Wellington Master Servicing Plan – Technical Memorandum 1

Population, Water Demand and Wastewater Flow Projection Review

FINAL

Corporation of the County of Prince Edward

RVA 184179

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Wellington Master Servicing Plan
Population, Water Demand and Wastewater Flow Projection Review
Technical Memorandum 1

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1.0 INTRODUCTION

R.V. Anderson Associates Limited (RVA) was retained by the Corporation of the County of Prince Edward to complete a Master Servicing Plan for the Wellington Urban Area.

The purpose of this technical memorandum is to review relevant background information and recommend the population, water demands, and wastewater flows to be considered in the Wellington Master Servicing Plan.

1.1 Background Studies

The following documents were reviewed during the development of this Technical Memorandum:

- Prince Edward County - Official Plan, as amended
- Water and Wastewater Rate and Study and Connection Charges Update (Watson and Associates, 2015)
- Long Term Population, Housing and Employment Forecast and Capital Needs Assessment (Watson and Associates, 2013)
- Wellington Urban Centre Secondary Plan, as amended (IBI, 2013)
- Wellington Sanitary Sewer Capacity Analysis (RVA, 2018)
- 2008 – 2018 Prince Edward County Water and Wastewater Operations Data
- Prince Edward County Council Ledger
- Federal Census Data

2.0 DEVELOPMENT PROJECTIONS

2.1 Residential Population Projections

Federal census data (1996 to 2016) and other population studies were reviewed to generate an historic population profile and trend. Wellington has experienced consistent linear growth over this period, though rates have been on average 0.8%. Wellington also experiences a seasonal population influx, which can add an estimated 10 – 14% of its total population. At present, there is limited information regarding this seasonal demographic. Figure 2.1 illustrates the historical growth experienced in Wellington. If census data is extrapolated to 2020 using the same growth rate as prior years, Wellington would have a permanent population of 1970, a seasonal population influx of 219 and a total population of 2189. If the historic growth rate is maintained, then the permanent population could increase to 2118 by 2031 and 2378 by 2052. This

represents a conservative baseline growth option for Wellington, without any major changes in development.

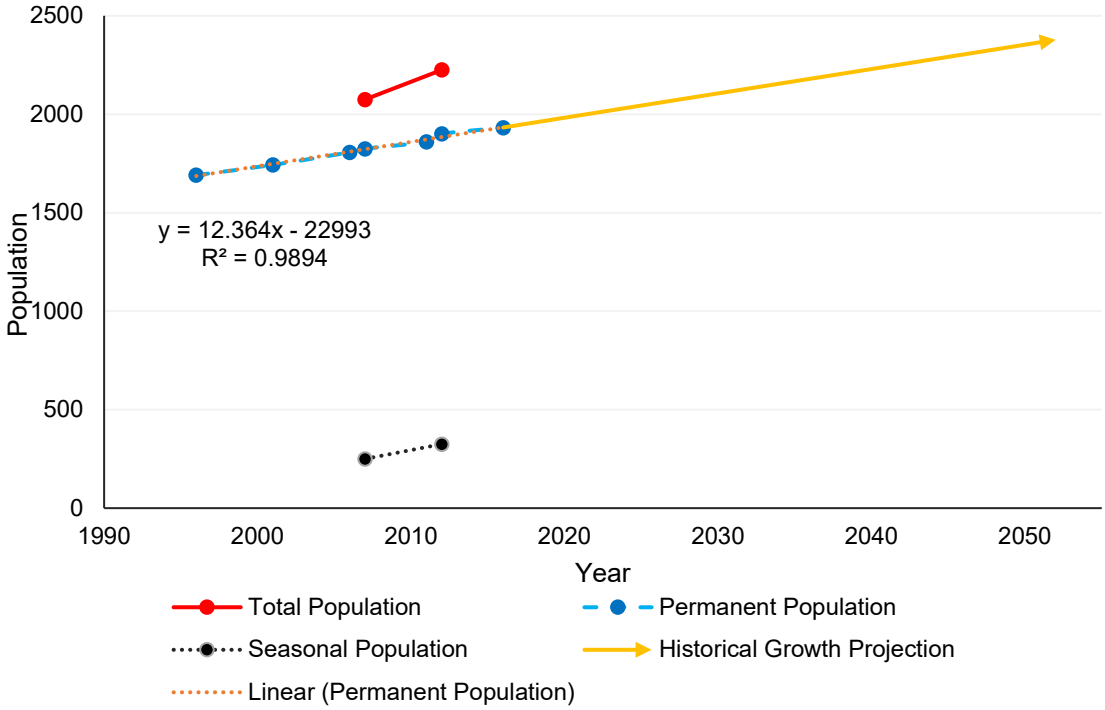

Figure 2.1 – Historical Population Trends in Wellington

A number of population projections exist for Wellington, all with a level of uncertainty regarding timelines for new developments being brought online and the occupancy density per unit. The Figure 2.2 illustrates the most recent projection (Watson and Associates, 2013), which indicates that new developments will stimulate growth rates significantly above current levels. This includes both new greenfield developments and redevelopment of properties within the village of Wellington. This projection indicates that by 2032 the total and permanent population of the Wellington Urban Center will increase to 4,200 and 3,625, respectively. This will increase linearly until buildout in 2066 with total and permanent population plateauing at 9600 and 8600, respectively. Based on this projection, the percentage of the seasonal population will remain within historical ranges (~10 %).

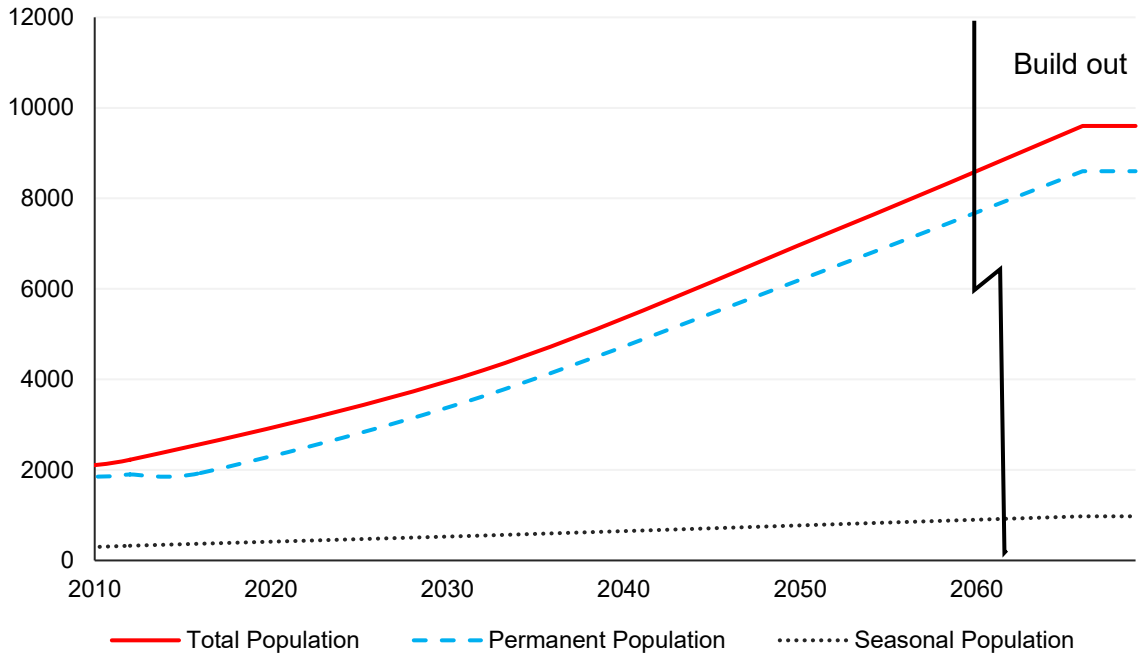

Figure 2.2 – Population Projections for Wellington (Watson and Associates, 2013)

The 2013 Watson and Associate projections were then compared to the Secondary Plan for the Wellington Urban Center (IBI, 2013). The Secondary Plan has a number of scenarios for permanent residents in 2031 which range between 2,548 and 5,085. These scenarios are also dependant on the timing of developments taking place and have been categorized in the following section and in Table 2.1.

Growth Scenario A

Scenario A assumes that, present population trends would continue, and the permanent population of Wellington would increase by 543 people to a total of 2,548 people.

- Permanent Population in 2031: 2,548
- New Residents: 543
- New Residential Units: 251
- New Residential Units per Year: 23

Growth Scenario B

Scenario B assumes that an increase in new units being constructed would occur, partially mirroring historical average. As such, Growth Scenario B assumes that the permanent population of Wellington would increase to a total of 3,589 people by 2031.

- Permanent Population in 2031: 3,589
- New Residents: 1,584
- New Residential Units: 726
- New Residential Units per Year: 66

Growth Scenario C

Scenario C assumes that all of the residential units in Wellington that are in various stages of planning approval at the County or are being considered for future development, are built out by 2031. As such, the permanent population of Wellington would increase to a total of 5,085 people by 2031.

- Permanent Population in 2031: 5,085
- New Residents: 3,080
- New Residential Units: 1,413
- New Residential Units per Year: 129

Since the creation of the Secondary Plan, the number and types of new developments have changed. Presently, there are four large developments planned (Wellington Bay Estates, Lakeside Estates (Schickedanz Development), Country Club Estates (Kaitlin Development) and Fields of Wellington (Hirschfield Development). These developments have the potential to increase the population of Wellington by 3,227 (As shown in Table 2.2); however, this increase would be over the development timeline, which is presently not defined. These would be developed on greenfield areas outside of the current servicing area. These population projections are in line with Growth Scenario C projections from the Wellington Secondary Plan; though, within the Wellington Secondary Plan there are no projections for seasonal residents.

In addition, there are several smaller properties (LCBO, Wellington Hotel, Maple Street, Twelve Trees, etc.) that are presently on the county ledgers. These are properties that either have tentative development plans in place or have the potential to be readily

developed. These properties are within the existing servicing area and could be readily connected. These properties have the potential to increase the population by 772 and in essence theses properties could be developed at any time. These have been isolated in the following Growth Scenario D, which is not contained in the Secondary Plan.

Growth Scenario D

Scenario D assumes that all of the Ledger Developments in Wellington could be built in the immediate future, prior to 2031; however, this only incorporates development within the existing urban area. As such, the permanent population of Wellington would increase to a total of 2,691 people.

- Imminent Permanent Population: 2,730
- New Residents: 772
- New Residential Units: 309
- New Residential Units per Year: 28

Table 2.1 summarizes the population forecast to 2031 based on the four growth scenarios from the Secondary Plan.

Table 2.1 – Secondary Plan and Ledger Growth Scenarios

Scenario	2031 Population	New Residential Units	New Units/Year
A	2,548	251	23
B	3,589	726	66
C	5,085	1,413	128
D	2,730	309	28

Table 2.2 below summarizes the known developments' plans and the associated population for the immediate growth horizon.

Table 2.2 – Proposed Additional Population Summary

Proposed Development	Phase 1 Equivalent Population	Phase 2 Equivalent Population	Total Equivalent Population
Wellington Bay Estates	348	558	906
Lakeside Estates (Schickedanz Development)	238		238
Country Club Estates (Kaitlin Development)	734	341	1075
Fields of Wellington (Hirschfield Development)	403	605	1008
Total - Large Developments	1722	1504	3227
Ledger Developments	772		772
Total	2495	1504	3999

Notes:
1. Unit types were interpreted from proposed development drawings and reports, as provided
2. Estimated populations calculated by multiplying the total number of units by their respective persons per unit figures as follows (Watson and Associates, 2013):
singles and semi's - 2.5 ppu
townhouses - 2.28 ppu
Apartments – 1.79 ppu

For the purposes of this Technical Memorandum #1, one growth option has been assumed, as directed by the County, as shown in Table 2.2. This growth options assumes the projections outlined in the Long-Term Population, Housing and Employment Forecast and Capital Needs Assessment (Watson and Associates, 2013) would be used, as previously shown in Figure 2.2. This represents a more comprehensive assessment of potential growth projections. In subsequent sections this option is referred to as the Watson and Associates Projection. In comparison to the Secondary Plan Scenarios (A – D), the Watson and Associates Projection is similar to Scenarios B, C and D which indicates that new development will occur above historical rates; however, growth will not be as aggressive as Scenarios C and D.

At the earliest, new developments could be built in **2020** with occupancy likely occurring in the following year. Growth prior to 2021 would therefore match historical rates. The County has also indicated that all new greenfield developments would initially be **25 building permits per year** for the first year. This is to ensure that the required infrastructure upgrades can be put into place prior to the full developments occurring.

In addition, the impact of non-permanent residents is currently contained in historical per capita data, with their relative proportion predicted to remain within historical averages. This allows the assumption that servicing projections based on permanent populations will also account for non-permanent residents. It has also been assumed that population growth within Wellington would remain within historical levels until 2020, after which increased development may occur.

For the purposes of setting a feasible implementation plan, the County included a 20-year phase of 2042, based on the projections from 2013 Watson and Associate Projections.

It should be stressed that timelines for the growth scenarios are subject to many different variables, which could result in an undefined period to reach buildout. Historic growth forecast will also be used to provide a baseline comparison for servicing needs.

Table 2.3 – Updated Population Projections

	Total[1]	Permanent	Seasonal[1]
2006 Population	2008	1807	201
2011 Population	2067	1860	207
2016 Population	2147	1932	215
Population as of 2020[2]	**2189**	**-**	**-**
Watson and Associates Projections, as implemented by The County			
Estimated Total Population of 2032[3]	**4200**	**-**	**-**
Estimated Total Population of 2042[3]	**6000**	**-**	**-**
Buildout [3]	**8,600**	**-**	**-**

Notes:
Population has been rounded. Does not account for deaths, migration or Census undercount.
1: Interpolated and extrapolated from Long Term Population, Housing and Employment Forecast and Capital Needs Assessment (Watson and Associates, 2015)
2: Extrapolated from Federal Census Data
3. Long Term Population, Housing and Employment Forecast and Capital Needs Assessment (Watson and Associates, 2013), as implemented by Prince Edward County. Numbers have been rounded for the use in the MSP.

2.2 Land Use Projections

The Wellington Secondary Plan identifies that at present, the majority of Wellington is residential with less than 10% of its land area designated as Industrial, Commercial or Institutional (ICI), with a total service area of **219 ha**. This land is presently intermixed within the existing residential areas, without any major differentiation. Current usage and generation rates of these areas are captured within historical per capital usage.

Presently, there is a total of **279 ha** allocated for residential development in the secondary plan, with **136 ha** at advanced planning stages for development by 2031 under growth Scenario C. The Watson and Associates Projection up to 2031 would proceed at a lower rate and only **70 ha** would be developed in this timeframe.

The Secondary Plan identifies that there are two areas that will be dedicated as an "employment area" for the development of ICI, one with **19.2** ha and the other with **8.8 ha**. The servicing needs of these areas must be considered separately; however, it is likely that ICI development would need to be limited at first to allow the required servicing upgrades. It is likely that the 19.2 ha area will be developed first after **2023** with the potential for completion by the 2031 timeline. The second 8.8 ha portion will likely be developed by 2052. The nature of these developments is currently unknown; however, it is likely to comprise commercial businesses and light industry, similar to other areas in the County. The lack of definition adds level uncertainty to future projections.

3.0 WATER SYSTEM AND WATER DEMANDS

3.1 Existing Water System

Wellington is presently serviced by the Wellington Water Treatment Plant, which uses Lake Ontario as its source water. The plant operates as a direct filtration system with a total rated capacity of 2,488 m^3/day (29 L/s) and reliable operating capacity of 1,225 m^3/day (14 L/s). Operational processes include coagulation, flocculation, filtration.

High Lift Capacity

- Four (4) (three (3) duty and one (1) standby, all in duty rotation) vertical turbine high lift pumps, with each having a rated capacity of 23 L/s (1987 m^3/day) at a TDH of 47 m
- Firm capacity of 32 L/s (2762 m^3/day) at a TDH of 47 m

Onsite Storage

- Twin Clearwell cells with dimensions of 6.12 m x 22.5 m x 4.7 m with a total storage volume of approximately 1,300 m^3
    - A minimum 1.5 m level must be maintained, without impacting disinfection requirements
    - Equates to 881 m^3 of effective storage, without replenishment

Offsite Storage

- Elevated Water tower with a total storage volume of 568 m^3

Fire protection and sample hydrants are located throughout the water distribution system.

3.2 Historical Water Demands

Daily "Operations Data" were provided by the County for the years 2009 through 2017. The data is appended in **Appendix 8**. The data lists the daily totalized flows from the Wellington Water Treatment Plant, into the distribution system.

The Average Day Demands for Wellington were calculated as follows:

> Sum of by monthly total high lift pumping station outflows
> Divided by 365 days

Historical Maximum Day Demands were determined by looking for the highest day demand recorded in the monthly summary sheets.

Figure 3.1 shows the historical water usage between 2008 – 2018, with overlaid meteorological data to corelate usage patterns. The system follows typically seasonal use patterns, with increased demand during warmer summer periods or after periods with limited precipitation. This seasonal pattern may also reflect the impact of summer tourism on the area.

Figure 3.2 shows a summary of key water usage parameters between 2008 – 2018. From the historical data, it can be seen that the average day demands in Wellington have remained relatively stable since 2011 (545 – 535 m^3/day). The per capita user demands have varied between 408 L/capita/day to 268 L/capita/day since 2009, with a decreasing trend present. This is consistent with the fact that the Wellington system is primarily comprised of residential users, has had little population change, and has had new water conservation measures causing a reduction in water use. The highest

maximum day demand to average day demand ratio, or Max Day Demand Factor was 2.82, with the typical Max Day Demand Factor over this period being 2.0.

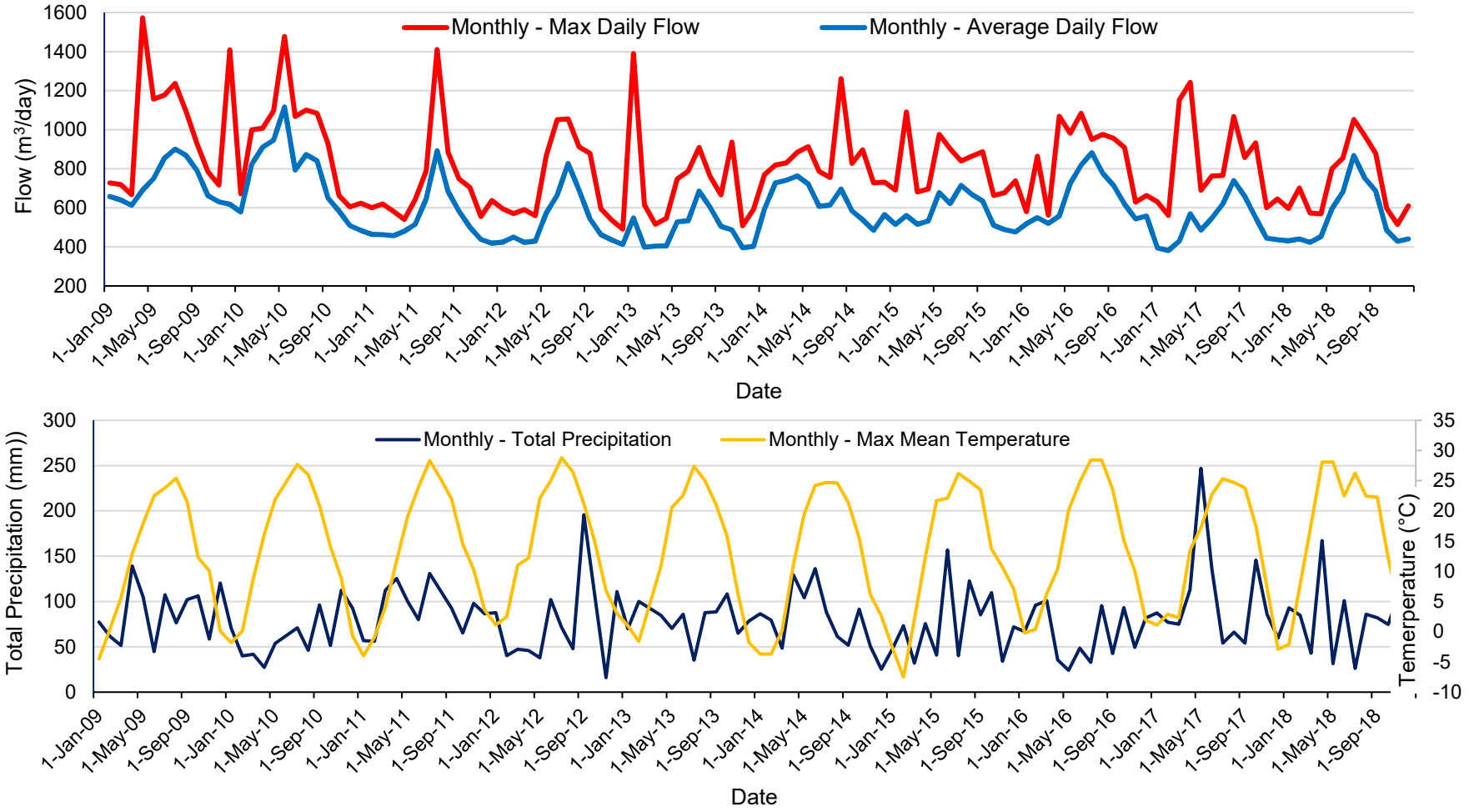

Figure 3.1 – Historical Wellington Water and Meteorological Data

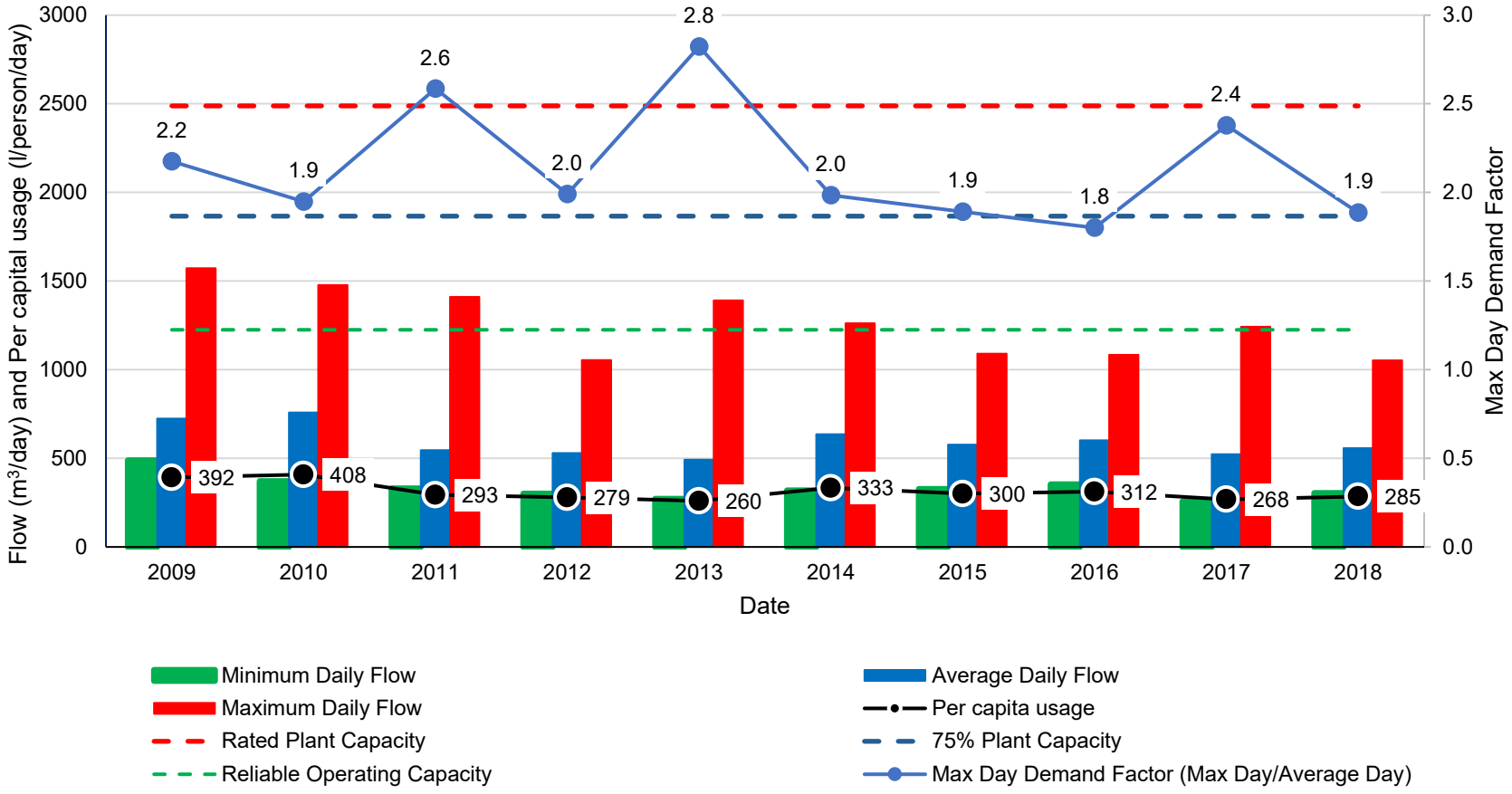

Figure 3.2 – Summarized Wellington Water Parameter

3.3 Future Demands

Table 3.1 provides a summary of water usage statistics for determining future projections. If available, historical values are compared to typical usage statistics for Ontario. Per capita usage for the Wellington system is within a typical range; however peaking factors show slightly more variance.

It is recommended that **320 L/capita/day** demands be used when calculating the water demands for the increased population in the year 2031 – 2052. This demand was selected based on historical data, though there is the potential for increased water efficiency and a continued reduction in per capita water demands. This higher value will also help to offset the unknown impact of increased tourism and non-seasonal residents.

There is presently no historical ICI data for Wellington and the nature of the proposed "employment areas" is uncertain. The MECP has a recommended range depending on the nature of the users, classed as either light or heavy industry; however, these two classes are quite broad in definition and can be inaccurate. Table 3.2 presents a range of historical ICI planning values from other Master Servicing Plans; however, at present, it is recommended to use the MECP light industry class of **35 m^3/ha/day** for projections, as to not constrain the type of ICI development that may occur and due to the lack of available data. These values can be updated in future to reflect actual usage rates.

Similar to the average day demands, we would recommend using community specific maximum day factors up to 2031. Therefore, we recommend the demand projections as follows:

- Max day/peak demand factor of **2.0** for residential areas based on typical values from the past 5 years of data
- Apply the maximum day factor of **3.0** to projected ICI demands

Table 3.1 – Water Usage Statistics used for Future Projections

	Unit	Value	Peak Factor	Peak Hour	Reference Source Note
Historical per capita use	L/capital/day	313	1.8 – 2.8		1
Typical per capita use	L/capital/day	270 - 450	2.0 – 2.25	3.0 – 3.38	2
Projected per capita use	**L/capital/day**	**320**	**2.0**	**3.38**	1
Typical use Industrial Parks	m^3/ha/day	35 – 55	2 – 4		2
Projected use Industrial Parks 2031	**m^3/ha/day**	**35**	**4**		2,3

Note:
Historical data for Wellington
MECP, 2008 Design Guidelines for Drinking Water Systems
Comparison ICI values from Table 3.2

Table 3.2 – Comparison ICI Demand Planning Values

Source	Unit	Light Industrial	Heavy Industrial	Commercial	Institutional	Other
MECP, 2008 Design Guidelines for Drinking Water Systems	m^3/ha/d	35	55			
MECP, 2008 Design Guidelines for Sewage Work	m^3/ha/d					28 - Commercial and tourist areas
Water Supply and Wastewater Servicing Master Plan Update, Town of Bradford West Gwillimbury	m^3/ha/d	2.2	60	2.2		5 - Blended water use rate (assuming heavy industrial land use at 5%) 8 - commercial and industrial development along HWY 400 employment area

Source	Unit	Light Industrial	Heavy Industrial	Commercial	Institutional	Other
City of Barrier Water Storage and Distribution Master Plan	m^3/ha/d	28				
City of Orillia Water System Master Plan Update	m^3/ha/d	36	36	28		
City of London Master Plan	m^3/ha/d	16	16	7	15	
Town of Innisfil Master Plan	m^3/ha/d	20				
South Collingwood Water Booster Station and Reservoir Design Report	m^3/ha/d	25				

Table 3.4 and Table 3.5 present the future water use projections for Wellington, with projections commencing in 2020.

Table 3.3 – Wellington Future Projections to 2032 – Water

Parameter	Demand Projection Value		Comments
2020 Daily Water Demands			
Wellington Population	2189	c	Extrapolated from Census data
Average Water Demand	700	m^3/d	Based on historical data
Max Day Water Demand	1401	m^3/d	Based on assumed max day factor of 2.0
Initial Permit Release	25	units/year	Based on initial release of 25 building permits
Initial Permit Release	2021	year	
2032 Residential Daily Water Demands			
Wellington Population	4200	c	PEC Projection
Average Population Increase per Year	168	c	
Average Units per Year	67	units	2.5 unit density
Historical Per Capita Demand	320	L/c/d	Planning Per Capita Demand
Max Day Demand Factor	2.0		Based on historical data
Average Water Demand	1344	m^3/d	
Max Water Demand	2688	m^3/d	
2032 ICI Average Day Water Demands			
Available Employment Land	19.2	ha	Allotted ICI area in Secondary Plan
Unit Demand	35	$m^3/ha/d$	
Per Capita Equivalent	109	c/ha	
Max Day Demand Factor	3.0		Average based on historical data
ICI Development Starts	2023	year	
New ICI Area per Year	2	ha/year	
Projected New Industrial Demand	672	m^3/d	Average
	2016	m^3/d	Max
Total 2032 Projected Demands			

Total 2032 Average Day Water Demand	**2016**	**m^3/d**	**Average**
Total 2032 Maximum Day Water Demand	**4704**	**m^3/d**	**Max**

Table 3.4 – Wellington Future Projections to 2042 – Water

Parameter	Demand Projection Value		Comments
2042 Residential Daily Water Demands			
Wellington Population	**6000**	**c**	**Based on Watson and Associates Projection**
Historical Per Capita Demand	**320**	**L/c/d**	**Planning Per Capita Demand**
Max Day Demand Factor	**2.0**		
Average Water Demand	**1920**	**m^3/d**	
Max Water Demand	**3840**	**m^3/d**	
2042 ICI Average Day Water Demands			
Available Employment Land	**28**	**ha**	**Allotted ICI area in Secondary Plan**
Unit Demand	**35**	**$m^3/ha/d$**	
Max Day Demand Factor	**3.0**		
Projected New Industrial Demand	**980**	**m^3/d**	**Average**
	2940	**m^3/d**	**Max**
Total 2042 Projected Demands			
Total 2042 Average Day Water Demand	**2900**	**m^3/d**	**Average**
Total 2042 Maximum Day Water Demand	**6780**	**m^3/d**	**Max**

Table 3.5 – Wellington Future Projections to Buildout – Water

Parameter	Demand Projection Value		Comments
Buildout Residential Daily Water Demands			
Wellington Population	**8600**		**Based on Watson and Associates Projection**
Historical Per Capita Demand	**320**	**L/c/d**	**Planning Per Capita Demand**
Max Day Demand Factor	**2.0**		
Average Water Demand	**2752**	**m^3/d**	

Max Water Demand	**5504**	**m^3/d**	
Buildout ICI Day Water Demands			
Available Employment Land	**28**	**ha**	**Allotted ICI area in Secondary Plan**
Unit Demand	**35**	**$m^3/ha/d$**	
Max Day Demand Factor	**3.0**		
Projected New Industrial Demand	**980**	**m^3/d**	**Average**
	2940	**m^3/d**	**Max**
Total Buildout Projected Demands			
Total Buildout Average Day Water Demand	**3732**	**m^3/d**	**Average**
Total Buildout Maximum Day Water Demand	**8444**	**m^3/d**	**Max**

Figure 3.3 illustrates the increase in water demand for baseline historical growth, and the Watson and Associates Projection, assuming a linear growth distribution. ICI demands have been isolated for each option. In terms of plant expansion, the County utilizes a 75% rated capacity trigger or a reliable operating capacity trigger to begin design proceedings. The reliable operating capacity represents one train out of service, which is the operationally sustainable level for average production. Historically, max day demands have exceeded the plants reliable operating capacity and continual operation at this rate would not be sustainable. The provision of addition treated water storage capacity could help to alleviate this issue.

For the baseline historical growth, the following could occur:

- Max day demand currently exceeds reliable operating capacity.

For the Watson and Associates Projection the following would occur:

- Max day residential demands without ICI development, would result in the 75% capacity trigger being reach in 2025/26.
    - Rated plant capacity would be exceeded after 2031.
- Residential demands with ICI development, would result in the 75% capacity trigger being reached in 2024.
    - Rated plant capacity would be exceeded by 2025.

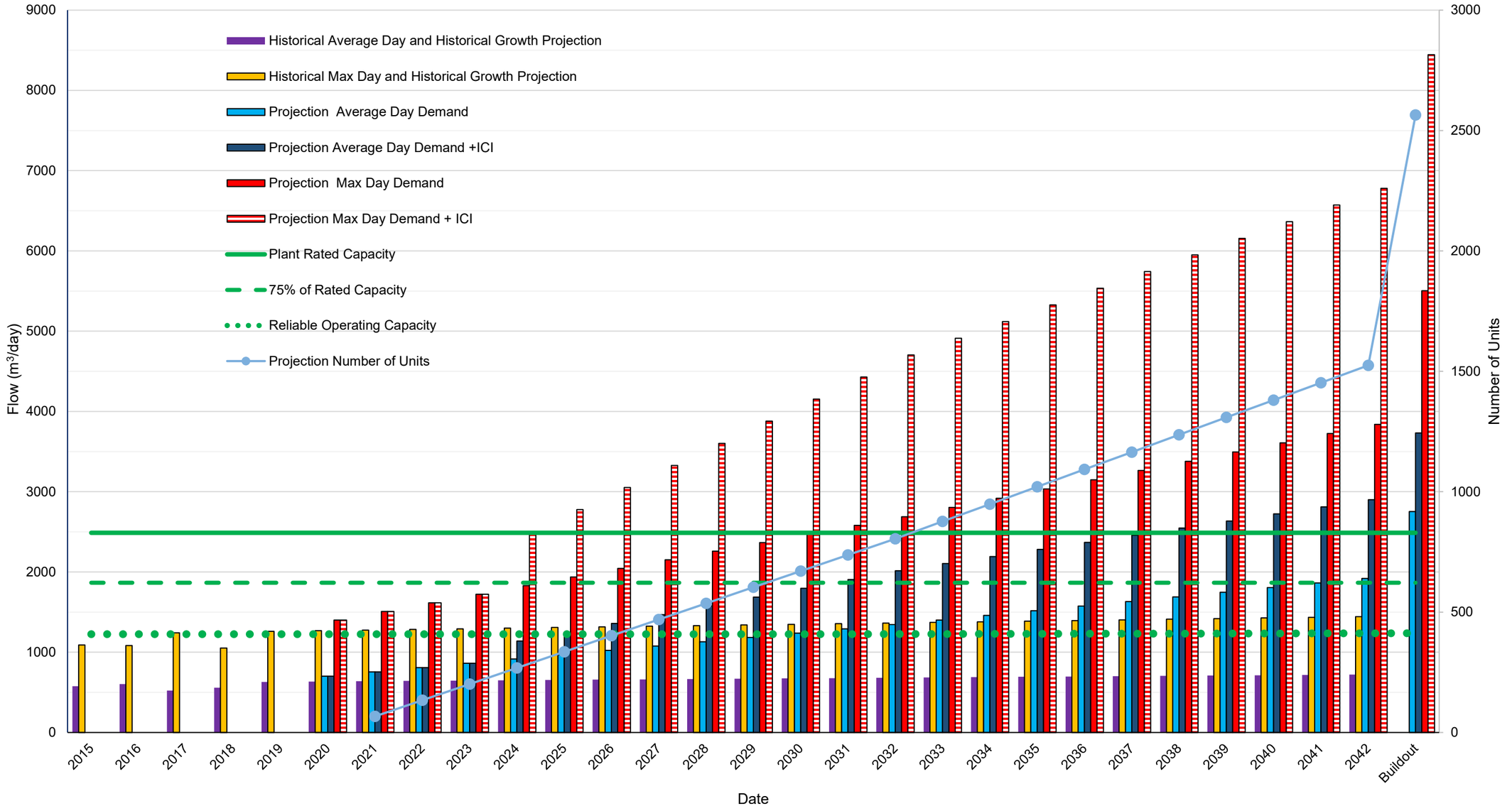

Figure 3.3 – Wellington Water Projections

3.4 Distribution system

The primary goals of the optimized distribution system should aim to satisfy the following criteria:

- Provide the MECP recommended pressures as much as possible throughout the distribution system:
    - Normal operating pressure ranges from 350 kPa to 480 kPa (50 to 70 psi) under maximum day flow conditions
    - Maximum pressures in general should not exceed 700 kPa (100 psi)
    - Minimum pressure of 275 kPa (40 psi) under peak hour demand conditions
    - Minimum pressure of 140 kPa (20 psi) under maximum day plus fire flow conditions.

3.5 Fire flow

3.5.1 Ministry of the Environment, Conservation and Parks Guidelines

Fire protection is a municipal responsibility and the municipality may elect to provide for higher fire flow requirements or entirely forgo fire protection by way of the drinking-water distribution system; however, the MECP Guidelines for Drinking Water Systems (2008) provides the following general guidance to municipalities, which many municipalities adopt and these are summarized in Table 3.6.

Table 3.6 – MECP Fire Flow Guidelines

Equivalent Population	Suggested Fire Flow (L/s)	Duration (hours)
500 – 1,000	38	2
1,000	64	2
1,500	79	2
2,000	95	2
3,000	110	2
4,000	125	2
5,000	144	2
6,000	159	3
10,000	189	3

3.5.2 Fire Underwriters Survey

The MECP Guidelines note that the above flows may not fulfill the fire protection requirements of the municipality's insurance company or the Fire Underwriters Survey, and therefore for fire flow requirements, the latest edition of the Fire Underwriters Survey document should be referenced.

The Fire Underwriters Survey (FUS) published a booklet in 1999 entitled: "Water Supply for Public Fire Protection" which contains a methodology that can be used to aid in estimating fire flow requirements for municipal fire protection on a building by building basis, based on materials of construction, size, fire protection, proximity to other buildings, etc.

Some example ranges of fire flows for various land uses are summarized in Table 3.7.

Table 3.7 – FUS Fire Flow Guidelines

Exposure Distance	Suggested Required Fire Flow (L/s)
Detached one family and small two-family dwellings less than 2 stories in height (Less than 3 m separation)	100 L/s *(masonry construction) Wood frame construction with a separation <3 m to be considered one fire area*
Detached one family and small two-family dwellings less than 2 stories in height (3 to 10 m separation)	67
Detached one family and small two-family dwellings less than 2 stories in height (10 to 30 m separation)	50
Detached one family and small two-family dwellings less than 2 stories in height (Greater than 30 m separation)	33
Modern townhouse groups	100 – 167
Apartment building	117 – 250
Institutional building	83 – 250
Industrial park	233
Commercial shopping centers	200 – 367
Warehouse	333 – 420
Old congested 2 and 3 family apartment buildings with less than 3 m separation running the length of a block	233 – 417

For the current stage of this Master Servicing Plan, it is recommended to use the MECP recommended fire flows, which are typical of other municipalities in Ontario. If ICI

development proceeds FUS requirements can be adjusted to reflect actual requirements.

The fire flow requirements for the ICI and residential blocks should be reassessed when further information is available. Design and construction approaches can help to reduce the flow requirements to be within a similar range as residential requirements. This includes the use of fire resistive construction, separation distances, firewalls or compartments, reassessment of occupancy hazard and sprinkler design.

In addition, the mechanical engineer for these buildings and developments will complete the required analyses for fire protection, and the architect will design fire separation methods per the determined fire flow rate, in order to meet municipally available flows and pressures.

3.5.3 Recommended Water Storage Volume

Fire protection is a municipal responsibility, and the following approach is recommended by the MECP to calculate required treated water storage volume, with the results shown in Table 3.8:

Total Treated Water Storage Requirement = A + B + C

Where:

A = Fire Storage

B = Equalization Storage (25% of maximum day demand)

C = Emergency Storage (25% of (A + B)).

Table 3.8 – MECP Water Storage Volumes – Based Watson and Associates Population Projections

3.5.4

Year	Population Category	Conditions			
		A	B	C	
		Fire Storage (m^3)	Equalization Storage (m^3)	Emergency Storage (m^3)	Total Volume (m^3)
2020	2000	684	350	259	1293
2021	2000	684	377	265	1326
2022	3000	792	404	299	1495
2023	3000	792	431	306	1528
2024	3000	792	625	354	1772
2025	3000	792	694	372	1858
2026	3000	792	763	389	1944
2027	3000	792	832	406	2030
2028	4000	900	901	450	2251
2029	4000	900	970	467	2337
2030	4000	900	1038	485	2423
2031	4000	900	1107	502	2509
2032	4000	900	1176	519	2595
2042	6000	1717	1695	853	4265
Buildout	8600	1928	2111	1010	5049
2032-Industrial Park[2]		2516	1176	923	4615
2042-Industrial Park[2]		2516	1695	1053	5264
Buildout-Industrial Park[2]		2516	2111	1157	5784

Note:
1.Values without industrial park FUS requirements unless stated.
2.With Industrial park FUS requirements

3.5.5 Storage Recommendations

Currently, the Wellington system does not have adequate storage capacity to accommodate future growth and additional storage will be required. One potential

alternative is the replacement of the current elevated tank with a larger model. Another item to consider is the fire flow requirements for the industrial area skews the sizing and should be reviewed in future.

The transition of the distribution system to the new elevated tank may need to make accommodations for the new pressure regime. This may require consideration for pressure zones within the distribution system and increases in distribution systems leaks. One option that has been proposed by the PEC to minimize the impact on end users is the rollout of new flowmeters with pressure regulating valves to limit the impact of pressure increases on older domestic plumbing.

4.0 WASTEWATER SYSTEM AND WASTEWATER GENERATION

4.1 Existing System

The Wellington WWTP has a rated capacity of 1,500 m^3/day (17.4 L/s) and a peak hydraulic capacity of 4,550 m^3/day (52.7 L/s). The system operates and the collection system's pumping stations are summarized in Table 4.1.

Table 4.1 – Sanitary Sewer System Pumping Capacities

Pump Station	# Pumps	Rated Capacity
Belleville Street PS	2	30.3 L/s @ 13.7 m TDH
Wharf Street PS	2	34.1 L/s @ 11.6 m TDH
WWTP	3	29.5 L/s @ 6.7 m TDH

4.2 Historical Generation Rates

Figure 4.1 – show the historical water usage between 2013 – 2018, with overlaid water consumption and precipitation data to correlate flows. It is evident that the system flow rates are being impacted by wet weather events, with monthly precipitation often mirrored in the monthly wastewater flow data. Since 2017, there have been an increase in months with elevated precipitation totals (greater than 100 mm), with five peaks recorded between 2017 – 2018 and only three similar events occurring in prior years.

Figure 4.2 shows a summary of key wastewater parameters between 2013 – 2018. The system has seen an increase in flows over this period, likely tied to higher volume precipitation events in recent years.

Average and max day flows have increased since 2013 and it appears that the rated capacity of the plant is exceeded during these events. Annual average day flows have ranged between 699 – 949 m^3/day with an increasing trend present. The plants 4 years running average is 770 m^3/day. For a few weeks during the spring season the flows often exceeds the rated capacity requiring the system to bypass the treatment system

When comparing ratios of wastewater generated to water used, the values have increased from 1.0 in 2013 to a high of 1.8 in 2017. This further supports that a significant amount of inflow and infiltration is occurring during wet weather/precipitation events. This has led to an increase in per capital generation rates from 343 to 488 L/capita/day, with 4 year running average of 399 L/capital/day; however, this is not reflective of water usage data. Return rates of potable water into the sanitary system in July, August and September were found to range between 55% to 100%, with an average of 80%. The highest maximum day flows to average day flows, or Peaking Factor was 5.5, with the Average Peaking Factor of 3.4 over this period. Elevated peaking factors are linked to precipitation events and do not reflect actual wastewater generation rates. Water usage (monthly average and maximum) has an inconsistent trend with the corresponding wastewater generation rates.

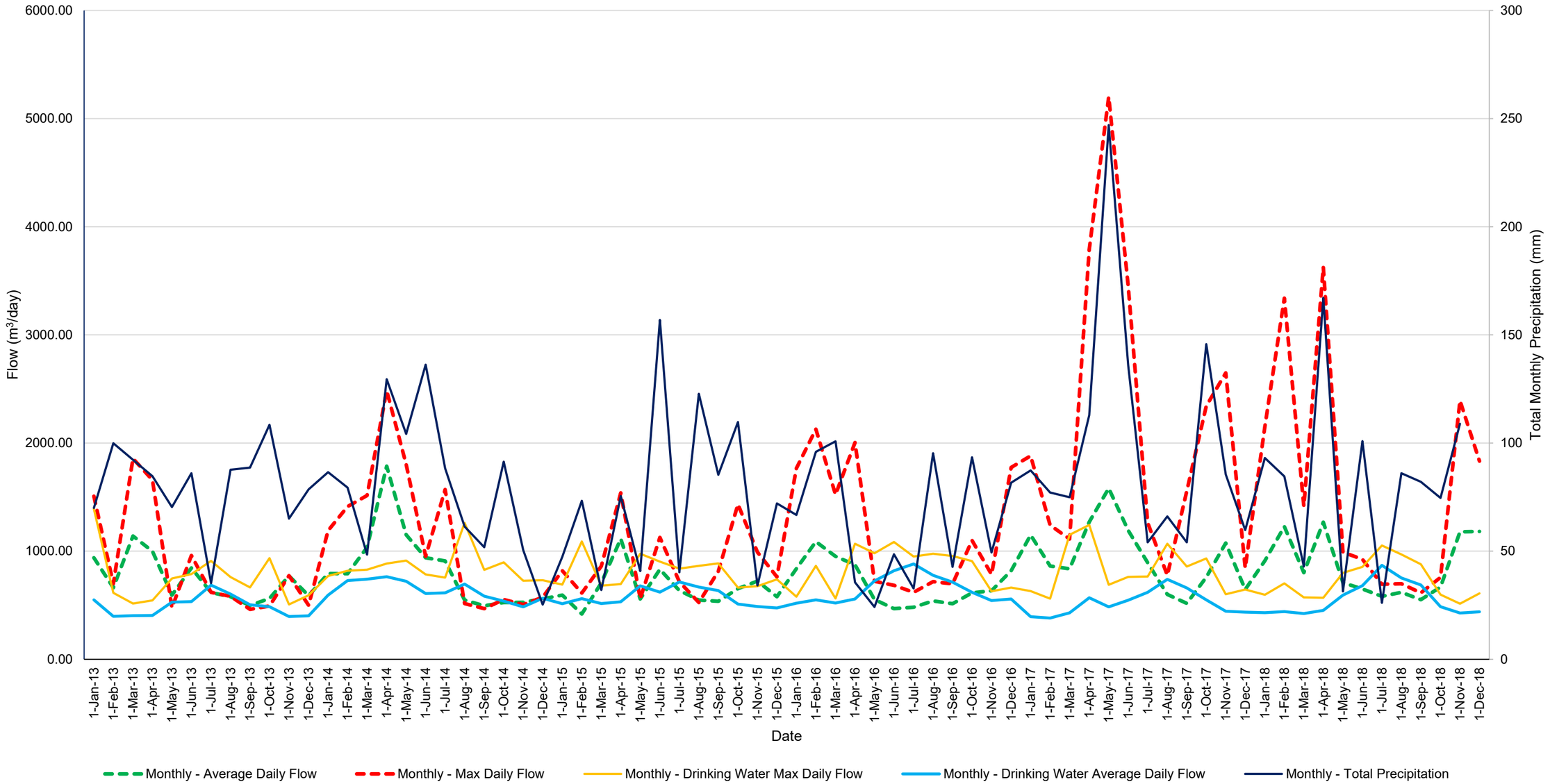

Figure 4.1 – Historical Wellington Wastewater Data

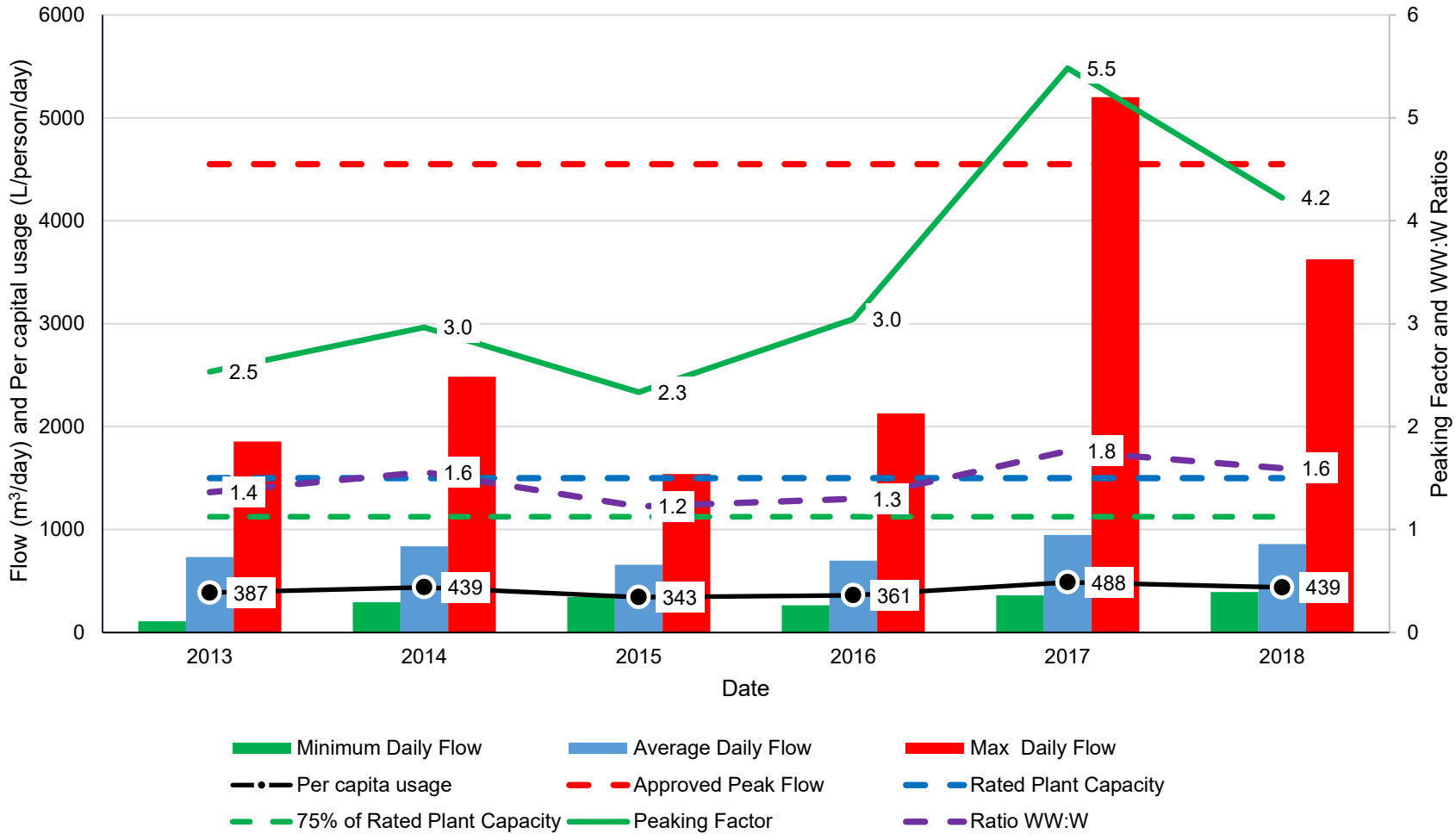

Figure 4.2 – Summarized Wellington Wastewater Parameters

4.3 Future Wastewater Flowrates

Table 4.2 provides a summary of wastewater statistics for determining future projections. If available, historical values are compared to typical rate statistics for Ontario. Per capita usage for the Wellington system is within a typical range, though the system is current heavily influenced by inflow and infiltration events.

Historic per capita flows are **400 L/capita/day** (inclusive of I&I); however, actual per capita flows are **260 L/capita/day** (80% return rate of water use, exclusive of I&I) and this latter value will be used for both existing and new developments.

Due to the impact of inflow and infiltration on community specific maximum day factors it is recommended to use the Harmon formula to calculate peaking factors. Peaking factors have the tendency to decrease as a community's population increases.

There is presently no historical ICI data for Wellington and the nature of the proposed development park is uncertain. The MECP does not recommend going below **28 m^3/ha/day**; and it should match expected water usage. At present, it is recommended to match the proposed water usage until the nature of the development is better defined.

It is recommended to use an average inflow and infiltration (I&I) allowance of **1.27 m^3/ha/day** for new and existing residential areas and a value of **1.27 m^3/ha/day** for the new ICI areas. These values were calibrated based on historical Wellington data and are below typical average inflow and infiltration values (MOE, 2008)

It is recommended to use a peak inflow and infiltration allowance of **21.40 m^3/ha/day** for existing areas and a value of **4.75 m^3/ha/day** (MOE, 1984) for the new residential and ICI areas. Existing values were calibrated based on historical Wellington data and there is the potential for these values to be reduced if inflow and infiltration into the sanitary system is addressed. New values are based on the higher range of MOE guidelines, which is equivalent to **500 L/capita/day.** Although new construction methods can in theory achieve lower I&I rates, often in practice this does not occur and likely, as the system ages I&I increases. In addition, sewers should be designed with the capability to accommodate **24.19 m^3/ha/day** (0.28 L/s/ha), to accommodate peak I&I events (ICLR, 2017). A pending update to the MECP design criteria for sanitary sewers is proposing I&I flows of 0.25 L/s/ha. To be conservative, this report uses the I&I flow of 0.28 L/s/ha from the Guidelines for Design of Sanitary Sewage Systems (MOE, 1985).

Table 4.2 – Wastewater Generation Statistics used for Future Projections

	Unit	Value	Peak Factor	Reference Source
Historical per capita rates	L/capital/day	343 - 488	2.3 – 5.5	1
Typical per capita rates	L/capital/day	225 - 570	Varies	2
Projection per capita use	**L/capital/day**	**260**	**Harmon**	
Typical rates ICI	m^3/ha/day	28 – 55	2 – 4	3,4
Projection ICI	**m^3/ha/day**	**35**	**2.0**	**3,4**
Historical average I&I	m^3/ha/day	**1.27**		1
Typical I&I	m^3/ha/day	**3.72**		4,5
Projection average I&I (New and existing)	**m^3/ha/day**	**1.27**		**1**
Historical peak I&I	m^3/ha/day	21.40		1
Typical peak I&I	m^3/ha/day	**10.24 – 24.19**		4,5
Projection peak I&I (existing)	**m^3/ha/day**	**21.40**		**1**
Projection peak I&I (new)	**m^3/ha/day**	**4.75**		**5**
Projection peak I&I (sewer design)	**L/s/ha**	**0.28**		**5**

Note:

1. *Historical data for Wellington*
2. *MECP, 2008, Design Guidelines for Sewage Works*
3. *MECP, 2008 Design Guidelines for Drinking Water Systems*
4. *NRC, 2003, National Guide to Sustainable Municipal Infrastructure -Infiltration/Inflow Control/Reduction for Wastewater Collection Systems*
5. *MOE, 1985, Design Guidelines for Sanitary Sewage Systems. A pending update to the MECP design criteria for sanitary sewers is proposing I&I flows of 0.25L/s/ha. To be conservative, this report uses the 0.28L/s/ha from the 1984 MOE design guidelines.*

Table 4.3, Table 4.4 and Table 4.5 present the future wastewater use projections for Wellington, with projections commencing in 2020. A few of these numbers were updated since the original version of TM#1 and the data shown in the Public Information Centre (PIC) Panels #1 and #2. The main changes include a more realistic approach to future I&I flow rate and maximum day flow calculations. Under the full build out scenario, the average day flow remains the same (e.g. approximately 3,900 m^3/day), however the peak day flow is reduced to 10,440 m^3/day instead of 16,900 m^3/day. The peak hour flow is estimated at 18,000 m^3/day. This means that the footprint of the ultimate wastewater treatment plant may be a bit smaller than originally presented in the PIC panels and could have some reduction to the capital cost. However, the full benefits of the flow update would be best realized if the County incorporated an equalization tank strategy with the long term WWTP strategy, as it will help to optimize the process treatment sizes for secondary clarifiers, UV and tertiary treatment processes while still accounting for peak flows.

Table 4.3 – Wellington Future Projections to 2032 – Wastewater

Parameter	Demand Projection Value		Comments
2020 Average Day Flows			
Wellington Population	2189		Extrapolated from Census data
Historical Per Capita Flow (Includes ICI and I&I)	400	L/c/d	4-yr Running Average
Historical Per Capita Flow (excluding I&I)	260	L/c/d	80% return rate
Peaking Factor	3.55		Harmon - for sewers
Historical Average I&I	140	L/c/d	Average based on historical data
Typical Peak I&I	1162	L/c/d	Average peak based on historical data
Future Peak I&I	500	L/c/d	Peak based on (MOE guidelines, 1984) - New area only
Historical Peak I&I	2116	L/c/d	Peak based on historical data
Current Area Serviced	219	ha	
Average Wastewater Generation Rate	876	m^3/d	Average based on historical data
Typical Peak Wastewater Generation Rate	4567	m^3/d	Average peak based on historical data
Peak Wastewater Generation Rate	5202	m^3/d	Peak based on historical data
Average I&I Rate	1.40	$m^3/ha/d$	Average based on historical data (for new and exisitng)
Typical Peak I&I	11.61	$m^3/ha/d$	Peak based on historical data
Future Peak I&I	5.25	$m^3/ha/d$	Peak based on (MOE guidelines, 1984) - New area only
Historical Peak I&I	21.15	$m^3/ha/d$	Peak based on historical data
2032 Residential Flows			
Wellington Population	4200		PEC Projection
Population Increase per Year	168	c	
Average Units per Year	67	units	2.5 unit density
Projected Per Capita Flow	260	L/c/d	
Peaking Factor	3.31		Harmon - for sewers
Average Day Flow	1092	m^3/d	
Peak Day Flow	3619	m^3/d	For sewers
2032 New ICI Flows			
Available Employment Land	19.2	ha	Based on Secondary Plan
Unit Rate	35	$m^3/ha/d$	MECP “Light Industry”
Per Capita Equivalent	135	c/ha	
Peaking Factor	2.00		Typical
ICI Development Starts	2023	year	
New ICI Area per Year	2	ha/year	
Average Day Flow	672	m^3/d	
Peak Day Flow	1344	m^3/d	
2032 Average Inflow and Infiltration (I&I)			
New Residential Area	136	ha	Prorated area
Residential I&I Rate	1.40	$m^3/ha/day$	Calibrated based on historical data
Residential I&I	497	m^3/d	
New ICI Area	19.2	ha	Allotted ICI area in Secondary Plan
ICI I&I Rate	1.399	$m^3/ha/day$	Calibrated based on historical data

ICI I&I	**27**	**m^3/d**	
Total	**524**	**m^3/d**	
2032 Peak Inflow and Infiltration (I&I)			
New Residential Area	**136**	**ha**	**Proposed Developments**
Residential I&I Rate	**5.25**	**m3/ha/d**	**Peak based on (MOE guidelines, 1984) - New area only**
Residential I&I	**5348**	**m^3/d**	**New and existing at differing rates - refer to 2020 table**
New ICI Area	**19.2**	**ha**	**Allotted ICI area in Secondary Plan**
ICI I&I Rate	**5.250**	**m3/ha/d**	**Peak based on (MOE guidelines, 1984) - New area only**
ICI I&I	**101**	**m^3/d**	
Total	**5449**	**m^3/d**	
2032 Projected Flows			
2031 Average Day without ICI	**1589**	**m^3/d**	
2032 Per Capita Average Day without ICI	**378**	**L/c/d**	
2032 Average Day with ICI	**2288**	**m^3/d**	
2032 Per Capita Average Day with ICI	**545**	**L/c/d**	
2032 Peak Day (Residential and Peak I&I)	**6440**	**m^3/d**	
2032 Peak Day (Residential, Peak ICI and Peak I&I)	**7885**	**m^3/d**	

Table 4.4 – Wellington Future Projections to 2042 – Wastewater

2042 Residential Flows			
Parameter	**Value**		**Comments**
Wellington Population	6000	c	Based on Watson and Associates Projection
Peaking Factor	3.17		Harmon - for sewers
Projected Per Capita Flow	260	L/c/d	
Average Day Flow	1560	m3/d	
Peak Day Flow	4946	m3/d	For sewers
2042 ICI Day Flows			
Available Employment Land	28	ha	Allotted ICI area in Secondary Plan
Unit Rate	35	m3/ha/d	
Per Capita Equivalent	135	c/ha	
Peaking Factor	2.00		Typical
Average Day Flow	980	m3/d	
Peak Day Flow	1960	m3/d	
2042 Average Inflow and Infiltration (I&I)			
Residential Area	195	ha	Prorated area
Residential I&I Rate	1.40	m3/ha/day	Calibrated based on historical data
Residential I&I	579	m3/d	
ICI Area	28	ha	Allotted ICI area in Secondary Plan
ICI I&I Rate	1.399	m3/ha/day	Calibrated based on historical data
ICI I&I	39	m3/d	
Total	618	m3/d	
2042 Peak Inflow and Infiltration (I&I)			
Residential Area	195	ha	Allotted residential area in Secondary Plan
Residential I&I Rate	5.3	m3/ha/d	Peak based on (MOE guidelines, 1984) - New area only
Residential I&I	5654	m3/d	New and existing at differing rates - refer to 2020 table
ICI Area	28	ha	Allotted ICI area in Secondary Plan
ICI I&I Rate	5.3	m3/ha/d	Peak based on (MOE guidelines, 1984) - New area only
ICI I&I	147	m3/d	
Total	5801	m3/d	
2042 Projected Flows			
2042 Average Day without ICI	2139	m3/d	
2042 Per Capita Average Day without ICI	356	L/c/d	
2042 Average Day with ICI	3158	m3/d	
2042 Per Capita Average Day with ICI	526	L/c/d	
2042 Peak Day (Residential and I&I)	7214	m3/d	
2042 Peak Day (Residential, Peak ICI and I&I)	9321	m3/d	

Table 4.5 – Wellington Future Projections to Buildout – Wastewater

Buildout Residential Flows			
Parameter	**Value**		**Comments**
Wellington Population	8600	c	Based on Watson and Associates Projection
Peaking Factor	3.02		Harmon - for sewers
Projected Per Capita Flow	260	L/c/d	
Average Day Flow	2236	m^3/d	
Peak Day Flow	6751	m^3/d	For sewers
Buildout ICI Day Flows			
Available Employment Land	28	ha	Allotted ICI area in Secondary Plan
Unit Rate	35	$m^3/ha/d$	
Per Capita Equivalent	135	c/ha	
Peaking Factor	2.00		Typical
Average Day Flow	980	m^3/d	
Peak Day Flow	1960	m^3/d	
Buildout Average Inflow and Infiltration (I&I)			
Residential Area	279	ha	Allotted residential area in Secondary Plan
Residential I&I Rate	1.399	$m^3/ha/day$	Calibrated based on historical data
Residential I&I	697	m^3/d	Calibrated based on historical data
ICI Area	28	ha	Allotted ICI area in Secondary Plan
ICI I&I Rate	1.399	$m^3/ha/day$	Calibrated based on historical data
ICI I&I	39	m^3/d	
Total	736	m^3/d	
Buildout Peak Inflow and Infiltration (I&I)			
Residential Area	279	ha	Allotted residential area in Secondary Plan
Residential I&I Rate	5.25	m3/ha/d	Peak based on (MOE guidelines, 1984) - New area only
Residential I&I	6097	m^3/d	New and existing at differing rates - refer to 2020 table
ICI Area	28	ha	Allotted ICI area in Secondary Plan
ICI I&I Rate	5.25	m3/ha/d	Peak based on (MOE guidelines, 1984) - New area only
ICI I&I	147	m^3/d	
Total	6244	m^3/d	
Buildout Projected Flows			
Buildout Average Day without ICI	2933	m^3/d	
Buildout Per Capita Average Day without ICI	341	L/c/d	
Buildout Average Day with ICI	3952	m^3/d	
Buildout Per Capita Average Day with ICI	460	L/c/d	
Buildout Peak Day (Residential and I&I)	8333	m^3/d	
Buildout Peak Day (Residential, Peak ICI and I&I)	10440	m^3/d	

Peak Day Flow Factor	**2.6**	**m^3/d**	
Peak Hour Flow Factor to Peak Day Flow Factor	**1.7**	**m^3/d**	**WEF guidelines based on average capacity**
Peak Hour Flow Factor	**4.6**	**m^3/d**	
Peak Hourly Flow	**18021**	**m^3/d**	

Figure 4.3 illustrates the increase in wastewater flows for historical growth, and the Watson and Associates Projection, and ICI demands have also been isolated for each option. In terms of plant expansion, the County utilizes a 75% of the rated capacity trigger to begin design. Of particular note is that the plant is currently at the threshold of the capacity trigger, based on peak flows. In recent years the plant has also had a number of flow events that have exceeded the peak flow capacity of the plant.

For the baseline historical growth, the following could occur:

- Current peak flows exceed peak plant capacity.
- During certain periods of the year the average day flows exceed the rated capacity.

For the Watson and Associates Projection the following could occur:

- Current peak flows exceed peak hydraulic capacity
- Residential flows without ICI development would exceed 75% of the rated plant capacity by 2027.
    - Rated capacity would be exceeded after 2031/32
    - With ICI included, rated capacity would also be exceeded by 2025/26

This indicates that modifications to the wastewater treatment plant will be required to accommodate additional wastewater flows or new development needs to be limited until the wastewater treatment is upgraded. The immediate concern is addressing the plants capacity to handle peak flows. County staff have indicated that the existing treatment trains are not used to their full rated capacity, however the treatment process have hydraulic limitations and experience partial treatment bypasses during wet weather events.

The impacts of Inflow and infiltration is also significant concern and should be addressed and the following should be completed:

- Carry out a prolonged flow study.
- Identify the major problem areas and fix significant issues, as system wide rehabilitation may be cost prohibitive.

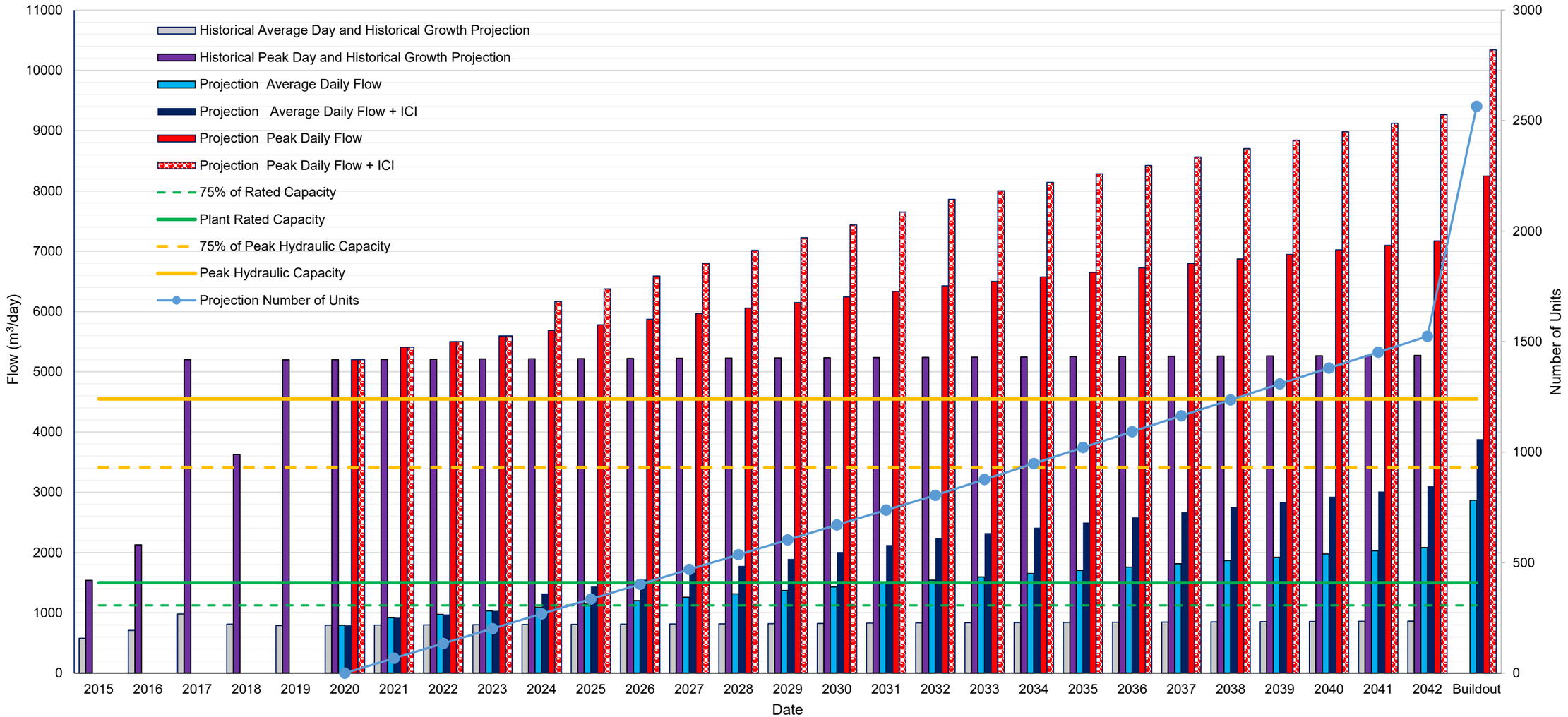

Figure 4.3 – Wellington Wastewater Projection

5.0 SUMMARY

Historical Growth projection:

Water

- Historically, max day demands have exceeded the water treatment plant's reliable operating capacity and continual operation at this rate would not be sustainable. The provision of additional treated water storage capacity could help to alleviate this issue in the short term.
- With historic growth projections the water treatment plant could continue to satisfy demands beyond 2031; however, it would be operating above the reliable operating capacity continuously.
- Storage is currently in deficit and should be addressed.

Wastewater

- Wastewater treatment plant's peak capacity historically exceeded
    - Inflow and infiltration significantly contribute to wastewater flows
    - Historical incidents of average day flows (averaged over a month) had exceeded the wastewater treatment plant's rated capacity, leading to bypass events.
    - Historically, peak day flows exceeded the wastewater treatment plant's peak capacity, leading to bypass events.
- With historic growth projections the wastewater treatment plant could continue to satisfy average days flows to beyond 2031; however, the industry standard is to begin planning for expansion when the wastewater treatment plant reaches 75-80% of its rated capacity, which would be reached much sooner than 2031. In addition, the peak flow limitations are a current problem that need to be addressed immediately before additional flows can be added, as it will further exacerbate the current bypass issues.

General Servicing

Should the County wish to take immediate steps to allow for a limited number of additional housing units, it would require addressing the water storage issue and shaving

the peak wastewater flows by reducing inflow and infiltration going to the wastewater treatment plant. The number of additional units feasible under this step would depend on how much of the peak flows can be reduced below the WWTP's rated capacity. The next step to accommodate more housing units would be to increase the redundancy at the water treatment plant (one additional train) and implement an interim solution for the wastewater treatment plant to take handle more peak flows during wet weather events. However, these would be short-term solutions to allow for limited number of housing units. The preferred alternatives for long term, sustainable servicing would still be required to accommodate growth. Additional information and details of this is covered under Technical Memorandum No. 2 and the Implementation Plan of the final Master Servicing Report.

Servicing projections for Watson and Associates Projection:

Water

- Average residential demands without ICI development would exceed the reliable operating capacity by 2031.
- Average residential demands with ICI development would exceed the reliable operating capacity by 2026.
- Residential demands without ICI development, would result in the 75% rated capacity trigger being reach in 2026.
    - Existing plant rated capacity would be exceeded after 2031.
- Residential demands with ICI development, would result in the 75% rated capacity trigger being reached in 2024.
    - Existing plant rated capacity would be exceeded by 2025.
- Treatment capacity requirements
    - 4700 m^3/day for 2032 requirements
    - 6800 m^3/day for 2042 requirements
    - 8500 m^3/day for buildout requirements
- Current water storage requirements.

- 5049 m^3 required to satisfy residential buildout requirements (based on FUS)
- 5784 m^3 required to satisfy residential and ICI buildout requirements (based on FUS)

Wastewater

- Residential flows, without ICI development, would exceed 75% of the rated plant capacity by 2024.
  - Ex. rated capacity would be exceeded by 2031/2032
  - With ICI included, existing rated capacity would be exceeded by 2025/2026
- Treatment capacity requirements
  - 2,300 m^3/d 2032 for average day flows
  - 7,900 m^3/d 2032 for peak day flows
  - 3,100 m^3/d 2042 for average day flows
  - 9,300 m^3/d 2042 for peak day flows
  - 3,900 m^3/d Buildout for average day flows
  - 10,440 m^3/d Buildout for peak day flows
  - 18,000 m^3/d Buildout for peak hourly flows

Phasing and implementation to be developed to satisfy water and wastewater servicing requirements. Certain elements may need to be sized for future servicing requirements (2042, buildout, etc.) due to phasing constraints. In addition, the phased approach requires that servicing is constructed in advance of the servicing requirements (i.e. services for 2032 requirements need to be operational prior to 2032).

It should be noted that for both projections, there is uncertainty regarding the nature and development timelines for the “employment areas”, which have a significant contribution to servicing requirements. In future, these values should be updated when the ICI developments are better defined.

The values and timelines in this technical memorandum will be carried forward for further review; however, the projections from The Watson and Associate Report and Secondary

Plan have identified growth rates which are well above historic values. Given the magnitude of growth projected it may be prudent to size servicing in a phased/staged manner to accommodate for lower than expected growth.

Respectfully submitted,

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Project Manager

6.0 REFERENCES

The Corporation of the County of Prince Edward, "Water and Wastewater Operations Data", 2019

Ainley and Associates Limited, "Prince Edward County - Official Plan, as amended", Belleville, Ontario, 2006

IBI Group, "Wellington Urban Centre Secondary Plan, as amended", Toronto, Ontario, 2013

R.V. Anderson, "Wellington Sanitary Sewer Capacity Analysis", Toronto. Ontario, 2018

MECP," Design Guidelines for Drinking-Water Systems", Toronto. Ontario, 2008

MECP," Design Guidelines for Sewage Works", Toronto. Ontario, 2008

MOE, "Design Guidelines for Sewage Works", Toronto, 1984

ICLR, "Project to Address Unacceptable Inflow and Infiltration (I/I) in New Subdivisions, Toronto, Ontario, 2017.

National Guide to Sustainable Municipal Infrastructure Infiltration/Inflow, “Control/Reduction for Wastewater Collection Systems”, Ottawa, Ontario, 2003

Watson and Associates,” Long Term Population, Housing and Employment Forecast and Capital Needs Assessment”, Mississauga. Ontario, 2013

Watson and Associates,” Water and Wastewater Rate and Study and Connection Charges Update”, Mississauga. Ontario, 2015