Fergus Golf Club Redevelopment

Servicing Capacity Study

Prepared For:

Fergus Development Inc.

June 30, 2026

CREATING QUALITY SOLUTIONS TOGETHER

FERGUS GOLF CLUB REDEVELOPMENT
SERVICING CAPACITY STUDY

PROJECT NO. 123016
Prepared For:

Fergus Development Inc.

Date:

June 30, 2026

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Executive Summary

Project Overview

Ainley & Associates Ltd. (Ainley) was retained by Fergus Development Inc. to prepare this Water and Wastewater Servicing Study in support of a draft plan of subdivision for a proposed residential development on the former Fergus Golf Club lands in the Township of Centre Wellington (Township). The site consists of two parcels on either side of Wellington Road 19: the northwest parcel (North West Site, ~42 hectares (ha)), which is proposed to continue to operate as a golf club, and the southeast parcel (South East Site, ~40 ha), which is proposed to be developed as 446 single-detached residential lots. All water and wastewater treatment infrastructure is proposed on the North West Site, with the Township anticipated to assume ownership upon completion. Final servicing concepts are subject to confirmation through the concurrent Schedule C Municipal Class Environmental Assessment (EA) Addendum.

Water Supply and Treatment

For the purpose of this assessment, it is assumed raw water would be drawn from three or four drilled production wells on the North West Site, with a required firm pumping capacity (capacity with largest well out of service) of at least 14.4 liters per second (L/s). The water treatment plant (WTP), housed in an approximately 200 square metres (m^2) steel building, would provide primary and secondary chlorine disinfection to achieve 4-log virus inactivation per O.Reg. 170/03. An above-ground standpipe (approximately 14.0 metre (m) internal diameter) would provide approximately 2,050 cubic metres (m^3) of treated water storage, including fire-flow storage (1,325 m^3, based on 184 L/s for two (2) hours per Fire Underwriters Survey, 2022), equalization storage (311 m^3), and emergency storage (409 m^3). A dedicated booster pumping station would maintain distribution system pressures between 345 kilopascals (kPa) and 552 kPa under normal operating conditions. The WTP, standpipe, and booster pumping station would be co-located adjacent to the wastewater treatment plant (WWTP), with a minimum 15m separation between potable water infrastructure and wastewater infrastructure. A shared diesel standby generator would provide backup power for the proposed infrastructure for both water and wastewater treatment plants.

Wastewater

In this assessment, it is assumed wastewater from the South East Site would drain by gravity to a sewage pumping station (SPS) on the southeast parcel, designed for a peak instantaneous flow of 37 L/s. A 250 m diameter High-Density Polyethylene forcemain, approximately 770 m in length, would convey flows across Wellington Road 19 to the treatment site. A bioreactor treatment process has been assessed as one candidate treatment concept for sizing and feasibility purposes. Final technology selection remains subject to the EA Addendum process. The wastewater treatment plant is sized for a combined average daily flow of approximately 500 m^3/day from the subdivision and golf club and would occupy a preliminary footprint of approximately 900 m^2. The complete treatment train includes fine and coarse screening, grit removal, flow equalization (500 m^3), dual-train biological nutrient removal with membrane bioreactor separation, alum dosing for phosphorus removal, and ultra violet light disinfection. Solids handling comprises rotary drum thickening, aerobic digestion, and 240-day winter sludge storage (approximately 550 m^3). Treated effluent would be conveyed by a dedicated forcemain to either Belwood Lake (approximately 3 kilometers (km), 200 millimetre (mm) High Density Polyethylene) or the Grand River (approximately 4 km, 300 mm High Density Polyethylene), with the alignment to be evaluated through the Environmental Assessment Addendum and assimilative capacity assessment.

Next Steps

Treatment technology and effluent discharge alternatives (e.g. Belwood Lake vs. Grand River) are to be evaluated through the Class EA Assessment Addendum and supporting studies (e.g. assimilative capacity study). The Class EA Assessment Addendum process also includes extensive consultation with the public, agencies (including the Grand River Conservation Authority and the Ministry of Environment, Conservation and Parks), and other stakeholder consultations, as well as Indigenous Communities. Township of Centre Wellington is a co-proponent of this EA Addendum.

A final Water Supply Investigation from GEMTEC will need to be advanced to confirm sustainable yields for the wells, and to address source water protection requirements under the Clean Water Act (2006).

Hydraulic modelling (InfoWater) to be completed during detailed design to confirm watermain sizing and pressure performance under all design scenarios.

Building architecture, materials, and separation to confirm the fire flow and storage volume

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Acronyms and Definitions

Acronym	Full Term	Definition/Context
ADF	**Average Daily Flow**	Mean volume of wastewater or water generated per day under normal operating conditions.
BNR	**Biological Nutrient Removal**	Secondary treatment process using specialized microorganisms to remove carbon, nitrogen, and phosphorus from wastewater.
BOD_5	**Biochemical Oxygen Demand (5-day)**	Measure of organic matter in wastewater; oxygen consumed by biological processes over five days.
Class EA	**Class Environmental Assessment**	Pre-approved provincial EA process under Ontario's Environmental Assessment Act for municipal infrastructure.
EQ Tank	**Equalization Tank**	A storage tank upstream of biological treatment used to attenuate peak flows and smooth variability in systems.
FUS	**Fire Underwriters Survey**	Methodology used to determine required fire flows for public fire protection. 2022 Edition referenced.
GUDI	**Groundwater Under the Direct Influence of Surface Water**	Regulatory designation under Ontario Regulation 170/03 requiring enhanced treatment when wells are hydraulically connected to surface water.
HDD	**Horizontal Directional Drilling**	Trenchless installation method used to bore beneath roads, waterways, and environmentally sensitive features without open-cut excavation.
HDPE	**High-Density Polyethylene**	Thermoplastic pipe material typically used for pipes due to its corrosion resistance and flexibility.
I&I	**Infiltration and Inflow**	Extraneous groundwater and stormwater entering the sanitary sewer system through defects and connections.
MBR	**Membrane Bioreactor**	Advanced wastewater treatment process combining biological nutrient removal with ultrafiltration or microfiltration membranes.
MDD	**Maximum Day Demand**	Peak daily water demand: average day demand × Maximum Day Factor. Governs production well and WTP sizing.
MDD + FF	**Maximum Day Demand plus Fire Flow**	Peak daily water demand with the flow of water required for fire fighting.
MECP	**Ministry of the Environment, Conservation and Parks**	Ontario provincial regulator for water and wastewater systems.
PLC	**Programmable Logic Controller**	Industrial computer housed in the SPS control building used to automate pump operations, monitor alarms, and communicate with supervisory systems.
ppu	**Persons Per Unit**	Population density factor for converting unit counts to equivalent population.

Acronym	Full Term	Definition/Context
RAS	**Return Activated Sludge**	Biological solids recycled to maintain the active microbial population.
RDT	**Rotary Drum Thickener**	Mechanical equipment that concentrates waste activated sludge before transfer to the aerobic digester.
SPS	**Sewage Pumping Station**	Facility that lifts wastewater from low elevations to higher elevations.
TIN	**Total Inorganic Nitrogen**	Sum of ammonia, nitrate, and nitrite in treated effluent.
TKN	**Total Kjeldahl Nitrogen**	Measure of organic nitrogen and ammonia in raw wastewater.
TP	**Total Phosphorus**	All forms of phosphorus in wastewater.
TSS	**Total Suspended Solids**	Fine particles suspended in wastewater or effluent.
UV	**Ultraviolet Disinfection**	Physical disinfection process that inactivates pathogens using UV light.
VFD	**Variable Frequency Drive**	Electronic device controlling pump motor speed to modulate flow.
WAS	**Waste Activated Sludge**	Excess biological solids wasted from the treatment process to control the mixed liquor suspended solids concentration system.
WTP	**Water Treatment Plant**	Location where water is treated for consumption.
WWTP	**Wastewater Treatment Plant**	Location where wastewater is treated for discharge.

1 Introduction

1.1 Introduction

Ainley and Associated Ltd. (Ainley) has been retained by Fergus Development Inc. to prepare a water and wastewater Servicing Capacity Study pertinent to the revision to the draft plan of subdivision for a development located in Township of Centre-Wellington, Ontario. This document reviews candidate alternatives for water treatment and wastewater treatment (with discharge) infrastructure required to service the proposed development. The final technology and servicing solution will be subject to the findings of an Addendum to the original 2024 Fergus Golf Club Redevelopment Environmental Assessment (EA).

The original EA's Environmental Study Report (ESR) developed a water and wastewater servicing solution for this proposed development. The preferred alternative for water supply was to use groundwater on the golf course lands and treat it on a treatment campus directly adjacent to the golf course. The preferred alternative for wastewater was to collect raw sewage within the development via a sewage pumping station (SPS) and conveyed to a wastewater treatment plant on the same treatment campus. The wastewater would be treated there using Waterloo Biofilters and discharged to an irrigation pond that would be spray irrigated on the course.

The increase in the number of units from 118 to 446 in the development means that additional water and wastewater treatment must be provided. In addition, the increased flows make the Waterloo Biofilters a less feasible option due to the higher quantity of flows and nutrient loads. The Class EA Addendum will review future treatment capacities, assess the need for additional wells, and evaluate feasible wastewater technologies and discharge receivers. The conceptual plan presented in this report serves as a feasibility assessment. The details on the water supply, water treatment, wastewater collection, wastewater treatment and effluent discharge receiver may change pending the Class EA Addendum.

The existing site, shown on Figure 1, consists of two parcels; the northwest parcel, which is 42.35 ha, situated on the north side of Wellington Road 19, and the southeast parcel, which is 39.85 ha, situated on the south side of Wellington Road 19. The proposed residential development would include 446 lots located on the southeast parcel (the "SE Site"). The water supply/treatment and wastewater treatment facilities would be proposed to be integrated into the existing Golf Club, which would remain on the northwest parcel (the "NW Site").

1.2 Purpose

This study focuses on identifying alternatives for water and wastewater servicing concepts for the Fergus Golf Club Development, necessitated by an increased unit count and higher servicing demands. The servicing concepts are subject to change based on the results of the Class EA amendment process being undertaken concurrently due to the increase number of units needing water and wastewater servicing, though they remain preliminary and may be adjusted based on public, agency, or Indigenous input during the Class EA addendum process.

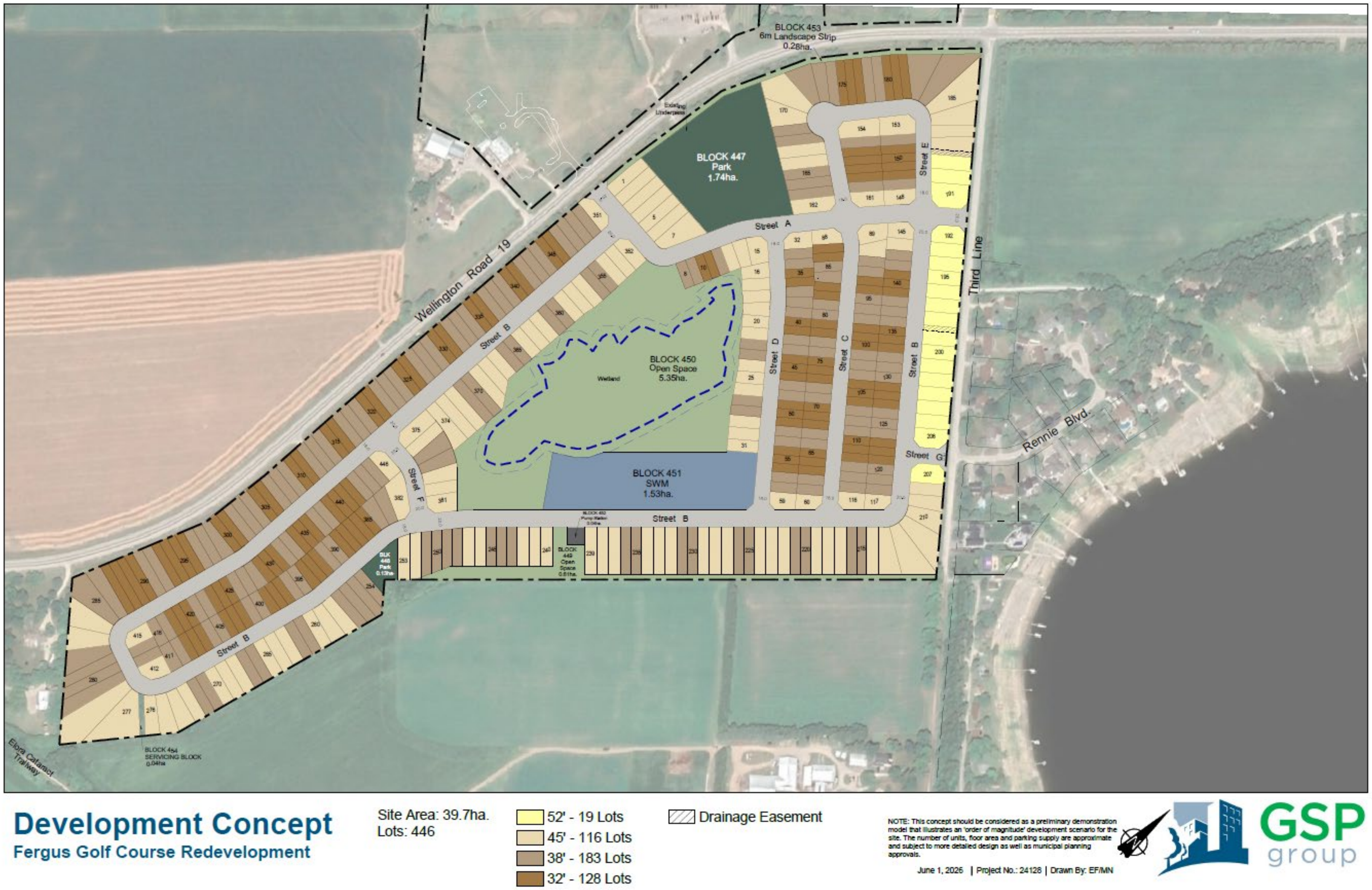


Figure 1: Fergus Golf Club Development Plan

2 Design Criteria

The design criteria for the water and wastewater infrastructure are based on flow values outlined in the *Township of Centre Wellington Development Manual (June 2024)*. Additional design parameters have been established with consideration of the Township's *Development Charges Background Study (April 2021)* and the relevant guidelines from the Ontario Ministry of Environment, Conservation and Parks' (MECP) *Design Guidelines for Drinking-Water Systems (2016)* and *Design Guidelines for Sewage Works (2016)*. For the specific sections of the referenced design criteria, see Table 1.

2.1 Water Design Criteria

The following design criteria have been used to establish the design basis for the WTP.

Table 1: Water Design Criteria for the Proposed Fergus Golf Club Redevelopment

Parameter	Value	Source
Number of Units	446	Fergus Development Inc.
Persons Per Unit	3.094 ppu	Township of Centre Wellington 2021 Development Charges Background Study (Section 3.3)
Residential Population	1,380	Calculated from the Above
Average Day Flow	350 L/Capita/Day	2024 Centre Wellington Development Manual (D.1.1.2)
Maximum Day Factor	2.50	Design Guidelines for Drinking-Water System (Section 3.4.2)
Peak Hour Factor	3.75	Design Guidelines for Drinking-Water System (Section 3.4.2)
Peak Hour to Instantaneous Factor	1.5	Estimated

2.2 Wastewater Design Criteria

The following design criteria have been used to establish the design basis for the WWTP.

Table 2: Wastewater Design Criteria for the Proposed Fergus Golf Club Redevelopment Wastewater Treatment Plant

Parameter	Value	Source
Number of Units	446	Fergus Development Inc.
Persons Per Unit	3.094 ppu	Township of Centre Wellington 2021 Development Charges Background Study (Section 3.3)
Residential Population	1,380	Calculated from the Above
Average Day Flow	350 L/Capita/Day	2024 Centre Wellington Development Manual (D.1.1.2)
Harmon Peaking Factor	3.72	Ontario Design Guidelines for Sewage Works (5.5.2.1)
I&I Allowance	0.15 L/ha/s	2024 Centre Wellington Development Manual (D.1.1.2)
Peak Hour to Instantaneous Factor	1.5	Estimated

3 Water Treatment

3.1 Plant Design Basis

The projected maximum daily water demand that would need to be met by the new WTP at the development's full build-out conditions is summarized in Table 3.

Table 3: Projected Residential Water Demands at Development Build-Out

Parameter	Residential	Club House	Maintenance Building	Total
Total Units	446	-	-	446 Units
Population	1,380 people[1]	150 seats[3]	-	-
Average Water Demand (m^3/day)[2]	484	-	-	484
Average Water Demand (L/s)	5.8	-	-	5.8
Maximum Day Factor	2.50	-	-	-
Maximum Day Flow (L/s)	14.0	0.41[1,2,3]	0.016[2,3,4]	**14.4**
Peak Hour Factor	3.75	-	-	-
Peak Hour Flow (L/s)	21.0	-	-	21.0
Peak Inst. Factor (-)	1.5	-	-	-
Peak Inst. Flow (L/s)	31.4	-	-	31.4

1. Based on Ontario Building Code 8.2.1.3. (1).6.c – Maximum Wastewater Flow (food services operation) and Ontario Building Code 8.2.1.3.(1).12. a – Maximum Wastewater Flow (Club House excluding food services operation).
2. A conversion factor of 0.90 from wastewater to water was applied, as well as a 30% safety factor.
3. Based on Ontario Building Code 8.2.1.3.(1).26. a –Wastewater Flow (water closet for warehouse).
4. A conversion factor of 0.90 from wastewater to water was applied, as well as a 30% safety factor.

3.2 Water Supply

The raw water supply required by the new water system would be derived from three (or four) drilled wells located in the NW site area. Well supply systems must be designed to provide a firm capacity (largest well out of service) which is capable of meeting projected maximum day demand (MDD) for communal systems with storage. A Water Supply Investigation report by GEMTEC is in progress for the wells on the Fergus Golf Course Redevelopment lands with a draft report was reviewed. The estimated pumping rates for the wells are summarized in Table 4 below.

Table 4: Estimated Well Pumping Rates

Well No.	Estimated Pumping Rate
Well 1 (PW21-1)	8.0 L/s
Well 2 (PW25-2)	2.5 L/s
Well 3 (PW25-3)	5.2 L/s
Well 4 (PW26-4)	Equal to or Greater than 6.7 L/s*

*Well 4 estimated pumping rate is yet to be confirmed and requires further testing to confirm the estimated pumping rate. To obtain the required firm capacity, Well 4 will need to yield a minimum pumping rate of 6.7 L/s or higher.

The proposed water supply system would be designed to provide a firm pumping capacity of at least 14.4 L/s, corresponding to the projected maximum day demand for the residential subdivision and golf club. The total number of production wells required would depend on the confirmed sustainable pumping capacity of future Well No. 4. Based on the available information, a minimum of three wells is anticipated to be required to satisfy the firm-capacity criterion, with the largest-capacity well assumed to be out of service.

3.3 Water Quality

Review of water quality data for observation wells and test wells at various locations near the site of the proposed new production well supply, and for existing wells supplying the community, suggests that the new source water would comply with all current Ontario Drinking Water Quality Standards. The hardness levels were found to be in excess of the operational guidelines (80–100 mg/L). The water test results can be found in Appendix B. Based on the initial water quality data, the wells are assumed to be non-GUDI subject to confirmation through the water supply investigation report from GEMTEC.

3.4 Water Treatment Requirements

As per MECP regulatory guidelines primary and secondary disinfection would be required at the water treatment plant.

The design of the WTP to serve the redevelopment is therefore based on the following assumptions:

- The proposed wells are strictly groundwater, with no direct surface water influence.
- Provisional cartridge filters could be considered in the design pending further investigation of the Wells.
- Provisions for disinfection to achieve a minimum 4-log (99.99 percent) inactivation of viruses would be included, in accordance with the requirements of Ontario Regulation 170/03 (revised June 2006).
- Primary and secondary disinfection would be provided by sodium hypochlorite. The facility would be designed with future provisions to include an UV disinfection system if needed.
- The water treatment plant would include an above-ground standpipe for storage with provisions for mixing. Chlorine would be injected prior to the standpipe with a top-up prior to discharge to the distribution system.

4 Water Distribution System

4.1 Introduction

The Class EA Addendum will provide an update of water supply needs and a review of water supply and treatment alternatives. Although still subject to the EA, the previous conclusions of the water supply and treatment are assumed, with additional wells and a larger treatment plant used to meet the greater demands.

4.2 Design Criteria

The design criteria that would be utilized in the hydraulic model are outlined in Table 1.

The required fire flow for the proposed facility was determined in accordance with the Fire Underwriter's Survey (FUS) Water Supply for Public Fire Protection methodology (2022 edition).

At this stage of design, the calculation has been based on a two-storey building with an exterior wall fire-resistance rating of less than one hour and setbacks of less than 3 m from adjacent structures. These assumptions represent a conservative design basis and would be confirmed during subsequent phases of design as the building architecture, fire separation distances, and fire-resistance ratings are finalized.

Based on the above assumptions, the required fire flow was determined to be 184 L/s for a duration of two hours.

4.3 Water Storage

A dedicated standpipe would be a candidate to provide the required treated-water storage for the proposed development. Based on the preliminary water-demand assumptions and the calculated fire-flow requirement, the standpipe should provide a minimum usable storage volume of approximately 2,050 m^3. The required usable volume includes fire-flow storage (1,325 m^3), equalization storage (311 m^3), and emergency storage (409 m^3).

The required standpipe capacity is preliminary and would be confirmed during subsequent design phases. In particular, the governing fire-flow requirement may need to be revised once the proposed building types, construction materials, occupancy classifications, building areas, and fire-protection measures within the development have been confirmed. Any revisions to the fire-flow requirement will affect the required fire-storage volume and the total standpipe capacity.

The preliminary treated-water storage requirement was calculated in accordance with the Ontario Ministry of the Environment, Conservation and Parks Design Guidelines for Drinking-Water Systems. The guideline calculates the total treated-water storage requirement as the sum of the fire-storage, equalization-storage, and emergency-storage components. Equalization storage is calculated as 25% of the maximum day demand. Emergency storage is calculated as 25% of the combined fire-storage and equalization-storage volumes.

The preliminary storage calculation is summarized below in Table 5.

Table 5: Preliminary Standpipe Storage Requirements

Criteria	Value	Unit
Equalization Storage	311	m^3
Fire Storage[1]	1,325	m^3
Emergency Storage	409	m^3
Total Storage	2,045	m^3

Notes:

1. As discussed in Section 4.1, the fire storage was calculated on the basis of 184 L/s for a duration 2 hours

The standpipe dimensions will be refined during detailed design. Based on a conceptual maximum usable water depth of approximately 15.0 m, a cylindrical standpipe with an internal diameter of approximately 14.0 m would be required to provide the usable storage volume of 2,050 m^3 when equipped with a booster pumping station. The candidate tank dimensions will be confirmed based on the selected tank configuration, required freeboard, minimum operating level, unusable storage below the outlet elevation, site-specific zoning requirements, and the hydraulic grade line required to maintain adequate distribution-system pressures during normal operating conditions and service interruptions.

A dry hydrant is a candidate to be installed at the Fergus Golf Club irrigation pond to provide an emergency source of non-potable water for firefighting if the standpipe is unavailable. The dry hydrant would be intended strictly as a contingency measure for emergency firefighting use when the potable-water storage and pumping system is out of service.

4.4 Booster Pumping Station

With the conceptual standpipe, a dedicated booster-pumping system would be required to provide flow in the distribution system. A preliminary pumping configuration includes one jockey pump and three high-lift pumps arranged as two duty pumps and one standby pump. The jockey pump would maintain distribution-system pressure during periods of low demand and reduce unnecessary cycling of the larger high-lift pumps. The high-lift pumps would operate in a staged configuration to satisfy the normal operating range. Fire protection would be provided by two dedicated fire-flow pumps arranged in a duty-standby configuration. The fire-flow pumps would be sized to deliver the required fire flow while maintaining the minimum required residual pressure within the distribution system. A backpressure valve would be part of the design, as required, to maintain an acceptable fire-pump operating condition and regulate discharge pressure over the anticipated range of fire-flow demands. The detailed valve arrangement and control strategy would be confirmed based on the selected pump curves and the results of the hydraulic analysis.

4.5 Water Distribution System Level of Service

The water system evaluation would involve assessing the system performance under various demand scenarios. The water distribution system is required to operate within pressures of 345 kPa (50 psi) to 552 kPa (80 psi) under normal operating conditions (average day and maximum day), and a slightly expanded pressure range (275 kPa (40 psi) to 700 kPa (100 psi) under peak hour conditions. A minimum of 140 kPa (20 psi) is required under the maximum day plus fire flow (MDD + FF) condition.

4.6 Watermain Network

The water model would use the hydraulic software InfoWater. Demands would be assigned through nodes in the system to force water through multiple watermains.

A modelling exercise would be completed to confirm the requirements of the watermain to provide MDD + FF with the levels of service identified in accordance with the MECP design guidelines, including water quality.

4.7 Modelling Scenarios and Results

It is recommended that four modelling scenarios be analyzed as part of the detailed design to assess the system performance and conformance with the pressure level of service. These included - Average day demand, Maximum day demand, Peak hour demand and Maximum day demand plus fire flow. The booster pumping station would be sized to accommodate both the MECP fire flow requirements and the FUS criteria, once confirmed.

5 Wastewater

5.1 Introduction

The EA Addendum will provide an analysis of the wastewater collection, wastewater treatment and discharge alternatives. Treatment processes being evaluated by the EA Addendum range from conventional activated sludge, the previously evaluated Waterloo Biofilters, and an advanced treatment process such as a package Membrane Bioreactor (MBR). A packaged MBR WWTP with discharge to the Grand River watershed will be assessed as a candidate treatment concept for sizing and feasibility purposes. Final treatment technology selection remains subject to the EA Addendum evaluation.

5.2 Collection System

The collection system would consist of a network of gravity sanitary sewers, maintenance holes, and associated appurtenances designed to service the proposed development. Design of the subdivision internal sanitary collection system would be completed by RJ. Burnside & Associates and is not included within the scope of this study.

5.3 Sewage Pumping Station

The proposed sanitary collection system would convey wastewater from the residential subdivision by gravity sewer to a local SPS located on the southeast parcel of the development as identified in the Figure 2.

Figure 2: Proposed Location of SPS within the SE Parcel.

5.3.1 SPS Design Flows

The SPS design flows are shown in Table 6 and were calculated using the design criteria noted in Section 2. These design flows are specific to the residential SPS and exclude any sanitary flows from the NW parcel Golf Club Lands.

Table 6: Project Flows from the Proposed Fergus Golf Club Redevelopment Sewage System

Criteria	Value	Unit
Average Daily Flow	483	m3/d
Harmon Peaking Factor	3.71	-
Peak Day Dry Weather Flow	1,797	m3/d
Infiltration Flowrate[1]	516	m3/d
Peak Hour Wet Weather Flow	2,313	m3/d
Peak Instantaneous Flow[2]	3,212	m3/d
Peak Instantaneous Flow[2]	37	L/s

[1]Infiltration factor of 0.15 L/s/ha (Township Development Manual) using the area identified for the SE parcel (39.85 ha)
[2]Peak Instantaneous Flow is the criteria used to size pump station requirements.
[3]Design flows calculated assuming 446 units and serviced by the SPS

5.3.2 SPS Design Basis

For the purposes of this servicing study, the design of the sewage pumping station would adhere to the MECP design guidelines and applicable Township design standards, while also incorporating responses to comments provided by the Township during previous review submissions

As such, the following design features are proposed:

- A subgrade circular concrete wet well that would house two (2) submersible sewage pumps (duty/standby), controls (floats/level transmitter) and discharge piping including 6-hours of storage during average day flows. A spare pump would be kept at the SPS at all times.
- A separate subgrade valve chamber that would house all the valving, flow and pressure monitoring equipment.
- Odour control system with active carbon media.
- Above ground control building that would house the electrical equipment and controls (i.e., motor control centers, automatic transfer switch, PLC, etc.) and spare parts.
- An outdoor emergency standby generator (natural gas).

5.3.3 SPS Conceptual Site Plan

A conceptual site plan layout based on the design basis for the facility is shown in Figure 3.

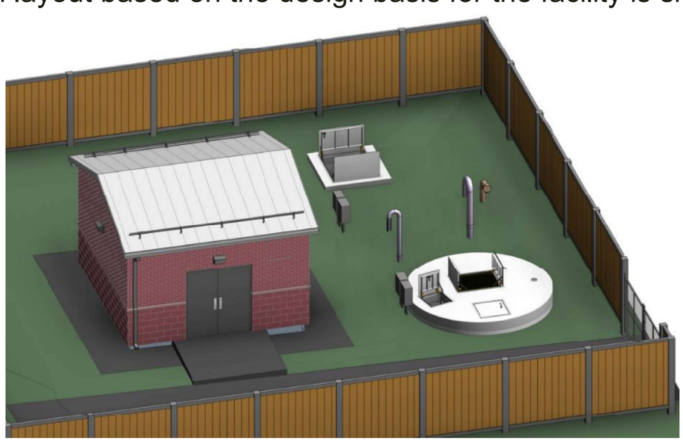


Figure 3: Preliminary 3D Model of the Proposed Fergus Golf Club Redevelopment Sewage Pumping Station

5.3.4 Forcemain Alignment

While the Class EA Addendum will formally evaluate alternative forcemain alignments, this feasibility study investigates a candidate alignment through the development . As shown in Figure 4, this alignment conveys sanitary flows from the residential subdivision on the SE parcel to the WWTP located on the NW parcel. However, the final alignment remains subject to the natural, social/cultural, technical and economic impacts evaluation required by the Class EA Addendum.

The proposed forcemain is anticipated to be approximately 770 m long and constructed of high-density polyethylene (HDPE) pipe. A nominal diameter of 250 mm is currently expected but is subject to confirmation during detailed design.

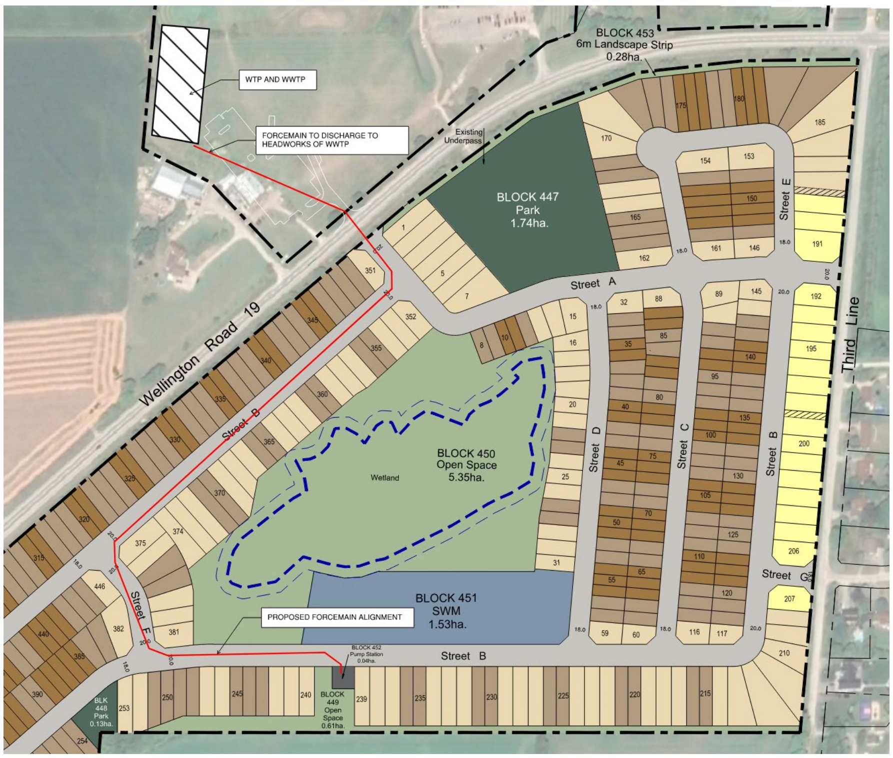


Figure 4: Conceptual Forcemain Alignment

5.4 Wastewater Treatment Plant

As mentioned in the introduction, a packaged MBR WWTP with discharge to the Grand River watershed will be assessed as a candidate treatment concept for sizing and feasibility purposes. Final treatment technology selection remains subject to the EA Addendum evaluation.

5.4.1 Design Basis

The WWTP would be capable of serving the residential population of 1,380 persons along with the golf club, with the following preliminary design criteria and assumed influent characteristics:

Wastewater Flows

Table 7: Projected Wastewater Flows for the Fergus Golf Club Redevelopment

Criteria	Value	Unit
Average Daily Flow (Subdivision only) *	483	m3/d
Average Daily Flow (Golf Club)	13	m3/d
Combined Average Daily Flow	496	m3/d
Peak Hour Dry Weather Flow	1,838	m3/d
Infiltration Flow Allowance	517	m3/d
Peak Hour Wet Weather Flow	2,355	m3/d
Peak Instantaneous Flow	3,274 (37.9)	m3/d (L/s)

Influent Characteristics

- Five-day biochemical oxygen demand (BOD5) 250 mg/L
- Total suspended solids (TSS) 250 mg/L
- Total Kjeldahl nitrogen (TKN) 35 mg/L
- Total phosphorus (TP) 7 mg/L
- E. coli (geometric mean) 10^7 per 100 mL

The following monthly average effluent requirements are assumed and would be confirmed once the assimilative capacity study is complete and accepted by the MECP.

Effluent Characteristics

- BOD5 10 mg/L
- TSS 10 mg/L
- Total inorganic nitrogen (TIN) 2.0 mg/L (summer), 3.0 mg/L (winter)
- TP 0.03 mg/L
- E. coli (geometric mean) 100 per 100 mL

As part of the Class EA Addendum, it will be necessary to assess alternative process technologies. For purposes of estimating plant footprint requirements for the WWTP, the following liquid-stream treatment processes have been assumed:

- Screening (Coarse and Fine)
- Grit removal
- Equalization
- Biological nutrient removal (BNR) process with membrane solids separation (i.e. MBR)
- Ultraviolet (UV) disinfection

The following solids-stream processes have been assumed:

- Waste activated sludge thickening
- Aerobic digestion for sludge stabilization
- Liquid-sludge storage

5.4.2 Process Overview

For a feasibility assessment for the proposed subdivision, a packaged WWTP utilizing membrane bioreactor (MBR) technology is investigated.

The treatment process would include preliminary treatment for screening and grit removal, followed by flow equalization and secondary treatment incorporating biological nutrient removal and membrane filtration. Treated effluent would undergo ultraviolet disinfection prior to discharge to the nearest and acceptable receiving watercourse.

Sludge generated through the treatment process would be thickened and stored for up to 240 days before being transported off-site for disposal at an approved facility or beneficially reused through land application, where permitted.

An odour-control strategy and process would be developed for this candidate plant to mitigate potential nuisance odours, with particular emphasis on the headworks area where raw sewage handling may result in elevated concentrations of odour-generating compounds.

A conceptual block flow diagram for the WWTP facility is shown in Figure 5.

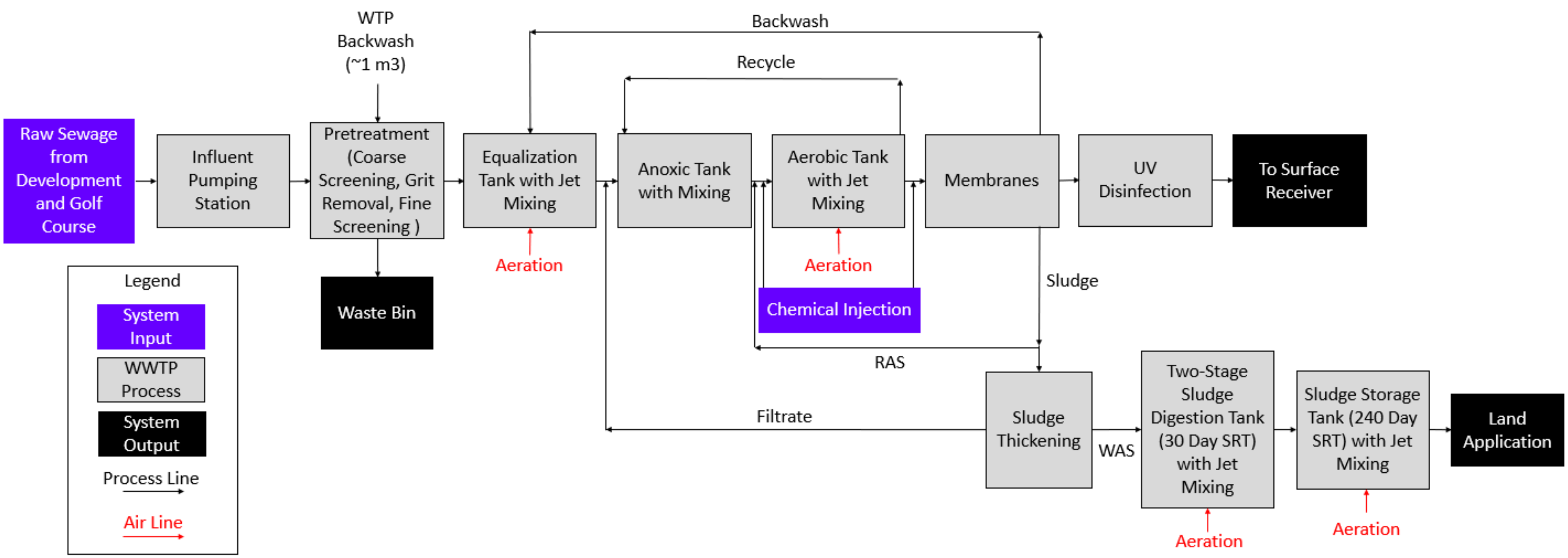


Figure 5: Candidate Treatment Process Block Flow Diagram for Proposed Fergus Golf Club Redevelopment Wastewater Treatment Plant

5.4.3 Liquid Stream Treatment Process

5.4.3.1 Screening and Grit Removal

The primary treatment process (headworks) would consist of coarse screening, grit removal, and fine screening. The purpose of the headworks process is to remove large debris, rags, stringy material, grit, and other inorganic materials that could interfere with downstream treatment processes, increase equipment wear, and/or result in maintenance issues. Treatment of fats, oils and greases would be part of the headworks to protect downstream processes.

The screening system would consist of duty and standby each sized for peak instantaneous flows as per MECP design guidelines. Screenings would be washed and compacted prior to discharge into a waste bin for off-site disposal. Following screening, wastewater would enter a grit removal system where heavier inorganic particles such as sand and gravel would settle and be removed from the process stream. Grit would be collected, washed, and discharged to a separate waste container for disposal.

Following pretreatment, screened and degritted wastewater would be conveyed to the equalization tank.

5.4.3.2 Equalization Tank

The equalization (EQ) tank is designed to provide storage and attenuate peak instantaneous flows coming to the WWTP. Level transmitters in the EQ tank would control pumps that would send the wastewater to the Biological Nutrient Removal process. The equalization tank would be equipped with a jet-mixing system to maintain the wastewater in suspension and minimize solids deposition. An aeration system would also be provided to maintain aerobic conditions and reduce the potential for septicity and associated odour generation. The equalization tank is anticipated to have an approximate storage volume of 500 m^3, which is equivalent to approximately one day of storage at the projected design average daily influent flow of 500 m^3/d.

5.4.3.3 Biological Nutrient Removal System

A multistage biological nutrient removal (BNR) treatment process which uses specialized microorganisms to naturally extract carbon, nitrogen and phosphorus from wastewater – with the addition of metal salt (e.g. alum) additions would be used. Two parallel process trains would be provided to support operational redundancy. The process equipment within each train would be sized to accommodate 100% of the peak hourly wet-weather flow, allowing either train to remain in service while the other is offline for maintenance or repairs. Process tankage would be sized based on the projected average daily flow and the applicable hydraulic retention time requirements.

The BNR process includes an anoxic stage, followed by an aerobic stage, before discharging into the membrane separation stage.

The anoxic stage where there is oxygen present, but it is bound up in nitrate and nitrite (NO2 and NO), is where bacteria use the bound oxygen in nitrates and nitrites for metabolism and release harmless nitrogen gas into the atmosphere. This process is called denitrification. This stage in the BNR process would be mechanically agitated.

The aerobic stage would be aerated and mixed to provide free oxygen. The aeration system would be tapered along the length of the aerobic tank to reduce the oxygen concentration being recycled to the anoxic zone for de-nitrification purposes.

Process air would be supplied by dedicated blowers. The blower technology and configuration would be evaluated during detailed design in consultation with the Township's Operations staff. Airflow modulation and system turndown would be achieved through blower inlet throttling, variable-frequency drives, or a combination of both, as appropriate for the selected equipment.

Mixed liquid from the BNR process would flow to immersed membrane cassettes in steel tanks, configured in a duty/standby configuration. Depending on the supplier, these could be ultrafiltration or microfiltration membranes, configured either as hollow fibres or flat plates. This is to be determined, see comparisons of technology in Table 8. Permeate pumps would be used to draw solids-free water through the membranes and convey flows through the effluent main, eliminating the need for dedicated final effluent SPS. Return Activated Sludge (RAS) (mixed liquid suspended solids rejected by the membranes) would be pumped to the aerobic zone of the BNR train. Waste activated sludge (WAS) pumps would transfer mixed liquor to the plant solids handling facilities to prevent the accumulation of solids.

Table 8: General Comparisons of Microfiltration and Ultrafiltration

Feature	Microfiltration	Ultrafiltration
Pore Size	0.1 to 10 µm	0.01 to 0.1 µm
Operating Pressure	Low	Moderate
Removes Bacteria?	Yes	Yes
Removes Viruses?	No	Yes

Equipment associated with membrane separation (permeate pumps, backpulse system, and cleaning system) would be located adjacent to the membrane tanks.

Membrane productivity would be sustained by a variety of methods:

- Air scour
- Backpulsing (with or without a chemical such as bleach)
- Maintenance cleaning (performed several times per week)
- Recovery cleaning (performed several times per year)

Air for membrane air scour would be supplied by a second set of blowers. These blowers likely would be located with the blowers used for process aeration.

5.4.3.4 Phosphorus Removal and Tertiary Treatment

The proposed MBR process, in conjunction with chemical phosphorus removal through alum dosing, is anticipated to achieve a high degree of phosphorus removal. Alum would be added upstream of the membrane process to precipitate soluble phosphorus, allowing it to be removed with the waste sludge stream.

The final effluent phosphorus criterion as noted previously, will be established through the Environmental Assessment Addendum and the associated assimilative capacity assessment. The treatment process will be refined during preliminary and detailed design, as required, to achieve the approved effluent discharge limits.

5.4.3.5 Ultraviolet Disinfection

The UV disinfection process would be designed for peak-hour wet-weather flow to meet discharge requirements for *E. coli*, but the membrane process also would remove pathogens such as bacteria and viruses. To provide necessary redundancy, there would be multiple inline UV units in a duty-standby configuration.

5.4.3.6 Effluent Pumping

The treated effluent would be conveyed to the receiving waterbody using the permeate pumps and a dedicated effluent main. The final effluent discharge location and effluent main alignment would be confirmed through the Environmental Assessment Addendum process.

Effluent flow monitoring equipment, including a magnetic flow meter and automatic sampler would be provided to continuously measure plant discharge rates and support regulatory reporting requirements.

A non-potable water system consisting of a small service pump and pressure tank would also be provided to supply process water for screenings and grit handling, membrane cleaning, sludge handling, and general plant housekeeping activities.

5.4.4 Solids Stream Treatment Process

5.4.4.1 Waste Activated Sludge Thickening

Waste activated sludge (WAS) from the BNR process would be pumped to a rotary drum thickener (RDTs), which would be located in the WWTP building near the aerobic digesters. The RDT would consist of a feed system, rotating assembly, and support equipment. Polymer may be added upstream of the RDTs to coagulate and thicken the solids. The RDT filtrate would be returned upstream of the anoxic tank in the secondary treatment.

5.4.4.2 Aerobic Digestion

Waste activated sludge (WAS) would be stabilized through aerobic digestion to reduce the volatile solids content and overall solids mass prior to storage and subsequent land application or off-site disposal. Thickened WAS would be transferred to the aerobic digester using dedicated sludge feed pumps. The digester would be equipped with aeration and mixing systems to maintain aerobic conditions and promote effective solids stabilization.

A supernatant decant and return system would not be provided. This approach would minimize the recycle of soluble phosphorus to the liquid treatment process and retain phosphorus within the stabilized sludge for removal from the facility with the thickened biosolids.

5.4.4.3 Sludge Storage

Due to the long winter period during which stabilized sludge (Biosolids) cannot be land applied to existing users within the area, provisions for storage must be made. The aerobically stabilized and thickened solids would be pumped to one sludge storage tank. The tank would be sized to accommodate winter storage of the solids production from the plant for a period of 240 days (approximately 550 m^3, based on approximately 180 g dry solids of sludge/m^3 of raw wastewater for undigested waste activated sludge in a system with phosphorus removal, MECP *Design Guidelines for Sewage Works Table 16-1*). Providing winter sludge storage at the plant represents a worst-case scenario from a layout perspective, so this has been assumed for planning.

The aerobic digester and sludge storage tanks would be constructed of bolted, glass-fused-to-steel panels and equipped with aluminum geodesic dome covers. Each tank would be provided with an aerated jet-mixing system to maintain a homogeneous sludge mixture and minimize solids settling. The sludge recirculation pumps serving the jet-mixing system would also be configured to transfer sludge to sewage-hauler trucks for off-site disposal.

5.5 Treated Effluent Main

As part of the design of the proposed WWTP, alternative effluent main alignments would be evaluated through the Environmental Assessment Addendum to either potential discharge to suitable receiving waters within the Belwood Lake/Grand River System (e.g. via 3rd line, 2nd line).

As example, these current alternative alignments are shown on Figure 6 and Figure 7.

Figure 6: Potential Effluent Main Alignment from WWTP to Belwood Lake and 3rd line.

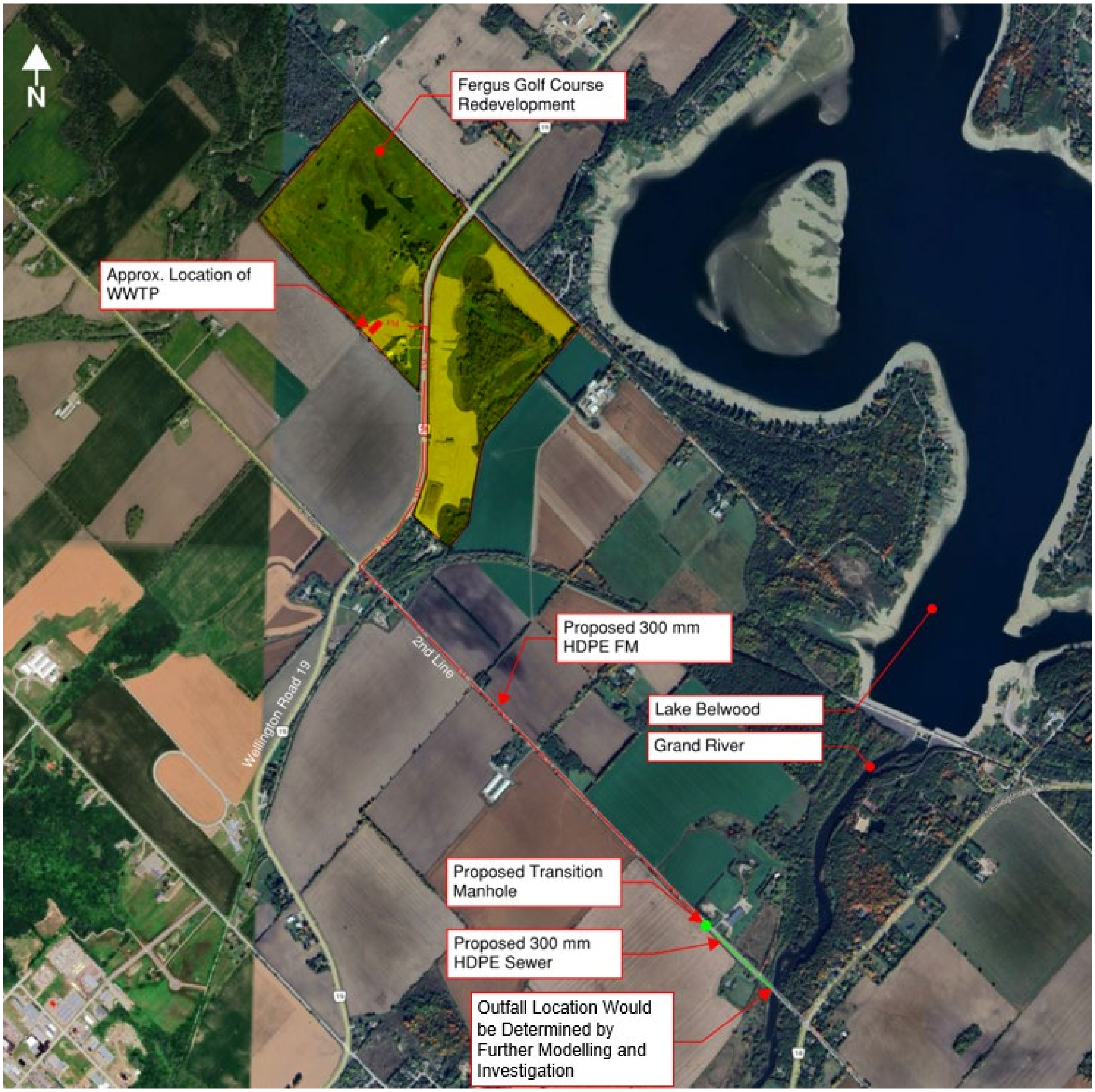


Figure 7: Potential Effluent Main Alignment from WWTP to Grand River along 2nd Line

5.5.1 Effluent Main Option 1: Belwood Lake Discharge

Under this alternative, treated effluent from the proposed wastewater treatment plant would be conveyed to Belwood Lake through a 200 mm HDPE effluent forcemain extending approximately 3 km from the WWTP site to the proposed discharge location. The alignment generally traverses lands east of the proposed development before terminating at a shoreline transition manhole, where the forcemain transitions to a submerged lake outfall. The submerged discharge pipe would extend into Belwood Lake and discharge through a diffuser system located below the lake surface.

Several installation methods would be considered as part of the class environmental assessment addendum for the submerged section of the outfall, including float-and-sink installation, bottompull installation, and horizontal directional drilling (HDD) during design and pending geotechnical investigation.

5.5.2 Effluent Main Option 2: Potential Grand River Discharge

Under this option, treated effluent would be conveyed from the proposed wastewater treatment plant through a dedicated 300 mm HDPE effluent forcemain extending approximately 3.7 km to a discharge location at the Grand River. The proposed alignment generally follows Wellington County Road 19 and 2nd Line within the municipal road allowance.

The forcemain would be installed using a combination of construction methods. Within the development limits, the forcemain would be installed by open-cut construction. Along Wellington County Road 19, the forcemain would be installed using horizontal directional drilling (HDD) to minimize impacts to existing infrastructure and road operations. Along 2nd Line, the forcemain could be installed within the road allowance using open-cut construction however, investigations into the constraints of said construction would need to be conducted.

The alignment traverses several areas containing existing utility infrastructure and environmentally sensitive features, including hydro corridors, a creek crossing, and natural heritage features adjacent to the Grand River corridor. Appropriate utility clearances and environmental mitigation measures would be required during detailed design and permitting.

The feasibility of this discharge alternative would be evaluated through the Class EA Addendum.

6 Preliminary Site Footprint

6.1 Wastewater Treatment Plant

A preliminary wastewater treatment plant (WWTP) footprint has been developed based on the anticipated effluent discharge requirements, the treatment processes described above, Ainley's experience with municipal wastewater-treatment design, and preliminary information obtained from equipment vendors. The conceptual layout has been prepared for site-planning purposes and reflects the best available information at this stage of the project.

The proposed WWTP is anticipated to occupy an approximate overall footprint of 26.5 m by 36.0 m, corresponding to an area of approximately 960 m². The footprint is intended to accommodate the principal liquid-treatment processes, process-mechanical equipment, electrical systems, instrumentation and control systems, building-mechanical systems, ancillary equipment, and associated external tankage required for operation of the facility.

External tankage for the candidate plant would include an equalization tank, an aerobic digester, and a stabilized-sludge storage tank. The equalization tank would have an approximate storage volume of 500 m³ and a diameter of approximately 9 m. The aerobic digester would have an approximate working volume of 150 m³ and a diameter of approximately 7 m. For understanding sizing, the candidate stabilized-sludge storage tank would provide approximately 550 m³ of storage volume and would have a diameter of approximately 12 m. The conceptual layout, including treatment technologies, will be confirmed through the Class EA Addendum, and measures to mitigate impacts will be described. Final tank dimensions, operating volumes, side-water depths, process configuration, equipment selection, and exact site footprint will be refined through subsequent design phases.

As illustrated in Figure 8, the candidate WWTP would be located north of Wellington Road 19, northwest of the proposed golf-club entrance.

This candidate WTP, standpipe, and booster pumping station would be located adjacent to the WWTP and are described further in the next section. A preliminary minimum separation distance of 15 m has been provided between the WWTP and the nearest WTP infrastructure to mitigate potential contamination risks. The required separation distance and site layout would be confirmed during subsequent design phases based on the applicable regulatory requirements and the final configuration of the facilities.

6.2 Water Treatment Plant, Standpipe and Booster Pumping Station

For a feasibility assessment, a candidate WTP is described in this section. The WTP would be housed within an approximately 200 m² pre-engineered steel building (16 m by 12 m) including a basement to accommodate the booster pumping station. The building would accommodate the water-treatment process equipment, electrical and instrumentation systems, building-mechanical systems, chemical-storage and dosing equipment, and associated control infrastructure.

A candidate for the storage of this conceptual WTP design would be a separate above-ground treated-water reservoir configured as a standpipe adjacent to the WTP. The standpipe would provide the required fire-flow, equalization, and emergency storage volumes. A dedicated booster pumping station would convey treated water from the standpipe to the distribution system and maintain the required distribution-system operating pressures.

A diesel standby generator would provide backup power to both the WTP and the WWTP. The shared generator would be located outside the treatment buildings within a sound-attenuating enclosure and would be surrounded by an acoustic barrier wall, as required. The WTP building footprint, standpipe dimensions, booster pumping station configuration, generator sizing, and overall site layout would be refined during detailed design based on the selected treatment equipment, access and maintenance requirements, chemical-handling provisions, standby-power requirements, and applicable code and zoning requirements.

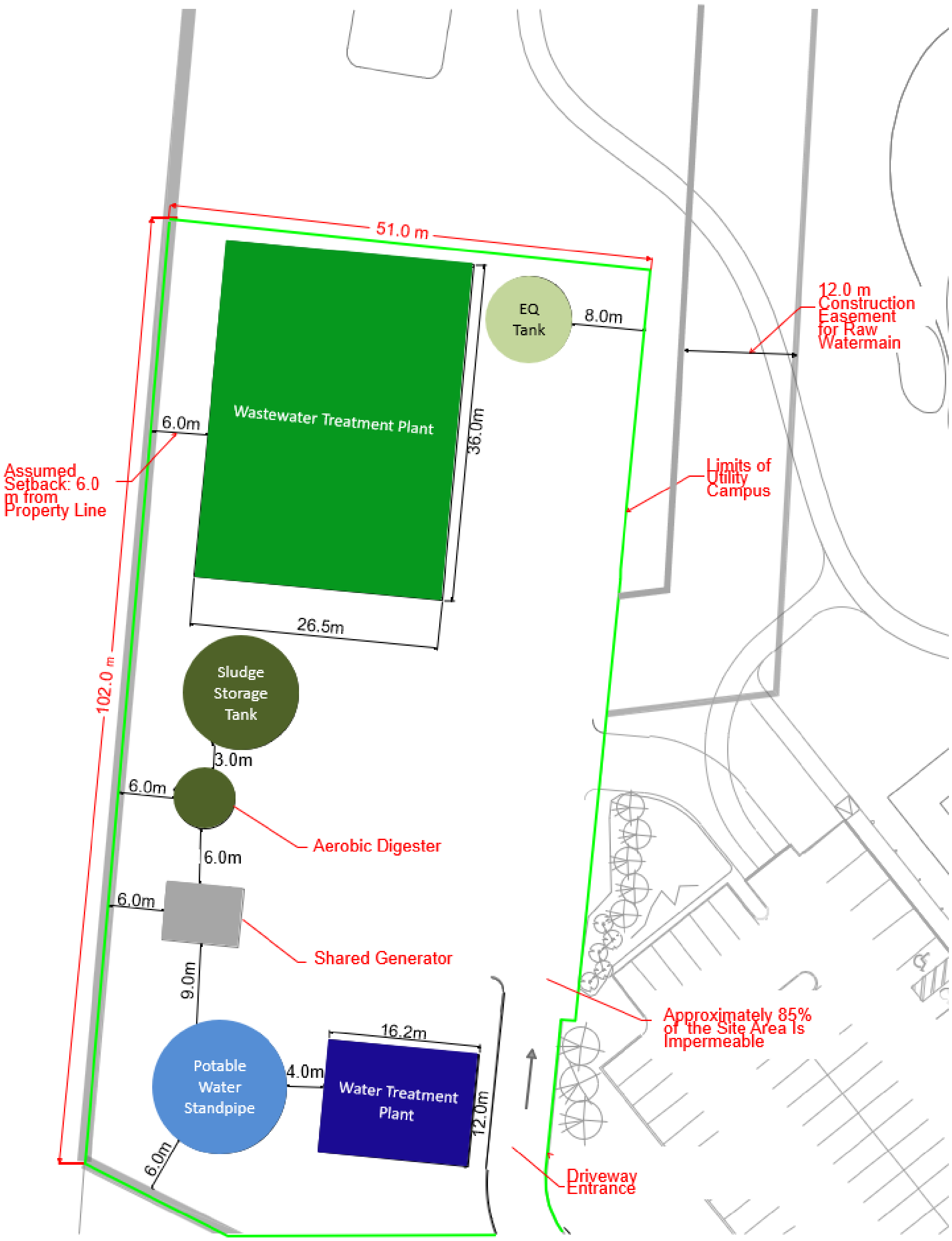


Figure 8: Preliminary Wastewater and Water Treatment Plant Site Footprint

7 Summary

This servicing study evaluates feasible alternatives for water supply/treatment and wastewater collection, treatment, and discharge to support the proposed Fergus Golf Club Redevelopment. Based on the information available to date, there are viable and implementable servicing solutions that can reliably accommodate the proposed development. However, these alternatives and their environmental impacts, including natural heritage, aquatic habitat, archaeology, cultural heritage, source water, assimilative capacity study, outfall, construction, traffic/access, and receiving-water impacts, will be fully assessed through the concurrent Class EA Addendum process.

Viable servicing solutions exist and will be further evaluated for both water and wastewater in the ongoing EA Addendum. These solutions, supported by detailed technical studies, provide a level of confidence that a fully compliant and sustainable servicing strategy can be implemented.

8 References

Township of Centre Wellington. (2024). *Development Manual*

Golder Associates Ltd. (2021). *Water Quality Test Results*

GSP. (2026). *Draft Subdivision Plan for Fergus Golf Course Development*

GSP. (2015). *Northwest Fergus Secondary Planning Area Study*

Hutchinson Environmental Sciences. (2021). *Assimilation Feasibility Investigation Report*

Ontario Ministry of Environment. (2016). *Design Guidelines for Drinking-Water Systems*

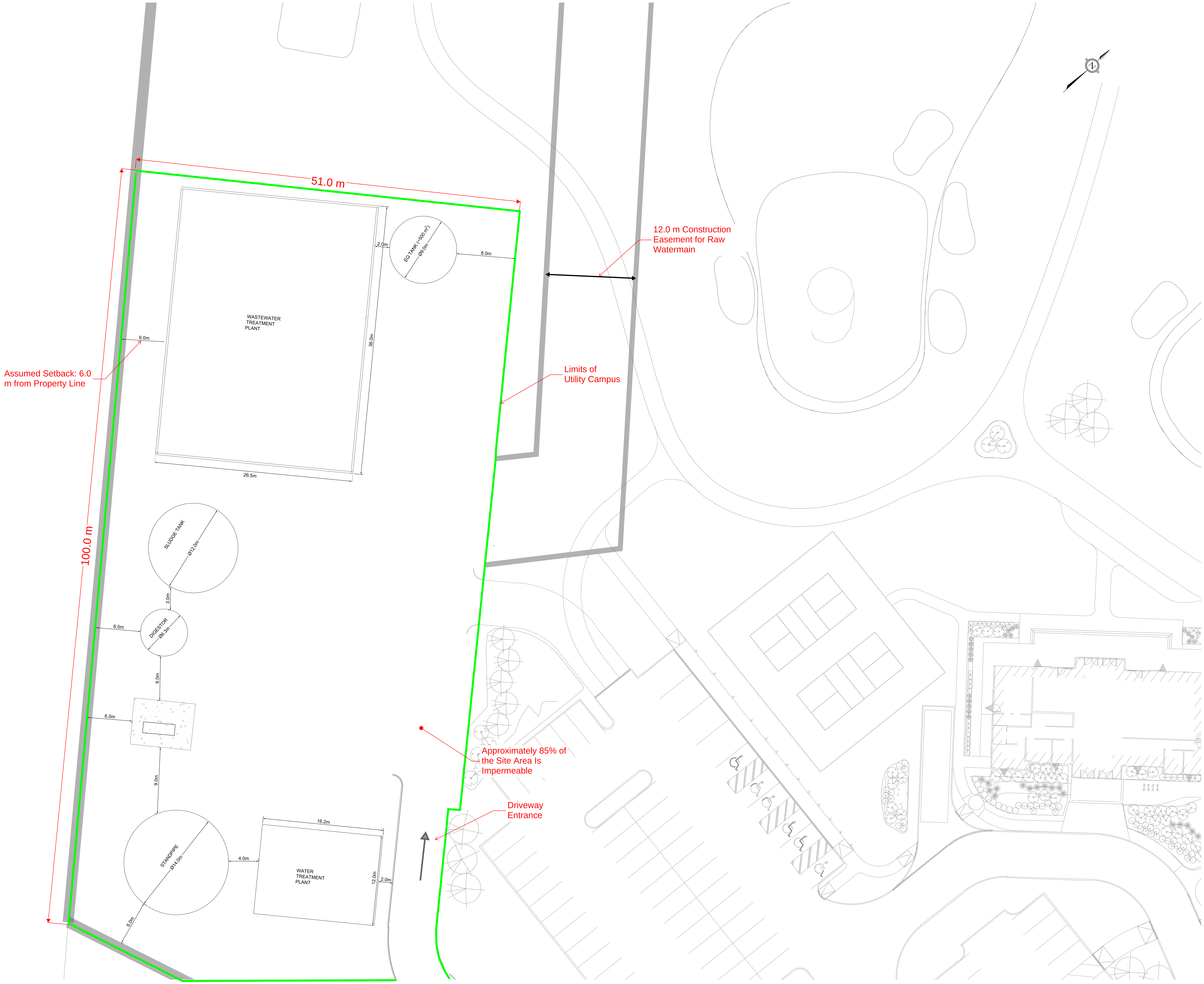
Stantec. (2016). *Township of Centre Wellington Growth Management Plan*

R-PE Surveying. (2021). *Topographical Survey*

Watson & Associates. (2021). *Development Charges Background Study: Township of Centre Wellington*

Appendix A

Concept Plan


51.0 m
100.0 m
12.0 m Construction Easement for Raw Watermain
Limits of Utility Campus
Assumed Setback: 6.0 m from Property Line
WASTEWATER TREATMENT PLANT
2.0m
36.0m
26.5m
6.0m
EQ TANK (~500 m³)
Ø9.0m
8.0m
SLUDGE TANK
Ø12.0m
3.0m
DIGESTOR
Ø8.3m
6.0m
6.0m
6.0m
9.0m
STANDPIPE
Ø14.0m
6.0m
4.0m
WATER TREATMENT PLANT
16.2m
12.0m
2.0m
Approximately 85% of the Site Area Is Impermeable
Driveway Entrance

Appendix B
Water Quality Test Results

BUREAU VERITAS

Your Project #: 21456909
Your C.O.C. #: 842984-01-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/09/22
Report #: R6822678
Version: 2 - Partial

CERTIFICATE OF ANALYSIS – PARTIAL RESULTS

BV LABS JOB #: C1P4129
Received: 2021/09/03, 13:54

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	1	N/A	2021/09/07	CAM SOP-00448	SM 23 2320 B m
Chloride by Automated Colourimetry	1	N/A	2021/09/07	CAM SOP-00463	SM 23 4500-Cl E m
Colour	1	N/A	2021/09/09	CAM SOP-00412	SM 23 2120C m
Free (WAD) Cyanide	1	N/A	2021/09/10	CAM SOP-00457	OMOE E3015 m
Diuron, Guthion, Temephos	1	2021/09/10	2021/09/10	CAM SOP-00306	EPA 532 m
Dissolved Organic Carbon (DOC) (1)	1	N/A	2021/09/08	CAM SOP-00446	SM 23 5310 B m
Diquat / Paraquat	1	2021/09/07	2021/09/09	CAM SOP-00327	EPA 549.2 m
Fluoride	1	2021/09/04	2021/09/07	CAM SOP-00449	SM 23 4500-F C m
Glyphosate	1	2021/09/09	2021/09/09	CAM SOP-00305	HPLC in-house method
Hardness (calculated as CaCO3)	1	N/A	2021/09/08	CAM SOP 00102/00408/00447	SM 2340 B
Mercury in Water by CVAA	1	2021/09/07	2021/09/07	CAM SOP-00453	EPA 7470A m
Metals Analysis by ICPMS (as received) (2)	1	N/A	2021/09/07	CAM SOP-00447	EPA 6020B m
Total Coliforms/ E. coli, CFU/100mL	1	N/A	2021/09/03	CAM SOP-00551	MOE E3407
Dissolved Methane in Water	1	N/A	2021/09/08	CAM SOP-00219 Modified Combustible Gas Indicator Method	RSKSOP-175 m
Heterotrophic plate count, (CFU/mL)	1	N/A	2021/09/03	CAM SOP-00512	SM 9215B
Microcystin	1	N/A	2021/09/08	CAM SOP-00476	OMECC-LSB E3469
NDMA in Drinking Water (MSABN-3291Amod)	1	2021/09/09	2021/09/14	BRL SOP-00012	MOE Method E3388
Total Ammonia-N	1	N/A	2021/09/09	CAM SOP-00441	USGS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (3)	1	N/A	2021/09/07	CAM SOP-00440	SM 23 4500-NO3I/NO2B
Nitrilotriacetic Acid (NTA) (4)	1	2021/09/07	2021/09/07	CAM SOP-00411	EPA 430.1 m
OC Pesticides (Selected) & PCB (5)	1	2021/09/08	2021/09/10	CAM SOP-00307	EPA 8081A/ 8082B m
OC Pesticides Summed Parameters	1	N/A	2021/09/04	CAM SOP-00307	EPA 8081A/8082B m
ODWS - Semi-Volatiles	1	2021/09/09	2021/09/10	CAM SOP-00301	EPA 8270 m
Organic Nitrogen	1	N/A	2021/09/10	Auto Calc.	
pH	1	2021/09/04	2021/09/07	CAM SOP-00413	SM 4500H+ B m
Sulphate by Automated Colourimetry	1	N/A	2021/09/07	CAM SOP-00464	EPA 375.4 m
Sulphide	1	N/A	2021/09/07	CAM SOP-00455	SM 23 4500-S G m
Total Dissolved Solids (TDS calc)	1	N/A	2021/09/08		Auto Calc

Your Project #: 21456909
Your C.O.C. #: 842984-01-01

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Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/09/22
Report #: R6822678
Version: 2 - Partial

CERTIFICATE OF ANALYSIS – PARTIAL RESULTS

BV LABS JOB #: C1P4129
Received: 2021/09/03, 13:54

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Total Kjeldahl Nitrogen in Water	1	2021/09/07	2021/09/09	CAM SOP-00938	OMOE E3516 m
Turbidity	1	N/A	2021/09/07	CAM SOP-00417	SM 23 2130 B m
VOCs (Drinking Water)	1	N/A	2021/09/07	CAM SOP-00226	EPA 8260C m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(2) Metals analysis was performed on the sample 'as received'.
(3) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.
(4) Bureau Veritas Laboratories attempt to commence NTA analysis as soon as possible in accordance with the reference method. However, rapid analysis may not be practically achievable, particularly for samples from remote locations. Extended delay in analysis times may increase the uncertainty of the test results, but does not necessarily imply that the results are compromised.
(5) Chlordane (Total) = Alpha Chlordane + Gamma Chlordane

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Your Project #: 21456909
Your C.O.C. #: 842984-01-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/09/22
Report #: R6822678
Version: 2 - Partial

CERTIFICATE OF ANALYSIS – PARTIAL RESULTS

BV LABS JOB #: C1P4129
Received: 2021/09/03, 13:54

Encryption Key

Ema Gitej
Senior Project Manager
22 Sep 2021 18:22:54

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: emese.gitej@bureauveritas.com
Phone# (905)817-5829
==
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

RESULTS OF ANALYSES OF WATER

BV Labs ID				QOI268		
Sampling Date				2021/09/03 10:00		
COC Number				842984-01-01		
	UNITS	**MAC**	**A/O**	**PW21-1**	**RDL**	**QC Batch**
Calculated Parameters						
Calculated TDS	mg/L	-	500	550	1.0	7559099
Hardness (CaCO3)	mg/L	-	80:100	380	1.0	7558603
Total Organic Nitrogen	mg/L	-	0.15	<0.10	0.10	7560118
Inorganics						
Total Ammonia-N	mg/L	-	-	0.21	0.050	7564744
Colour	TCU	-	5	<2	2	7563603
Fluoride (F-)	mg/L	**1.5**	-	0.62	0.10	7560960
Total Kjeldahl Nitrogen (TKN)	mg/L	**-**	-	0.23	0.10	7563005
Microcystin	ug/L	**-**	-	<0.10	0.10	7564587
Dissolved Organic Carbon	mg/L	**-**	5	0.48	0.40	7562606
pH	pH	**-**	6.5:8.5	8.02		7560966
Dissolved Sulphate (SO4)	mg/L	**-**	500	270	1.0	7560983
Sulphide	mg/L	**-**	0.05	<0.020	0.020	7562455
Turbidity	NTU	**-**	5	0.7	0.1	7560716
WAD Cyanide (Free)	mg/L	**0.2**	-	<0.0010	0.0010	7567661
Alkalinity (Total as CaCO3)	mg/L	**-**	30:500	180	1.0	7560961
Dissolved Chloride (Cl-)	mg/L	**-**	250	9.6	1.0	7560985
Nitrite (N)	mg/L	**1**	-	<0.010	0.010	7560968
Nitrate (N)	mg/L	**10**	-	<0.10	0.10	7560968
Nitrate + Nitrite (N)	mg/L	**10**	-	<0.10	0.10	7560968
Miscellaneous Parameters						
NTA	mg/L	**0.4**	-	<0.050	0.050	7561547

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
MAC,A/O: Ontario Drinking Water Standards - Maximum Acceptable Concentration [MAC] & Table 4-Chemical/Physical Objectives [A/O] - Not Health Related, respectively (Made under the Ontario Safe Drinking Water Act, 2002)

BV Labs Job #: C1P4129
Report Date: 2021/09/22

Golder Associates Ltd
Client Project #: 21456909
Sampler Initials: PM

PERMANENT GASES (WATER)

BV Labs ID			QOI268		
Sampling Date			2021/09/03 10:00		
COC Number			842984-01-01		
	UNITS	**A/O**	**PW21-1**	**RDL**	**QC Batch**
Fixed Gases					
Methane	L/m3	3	0.019	0.005	7565203

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
A/O: Ontario Drinking Water Standards - Maximum Acceptable Concentration [MAC] & Table 4-Chemical/Physical Objectives [A/O] - Not Health Related, respectively
(Made under the Ontario Safe Drinking Water Act, 2002)

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ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID				QOI268		
Sampling Date				2021/09/03 10:00		
COC Number				842984-01-01		
	UNITS	MAC	A/O	PW21-1	RDL	QC Batch
Metals						
Mercury (Hg)	mg/L	**0.001**	-	<0.00010	0.00010	7562014
Aluminum (Al)	ug/L	-	100	<4.9	4.9	7561948
Antimony (Sb)	ug/L	**6**	-	<0.50	0.50	7561948
Arsenic (As)	ug/L	**10**	-	1.5	1.0	7561948
Barium (Ba)	ug/L	**1000**	-	21	2.0	7561948
Boron (B)	ug/L	**5000**	-	74	10	7561948
Cadmium (Cd)	ug/L	**5**	-	<0.090	0.090	7561948
Calcium (Ca)	ug/L	-	-	93000	200	7561948
Chromium (Cr)	ug/L	**50**	-	<5.0	5.0	7561948
Copper (Cu)	ug/L	-	1000	<0.90	0.90	7561948
Iron (Fe)	ug/L	-	300	130	100	7561948
Lead (Pb)	ug/L	**10**	-	<0.50	0.50	7561948
Magnesium (Mg)	ug/L	-	-	36000	50	7561948
Manganese (Mn)	ug/L	-	50	20	2.0	7561948
Potassium (K)	ug/L	-	-	1100	200	7561948
Selenium (Se)	ug/L	**50**	-	<2.0	2.0	7561948
Sodium (Na)	ug/L	-	200000	28000	100	7561948
Uranium (U)	ug/L	**20**	-	0.16	0.10	7561948
Zinc (Zn)	ug/L	-	5000	<5.0	5.0	7561948

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC,A/O: Ontario Drinking Water Standards - Maximum Acceptable Concentration [MAC] & Table 4-Chemical/Physical Objectives [A/O] - Not Health Related, respectively (Made under the Ontario Safe Drinking Water Act, 2002)

SEMI-VOLATILE ORGANICS BY GC-MS (WATER)

BV Labs ID				QOI268		
Sampling Date				2021/09/03 10:00		
COC Number				842984-01-01		
	UNITS	**MAC**	**A/O**	**PW21-1**	**RDL**	**QC Batch**
Semivolatile Organics						
2,3,4,6-Tetrachlorophenol	ug/L	**100**	1	<0.50	0.50	7566501
2,4,5-T	ug/L	**280**	-	<1.0	1.0	7566501
2,4,6-Trichlorophenol	ug/L	**5**	2	<0.50	0.50	7566501
2,4-D	ug/L	**100**	-	<1.0	1.0	7566501
2,4-Dichlorophenol	ug/L	**900**	0.3	<0.25	0.25	7566501
Alachlor	ug/L	**5**	-	<0.50	0.50	7566501
Aldicarb	ug/L	-	-	<5.0	5.0	7566501
Atrazine	ug/L	-	-	<0.50	0.50	7566501
Des-ethyl atrazine	ug/L	-	-	<0.50	0.50	7566501
Atrazine + Desethyl-atrazine	ug/L	**5**	-	<1.0	1.0	7566501
Bendiocarb	ug/L	-	-	<2.0	2.0	7566501
Bromoxynil	ug/L	**5**	-	<0.50	0.50	7566501
Carbaryl	ug/L	**90**	-	<5.0	5.0	7566501
Carbofuran	ug/L	**90**	-	<5.0	5.0	7566501
Chlorpyrifos (Dursban)	ug/L	**90**	-	<1.0	1.0	7566501
Cyanazine (Bladex)	ug/L	-	-	<1.0	1.0	7566501
Diazinon	ug/L	**20**	-	<1.0	1.0	7566501
Dicamba	ug/L	**120**	-	<1.0	1.0	7566501
Diclofop-methyl	ug/L	**9**	-	<0.90	0.90	7566501
Dimethoate	ug/L	**20**	-	<2.5	2.5	7566501
Dinoseb	ug/L	**10**	-	<1.0	1.0	7566501
Malathion	ug/L	**190**	-	<5.0	5.0	7566501
Metolachlor	ug/L	**50**	-	<0.50	0.50	7566501
Metribuzin (Sencor)	ug/L	**80**	-	<5.0	5.0	7566501
Ethyl Parathion	ug/L	**50**	-	<1.0	1.0	7566501
Pentachlorophenol	ug/L	**60**	30	<0.50	0.50	7566501
Phorate	ug/L	**2**	-	<0.50	0.50	7566501
Picloram	ug/L	**190**	-	<5.0	5.0	7566501
Prometryne	ug/L	**1**	-	<0.25	0.25	7566501
Simazine	ug/L	**10**	-	<1.0	1.0	7566501
Terbufos	ug/L	**1**	-	<0.50	0.50	7566501

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
MAC,A/O: Ontario Drinking Water Standards - Maximum Acceptable Concentration [MAC] & Table 4-Chemical/Physical Objectives [A/O] - Not Health Related, respectively (Made under the Ontario Safe Drinking Water Act, 2002)

SEMI-VOLATILE ORGANICS BY GC-MS (WATER)

BV Labs ID				QOI268		
Sampling Date				2021/09/03 10:00		
COC Number				842984-01-01		
	UNITS	MAC	A/O	PW21-1	RDL	QC Batch
Triallate	ug/L	**230**	-	<1.0	1.0	7566501
Trifluralin	ug/L	**45**	-	<1.0	1.0	7566501
Benzo(a)pyrene	ug/L	**0.01**	-	<0.0050	0.0050	7566501
Methyl parathion	ug/L	-	-	<1.0	1.0	7566501
Surrogate Recovery (%)						
2,4,6-Tribromophenol	%	-	-	78		7566501
2,4-Dichlorophenyl Acetic Acid	%	-	-	79		7566501
2-Fluorobiphenyl	%	-	-	69		7566501
D14-Terphenyl (FS)	%	-	-	83		7566501
D5-Nitrobenzene	%	-	-	83		7566501

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
MAC,A/O: Ontario Drinking Water Standards - Maximum Acceptable Concentration [MAC] & Table 4-Chemical/Physical Objectives [A/O] - Not Health Related, respectively (Made under the Ontario Safe Drinking Water Act, 2002)

VOLATILE ORGANICS BY GC/MS (WATER)

BV Labs ID				QOI268		
Sampling Date				2021/09/03 10:00		
COC Number				842984-01-01		
	UNITS	**MAC**	**A/O**	**PW21-1**	**RDL**	**QC Batch**
Volatile Organics						
1,1-Dichloroethylene	ug/L	**14**	-	<0.10	0.10	7559332
1,2-Dichlorobenzene	ug/L	**200**	3	<0.20	0.20	7559332
1,2-Dichloroethane	ug/L	**5**	-	<0.20	0.20	7559332
1,4-Dichlorobenzene	ug/L	**5**	1	<0.20	0.20	7559332
Benzene	ug/L	**1**	-	<0.10	0.10	7559332
Bromodichloromethane	ug/L	-	-	<0.10	0.10	7559332
Bromoform	ug/L	-	-	<0.20	0.20	7559332
Carbon Tetrachloride	ug/L	**2**	-	<0.10	0.10	7559332
Chlorobenzene	ug/L	**80**	30	<0.10	0.10	7559332
Chloroform	ug/L	-	-	<0.10	0.10	7559332
Dibromochloromethane	ug/L	-	-	<0.20	0.20	7559332
Methylene Chloride(Dichloromethane)	ug/L	**50**	-	<0.50	0.50	7559332
Ethylbenzene	ug/L	**140**	1.6	<0.10	0.10	7559332
Tetrachloroethylene	ug/L	**10**	-	<0.10	0.10	7559332
Toluene	ug/L	**60**	24	<0.20	0.20	7559332
Trichloroethylene	ug/L	**5**	-	<0.10	0.10	7559332
Vinyl Chloride	ug/L	**1**	-	<0.20	0.20	7559332
o-Xylene	ug/L	-	-	<0.10	0.10	7559332
p+m-Xylene	ug/L	-	-	<0.10	0.10	7559332
Total Xylenes	ug/L	**90**	20	<0.10	0.10	7559332
Total Trihalomethanes	ug/L	-	-	<0.20	0.20	7559332
Surrogate Recovery (%)						
4-Bromofluorobenzene	%	-	-	96		7559332
D4-1,2-Dichloroethane	%	-	-	96		7559332
D8-Toluene	%	-	-	106		7559332

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC,A/O: Ontario Drinking Water Standards - Maximum Acceptable Concentration [MAC] & Table 4-Chemical/Physical Objectives [A/O] - Not Health Related, respectively
(Made under the Ontario Safe Drinking Water Act, 2002)

PESTICIDES & HERBICIDES BY HPLC (WATER)

BV Labs ID			QOI268		
Sampling Date			2021/09/03 10:00		
COC Number			842984-01-01		
	UNITS	MAC	PW21-1	RDL	QC Batch
Pesticides & Herbicides					
Glyphosate	ug/L	**280**	<10	10	7567026
Diquat	ug/L	**70**	<7.0	7.0	7561822
Diuron	ug/L	**150**	<10	10	7569961
Guthion (Azinphos-methyl)	ug/L	**20**	<2.0	2.0	7569961
Paraquat	ug/L	**10**	<1.0	1.0	7561822
Temephos	ug/L	-	<10	10	7569961

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC: Ontario Drinking Water Standards - Maximum Acceptable Concentration [MAC] & Table 4-Chemical/Physical Objectives [A/O] - Not Health Related, respectively
(Made under the Ontario Safe Drinking Water Act, 2002)

ORGANOCHLORINATED PESTICIDES BY GC-ECD (WATER)

BV Labs ID			QOI268		
Sampling Date			2021/09/03 10:00		
COC Number			842984-01-01		
	UNITS	MAC	PW21-1	RDL	QC Batch
Calculated Parameters					
Aldrin + Dieldrin	ug/L	**0.7**	<0.006	0.006	7558226
Chlordane (Total)	ug/L	**7**	<0.006	0.006	7558226
DDT+ Metabolites	ug/L	**30**	<0.006	0.006	7558226
Heptachlor + Heptachlor epoxide	ug/L	**3**	<0.006	0.006	7558226
Total PCB	ug/L	**3**	<0.05	0.05	7558226
Pesticides & Herbicides					
Lindane	ug/L	**4**	<0.0060	0.0060	7565829
Heptachlor	ug/L	-	<0.0060	0.0060	7565829
Aldrin	ug/L	-	<0.0060	0.0060	7565829
Heptachlor epoxide	ug/L	-	<0.0060	0.0060	7565829
Oxychlordane	ug/L	-	<0.0060	0.0060	7565829
g-Chlordane	ug/L	-	<0.0060	0.0060	7565829
a-Chlordane	ug/L	-	<0.0060	0.0060	7565829
Dieldrin	ug/L	-	<0.0060	0.0060	7565829
o,p-DDE	ug/L	-	<0.0060	0.0060	7565829
p,p-DDE	ug/L	-	<0.0060	0.0060	7565829
o,p-DDD	ug/L	-	<0.0060	0.0060	7565829
p,p-DDD	ug/L	-	<0.0060	0.0060	7565829
o,p-DDT	ug/L	-	<0.0060	0.0060	7565829
p,p-DDT	ug/L	-	<0.0060	0.0060	7565829
Methoxychlor	ug/L	**900**	<0.024	0.024	7565829
Aroclor 1016	ug/L	-	<0.050	0.050	7565829
Aroclor 1221	ug/L	-	<0.050	0.050	7565829
Aroclor 1232	ug/L	-	<0.050	0.050	7565829
Aroclor 1242	ug/L	-	<0.050	0.050	7565829
Aroclor 1248	ug/L	-	<0.050	0.050	7565829
Aroclor 1254	ug/L	-	<0.050	0.050	7565829
Aroclor 1260	ug/L	-	<0.050	0.050	7565829
Surrogate Recovery (%)					
2,4,5,6-Tetrachloro-m-xylene	%	-	50		7565829
Decachlorobiphenyl	%	-	104		7565829

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC: Ontario Drinking Water Standards - Maximum Acceptable Concentration [MAC] & Table 4-Chemical/Physical Objectives [A/O] - Not Health Related, respectively
(Made under the Ontario Safe Drinking Water Act, 2002)

SEMI-VOLATILE ORGANICS BY HRMS (WATER)

BV Labs ID			QOI268		
Sampling Date			2021/09/03 10:00		
COC Number			842984-01-01		
	UNITS	**MAC**	**PW21-1**	**RDL**	**QC Batch**
Semivolatile Organics					
N-Nitrosodimethylamine	ug/L	**0.009**	<0.0009	0.0009	7566404
Surrogate Recovery (%)					
D6-N-Nitrosodimethylamine	%	-	39		7566404

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC: Ontario Drinking Water Standards - Maximum Acceptable Concentration [MAC] & Table 4-Chemical/Physical Objectives [A/O] - Not Health Related, respectively
(Made under the Ontario Safe Drinking Water Act, 2002)

BV Labs Job #: C1P4129
Report Date: 2021/09/22

Golder Associates Ltd
Client Project #: 21456909
Sampler Initials: PM

MICROBIOLOGY (WATER)

BV Labs ID			QOI268	
Sampling Date			2021/09/03 10:00	
COC Number			842984-01-01	
	UNITS	**MAC**	**PW21-1**	**QC Batch**
Microbiological				
Heterotrophic plate count	CFU/mL	-	0	7560282
Background	CFU/100mL	-	0	7560239
Total Coliforms	CFU/100mL	**0**	0	7560239
Escherichia coli	CFU/100mL	**0**	0	7560239

QC Batch = Quality Control Batch
MAC: Ontario Drinking Water Standards - Maximum Acceptable Concentration [MAC] & Table 4-Chemical/Physical Objectives [A/O] - Not Health Related, respectively
(Made under the Ontario Safe Drinking Water Act, 2002)

TEST SUMMARY

BV Labs ID: QOI268
Sample ID: PW21-1
Matrix: Water

Collected: 2021/09/03
Shipped:
Received: 2021/09/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7560961	N/A	2021/09/07	Yogesh Patel
Chloride by Automated Colourimetry	KONE	7560985	N/A	2021/09/07	Alina Dobreanu
Colour	SPEC	7563603	N/A	2021/09/09	Viorica Rotaru
Free (WAD) Cyanide	SKAL/CN	7567661	N/A	2021/09/10	Aditiben Patel
Diuron, Guthion, Temephos	LC/UV	7569961	2021/09/10	2021/09/10	Kimberley Linde
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7562606	N/A	2021/09/08	Julianna Castiglione
Diquat / Paraquat	LC/UV	7561822	2021/09/07	2021/09/09	James Lee
Fluoride	ISE	7560960	2021/09/04	2021/09/07	Yogesh Patel
Glyphosate	LC/FLU	7567026	2021/09/09	2021/09/09	Furneesh Kumar
Hardness (calculated as CaCO3)		7558603	N/A	2021/09/08	Automated Statchk
Mercury in Water by CVAA	CV/AA	7562014	2021/09/07	2021/09/07	Gagandeep Rai
Metals Analysis by ICPMS (as received)	ICP/MS	7561948	N/A	2021/09/07	Azita Fazaeli
Total Coliforms/ E. coli, CFU/100mL	PL	7560239	N/A	2021/09/03	Soham Patel
Dissolved Methane in Water	GC/FID	7565203	N/A	2021/09/08	Shilpa Kataria
Heterotrophic plate count, (CFU/mL)	PL	7560282	N/A	2021/09/03	Farhana Rahman
Microcystin	ELIS	7564587	N/A	2021/09/08	Chris Li
NDMA in Drinking Water (MSABN-3291Amod)	GCTQ/MS	7566404	2021/09/09	2021/09/14	Wenhui (Susie) Shi
Total Ammonia-N	LACH/NH4	7564744	N/A	2021/09/09	Viorica Rotaru
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7560968	N/A	2021/09/07	Chandra Nandlal
Nitrilotriacetic Acid (NTA)	SPEC	7561547	2021/09/07	2021/09/07	Viorica Rotaru
OC Pesticides (Selected) & PCB	GC/ECD	7565829	2021/09/08	2021/09/10	Joy Zhang
OC Pesticides Summed Parameters	CALC	7558226	N/A	2021/09/04	Automated Statchk
ODWS - Semi-Volatiles	GC/MS	7566501	2021/09/09	2021/09/10	Wendy Zhao
Organic Nitrogen	CALC	7560118	N/A	2021/09/10	Automated Statchk
pH	AT	7560966	2021/09/04	2021/09/07	Yogesh Patel
Sulphate by Automated Colourimetry	KONE	7560983	N/A	2021/09/07	Alina Dobreanu
Sulphide	ISE/S	7562455	N/A	2021/09/07	Neil Dassanayake
Total Dissolved Solids (TDS calc)	CALC	7559099	N/A	2021/09/08	Automated Statchk
Total Kjeldahl Nitrogen in Water	SKAL	7563005	2021/09/07	2021/09/09	Rajni Tyagi
Turbidity	AT	7560716	N/A	2021/09/07	Neil Dassanayake
VOCs (Drinking Water)	P&T/MS	7559332	N/A	2021/09/07	Dina Wang

BV Labs ID: QOI268 Dup
Sample ID: PW21-1
Matrix: Water

Collected: 2021/09/03
Shipped:
Received: 2021/09/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7560961	N/A	2021/09/07	Yogesh Patel
Diuron, Guthion, Temephos	LC/UV	7569961	2021/09/10	2021/09/10	Kimberley Linde
Fluoride	ISE	7560960	2021/09/04	2021/09/07	Yogesh Patel
Mercury in Water by CVAA	CV/AA	7562014	2021/09/07	2021/09/07	Gagandeep Rai
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7560968	N/A	2021/09/07	Chandra Nandlal
pH	AT	7560966	2021/09/04	2021/09/07	Yogesh Patel
VOCs (Drinking Water)	P&T/MS	7559332	N/A	2021/09/07	Dina Wang

GENERAL COMMENTS

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7559332	4-Bromofluorobenzene	2021/09/07	98	70 - 130	97	70 - 130	94	%				
7559332	D4-1,2-Dichloroethane	2021/09/07	91	70 - 130	95	70 - 130	98	%				
7559332	D8-Toluene	2021/09/07	105	70 - 130	103	70 - 130	105	%				
7565829	2,4,5,6-Tetrachloro-m-xylene	2021/09/09	58	30 - 130	57	30 - 130	58	%				
7565829	Decachlorobiphenyl	2021/09/09	108	30 - 130	95	30 - 130	98	%				
7566404	D6-N-Nitrosodimethylamine	2021/09/14			39	10 - 85	40	%				
7566501	2,4,6-Tribromophenol	2021/09/09	77	30 - 130	76	30 - 130	82	%				
7566501	2,4-Dichlorophenyl Acetic Acid	2021/09/09	75	30 - 130	71	30 - 130	77	%				
7566501	2-Fluorobiphenyl	2021/09/09	63	30 - 130	65	30 - 130	67	%				
7566501	D14-Terphenyl (FS)	2021/09/09	81	30 - 130	81	30 - 130	87	%				
7566501	D5-Nitrobenzene	2021/09/09	75	30 - 130	77	30 - 130	85	%				
7559332	1,1-Dichloroethylene	2021/09/07	93	70 - 130	92	70 - 130	<0.10	ug/L	NC	30		
7559332	1,2-Dichlorobenzene	2021/09/07	88	70 - 130	90	70 - 130	<0.20	ug/L	NC	30		
7559332	1,2-Dichloroethane	2021/09/07	78	70 - 130	83	70 - 130	<0.20	ug/L	NC	30		
7559332	1,4-Dichlorobenzene	2021/09/07	105	70 - 130	105	70 - 130	<0.20	ug/L	NC	30		
7559332	Benzene	2021/09/07	81	70 - 130	84	70 - 130	<0.10	ug/L	NC	30		
7559332	Bromodichloromethane	2021/09/07	NC	70 - 130	88	70 - 130	<0.10	ug/L	NC	30		
7559332	Bromoform	2021/09/07	82	70 - 130	87	70 - 130	<0.20	ug/L	NC	30		
7559332	Carbon Tetrachloride	2021/09/07	88	70 - 130	88	70 - 130	<0.10	ug/L	NC	30		
7559332	Chlorobenzene	2021/09/07	90	70 - 130	90	70 - 130	<0.10	ug/L	NC	30		
7559332	Chloroform	2021/09/07	NC	70 - 130	89	70 - 130	<0.10	ug/L	NC	30		
7559332	Dibromochloromethane	2021/09/07	82	70 - 130	87	70 - 130	<0.20	ug/L	NC	30		
7559332	Ethylbenzene	2021/09/07	88	70 - 130	86	70 - 130	<0.10	ug/L	NC	30		
7559332	Methylene Chloride(Dichloromethane)	2021/09/07	85	70 - 130	86	70 - 130	<0.50	ug/L	NC	30		
7559332	o-Xylene	2021/09/07	87	70 - 130	86	70 - 130	<0.10	ug/L	NC	30		
7559332	p+m-Xylene	2021/09/07	95	70 - 130	90	70 - 130	<0.10	ug/L	NC	30		
7559332	Tetrachloroethylene	2021/09/07	85	70 - 130	83	70 - 130	<0.10	ug/L	NC	30		
7559332	Toluene	2021/09/07	88	70 - 130	88	70 - 130	<0.20	ug/L	NC	30		
7559332	Total Trihalomethanes	2021/09/07					<0.20	ug/L	NC	30		
7559332	Total Xylenes	2021/09/07					<0.10	ug/L	NC	30		
7559332	Trichloroethylene	2021/09/07	92	70 - 130	91	70 - 130	<0.10	ug/L	NC	30		

BUREAU VERITAS

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7559332	Vinyl Chloride	2021/09/07	92	70 - 130	88	70 - 130	<0.20	ug/L	NC	30		
7560716	Turbidity	2021/09/07			99	85 - 115	<0.1	NTU	5.2	20		
7560960	Fluoride (F-)	2021/09/07	101	80 - 120	96	80 - 120	<0.10	mg/L	1.4	20		
7560961	Alkalinity (Total as CaCO3)	2021/09/07			96	85 - 115	<1.0	mg/L	0.48	20		
7560966	pH	2021/09/07			101	98 - 103			0.36	N/A		
7560968	Nitrate (N)	2021/09/07	99	80 - 120	101	80 - 120	<0.10	mg/L	NC	20		
7560968	Nitrite (N)	2021/09/07	104	80 - 120	103	80 - 120	<0.010	mg/L	NC	20		
7560983	Dissolved Sulphate (SO4)	2021/09/07	NC	75 - 125	103	80 - 120	<1.0	mg/L	0.25	20		
7560985	Dissolved Chloride (Cl-)	2021/09/07	NC	80 - 120	104	80 - 120	<1.0	mg/L	1.3	20		
7561547	NTA	2021/09/07	83	80 - 120	93	80 - 120	<0.050	mg/L	NC	20		
7561822	Diquat	2021/09/09	83	50 - 130	95	50 - 130	<7.0	ug/L	4.2	40		
7561822	Paraquat	2021/09/09	62	50 - 130	101	50 - 130	<1.0	ug/L	7.7	40		
7561948	Aluminum (Al)	2021/09/07	101	80 - 120	101	80 - 120	<4.9	ug/L	NC	20		
7561948	Antimony (Sb)	2021/09/07	103	80 - 120	99	80 - 120	<0.50	ug/L	NC	20		
7561948	Arsenic (As)	2021/09/07	100	80 - 120	97	80 - 120	<1.0	ug/L	0.41	20		
7561948	Barium (Ba)	2021/09/07	97	80 - 120	98	80 - 120	<2.0	ug/L	1.4	20		
7561948	Boron (B)	2021/09/07	97	80 - 120	97	80 - 120	<10	ug/L	2.0	20		
7561948	Cadmium (Cd)	2021/09/07	100	80 - 120	100	80 - 120	<0.090	ug/L	NC	20		
7561948	Calcium (Ca)	2021/09/07	NC	80 - 120	99	80 - 120	<200	ug/L	2.1	20		
7561948	Chromium (Cr)	2021/09/07	100	80 - 120	99	80 - 120	<5.0	ug/L	NC	20		
7561948	Copper (Cu)	2021/09/07	98	80 - 120	98	80 - 120	<0.90	ug/L	11	20		
7561948	Iron (Fe)	2021/09/07	98	80 - 120	97	80 - 120	<100	ug/L	1.1	20		
7561948	Lead (Pb)	2021/09/07	96	80 - 120	98	80 - 120	<0.50	ug/L	NC	20		
7561948	Magnesium (Mg)	2021/09/07	NC	80 - 120	97	80 - 120	<50	ug/L	1.4	20		
7561948	Manganese (Mn)	2021/09/07	98	80 - 120	99	80 - 120	<2.0	ug/L	1.0	20		
7561948	Potassium (K)	2021/09/07	98	80 - 120	96	80 - 120	<200	ug/L	1.9	20		
7561948	Selenium (Se)	2021/09/07	103	80 - 120	102	80 - 120	<2.0	ug/L	NC	20		
7561948	Sodium (Na)	2021/09/07	97	80 - 120	98	80 - 120	<100	ug/L	1.2	20		
7561948	Uranium (U)	2021/09/07	100	80 - 120	104	80 - 120	<0.10	ug/L	3.0	20		
7561948	Zinc (Zn)	2021/09/07	98	80 - 120	98	80 - 120	<5.0	ug/L	NC	20		
7562014	Mercury (Hg)	2021/09/07	95	75 - 125	97	80 - 120	<0.00010	mg/L	NC	20		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7562455	Sulphide	2021/09/07	103	80 - 120	103	80 - 120	<0.020	mg/L	NC	20		
7562606	Dissolved Organic Carbon	2021/09/08	80	80 - 120	96	80 - 120	<0.40	mg/L	0.84	20		
7563005	Total Kjeldahl Nitrogen (TKN)	2021/09/09	NC	80 - 120	95	80 - 120	<0.10	mg/L			96	80 - 120
7563603	Colour	2021/09/09			99	80 - 120	<2	TCU	NC	25		
7564587	Microcystin	2021/09/08	96	60 - 140	94	60 - 140	<0.10	ug/L	NC	20		
7564744	Total Ammonia-N	2021/09/09	100	75 - 125	97	80 - 120	<0.050	mg/L	2.8	20		
7565203	Methane	2021/09/09					<0.005	L/m3	6.1	20		
7565829	a-Chlordane	2021/09/09	89	30 - 130	85	30 - 130	<0.0060	ug/L	6.5	40		
7565829	Aldrin	2021/09/09	78	30 - 130	71	30 - 130	<0.0060	ug/L	5.0	40		
7565829	Aroclor 1016	2021/09/09					<0.050	ug/L				
7565829	Aroclor 1221	2021/09/09					<0.050	ug/L				
7565829	Aroclor 1232	2021/09/09					<0.050	ug/L				
7565829	Aroclor 1242	2021/09/09					<0.050	ug/L				
7565829	Aroclor 1248	2021/09/09					<0.050	ug/L				
7565829	Aroclor 1254	2021/09/09					<0.050	ug/L				
7565829	Aroclor 1260	2021/09/09					<0.050	ug/L				
7565829	Dieldrin	2021/09/09	105	30 - 130	99	30 - 130	<0.0060	ug/L	5.2	40		
7565829	g-Chlordane	2021/09/09	94	30 - 130	85	30 - 130	<0.0060	ug/L	5.6	40		
7565829	Heptachlor epoxide	2021/09/09	100	30 - 130	89	30 - 130	<0.0060	ug/L	3.4	40		
7565829	Heptachlor	2021/09/09	83	30 - 130	75	30 - 130	<0.0060	ug/L	6.1	40		
7565829	Lindane	2021/09/09	97	30 - 130	88	30 - 130	<0.0060	ug/L	3.7	40		
7565829	Methoxychlor	2021/09/09	110	30 - 130	100	30 - 130	<0.024	ug/L	6.6	40		
7565829	o,p-DDD	2021/09/09	105	30 - 130	102	30 - 130	<0.0060	ug/L	6.0	40		
7565829	o,p-DDE	2021/09/09	114	30 - 130	94	30 - 130	<0.0060	ug/L	4.5	40		
7565829	o,p-DDT	2021/09/09	104	30 - 130	90	30 - 130	<0.0060	ug/L	7.6	40		
7565829	Oxychlordane	2021/09/09	91	30 - 130	84	30 - 130	<0.0060	ug/L	5.0	40		
7565829	p,p-DDD	2021/09/09	101	30 - 130	93	30 - 130	<0.0060	ug/L	6.0	40		
7565829	p,p-DDE	2021/09/09	82	30 - 130	74	30 - 130	<0.0060	ug/L	6.8	40		
7565829	p,p-DDT	2021/09/09	107	30 - 130	91	30 - 130	<0.0060	ug/L	9.9	40		
7566404	N-Nitrosodimethylamine	2021/09/14			102	65 - 135	<0.0009	ug/L	1.5	25		
7566501	2,3,4,6-Tetrachlorophenol	2021/09/09	83	30 - 130	82	30 - 130	<0.50	ug/L	1.7	40		

BUREAU VERITAS

BV Labs Job #: C1P4129
Report Date: 2021/09/22

QUALITY ASSURANCE REPORT(CONT'D)

Golder Associates Ltd
Client Project #: 21456909
Sampler Initials: PM

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7566501	2,4,5-T	2021/09/09	82	30 - 130	80	30 - 130	<1.0	ug/L	4.9	40		
7566501	2,4,6-Trichlorophenol	2021/09/09	77	30 - 130	78	30 - 130	<0.50	ug/L	2.4	40		
7566501	2,4-D	2021/09/09	74	30 - 130	70	30 - 130	<1.0	ug/L	3.3	40		
7566501	2,4-Dichlorophenol	2021/09/09	68	30 - 130	69	30 - 130	<0.25	ug/L	0.99	40		
7566501	Alachlor	2021/09/09	108	40 - 130	108	40 - 130	<0.50	ug/L	2.0	40		
7566501	Aldicarb	2021/09/09	89	70 - 130	90	70 - 130	<5.0	ug/L	3.4	40		
7566501	Atrazine + Desethyl-atrazine	2021/09/09	64	30 - 130	62	30 - 130	<1.0	ug/L	0.36	40		
7566501	Atrazine	2021/09/09	86	30 - 130	84	30 - 130	<0.50	ug/L	0.95	40		
7566501	Bendiocarb	2021/09/09	89	40 - 130	90	40 - 130	<2.0	ug/L	2.4	40		
7566501	Benzo(a)pyrene	2021/09/09	101	30 - 130	96	30 - 130	<0.0050	ug/L	3.3	40		
7566501	Bromoxynil	2021/09/09	87	40 - 130	85	40 - 130	<0.50	ug/L	1.3	40		
7566501	Carbaryl	2021/09/09	91	40 - 130	91	40 - 130	<5.0	ug/L	0.80	40		
7566501	Carbofuran	2021/09/09	92	40 - 130	90	40 - 130	<5.0	ug/L	0.47	40		
7566501	Chlorpyrifos (Dursban)	2021/09/09	86	40 - 130	86	40 - 130	<1.0	ug/L	3.0	40		
7566501	Cyanazine (Bladex)	2021/09/09	80	40 - 130	76	40 - 130	<1.0	ug/L	1.9	40		
7566501	Des-ethyl atrazine	2021/09/09	42	30 - 130	40	30 - 130	<0.50	ug/L	3.1	40		
7566501	Diazinon	2021/09/09	77	40 - 130	78	40 - 130	<1.0	ug/L	2.4	40		
7566501	Dicamba	2021/09/09	75	30 - 130	73	30 - 130	<1.0	ug/L	2.8	40		
7566501	Diclofop-methyl	2021/09/09	89	40 - 130	87	40 - 130	<0.90	ug/L	1.2	40		
7566501	Dimethoate	2021/09/09	76	40 - 130	74	40 - 130	<2.5	ug/L	1.9	40		
7566501	Dinoseb	2021/09/09	84	40 - 130	82	40 - 130	<1.0	ug/L	1.3	40		
7566501	Ethyl Parathion	2021/09/09	80	40 - 130	78	40 - 130	<1.0	ug/L	0.67	40		
7566501	Malathion	2021/09/09	86	40 - 130	85	40 - 130	<5.0	ug/L	0.19	40		
7566501	Methyl parathion	2021/09/09	81	30 - 130	79	30 - 130	<1.0	ug/L	0.14	40		
7566501	Metolachlor	2021/09/09	77	40 - 130	77	40 - 130	<0.50	ug/L	0.72	40		
7566501	Metribuzin (Sencor)	2021/09/09	107	40 - 130	105	40 - 130	<5.0	ug/L	0.63	40		
7566501	Pentachlorophenol	2021/09/09	80	25 - 130	79	25 - 130	<0.50	ug/L	0.13	40		
7566501	Phorate	2021/09/09	74	40 - 130	74	40 - 130	<0.50	ug/L	2.5	40		
7566501	Picloram	2021/09/09	41	10 - 130	38	10 - 130	<5.0	ug/L	13	40		
7566501	Prometryne	2021/09/09	85	30 - 130	81	30 - 130	<0.25	ug/L	4.9	40		
7566501	Simazine	2021/09/09	80	40 - 130	78	40 - 130	<1.0	ug/L	0.038	40		

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7566501	Terbufos	2021/09/09	79	40 - 130	79	40 - 130	<0.50	ug/L	1.3	40		
7566501	Triallate	2021/09/09	84	40 - 130	83	40 - 130	<1.0	ug/L	1.2	40		
7566501	Trifluralin	2021/09/09	94	40 - 130	91	40 - 130	<1.0	ug/L	3.6	40		
7567026	Glyphosate	2021/09/09	106	50 - 130	108	50 - 130	<10	ug/L	NC	40		
7567661	WAD Cyanide (Free)	2021/09/10	97	80 - 120	98	80 - 120	<0.0010	mg/L	NC	20		
7569961	Diuron	2021/09/10	88	40 - 130	85	40 - 130	<10	ug/L	NC	40		
7569961	Guthion (Azinphos-methyl)	2021/09/10	102	40 - 130	98	40 - 130	<2.0	ug/L	NC	40		
7569961	Temephos	2021/09/10	70	40 - 130	65	40 - 130	<10	ug/L	NC	40		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Brad Newman, B.Sc., C.Chem., Scientific Service Specialist

CHARTERED
Eva Pranjic
CHEMIST

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

Farhana Rahman

Farhana Rahman, Senior Analyst

M Di Grazia

Melissa DiGrazia, Operations Manager, HRMS Department

Soham N Patel

Soham Patel, Analyst 2

Tom Mitchell, B.Sc, Supervisor, Compressed Gases

Bureau Veritas Laboratories
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CHAIN OF CUSTODY RECORD

Page 1 of 1

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:
Company Name:	#21375 Golder Associates Ltd	Company Name:		Quotation #:	B80683	BV Labs Job #:
Attention:	Accounts Payable	Attention:	Gregory Padusenko	P.O. #:		Bottle Order #: 842984
Address:	210 Sheldon Drive, Cambridge ON N1T 1A8	Address:		Project:	21456909	COC #: C#842984-01-01
Tel:	(519) 620-8182 Fax:	Tel:	(519) 620-8182 Ext: 6509 Fax: (519) 620-9878	Project Name:		Project Manager: Ema Gitej
Email:	CanadaAccountsPayableInvoices@golder.com	Email:	Gregory_Padusenko@golder.com	Site #:		
				Sampled By:	PEM	

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ___ ☐ PWQO ☐ Reg 406 Table ___ ☐ Other ___

Special Instructions:

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC): Field Filtered (please circle): Metals / Hg / Cr VI; ODWQSOG Tables 1, 2 and 4

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___
Rush Confirmation Number: ___ (call lab for #)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered	ODWQSOG Tables 1, 2 and 4	# of Bottles	Comments
1		PW21-1	21/09/03	10:00	GW		X	27	disregard date on label
2									
3									
4									
5									
6									REC'D IN WATERLOO
7									03-Sep-21 13:54
8									Ema Gitej
9									C1P4129
10									YTH ENV-1270 On Ice Packs

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Paul McKold / Paul McKold	21/09/03	13:55	Jaspreet Kaur	2021/09/03	13:54	
			Raj Rajnarain	21/09/03	18:05	

Laboratory Use Only: Time Sensitive; Temperature (°C) on Recei: 9/11/12 15/15/15; Custody Seal Present / Intact: Yes / No (No)

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

BV#42115 Bureau Veritas Canada (2019) Inc. ON ICE 7/7/4 9/4/6 9/9/9 Submitted as 2 coolers

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Works #: 210000568-NR

22-September-2021

Bureau Veritas Canada - Mississauga
Attn : Subcontract Coordinator

6740 Campobello Road
Mississauga, ON
L5N 2L8, Canada

Phone: 905-817-5798
Fax:

Date Rec. : 07 September 2021
LR Report: **CA15208-SEP21**
Reference: Job#: C1P4129

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Sample ID	Sample Date & Time	Temperature Upon Receipt °C	Bromate mg/L
1: Analysis Start Date		---	16-Sep-21
2: Analysis Start Time		---	13:01
3: Analysis Completed Date		---	22-Sep-21
4: Analysis Completed Time		---	11:40
5: MAC		---	0.01
6: MDL		---	0.005
7: QC - Blank		---	< 0.005
8: QC - STD % Recovery		---	98%
9: QC - DUP % RPD		---	ND
10: NR PW21-1	03-Sep-21 10:00	14.0	< 0.005

MAC - Maximum Acceptable Concentration
MDL - SGS Method Detection Limit
NR - Not regulated / reportable under applicable Provincial drinking water regulations as per client.
ND - Not Detected

Method Descriptions

Parameter	Description	SGS Method Code
Bromate	Bromate by Ion Chromatograph	ME-CA-[ENV]IC-LAK-AN-006

Kimberley Didsbury,
Project Specialist,
Environment, Health & Safety

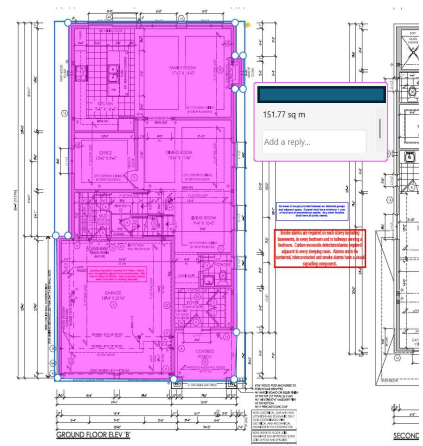
OnLine LIMS

0002649470

Appendix C

Fire Underwriter Survey's Required Fire Flow Calculation

Fire Flow Calculation Sheet



Client:	Geranium
Project:	Fergus Golf Course Redevelopment
Date:	21-May-26
Property Address:	
Notes:	Single Family House

Step	Task	Notes						Value	Required Fire Flow
1	Determined Type of Construction	**1.5 - Type V - Wood Frame Construction**						1.5	
		With Unprotected Openings							
2	Determine Floor Area	Does not include Floors Below Grade or Open Attic Space For Construction Coefficient 1.0 to 1.5 - Use Total Floor Area For Construction Coefficient Below 1.0 - With Unprotected Vertical Openings - Use Two largest Floors + 50% of all floors above up to 8 - With protected vertical openings - Use Largest Floor + 25% of each of the two adjoin floors						**151.8**	
3	Determine Number of Stories	Single Stories exceeding 3 m - Calculated equivalent stories if used for were housing						**2**	
4	Determine Effective Floor area							303.6	
5	Determine Required Fire Flow	F = 220xCxA^1/2 - to Nearest 100 L/min							6,000
6	Determine Occupancy Charge	**+15% Free Burning Contents**						0.15	6,900
7	Determine Sprinkler Reduction	30% Automatic Sprinkler Protection					**No**	0%	
		10% Water Supply is Standard					**No**	0%	
		10% Fully Supervised System					**No**	0%	
		Total Sprinkler Coverage						0%	-
8	Determine Increase for Exposure	**Direction**	**Exposure Distance**	**Exposed Length**	**Exposed Stories**	**Length Height Factor**	**Building Class**		
		N	**10.1 m to 20 m**	**9**	**2**	0-20	Type V-W	10%	
		E	**0 m to 3 m**	**17.2**	**2**	21-40	Type V-W	21%	
		S	**10.1 m to 20 m**	**9**	**2**	0-20	Type V-W	10%	
		W	**0 m to 3 m**	**17.2**	**2**	21-40	Type V-W	21%	
		Total Exposure Charge						62%	4,278
9	Determined Final Required Fire Flow	**Total Required Fire Flow (L/min) - Rounded to Nearest 100L**							**11,000**
		Total Required Fire Flow (L/s)							**184**
		Required Fire Flow Duration (hrs)							**2.0**
10	Determine Total Water Storage Requirement	**A = Required Fire Flow Volume (cu.m)**							**1,325**
		Maximum Day Flow (m3/day)							**1,244**
		B = Equalization Storage (m3)							**311**
		C = Emergency Storage (m3)							**409**
		Total Treated Water Storage Requirement (m3) (A+B+C)							**2,045**

Appendix D

Draft Assimilation Feasibility Investigation:
Hutchinson Environmental Sciences

Hutchinson

Environmental Sciences Ltd.

Grand River at 2nd Line
Assimilative Capacity Study

Prepared for: Geranium Corporation
Job #: J210025

October 6, 2021

DRAFT FOR DISCUSSION

1-5 Chancery Lane, Bracebridge ON P1L 2E3 | 705-645-0021
202-501 Krug Street, Kitchener ON N2B 1L3 | 519-576-1711

Hutchinson
Environmental Sciences Ltd.

1-5 Chancery Lane, Bracebridge, ON P1L 2E3 | 705-645-0021
202-501 Krug Street, Kitchener, ON N2B 1L3 | 519-576-1711
www.environmentalsciences.ca

October 6, 2021. HESL Job #: J210025

Farrah Ward
Geranium Corporation
3190 Steeles Avenue
Markham, ON L3R 1G9

Dear Ms. Ward:

Re: Grand River at 2nd Line Assimilative Capacity Study – Draft Report.

We are pleased to provide the draft report for Grand River at 2nd Line assimilative capacity study (ACS). Hutchinson Environmental Sciences Ltd. (HESL) was retained by Geranium Corporation to complete an ACS for the discharge of treated effluent from a wastewater treatment plant (WWTP) servicing a 465-unit development near the Fergus Golf course. The ACS found that the discharge of treated effluent at the proposed effluent concentrations will not change fully mixed water quality in the Grand River. In addition, 50 cottages on septic systems surrounding Belwood Lake that could be serviced as part of the development could potentially offset the additional phosphorus loads from the development.

The Grand River provides habitat for range of water temperature regimes, supporting species of all thermal regimes and provides habitat for a target species (Brown Trout). The Department of Fisheries and Oceans (DFO) Aquatic Species at Risk Mapping identifies the reach of the Grand River upstream and downstream of 2nd Line as Silver Shiner critical habitat. The GRCA Natural Heritage Characterization Report (GRCA 2019) states that the Silver Shiner is found in the Grand River approximately 7 km downstream of Elora to just below the Caledonia dam. Discussions with MECP are being conducted to confirm the range of Silver Shiner.

We thank Geranium Corporation for the opportunity to work on this project and look forward to continuing to work together.

Sincerely,
per: Hutchinson Environmental Sciences Ltd.

Deborah L. Sinclair

Deborah Sinclair, M.A.Sc.
Deborah.sinclair@environmentalsciences.ca

Signatures

Report Prepared by:

Christine Geiger, M.Sc.
Aquatic Scientist

Sarah Aitken B.Sc.
Senior Aquatic Ecologist

Report Reviewed by:

Deborah Sinclair. M.A.Sc
Senior Aquatic Scientist

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Appendices

1. Introduction and Background

Hutchinson Environmental Sciences Ltd. (HESL) was retained by Geranium Corporation to complete a preliminary assimilative capacity study for the discharge of treated effluent from a wastewater treatment plant (WWTP) servicing a 465-unit development near the Fergus Golf course. The development will be located at 3rd Line and Wellington Road 19, in Fergus, Ontario (Figure 1) and discharge to the Grand River at 2nd Line (Figure 1).

HESL was also requested to evaluate the potential of phosphorus load offsetting by incorporating the treatment of effluent from 50 cottages surrounding Belwood Lake which are currently serviced through septic systems.

Suggested WWTP effluent objectives (Table 1) were provided by R.J. Burnside & Associates Limited. These were used as a starting point for assessing the effects of WWTP effluent on the Grand River water quality at 2nd Line. The projected WWTP discharge is 600 m^3/d, which includes the 50 cottages surrounding Bellwood Lake that are currently serviced by septic systems.

Figure 1. Proposed WWTP Discharge Location.

Table 1. Preliminary WWTP Effluent Objectives (Provided by R.J. Burnside & Associates Limited).

Design Parameter	Units	Effluent Objective
Total Biochemical Oxygen Demand – 5 Days (BOD5)	mg/L	10
Total Suspended Solids (TSS)	mg/L	10
Total Phosphorus (TP)	mg/L	0.1
Total Ammonia (TAN)	mg/L	1.0
Total Nitrogen	mg/L	10
pH		6.5 to 9.5
E. Coli	CFU/ 100 mL	100

2. Regulatory Context

Ontario's Ministry of Environment, Conservation and Parks (MECP) have established policies and guidelines that direct the discharge requirements for WWTPs in the province. In "Water Management Policies, Guidelines and Provincial Water Quality Objectives of the Ministry of Environment and Energy" (MOE 1994a) the MECP provides direction on the management of surface water and groundwater quality and quantity for the Province of Ontario. The two policies that relate to the determination of WWTP discharges limits are:

Policy 1 – In areas which have water quality better than the PWQO, water quality shall be maintained at or above the objectives.

Policy 2 - Water quality which presently does not meet the PWQO shall not be degraded further, and all practical measures shall be taken to upgrade the water quality to the objectives.

The PWQO (Provincial Water Quality Objectives) are numerical and narrative criteria that serve as chemical and physical indicators representing a satisfactory level for surface waters (i.e. lakes and rivers) and where it discharges to the surface, the groundwater of the Province of Ontario. The PWQO are set at a level of water quality, which is protective of all forms of aquatic life and all aspects of the aquatic life cycles during indefinite exposure to the water (MOE 1994a).

In Deriving Receiving Water Based, Point-Source Effluent Requirements for Ontario Waters (MOE 1994b), the MECP provides guidance with regard to the requirements for point-source discharges and the procedures for determining effluent limits. For continuous discharges to streams and rivers, the 7Q20 low-flow statistic is used as a basic design flow to determine the assimilative capacity. The 75th percentile concentration is used to determine background water quality when developing receiver-based effluent limits and is to reflect the existing conditions of the receiver. The 75th percentile background concentrations are also used to determine the Policy status for each of the contaminants expected in the effluent. The following presents MECP guidance for effluent limits based on receiver Policy Status.

- For Policy 1 receivers, an evaluation is made as to what treatment or other measure is required to maintain water quality at or above the PWQO. Although some lowering of the water quality is permissible, violation of the PWQO is not allowed.

• For Policy 2 receivers no further lowering of water quality is permitted, and all reasonable and practical measures to improve water quality shall be undertaken (MOECC 1994b).

3. Water Quality and Quantity

3.1 Grand River 7Q20 Flow Analysis

In Ontario streams and rivers, the 7Q20 low-flow statistic is used as a basic design flow to determine the assimilative capacity of a stream or river. The 7Q20 flow represents the minimum 7-day average flow with a recurrence period of 20 years. This value determines the 5% chance of there not being adequate streamflow to properly dilute the point source discharge.

The operation of the Shand Dam regulates the flow in the Grand River to maintain assimilation volumes and to manage flooding and drought conditions in the main branch of the Grand River. The reservoir (Belwood Lake) behind the dam captures runoff from spring snow melt and heavy rains and releases the stored water during the summer and fall to maintain flow in the system. The water levels in the reservoir is typically highest around June 1 and lowest in the winter (GRCA 2014).

In regulated systems such as the Grand River, the low flow analysis is complex because it needs to consider how reservoir operations affect flows. The GRCA (Boyd and Shifflett, 2016) completed an analysis of low flows in the Grand River watershed and proposed seasonal 7Q20 flow equivalents for the Grand River that should be used in assimilation studies. The 7Q20 seasons coincide with the operation of the upstream Shand dam (located just upstream of 2nd Line). The seasonal 7Q20 flow equivalents determined by GRCA for the Grand River below the Shand dam are 1.4 m^3/s winter/spring, 2.7 m^3/s in summer, and 1.5 m^3/s in fall (Table 2).

Table 2. 7Q20 statistics and Q99.6 Flows (m^3/s) for the Grand River at Shand Dam.

Parameter	Grand River – Below Shand Dam		
	Winter/Spring	Summer	Fall
7Q20 Equivalent (m^3/s)	1.4	2.7	1.5
Q99.6	1.5	3.0	1.5

The summer 7Q20 equivalent (2.7 m^3/s) is higher than the fall (1.5 m^3/s) and winter/spring periods (1.4 m^3/s), which is in contrast to a natural system, where the summer season typically has the lowest 7Q20 flow. During the summer, water temperatures are high, and flows are typically low, which can result in low dissolved oxygen (DO), elevated un-ionized ammonia, high total phosphorus (TP) concentrations and excessive aquatic plant growth. The higher summer 7Q20 is because the flows are highly regulated in the summer to maintain water quality, aquatic habitat, sediment flushing and summer assimilation volumes in the Speed River (Boyd and Shifflet, 2014).

The GRCA have calculated seasonal $Q_{99.6}$ flows for the Grand River at the Shand gauge. A $Q_{99.6}$ flow is the value at which flows are expected to be higher 99.6% of the time (consistent with natural 7Q20 systems). The calculated summer $Q_{99.6}$ for the Grand River at Shand (Table 2) are higher than the 7Q20 equivalents, meaning that flows will be higher than the 7Q20 equivalents 99.6% of the time.

Seasonal 7Q20 flows of 1.4 m^3/s (winter/spring), 2.7 m^3/s (summer) and 1.5 m^3/s (fall) provide 202, 389 and 187-times dilution, respectively of the effluent under an expected 600 m^3/d of effluent discharge. Flows, and hence effluent dilution will be higher 99.6% of the time.

Table 3. WWTP Effluent Dilution Under 7Q20 Equivalent Flows.

Parameter	Grand River – Below Shand Dam		
	Winter/Spring	Summer	Fall
Effluent dilution during 7Q20 flow conditions	202	389	187

3.2 Water Quality

Background water quality in the vicinity of a WWTP is required to determine the policy status of a receiver, and as input into deriving receiving water-based effluent limits for WWTPs (MOE 1994b). The MECP maintain a long-term Provincial Water Quality Network (PWQMN) station on the Grand River at 2nd Line (Station# 16018403702).

Parameters assessed include those usually regulated by an Environmental Compliance Approval (ECA), have a PWQO or Canadian Water Quality Guideline for the Protection of Aquatic life (CWQG; CCME 1999), or required to calculate a regulated parameter. These include: dissolved oxygen, pH, total phosphorus (TP), total suspended solids (TSS), total ammonia nitrogen (TAN), un-ionized ammonia (UIAN), and water temperature. Although not typically regulated by an ECA, nitrate (NO_3-N) concentrations were also considered as it has a CWQG and can be enriched in WWTP effluent. Seasonal 75th percentile concentrations of each parameter, used to determine policy status of a receiver, are presented in (Table 4).

Table 4. Grand River at 2nd Line Water Quality (PWQMN 16018403702, 2010 to 2019).

Parameter	PWQO/ CWQG	75% All data	75% Seasonal Concentrations		
			Winter/Spring	Summer	Fall
Dissolved Oxygen*	a	9.19	13.14	8.75	10.9
Field pH	6.5-8.5	8.48	8.57	8.49	8.46
Water Temperature		19.4	9.8	20.2	10.9
Total phosphorus	0.03	0.045	0.035	0.042	0.047
Total suspended solids		10	5	9	11
Total ammonia (as N)		0.121	0.065	0.124	0.121
Un-ionized ammonia (as N)	0.0164	0.0065	0.0022	0.0078	0.0043
Nitrate (as N)	3	1.46	1.6	1.42	1.43

*Notes: All concentrations in mg/L except pH (dimensionless) and temperature (°C), a – PWQO is temperature and biota dependent; Shaded cells show guideline exceedances. * - 25th percentile concentration*

In the Grand River, the seasonal 75th percentile concentrations of TP ranged from 0.035 mg/L in winter/spring to 0.047 mg/L in fall, all above the PWQO of 0.03 mg/L. 75th percentile concentrations of un-ionized ammonia (0.0022 to 0.0078 mg-N/L) and nitrate (1.42 to 1.60 mg-N/L) and 25th percentile DO (between 8.75 to 10.90 mg/L) were all below/within their related PWQO/CWQG. The 75th percentile pH (8.57) in winter/spring was slightly above the upper PWQO limit of 8.5; however all other seasons were within with PWQO range of 6.5-8.5.

Based on the PWQMN data, the Grand River at 2nd Line is:

- Policy 2 for TP during all seasons,
- Policy 2 for pH in winter/spring, and
- Policy 1 for un-ionized ammonia, dissolved oxygen, and nitrate.

4. Aquatic Biology

4.1 Aquatic Habitat

4.1.1 Methods

Aquatic habitat in the Grand River was characterized through background review and a field assessment upstream of the 2nd Line bridge. The following habitat features were noted: stream morphology, substrate types, riparian vegetation, aquatic vegetation, fish barriers and other in-stream cover features. Habitat requirements of resident fish species were compared to habitat found in the study area to determine the presence or absence of critical habitats.

4.1.2 Results

The Upper Middle Grand River stretches between Shand Dam and the Village of Conestogo and drains an area of 640 km^2 of land and is fed by seven (7) major tributaries. Surficial geology within this reach of the Grand River is Paleozoic bedrock, physiography and soil types vary across the subwatershed resulting in varied annual groundwater recharge to the Grand River (GRCA 2019). The Shand Dam located approximately 1.3 km upstream of 2nd Line was constructed in 1942, creating the Belwood Lake Reservoir which regulates the flow regime of the Grand River (GRCA 2019).

HESL staff completed a preliminary assessment of the aquatic habitat on September 7th, 2021, in the general location of the proposed discharge at 2nd Line in Fergus. Aquatic habitat was characterized where access allowed and by visual observation from the bridge. The Grand River within the vicinity of 2nd Line bridge is approximately 35 m wide and sinuous with fairly straight reaches. Substrates are described as predominately cobble, gravel, sand/silt fines with boulders scattered throughout. Aquatic vegetation was observed along the edges of the river and periphyton was abundant. Depositional areas with terrestrial vegetation were scattered through the channel creating a 'braided/side channel' formation. The main body of the river along the left bank was deep with flowing water described as a run. The river portion located adjacent to the depositional areas and the right bank provided riffle/run/pool habitat. This stretch of the river had approximately 15-20% canopy cover provided by large mature coniferous and deciduous trees. The river banks were well vegetated and provided overhanging cover.

Habitat within this reach of the Grand River is of moderate to good quality and has been identified as potential Critical Habitat for Silver Shiner (DFO 2021). The aquatic habitat will be protected from any impacts associated with effluent discharge through adherence to Provincial and Federal Water Quality Objectives.

4.2 Fisheries

4.2.1 Methods

Resident fish assemblages were characterized in the study area through background review of fish records provided by GRCA and Land Information Ontario (LIO).

HESL received a Licence to Collect Fish for Scientific Purposes (LCSFP #1099381) from the Ministry of Northern Development, Mines, Natural Resources and Forestry (MNDMNRF) to collect fish and characterize the resident fish assemblage via backpack electrofishing. However, due to the potential presence of Silver Shiner in the Grand River, the LCFSP is currently being reviewed by MECP to identify any requirements under the Endangered Species Act (ESA 2007). This report will be updated to reflect the decision by MECP and the results of the sampling program if completed.

4.2.2 Results

The study area is located in the Upper Middle Grand River subwatershed which is located within the central part of the Grand River Watershed (GRCA 2019). This reach of the Grand River from Shand Dam downstream to West Montrose is known for its Brown Trout (*Salmo trutta*) fishery. There are several barriers located between Elora and Fergus that act as barriers to upstream movement of fishes, including the Shand Dam in Belwood. The Shand Dam maintains a cool-coldwater thermal regime in the Grand River by the controlled discharge of cold water from the Belwood Reservoir (GRCA 2019).

A total of 44 fish species have been recorded in the Upper Middle Grand River including its tributaries. Table 5 presents fish species captured in the Grand River within the vicinity of 2nd Line.

Table 5. Fish species Recorded in the Grand River within vicinity of 2nd Line.

Common Name[1]	Species	Thermal Regime[2]	SARO Status[2]	COSWEIC Status[2]	Tolerance[2]	Abundance[4]
Black Crappie	*Pomoxis nigromaculatus*	Coolwater	None	None	Tolerant	Common
Blacknose Dace	*Rhinichthys obtusus*	Coolwater	None	None	Intermediate	Common
Bluegill	*Lepomis macrochirus*	Warmwater	None	None	Intermediate	Common
Bluntnose Minnow	*Pimephales notatus*	Warnwater	None	None	Intermediate	Common
Bowfin	*Amia calva*	Warnwater	None	None	Intermediate	Common
Brassy Minnow	*Hybognathus hankinsoni*	Coolwater	None	None	Intermediate	Common
Brown Bullhead	*Ameiurus nebulosus*	Coolwater	None	None	Intermediate	Common
Brown Trout	*Salmo trutta*	Coldwater	None	None	Intolerant	Common
Channel Catfish	*Ictalurus punctatus*	Warmwater	None	None	Tolerant	Common
Coho Salmon	*Oncorhynchus kisutch*	Coldwater	None	None	Intolerant	Uncommon
Common Carp	*Cyprinus carpio*	Warmwater	None	None	Tolerant	Common
Common Shiner	*Luxilus cornutus*	Coolwater	None	None	Intermediate	Common
Creek Chub	*Semotilus atromaculatus*	Coolwater	None	None	Intermediate	Common
Fathead Minnow	*Pimephales promelas*	Warmwater	None	None	Tolerant	Common

Common Name[1]	Species	Thermal Regime[2]	SARO Status[2]	COSWEIC Status[2]	Tolerance[2]	Abundance[4]
Freshwater Drum	*Aplodinotus grunniens*	Warmwater	None	None	Tolerant	Common
Golden Shiner	*Notemigonus crysoleucas*	Coolwater	None	None	Intermediate	Common
Hornyhead Chub	*Nocomis biguttatus*	Coolwater	None	None	Intermediate	Common
Largemouth Bass	*Micropterus salmoides*	Warmwater	None	None	Tolerant	Common
Longnose Dace	*Rhinichthys cataractae*	Coolwater	None	None	Intermediate	Common
Mooneye	*Hiodon tergisus*	Coolwater	None	None	Intolerant	Common
Mottled Sculpin	*Cottus bairdii*	Coolwater	None	None	Intermediate	Common
Muskellunge	*Esox masquinongy*	Warmwater	None	None	Intermediate	Common
Northern Pearl Dace	*Margariscus nachtriebi*	Coolwater	None	None	Intermediate	Common
Northern Pike	*Esox lucius*	Coolwater	None	None	Intermediate	Common
Pumpkinseed	*Lepomis gibbosus*	Warmwater	None	None	Intermediate	Common
Rainbow Trout	*Oncorhynchus mykiss*	Coldwater	None	None	Intolerant	Common
River Chub	*Nocomis micropogon*	Coolwater	None	None	Intermediate	Common
Rock Bass	*Ambloplites rupestris*	Coolwater	None	None	Intermediate	Common
Rosyface Shiner	*Notropis rubellus*	Warmwater	None	None	Intermediate	Common

Common Name[1]	Species	Thermal Regime[2]	SARO Status[2]	COSWEIC Status[2]	Tolerance[2]	Abundance[4]
Silver Shiner	*Notropis photogenis*	Warmwater	Threatened	Threatened	Intolerant	Uncommon
Smallmouth Bass	*Micropterus dolomieu*	Coolwater	None	None	Intermediate	Common
Walleye	*Stizostedion vitreum*	Coolwater	None	None	Intermediate	Common
White Crappie	*Pomoxis annularis*	Warmwater	None	None	Tolerant	Uncommon
White Sucker	*Catostomus commersonii*	Coolwater	None	None	Tolerant	Common
Yellow Bullhead	*Ameiurus natalis*	Warmwater	None	None	Tolerant	Uncommon
Yellow Perch	*Perca flavescens*	Coolwater	None	None	Intermediate	Common

Notes:
1. Fish species records obtained from Land Information Ontario Aquatic Resource Area Survey Point (https://geohub.lio.gov.on.ca/datasets/aquatic-resource-area-survey-point/explore?location=43.726008%2C-80.340695%2C15.89) and Ministry of Natural Resources and Forestry – Fish ON-Line (https://www.lioapplications.lrc.gov.on.ca/fishonline/Index.html?viewer=FishONLine.FishONLine)
2. Thermal Regime preference obtained from Ontario Freshwater Fishes Life History Database - https://www.ontariofishes.ca/home.htm
   - Coldwater - Species that is best adapted, prefers or usually occurs at water temperatures less than 19°C, during summer months.
   - Coolwater - Species that is best adapted, prefers or usually occurs at water temperatures between 19 and 25°C, during summer months. Preferred temperatures may also include coldwater or warmwater ranges.
   - Warmwater - Species that is best adapted, prefers or usually occurs at water temperatures greater than 25°C, during summer months.

SARO Status provided by Ontario Freshwater Fishes Life History Database
- Threatened - A species lives in the wild in Ontario, is not endangered, but is likely to become endangered if steps are not taken to address factors threatening it.

COSEWIC Status provided by Ontario Freshwater Fishes Life History Database
- Threatened - A wildlife species that is likely to become an endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

Tolerance provided by Ontario Freshwater Fishes Life History Database
- Tolerant - Species that is insensitive or adaptive to environmental or anthropogenic stresses.
- Intermediate - Species that is neither particularly sensitive nor insensitive to environmental or anthropogenic stresses.
- Intolerant - Species that is sensitive to environmental or anthropogenic stresses.

Abundance provided by Ontario Freshwater Fishes Life History Database
- Uncommon - Species occasionally encountered, may have a somewhat restricted range.
- Common - Species frequently encountered, usually with a widespread range.

The fish species recorded in the Grand River within the vicinity of 2nd Line reflect the range of water temperature regimes, supporting species of all thermal regimes - warmwater, coolwater and coldwater. Three fish species documented are restricted to coldwater habitats. These species include: Rainbow Trout, Coho Salmon and Brown Trout, all of which are introduced species to Ontario but are now naturalized and can sustain their populations. This reach of the Grand River contains several large piscivorous fish species such as Largemouth Bass, Northern Pike and Walleye. Majority of the fish species recorded are common and widespread throughout Ontario and are identified as habitat generalists. Most species are classified as tolerant to intermediate tolerance to environmental or anthropogenic stresses. The *Salmonid* species and Silver Shiner are classified as intolerant and sensitive to environmental and anthropogenic stresses.

4.2.2.1 Silver Shiner

Silver Shiner is listed as Threatened under the ESA (2007) and was added to Schedule 1 as Threatened in 2019 under the Species at Risk Act (SARA). The Silver Shiner is a small silvery fish that is a member of the carp family. In Canada it occurs in southern Ontario in the Grand River, Thames River and Bronte Creek watersheds. It prefers moderate to large, deep and relatively clear streams with swift currents (SARA 2021). Poor water quality, dam construction and channelization have been responsible for the decrease in numbers. The GRCA Natural Heritage Characterization Report (GRCA 2019) states that the Silver Shiner is found in the Grand River approximately 7 km downstream of Elora for a 145 km stretch to just below the Caledonia dam (GRCA 2019). The Department of Fisheries and Oceans (DFO) Aquatic Species at Risk Mapping identifies the reach of the Grand River upstream and downstream of 2nd Line as Silver Shiner critical habitat. The presence of Silver Shiner within this reach of the Grand River will be confirmed through electrofishing and through discussions with MECP.

4.3 Benthic Macroinvertebrates

4.3.1 Methods

Benthic invertebrates are the most used organism in the bioassessment of freshwater ecosystems (Bailey et al. 2004). Reasons for their popularity include their limited mobility so they are constantly exposed to the effects of pollution, they are reasonably long-lived so the effects of stressors can be integrated over a longer time period, and they are a well-documented, aquatic ecological indicator with various tolerance levels (Resh and Rosenberg 1993).

Benthic invertebrates were sampled on September 7, 2021 to establish the baseline community structure within the Grand River for comparison with future monitoring surveys. Benthic invertebrates were sampled following the Ontario Benthos Biomonitoring Network protocol (MOE 2007). One site was selected upstream of 2nd Line. Samples were collected using a 3-minute timed, kick-and-sweep sampling method over a ~10 m reach for 2 riffle transects and 1 pool transect. Riffle habitat typically support benthic invertebrate species that are most sensitive to water quality impacts which improves the sensitivity of the bioassessment. Samples were preserved with 10% buffered formalin and borax to prevent the mollusc shells from dissolving. Samples were sent to ZEAS Incorporated for sorting and taxonomic identification to the lowest practical level (raw benthic data are provided in Appendix A).

Taxonomic data was interpreted through a variety of biological metrics designed to describe community composition: abundance, richness, Shannon's diversity, %EPT, Hilsenhoff Biotic Index to establish background benthic invertebrate communities. Taxa tolerance values for individual species were updated following Benthic Macroinvertebrates in Freshwaters – Taxa Tolerance Values, Metrics, and Protocols (Mandaville 2002).

Habitat is a critical driver of benthic invertebrate assemblages. The effects of habitat on benthic assemblage were partially controlled by selectively sampling riffle and pool habitats during temporal comparisons of sites. Habitat was also described at each sampling location so that results could be related to habitat variables as required.

4.3.2 Results

Benthic invertebrates were collected from riffle and pool habitats with predominantly sand/silt with rocky substrates (Table 6). Habitat characteristics are described in Table 6 and biological metric results are provided in Table 7. *Annelids* (worms) made up just under half of the of the species identified in the Pool sample followed by True Flies. The pool habitat contained silty/sand substrates with some cobble and gravel. Both samples collected from the riffle habitat were dominated by True Flies (midges) and *Trichoptera* (caddisflies).

All samples were extremely productive with abundance ranging from 16960 individuals collected in the pool transect to 41344 at the Riffle 1 site.

Richness was similar at all three sites ranging from 39 taxa to 44 taxa at Riffle 1 and Pool, respectively. Species diversity, as measured by Shannon's Diversity, was high ranging from 2.85 (Riffle 1 and 2) to 3.14 (Pool). The percentage of EPT taxa was low, ranging from 3.40% (Pool) to 18.87% (Riffle 2).

HBI ranged from 5.62 (Riffle 2) to 7.45 (pool), indicating "Fair" to "Very Poor" water quality. It is interesting to note that the lowest % EPT and highest HBI values were located at the Pool site, likely due to the slight difference in habitat characteristics. % Oligochaeta and % Isopoda were also highest at the Pool location as well. An abundance of *Chironomidae* as measured through % *Chironomidae*, can indicate degraded conditions because *Chironomidae* are a tolerant species that tend to thrive where other more sensitive species cannot. % Chironomidae were lowest at the pool location and highest at Riffle 1 and Riffle 2.

Table 6. Habitat Characteristics at Sampling Locations.

	GR - Riffle 1	GR - Riffle 2	GR - Pool
Morphology	Riffle	Riffle	Pool
Water depth (cm)	20-30	15-25	30-40
Substrates	Bedrock bottom with rocky substrates, primarily gravel with some silty sand	Bedrock bottom with rocky substrates, primarily cobble and gravel with some silty sand	Bedrock bottom with primarily silty sand with cobble and gravel

	GR - Riffle 1	GR - Riffle 2	GR - Pool
Woody debris and macrophytes	Sparse woody debris but lots of periphyton growth and macrophytes present	Sparse woody debris but lots of periphyton growth and macrophytes present	Sparse woody debris with macrophytes present

Table 7. Benthic Invertebrate Biological Metric Results.

	GR - Riffle 1	GR - Riffle 2	GR - Pool
Abundance	41,344	19,328	16,960
Richness	39	43	44
Diversity (Shannon-Wiener)	2.85	2.85	3.14
Hilsenhoff Index	5.88	5.62	7.45
HBI Index WQ Comment	Fairly Poor	Fair	Very Poor
Number of EPT Taxa	11	11	7
% EPT	10.99	18.87	3.40
% Oligochaeta	6.04	1.16	42.26
% Chironomidae	65.63	52.73	26.04
% Isopoda	3.72	6.71	12.64

Based on the benthic invertebrate sampling results, habitat is the major driver of benthic assemblages as seen in the results for the riffle and pool habitats.

5. Water Quality Modelling

A mass balance loading analysis was undertaken to predict the effect of the WWTP on the Grand River water quality assuming complete mixing of effluent with the river water.

Parameters modeled include those regularly regulated by Environmental Compliance Approvals (ECA): TP, TSS, and TAN. Although pH and *E. coli* are also regulated by ECAs, these parameters were not modeled as mass balance analysis is not recommended for these parameters. In these two cases, pH is more influenced by alkalinity reactions than by dilution, and *E. coli* are living organisms, and their numbers may increase or decrease in the receiving environment independent of dilution. Dissolved oxygen and nitrate were also modeled; to assess the effect of nitrification (biological conversion of ammonia to nitrate) and effluent cBOD concentrations on downstream water quality.

Mass-balance modeling assumes instantaneous and complete mixing of the effluent within the receiver. The modeling does not account for uptake that would reduce phosphorus concentrations, or the removal of ammonia from nitrification. It does, however, provide a conservative calculation of fully mixed concentrations in the receiver. The mass balance model was completed using seasonal 7Q20 flow estimates and 75th% upstream concentrations to represent the conservative assessment of the extreme response of the river to the WWTP discharge. Flows will be higher and background concentrations will be lower 99.6% (Boyd and Shifflett, 2016) and 75% of the time respectively; therefore, resultant fully mixed concentrations would be lower over 99.6% of the time.

5.1 Methods

The upstream, background loads in the Grand River were estimated by multiplying the seasonal 75th percentile concentrations at the PWQMN station (Table 4) by the seasonal 7Q20 flow equivalents for the Grand River at the Shand dam estimated by the GRCA (Table 2). Loads from the WWTP were estimated by multiplying the effluent objectives (Table 1) provided by R.J. Burnside & Associates Limited by the proposed flow rate of 600 m^3/s. The WWTP loads were added to the calculated Grand River background loads to predict downstream loads and water quality.

The effect of WWTP effluent on Grand River nitrate concentrations was estimated by assuming that all of the total nitrogen in the effluent is expressed as nitrate. This is a conservative estimate, as total nitrogen is the sum of inorganic (nitrate, nitrite), organic, and ammonia. Effluent total nitrogen concentration of 10 mg-N/L (objective) was used for nitrate concentrations and loads from the WWTP were added to upstream background loads to predict downstream loads and concentrations.

The total oxygen demand (TOD) of the effluent was estimated as 4.57 times the TAN objective (1 mg-N/L; NOD load) plus the cBOD objective (10 mg/L), for a TOD of 14.57 mg/L. Seasonal 25th percentile DO concentrations (winter/spring 13.14 mg/L, summer 8.75 mg/L and fall 10.90 mg/L) from the PWQMN data (Section 3.1, Table 4) was used to estimate the DO concentration during periods of low oxygen conditions. The reduction in oxygen in the Grand River downstream of the effluent discharge was estimated by subtracting the TOD from the DO load in the Grand River.

5.2 Results

Due to the high assimilative capacity of the Grand River, fully mixed concentrations of TP, TSS, and nitrate are not predicted to change downstream of the WWTP discharge (Table 8).

A nominal (0.10 mg/L) decrease in DO concentrations may occur from the nitrification of ammonia and biological oxygen demand of the effluent; however concentrations are maintained well above the most stringent PWQO for cold water biota of 8 mg/L at a water temperature of 0ºC.

TAN is expected to slightly increase (between 0.002 mg-N/L in summer and 0.005 mg-N/L in winter/spring) during all seasons (Table 8). Using 75th percentile seasonal water temperatures and pH (Table 4) the calculated un-ionized ammonia-N concentrations are below the PWQO of 0.0164 mg-N/L (0.044 mg-N/L in winter/spring, 0.0138 mg-N/L in summer and 0.0067 mg-N/L in the fall).

These predictions are made for 7Q20 conditions and 75th percentile background water quality, downstream fully mixed water quality will be better 99.6% of the time.

Table 8. Grand River at 2nd Line Mass Balance Modelling.

		Upstream Grand River			WWTP Effluent			Calculated Grand River Downstream			Concentration Change
		75th%	7Q20	Load	Objective	Flow	Load	Load	Flow	Conc	
Parameter	**Season**	**mg/L**	**L/s**	**mg/s**	**mg/L**	**L/s**	**mg/s**	**mg/s**	**L/s**	**mg/L**	**mg/L**
Total Phosphorus	winter/spring	0.035	1400	49.00	0.1	6.94	0.694	49.7	1406.9	0.035	0.000
	summer	0.042	2700	113.4	0.1	6.94	0.694	114.1	2706.9	0.042	0.000
	fall	0.047	1500	70.5	0.1	6.94	0.694	71.2	1506.9	0.047	0.000
Total Suspended Solids	winter/spring	5	1400	7000	10	6.94	69.4	7069	1407	5.0	0.0
	summer	9	2700	24300	10	6.94	69.4	24369	2707	9.0	0.0
	fall	11	1500	16500	10	6.94	69.4	16569	1507	11.0	0.0
Nitrate	winter/spring	1.6	1400	2240	10	6.94	69.4	2309	1407	1.6	0.0
	summer	1.42	2700	3834	10	6.94	69.4	3903	2707	1.4	0.0
	fall	1.43	1500	2145	10	6.94	69.4	2214	1507	1.5	0.0
Dissolved Oxygen	winter/spring	13.1[a]	1400	18400	14.57[b]	6.94	101.1	18298	1407	13.0	-0.1
	summer	8.8[a]	2700	23625	14.57[b]	6.94	101.1	23524	2707	8.7	-0.1
	fall	10.9[a]	1500	16346	14.57[b]	6.94	101.1	16245	1507	10.8	-0.1
Total Ammonia Nitrogen	winter/spring	0.065	1400	91	1	6.94	6.94	98	1407	0.070	0.005
	summer	0.124	2700	335	1	6.94	6.94	342	2707	0.126	0.002
	fall	0.121	1500	182	1	6.94	6.94	188	1507	0.125	0.004

*Note: a - 25th percentile DO concentration used for Grand River Upstream. b - TOD = 4.57 * 1 mg-N/L TAN + 10 mg/L BOD*

6. TP Offsetting

The Grand River is Policy 2 for TP. For Policy 2 receivers MECP state:

Water quality which presently does not meet the PWQO shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the objectives.

The effluent TP objectives maintain TP concentrations in the river; meeting Policy 2 criteria, however the TP load in the watershed will slightly increase from the development (Table 6). There are 50 cottages on septic systems surrounding Belwood Lake that could be serviced as part of the development; potentially offsetting phosphorus loads from the development. The annual TP load from 50 cottages was estimated as 41.9 kg/yr following MECP's (MOE 2010) approach and assuming extended seasonal occupancy of the cottages.

The annual TP load from the WWTP (without the cottages) is 19.9 kg/y (Table 9). Hooking up all 50 cottages to the WWTP would increase the WWTP TP load to 21.9 kg/yr (Table 9).

Table 9. Annual Total Phosphorus Load from the WWTP with and without Cottages.

Scenario	TP Load (kg/yr)
Without cottages	19.9
With 50 cottages	21.9

Notes: Loads calculated using effluent TP of 0.1 mg/L

Servicing all 50 cottages with the new development therefore has the potential to reduce the annual TP load to the Grand River watershed by 20 kg/yr (Table 10); meeting the intent of Policy 2.

Table 10. Change in Total Phosphorus Load to the Grand River

Scenario	Annual Load (kg/yr)
WWTP with 50 cottages	21.9
50 septic systems removed	-41.9
Reduction in TP Load	-20

It should be noted that research over the past 20 years has shown that septic system phosphorus is immobilized in Precambrian Shield soils, such that over 90% of septic phosphorus may be immobilized. Robertson et al. (2019) also found that approximately 66% of TP is immobilized in soils off shield. The MECP should therefore be consulted to determine appropriate immobilization rates for Belwood Lake area.

The actual reduction in phosphorus from servicing 50 cottages will depend on the number of units serviced, their occupancy (e.g. extended seasonal, permanent), and the immobilization of phosphorus in the soils.

7. Conclusions and Recommendations

7.1 Water quality and quantity

PWQMN data collected between 2010 and 2019 by the MECP on the Grand River at 2nd Line was used to determine policy status for WWTP indicators. 75th percentile TP concentrations were above the PWQO value of 0.03 mg/L during all seasons; indicating Policy 2 status all year round. 75th Percentile pH in the spring was outside the PWQO range of 6.5 to 8.5 indicating Policy 2 status but was within range in summer and fall. Dissolved oxygen concentrations were above the PWQO for cold water species, indicating a well oxygenated Policy 1 system. Un-ionized ammonia concentrations were low, indicating Policy 1 status for TAN.

The GRCA have proposed seasonal 7Q20 flow equivalents for the Grand River to be used in assimilation studies. The seasonal 7Q20 flow equivalents determined by GRCA for the Grand River below the Shand dam are 1.4 m^3/s winter/spring, 2.7 m^3/s in summer, and 1.5 m^3/s in fall. At an effluent discharge of 600 m^3/d these flows provide 187 to 389 times dilution of the effluent. Flows, and effluent dilution will be higher 99.6% of the time.

7.2 Aquatic Biology

The study area supports a wide range of fish species indicative of warm, cool and coldwater thermal regimes, including a management target species (Brown Trout) and SAR (Silver Shiner). The Grand River provides important habitat for a variety of species and their life cycle stages, including rearing, feeding and spawning. All species will be protected from impacts associated with the conveyance of treated effluent through adherence to PWQOs.

The Department of Fisheries and Oceans (DFO) Aquatic Species at Risk Mapping identifies the reach of the Grand River upstream and downstream of 2nd Line as Silver Shiner critical habitat. The GRCA Natural Heritage Characterization Report (GRCA 2019) states that the Silver Shiner is found in the Grand River approximately 7 km downstream of Elora to just below the Caledonia dam. Discussions with MECP are being conducted to confirm the range of Silver Shiner.

The diversity of the benthic invertebrate community and the Hilsenhoff Biotix Index suggest the differences are related to changes in habitat characteristics between the riffle and pool locations. The study area supports a wide range of fish species indicative of warm, cool and coldwater thermal regimes, including a management target species (Brown Trout). All species are protected from impacts associated with the conveyance of treated effluent through adherence to PWQOs and ECA process.

7.3 Water Quality Modelling

Mass-balance modelling was conducted to assess the effect of discharge of treated effluent to the Grand River at the proposed effluent objectives (Table 1). At a TP effluent objective of 0.1 mg/L and design flow of 600 m^3/d, the fully mixed TP concentration in the Grand River would not change; and therefore remain above the PWQO of 0.03 mg/L.

At the proposed effluent objectives of 10 mg/L for total nitrogen and TSS would not cause any change in TSS or nitrate concentrations in the Grand River at 2nd Line.

At an effluent TAN of 1 mg-N/L fully mixed Grand River concentrations would increase nominally, and un-ionized ammonia concentrations remain below the PWQO.

The 25th percentile dissolved oxygen concentration would decrease; however concentrations in the Grand River at 2nd Line would remain high, and above the PWQO of 8 mg/L at a water temperature of 0°C (the most stringent PWQO for dissolved oxygen).

Based on mass-balance modeling, discharge of WWTP effluent at the proposed WWTP objectives will maintain water quality in the Grand River under 7Q20 conditions and 75th percentile background water quality conditions, downstream fully mixed water quality will be better than predicted concentrations 99.6% of the time.

7.4 TP Offsetting

The effluent TP objectives maintain TP concentrations in the river; however the TP load will slightly increase from the development (Table 6). Incorporating 50 existing residences with septic systems into the WWTP can offset TP loads from the proposed developments WWTP; and meet MECP Policy 2 that *Water quality which presently does not meet the PWQO shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the objectives.* The actual load reduction can be calculated once the number of cottages and their occupancy is determined, and MECP's agreement TP immobilization in soils.

7.5 Recommendations

Based on the results of the ACS we recommend:

1. Effluent criteria of 0.1 mg/L for TP, 10 mg/L for cBOD and TSS, 1 mg-N/L for TAN, 10 mg-N/L TN, 6.5-9.5 for pH, and 100 CFU/100 mL *E. coli* to maintain water quality in the Grand River.

2. Continue discussions with MECP and conduct fish sampling to confirm range of Silver Shiner (SAR) in the Grand River.

3. Meet with agencies (e.g. GRCA and MECP) to determine the presence of constraints at the preferred discharge location and determine, any supporting studies (e.g. Environmental Impact Study, geomorphological, geotechnical), and discuss the feasibility for using phosphorus offsets as a means to mitigate loadings from the WWTP. Share this report for their review and feedback.

8. References

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Appendix A. Raw Benthic Invertebrate Data

TABLE 1: BENTHIC MACROINVERTEBRATES COLLECTED FROM GRAND RIVER IRVINE CREEK, 2021 (Densities expressed per sampled area)

Station	Grand River		
	Riffle 1	Riffle 2	Pool
ROUNDWORMS			
P. Nemata	64	-	-
FLATWORMS			
P. Platyhelminthes			
Cl. Turbellaria			
O. Tricladida	320	-	-
F. Dugesiidae	-	320	416
ANNELIDS			
P. Annelida			
WORMS			
Cl. Oligochaeta			
F. Naididae			
S.F. Naidinae			
Nais bretscheri	2310	160	424
Nais	122	32	212
Ophidonais serpentina	-	32	2120
Slavina appendiculata	-	-	424
Specaria josinae	-	-	-
Stylaria lacustris	64	-	2080
S.F. Tubificinae			
Aulodrilus limnobius	-	-	636
Aulodrilus pigueti	-	-	-
Limnodrilus hoffmeisteri	-	-	212
immatures with hair chaetae	-	-	848
immatures without hair chaetae	-	-	212
S.F. Rhyacodrilinae			
Branchiura sowerbyi	-	-	-
LEECHES			
Cl. Hirudinea			
F. Glossiphoniidae			
Glossiphonia complanata	-	-	32
ARTHROPODS			
P. Arthropoda			
MITES			
Cl. Arachnida			
Subcl. Acari	-	-	-
O. Trombidiformes			
F. Hygrobatidae			
Hygrobates	128	128	32
F. Lebertiidae			
Lebertia	-	16	-
F. Mideopsidae			
Mideopsis	-	-	-
F. Sperchontidae			
Sperchon	-	16	-
F. Unionicolidae			
Neumania	-	-	-
SEED SHRIMPS			
Cl. Ostracoda	64	-	352
WATER SCUDS			
O. Amphipoda			
F. Crangonyctidae			
Crangonyx	-	-	-
F. Gammaridae			
Gammarus	-	-	-
F. Hyalellidae			
Hyalella	-	-	64
AQUATIC SOW BUGS			
O. Isopoda			
F. Asellidae			
Caecidotea	1536	1296	2144
CRAYFISH			
O. Decapoda			
F. Cambaridae			
Orconectes propinquus	-	-	-
INSECTS			

TABLE 1: BENTHIC MACROINVERTEBRATES COLLECTED FROM GRAND RIVER IRVINE CREEK, 2021 (Densities expressed per sampled area)

Station	Grand River		
	Riffle 1	Riffle 2	Pool
Cl. Insecta			
BEETLES			
O. Coleoptera			
F. Elmidae			
Dubiraphia bivittata	-	-	-
Dubiraphia minima	-	-	-
Dubiraphia larvae	-	-	32
Macronychus	-	-	-
Optioservus larvae	64	272	-
Stenelmis crenata	-	-	-
Stenelmis larvae	-	32	-
F. Psephenidae			
Ectopria	64	-	-
Psephenus	-	-	-
MAYFLIES			
O. Ephemeroptera			
F. Baetidae			
Acerpenna	64	-	-
Baetis	64	80	-
Callibaetis	-	-	32
Procloeon viridoculare	-	-	-
Procloeon	-	-	-
F. Caenidae			
Caenis	-	16	64
F. Ephemeridae			
Ephemera	-	-	-
Hexagenia	-	-	-
F. Ephemerellidae			
Eurylophella	-	-	-
F. Heptageniidae			
Maccaffertium vicarium	-	-	-
Maccaffertium	-	-	-
Stenacron	-	-	-
Stenonema femoratum	-	-	-
F. Leptohyphidae			
Tricorythodes	-	64	-
O. Megaloptera			
FISHFLIES & DOBSONFLIES			
ALDERFLIES			
F. Sialidae			
Sialis	-	-	-
O. Odonata			
DAMSELFLIES			
F. Coenagrionidae			
immature	-	-	-
DRAGONFLIES			
F. Aeshnidae			
Basiaeschna janata	-	-	-
BUGS			
O. Hemiptera			
F. Corixidae			
Sigara mathesoni	-	-	64
Trichocorixa	-	-	32
immature	-	-	**224**
CADDISFLIES			
O. Trichoptera			
trichoptera pupae	**192**	48	-
F. Brachycentridae			
Micrasema	-	-	32
F. Helicopsychidae			
Helicopsyche	64	-	-
F. Hydropsychidae			
Cheumatopsyche	512	832	-
Hydropsyche alternans	64	-	-
Hydropsyche betteni	576	608	-
Hydropsyche bronta	256	128	-
Hydropsyche morosa	448	384	-
Hydropsyche slossonae	-	192	32
Hydropsyche sparna	128	144	-
Hydropsyche	**960**	**720**	-
pupae	-	**80**	-
F. Hydroptilidae			

TABLE 1: BENTHIC MACROINVERTEBRATES COLLECTED FROM GRAND RIVER IRVINE CREEK, 2021 (Densities expressed per sampled area)

Station	Grand River Riffle 1	Riffle 2	Pool
Hydroptila	576	224	-
pupae	**576**	**96**	128
F. Leptoceridae			
Ceraclea	-	-	-
Mystacides	64	-	224
Oecetis	-	-	64
pupae	-	-	-
immature	-	-	-
F. Polycentropodidae			
Nyctiophylax	-	-	-
F. Psychomyiidae			
Psychomyia	-	32	-
TRUE FLIES			
O. Diptera			
BITING-MIDGE			
F. Ceratopogonidae			
Mallochohelea	-	-	-
Probezzia	-	-	-
MIDGES			
F. Chironomidae			
chironomid pupae	**2048**	**912**	**224**
S.F. Chironominae			
Chironomus	182	64	576
Cladotanytarsus	-	-	-
Cryptochironomus	-	-	32
Cryptotendipes	-	-	-
Dicrotendipes	909	191	608
Microtendipes	4363	826	192
Nilothauma	-	64	-
Paratanytarsus	1818	254	256
Paratendipes	364	-	736
Phaenopsectra	545	64	256
Polypedilum flavum	9271	4704	352
Polypedilum	-	-	-
Pseudochironomus	-	-	-
Rheotanytarsus	-	254	-
Stempellinella	-	-	-
Stictochironomus	-	-	288
Tanytarsus	1273	254	480
Tribelos	-	-	-
S.F. Diamesinae			
Pagastia	909	254	-
S.F. Orthocladiinae			
Brillia	-	-	-
Cricotopus	3272	1207	64
Cricotopus trifascia	364	-	-
Cricotopus/Orthocladius	-	254	-
Eukiefferiella	-	63	-
Nanocladius	-	-	64
Parametriocnemus	-	64	-
Thienemanniella	-	-	32
Tvetenia	364	254	-
S.F. Tanypodinae			
Ablabesmyia	-	-	-
Natarsia	-	-	-
Procladius	-	-	96
Rheopelopia	-	64	-
Thienemannimyia complex	1454	445	160
F. Empididae			
Hemerodromia	448	112	-
F. Simuliidae	3008	2896	-
F. Tabanidae			
Chrysops	-	-	-
F. Tipulidae			
Antocha	64	-	-
MOLLUSCS			
P. Mollusca			
SNAILS			
Cl. Gastropoda			
F. Ancylidae			
Ferrissia	-	-	-

TABLE 1: BENTHIC MACROINVERTEBRATES COLLECTED FROM GRAND RIVER IRVINE CREEK, 2021 (Densities expressed per sampled area)

Station	Grand River Riffle 1	Riffle 2	Pool
F. Physidae			
Physella	1216	128	800
F. Planorbidae			
Gyraulus	192	32	544
Helisoma anceps	-	-	32
CLAMS			
Cl. Bivalvia			
F. Sphaeriidae			
Pisidium/Cyclocalyx	-	16	32
Sphaerium (Amesoda) striatinum	-	-	-
TOTAL NUMBER OF ORGANISMS	#####	#####	#####
TOTAL NUMBER OF TAXA [a]	39	43	44

[a] Bold entries excluded from taxa count