REPORT

Havelock WWTP Assimilative Capacity Study

Schedule C Class Environmental Assessment, Havelock Wastewater Treatment Plan, Havelock, Ontario

Submitted to:

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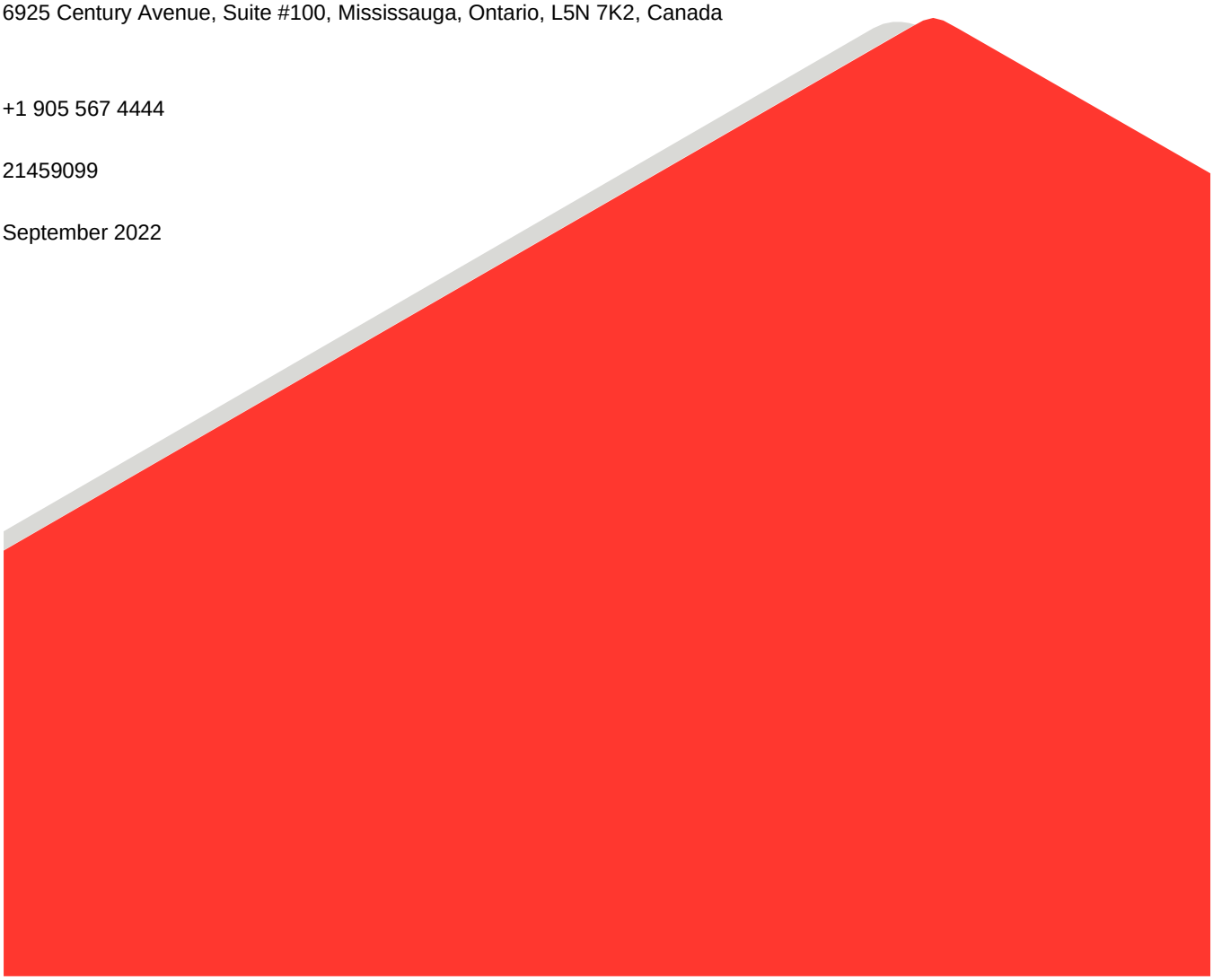

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder), a member of WSP, was retained by CIMA+ carry out an assimilative capacity study of Plato Creek for the proposed expansion of the Havelock Wastewater Treatment Plant (WWTP) servicing the Township of Havelock-Belmont-Methuen (Township). This assimilative capacity study forms one sub-component of a Planning and Environmental Assessment (EA) Study currently being carried out by CIMA+ for the proposed WWTP expansion in accordance with the Ontario Environmental Assessment Act. This EA is intended to develop a master plan for a long-term solution for wastewater treatment.

2.0 BACKGROUND

The Havelock WWTP is located at 719 Old Norwood Road, in the Village of Havelock, Ontario (Figure 1). The WWTP currently has a rated capacity of 1,200 m^3/day with a peak flow capacity of 3,000 m^3/day. Treated water is discharged via a 1.2 km-long pipeline to Plato Creek according to the requirements of Amended Certificate of Approval (CofA) number 7399-7YTUGW, issued on December 22, 2009. The existing WWTP replaced a lagoon treatment system in 2009.

Effluent objectives/limits for the existing WWTP are presented in Table 1 below.

Table 1: Existing WWTP Discharge Objectives/Limits per Amended CofA 7399-7YTUGW

Effluent Parameter	Concentration Objective	Concentration Limit
CBOD5	6.6 mg/L	10 mg/L
Total Suspended Solids	6.6 mg/L	10 mg/L
Total Phosphorus	0.1 mg/L (Jul – Oct) 0.2 mg/L (Nov – Apr)	0.14 mg/L (Jul – Oct) 0.3 mg/L (Nov – Jun)
Total Ammonia as N1	2.0 mg/L (May – Oct) 3.3 mg/L (Nov – Apr)	3 mg/L (May – Oct) 5 mg/L (Nov – Apr)
Acute Lethality to Rainbow Trout and Daphnia magna	n/a	Non-acutely lethal
E.Coli	133 counts / 100ml	200 counts / 100ml
pH	n/a	6.0 – 9.5

By considering the 2021 Design Basis and Problem/Opportunity statement prepared by CIMA+, (CIMA+ 2021) and the anticipated population growth documented in the Ontario Clean Water Agency (OCWA) Request for Services for Schedule C Class Environmental Assessment for the Havelock Wastewater Treatment Plant (OCWA 2021), the average daily flows to the plant are expected to exceed the plant capacity by 75% in the next two to three years as a result of all proposed development in the Havelock South Development Area.

In order to accommodate future population growth, the Township has decided to complete a Schedule C Municipal Class EA to expand WWTP capacity. Working with the Township and the OCWA, CIMA+ has prepared two potential future discharge scenarios for the WWTP that are being considered as part of the EA, namely:

- A rated capacity of 1,335 m^3/day to accommodate a planned population of 1,991 people (i.e., current population of 1,350 plus an estimated increase of 641 in the next 2 to 3 years)
- A rated capacity of 1,580 m^3/day to accommodate a future projected population of 2,400 people in 2041

The evaluation of the assimilative capacity of Plato Creek is considered key to establishing WWTP effluent objectives/limits as part of the EA process.

3.0 OBJECTIVES

The purpose of this report is to document the methodology, assumptions, and results of an assimilative capacity study carried out on the receiving reach of Plato Creek to estimate the assimilative capacity available to accommodate the increased effluent discharges associated with the proposed WWTP expansion. Specifically, the objectives of this memorandum are to:

- Characterise existing water quality and flow conditions in Plato Creek; and,
- Establish proposed WWTP effluent objective/limit concentrations such that:
  - The water quality of Plato Creek will remain at or below Provincial Water Quality Objectives (PWQOs) or, where applicable, water quality guidelines for the Canadian Council of Ministers for the Environment (CCME); or
  - No further degradation of water quality occurs for Policy 2 parameters that exceed PWQO or CCME under historical conditions; or
  - Where either of the above are not possible, establish effluent objectives/limits that maintain existing parameter loading or are based on the best reasonably available technology.

The parameters of interest in this assessment include five-day Carbonaceous Biochemical Oxygen demand ($CBOD_5$), total and unionized ammonia, total phosphorus, pH, *Escherichia coli* (*E. coli*), and Total Suspended Solids (TSS). Dissolved oxygen and temperature are also used here to support calculations for $CBOD_5$ and unionized ammonia objectives/limits.

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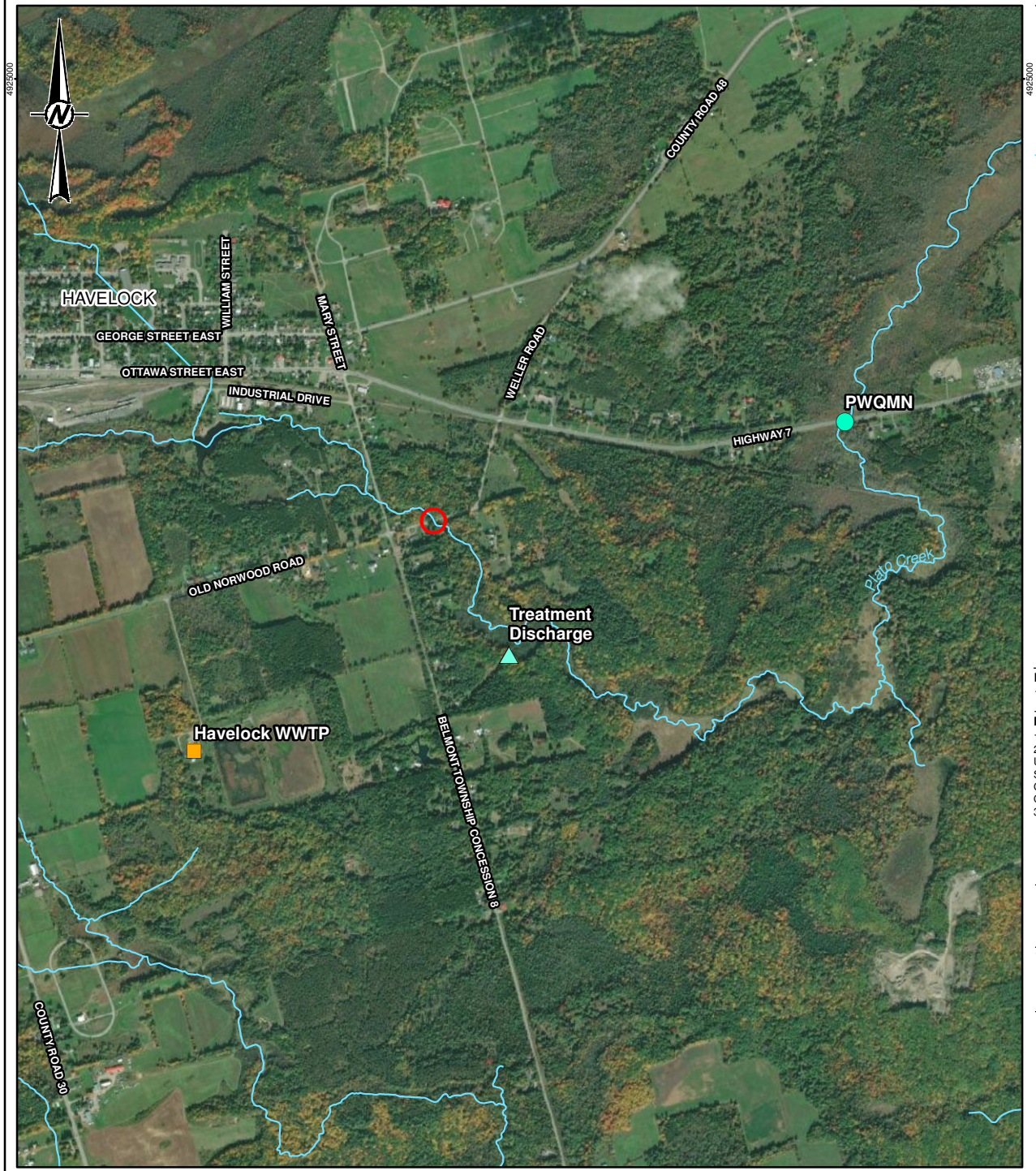

LEGEND

- 2021/2022 FIELD SAMPLING LOCATION
- DISCHARGE LOCATION TO PLATO CREEK
- PWQMN LOCATION
- WASTEWATER TREATMENT PLANT
- WATERCOURSE

0 500 1,000

1:20,000 METRES

NOTE(S)

1. LOCATIONS ARE APPROXIMATE.

REFERENCE(S)

1. BASE DATA: MNRF, 2021
2. BASE IMAGE: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY
SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 18N

CLIENT
CIMA+

PROJECT
HAVELOCK WASTEWATER TREATMENT PLANT (WWTP)

TITLE
HAVELOCK WWTP SITE PLAN

CONSULTANT
WSP GOLDER

YYYY-MM-DD	2022-03-23
DESIGNED	CGE
PREPARED	CGE
REVIEWED	CD
APPROVED	GVA

PROJECT NO.	CONTROL	REV.	FIGURE
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4.0 DATA REVIEW AND COMPILATION

This assimilative capacity study uses the following datasets to characterise the receiving water quality and flow conditions in Plato Creek that are ultimately used to establish available assimilative capacity and effluent concentration objectives/limits for the WWTP:

- Historical water quality records (1972-1988) for Plato Creek from the Provincial Water Quality Monitoring Network (PWQMN) (located downstream of, and thus affected by, historical WWTP discharges).
- Water quality samples were collected 500 m upstream of the WWTP Discharge at Old Norwood Road (Figure 1) in July, August, September, and November of 2021 and March of 2022.
- Historical daily flow records for nearby Water Survey of Canada (WSC) stream flow gauges.

A review of the selected water quality guidelines used in this assessment and a characterisation of background conditions for Plato Creek are provided in the subsections below.

4.1 Review of Applicable Guidelines and Objectives

Table 2 identifies the in-stream water quality criteria adopted for the purposes of evaluating the assimilative capacity of Plato Creek. Provincial Water Quality Objectives (PWQOs) were used as targets for parameters of interest where available (MECP, 1994); CCME guidelines were used for parameters without corresponding PWQOs (CCME, 2012).

Table 2: In-Stream Water Quality Criteria Used for Determining the Available Assimilative Capacity for Plato Creek

Parameter	Units	Criteria	Regulatory Driver
Dissolved Oxygen	mg/L	5 to 8 (for cold water biota)[1]	PWQO
Unionized Ammonia [2]	µg/L as N	16	PWQO
Total Phosphorus	mg/L	0.030[3]	PWQO
pH	-	6.5 – 8.5	PWQO
E. coli	cfu/100 ml	100	PWQO
Total Suspended Solids	mg/L	Background Concentration + 5 mg/L[4]	CCME

Notes:

1. Plato Creek was assumed to be a cold water fishery from Natural Environment Report (Golder, 2022).
2. Unionized ammonia targets converted to total ammonia using the Plato Creek monthly 75th percentile for pH and Temperature
3. PWQO for total phosphorus to prevent the growth of nuisance plants in streams and rivers.
4. CCME guideline for TSS criteria in dry conditions.

4.2 Background and Field Measured Water Quality for Plato Creek

Background water quality is based on mix of data acquired from the Ontario Ministry of the Environment, Conservation, and Parks (MECP) and field-measured data. Data sources and method for estimating historical water quality are presented below.

PWQMN water quality in Plato Creek has been measured at Hwy 7 (Station ID#17002107202 "Highway 7, 1 Mile East of Havelock") from 1972 to 1998 approximately 2.5 km downstream of the WWTP discharge (Figure 2). Water quality data for that location are therefore anticipated to have been influenced by WWTP loadings from the now decommissioned lagoon system that discharged to Plato Creek up to 2009. However, the degree of influence is uncertain as to which samples were potentially influenced since the lagoon system discharged seasonally (e.g., spring and fall) and the creek flows through a wetland which can both accumulate and release constituent loadings to Plato Creek depending on conditions.

Monthly statistics were calculated for all parameters of interest and those parameters required to calculate the outcome of parameters of interest. Per the pre-consultation meeting with the MECP on June 4, 2021, the following PWQMN data statistics or 2021-2022 field sampling results were considered for background conditions in Plato Creek:

- The monthly 25th percentile results for Dissolved Oxygen using all the PWQMN data.
- For all other parameters where no long-term trends were identified;
  - The monthly 75th percentile results where seasonal trends are evident.
  - An annual 75th percentile results where seasonal trends are not evident.
- Where a year-over-year trend was evident in the 1972-1998 data, an average of the 2021-2022 field measured data was used.

Where applicable, the values estimated using the historical PWQMN data were compared to the values from the samples collected in 2021-2022. Monthly values for these PWQMN statistics are shown in Appendix A and results from the 2021-2022 sampling are provided in Appendix B.

A summary of findings for each parameter of interest, or parameter required to calculate the outcome of parameters of interest, are discussed below and summarized in Table 3.

Dissolved Oxygen

Relative to the 5 mg/L to 8 mg/L dissolved oxygen PWQO for cold water biota, the monthly 25th percentile dissolved oxygen concentrations in Plato Creek ranged from 4.7 mg/L in July to 9.8 mg/L in January. The results showed a strong seasonal trend, no year-over-year trend, and while field measured results (8.2 to 9.5 mg/L) are slightly higher than 25th percentile summer values they are within historic range for summer values; therefore, the historical monthly 25th percentile results were used to characterise monthly background concentrations for Plato Creek. Based on historic data, the creek is under a Policy 2 condition (i.e., concentration background below PWQO) for the months of July (PWQO of 5 mg/L, background concentration of 4.7 mg/L) and September (PWQO of 6 mg/L, background concentration of 5.0 mg/L).

$CBOD_5$

The monthly 75th percentile of $CBOD_5$ concentrations in Plato Creek ranged from 0.8 mg/L in April to 2.0 mg/L in August. The results showed no significant seasonal or year-over-year trend (Figure 2) and 2021-2022 field measured results (<2.0 mg/L) are in line with historical values; therefore, the long-term historical annual average of 1.1 mg/L was used to characterise the background concentration for Plato Creek.

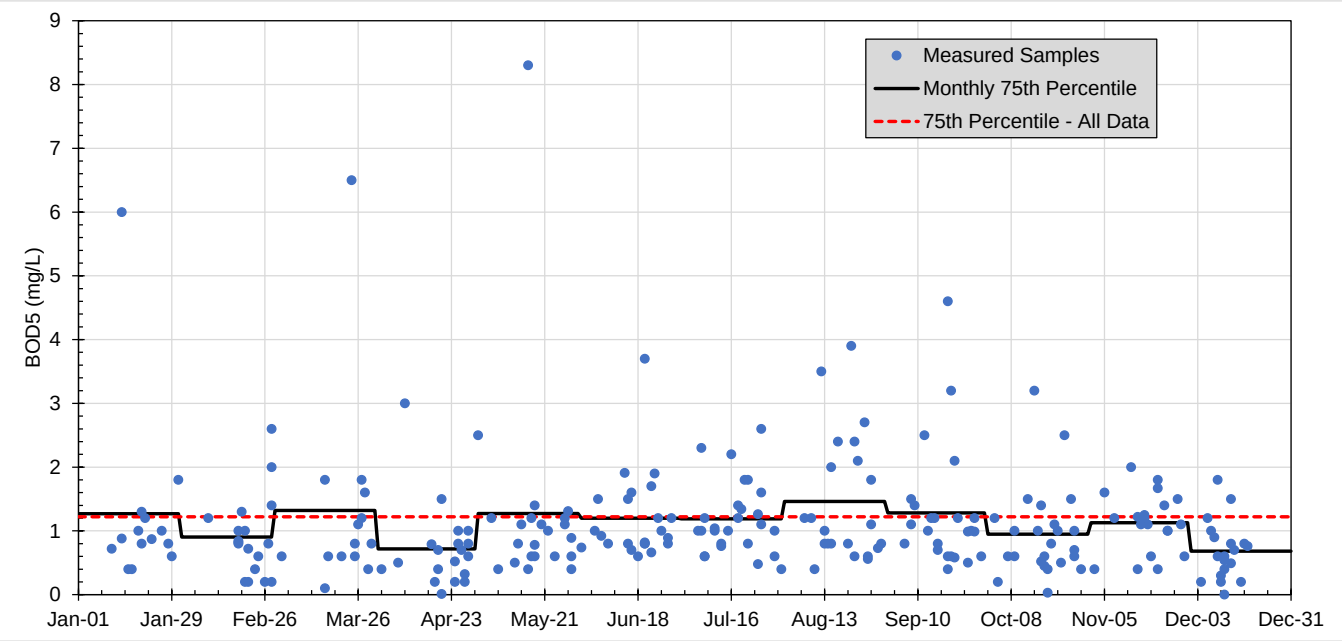

Figure 2: Measured BOD_5 in Plato Creek (PWQMN Data 1972-1998)

Water Temperature

Water temperatures are used to support the calculation of unionized ammonia concentration. Monthly 75th percentile water temperatures for Plato Creek ranged from 0.7°C in January to 21.6°C in July. The results show a strong seasonal trend with no year-over-year trend and are consistent with the field measured results (0.7 to 19.7°C).

Unionized Ammonia

The monthly 75th percentile of unionized ammonia for Plato Creek ranged from 0.04 µg/L as N in December to 1.48 µg/L as N in August, which is below the PWQO of 16 µg/L as N. The results showed a strong seasonal trend, no year-over-year trend, and were lower than the field measured results (0.15 ug/L as N to 11.27 ug/L as N); therefore, the historical monthly 75th percentile results were used to characterise monthly background concentrations for Plato Creek, recognising that measured water quality data have likely been influenced by historical loadings from the previous lagoon treatment system.

Total Ammonia

Total ammonia concentrations in Plato Creek are used to support calculations for unionized ammonia concentration. The monthly 75th percentile of total ammonia concentrations in Plato Creek ranged from 0.14 mg/L as N in April to 0.13 mg/L as N in February. The results show a strong seasonal trend with no year-over-year trend and field measured results (<0.05 mg/L) are slightly lower than historical values; therefore, the historical monthly 75th percentile results were used to characterise monthly background total ammonia concentrations for Plato Creek, recognising that measured water quality data have likely been influenced by historical loadings from the previous lagoon treatment system.

Total Phosphorus

Relative to the PWQO of 0.030 mg/L, the monthly 75th percentile of total phosphorus for Plato Creek ranged from 0.022 mg/L in April to a maximum value of 0.084 mg/L in September. Based on historical data, the creek is under a Policy 2 condition for January, February, between May through September and November. The results show a strong seasonal trend with no year-over-year trend and were comparable to the field measured results (<0.020 to 0.049 mg/L); therefore, the historical monthly 75th percentile results were used to characterise monthly total phosphorus concentrations for Plato Creek, recognising that measured water quality data have likely been influenced by historical loadings from the previous lagoon treatment system.

pH

The monthly 75th percentile of pH measured in Plato Creek ranged from 7.6 to 7.9, which is within the 6.5 and 8.5 PWQO range. The results show a seasonal trend (higher in spring, lower in winter) with no year-over-year trend and were only slightly lower than the field measured results (7.8 to 8.9); therefore, the historical monthly 75th percentile results were used to characterise monthly background pH for Plato Creek.

Escherichia coli

E. coli results for Plato Creek were not included in the PWQMN data; therefore, the average of field measured values (490 cfu/100ml) were used to characterise the annual background concentration for Plato Creek.

TSS

Results for TSS showed that 75th percentiles ranged from to 1.5 mg/L in April to 7.0 mg/L in January. The corresponding in-stream CCME guideline for TSS is background TSS plus 5 mg/L. The results show a strong seasonal trend with no year-over-year trend and samples from 2021-2022 were not tested for TSS; therefore, the historical monthly 75th percentile results were used to characterise monthly background TSS concentrations in Plato Creek.

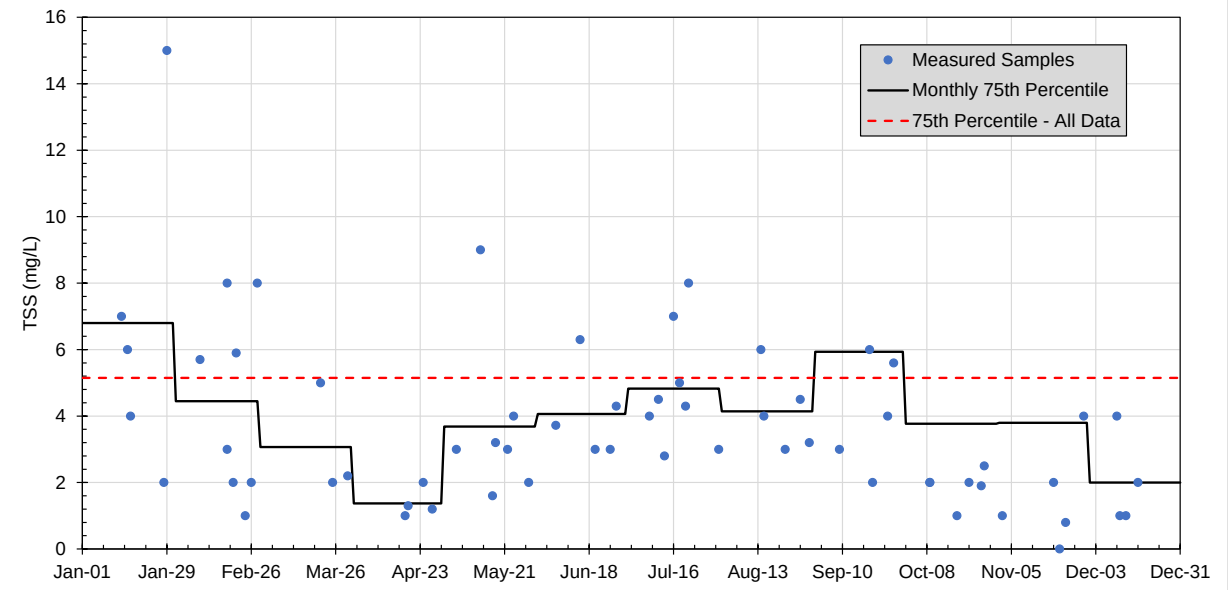

Figure 3: Measured TSS in Plato Creek (PWQMN Data 1974-1998)

Table 3: Assumed Background Concentrations for Plato Creek corresponding to the 25th Percentile for Dissolved Oxygen and 75th Percentile for All Other Parameters

Parameter	Units	PWQO / CCME[1]	Assumed Background Concentrations for Plato Creek (Number of Samples)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dissolved Oxygen[2]	mg/L	4	9.8 (12)	9.9 (16)	9.8 (14)	8.7 (19)	7.5 (19)	5.7 (20)	4.7 (20)	5.0 (20)	5.0 (22)	7.3 (19)	8.9 (19)	8.9 (16)
$CBOD_5$	mg/L	-	1.1 (245)											
Unionized Ammonia[3]	µg/L	20 (16 as N)	0.25 (6)	0.18 (7)	0.10 (8)	0.08 (10)	0.27 (12)	0.79 (12)	1.05 (13)	1.48 (8)	1.07 (11)	0.18 (10)	0.31 (13)	0.04 (9)
Total Ammonia (Filtered)	mg/L	-	0.08 (13)	0.13 (16)	0.03 (15)	0.01 (19)	0.03 (21)	0.05 (22)	0.07 (22)	0.06 (20)	0.08 (23)	0.02 (20)	0.03 (20)	0.02 (17)
Temperature	°C	-	0.7 (12)	1.5 (16)	4.6 (14)	11.0 (19)	16.0 (21)	21.5 (21)	21.6 (24)	19.6 (22)	16.0 (23)	10.2 (22)	6.3 (20)	2.0 (14)
Total Phosphorus (Unfiltered)	mg/L	0.03	0.03 (15)	0.04 (18)	0.02 (15)	0.02 (19)	0.04 (23)	0.05 (23)	0.07 (25)	0.07 (22)	0.08 (24)	0.03 (24)	0.05 (21)	0.03 (19)
pH (field-measured)	-	6.5 – 8.5	7.7 (8)	7.6 (9)	7.6 (8)	7.9 (10)	7.9 (12)	7.8 (12)	7.8 (14)	7.8 (9)	7.7 (11)	7.7 (10)	7.8 (13)	7.6 (11)
E. coli	CFU / 100 ml	100	490 (2)											
Residue, Particular (TSS)	mg/L	Background + 5 mg/L (CCME long-term exposure)	12.0 (5)	11.4 (8)	8.6 (3)	6.5 (4)	8.6 (7)	9.3 (5)	10.5 (8)	9.5 (5)	10.9 (6)	7.3 (7)	8.5 (6)	7.5 (4)

1. Unless otherwise stated, values are PWQO (MECP 1994)
2. Results for dissolved oxygen reflect the 25th percentile
3. Results for unionized ammonia are estimated as a fraction of “Ammonium, Total Filtered Reactive” using the field-measured temperature, and pH measured on the day the sample was taken
4. Bracketed values indicate the number of samples that background concentrations are derived from

4.3 Background Flows

Since there are no continuous flow data for Plato Creek, an estimate of flows for the subject reach was developed using daily flow data provided for two nearby WSC stations: 02HK006 Beaver Creek near Marmora (1974 to 2020) and 02HJ003 Ouse River near Westwood (1968 to 2019). While the catchment areas for both WSC stations are larger than that of Plato Creek (541 km^2 for Beaver Creek and 282 km^2 for the Ouse River, compared to 23 km^2 for Plato Creek based on the 2007 Jacques Whitford "Assimilative Capacity Study for Plato Creek (Jacques Whitford, 2007)), both stations were regarded to have similar upstream land use and were used to develop flow estimates for the subject reach of Plato Creek.

The monthly $7Q_{20}$ results at Beaver Creek and Ouse River were estimated from the available daily data and are shown in Table 4 below. The $7Q_{20}$ is the minimum 7-day average flow during a year with a 5% chance of occurring in a given year; it is used as a common benchmark for evaluating discharges and water takings in Ontario. Monthly $7Q_{20}$ results were estimated by taking the lowest 7-day average flow for each month and then fitting the results for each month to a Log Pearson III distribution. The monthly $7Q_{20}$ flow results were then prorated to the Plato Creek location based on differences in catchment area, using the formula:

$$Q_2 = Q_1 \times (A_2 / A_1)$$

where Q_2 is the estimated flow at Plato Creek, Q_1 is the flow at the WSC gauge, A_2 is the catchment at Plato Creek (23 km^2) and A_1 is the catchment to the WSC station.

The results of the prorating exercise are shown in Table 5 below, with the flow in Plato Creek at the WWTP discharge location assumed as the average of the two prorated flows.

Table 4: Summary of Beaver Creek and Ouse River Flows

Month	Beaver Creek (m^3/s)	Ouse River (m^3/s)
	$7Q_{20}$ Flow	$7Q_{20}$ Flow
January	1.729	0.449
February	1.494	0.385
March	1.685	0.461
April	4.625	2.306
May	2.273	1.108
June	0.588	0.460
July	0.117	0.151
August	0.029	0.047
September	0.006	0.033
October	0.111	0.058
November	0.505	0.203
December	1.257	0.332

Table 5: Estimated Prorated Flows for Plato Creek

Month	$7Q_{20}$ Flow		
	Prorated from Beaver Creek (m^3/s)	Prorated from Ouse River (m^3/s)	Assumed Plato Creek (m^3/s)
January	0.074	0.037	0.055
February	0.064	0.031	0.047
March	0.072	0.038	0.055
April	0.197	0.188	0.192
May	0.097	0.090	0.093
June	0.025	0.038	0.031
July	0.005	0.012	0.009
August	0.001	0.004	0.003
September	0.000	0.003	0.001
October	0.005	0.005	0.005
November	0.021	0.017	0.019
December	0.053	0.027	0.040

4.4 WWTP Effluent Flows

Proposed WWTP effluent flows are presented in the Design Basis document (CIMA+ 2021). The design basis proposes 1,335 m^3/day for the "*New Plant Design Flowrate – Planned Population*" and 1,580 m^3/day for the "*New Plant Design Flowrate – Future Growth*". The two flows ("Planned Population" and "Future Growth") were used to evaluate effluent quality objectives/limits under two operational conditions (Scenario 1 and Scenarios 2, respectively).

5.0 ASSESSMENT METHODOLOGY

The methodology applied for the assimilative capacity study is presented below, including selected operational scenarios, water quality representation for mixing, and key assumptions for the methods applied.

This assessment estimates the maximum allowable effluent concentration for each parameter that results in the downstream water quality meeting the selected water quality guideline or objective for that parameter. The estimated maximum allowable effluent concentrations are then used as a basis for establishing the proposed effluent limits presented in this report.

5.1 Selected Operational Scenarios

Based on the above data compilation, two operational scenarios were selected for this assessment, corresponding to the following conditions:

- Scenario 1: Using the 75th Percentile water quality for Plato Creek, Planned Population WWTP discharge rate of 1,335 m^3/day, and estimated $7Q_{20}$ monthly flows in Plato Creek.
- Scenario 2: Using the 75th Percentile water quality for Plato Creek, Future Growth WWTP discharge rate of 1,580 m^3/day, and estimated $7Q_{20}$ monthly flows in Plato Creek.

CIMA+ has indicated that Scenario 2 (1,580 m^3/day) will likely form the basis of the Environmental Compliance Approval (ECA) application. While results for both Scenarios are presented here for consistency with the CIMA+ design basis (CIMA+, 2021), the conclusions and recommendations in this report address only Scenario 2.

5.2 Water Quality Representation

Monthly estimated flows (Table 5) and assumed background water quality (Table 3) were used to calculate the assimilative capacity of Plato Creek and estimate the effluent concentration limits for each parameter of interest and scenario. The effluent concentration limits represent an effluent concentration that would result in fully mixed water quality conditions (combined effluent and upstream flow) equal to the PWQO or CCME water quality criterion.

The following sections outline the two methods used to estimate assimilative capacity, and the resulting effluent limit concentrations under ACS conditions.

Mass Balance Modelling

The *E. coli*, and TSS concentrations in the creek downstream of the discharge were estimated using a conservative mass balance model based on the following equation that assumes that effluent and creek flow are instantaneously mixed.

$$C_d = \frac{Q_r C_r + Q_e C_e}{Q_r + Q_e} \qquad \textbf{Equation 1}$$

Where:
- C_d Predicted downstream concentration (mg/L),
- Q_r Creek flowrate (m3/s),
- C_r Upstream/background concentration (mg/L),
- Q_e Effluent flowrate (m3/s), and
- C_e Effluent concentration (mg/L).

In the mass balance model, equation was rearranged to solve for the effluent concentration (C_d) and the downstream concentration (C_d) was assumed to be equal to the selected water quality guideline for each parameter.

It should be noted that downstream concentrations of ammonia are typically a function of decay, nutrient uptake, nitrification, and oxygen decay; however, ammonia was assumed to be a conservative parameter for this assessment. As the PWQO for ammonia is for the unionized fraction, the PWQO for ammonia was converted to total ammonia based on the assumed monthly water temperature and pH.

Dissolved Oxygen and $CBOD_5$

Dissolved oxygen downstream of the discharge is depleted by the decay of organic material in the water (e.g., CBOD) and in the sediment and is replenished by surface re-aeration. The Streeter-Phelps model (Streeter 1925) was used to estimate the dissolved oxygen deficit and, thus, dissolved oxygen concentrations in the creek

below the discharge locations by representing both effluent and background concentrations for dissolved oxygen, biochemical oxygen demand, and sediment oxygen demand as shown in the following equations.

$$D_0 = C_s - C_0 \quad \textbf{Equation 2}$$

$$D_t = D_0 e^{-k_a t} + \frac{k_r L_0}{k_a - k_r}\left[e^{-k_r t} - e^{-k_a t} + \frac{SOD}{k_a}(1 - e^{-k_a t})\right] \quad \textbf{Equation 3}$$

$$L_0 = {L_5}/{e^{-5k_d}} \quad \textbf{Equation 4}$$

$$C_t = C_s - D_t \quad \textbf{Equation 5}$$

Where:
- t Elapsed time (days),
- C_0 Initial dissolved oxygen concentration (mg/L),
- C_s Saturation dissolved oxygen concentration (mg/L),
- D_0 Initial dissolved oxygen deficit (mg/L),
- L_0 Initial ultimate $CBOD_5$ (mg/L),
- L_5 Initial $CBOD_5$ (mg/L),
- D_t Dissolved oxygen deficit at time t (mg/L),
- C_t Dissolved oxygen concentration at time t (mg/L),
- SOD Sediment oxygen demand rate at 25ºC (g/m²/d),
- k_a Surface reaeration constant at 20ºC (1/d), and
- k_r $CBOD_5$ decay rate at 20ºC (1/d).

The dissolved oxygen modelling uses the following inputs based on literature values:

- For each month, the saturation dissolved oxygen concentration was estimated based on ambient temperature and elevation using the equation presented by Chapra (1996).
- The $CBOD_5$ decay rate was assumed to be 0.05 1/d at 20ºC based on measured values for effluent from activated sludge systems (Nuruzzaman et al 2018).
- The sediment oxygen demand (SOD) was assumed to be 2 g/m²/d at 25ºC as typical for aged deposits downstream of a WWTP (Chapra 1996).
- Surface reaeration was estimated based on water depth and current speed using the Owens-Gibbs formulation for streams with water depths less than 0.6 m (Chapra 1996).
- Temperature correction factors of 1.024, 1.047, and 1.080 were used in an Arrhenius equation for surface reaeration, CBOD decay, and SOD respectively to estimate monthly rates based on ambient water temperature (EPA 1985).

The dissolved oxygen modelling approach assumes that the effluent discharge to the creek is immediately distributed evenly across the creek. The initial concentrations used in the model are estimated by mixing the effluent flow with the upstream creek flow (e.g., similar to mass balance model).

This assessment assumes that the dissolved oxygen concentration in the final effluent can be easily maintained at a minimum concentration of 5.7 mg/L from June to October, and 7.1 mg/L from November to May (or roughly

70%-75% dissolved oxygen saturation year-round). The dissolved oxygen model was iteratively used to estimate the $CBOD_5$ effluent concentration limit that would result in the minimum downstream dissolved oxygen concentration equal to the dissolved oxygen objectives for each month and scenario. An example of the predicted dissolved oxygen concentrations downstream of the outfall is provided in Figure 4.

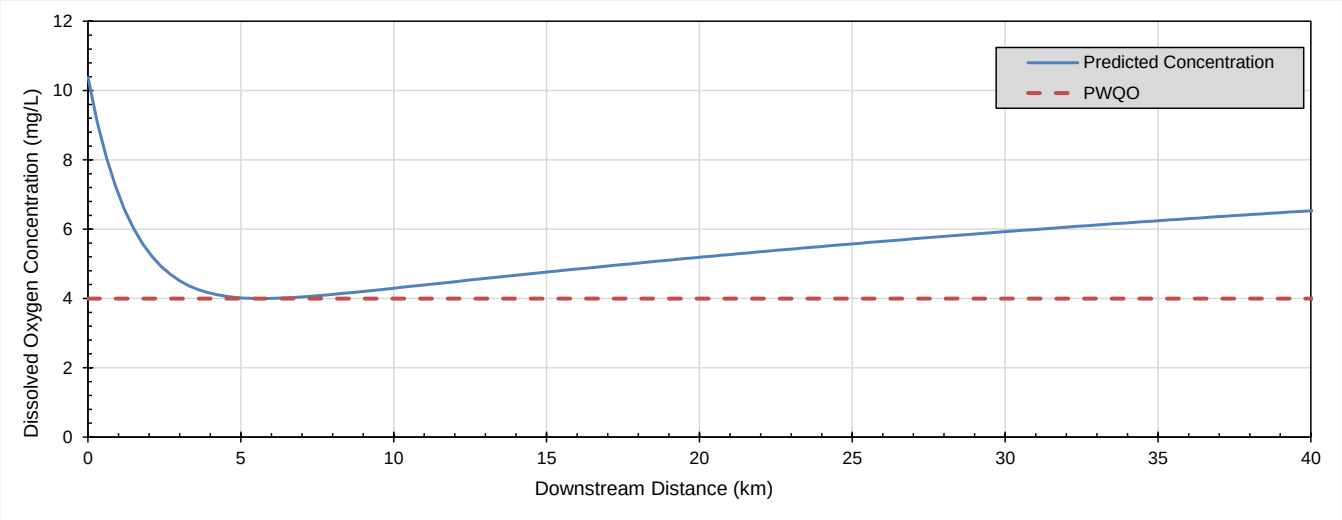

Figure 4: Example of Predicted Dissolved Oxygen Concentrations Downstream of Outfall

Alternative Effluent Concentration Limit Determination

Alternative approaches to the ones described above were ultimately used to establish effluent discharge limits for total phosphorus and ammonia, respectively, given the limited assimilative capacity available in Plato Creek.

- For total phosphorus, proposed effluent discharge limits were calculated to maintain the same seasonal loading limits as under the current CofA using the higher effluent rate.
- For ammonia, a proposed effluent discharge limit only slightly above that calculated from the assimilative capacity was established based on limitations of technological feasibility.
- For pH, an effluent discharge concentration was set based on PWQO limits 6.5 to 9.5.

5.3 Key Assessment Assumptions and Limitations

Key assumptions in the methodology applied in this scope are presented below.

- This analysis does not consider the effect of any additional sources beyond the single point of discharge from the plant.
- Background conditions based on historical water quality data are likely influenced by former loadings from the WWTP and may therefore result in underestimates of assimilative capacity in the creek and the resulting proposed effluent objectives/limits.
- Plato Creek at the point of discharge is assumed to be on average of 2.5 m wide. The average depth of the creek was assumed as between 0.40 m and 0.46 m based on measured flow data collected between July and September 2021. The velocity of the creek downstream of the mixing point was likewise assumed as

between 0.04 m/s and 0.16 m/s based on the same data. Continuity of flow was maintained by adjusting the effective width of the channel.

- Assimilative capacity calculations assume the plant discharge is fully mixed in the receiving Plato Creek at the point of discharge. This is considered reasonable given the relatively small width and flow of Plato Creek. The effluent is expected to become fully mixed with the upstream flow in Plato Creek at a maximum distance of 250 m, equal to one hundred times the stream width.
- Based on the length of the discharge pipe (approximately 1.2 km between the plant and Plato Creek), the discharge water temperature is assumed to maintain a constant 8°C throughout the year, broadly reflecting average annual air temperature in the region.
- The water temperature of the receiving stream was assumed to correspond to the monthly 75th percentile temperature calculated from the historical data for each month.
- Plant discharge flows were assumed to be constant and continuous.
- Plant discharge was assumed to have an effluent dissolved oxygen concentration of 5.7 mg/L between June and October, and 7.1 mg/ between November and May. These periods were chosen to match the periods for Ammonia and Phosphorus, with the minimum effluent concentrations determined by a mass balance such that the resulting dissolved oxygen concentration in Plato Creek at the mixing point did not drop below the PWQO.
- The typical $CBOD_5$ effluent concentration achievable by a conventional activated sludge system is assumed to be 25 mg/L (MECP 2019). In follow-up comments from the MECP in 2022, the MECP asked that the $CBOD_5$ limit in the 2009 ECA (10 mg/L). This was therefore used as the maximum proposed $CBOD_5$ limit where this method showed effluent concentrations above 10 mg/L.
- Wind effects on surface reaeration in Plato Creek downstream of the discharge are assumed to be negligible.
- Sediment oxygen demand is assumed to be 2 mg/L/day based on literature values for aged depositions of organic matter downstream of wastewater treatment plants (Chapra 1996).
- The estimated effluent concentration objectives/limits are assumed to be applicable as maximum mean monthly concentrations in the proposed effluent concentration objectives/limits.

6.0 ASSESSMENT RESULTS

Key assessment results are summarised below for each parameter of interest and both operational scenarios, with detailed results for each month provided in Appendix C. ECA effluent limits were estimated by:

- Identifying the maximum effluent concentration that would still result in regulatory (PWQO/CCME) objectives or Policy 2 requirements following complete mixing under each selected assessment scenario for each month; or
- In the case of total phosphorus, maintaining the seasonal loading limit associated with the existing CofA; or

- In the case of ammonia, based on technologically feasible treatment solutions, where 7Q20 flow conditions between August and September limited attainment of instream regulatory criteria.

For the purpose of this assessment, the maximum allowable effluent concentrations reported below represent the lowest monthly value for each scenario when the background 75th percentile concentrations are below their respective PWQO values. As the assessment was completed on a monthly basis, the estimated maximum allowable effluent concentrations are used to develop the proposed monthly mean limits.

For total phosphorus, seasonal loading to Plato Creek for the proposed WWTP was maintained according to existing CofA conditions. For total ammonia, ensuing proposed ECA effluent limits (Section 7.0) are based on the limits of what is technologically feasible.

Dissolved Oxygen

Background dissolved oxygen concentrations below the PWQO concentration for cold water fisheries in July (5.0 mg/L) and September (6.0 mg/L) trigger a Policy 2 condition with respect to the PWQO. In those months, the background 25th percentile concentration was 4.7 mg/L and 5.0 mg/L, respectively. In all other months, the PWQO targets for dissolved oxygen were used.

As stated in Section 5.2 above, effluent dissolved oxygen concentration was assumed to be maintained at 5.7 mg/L or greater for the low flow period in Plato Creek (June through October) and 7.1 mg/L or greater for the high flow period in Plato Creek (November through May). The proposed effluent limits are not related to $CBOD_5$ downstream of the mixing point, but rather based on a mass balance between the effluent and upstream flows and maintaining the dissolved oxygen levels at the mixing point.

These minimum concentrations were applied in the development of proposed $CBOD_5$ effluent limits.

$CBOD_5$

For both Operational Scenario 1 and 2, the lowest assimilative capacity in Plato Creek occurs in August, resulting in an estimated maximum allowable effluent concentration for $CBOD_5$ of 52 mg/L. As discussed in Section 5.3, the MECP has asked for a effluent limit of 10 mg/L (matching the limit in the 2009 ECA); that concentration is therefore recommended as the proposed effluent limit for this system for both scenarios.

Total Ammonia

As the proposed limit for ammonia is typically set as total ammonia, the unionized ammonia objective (0.016 mg/L as N) was converted to monthly total ammonia objectives using the Plato Creek monthly 75th percentile for pH and Temperature from Table 3.

- During the low flow period (June to October), the lowest assimilative capacity in Plato Creek for both Operational Scenario 1 and 2 occurs in August, resulting in a maximum allowable effluent concentration for total ammonia of 0.8 mg/L as N. It is noted, as reflected in Section 7.0, that for reasons of technological feasibility, this estimated maximum allowable monthly concentration has been set at 1.0 mg/L (as N) for the June to October Period.
- For the remainder of the year (November to May), the lowest assimilative capacity in Plato Creek for both Operational Scenario 1 and 2 occurs in November. Based on this result, the estimated maximum allowable monthly concentration has been set at 4.3 mg/L (as N) for Operational Scenario 1 and 3.9 mg/L (as N) for Operational Scenario 2.

Total Phosphorus

Background total phosphorus concentrations above the 0.030 mg/L PWQO concentration in 8 of 12 months trigger a Policy 2 condition with respect to the PWQO. In those months, the background 75th percentile concentrations from 0.0325 mg/L to 0.0835 mg/L.

In the remaining months when the background 75th percentile concentrations are below the PWQO of 30 µg/L, the proposed effluent limit concentrations calculated from the ACS were 0.032 mg/L and 0.031 mg/L for Scenarios 1 and 2 respectively.

For reasons of technological feasibility, meeting the ACS-derived effluent limits is not achievable during some low-flow months in late summer. Because total phosphorus is not toxic in of itself but can promote excessive algal growth under the low flow and elevated temperature conditions, the approach for establishing effluent concentration limits was premised on maintaining the seasonal phosphorus load currently associated with limits approved under the existing CofA.

The following estimated maximum allowable effluent concentration for total phosphorus were estimated for the increased flows:

- Scenario 1: for an effluent flow increase from 1,200 m³/day to 1,335 m³/day:
  - the estimated maximum allowable effluent concentration will need to decrease from 0.14 mg/L to 0.13 mg/L for the low flow period (July to October), and,
  - the estimated maximum allowable effluent concentration will need to decrease from 0.30 mg/L to 0.27 for the remainder of the year (November to June).
- Scenario 2: for an effluent flow increase from 1,200 m³/day to 1,580 m³/day:
  - the estimated maximum allowable effluent concentration decreases from 0.14 mg/L to 0.11 mg/L for the low flow period (July to October), and,
  - the estimated maximum allowable effluent concentration decreases from 0.30 mg/L to 0.23 for the remainder of the year (November to June).

pH

The effluent pH should match the 6.5 to 9.5 range from the PWQO.

Escherichia coli

The *E. coli* concentration should match the 100 CFU / 100 ml limit from the PWQO.

Total Suspended Solids

For Operational Scenario 1, the lowest assimilative capacity in Plato Creek occurs in October, resulting in an estimated maximum allowable effluent concentration for TSS of 8.8 mg/L.

For Operational Scenario 2, the lowest assimilative capacity in Plato Creek occurs in September, resulting in an estimated maximum allowable effluent concentration for TSS of 8.5 mg/L.

Summary

Table 6 below summarises the maximum allowable effluent concentration developed for WWTP expansion under Scenario 1 and Scenario 2 within the preceding sections of this Report. It is noted that the results for Scenario 1 is presented here for consistency with the CIMA+ design basis (CIMA+, 2021).

Table 6: Estimated Maximum Allowable Effluent Concentrations for Scenario 1 and 2

Parameter		Maximum Monthly Mean[1]	
		Scenario 1 Expansion to 1,335 m^3/day	Scenario 2 Expansion to 1,580 m^3/day
Dissolved Oxygen Concentration (mg/L)	June to October	5.7 (minimum)	
	November to May	7.1 (minimum)	
$CBOD_5$ (mg/L)[2]		10	10
Total Ammonia (mg/L as N)	June to October	1.0	1.0
	November to May	4.3	3.9
Phosphorus (mg/L)	June to October	0.13	0.11
	November to May	0.27	0.23
pH		6.5 to 9.5	
E. coli (cfu/100 mL)		100	
TSS (mg/L)		8.8	8.5

Notes:

1. Unless otherwise noted, concentrations represent maximum values.
2. Based on the MECP request to maintain the $CBOD_5$ limit in the 2009 ECA, or 10 mg/L.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis and modelling presented in this report, the following conclusions are drawn with respect to Scenario 2 (WWTP expansion from 1,200 m^3/day to 1,580 m^3/day):

- Based on the PWQMN data, historical water quality in Plato Creek generally met PWQO and CCME criteria for all parameters of interest except total phosphorus, total ammonia, and *E. coli*.
- Low flow in Plato Creek creates a constraining condition where the WWTP discharge must essentially match the PWQO or CCME criteria during low flow conditions. In some instances (total phosphorus and ammonia), the proposed effluent limits are based on the limits of technological feasibility.
  - For dissolved oxygen, background concentrations of dissolved oxygen compared to the PWQO targets for cold water fisheries trigger Policy 2 conditions for July and September. Minimum dissolved oxygen concentrations were set to maintain PWQO and Policy 2 targets at the mixing point for those months.
  - For $CBOD_5$, while Streeter-Phelps analysis results suggested relatively high allowable effluent concentrations, a limit of 10 mg/L was applied based on the MECP request to match the limit in the 2009 ECA.

- For total phosphorus, background concentrations and flows prevent technologically-feasible determination of proposed effluent limit concentrations to meet the PWQO for phosphorus (0.03 mg/L) in Plato Creek. *Using the WWTP's existing seasonal loading, to avoid further degradation of the Policy 2 receiver, proposed ACS-supported effluent concentration limits were determined on maintaining existing total phosphorus loading to Plato Creek*.
- For total ammonia, where removal below 3 mg/L is considered difficult during colder months, seasonal limits are proposed, with the lower limit during the low flow period (June to October) being set at 1.0 mg/L due to limitations of technological feasibility and a higher objective/limit applied during higher flow months (November to May). For the remainder of the year (November to May), the proposed limit has been set at 3.9 mg/L (as N).

- For *E.coli*, background concentrations from sampling were above the PWQO, however a proposed limit of 100 CFU / 100 ml (matching the PWQO) is considered achievable with the ultraviolet disinfection currently employed at the WWTP.
- Monitoring of upstream water quality should continue in order to establish baseline conditions that are up to date and not influenced by historical WWTP discharges.

The resulting proposed effluent objectives/limits are summarized in Table 7.

Table 7: Proposed ECA Effluent Objectives/Limits for Scenario 2 (WWTP Expansion to 1,580 m³/day)

Parameter		Effluent Objectives	Effluent Limits
		Maximum Monthly Mean Concentration[1]	Maximum Monthly Mean Concentration[1]
Dissolved Oxygen Concentration (mg/L)	June to October	7.6 (minimum)	5.7 (minimum)
	November to May	9.5 (minimum)	7.1 (minimum)
$CBOD_5$ (mg/L)[2]		6.6	10
Total Ammonia (mg/L as N)	June to October	0.8	1.0
	November to May	3.0	3.9
Phosphorus (mg/L)	June to October	0.08	0.11
	November to May	0.17	0.23
pH		6.5 to 8.5	6.5 to 9.5
E. coli (CFU/100ml)		100	100
TSS (mg/L)		6.4	8.5

Notes:

1. Unless otherwise noted, concentrations represent maximum values.
2. Based on the MECP request to maintain the $CBOD_5$ limit from the 2009 ECA, or 10 mg/L.

Signature Page

We trust this submission meets your current requirements. If you have any questions about this technical memorandum or the original ACS, please contact Christopher Davidson or Gerard Van Arkel.

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https://golderassociates.sharepoint.com/sites/143155/project files/6 deliverables/assimilative capacity/rev4/21459099_r_rev4_havelock_wwtp_acs_08sep2022.docx

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APPENDIX A

PWQMN Monthly 75th Percentile Results

Appendix A: PWQMN Monthly 75th Percentile Results

Parameter	Units	PWQO / CCME	Monthly 75th Percentile Statistics											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dissolved Oxygen[1]	mg/L	4	9.8 (12)	9.9 (16)	9.8 (14)	8.7 (19)	7.5 (19)	5.7 (20)	4.7 (20)	5 (20)	5 (22)	7.3 (19)	8.9 (19)	8.9 (16)
$CBOD_5$	*mg/L*	-	1.15 (14)	1.15 (18)	1.5 (14)	0.8 (19)	1.2 (22)	1.5 (23)	1.39 (26)	2.08 (22)	1.25 (24)	1.13 (24)	1.43 (20)	0.85 (19)
Unionized Ammonia[2]	ug/L	20	0.25 (6)	0.18 (7)	0.1 (8)	0.08 (10)	0.27 (12)	0.79 (12)	1.05 (13)	1.48 (8)	1.07 (11)	0.18 (10)	0.31 (13)	0.04 (9)
Temperature	*Deg.C*	-	0.7 (12)	1.5 (16)	4.63 (14)	11 (19)	16 (21)	21.5 (21)	21.63 (24)	19.6 (22)	16 (23)	10.15 (22)	6.25 (20)	2 (14)
Total Ammonia (Filtered)	*mg/L*	-	0.08 (13)	0.13 (16)	0.03 (15)	0.01 (19)	0.03 (21)	0.05 (22)	0.07 (22)	0.06 (20)	0.08 (23)	0.02 (20)	0.03 (20)	0.02 (17)
Total Phosphorus (Unfiltered)	mg/L	0.03	0.03 (15)	0.04 (18)	0.02 (15)	0.02 (19)	0.04 (23)	0.05 (23)	0.07 (25)	0.07 (22)	0.08 (24)	0.03 (24)	0.05 (21)	0.03 (19)
Nitrate, Total Filtered (Reactive)	mg/L	3	0.39 (8)	0.59 (8)	0.43 (9)	0.07 (12)	0.28 (13)	0.11 (14)	0.2 (14)	0.13 (13)	0.07 (14)	0.06 (12)	0.26 (12)	0.31 (12)
pH (field-measured)	-	6.5 – 8.5	7.7 (8)	7.6 (9)	7.6 (8)	7.9 (10)	7.9 (12)	7.8 (12)	7.8 (14)	7.8 (9)	7.7 (11)	7.7 (10)	7.8 (13)	7.6 (11)
Residue, Particular (TSS)	mg/L		7 (5)	6.4 (8)	3.6 (3)	1.5 (4)	3.6 (7)	4.3 (5)	5.5 (8)	4.5 (5)	5.9 (6)	2.3 (7)	3.5 (6)	2.5 (4)

[1] Results for dissolved oxygen reflect the 25th percentile

[2] Results for unionized ammonia are estimated as a fraction of “Ammonium, Total Filtered Reactive” using the field-measured temperature, and pH measured on the day the sample was taken

APPENDIX B

Field Measured Water Quality Results

Havelock WQ Monitoring: 2021 and 2022 Field-Measured Water Quality Results

Parameter	UNITS	RDL	PWQO / CCME	Date				
				2021-07-20	2021-08-30	2021-09-16	2021-11-23	2021-03-09[2]
Parameters of Interest								
Dissolved Oxygen	mg/L		4	8.3	8.2	8.7	9.1	9.5
Total BOD	*mg/L*	*2*		*<2*	*<2*	*<2*	*<2*	*<2*
Unionized Ammonia (Golder Calculated)[1]	ug/L		20	5.13	11.27	1.03	0.35	0.15
Total Ammonia-N	*mg/L*	*0.05*		*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*
Field Temperature	*Deg C*			*19.7*	*18.6*	*17.7*	*2.2*	*0.7*
Total Phosphorus	ug/L	20	30	21	37	49	<20	<20
Nitrate + Nitrite (N)	mg/L	0.1	3	0.18	0.37	0.19	<0.10	0.14
Nitrite (N)	*mg/L*	*0.01*		*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*
Nitrate (N)	*mg/L*	*0.1*		*0.18*	*0.37*	*0.19*	*<0.10*	*0.14*
Dissolved Chloride (Cl-)	mg/L	1	120	56	95	65	29	40
Field pH				8.5	8.9	7.8	8.2	8.0
Inorganics								
Alkalinity (Total as CaCO3)	mg/L	1		240	250	230	190	220
Conductivity	mS/cm	0.001		0.574	0.746	0.631	0.460	0.526
Microbiological								
Escherichia coli	CFU/100mL	10	100	530	780	160	10	<10
Metals								
Total Aluminum (Al)	ug/L	4.9	7.5	8.8	20.0	16.0	Metals sample not collected	25
Total Antimony (Sb)	ug/L	0.5	20	<0.50	<0.50	<0.50		<0.50
Total Arsenic (As)	ug/L	1	5	<1.0	<1.0	<1.0		<1.0
Total Barium (Ba)	ug/L	2		73	83	81		79
Total Beryllium (Be)	ug/L	0.4	1100	<0.40	<0.40	<0.40		<0.40
Total Bismuth (Bi)	ug/L	1		<1.0	<1.0	<1.0		<1.0
Total Boron (B)	ug/L	10	200	15	23	21		16
Total Cadmium (Cd)	ug/L	0.09	0.5	<0.090	<0.090	<0.090		<0.090
Total Calcium (Ca)	ug/L	200		88,000	89,000	95,000		150,000
Total Chromium (Cr)	ug/L	5		<5.0	<5.0	<5.0		<5.0
Total Cobalt (Co)	ug/L	0.5	0.9	<0.50	<0.50	<0.50		<0.50
Total Copper (Cu)	ug/L	0.9	5	<0.90	0.99	1.10		<0.90
Total Iron (Fe)	ug/L	100	300	110	<100	<100		<100
Total Lead (Pb)	ug/L	0.5	5	<0.5	<0.5	<0.5		<0.5
Total Lithium (Li)	ug/L	5		<5.0	<5.0	<5.0		<5.0
Total Magnesium (Mg)	ug/L	50		5,500	6,400	5,900		7,600
Total Manganese (Mn)	ug/L	2		57	110	58		16
Total Molybdenum (Mo)	ug/L	0.5	40	<0.50	<0.50	<0.50		<0.50
Total Nickel (Ni)	ug/L	1	25	<1.0	<1.0	<1.0		<1.0
Total Potassium (K)	ug/L	200		730	1,800	1,400		1,800
Total Selenium (Se)	ug/L	2	100	<2.0	<2.0	<2.0		<2.0
Total Silicon (Si)	ug/L	50		4,600	4,300	6,400		4,200
Total Silver (Ag)	ug/L	0.09	0.1	<0.090	<0.090	<0.090		<0.090
Total Sodium (Na)	ug/L	100		33,000	56,000	39,000		36,000
Total Strontium (Sr)	ug/L	1		200	240	200		250
Total Tellurium (Te)	ug/L	1		<1.0	<1.0	<1.0		<1.0
Total Thallium (Tl)	ug/L	0.05	0.3	<0.05	<0.05	<0.05		<0.05
Total Tin (Sn)	ug/L	1		<1.0	<1.0	<1.0		<1.0
Total Titanium (Ti)	ug/L	5		<5.0	<5.0	<5.0		5.9
Total Tungsten (W)	ug/L	1	30	<1.0	<1.0	<1.0		<1.0
Total Uranium (U)	ug/L	0.1	5	<0.10	0.22	<0.10		0.24
Total Vanadium (V)	ug/L	0.5	6	<0.50	<0.50	0.6		<0.50
Total Zinc (Zn)	ug/L	5	20	<5.0	<5.0	<5.0		<5.0
Total Zirconium (Zr)	ug/L	1	4	<1.0	<1.0	<1.0		<1.0

[1] Unionized Ammonia calculated assuming total ammonia at 50% RDL

[2] Metals for March 2022 sampled during a follow-up visit on April 1, 2022

APPENDIX C

Monthly Water Quality Results

Parameter	Unit	Scenario	WWTP Flow (m^3/day)	Plato Creek Flow	Monthly WWTP Discharge Target											
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dissolved Oxygen	mg/L	Scenario 1	1,335	7Q20	7.1					5.7					7.1	
		Scenario 2	1,580	7Q20	7.1					5.7					7.1	
$CBOD_5$	mg/L	Scenario 1	1,335	7Q20	403	326	406	1528	574	165	73	52	55	71	138	265
		Scenario 2	1,580	7Q20	357	291	356	1304	500	151	71	52	57	71	129	238
Total Ammonia	mg/L	Scenario 1	1,335	7Q20	18.0	17.4	14.4	14.0	5.0	1.6	*1.0*	*1.0*	1.2	2.2	4.3	14.4
		Scenario 2	1,580	7Q20	15.8	15.4	12.7	12.0	4.3	1.4	*1.0*	*1.0*	1.2	2.1	3.9	12.8
Total Phosphorus	ug/L	Scenario 1	1,335	7Q20	270					126					270	
		Scenario 2	1,580	7Q20	228					106					228	
pH		Scenario 1	1,335	7Q20	6.5 - 8.5											
		Scenario 2	1,580	7Q20	6.5 - 8.5											
E.Coli	cfu/100ml	Scenario 1	1,335	7Q20	100											
		Scenario 2	1,580	7Q20	100											
TSS	mg/L	Scenario 1	1,335	7Q20	29.8	26.8	26.3	68.7	38.9	19.4	13.3	10.3	11.4	8.8	14.6	20.5
		Scenario 2	1,580	7Q20	27.1	24.4	23.5	59.1	34.2	17.8	12.9	10.2	11.3	8.5	13.7	18.5

Minimum Annual
Minimum (Nov - May)
Minimum (Jun to Oct)

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