Stantec

Memo

To:	Guy Bourgon, P. Eng Town of Carleton Place	From:	Pierre Wilder, P. Eng; Kevin Alemany, P. Eng, M.A.Sc;. Christene Razafimaharo, M. Sc., EIT Stantec Consulting, Ottawa
File:	Water & Wastewater Master Plan	Date:	July 12, 2021

Reference: Design Basis and Existing Conditions Review

Introduction

Stantec Consulting has been retained by the Town of Carleton Place (the Town) to undertake a Municipal Class Environmental Assessment (MCEA) and prepare a Master Plan for the expansion of the Town's Water Treatment Plant (WTP) and Wastewater Treatment Plant (WWTP) and the addition of a new water storage reservoir. The Master Planning assignment will evaluate the Town's water and wastewater infrastructure needs over 5-year, 10-year and 20-year horizons. In addition to the treatment facility expansions and the water reservoir, the assessment will investigate current and future needs of the potable water distribution and wastewater collection systems.

The purpose of this technical memorandum is to confirm the design bases for the Master Plan for the Town's water and wastewater infrastructure. Recommended values to be used in this Water and Wastewater Master Plan (W&WWMP) are presented. Existing system potable water demand and wastewater generation rates are also calculated and compared to the recommended values and various design guidelines. This memo will be used to evaluate system requirements to meet the forecasted growth.

Background

Potable water is provided throughout the Town via a municipal water distribution system. Raw water is drawn from the Mississippi River, treated through a chemically assisted filtration process and discharged to a pipe network through high lift pumps situated at the WTP. Within the distribution network, an existing elevated storage tank situated south of the river assists in providing balancing, fire flow and emergency flows.

The existing WTP operates under the following permits and approvals:

- *Certificate of Approval (*CofA*)* No. 1150-69XLVM (April 1, 2005)
- Permit to Take Water No. 1310-9UHPPW (March 13, 2015)
- Drinking Water Works Permit (DWWP) No. 172-201
- Municipal Drinking Water Licence (MDWL) No. 172-101

As per these approvals, the WTP has a rated capacity of 12,000 m^3/day, including drinking water demand and process wastewater. The plant is capable of treating raw water at a rate of 8,400 m^3/d. An operational benchmark of 7,700 m^3/d monitored by Ontario Clean Water Agency (OCWA) for water use by-law considerations.

The Town's wastewater is conveyed to the WWTP via a separated gravity sewer network including eleven (11) pumping stations. The existing WWTP has a rated capacity of 7,900 m^3/d annual average flow and a peak design flow of 22,000 m^3/d. The plant is considered a conventional activated sludge plant with base flow treatment through complete works for flows up to 10,400 m^3/d and excess wet weather flows greater than this passing through physical/chemical clarifiers for enhanced primary treatment. The plant operates under *Carleton Place Water Pollution Control Pant* CofA No. *5001-7FZT4A* (MOE, October 3, 2008).

Growth Projections

Population growth projections over multiple planning horizons need to be developed as the basis of the Master Plan. This study addresses the following horizons:

- Baseline year 2021;
- Short term, or 5-year planning horizon, in the year 2026;
- Medium term, or 10-year planning horizon, in the year 2031; and,
- Long term, or 20-year planning horizon, in the year 2041;

The following reports were reviewed to inform the population growth projections used in this Master Plan:

- <u>2020 Development Charges Background Study</u> (Watson & Associates Economists Ltd, 2020). This report developed forecasts for population and housing units within the Town, for 4 different time horizons (early 2020, early 2030, mid 2038 and buildout); employment and non-residential gross floor area estimates were also forecasted. This information is used in the current Design

Basis Memo to project the Town's population to the years 2021, 2026, 2031 and 2041.

- Preliminary Findings on Residential Supply vs Demand and three Growth Scenarios for the Town of Carleton Place (J.L. Richards, March 2021) also published as a staff report to Council on the subject of Carleton Place Comprehensive Review (Town of Carleton Place / J.L. Richards, 2021). This report identified different growth scenarios, whereby growth was distributed differently within the Town's boundary; for each scenario, the total number of units that can be built in each area was calculated. This information is used in the current Design Basis Memo to predict ICI (industrial, commercial and institutional) growth and the geospatial distribution of new development for incorporation into the sanitary sewer and water distribution models.

The baseline (2021) population and number of units were determined based on the forecasts for 2020 taken from the *Development Charges By-law and Background Study (DC Study)* (Watson & Associates Economists Ltd, December 2020). The number of housing units was increased by +315 units, as provided in Figure 3-2 in the *DC Study*, and the number of institutional units by +34 units (based on the forecasted ratio of additional institutional units to additional housing units of 5.7% in 2038). The same population density as in 2020 was maintained to estimate the 2021 population.

The same approach was retained for the projections in the different planning horizons, using the number of housing units provided in Figure 3-2 of the DC Study (offset by one year, and maintaining +160 units/year past 2039), and the population densities specified in the study.

The baseline and future ICI areas were estimated by using an employment density of 50 jobs/ha, for an activity rate of 17% of the population (employed and working in the Town), as provided in the *Carleton Place* Comprehensive Review*, Council Report* (Town of Carleton Place / J.L. Richards, March 2021).

The resulting growth projections for the Town of Carleton Place are presented in **Table 1.** The detailed geospatial distribution and phasing of development are illustrated in **Appendix A** - **Figure A-1** (2026), **Figure A-2** (2031) and **Figure A-3** (2041) and proposed in **Appendix B - Table B-1** and **Table B-2**.

Table 1: Town of Carleton Place Growth Projections (2021-2041)

	Baseline (2021) (1)	2026	2031	2041
Additional Number of Units (2)	-	1,563	2,912	4,958
Total Number of Units	5,623	7,186	8,535	10,581
Population Density (persons per unit, PPU) (3)	2.448	2.448	2.313	2.262
Additional ICI Area (ha) (4)	-	7.2	13.7	22.4
Total ICI Area (ha)	35.0	42.2	48.7	57.4
Additional Population (5)	-	3,500	7,000	11,500
Total Population (6)	13,500	17,000	20,500	25,000

Notes:

(1) 2021 Baseline population and number of units based on 2020 DC Study population and number of units for 2020, increased using 315 additional housing units, 34 additional institutional units (see Note 2), and 2020 population density of 2.448 PPU. 2021 Baseline ICI area based on review of GIS data.

(2) Housing and institutional units combined. Additional number of housing units based on *Development Charges By-law and Background Study* (Watson & Associates Economists Ltd, December 2020) Figure 3-2. Ratio of institutional units / housing units = 245 / 4,330 = 5.7%, based on 2020 DC Study projections for 2038.

(3) Population density as specified in 2020 DC Study. Applicable to year specified, and all following years until next time horizon.

(4) ICI area development rate assumed similar to residential area development rate, see **Appendix B – Table B-1**.

(5) Additional population obtained by subtracting baseline (2021) population from total population; may not correspond to product of additional number of units and population density due to rounding.

(6) Total population rounded to nearest 500.

Potable Water Distribution

Existing System Demands

Table 2 summarizes the Town's recent historical average and maximum daily treated water volumes and associated estimated per capita consumption rates and maximum day peak factors. The average daily treated water volumes are taken as the average of the monthly average rated flows reported in the Drinking Water System Annual Reports for the 2017-2020 period. Similarly, the maximum daily treated water volumes are taken as the maximum of the monthly maximum rated flows. Per capita consumption rates were calculated using these treated flows and the estimated populations for years 2017 to 2020 based on growth projection assumptions noted in the **Growth Projections** section of this report.

Table 2: Historical System Water Demands

Parameter	Unit	2017	2018	2019	2020
Estimated Population (1)	persons	11,269	11,894	12,519	13,144
Average Daily Treated Drinking Water Flows	m^3/d	4,348	4,823	4,962	5,488
Maximum Daily Treated Drinking Water Flows	m^3/d	6,556	9,554	8,716	9,730
Average Day Demand (mixed use)	L/c/d	386	405	396	418
Maximum Day Demand (mixed use)	L/c/d	582	803	696	740
Maximum Day Factor (mixed use)	-	1.51	1.98	1.76	1.77

Notes:

(1) Estimated populations based on the 2016 Census population of 10,644 and assumed linear growth of 250 new building permits per year with a population density of 2.5 persons per unit (population density previously used by *Hydraulic Water Model Investigation Future Development* memo, (J.L. Richards, September 2013), *Town of Carleton Place 2021 WaterCAD Model Update* (J.L. Richards, March 2021), *Preliminary Findings on Residential Supply vs Demand and three (3) growth scenarios for the Town of Carleton Place* (J.L. Richards, March 2021), and corresponding to historical densities in the 2020 *DC Study* (Watson & Associates Economists Ltd, December 2020).

During the past four years, the day demand averages at about 401 L/c/d, with the highest consumption rate of 418 L/c/d observed in 2020. For the same four-year period, the average maximum day factor averages at 1.76, with the highest max day factor of 1.98 observed in 2018. A comparison of these values against various design criteria and values used in previous water distribution system analyses completed for the Town is discussed in the following section.

Distribution System Design Criteria

The Town of Carleton Place currently uses a combination of provincial and municipal guidelines, as well as historical data to assess and design water distribution system infrastructure to accommodate future development, both at the neighbourhood level (e.g., sizing of local watermains) and a system-wide level (e.g., transmission mains).

Table 3 summarizes the applicable potable water distribution design criteria specified across various guidelines and other sources and presents Stantec's recommended values to be used in the Water and Wastewater Master Plan (W&WWMP). Based on a comparison of these values, the following notes and recommendations were made for consideration for assessment of future growth:

- For future average day residential demand, it is recommended that a rate of 350 L/c/d be applied. This value has also been used to establish future water demands in previous hydraulic analyses completed for the Town and matches guidelines presented by the City of Ottawa and the Ontario Ministry of Environment, Conservation and Parks (MECP). This value is lower than the total water demand reported in recent WTP Annual Reports; however, this data includes industrial/commercial/institutional (ICI) water demands as well as system leaks, and therefore is expected to be higher than the actual average day residential consumption rate.
- For future average day light industrial and commercial/institutional demands, it is recommended that rates of 35,000 and 28,000 L/gross ha/d be applied, respectively. These rates are both consistent with values used to establish future water demands in previously completed hydraulic analyses and all applicable design guidelines.
- For peak factors, it is recommended to use 2.0 and 1.5 for future residential and ICI maximum day, respectively, and 3.0 and 2.7 for residential and ICI peak hour, respectively. These factors are consistent with values used in previously completed hydraulic analyses and are similar to those based on recent drinking water system Annual Reports and MECP guidelines.
- For fire demands, the Fire Underwriters Survey (FUS) method of calculating fire flows is appropriate for the sizing of local water distribution mains. Fire flows calculated using the FUS guidelines are specific to actual building developments and are considered appropriate when sizing local distribution watermains in new developments. The Ontario Fire Marshall (OFM) Guidelines for fire flow which form part of Part 3 of the Ontario Building Code (OBC) provides an additional guideline for fire flow and is designed to provide sufficient fire flow for evacuation of persons and is considered a "life protection" fire flow and not a property protection fire flow for which the FUS is designed. The maximum required fire flow specified by the OFM method is 150 L/s (9,000 L/min).

Reference: **Design Basis and Existing Conditions Review**

Table 3: Comparison of Potable Water Design Criteria & Level of Service Requirements

Design Parameter	Value					Recommended Value for W&WWMP
	Previous Potable Water Hydraulic Analyses [5]	Carleton Place WTP Annual Reports (2017 - 2020)	MECP Design Guidelines	Ottawa Water Design Guidelines & Tech Bulletins	2013 Ottawa Water Master Plan	
Average Day (AVDY)						
AVDY Demand, Residential (L/c/d)	350	386 - 418	270 - 450	350	350 [1]	350
AVDY Demand, Light Industrial (L/gross ha/d)	35,000		35,000	35,000	35,000 [1]	35,000
AVDY Demand, Commercial/Institutional (L/gross ha/d)	28,000		28,000	28,000	28,000 [1]	28,000
Maximum Day (MXDY)						
MXDY Factor, Residential [2]	2.0	1.5 - 2.0	1.8 [3]	2.5	2.5 [1]	2.0
MXDY Factor, ICI [2]	1.5			1.5	1.5 [1]	1.5
Peak Hour (PKHR)						
PKHR Factor, Residential	3.0	-	2.7 [3]	5.5 (2.2*MXDY)	5.5 [1] (2.2*MXDY)	3.0
PKHR Factor, ICI	2.7	-		2.7 (1.8*MXDY)	2.7 [1] (1.8*MXDY)	2.7
Fire Demand						
Fire Flow (L/s)	-	-	311 [3]	167 - 217 [4] or Per FUS [1]	Per FUS	Per FUS (for local watermain sizing)
Duration	-	-	4 [3]	Per FUS [1]	Per FUS	

Design Parameter	Value					Recommended Value for W&WWMP
	Previous Potable Water Hydraulic Analyses (5)	Carleton Place WTP Annual Reports (2017 - 2020)	MECP Design Guidelines	Ottawa Water Design Guidelines & Tech Bulletins	2013 Ottawa Water Master Plan	
System Pressures						
Minimum Pressure (psi)	40	-	40	40	40	40
Minimum Pressure, MXDY + Fire Flow (psi)	20	-	20	20	20	20
Maximum Pressure (psi)	80	-	100	80-100	80-100	80-100

Notes:

(1) Value for subdivision/site level.
(2) MXDY = Max Day Factor * AVDY.
(3) Based on MECP Guidelines, for an ultimate population of 25,000 people in 2041.
(4) For system-level consideration.
(5) Sources:
- Hydraulic Water Model Investigation Future Development memo (J.L. Richards, September 2013).
- Potable Water Storage Study (J.L. Richards, November 2018).
- Town of Carleton Place 2021 WaterCAD Model Update (J.L. Richards, March 2021).

Potable Water Treatment

Raw Water Quality

Ontario Clean Water Agency (OCWA) monitors raw water quality quarterly at the WTP. The primary water quality parameters of concern for water treatment are presented in **Table 4** with the range of observed values reported from 2017 to 2020 (OCWA 2017**;** OCWA 2018**;** OCWA 2019**;** OCWA 2020) and the recommended design value for this W&WWMP.

Table 4: Observed Raw Water Quality

Parameter	Unit	Range Observed 2017 – 2020	Associated Challenges	Recommended Design Value
E.Coli	cnt/100mL	0 – 20	Filtration, disinfection	20
Total Coli	cnt/100mL	0 – 124	Filtration, disinfection	150
Turbidity	NTU	0 – 20	Filtration, disinfection	20
Alkalinity	$mgCaCO_3/L$	70 – 112	Coagulation, water corrosiveness	70
Colour	TCU	2 – 39	THM formation	40
DOC	mg/L	5.5 - 8.2	THM formation	10
TOC	mg/L	5.5 - 8.3	THM formation	10
pH	pH unit	7.7 - 8.49	Coagulation, water corrosiveness	7.5

Water Treatment Design Criteria

The Carleton Place Water Treatment Plant and elevated water storage tank must conform to the requirements of O.Reg. 169/03 Ontario Drinking Water Quality Standards, January 1st, 2020 version (https://www.ontario.ca/laws/regulation/030169), for drinking water quality standards, and O.Reg, 170/03 Drinking Water Systems April 1st, 2020 version (https://www.ontario.ca/laws/regulation/030170), for water sampling program and disinfection requirement. These also must meet the requirements of Procedure for disinfection of drinking water in Ontario, updated on April 17th, 2021 (https://www.ontario.ca/page/procedure-disinfection-drinking-water-ontario).

Wastewater Collection

Existing Dry Weather Flows - Approximation

In the absence of detailed sanitary flow monitoring data, the dry weather flows in the existing collection system can be approximated by the treated potable water flows from the WTP. Table 5 summarizes the Town's recent historical average treated potable water volumes from the WTP Annual Reports, which can be correlated with dry weather wastewater flow (DWF) generation, and thus provide an estimate of per capita dry weather wastewater flow rates. This analysis does not take into consideration outdoor water demands, such as watering lawns, or losses in the distribution system due to watermain leaks and breaks.

For the year 2020, an adjusted population (and thus, an adjusted flow rate) was provided based on information from *Update to Wastewater Trunk Sanitary Sewer Model* memo, (J.L. Richards, March 2021) regarding population serviced by private wastewater systems (e.g., septic tanks), and therefore not connected to the Town's sanitary system. A total of 65 units were identified in J.L. Richards 2021 Update as having private wastewater systems, resulting in approximately 163 persons (65 units x 2.5 persons/unit), or ~1.2% of the Town's total 2020 population. This percentage of private systems can be considered negligible at this scale and is therefore not included in the following analyses.

Table 5: Approximation of Sanitary DWF from Historical Water Treatment Plant Flows

Parameter	Unit	2017	2018	2019	2020
Estimated Population (1)	persons	11,269	11,894	12,519	13,144
Average Daily Treated Potable Water Flows	m^3/d	4,348	4,823	4,962	5,488
Average DWF Rate – Based on Total Population	L/c/d	386	405	396	418 (2)
Harmon Peaking Factor (3)	-	2.90	2.88	2.86	2.84
Peak DWF Rate – Based on Total Population	L/c/d	1,119	1,166	1,133	1,187

Notes:

(1) Estimated populations based on the 2016 Census population of 10,644 and assumed linear growth of 250 new building permits per year with a population density of 2.5 persons per unit (population density previously used by *Trunk Sanitary Sewers – Hydraulic Capacity Investigation* memo (J.L. Richards, March 2014), *Update to Wastewater Trunk Sanitary Sewer Model* memo (J.L. Richards, March 2021), *Preliminary Findings on Residential Supply vs Demand and three (3) growth scenarios for the Town of Carleton Place* letter (J.L. Richards, March 2021), and corresponding to historical densities in the *Development Charges By-law and Background Study* (Watson & Associates Economists Ltd, December 2020).

- The average DWF rate for 2020 presented in *Update to Wastewater Trunk Sanitary Sewer Model* memo (J.L. Richards, March 2021).is 392 L/c/d, which differs from the values presented in this table due to the following:
    a. Different total populations in 2020 (13,153 inhabitants in *Update to Wastewater Trunk Sanitary Sewer Model* memo (JL. Richards, March 2021).
    b. The population in *Update to Wastewater Trunk Sanitary Sewer Model* memo (JL. Richards, March 2021) was adjusted by removing the number of inhabitants not connected to the system.
    c. The treated potable water flow in *Update to Wastewater Trunk Sanitary Sewer Model* memo (JL. Richards, March 2021) for 2020 was based on an average of the flows from 2018 to 2020.

(2) Harmon Peaking Factor calculated using a correction factor of K=1, as done in *Update to Wastewater Trunk Sanitary Sewer Model* memo (JL. Richards, March 2021).

Over the past 4 years, the average DWF rate is approximately 400 L/c/d with the highest per capita flow rate of 418 L/c/d in 2020. *Update to Wastewater Trunk Sanitary Sewer Model* memo (JL. Richards, March 2021) uses a per capita rate of 392 L/c/d in the existing conditions model, which aligns with the average DWF per capita rate calculated above. The 392 L/c/d rate will therefore continue to be used in this Master Plan for existing conditions analyses but should be validated through flow monitoring when available. The Harmon Peaking Factor for 2017-2020 varies from 2.84 to 2.90. The decreasing trend for Peaking

Factor is expected as variances in flow generation typically decrease with population increases.

Existing Extraneous Flows - Approximation

Extraneous flows, also referred to as inflow and infiltration (I/I), consists of groundwater infiltration (GWI) into sewers through cracks and stormwater flows into the system from surface during wet weather events. The Town has indicated that illegal sump pump connections could also contribute to extraneous flows. These flows are typically quantified using flow monitoring data, however in the absence of recent flow monitoring data, the existing I/I rates can be evaluated using WWTP data.

Table 6 presents the Town's historical average and maximum raw sewage influent, measured at the WWTP. The average and maximum daily sewage influents are reported in the Annual Reports and in the Facility Optimization Report for each year in the 2017-2020 period. Average and peak dry weather flows were obtained from the **Table 5** (approximated based on WTP flows). A tributary area of 578 ha was specified in *Update to Wastewater Trunk Sanitary Sewer Model* memo (JL. Richards, March 2021) for the year 2020. Using the tributary area of 486 ha for the year 2013 (as specified in *Trunk Sanitary Sewers – Hydraulic Capacity Investigation* (J.L. Richards, March 2014), the tributary areas for the years 2017 to 2019 were interpolated.

Table 6: Historical Extraneous Flows

Parameter	Unit	2017	2018	2019	2020
Total Tributary Area (1)	ha	539	552	565	578
WWTP Average Influent (2)	m^3/d	7,340	6,165	6,119	6,132
WWTP Average DWF Generation (3)	m^3/d	4,348	4,823	4,962	5,488
Average I/I (GWI) (4)	m^3/d	2,992	1,342	1,157	644
Equivalent Average I/I (GWI) Rate (5)	L/s/ha	0.06	0.03	0.02	0.01
WWTP Peak Influent (6)	m^3/d	29,690	15,272	31,856	22,111
WWTP Peak DWF (7)	m^3/d	12,610	13,868	14,184	15,602
Peak Total I/I (8)	m^3/d	25,342	10,449	26,894	16,623
Equivalent Peak I/I Rate (9)	L/s/ha	0.54	0.22	0.55	0.33

Notes:

(1) Tributary area for 2020 specified in *Update to Sanitary Wastewater Trunk Sewer Model* memo (J.L. Richards, March 2021,); tributary area for 2013 specified in *Trunk Sanitary Sewers – Hydraulic Capacity Investigation* (J.L. Richards, March 2014). Tributary areas for 2017-2019 obtained from linear interpolation by year.

(2) Average influent values provided in the *Carleton Place Drinking Water System* Annual Reports and the Facility Optimization Report *for the Carleton Place Water Pollution Control Plant* (OCWA 2020).

(3) Taken from **Table 5**: Average Daily Treated Potable Water Flows.

(4) WWTP Average Influent – WWTP Average DWF; An estimation of Groundwater Infiltration (GWI).

(5) Average I/I (GWI) / Total Tributary Area

(6) Maximum influent values provided in the *Carleton Place Drinking Water System* Annual Reports (OCWA 2017; OCWA 2018; OCWA 2019; OCWA 2020) and the Facility Optimization Report *for the Carleton Place Water Pollution Control Plant* (OCWA 2020).

(7) Calculated using the rates in **Table 5**: Total population x Peak DWF Rate; Based on total population.

(8) WWTP Peak Influent – WWTP Average DWF

(9) Peak Total I/I / Total Tributary Area.

Based on the 2017 to 2020 WWTP influent data, the average groundwater infiltration (GWI) flow rates for the Town vary between 0.01 L/s/ha and 0.06 L/s/ha, and the peak extraneous flow rates vary between 0.22 L/s/ha and 0.55 L/s/ha. Based on a previous flow monitoring program in 2013, *Trunk Sanitary Sewers – Hydraulic Capacity Investigation* (J.L. Richards, March 2014), average rates of up to 0.19 L/s/ha in some areas of the Town were reported, with peak rates of up to 0.40 L/s/ha in other areas (Flow Monitor # 6 on High St at Thomas St, comprising the western ~80 ha of the Town, west of the river).

As previously noted, the dry weather and I/I flow rates presented in **Table 6** above are high level approximations based on flows measured at the treatment plants. Flow monitoring programs provide more detailed insights into the collection system's workings on a more localized scale. Further flow monitoring programs can improve the understanding of the Town's collection system under varying precipitation events and provide more up-to-date indications of higher I/I areas within the Town, as well as areas with greater residual capacity that can service additional growth.

Wastewater Collection Design Criteria

The sanitary flow generation rates summarized in **Table 7** are recommended for use in this W&WWMP. In general, existing residential and ICI sanitary dry weather flows will be based on the rates used in previous modelling studies (392 L/c/d). Previously used rates aligned closely with the 2012 City of Ottawa Sewer Design Guidelines, which have been used by Stantec in studies for nearby municipalities of similar size to the Town of Carleton Place. Recent updates have been made in the 2018 City of Ottawa Technical Bulletin ISTB-2018-01 that account for the transition seen to higher I/I contributions and lower domestic per capita rates, and to conform to climate change consideration requirements. This includes stress-testing the system and assessing the resulting hydraulic gradelines (HGLs) in an “annual” and “rare” event with failed or as-designed pumping station operations (respectively), in addition to assessing capacity during the design event. The annual event represents the highest I/I within a typical year during which critical pump station(s) have failed, and the rare event represents conditions of high extraneous flows with pump stations operating as designed (assumed equivalent to the 1:100-yr I/I).

With the absence of up-to-date flow monitoring data, it is recommended that these Technical Bulletin updates be incorporated in the Town's model while maintaining the model's current residential and ICI distributions, equivalent population calculations, and DWF per capita rate for existing conditions, which can be validated with further flow monitoring programs in the future. In the current model, ICI flows are calculated in the same manner as residential flows, both based on the number of units and average population density of 2.5 persons/unit. It is proposed that parameters for growth be based on the City of Ottawa's guidelines, including the separation between residential and ICI flow generation. The lower residential per capita rates as defined in the guidelines will be applied to account for this. The system will be assessed based on the City of Ottawa's design, annual and rare event I/I rates and Harmon's Correction Factors, as outlined in the 2018 Technical Bulletin and **Table 7** below.

Although there is limited information on the previous flow monitoring programs and observed rainfall events (completed in 2012-2013; 8+ years ago) and with the absence of more up-to-date data, the previously derived peak I/I rate for the area tributary to 2013's flow monitor (FM) #6 (0.40 L/s/ha, *Trunk Sanitary Sewers – Hydraulic Capacity Investigation* (J.L. Richards, March 2014), can be used in the annual event analysis for that area until more recent flow monitoring and rainfall data is obtained. This value falls within the range of peak I/I rates observed more recently at the WWTP (see **Table 6**); however, it should be noted that the WWTP values are representative of the entire Town and are not specific to any one area. The FM #6 sub-basin is comprised of ~80 ha of the western portion of the Town, west of Bridge Street and the river with sewers ranging in age from 30 to 50 years (77% of total sewer lengths in sewershed). Older, leakier sewers contribute to higher I/I rates, which can explain the rate obtained during the previous flow monitoring program for this sewershed.

In the rare event, a peak extraneous I/I rate of 3.0 L/s/ha will be applied for the FM #6 sub-basin only. This rate corresponds to the 2018 Technical Bulletin peak extraneous I/I rate for partially separated areas between 10 and 100 ha in size. Although the Town's sewer system consists of a separated network, the rates observed in the FM #6 sub-basin during the flow monitoring program in 2012-2013 were higher than typical design I/I rates for separated systems, hence the selection of a higher rate in the rare event as well.

Table 7: Recommended Sanitary Flow Generation Parameters

Design Parameter		Existing (2020) Conditions			Future Development (Growth)		
		Design (1)	**Annual**	**Rare**	**Design**	**Annual**	**Rare**
Residential	**Average Flow Rate**	392 L/c/d			280 L/c/d	200 L/c/d	200 L/c/d
	Peaking Factor	Harmon Peaking Factor with Correction Factor: 0.8	Harmon Peaking Factor with Correction Factor: 0.6	Harmon Peaking Factor with Correction Factor: 0.6	Harmon Peaking Factor with Correction Factor: 0.8	Harmon Peaking Factor with Correction Factor: 0.6	Harmon Peaking Factor with Correction Factor: 0.6
Extraneous Flows (2)	**Peak Rate**	0.33 L/s /effective gross ha	0.30 L/s /effective gross ha 0.40 L/s /effective gross area for FM#6 sub-basin, taken from J.L. Richards (2014) (3)	0.55 L/s /effective gross ha 3.0 L/s/ha for FM#6 sub-basin (higher rate from 2018 Technical Bulletin)	0.33 L/s /effective gross ha	0.30 L/s /effective gross ha 0.40 L/s /effective gross area for FM#6 sub-basin, taken from J.L. Richards (2014) (3)	0.55 L/s /effective gross ha 3.0 L/s/ha for FM#6 sub-basin (higher rate from 2018 Technical Bulletin)
Institutional/ Commercial	**Average Flow Rate**	-	-	-	28,000 L/gross ha/d	17,000 L/gross ha/d	17,000 L/gross ha/d
	Peaking Factor	-	-	-	ICI contribution > 20% : 1.5 ICI contribution ≤ 20% : 1.0	ICI contribution > 20% : 1.0 ICI contribution ≤ 20% : 1.0	ICI contribution > 20% : 1.0 ICI contribution ≤ 20% : 1.0

Design Parameter		Existing (2020) Conditions			Future Development (Growth)		
		Design (1)	Annual	Rare	Design	Annual	Rare
Light Industrial	**Average Flow Rate**	-	-	-	35,000 L/gross ha/d	10,000 L/gross ha/d	10,000 L/gross ha/d
	Peaking Factor	-	-	-	ICI contribution > 20% : 1.5 ICI contribution ≤ 20% : 1.0	ICI contribution > 20% : 1.0 ICI contribution ≤ 20% : 1.0	ICI contribution > 20% : 1.0 ICI contribution ≤ 20% : 1.0
(1)							

Notes:

(1) Corresponds to 2020 model of existing conditions done by *Update to Wastewater Trunk Sanitary Sewer Model* memo (J.L. Richards, March 2021).

(2) *Update to Wastewater Trunk Sanitary Sewer Model* memo (J.L. Richards, March 2021).

(3) Includes dry weather flow (GWI) & wet weather inflows

(4) Rate taken from *Trunk Sanitary Sewers – Hydraulic Capacity Investigation* memo (J.L. Richards, March 2014).

Wastewater Treatment

Existing Raw Sewage Flows, Concentrations and Loadings

The following Table 8 presents the annual average raw wastewater flows and concentrations for key parameters as reported in the WWTP Annual Reports from 2017 to 2020 (OCWA 2017; OCWA 2018; OCWA 2019; OCWA 2020):

Table 8: Wastewater Concentration & Per Capita Generation Rates

Year	Pop.	Avg. Flow	Per capita flow	Average WW concentrations (mg/L)				Per Capital Loads (g/cap/d)			
		(m^3/d)	(L/cap/d)	BOD5[1]	TSS	TP	TKN	BOD5[1]	TSS	TP	TKN
2017	11,269	7,340	651	147	168	3.9	30.3	96	109	2.5	19.7
2018	11,894	6,165	518	141	208	6.20	33.7	73	108	3.2	17.5
2019	12,519	6,119	489	-	250	5.1	37.2	-	122	2.5	18.2
2020	13,144	6,132	466	88	136	4.24	39.7	41	63	2.0	18.5
Avg.	12,207	6,439	527	125	191	5	35	70	101	2.6	18.5

Notes:

(1) BOD5 influent data not listed in *Carleton Place Water Pollution Control Plant Annual Report* (OCWA, 2019)

Per capita flow generation is higher than normal at >500 L/cap/d. Max day flows regularly occur in the 20,000 – 30,000 m^3/d range, translating into max day peaking factors of 3 to 4.9x annual average, which is also higher than expected. This is likely due to the high influence of groundwater infiltration, wet weather inflow and possible residential sump pump connections. It is reasonable to assume that current generation rates will remain similar for the existing collection system whereas for collection system expansions, the influence of (I/I) will be less and that a lower per capita generation rate can be applied.

The per capita contaminant loadings are also generally higher than MECP typical values. This may be due to a number of raw sewage factors including: 1) influence of biosolids recycle loads, 2) water treatment plant residuals loading, and 3) septage receiving loads. It is reasonable to assume the influence of these recycle streams will continue in future at similar flow pro-rated rates with the exception of septage receiving loads, as discussed below.

Reference: Design Basis and Existing Conditions Review

Water Plant Residuals

The waste residuals from the WTP are currently discharged to the sewer and received and treated at the WWTP. It is understood that a new forcemain between the two plants is partially constructed that may be used in the future to separate the residuals stream from the raw sewage for treatment. This option will be evaluated in the Master Plan and if preferred, the design basis loadings may need to be adjusted accordingly.

Carleton Place Drinking Water System Annual Reports for 2017-2020 were reviewed to estimate the septage receiving at the WWTP. The WWTP is currently permitted to receive a maximum of 4.5 m^3/d septage (or equivalent to 0.057% of the rated plant 7,900 m3/d capacity). It is understood that the facility no longer intends to receive septage or other hauled liquid wastes in the future. This waste stream is mixed into the raw sewage upstream of the plant influent flowmeter and raw sewage sampler, and thus these historical values have been impacted by septage receiving. This makes the design basis values presented herein somewhat conservative in that regard. If further accuracy in loading values is required later in this Master Plan study, this waste stream could be removed from the predicted raw sewage data.

Proposed Design Flows, Concentrations and Loadings

The design basis for wastewater flows is listed in **Table 9**. Note that the per capita flow generation rates listed below are different than those recommended in **Table 7** for the sanitary collection system analysis because the per capita flows below are those observed at the plant and include ICI contributions. These design values may be adjusted once sanitary modelling is further developed.

Table 9: Design Basis Flows

Year	Flow Design Assumptions			
	Per capita flow (1) (L/cap/d)	Max Month PF (2) (-)	Max Day PF (3) (-)	Peak Hr PF(4) (-)
2021	500	1.8	4.5	5.0
2026	480	1.7	4.3	4.8
2031	460	1.7	4.0	4.5
2041	425	1.6	3.5	4.0
MECP Typical Values	350 - 500		2.5 - 3.5	
OCWA FOP Report (OCWA 2020)	545		4.9	
2017 – 2020 Data Average	527	1.8	3 - 4.9	
(1)				

Notes:

(1) Includes inflow and infiltration. Existing per capita flow rates are varying 465-650 L/capita/d according to historical data; therefore 500 L/capita/d applied for year 2021. Future per capita flow generation rates will be affected by degree of water conservation measures applied and the ability of new sanitary collection system to reduce inflow/infiltration. Assuming that the population is doubled by 2041 with all new development at the lower MECP range of 350 L/capita/d, the average in 2041 would be approximately 425 L/cap/d. Values used in 2026 and 2031 are interpolated and rounded.

(2) Existing maximum month flow peaking factor has been estimated at 1.8x annual average flow; therefore 1.8x is applied for year 2021. Future maximum month peaking factor will be affected by the ability of new sanitary collection system to reduce wet season inflow/infiltration and is expected to be as low as 1.3x for new construction, and thus an average of 1.6 by 2041. Values used in 2026 and 2031 are interpolated and rounded.

(3) Existing maximum day flow peaking factor has been estimated at 3-4.9x annual average flow; therefore 4.5x applied for year 2021. Future maximum day peaking factor will be affected by the ability of new sanitary collection system to reduce inflow/infiltration and is expected to be as low as 2.6x for new construction, and thus an average of 3.5 by 2041. Values used in 2026 and 2031 are interpolated and rounded.

(4) Existing peak hour flow peaking factor is unknown but greater than max day peaking factor estimated at 3-4.9x annual average flow; therefore, 5x assumed and applied for year 2021. Future maximum day peaking factor will be affected by the ability of new sanitary collection system to reduce inflow/infiltration and is expected to be as low as 3x for new construction, and thus an average of 4.0 by 2041. Values used in 2026 and 2031 are interpolated and rounded.

The design basis for wastewater loadings is listed in **Table 10**.

Table 10: Design Basis Loadings

Year	Per Capita Loading Design Assumptions			
	BOD5 (1) (g/cap/d)	TSS (2) (g/cap/d)	TKN (3) (g/cap/d)	TP (4) (g/cap/d)
2021	70	105	18	2.6
2026	70	105	18	2.6
2031	70	105	18	2.6
2041	70	105	18	2.6
MECP Typical Values	35-65	35-75	6-17	1-2
OCWA FOP Report (OCWA 2020)	68	129	16.5	2.7
2017 – 2020 Data Average	70	101	18.5	2.6

Notes:

(1) Current BOD5 generation rates are higher range than typical MECP generation rates of 35-75 g/capita/d, possibly due to influence of biosolids decanting. Future per capita BOD5 loading generation rates may be affected by changes in cBOD5 mass loading from biosolids handling and septage receiving. It is assumed at this time that per capita loadings will continue at these current rates.

(2) Current TSS generation rates are higher range than typical MECP generation rates of 35-75 g/capita/d, likely due to influence of water treatment plant residuals. Future per capita TSS loading generation rates may be affected by changes in TSS mass loading from biosolids handling, septage receiving, and water treatment plant residuals loading. It is assumed at this time that per capita loadings will continue at these current rates.

(3) Current TKN generation rates are higher range than typical MECP generation rates of 35-75 g/capita/d, likely due to influence of biosolids decanting. Future per capita TKN loading generation rates may be affected by changes in TKN mass loading from biosolids handling, and septage receiving. It is assumed at this time that per capita loadings will continue at these current rates.

(4) Current TP generation rates are higher range than typical MECP generation rates of 1-2 g/capita/d. Future per capita TP loading generation rates may be affected by changes in TP mass loading from biosolids handling and septage receiving. It is assumed at this time that per capita loadings will continue at these current rates.

(5) The mass loading changes in recycle loads from biosolids handling and in degree of water conservation measures applied and the ability of new sanitary collection system to reduce inflow/infiltration.

(6) No wastewater temperature information was available to assess seasonal variation. A typical seasonal variation will been assumed for now until temperature data becomes available.

(7) No wastewater alkalinity information was available to assess seasonal variation. A typical seasonal variation will been assumed for now until alkalinity data becomes available.

Wastewater Effluent Criteria

The current non-compliance monthly effluent limits for the WWTP are shown in **Table 11**.

Table 11: WWTP Non-Compliance Monthly Effluent Limits

Effluent Parameter	Non-compliance Concentration Limits (mg/L unless otherwise stated)	Non-compliance Loading (kg/d unless otherwise stated)
cBOD5	25.0	550
Total Suspended Solids	25.0	550
Total Phosphorus	1.0	22.0
Total Ammonia Nitrogen	4.0 (May 15 to Sept. 30)	88.0 (May 15 to Sept 30)
pH of the effluent maintained between 6.0 to 9.5, inclusive, at all times		

In addition to these non-compliance limits, the minimum effluent standards need to meet federal WSER standards including: cBOD5/TSS = 25 mg/L, total residual chlorine = 0.02 mg/L, and passing acute lethality testing with respect to un-ionized ammonia.

Assimilation Capacity and Future Effluent Criteria

Stantec completed a desktop assimilative capacity assessment (ACS) as part of the 2011 Master Plan to expand the Town of Carleton Place WWTP to 10,000 m^3/d average flow [*Receiving Water Assessment Review for Carleton Place Water Pollution Control Plant Discharge to Mississippi River* (Stantec Consulting Ltd., May 2009)]. Key assumptions made in the analysis include:

- WWTP is expanded to 10,000 m^3/d average flow capacity.
- The 7Q20 flow of the Mississippi River is 4.07 m^3/s.
- The water quality data from the closest sampling site (Almonte) is a reasonable estimate of the river water quality conditions at Town of Carleton Place WWTP.

Mass balance calculations were performed to determine non-compliance limits needed to maintain provincial water quality objectives for three seasons: summer (June-August), autumn/winter (Sept-Mar), and spring (April-May). The assimilative capacity assessment derived effluent limits and proposed non-compliance limits are summarized in **Table 12.**

Assuming the allowable discharge loadings remain unchanged and acceptable to the MECP, then revised non-compliance limits will be based on maintaining the mass load to the river. At the time of writing, it is unknown what size of expansion is required at the

WWTP; this will be confirmed during the Phase 1 Report. To demonstrate the effect of flow on effluent limits (assuming the current loadings to the River must be maintained), example limits are shown in **Table 12** based on hypothetical plant expansions to 11,000 m^3/d, 12,000 m^3/d, or 13,000 m^3/d.

Table 12: Non-compliance Effluent Limits vs Future Treatment Capacity Increases

Parameter/Period	From Stantec ACS Study (10,000 m^3/d Capacity)		For Future Expansion (11,000 / 12,000 / 13,000 m^3/d Capacity)		
	Allowable Concentrations derived from ACS (mg/L)	Proposed Non-compliance Limits (mg/L)	Proposed Non-compliance Limits (mg/L)		
Plant Capacity	10,000 m^3/d	10,000 m^3/d	11,000 m^3/d	12,000 m^3/d	13,000 m^3/d
cBOD5 / year-round	25	25	22.7	20.8	19.2
TSS / year-round	Not modeled	25	22.7	20.8	19.2
TP / Sept1-May31	0.38	0.3	0.27	0.25	0.23
TP / June1-Aug31	0.38	0.2	0.18	0.17	0.15
Total Ammonia N (June1-Aug31)	3.63	3.63	3.30	3.03	2.79
Total Ammonia N (Sept1-Mar31)	25.3	15	13.64	12.50	11.54
Total Ammonia N (April1-May31)	16.2	15	13.64	12.50	11.54

Note that the effluent limits decrease with increasing effluent flow and that a treatment expansion to approximately 13,000 m^3/d will yield summer TP = 0.15 mg/L for non-compliance; meaning the filters will need to operate consistently near 0.1 mg/L, or at the practical limit for standard filtration. Any lower limit will require enhance TP removal technology such as membranes.

Wet Weather (Secondary Bypass) Treatment Criteria

In addition, given the high wet weather flows experienced at the plant, continuing the current wet weather flow treatment strategy is recommended to maintain stable secondary and tertiary treatment operation and performance. It's uncertain how the MECP will amend the current ECA limits for wet weather operation but effluent objectives and mass loading targets that are eventually selected will need to reflect the practical treatment removals expected within the phys-chem primary clarifiers.

Conclusions and Next Steps

This memo presents the parameters that will be used as the basis for the Town of Carleton Place's water and wastewater Master Plan study.

Relevant background studies previously done for the Town of Carleton Place were gathered and reviewed. These documents indicate that the Town has been experiencing accelerated population growth, which has triggered the need for expansions in the water and wastewater systems.

Growth projections in residential population and institutional, commercial and industrial (ICI) areas were developed for the different planning horizons (2026, 2031 and 2041), based on a review of recent planning studies completed for the Town. The phasing and spatial distribution of developments were proposed and will be confirmed with the Town. These will form the basis for the water and wastewater flow projections throughout the collection and distribution networks.

The Town's existing linear and treatment infrastructure and relevant design parameters were analyzed. Applicable guidelines and studies were reviewed and compared, and design criteria and level of service requirements are recommended. These will be used to assess the water and wastewater infrastructure's performance, compliance to regulatory requirements and to identify constraints and develop solutions in subsequent steps.

The next steps of this study will consist of analyzing the different components of the Town's water and wastewater infrastructure system using the future growth projections and with considerations for climate change impacts, where applicable. Based on the design criteria and regulatory requirements outlined in this document, constraints and expansion requirements will be identified, and presented in the Environmental Assessment Phase 1 Report.

References

Development Planning Studies:

- *Development Charges By-law and Background Study* (Watson & Associates, December 2020).
- *Preliminary Findings on Residential Supply vs Demand and three (3) growth scenarios for the Town of Carleton Place* letter (J.L. Richards, March 2021).
- *Council Report for Comprehensive Review* (Town of Carleton Place / J.L. Richards, March 2021).

Water Treatment Plant:

- *Carleton Place Drinking Water System* (OCWA, 2017).
- *Carleton Place Drinking Water System* (OCWA, 2018).
- *Carleton Place Drinking Water System* (OCWA, 2019).
- *Carleton Place Drinking Water System* (OCWA, 2020).
- *Permit to Take Water No. 1310-9UHPPW* (MECC, March 13, 2015).
- *Drinking Water Works Permit Number 172-201, Issue Number 3* (MECP, February 26, 2021).
- *Drinking Water Works License Number 172-101, Issue Number 3* (MECP, February 26, 2021).

Wastewater Treatment Plant:

- *Carleton Place Drinking Water System* (OCWA, 2017).
- *Carleton Place Drinking Water System* (OCWA, 2018).
- *Carleton Place Drinking Water System* (OCWA, 2019).
- *Carleton Place Drinking Water System* (OCWA, 2020).
- *Receiving Water Assessment Review for Carleton Place Water Pollution Control Plant Discharge to Mississippi River* (Stantec Consulting Ltd., May 2009).
- *Water Pollution Control Plant Capacity Expansion Master Plan* (Stantec Consulting Ltd., August 2011).
- *Facility Optimization Report for the Carleton Place Water Pollution Control Plant* draft memo (OCWA, April 2020).

- *Carleton Place Water Pollution Control Pant Certificate of Approval Number 5001-7FZT4A*, (MOE, October 3, 2008.

Sanitary Sewer System:

- *Trunk Sanitary Sewers – Hydraulic Capacity Investigation* memo (J.L. Richards, March 2014).
- *Update to Wastewater Trunk Sanitary Sewer Model* memo (J.L. Richards, March 2021).

Water Distribution System:

- *Hydraulic Water Model Investigation Future Development* memo, (J.L. Richards, September 2013).
- *Potable Water Storage Study* (J.L. Richards, November 2018).
- *Town of Carleton Place 2021 WaterCAD Model Update* (J.L. Richards, March 2021).

Closure

We trust this information is satisfactory for your purposes. If you have any questions, please contact the undersigned.

Stantec Consulting Ltd.

Digitally signed by Pierre Wilder
Date: 2022.05.03 15:07:27
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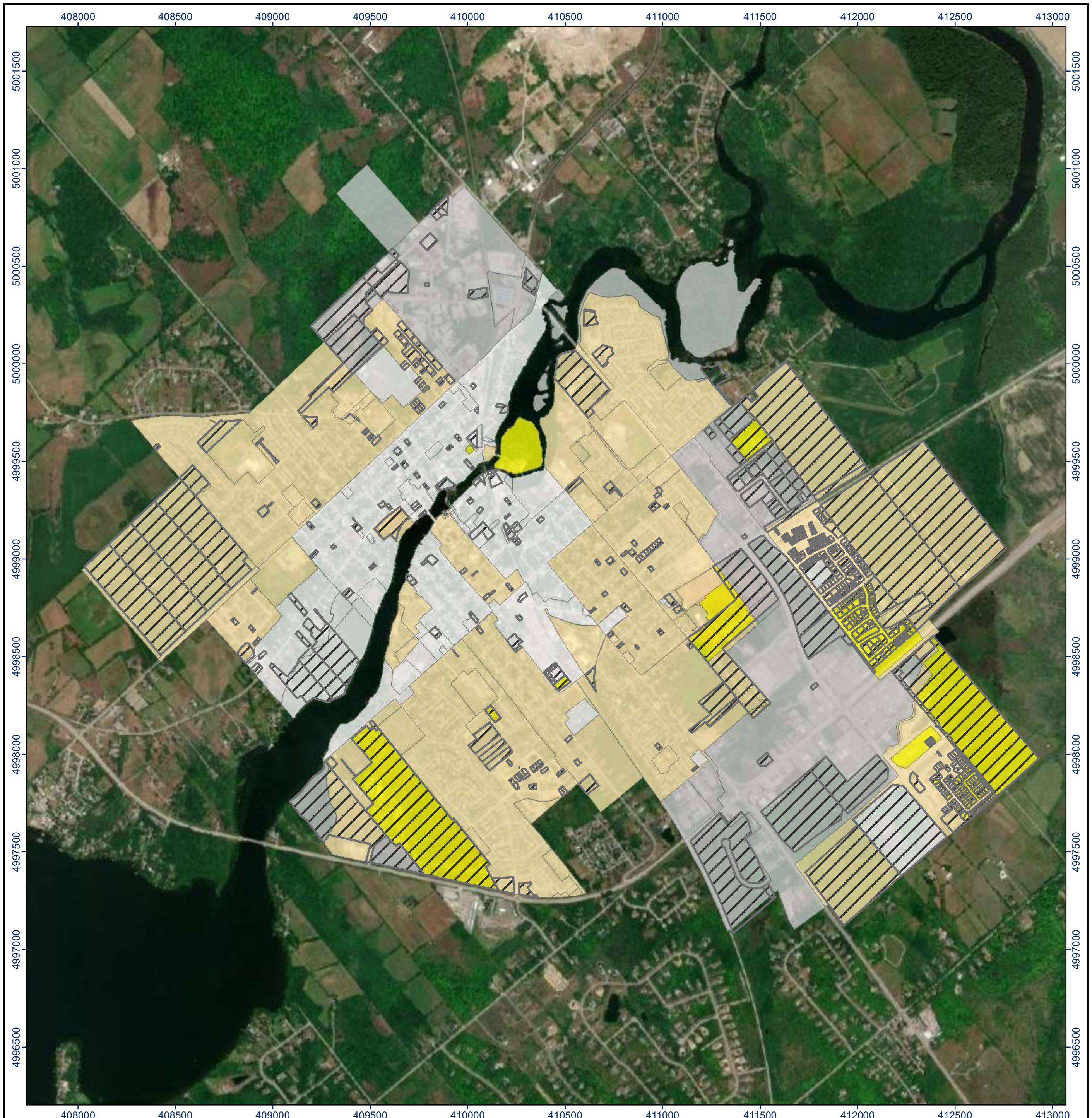
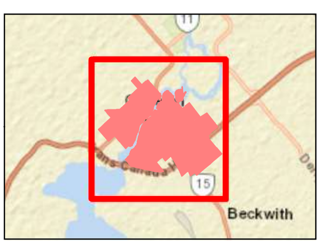
Attachments: Appendix A: Projected Growth Distribution Figures
Appendix B: Projected Development Phasing Tables
Appendix C: Wastewater Collection System Design Parameters and Level of Service Comparison

Appendix A Projected Growth Distribution Figures





Legend

- Vacant Land
- No Planned Development
- 0% Developed
- ≥ 25% Developed
- ≥ 50% Developed
- ≥ 80% Developed
- 100% Developed

0 380 760 metres

(At original document size of 8.5x11)
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N

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *parcelfabric.shp* provided by the Town of Carleton Place and *DP_landuse.shp* provided by J.L. Richards
3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Stantec

Carleton PLACE

Project Location

Carleton Place, ON

Client/Project Carleton Place W&WW Master Plan

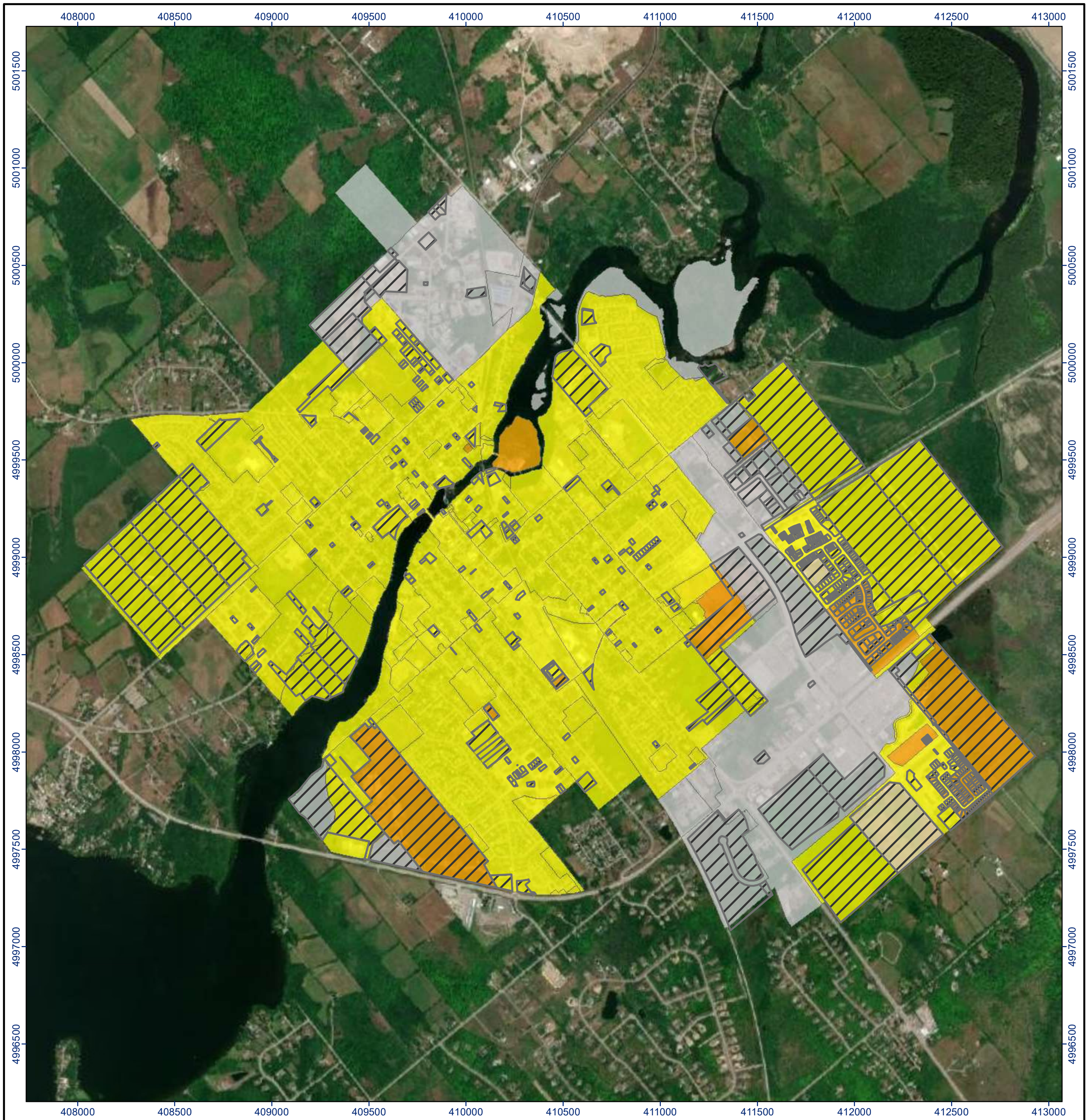
Town of Carleton Place
Carleton Place W&WW Master Plan
Design Basis Memo

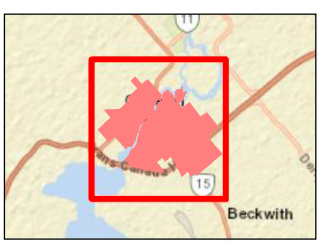
Figure No.

A-1

Title

Projected Land Development in Carleton Place (2026)





Legend

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0 380 760 metres

(At original document size of 8.5x11)
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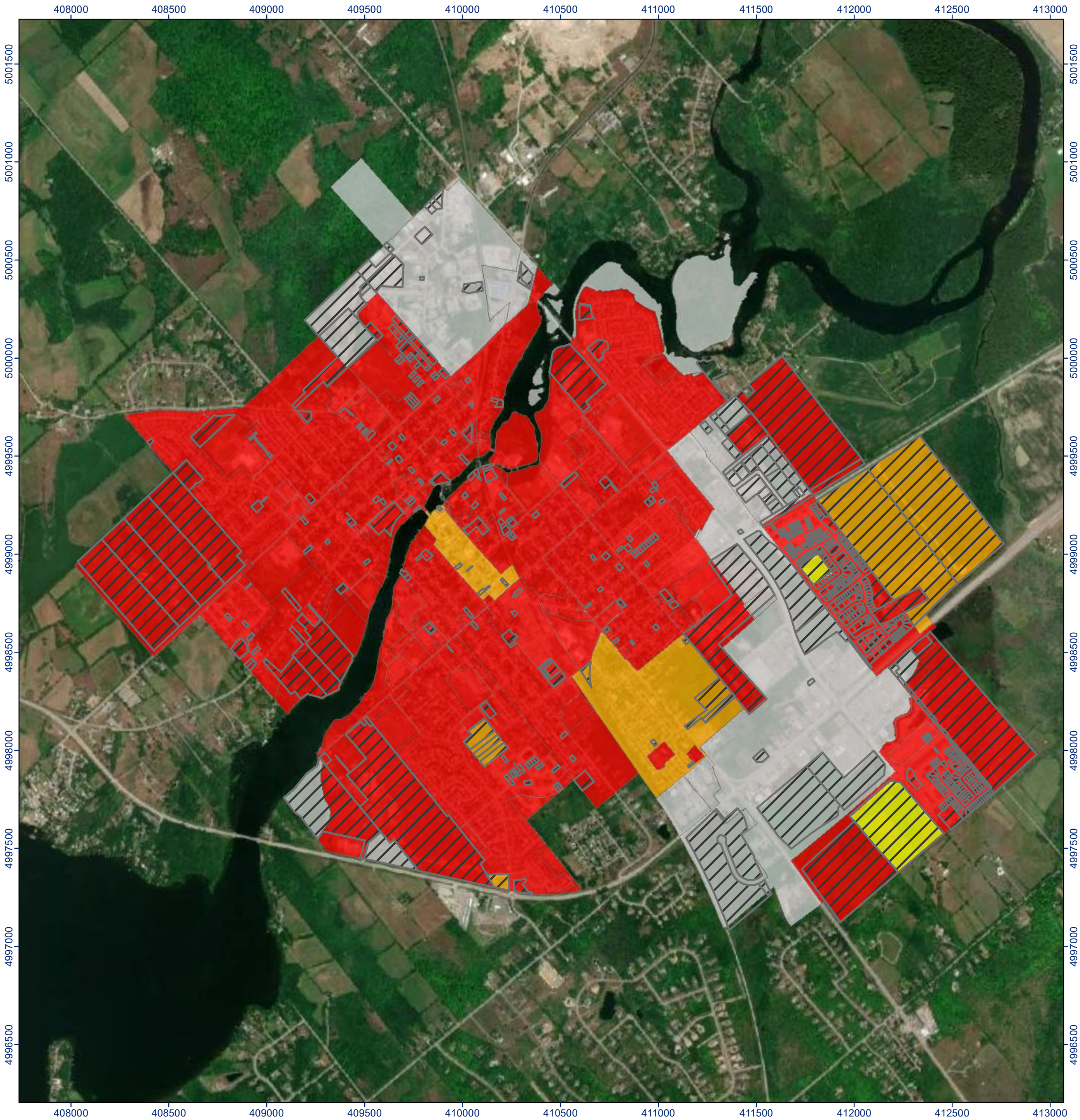
3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

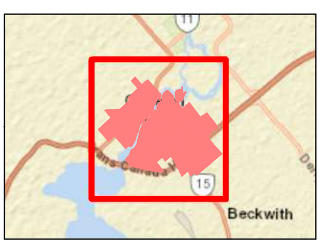
Project Location
Carleton Place, ON

Client/Project
Carleton Place W&WW Master Plan
Town of Carleton Place
Carleton Place W&WW Master Plan
Design Basis Memo

Figure No.
A-2

Title
Projected Land Development in Carleton Place (2031)





Legend

- Vacant Land
- No Planned Development
- 0% Developed
- ≥ 25% Developed
- ≥ 50% Developed
- ≥ 80% Developed
- 100% Developed

0 380 760
metres
(At original document size of 8.5x11)
1:30,000

N

Notes
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2. Data Sources: *parcelfabric.shp* provided by the Town of Carleton Place and *DP_landuse.shp* provided by J.L. Richards
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Project Location
Carleton Place, ON

Client/Project Carleton Place W&WW Master Plan
Town of Carleton Place
Carleton Place W&WW Master Plan
Design Basis Memo

Figure No.
A-3

Title
Projected Land Development in Carleton Place (2041)

Appendix B Projected Development Phasing Tables

163401646 - Town of Carleton Place W/WW Master Plan

Table B-1: Detailed Growth Forecast Phasing (as Percentage of Buildout) & Spatial Distribution (as Total upon Buildout)

Manual Input	
Calculated Value	

Average Population Density from 2021 to Buildout (0)	2.36	PPU
Population 15-64 years old (1)	60%	
Activity Rate (2)	17%	
Employment Density (9)	50	jobs/ha

JLR (2021) Growth Scenario 3 Developments + Active Development Applications		Adjusted Unit Count (3)		Land Use (Buildout)				% Developed - Residential (4)				% Developed - Commercial (4)				% Developed - Light Industrial (4)			
		Unit Count	New Density	Residential	Residential Area	Institutional/Commercial Area (5)	Light Industrial Area (5)	5-year Horizon 2026	10-year Horizon 2031	20-year Horizon 2041	Buildout (6)	5-year Horizon 2026	10-year Horizon 2031	20-year Horizon 2041	Buildout (6)	5-year Horizon 2026	10-year Horizon 2031	20-year Horizon 2041	Buildout (6)
Area	Sub-Neighbourhood	(-)	Units/ha	Population	ha	ha	ha	%	%	%	%	%	%	%	%	%	%	%	%
Strategic Properties	Strategic Property-25	103	35.0	244	2.94	0.25	0.25	25	50	100	100	25	50	100	100	25	50	100	100
Strategic Properties	Strategic Property-26 (7)	94	35.3	222	2.66	0.00	0.00	25	50	100	100	0	0	0	0	0	0	0	0
Strategic Properties	Strategic Property-27	52	35.4	123	1.47	0.13	0.13	25	50	100	100	25	50	100	100	25	50	100	100
Strategic Properties	Strategic Property-29	15	35.7	36	0.42	0.04	0.04	25	50	100	100	25	50	100	100	25	50	100	100
Residential Districts - Infill	Mississippi Residential Sector-38 (8)	31	30.4	74	1.02	0.00	0.00	0	50	100	100	0	0	0	0	0	0	0	0
Residential Districts - Infill	Mississippi Residential Sector-39	19	30.6	45	0.62	0.00	0.00	0	50	100	100	0	0	0	0	0	0	0	0
Residential Districts - Infill	Mississippi Residential Sector-40	9	31.0	22	0.29	0.00	0.00	0	50	100	100	0	0	0	0	0	0	0	0
Residential Districts - Infill	Mississippi Residential Sector-44	11	30.6	26	0.36	0.00	0.00	0	50	100	100	0	0	0	0	0	0	0	0
Residential Districts - Infill	Mississippi Residential Sector-30	9	33.3	22	0.27	0.00	0.00	0	50	100	100	0	0	0	0	0	0	0	0
Residential Districts - Infill	Mississippi Residential Sector-31	5	55.6	12	0.09	0.00	0.00	0	50	100	100	0	0	0	0	0	0	0	0
Residential Districts - Infill	Residential District-35	164	30.0	388	5.46	0.40	0.40	25	50	100	100	25	50	100	100	25	50	100	100
Residential Districts - Infill	Residential District-36	116	30.1	274	3.86	0.28	0.28	25	50	100	100	25	50	100	100	25	50	100	100
Residential Districts - Infill	Residential District-41	41	30.1	97	1.36	0.10	0.10	25	50	100	100	25	50	100	100	25	50	100	100
Residential Districts - Infill	Residential District-42	60	30.3	142	1.98	0.14	0.14	25	50	100	100	25	50	100	100	25	50	100	100
Residential Districts - Infill	Residential District-43	278	30.0	657	9.26	0.67	0.67	25	50	100	100	25	50	100	100	25	50	100	100
Residential Districts - Infill	Residential District-45	17	31.5	41	0.54	0.04	0.04	25	50	100	100	25	50	100	100	25	50	100	100
Residential Districts - Infill	Residential District-46	153	30.1	362	5.09	0.37	0.37	25	50	100	100	25	50	100	100	25	50	100	100
Residential Districts - Infill	Residential District-47	12	30.8	29	0.39	0.03	0.03	25	50	100	100	25	50	100	100	25	50	100	100
Residential Districts - Infill	Downtown District-33	3	50.0	8	0.06	0.01	0.01	25	50	100	100	25	50	100	100	25	50	100	100
Residential Districts - Urban Greenfield	Urban Greenfield-20	168	26.1	397	6.44	0.40	0.40	0	25	75	100	0	25	75	100	0	25	75	100
Residential Districts - Urban Greenfield	Urban Greenfield-30	21	27.3	50	0.77	0.05	0.05	0	25	75	100	0	25	75	100	0	25	75	100
Residential Districts - Urban Greenfield	Urban Greenfield-40	31	26.7	74	1.16	0.08	0.08	25	50	90	100	25	50	90	100	25	50	90	100
Residential Districts - Urban Greenfield	Urban Greenfield-50	647	26.0	1,527	24.88	1.56	1.56	25	50	90	100	25	50	90	100	25	50	90	100
Residential Districts - Intensification Sites	Intensification-10	102	26.0	241	3.92	0.25	0.25	0	50	100	100	0	50	100	100	0	50	100	100
Residential Districts - Intensification Sites	Intensification-20	8	28.6	19	0.28	0.02	0.02	0	50	100	100	0	50	100	100	0	50	100	100
Residential Districts - Intensification Sites	Intensification-30	31	26.1	74	1.19	0.08	0.08	0	50	100	100	0	50	100	100	0	50	100	100
Residential Districts - Intensification Sites	Intensification-40	4	28.6	10	0.14	0.01	0.01	0	50	100	100	0	50	100	100	0	50	100	100
Settlement Boundary - Rural Greenfield	Rural Greenfield-10	429	19.6	1,013	21.84	1.03	1.03	0	0	90	100	0	25	90	100	0	25	90	100
Settlement Boundary - Rural Greenfield	Rural Greenfield-50	209	19.7	494	10.62	0.50	0.50	0	25	90	100	0	25	90	100	0	25	90	100
Additional Residential Units	5% of all units	143	-	338	0	0.00	0.00	25	50	100	100	25	50	100	100	25	50	100	100
Active Development Applications	Bodnar Lands	582	-	1,374	0	0.00	0.00	50	80	100	100	50	80	100	100	50	80	100	100
Active Development Applications	Carmichael Farm Phase 2	323	-	763	0	0.00	0.00	50	80	100	100	50	80	100	100	50	80	100	100
Active Development Applications	Carmichael Farm Phase 1	24	-	57	0	0.00	0.00	50	80	100	100	50	80	100	100	50	80	100	100
Active Development Applications	NuGlobe Developments (Nelson St E, Coleman/McNeely)	128	-	303	0	0.00	0.00	50	80	100	100	50	80	100	100	50	80	100	100
Active Development Applications	Strategic Property (McArthur Island)	595	-	1,405	0	0.00	0.00	50	80	100	100	50	80	100	100	50	80	100	100
Active Development Applications	LCHC - 7 Arthur St	20	-	48	0	0.00	0.00	50	80	100	100	50	80	100	100	50	80	100	100
Active Development Applications	119 Bell St	51	-	121	0	0.00	0.00	50	80	100	100	50	80	100	100	50	80	100	100
Active Development Applications	127 Boyd	32	-	76	0	0.00	0.00	50	80	100	100	50	80	100	100	50	80	100	100
Active Development Applications	Millers Crossing (remaining lots)	114	-	270	0	0.00	0.00	50	80	100	100	50	80	100	100	50	80	100	100
Active Development Applications	Highway 7 behind Canadian Tire	152	-	359	0	0.00	0.00	50	80	100	100	50	80	100	100	50	80	100	100
Active Development Applications	Stoneridge Manor Long-Term Care Home (29 Costello)	128	-	303	0	0.00	0.00	50	80	100	100	50	80	100	100	50	80	100	100

Subtotal Additional Growth Units		2,842		6,723	109	6	6												
Total (Growth + Additional 5%)		2,985		7,061	109	6	6												
Active Development Applications		2,149		5,079	-	5.18	5.18	Average % Developed											
Total Growth (Growth + Additional 5% + Active Development Applications)		5,134		12,140	109	12	12	23	55	98	100	23	47	81	83	23	47	81	83

Baseline (2021) (9)		5,623		13,244		17.5	17.5
Total upon Buildout (Baseline + Growth)		10,757		25,384		29.1	29.1
Total upon Buildout (Baseline + Growth) - Rounded				25,500			

Notes & Assumptions

(0) Average population density based on 2020 DC Study forecasted population densities.
(1) Assume similar age distribution as in 2020 in JLR's Comprehensive Review; proportion of population between 15-64 years of age constant
(2) Activity rate for 2020 from JLR's Comprehensive Review
(3) Adjusted unit count to match projected 20-year additional unit count (+4,958 units in 2041), based on 2020 DC Study additional housing units, while meeting density targets
(4) Assume that ICI develops at the same rate as the residential areas
(5) Assumed 50% of ICI development is institutional/commercial, and 50% is light industrial; ICI area based on activity rate of 17% and employment density of 50 jobs/ha
(6) Buildout provided for reference, but not part of scope
(7) DRS Strategic Property; Official Plan (2013) limits development/redevelopment to residential uses
(8) Official Plan (2013) Section 3.2.2: "[…] it is not the intention of this Plan to permit new local commercial uses in the Mississippi District Residential Policy Area"
(9) 2021 Baseline number of units & population based on Comprehensive Review by JLR (includes active development applications) for 2020 + follow similar approach to expand to 2021

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Table B-2: Detailed Growth Forecast Phasing & Spatial Distribution (as Total per Planning Horizon)

Manual Input
Calculated Value

JLR (2021) Growth Scenario 3 Developments + Active Development Applications		# of Units Developed - Residential				Population - Residential				Area Developed - Residential				Area Developed - Commercial				Area Developed - Light Industrial			
		5-year Horizon 2026	10-year Horizon 2031	20-year Horizon 2041	Buildout[5]	5-year Horizon 2026	10-year Horizon 2031	20-year Horizon 2041	Buildout[5]	5-year Horizon 2026	10-year Horizon 2031	20-year Horizon 2041	Buildout[5]	5-year Horizon 2026	10-year Horizon 2031	20-year Horizon 2041	Buildout[5]	5-year Horizon 2026	10-year Horizon 2031	20-year Horizon 2041	Buildout[5]
Area	**Sub-Neighbourhood**	(-)	(-)	(-)	(-)	ppl	ppl	ppl	ppl	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha
Strategic Properties	Strategic Property-25	26	52	103	103	61	122	244	244	0.74	1.47	2.94	2.94	0.06	0.12	0.25	0.25	0.06	0.12	0.25	0.25
Strategic Properties	Strategic Property-26[7]	24	47	94	94	56	111	222	222	0.67	1.33	2.66	2.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Strategic Properties	Strategic Property-27	13	26	52	52	31	62	123	123	0.37	0.74	1.47	1.47	0.03	0.06	0.13	0.13	0.03	0.06	0.13	0.13
Strategic Properties	Strategic Property-29	4	8	15	15	9	18	36	36	0.11	0.21	0.42	0.42	0.01	0.02	0.04	0.04	0.01	0.02	0.04	0.04
Residential Districts - Infill	Mississippi Residential Sector-38[8]	0	16	31	31	0	37	74	74	0.00	0.51	1.02	1.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential Districts - Infill	Mississippi Residential Sector-39	0	10	19	19	0	23	45	45	0.00	0.31	0.62	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential Districts - Infill	Mississippi Residential Sector-40	0	5	9	9	0	11	22	22	0.00	0.15	0.29	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential Districts - Infill	Mississippi Residential Sector-44	0	6	11	11	0	13	26	26	0.00	0.18	0.36	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential Districts - Infill	Mississippi Residential Sector-30	0	5	9	9	0	11	22	22	0.00	0.14	0.27	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential Districts - Infill	Mississippi Residential Sector-31	0	3	5	5	0	6	12	12	0.00	0.05	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential Districts - Infill	Residential District-35	41	82	164	164	97	194	388	388	1.37	2.73	5.46	5.46	0.10	0.20	0.40	0.40	0.10	0.20	0.40	0.40
Residential Districts - Infill	Residential District-36	29	58	116	116	69	137	274	274	0.97	1.93	3.86	3.86	0.07	0.14	0.28	0.28	0.07	0.14	0.28	0.28
Residential Districts - Infill	Residential District-41	11	21	41	41	25	49	97	97	0.34	0.68	1.36	1.36	0.02	0.05	0.10	0.10	0.02	0.05	0.10	0.10
Residential Districts - Infill	Residential District-42	15	30	60	60	36	71	142	142	0.50	0.99	1.98	1.98	0.04	0.07	0.14	0.14	0.04	0.07	0.14	0.14
Residential Districts - Infill	Residential District-43	70	139	278	278	165	329	657	657	2.32	4.63	9.26	9.26	0.17	0.34	0.67	0.67	0.17	0.34	0.67	0.67
Residential Districts - Infill	Residential District-45	5	9	17	17	11	21	41	41	0.14	0.27	0.54	0.54	0.01	0.02	0.04	0.04	0.01	0.02	0.04	0.04
Residential Districts - Infill	Residential District-46	39	77	153	153	91	181	362	362	1.27	2.55	5.09	5.09	0.09	0.18	0.37	0.37	0.09	0.18	0.37	0.37
Residential Districts - Infill	Residential District-47	3	6	12	12	8	15	29	29	0.10	0.20	0.39	0.39	0.01	0.01	0.03	0.03	0.01	0.01	0.03	0.03
Residential Districts - Infill	Downtown District-33	1	2	3	3	2	4	8	8	0.02	0.03	0.06	0.06	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
Residential Districts - Urban Greenfield	Urban Greenfield-20	0	42	126	168	0	100	298	397	0.00	1.61	4.83	6.44	0.00	0.10	0.30	0.40	0.00	0.10	0.30	0.40
Residential Districts - Urban Greenfield	Urban Greenfield-30	0	6	16	21	0	13	38	50	0.00	0.19	0.58	0.77	0.00	0.01	0.04	0.05	0.00	0.01	0.04	0.05
Residential Districts - Urban Greenfield	Urban Greenfield-40	8	16	28	31	19	37	67	74	0.29	0.58	1.04	1.16	0.02	0.04	0.07	0.08	0.02	0.04	0.07	0.08
Residential Districts - Urban Greenfield	Urban Greenfield-50	162	324	583	647	382	764	1375	1527	6.22	12.44	22.39	24.88	0.39	0.78	1.40	1.56	0.39	0.78	1.40	1.56
Residential Districts - Intensification Sites	Intensification-10	0	51	102	102	0	121	241	241	0.00	1.96	3.92	3.92	0.00	0.12	0.25	0.25	0.00	0.12	0.25	0.25
Residential Districts - Intensification Sites	Intensification-20	0	4	8	8	0	10	19	19	0.00	0.14	0.28	0.28	0.00	0.01	0.02	0.02	0.00	0.01	0.02	0.02
Residential Districts - Intensification Sites	Intensification-30	0	16	31	31	0	37	74	74	0.00	0.60	1.19	1.19	0.00	0.04	0.08	0.08	0.00	0.04	0.08	0.08
Residential Districts - Intensification Sites	Intensification-40	0	2	4	4	0	5	10	10	0.00	0.07	0.14	0.14	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Settlement Boundary - Rural Greenfield	Rural Greenfield-10	0	0	387	429	0	0	912	1013	0.00	0.00	19.66	21.84	0.00	0.26	0.93	1.03	0.00	0.26	0.93	1.03
Settlement Boundary - Rural Greenfield	Rural Greenfield-50	0	53	189	209	0	124	445	494	0.00	2.66	9.56	10.62	0.00	0.13	0.45	0.50	0.00	0.13	0.45	0.50
Additional Residential Units	5% of all units	36	72	143	143	85	169	338	338	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Active Development Applications	Bodnar Lands	291	466	582	582	687	1100	1374	1374	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Active Development Applications	Carmichael Farm Phase 2	162	259	323	323	382	611	763	763	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Active Development Applications	Carmichael Farm Phase 1	12	20	24	24	29	46	57	57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Active Development Applications	NuGlobe Developments (Nelson St E, Coleman/McNeely)	64	103	128	128	152	243	303	303	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Active Development Applications	Strategic Property (McArthur Island)	298	476	595	595	703	1124	1405	1405	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Active Development Applications	LCHC - 7 Arthur St	10	16	20	20	24	39	48	48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Active Development Applications	119 Bell St	26	41	51	51	61	97	121	121	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Active Development Applications	127 Boyd	16	26	32	32	38	61	76	76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Active Development Applications	Millers Crossing (remaining lots)	57	92	114	114	135	216	270	270	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Active Development Applications	Highway 7 behind Canadian Tire	76	122	152	152	180	288	359	359	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Active Development Applications	Stoneridge Manor Long-Term Care Home (29 Costello)	64	103	128	128	152	243	303	303	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Growth (Growth + Additional 5% + Active Development Applications)		1,563	2,912	4,958	5,134	3,690	6,863	11,720	12,140	15	39	102	109	1.02	2.71	5.99	6.43	1.02	2.71	5.99	6.43
Baseline (2021)[9]		5,623	5,623	5,623	5,623	13,244	13,244	13,244	13,244					17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5
Total upon Buildout (Baseline + Growth)		7,186	8,535	10,581	10,757	16,934	20,107	24,964	25,384					21.1	24.4	28.7	29.1	21.1	24.4	28.7	29.1
Total upon Buildout (Baseline + Growth) - Rounded																					

Notes & Assumptions

(0) Average population density based on 2020 DC Study forecasted population densities.
(1) Assume similar age distribution as in 2020 in JLR's Comprehensive Review; proportion of population between 15-64 years of age constant
(2) Activity rate for 2020 from JLR's Comprehensive Review
(3) Adjusted unit count to match projected 20-year additional unit count (+4,958 units in 2041), based on 2020 DC Study additional housing units, while meeting density targets
(4) Assume that ICI develops at the same rate as the residential areas
(5) Assumed 50% of ICI development is institutional/commercial, and 50% is light industrial; ICI area based on activity rate of 17% and employment density of 50 jobs/ha
(6) Buildout provided for reference, but not part of scope
(7) DRS Strategic Property; Official Plan (2013) limits development/redevelopment to residential uses
(8) Official Plan (2013) Section 3.2.2: "[…] it is not the intention of this Plan to permit new local commercial uses in the Mississippi District Residential Policy Area"
(9) 2021 Baseline number of units & population based on Comprehensive Review by JLR (includes active development applications) for 2020 + follow similar approach to expand to 2021

Appendix C Wastewater Collection System Design Parameters and Level of Service Comparison

Table C-1: Comparison of Sanitary Flow Generation and Level of Service Parameters

Design Parameter	Previous Modelling Studies [1]			Annual Performance Reports (2017 - 2020)	2019 MECP Guidelines	Ottawa Design Guidelines - Sewer		
	2014 Model (Existing)	2014 Model (Future)	2021 Model (Existing)			Design	Annual [1]	Rare [2]
Population Densities								
Single Family	2.5 persons/unit			2.5 persons/unit	-	3.4 persons/unit		
Semi-Detached					-	2.7 persons/unit		
Duplex					-	2.3 persons/unit		
Townhouse (Row)					-	2.7 persons/unit		
Apartments, Bachelor/1-Bedroom					-	1.4 persons/unit		
Apartments, 2-Bedroom					-	2.1 persons/unit		
Apartments, 3-Bedroom					-	3.1 persons/unit		
Average Apartment					-	1.8 persons/unit		
Average Residential Population per Area	-	20 units/ha	-	-	Min.:25 persons/gross ha	60 persons/gross ha		
Flow Generation								
Average DWF Rate, Residential	430 L/c/d	350 L/c/d	392 L/c/d	386 L/c/d – 423 L/c/d	225 to 450 L/c/d	280 L/c/d	200 L/c/d	
Peaking Factor, Residential	Harmon Peaking Factor (PF) with Correction Factor: 1			2.84 – 2.90	Harmon or Babbitt formula Minimum: 2	Harmon PF with Correction Factor: 0.8	Harmon PF with Correction Factor: 0.6	Harmon PF with Correction Factor: 0.6
Groundwater Infiltration (Dry Weather Extraneous Flows)	0.10 L/s/ha	-	0.10 L/s/ha	0.01 L/s/ha – 0.06 L/s/ha	-	I/I Dry: 0.05 L/s/eff. gross ha I/I Wet: 0.28 L/s/eff. gross ha Total I/I: 0.33 L/s/eff. gross ha	Separated sewers: I/I Dry: 0.02 L/s/eff. gross ha I/I Wet: 0.28 L/s/eff. gross ha Total I/I 0.3 L/s/eff. gross ha Partially separated sewers [3]: Total I/I: to be determined at design	Separated sewers: I/I Dry: 0.02 L/s/eff. gross ha I/I Wet: 0.53 L/s/eff. gross ha Total I/I 0.55 L/s/eff. gross ha Partially separated sewers [3]: Total I/I: 3.0 L/s/gross ha
Peak Rate, Extraneous Flows	0.28 L/s/ha 0.40 L/s/ha for drainage areas tributary to flow monitor (FM) #6 located on High St at Thomas St, representing the western portion of the Town			0.22 L/s/ha – 0.55 L/s/ha	Peak extraneous flows from applicable references			
Average DWF Rate, Commercial	-	28,000 L/ha/d	-	-	28 m^3/ha/d [4]	28,000 L/gross ha/d	17,000 L/gross ha/d	
Peaking Factor, Commercial	-	2.7	-	-	Similar to relative peak water usage rates	ICI contribution > 20% : 1.5 ICI contribution ≤ 20% : 1.0	ICI contribution > 20% : 1.0 ICI contribution ≤ 20% : 1.0	
Average DWF Rate, Institutional	-	-	-	-	28 m^3/ha/d [4]	28,000 L/gross ha/d	17,000 L/gross ha/d	

Design Parameter	Previous Modelling Studies [1]			Annual Performance Reports (2017 - 2020)	2019 MECP Guidelines	Ottawa Design Guidelines - Sewer		
	2014 Model (Existing)	2014 Model (Future)	2021 Model (Existing)			Design	Annual [1]	Rare [2]
Peaking Factor, Institutional	-	-	-	-	Similar to relative peak water usage rates	ICI contribution > 20% : 1.5 ICI contribution ≤ 20% : 1.0	ICI contribution > 20% : 1.0 ICI contribution ≤ 20% : 1.0	
Average DWF Rate, Light Industrial	-	35,000 L/gross ha/d	-	-	Industry/process-specific rates. Based on monitoring.	35,000 L/gross ha/d	10,000 L/gross ha/d	
Peaking Factor, Light Industrial	-	2.7	-	-		ICI contribution > 20% : 1.5 ICI contribution ≤ 20% : 1.0	ICI contribution > 20% : 1.0 ICI contribution ≤ 20% : 1.0	
Level of Service								
Sewer Capacity	Identified trunk sewers at 90% theoretical conveyance capacity		-	-	Flows from residential, commercial, institutional and industrial establishments, plus extraneous flow (groundwater, surface runoff) Peak sewage flow rates for present and future conditions Design for ultimate tributary population, and for maximum anticipated capacity of institutions, industrial parks and other sewage sources	In existing separated areas: • Peak sewage flow from the ultimate development level expected from the tributary area • Clean sewers not surcharged under peak flow conditions In greenfield areas: • Peak sewage flow from the ultimate development Level expected form the tributary area		
Hydraulic Grade Line	-	-	-	-	-	**-**	HGL must be at least 0.3 m below the underside of footing	HGL must not touch the underside of footing

Notes:

(1) Previous modelling studies: JLR (2014) and JLR (2021)

(2) Annual: Assessment of HGL in the sanitary system, assuming pumping station failure

(3) Rare: Assessment of HGL in the sanitary system, under normal pumping station conditions (station operating at its rated capacity)

(4) Rates for a neighbourhood-level analysis

(5) Minimum for commercial tourist areas; should be based on historical records, if available. Also refer to rates in MECP (2019) Table 5-3.