555 CANAL BANK DEVELOPMENTS GP INC.

401 CANAL BANK ST. DEVELOPMENTS

WELLAND CITY WATER AND WASTEWATER SERVICING - PRELIMINARY CAPACITY ASSESSMENT

MARCH 10, 2020

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555 CANAL BANK DEVELOMPENT GP INC.

PRELIMINARY SERVICING CAPACITY ASSESSMENT REPORT

PROJECT NO.: 19M-01173
DATE: MARCH 10, 2020

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EXECUTIVE SUMMARY

WASTEWATER SERVICING

The proposed development will consist of mix-use work laneway, main street medium density residential laneway (stack townhouses and low-rise apartment), laneway residential (townhouse, semi and single houses), conventional residential (front loaded, i.e. single houses), park and open spaces, internal street, and 7.0 ha of stormwater management ponds. The 401 Canal Bank Street development will consist of approximately 1,405 units with an estimated population of 4,215 people. The proposed development will generate an approximate wet weather peak flow rate of 92.5 l/s including the 4,215 people on the 401 Canal Bank Street site and the as-of-right flows from the former John Deere site.

The Welland Wastewater Treatment Plant should have adequate capacity to accommodate wastewater from the proposed developments, in addition to the 2041 projected wastewater flows of the tributary area.

The site is proposed to be connected to Ontario Road Sewage Pumping Station and Dain City Sewage Pumping Station. Based on design flows, the Ontario Road Sewage Pumping Station should have an extra capacity of 256.9.1/s by 2041 for the proposed developments (92.5/s). The Dain City Sewage Pumping Station does not have enough capacity for the proposed developments by 2041. The Region of Niagara is planning to complete a state of good repair upgrades to the Dain City pumping station with tentative start of design in 2020. The Region have been advised of the proposed development potential that would be tributary to the Dain City Pumping Station and the increase in capacity should be incorporated into the upgrades to the pumping station.

The Region is replacing the existing 250mm forcemain with a 300mm forcemain from the Dain City Pumping Station which will have sufficient capacity for the 2041 flows including the proposed development.

The analysis by BluePlan Engineering for the City of Welland has indicated that 350 metres of sewer need upgraded on Forks Road East to Crescent Avenue with the proposed development flows. Further analysis will be required by the City to confirm the timing requirements for the sewer upgrades. The BluePlan memo also indicated that an I&I reduction of at least 25% in Dain City is required to facilitate phased growth in the proposed development area. The developer intends to disconnect the existing sanitary sewer that services the former John Deere site which had an as of right allocation of 652 people plus an infiltration allowance of 21.5 l/s. The removal of this connection will provide immediate relief to the Dain City sewers and pumping station to allow for the initial phases of the development to proceed.

WATER

The site is proposed to be serviced by a regional network connected with Bemis Park Elevated Tank (BPET) and supplied from Welland Water Treatment Plant (WWTP) through Welland Water Treatment Plant Reservoir (WWTPR) and pumping station, within the 220m pressure zone.

The Welland Water Treatment Plan has a total effective capacity of 117.7 $x10^6$ L/day which is sufficient to meet the projected 2041 maximum day demand of 50.3 $x10^6$ L/day which includes the maximum day demand of the proposed developments of 2.3$x10^6$ L/day**.**

Existing storage facilities in zone 220m have existing capacity of 37 ML which are adequate for the required fire storage in Pressure Zone 220 of 22.2 ML which means there should be adequate storage capacity for the proposed developments.

The GHD water distribution memo indicates that fire flows ranging from 136 l/s to 248 l/s will be available within the proposed development. The GHD memo also states that many of the hydrants in the vicinity of the development will have improved fire flow due to increased looping.

The GHD water distribution memo noted that the modelling indicates that the Hydraulic Grade Line (HGL) at the Bemis Tank with the 401 Canal Bank St. development would lowered to 215.4m during a maximum day demand which is lower than what is required to supply 275 kPa (40 psi) for portions of the site with ground elevations above 185m. To meet the City's pressure requirement of 275 kPa during maximum day demands, the ground elevations within the proposed development should be lower than 185.0m.

TABLE OF CONTENTS

EXECUTIVE SUMMARY II
Wastewater Servicing ii
Water iii
1 INTRODUCTION 1
1.1 Scope of Preliminary Capacity Assessment 1
1.2 Site Description 1
2 WASTEWATER SERVICING CAPACITY 4
2.1 Existing Conditions 4
2.2 Preliminary Wastewater Demand 4
2.2.1 DESIGN PARAMTERS 4
2.3 Proposed Sanitary Flows 4
2.4 Capacity OF Existing WASTEWATER System 5
2.4.1 WELLAND WASTEWATER TREATMENT PLANT (WWWTP) CAPACITY 5
2.4.2 WELLAND WASTEWATER TREATMENT PLANT (WWWTP) - EXISTING AND PROJECTED DEMAND 6
2.4.3 PUMPING STATION FACILITIES PERFORMANCE - EXISTING AND PROJECTED DEMAND 7
2.4.4 FORCEMAIN FACILITIES PERFORMANCE - EXISTING AND PROJECTED DEMAND 8
2.4.5 DOWNSTREAM SEWERS CONVEYANCE CAPACITY - EXISTING AND PROJECTED DEMAND 9
2.4.6 SYSTEM CONSTRAINTS 9
3 WATER SERVICING CAPACITY 13
3.1 Existing Conditions 13
3.2 Preliminary Water DEMAND 13
3.2.1 DESIGN PARAMTERS 13
3.3 Estimated Water Demands 14
3.4 Capacity OF Existing WATER System 14
3.4.1 WELLAND WATER TREATMENT PLANT (WWTP) CAPACITY 14
3.4.2 WELLAND WATER TREATMENT PLANT (WWTP) - EXISTING AND PROJECTED DEMAND 16
3.4.3 PUMPING STATION FACILITIES PERFORMANCE - EXISTING AND PROJECTED DEMAND 16
3.4.4 STORAGE FACILITIES PERFORMANCE - EXISTING AND PROJECTED DEMAND 17

3.4.5 SYSTEM PRESSURE AND FIRE FLOWS - EXISTING AND PROJECTED DEMAND 17
3.4.6 SYSTEM CONSTRAINTS- EXISTING AND PROJECTED DEMAND 18

4 CONCLUSIONS 21

4.1 Sanitary 21

4.2 Water 21

FIGURES

FIGURE 1.1 – EXISTING CONDITION AND LOCATION PLAN 2
FIGURE 1.2 – CONCEPT DEVELOPMENT PLAN 3
FIGURE 2.1– EXISTING WASTEWATER SYSTEM 11
FIGURE 2.2– WASTEWATER SYSTEM SCHEMATIC DIAGRAM. 12
FIGURE 3.1– EXISTING WATER SYSTEM 19
FIGURE 3.2– WATER SYSTEM SCHEMATIC DIAGRAM. 20

APPENDICES

A NIAGARA REGION WATER WASTEWATER MASTER SERVICNG PLAN UPDATES-VOLUME IV- WASTEWATER MASTER SERVICNG PLAN

B NIAGARA REGION WATER WASTEWATER MASTER SERVICNG PLAN UPDATES-VOLUME III- WATER MASTER SERVICNG PLAN

C BLUEPLAN ENGINEERING TECHNICAL MEMO REGARDING WASTEWATER CAPACITY TO CITY OF WELLAND DATED JAN. 15, 2020

D GHD TECHNICAL MEMO REGARDING WATER CAPACITY TO CITY OF WELLAND DATED DEC 3, 2019

1 INTRODUCTION

1.1 SCOPE OF PRELIMINARY CAPACITY ASSESSMENT

WSP Canada Group Limited has been retained to prepare a Preliminary Capacity Assessment Report to assess the external water and wastewater servicing capacity in support of the proposed combined residential and mixed-used developments called 401 Canal Bank St. This report provides a preliminary assessment for the Welland Water and Wastewater servicing potential capacity to accommodate the water demands and sanitary sewage generated from the redevelopment of the study area.

In preparing this report, WSP staff reviewed the available documents of Niagara Region Water and Wastewater Master Servicing Plan update (2016), Volume I[1], II[2], II[3] and IV[4] (Appendix A and B), the BluePlan Engineering memo (Appendix C) to the City of Welland dated January 15, 2020 regarding the wastewater system (Appendix C) and the GHD memo to the City of Welland dated December 3, 2019 regarding the Water Distribution System Review (Appendix D)

1.2 SITE DESCRIPTION

The site has an area of 151.4 ha, occupied by warehouses, parking lots and driveways. The remaining area is covered by vegetation. The site is bounded by Townline Tunnel Road to the north, Atlantic Biodiesel building and St Clair Drive to the south, and Recreational Canal to the east and west. Please refer to **Figure 1.1** for an illustration of the existing site condition and site location

The proposed developments will consist of mix-use work laneway, main street medium density residential laneway (stack townhouses and low-rise apartment), laneway residential (townhouse, semi and single houses), conventional residential (front loaded, i.e. single houses), park and open spaces, internal street, and 7.0 ha of stormwater management ponds.

Please refer to **Figure 1.2** for an illustration of the concept development plan.

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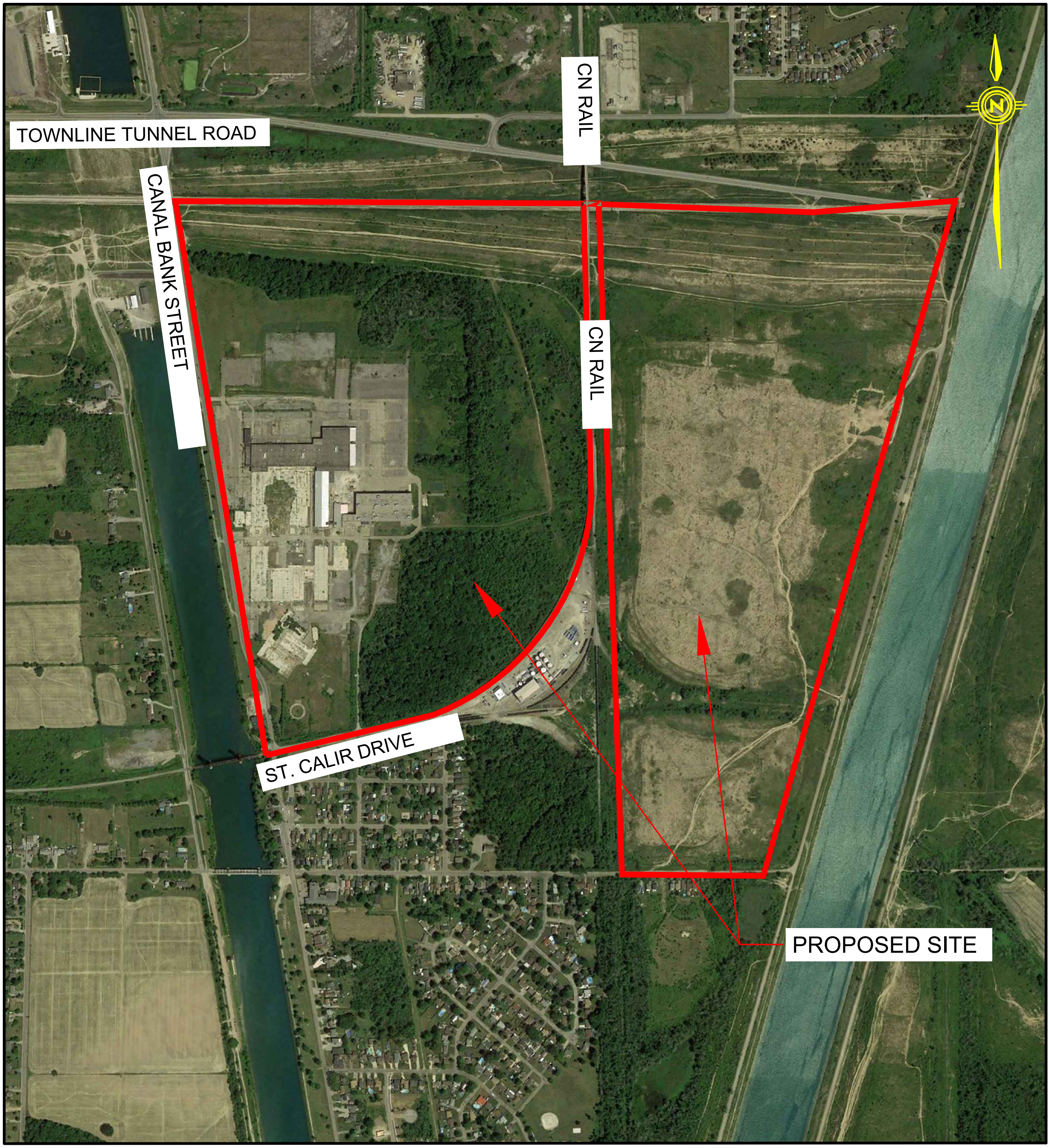
[1] Niagara Region, 2016 Water and Wastewater Master Servicing Plan Update, Volume I- Executive Summary, Final Report, June 2017

[2] Niagara Region, 2016 Water and Wastewater Master Servicing Plan Update, Volume II- Background and Planning Context, Final Report, June 2017

[3] Niagara Region, 2016 Water and Wastewater Master Servicing Plan Update, Volume III- Water Master Servicing Plan Update, Final Report, June 2017

[4] Niagara Region, 2016 Water and Wastewater Master Servicing Plan Update, Volume IV- Wastewater Master Servicing Plan Update, Final Report, June 2017



CLIENT	555 CANAL BANK LTD.
TITLE	DAIN CITY DEVELOPMENTS EXISTING CONDITION & SITE LOCATION

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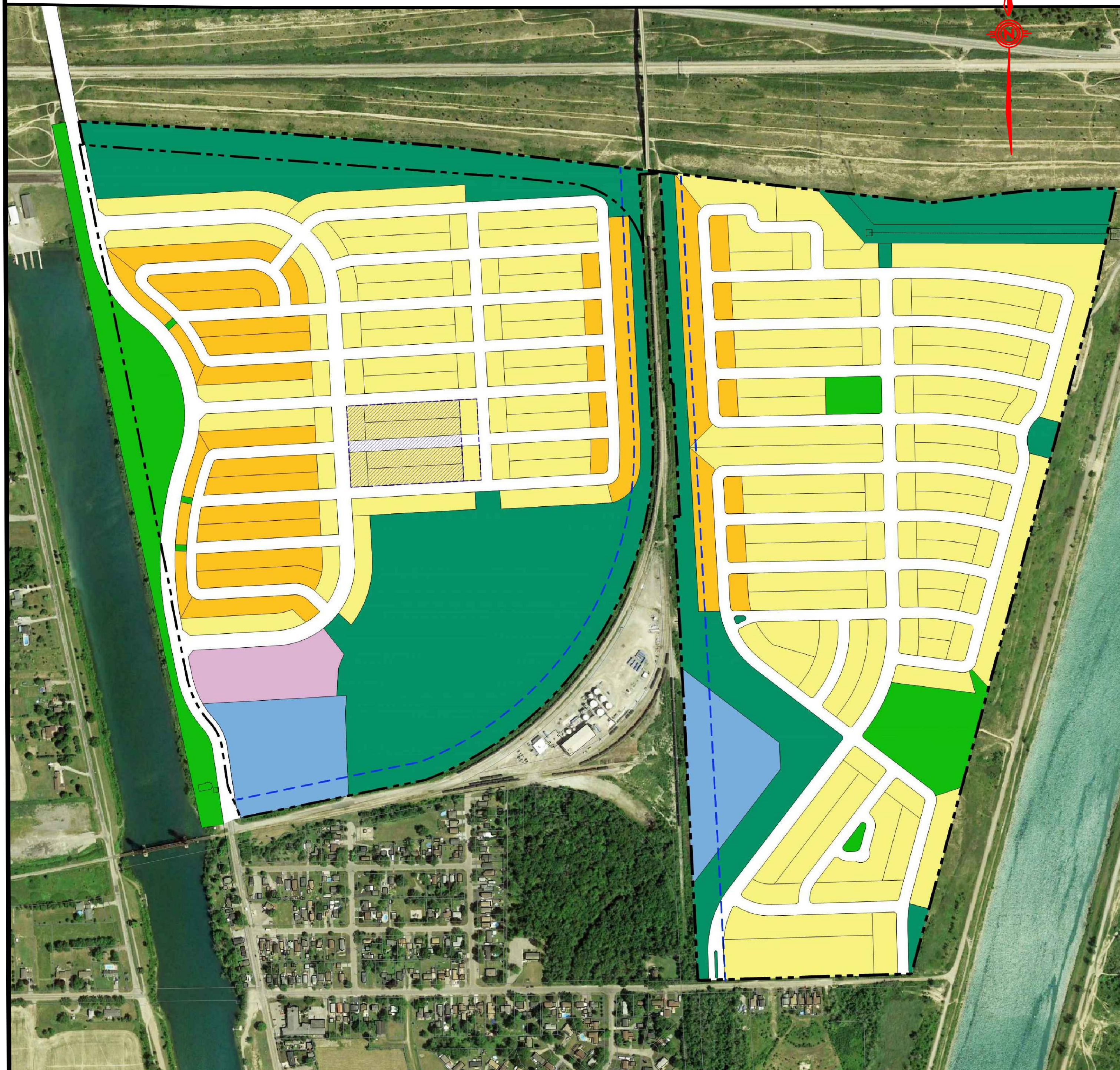

CLIENT	555 CANAL BANK LTD.		
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2 WASTEWATER SERVICING CAPACITY

2.1 EXISTING CONDITIONS

There are two existing sewage pumping stations in the vicinity of the site, the Ontario Road Sewage Pumping Station located to the north-east side of the study area, and the Dain City Sewage Pumping Station located south of the study area. The pumping capacity of Ontario Road PS and Dain City PS are 600 L/s and 94 L/s respectively. Please refer to **Figure 2.1** for existing wastewater system and **Figure 2.2** for schematic diagram.

2.2 PRELIMINARY WASTEWATER DEMAND

2.2.1 DESIGN PARAMTERS

The following design criteria have been taken from Niagara Region, 2016 Water and Wastewater Master Servicing Plan Update, Volume IV, Section 2.4, Page 12:

- 275 L/cap/day average day flow generation rate for new residential development;
- 275 L/cap/day average day flow generation rate for employment development;
- Peaking Factor
  - Residential Harmon, Harmon Peaking Factor = $1+14/(4+(P)^{0.5})$, where P = population in thousands;
  - Peak factor shall be between 2 and 4; and
- Infiltration = 0.286 L/s/ha for wet weather level of service.

The following criteria have been used to estimate population density

- Population densities of 2.7 person per suite for Townhouse and Semi-detached houses;
- Population densities of 3.5 person per suite for single houses; and
- Population densities of 2.1 person per suite for 3-storeys Apartments.

2.3 PROPOSED SANITARY FLOWS

The projected sanitary flows from the proposed developments have been estimated using the design criteria outlined in **Section 2.2.1** above, and summarised in in **Table 2.1** below. The effluent of the northern part of the site is proposed to be directly carried to Ontario Road PS, while the southern part will be directed to the Dain City PS, which is ultimately be pumped to Ontario Road PS.

Table 2.1– Preliminary Sanitary Flows

Developments	Population (cap)	Demand Rate (L/cap/ Day)	Average Sanitary Flows (L/s)	Peaking Factor	Peak Sanitary Flows (L/s)	Site RDII (L/s)	Total Peak Wet Weather Flow (L/)
Dain City Residential	4215	275	13.42	3.31	44.4	20.6	65.0
Former John Deere Site	652* (as-of-right)	275	2.08	3.91	8.1	21.5	29.6
***TOTAL SANITARY FLOWS TO* DAIN CITY P.S.**	***4,857***	***275***	**15.49**	**3.26**	**50.4**	**42.0**	**92.5**

- The existing sanitary sewer from the former John Deere site will be decommissioned and capped. The as-of-right capacity for the equivalent population of 652 people and the wet weather flow rate for the site will be used for the initial servicing allocation for the proposed development.

2.4 CAPACITY OF EXISTING WASTEWATER SYSTEM

2.4.1 WELLAND WASTEWATER TREATMENT PLANT (WWWTP) CAPACITY

The subject site is located within the tributary area of Welland Wastewater Treatment Plant (WWWTP), estimated at 3,550.9ha, and discharge into Welland River. The current rated and peak flow capacity of the WWTP[5] is 54.6×10^6 L/day and 136.2×10^6 L/day, respectively. The main characteristics of the WWTP are shown in **Table 2.2**. Refer to Volume IV, Wastewater Master Servicing Plan in **Appendix A** for more details about WWWTP.

[5] Part K, Welland Wastewater System, Niagara Region, 2016 Water and Wastewater Master Servicing Plan Update, Volume IV- Wastewater Master Servicing Plan Update, Final Report, June 2017

Table 2.2– Characteristics of WWWTP (adapted from Volume IV, Wastewater Master Servicing Plan Update)

Average Daily Flow Capacity	$54.6x10^6$ L/day
Peak Flow Capacity (Dry Weather)	136.2 $x10^6$ L/day
Feeding Pumping Station	Direct:9 Total:13

As mentioned before, the site is proposed to be connected to the Dain City PS and Ontario Road PS. **Table 2.3** below summarise the characteristics of each pumping station and forcemain.

Table 2.3– Characteristics of Pumping Stations and Forcemain (adapted from Volume IV, Wastewater Master Servicing Plan Update)

Pumping Station	Number of Pumps	Operational Firm Capacity (L/s)	ECA Firm Capacity (L/s)	Forcemain		
				Length (m)	Diameter (m)	Capacity at 2.5m/s (L/s)
Dain City Pumping Station	2	94.0	192.0	3,030	250	122.7
Ontario Road Pumping Station	3	600.0	600.0	1,122	600	706.9

2.4.2 WELLAND WASTEWATER TREATMENT PLANT (WWWTP) - EXISTING AND PROJECTED DEMAND

Figure 4.K.3 of the Wastewater Master Servicing Plan included in **Appendix A**, indicates that the WWWTP flow varied between $25.0x10^6$ L/day and $41.0x10^6$ L/day, in the period 2011-2015. The figure also shows the projected future demands from 2016 to 2041, with average flow of $37.9x10^6$ L/day in 2041, that is 70% of the Plant design capacity. The dry weather wastewater average flow of the proposed developments is approximately $1.3x10^6$ L/day and the wet weather average flow is $5.0x10^6$ L/day (for I/I rate of 0.286 l/s/da), as shown in Section 2.3 above. The total future demands will be $42.9x10^6$ L/day, including flows from the proposed developments ($5.0x10^6$ L/day), which is less than 80% of the Plant capacity. Therefore, WSP concluded that the WWWTP should have adequate capacity for the proposed developments.

2.4.3 PUMPING STATION FACILITIES PERFORMANCE - EXISTING AND PROJECTED DEMAND

The performance of pumping station facilities under the existing and projected demands is shown in the **Table 4.K.12** of the Wastewater Master Servicing Plan in **Appendix A.** The table shows that the Ontario Road PS, Dain City PS and Seaway Heights PS will have the largest capacity surplus by 2041. **Table 2.4** below shows the pumping stations that the site will be connected. The proposed site will drain to the Dain City Pumping Station which discharges flows to the Ontario Road PS before discharging to the Wastewater Treatment Plant.

The preliminary estimates of the wet weather sanitary flows to Dain City PS (104.3L/s) exceeds the 2041 surplus capacity of the pumping station. The City and Regional staff have advised that recent studies after the Master Plan was completed indicate that the wet weather flow to the Dain City PS is much higher than the flows assumed in the Master Plan and that the Dain City Pumping Station does not have surplus capacity. As outlined in the BluePlan Engineering memo to the City of Welland dated January 15, 2020, the existing peak weather flows to the Dain City PS exceed the station ECA capacity in a 10 year storm scenario but due to a Combine Sewer Overflow (CSO) tank, the 10 year storm does not result in basement flooding.

The Region is planning to complete a state of good repair upgrades to the Dain City pumping station with tentative start of design in 2020. The Region have been advised of the proposed development potential that would be tributary to the Dain City Pumping Station and the increase in capacity should be incorporated into the upgrades to the pumping station. The upgrades to the Dain City pumping station should be monitored with the Region as their design of the Dain City PS improvements move forward to ensure adequate capacity is constructed into the pumping station. As noted in the BluePlan Engineering memo, the increase in capacity of the Dain City PS may have downstream impacts on the Ontario Road PS but their memo advises that growth flows to the Ontario Road PS using design criteria do not trigger an upgrade at the Ontario Road PS.

The City is currently investigation measures to reduce inflow to help alleviate past flooding to the Dain City Pumping Station. The BluePlan Engineering memo indicates that an I&I reduction of at least 25% in Dain City is required to facilitate phased growth in the proposed development area.

The client intends to disconnect the existing sanitary sewer that services the former John Deere site which has an as-of-right allocation of 652 people plus an infiltration allowance of 21.5 l/s for a total flow of 29.6 l/s as shown in Table 2.1. The removal of this connection will provide immediate relief to the Dain City sewers and pumping station to allow for the initial phases of the development to proceed.

Table 2.4– Pumping Stations available for Connection (adapted from Table 4.K.12, Volume IV, Wastewater Master Servicing Plan Update)

Pumping Station	Facility Operational Capacity (L/s)	Existing Peak Wet Weather Flow (L/s)	2041 Projected Peak Wet Weather Flow (L/s)	2041 Surplus/ Deficit (L/s)
Dain City Sewage Pumping Station	94	38.5	131.0	-37.0 (Note 1)
Ontario Road Sewage Pumping Station	600	250.6	343.1	256.9

1) The City and Regional staff have advised that recent studies after the Master Plan was completed indicate that the wet weather flow to the Dain City PS is much higher than the flows assumed in the Master Plan and that the Dain City Pumping Station does not appear to have surplus capacity.

2.4.4 FORCEMAIN FACILITIES PERFORMANCE - EXISTING AND PROJECTED DEMAND

The performance of Ontario Road PS and Dain City PS forcemains are shown **Table 2.5** below. The Ontario Road forcemain has capacity for all proposed flows. The Region is currently upgrading the existing 250mm forcemain of Dain City PS to 300mm diameter. The upgraded forcemain should have capacity of 141 L/s at 2 m/s and 176L/s at 2.5m/s. The forcemain following upgrade should be able to adequately convey the 131.0 L/s flows from Dain City PS, estimated based on the existing wet weather flows of 38.5 l/s and the flows from the proposed developments of 92.5/s. The estimated flow to Dain City PS do not reflect the recent flow monitoring by City nor the inflow improvements proposed by the City.

Table 2.5– Performance of Ontario Road PS and Dain City PS Forcemain (adapted from Table 4.K.13, Volume IV, Wastewater Master Servicing Plan Update)

Pumping Station	Pumping Station Operational Capacity (L/s)	Capacity at 2.5m/s (L/s)	Existing Peak Wet Weather Flow (L/s)	2041 Projected Peak Wet Weather Flow (L/s)	2041 Surplus/ Deficit (L/s) (Note 1)
Dain City Sewage Pumping Station	94	122.7 (250mm) 176.7 (300mm)	38.5	131.0	-8.3 (250mm) 45.7 (300mm)
Ontario Road Sewage Pumping Station	600	706.9	250.6	343.1	363.8

1) The City and Regional staff have advised that recent studies after the Master Plan was completed indicate that the wet weather flow to the Dain City PS is much higher than the flows assumed in the Master Plan and the surplus capacity in the Dain City Pumping Station forcemain is less than the value shown in this table.

2.4.5 DOWNSTREAM SEWERS CONVEYANCE CAPACITY - EXISTING AND PROJECTED DEMAND

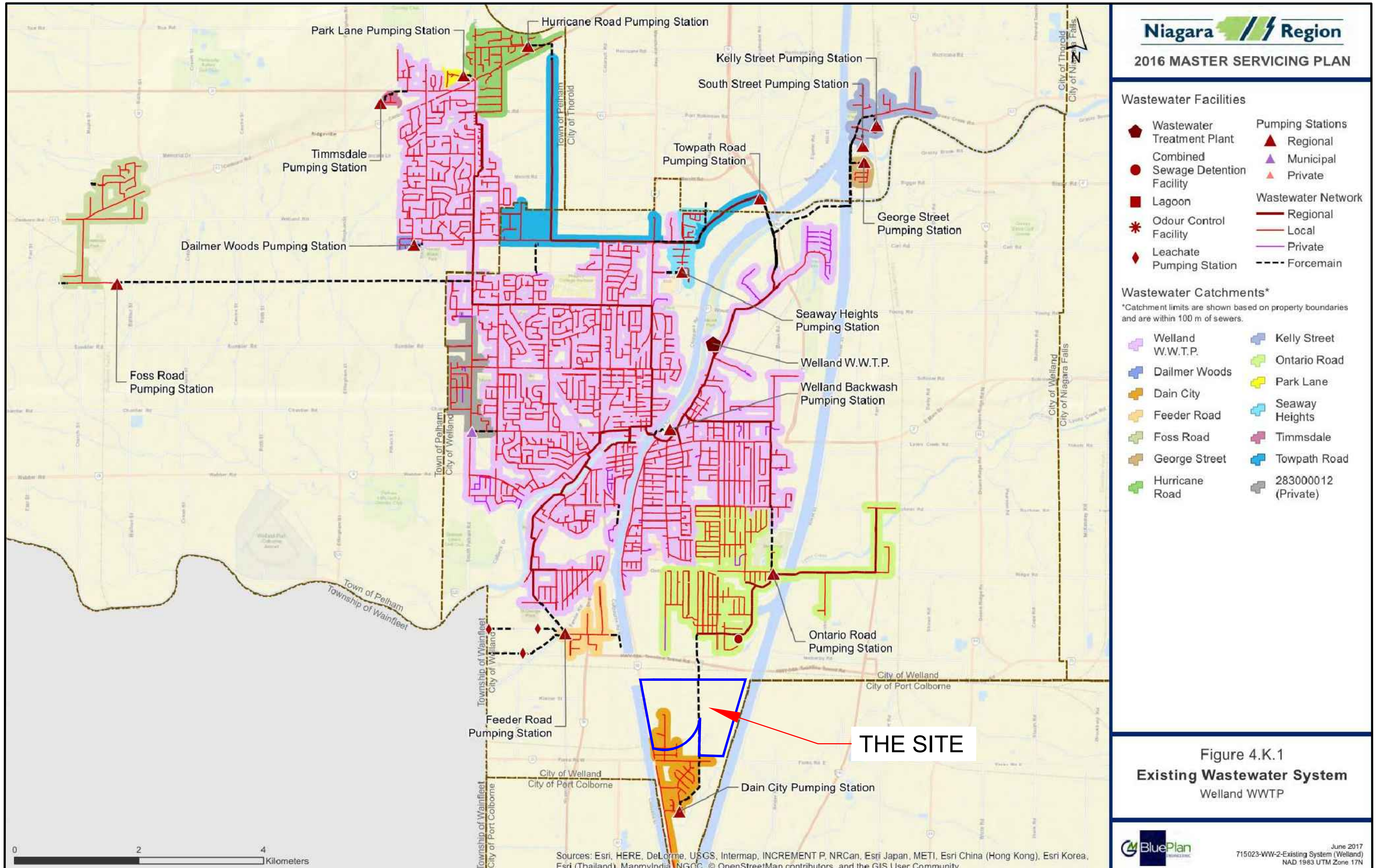
As shown in **Figure 4.K.5** of the Wastewater Master Servicing Plan, included in **Appendix A,** conveyance capacity of downstream sewers based on 2041 demands show some surplus. The capacity will be less than 85%, considering projected demands in 2041.

The BluePlan Engineering memo indicates that 350m of sewer upgrades for the 250mm sewer on Forks Road East to Crescent Avenue is required with the ultimate proposed development flows. Further analysis will be required by the City to confirm the timing requirements for the sewer upgrades.

2.4.6 SYSTEM CONSTRAINTS

There are no sanitary constraints identified in Master Plan for downstream sewers for proposed developments (**Figure 4.K.6 – Appendix A)**. However, the City has noted wet weather concerns for the Dain City P.S. drainage area. It is noted that only sanitary project identified in Master Plan for downstream sewers is the implementation of wet weather management program to reduce the wet weather inflow and infiltration, as shown in **Figure 4.K.7** of the Wastewater Master Serving Plan. The

BluePlan memo indicates that that an I&I reduction of at least 25% in Dain City is required to facilitate phased growth in the proposed development area.



SOURCE OF FIGURE :

2016 WATER AND WASTEWATER MASTER SERVICING PLAN UPDATE,

VOLUME IV- WASTEWATER MASTER SERVICING PLAN UPDATE, FINAL REPORT, JUNE 2017,

PART K, WELLAND WASTEWATER SYSTEM

BY:
GM BLUE PLAN ENGINEERING LTD

NOTE:
PROPOSED DEVELOPMENTS ARE TRIBUTARY TO DAIN CITY P.S., ONTARIO ROAD P.S., AND GRAVITY SEWERS DRAINING DIRECTLY TO WELLAND W.W.T.P.

CLIENT
555 CANAL BANK LTD.

TITLE
DAIN CITY DEVELOPMENTS
WELLAND WASTEWATER TREATMENT PLANT
EXISTING WASTEWATER SYSTEM

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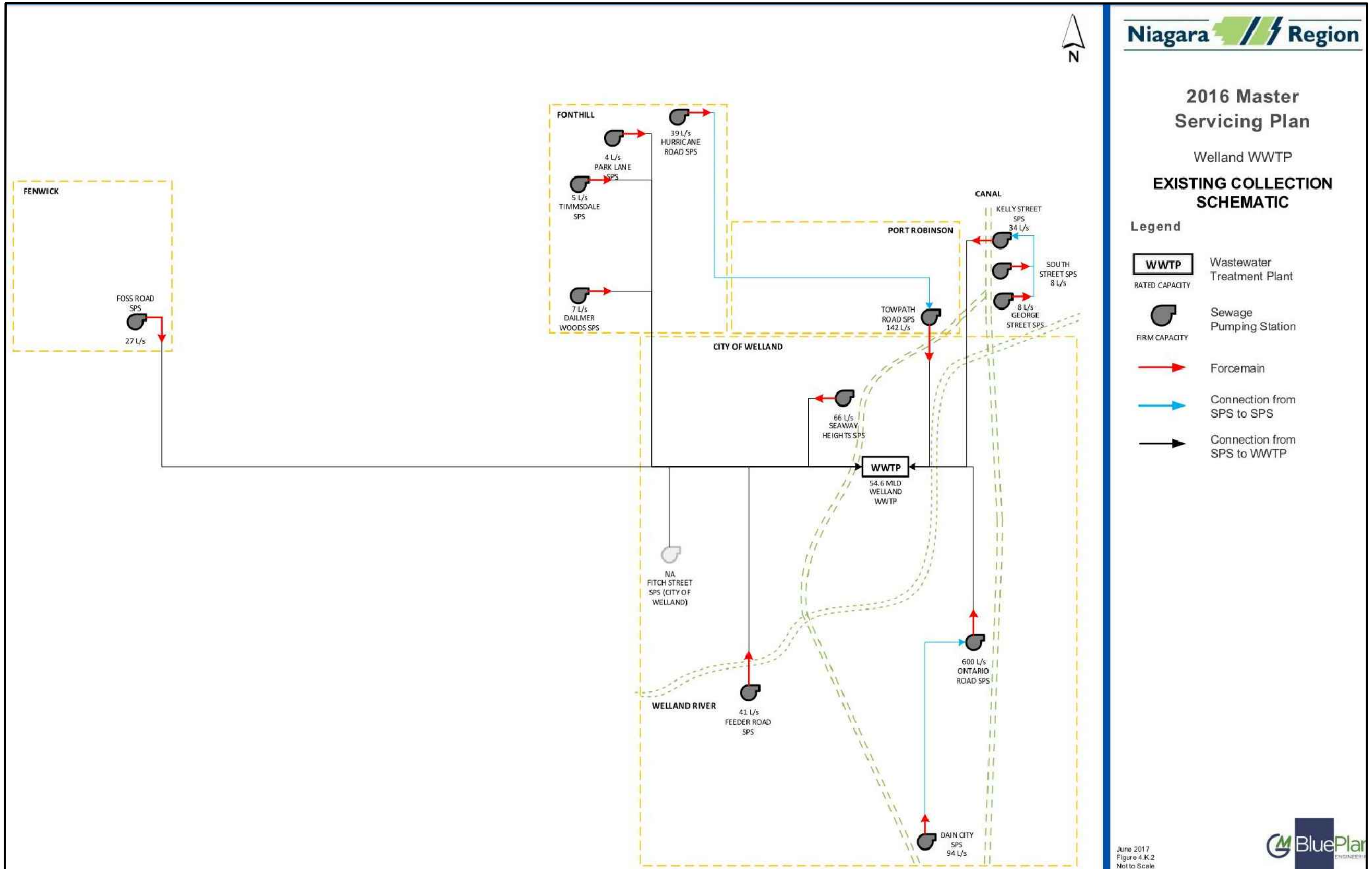

SOURCE OF FIGURE:

2016 WATER AND WASTEWATER MASTER SERVICING PLAN UPDATE,

VOLUME IV- WASTEWATER MASTER SERVICING PLAN UPDATE, FINAL REPORT, JUNE 2017,

PART K, WELLAND WASTEWATER SYSTEM

BY:
GM BLUE PLAN ENGINEERING LTD

CLIENT	555 CANAL BANK LTD.
TITLE	DAIN CITY DEVELOPMENTS WELLAND WASTEWATER TREATMENT PLANT WASTEWATER COLLECTION SYSTEM SCHEMATIC DIAGRAM

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Date	FEB 2020	Proj. No.	19M-01173
Scale	NTS	Figure No.	2.2

3 WATER SERVICING CAPACITY

3.1 EXISTING CONDITIONS

The site is located within the 220m pressure zone. The Regional network near the site is connected with Bemis Park Elevated Tank (BPET), located at north-east of the site. BPET is supplied from Welland Water Treatment Plant (WWTP) through Welland Water Treatment Plant Reservoir (WWTPR) and pumping station within the 220m pressure zone. The Welland Water Treatment pumping station (WWTPPS) also supplies Shoalt's Drive reservoir which also services pressure zone 248m which supplies Pelham Elevated Tank. The Pelham elevated tank is located at the end of pressure zone 272m within the Town of Pelham. Please refer to **Figure 3.1** for existing water system and **Figure 3.2** for schematic diagram.

3.2 PRELIMINARY WATER DEMAND

3.2.1 DESIGN PARAMTERS

The following design criteria have been taken from GHD Technical Memo dated December 3, 2019 to the City of Welland regarding the Water Distribution System Review

- 320 L/cap/day average day flow generation rate for new residential development;
- 320 L/cap/day average day flow generation rate for employment development;
- Maximum Day Factors: Based on rolling average for each system from last 5years. For Welland water system, the Maximum Day Factor =1.50;
- Peak Hour Factor is 1.87 times the maximum day demand.

The following criteria have been used to estimate population density

- Population densities of 2.7 person per suite for Townhouse and Semi-detached houses;
- Population densities of 3.5 person per suite for single houses; and
- Population densities of 2.1 person per suite for 3-storeys Apartments;

3.3 ESTIMATED WATER DEMANDS

The projected water demands from the proposed developments have been estimated using the design criteria outlined in **Section 3.2.1** above, and summarised in in **Table 3.1** below. The total average and maximum day water demand of the proposed developments are estimated as 21.5 L/s and 32.9 L/s, respectively.

Table 3.1– Preliminary Water Flows

Development	Population (cap)	Demand Rate (L/cap/Day)	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)
Dain City Residential	4,215	320	15.61	23.42	43.79
Former John Deere Residential	652	320	2.41	3.62	6.77
TOTAL WATER DEMANDS	**4,867**	**320**	**18.03**	**27.04**	**50.56**

3.4 CAPACITY OF EXISTING WATER SYSTEM

3.4.1 WELLAND WATER TREATMENT PLANT (WWTP) CAPACITY

As mentioned above, the subject site is located within 220m pressure zone and the source of water supply is WWTP. The water from WWTP is stored in WWTPR to be distributed through WWTPPS. The maximum day demand capacity of the WWTP is $102.3x10^6$ L/day[6]. The main characteristics of the storage facilities and pumping stations available for servicing pressure zone 220m are shown in **Table 3.2**, and **Table 3.3**, respectively. Refer to Volume III-Water Master Servicing Plan in **Appendix B** for more details about WWTP.

[6] Part F, Welland Water System, Niagara Region, 2016 Water and Wastewater Master Servicing Plan Update, Volume III- Water Master Servicing Plan Update, Final Report, June 2017

Table 3.2– Characteristics of Storage Facilities Available for Servicing Pressure Zone 220m (adapted from Table 3.F.3, Volume III, Water Master Servicing Plan Update)

Reservoir	Location (Zone)	Supply Zone	Type of Storage	Volume (10^6 L)	Maximum Water Level (m)
Welland Water Treatment Plant Reservoir (WWTPR)	220	220	Pumped Reservoir	5.6	175
Bemis Elevated Tank	220	220	Elevated Reservoir	5.7	219.4
Shoalt's Drive Reservoir	220	220 (Floating) 248 (Pumped)	Pumped/ Floating Reservoir	25.7	220.1

Table 3.3– Characteristics of Pumping Stations (adapted from Volume III, Water Master Servicing Plan Update)

Pumping Station	Welland Water Treatment Plant Pumping Station (WWTPPS)
Inlet	WWTP
Number of Pumps (Total)	6
Number of Pumps (Firm)	5
Firm Capacity	117.7 x10^6 L/day
Total Head	53.3 m

3.4.2 WELLAND WATER TREATMENT PLANT (WWTP) - EXISTING AND PROJECTED DEMAND

Figure 3.F.3 of the Water Master Servicing Plan included in **Appendix B**, indicates that WWTP Maximum day demand during 2011-2015 varied between $29.0x10^6$ L/day and $40.5x10^6$ L/day. The figure also showed the projected future demands from 2016 to 2041, with average maximum day demand of $48.0x10^6$ L/day in 2041, estimated as 47% of the Plant design capacity. The maximum day demand of the proposed developments is approximately $2.3x10^6$ L/day as shown in **Section 3.3** above. The total future demands estimated at 50.3 $x10^6$ L/day is less than 60% of the Plant capacity, including flows from the proposed developments ($2.3x10^6$ L/day). Therefore, WSP concluded that the WWTP has enough capacity to accommodate the wastewater flows of the proposed demands.

It is noted from **Figure 3.F.12** of the Water Master Servicing Plan Included in **Appendix B,** that the site is located in an area that currently has water age issues, occurring at dead end watermains. The proposed developments will improve water age with increased demands and looping.

3.4.3 PUMPING STATION FACILITIES PERFORMANCE - EXISTING AND PROJECTED DEMAND

The performance of pumping station facilities under the existing and projected demands is shown in the **Table 3. F.11** of the Water Master Servicing Plan, included in **Appendix B. Table 3.4** below shows the existing and projected maximum day demand of the WWTPPS. The projected demand in 2041 is estimated at $48.0x10^6$ L/day, indicating that WWTPPS will have surplus capacity of $67.4x10^6$ L/day. The total future water demands of the pumping station will be 50.3 $x10^6$ L/day including proposed developments (2.3 $x10^6$ L/day), that are less than 50% of firm pumping capacity. Therefore, the WWTPPS will have adequate capacity for the proposed developments.

Table 3.4– Existing and Projected Demands- Welland Water Treatment Pumping Station (WWTPPS) (adapted from Table 3.F.11, Volume III, Water Master Servicing Plan Update)

Pumping Station	Operational Capacity (10^6 L/day)	Existing Maximum Day demand (10^6 L/day)	2041 Projected Maximum Day Demand (10^6 L/day)	2041 Surplus (10^6 L/day)
Welland Water Treatment Plant Pumping Station (WWTPPS)	117.7	33.2	50.3	67.4

3.4.4 STORAGE FACILITIES PERFORMANCE - EXISTING AND PROJECTED DEMAND

As mentioned above, there are three storage facilities for servicing pressure zone 220m, including WWTPR, Bemis Elevated tank, and Shoalt's Drive Reservoir. The performance of reservoirs at the existing and future conditions is shown **Table 3.5** below. The collective storage of the three reservoirs is 37.0 x 10^6 L.

As outlined in the GHD water distribution memo, the 2041 required storage without the 401 Canal Bank St. development is 21.5x10^6 L is approximately 60% of reservoirs capacity. The required increase in storage for the proposed development is based on 25% of the Maximum Day Demand for equalization storage plus 25% of the equalization storage for emergency storage. The estimate increase in storage requiements for the proposed development 0.7x10^6 L for a total required storage will be 22.4x10^6 L, including proposed developments which is less than the 61% of the total storage capacity. Therefore, storage facilities within zone pressure 220m should have adequate capacity for the proposed developments.

Table 3.5– Performance of Storage Facilities (adapted from Table 3.F.12, Volume III, Water Master Servicing Plan Update)

Reservoir	Design Storage (10^6 L)	Existing Storage Demand (10^6 L)	2041 Projected Storage Demand without Development (10^6 L)	2041 Projected Storage Demand without Development (10^6 L)	2041 Surplus (10^6 L)
Welland Water Treatment Plant	37.0	18.5	21.5	22.2	14.8
Bemis Elevated Tank					
Shoalt's Drive Reservoir					

3.4.5 SYSTEM PRESSURE AND FIRE FLOWS - EXISTING AND PROJECTED DEMAND

As shown in **Figure 3.F.9** of the Water Master Servicing Plan, included in **Appendix B**, the projected minimum maximum day demands pressure of water servicing system surrounding the site is between 50psi-60psi. The 2041 projected fire flow in the watermain is greater than 250L/s, as presented in **Figure 3.F.10** in **Appendix B**.

The GHD water distribution memo outlines the results of the fire flow modelling which indicate that the following fire flows should be available during a maximum day plus fire demand

Table 3.6– Summary of GHD Maximum Day plus Fire Modelling

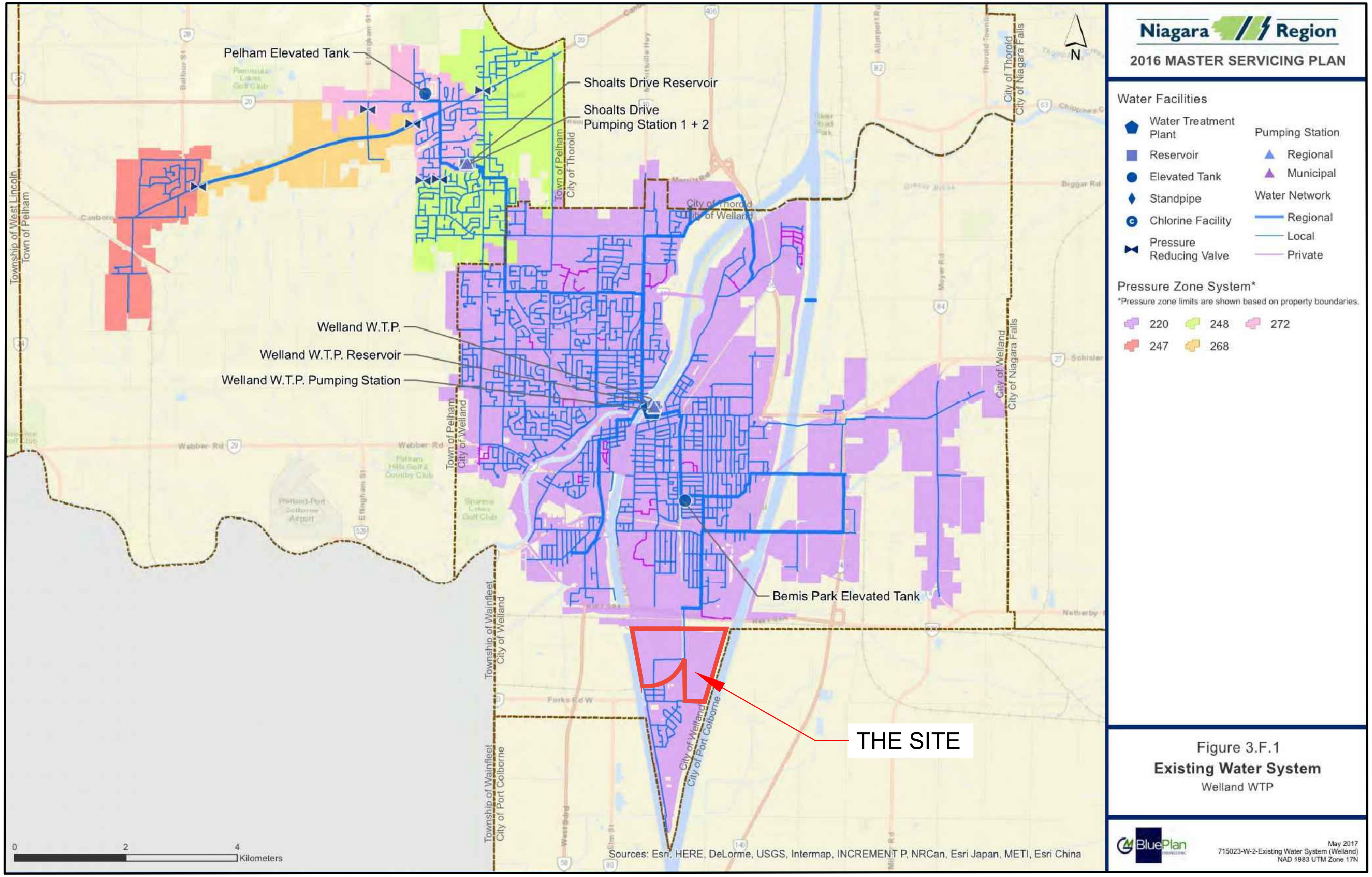
Junction ID	Location	Existing Maximum Day demand (10^6 L/day)
435701WJ01	Former John Deere	248 l/s
J-EH-1	Former John Deere	174 l/s
J-EH-2	Canal Bank/Dain Avenue	173 l/s
J-EH-3	Canal Bank/Dain Avenue	191 l/s
J-EH-4	Dain City Residential	143 l/s
J-EH-5	Canal Bank/Dain Avenue	136 l/s

The GHD memo also states that many of the hydrants in the vicinity of the development will have improved fire flow due to increased looping.

3.4.6 SYSTEM CONSTRAINTS- EXISTING AND PROJECTED DEMAND

There were no constraints outlined in the Master serving Plan pertaining to the water distribution in the location of proposed developments. The only constraint noted in the Master Plan for the 220m Pressure District is the Peak Hour Transmission capacity limits to the Shoalt's Drive Reservoir which is north of the Water Treatment Plant. This constraint should not impact the proposed supply to the proposed development as the study area is located south of the water treatment plant and the transmission restriction is located north of the water treatment plant.

The GHD water distribution memo noted that the modelling indicates that the Hydraulic Grade Line (HGL) at the Bemis Tank with the 401 Canal Bank St. development would be lowered to 215.4m during a maximum day demand which is lower than what is required to supply 275 kPa (40 psi) for portions of the site with ground elevations above 185m. In order to meet the City's pressure requirement of 275 kPa during maximum day demands, the ground elevations within the proposed development should be lower than 185.0m.



SOURCE OF FIGURE :

2016 WATER AND WASTEWATER MASTER SERVICING PLAN UPDATE,

VOLUME III- WATER MASTER SERVICING PLAN UPDATE, FINAL REPORT, JUNE 2017,

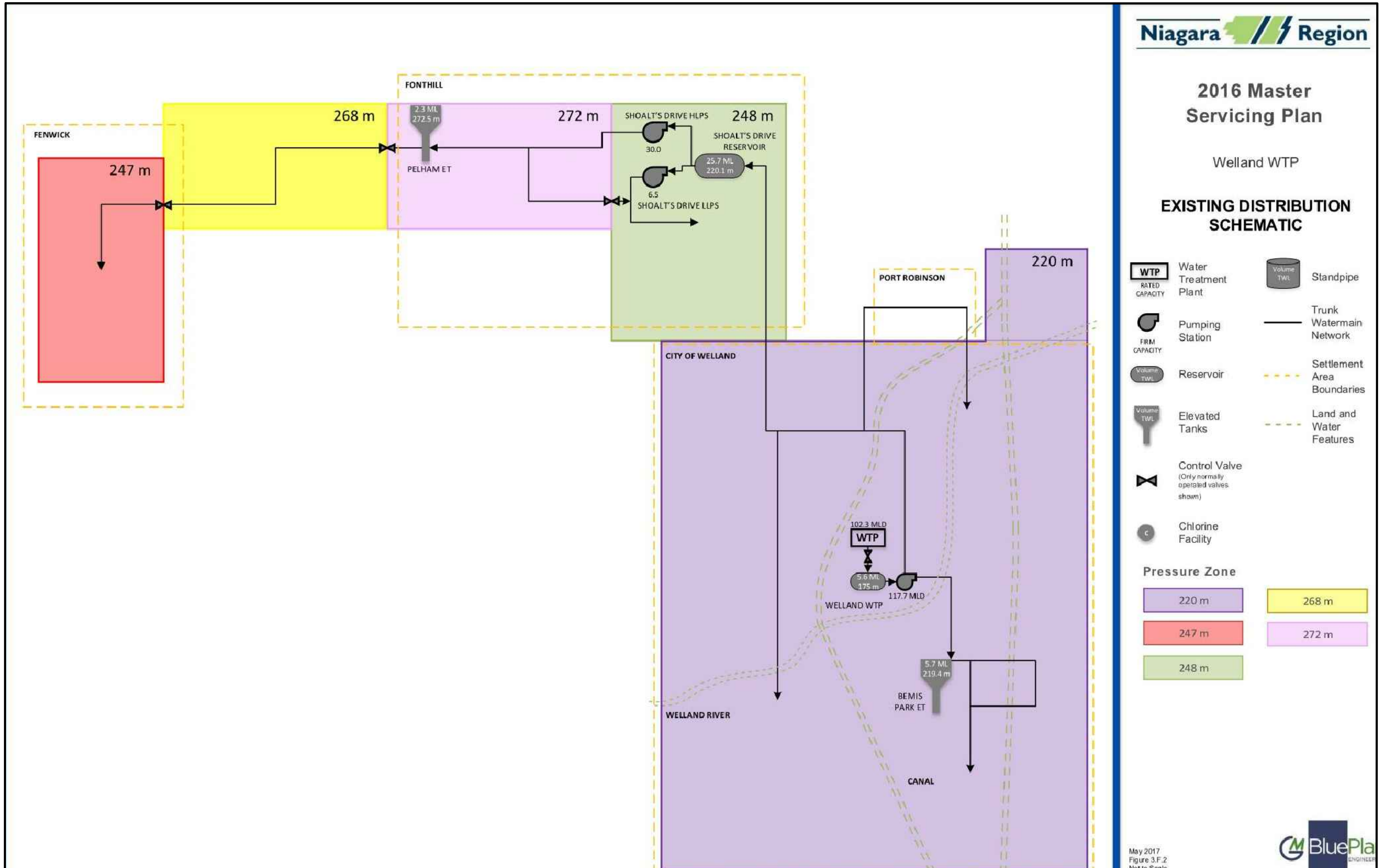
PART F, WELLAND WATER SYSTEM

BY:
GM BLUE PLAN ENGINEERING LTD

NOTE:
PROPOSED DEVELOPMENTS LOCATED IN PRESSURE ZONE 220m.

CLIENT	555 CANAL BANK LTD.
TITLE	DAIN CITY DEVELOPMENTS WELLAND WATER TREATMENT PLANT EXISTING WATER SYSTEM

Checked	R.K.	Drawn	10/12 Cad
Date	FEB 2020	Proj. No.	19M-01173
Scale	NTS	Figure No.	3.1



SOURCE OF FIGURE :

2016 WATER AND WASTEWATER MASTER SERVICING PLAN UPDATE,

VOLUME III- WATER MASTER SERVICING PLAN UPDATE, FINAL REPORT, JUNE 2017,

PART F, WELLAND WATER SYSTEM

BY:
GM BLUE PLAN ENGINEERING LTD

CLIENT	555 CANAL BANK LTD.
TITLE	DAIN CITY DEVELOPMENTS WELLAND WATER TREATMENT PLANT WATER DISTRIBUTION SYSTEM SCHEMATIC DIAGRAM

wsp

Checked	R.K.	Drawn	10/12 Cad
Date	FEB 2020	Proj. No.	19M-01173
Scale	NTS	Figure No.	3.2

4 CONCLUSIONS

4.1 SANITARY

The Welland Wastewater Treatment Plant should have adequate capacity to accommodate wastewater from the proposed developments in addition to the 2041 projected wastewater flows of the tributary area.

The site is proposed to be connected to Ontario Road Sewage Pumping Station and Dain City Sewage Pumping Station. Based on design flows, the Ontario Road Sewage Pumping Station should have an surplus capacity of 256.9.1/s by 2041 for the proposed developments (92.5/s). With deficit in capacity of 37.0/s, the Dain City Sewage Pumping Station will not have enough capacity for the proposed developments by 2041. The Region is planning to complete a state of good repair upgrades to the Dain City pumping station with tentative start of design in 2020. The Region have been advised of the proposed development potential that would be tributary to the Dain City Pumping Station and that an increase in capacity should be incorporated into the upgrades to the pumping station. The upgrades to the Dain City pumping station should be monitored with the Region as their design of the Dain City PS improvements move forward to ensure adequate capacity is constructed into the pumping station.

The Region is replacing the existing 250mm forcemain with a 300mm forcemain from the Dain City Pumping Station which will have sufficient capacity for the 2041 flows including the proposed development.

The conveyance capacity of downstream sewers based on 2041 demands from the Region's Master Plan shows some surplus capacity. The analysis by BluePlan Engineering for the City of Welland has indicated that 350m of sewer require upgrades on Forks Road East to Crescent Avenue with the proposed development flows. Further analysis will be required by the City to confirm the timing requirements for the sewer upgrades. The BluePlan memo also indicates that that an I&I reduction of at least 25% in Dain City is required to facilitate phased growth in the proposed development area. The developer intends to disconnect the existing sanitary sewer that services the former John Deere site which had an as of right allocation of 652 people plus an infiltration allowance of 21.5 l/s. The removal of this connection will provide immediate relief to the Dain City sewers and pumping station to allow for the initial phases of the development to proceed.

4.2 WATER

The site is proposed to be serviced by a regional network connected with Bemis Park Elevated Tank (BPET) and supplied from Welland Water Treatment Plant (WWTP) through Welland Water Treatment Plant Reservoir (WWTPR) and pumping station, within the 220m pressure zone.

The Welland Water Treatment Plan has a total effective capacity of 117.7 $x10^6$ L/day which is sufficient to meet the projected 2041 maximum day demand of 50.3 $x10^6$ L/day which includes the maximum day demand of the proposed developments of $2.3x10^6$ L/day.

Existing storage facilities in zone 220m have existing capacity of 37 ML which are adequate for the required fire storage in Pressure Zone 220 of 22.2 ML which means there should be adequate storage capacity for the proposed developments.

The GHD water distribution memo indicates that fire flows ranging from 136 l/s to 248 l/s will be available within the proposed development. The GHD memo also states that many of the hydrants in the vicinity of the development will have improved fire flow due to increased looping.

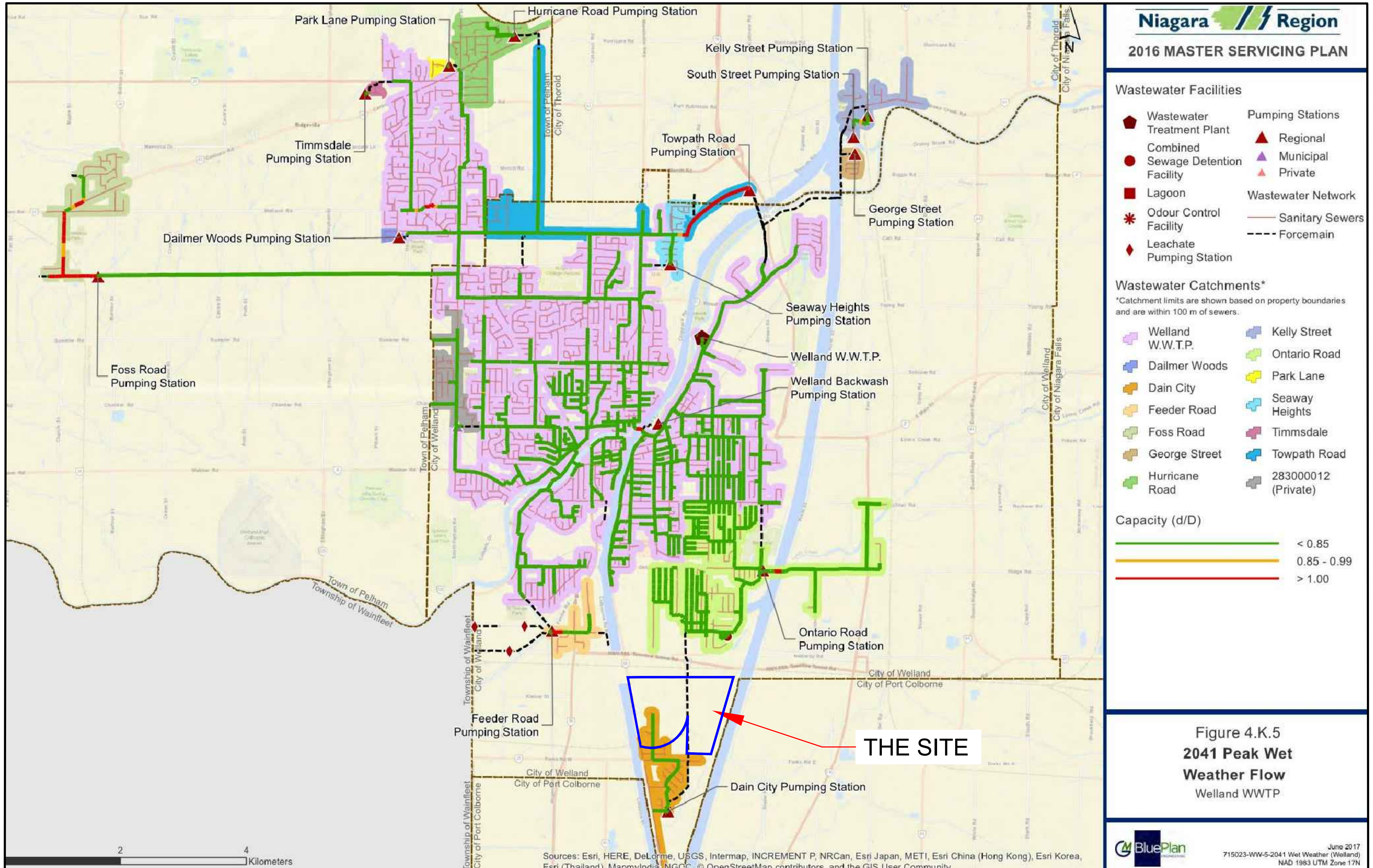
There were no constraints outlined in the Master serving Plan pertaining to the water distribution in the location of proposed developments. The only constraint noted in the Master Plan for the 220m Pressure District is the Peak Hour Transmission capacity limits to the Shoalt's Drive Reservoir which will north of the Water Treatment Plant. This constraint should not impact the proposed supply to the proposed development as the study area is located south of the water treatment plant and the transmission restriction is located north of the water treatment plant.

The GHD water distribution memo noted that the modelling indicates that the Hydraulic Grade Line (HGL) at the Bemis Tank with the 401 Canal Bank St. development would lowered to 215.4m during a maximum day demand which is lower than what is required to supply 275 kPa (40 psi) for portions of the site with ground elevations above 185m. To meet the City's pressure requirement of 275 kPa during maximum day demands, the ground elevations within the proposed development should be lower than 185.0m.

APPENDIX

A

NIAGARA REGION WATER WASTEWATER MASTER SERVICNG PLAN UPDATES- VOLUME IV- WASTEWATER MASTER SERVICNG PLAN



SOURCE OF FIGURE :

2016 WATER AND WASTEWATER MASTER SERVICING PLAN UPDATE,

VOLUME IV- WASTEWATER MASTER SERVICING PLAN UPDATE, FINAL REPORT, JUNE 2017,

PART K, WELLAND WASTEWATER SYSTEM

BY:
GM BLUE PLAN ENGINEERING LTD

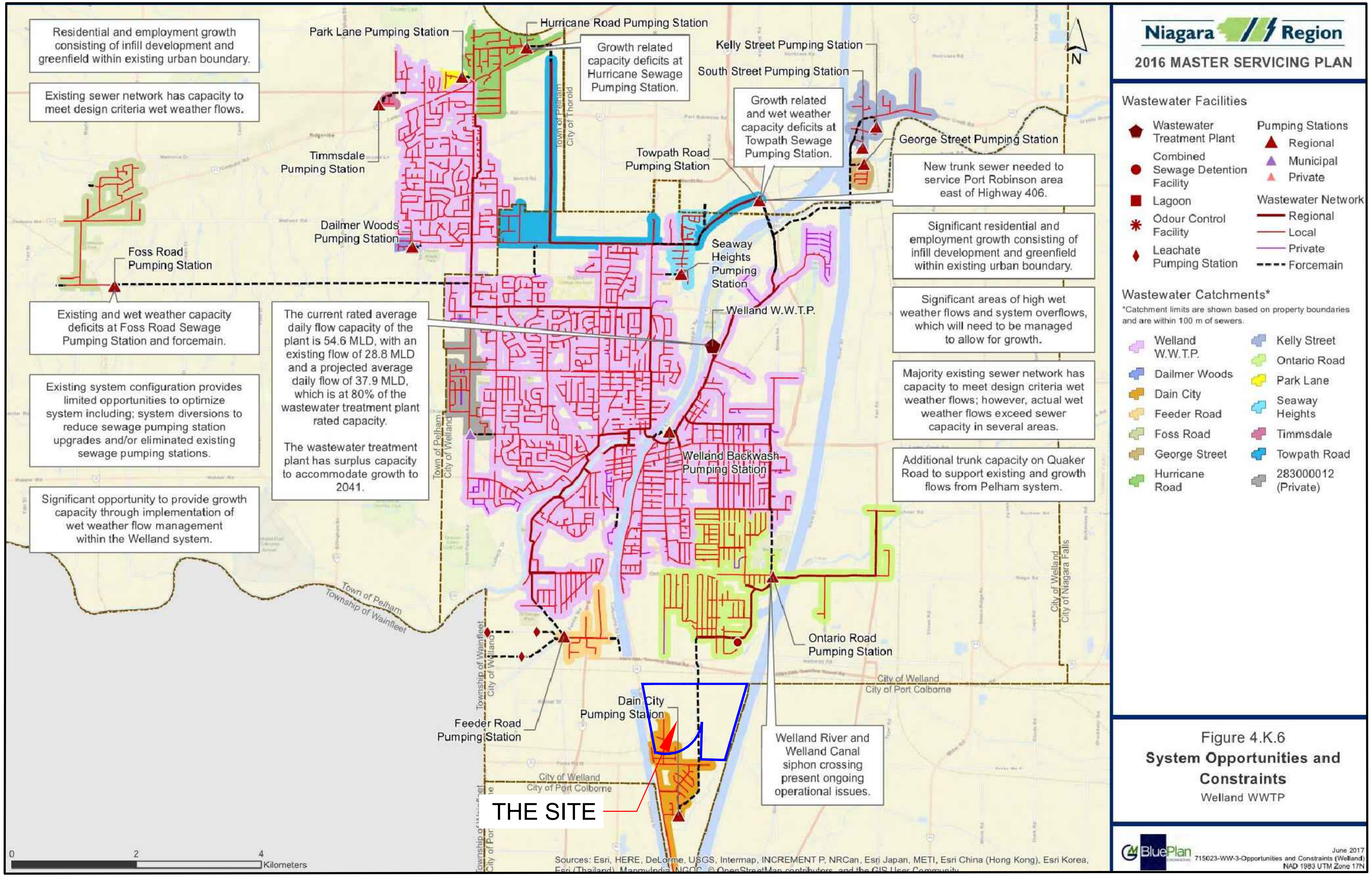
NOTE:
ADDITIONAL ANALYSIS FOR CONVEYANCE CAPACITY OF DOWNSTREAM SEWERS WILL BE REQUIRED TO CONFIRM SUFFICIENT CAPACITY FOR THE PROPOSED DEVELOPMENT.

CLIENT
555 CANAL BANK LTD.

TITLE
DAIN CITY DEVELOPMENTS
WELLAND WASTEWATER TREATMENT PLANT
DOWNSTREAM CONVEYANCE CAPACITY-2041 PROJECTED PEAK WET WEATHER FLOW

wsp

Checked	R.K.	Drawn	10/12 Cad
Date	FEB 2020	Proj. No.	19M-01173
Scale	NTS	Figure No.	



SOURCE OF FIGURE :

2016 WATER AND WASTEWATER MASTER SERVICING PLAN UPDATE,

VOLUME IV- WASTEWATER MASTER SERVICING PLAN UPDATE, FINAL REPORT, JUNE 2017,

PART K, WELLAND WASTEWATER SYSTEM

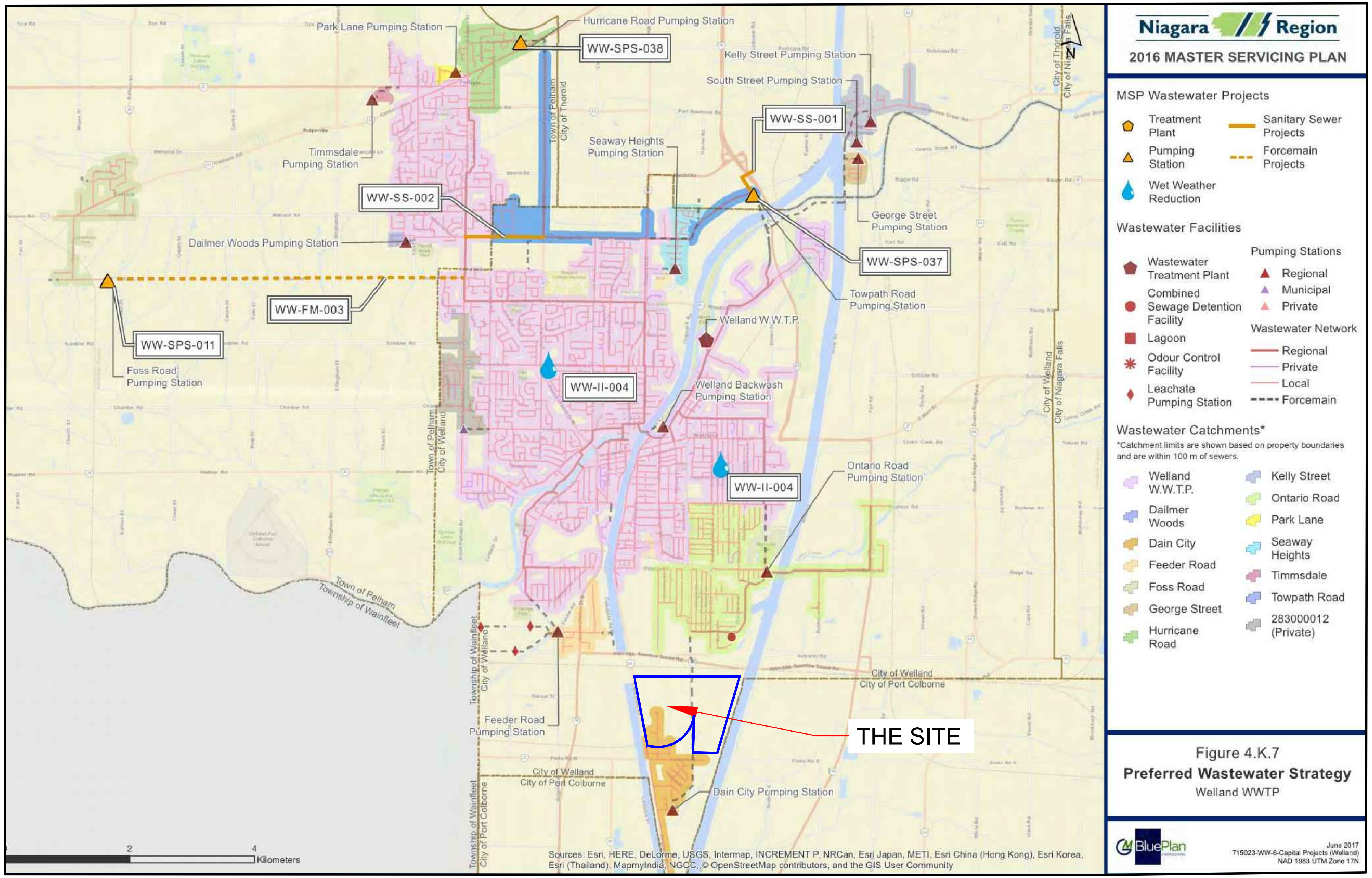
BY:
GM BLUE PLAN ENGINEERING LTD

NOTE:
NO SANITARY CONSTRAINTS IDENTIFIED IN MASTER PLAN FOR DOWNSTREAM SEWERS FOR PROPOSED DEVELOPMENTS. HOWEVER, CITY HAS NOTED WET WEATHER CONCERNS FOR THE DAIN CITY P.S. DRAINAGE AREA.

CLIENT	555 CANAL BANK LTD.
TITLE	DAIN CITY DEVELOPMENTS WELLAND WASTEWATER TREATMENT SYSTEM SYSTEM OPPORTUNITIES AND CONSTRAINTS

wsp

Checked	R.K.	Drawn	10/12 Cad
Date	FEB 2020	Proj. No.	19M-01173
Scale	NTS	Figure No.	



SOURCE OF FIGURE :

2016 WATER AND WASTEWATER MASTER SERVICING PLAN UPDATE,

VOLUME IV- WASTEWATER MASTER SERVICING PLAN UPDATE, FINAL REPORT, JUNE 2017,

PART K, WELLAND WASTEWATER SYSTEM

BY:
GM BLUE PLAN ENGINEERING LTD

NOTE:
ONLY SANITARY PROJECT IDENTIFIED IN MASTER PLAN FOR DOWNSTREAM SEWERS IS THE IMPLEMENTATION OF A WET WEATHER MANAGEMENT PROGRAM TO REDUCE WET WEATHER INFLOWS AND INFILTRATION.

CLIENT: 555 CANAL BANK LTD.			
TITLE: DAIN CITY DEVELOPMENTS WELLAND WASTEWATER TREATMENT SYSTEM MASTER SERVICING PLAN WASTEWATER PROJECTS			
Checked: R.K.	Drawn: 10/12 Cad		
Date: FEB 2020	Proj. No. 19M-01173		
Scale: NTS	Figure No.		

Niagara Region

2016 Water and Wastewater
Master Servicing Plan Update

HOW WE **FLOW**

Volume IV - Wastewater Master Servicing Plan Update

Final Report

June, 2017

GM BluePlan ENGINEERING

Table of Contents

1. INTRODUCTION 1
1.1 Background 1
1.2 Integrated Planning Process.. 2
1.3 Master Servicing Plan Update Report Objectives 3
1.4 Master Servicing Plan Class EA Report Outline 4
1.5 Master Servicing Plan Report Volume IV... 6
2. ANALYSIS METHODOLOGY 8
2.1 Project Assumptions 8
2.2 Flow Projections and Allocations 8
2.3 Study Area Population and Employment 10
2.4 Design Criteria... 12
2.5 Flow Projection 13
2.6 Wastewater Infrastructure Capacity... 14
3. WASTEWATER SERVICING STRATEGY 17
3.1 Servicing Principles and Policies 17
3.2 Evaluation Methodology 17
3.3 Alternative Strategies... 18
4. CAPITAL PROGRAM 20
4.1 Wastewater System Recommendations Overview 20
4.2 Wet Weather Management Strategy 24
4.3 South Niagara Falls Servicing Strategy 24
4.4 Capital Program... 25

PART A BAKER WASTEWATER SYSTEM
PART B PORT DALHOUSIE WASTEWATER SYSTEM
PART C PORT WELLER WASTEWATER SYSTEM
PART D NIAGARA-ON-THE-LAKE WASTEWATER SYSTEM
PART E QUEENSTON WASTEWATER SYSTEM

PART F	**NIAGARA FALLS WASTEWATER SYSTEM**
PART G	**STEVENSVILLE-DOUGLASTOWN WASTEWATER SYSTEM**
PART H	**ANGER WASTEWATER SYSTEM**
PART I	**CRYSTAL BEACH WASTEWATER SYSTEM**
PART J	**SEAWAY WASTEWATER SYSTEM**
PART K	**WELLAND WASTEWATER SYSTEM**

1. INTRODUCTION

1.1 Background

Niagara Region currently services the urban area of the municipalities of Grimsby, West Lincoln, Lincoln, St. Catharines, Thorold, Welland, Pelham, Port Colborne, Niagara-on-the-Lake, Niagara Falls, and Fort Erie. Water and wastewater servicing is operated under a two-tier system. Niagara Region is responsible for water treatment, transmission mains, storage facilities and major booster pumping stations; as well as wastewater treatment, trunk sewers and sewage pumping stations. The area municipalities are responsible for local water distribution networks and local sewer collection systems.

Niagara Region is part of the Greater Golden Horseshoe (GGH) area situated around the western and southern end of Lake Ontario that continues to be one of the fastest growing regions in North America. The Government of Ontario's legislative growth plan, *Places to Grow Act 2005* and recent amendments, identifies substantial population and employment growth for the GGH to year 2041.

Readily available and accessible public infrastructure is essential to the viability of existing and growing communities. Infrastructure planning, land use planning and infrastructure investment require close integration to ensure efficient, safe and economically achievable solutions to provide the required water and wastewater infrastructure. To balance the needs of growth with the protection and preservation of natural, environmental and heritage resources, Niagara Region initiated an integrated process under the umbrella "Niagara 2041" to complete a Municipal Comprehensive Review, a new Transportation Master Plan, and a Water and Wastewater Master Servicing Plan Update.

The 2016 Master Servicing Plan Update provides a review, evaluation and development of water and wastewater servicing strategies for all servicing within the urban areas of the Region. The 2016 Master Servicing Plan Update uses updated population and employment growth forecasts based on a 2041 planning horizon.

The Study Area for the Master Servicing Plan Update covers primarily the urban areas of the local municipalities in Niagara Region serviced by the lake-based systems. The Township of Wainfleet is not included in the scope of this Master Servicing Plan Update.

Figure 4.1 Study Area

The 2016 Master Servicing Plan Update builds on previous work undertaken as part of the 2011 Master Servicing Plan and previous long term infrastructure planning studies. The 2016 Master Servicing Plan Update is a critical component in the Region's planning for growth and will provide the framework and vision for the water and wastewater servicing needs for the lake-based service areas of the Region to year 2041.

1.2 Integrated Planning Process

Niagara, as a whole, must proactively plan for and facilitate growth in order to conform with Provincial land use plans (*Places to Grow*). The Region is currently planning the best way to accommodate anticipated and targeted population and employment growth over the next 25 years. Under the umbrella "Niagara 2041" the Region will be establishing a growth strategy that will be urban in nature.

The establishment of the growth strategy involves completing (3) three projects:

1) Municipal Comprehensive Review (MCR) – ***How We Grow***

   Look at the land available across Niagara, ensure there is enough land to sustain the expected growth to year 2041 and examine how the land is distributed throughout Niagara

2) Transportation Master Plan (TMP) – ***How We Go***

   Look at current travel methods across Niagara and look to improve transportation systems including options for walking, cycling and public transit to better serve Niagara's future needs

3) Water and Wastewater Master Servicing Plan (MSP) – ***How We Flow***

   Ensure Niagara has the infrastructure to provide critical water and wastewater services to the growing Region in a sustainable and financially responsible way

These three projects are inter-connected and collectively form the foundation to support and foster Niagara's growth and input into the Niagara Region Development Charge Study. The Master Plans will identify the preferred servicing solution and associated infrastructure needs to support projected growth as set out in the Municipal Comprehensive Review.

1.3 Master Servicing Plan Update Report Objectives

The Master Servicing Plan Update comprehensively documents the development, evaluation and selection of the preferred water and wastewater servicing strategies to meet the servicing needs of existing users and future development to 2041.

The Master Servicing Plan Update evaluates the ability of existing and planned water and wastewater infrastructure in Niagara Region to efficiently and effectively service the Region's existing users, service anticipated growth, and to evaluate and develop recommended servicing strategies.

The key objectives of the 2016 Master Servicing Plan Update are as follows:

- Review planning forecasts to 2041 and determine the impacts on servicing needs for the Region's lake-based water and wastewater infrastructure;
- Evaluate the ability of existing and planned water and wastewater infrastructure to efficiently and effectively service the Region's existing users and anticipated growth;

- Undertake a comprehensive review and analysis for both water and wastewater servicing requirements;
- Address key servicing considerations as part of the development and evaluation of water and wastewater servicing strategies including:
  - Level of service to existing users and approved growth
  - Operational flexibility and system security and reliability
  - Mitigation of impacts to natural, social and economic environments
  - Opportunity to meet policy, policy statements, regulations and technical criteria
  - Opportunity to optimize existing infrastructure and servicing strategies
  - Ensuring the strategies are cost effective
- Consider and develop sustainable servicing solutions with lifecycle considerations;
- Update the capital program cost estimating methodology and utilize updated industry trends and more detailed information from relevant Region studies and projects to provide appropriate capital cost estimates;
- Utilize the updated water and wastewater hydraulic models for the analysis of servicing alternatives;
- Establish a complete and implementable water and wastewater capital program;
- Provide extensive consultation with the public and stakeholders; and
- Complete the Master Servicing Plan Update in accordance with the MEA Class EA process for Master Plans.

1.4 Master Servicing Plan Class EA Report Outline

The 2016 Water and Wastewater Master Servicing Plan Update Report, including all supporting volumes, is the documentation placed on public record for the prescribed review period. The documentation, in its entirety, describes all required phases of the planning process and incorporates the procedure considered essential for compliance with the *Environmental Assessment Act*.

The 2016 Master Servicing Plan Update documentation is organized into five volumes as illustrated in the following Figure and as described below:

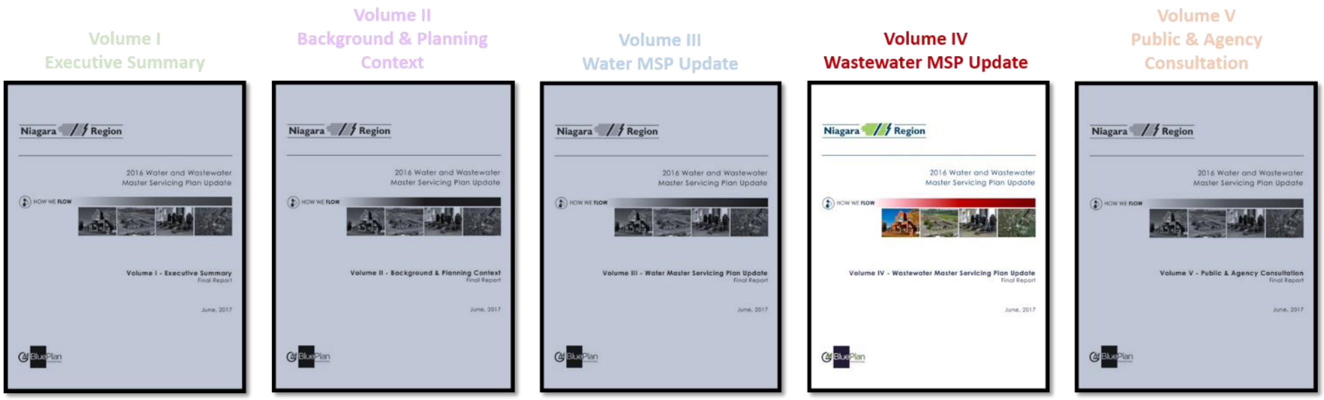


Figure 4.2 Master Servicing Plan Document Layout

Volume I – Executive Summary

Volume I provides a brief overview of the 2016 Master Servicing Plan Update. It summarizes the information contained in Volumes II, III, IV and V, including problem statement, purpose of the study, significant planning, policy and technical considerations, and description of the preferred water and wastewater servicing strategies including depiction of the projects and documentation of the capital programs.

Volume II – Background and Planning Context

Volume II details the master planning process including the Master Plan Class EA process, related studies, legislative and policy planning context, water and wastewater servicing principles and policies, population and employment growth forecasts, existing environmental and servicing conditions and future considerations.

Volume III – Water Master Servicing Plan Update and Project File

Volume III is the principle document summarizing the study objectives, approach, methodologies, technical analyses, evaluation and selection of the preferred water servicing strategy for each of the water systems. This volume contains baseline water system data and performance information. This volume documents the water servicing strategy development with detailed information on the projects and capital program associated with the preferred water servicing strategy.

Volume IV – Wastewater Master Servicing Plan Update and Project File

Volume IV is the principle document summarizing the study objectives, approach, methodologies, technical analyses, evaluation and selection of the preferred wastewater servicing strategy for each of the wastewater systems. This volume contains baseline wastewater system data and performance information. This volume documents the wastewater servicing strategy development with detailed information on the projects and capital program associated with the preferred wastewater servicing strategy.

Volume V – Public and Agency Consultation

Volume V contains all relevant documentation of the public consultation process including notices, comments and responses, and distribution information. Presentation material from all Public Information Centres (PICs) held during the process is included. Other presentation material and discussion information from workshops held with relevant agencies, approval bodies and other stakeholders are also included.

1.5 Master Servicing Plan Report Volume IV

The current volume provides the overall approach, methodologies, technical analyses, evaluation and selection of the preferred water servicing strategy for each of the wastewater systems.

This main section of Volume IV has been organized into four sections as described below, outlining the general approach, methodologies, and technical analysis used to develop the preferred wastewater servicing strategy.

This volume's Introduction has been organized in 4 sections as described below:

1. Introduction
2. Analysis Methodology
3. Evaluation Methodology
4. Wastewater Capital Program

Further to the volume's Introduction, individual Sub-Parts A to K – one for each wastewater system – is also included to summarize the technical analyses and evaluation of the preferred water servicing strategy for each system.

Each volume Sub-Part A to K has been organized in 8 sections as described below:

1. Existing System Overview
2. Growth Projections
3. Assessment of Wastewater Infrastructure
4. System Opportunities and Constraints
5. Assessment of Alternatives
6. Preferred Servicing Strategy
7. Capital Program
8. Project Files (If Applicable)

Volume IV is one of five volumes that make up the complete Master Servicing Plan Class EA Study Report and should be read in conjunction with the other volumes.

2. ANALYSIS METHODOLOGY

The current analysis calculates the following:

- Total equivalent population fed by each wastewater treatment plant at the following time horizon: 2021, 2026, 2031, 2036, 2041.
- Total equivalent population fed by each pumping station at each time horizon.
- Peak Dry Weather Flow and Peak Wet Weather Flow for each pumping station at each time horizon.

The results of the analyses are used as input for this Master Servicing Plan, which identifies the problem and opportunity and develops alternative solutions to address system deficiencies.

2.1 Project Assumptions

The following key assumptions have been made as part of the analysis:

- Niagara Municipal Comprehensive Review 2041 growth projections were used:
    - To estimate growth related flows within the wastewater system.
    - To spatially allocate growth flow within the individual water system.
- Institutional, industrial, and commercial growth flows were estimated using equivalent employment projections.
- The following growth related wet weather flows assumptions were applied:
    - Intensification growth (growth located within the existing sewer service catchment) will not contribute additional wet weather flows to the system
    - Greenfield growth (growth located outside the existing sewer service catchment) will contribute additional wet weather flows to the system, in line with the design criteria provided in Section 2.4)
- Pumping station firm capacity is the firm capacity given in the latest Environmental Certificate of Approval (ECA) for each station. System capacity analysis was completed using the lesser of the ECA firm capacity or actual operational capacity as provided by Regional operational staff (where provided).
    - Where this value is not provided, for the purpose of this master plan, the firm capacity is taken as the sum of individual pump capacities with the largest pump out of service.

2.2 Flow Projections and Allocations

The study area consists of the existing service area as well as residential and industrial land supply within the existing urban boundary. The MCR population and employment projects were provided in five year increments on a traffic survey zone basis.

Tributary population employment numbers to each pressure zone and treatment facility were calculated using the following process:

- A baseline growth area shapefile was provided by the Region. The growth area included all existing available vacant land supply, as well as known growth nodes and corridors.
- Traffic survey zones were overlaid with the growth area shapefile. The total traffic survey zone growth was assigned to the growth areas proportionally based on area-weighted basis.
- For traffic survey zone with no corresponding growth area shapes, all growth was assumed to be proportionally applied to existing area within the urban boundary.
- For traffic survey zones partially in the urban boundary, all growth was assumed to occur within the urban boundary with no growth outside the urban boundary.
- For traffic survey zones entirely outside the urban boundary, growth was only applied to existing service areas proportionally based on area-weighted basis or total service area within the traffic survey zone.
- The total population growth serviced by wastewater out to 2041 will be less than the total growth presented in Table 4.1 and Table 4.2 as this includes unserviced areas outside the urban area boundary.
- The growth shapes were overlaid with the existing sewershed areas to assign growth to individual sewersheds.
- For unassigned growth shapes, a manual review of existing service network, topographic, and existing natural and physical features was reviewed and growth was assigned to individual sewersheds based on likely service connection.
- The following growth related wet weather flow assumptions were applied:
  - Intensification growth (growth located within the existing sewer service catchment) will not contribute additional wet weather flows to the system
  - Greenfield growth (growth located outside the existing sewer service catchment) will contribute additional wet weather flows to the system, in line with the design criteria provided in Section 2.4)
- For allocation to the InfoSWMM model, the growth area shapes were then allocated to the closest existing node within the growth shapes' previously assigned sewershed.

Figure 4.3 provides an example of the process used to allocate system demands.

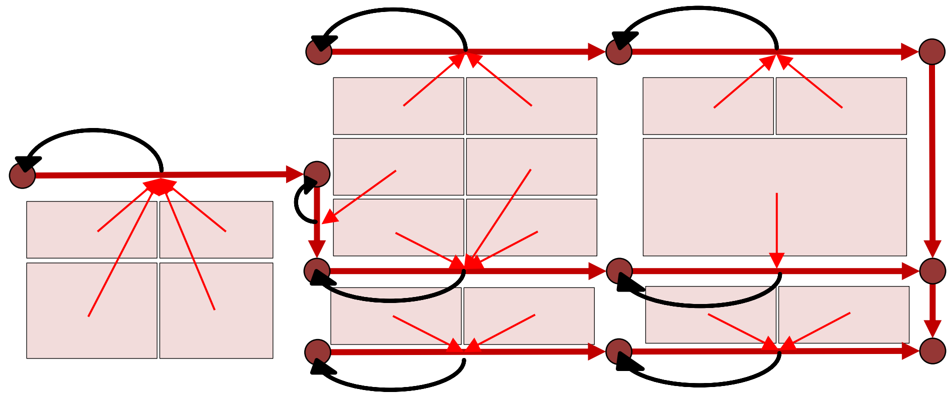


Figure 4.3 Process for Allocating System Demands

2.3 Study Area Population and Employment

Table 4.1 and Table 4.2 present the MCR projected population and employment by municipality.

Table 4.1 MCR Population Growth by Municipality

MCR Strategic Growth Option Forecast Total Population by Local Municipality								
Municipality	**Total Population Including Net Undercoverage**							
	2011	**2014 ***	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**
Fort Erie	30,760	31,216	31,520	32,310	34,720	37,780	41,220	43,940
Grimsby	26,000	27,224	28,040	29,430	31,400	33,200	35,140	37,150
Lincoln	23,080	23,884	24,420	24,990	26,230	28,060	30,030	31,590
Niagara Falls	85,200	88,326	90,410	92,830	99,990	108,770	117,670	124,580
Niagara-on-the-Lake	15,810	17,112	17,980	19,750	21,420	22,850	24,700	26,580
Pelham	17,040	17,352	17,560	17,900	19,410	21,560	23,720	25,260
Port Colborne	18,910	18,838	18,790	18,600	19,210	20,080	21,050	21,820
St. Catharines	134,890	135,940	136,640	136,930	142,560	150,590	160,040	167,480
Thorold	18,410	18,944	19,300	19,680	21,500	23,850	26,470	28,470
Wainfleet	6,520	6,532	6,540	6,590	6,760	6,990	7,260	7,480
Welland	51,980	53,000	53,680	54,130	56,540	59,600	63,160	66,180
West Lincoln	14,200	14,608	14,880	16,170	18,930	22,630	26,530	29,460
Niagara Region	**442,800**	**452,976**	**459,760**	**469,310**	**498,670**	**535,960**	**576,990**	**609,990**

* Note: The Master Servicing Plan Update has an established baseline condition of year 2014. 2014 represents the best available system information and system calibration data for the water and wastewater models at the time of study initiation. The Master Servicing Plan Update has projected growth from year 2014 to establish the 2041 infrastructure needs.

Table 4.2 MCR Employment Growth by Municipality

MCR Strategic Growth Option Forecast Employment by Local Municipality								
Municipality	**Total Place of Work Employment**							
	2011	**2014 ***	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**
Fort Erie	11,290	11,992	12,460	13,270	13,960	14,920	15,940	17,240
Grimsby	7,720	9,010	9,870	10,780	11,440	12,380	13,310	14,630
Lincoln	9,740	10,664	11,280	11,870	12,300	13,040	13,710	14,600
Niagara Falls	41,030	43,628	45,360	47,790	49,630	52,060	54,570	57,720
Niagara-on-the-Lake	10,650	12,066	13,010	13,720	14,150	14,660	15,230	16,030
Pelham	4,090	4,360	4,540	4,880	5,220	5,750	6,280	6,930
Port Colborne	5,860	5,806	5,770	5,900	6,080	6,350	6,640	7,000
St. Catharines	60,180	61,668	62,660	65,530	67,820	71,480	75,240	80,240
Thorold	7,360	7,786	8,070	8,480	8,870	9,390	9,960	10,660
Wainfleet	1,160	1,244	1,300	1,350	1,400	1,470	1,550	1,650
Welland	22,090	22,990	23,590	24,490	25,170	26,220	27,300	28,760
West Lincoln	4,280	4,802	5,150	5,770	6,370	7,270	8,280	9,560
Niagara Region	**185,450**	**196,016**	**203,060**	**213,830**	**222,410**	**234,990**	**248,010**	**265,020**

* Note: The Master Servicing Plan Update has an established baseline condition of year 2014. 2014 represents the best available system information and system calibration data for the water and wastewater models at the time of study initiation. The Master Servicing Plan Update has projected growth from year 2014 to establish the 2041 infrastructure needs.

2.4 Design Criteria

The Master Servicing Plan Update has used the following design criteria to project wastewater flows, determine capacity requirements and establish the wastewater infrastructure program:

- Residential Average Day Demand: 275 Lpcd
- Employment Average Day Demand: 275 Lped
- Peak Factor based on Harmon formula with values between 2 and 4 with consideration to the catchment area performance.
- Utilize an extraneous flow rate of 0.286 L/ha/s as the wet weather level of service for triggering and sizing Regional wastewater infrastructure.

2.5 Flow Projection

2.5.1 Starting Point Methodology

Niagara Region provided daily flows at each plant for 2011 – 2015. Using this data, an average daily flow was calculated for each year. The five year rolling average of average day flows was used to establish baseline (2014*) system average day flows.

2.5.2 Growth Flow Projections

Future average daily system flows at wastewater treatment plant facilities were developed using a starting point methodology. Expected flow due to growth were added to the starting point flows to establish future flows. An example for the Welland system is provided below.

44.8 MLD = 35.6 MLD + (129,679 – 96,106) * 275 Lpcd
2041 ADD = Baseline ADD + (2041 total equ.pop. – 2014 total equ.pop) * 275 Lpcd

Table 4.3 Wastewater Flow Projections

Wastewater System	2014 – 2041 Growth *			2014	2041
	Growth Population	Growth Employment	Total Equivalent Growth	Average Daily Flow (MLD)	Average Daily Flow (MLD)
Baker Road Wastewater Treatment Plant (WWTP)	31,428	12,229	43,656	20.5	32.5
Port Dalhousie WWTP	24,252	14,761	39,012	34.7	45.4
Port Weller WWTP	17,601	8,531	26,995	36.0	43.4
Niagara-on-the-Lake WWTP	5,140	1,735	6,874	4.4	6.3
Niagara Falls WWTP	38,321	13,626	51,949	41.5	55.8
Stevensville and Douglastown Lagoons	1,544	522	2,068	1.3	1.9
Anger Avenue WWTP	7,666	3,456	11,119	13.1	16.2
Crystal Beach WWTP	3,495	256	3,752	5.5	6.5
Seaway WWTP	3,014	1,202	4,216	12.1	13.3
Welland WWTP	25,065	8,508	33,571	35.6	44.8

* Note: The Master Servicing Plan Update has an established baseline condition of year 2014. 2014 represents the best available system information and system calibration data for the water and wastewater models at the time of study initiation. The Master Servicing Plan Update has projected wastewater flows from year 2014 to establish the 2041 infrastructure needs.

2.6 Wastewater Infrastructure Capacity

2.6.1 Sizing of Treatment Plant

Treatment plants are designed to treat the average daily flows. The following criteria were used to assess when water treatment facilities require expansion, as agreed upon with the Region.

- When flows reach 80% of plant capacity, the planning process for plant expansion will be flagged.
- When 90% of plant capacity has been reached, expansion should be completed.

2.6.2 Sizing of Pumping Station

Pumping stations are sized to provide peak wet weather flows, using the extraneous flow rate of 0.286 L/ha/s.

The following criterion is used to assess when a pumping station requires expansion:

- Capacity expansion will be triggered once the peak wet weather flow reaches the station's firm capacity.

Once capacity expansion has been triggered, site capacity will be evaluated to determine if a new or expanded site is required. When proposing a new site for a pumping station, an allowance in building facility and equipment will be considered to account for future expansion and staging of works.

The following presents an example calculation of projected peak dry weather flow.

2041 Peak Dry Weather Flow for Douglastown Sewage Pumping Station:
= (2014 Average Dry Weather Flow × Peaking Factor) +
(2041 Equivalent Population – 2014 Equivalent Population) × 275 L/cap/day ×
1 day/86400 s × Harmon Peaking Factor for Growth Population
= (2.66 L/s × 2.0) + (2,818 – 1,523 people) × 275 L/cap/day × 1 day/86400 s × 3.465
= 19.6 L/s

The following presents an example calculation of projected peak wet weather flow.

2041 Peak Wet Weather Flow for Douglastown Sewage Pumping Station:
= 2041 Peak Dry Weather Flow + 2041 Design RDII
= 2041 Peak Dry Weather Flow + (2041 Catchment Area × 0.286 L/s/ha)
= 19.6 L/s + (97.9 ha × 0.286 L/s/ha)
= 47.6 L/s

2.6.3 Sizing of Forcemains

Forcemain capacity is sized based on the firm capacity of the pumping station.

The following criterion is used to assess when a forcemain for a pumping station requires expansion:

- Capacity expansion will be triggered once the forcemain design velocity exceeds 2.5 m/s.

Sizing of new forcemains will target the following criteria:

- Design velocity exceeds 0.8 m/s with an ideal target of 1.0 m/s
- Where presently feasible, capacity requirements will be achieved by twinning of existing forcemain with same size as existing.

2.6.4 Sizing of Sewermains

Sewer capacities are sized to provide peak wet weather flows, using the extraneous flow rate of 0.286 L/ha/s (2.6.2).

The following criterion is used to assess when a sewermain requires expansion:

- Capacity expansion will be triggered once the sewermains peak hydraulic grade line exceeds the pipe obvert.

Sizing of new sewermains will have the following criterion:

- Target 2041 peak wet weather flows hydraulic grade line less than 70% of pipe obvert.

3. WASTEWATER SERVICING STRATEGY

3.1 Servicing Principles and Policies

Through the course of the Master Servicing Plan Update, priority policy areas were brought forward including:

- Health and safety;
- System reliability and security;
- Reserve capacity for operational flexibility and level of service;
- Impacts of climate change;
- Considerations to energy use and efficiency;
- Recognition of impacts from water efficiency and conservation;
- Addressing issues related to the full lifecycle of water and wastewater services.

A comprehensive list of general wastewater policies were established. As a result from the priority policy areas, key principle and policy statements were developed as highlighted below:

- Niagara Region will endeavor to maintain sufficient reserve capacity in its water and wastewater infrastructure and facilities to provide operational flexibility and meet potential changes in servicing conditions
- Niagara Region shall endeavor to provide reliability, redundancy and security in its water and wastewater systems with attention to high risk and critical areas
- Niagara Region shall be aware of and consider the potential impact of climate change on the planning and sizing of infrastructure
- Niagara region shall design wastewater facilities with consideration to energy use
- Niagara Region will review a combination of servicing strategies including infrastructure and non-infrastructure (e.g. i/i reduction) solutions to meet wet weather level of service and provide sufficient wastewater capacity
- Niagara Region will approach Guidelines F-5-5 and F-5-1 such that new development will not put the Region out of compliance with regulations and the Region will consider opportunities to not increase wet weather overflows beyond current conditions

3.2 Evaluation Methodology

The process for developing, evaluating and selecting the preferred wastewater servicing strategy followed these key steps:

- Review of baseline conditions across each wastewater system;
- Identify opportunities and constraints for each system;

- Develop high level servicing concepts;
- Review each concept with respect to environmental, social, legal, technical and financial factors. Develop advantages and disadvantages for each;
- Provide additional detail for the preferred concept ensuring alignment, siting, capacity, timing and other technical factors are identified; and
- Develop a conceptual cost estimate for each project.

Each alternative was evaluated through the reasoned argument approach which provided a clear and thorough rationale of the trade-offs among the various options based on the anticipated impacts caused by various evaluation criteria and factors. The basis of this approach is to qualitatively evaluate the relative advantages, disadvantages, and impacts of each alternative against the established criteria. This process was intended to highlight why the preferred alternative was chosen through evaluation of technical, environmental, social/cultural, financial, and legal/jurisdictional criteria.

3.3 Alternative Strategies

The wastewater systems across the Region are impacted not only by growth but through wet weather responses in the systems compromising infrastructure capacity.

When reviewing wastewater system servicing alternatives, 3 typical strategies were considered for all systems:

1. Capacity Upgrades: Wastewater Treatment Plant (WWTP), Pumping (SPS), Trunk Sewer
2. Upstream Management: Storage, Peak Shaving, Diversion
3. Peak Flow Management: Flow Reduction, Rainfall Derived Inflow and Infiltration (RDII) Removal

In the review and evaluation of the 3 strategies it was found that hybrid approach should be used consisting of:

- Providing capacity within Regional SPS and trunk sewer to convey peak wet weather flows up to the design criteria of 0.286 L/s/ha.
- Provide upstream flow management and peak flow management address peak flows in systems where peak wet weather flows exceed the design criteria of 0.286 L/s/ha resulting in basement flooding and overflow risks.

Under this strategy:

- The existing regional infrastructure configuration would remain as is, with capacity upgrades to existing facilities as needed.
- The best strategy for upstream flow management and peak flow management would de identified through next step area-specific wet weather flow studies, including Pollution Prevention Control Plan, Inflow and Infiltration Study, Intensification Studies, and others.
- Upstream flow management and peak flow management projects would be primarily lead by local municipalities with support from the Region.
- Wet weather management projects would prioritize growth areas with existing wet weather flow issues.

Further to the overall hybrid approach, area-specific alternatives were reviewed where warranted.

4. CAPITAL PROGRAM

4.1 Wastewater System Recommendations Overview

A summary of the key aspects of the wastewater servicing strategy are in Table 4.4.

Table 4.4 Wastewater Servicing Strategy

System	Special Project Implementation and Considerations
Baker Road	• Based on the level of growth in the system, the Baker Road Wastewater Treatment Plant (WWTP) will require additional wastewater treatment capacity. • The projected growth and wet weather flow needs across much of the service area has triggered sewage pumping station (SPS) upgrades across many of the facilities. • The SPS upgrades and potential trunk sewer capacity constraints will be mitigated by implementing wet weather management programs in West Grimsby, Beamsville and Vineland. • There is significant growth projected in Smithville in relation to existing infrastructure capacity. A new trunk sewer in the community plus an expansion of the SPS will be required for the growth flows. The additional SPS capacity will require forcemain twinning and trunk sewer capacity upgrades downstream of the new forcemain.
Port Dalhousie	• While infrastructure capacity upgrades were considered, the recommended solution for the Port Dalhousie WWTP system is to provide wet weather management across the system. This will require Regional solutions as well as local municipal solutions. • An upgrade to the Beaverdams SPS has been identified to support growth in the area. • With implementation of the wet weather program, the Port Dalhousie WWTP will have sufficient capacity to meet growth to year 2041.

System	Special Project Implementation and Considerations
Port Weller	• While infrastructure capacity upgrades were considered, the recommended solution for the Port Weller WWTP wastewater system is to provide wet weather management across the system. This will require Regional solutions as well as local municipal solutions. • In addition to the wet weather program, there is opportunity to re-direct the Thorold South wastewater flows to the new South Niagara Falls system. • The preferred strategy includes upgrades to the Peel Street SPS and forcemain to pump south and upgrades to the Black Horse SPS and forcemain to pump to the new South Niagara Falls wastewater system. • The preferred strategy will remove flows from Thorold South on the Port Weller system alleviating some existing capacity impacts. • With implementation of the wet weather program and redirecting the Thorold South flows, the Port Weller WWTP will have sufficient capacity to meet growth to year 2041.
Niagara-On-The-Lake	• The pockets of urban areas in Niagara-On-The-Lake ultimately convey flows to the Niagara-On-The-Lake WWTP. There is some growth projected for these areas. • The Niagara-On-The-Lake WWTP is a newly constructed facility. The WWTP has sufficient capacity to support growth to year 2041. • The wastewater strategy is comprised of only a few sewage pumping station capacity upgrades to address additional growth flows. • Wet weather management is recommended for the system.
Queenston	• The Queenston WWTP system is a small system in Niagara-On-The-Lake. There is minimal growth projected and the system has capacity to support its needs. However, from a lifecycle perspective, it can be inefficient to operate small independent systems. • The South Niagara Falls wastewater strategy presents opportunities for adjacent systems. On this basis, it is recommended to redirect the Queenston flows with a new sewage pumping station to Niagara Falls and decommission the Queenston WWTP.

System	Special Project Implementation and Considerations
Niagara Falls	• Based on the level of growth in the system, the Niagara Falls WWTP is approaching capacity within the 2041 planning horizon. The plant is aging and requires sustainability upgrades to maintain level of service. • Conveying growth flows to the Niagara Falls WWTP will require significant infrastructure upgrades across the system and within the built boundary of the City. • Given the level of impact on the existing system based on current system conveyance, a broader evaluation process was undertaken to develop Niagara Falls servicing alternatives. A South Niagara Falls wastewater strategy was developed. • The South Niagara Falls wastewater strategy resulted in the recommendation for a new South Niagara Falls WWTP. • The Niagara Falls service area south of Lundy's Lane will convey flows to the new plant. The remaining service areas will continue to convey flows to the existing plant. • Capacity upgrades in the St. David's area are required to support growth. This area, as well as the Queenston service area, will direct flows to the existing plant. • The Thorold South service area will be directed to the new South Niagara Falls WWTP. • The South Side High Lift pumping station will be directed south to the new plant. • Isolated pumping stations will require capacity upgrades to support the project growth. • In order to minimize infrastructure upgrades, wet weather management will be required across the Niagara Falls system.
Stevensville and Douglastown	• The treatment plant will have sufficient capacity to support growth to 2041. • The Stevensville SPS will require additional capacity. • Wet weather management is recommended for the system.

System	Special Project Implementation and Considerations
Anger Avenue	• The Anger Avenue WWTP has sufficient capacity to support growth to year 2041. • The projected growth will require expansions at Alliston SPS, Lakeshore Road SPS, and Catherine Street SPS and forcemain. • Additional wet weather management is recommended to minimize impact to existing infrastructure and support the growth to year 2041
Crystal Beach	• The Crystal Beach WWTP has sufficient capacity to support growth to year 2041. • The growth flows will require additional capacity at the Nigh Road SPS and Shirley Road SPS. • Additional wet weather management in the core of the service area is recommended to minimize impact to existing infrastructure and support growth to year 2041.
Seaway	• The Seaway WWTP has sufficient capacity to support growth to year 2041. • The projected growth will require pumping station expansions at Oxford Road SPS, Steele Street SPS and Rosemount South SPS. • Additional wet weather management, particularly on the east side of the canal is recommended to minimize impact to existing infrastructure and support growth to year 2041.
Welland	• The Welland WWTP has sufficient capacity to support growth to year 2041. • Due to the projected growth in the Fenwick area, additional pumping station and forcemain capacity is required. • Additional capacity is required at the Hurricane Road SPS and Towpath SPS. • Additional conveyance capacity across Highway 406 at the Towpath SPS is required to support growth. • The wet weather management program within the core areas of Welland and within the combined sewer systems is required to support growth and minimize infrastructure costs within the built boundary.

4.2 Wet Weather Management Strategy

A significant element of the Niagara Region wastewater servicing strategy is the wet weather management program.

The Niagara Region wastewater systems are a mix of separated and combined sewer systems. Each system experiences varying levels of impact during wet weather conditions. Climate change continues to create changing weather conditions and the wastewater systems experience high peak flows under rainfall events in most cases. Providing infrastructure capacity for the peak flow events would require upgrades not only for local sewers, but also trunk sewers, pumping stations and ultimately the treatment plants. The infrastructure capacity approach can prove costly.

The wet weather management program has been developed to identify targeted amounts of inflow and infiltration reduction. The program is intended to deal with existing capacity constraints, and to provide for growth-related capacity without expanding/upgrading existing trunk infrastructure, or by minimizing the required expansion/upgrade.

The wet weather management program currently identifies overall preliminary priority, staging of location and target amount of inflow and infiltration reduction across all systems. This program provides for a proactive and targeted approach to addressing wet weather impacts.

4.3 South Niagara Falls Servicing Strategy

The South Niagara Falls servicing strategy has been highlighted based on the significant change in servicing strategy from previous Master Plans.

The Niagara 2041 planning exercise resulted in significant growth in South Niagara Falls, partly based on the extension of the planning horizon from 2031 to 2041. It is noted that 64% of the growth in Niagara Falls is projected south of Lundy's Lane and 22.5% of the growth is projected south of the Welland River. This growth in combination with wet weather issues in South Niagara Falls as well as servicing constraints in adjacent wastewater systems including Thorold South and St. Catharines, prompted a broader review of wastewater servicing strategies for the area.

The analysis for the South Niagara Falls servicing strategy followed these principal steps:

- Review of system integration opportunities
- Hydraulic analysis of the systems
- Preliminary identification of infrastructure needs and alignments/sites

- Detailed cost benefit analysis considering capital, lifecycle and offsetting cost components
- Multiple bottom line evaluation process

The analysis developed and evaluated two options for the servicing of future growth:

1. Go North: Accommodate only the south Niagara Falls growth through the existing Niagara Falls Wastewater Treatment Plant (Go North) including all necessary upgrades / upsizing of existing infrastructure.
2. New Plant: Construct a new South Niagara Falls Wastewater Treatment Plant (New Plant), divide the Niagara Falls service area into two, provide additional capacity suitable for the servicing of Thorold South, introduce additional capacity in the Port Weller sewer shed area of St. Catharines, create the opportunity to service future growth in the St. David's area of Niagara-on-the-Lake, and introduce significant capacity in the north sewer shed area of Niagara Falls for intensification and growth.

Option 2 – New Plant was selected as the preferred South Niagara Falls servicing strategy. Overall comments related to the selection of the New Plant option are:

- Providing a new South Niagara Falls Wastewater Treatment Plant provides the greatest flexibility and support for long term servicing and benefit to the Niagara Falls and surrounding systems.
- A New Plant provides the greatest opportunity to mitigate risks including cost risks, implementation risks, and capacity risks.
- The New Plant option does have higher capital costs for 2041 program and higher annual lifecycle costs than the Go North option. However, the New Plant can provide more flexible and less expensive post 2041 costs.
- Based on the opportunity to implement green technologies and address wet weather issues, the New Plant provides opportunity for other funding sources similar to the Niagara-on-the-Lake plant.

Under either option, continued sustainability upgrades will be required for existing infrastructure including the existing Niagara Falls Wastewater Treatment Plant.

4.4 Capital Program

A summary of the wastewater servicing strategy capital program with details for each project is provided in Table 4.5.

Table 4.5 Wastewater Servicing Strategy

Master Plan ID	Name	Description	Size / Capacity	Year in Service	Municipality	Class EA Schedule	Class EA Status	Project Type	Total Component Estimated Cost
WW-D-001	Decommissioning of Queenston Wastewater Treatment Plant (WWTP)	Decommissioning of Queenston WWTP, to be replaced by new SPS and forcemain to St. David's #1	N/A	2022-2031	Niagara Falls	A+	To be Satisfied Under Consolidated Queenstown Schedule B EA - Separate Study	Treatment	$ 1,979,000
WW-FM-001	Upgrade Catherine Street Sewage Treatment Plant (SPS) Forcemain	Upgrade Catherine Street SPS Forcemain in Fort Erie	300 mm	2032-2041	Fort Erie	A+	Satisfied	Forcemain	$ 467,000
WW-FM-003	Upgrade Foss Road SPS Forcemain	Upgrade Foss Road SPS Forcemain in Welland	250 mm	2022-2031	Pelham	A+	Satisfied	Forcemain	$ 4,500,000
WW-FM-004	Laurie Avenue SPS Forcemain Upgrade	Laurie Avenue SPS Forcemain Upgrade in Lincoln	250 mm	2017-2021	Lincoln	A+	Satisfied	Forcemain	$ 2,981,000
WW-FM-005	New Peel Street SPS Forcemain	New Peel Street SPS Forcemain in Thorold from station to Black Horse SPS	400 mm	2022-2031	Thorold	A+	To be Satisfied Under Consolidated South NF Schedule C EA - Separate Study	Forcemain	$ 4,889,000
WW-FM-006	New Black Horse Forcemain to Niagara Falls	New Black Horse Forcemain to Niagara Falls	400 mm	2022-2031	Niagara Falls	A+	To be Satisfied Under Consolidated South NF Schedule C EA - Separate Study	Forcemain	$ 9,820,000
WW-FM-008	South Side High Lift conveyance	South Side High Lift to new South Niagara Falls WWTP	900 mm	2022-2031	Niagara Falls	A+	To be Satisfied Under Consolidated South NF Schedule C EA - Separate Study	Sewer	$ 38,039,000
WW-FM-009	Dorchester Forcemain twinning	Twin existing Dorchester Forcemain in Niagara Falls	300 mm	2022-2031	Niagara Falls	A+	Satisfied	Forcemain	$ 303,000
WW-FM-010	St. Davids #1 Forcemain twinning	Twin existing St. Davids #1 Forcemain in Niagara-on-the-Lake	300 mm	2022-2031	Niagara-on-the-Lake	A+	Dependent on outcome of wet weather flow study	Forcemain	$ 3,923,000
WW-FM-011	Smithville Forcemain twinning	Twin existing Smithville Forcemain	400 mm	2022-2031	West Lincoln	A+	Satisfied	Forcemain	$ 18,132,000

Master Plan ID	Name	Description	Size / Capacity	Year in Service	Municipality	Class EA Schedule	Class EA Status	Project Type	Total Component Estimated Cost
WW-FM-012	New Queenston Forcemain	New Queenston Forcemain into Niagara Falls system	250 mm	2022-2031	Niagara-on-the-Lake	A+	To be Satisfied Under Consolidated Queenstown Schedule B EA - Separate Study	Forcemain	$ 11,136,000
WW-II-001	Wet weather reduction in East Fort Erie	Wet weather reduction in East Fort Erie	30 L/s reduction	2022-2031	Fort Erie	N/A	Dependent on outcome of wet weather flow study	Wet Weather Reduction	$ 4,500,000
WW-II-002	Wet weather reduction in Crystal Beach	Wet weather reduction in Crystal Beach	30 L/s reduction	2022-2031	Fort Erie	N/A	Dependent on outcome of wet weather flow study	Wet Weather Reduction	$ 4,500,000
WW-II-003	Wet weather reduction in Stevensville/Douglastown	Wet weather reduction in Stevensville/Douglastown	30 L/s reduction	2022-2031	Fort Erie	N/A	Dependent on outcome of wet weather flow study	Wet Weather Reduction	$ 4,500,000
WW-II-004	Wet weather reduction in Central Welland	Wet weather reduction in Central Welland	200 L/s reduction	2022-2031	Welland	N/A	Dependent on outcome of wet weather flow study	Wet Weather Reduction	$ 30,000,000
WW-II-005	Wet weather reduction in West Grimsby	Wet weather reduction in West Grimsby	50 L/s reduction	2022-2031	Grimsby	N/A	Dependent on outcome of wet weather flow study	Wet Weather Reduction	$ 7,500,000
WW-II-006	Wet weather reduction in Beamsville	Wet weather reduction in Beamsville	20 L/s reduction	2022-2031	Lincoln	N/A	Dependent on outcome of wet weather flow study	Wet Weather Reduction	$ 3,000,000
WW-II-007	Wet weather reduction in Jordan Valley	Wet weather reduction in Jordan Valley	10 L/s reduction	2022-2031	Lincoln	N/A	Dependent on outcome of wet weather flow study	Wet Weather Reduction	$ 1,500,000
WW-II-008	Wet weather reduction in St. Catharines - Port Dalhousie	Wet weather reduction in St. Catharines - Port Dalhousie	200 L/s reduction	2022-2031	St. Catharines	N/A	Dependent on outcome of wet weather flow study	Wet Weather Reduction	$ 30,000,000
WW-II-009	Wet weather reduction in North Thorold	Wet weather reduction in North Thorold	90 L/s reduction	2022-2031	Thorold	N/A	Dependent on outcome of wet weather flow study	Wet Weather Reduction	$ 13,500,000
WW-II-010	Wet weather reduction in St. Catharines and Thorold - Port Weller	Wet weather reduction in St. Catharines and Thorold - Port Weller	134 L/s reduction	2017-2021	St. Catharines	N/A	Dependent on outcome of wet weather flow study	Wet Weather Reduction	$ 20,100,000

Master Plan ID	Name	Description	Size / Capacity	Year in Service	Municipality	Class EA Schedule	Class EA Status	Project Type	Total Component Estimated Cost
WW-II-011	Wet weather reduction in Central Port Colborne	Wet weather reduction in Central Port Colborne	20 L/s reduction	2022-2031	Port Colborne	N/A	Dependent on outcome of wet weather flow study	Wet Weather Reduction	$ 3,000,000
WW-II-012	Wet weather reduction in Central Niagara Falls	Wet weather reduction in Central Niagara Falls	100 L/s reduction	2022-2031	Niagara Falls	N/A	Dependent on outcome of wet weather flow study	Wet Weather Reduction	$ 15,000,000
WW-II-013	Wet weather reduction in South Side Niagara Falls	Wet weather reduction in South Side Niagara Falls	100 L/s reduction	2017-2021	Niagara Falls	N/A	Dependent on outcome of wet weather flow study	Wet Weather Reduction	$ 15,000,000
WW-II-014	Wet weather reduction in Northeast Niagara-on-the-Lake	Wet weather reduction in Northeast Niagara-on-the-Lake	5 L/s reduction	2022-2031	Niagara-on-the-Lake	N/A	Dependent on outcome of wet weather flow study	Wet Weather Reduction	$ 750,000
WW-II-015	Wet weather reduction in Virgil	Wet weather reduction in Virgil – Niagara-on-the-Lake	5 L/s reduction	2022-2031	Niagara-on-the-Lake	N/A	Dependent on outcome of wet weather flow study	Wet Weather Reduction	$ 750,000
WW-SPS-001	Alliston SPS Pump Replacement - Anger Avenue	Increase station capacity from 43 L/s to 129 L/s.	129 L/s	2022-2031	Fort Erie	A+	Satisfied	Pumping	$ 989,000
WW-SPS-002	Catherine Street SPS Expansion - Anger Avenue	Increase station capacity from 117 L/s to 140 L/s	140 L/s	2032-2041	Fort Erie	A+	Satisfied	Pumping	$ 2,945,000
WW-SPS-003	Lakeshore SPS Upgrade - Anger Avenue	Increase station capacity from 63 L/s to 70 L/s	70 L/s	2022-2031	Fort Erie	A+	Satisfied	Pumping	$ 2,618,000
WW-SPS-004	Shirley SPS Upgrade - Crystal Beach	Increase station capacity from 29 L/s to 63 L/s; Also includes sustainability upgrades to the station	63 L/s	2032-2041	Fort Erie	A+	Satisfied	Pumping	$ 2,889,000
WW-SPS-005	Nigh Road SPS Pump Replacement - Crystal Beach	Increase station capacity from 29 L/s to 45 L/s Use implementation plan prior to upgrade: Flow monitoring, validate wet weather flows, re-evaluate required upgrades	45 L/s	2022-2031	Fort Erie	A+	Dependent on outcome of wet weather flow study	Pumping	$ 989,000
WW-SPS-006	Stevensville SPS Upgrade - Stevensville Douglastown	Increase station capacity from 42 L/s to 65 L/s	65 L/s	2022-2031	Fort Erie	A+	Satisfied	Pumping	$ 1,022,000

Master Plan ID	Name	Description	Size / Capacity	Year in Service	Municipality	Class EA Schedule	Class EA Status	Project Type	Total Component Estimated Cost
WW-SPS-007	Rosemount South SPS Pump Replacement - Seaway	Increase station capacity from 9 L/s to 17 L/s	17 L/s	2017-2021	Port Colborne	A+	Satisfied	Pumping	$ 665,000
WW-SPS-008	Oxford SPS Pump Replacement - Seaway	Increase station capacity from 7 L/s to 10 L/s	10 L/s	2032-2041	Port Colborne	A+	Satisfied	Pumping	$ 665,000
WW-SPS-009	Steele SPS Pump Replacement - Seaway	Increase station capacity from 16 L/s to 40 L/s	40 L/s	2032-2041	Port Colborne	A+	Satisfied	Pumping	$ 989,000
WW-SPS-011	Foss Road SPS Upgrade - Welland	Increase station capacity from 27 L/s to 76 L/s	76 L/s	2022-2031	Pelham	B	Satisfied (Project File Included)	Pumping	$ 1,866,000
WW-SPS-012	Smithville SPS Expansion - Baker Road	Increase station capacity from 120 L/s to 375 L/s	375 L/s	2022-2031	West Lincoln	B	Satisfied (Project File Included)	Pumping	$ 8,241,000
WW-SPS-013	Campden SPS Pump Replacement - Baker Road	Increase station capacity from 11 L/s to 19 L/s pumps	19 L/s	2022-2031	Lincoln	A+	Satisfied	Pumping	$ 1,299,000
WW-SPS-014	Laurie Avenue SPS Expansion - Baker Road	Increase station capacity from 28 L/s to 48 L/s	48 L/s	2017-2021	Lincoln	B	Satisfied (Project File Included)	Pumping	$ 1,814,000
WW-SPS-015	Victoria Avenue SPS Upgrade - Baker Road	Increase station capacity from 120 L/s to 230 L/s	230 L/s	2017-2021	Lincoln	B	Satisfied (Project File Included)	Pumping	$ 4,051,000
WW-SPS-016	Bridgeport SPS Pump Replacement - Baker Road	Increase station capacity from 11 L/s to 24 L/s Use implementation plan prior to upgrade: Flow monitoring, validate wet weather flows, re-evaluate required upgrades	24 L/s	2022-2031	Lincoln	A+	Dependent on outcome of wet weather flow study	Pumping	$ 834,000
WW-SPS-017	Jordan Valley SPS Pump Replacement - Baker Road	Increase station capacity from 40 L/s to 74 L/s Use implementation plan prior to upgrade: Flow monitoring, validate wet weather flows, re-evaluate required upgrades	74 L/s	2022-2031	Lincoln	A+	Dependent on outcome of wet weather flow study	Pumping	$ 1,145,000
WW-SPS-018	Ontario Street SPS Upgrade - Baker Road	Increase station capacity from 420 L/s to 600 L/s	600 L/s	2032-2041	Lincoln	B	Satisfied (Project File Included)	Pumping	$ 3,755,000
WW-SPS-019	Biggar Lagoon Pump Replacement - Baker Road	Increase station capacity from 60 L/s to 105 L/s; Also includes SOGR project as per Niagara Region capital forecast	105 L/s	2017-2021	Grimsby	A+	Satisfied	Pumping	$ 3,902,000

Master Plan ID	Name	Description	Size / Capacity	Year in Service	Municipality	Class EA Schedule	Class EA Status	Project Type	Total Component Estimated Cost
WW-SPS-020	Lake Street SPS Upgrade - Baker Road	Increase station capacity from 375 L/s to 495 L/s	495 L/s	2017-2021	Grimsby	B	Satisfied (Project File Included)	Pumping	$ 4,410,000
WW-SPS-021	Beaverdams SPS Pump Replacement - Port Dalhousie	Increase station capacity from 10 L/s to 20 L/s	20 L/s	2017-2021	Thorold	A+	Satisfied	Pumping	$ 665,000
WW-SPS-025	Garner Road SPS Pump Replacement - Niagara Falls	Increase station capacity from 81 L/s to 206 L/s. Addition of a third 103 L/s pump	206 L/s	2032-2041	Niagara Falls	B	Satisfied (Project File Included)	Pumping	$ 824,000
WW-SPS-026	Dorchester SPS Pump Replacement - Niagara Falls	Increase station capacity from 220 L/s to 270 L/s	270 L/s	2022-2031	Niagara Falls	A+	Satisfied	Pumping	$ 2,414,000
WW-SPS-028	Black Horse SPS Upgrade - South Niagara Falls	Increase station capacity from 21 L/s to 180 L/s	180 L/s	2022-2031	Thorold	C	To be Satisfied Under Consolidated South NF Schedule C EA - Separate Study	Pumping	$ 4,620,000
WW-SPS-031	St. Davids #2 SPS Expansion - Niagara Falls	Increase station capacity from 44 L/s to 104 L/s	104 L/s	2022-2031	Niagara-on-the-Lake	B	Dependent on outcome of wet weather flow study	Pumping	$ 3,836,000
WW-SPS-032	St. Davids #1 SPS Upgrade - Niagara Falls	Increase station capacity from 41 L/s to 88 L/s Use implementation plan prior to upgrade: Flow monitoring, validate wet weather flows, re-evaluate required upgrades	88 L/s	2022-2031	Niagara-on-the-Lake	B	Dependent on outcome of wet weather flow study	Pumping	$ 1,794,000
WW-SPS-033	Lakeshore Road SPS Pump Replacement - Niagara-on-the-Lake	Increase station capacity from 90 L/s to 142 L/s	142 L/s	2032-2041	Niagara-on-the-Lake	A+	Satisfied	Pumping	$ 1,512,000
WW-SPS-034	Niagara Stone Road SPS Pump Replacement - Niagara-on-the-Lake	Increase station capacity from 22 L/s to 27 L/s	27 L/s	2032-2041	Niagara-on-the-Lake	A+	Satisfied	Pumping	$ 834,000
WW-SPS-035	Line 2 SPS Pump Replacement – Niagara-on-the-Lake	Increase station capacity from 8 L/s to 17 L/s	17 L/s	2017-2021	Niagara-on-the-Lake	A+	Satisfied	Pumping	$ 665,000

Master Plan ID	Name	Description	Size / Capacity	Year in Service	Municipality	Class EA Schedule	Class EA Status	Project Type	Total Component Estimated Cost
WW-SPS-036	Garrison Village SPS Pump Replacement - Niagara-on-the-Lake	Increase station capacity from 62 L/s to 68 L/s	68 L/s	2032-2041	Niagara-on-the-Lake	A+	Satisfied	Pumping	$ 1,250,000
WW-SPS-037	Towpath SPS Pump Replacement - Welland	Increase station capacity from 150 L/s to 300 L/s. Addition of a third 150 L/s pump.	300 L/s	2022-2031	Thorold	A+	Satisfied	Pumping	$ 834,000
WW-SPS-038	Huricane Road SPS Pump Replacement - Welland	Increase station capacity from 39 L/s to 52 L/s	52 L/s	2022-2031	Pelham	A+	Satisfied	Pumping	$ 1,250,000
WW-SPS-039	Queenston SPS	New Queenston SPS with firm capacity of 45 L/s	45 L/s	2022-2031	Niagara-on-the-Lake	B	To be Satisfied Under Consolidated Queenstown Schedule B EA - Separate Study	Pumping	$ 2,996,000
WW-SS-001	Highway 406 Trunk Sewer Crossing	New trunk sewer crossing of HWY 406 between Merritt Rd and recreational waterway in Thorold to support development of the Port Robinson West area	600 mm	2017-2021	Thorold	A+	Satisfied	Sewer	$ 1,450,000
WW-SS-002	Quaker Road Trunk Sewer	New sewer on Quaker Rd. between Pelham Street trunk and Rice Road trunk sewers	600 mm	2022-2031	Welland	A+	Satisfied	Sewer	$ 1,725,000
WW-SS-003	Gravity Sewer upgrade in Grimsby	Upgrade gravity sewer downstream of Smithville forcemain from 375 mm to 525 mm	525 mm	2022-2031	Grimsby	A+	Satisfied	Sewer	$ 5,667,000
WW-SS-004	Gravity Sewer upgrade in Grimsby	Upgrade gravity sewer downstream of Smithville forcemain from 375 mm to 525 mm	525 mm	2022-2031	Grimsby	A+	Satisfied	Sewer	$ 923,000
WW-SS-005	Gravity Sewer upgrade in Smithville	Upgrade gravity sewer upstream of Smithville SPS from 450 mm to 600 mm	600 mm	2022-2031	West Lincoln	A+	Satisfied	Sewer	$ 2,286,000
WW-TP-001	Baker Road WWTP Upgrade	Baker Road WWTP Upgrade to provide an additional 16 MLD	47.3 MLD	2022-2031	Grimsby	C	Separate EA Required	Treatment	$ 41,730,000
WW-TP-002	South Niagara Falls Wastewater Treatment Plant	New South Niagara Falls WWTP	30 MLD	2022-2031	Niagara Falls	C	Separate EA Required	Treatment	$ 128,186,000
Total									**$ 500,318,000**

PART K
WELLAND WASTEWATER SYSTEM

K. WELLAND WASTEWATER TREATMENT PLANT

K.1 Existing System Overview

The Welland wastewater system services the City of Welland, Town of Pelham, and the Port Robinson area of City of Thorold. The system services an existing population of 68,722 residents and 27,380 employees[1].

The system is serviced by the Welland Wastewater Treatment Plant, located on 505 River Road, R.R. #1, Welland City. The Welland Wastewater Treatment Plant has conventional activated sludge treatment, grit removal, effluent disinfection and tertiary filtration.

Welland Wastewater Treatment Plant has a current rated capacity of 54.6 MLD and a peak flow capacity of 136.2 MLD[2].

Figure 4.K.1 and Figure 4.K.2 present an overview of the wastewater system and a wastewater system schematic diagram, respectively.

[1] *Hemson Consulting Ltd, 2016. Niagara Region TAZ Forecasts to 2041*

[2] *Ministry of Environment and Climate Change, 30 July 2015. Ammeded Environmental Compliance Approval. Number 5599-9VTGG2*

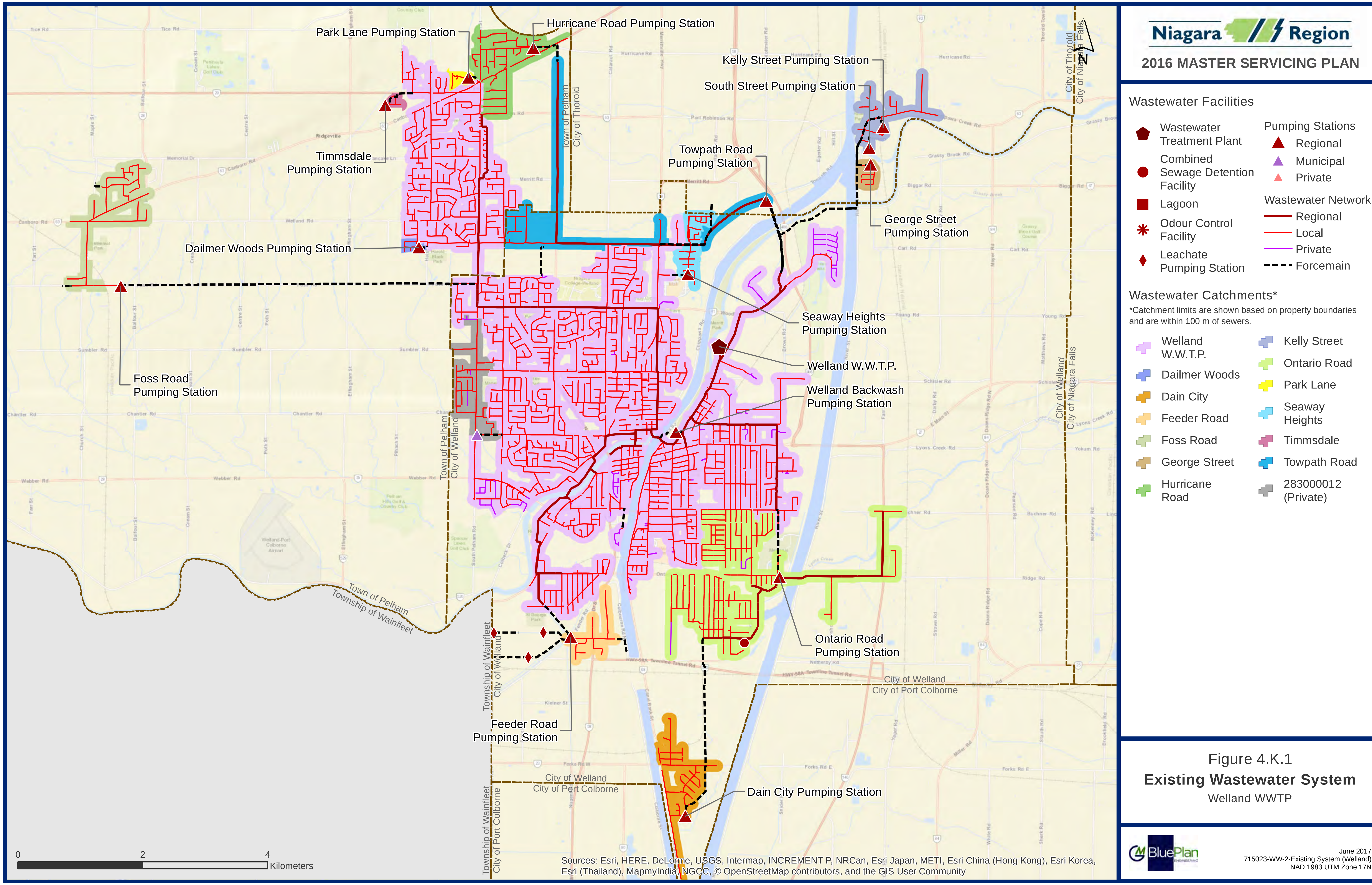
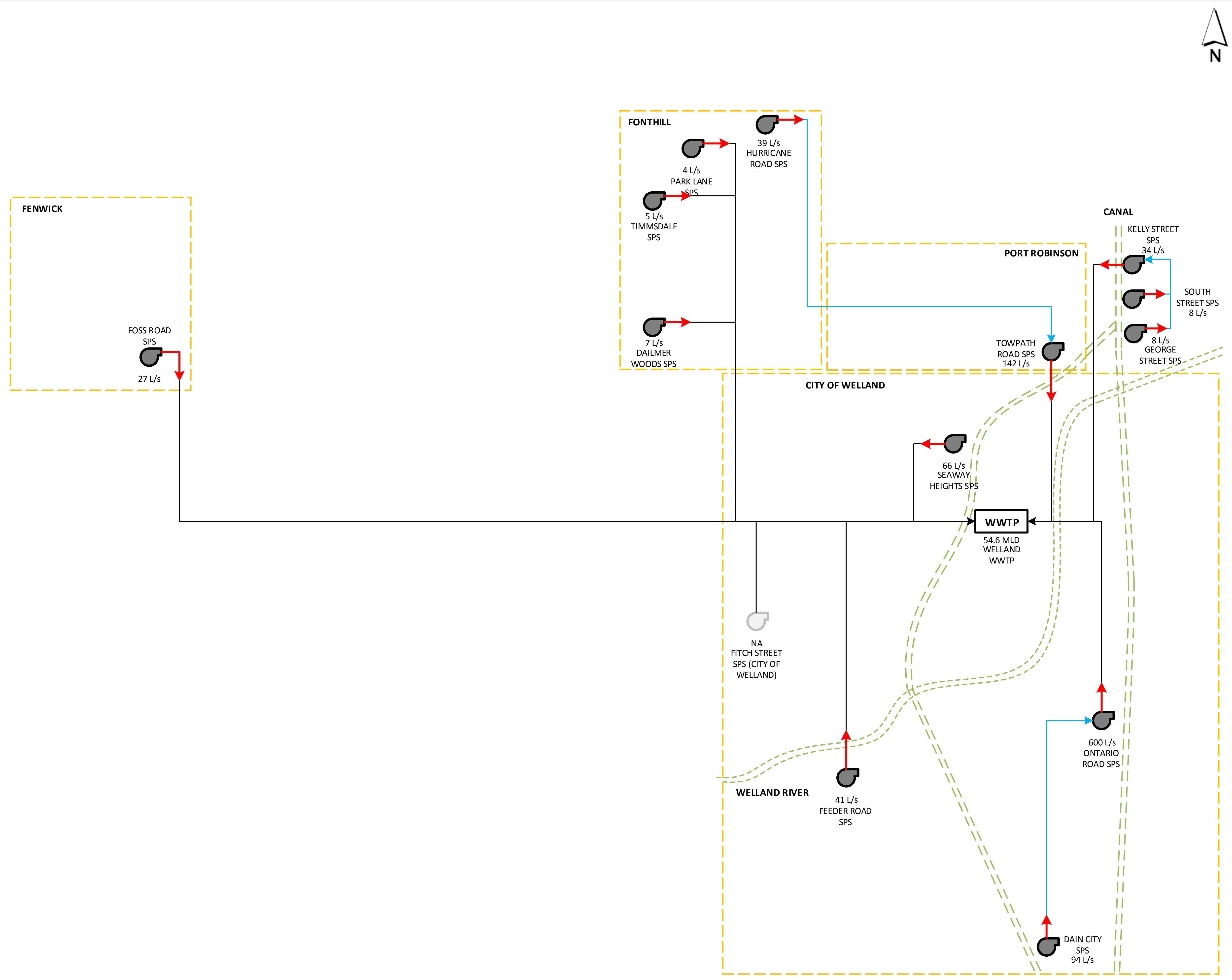


Figure 4.K.1
Existing Wastewater System
Welland WWTP



Niagara Region

2016 Master Servicing Plan

Welland WWTP

EXISTING COLLECTION SCHEMATIC

Legend

WWTP (RATED CAPACITY)	Wastewater Treatment Plant
(FIRM CAPACITY)	Sewage Pumping Station
	Forcemain
	Connection from SPS to SPS
	Connection from SPS to WWTP

June 2017
Figure 4.K.2
Not to Scale

GM BluePlan ENGINEERING

K.1.1 Service Area Overview

Table 4.K.1 provides a list of facility catchments and their areas. Refer to Figure 4.K.1 for the catchment areas of each facility.

Table 4.K.1 Facilities and Catchment Areas

Facility	Catchments	Catchment Area (ha)
Welland Wastewater Treatment Plant (WWTP)	**Welland WWTP** (including sub catchments) Towpath Road SPS Foss Road SPS Feeder Road SPS Seaway Heights SPS Ontario Road SPS Kelly Street SPS Park Lane SPS Dailmer Woods SPS	3,550.9
	Welland WWTP (excluding sub catchments)	2,408.4
Timmsdale Sewage Pumping Station (SPS)	Timmsdale SPS	6.7
Towpath Road SPS	**Towpath Road SPS** (including sub catchments) Hurricane Road SPS	289.3
	Towpath Road SPS (excluding sub catchments)	172.7
Hurricane Road SPS	Hurricane Road SPS	116.6
Foss Road SPS	Foss Road SPS	125.0
Feeder Road SPS	Feeder Road SPS	55.8
Seaway Heights SPS	Seaway Heights SPS	46.2
Ontario Road SPS	**Ontario Road SPS** (including sub catchments) Dain City SPS	503.8
	Ontario Road SPS (excluding sub catchments)	400.5
Dain City SPS	Dain City SPS	103.3
Kelly Street SPS	**Kelly Street SPS** (including sub catchments) George Street SPS South Street SPS	99.5
	Kelly Street SPS (excluding sub catchments)	81.1

Facility	Catchments	Catchment Area (ha)
George Street SPS	George Street SPS	18.4
South Street SPS	South Street SPS	0.0
Park Lane SPS	Park Lane SPS	9.3
Dailmer Woods SPS	Dailmer Woods SPS	6.9

K.1.2 Facility Overview

Table 4.K.2 Wastewater Treatment Plant Overview

Plant Name	Welland Wastewater Treatment Plant
Address	505 River Road, R.R. #1, Welland
Discharge Water	Welland River
Rated Capacity: Average Daily Flow	54.6 MLD
Rated Capacity: Peak Flow Rate (Dry Weather)	Not available
Rated Capacity: Peak Flow Rate (Wet Weather)	136.2 MLD
Key Processes	• Conventional activated sludge treatment with screening • Grit removal • Effluent disinfection • Tertiary filtration

Table 4.K.3 Wastewater Treatment Plant Effluent Objectives

Effluent Parameter	Objective Concentration[3]
$CBOD_5$	15.0 mg/L
TSS	15.0 mg/L
Total Phosphorus	0.4 mg/L
Total Ammonia Nitrogen *November – April* *May – December*	 10 mg/L 5 mg/L
E. Coli	100 organisms/100 mL
Total Chlorine Residual	Non-detect

[3] *Ministry of Environment and Climate Change, 30 July 2015. Ammeded Environmental Compliance Approval. Number 5599-9VTGG2*

Table 4.K.4 Pumping Station Overview

Sewage Pumping Station	Location	Number of Pumps	ECA Firm Capacity (L/s)	Operational Firm Capacity (L/s)	Total Dynamic Head (m)
Timmsdale Sewage Pumping Station (SPS)	Timmsdale Estates, Pelham	2	4.4	5.0	20.0
Towpath Road SPS	Towpath Road, Thorold	2	150.0	141.7	25.0
Hurricane Road SPS	92 Hurricane Road, Pelham	2	39.4	39.0	N/A
Foss Road SPS	736 Foss Road, Pelham	2	27.0	26.6	23.0
Feeder Road SPS	Feeder Road, Welland	2	44.0	41.0	N/A
Seaway Heights SPS	Lancaster Drive, Welland	2	60.0	65.7	11.9
Ontario Road SPS	1200 Ontario Road, Welland	3	600.0	600.0	21.6
Dain City SPS	144 Logan Avenue, Welland	2	192.0	94.0	43.0
Kelly Street SPS	51 Kelly Street, Thorold	2	24.6	34.4	16.2
George Street SPS	George Street, Thorold	2	8.2	8.0	13.1
South Street SPS	South Street, Thorold	2	8.2	8.1	10.0
Park Lane SPS	Park Lane, Pelham	2	5.3	4.0	N/A
Dailmer Woods SPS	Haist Street, Pelham	2	9.2	7.4	6.6

Table 4.K.5 Forcemain Overview

Sewage Pumping Station	Pump Station Operational Capacity (L/s)	Length (m)	Diameter (mm)	Capacity @ 2.5 m/s (L/s)
Timmsdale Sewage Pumping Station (SPS)	5.0	573	100	19.6
Towpath Road SPS	141.7	647	400	1,021.0
Hurricane Road SPS	39.0	670	250	122.7
Foss Road SPS	26.6	5,718	200	78.5
Feeder Road SPS	41.0	677	250	122.7
Seaway Heights SPS	65.7	291	300	176.7
Ontario Road SPS	600.0	1,122	600	706.9
Dain City SPS	94.0	3,030	250	122.7
Kelly Street SPS	34.4	3,813	200	78.5
George Street SPS	8.0	643	100	19.6
South Street SPS	8.1	180	100	19.6
Park Lane SPS	4.0	165	100	19.6
Dailmer Woods SPS	7.4	176	100	19.6

K.1.3 Flows Overview

Table 4.K.6 shows the historical system flows obtained from wastewater treatment plant production data for 2011 to 2015. Table 4.K.7 shows the existing wastewater system flows by catchment.

Table 4.K.6 Historic Welland Wastewater Treatment Plant Flows

Year	Average Dry Weather Flow		Average Daily Flow		Peak Daily Flow	
	MLD	**L/s**	**MLD**	**L/s**	**MLD**	**L/s**
2011	30.0	347.2	41.7	482.6	111.7	1,292.8
2012	28.4	328.7	35.5	410.9	111.2	1,287.0
2013	33.8	391.2	40.6	469.9	144.6	1,673.6
2014	28.7	332.2	35.1	406.3	105.7	1,223.4
2015	23.0	266.2	24.9	288.2	81.9	947.9
5 Year Average	28.8	333.3	35.6	412.0	111.0	1,284.7
5 Year Peak	33.8	391.2	41.7	482.6	144.6	1,673.6

Table 4.K.7 Existing Wastewater System Flows by Catchment

Catchment	Total Service Equivalent Population	Existing Average Dry Weather Flow (L/s)	Existing Design Peak Wet Weather Flow (L/s)	Existing 2-Year Flow (L/s)	Existing 5-Year Flow (L/s)
Welland Wastewater Treatment Plant (WWTP)	94,351	325.8	1,667.1	2,713.2	3,582.9
Welland WWTP	64,810	244.4	1,177.7	1,980.0	2,725.0
Timmsdale Sewage Pumping Station (SPS)	28	0.6	3.1	8.1	10.4
Towpath Road SPS	7,555	14.5	111.7	150.0	180.7
Towpath Road SPS	5,133	8.4	66.1	111.0	143.0
Hurricane Road SPS	2,422	6.1	45.6	85.0	113.0
Foss Road SPS	4,748	3.8	43.3	24.0	32.0
Feeder Road SPS	2,563	3.3	22.6	71.0	95.0
Seaway Heights SPS	2,704	2.8	18.8	98.0	131.0
Ontario Road SPS	11,812	53.2	250.6	413.0	534.0
Ontario Road SPS	11,455	49.2	212.9	320.0	440.0
Dain City SPS and Detention Facility	357	4.1	37.7	93.0	124.0
Kelly Street SPS	0	2.3	33.1	39.0	52.0
Kelly Street SPS	0	1.9	27.0	31.8	42.4
George Street SPS	0	0.4	6.1	7.2	9.6
South Street SPS	0	0.0	0.0	0.0	0.0
Park Lane SPS	0	0.2	3.0	4.1	5.2
Dailmer Woods SPS	132	0.7	3.3	4.4	5.5

Note: Flow numbers may not sum due to rounding.

K.2 Growth Projections

K.2.1 Population Projections and Allocations

Table 4.K.8 and Table 4.K.9 outline the existing and projected serviced population and employment by catchment.

Table 4.K.8 Welland Wastewater Treatment Plant Existing and Projected Serviced Population by Catchment

Catchment	2014	2021	2026	2031	2036	2041	Growth 2014 - 41
Welland Wastewater Treatment Plant	48,303	49,550	51,614	54,283	56,556	58,299	9,996
Dailmer Woods Sewage Pumping Station (SPS)	115	112	113	114	115	115	-1
Dain City SPS and Detention Facility	341	801	922	1,077	2,041	3,211	2,869
Feeder Road SPS	1,078	1,069	1,071	1,079	1,106	1,132	54
Foss Road SPS	3,894	4,003	4,311	4,726	5,188	5,768	1,875
George Street SPS	0	0	0	0	0	0	0
Hurricane Road SPS	1,543	1,502	1,502	1,513	1,577	1,580	37
Kelly Street SPS and Storage Facility	0	0	0	0	0	0	0
Ontario Road SPS	7,924	7,890	8,148	8,483	9,160	9,405	1,482
Park Lane SPS	0	0	0	0	0	0	0
Seaway Heights SPS	1,165	1,273	1,445	1,577	1,619	1,756	591
South Street SPS	0	0	0	0	0	0	0
Timmsdale SPS	0	0	0	0	0	0	0

Catchment	2014	2021	2026	2031	2036	2041	Growth 2014 - 41
Towpath Road SPS	3,085	4,467	6,444	8,694	9,965	11,229	8,144
Total	**68,722**	**72,027**	**76,987**	**83,038**	**88,853**	**94,050**	**25,328**

Note: Population numbers may not sum due to rounding.

Table 4.K.9 Welland Wastewater Treatment Plant Existing and Projected Serviced Employment by Catchment

Catchment	2014	2021	2026	2031	2036	2041	Growth 2014 - 41
Welland Wastewater Treatment Plant	16,507	17,151	17,515	17,941	18,459	19,106	2,598
Dailmer Woods Sewage Pumping Station (SPS)	16	17	18	18	19	20	4
Dain City SPS and Detention Facility	15	47	65	103	151	210	194
Feeder Road SPS	1,486	1,573	1,613	1,675	1,737	1,826	340
Foss Road SPS	855	970	1,042	1,153	1,265	1,406	551
George Street SPS	0	0	0	0	0	0	0
Hurricane Road SPS	879	981	1,048	1,152	1,257	1,387	508
Kelly Street SPS and Storage Facility	0	0	0	0	0	0	0
Ontario Road SPS	3,531	4,233	4,498	5,020	5,427	6,104	2,573
Park Lane SPS	0	0	0	0	0	0	0
Seaway Heights SPS	1,539	1,581	1,604	1,628	1,658	1,697	158

Catchment	2014	2021	2026	2031	2036	2041	Growth 2014 - 41
South Street SPS	0	0	0	0	0	0	0
Timmsdale SPS	28	29	30	32	33	35	7
Towpath Road SPS	2,048	2,337	2,505	2,811	3,130	3,544	1,496
Total	**27,380**	**29,408**	**30,434**	**32,035**	**33,650**	**35,859**	**8,479**

Note: Population numbers may not sum due to rounding.

K.2.2 Future Flow Projections

Table 4.K.10 and Table 4.K.11 summarize the projected peak dry weather flow and peak wet weather flow by catchment.

Table 4.K.10 Projected Dry Weather Daily Flow by Catchment

Catchment	2021 Design Peak Dry Weather Flow (L/s)	2026 Design Peak Dry Weather Flow (L/s)	2031 Design Peak Dry Weather Flow (L/s)	2036 Design Peak Dry Weather Flow (L/s)	2041 Design Peak Dry Weather Flow (L/s)
Welland Wastewater Treatment Plant	501.8	518.2	538.9	557.3	572.8
Dailmer Woods Sewage Pumping Station (SPS)	1.3	1.3	1.4	1.4	1.4
Dain City SPS and Detention Facility	14.1	15.7	17.9	28.9	41.2
Feeder Road SPS	7.5	7.9	8.7	9.7	10.9
Foss Road SPS	9.9	13.8	19.0	24.6	31.5
George Street SPS	0.8	0.8	0.8	0.8	0.8
Hurricane Road SPS	12.9	13.6	14.9	16.7	18.2
Kelly Street SPS and Storage Facility	3.8	3.8	3.8	3.8	3.8
Ontario Road SPS	104.5	109.2	116.8	126.2	134.0
Park Lane SPS	0.3	0.3	0.3	0.3	0.3
Seaway Heights SPS	7.2	9.4	11.0	11.8	13.7
South Street SPS	0.0	0.0	0.0	0.0	0.0
Timmsdale Sewage Pumping Station	1.2	1.3	1.3	1.3	1.3
Towpath Road SPS	33.3	53.2	75.4	88.6	102.2
Total	**698.7**	**748.6**	**810.3**	**871.4**	**932.1**

2041 Peak Dry Weather Flow for Seaway Heights Sewage Pumping Station:
= (2014 Average Dry Weather Flow × Peaking Factor) +
(2041 Equivalent Population – 2014 Equivalent Population) × 275 L/cap/day ×
1 day/86400 s × Harmon Peaking Factor for Growth Population
= (2.79 L/s × 2.0) + (3,453 – 2,704 people) × 275 L/cap/day × 1 day/86400 s × 3.39
= 13.7 L/s

Table 4.K.11 Projected Peak Wet Weather Flow by Catchment

Catchment	2021 Design Peak Wet Weather Flow (L/s)	2026 Design Peak Wet Weather Flow (L/s)	2031 Design Peak Wet Weather Flow (L/s)	2036 Design Peak Wet Weather Flow (L/s)	2041 Design Peak Wet Weather Flow (L/s)
Welland Wastewater Treatment Plant	1,190.6	1,207.0	1,227.7	1,246.1	1,261.6
Dailmer Woods Sewage Pumping Station (SPS)	3.3	3.3	3.3	3.4	3.4
Dain City SPS and Detention Facility	43.7	45.3	47.5	58.4	70.7
Feeder Road SPS	23.4	23.9	24.7	25.6	26.9
Foss Road SPS	45.7	49.5	54.8	60.4	67.3
George Street SPS	6.1	6.1	6.1	6.1	6.1
Hurricane Road SPS	46.2	47.0	48.3	50.1	51.5
Kelly Street SPS and Storage Facility	27.0	27.0	27.0	27.0	27.0
Ontario Road SPS	219.0	223.7	231.3	240.7	248.6
Park Lane SPS	3.0	3.0	3.0	3.0	3.0
Seaway Heights SPS	20.5	22.6	24.3	25.0	26.9
South Street SPS	0.0	0.0	0.0	0.0	0.0
Timmsdale Sewage Pumping Station	3.1	3.2	3.2	3.2	3.2
Towpath Road SPS	82.7	102.6	124.8	138.0	151.5
Total	**1,714.3**	**1,764.1**	**1,825.8**	**1,887.0**	**1,947.7**

Note: 25% of the growth catchment area was used in calculation for Feeder Road Sewage Pumping Station design peak wet weather flow due to low equivalent population growth in the catchment.

The following presents an example calculation of projected peak wet weather flow.

2041 Peak Wet Weather Flow for Seaway Heights Sewage Pumping Station:
= 2041 Peak Dry Weather Flow + 2041 Design RDII
= 2041 Peak Dry Weather Flow + (2041 Catchment Area × 0.286 L/s/ha)
= 13.7 L/s + (46.2 ha × 0.286 L/s/ha)
= 26.9 L/s

K.3 Assessment of Wastewater Infrastructure (Existing and Future)

K.3.1 Treatment Plant Capacity

Figure 4.K.3 shows the projected future demands at the Welland Wastewater Treatment Plant. The plant has surplus capacity and will not reach 80% capacity within the 2041 time horizon.

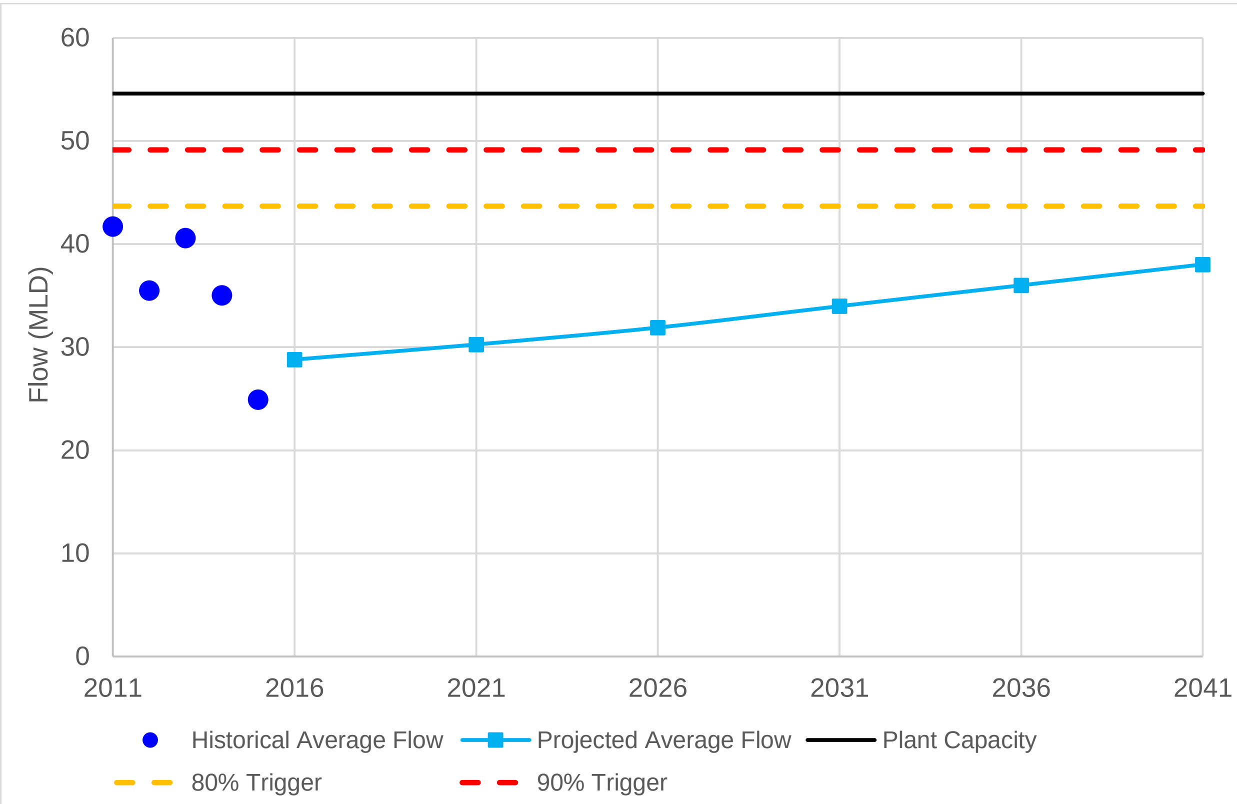


Figure 4.K.3 Projected future demands at Welland Wastewater Treatment Plant

K.3.2 Sewage Pumping Station

Table 4.K.12 highlights the sewage pumping station existing and projected capacity.

Table 4.K.12 System Sewage Pumping Station Performance

Sewage Pumping Station	Contributing Catchments	Facility Operational Capacity (L/s)	Existing Design Peak Wet Weather Flow (L/s)	2041 Design Peak Wet Weather Flow (L/s)	2041 Surplus/ Deficit (L/s)
Timmsdale Sewage Pumping Station (SPS)	Timmsdale SPS	5.0	3.1	3.2	1.8
Towpath Road SPS	Towpath Road SPS	141.7	111.7	199.3	-57.6
Hurricane Road SPS	Hurricane Road SPS	39.0	45.6	51.5	-12.5
Foss Road SPS	Foss Road SPS	26.6	43.3	67.3	-40.7
Feeder Road SPS	Feeder Road SPS	41.0	22.6	26.9	14.1
Seaway Heights SPS	Seaway Heights SPS	65.7	18.8	26.9	38.8
Ontario Road SPS	Ontario Road SPS Dain City SPS	600.0	250.6	311.2	288.8
Dain City SPS	Dain City SPS	94.0	37.7	70.7	23.3
Kelly Street SPS	Kelly Street SPS George Street SPS South Street SPS	34.4	33.1	33.1	1.3
George Street SPS	George Street SPS	8.0	6.1	6.1	1.9
South Street SPS	South Street SPS	8.1	0.0	0.0	8.1
Park Lane SPS	Park Lane SPS	4.0	3.0	3.0	1.0
Dailmer Woods SPS	Dailmer Woods SPS	7.4	3.3	3.4	4.0

The following sewage pumping stations have projected pumping deficits:

- Towpath Road Sewage Pumping Station
- Hurricane Road Sewage Pumping Station
- Foss Road Sewage Pumping Station

K.3.3 Forcemain

Table 4.K.13 highlights the existing and projected forcemain performance.

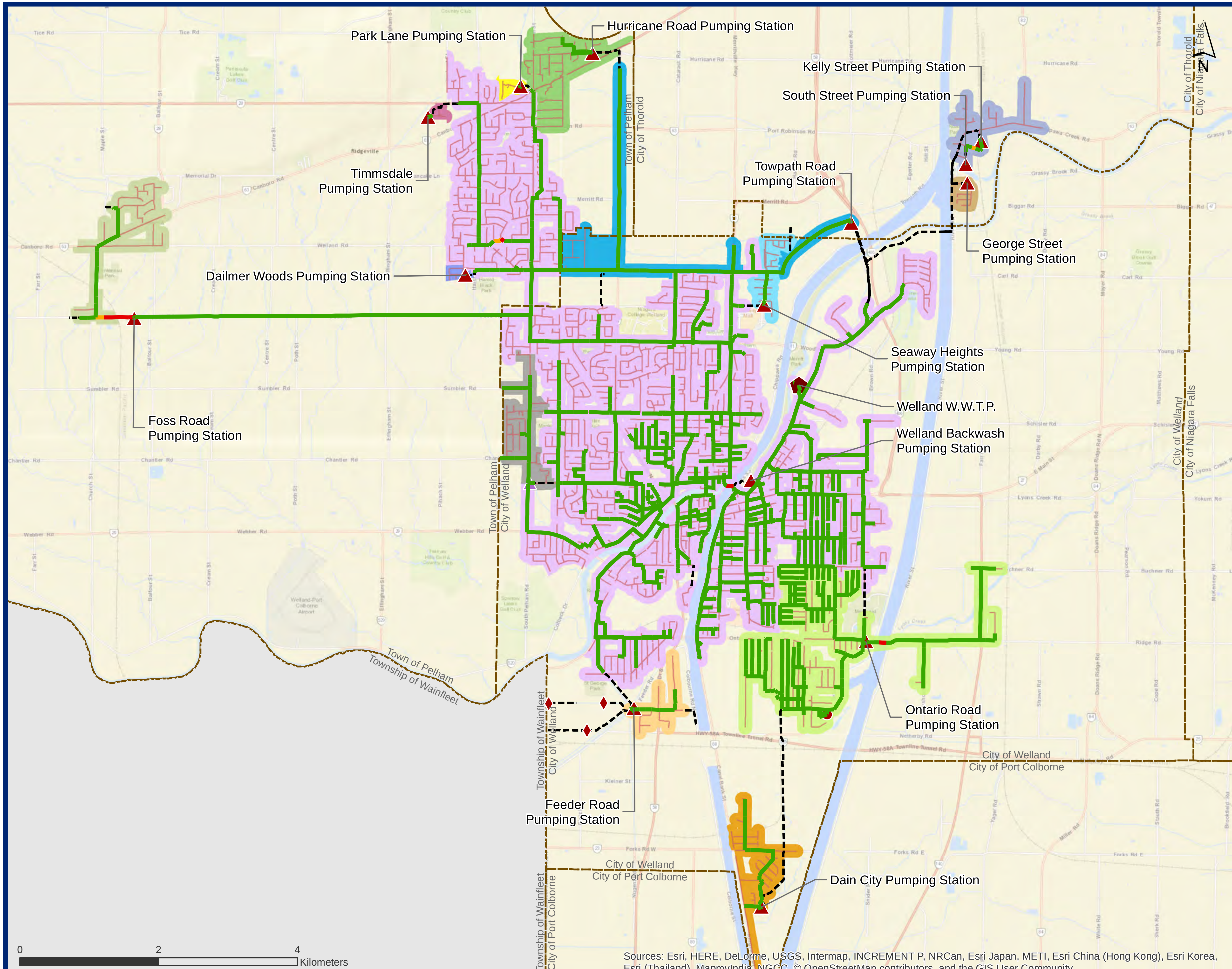
Table 4.K.13 Forcemain Performance

Sewage Pumping Station	Pump Station Operational Capacity (L/s)	Capacity @ 2.5 m/s (L/s)	Existing Design Peak Wet Weather Flow (L/s)	2041 Design Peak Wet Weather Flow (L/s)	2041 Surplus/ Deficit (L/s)
Timmsdale Sewage Pumping Station (SPS)	5.0	19.6	3.1	3.2	16.4
Towpath Road SPS	141.7	1,021.0	111.7	199.3	821.7
Hurricane Road SPS	39.0	122.7	45.6	51.5	71.2
Foss Road SPS	26.6	78.5	43.3	67.3	11.2
Feeder Road SPS	41.0	122.7	22.6	26.9	95.8
Seaway Heights SPS	65.7	176.7	18.8	26.9	149.8
Ontario Road SPS	600.0	706.9	250.6	311.2	395.7
Dain City SPS	94.0	122.7	37.7	70.7	52.0
Kelly Street SPS	34.4	78.5	33.1	33.1	45.4
George Street SPS	8.0	19.6	6.1	6.1	13.5
South Street SPS	8.1	19.6	0.0	0.0	19.6
Park Lane SPS	4.0	19.6	3.0	3.0	16.6
Dailmer Woods SPS	7.4	19.6	3.3	3.4	16.2

All forcemains have a projected surplus capacity.

K.3.4 Trunk Sewer

Figure 4.K.4 and Figure 4.K.5 highlight the existing and projected peak wet weather flow, respectively. Trunk sewers upstream of Foss Road Sewage Pumping Station ad Towpath Road Sewage Pumping Station are approaching capacity within the 2041 time horizon.



Niagara Region

2016 MASTER SERVICING PLAN

Wastewater Facilities

- Wastewater Treatment Plant
- Combined Sewage Detention Facility
- Lagoon
- Odour Control Facility
- Leachate Pumping Station

Pumping Stations

- Regional
- Municipal
- Private

Wastewater Network

- Sanitary Sewers
- Forcemain

Wastewater Catchments*

*Catchment limits are shown based on property boundaries and are within 100 m of sewers.

- Welland W.W.T.P.
- Dailmer Woods
- Dain City
- Feeder Road
- Foss Road
- George Street
- Hurricane Road
- Kelly Street
- Ontario Road
- Park Lane
- Seaway Heights
- Timmsdale
- Towpath Road
- 283000012 (Private)

Capacity (d/D)

- < 0.85
- 0.85 - 0.99
- > 1.00

Figure 4.K.4

Existing Peak Wet Weather Flow

Welland WWTP

GM BluePlan Engineering

June 2017
715023-WW-4-Existing Wet Weather (Welland)
NAD 1983 UTM Zone 17N

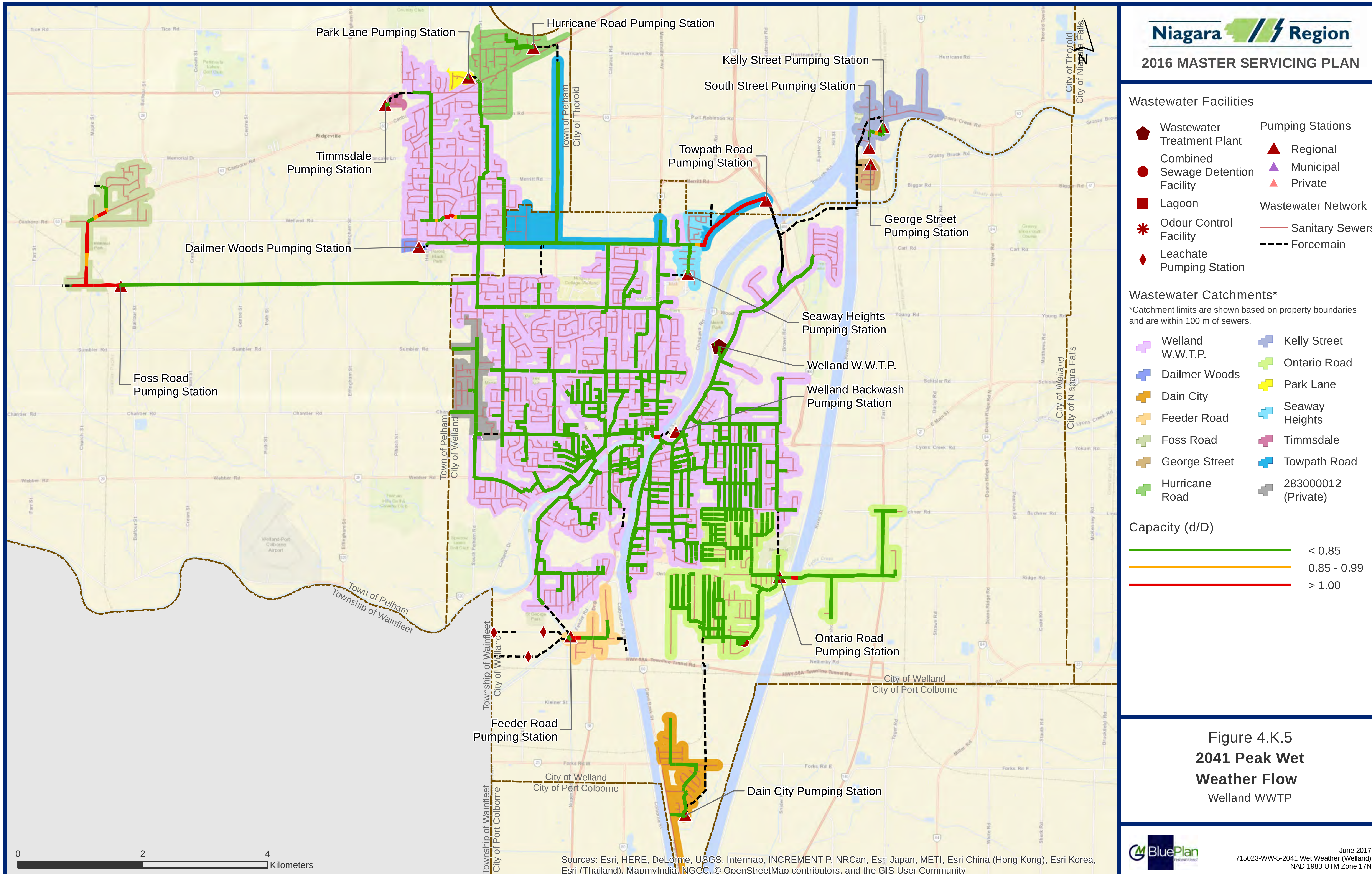


Figure 4.K.5
2041 Peak Wet Weather Flow
Welland WWTP

K.4 System Opportunities and Constraints

Figure 4.K.6 highlights the existing opportunities and constraints.

K.4.1 Welland Wastewater Treatment Plant

- The current rated average daily flow capacity of the plant is 54.6 MLD, with an existing flow of 28.8 MLD and a projected average daily flow of 37.9 MLD, which is at 80% of the wastewater treatment plant rated capacity. The wastewater treatment plant has surplus capacity to accommodate growth to 2041.

K.4.2 Welland

- Significant residential and employment growth consisting of infill and greenfield development within existing urban boundary.
- Growth related and wet weather capacity deficits at Towpath Sewage Pumping Station.
- Significant areas of high wet weather flows and system overflows, which will need to be managed to allow for growth.
- Majority of existing sewer network has capacity to meet design criteria wet weather flows; however, actual wet weather flows exceed sewer capacity in several areas.
- Welland River and Welland Canal siphon crossing present ongoing operational issues
- Additional trunk capacity on Quaker Road to support existing and growth flows from Pelham system.

K.4.3 Pelham

- Residential and employment growth consisting of infill and greenfield development within existing urban boundary.
- Growth related capacity deficits at Hurricane Sewage Pumping Station.
- Existing and wet weather capacity deficits at Foss Road Sewage Pumping Station and forcemain.
- Existing sewer network has capacity to meet design criteria wet weather flows.

K.4.4 Port Robinson – Thorold System

- Significant residential and employment growth consisting of infill and greenfield development within the Port Robinson area.
- New trunk sewer under Highway 406 required to service the Port Robinson growth area.
- Growth related and wet weather capacity deficits at Towpath Sewage Pumping Station.

K.4.5 System Optimization Opportunities

- Existing system configuration provides limited opportunities to optimize system including; system diversions to reduce sewage pumping station upgrades and/or eliminated existing sewage pumping stations.
- Significant opportunity to provide growth capacity through implementation of wet weather flow management within Welland system.

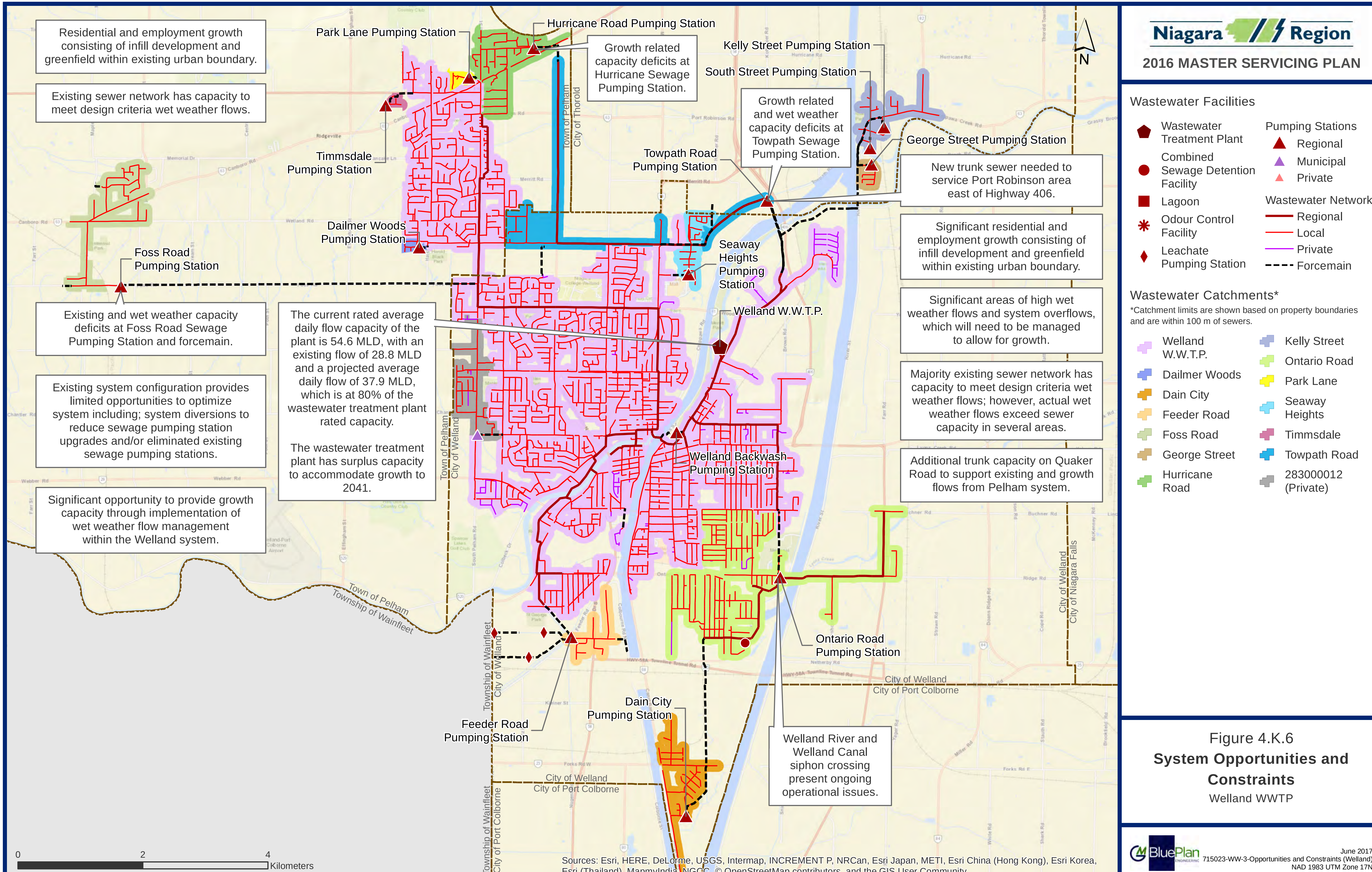


Figure 4.K.6
System Opportunities and Constraints
Welland WWTP

BluePlan
June 2017
715023-WW-3-Opportunities and Constraints (Welland)
NAD 1983 UTM Zone 17N

K.5 Assessment of Alternatives

No further alternative beyond application the hybrid management strategy below were identified.

- Providing capacity within Regional pumping stations and trunk sewers to convey peak wet weather flows up to the design criteria of 0.286 L/s/ha.
- Provide upstream flow management and peak flow management to address peak flows in systems where peak wet weather flows exceed the design criteria of 0.286 L/s/ha resulting in potential basement flooding and overflow risks.

K.6 Preferred Servicing Strategy

The following is a summary of the Welland wastewater servicing strategy, presented in Figure 4.K.7 and Figure 4.K.8:

- The Welland Wastewater Treatment Plant has sufficient capacity to support growth to year 2041.
- Due to the projected growth in the Fenwick area, additional pumping station and forcemain capacity is required.
- Additional capacity is required at the Hurricane Road Sewage Pumping Station and Towpath Sewage Pumping Station.
- Additional conveyance capacity under Highway 406 at the Towpath Sewage Pumping Station is required to support growth.
- The wet weather management program within the core areas of Welland and within the combined sewer systems is required to support growth and minimize infrastructure costs within the built boundary.

K.6.1 Pumping Stations

The following sewage pumping station upgrades are required:

- Foss Road Sewage Pumping Station upgrade: Increase capacity from 27 L/s to 76 L/s, and forcemain upgrade to 250 mm.
- Towpath Sewage Pumping Station pump replacement: Increase capacity from 150 L/s to 300 L/s.
- Hurricane Road Sewage Pumping Station upgrade: Increase capacity from 39 L/s to 52 L/s.

K.6.2 Trunk Sewers

The following trunk sewers are required:

- Highway 406 from Towpath Sewage Pumping Station to south end of Kottmeier Road in Thorold – 600 mm
- Quaker Road between Pelham Street and Rice Road – 600 mm

K.6.3 Wet Weather

A significant element of the Niagara Region wastewater servicing strategy is the wet weather management program. The program is intended to deal with existing capacity constraints, and to provide for growth-related capacity without expanding/upgrading existing trunk infrastructure, or by minimizing the required expansion/upgrade.

The wet weather management program currently identifies overall preliminary priority, staging of location and target amount of inflow and infiltration reduction across all systems. This program provides for a proactive and targeted approach to addressing wet weather impacts. These wet weather management programs will need to be a joint initiative between the Region and local municipalities.

For the Welland system, the following priority areas are identified:

- Central Welland on the east and west sides of the Welland River within the Welland Wastewater Treatment Plant catchment.

Further flow monitoring and area-specific wet weather flow studies, including Pollution Prevention Control Plan, Inflow and Infiltration Study, Intensification Studies, Preferred Servicing Strategy are needed to identify area specific strategies and projects required to achieve the wet weather flow reduction objectives. Following the outcomes of the further studies, targeted funding can be applied outside the priority areas if the projects are found to address capacity issues and support growth capacity needs.

K.7 Capital Program

Table 4.K.14 summarizes the recommended project costing, implementation schedule and Class EA requirements.

K.7.1 Schedule B Project Files

Project files for Municipal Class Schedule B Environmental Assessment are attached in Appendix 1.

Niagara Region
2016 MASTER SERVICING PLAN

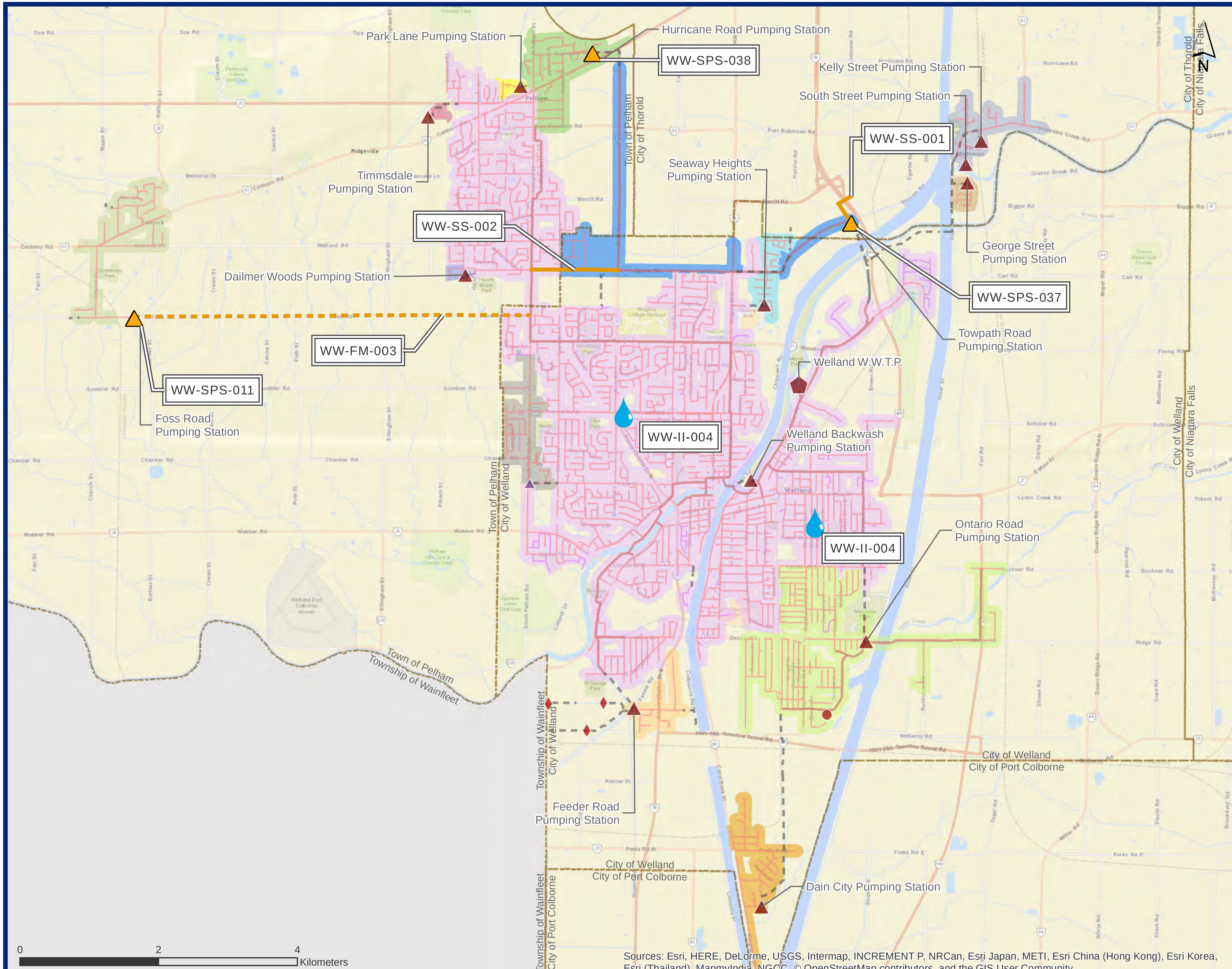
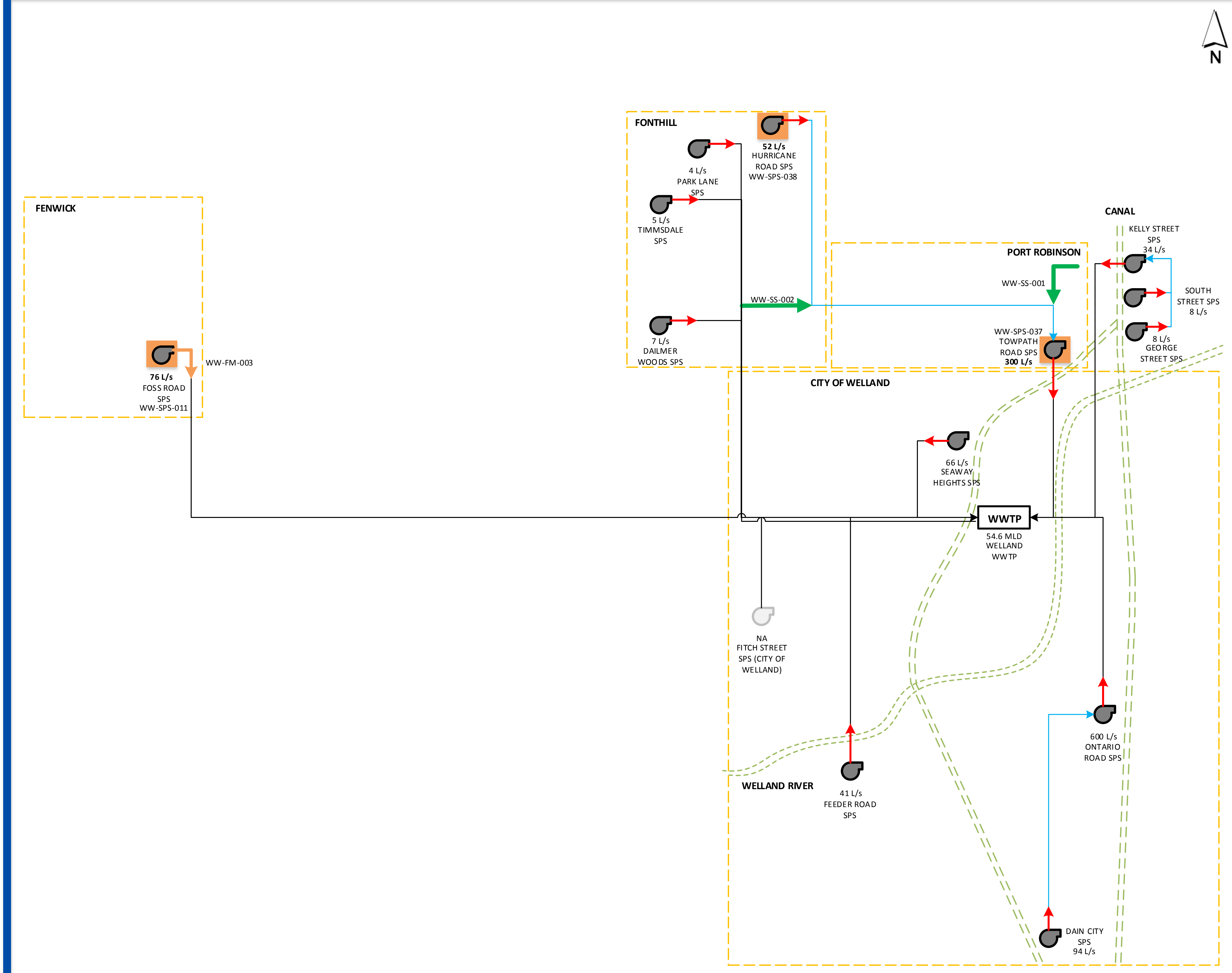


Figure 4.K.7
Preferred Wastewater Strategy
Welland WWTP

GM BluePlan Engineering

June 2017
715023-WW-6-Capital Projects (Welland)
NAD 1983 UTM Zone 17N



Niagara Region

2016 Master Servicing Plan

Welland WWTP

2041 COLLECTION SCHEMATIC

WWTP — RATED CAPACITY — Wastewater Treatment Plant

FIRM CAPACITY — Sewage Pumping Station

Forcemain

Connection from SPS to SPS

Connection from SPS to WWTP

Facility Upgrade

New Facility

Upgrade Forcemain or Sewer

New Forcemain or Sewer

Decommission Project

June 2017
Figure 4.K.8
Not to Scale

GM BluePlan ENGINEERING

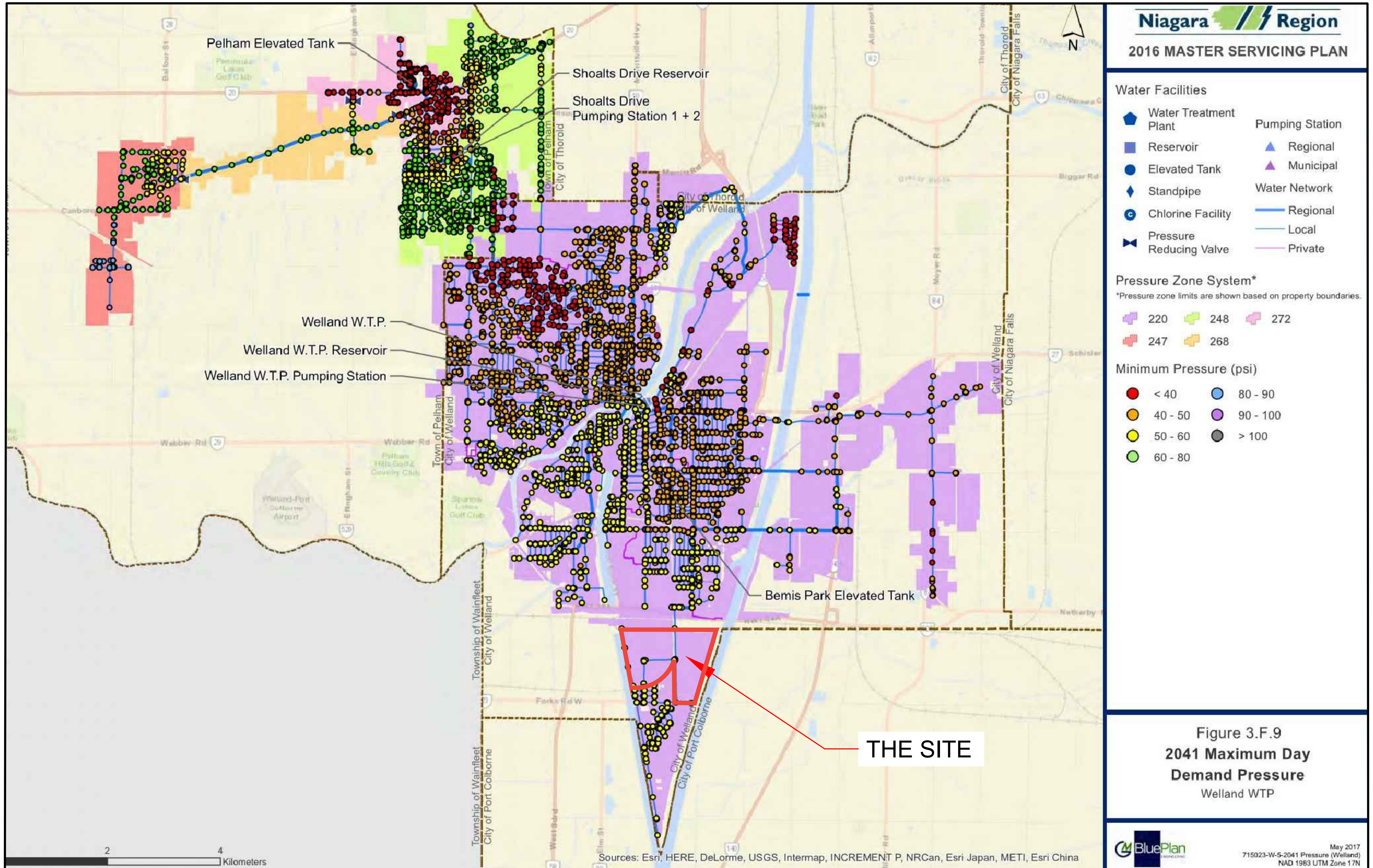
Table 4.K.14 Summary of Welland Wastewater Capital Program

Master Plan ID	Name	Description	Size / Capacity	Year in Service	Municipality	Class EA Schedule	Class EA Status	Project Type	Total Component Estimated Cost
WW-FM-003	Upgrade Foss Road Sewage Pumping Station (SPS) Forcemain	Upgrade Foss Road SPS Forcemain in Welland	250 mm	2022-2031	Pelham	A+	Satisfied	Forcemain	$4,500,000
WW-II-004	Wet weather reduction in Central Welland	Wet weather reduction in Central Welland	200 L/s reduction	2022-2031	Welland	N/A	Dependent on outcome of wet weather flow study	Wet Weather Reduction	$30,000,000
WW-SPS-011	Foss Road SPS Upgrade - Welland	Increase station capacity from 27 L/s to 76 L/s	76 L/s	2022-2031	Pelham	B	Satisfied	Pumping	$1,866,000
WW-SPS-037	Towpath SPS Pump Replacement - Welland	Increase station capacity from 150 L/s to 300 L/s with addition of a third 150 L/s pump.	300 L/s	2022-2031	Thorold	A+	Satisfied	Pumping	$834,000
WW-SPS-038	Huricane Road SPS Pump Replacement - Welland	Increase station capacity from 39 L/s to 52 L/s	52 L/s	2022-2031	Pelham	A+	Satisfied	Pumping	$1,250,000
WW-SS-001	Highway 406 Trunk Sewer Crossing	New trunk sewer crossing of HWY 406 between Merritt Rd and recreational waterway in Thorold to support development of the Port Robinson West area.	600 mm	2017-2021	Thorold	A+	Satisfied	Pumping	$1,450,000
WW-SS-002	Quaker Road Trunk Sewer	New sewer on Quaker Rd. between Pelham Street trunk and Rice Road trunk sewers.	600 mm	2022-2031	Welland	A+	Satisfied	Pumping	$1,725,000
Total									**$41,625,000**

APPENDIX

B

NIAGARA REGION WATER WASTEWATER MASTER SERVICNG PLAN UPDATES- VOLUME III- WATER MASTER SERVICNG PLAN



SOURCE OF FIGURE :

2016 WATER AND WASTEWATER MASTER SERVICING PLAN UPDATE,

VOLUME III- WATER MASTER SERVICING PLAN UPDATE, FINAL REPORT, JUNE 2017,

PART F, WELLAND WATER SYSTEM

BY:
GM BLUE PLAN ENGINEERING LTD

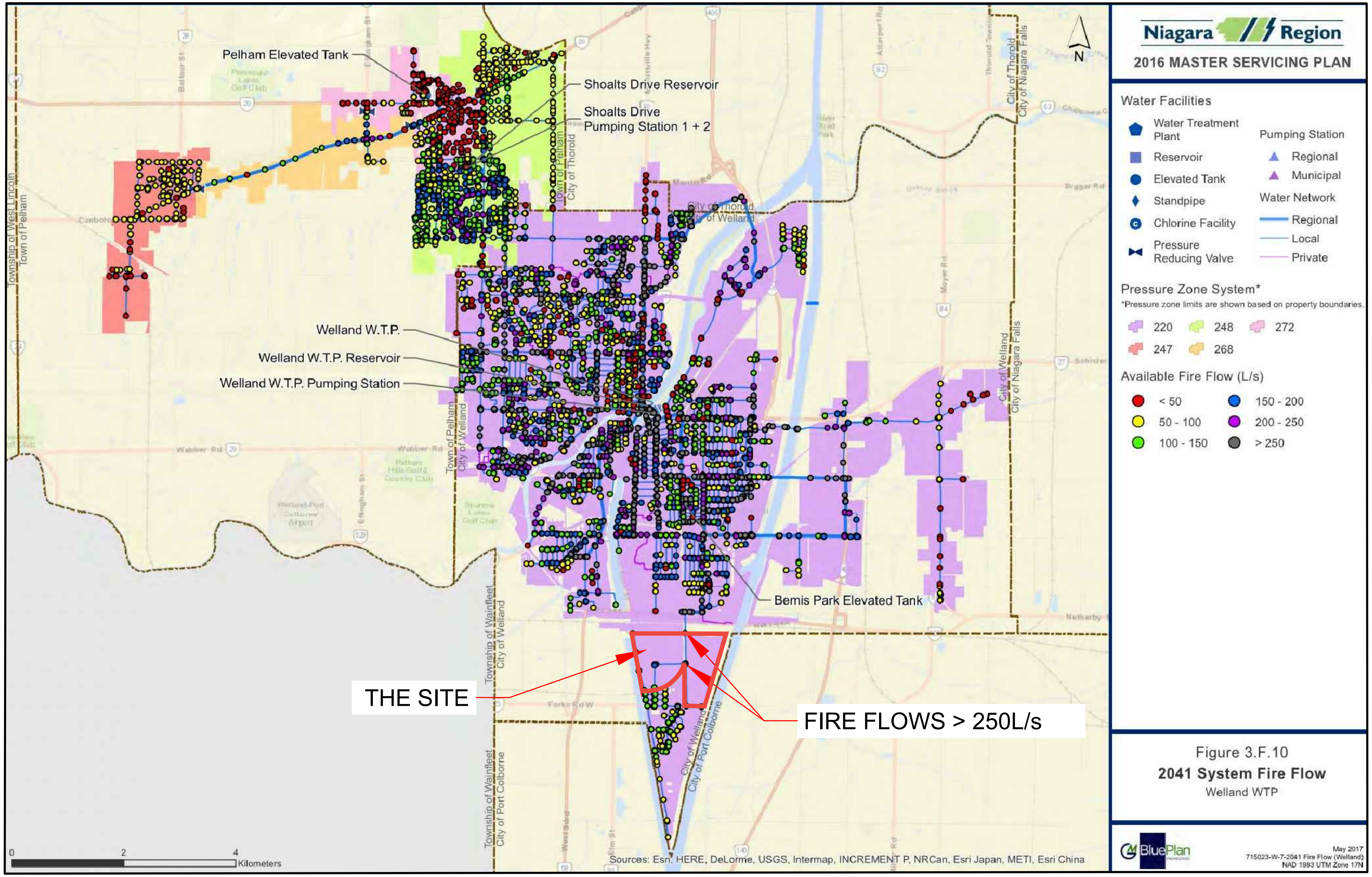
NOTE:
MAXIMUM DAY PRESSURE OF WATERMAINS SERVICING THE PROPOSED DEVELOPMENTS WILL BE BETWEEN 50psi AND 60psi.

CLIENT
555 CANAL BANK LTD.

TITLE
DAIN CITY DEVELOPMENTS
WELLAND WASTEWATER TREATMENT PLANT
MAXIMUM DAY DEMAND PRESSURE-2041 PROJECTED DEMAND

wsp

Checked	R.K.	Drawn	10/12 Cad
Date	FEB 2020	Proj. No.	19M-01173
Scale	NTS	Figure No.	



SOURCE OF FIGURE :

2016 WATER AND WASTEWATER MASTER SERVICING PLAN UPDATE,

VOLUME III- WATER MASTER SERVICING PLAN UPDATE, FINAL REPORT, JUNE 2017,

PART F, WELLAND WATER SYSTEM

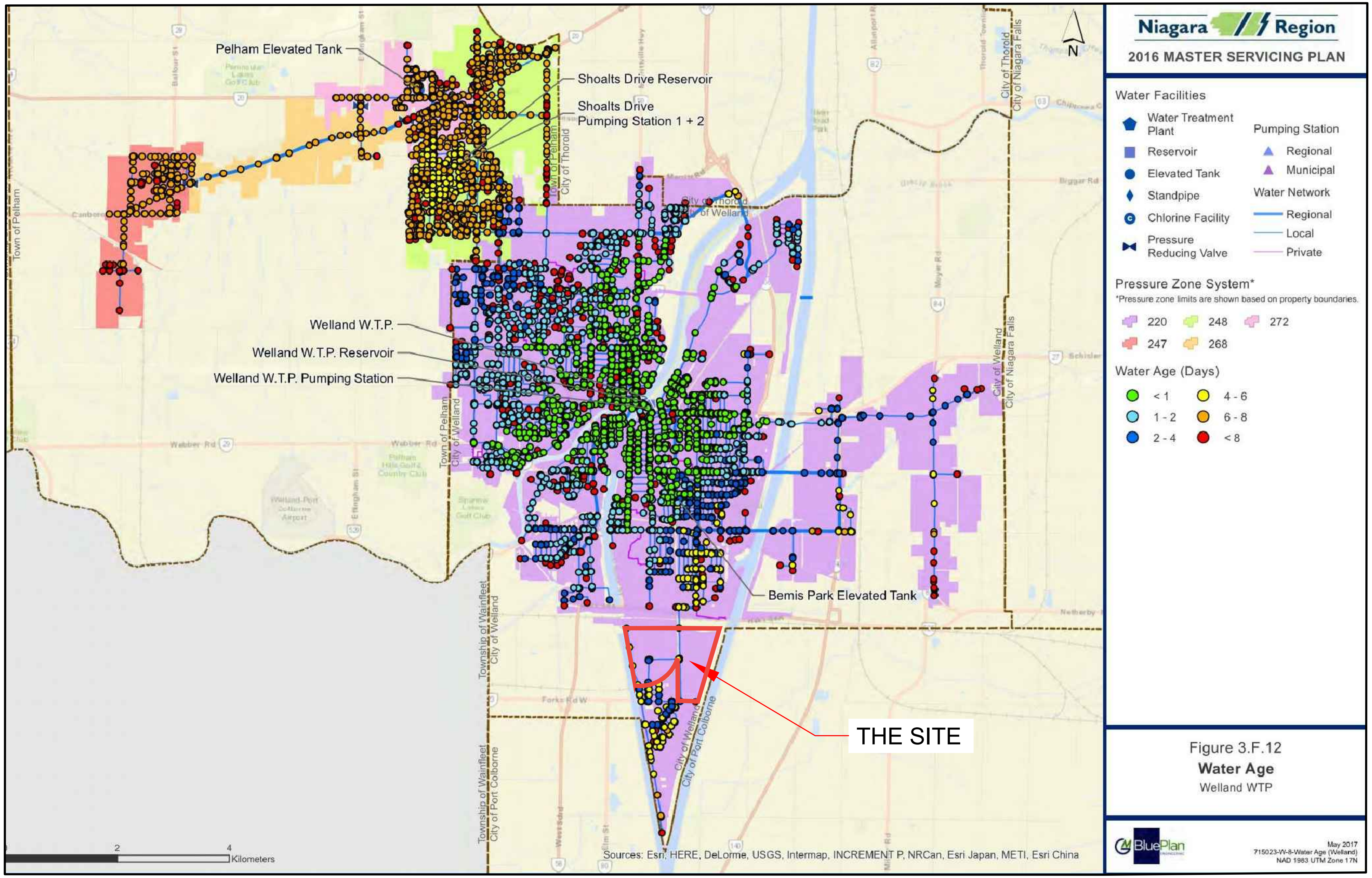
BY:
GM BLUE PLAN ENGINEERING LTD

CLIENT
555 CANAL BANK LTD.

TITLE
DAIN CITY DEVELOPMENTS
WELLAND WATER TREATMENT SYSTEM
FIRE SYSTEM FLOWS -2041 DEMAND PROJECTION

wsp

Checked	R.K.	Drawn	10/12 Cad
Date	SEP 2019	Proj. No.	19M-01173
Scale	NTS	Figure No.	



SOURCE OF FIGURE :

2016 WATER AND WASTEWATER MASTER SERVICING PLAN UPDATE,

VOLUME III- WATER MASTER SERVICING PLAN UPDATE, FINAL REPORT, JUNE 2017,

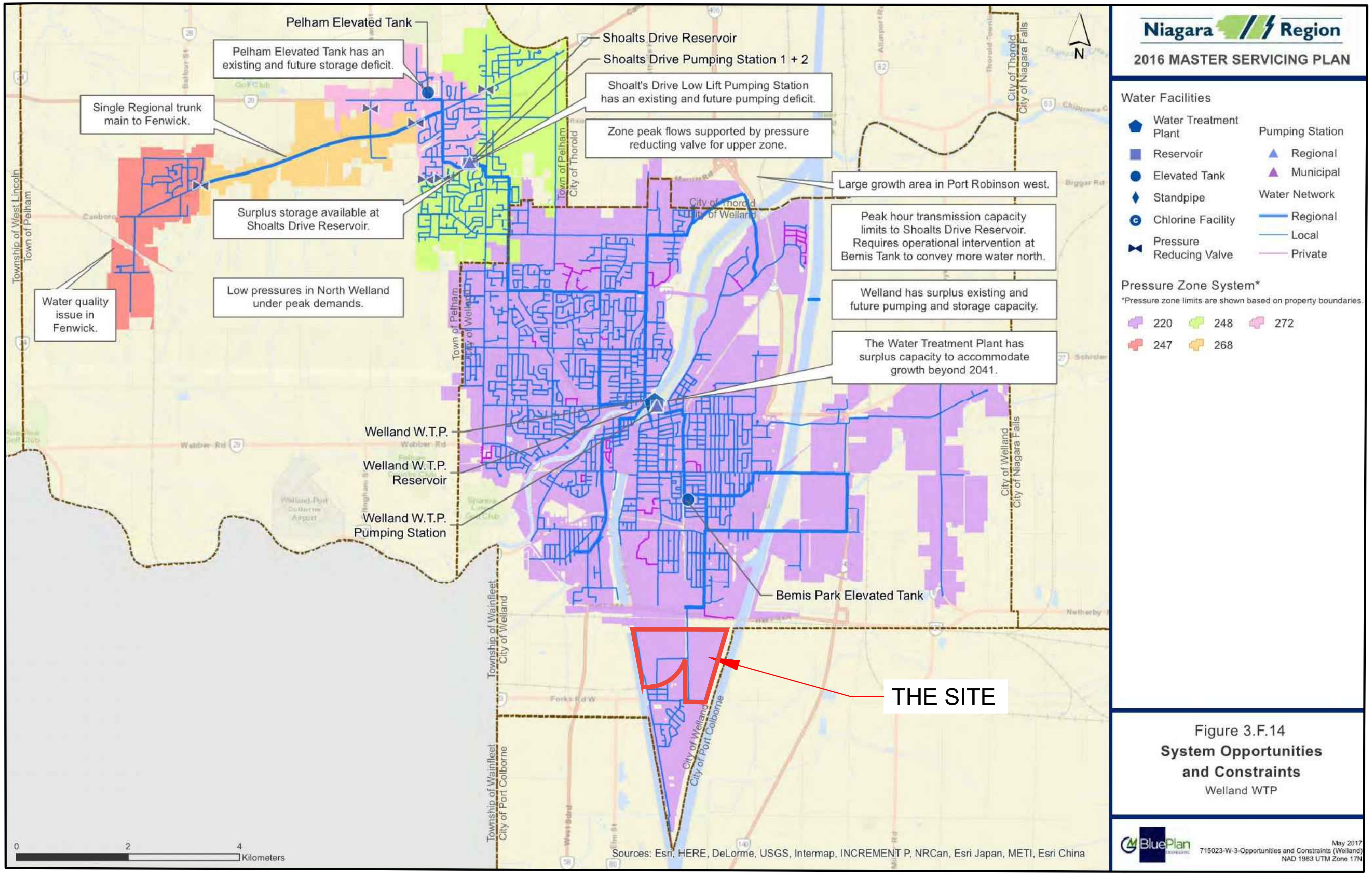
PART F, WELLAND WATER SYSTEM

BY:
GM BLUE PLAN ENGINEERING LTD

CLIENT
555 CANAL BANK LTD.

TITLE
DAIN CITY DEVELOPMENTS
WELLAND WATER TREATMENT SYSTEM
WATERMAIN WATER AGE

Checked R.K.	Drawn 10/12 Cad
Date FEB 2020	Proj. No. 19M-01173
Scale NTS	Figure No.



SOURCE OF FIGURE :

2016 WATER AND WASTEWATER MASTER SERVICING PLAN UPDATE,

VOLUME III- WATER MASTER SERVICING PLAN UPDATE, FINAL REPORT, JUNE 2017,

PART F, WELLAND WATER SYSTEM

BY:
GM BLUE PLAN ENGINEERING LTD

NOTE:
ALL WATER DISTRIBUTION CONSTRAINTS LOCATED IN NORTHERN PORTION OF WELLAND CITY.

CLIENT	EMPIRE COMMUNITIES
TITLE	DAIN CITY DEVELOPMENTS WELLAND WATER TREATMENT SYSTEM SYSTEM CONSTRAINTS

wsp

Checked: R.K.	Drawn: 10/12 Cad
Date: FEB 2020	Proj. No.: 19M-01173
Scale: NTS	Figure No.:

2016 Water and Wastewater
Master Servicing Plan Update

HOW WE **FLOW**

Volume III - Water Master Servicing Plan Update
Final Report

June, 2017

BluePlan ENGINEERING

Table of Contents

1. INTRODUCTION 1
1.1 Background 1
1.2 Integrated Planning Process 2
1.3 Master Servicing Plan Update Report Objectives 3
1.4 Master Servicing Plan Class EA Report Outline 4
1.5 Master Servicing Plan Report Volume III 6
2. ANALYSIS METHODOLOGY 8
2.1 Project Assumptions 8
2.2 Demand Projections and Allocations 8
2.3 Study Area Population and Employment 11
2.4 Design Criteria 12
2.5 Demand Projection 13
2.6 Water Infrastructure Capacity 14
3. WATER SERVICING STRATEGY 17
3.1 Servicing Principles and Policies 17
3.2 Evaluation Methodology 18
4. CAPITAL PROGRAM 19
4.1 Water System Recommendations Overview 19
4.2 Capital Program 21

PART A GRIMSBY WATER SYSTEM
PART B DECEW WATER SYSTEM
PART C NIAGARA FALLS WATER SYSTEM
PART D FORT ERIE WATER SYSTEM
PART E PORT COLBORNE WATER SYSTEM
PART F WELLAND WATER SYSTEM

1. INTRODUCTION

1.1 Background

Niagara Region currently services the urban area of the municipalities of Grimsby, West Lincoln, Lincoln, St. Catharines, Thorold, Welland, Pelham, Port Colborne, Niagara-on-the-Lake, Niagara Falls, and Fort Erie. Water and wastewater servicing is operated under a two-tier system. Niagara Region is responsible for water treatment, transmission mains, storage facilities and major booster pumping stations; as well as wastewater treatment, trunk sewers and sewage pumping stations. The area municipalities are responsible for local water distribution networks and local sewer collection systems.

Niagara Region is part of the Greater Golden Horseshoe (GGH) area situated around the western and southern end of Lake Ontario that continues to be one of the fastest growing regions in North America. The Government of Ontario's legislative growth plan, *Places to Grow Act 2005* and recent amendments, identifies substantial population and employment growth for the GGH to year 2041.

Readily available and accessible public infrastructure is essential to the viability of existing and growing communities. Infrastructure planning, land use planning and infrastructure investment require close integration to ensure efficient, safe and economically achievable solutions to provide the required water and wastewater infrastructure. To balance the needs of growth with the protection and preservation of natural, environmental and heritage resources, Niagara Region initiated an integrated process under the umbrella "Niagara 2041" to complete a Municipal Comprehensive Review, a new Transportation Master Plan, and a Water and Wastewater Master Servicing Plan Update.

The 2016 Master Servicing Plan Update provides a review, evaluation and development of water and wastewater servicing strategies for all servicing within the urban areas of the Region. The 2016 Master Servicing Plan Update uses updated population and employment growth forecasts based on a 2041 planning horizon.

The Study Area for the Master Servicing Plan Update covers primarily the urban areas of the local municipalities in Niagara Region serviced by the lake-based systems. The Township of Wainfleet is not included in the scope of this Master Servicing Plan Update.

Figure 3.1 Study Area

The 2016 Master Servicing Plan Update builds on previous work undertaken as part of the 2011 Master Servicing Plan and previous long term infrastructure planning studies. The 2016 Master Servicing Plan Update is a critical component in the Region's planning for growth and will provide the framework and vision for the water and wastewater servicing needs for the lake-based service areas of the Region to year 2041.

1.2 Integrated Planning Process

Niagara, as a whole, must proactively plan for and facilitate growth in order to conform with Provincial land use plans (*Places to Grow*). The Region is currently planning the best way to accommodate anticipated and targeted population and employment growth over the next 25 years. Under the umbrella "Niagara 2041" the Region will be establishing a growth strategy that will be urban in nature.

The establishment of the growth strategy involves completing (3) three projects:

1) Municipal Comprehensive Review (MCR) – ***How We Grow***

   Look at the land available across Niagara, ensure there is enough land to sustain the expected growth to year 2041 and examine how the land is distributed throughout Niagara

2) Transportation Master Plan (TMP) – ***How We Go***

   Look at current travel methods across Niagara and look to improve transportation systems including options for walking, cycling and public transit to better serve Niagara's future needs

3) Water and Wastewater Master Servicing Plan (MSP) – ***How We Flow***

   Ensure Niagara has the infrastructure to provide critical water and wastewater services to the growing Region in a sustainable and financially responsible way

These three projects are inter-connected and collectively form the foundation to support and foster Niagara's growth and input into the Niagara Region Development Charge Study. The Master Plans will identify the preferred servicing solution and associated infrastructure needs to support projected growth as set out in the Municipal Comprehensive Review.

1.3 Master Servicing Plan Update Report Objectives

The Master Servicing Plan Update comprehensively documents the development, evaluation and selection of the preferred water and wastewater servicing strategies to meet the servicing needs of existing users and future development to 2041.

The Master Servicing Plan Update evaluates the ability of existing and planned water and wastewater infrastructure in Niagara Region to efficiently and effectively service the Region's existing users, service anticipated growth, and to evaluate and develop recommended servicing strategies.

The key objectives of the 2016 Master Servicing Plan Update are as follows:

- Review planning forecasts to 2041 and determine the impacts on servicing needs for the Region's lake-based water and wastewater infrastructure;
- Evaluate the ability of existing and planned water and wastewater infrastructure to efficiently and effectively service the Region's existing users and anticipated growth;

- Undertake a comprehensive review and analysis for both water and wastewater servicing requirements;
- Address key servicing considerations as part of the development and evaluation of water and wastewater servicing strategies including:
  - Level of service to existing users and approved growth
  - Operational flexibility and system security and reliability
  - Mitigation of impacts to natural, social and economic environments
  - Opportunity to meet policy, policy statements, regulations and technical criteria
  - Opportunity to optimize existing infrastructure and servicing strategies
  - Ensuring the strategies are cost effective
- Consider and develop sustainable servicing solutions with lifecycle considerations;
- Update the capital program cost estimating methodology and utilize updated industry trends and more detailed information from relevant Region studies and projects to provide appropriate capital cost estimates;
- Utilize the updated water and wastewater hydraulic models for the analysis of servicing alternatives;
- Establish a complete and implementable water and wastewater capital program;
- Provide extensive consultation with the public and stakeholders; and
- Complete the Master Servicing Plan Update in accordance with the MEA Class EA process for Master Plans.

1.4 Master Servicing Plan Class EA Report Outline

The 2016 Water and Wastewater Master Servicing Plan Update Report, including all supporting volumes, is the documentation placed on public record for the prescribed review period. The documentation, in its entirety, describes all required phases of the planning process and incorporates the procedure considered essential for compliance with the *Environmental Assessment Act*.

The 2016 Master Servicing Plan Update documentation is organized into five volumes as illustrated in the following Figure and as described below:

Figure 3.2 Master Servicing Plan Document Layout

Volume I – Executive Summary

Volume I provides a brief overview of the 2016 Master Servicing Plan Update. It summarizes the information contained in Volumes II, III, IV and V, including problem statement, purpose of the study, significant planning, policy and technical considerations, and description of the preferred water and wastewater servicing strategies including depiction of the projects and documentation of the capital programs.

Volume II – Background and Planning Context

Volume II details the master planning process including the Master Plan Class EA process, related studies, legislative and policy planning context, water and wastewater servicing principles and policies, population and employment growth forecasts, existing environmental and servicing conditions and future considerations.

Volume III – Water Master Servicing Plan Update and Project File

Volume III is the principle document summarizing the study objectives, approach, methodologies, technical analyses, evaluation and selection of the preferred water servicing strategy for each of the water systems. This volume contains baseline water system data and performance information. This volume documents the water servicing strategy development with detailed information on the projects and capital program associated with the preferred water servicing strategy.

Volume IV – Wastewater Master Servicing Plan Update and Project File

Volume IV is the principle document summarizing the study objectives, approach, methodologies, technical analyses, evaluation and selection of the preferred wastewater servicing strategy for each of the wastewater systems. This volume contains baseline wastewater system data and performance information. This volume documents the wastewater servicing strategy development with detailed information on the projects and capital program associated with the preferred wastewater servicing strategy.

Volume V – Public and Agency Consultation

Volume V contains all relevant documentation of the public consultation process including notices, comments and responses, and distribution information. Presentation material from all Public Information Centres (PICs) held during the process is included. Other presentation material and discussion information from workshops held with relevant agencies, approval bodies and other stakeholders are also included.

1.5 Master Servicing Plan Report Volume III

The current volume provides the overall approach, methodologies, technical analyses, evaluation and selection of the preferred water servicing strategy for each of the water systems.

This main section of Volume III has been organized into four sections as described below, outlining the general approach, methodologies, and technical analysis used to develop the preferred water servicing strategy.

This volume's Introduction has been organized in 4 sections as described below:

1. Introduction
2. Analysis Methodology
3. Evaluation Methodology
4. Water Capital Program

Further to the Introduction, individual Sub-Parts A to F – one for each water system – is also included to summarize the technical analyses and evaluation of the preferred water servicing strategy for each system.

Each Sub-Part A to F has been organized in 8 sections as described below:

1. Existing System Overview
2. Growth Projections
3. Assessment of Water Infrastructure
4. System Opportunities and Constraints
5. Assessment of Alternatives
6. Preferred Servicing Strategy
7. Capital Program
8. Project Files (If Applicable)

Volume III is one of five volumes that make up the complete Master Servicing Plan Class EA Study Report and should be read in conjunction with the other volumes.

2. ANALYSIS METHODOLOGY

The current analysis calculates the following:

- Total equivalent population fed by each water treatment plant at the following time horizon: 2021, 2026, 2031, 2036, 2041.
- Total equivalent population fed by each pumping station at each time horizon.
- Total equivalent supported by each storage facility at each time horizon.
- Maximum day demand for each pumping station at each time horizon.
- Maximum day storage requirement for each pressure zone.

The results of this analyses are used as input to this Master Servicing Plan, which identifies the problem and opportunity and develops alternative solutions to address.

2.1 Project Assumptions

The following key assumptions have been made as part of the analysis:

- Niagara Municipal Comprehensive Review 2041 growth projections were used:
  - To estimate growth related demands within the water system.
  - To spatially allocate growth demands within the individual water system.
- Institutional, industrial, and commercial growth flows were estimated using equivalent employment projections.
- Pumping station firm capacity is the firm capacity given in the latest Environmental Certificate of Approval (ECA) for each station. System capacity analysis was completed using the lesser of the ECA firm capacity or actual operational capacity as provided by Regional operational staff (if provided).
  - Where this value is not provided, for the purpose of this master plan, the firm capacity is taken as the sum of individual pump capacities with the largest pump out of service.

2.2 Demand Projections and Allocations

The study area consists of the existing service area as well as residential and industrial land supply within the existing urban boundary. The MCR population and employment projects were provided in five year increments on a traffic survey zone basis.

Tributary population employment numbers to each pressure zone and treatment facility were calculated using the following process:

- A baseline growth area shapefile was provided by the Region. The growth area included all existing available vacant land supply, as well as know growth nodes and corridors.
- Traffic survey zones were overlaid with the growth area shapefile. The total traffic survey zone growth was assigned to the growth areas proportionally based on area-weighted basis.
- For traffic survey zone with no corresponding growth area shapes, all growth was assumed to be proportionally applied to existing area within the urban boundary.
- For traffic survey zones partially in the urban boundary, all growth was assumed to occur within the urban boundary with no growth outside the urban boundary.
- For traffic survey zones entirely outside the urban boundary, growth was only applied to existing service areas proportionally based on area-weighted basis or total service area within the traffic survey zone.
- The total population growth serviced by water out to 2041 will be less than the total growth presented in Table 3.1 and Table 3.2 as this includes unserviced areas outside the urban area boundary.
- The growth shapes were overlaid with the existing pressure zone boundary to assign growth to individual pressure zones.
- For unassigned growth shapes, a manual review of existing service network, topographic, and existing natural and physical features was conducted and growth was assigned to individual pressure zones based on likely service connection.
- For allocation to the InfoWater model, the growth area shapes where then allocated to the closest existing water system zone within the growth shapes previously assigned pressure zone.

Figure 3.3 provides an example of the process used to allocate system demands.

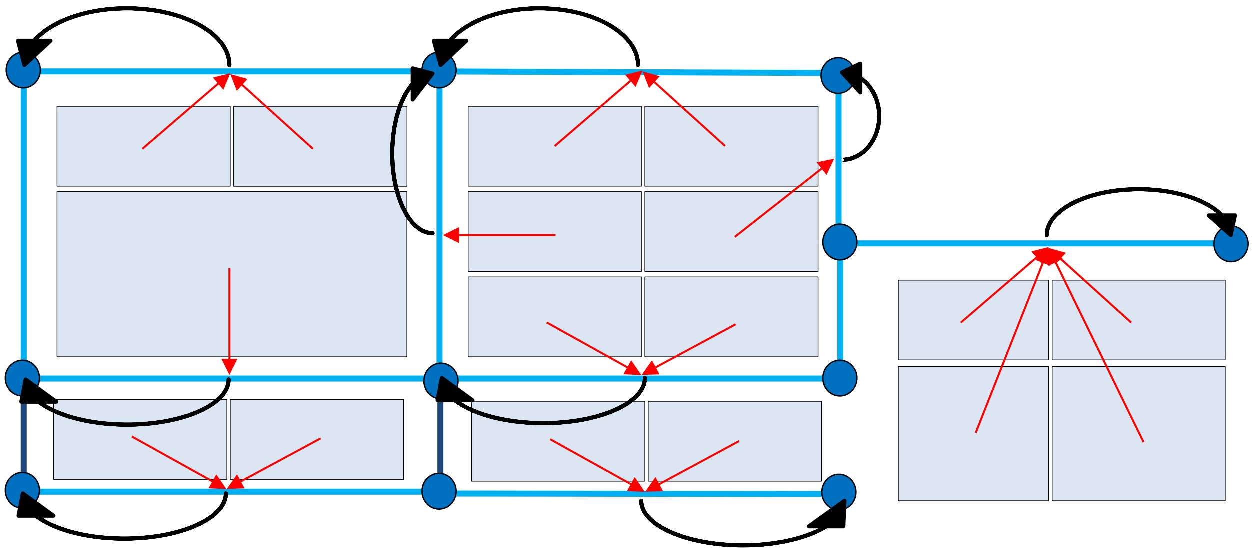


Figure 3.3 Process for Allocating System Demands

2.3 Study Area Population and Employment

Table 3.1 and Table 3.2, present the MCR projected population and employment by municipality.

Table 3.1 Municipal Comprehensive Review Population Growth by Municipality

Municipal Comprehensive Review Strategic Growth Option Forecast Total Population by Local Municipality								
Municipality	**Total Population Including Net Undercoverage**							
	2011	**2014 ***	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**
Fort Erie	30,760	31,216	31,520	32,310	34,720	37,780	41,220	43,940
Grimsby	26,000	27,224	28,040	29,430	31,400	33,200	35,140	37,150
Lincoln	23,080	23,884	24,420	24,990	26,230	28,060	30,030	31,590
Niagara Falls	85,200	88,326	90,410	92,830	99,990	108,770	117,670	124,580
Niagara-on-the-Lake	15,810	17,112	17,980	19,750	21,420	22,850	24,700	26,580
Pelham	17,040	17,352	17,560	17,900	19,410	21,560	23,720	25,260
Port Colborne	18,910	18,838	18,790	18,600	19,210	20,080	21,050	21,820
St. Catharines	134,890	135,940	136,640	136,930	142,560	150,590	160,040	167,480
Thorold	18,410	18,944	19,300	19,680	21,500	23,850	26,470	28,470
Wainfleet	6,520	6,532	6,540	6,590	6,760	6,990	7,260	7,480
Welland	51,980	53,000	53,680	54,130	56,540	59,600	63,160	66,180
West Lincoln	14,200	14,608	14,880	16,170	18,930	22,630	26,530	29,460
Niagara Region	**442,800**	**452,976**	**459,760**	**469,310**	**498,670**	**535,960**	**576,990**	**609,990**

* Note: The Master Servicing Plan Update has an established baseline condition of year 2014. 2014 represents the best available system information and system calibration data for the water and wastewater models at the time of study initiation. The Master Servicing Plan Update has projected growth from year 2014 to establish the 2041 infrastructure needs.

Table 3.2 Municipal Comprehensive Review Employment Growth by Municipality

Municipal Comprehensive Review Strategic Growth Option Forecast Employment by Local Municipality								
Municipality	**Total Place of Work Employment**							
	2011	**2014 ***	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**
Fort Erie	11,290	11,992	12,460	13,270	13,960	14,920	15,940	17,240
Grimsby	7,720	9,010	9,870	10,780	11,440	12,380	13,310	14,630
Lincoln	9,740	10,664	11,280	11,870	12,300	13,040	13,710	14,600
Niagara Falls	41,030	43,628	45,360	47,790	49,630	52,060	54,570	57,720
Niagara-on-the-Lake	10,650	12,066	13,010	13,720	14,150	14,660	15,230	16,030
Pelham	4,090	4,360	4,540	4,880	5,220	5,750	6,280	6,930
Port Colborne	5,860	5,806	5,770	5,900	6,080	6,350	6,640	7,000
St. Catharines	60,180	61,668	62,660	65,530	67,820	71,480	75,240	80,240
Thorold	7,360	7,786	8,070	8,480	8,870	9,390	9,960	10,660
Wainfleet	1,160	1,244	1,300	1,350	1,400	1,470	1,550	1,650
Welland	22,090	22,990	23,590	24,490	25,170	26,220	27,300	28,760
West Lincoln	4,280	4,802	5,150	5,770	6,370	7,270	8,280	9,560
Niagara Region	**185,450**	**196,016**	**203,060**	**213,830**	**222,410**	**234,990**	**248,010**	**265,020**

* Note: The Master Servicing Plan Update has an established baseline condition of year 2014. 2014 represents the best available system information and system calibration data for the water and wastewater models at the time of study initiation. The Master Servicing Plan Update has projected growth from year 2014 to establish the 2041 infrastructure needs.

2.4 Design Criteria

The Master Servicing Plan Update has used the following design criteria to project water demands, determine capacity requirements and establish the water infrastructure program:

- Residential Average Day Demand: 300 Lpcd
- Employment Average Day Demand: 300 Lped
- Maximum Day Factors: Based on rolling average for each system from last 5 years

- Residential Peak Hour Factor: 4
- Employment Peak Hour Factor: 2

2.5 Demand Projection

2.5.1 Starting Point Methodology

Niagara Region provided daily demand at each plant for 2011 – 2015. Using this data, an average day demand and maximum day demand peaking factor was calculated for each year. The five year rolling average of average day demands and maximum day peaking factor was used to establish baseline (2014*) system average day demands and maximum day demands.

2.5.2 Growth Demand Projections

Future system demands were developed using a starting point methodology. Expected demand due to growth were added to the starting point demand to establish future demands. Example for the Fort Erie system is provided below.

2041 ADD = Baseline ADD + (2041 total equ.pop. – 2014 total equ.pop) * 300 Lpcd
17.4 MLD = 12.4 MLD + (57,832 – 41,258) * 300 Lpcd

Table 3.3 Water Demand Projections

Water System	2014 – 2041 Growth *			2014 Demands		2041 Demands	
	Growth Population	Growth Employment	Total Equivalent Growth	Average Day Demand (MLD)	Maximum Day Demand (MLD)	ADD (MLD)	MDD (MLD)
Grimsby Water Treatment Plant (WTP)	27,244	11,159	38,404	14.9	25.9	26.4	45.9
Decew WTP	53,246	25,793	79,036	60.4	93.6	84.1	130.4
Niagara Falls WTP	35,350	13,587	48,937	41.7	64.2	56.4	86.9
Fort Erie WTP	12,715	3,859	16,574	12.4	19.1	17.4	26.8
Port Colborne WTP	3,011	1,024	4,035	8.3	12.9	9.5	14.8
Welland WTP	23,484	8,473	31,958	21.7	33.2	31.3	47.9

* Note: The Master Servicing Plan Update has an established baseline condition of year 2014. 2014 represents the best available system information and system calibration data for the water and wastewater models at the time of study initiation. The Master Servicing Plan Update has projected water demands from year 2014 to establish the 2041 infrastructure needs.

2.6 Water Infrastructure Capacity

2.6.1 Sizing of Treatment Plant

Treatment plants are designed to treat the maximum day demand. The following criteria were used to assess when water treatment facilities require expansion, as agreed upon with the Region.

- When flows reach 80% of plant capacity, the planning process for plant expansion will be flagged.
- When 90% of plant capacity has been reached, expansion should be completed.

2.6.2 Sizing of Pumping Station

Pumping stations are sized to provide maximum day demands, assuming there is sufficient storage in the pressure zone. When storage in the pressure zone is not provided, the pumping requirement is for:

- Peak hour demands when there is insufficient balancing storage, or
- Maximum day plus equivalent fire storage deficit flow transfer.

The following criterion is used to assess when a pumping station requires expansion:

- Capacity expansion will be triggered once the station's firm capacity reaches the required demands.

Once capacity expansion has been triggered, site capacity will be evaluated to determine if a new or expanded site is required. When proposing a new site for a pumping station, an allowance in building facility will be considered to account for future expansion and staging of works.

2.6.3 Sizing of Storage

The capacity of the required storage was estimated using Typical Ministry of the Environment and Climate Change (MOECC) criteria:

- Fire Storage in accordance with the MOECC Guideline for the Design of Water Distribution Systems, based on equivalent population (A)
- Equalization stage at 25% of the maximum day demand (B)
- Emergency storage at 25% of equalization plus fire storage (C = 25% of A+B)

In instances where the zone's supply capacity exceeds peak hour demand, equalization storage of 15% may be considered if it supports improved system operations or energy efficiency.

2.6.4 Sizing of Watermains

Feedermains are sized based on flow demands and pressure requirements, which includes maintaining:

- Local system pressures between 40 and 100 psi.
- Regional watermains pressure of at least 50 psi.

Velocities in the pipe and headloss in the system have been considered, including:

- Target headloss of 2.5 m/km or less to reduce pumping costs.
- Target velocity less than 2.0 m/s under normal operating conditions.

The water models have been utilized to assess the network and to run four main scenarios (minimum hour, maximum day, peak hour, and maximum day plus fire) to confirm transmission requirements.

Transmission watermain capacity expansions are based on service level (pressure, velocity, headloss). Oversizing may be considered in areas with an excess of land supply to plan for future potential.

3. WATER SERVICING STRATEGY

3.1 Servicing Principles and Policies

Through the course of the Master Servicing Plan Update, priority policy areas were brought forward including:

- Health and safety;
- System reliability and security;
- Reservation of capacity for operational flexibility and level of service;
- Impacts of climate change;
- Considerations for energy use and efficiency;
- Recognition of impacts from water efficiency and conservation;
- Addressing issues related to the full lifecycle of water and wastewater services;
- A comprehensive list of general, water and wastewater policies were established. As a result from the priority policy areas, key principle and policy statements were developed as highlighted below:
- Niagara Region will endeavor to maintain sufficient reserve capacity in its water and wastewater infrastructure and facilities to provide operational flexibility and meet potential changes in servicing conditions.
- Niagara Region shall endeavor to provide reliability, redundancy and security in its water and wastewater systems with attention to high risk and critical areas
- Niagara Region shall be aware of and consider the potential impact of climate change on the planning and sizing of infrastructure.
- Niagara region shall design water and wastewater facilities with consideration to energy use.
- Niagara Region will consider levels of storage beyond MOE Guidelines where appropriate in order to provide operational flexibility, energy management and system security.

3.2 Evaluation Methodology

The process for developing, evaluating and selecting the preferred water servicing strategy followed these key steps:

- Review of baseline conditions across each water system;
- Identification of opportunities and constraints for each system;
- Development of high level servicing concepts;
- Review of each concept with respect to environmental, social, legal, technical and financial factors. Development of advantages and disadvantages for each;
- Provide additional detail for the preferred concept ensuring alignment, siting, capacity, timing and other technical factors are identified; and
- Development of a conceptual cost estimate for each project.

Each alternative was evaluated through the reasoned argument approach which provided a clear and thorough rationale of the trade-offs among the various options based on the anticipated impacts caused by various evaluation criteria and factors. The basis of this approach is to qualitatively evaluate the relative advantages, disadvantages, and impacts of each alternative against the established criteria. This process was intended to highlight why the preferred alternative was chosen through evaluation of technical, environmental, social/cultural, financial, and legal/jurisdictional criteria.

4. CAPITAL PROGRAM

4.1 Water System Recommendations Overview

A summary of the key aspects of the water servicing strategy are in Table 3.4.

Table 3.4 Water Servicing Strategy

System	Water Servicing Strategy
Grimsby	• Based on the level of growth on the system, the Grimsby Water Treatment Plant will require additional water treatment capacity. • The location of water storage to optimize pumping costs and provide equalization and emergency storage to the system has been addressed. A new storage facility to support the Grimsby and Smithville service areas has been established. The new location results in decommissioning the existing reservoir and pumping station. • To support the new storage location and to provide additional water transmission capacity through the Grimsby system, a new feedermain across Grimsby and a new feedermain from the Grimsby Water Treatment Plant are required. • The level of growth in the Smithville area requires additional trunk watermain capacity through the network. • Additional pumping capacity is required to support the Lincoln service area growth.

Decew and Niagara Falls	• Both the Decew Water Treatment Plant and the Niagara Falls Water Treatment Plant have sufficient capacity to support growth to year 2041. • The inlet channel for the Decew Water Treatment Plant will have upgrades. This project is a shared project with OPG. • Additional feedermain capacity is required in Niagara-on-the-Lake to support water supply to the growth areas. • The storage location in Niagara Falls will be optimized with additional storage capacity provided in a new tank located in closer proximity to the growth areas in South Niagara Falls. The existing Lundy's Lane tank will be decommissioned. • Due to the amount of growth in South Niagara Falls, a new trunk water feedermain will be required to support the growth demands. • Additional feedermain capacity is required in the Port Robinson area due to growth and for trunk system connectivity.
Fort Erie	• The Rosehill Water Treatment Plant has sufficient capacity to support growth to year 2041. • The components of the Fort Erie water strategy are focused on providing additional storage for the growth in the area while optimizing the storage/pumping relationship to reduce long term lifecycle costs. • A new water tank will be provided in central Fort Erie to support the system growth and directly support the employment centre. • The new tank will allow for decommissioning of the existing Stevensville reservoir and pumping station as well as Central Avenue Elevated Tank. • Additional trunk feedermain capacity is required to support the new tank and for distribution in central Fort Erie.

Port Colborne	• The Port Colborne Water Treatment Plant has sufficient capacity to support growth to year 2041. • The components of the Port Colborne water strategy are focused on providing additional storage for the growth in the area while optimizing the storage/pumping relationship to reduce long term lifecycle costs. • New Barrick Road Elevated Tank will be provided in northern Port Colborne to support the system growth and optimize water levels for the system. • The new tank will allow for decommissioning of the Fielden reservoir and pumping station as well as the King Street Elevated Tank. • Additional trunk water feedermain will be provided crossing the Canal to support growth on the East and West side of Port Colborne.
Welland	• The Welland Water Treatment Plant has sufficient capacity to support growth to year 2041. • The components of the Welland water strategy are focused on providing additional storage for the growth in the area while optimizing the storage/pumping relationship to reduce long term lifecycle costs. • Both sets of pumps in the Shoalt's Drive pumping station for the higher and lower pressure zones will be upgraded to support growth. • A new water tank at the Pelham Elevated Tank site, replacing the existing water tank, will be provided to support growth and optimize system pressures and performance in the area. • Based on growth in the north and east limits of the system, additional water feedermain capacity is required.

4.2 Capital Program

A summary of the water servicing strategy capital program with details for each project is provided in Table 3.5.

Table 3.5 Water Servicing Strategy

Master Plan ID	Name	Description	Size / Capacity	Year in Service	Municipality	Class EA Schedule	Class EA Status	Project Type	Total Component Estimated Cost
W-D-001	Decommissioning of Central Avenue (Fort Erie South) Elevated Tank	New Fort Erie Elevated Tank to replace the Central Avenue Elevated Tank and Stevensville Reservoir; Central Avenue Elevated Tank to be decommissioned	N/A	2022 - 2031	Fort Erie	A+	Satisfied	Storage	$ 1,979,000
W-D-002	Decommissioning of Stevensville Reservoir + Pumping Station	New Fort Erie Elevated Tank to replace the Central Avenue Elevated Tank and Stevensville Reservoir; Stevensville Reservoir and Pumping Station to be decommissioned	N/A	2022 - 2031	Fort Erie	A+	Satisfied	Storage	$ 2,913,000
W-D-003	Decommissioning of Park Road Reservoir + Pumping Station	Decommissioning of Park Road Reservoir and Pumping Station, to be replaced by new Grimsby Reservoir and additional pumping capacity at the Water Treatment Plant	N/A	2022 - 2031	Grimsby	A+	Satisfied	Storage	$ 523,000
W-D-004	Decommissioning of Lundy's Lane Elevated Tank	Lundy's Lane Elevated Tank to be decommissioned and replaced by new South Niagara Falls Elevated Tank	N/A	2032 - 2041	Niagara Falls	A+	Satisfied	Storage	$ 1,979,000
W-D-005	Decommissioning of Pelham Elevated Tank	Decommissioning of existing Pelham Elevated Tank, to be replaced by a new Elevated Tank	N/A	2022 - 2031	Pelham	A+	Satisfied	Storage	$ 1,028,000
W-D-006	Decommissioning of King Street Elevated Tank	Decommissioning of King Street Elevated Tank, to be replaced by storage at new Barrick Road Elevated Tank	N/A	2017 - 2021	Port Colborne	A+	Satisfied	Storage	$ 1,979,000
W-D-007	Decommissioning of Fielden Avenue Reservoir + Pumping Station	Decommissioning of Fielden Avenue Reservoir and Pumping Station	N/A	2032 - 2041	Port Colborne	A+	Satisfied	Storage	$ 2,913,000
W-F-001	Grimsby Water Treatment Plant Expansion	Provide an additional 15 MLD treatment, and new high lift pumping capacities to support feed to new Grimsby Reservoir	59 MLD	2022 - 2031	Grimsby	C	Separate EA Required	Treatment	$ 51,496,000
W-F-002	Decew inlet channel	New intake channel from Welland Canal to the Decew Water Treatment Plant. This will provide capacity above the current 147 MLD. Recommended in 2011 MSP	256 MLD	2017 - 2021	St. Catharines	B	Region to Satisfy EA Requirements	Treatment	$ 22,969,000
W-M-001	New trunk main in Central Fort Erie	New trunk main in Central Fort Erie	450 mm	2022 - 2031	Fort Erie	A+	Satisfied	Watermain	$ 9,479,000

Master Plan ID	Name	Description	Size / Capacity	Year in Service	Municipality	Class EA Schedule	Class EA Status	Project Type	Total Component Estimated Cost
W-M-002	New Conveyance to Port Colborne East side	New Conveyance to East side of Port Colborne across canal	450 mm	2017 - 2021	Port Colborne	A+	Satisfied	Watermain	$ 11,548,000
W-M-003	New trunk main from Welland Water Treatment Plant to North	New trunk main from Welland Water Treatment Plant to North service area	450 mm	2032 - 2041	Welland	A+	Satisfied	Watermain	$ 7,556,000
W-M-004	Upgrade trunk main from Grimsby Water Treatment Plant to Park Road	Upgrade trunk main from Grimsby Water Treatment Plant to Park Road	750 mm	2017 - 2021	Grimsby	A+	Satisfied	Watermain	$ 13,139,000
W-M-005	New trunk main from Grimsby Water Treatment Plant to New Grimsby Reservoir	New trunk main from Grimsby Water Treatment Plant to New Grimsby Reservoir	750 mm	2022 - 2031	Grimsby	B	To Be Satisfied Through Secondary Plan	Watermain	$ 42,044,000
W-M-006	New trunk main in Smithville	New trunk main in Smithville	400 mm	2022 - 2031	West Lincoln	A+	Satisfied	Watermain	$ 14,357,000
W-M-007	New trunk main from PRV to Port Robinson Chlorine Booster Pumping Station in Niagara Falls	New trunk main from PRV to Port Robinson Chlorine Booster Pumping Station in Niagara Falls	450 mm	2017 - 2021	Niagara Falls	A+	Satisfied	Watermain	$ 2,543,000
W-M-008	Trunk main from South Niagara-on-the-Lake to Virgil Elevated Tank	Trunk main from South Niagara-on-the-Lake to Virgil Elevated Tank with PRV in Niagara-on-the-Lake to supply Decew system from Niagara Falls system	600 mm	2032 - 2041	Niagara-on-the-Lake	A+	Satisfied	Watermain	$ 13,535,000
W-M-009	New Niagara Falls South trunk main to New Elevated Tank	New Niagara Falls South trunk main to provide additional supply to new growth areas and to serves as connection between existing transmission network and new South Niagara Falls Elevated Tank	750 mm	2032 - 2041	Niagara Falls	A+	To Be Satisfied Through Secondary Plan	Watermain	$ 4,858,000
W-M-010	New Niagara Falls South trunk main	New Niagara Falls South trunk main to provide additional supply to new growth areas	400 mm	2032 - 2041	Niagara Falls	B	To Be Satisfied Through Secondary Plan	Watermain	$ 18,316,000
W-M-011	New trunk main to Fort Erie Elevated Tank	New trunk main to Fort Erie Elevated Tank	450 mm	2017 - 2021	Fort Erie	A+	EA Previously Completed	Watermain	$ 4,107,000
W-M-012	Upgrade watermain in Port Colborne to new Barrick Road Elevated Tank	Upgrade watermain in Port Colborne to new Barrick Road Elevated Tank	450 mm	2017 - 2021	Port Colborne	A+	Satisfied	Watermain	$ 2,185,000

Master Plan ID	Name	Description	Size / Capacity	Year in Service	Municipality	Class EA Schedule	Class EA Status	Project Type	Total Component Estimated Cost
W-P-001	Upgrade Shoalt's Drive Low Lift Pumping Station	Replace both 3 MLD low lift pumps with 6.5 MLD pumps each	75 L/s	2017 - 2021	Pelham	A+	Satisfied	Pumping	$ 3,062,000
W-P-002	Upgrade Shoalt's Drive High Lift Pumping Station	Replace all four 5.4 MLD high lift pumps with 10 MLD pumps each	347 L/s	2017 - 2021	Pelham	A+	Satisfied	Pumping	$ 7,882,000
W-P-003	Upgrade Lincoln/Grimsby Booster Pumping Station	Add third 9.5 MLD pump	110 L/s	2032 - 2041	Grimsby	A+	Satisfied	Pumping	$ 989,000
W-S-001	New Fort Erie Elevated Tank	New Fort Erie Elevated Tank to replace the Central Avenue Elevated Tank and Stevensville Reservoir	8 ML	2017 - 2021	Fort Erie	B	Satisfied (Project File Included)	Storage	$ 12,838,000
W-S-002	New Barrick Road Elevated Tank in Port Colborne	New Barrick Road Elevated Tank in Port Colborne to replace the King Street Elevated Tank	6 ML	2017 - 2021	Port Colborne	B	EA Previously Completed	Storage	$ 8,022,000
W-S-003	New Pelham Elevated Tank	New Pelham Elevated Tank to replace existing Elevated Tank	6 ML	2022 - 2031	Pelham	B	Satisfied (Project File Included)	Storage	$ 9,307,000
W-S-004	New South Niagara Falls Elevated Tank	New South Niagara Falls Elevated Tank to replace the Lundy's Lane Elevated Tank and provide additional storage	6 ML	2032 - 2041	Niagara Falls	B	To Be Satisfied Through Secondary Plan	Storage	$ 9,629,000
W-S-005	New Grimsby Reservoir	New Grimsby Reservoir to provide additional storage – already designed Includes associated connection to existing Park Road facility and associated upgrades to Park Road pump station to support interim operational configuration	15 ML	2017 - 2021	Grimsby	B	EA Previously Completed	Storage	$ 23,474,000
Total									$ **306,649,000**

PART F
WELLAND WATER SYSTEM

F. WELLAND WATER TREATMENT PLANT

F.1 Existing System Overview

The Welland water system services the City of Welland, the Town of Pelham (Fonthill and Fenwick), and the southern part of the City of Thorold (Port Robinson West Area). The system services an existing population of 68,288 and 27,304 employees.[1]

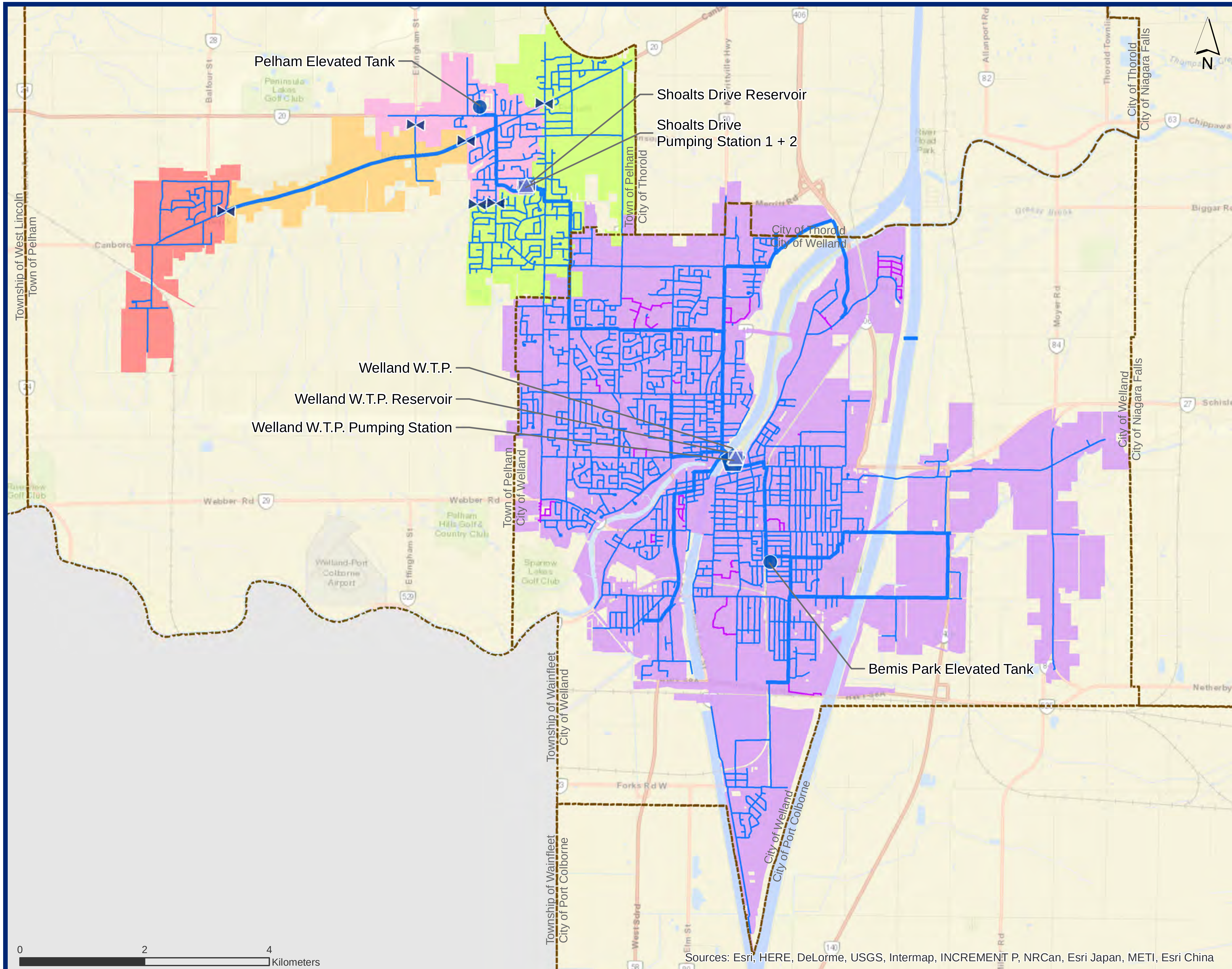
The system is supplied by the Welland Water Treatment Plant, located on 4 Cross Street North in Welland. The plant is a conventional surface water treatment plant with zebra mussel control, travelling screens, coagulation, flocculation, sedimentation, filtration, and disinfection processes. Lake Erie (via the Welland Canal) serves as a source to the plant. The plant has a rated capacity of 102.3 MLD (1,184 L/s).[2]

The system supplies local area municipalities via a water main network, pumping stations, and service reservoirs. The supply area is divided into five pressure zones.

Figure 3.F.1 and Figure 3.F.2 present an overview of the water system and a water system schematic diagram, respectively.

[1] *Hemson Consulting Ltd, 2016. Niagara Region TAZ Forecasts to 2041*

[2] *Ministry of Environment Ontario, 15 August 2014. Drinking Water Works Permit. Number 007-204*



Niagara Region

2016 MASTER SERVICING PLAN

Water Facilities

- Water Treatment Plant
- Reservoir
- Elevated Tank
- Standpipe
- Chlorine Facility
- Pressure Reducing Valve

Pumping Station

- Regional
- Municipal

Water Network

- Regional
- Local
- Private

Pressure Zone System*

*Pressure zone limits are shown based on property boundaries.

- 220
- 248
- 272
- 247
- 268

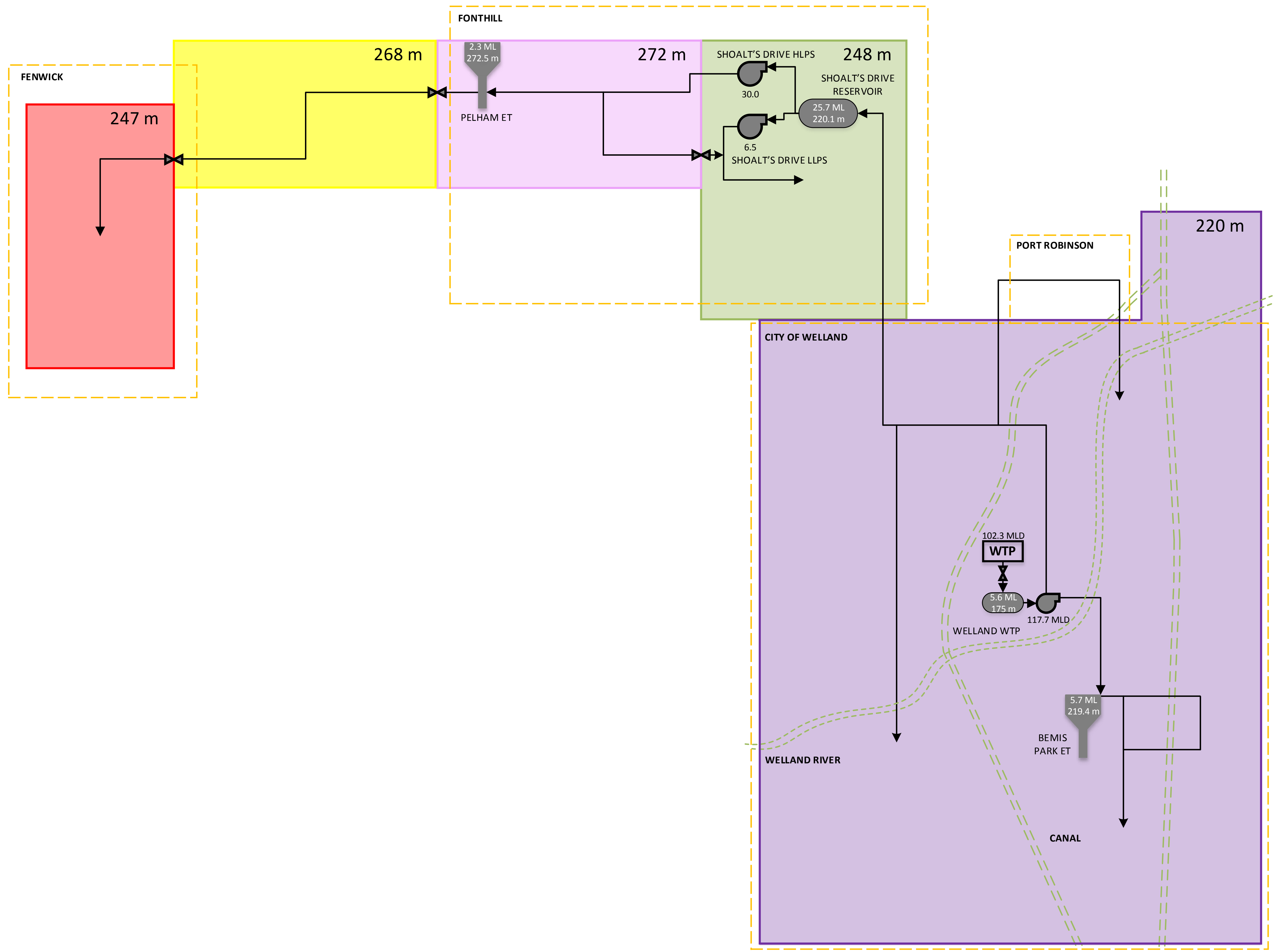
Figure 3.F.1

Existing Water System

Welland WTP

BluePlan

May 2017
715023-W-2-Existing Water System (Welland)
NAD 1983 UTM Zone 17N



Niagara Region

2016 Master Servicing Plan

Welland WTP

EXISTING DISTRIBUTION SCHEMATIC

WTP RATED CAPACITY — Water Treatment Plant
Volume TWL — Standpipe
FIRM CAPACITY — Pumping Station
Trunk Watermain Network
Volume TWL — Reservoir
Settlement Area Boundaries
Volume TWL — Elevated Tanks
Land and Water Features
Control Valve (Only normally operated valves shown)
c — Chlorine Facility

Pressure Zone

220 m
268 m
247 m
272 m
248 m

May 2017
Figure 3.F.2
Not to Scale

BluePlan ENGINEERING

F.1.1 Facility Overview

Table 3.F.1 Water Treatment Plant Overview

Plant Name	Welland Water Treatment Plant[3]
Address	4 Cross Street North, Welland
Source Water	Lake Erie via Welland Canal
Rated MDD Capacity	102.3 MLD
Key Processes	• Zebra mussel control • Traveling screens • Coagulation • Flocculation • Sedimentation • Filtration • Disinfection

Table 3.F.2 Pump Stations Overview

Pump Station	Location	Inlet Source (Pressure Zone)	Discharge (Pressure Zone)	Zones Supplied	Number of Pumps (Total/ Firm)	Firm Capacity (MLD)	Total Dynamic Head (m)
Welland Water Treatment Plant (WTP) High Lift Pumps	4 Cross Street North, Welland	WTP	220	All	6/5	117.7	53.3
Shoalt's Drive High Lift Pumping Station	5 Shoalt's Drive, Fonthill	220	272	247, 268, 272	4/3	16.4	65.0
Shoalt's Drive Low Lift Pumping Station		220	248	248	2/1*	3.0	40.0

*Closed pressure zone with additional supply via a PRV flows from 272 m Zone. Station Firm Capacity calculated with largest pump out of service.

[3] *Ministry of Environment Ontario, 15 August 2014. Drinking Water Works Permit. Number 007-204*

Table 3.F.3 Storage Facilities Overview

Storage Facility	Location	Storage Type	Volume (ML)	Top Water Level (m)	Fire Supply Zones	Maximum Day Demand Supply Zones
Welland Water Treatment Plant Reservoir	4 Cross Street North, Welland	Pumped Reservoir	5.6	175.0	220	220
Shoalt's Drive Reservoir	5 Shoalt's Drive, Fonthill	Pumped/ Floating Reservoir	25.7	220.1	220 Floating, 248 Pumped	220 Floating, 248 Pumped
Pelham Elevated Tank	177 Highway #20 West, Fonthill	Elevated Tank	2.3	272.5	247, 268, 272	247, 268, 272
Bemis Elevated Tank	Coventry Road-East Side, Welland	Elevated Tank	5.7	219.4	220	220

Refer to Figure 3.F.1 for pumping station and storage facility locations.

F.1.2 Demands Overview

Table 3.F.4 Historic Water System Demands

Year	Average Day Demand (MLD)	Maximum Day Demand (MLD)	Maximum Day Demand Peaking Factor
2011	22.2	35.0	1.58
2012	24.4	41.0	1.68
2013	20.7	30.6	1.48
2014	20.7	30.0	1.45
2015	20.5	30.0	1.46
5 Year Average	***21.7***	***33.2***	***1.53***
5 Year Peak	***24.4***	***41.0***	***1.68***

Table 3.F.5 Water System Max Day Peaking Factor

Existing Service Population	68,288
Existing Service Employment	27,304
Total Service Equivalent Population	**95,592**
MOECC Peaking Factor[4]	1.65
Historic 5 Year Average Peaking Factor	1.53
Historic 5 Year Max Peaking Factor	1.68
2016 MSP Peaking Factor	**1.53**

The 2016 MSP peaking factor is the average of the peaking factors from 2011 to 2015.

[4] *Ministry of the Environment and Climate Change, 2008, Design Guidelines for Drinking-Water Systems, ISBN 978-1-4249-8517-3*

Table 3.F.6 Water System Demands by Pressure Zone*

Pressure Zone	Total Service Equivalent Population	2014 Average Day Demand (MLD)	2014 Maximum Day Demand (MLD)
220	76,412	17.3	26.5
247	2,284	0.7	1.0
248	10,239	2.2	3.4
268	2,459	0.3	0.4
272	4,198	1.2	1.9
Total	**95,592**	**21.7**	**33.2**

Pressure zone existing equivalent population estimates were derived using the Niagara 2041 MCR traffic survey zone population allocations and are calculated to the end of 2014. [5]

[5] *Hemson Consulting Ltd, 2016. Niagara Region TAZ Forecasts to 2041*

F.2 Growth Projections

F.2.1 Population Projections and Allocations

Table 3.F.7 and Table 3.F.8 outline the existing and projected serviced population and employment by pressure zone.

Table 3.F.7 Welland Water Treatment Plant Serviced Population by Pressure Zone

Pressure Zone	2014	2021	2026	2031	2036	2041	Growth: 2014 - 41
220	53,149	55,286	58,223	61,696	65,209	68,490	15,341
247	1,664	1,710	1,853	2,042	2,268	2,550	886
248	7,968	8,630	9,824	11,503	12,833	13,685	5,717
268	2,229	2,297	2,458	2,675	2,914	3,212	983
272	3,278	3,321	3,337	3,378	3,753	3,835	557
Total	**68,288**	**71,244**	**75,695**	**81,294**	**86,977**	**91,772**	**23,485**

Note: Population numbers may not sum due to rounding.

Table 3.F.8 Welland Water Treatment Plant Serviced Employment by Pressure Zone

Pressure Zone	2014	2021	2026	2031	2036	2041	Growth: 2014 - 41
220	23,263	24,818	25,543	26,662	27,801	29,415	6,152
247	620	709	764	855	945	1,061	441
248	2,271	2,522	2,693	2,964	3,233	3,572	1,301
268	230	257	273	293	315	340	110
272	920	1,009	1,072	1,170	1,268	1,389	469
Total	**27,304**	**29,315**	**30,345**	**31,944**	**33,562**	**35,777**	**8,473**

Note: Population numbers may not sum due to rounding.

F.2.2 Future Demand Projections

Table 3.F.9 and Table 3.F.10 summarize the projected average and maximum system demands by pressure zone.

Table 3.F.9 Projected Water System Average Day Demands (ADD) by Pressure Zone

Pressure Zone	2021 ADD (MLD)	2026 ADD (MLD)	2031 ADD (MLD)	2036 ADD (MLD)	2041 ADD (MLD)
220	18.4	19.5	20.9	22.3	23.8
247	0.7	0.8	0.9	0.9	1.1
248	2.5	2.9	3.5	4.0	4.3
268	0.3	0.3	0.4	0.5	0.6
272	1.3	1.3	1.3	1.5	1.5
Total	**23.2**	**24.8**	**27.0**	**29.2**	**31.3**

Table 3.F.10 Projected Water System Maximum Day Demands (MDD) by Pressure Zone

Pressure Zone	2021 MDD (MLD)	2026 MDD (MLD)	2031 MDD (MLD)	2036 MDD (MLD)	2041 MDD (MLD)
220	28.2	29.9	32.0	34.1	36.5
247	1.1	1.2	1.3	1.4	1.6
248	3.8	4.5	5.3	6.1	6.6
268	0.4	0.5	0.6	0.8	0.9
272	1.9	2.0	2.0	2.2	2.3
Total	**35.4**	**38.1**	**41.2**	**44.6**	**47.9**

F.3 Assessment of Water Infrastructure (Existing and Future)

F.3.1 Treatment Plant Capacity

Table 3.F.3 shows the projected future demands at the Welland Water Treatment Plant. The plant has surplus capacity and will not reach 80% capacity within the 2041 time horizon.

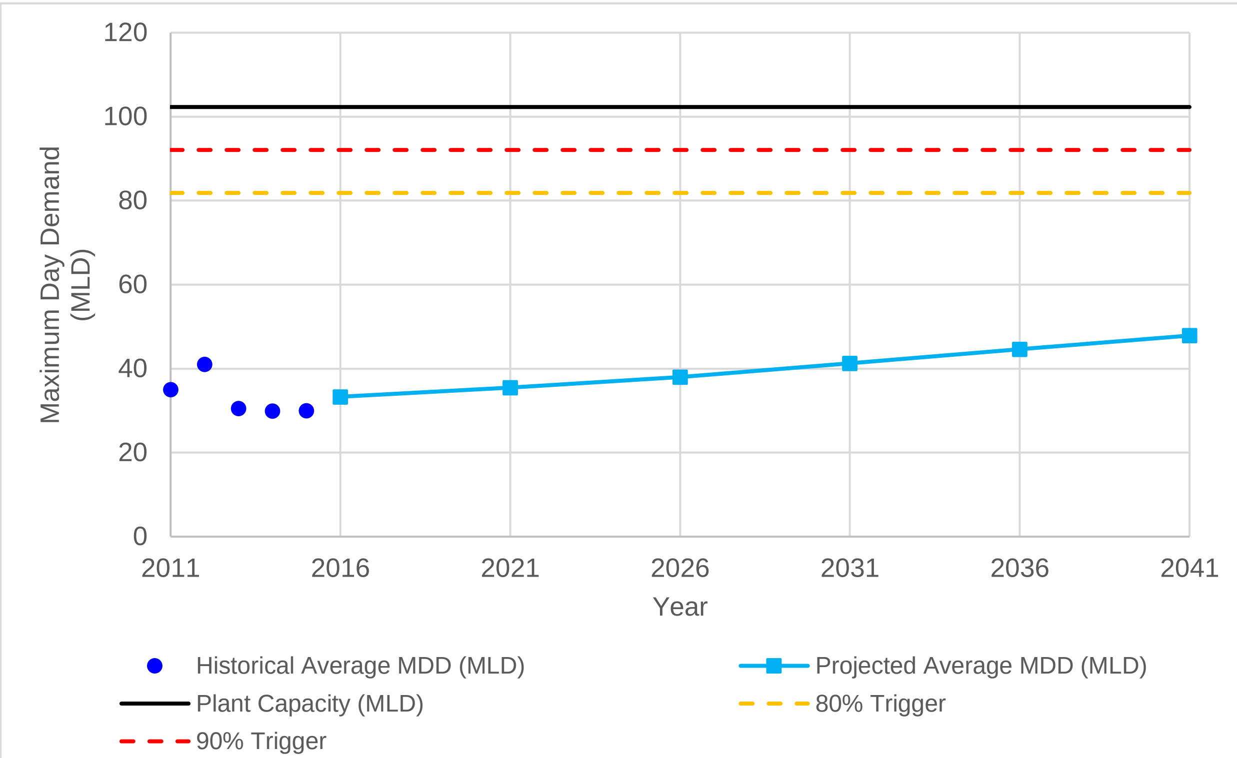


Figure 3.F.3 Projected Maximum Day Demand at Welland Water Treatment Plant

F.3.2 Pumping Capacity

Table 3.F.11 highlights the pumping station existing and projected capacity.

Table 3.F.11 System Pumping Station Performance

Pump Station	Pressure Zones Supplied	Total Effective Capacity (MLD)	Existing Maximum Day Demand (MLD)	2041 Maximum Day Demand (MLD)	2041 Surplus/ Deficit (MLD)
Welland Water Treatment Plant/High Lift Pumping Station	All	117.7	33.2	47.9	69.8
Shoalt's Drive High Lift Pumping Station	247, 268, 272	16.4	3.3	4.9	11.5
Shoalt's Drive Low Lift Pumping Station	248	3.0	3.4	6.6	-3.6

The Shoalt's Drive Low Lift Pumping Station has an existing pumping deficit of 0.4 MLD and a 3.6 MLD deficit projected for 2041.

F.3.3 Storage Capacity

Table 3.F.12 highlight the storage existing and projected capacity.

Table 3.F.12 System Storage Capacities

Pressure Zones Supplied	Storage	Existing and 2041 Total Available Storage (ML)	Existing Required Storage (ML)	2041 Required Storage (ML)	2041 Surplus/ Deficit (ML)
220	Welland WTP Reservoir	37.0	18.5	21.6	15.4
	Bemis Elevated Tank				
	Shoalt's Drive Reservoir				
247, 248, 268, & 272	Pelham Elevated Tank	2.3	7.2	11.0	-8.7

The upper pressure zones (247, 248, 268, and 272) have an existing storage deficit and an 8.7 MLD deficit projected for 2041.

Figure 3.F.4 through Figure 3.F.6 show the 5-day MDD storage performance for each storage facility.

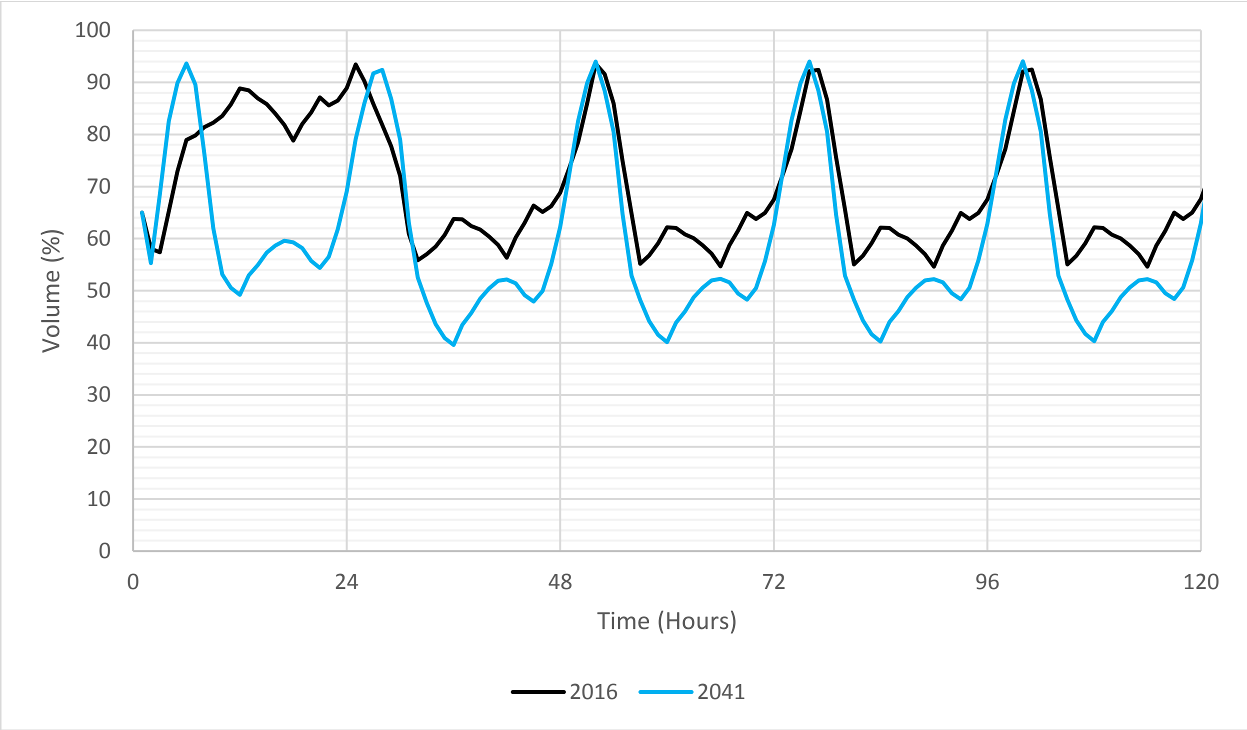


Figure 3.F.4 5-Day MDD Storage Performance – Pelham Elevated Tank

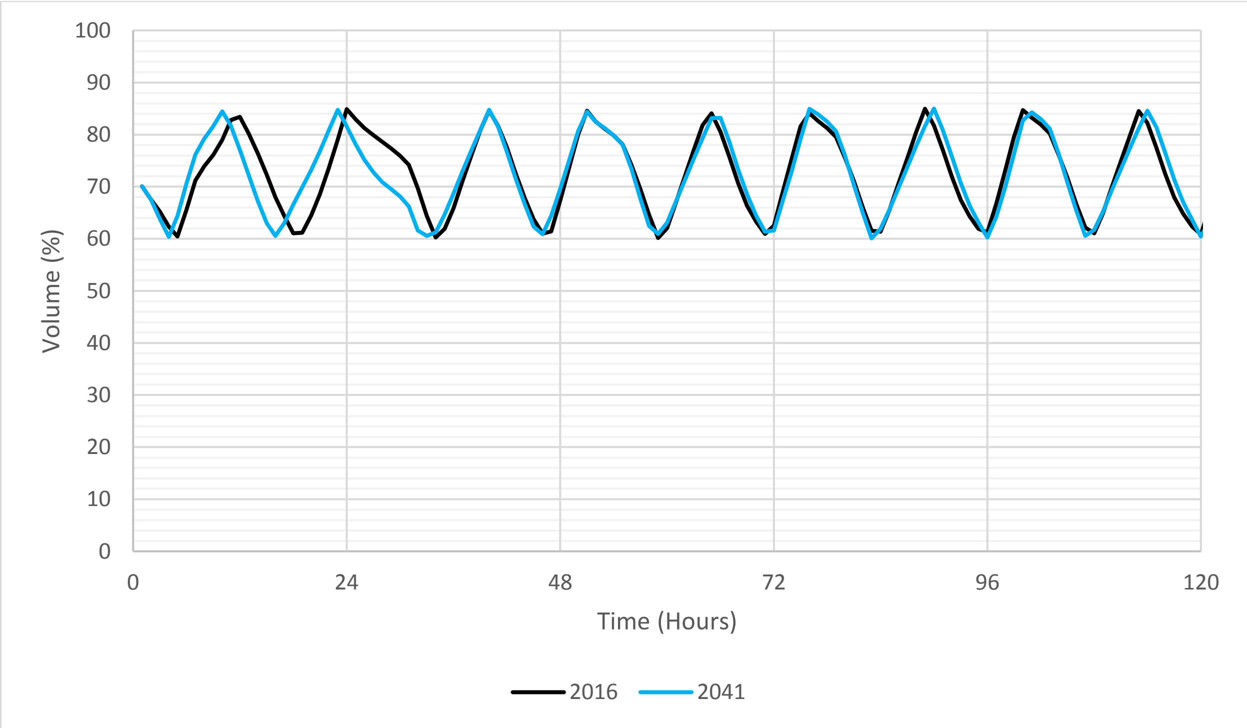


Figure 3.F.5 5-Day MDD Storage Performance – Shoalt's Reservoir

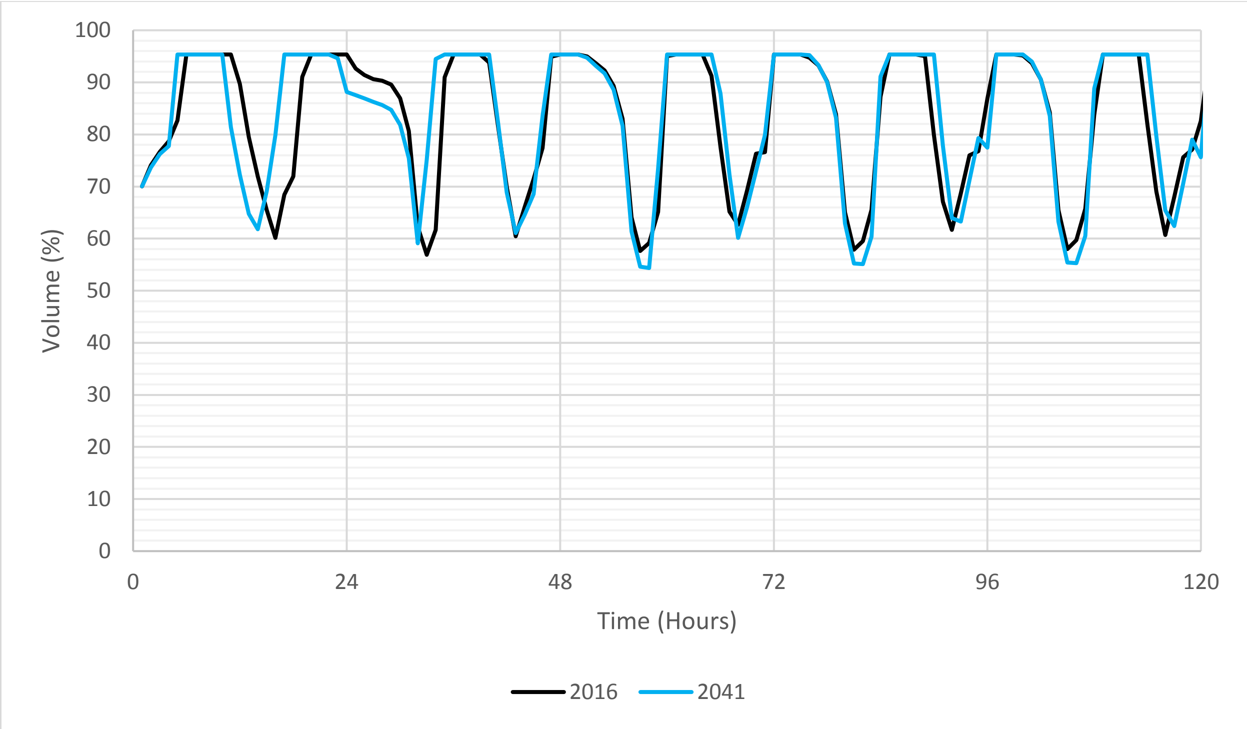
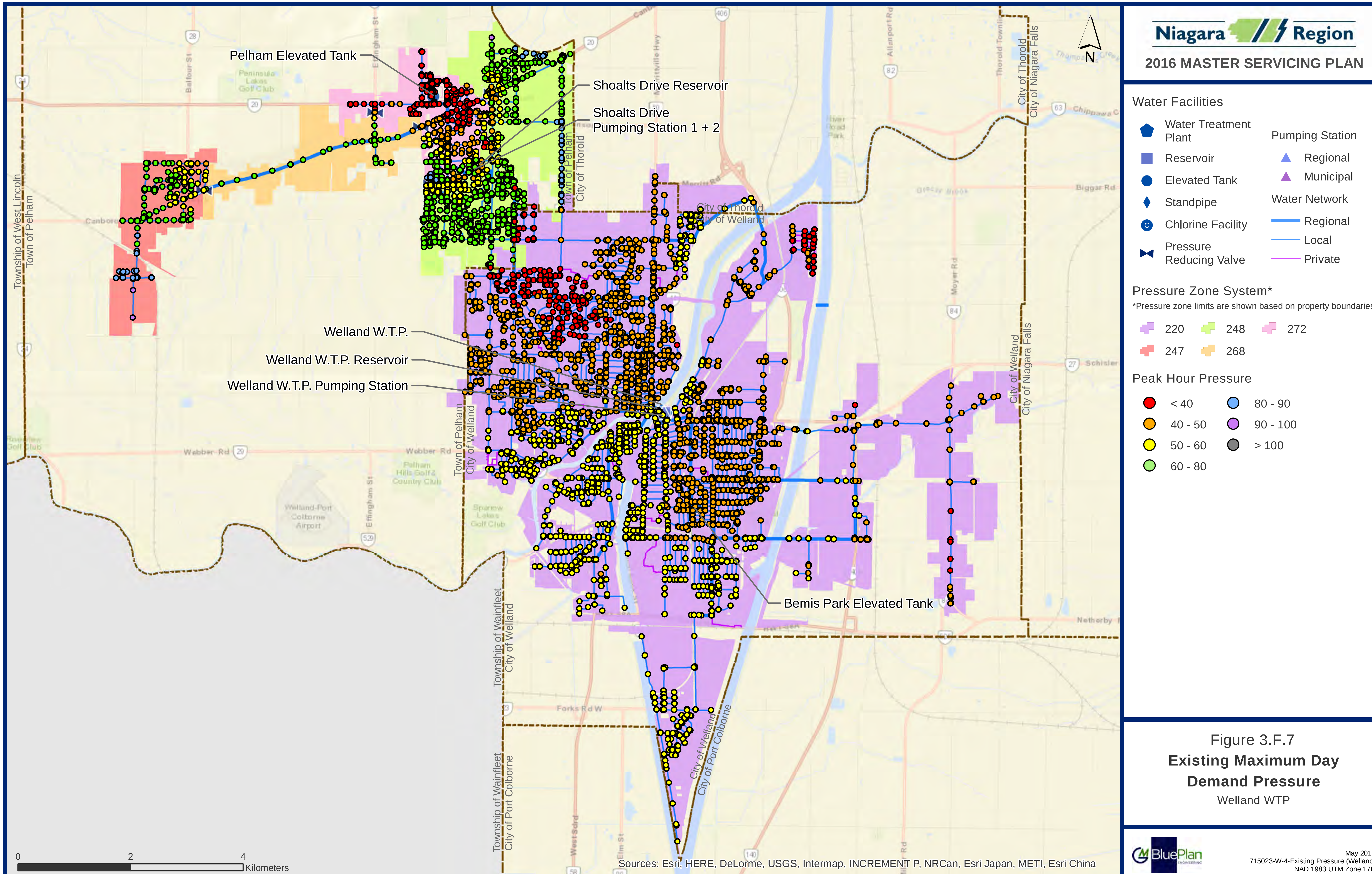


Figure 3.F.6 5-Day MDD Storage Performance – Bemis Elevated Tank

F.3.4 System Pressures and Fire Flows

Figure 3.F.7 to Figure 3.F.10 present the existing and project 2041 system performance, based on existing system configuration and capacities.



Niagara Region

2016 MASTER SERVICING PLAN

Figure 3.F.7
Existing Maximum Day Demand Pressure
Welland WTP

BluePlan ENGINEERING

May 2017
715023-W-4-Existing Pressure (Welland)
NAD 1983 UTM Zone 17N

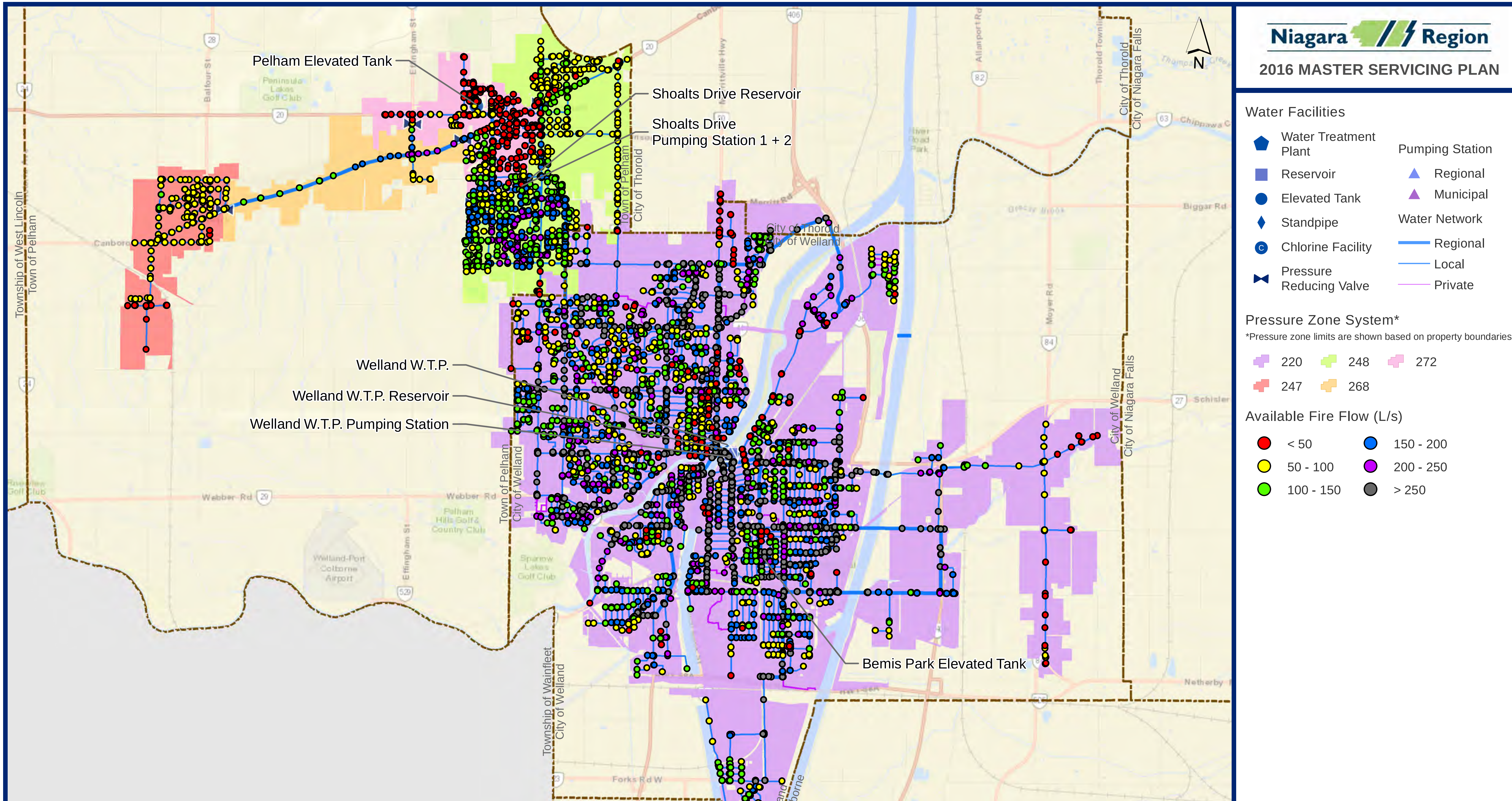


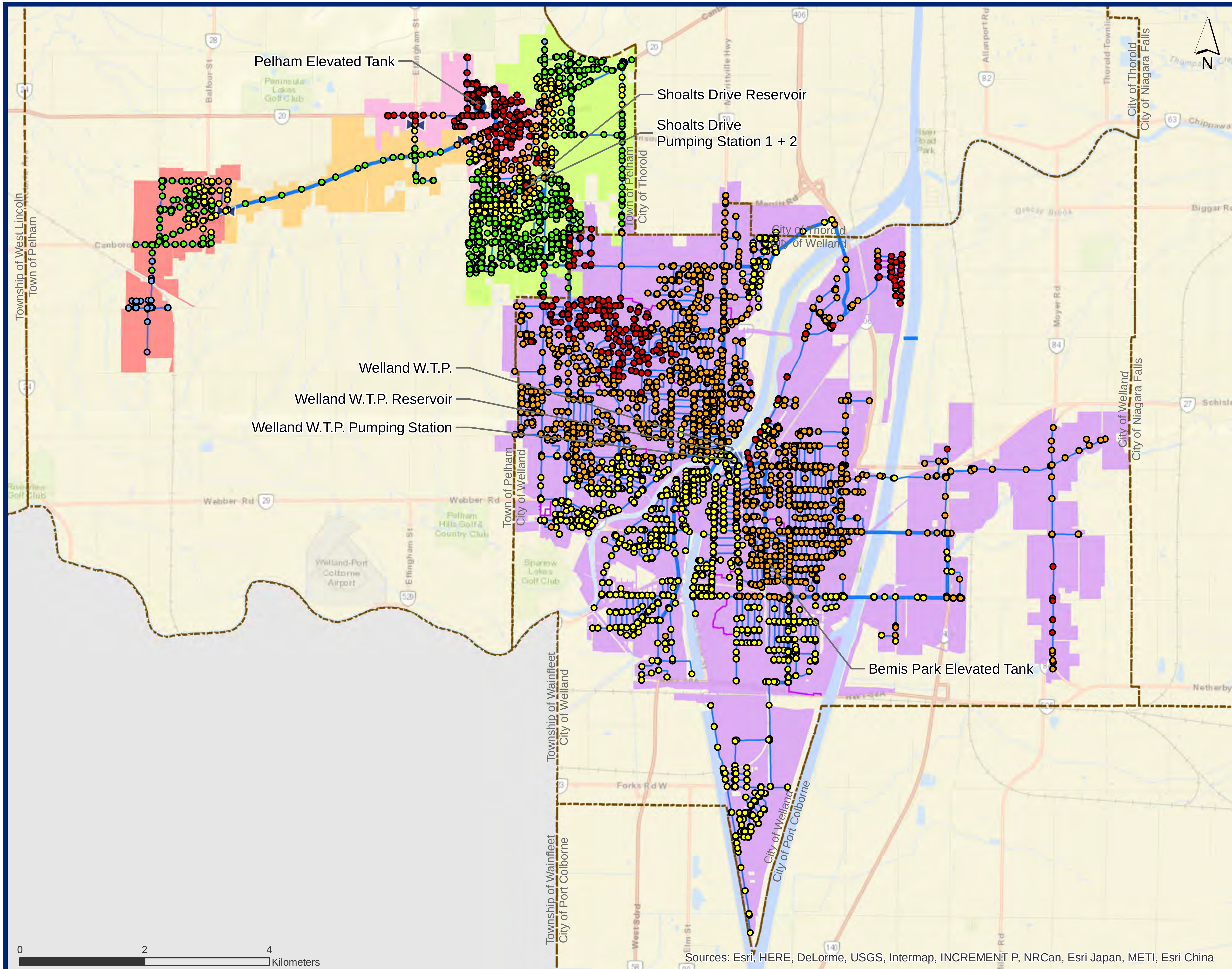
Figure 3.F.8

Existing System Fire Flow

Welland WTP

BluePlan

May 2017
715023-W-6-Existing Fire Flow (Welland)
NAD 1983 UTM Zone 17N



Niagara Region

2016 MASTER SERVICING PLAN

Water Facilities
- Water Treatment Plant
- Reservoir
- Elevated Tank
- Standpipe
- Chlorine Facility
- Pressure Reducing Valve

Pumping Station
- Regional
- Municipal

Water Network
- Regional
- Local
- Private

Pressure Zone System*

*Pressure zone limits are shown based on property boundaries.

- 220
- 248
- 272
- 247
- 268

Minimum Pressure (psi)
- < 40
- 40 - 50
- 50 - 60
- 60 - 80
- 80 - 90
- 90 - 100
- > 100

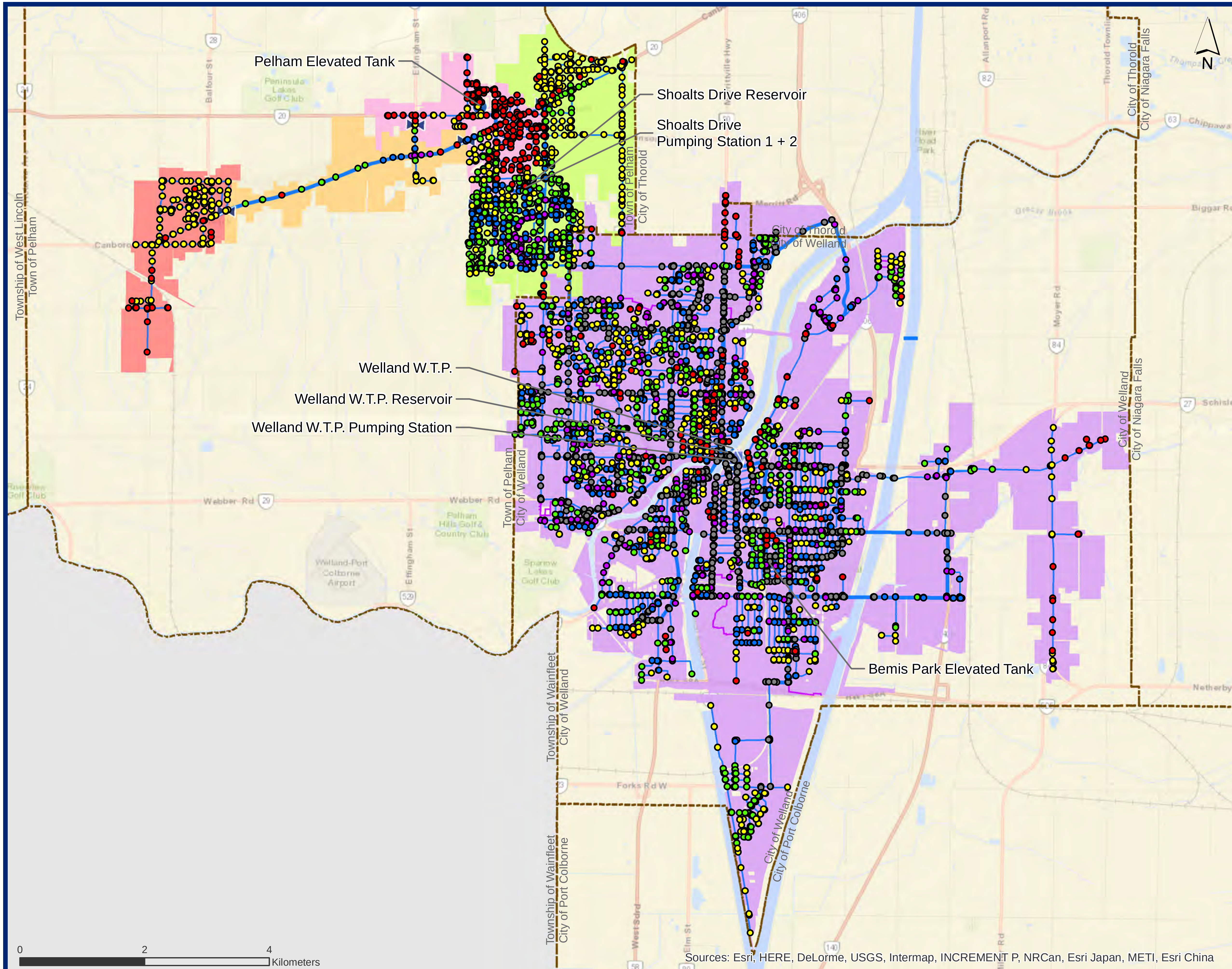
Figure 3.F.9

2041 Maximum Day Demand Pressure

Welland WTP

BluePlan

May 2017
715023-W-5-2041 Pressure (Welland)
NAD 1983 UTM Zone 17N



Niagara Region

2016 MASTER SERVICING PLAN

Water Facilities

- Water Treatment Plant
- Reservoir
- Elevated Tank
- Standpipe
- Chlorine Facility
- Pressure Reducing Valve

Pumping Station

- Regional
- Municipal

Water Network

- Regional
- Local
- Private

Pressure Zone System*

*Pressure zone limits are shown based on property boundaries.

- 220
- 248
- 272
- 247
- 268

Available Fire Flow (L/s)

- < 50
- 50 - 100
- 100 - 150
- 150 - 200
- 200 - 250
- > 250

Figure 3.F.10

2041 System Fire Flow

Welland WTP

BluePlan ENGINEERING

May 2017
715023-W-7-2041 Fire Flow (Welland)
NAD 1983 UTM Zone 17N

F.3.5 Welland Water Treatment Plant

Figure 3.F.11 highlights the sampled chlorine residual (mg/L) versus the modelled water system age at each sample location.

The 90th percentile trend line represents the chlorine residual achieved by the bottom 10% of samples at a location, meaning that 90% of the samples taken at that location were above the 90th percentile trend line. Similarly, the 99th percentile trend line represents the chlorine residual achieved by the bottom 1% of samples at a location, meaning that 99% of the samples taken at that location were above the 99th percentile trend line. It is assumed that <10 days is required to maintain the 0.25 mg/L chlorine residual objective.

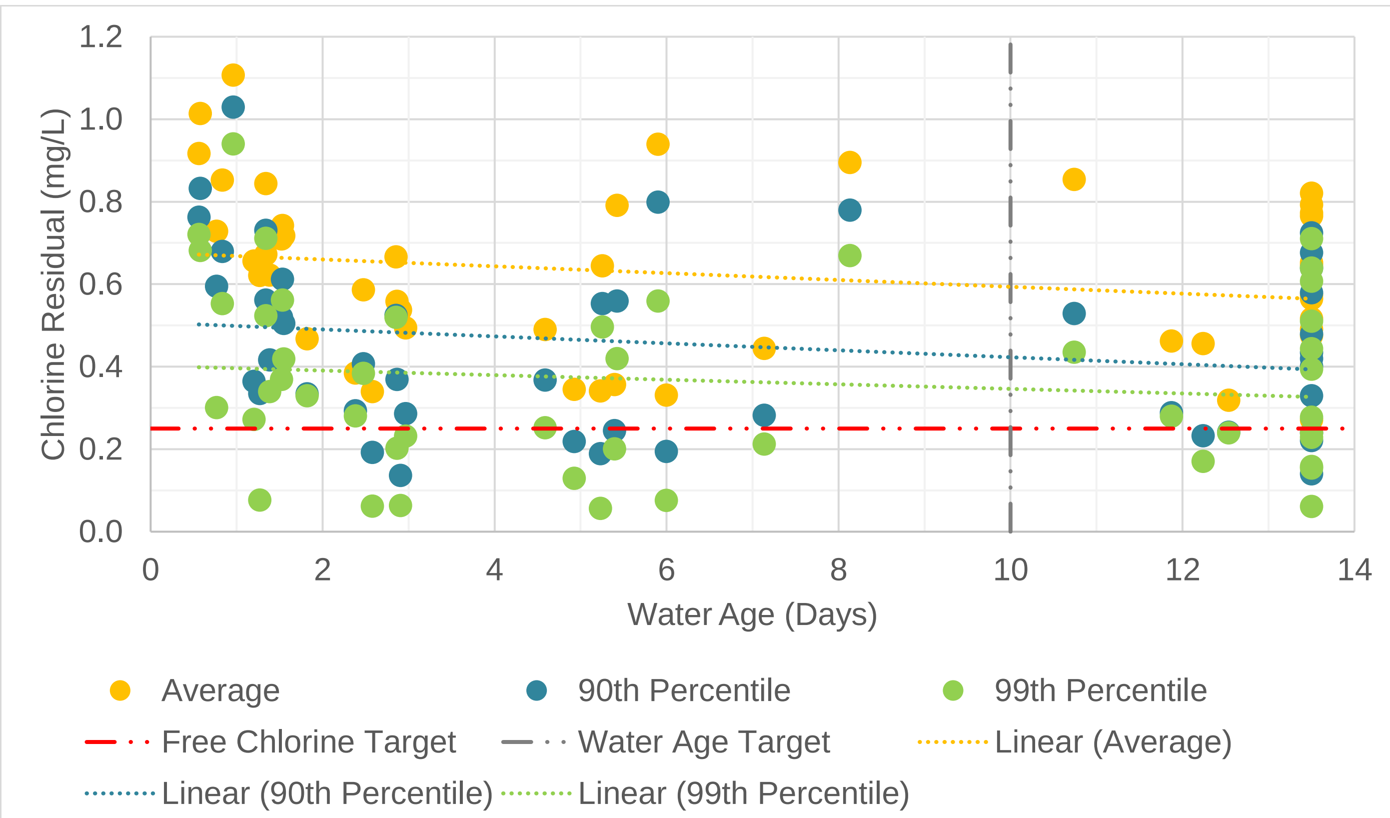
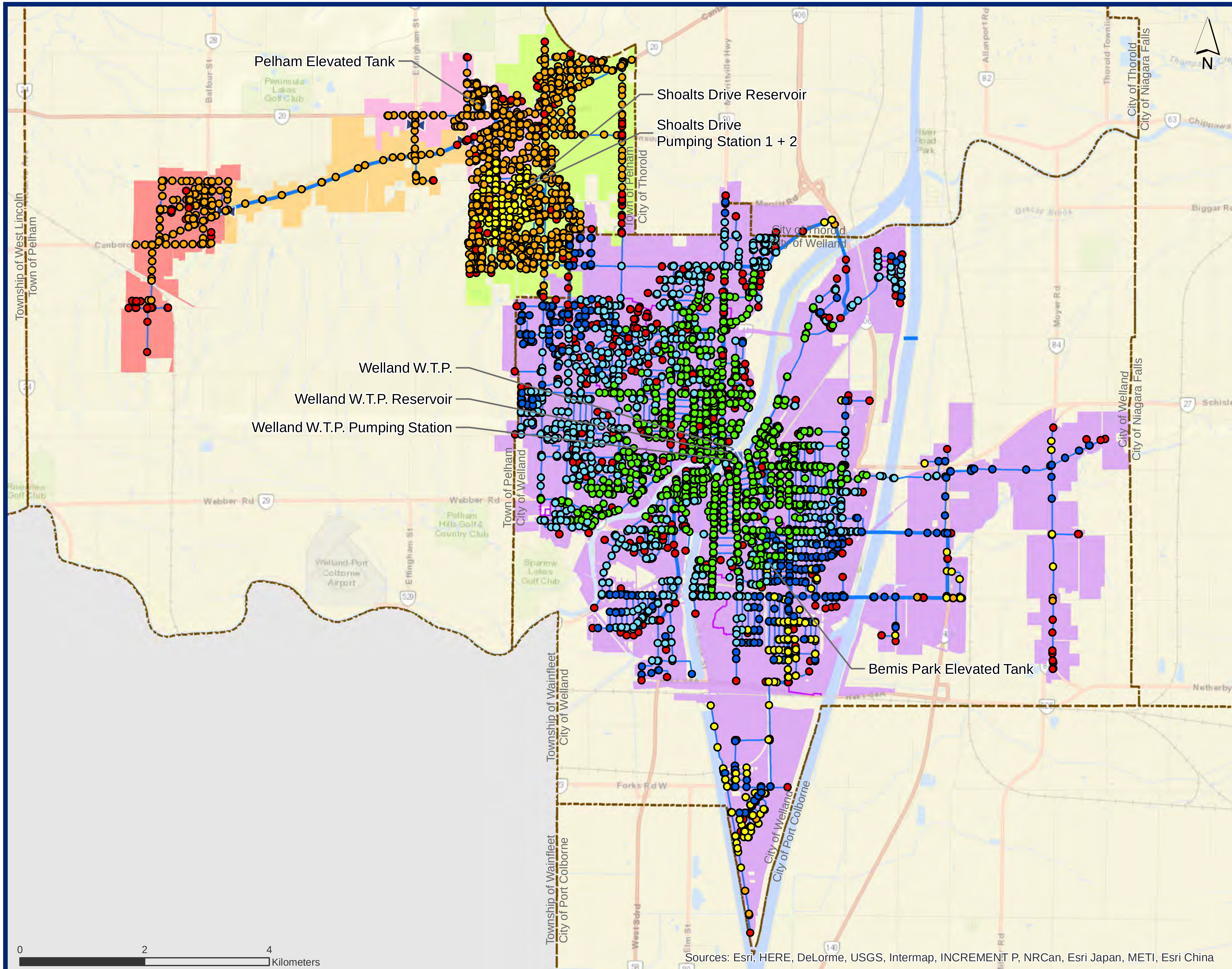


Figure 3.F.11 Existing Chlorine Residual vs Water System Age

Figure 3.F.12 shows the modelled water age throughout the system. Figure 3.F.13 shows the existing watermain capacity in the system as maximum head loss (m/km).



Niagara Region

2016 MASTER SERVICING PLAN

Water Facilities

- Water Treatment Plant
- Reservoir
- Elevated Tank
- Standpipe
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Pumping Station

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- Municipal

Water Network

- Regional
- Local
- Private

Pressure Zone System*

*Pressure zone limits are shown based on property boundaries.

- 220
- 248
- 272
- 247
- 268

Water Age (Days)

- < 1
- 4 - 6
- 1 - 2
- 6 - 8
- 2 - 4
- < 8

Figure 3.F.12

Water Age

Welland WTP

BluePlan ENGINEERING

May 2017
715023-W-8-Water Age (Welland)
NAD 1983 UTM Zone 17N

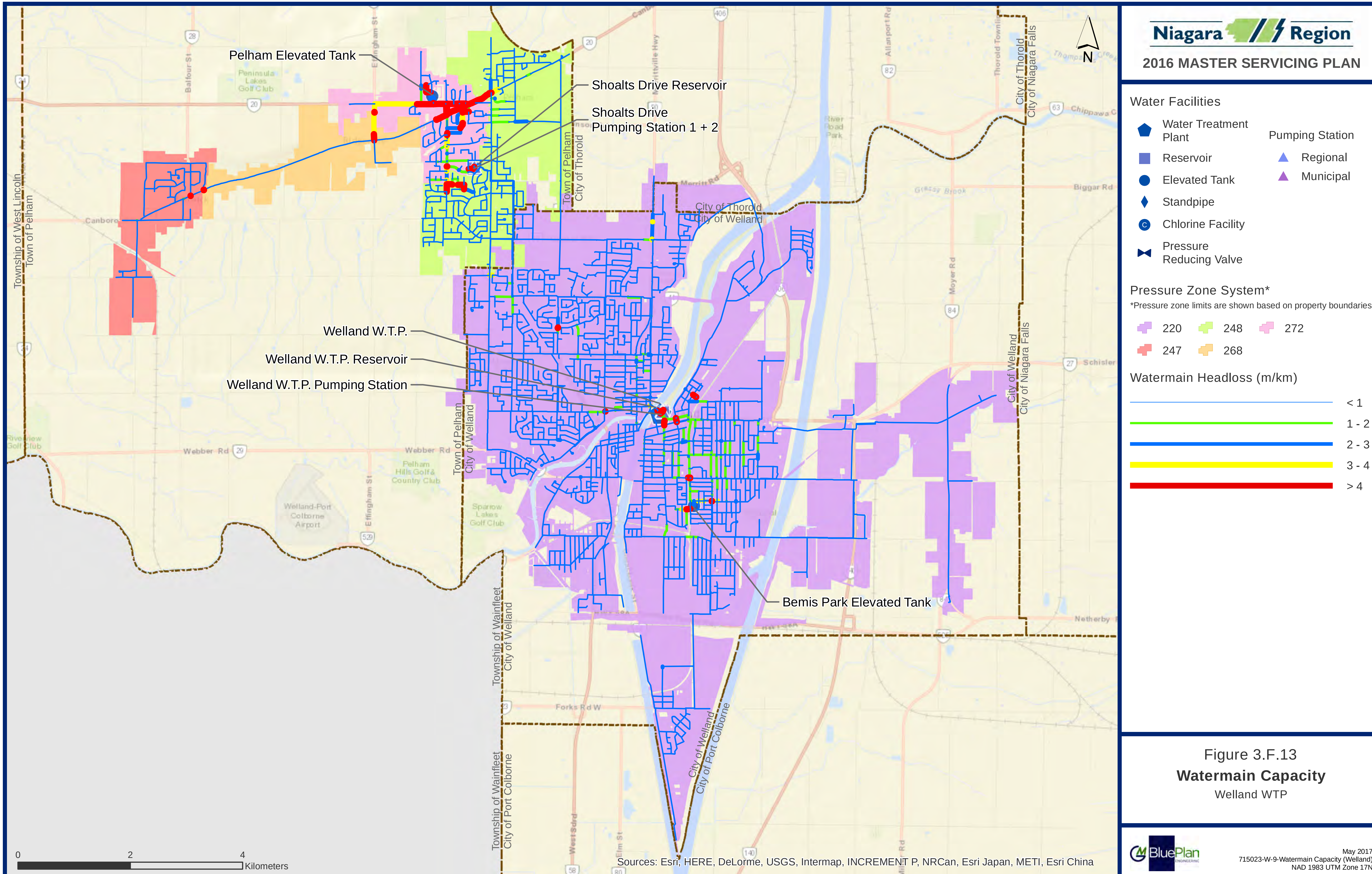


Figure 3.F.13
Watermain Capacity
Welland WTP

F.4 System Opportunities and Constraints

Figure 3.F.14 highlights the existing opportunities and constraints.

F.4.1 Welland Water Treatment Plant

- The current rated MDD capacity is 102.3 MLD, with an existing demand of 33.2 MLD. The projected 2041 MDD is 47.9 MLD, which is below 80% of the water treatment plant rated capacity. As such, the water treatment plant has surplus capacity to accommodate growth beyond 2041.

F.4.2 Welland System

- Welland has surplus existing and future pumping and storage capacity.
- There are localized low pressure area in northwest Welland under Peak Hour conditions.
- Under peak demand conditions there is operational difficulty filling the Shoalt's Drive Reservoir, due to restricted transmission capacity. To overcome this restriction the operations group temporally isolates of the Bemis Elevated Tank thereby directing more flow to the Shoalt's Drive Reservoir.

F.4.3 Pelham System

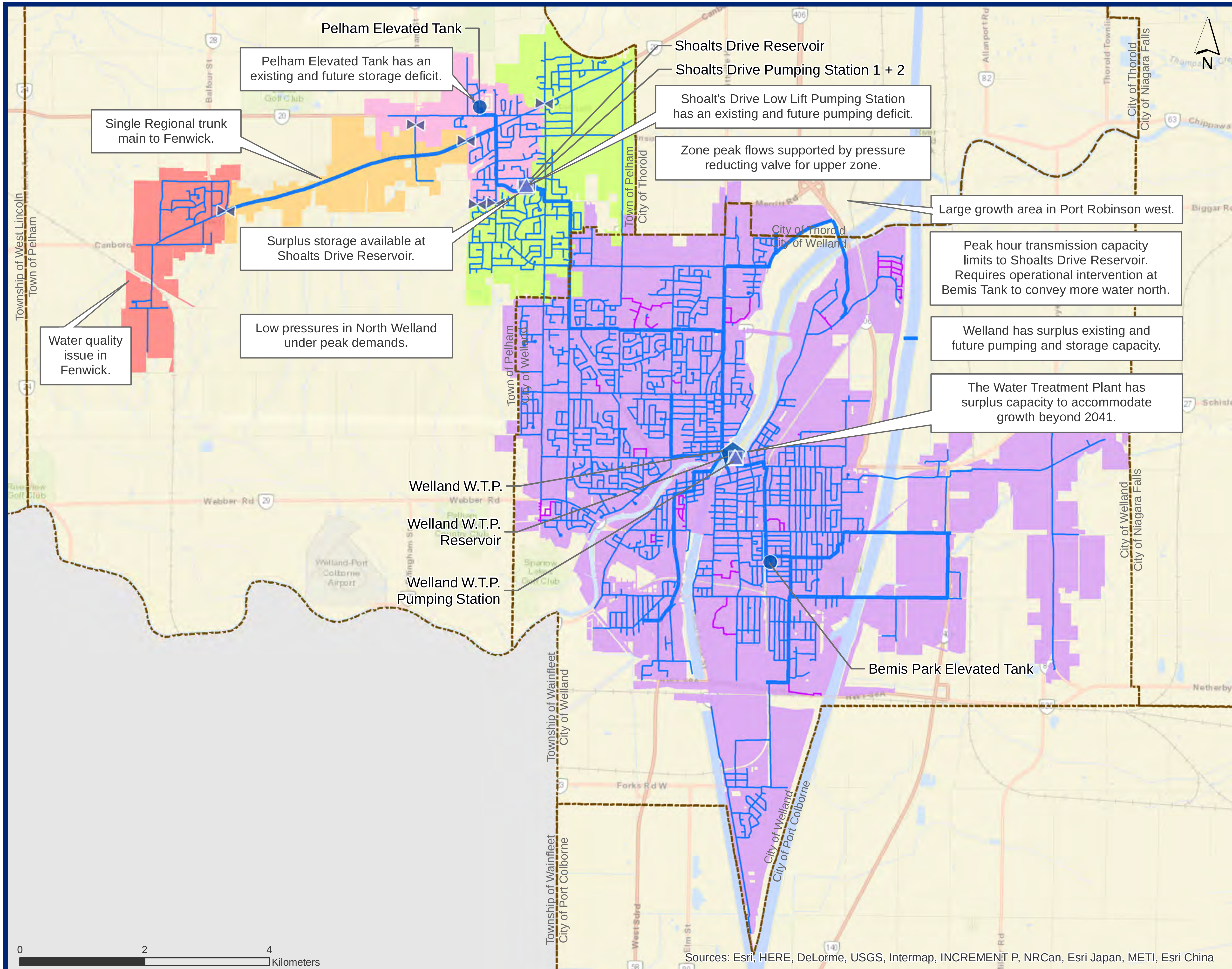
- The Shoalt's Drive Low Lift Pumping Station has an existing and future pumping deficit. Currently, a PRV from the upper zone is utilized to support the existing pumping deficit. Growth in Pelham will minimize the total available capacity that can be transferred thought the PRVs.
- The Pelham Elevated Tank has an existing and future storage deficit. Currently, the storage deficit is supported through pumped transfers from the Shoalt's Drive Reservoir and High Lift Pumps. Growth in Pelham will minimize the surplus capacity, triggering a pumping and/or storage upgrade need.
- There is limited floating storage Pelham as the Pelham Elevated Tank is 2.3 ML.
- There are existing pressure and fire flow capacity limitations within the 272 Pressure Zone. These capacity limitations are primarily the result of localized system dead-ends and small watermain diameters in the distribution network.
- High water age within Pelham system, leading to existing operational challenges in maintaining water quality objectives.

F.4.4 Thorold – Port Robinson Area System

- New trunk watermain is required to support large growth area.

F.4.5 System Security of Supply & Interconnections

- There is a single trunk main to North Welland and the Shoalt's Drive Reservoir.
- There is a single trunk main to Fenwick.



Niagara Region

2016 MASTER SERVICING PLAN

Water Facilities

- Water Treatment Plant
- Reservoir
- Elevated Tank
- Standpipe
- Chlorine Facility
- Pressure Reducing Valve

Pumping Station
- Regional
- Municipal

Water Network
- Regional
- Local
- Private

Pressure Zone System*

*Pressure zone limits are shown based on property boundaries.

220 248 272 247 268

Figure 3.F.14
System Opportunities and Constraints
Welland WTP

BluePlan ENGINEERING

May 2017
715023-W-3-Opportunities and Constraints (Welland)
NAD 1983 UTM Zone 17N

F.5 Assessment of Alternatives

To address growth related capacity needs, the following servicing alternatives were evaluated:

- Baseline (No Changes)
- New Storage in Pelham
- Upgrades at Shoalt's Drive High Lift and Low Lift Pumping Stations
- Optimize Pumping and Storage Upgrades in Pelham

All alternatives include:

- New trunk watermain along River Road and Woodlawn Road to support increased conveyance from the Welland Water Treatment Plant to North Welland to support growth and address existing operational issues at the Shoalt's Drive Reservoir.
- New trunk watermain under Highway 406 to support growth in the Port Robinson Area.[6]

F.5.1.1 Fenwick Security of Supply

To address the identified security of supply concerns to Fenwick area the following concepts were considered:

- New secondary trunk connections from the 248 Pressure Zone.
- New elevated storage in Fenwick.

However, the supplemental analysis indicated that:

- New secondary trunk connection or new elevated storage are not needed to support growth.
- New secondary trunk connection or new elevated storage would increase the existing water quality issues within Fenwick, increasing operational cost.

[6] New trunk watermain to service the Port Robinson area is currently under construction. This project has been included as part of the overall recommended servicing strategy, but due to its current status has not been included in the final capital project list.

- The current supply main to Fenwick is in good condition with no break history. Further, operations staff do not anticipate repair issues in the event of a watermain break.

Based on the notes above, the relative high cost of the new secondary trunk connection or new elevated storage combined with the resulting operational issues related to water quality, these concepts were not carried forward for further evaluation.

F.5.1.2 Pelham Local Capacity Issues

The identified fire flow and capacity issues in Pelham (Fonthill) can be addressed through changes within the local distribution system through either the local upsizing and or system looping[7].

[7] Pelham Elevated Tank and Fonthill Analysis – 2013 (BluePlan Engineering Consultants Ltd.)

F.5.2 Alternative 1 – New Storage in Pelham

Alternative 1, highlighted in Figure 3.F.15, includes a new storage facility size to support the full storage needs within the Pelham system. This will address existing and future storage deficit, and reduces total pumping needs from the Shoalt's Drive Reservoir. Under this configuration, the pumping deficits at the Shoalt's Drive Low Lift Pumps will continue to be addressed through the existing PRVs.

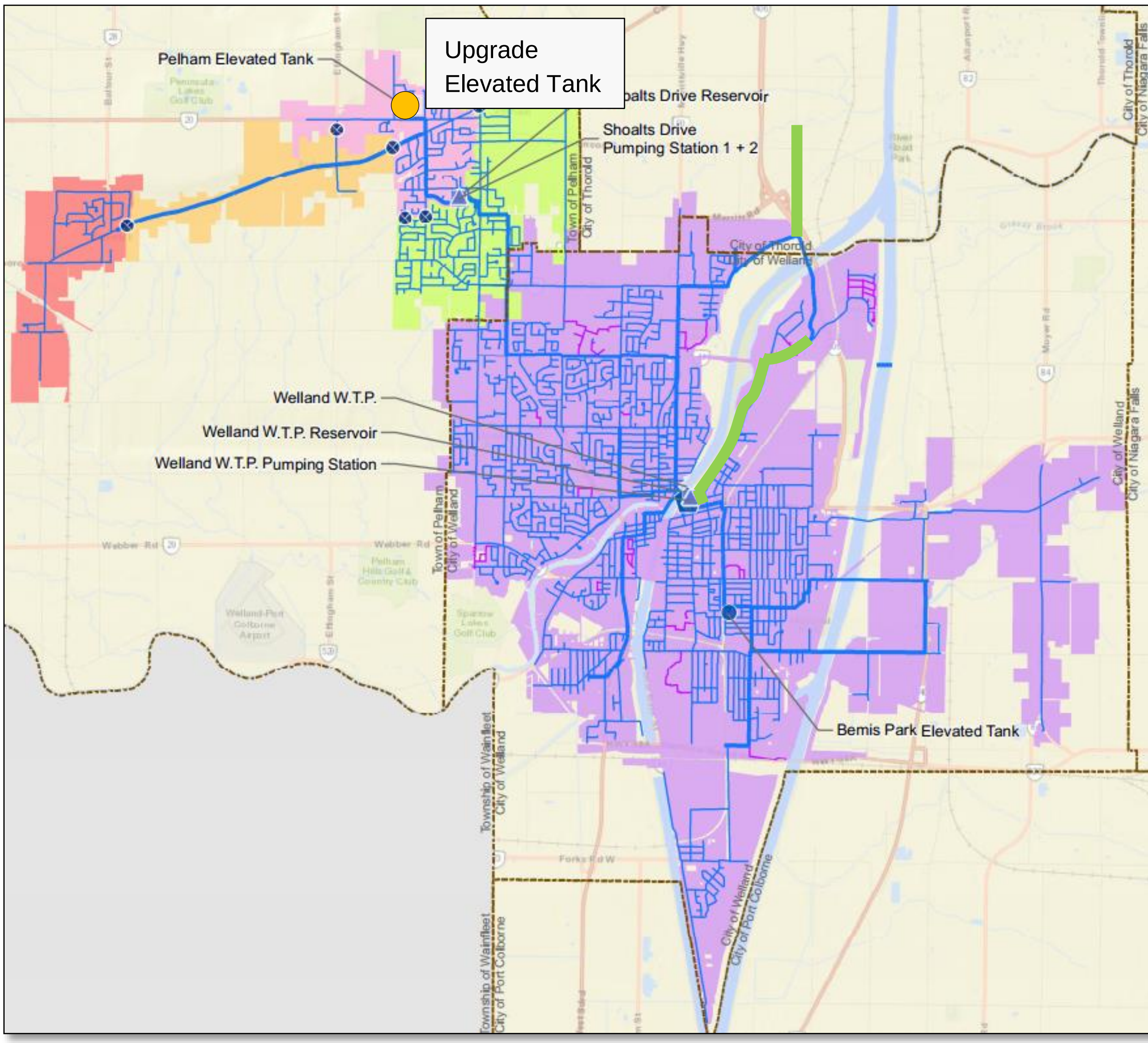


Figure 3.F.15 Alternative 1 – New Storage in Pelham

F.5.3 Alternative 2 – Upgrades at Shoalt's Drive High Lift and Low Lift Pumping Stations

Alternative 2, highlighted in Figure 3.F.16, includes upgrades to the Shoalt's Drive High Lift and Low Lift Pumping Stations to improve existing conditions and support growth. Under this configuration the surplus storage capacity at the Shoalt's Drive Reservoir will be utilized to support pumped transfers to the Pelham system. However this will increase total pumping capacity needed to overcome the floating storage deficit, and requiring upgrades to both the Shoalt's Drive High Lift and Low Lift Pumps.

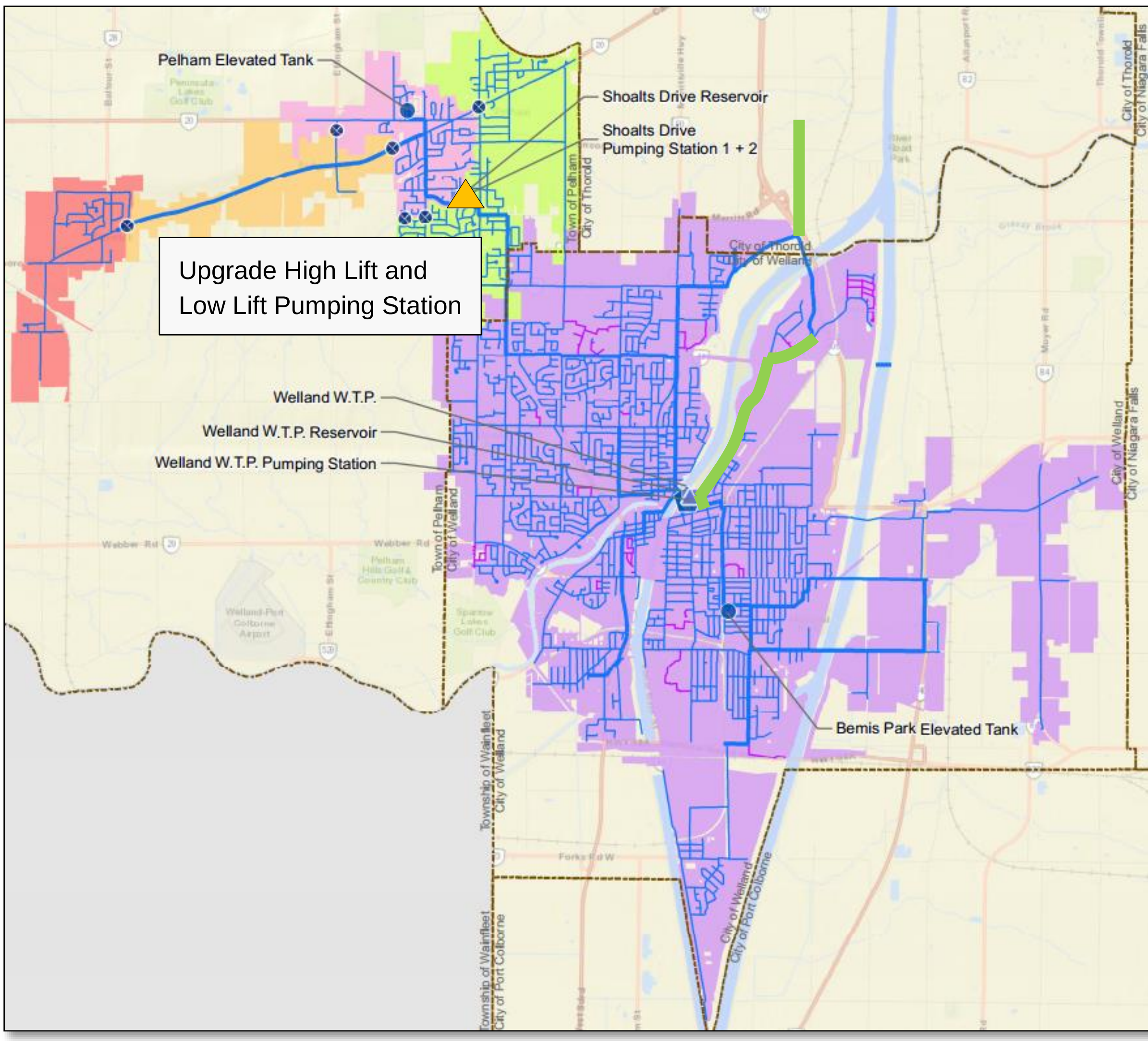


Figure 3.F.16 Alternative 2 – Upgrades at Shoalt's Drive High Lift and Low Lift Pumping Stations

F.5.4 Alternative 3 – Optimize Pumping and Storage Upgrades in Pelham

Alternative 3, highlighted in Figure 3.F.17, includes upgrades replacing the existing Pelham Elevated Tank with a new elevated tank to provide additional capacity to improve existing conditions and support growth. The elevated tank will be size to provide balancing storage requirements. This options includes upgrade to both the Shoalt's Drive High Lift and Low Lift Pumping Stations. The Low Lift Pumping Station will be sized to provide MDD to the lower zone and the High Lift Pumping Station will be sized to support pumped storage transfer needs from the Shoalt's Reservoir to Pelham.

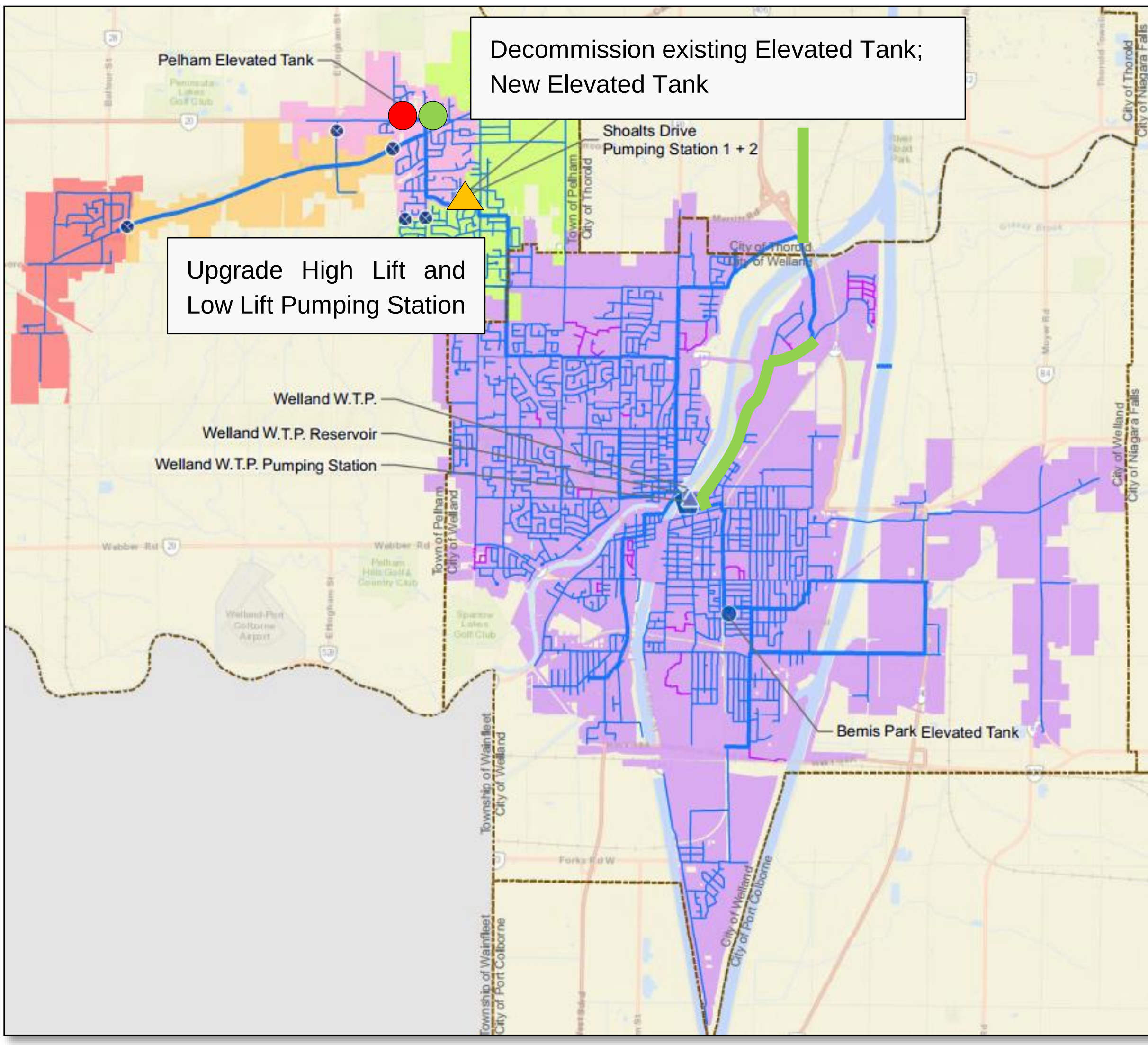


Figure 3.F.17 Alternative 3 – Optimize Pumping and Storage Upgrades in Pelham

F.5.5 Alternatives Evaluation

Alternative 3 – Optimize Pumping and Storage Upgrades in Pelham is the preferred servicing strategy as:

- Baseline strategy does not satisfy the existing and future servicing needs of the water system.
- Alternative 3 allows for:
  - Increased security of transmission to North Welland with the addition of a new alternate connection from the water treatment plant to the north, allowing for improved capacity within the new growth area.
  - Maximizes the existing capacity at the Shoalt's Drive Reservoir.
  - The combination of increased pumping and storage capacity:
  - Allows for a more efficient operation of the overall system.
  - Increases the operational flexibility within the Pelham system.
- Alternative 1 requires significant elevated storage volume resulting in:
  - A significant cost impact relative to the other alternatives.
  - Pump upgrades may still be required to support maintenance of the tank.
  - Potential construction and implementation challenges due to tank size, including the sighting of a new tank location and potential transmission upgrades.
- Alternative 2 increases the system reliance on pumping resulting in:
  - Increased pump sizing requirements to overcome balancing storage deficits.
  - Sub-optimal system operations and energy usage.

F.6 Preferred Servicing Strategy

The following is a summary of the Welland water servicing strategy:

- The Welland Water Treatment Plant has sufficient capacity to support growth to year 2041.
- The components of the Welland water strategy are focused on providing additional storage for the growth in the area while optimizing the storage/pumping relationship to reduce long term lifecycle costs.
- Both sets of pumps in the Shoalt's Drive Pumping Station for the higher and lower pressure zones will be upgraded to support growth.
- A new water tank replacing the existing water tank, at the same location, will be provided to support growth and optimize system pressures and performance in the area.
- Based on growth in the north and east limits of the system, additional water feedermain capacity is required.

Figure 3.F.18 and Figure 3.F.19 show the preferred servicing strategy and schematic, consisting of:

F.6.1 Storage

A new 6.0 ML elevated tank is to be built in Pelham to replace the existing Pelham Elevated Tank at the same location. It will be installed following the upgrades at the Shoalt's Drive High Lift and Low Lift Pumping Stations and the decommissioning of the existing Pelham Elevated Tank.

F.6.2 Pumping

- All four (4) existing 5.4 MLD pumps will be replaced with 10.0 MLD pumps at the Shoalt's Drive High Lift Pumping Station.
- Both (2) existing 3.0 MLD pumps will be replaced with 6.5 MLD pumps at the Shoalt's Drive Low Lift Pumping Station.

F.6.3 Decommissioning of Existing Facilities

The Pelham Elevated Tank will be decommissioned and replaced with a new elevated tank following the upgrades at Shoalt's Drive High Lift and Low Lift Pumping Stations.

F.6.4 Trunk Watermain

- New 450 mm trunk main from Welland Water Treatment Plant to north service area.
- New trunk watermain crossing the Highway 406 to support growth in the Port Robinson Area.[8]

F.6.5 Project Implementation and Considerations

Special project implementation and considerations for the preferred servicing strategy consist of:

- The Region must upgrade the Shoalt's Drive High Lift and Low Lift Pumping Stations prior to decommissioning the Pelham Elevated Tank.
- The new elevated tank must be built following the decommissioning of the existing Pelham Elevated Tank.

[8] New trunk watermain to service the Port Robinson area is currently under construction. This project has been included as part of the overall recommended servicing strategy, but due to its current status has not been included in the final capital project list.

F.7 Capital Program

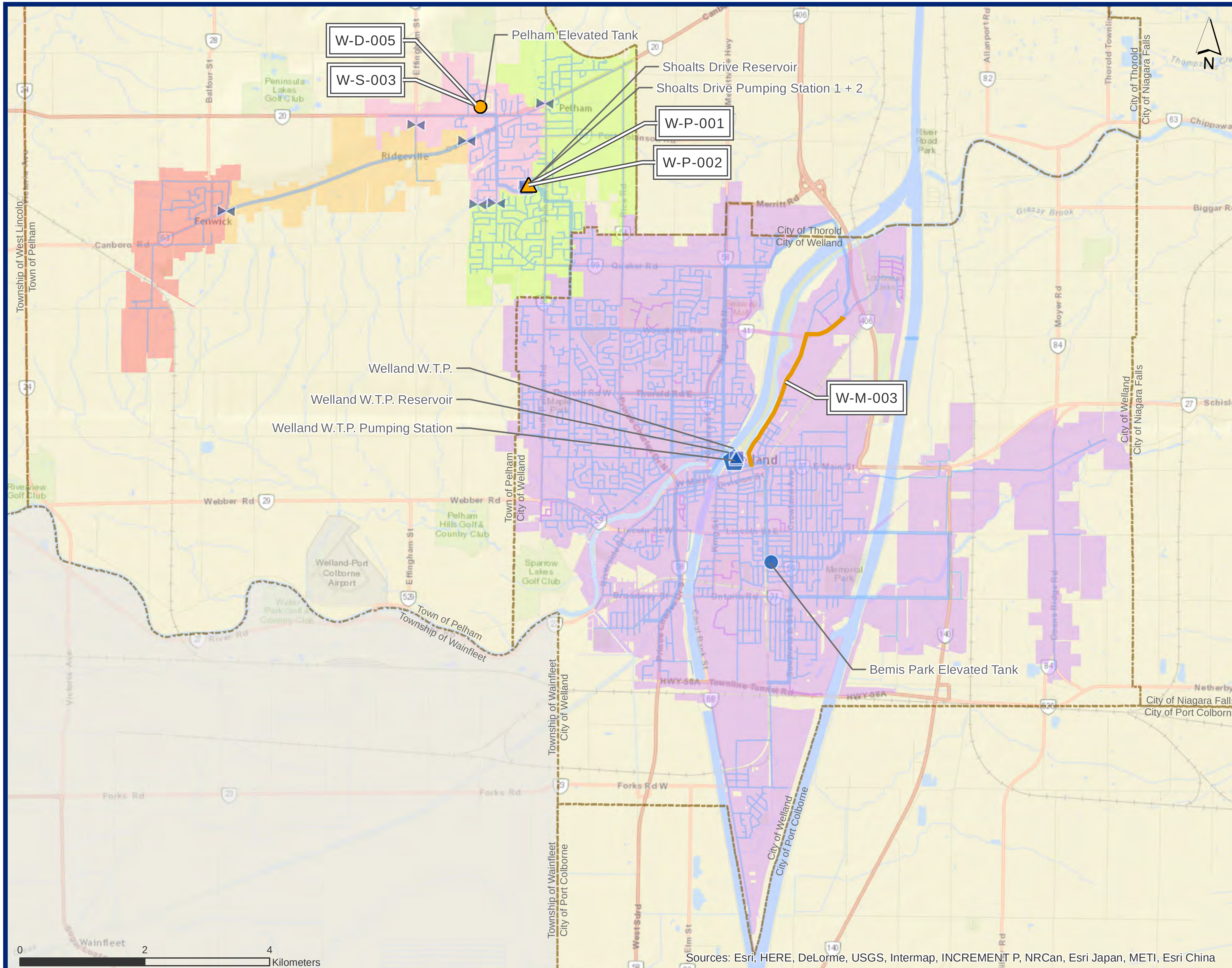
Table 3.F.13 summarizes the recommended project costing, implementation schedule and Class EA requirements.

F.7.1 Schedule B Project Files

Project files for Municipal Class Schedule B Environmental Assessment are attached in Appendix 1.

Niagara Region

2016 MASTER SERVICING PLAN



MSP Water Projects

- Treatment Plant
- Reservoir
- Pumping Station
- Elevated Tank
- Watermain Projects

Water Facilities

- Water Treatment Plant
- Reservoir
- Elevated Tank
- Standpipe
- Chlorine Facility
- Pressure Reducing Valve

Pumping Station

- Regional
- Municipal

Water Network

- Regional
- Local
- Private

Pressure Zone System*

*Pressure zone limits are shown based on property boundaries.

220, 248, 272, 247, 268

Figure 3.F.18

Preferred Water Strategy

Welland WTP

BluePlan ENGINEERING

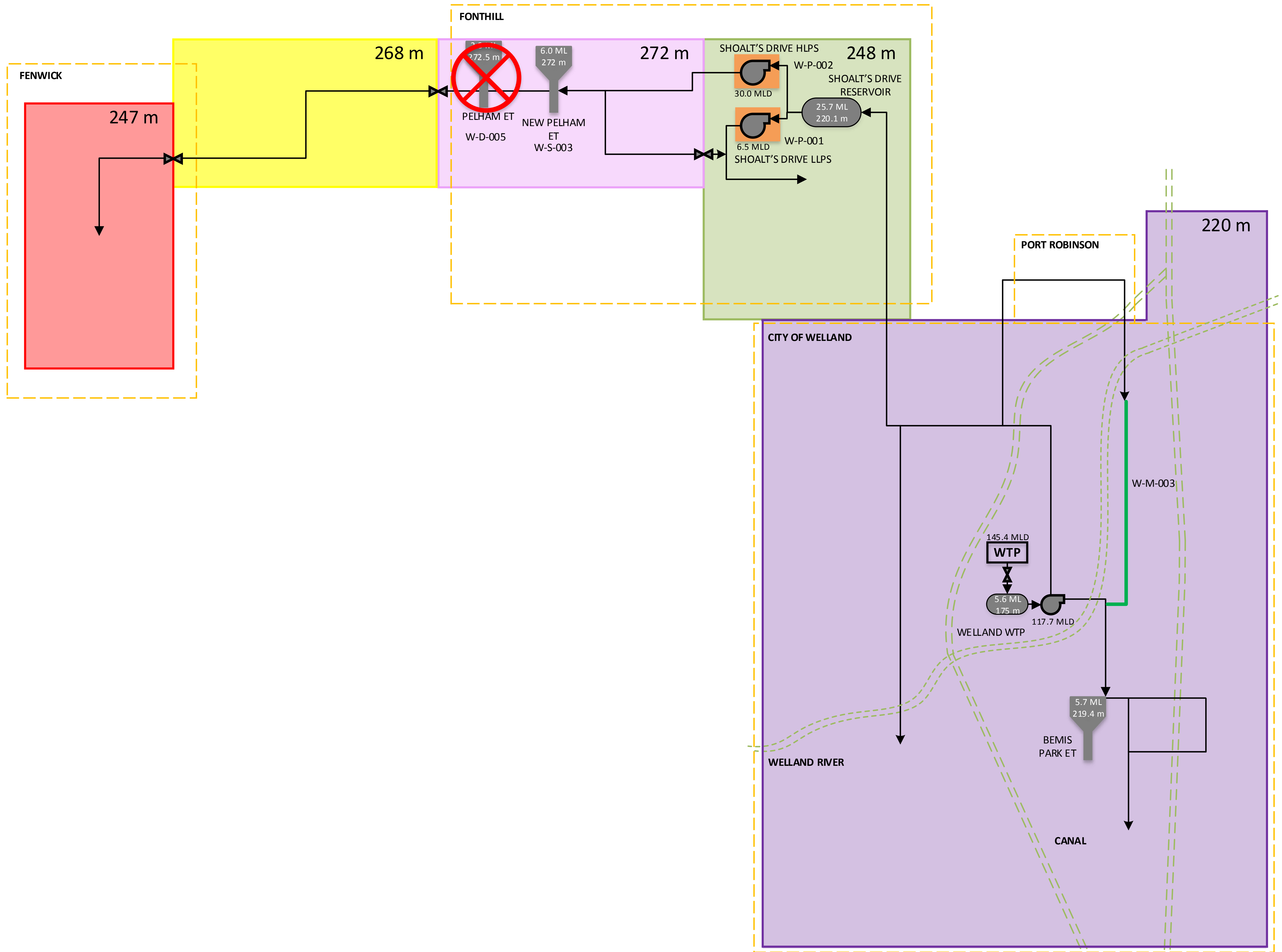
May 2017
715023-W-6-Capital Projects (Welland)
NAD 1983 UTM Zone 17N

Niagara Region

2016 Master Servicing Plan

Welland WTP

2041 DISTRIBUTION SCHEMATIC



May 2017
Figure 3.F.19
Not to Scale

BluePlan ENGINEERING

Table 3.F.13 Summary of Welland Water Capital Program

Master Plan ID	Name	Description	Size / Capacity	Year in Service	Municipality	Class EA Schedule	Class EA Status	Project Type	Total Component Estimated Cost
W-D-005	Decommissioning of Pelham Elevated Tank	Decommissioning of existing Pelham Elevated Tank, to be replaced by a new Elevated Tank	N/A	2022 - 2031	Pelham	A+	Satisfied	Storage	$ 1,028,000
W-M-003	New trunk main from Welland Water Treatment Plant to North	New trunk main from Welland Water Treatment Plant to North service area	450 mm	2032 - 2041	Welland	A+	Satisfied	Watermain	$ 7,556,000
W-P-001	Upgrade Shoalt's Drive Low Lift Pumping Station	Replace both 3 MLD low lift pumps with 6.5 MLD pumps each	75 L/s	2017 - 2021	Pelham	A+	Satisfied	Pumping	$ 3,062,000
W-P-002	Upgrade Shoalt's Drive High Lift Pumping Station	Replace all four 5.4 MLD high lift pumps with 10 MLD pumps each	347 L/s	2017 - 2021	Pelham	A+	Satisfied	Pumping	$ 7,882,000
W-S-003	New Pelham Elevated Tank	New Pelham Elevated Tank to replace existing Elevated Tank	6 ML	2022 - 2031	Pelham	B	Satisfied (Project File Included)	Storage	$ 9,307,000
Total									**$ 28,835,000**

APPENDIX

C

BLUEPLAN ENGINEERING TECHNICAL MEMO REGARDING WASTEWATER CAPACITY TO CITY OF WELLAND DATED JAN. 15, 2020

Date:	1/15/2020	File:	418024
To:	Marvin Ingebrigtsen		
From:	Julien Bell, P.Eng., Elaine Samuel, E.I.T.		
Project:	Development Review		
Subject:	Empire Homes Developments		

TECHNICAL MEMO

Background

The City of Welland is currently undertaking the Pollution Prevention and Control Plan – Wastewater Master Servicing Plan to evaluate growth impacts and develop long term servicing alternatives to meet Ministry of the Environment, Parks, and Recreation (MECP) regulatory requirements for the F-5-5. Interim to the final report and implementation plan of the PPCP-MSP, this technical memo summarizes the results of a high-level assessment of the growth capacity risks related to the proposed Empire Homes developments.

Background Documents

Previous development reviews for these areas will be referred to throughout this memo.

- Dain City Community Development Review – March 22, 2018
- Dain City Basement Flooding Investigation, TM#1 Flooding Event Analysis – April 2019
- Dain City Forcemain Replacement Capacity Review – July 12, 2019
- Pollution Prevention and Control Plan & Wastewater Master Servicing Plan (PPCP-MSP) 50% Submission Report Draft – September 2019

Other documents referenced for this review include:

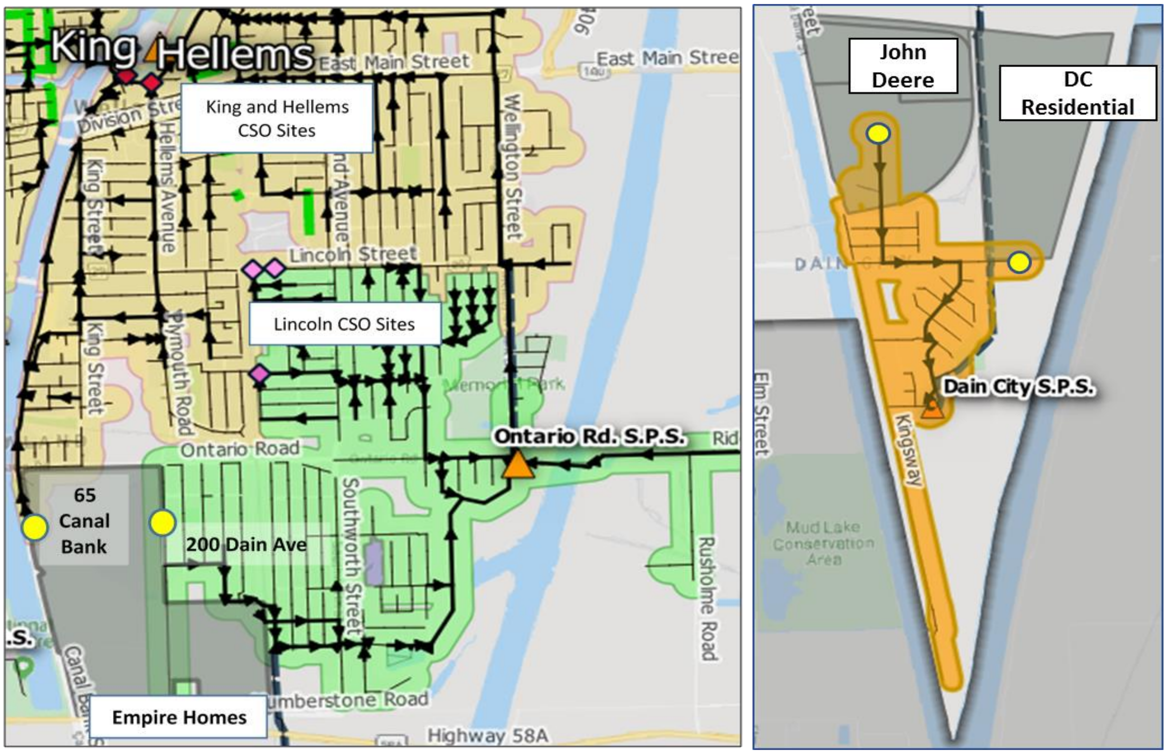
- City of Welland Municipal Standards
- 2016 Niagara Region Master Servicing Plan

Proposed Developments

Empire Homes has 3 major development properties for potential development, shown in **Figure 1**. Population numbers, area, and the preliminary/preferred tie in locations have been provided by the Developer's Engineer, WSP, and are summarized in **Table 1**. The tie in locations are indicated by yellow dots on **Figure 1 and 2**.

Table 1. Development Populations and Contributing Areas

Development	Catchment	Units	Population	Site Area (ha)
Dain City Residential *Forks Road East*	Dain City SPS	1,350	2,990	72
John Deere *Bay Avenue*	Dain City SPS	1,450	3,200	75
Total to Dain City Pumping Station		**2,800**	**6,190**	**147**
Empire Homes *65 Canal Bank*	WWTP	1,910	4,219	75
Empire Homes *200 Dain Avenue*	Ontario Rd SPS	1,250	2,764	31



Figures 1 and 2. Proposed Empire Homes developments.

Dain City Residential: The proposed tie in point is at the south end of the property at Forks Rd East. The sewer on Forks Rd East is a 250 mm sewer which connects to a 450 mm trunk on Crescent Drive, which is conveyed by gravity to the Dain City SPS.

John Deere Development: The proposed tie in point is at the Bay Ave 400 mm sewer that previously serviced the previous John Deere industrial property. Sewage is conveyed by gravity to the Dain City SPS. The Dain City SPS forcemain outlets to the Ontario Rd SPS catchment, which pumps flows northwards where flows are ultimately conveyed by gravity to the Welland Wastewater Treatment Plant (WWTP).

Empire Homes Development – 65 Canal Bank St: The proposed tie in point is to a 900 mm sewer that conveys flows by gravity to the Region Interceptor Sewer. Two major (and active) Combined Sewer Overflows (CSOs), King and Hellems, are located downstream from this tie in point.

Empire Homes – 200 Dain Ave: The proposed tie in point at 200 Dain Ave is to connect to a 300 mm sewer, these flows are conveyed via a 600 mm trunk sewer to the Ontario Rd SPS where flows are then pumped northwards where flows are ultimately conveyed by gravity to the Welland Wastewater Treatment Plant (WWTP).

Existing System – Opportunities and Constraints
The goals of the PPCP-MSP are to facilitate growth while reducing I&I and CSO overflows. Several priority areas have been identified through the PPCP-MSP for special consideration in the implementation plan; these areas were flagged for existing system issues. The Empire Homes developments will directly impact these areas.

1. **Dain City** is a catchment with historic basement flooding and high inflow and infiltration (I&I). The Region is undertaking the replacement of the forcemain, which may have the potential to increase the sewage pumping station ECA capacity beyond 115 L/s. Increasing the station capacity will have a cascading impact on Ontario Rd SPS trunk and station capacity.

2. The **Ontario Rd SPS** catchment is subject to high I&I, which results in backups in the trunk sewers upstream of the station. Growth flows tributary to the Ontario Rd SPS should be reviewed with special consideration for impacts that may occur upstream elsewhere within the Ontario Rd SPS catchment.

3. There is currently a manual wastewater bypass system set up at the South end of **Commercial Street** due to a history of basement flooding. Adding more flow through this system could negatively impact this condition.

4. **Wastewater System Overflows**

   The Empire Homes connection to Canal Bank St is directly upstream from two active CSOs, Hellems and King. The MECP has highlighted sections of the F-5-5 regulation that must be followed and demonstrated through the implementation plan:

   Section (6g)
   "No increases in CSO volumes above existing levels at each outfall will be allowed except where the increase is due to the elimination of upstream CSO outfalls."

   Section (11)
   "When and where significant combined sewer system deficiencies exist, the Regional Office of the Ministry shall require that the provision of sanitary servicing for additional development tributary to the deficient system be curtailed to prevent aggravation of the problem until the necessary upgrading, as outlined by a Pollution Prevention and Control Plan is carried out in keeping with the requirements of this Procedure. Some development is allowed as upgrading proceeds, conditional upon its progress. The staged upgrading should at a minimum provide for the transmission and treatment of all flows from the additional development. This provision applies to significant development i.e. not to simple, one lot infill cases."

Development Flows

The flows received from WSP for the proposed developments were reviewed to ensure they were calculated using City of Welland's design criteria. These developments are assumed to be entirely residential populations. The design criteria for new developments are:

- Sewage generation - 275 L/capita/day
- Harmon's Peaking Factor
- Design Rain Derived Inflow and Infiltration (RDII) - 0.286 L/s/ha

Table 2. Design flows from developments

Development & Tie In Point	Catchment	Average Sanitary Flows (L/s)	Peaking Factor	Peak Sanitary Flow (L/s)	Site RDII (L/s)	Total Design PWWF (L/s)
Dain City Residential *Forks Road East*	Dain City SPS	9.5	3.4	32.8	20.6	53.4
John Deere *Bay Avenue*	Dain City SPS	10.2	3.4	34.8	21.5	56.3
Total New Development Flows to Dain City SPS		**19.7**	**3.2**	**62.2**	**42.0**	**104.2**
Empire Homes *65 Canal Bank*	WWTP	13.4	3.3	44.5	21.5	66.0
Empire Homes *200 Dain Avenue*	Ontario Rd SPS	8.8	3.5	30.5	8.9	39.4

The City is targeting a 10 year level of service with respect to basement flooding risks. As such the wastewater hydraulic model was utilized to determine infrastructure deficiencies downstream from the developments. Existing infrastructure will be flagged for upgrade when the hydraulic grade line (HGL) exceeds a freeboard of 2.4 m in the 10 year design storm + growth scenario.

System Impacts

Dain City
Growth in the catchment exceeds the populations considered for previous reviews. The "Dain City Forcemain Replacement Capacity Review" analyzed a maximum of 2,000 units added to the Dain City Catchment. The proposed units for the Empire Homes developments total 2,800 units which is equivalent to 6,200 people.

The existing Dain City design flows are 38.5 L/s with peaked dry weather flows and design RDII, totalling 38.5 L/s. The buildout scenario for the PPCP has estimated design RDII flow for Dain City to be 150.1 L/s, including these two developments.

Sewers

- The Dain City Residential Development would trigger 350 m of sewer upgrades from 250 mm to 300 mm sewers on Forks Rd East to Crescent Ave.

Dain City SPS

- Existing peak wet weather flows to the station exceed the station ECA capacity in the 10 year design storm scenario, however due to the CSO storage tank, the 10 year storm does not cause basement flooding.
- Under the full buildout scenario, design flows (0.286 L/s/ha) exceed station ECA capacity, and upgrades to the station capacity are needed.
- Previous analyses indicate high I&I in the Dain City catchment. I&I reduction of at least 25% in Dain City is required to facilitate phased growth.
- The Region is undertaking the replacement of the Dain City forcemain. The previous GMBP memo "Dain City Forcemain Replacement Capacity Review" determined the planned 300 mm forcemain may allow the existing well pumps' firm capacity to be increased to 151 L/s due to improved system hydraulics. Further, the ultimate capacity of the 300 mm forcemain is 176 L/s, based on the Region's criteria of 2.5 m/s, however, pump upgrades would be required to support this higher flow rate.
- The replacement of the Dain City forcemain presents an opportunity for station capacity to be increased, allowing for phased growth to occur while the City implements upstream I&I reductions.
- Increasing the capacity of the Dain City SPS may have downstream impacts on the Ontario Rd SPS catchment and would require further system review of downstream impacts and opportunities.

Ontario Rd SPS Catchment
Sewers

- The Empire Homes development would trigger 300 m of sewer upgrades from 375 mm to 450 mm sewers needed on Devon St to the south end of Alberta St, sized assuming 25% of I&I reduction in the catchment.

Ontario Rd SPS

- Growth flows to the station using design criteria do not trigger an upgrade at the Ontario Rd SPS. However, existing wet weather flows currently exceed station capacity, without growth.
- The development exacerbates issues in the Commercial Street area.
- Aggressive I&I reduction of 25% is needed within the catchment in advance of the development.

Canal Bank St

- The development causes some surcharging downstream under the 10 year storm scenario but the HGL remains within the 2.4 m freeboard. Sewer upgrades are not needed to meet the 10 year level of service target.
- The development will increase overflows at King and Hellems. The PPCP implementation plan will identify alternatives to remove system I&I to facilitate development at this location.
- Developments may be approved in phases provided the City follows the PPCP implementation plan. I&I reduction of 25% throughout the wastewater system is required to provide capacity in the Interceptor trunk to accommodate growth.

Recommendations

The Empire Homes developments will be required to meet the F-5-5 requirements and meet the City's target basement flooding level of service, which maintains a minimum of 2.4 m HGL freeboard in the 10 year design storm scenario.

The following outlines the strategy to facilitate growth of the proposed developments:

1. Dain City: Phased development may be possible with a combined strategy of increasing the Dain City SPS capacity and the implementation of an aggressive I&I program, which was not identified through the Niagara Region MSP in 2016
2. Ontario Rd SPS: Demonstrated I&I reduction and basement flooding mitigation should precede development within the Ontario Rd catchment, specifically at Commercial Street. Upgrades on
3. Canal Bank St: Developments may be approved in phases provided the City follows the PPCP implementation plan. I&I reduction throughout the system will free up some capacity in the Interceptor trunk to accommodate growth.

Details about the preferred implementation plan are needed to support the phased growth approach, which will be further outlined in the PPCP.

APPENDIX

D

GHD TECHNICAL MEMO REGARDING WATER CAPACITY TO CITY OF WELLAND DATED DEC 3, 2019

Memorandum

December 3, 2019

To:	Marvin Ingebrigsten, P.Eng	Ref. No.:	11155923
From:	Samantha McCauley, P.Eng	Tel:	905-346-3857
CC:			

Subject: Empire Homes Development – Water Distribution System Review

1. Introduction

GHD was retained by the City of Welland to review the impacts of the proposed Empire Homes Development on the Welland water distribution system. Figure 1.1, attached at end, shows the location of the proposed development, which is broken up into three areas – Dain City Residential, Former John Deere, and Canal Bank/Dain Avenue.

Results of the completed analysis are described herein.

2. Model Set Up

2.1 Existing Model

The City of Welland's existing InfoWater all pipe water model was used as the base for the completion of this analysis. A model review was last conducted in 2018 with recent watermain construction projects incorporated, and updates made to the Welland Water Treatment Plant (WTP), including addition of pump curves for recently replaced pumps, and modification of base operational settings (on/off pump settings) to match settings determined from a review of 2017 SCADA data.

The City of Welland's existing InfoWater model also includes future development scenarios (average day and maximum day extended period simulations). These future development scenarios incorporate planned developments previously reviewed. These developments include:

- GE Plant (Built)
- Canal View Heights (Built/In construction)
- Hunter's Pointe Development Area (Future)
- Northern Reach Land Development (Future)
- Sauer Avenue, Louise Street, and Station Street (Future)

The review of the Empire Homes Development was completed using the future development scenarios.

2.2 Empire Homes Development Demands

Populations were provided by WSP for the proposed Empire Homes Development. Average day demands (ADD) were calculated using a per capita demand of 320 L/cap-day, a value which the City previously selected for use for development reviews. Maximum day demands (MDD) were calculated using a peaking factor of 1.5, which is the peaking factor used in the model established from historical demand data. The peak hour demand (PHD) peaking factor, which is based on the model MDD EPS demand pattern, is 1.87 (2.81 x ADD). Similar to the MDD peaking factor, the PHD peaking factor is based on historical demand data. Table 2.1 summarizes the demands assigned to the model for the Empire Homes Development, along with the resulting PHD.

Table 2.1 Empire Homes Development Demands

Location	Population	ADD (L/s)	MDD (L/s)	PHD (L/s)
Former John Deere	3200	11.85	17.78	33.25
Dain City Residential	2990	11.07	16.61	31.06
Canal Bank/Dain Avenue	6983	25.86	38.79	72.54
Total	13173	48.78	73.18	136.85

In addition to the demands noted above, a fire flow was also required to be used to assess the MDD + Fire Flow condition. The proposed development includes a mix of land uses, including single and multi-family units. The City's single family residential fire flow requirement is 67 L/s, while the City's requirement for multi-family units and some commercial properties is 133 L/s. A fire flow of 133 L/s was selected for the purpose of this analysis as it is a better representation of the fire flow needs for the development as a whole. This fire flow is applied at hour 7:00 of the MDD EPS scenario.

2.3 Development Servicing

Watermains and junctions were added to the model to represent the Empire Homes Development. Since a proposed servicing plan was not provided, watermain locations were assumed, with only watermains forming the assumed backbone of the servicing scheme (i.e. watermains connecting to the existing distribution network) included. Elevations were assigned to the junctions added to the model using the City's 1 m contours with the highest elevation for each area assigned. Figure 2.1 shows the watermains and junctions added to the model, including watermain sizing and assigned junction ground elevations. All pipes were assigned a C-Factor of 135, consistent with the C-Factor for plastic pipe established when the City's model was calibrated.

3. Review of Storage Requirements

Prior to completing the hydraulic analysis for the Empire Homes Development, a review of the City of Welland's overall storage capacity and existing and future storage requirements was completed. Per the MECP Design Guidelines for Drinking Water Systems, storage requirements for a water distribution system are as follows:

- Equalization Storage (A) = 25% of Maximum Day Demand
- Fire Storage (B) = 378 L/s for 6 hours (Based on MECP Equivalent Population Fire Flow Requirement)
- Emergency Storage (C) = 25% of A+B

The additional storage required for Empire Homes is 2.0 ML.

The total existing storage capacity was determined from the Region of Niagara Master Plan (2016). Table 3.1 summarizes the existing storage capacity, the existing and future storage requirement calculated in the master plan, and the existing and future storage requirement with and without the Empire Homes Development, calculated using the model demands and the procedure outlined above. As shown, the master plan appears to have included sufficient demand to account for the Empire Homes Development. Both the master plan and the model based calculations indicate that there is sufficient storage in the existing system to support the addition of the Empire Homes Development.

Table 3.1 Review of Storage Requirements

Description	Storage (ML)
Total Available Storage	37.0
Existing Required Storage – Master Plan	18.5
2041 Required Storage – Master Plan	21.6
Future Required Storage without Empire Homes Development – Model Demands	18.4
Future Required Storage with Empire Homes Development – Model Demands	20.4

4. Hydraulic Analysis

4.1 Design Criteria

In reviewing the impact of the Empire Homes Development on the existing distribution system, the following design criteria, as per City of Welland design standards and the MECP Design Guidelines for Drinking Water Systems, were used:

- Preferred system pressure between 350 to 550 kPa (50 to 80 psi)
- Minimum system pressure during normal operating conditions to be greater than 275 kPa (40 psi)
- Maximum system pressure during normal operating conditions to be less than 700 kPa (100 psi)
- System pressure with a 133 L/s fire flow during MDD to be greater than 140 kPa (20 psi)

4.2 Normal Operating Condition

Table 4.1 summarizes the minimum pressure during the ADD and MDD EPS scenarios within the proposed development with the existing water treatment plant pumping scheme.

Table 4.1 Empire Homes Development Normal Operating Pressures

Junction ID	Location	Junction Elevation	Minimum ADD EPS Pressure	Minimum MDD EPS Pressure
435701WJ01	Former John Deere	177 m	375 kPa (54 psi)	364 kPa (53 psi)
J-EH-1	Former John Deere	177 m	373 kPa (54 psi)	358 kPa (52 psi)
J-EH-2	Canal Bank/Dain Avenue	178 m	361 kPa (52 psi)	324 kPa (47 psi)
J-EH-3	Canal Bank/Dain Avenue	178 m	364 kPa (53 psi)	364 kPa (53 psi)
J-EH-4	Dain City Residential	189 m	257 kPa (37 psi)	243 kPa (35 psi)
J-EH-5	Canal Bank/Dain Avenue	177 m	373 kPa (54 psi)	347 kPa (50 psi)

As shown, pressures meet the design criteria at all locations with the exception of the Dain City Residential area, which does not meet the minimum 275 kPa (40 psi) requirement. The lower pressures in the Dain City Residential area are predominately due to the high ground elevation (maximum of 189 m) in this area in comparison to the hydraulic grade line of the system.

The top water level of the Bemis Elevated Tank, which represents the maximum hydraulic grade line of the system, is 219m – based on this top water level, and before accounting for any losses, the maximum pressure in the Dain City Residential area (at an elevation of 189 m) would, therefore, only be 294 kPa (43 psi). The low pressures in this area are further exacerbated by the current operating procedures at the WTP, where high lift pumps are shut down mid-morning, coinciding with periods of higher demand. Table 4.2 summarizes the minimum and maximum WTP flow and the minimum and maximum tank percent full with and without the Empire Homes Development. Note that both with and without the Empire Homes Development, the minimum percent full for the Bemis Tank coincides with the mid-morning WTP shutdown, while the maximum WTP flow coincides with the filling period that occurs when the WTP pumps turn back on after this mid-morning shutdown.

Table 4.2 Minimum and Maximum WTP Flow and Bemis Elevated Tank Volume

Parameter	Without Empire Homes Development		With Empire Homes Development	
	Minimum	Maximum	Minimum	Maximum
ADD EPS WTP Flow	0 L/s	326 L/s	0 L/s	328 L/s
ADD EPS Bemis Tank % Full	77%	100%	65%	100%
MDD EPS WTP Flow	0 L/s	789 L/s	0 L/s	799 L/s
MDD EPS Bemis Tank % Full	72%	100%	63%	100%

As shown in Table 4.2, with the addition of the Empire Homes development, there is an increase in the amount of drawdown that occurs at the Bemis Tank during the WTP mid-morning shutdown. The tank percent full of 63% that occurs during MDD EPS with the addition of the Empire Homes Development, corresponds to an HGL of 215.4 m, which is significantly lower than what it is needed to supply 275 kPa (40 psi) to the Dain City Residential area.

Modifying the WTP operating procedures, so that pumps are no longer off during mid-morning higher demand periods, would increase the minimum pressure in this area to above the MECP minimum; however, this strategy is not preferred since it relies exclusively on the operations of the WTP and limits the effective operating range of the Bemis Tank. Alternatively, limiting the ground elevation in the Dain City Residential area to 185 m would also increase the pressure to above 275 kPa (40 psi) without any modifications to the existing pumping scheme. Installation of a small booster pumping station to supply this area could also be considered as an alternative. Replacing the old cast iron watermain on Forks Road and increasing the size of the proposed watermain in this area was also reviewed as an alternative to limit headloss, however this would not increase the pressure to above 275 kPa (40 psi) due to the issue with the Bemis Tank HGL discussed above.

In addition to the pressures within the proposed Empire Homes Development, the pressures of the existing system were also reviewed. The addition of the Empire Homes Development results in a minor drop in pressure for the remainder of the system. The average drop to ADD pressure is 12 kPa (1.7 psi) and the average drop to MDD pressure is 17 kPa (2.5 psi). All system pressures in the existing network remain above 275 kPa (40 psi).

4.3 Fire Flow

Table 4.3 summarizes the available fire flow at each of the junctions added to the model to represent the Empire Homes Development. As shown, the existing system is capable of supplying greater than 133 L/s of fire flow (during MDD) to this development.

Table 4.3 Empire Homes Available Fire Flow

Junction ID	Location	Available Fire Flow during MDD (L/s)
435701WJ01	Former John Deere	248
J-EH-1	Former John Deere	174
J-EH-2	Canal Bank/Dain Avenue	173
J-EH-3	Canal Bank/Dain Avenue	191
J-EH-4	Dain City Residential	143
J-EH-5	Canal Bank/Dain Avenue	136

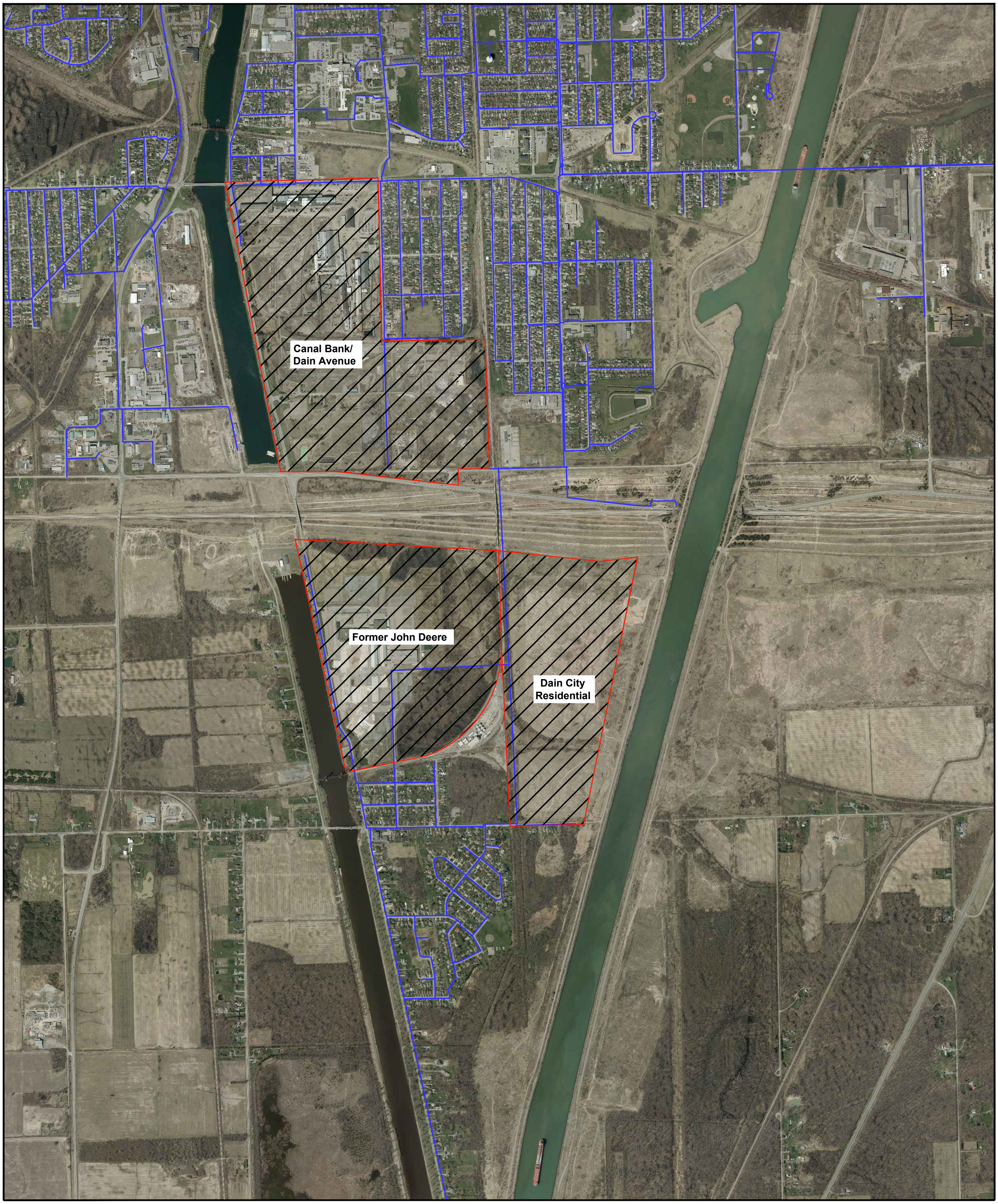
Additionally, the impact of the Empire Homes Development on the available fire flow within the existing system is minor, with many of the hydrants in the vicinity of the development having improved fire flow due to increased looping within the system. For hydrants within the existing system that do experience a drop in available fire flow with the addition of the Empire Homes Development, the average drop is approximately 1.3 L/s and does not change the NFPA 291 classification of the hydrant.

5. Conclusions and Recommendations

The City of Welland's water distribution system can supply water demand and fire flow to the proposed Empire Homes Development. This development will result in minor reductions in existing system pressure and available fire flow; however existing pressures will remain within MECP requirements.

During normal operating procedures, adequate pressure can be supplied to the Former John Deere and Canal Bank/Dain Avenue development areas without any modifications to the existing system operating procedures. However, the elevation in the Dain City Residential area (maximum elevation of 189m) results in pressures below the MECP recommendation of 275 kPa (40 psi) during high demand periods while the WTP is offline (mid-morning). Although these low pressures can be mitigated through changes to the operations of the WTP (eliminating mid-morning shut down), this strategy is not preferred since it relies exclusively on the operations of the WTP and limits the effective operating range of the Bemis Tank. Instead, the City should consider limiting the elevation of this portion of the development to a maximum of 185 m. Alternatively, a small booster station for this area could be considered.

Once a site servicing plan is developed, the Empire Homes Development should be reassessed to confirm required watermain sizing and connection locations to the existing system. Phasing plans should also be reviewed once available to confirm that suitable pressure and fire flow can be supplied not only during full buildout but during all interim phases.



Source: City of Welland 2013 Ortho Mosaic

NTS

CITY OF WELLAND
EMPIRE HOMES DEVELOPMENT

11155923

LOCATION PLAN

FIGURE 1.1

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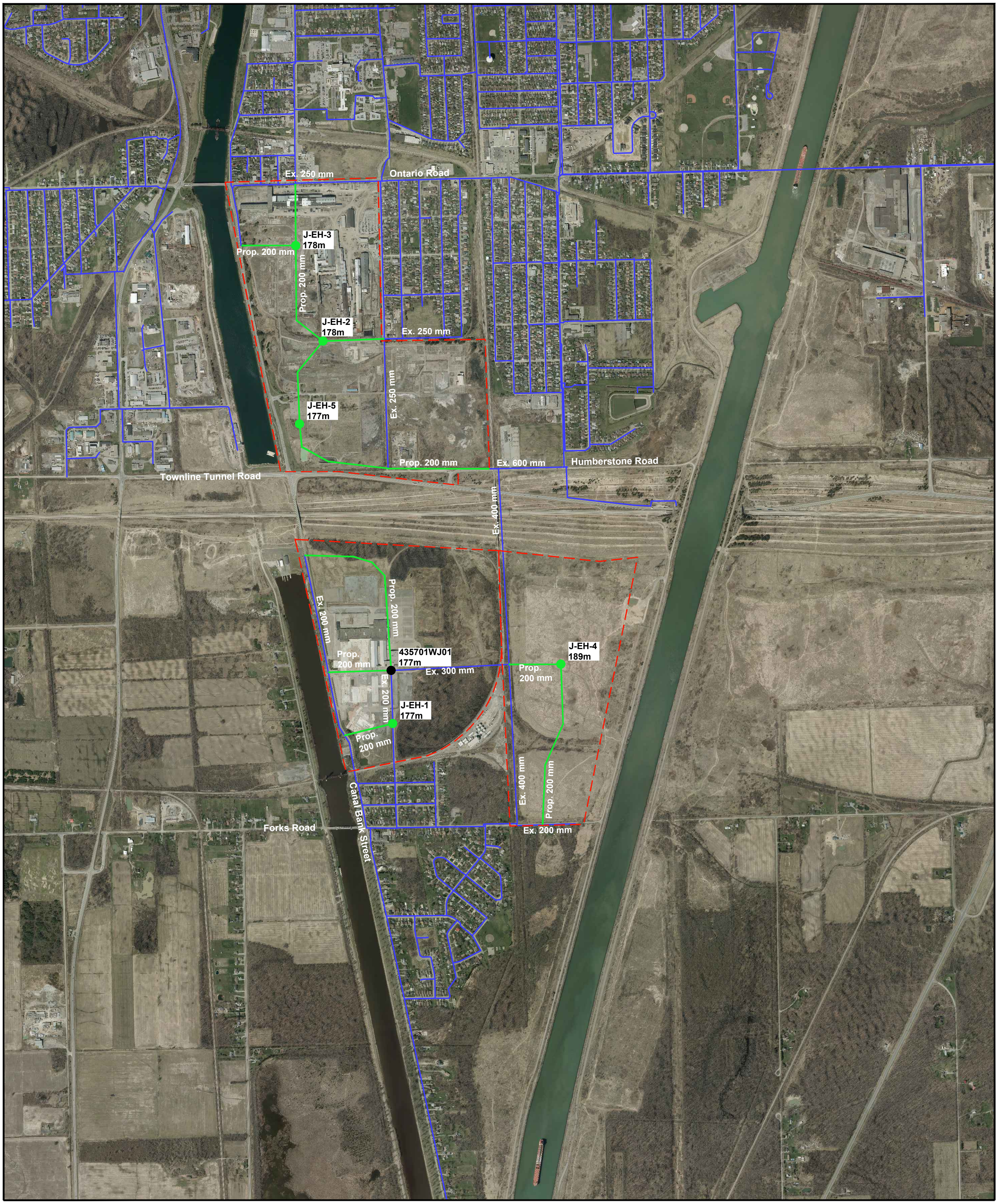

Source: City of Welland 2013 Ortho Mosaic

NTS

CITY OF WELLAND
EMPIRE HOMES DEVELOPMENT

11155923

WATER SERVICING

FIGURE 2.1

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