Final Report

Plympton Wastewater System Capacity Study

Prepared for

Town of Plympton-Wyoming

March 2015

CH2MHILL®

72 Victoria Street South, Suite 300
Kitchener, ON
N2G 4Y9

Certification

This report entitled *PLYMPTON WASTEWATER SYSTEM CAPACITY STUDY* was prepared under the direction of a professional engineer registered in the Province of Ontario. It is intended solely for the use of the individual, company, government, or other entity for which it was prepared, and for the purposes and within the limitations stated in the report.

Prepared by _____

Mike Kocher, B.A.Sc., P.Eng.
Project Manager, CH2M HILL Canada Limited

Reviewed by _____

Brian Graham, M.A.Sc., P.Eng.
Senior Technical Consultant, CH2M HILL Canada Limited

This page intentionally left blank.

Contents

Page

Figures

Acronyms and Abbreviations

%	percent
BOD_5	5-day biochemical oxygen demand
C of A	Certificate of Approval
$CBOD_5$	5-day carbonaceous biochemical oxygen demand
CH2M HILL	CH2M HILL Canada Limited
GIS	geographic information system
I/I	inflow and infiltration
L	litre
L/s	litre per second
L/s/ha	litre per second per hectare
Lpcd	litre per capita per day
m^3/capita/day	cubic metre per capita per day
m^3/day	cubic metre per day
mm	millimetre
n/a	not applicable
NH_3	ammonia
OMI	Operations and Maintenance Business Group
TKN	total Kjeldalh nitrogen
Town	Town of Plympton-Wyoming
TP	total phosphorus
TSS	total suspended solids
WWTP	Wastewater Treatment Plant

SECTION 1

Introduction

1.1 Introduction

Like many similar sized communities in Ontario, the Town of Plympton-Wyoming (Town) has experienced steady growth in recent decades, resulting in continuous expansion of the existing service area and increased demands on local infrastructure. CH2M HILL Canada Limited (CH2M HILL) was retained by the Town to evaluate the available capacity at the Plympton Wastewater Treatment Plant (WWTP) and the associated wastewater collection system, to facilitate future planned development.

1.2 Background Information

The Town was established in 2001 through the amalgamation of the Township of Plympton and the Village of Wyoming, and as of 2011 had a reported population of 7,576 (Statistics Canada, 2012). There are two WWTPs within the Town: the Plympton WWTP and the Wyoming WWTP. The Plympton WWTP is located on Aberarder Line and services customers along Lake Huron, primarily north and northwest of Lakeshore Road. The Wyoming WWTP services the former Village of Wyoming (not related to this study). Figure 1-1 presents an overview of the municipality, the location of the WWTPs, and the service area of the Plympton WWTP.

The Plympton WWTP and its associated collection system were originally constructed as part of Ontario Ministry of Environment sewage works projects in the 1990s. The rated capacity for the Plympton WWTP is 3,300 cubic metres per day (m^3/day). The sanitary collection system tributary to the WWTP contains 10 sanitary pumping stations, and has sewers ranging from 200 to 600 millimetres (mm) in diameter.

The Plympton WWTP and its associated pumping stations are operated by CH2M HILL's Operations and Management Business Group (OMI). Figure 1-2 presents an overview of the Plympton WWTP service area and its major components.

1.3 Study Objectives

The following are the primary study objectives for this assignment:

- Determine the uncommitted reserve capacity of the Plympton WWTP.
- Identify potential areas of concern within the sanitary collection system, for servicing future growth.

1.4 Study Approach

CH2M HILL's will meet the study objectives through the following approach:

- Collect and summarize planned or approved future developments by the Town.
- Collect and review available sanitary sewer system information, including geographic information system (GIS) data, Certificates of Approval (C of As), and record drawings.
- Collect and review recent flow and quality data from the Plympton WWTP, to establish the average daily flows to the plant and assess the plant's typical performance with respect to effluent quality limits.
- Calculate the Uncommitted Reserve Capacity of the Plympton WWTP.
- Collect and review recent pumping station monitoring data to determine average and peak daily flows, and observed per capita flow rates.
- Produce GIS mapping to illustrate the available sewer system capacity relative to proposed developments and any particular areas of concern.
- Based on the results of the study, develop a preliminary growth plan strategy for consideration by the Town, based on ongoing infill of existing developments and proposed future developments.

This page intentionally left blank.

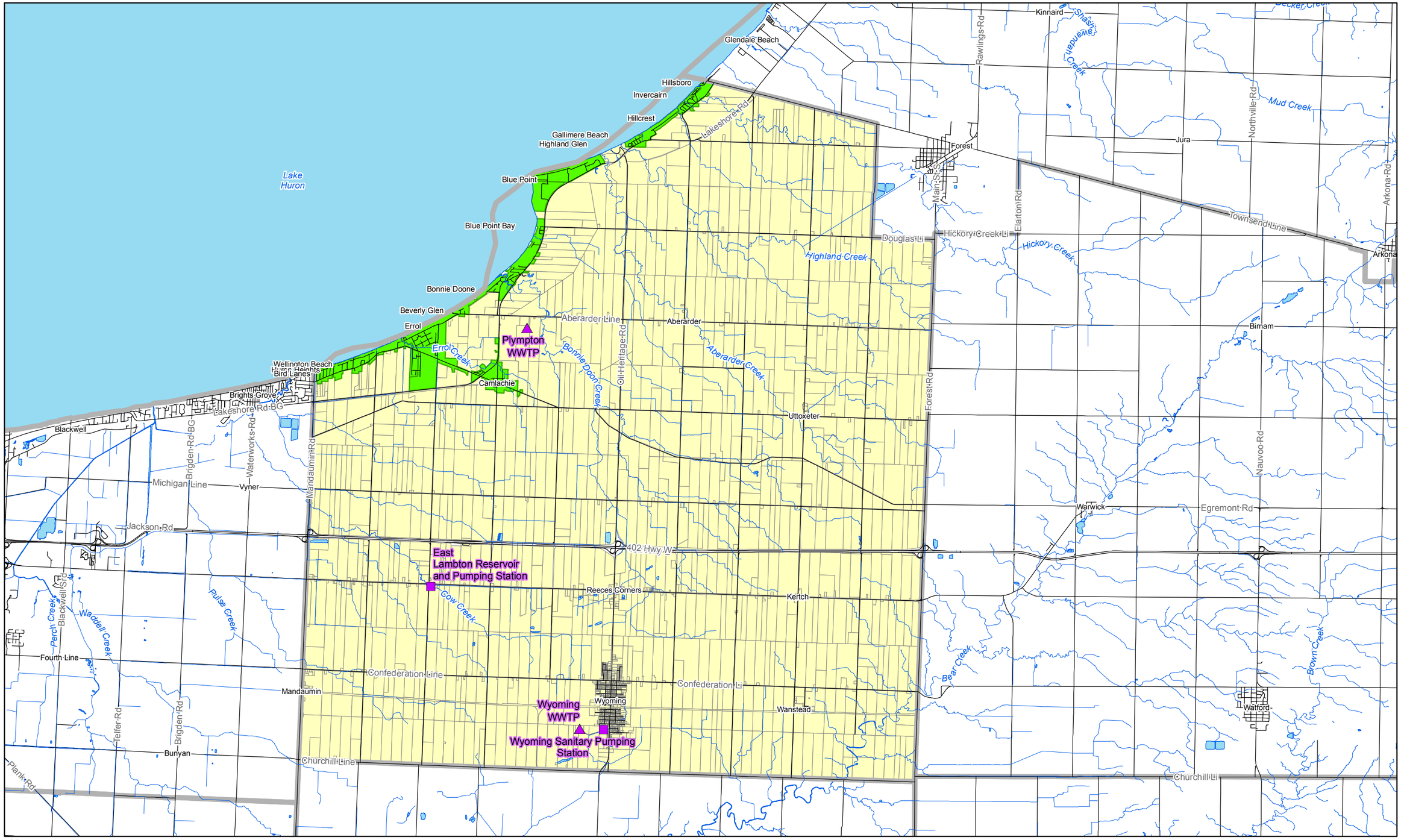


Figure 1-1
Municipality Overview

Town of Plympton-Wyoming
Lambton County, Ontario

CH2MHILL

\\WATERLOO\PROJ\PLYMPTONWYOMINGCORPO\494936PLYMPTONWWCS\GIS\MAPFILES\FINAL\FIGURE1-1_BASEMAP_OVERVIEW.MXD MKOCHER 5/28/2015 12:09:27 PM

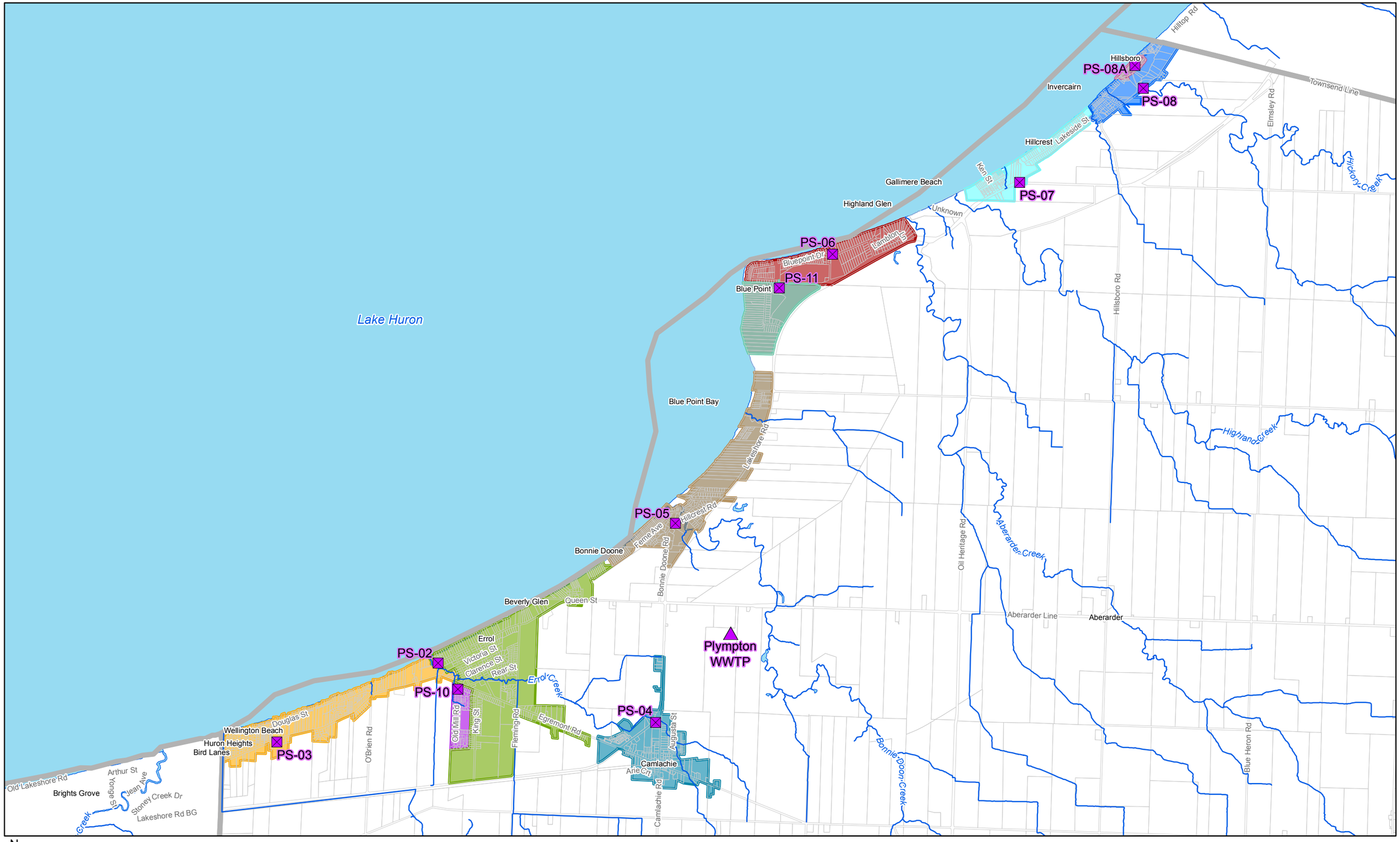


Figure 1-2
Plympton WWTP Collection System

Town of Plympton-Wyoming
Lambton County, Ontario

CH2MHILL

\\WATERLOO\PROJ\PLYMPTONWYOMINGCORPO\494936PLYMPTONWWCS\GIS\MAPFILES\FINAL\FIGURE1-2_WWTP_COLLECTIONSYSTEM.MXD MKOCHER 5/28/2015 12:10:15 PM

SECTION 2

Existing Service Areas and Future Development

2.1 Introduction

To assess the impact of future development on the Plympton WWTP and wastewater collection system, the existing and future service areas needed to be determined.

2.2 Methodology

Based on the layout of the wastewater collection system, the sanitary pumping station catchment areas provided an opportunity to evaluate growth within different regions of the Plympton WWTP collection system. The pumping station catchment areas were defined in GIS based on sewer flow direction, and include both existing and future areas of service.

The Town provided wastewater billing account data that was tied to GIS using municipal addresses, to determine the number of existing billing accounts within each pumping station catchment area. The existing service populations were then estimated based on the Billing Codes provided and assuming three persons per residential unit, consistent with the Town's typical sanitary sewer design criteria.

Once the existing service areas and user accounts were defined, CH2M HILL and the Town then conducted a detailed review to identify future growth areas using GIS mapping and aerial photography. Future growth included both vacant infill lots and proposed developments that have received Draft Plan Approval. The results of this exercise were plotted graphically and reviewed by the Town.

The pumping station catchment areas along with the future developments and the proposed number of lots are illustrated in Appendix A.

2.3 Existing Service Areas

Table 2-1 presents the number of existing billing accounts within each pumping station catchment area and the estimated populations. Certain pumping stations are connected in series before ultimately ending up at PS-02 or PS-05, which discharge to the Plympton WWTP. Therefore, the service areas are presented as both Unique Service Areas (those properties that drain by gravity directly to the pumping station) and Total Service Areas (includes all upstream contributing areas). Using the assumed three persons per residential unit, the total population for the entire Plympton WWTP service area was estimated to be 4,722.

TABLE 2-1
Plympton WWTP – Existing Service Areas

Service Area	Location	Upstream Pumping Stations	Unique Service Area		Total Service Area	
			Billing Accounts	Estimated Population*	Billing Accounts	Estimated Population*
PS-02	Queen St.	PS-03, PS-04, PS-10	308	924	922	2787
PS-03	Egremont Rd.	n/a	337	1017	337	1017
PS-04	Camlachie Rd.	n/a	180	555	180	555
PS-05	Bonnie Doon Rd.	PS-06	176	528	628	1935
PS-06	Blue Point Dr.	PS-07, PS-11	164	492	452	1407
PS-07	Lakeshore Rd.	PS-08	131	429	260	831
PS-08	Hillsboro Rd.	PS-08A	93	288	129	402
PS-08A	Shirley Lane	n/a	36	114	36	114
PS-10	Old Mill Rd.	n/a	97	291	97	291
PS-11	Cullen Dr.	n/a	28	84	28	84
WWTP	**Aberader Line**	**PS-02, PS-05**	**1550**	**4722**	n/a	n/a

Notes: n/a = not applicable
*Based on 3 persons per unit. In some cases, multiple units were contained in a single billing account.

2.4 Future Service Areas

The future service areas for each pumping station are summarized in Table 2-2. PS-04, which services the Camlachie area, is projected to be one of the largest growth areas with a population increase of 110 percent. Total anticipated growth for the entire Plympton WWTP service area, based on the existing service population of 4,722 and future service population of 7,986, was estimated to be 69 percent.

TABLE 2-2
Plympton WWTP – Future Service Areas

Service Area	Unique Service Area				Total Service Area				
	Existing Billing Accounts	Future Residential Units	Future Billing Accounts	Estimated Future Population	Existing Billing Accounts	Future Residential Units	Future Billing Accounts	Estimated Future Population	Percentage Increase (from Existing)
PS-02	308	425	733	2199	922	726	1648	4965	78%
PS-03	337	58	395	1191	337	58	395	1191	17%
PS-04	180	203	383	1164	180	203	383	1164	110%
PS-05	176	61	237	711	628	362	990	3021	56%
PS-06	164	163	327	981	452	301	753	2310	64%
PS-07	131	13	144	468	260	59	319	1008	21%
PS-08	93	46	139	426	129	46	175	540	34%
PS-08A	36	0	36	114	36	0	36	114	0%
PS-10	97	40	137	411	97	40	137	411	41%
PS-11	28	79	107	321	28	79	107	321	282%
WWTP	**1550**	**1088**	**2638**	**7986**	n/a	n/a	n/a	n/a	69%

Notes: n/a = not applicable % = percent

SECTION 3

Plympton WWTP Reserve Capacity Analysis

3.1 Historical Flows

The Plympton WWTP operator (CH2M HILL's OMI group) provided three years of historical flow data (January 2011 through December 2013) which is presented in Figure 3-1 and Table 3-1.

FIGURE 3-1
Plympton WWTP - Historical Influent Flow Data (January 2011 through December 2013)

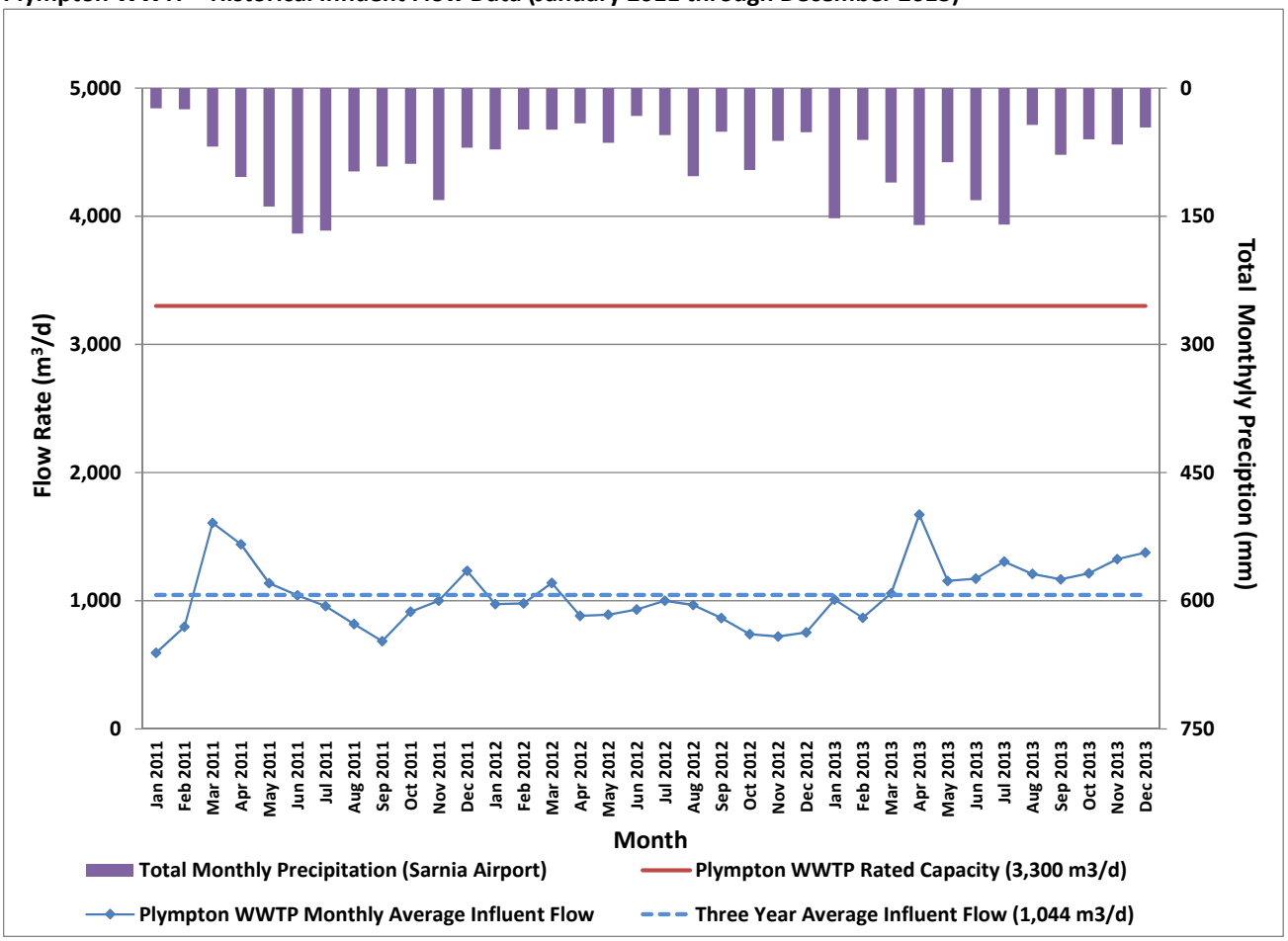


TABLE 3-2
Plympton WWTP – Historical Influent Flow Data (m^3/day)

Month	Year		
	2011	2012	2013
January	593	974	1,009
February	796	978	867
March	1,607	1,139	1,058
April	1,440	883	1,673
May	1,136	891	1,155
June	1,041	931	1,172
July	958	1,000	1,304
August	817	966	1,209
September	684	865	1,167
October	913	738	1,213
November	999	721	1,324
December	1,233	753	1,375
Annual Average	1,018	903	1,210
Three-Year Average	1,044		

Figure 3-1 and Table 3-1 illustrate that the average influent flow rate observed at the Plympton WWTP over the previous three years is 1,044 m^3/day.

3.2 Methodology

Procedure D-5-1 (MOE, 1995) outlines the methodology to be used to calculate uncommitted reserve capacity at WWTPs using the following formula:

$$Cu = Cr - \frac{L \bullet F \bullet P}{H}$$

Where Cu represents Uncommitted Hydraulic Reserve Capacity (m^3/day),
Cr represents Hydraulic Reserve Capacity (m^3/day),
L represents Number of Unconnected Approved Lots,
P represents Existing Connected Population,
F (for sewage treatment plants) represents Average Day Flow per Capita in cubic metres per capita per day (m^3/capita/day), and
H represents Number of Households or Residential Connections

3.2.1 Assumptions

There are certain limitations to this method of calculating the uncommitted hydraulic reserve capacity. Wastewater flows comprise more than simply residential sources. Additional contributions are made by inflow and infiltration (I/I), as well as industrial, commercial and institutional flows. This method assumes that the ratio of residential population to total flow remains constant. In addition, I/I reduction programs as well as water conservation measures may decrease the existing flows at the plant and create additional reserve capacity.

3.2.2 Hydraulic Reserve Capacity

The rated capacity of the Plympton WWTP is outlined in its C of A, 3-1291-91-926, dated May 28, 1992. The C of A states that the plant is rated at an average daily flow of 3,300 m^3/day and a peak flow of 10,500 m^3/day.

The hydraulic reserve capacity of the Plympton WWTP is equivalent to its rated capacity minus the average wastewater flows over the previous three years as outlined in the formula below:

$$Cr = Rated\ Capacity - Three\ Year\ Average\ Flow$$

$$Cr = 3{,}300\ \mathrm{m^3/day} - 1{,}044\ \mathrm{m^3/day}$$

$$Cr = 2{,}256\ \mathrm{m^3/day}$$

The hydraulic reserve capacity of the Plympton WWTP is 2,256 m^3/day.

3.2.3 Number of Unconnected Approved Lots

The Town provided wastewater billing account information which was used to determine that there is a total of 1,550 existing connected billing accounts in the Plympton WWTP sewershed. The breakdown of these accounts by pumping station is provided in Table 2-1.

The number of approved billing accounts was determined through an iterative review with the Town of future developments and infill lots. It is projected that at build-out, there will be 2,638 billing accounts in the Plympton WWTP sewershed. The breakdown of these accounts by pumping station is provided in Table 2-2.

The number of unconnected approved lots (residential units) can also be described as the number of commitments that have servicing agreements with the Plympton WWTP but have yet to be connected.

The following formula was used to calculate the number of unconnected approved lots:

$$L = Total\ Number\ of\ Approved\ Billing\ Accounts - Connected\ Billing\ Accounts$$

$$L = 2{,}638 - 1{,}550$$

$$L = 1{,}088$$

L, the number of unconnected approved lots, was calculated to be 1,088 lots. This value is also shown in Table 2-2 as the total number of Future Residential Units for the Unique Service Areas.

3.2.4 Existing Connected Population

Based on billing account information provided, there is an estimated 4,722 people who currently reside in the Plympton WWTP sewershed. The breakdown of this population by pumping station is provided in Table 2-1.

3.2.5 Average Day Flow per Capita

Metcalf & Eddy (2003) estimates that a household of three persons has a typical wastewater flow rate of 250 litres per capita per day (Lpcd). The range provided for the three person household is 194 to 335 Lpcd.

Dividing the 3-year average influent flow rate of 1,044 m^3/day by the existing connected population of 4,722 people yields an estimated average day flow per capita of 0.221 m^3/capita/day (221 Lpcd). This value compares favourably with typical values in the literature. However, the flow measured at a WWTP is typically larger than the residential wastewater flow, as the total WWTP flow includes I/I as well as industrial and commercial wastewater.

As an example for design methodology provided for development, the Town provided recent sanitary sewer design calculations from the Huroncrest Estates development, which used average daily per capita flow rate of 337 Lpcd, the Harmon formula for the peaking factor, and an I/I allowance of 0.10 litres per second per hectare (L/s/ha). For the Huroncrest Estates design calculations, the population flow was 5.27 liters per second (L/s) and the I/I flow was 3.84 L/s for a total design flow rate of 9.26 L/s. In this example, the I/I flow accounted for 41 percent of the total design flow rate. The calculated I/I flow will vary based on the service area identified in the calculations, therefore developments with large sized lots and lower population density will inherently produce greater proportion of I/I values in the sewer design calculations.

Based on the design values described above, in order to not overestimate the uncommitted hydraulic reserve capacity of the Plympton WWTP, CH2M HILL recommends using an average day flow-per-capita rate of 0.42 m^3/capita/day (420 Lpcd) for the reserve capacity calculations. This value reflects the sanitary sewer design value of 337 Lpcd plus a 25 percent allowance for I/I. It is also reflective of the typical per capita flow rate observed for each pumping station catchment area, further described in Section 4.

3.2.6 Number of Households or Residential Connections

As outlined in Section 3.2.3 above, the Town provided wastewater billing account information which indicated that there is a total of 1,550 billing accounts in the Plympton WWTP sewershed. The breakdown of these accounts by pumping station is provided in Table 2-1. Therefore, the total number of current households or residential connections (H) to the Plympton WTTP has been assumed to be 1,550.

3.2.7 Reserve Capacity Calculation

Based on the parameters determined and outlined above, the uncommitted hydraulic reserve capacity is calculated as follows:

$$Cu = 2{,}256\ m^3/day - \frac{L \bullet F \bullet P}{H}$$

$$Cu = 2{,}256\ m^3/day - \frac{1{,}079\ Unconnected\ Approved\ Lots \bullet \frac{0.42\ m^3}{capita \bullet day} \bullet\ 4{,}722\ Existing\ Connected\ Population}{1{,}550\ Total\ Current\ Connections}$$

$$Cu = 2{,}256\ m^3/day - \frac{1{,}088}{1{,}550}\ 1{,}983\ m^3/day$$

$$Cu = 2{,}256\ m^3/day - 0.70 \bullet 1{,}983\ m^3/day$$

$$Cu = 2{,}256\ m^3/day - 1{,}388\ m^3/day$$

$$Cu = 868\ m^3/day$$

Therefore, based on currently available information, the uncommitted hydraulic reserve capacity of the Plympton WWTP is estimated to be 868 m^3/day.

3.3 Historical Treatment Performance

The Plympton WWTP is an extended aeration WWTP that includes screening, vortex grit removal, raw sewage pumps, two two-pass aeration tanks, two secondary clarifiers, chemical phosphorus removal and UV disinfection. Solids treatment is provided by four aerobic digesters and one on-site sludge storage lagoon.

The influent concentrations observed at the Plympton WWTP are typical of those observed for residential wastewater.

The Plympton WWTP consistently meets its effluent criteria limits as outlined in its C of A. Figures 3-2 through 3-5 illustrate the influent and effluent concentrations measures at the plant as well as the effluent criteria for 5-day biochemical oxygen demand (BOD_5) and 5-day carbonaceous biochemical oxygen demand ($cBOD_5$), total suspended solids (TSS), total Kjeldalh nitrogen (TKN) and ammonia (NH_3), and total phosphorus (TP) respectively.

FIGURE 3-3
Plympton WWTP – Historical Influent and Effluent BOD_5 and $CBOD_5$ Concentrations (January 2011 through December 2013)

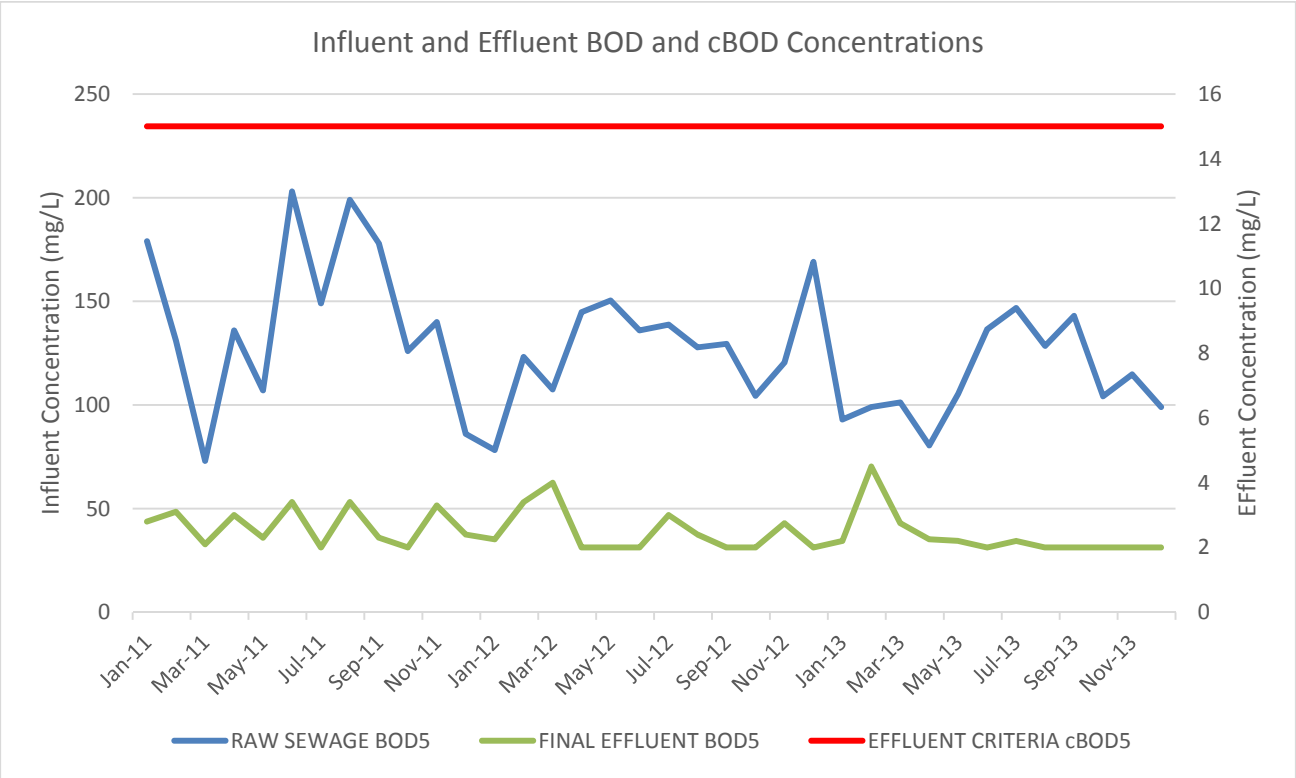


FIGURE 3-4
Plympton WWTP – Historical Influent and Effluent TSS Concentrations (January 2011 through December 2013)

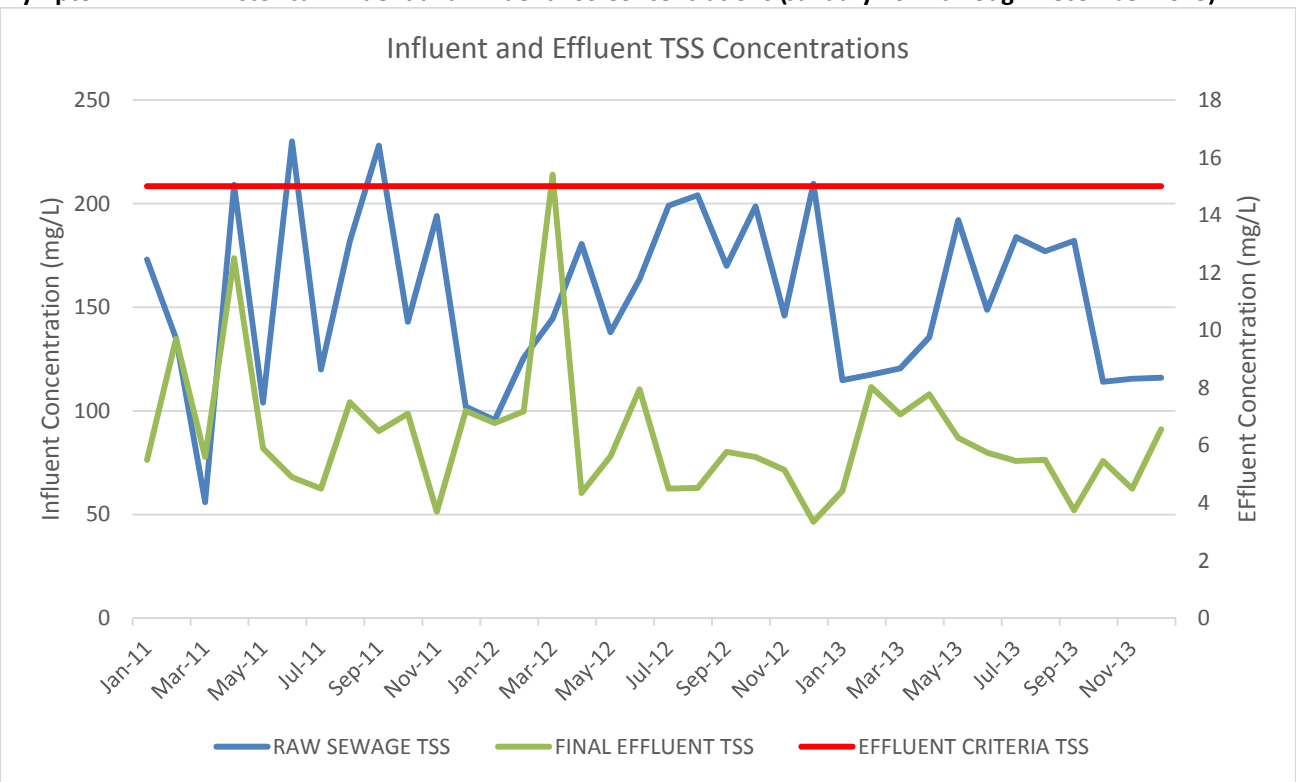


FIGURE 3-5
Plympton WWTP – Historical Influent and Effluent TKN and NH_3 Concentrations (January 2011 through December 2013)

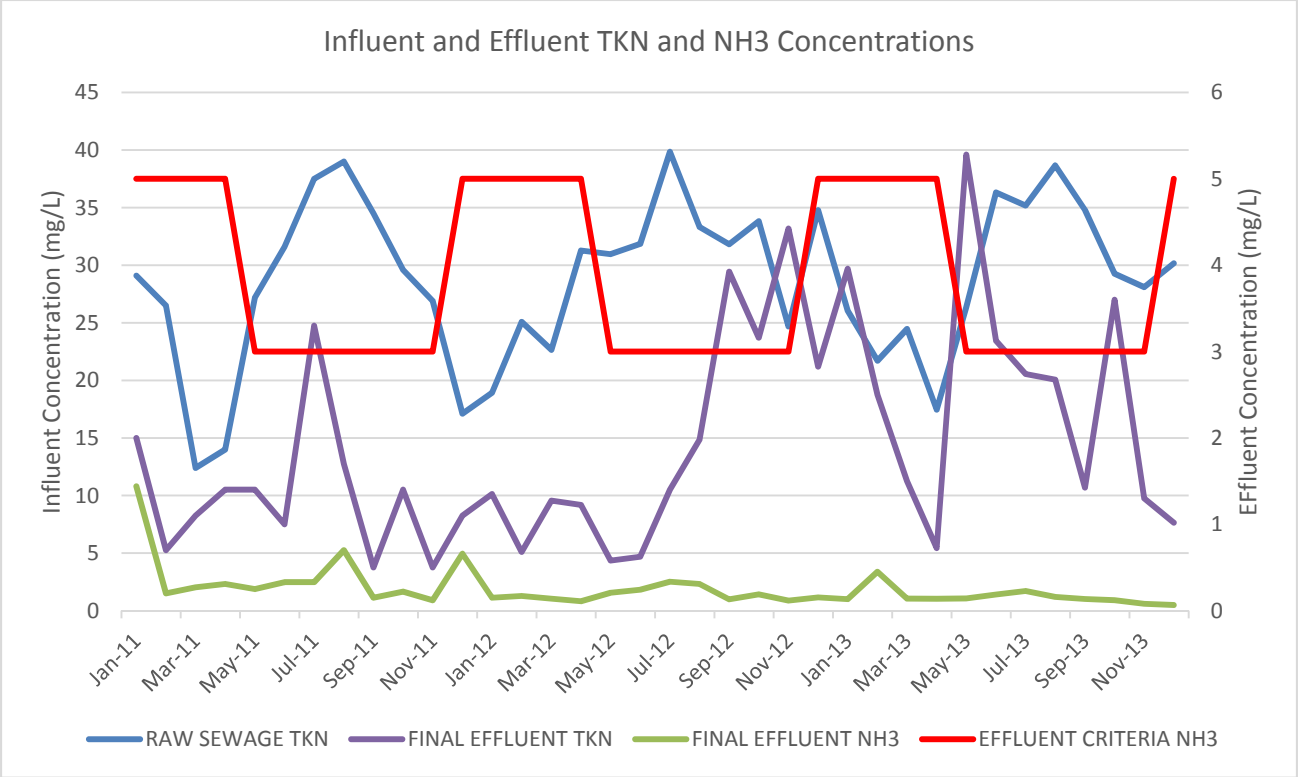
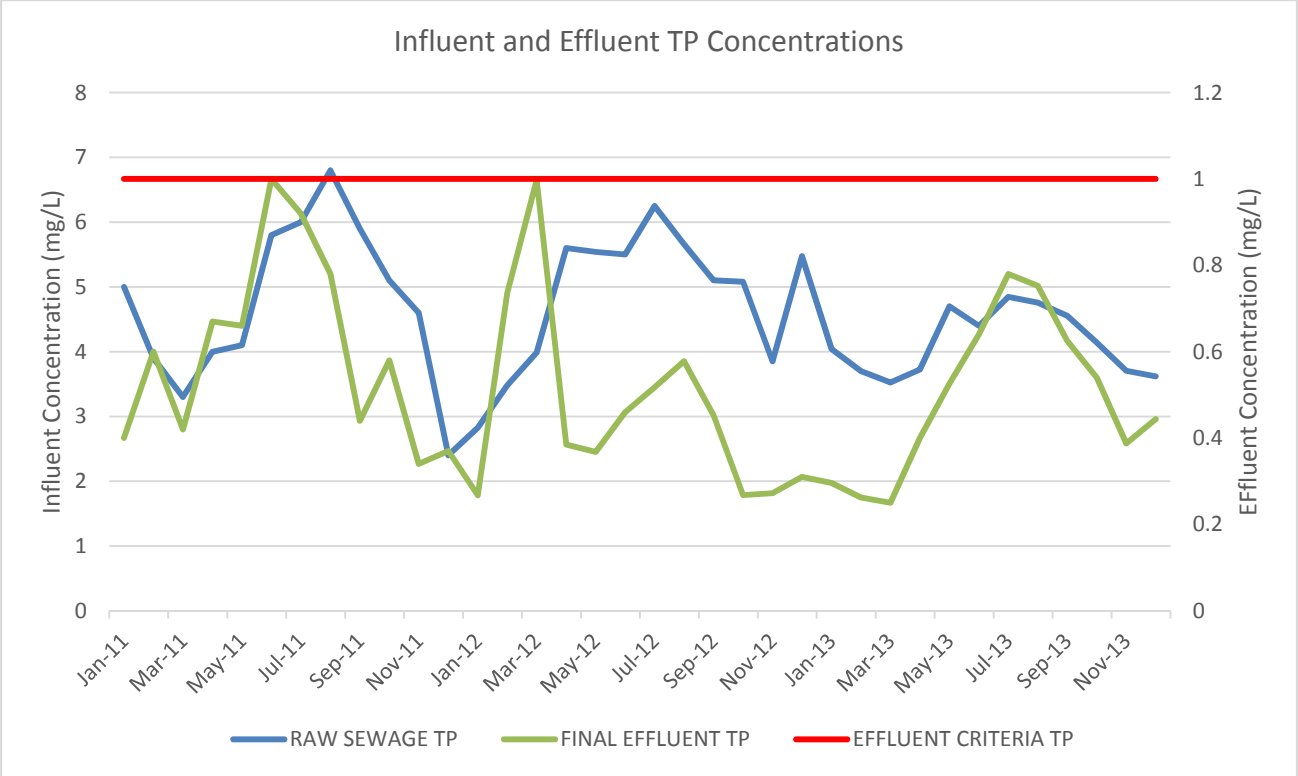


FIGURE 3-6
Plympton WWTP – Historical Influent and Effluent TP Concentrations (January 2011 through December 2013)



SECTION 4

Pumping Station Capacity Analysis

4.1 Introduction

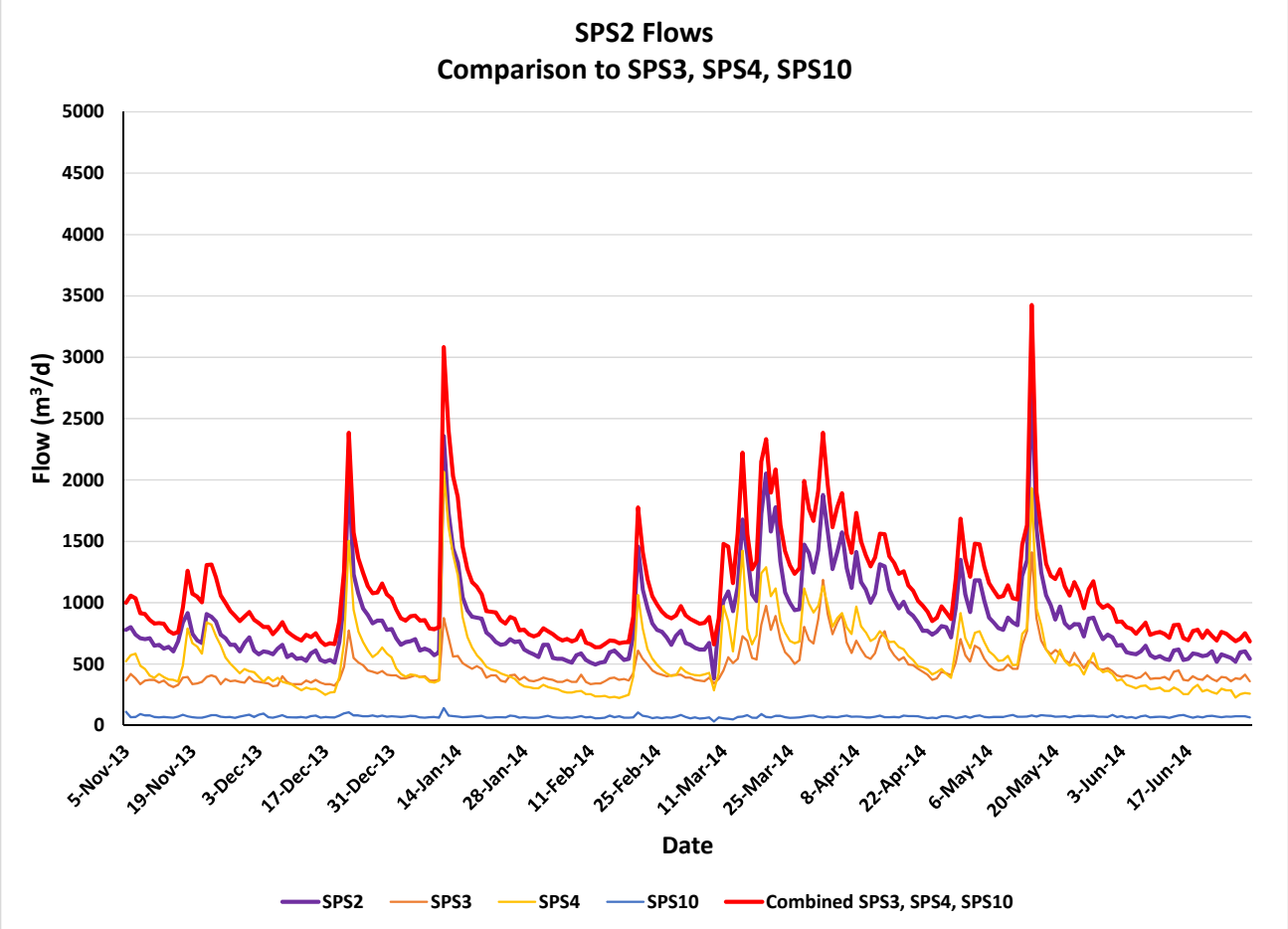
The impact of future growth on different portions of the Plympton WWTP collection system was evaluated through a detailed review of available monitoring data each pumping station.

4.2 Methodology

CH2M HILL OMI produces daily reports for each pumping station that summarize total pump run times to the nearest tenth of a minute. Using the design pump capacities for each station, the total daily pumped volume was calculated for each day from November 9, 2013, to June 31, 2014. The calculated daily flows were then reviewed to determine the average and maximum daily flows pumped from each station.

A comparison of the calculated flows for PS-02 and the cumulative flows from upstream contributing pumping stations is shown in Figure 4-1.

FIGURE 4-1
PS-02 Flows versus Upstream Pumping Stations



The results showed good correlation between the recorded daily flows at PS-02 versus the upstream contributing pump stations. The peak response during the monitoring was observed on May 15, 2014. Rainfall data was not readily available in the vicinity of Plympton-Wyoming for this period; however, a total rainfall of 35.4 mm was recorded at the Environment Canada Sarnia Airport weather station.

One limitation of this calculation method was that the average and maximum daily flow recorded at PS-02 were approximately 20% less than those from upstream contributing pump stations. This may be due to variance between the design-rated capacity versus the actual pump capacities at the pump stations, or due to the timing of peak flows occurring in the overall catchment area. The accuracy of the results could be further improved by carrying out pump station draw/fill tests to verify the actual pumping rates.

4.3 Results

The results of the pumping station capacity exercise are summarized in Tables 4-1 and 4-2.

4.3.1 Existing Condition

Table 4-1 evaluated the existing flow rates versus the rated capacity for each pump station. Comparing the maximum day flow versus the firm capacity for each pumping station, PS-04 (77 percent) and PS-06 (59 percent) used the highest percentage of firm capacity during the maximum day. Note the maximum day represents the peak daily flow recorded during the monitoring period, and not the ultimate maximum day that may be observed during higher rainfall events.

The results indicated that PS-04 (Camlachie) had both the highest per capita flow rate during dry weather (981 Lpcd), and also the highest peak wet weather I/I rate during the monitoring period (0.36 L/s/ha). It should be noted that the calculated per capita flow rate of 981 Lpcd would include base dry weather infiltration. PS-06 had the next highest peak wet weather I/I rate (0.29 L/s/ha) and also a high per capita flow rated during dry weather (457 Lpcd). These two catchment areas would appear to benefit the most from an investigation into possible sources of I/I.

The recorded results for newly developed areas, such as PS-10 and PS-11, were in line with expected per capita flow rates and I/I rates for new developments.

4.3.2 Future Condition

Table 4-2 presents the projected flows for each pumping station based on full build out of the proposed developments and available infill properties. The additional future flows for each catchment area were determined by calculating the following:

- The additional population based on the proposed number of lots and assuming three people/lot
- The additional average daily flow based on a per capita flow rates of 337 Lpcd
- The Harmon peaking factor, based on the additional service population
- I/I flow rate, based on the new development area and an I/I allowance of 0.10 L/s/ha

The sum of these values was then used to assess the projected increase in flows during average day and maximum day conditions, based on data collected during the monitoring period. PS-04 showed a total projected flow exceeding the firm capacity of the station, suggesting the need for careful monitoring of the system and investigation of possible I/I sources. PS-04, with 203 planned connections, is one of the highest planned growth areas as a percentage of the existing service population.

4.3.3 Limitations

The pumping station capacity analysis results presented in Tables 4-1 and 4-2 represent an approximation of future flows based on available monitoring data and projected areas of growth. Sanitary sewer servicing for new developments will require that a Sanitary Sewer Design capacity exercise to be carried out. Consideration should be given not only to the capacity of the local sanitary sewers and nearest pumping station, but the capacity of the entire service area downstream, all the way to the Plympton WWTP.

TABLE 4-1
Pumping Station Summary – Existing Condition

Pump Station	Location	Pumping Station Data					Total Service Area				Unique Service Area						
		# of Pumps	Pump Capacity (Each) (L/s)	Station Firm Capacity[1] (L/s)	Station Peak Capacity[2] (L/s)	Equipped with Overflow ?	Avg. Daily Flow (L/s)	% of Firm Capacity	Max. Day Flow (L/s)	% of Firm Capacity	Avg. Daily Flow (L/s)	Population	Avg. Per Capita Flow (Lpcd)	Max. Day Flow (L/s)	Peak I/I Flow (L/s)	Service Area (ha)	Peak I/I Rate (L/s/ha)
PS-02	3430 Queen St.	3	53	107	107	Yes	12.6	12%	39.7	37%	n/a	924	n/a	n/a	n/a	79.8	n/a[3]
PS-03	3111 Egremont Rd.	2	41	41	82	No	5.5	13%	16.3	40%	5.5	1017	467	16.3	10.8	80.5	0.13
PS-04	6767 Calmachie Rd.	2	31	31	62	Yes	6.3	20%	23.9	77%	6.3	555	981	23.9	17.6	49.0	0.36
PS-05	7166 Bonnie Doon Rd.	3	32.5	65	65	Yes	7.5	12%	26.8	41%	2.8	528	458	n/a	n/a	70.5	n/a[3]
PS-06	4255 Blue Point Dr.	2	43	43	86	Yes	4.5	10%	25.4	59%	2.6	492	457	13.8	11.2	38.3	0.29
PS-07	7802 Gordon Rd.	2	27	27	54	Yes	1.9	7%	11.6	43%	1.2	429	242	7.8	6.6	31.6	0.21
PS-08	8046 Hillsboro Rd.	2	12	12	24	Yes	0.7	6%	3.8	32%	0.7	288	210	3.8	3.1	26.1	0.12
PS-08A	4879 Forsyth Trail	2	4.5	4.5	9	No	*Not analyzed – no future growth in service area*										
PS-10	6836 Old Mill Rd.	2	12.6	12.6	25.2	No	0.8	6%	1.6	13%	0.8	291	238	1.6	0.8	9.8	0.08
PS-11	Cullen Drive	2	10.1	10.1	20.2	No	0.2	2%	1.4	14%	0.2	84	206	1.4	1.2	9.3	0.13

1. Firm Capacity = One pump out of service.

2 Peak Capacity = Theoretical capacity with all available pumps in operation (For PS-02 and PS-05, only two of three pumps can operate at one time).

3. The Unique peak I/I rate for PS-02 and PS-05 was not calculable as the cumulative upstream peak flow was greater than the peak flow measured at these pump stations.

Yellow cells highlight pumping stations with high average per capita flows or peak I/I rates.

TABLE 4-2
Pumping Station Summary – Future Condition

Pump Station	Location	Future Development Flows – Total Service Area								Existing Flows		Projected Flows - Total Service Area			
		Future Lots	Additional Population[1]	Additional Domestic Wastewater Flow[2] (L/s)	Additional Service Area (ha)	Inflow & Infiltration[3] (L/s)	Additional Avg. Daily Flow (L/s)	Harmon Peaking Factor[4] (M)	Additional Peak Flow (L/s)	Avg. Daily Flow (L/s)	Max. Day Flow (L/s)	Avg. Daily Flow (L/s)	% of Firm Capacity	Max. Day Flow (L/s)	% of Firm Capacity
PS-02	3430 Queen St.	726	2178	8.5	148.3	14.8	23.3	3.56	45.0	12.6	39.7	35.9	34%	84.7	79%
PS-03	3111 Egremont Rd.	58	174	0.7	12.6	1.3	1.9	4.17	4.1	5.5	16.3	7.4	18%	20.4	50%
PS-04	6767 Calmachie Rd.	203	609	2.4	26.8	2.7	5.1	3.93	12.0	6.3	23.9	11.4	37%	35.9	116%
PS-05	7166 Bonnie Doon Rd.	362	1086	4.2	104.4	10.4	14.7	3.78	26.4	7.5	26.8	22.2	34%	53.2	82%
PS-06	4255 Blue Point Dr.	301	903	3.5	77.9	7.8	11.3	3.83	21.3	4.5	25.4	15.8	37%	46.7	109%
PS-07	7802 Gordon Rd.	59	177	0.7	11.1	1.1	1.8	4.17	4.0	1.9	11.6	3.7	14%	15.6	58%
PS-08	8046 Hillsboro Rd.	46	138	0.5	9.4	0.9	1.5	4.20	3.2	0.7	3.8	2.2	18%	7.0	58%
PS-08A	4879 Forsyth Trail	0	0	0	*Not analyzed – no future growth*										
PS-10	6836 Old Mill Rd.	40	120	0.5	5.5	0.6	1.0	4.22	2.5	0.8	1.6	1.8	14%	4.1	33%
PS-11	Cullen Drive	79	237	0.9	46.1	4.6	5.5	4.12	8.4	0.2	1.4	5.7	57%	9.8	97%

1. Based on three persons/lot
2. Based on 337 L/capita/day
3. Based on 0.10 L/s/ha
4. Harmon Peaking Factor applied to Domestic Wastewater portion only

Yellow cells highlight projected flows approaching the pumping station firm capacity.

Orange cells highlight projected flows beyond the pumping station firm capacity.

SECTION 5

Conclusions and Recommendations

The study provides the following conclusions:

- The Town has identified an additional 1,088 lots for development through infill properties and planned developments. This represents approximately 69 percent new growth compared to the existing service population. Assuming 25 units are constructed each year, the Town has sufficient land identified for over 40 years of growth.
- Based on the calculated uncommitted reserve capacity and the historical treatment performance with respect to the current effluent limits, the Plympton WWTP appears capable of treating the increased flow in the future, as the additional units/lots that have been identified are connected to the system. Based on a per capita flow rate for future development of 420 Lpcd including a 25 percent allowance for I/I, the calculated Uncommitted Reserve Capacity of the Plympton WWTP was estimated to be 868 m^3/day.
- The pumping station capacity analysis showed certain areas exhibit higher per capita flow rates and peak weather I/I rates, specifically the catchment areas for PS-04 and PS-06. This suggests these areas may have higher water usage rates and/or greater quantities of I/I entering the system.
- The sanitary sewer design criteria provided by the Town used a per capita flow rate of 337 Lpcd, Harmon peaking factor, and I/I allowance of 0.10 L/s/ha. Based on the per capita flows and I/I rates observed during the monitoring period at newer pumping station catchment areas, these values appear suitable for the design of future sewer systems.
- Removal of extraneous I/I sources can provide additional capacity to the collection system and lower the overall volume of wastewater to be treated. Successful I/I reduction programs are typically an iterative process involving analysis, field investigations, remedial works, and follow-up monitoring. The *Infiltration/Inflow Control/Reduction for Wastewater Collection Systems Best Practice* by the National Guide to Sustainable Municipal Infrastructure is a valuable reference that can be used to help guide the development of an I/I control program for the Town.

The following recommendations are provided for consideration:

- It is recommended that the Town consider investigating potential sources of I/I in the PS-04 and PS-06 catchments areas. A budgetary cost for conducting field investigations and to identify potential remedial works as part of an overall I/I reduction program is $40,000.
- It is recommended that the Town conduct in-sewer flow monitoring upstream of PS-02 and PS-05, the two main pumping stations that discharge to the Plympton WWTP, to more accurately evaluate peak wet weather inflow rates versus available pumping capacity. The budgetary cost to install two flow monitors and a rain gauge for a three month monitoring period is $10,000.
- It is recommended that the Town conduct pumping station draw/fill tests to determine the actual pumping capacities at each station to increase the accuracy of the flow calculations developed using pump run times. Draw/fill tests can also be used to assess the amount of wear on pump impellers over time. The estimated time to complete draw/fill tests for all 10 pumping stations is 3 days. The estimated cost for one CH2M HILL engineering staff member to work with OMI and carry out the tests is $5,000.
- It is recommended that the Town review the observed flow rates at each pumping station and the Uncommitted Reserve Capacity of the Plympton WWTP at least once every two years, to monitor the available wastewater system capacity as development continues.

SECTION 6

References

Metcalf & Eddy., G. Tchobanoglous, F. L. 1. Burton, and H.D. Stensel. 2003. *Wastewater engineering: Treatment and reuse*. 4th edition. Boston: McGraw-Hill.

Ontario Ministry of the Environment (MOE). 1995. *Procedure D-5-1 (Formerly Appendix A) Calculating and reporting Uncommitted Reserve Capacity at Sewage and Water Treatment Plants*. March.

Statistics Canada. 2012. *Focus on Geography, 2011 Census. Census subdivision of Plympton-Wyoming, T – Ontario.* Web. Accessed November 2014.

Appendix A
Pumping Station Catchment Area Maps

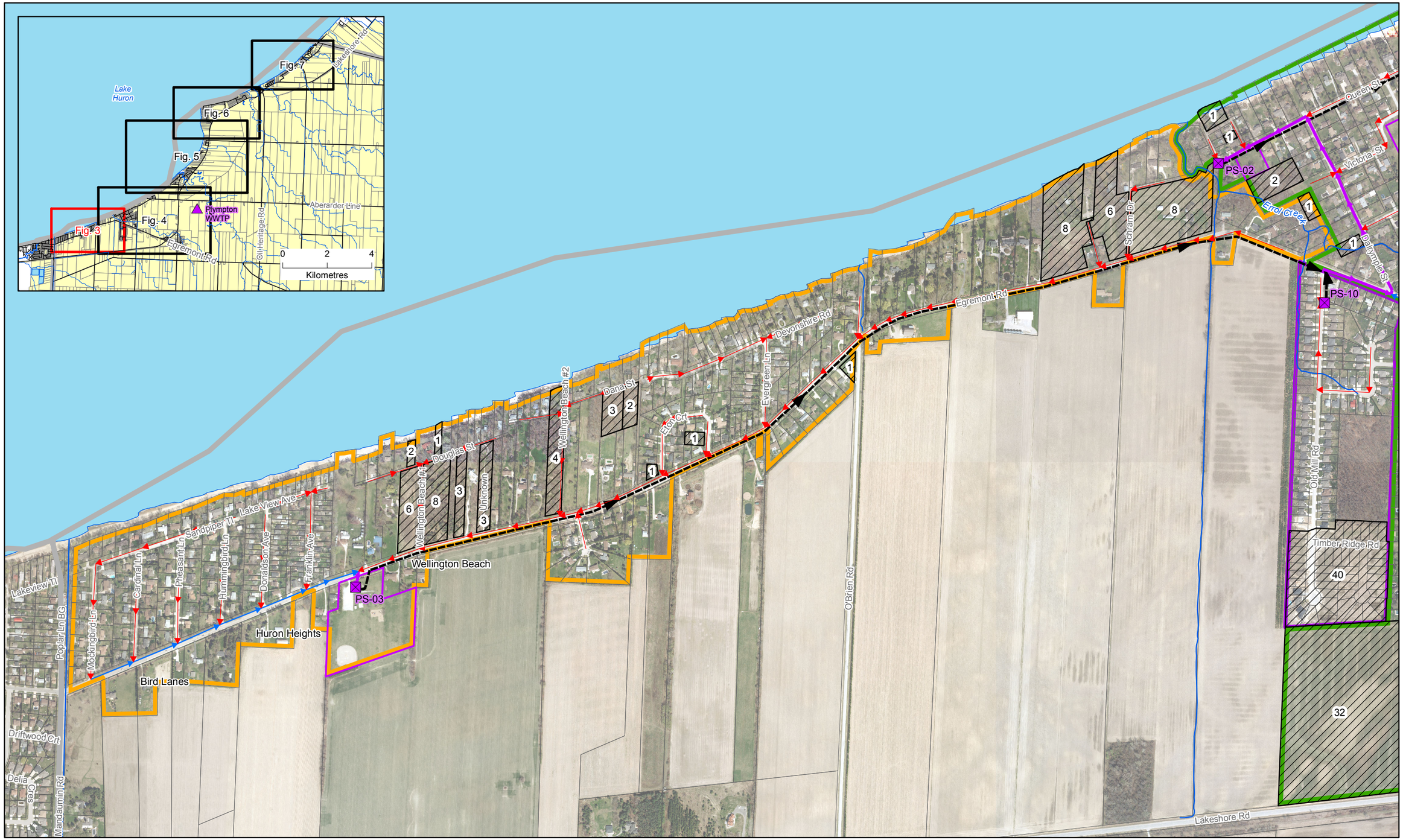


Figure 3
Pumping Station Catchment Areas
Pumping Station No.3
Town of Plympton-Wyoming
Lambton County, Ontario

CH2MHILL

\\WATERLOO\PROJ\PLYMPTONWYOMINGCORPO\494936PLYMPTONWWCS\GIS\MAPFILES\FINAL\FIGURE3_PS-03.MXD MKOCHER 2/23/2015 3:30:59 PM

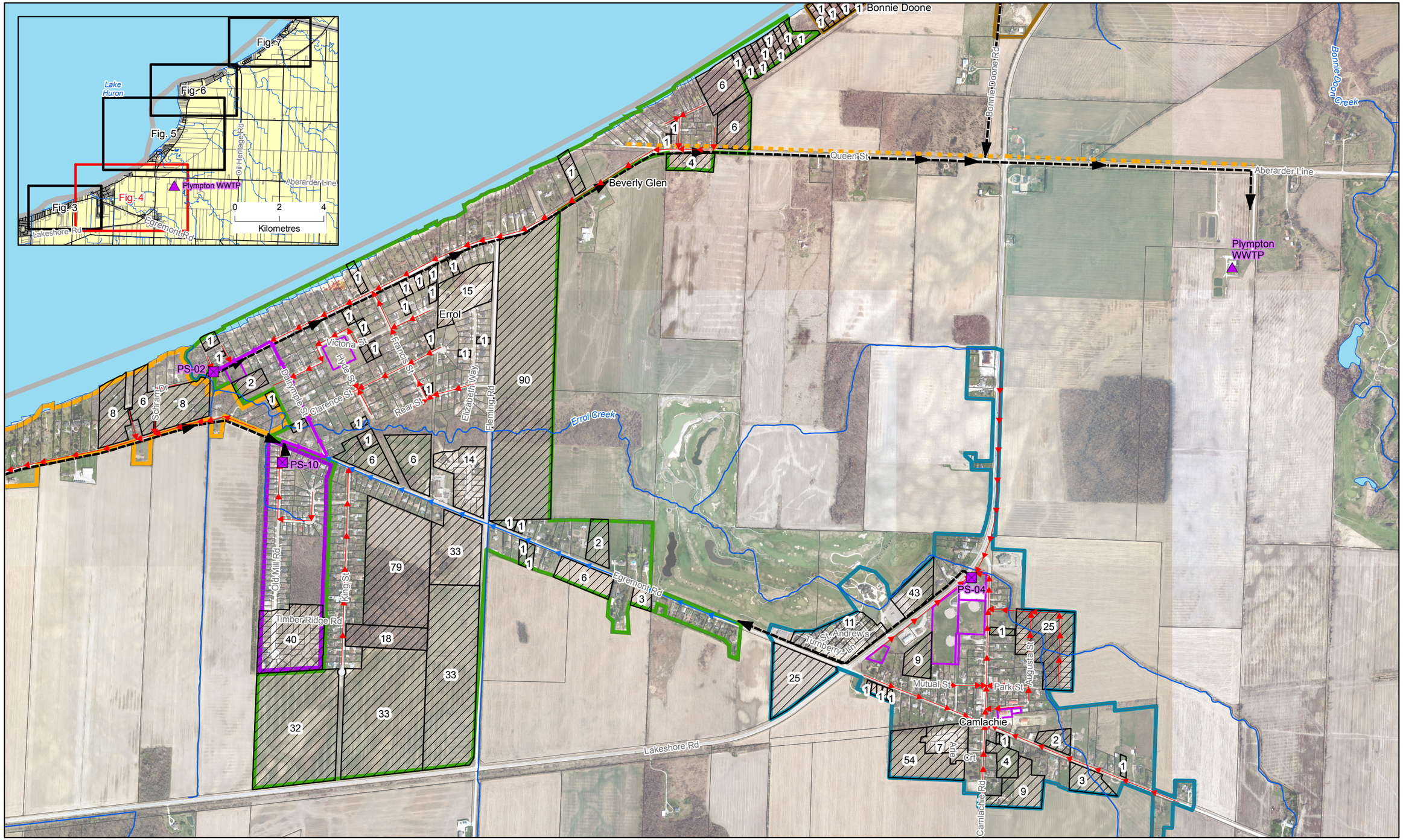


Figure 4
Pumping Station Catchment Areas
Pumping Station No.2, 4, and 10
Town of Plympton-Wyoming
Lambton County, Ontario

CH2MHILL

\\WATERLOO\PROJ\PLYMPTONWYOMINGCORPO\494936PLYMPTONWWCS\GIS\MAPFILES\FINAL\FIGURE4_PS-02_04_10.MXD MKOCHER 5/28/2015 12:07:09 PM

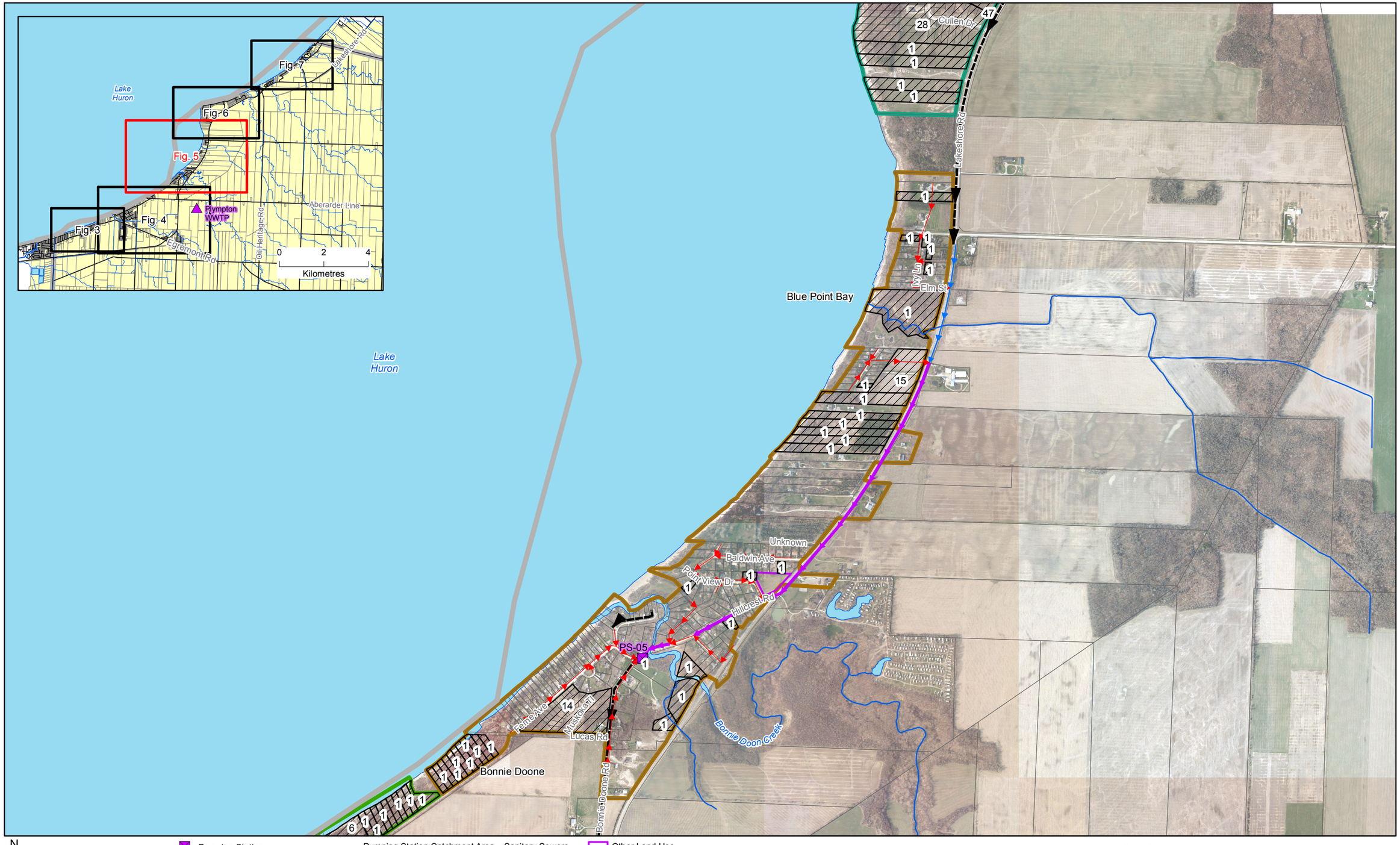
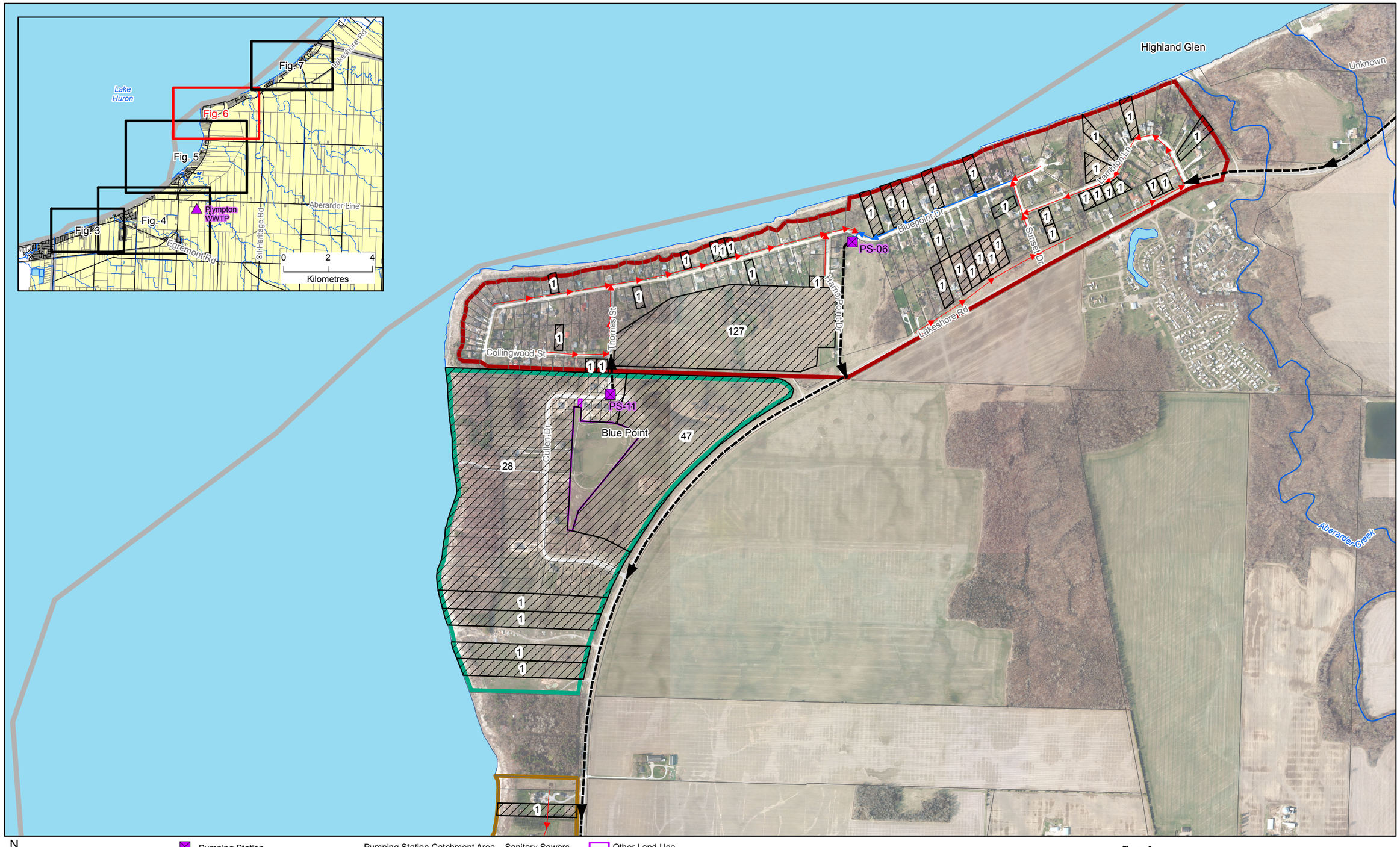


Figure 5
Pumping Station Catchment Areas
Pumping Station No.5
Town of Plympton-Wyoming
Lambton County, Ontario

CH2MHILL



N

0 100 200
Metres

Pumping Station
Assessment Parcel
Plympton-Wyoming Municpal Boundary
Waterbody
Watercourse

Pumping Station Catchment Area
PS-05
PS-06
PS-11

Sanitary Sewers
Forcemain
200 - 300mm
350 - 400mm

Other Land Use
Vacant Parcel or Land (With Proposed Number of Lots)

Figure 6
Pumping Station Catchment Areas
Pumping Station No.6 and 11
Town of Plympton-Wyoming
Lambton County, Ontario

CH2MHILL.

\\WATERLOO\PROJ\PLYMPTONWYOMINGCORPO\494936PLYMPTONWWCS\GIS\MAPFILES\FINAL\FIGURE6_PS-06_11.MXD MKOCHER 2/23/2015 2:24:10 PM

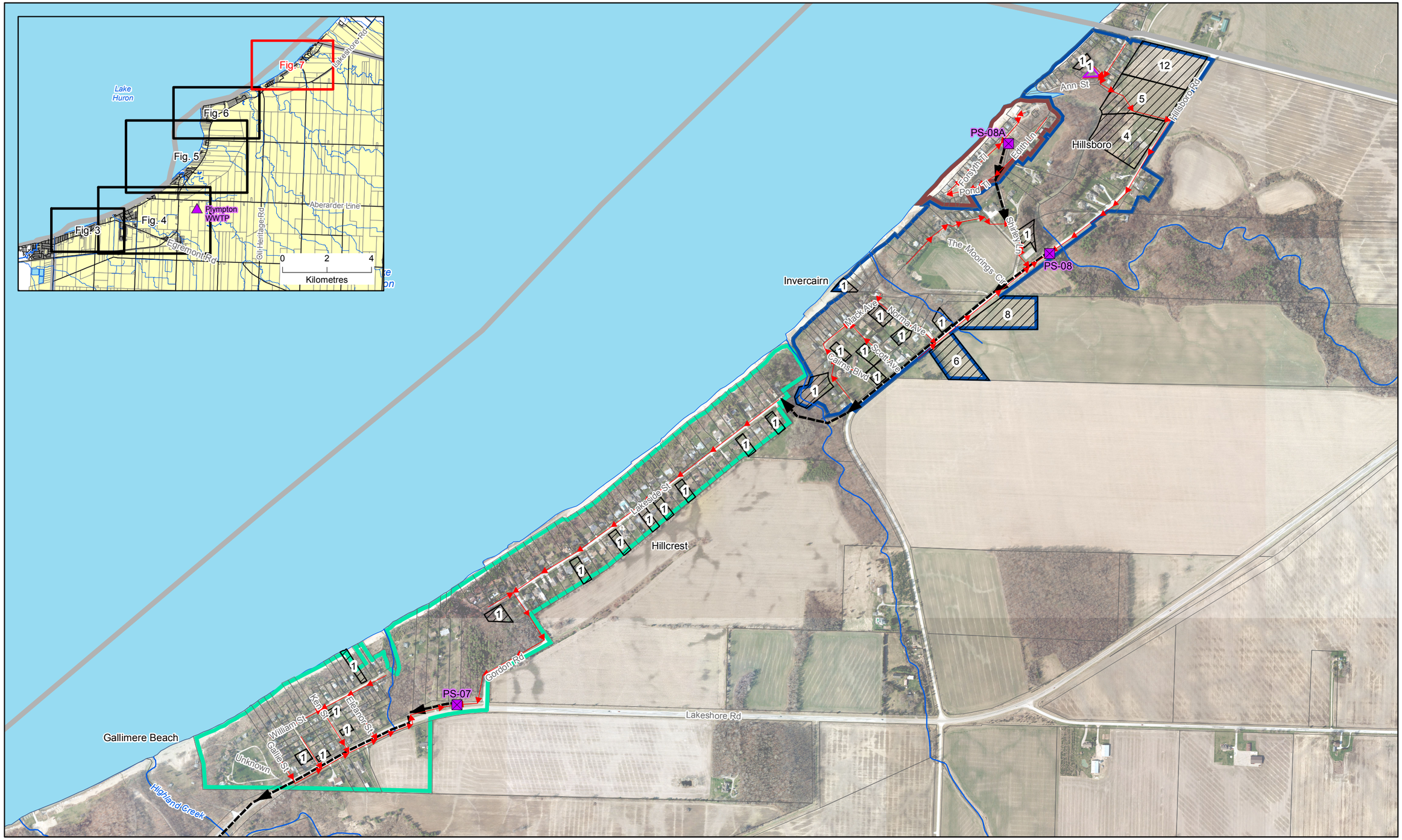


Figure 7
Pumping Station Catchment Areas
Pumping Station No.7, 8, and 8A
Town of Plympton-Wyoming
Lambton County, Ontario

CH2MHILL

\\WATERLOO\PROJ\PLYMPTONWYOMINGCORPO\494936PLYMPTONWWCS\GIS\MAPFILES\FINAL\FIGURE7_PS-07_08_08A.MXD MKOCHER 2/23/2015 3:04:21 PM