318	0.427	0.010	1.109	7.623	24.049	0.364
	20	523	0.021	0.056	2.183	0.382	0.007	0.888	7.596	18.283	0.130
	18	545	0.022	0.049	2.136	0.370	0.006	0.840	7.529	16.579	0.027
	16	577	0.023	0.043	2.088	0.360	0.005	0.811	7.504	15.276	0.045
	13	665	0.022	0.034	2.004	0.346	0.004	0.788	7.531	11.912	0.117
	11	751	0.022	0.029	1.919	0.334	0.004	0.811	7.482	10.623	0.066
	7	785	0.022	0.024	1.845	0.313	0.003	0.716	7.335	8.660	0.079
	5	788	0.021	0.019	1.797	0.294	0.002	0.604	7.248	7.350	0.018
Borden WWTP	4	822	0.025	0.043	1.722	0.282	0.006	0.750	7.107	15.389	0.192
	3	829	0.023	0.035	1.677	0.265	0.004	0.636	7.200	13.011	0.038
	2	851	0.024	0.035	1.659	0.264	0.004	0.654	7.225	12.564	0.004
	0	859	0.023	0.031	1.635	0.256	0.004	0.607	7.181	11.497	0.029

		Scenario 3 using 7Q20 Flow Condition									
	Dist. From Outlet (km)	Routed Flow at Node Outlet (L/sec) (Scn.3)	Average P concentration (mg/L) (Scn.3)	Average NH3+NH4 concentration (mg/L) (Scn.3)	Average NO2/NO3 concentration (mg/L) (Scn.3)	Average TKN concentration (mg/L) (Scn.3)	NH3 (un-ionized) (mg/L) (Scn.3)	BOD (mg/L) (Scn.3)	DO (mg/L) (Scn.3)	CFU/100 mL (Scn.3)	TSS at reach outlet node (mg/L) (Scn.3)
	52	192	0.030	0.057	4.650	1.033	0.007	1.500	8.626	0.000	0.151
	42	337	0.025	0.031	3.119	0.663	0.004	1.302	8.433	51.666	0.049
	31	405	0.022	0.015	2.580	0.486	0.002	0.838	7.984	25.457	0.151
	26	477	0.020	0.013	2.405	0.443	0.002	0.774	7.890	17.412	0.089
Everett WWTP	25	518	0.027	0.155	2.215	0.408	0.020	1.504	7.462	31.858	0.791
	20	546	0.024	0.110	2.110	0.366	0.014	1.174	7.428	24.135	0.249
	18	568	0.025	0.096	2.073	0.355	0.012	1.091	7.317	21.787	0.038
	16	600	0.025	0.084	2.034	0.346	0.011	1.027	7.260	19.826	0.044
	13	688	0.024	0.063	1.965	0.334	0.008	0.942	7.254	15.335	0.114
	11	774	0.024	0.053	1.890	0.324	0.007	0.934	7.185	13.442	0.064
	7	808	0.023	0.042	1.823	0.304	0.005	0.814	6.995	10.972	0.077
	5	811	0.022	0.034	1.779	0.286	0.004	0.686	6.880	9.314	0.018
Borden WWTP	4	845	0.026	0.057	1.707	0.274	0.007	0.825	6.757	17.054	0.187
	3	852	0.025	0.047	1.664	0.258	0.006	0.698	6.825	14.422	0.037
	2	874	0.025	0.045	1.648	0.257	0.006	0.713	6.856	13.937	0.004
	0	882	0.024	0.041	1.624	0.249	0.005	0.660	6.805	12.756	0.028

		Scenario 4 using 7Q20 Flow Condition									
	Dist. From Outlet (km)	Routed Flow at Node Outlet (L/sec) (Scn.4)	Average P concentration (mg/L) (Scn.4)	Average NH3+NH4 concentration (mg/L) (Scn.4)	Average NO2/NO3 concentration (mg/L) (Scn.4)	Average TKN concentration (mg/L) (Scn.4)	NH3 (un-ionized) (mg/L) (Scn.4)	BOD (mg/L) (Scn.4)	DO (mg/L) (Scn.4)	CFU/100 mL (Scn.4)	TSS at reach outlet node (mg/L) (Scn.4)
	52	192	0.030	0.057	4.650	1.033	0.007	1.500	8.626	0.000	0.151
	42	337	0.025	0.031	3.119	0.663	0.004	1.302	8.433	51.666	0.049
	31	405	0.022	0.015	2.580	0.486	0.002	0.838	7.984	25.457	0.151
	26	477	0.020	0.013	2.405	0.443	0.002	0.774	7.890	17.412	0.089
Everett WWTP	25	518	0.027	0.155	2.215	0.408	0.020	1.504	7.462	31.858	0.791
	20	546	0.024	0.110	2.110	0.366	0.014	1.174	7.428	24.135	0.249
	18	568	0.025	0.096	2.073	0.355	0.012	1.091	7.317	21.787	0.038
	16	600	0.025	0.084	2.034	0.346	0.011	1.027	7.260	19.826	0.044
	13	688	0.024	0.063	1.965	0.334	0.008	0.942	7.254	15.335	0.114
	11	774	0.024	0.053	1.890	0.324	0.007	0.934	7.185	13.442	0.064
	7	808	0.023	0.042	1.823	0.304	0.005	0.814	6.995	10.972	0.077
	5	811	0.022	0.034	1.779	0.286	0.004	0.686	6.880	9.314	0.018
Borden WWTP	4	858	0.027	0.066	1.681	0.270	0.008	0.875	6.715	19.837	0.254
	3	865	0.026	0.053	1.641	0.254	0.007	0.740	6.811	16.777	0.050
	2	888	0.026	0.052	1.625	0.253	0.007	0.753	6.841	16.219	0.004
	0	895	0.025	0.047	1.603	0.245	0.006	0.696	6.784	14.846	0.028

Appendix B

Dispersion Model Details: Session Report

CORMIX Session Report

Session Report

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 8.0E
                       HYDRO1:Version-8.0.0.0  April,2012
SITE NAME/LABEL:                Everett Proposed WWTP
  DESIGN CASE:                  Summer 7Q20 Flow
  FILE NAME:                    C:\Program Files\CORMIX8\Sample Files\Sample1.prd
  Using subsystem CORMIX1:     Single Port Discharges
  Start of session:             07/25/2012--15:46:00
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                         BS       = 8.4 m
  Channel regularity            ICHREG = 2
  Ambient flowrate              QA       = 0.47 m^3/s
  Average depth                 HA       = 1 m
  Depth at discharge            HD       = 1 m
  Ambient velocity              UA       = 0.0560 m/s
  Darcy-Weisbach friction factor  F      = 0.1961
    Calculated from Manning's n          = 0.05
  Wind velocity                 UW       = 2 m/s
  Stratification Type           STRCND = U
  Surface temperature                    = 22 degC
  Bottom temperature                     = 22 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density               RHOAS  = 997.7714 kg/m^3
  Bottom density                RHOAB  = 997.7714 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:           Single Port Discharge
  Nearest bank                           = right
  Distance to bank              DISTB  = 4 m
  Port diameter                 D0       = 0.1 m
  Port cross-sectional area     A0       = 0.0079 m^2
  Discharge velocity            U0       = 5.22 m/s
  Discharge flowrate            Q0       = 0.041 m^3/s
  Discharge port height         H0       = 0.09 m
  Vertical discharge angle      THETA  = 0 deg
  Horizontal discharge angle    SIGMA  = 0 deg
  Discharge temperature (freshwater)     = 22 degC
  Corresponding density         RHO0   = 997.7714 kg/m^3
  Density difference            DRHO   = 0 kg/m^3
  Buoyant acceleration          GP0      = 0 m/s^2
  Discharge concentration       C0       = 0.226 mg/l
  Surface heat exchange coeff.  KS       = 0 m/s
  Coefficient of decay          KD       = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.09 m          Lm  = 8.27 m          Lb  = 0 m
  LM  = 99999 m         Lm' = 99999 m         Lb' = 99999 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Port densimetric Froude number  FR0    = 99999
  Velocity ratio                R        = 93.30
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = yes
  CMC concentration             CMC      = 0.018 mg/l
  CCC concentration             CCC      = 0.002 mg/l
  Water quality standard specified       = given by CCC value
  Regulatory mixing zone                 = no
  Region of interest                     = 500 m downstream
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = H5-0 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.
  Applicable layer depth = water depth = 1 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the bottom below the port center:
    4 m from the right bank/shore.
  Number of display steps NSTEP = 20 per module.
-----------------------------------------------------------------------------
```

```
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 0.0057 mg/l
  Dilution at edge of NFR              s = 39.3
  NFR Location:                        x = 38.18 m
    (centerline coordinates)           y = 0 m
                                       z = 1 m
  NFR plume dimensions:  half-width (bh) = 3.16 m
                          thickness (bv) = 1 m
Cumulative travel time:       511.2476 sec.

WARNING:
 The LIMITING DILUTION (given by ambient flow/discharge ratio) is = 12.46
 This value is below the computed dilution of 39.34 at the end of the
 Near Field Region (NFR). Mixing for this discharge configuration is
 constrained by the ambient flow.
 Please carefully review the prediction file for additional warnings and information.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is equal or about about equal to the surrounding
  ambient water density at the discharge level.
  Therefore, the effluent behaves essentially as NEUTRALLY BUOYANT.
-----------------------------------------------------------------------------
Near-field instability behavior:
  The discharge flow will experience instabilities with full vertical mixing
  in the near-field.
  There may be benthic impact of high pollutant concentrations.
-----------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume becomes vertically fully mixed ALREADY IN NEAR-FIELD at 0 m
  downstream and continues as vertically mixed into the far-field.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at 0 m downstream.
  Plume contacts second bank at 0 m downstream.
************************ TOXIC DILUTION ZONE SUMMARY ************************
Recall: The TDZ corresponds to the three (3) criteria issued in the USEPA
  Technical Support Document (TSD) for Water Quality-based Toxics Control,
  1991 (EPA/505/2-90-001).
  Criterion maximum concentration (CMC)  = 0.018  mg/l
Corresponding dilution                   = 12.555556
The CMC was encountered at the following plume position:
  Plume location:                      x = 8.90 m
    (centerline coordinates)           y = 0 m
                                       z = 0 m
  Plume dimension:       half-width (bh) = 0.06 m
                          thickness (bv) = 0.06 m

 Computed distance from port opening to CMC location = 8.90 m.
 CRITERION 1: This location is beyond 50 times the discharge length scale of
             Lq = 0.09 m.
 +++++ The discharge length scale TEST for the TDZ has FAILED. ++++++

 Computed horizontal distance from port opening to CMC location = 8.90 m.
 CRITERION 2: This location is beyond 5 times the ambient water depth of
             HD = 1 m.
 ++++++++++ The ambient depth TEST for the TDZ has FAILED. ++++++++++

 CRITERION 3: No RMZ has been defined. Therefore, the Regulatory Mixing zone
             test for the TDZ cannot be applied.

 The diffuser discharge velocity is equal to 5.22 m/s.
 This exceeds the value of 3.0 m/s recommended in the TSD.

 *** This discharge DOES NOT SATISFY all three CMC criteria for the TDZ. ****
********************** REGULATORY MIXING ZONE SUMMARY ***********************
No RMZ has been specified.
The CCC for the toxic pollutant was not encountered within the predicted
  plume region.
********************* FINAL DESIGN ADVICE AND COMMENTS **********************
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

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VOLUME 2: BACKGROUND STUDIES

Part 6 – Natural Hazards Mapping

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY
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UTOPIA, ONTARIO. L0M 1T0
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ONTARIO REGULATION 172/06

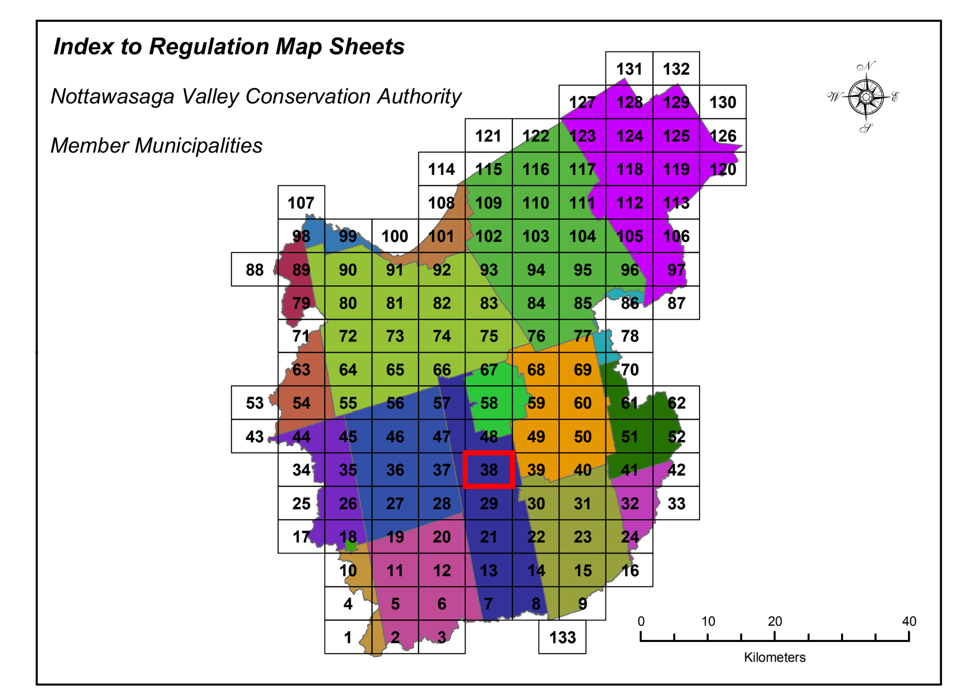
REGULATION FOR DEVELOPMENT, INTERFERENCE WITH WETLANDS, AND ALTERATIONS TO SHORELINES AND WATERCOURSES.

(IN CONFORMANCE WITH ONTARIO REGULATION 97/04)

N
W E
S

LEGEND

- MUNICIPAL BOUNDARY
- NVCA JURISDICTION
- REGULATION LIMIT
- LOT & CONCESSION FABRIC



In case of a conflict, the description of the areas provided in Section 2(1) of Ontario Regulation 172/06 prevails over the information shown on this map. Under Ontario Regulation 172/06 of the Conservation Authorities Act, the Nottawasaga Valley Conservation Authority regulates development in areas defined in Section 2, Subsection 1. The Regulation limit for riverine systems includes the greater (>) of the flood plain limit and the erosion hazard limit, plus an allowance of 15 metres. The Regulation limit for Lake Huron (Georgian Bay includes the high lake level (178.0 meters GSCD) plus an allowance of 45 metres (wave uprush, other water related hazards, dynamic beach). Provincially Significant Wetlands have been provided by the Ministry of Natural Resources. All other wetlands were delineated by the NVCA using the Ontario Wetland Evaluation System. The Regulation limit shown on this map includes wetlands greater than 2 hectares plus an allowance of 120 metres in order to identify lands where development could interfere with the function of a wetland. Ontario Regulation 172/06 applies to all wetlands and areas within the flooding hazard limit and erosion hazard limit shown and not shown on this map. Karst topography is a landscape created by groundwater dissolving sedimentary rock, such as limestone. This creates landforms such as shafts, tunnels, caves and sinkholes. Karst topography is considered to be a natural hazard. Further studies will be required for development proposals within areas where karst topography is suspected.

1:10,000

400 0 400 800 1,200

Meters

NO.	REVISIONS	DATE	
			CHECKED - PLANNING
			CHECKED - REGULATIONS
			CHECKED - ENGINEERING
2	REVISED FOLLOWING MUNICIPAL CONSULTATION	Feb 16, 2007	APPROVED
1	APPROVED, REGULATION NUMBER ADDED	May 4, 2006	DATE: May 15, 2006
			MAPPING BY: GIS DEPT

ONTARIO REGULATION 172/06

REGULATION FOR DEVELOPMENT, INTERFERENCE WITH WETLANDS, AND ALTERATIONS TO SHORELINES AND WATERCOURSES.

(IN CONFORMANCE WITH ONTARIO REGULATION 97/06)

PLOT DATE: February 2007

FILE: G:\NVCA_Data\Program_Data\GIS\Projects\GenericRegs

SHEET NO. 38 of 133