Report for

Increased Capacity of the Town of Shelburne's Water Pollution Control Plant
Schedule 'C'
Environmental Assessment Study Report (ESR)

Town of Shelburne

Prepared by

January 2024

S. Burnett & Associates Limited
210 Broadway Unit 203
Orangeville, ON L9W 5G4

January 31, 2024

The Corporation of the Town of Shelburne
203 Main Street East
Shelburne, ON L9V 3K7

Attn: Denyse Morrisey, CAO

Re: Town of Shelburne, Increased Capacity of the Water Pollution Control Plant
Environmental Assessment Report – Class 'C'
SBA File No. M16018

Dear Denyse,

As you are aware, S. Burnett & Associates Limited (SBA) was retained to complete a Schedule 'C' Class Environmental Assessment to determine the preferred means of meeting the Town of Shelburne's wastewater treatment needs for the next 20-years. Our assessment followed the Municipal Engineers Association Municipal Class EA process and is documented in this Environmental Screening Report. Upon approval from the Town of Shelburne, SBA will submit a Notice of Completion for this project and make this report available for public and agency review.

Thank you for the opportunity to work together on this important project. Should you have any questions, please do not hesitate to contact us.

Yours truly,

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Executive Summary

Background

S. Burnett & Associates Limited (SBA) was retained by the Town of Shelburne, herein referred to as the "Town", to provide engineering and environmental services to complete a Schedule 'C' Class Environmental Assessment to increase the rated capacity of the existing Water Pollution Control Plant (WPCP) to meet the Town's long-term needs.

In Ontario, projects undertaken by municipalities are subject to environmental assessment requirements outlined in the *Environmental Assessment Act*, *R.S.O. 1990, c. E.18* (the "EA Act"). Under Part II. 1 of the *EA Act*, projects can be assessed under an approved Class EA process. The Municipal Engineers Association has developed the Municipal Class EA process, which is an approved assessment process for a variety of municipal projects.

This Environmental Study Report (ESR), has been prepared in accordance with Municipal Class Environmental Process (Municipal Engineers Association, 2023) for a Schedule 'C' project, which includes the completion of the following phases:

- Phase 1: Problem / Opportunity Identification
- Phase 2: Alternative Solutions and Selection of Preferred Options
- Phase 3: Identification / Evaluation of the Design Alternatives for Implementing the Preferred Solution
- Phase 4: Preparation of the Environmental Study Report
- Phase 5: Implementation

Several alternative solutions were proposed as part of this study, and an assessment was completed to identify the preferred solution when considering environmental, technical, economic, and social considerations.

Problem Statement

Since 1995, the Town, has grown significantly and an average annual growth rate of 2.2.% is estimated for the next 20-years, with a predicted population of 10,000 in 2031 and 15,000 in 2041. Shelburne's WPCP does not have enough rated capacity to meet future wastewater treatment demands resulting from planned population growth and the Town's current build-out areas. Shelburne's build-out population is the population anticipated to fill all approved and potential future residential units (including planned urban boundary changes) within the current Town boundaries.

Alternative Solutions

To meet Shelburne's current and future wastewater treatment demands, the following Alternative Solutions were considered:

- **Option No. 1: "Do Nothing":** Limit population growth and water treatment demands to current levels.
- **Option No. 2: Water Efficiency and Extraneous Flow Reduction:** Implement programs to reduce the amount of water.
- **Option No. 3: Expand /Upgrade Existing WPCP:** Make changes to the WPCP to increase effluent limits from 3,420 m^3/day to either 4,400 m^3/day or 5,100 m^3/day, which translate to populations of 13,000 and 15,000 respectively.
- **Option No. 4: Maintain existing WPCP and Construct a Second WPCP:** A second WPCP would be constructed to meet the needs of the growing population, specifically, for effluent that exceeds 3,420 m^3/day.
- **Option No. 5: Construct a new WPCP:** Close the existing WPCP and construct a new WPCP with a discharge limit of 5,100 m^3/day of treated wastewater.
- **Option No. 6: Construct a pipeline:** Construct a pipeline to transport untreated wastewater to a neighboring municipality's water treatment plant with sufficient treatment capacity.

For Option No. 3, SBA completed an Assimilative Capacity Study to determine effluent limit concentrations for selected parameters (i.e., nitrate, ammonia, phosphorous, dissolved oxygen, and carbonaceous biological oxygen demand) that would avoid adverse effects to aquatic life at the proposed higher effluent discharge rates. The effluent limits derived form the Assimilative Capacity Study were approved by the Ministry of the Environment, Conservation and Parks on April 30, 2020.

Preliminary Screening of Alternative Solutions

A preliminary screening of Alternative Solutions was undertaken to rule out any Alternative Solutions that:

- Do not provide a viable solution to the problem.
- Are not proven technologies.
- Are not technically feasible.
- Are not consistent with planning objectives.
- Are not consistent with provincial government priority initiatives.
- Impact sensitive environmental features.
- Are not practical, financial realistic, or economically viable.
- Are not within the ability of the Town to implement.

On this basis, the "Do Nothing" option was screened-out as it does not address that the existing WPCP is at capacity and cannot meet planned population growth.

There were not enough water efficiency and extraneous flow reductions opportunities to result in a significant change in wastewater flows requiring treatment. This is in part due to universal metering introduced in 2011, sewer refurbishments also completed in 2011, and the implementation of an annual system-wide program to identify and repair infiltration leaks or inputs.

Similarly, water conservation on its own, would not provide adequate reduction in wastewater reporting to the WPCP. As an example, if 50% of the population did not currently have low flow toilets, and converted them to low flow toilets, this would only result in a 162 m^3/day[1] reduction, compared to the predicted shortfall of 1,680 m^3/day.

The new pipeline option has an installation cost of $100 million which does not include water treatment costs that would be passed on to the Town by the neighbouring municipality. This option is not financially realistic for the Town and is therefore not considered within the ability of the Town to implement.

Assessment of Remaining Alternative Solutions

The remaining Alternative Solutions were evaluated using a wide range of criterion that were broken into the technical, environmental, social, and economic categories. Each category received an equal weighting, with a total possible score of 25%. Criterion within each category were weighted based on environmental regulations, technical expertise, and input from the Town of Shelburne and the current WPCP operator. Alternative solutions were then evaluated for each criterion to determine whether they met the criteria, partially met, or did not meet the criterion. An example of a technical criterion is "results in effluent that consistently meets effluent requirements". The assessed weighted criterion for each category were totalled for each Alternative Solution and compared to determine the preferred Alternative Solution for each category and for an overall preferred alternative, which received the highest score across all four (4) categories. The results of this assessment are shown in the table below:

[1] Assumes a per capita wastewater generation rate of 0.265 m^3/day for a population of 8,126, 50% of whom would convert from conventional to low flow toilets. Assumes that 30% of wastewater generated is from toilets and that conversion would result in a 54% savings in wastewater generated.

Executive Table I: Summary of Assessment of Alternative Solutions

Evaluation Category Score Total	Evaluation Category Weighted Percentage (%)	Alternative Solutions (%)			
		3a Upgrade/Expand WPCP	3b Upgrade/Expand WPCP	4 New second WPCP for Additional Flow	5 New Replacement WPCP
Technical	25	21.1	22.1	18.2	22.0
Environmental	25	24.1	24.1	19.8	19.8
Economic	25	25.0	19.8	7.3	4.2
Social	25	17.3	23.7	18.3	16.7
TOTALS	**100**	**87.5**	**89.7**	**63.6**	**62.7**

Based on the assessment summarized in the table above, the preferred Alternative Solution is to expand / upgrade the existing WPCP to a rated capacity of 5,100 m^3/day (Alternative Solution 3b). This Alternative Solution has both the highest overall score and scored highest in three (3) of the four (4) Evaluation Categories (i.e., Technical, Environmental, and Social).

Alternative Design Concepts for Preferred Solution

Each existing treatment process at the WPCP was evaluated and identified options that would allow the expanded / upgraded WPCP to meet the design criteria of 5,100 m^3/day effluent and 12,750 m^3/day max day flow. In addition, the preferred design concept also considered a range of improvements that were needed irrespective of the increase in treatment capacity, including addressing historic plant odours that resulted primarily from undersized primary and secondary sludge digestors.

The preferred design concept took into consideration the existing environmental context, including the aquatic habitat in the Besley Drain where treated effluent is discharged, and the Boyne River, which the Besley Drain flows into. The preferred design concept also considered adjacent land uses, including both businesses and residential homes.

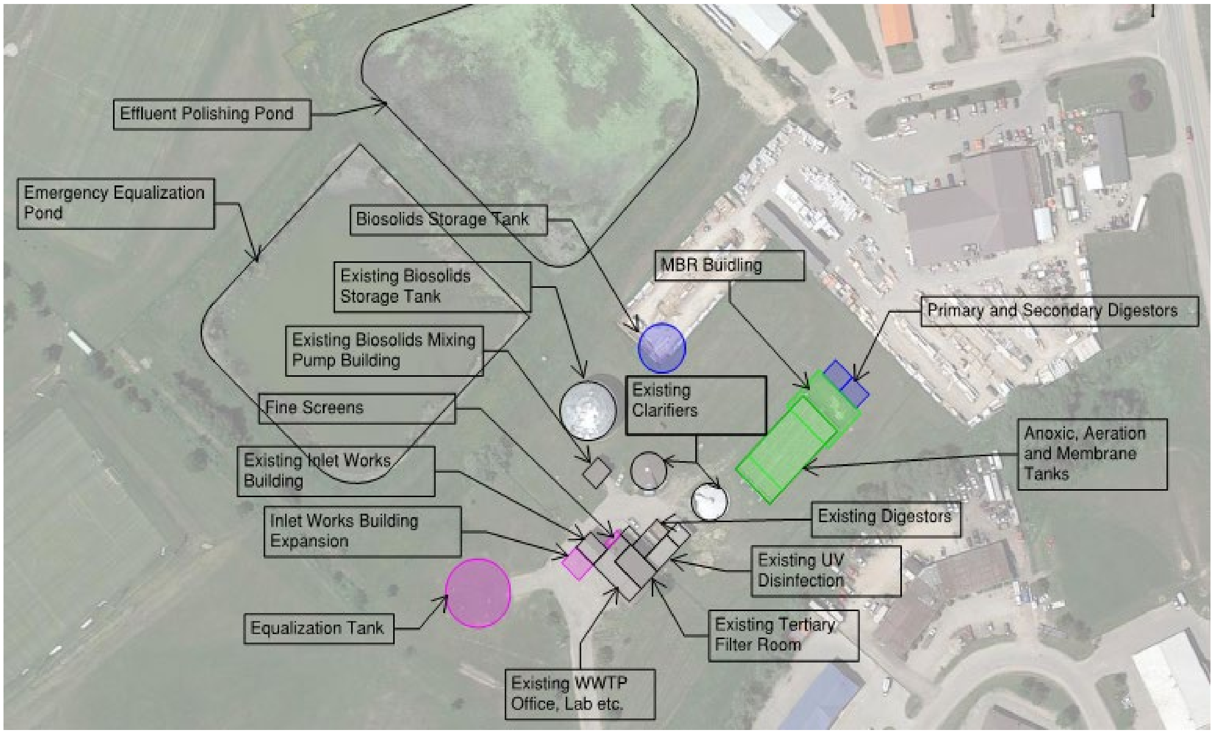
Executive Table II: Summary of Design Concept Evaluation

Process	Alternatives	Preferred Option	Rationale
Bar Screen	1. New screen (15,300 m^3/d) + manual backup. 2. Old screen (13,000 m^3/d) + new screen (13,000 m^3/d). 3. Two (2) new screens (15,300 m^3/d).	**Option 3:** Two (2) new screens.	• Ease of operation and maintenance.
Raw Sewage Pumping	1. Two (2) new high-capacity pumps (one (1) duty + one (1) standby). 2. Three (3) new pumps (two (2) duty + one (1) standby with VFD, 6,375 m^3/d each).	**Option 2:** Three (3) new pumps.	• Ease of operations (ADF – Pump 1 (ON), MDF – Pump 1 + 2 (ON)).
Wet Weather Management	1. Continued use of storm ponds. 2. New 2,550 m^3 storage tank (above or belowground). 3. New 5,100 m^3 storage tank (above or belowground).	**Option 2:** Above ground 2,550 m^3 storage tank with one (1) storm pond as emergency backup.	• Reduces use of storm ponds to emergency conditions only (2x per year max) while avoiding the cost of a larger tank that would be underutilized. • Above ground considerably less costly.
Vortex Degritter	1. New degritter 5,100 m^3/d. 2. New degritter 8,790 m^3/d. 3. New degritter 12,750 m^3/d.	**Option 3:** New degritter - 12,750 m^3/d capacity.	• Ease of operation and reliability (only option not requiring use of old degritter). Old vortex degritter maybe used when new one is down during maintenance.
Primary Treatment / Fine Screen	1. One (1) fine screen (12,750 m^3/d). 2. Two (2) fine screens (6,375 m^3/d).	**Option 2:** Two (2) Fine Screens – 6,375 m^3/day each.	• Other option cannot be retrofitted in existing channel and there is no redundancy at ADF.

Process	Alternatives	Preferred Option	Rationale
Secondary Treatment	1. Extended aeration (current) + nitrification / denitrification. 2. Sequence batch reactor (SBR) + nitrification / denitrification. 3. Membrane batch reactor (MBR) + nitrification / denitrification. 4. Integrated Fixed Film Activated Sludge (IFAS) + nitrification / denitrification.	**Option 3:** MBR With nitrification / denitrification.	Ease of construction: • Lower space requirement allows for expansion. • Best able to meet effluent limits. • Shares lowest lifecycle cost with IFAS. • Lowest capital costs since it uses the existing aeration channels.
Tertiary Treatment	1. Replace retired UV system with new.	**Option 1:** New UV system.	
Sludge Thickening	1. Gravity thickening. 2. Gravity belt. 3. Rotating drum.	**Option 3:** Rotating Drum Thickener.	• Lower odour potential. • More thickening than gravity. • Lower space requirement than gravity.
Sludge Digestion	1. Aerobic digestion. 2. Autothermal Thermophilic Aerobic Digestion (ATAD).	**Option 1:** Aerobic Digestion.	• Ease of operation. • Lower cost.
Sludge Storage	1. New biosolids storage tank. 2. Offsite haulage.	**Option 1:** New Tank.	• Lower lifecycle cost. • Ease of operations.

The preferred design concept, based on the preferred option selected for each treatment process is shown in the figure below with new buildings shown in colour.

Executive Figure I: Preferred Design Concept



Consultation

A Notice of Commencement was published on February 23, 2017, in the Orangeville Citizen and the Shelburne Free Press and posted on the Town's website. A discretionary Public Information Centre (PIC1) was held on June 4, 2018, at Town Hall in Shelburne to introduce the project. A Notice for PIC1 was issued in the Shelburne Free Press on May 5, 2018. The PIC 1 was conducted in an open house format and was attended by 13 participants.

A second Public Information Centre (PIC2) was held on June 24, 2020, from 6:30 p.m. to 7:30 p.m. to obtain input on the preferred Alternative Solution. Due to health and safety considerations arising from the COVID-19 virus, PIC2 was conducted as a video conference using the Zoom platform. Additionally, the meeting was livestreamed on the Town's YouTube Channel to create a meeting record and to allow viewing at other times for anyone who could not participate at the designated time. The presentation was attended by eight (8) participants. PIC2 also included a survey to further increase consultation on the selection of the preferred Alternative Solution. Based on the input received from PIC2, the Alternative Solution of increasing the capacity of the exiting WPCP to 5,100 m^3/day was confirmed as the preferred solution.

A third Public Information Centre (PIC3) was held on May 5, 2022, to obtain input on the preferred design concept. Due to health and safety considerations arising from the COVID-19 virus, PIC2 was conducted as a video conference using the Zoom platform. Additionally, the meeting was livestreamed on the Town's YouTube Channel to create a meeting record and to allow viewing at other times for anyone who could not participate at the designated time. Notification for PIC2 appeared in the Shelburne Free Press on April 21, 2022. Additionally, a stakeholder list was developed, consisting of agencies, neighbouring municipalities, First Nations and Metis communities and organizations. Stakeholders on the list were invited to participate in PIC2 by email on April 1, 2022. PIC2 attendees were instructed to contact the Town of Shelburne to register for the meeting. No participants registered for the presentation; however, the presentation went ahead and was recorded.

Monitoring

In partnership with the NVCA, the Town has developed the Boyne River Stewardship and Monitoring Plan. The goals of this adaptive monitoring plan are to:

- To better understand the current health of the Boyne River following its confluence with the Besley Drain to establish "baseline conditions".
- To develop monitoring protocols that would identify changes in the water quality of the Boyne River, resulting from the increase in WPCP discharge capacity.
- Establish a process for setting water quality "triggers" that, if exceeded, result in consultation between the Town and NVCA to address the issue.

To achieve the goals of the Plan, a monitoring program is anticipated to begin in March 2022 and continue to the end of February 2023 to establish a full year of baseline conditions. Further monitoring would then occur for a full year after the WPCP begins operating at its increased capacity and every subsequent five (5) years.

The Town is committed to working with the NVCA on a variety of stewardship projects to enhance the health of the Boyne River and to increase its assimilative capacity, thereby reducing the likelihood of exceeding the predetermined triggers. The following sections outline stewardship projects that the Town will endeavor to implement in partnership with the NVCA when feasibly and financially possible.

Once complete, the Town will issue a Notice of Completion on the Town's website, in the Shelburne Free Press, and to all project stakeholders on our stakeholder list. The Town will make this report available at Shelburne Town Hall, located at 203 Main Street East in Shelburne, for a period of 30 days for public, First Nation and Métis, and agency review.

During this period, members of the public, First Nations, or agencies can submit a Section 16(6) Order if they believe that the Town of Shelburne's e Water Supply Increased Capacity of the Town of Shelburne's Water Pollution Control Plant Project may result in an adverse impact on constitutionally protected Aboriginal and treaty rights and that completing an Individual Environmental Assessment may prevent, mitigate, or remedy this impact.

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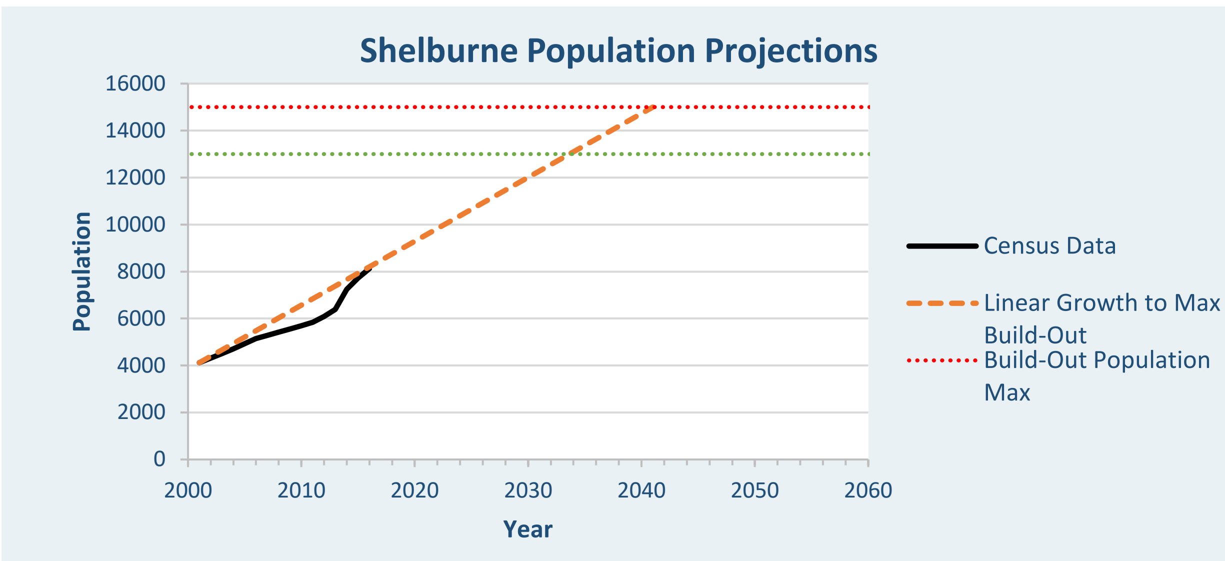
1.0 Introduction

1.1. Background

The Town of Shelburne (the "Town") is a lower-tiered municipality in Dufferin County, Ontario with a population of 8,126 (Government of Canada, 2016). The Town's population has increased by 39% since 2011 and this rapid growth has largely been attributed to the Town's relatively proximity to major centers, its relative affordability, and its small-town feel.

As shown in **Figure 1**, based on recent population growth and considering the build-out area for the Town, the population for the Town is expected to reach 15,000 by 2041.

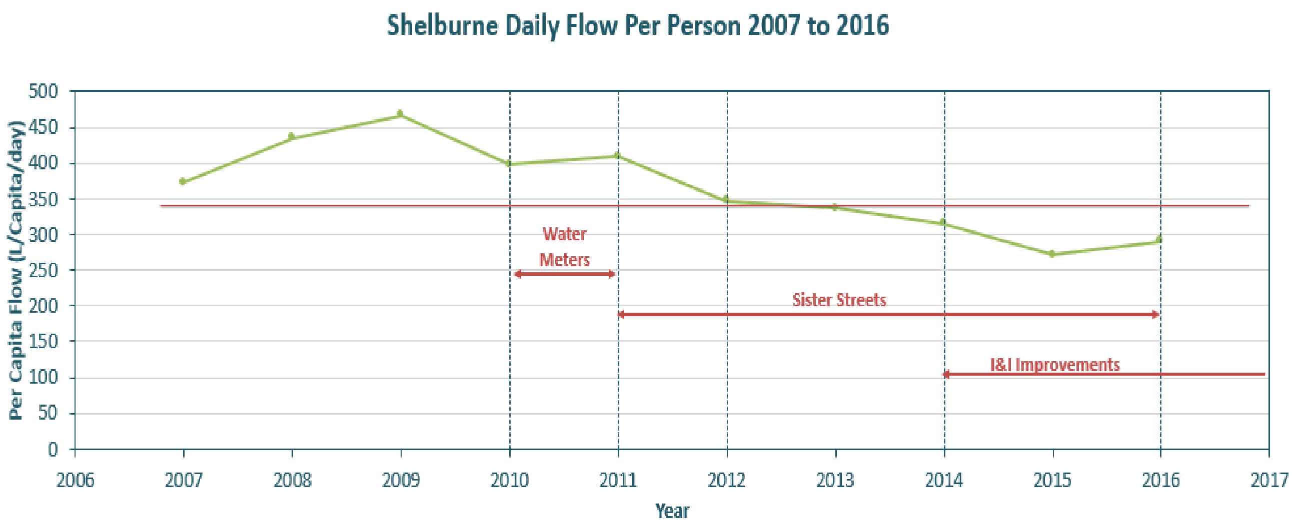
Figure 1: Town of Shelburne Population Projection



Population growth is currently limited by the treatment capacity of the Town's WPCP, which treats stormwater and residential, commercial, industrial, and institutional wastewater. The WPCP is currently rated to treat up to 3,420 m^3 of wastewater per day. Based on the 2021 wastewater allocations and reserves, there is only 19 m^3/day of remaining treatment capacity (refer to **Appendix A**).

The lack of capacity to meet the future population demand exists despite a decrease in the daily per capita wastewater resulting from the installation of water meters, sewer refurbishments on "Sister Streets" (Mary St. and Jane St.) and the system-wide identification and repair of infiltration leaks or inputs (I&I improvements), as shown in **Figure 2**.

Figure 2: Reduction in Per Capita Wastewater Flow from Infrastructure Projects



The Town has initiated a Municipal Class Environmental Assessment (Class EA) to determine the preferred means of increasing the Town's wastewater treatment capacity to meet the demands of a growing population. The Class EA process is documented in this Environmental Screening Report (ESR).

The preferred solution must be:

- Environmentally and socially responsible
- Cost effective.
- Technically feasible and;
- Be able to be completed in a timely manner.

2.0 Description of the Class Environmental Assessment Planning Process

Increasing the rated capacity of the WPCP is subject to *Ontario's Environmental Assessment Act, R.S.O. 1990, Chapter E.18 (EA Act)* (Government of Ontario, 1990). The Class EA process is an approved process under the *EA Act* for a specific "Class" of projects. Projects are approved subject to completion of an approved Class EA process, in this case the Municipal Class EA process.

2.1. Class EA Schedule

Under the Municipal Class EA Process, outlined in Municipal Class Environmental Assessment (Municipal Engineers Association, 2023), projects are categorized into different schedules, based on their complexity and potential environmental impact. With each higher schedule, additional steps must be followed, and these steps are divided into five (5) phases. The Class EA schedules include:

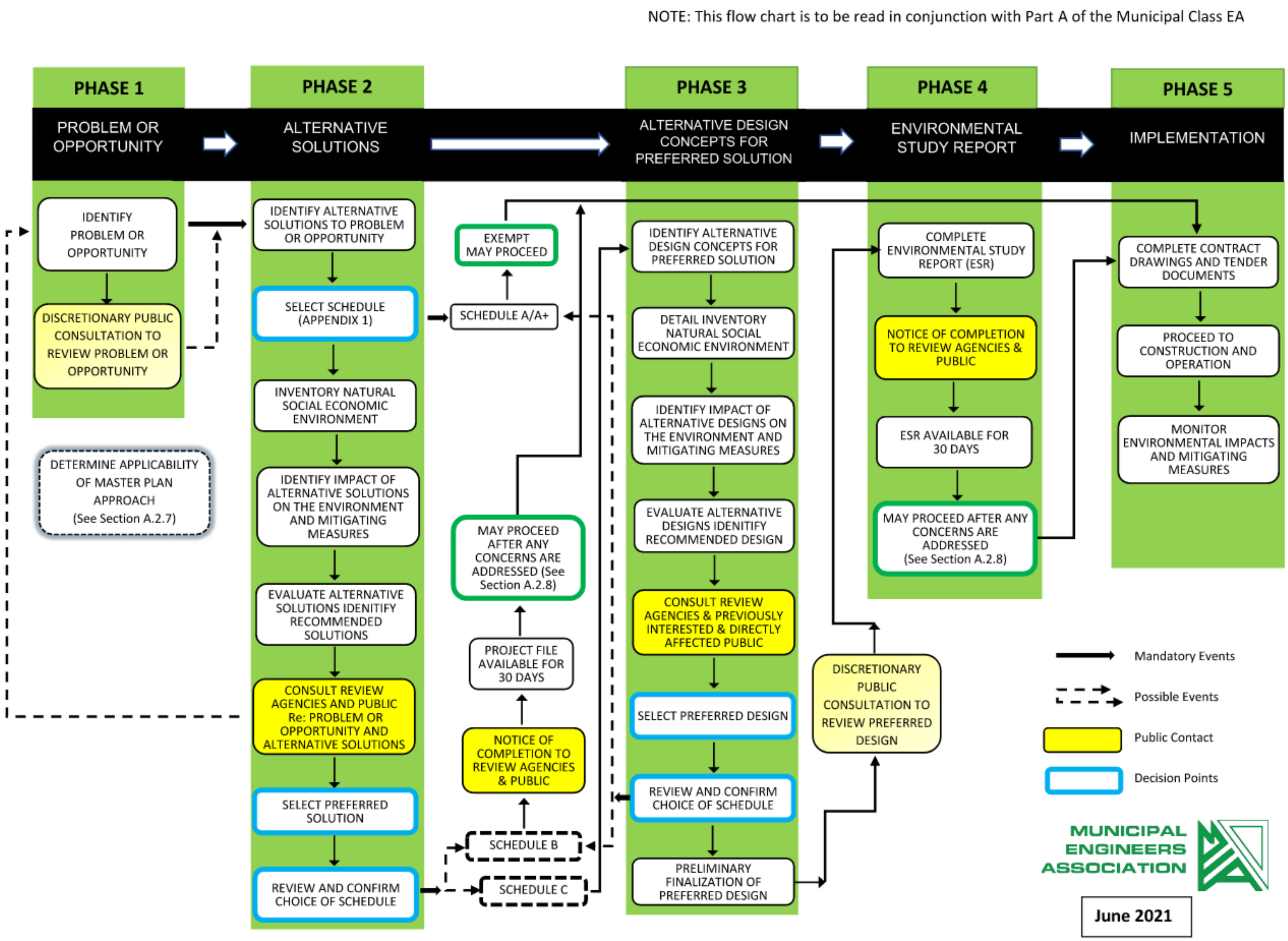
- **Schedule 'A' projects** Are limited in scale, have minimal adverse effects, and include most municipal maintenance and operational activities. These projects are pre-approved and may proceed directly to implementation without following the Class EA planning process. In the case of Schedule 'A+' the public must be notified of the project.
- **Schedule 'B' projects** have the potential for some adverse environmental effects. The Municipality is required to undertake a screening process (Phases One and Two) that evaluates Alternative Solutions to identify a preferred solution. This evaluation includes consultation with the public, government agencies, and First Nations and Métis to ensure that they are aware of the project and that their concerns are considered. Schedule 'B' projects require that a Project File be compiled and made available for a 30-day public and agency review. If there are no concerns raised during this review, then the Municipality may proceed to project implementation.
- **Schedule 'C' projects** have the potential for significant environmental effects and are subject to the requirements of all five (5) phases of the Class EA process. Schedule 'C' projects require at least two (2) points of public and agency consultation and the additional step of evaluating alternative designs for the preferred Alternative Solution. This process is documented in an Environmental Screening Report (ESR) that is made available for a 30-day public and agency review. If there are no concerns raised during this review, then the Municipality may proceed to project implementation.

As per the Project Schedules of Municipal Class Environmental Assessment (Municipal Engineers Association, 2023), increasing the rated capacity of a WPCP is considered a Schedule 'C' project.

2.2. The Class EA Process for a Schedule 'C' Project

The standard Class EA phases for a Schedule 'C' Project is shown in the **Figure 3**.

Figure 3: Municipal Class Environmental Assessment Process (Municipal Engineers Association, 2023)



2.3. Additional Regulatory Considerations

In addition to being subject to the *Ontario EA Act*, the Alternative Solutions are subject to other regulatory considerations that must be considered through this Class EA process. These considerations are summarized in the following sections.

2.3.1. Federal Regulatory Requirements

2.3.1.1. Canadian Environmental Assessment Act

Under the *Canadian Environmental Assessment Act*, 2012 (S.C. 2012, c. 19, s. 52) (Government of Canada, 2012), projects must undergo a federal environmental assessment for:

- Projects on Federal Lands (including reserve lands)
- Projects listed in the Regulations Designating Physical Activities, SOR/2012-147

Applicability of the Project
The project will not occur on federal lands and the construction and operation of a wastewater treatment facility, including a wastewater conveyance pipeline, is not included in the *Regulations Designating Physical Activities, SOR/2012-147* (Government of Canada, 2012). Therefore, the *Canadian Environmental Assessment Act* does not apply to the Alternative Solutions proposed in this ESR.

2.3.1.2. Fisheries Act

The *Fisheries Act, R.S.C., 1985, c. F-14* (Government of Canada, 1985), is the main federal law governing fisheries in Canada. Section 36(3) of this *Act* restricts depositing any deleterious substance in water frequented by fish. Under Section 34(1) of this Act, a deleterious substance is defined as:

a) Any substance that, if added to any water, would degrade, alter, or form part of a process of degradation or alteration of the quality of that water so that it is rendered, or is likely to be rendered, deleterious to fish or fish habitat or to the use by man of fish that frequent that water, or;
b) Any water that contains a substance in such quantity or concentration, or that has been so treated, processed or changed, by heat or other means, from a natural state that it would, if added to any other water, degrade or alter or form part of a process of degradation or alteration of the quality of that water so that it is rendered or is likely to be rendered deleterious to fish or fish habitat or to the use by man of fish that frequent that water.

For wastewater treatment facilities, the definition of a deleterious substance is further defined in the supporting *Wastewater Systems Effluent Regulation, SOR/2012-139* (Government of Ontario, 2012), which classifies the following substances as deleterious:

a) Carbonaceous biochemical oxygen demanding matter;
b) Suspended solids;
c) Total residual chlorine;
d) Un-ionized ammonia.

Section 36(4)(b) of the *Act* allows regulations to specify effluent concentration limits for deleterious substances. *The Wastewater Systems Effluent Regulation* allows the discharge of deleterious substances defined in the Regulation, provided that:

a) The average carbonaceous biochemical oxygen demand (CBDO) due to the quantity of CBOD matter in the effluent does not exceed 25 mg/L;
b) The average concentration of suspended solids in the effluent does not exceed 25 mg/L;
c) The average concentration of total residual chlorine in the effluent does not exceed 0.02 mg/L, if chlorine, or one of its compounds, was used in the treatment of wastewater;
d) The maximum concentration of un-ionized ammonia in the effluent is less than 1.25 mg/L, expressed as nitrogen (N), at 15°C ± 1°C.

Applicability of the Project

All Alternative Solutions that require the upgrade or construction of a new WPCP are subject to the requirements of the *Fisheries Act* and its supporting *Wastewater System Effluent Regulation* and the effluent limits contained therein.

2.3.1.3. Migratory Bird Act

The *Migratory Birds Convention Act* (Government of Canada, 1994) is the main federal law governing the protection of migratory Birds in Canada. Established in 1917 and significantly updated in June 1994, it contains regulations to protect migratory birds, their eggs and their nests from hunting, trafficking, and commercialization. The *Migratory Birds Convention Act* protects migratory birds, their nests and eggs and restricts depositing substances that are harmful to migratory birds.

The *Act* is supported by the *Migratory Birds Regulations, 2022 (SOR/2022-05)* (Government of Canada, 2022)and the *Migratory Bird Sanctuary Regulations C.R.C., c. 1036* (Government of Canada, 2022).

Applicability of the Project

For all Alternative Solutions that result in discharge of effluent to a natural waterbody, effluent limits will be set that are protective of the environment, including migratory birds. For Alternative Solutions that require tree clearing during construction, additional investigation would be required to determine evaluate the potential for impacts to potential bird habitat and seasonal concentration areas. It is possible that construction activities would need to occur outside of bird migration seasonal windows.

2.3.2. Provincial Regulatory Requirements

2.3.2.1. Planning Act

The *Planning Act, R.S.O. 1990, c. P.13* (Government of Ontario, 1990) is provincial legislation that lays out the ground rules for land use planning in Ontario.

Under the *Planning Act*, the Provincial Policy Statement, 2020 (PPS) (Government of Ontario, 2020) provides overall policy directions on matters of provincial interest related to land use planning and development by allowing appropriate development while protecting resources of provincial interest, public health and safety, and the quality of the natural and built environment.

To foster appropriate development the PPS restricts development and site alteration in the following areas unless it can be demonstrated that there will be no negative impacts on natural features or their ecological function:

- Significant wetlands
- Significant coastal wetlands
- Significant woodlands
- Significant valley lands
- Significant habitat of endangered and threatened species
- Fish habitat
- Significant areas of natural and scientific interest (ANSIs)
- Significant wildlife habitat

The PPS also restricts development on prime agricultural land and protects known mineral and mineral aggregate resources. The Town is located within Dufferin County, which falls within the planning area of the A Place to Grow - Growth Plan for the Greater Toronto Area. Considered an "outer ring" community, Dufferin County will establish the minimum percentage of all residential development occurring annually within the delineated built-up area, based on maintaining or improving upon the minimum intensification target contained in the applicable upper- or single-tier official plan during its next municipal review.
The PPS also requires that planning for sewage and water services:

- Accommodate forecasted growth in a manner that promotes the efficient use and optimization of existing municipal sewage services.
- Ensures that these systems a provided in a manner that:
    - Can be sustained by the water resources upon which such services rely.
    - Prepares for the impacts of a changing climate.
    - Is feasible and financially viable over their lifecycle.
    - Protects human health and safety, and the natural environment.
- Promotes water conservation and water use efficiency.
- Integrates servicing and land use consideration at all stages of the planning process.

Applicability of the Project
The existing WPCP property does not contain any significant areas outlined in the PPS, nor does it contain prime agricultural land, or known mineral or mineral aggregate resources. Should Alternative Solutions requiring a new WPCP location, or a pipeline be selected as the preferred alternative, additional desktop and / or field investigations will be required to determine if any of these features are present in areas that could be affected by construction or operations.

2.3.2.2. Ontario Water Resources Act

The *Ontario Water Resources Act, R.S.O. 1990, c. O.40* (Government of Ontario, 1990) focuses on both groundwater and surface water throughout the province, regulates sewage disposal and "sewage works", and prohibits the discharge of polluting substances that may impair water quality.

Section 53 of the *Act* requires an Environmental Compliance Approval for the operation, establishment, alteration, extension, or replacement of a new or existing sewage works.

Applicability of the Project
The operation of the existing WPCP is governed by Environmental Compliance Approval (ECA) #6413-ABLQQS, which was issued by the Ministry of the Environment, Conservation and Parks (MECP) on July 19, 2016 (**Appendix B**). Any changes to the operation of the existing WPCP will require an amendment to this approval. Construction and operation of any new sewage works would also require a new ECA.

3.0 Phase 1: Problem or Opportunity Statement

Since 1995, the Town has grown significantly in land area because of the annexation of lands in the Townships of Amaranth and Melancthon, employment opportunities have increased due to the introduction of new industry and population has increased due to increasing growth pressures and a desirable housing market (Town of Shelburne, 2017). Furthermore, an average annual growth rate of

2.2.% is estimated for the next 20-years, with a predicted population of 10,000 in 2031 and 15,000 in 2041.

Shelburne's WPCP does not have enough rated capacity to meet future wastewater treatment demands resulting from planned population growth and the Town's current build-out areas. Shelburne's build-out population is the population anticipated to fill all approved and potential future residential units (including planned urban boundary changes) within the current Town boundaries.

3.1. Notice of Commencement

A Notice of Commencement was published on February 23, 2017, in the Orangeville Citizen and the Shelburne Free Press and posted on the Town's website. The notice conveyed the following information:

- The need to increase the capacity of the existing WPCP to meet long-term needs;
- That the study would follow the Class EA process for a Schedule 'C' project;
- Who to contact for more information;
- Opportunities to provide input at public meets and by reviewing the study report.

A copy of the Notice of Commencement is provided in **Appendix C**.

3.2. Public Information Centre No. 1

A discretionary Public Information Centre (PIC1) was held on June 4, 2018, at Town Hall in Shelburne between 4:00 p.m. and 7:00 p.m. A Notice for PIC1 was issued in the Shelburne Free Press on May 5, 2018. The PIC1 was conducted in an open house format and included information on the following:

- Project background;
- The Municipal Class EA process;
- The need for additional wastewater treatment capacity;
- Describing Alternative Solutions;
- Funding opportunities;
- Next steps.

Based on the sign-in sheet, 13 community members attended this meeting. Copies of the public notice and poster boards for the first PIC are provided in **Appendix C**. Comment sheets were made available, but none were completed. A copy of a blank comment sheet is also provided in **Appendix C**.

4.0 Phase 2: Alternative Solutions

4.1. Identification of Alternative Solutions

The following alternatives solutions for increasing the Town's wastewater treatment capacity were evaluated.

4.1.1. Alternative No. 1: "Do Nothing"

The "Do Nothing" Alternative Solution involves no further action by the Town of Shelburne to increase the wastewater treatment capacity to address increased demands placed by planned population growth. This limitation requires that the Town limit future population growth, including planned developments. There is no direct cost associated with the "Do Nothing" Alternative Solution.

4.1.2. Alternative No. 2: Water Efficiency, Extraneous Flow Reduction

The second Alternative Solution involves continued implementation of water efficiency programs within the Town to achieve water efficiency and to reduce extraneous flow. Water efficiency measures include encouraging the use of low flow toilets and installing water saving fixtures in existing and new homes. Increased demand can be placed on wastewater treatment plants from inflow and infiltration (i.e., extraneous flow), where additional inflow is water that enters the sewer system through improper connections, such as downspouts and groundwater sump pumps, and infiltration is groundwater that enters the sewer system through leaks in sewer and wastewater pipes. Repair to pipes and connections can reduce flows to the wastewater treatment plants and therefore reduce demand.

4.1.3. Alternative No. 3: Expand / Upgrade Existing WPCP

This Alternative Solution involves upgrading the existing WPCP to increase its rated capacity so that it can meet the demands of a larger population.

On December 13, 2013, WSP submitted a Draft Technical Memorandum for the Assimilative Capacity Study Review of Shelburne WPCP, followed by the completion of a second submission dated August 15, 2016, which was not formally submitted to the Ministry of Environment, Conservation and Parks (MECP). These documents can be found in **Appendix D**. The assimilative capacity study looked at water quality in the Besley Drain and Boyne River, which are part of a drainage system starting northwest of Shelburne and flow eastward, to determine WPCP effluent concentration limits that would ensure that the WPCP effluent did not adversely affect aquatic life.

The WSP August 15, 2016, submission was submitted to the MECP by SBA for review in 2018 following a meeting between MECP, SBA and the Town of Shelburne. Comments on the 2016 report were provided by the MECP in a July 16, 2019, memorandum. To address MECP comments, SBA undertook modelling of the Boyne River using the QUAL2K model with support from Hutchinson Environmental Sciences.

Since MECP's review of the Draft Technical Memorandum, the Town's predicted 2041 population increased from 13,000 to 15,000. To accommodate this growth, the capacity of the WPCP would need to increase to 5,100 m^3/day, and this was reflected in SBA's revised Assimilative Capacity Study Technical Memorandum, which was submitted to the MECP on March 23, 2020, found in **Appendix E**.

The SBA ACS Technical Memorandum established recommended effluent limits that when met, would ensure that the distance downstream of the Besley Drain and Boyne River confluence where effluent parameter concentrations return to background (i.e., parameter concentrations upstream of the confluence) are less than, or the same distance when the WPCP is discharging at 3,420 m^3/day at currently permitted effluent limits. Due to the relatively high contribution of flow from the WPCP into the Besley Drain, especially during drier summer months, it was conservatively assumed that no dilution of effluent occurred in the Besley Drain. The SBA model was calibrated using 7Q20 flow data from the Boyne River, which represents the seven (7) consecutive day average low flow in a 20-year return period. Under this low flow condition, very little dilution occurs relative to typical average annual flow conditions.

4.1.3.1. Alternative No. 3a: Expand / Upgrade Existing WPCP

Upgrading the WPCP to 4,400 m^3/day was included as an Alternative Solution because the increase in WPCP effluent from 3,420 m^3/day to 5,100 m^3/day could have resulted in effluent concentration limits beyond the assimilative capacity of the Boyne River or could require more expensive treatment systems. With this Alternative Solution, the Town would need to curtail its growth by 2041 to 13,000.

Although the SBA ACS Technical Memo only considered a WPCP capacity of 5,100 m^3/day, the same model was used to establish effluent limits for 4,400 m^3/day that would ensure that the distance downstream of the Besley Drain / Boyne River confluence where effluent parameter concentrations return to background (i.e., parameter concentrations upstream of the confluence) are less than, or the same distance when the WPCP is discharging at 3,420 m^3/day at currently permitted effluent limits.

Given that effluent limits have the potential to affect the feasibility of expanding / upgrading the WPCP and could affect the required technology and associated cost, a summary of the effluent limits for key parameters for wastewater treatment plants are shown below in **Table 1.**

Table 1: Proposed WPCP Effluent Limits for a Capacity of 4,400 m^3/day

Parameter	Current 3,420 m^3/day Flow		Recommended Objective at 4,400 m^3/day	
	Objective (mg/L)	Compliance Limit (mg/L)	Objective (mg/L)	Compliance Limit (mg/L)
$cBOD_5$	4	5.0	4	5.0
TP	0.12	0.25	0.18	0.21
NO3-N	—	—	13.0	16.0
Total Ammonia as N (Oct 1 – May 31)	2.0	2.4	1.1	1.2
Total Ammonia as N (June 1 to Sept 30)	0.5	0.8	0.35	0.4
Total Suspended Solids	4.0	5.0	4.0	5.0
pH	6.5-9.5	6.5-9.5	6.5-9.0	6.5-9.5
E. coli	100 organisms / 100 mL	—	100 organisms / 100 mL	—

The capital and site-specific costs associated with this Alternative Solution are estimated to be between $25,000,000 and $30,000,000, with annual Operations and Maintenance (O&M) costs of $1,300,000.

4.1.3.2. Alternative No. 3b: Expand / Upgrade Existing WPCP

This Alternative Solution involves upgrading the WPCP to a capacity of 5,100 m^3/day to accommodate the predicted 20-year population growth of 15,000. A summary of the effluent limits for key parameters for wastewater treatment plants are shown below in **Table 2**.

Table 2: Proposed WPCP Effluent Limits for a Capacity of 5,100 m3/day

Effluent Parameter	Effluent Objectives		Effluent Limits[1]	
	Concentrations (mg/L)	Loadings (kg/d)	Average concentrations (mg/L)	Average loadings (kg/d)
$cBOD_5$	4	20.40	5	25.50
Total Suspended Solids	4	20.40	5	25.50
Total Phosphorus	0.09	0.46	0.12	0.61
NO3-N	10	51	13	66.30
Total Ammonia as N (Oct 1 – May 31)	0.35	1.79	0.4	2.04
Total Ammonia as N (June 1 to Sept 30)	1.1	5.61	1.2	6.12
E. coli[2]	100 organisms/100 mL	—	200 organisms/100 mL	—
pH[3]	6.5-8.5		6-9	

1 Based on monthly average, unless otherwise noted
2 Based on monthly geometric mean density
3 Any single grab sample

The capital and site-specific costs associated with this Alternative Solution are estimated to be between $33,000,000 and $46,000,000, with annual O&M costs of $1,500,000.

4.1.4. Alternative No. 4: Maintain Existing WPCP and Construct a Second WPCP

This Alternative Solution consists of maintaining the existing WPCP to manage wastewater up to its 3,420 m^3/day capacity. A second WPCP would be constructed to manage additional demand placed by a growing population. The capital and site-specific costs associated with this Alternative Solution are estimated at $45,000,000, including $6,000,000 in land acquisition costs and $3,000,000 for a new sanitary sewer trunk. Annual O&M costs are estimated at $2,000,000.

4.1.5. Alternative No. 5: Construct a Second WPCP

This Alternative Solution consists of constructing a new WPCP that would be rated to treat all wastewater for the Town and decommissioning the existing WPCP. The capital and site-specific costs associated with this Alternative Solution are estimated at $70,000,000, including $12,000,000 in land acquisition costs. Annual O&M costs are estimated at $1,500,000.

4.1.6. Alternative No. 6: Construct a New Pipeline

This Alternative Solution involves constructing a new pipeline that would transport wastewater from the Town to a neighbouring municipality with enough capacity in their WPCP to accept the additional wastewater. Possible municipalities include the Town of Orangeville, Adjala-Tosorontio, Alliston, or Grand Valley and interconnection distances would be approximately 20-30 km, depending on the point of interconnection with the receiving municipalities wastewater collection system.

Should this option be selected as the preferred Alternative Solution, the capacity for adjacent municipalities to receive the Town's wastewater would need to be confirmed, along with the receiving municipalities willingness to receive the Town's wastewater. For willing municipalities, a cost for wastewater treatment would need to be established. Also, should this option be selected, a separate Class EA would be required to determine the preferred pipeline route and destination, and to assess environmental effects.

The cost of the pipeline is estimated at $100,000,000, which does not include treatment costs charged by the receiving municipality.

4.2. Study Area Description

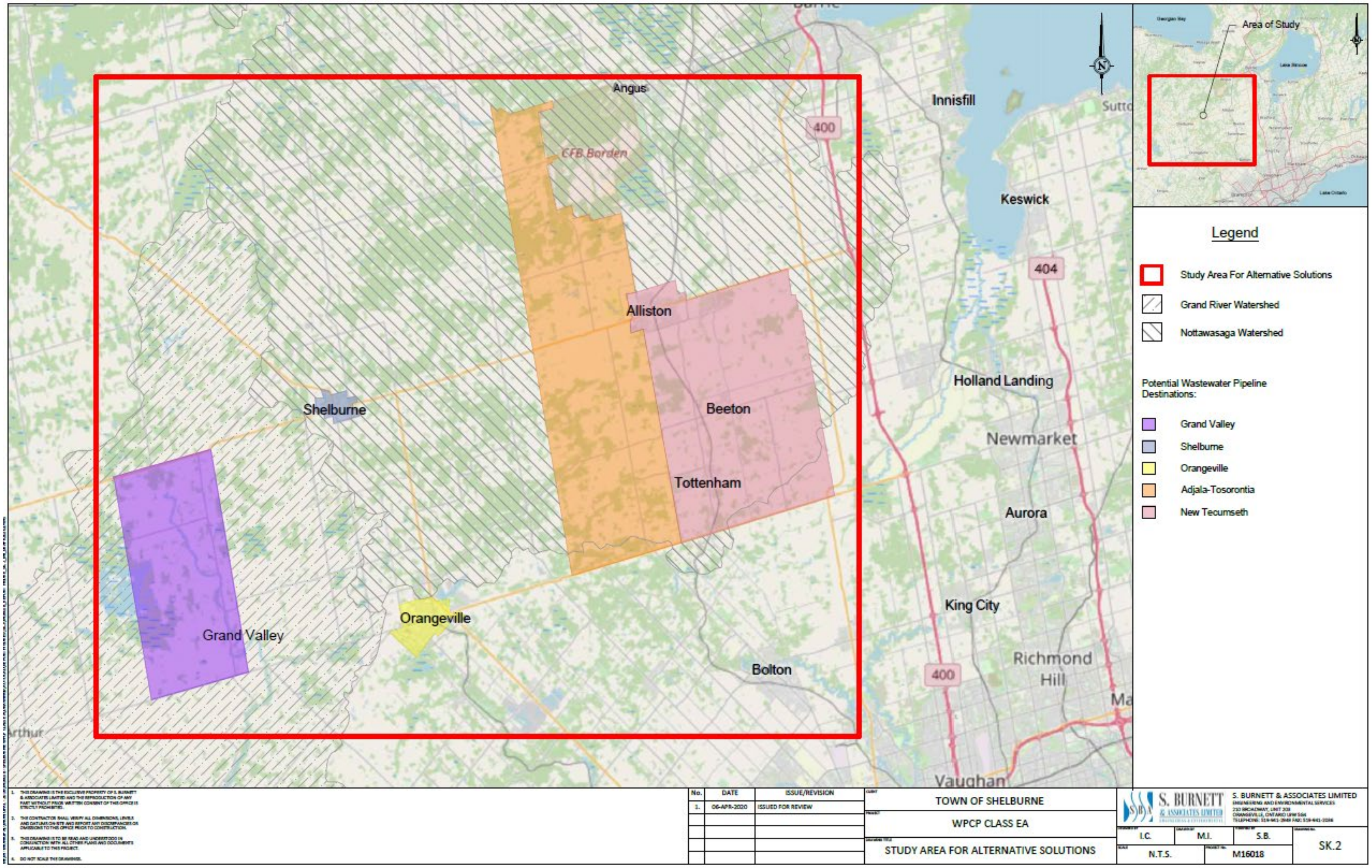
The study area for identifying Alternative Solutions focuses on the Town of Shelburne, with neighbouring municipalities included as potential pipeline routes and destinations, as shown in **Figure 4.**

The study area includes parts of the Grand Valley and Nottawasaga watersheds.

The Nottawasaga Valley watershed encompasses 3,700 km^2 and includes lands within 18 municipalities located in the upper-tier municipalities of Simcoe, Dufferin, and Grey County. It is generally located in an area bound by the Oak Ridges Moraine to the south, Niagara Escarpment to the west, Oro Moraine to the east, and Georgian Bay on Lake Huron to the north. The watershed includes all the land drained by the Nottawasaga River and its tributaries, which includes the Boyne River, Mad River, Innisfil Creek, Pine River, and Willow Creek. The watershed is managed by the Nottawasaga Valley Conservation Authority (NVCA). The watershed is an insensitive agriculture area, with farms making up about 55 percent of the watershed (Source Protection Committee, 2014).

The Grand River watershed encompasses 6,800 km^2 and includes 39 municipalities and two (2) First Nations territories. The watershed includes all the land drained by the Grand River and its tributaries, which include four major rivers feed: the Conestogo, Nith, Speed and Eramosa. The Grand River begins as a small stream in Dufferin County and travels 280 km before emptying into Lake Erie. The watershed is also an intensive agricultural area, with farms making up about 70% of the watershed (Grand River Conservation Authority, 2020).

Figure 4: Study Area for Alternative Solutions



The Township of Adjala-Tosorontio is predominantly rural and with a 2016 population of 10,975 (Statistics Canada, 2019) comprises the communities of Achill, Airlie, Athlone, Ballycroy, Cedarville, Colgan, Connor, Everett, Glencairn, Hockley, Keenansville, Lisle, Loretto, Rosemont, Sheldon, Tioga and Tuam. The Colgan Community is currently undertaking a Schedule 'C' Municipal Class EA for a new wastewater treatment plant and outfall to Colgan Community Wastewater Treatment Plant and Outfall to accommodate a new subdivision, which would generate an anticipated 691.2 m^3/day of wastewater (Aliston Herald, 2019). The Township also includes the New Horizons Water Treatment, which as of 2014, had a Design Capacity 175 m^3/day and an average daily flow of 65 m^3/day (Ontario Clean Water Agency, 2014).

Orangeville has a population of 28,900 (Statistics Canada, 2019) and has a WPCP that uses activated sludge with a Modified Ludzack-Ettinger (MLE) denitrification process, effluent filtration, chlorine disinfection and dichlorination. The plant was recently upgraded from a rated capacity of 14,000 m^3/day to 17,500 m^3/day and allows the plant to meet more stringent effluent requirements.

Grand Valley, with a population of 2,956 (Statistics Canada, 2019) has a Wastewater Treatment Plant that was commissioned in 2011 with a capacity of 1,244 m^3/day. In 2011, flows to the plant were 689 m^3/day, which are predicted to increase to 2,910 m^3/day by 2031 (Burnside, 2014).

The Town of Alliston is part of the Township of New Tecumseth, which has a population of 34,242 (Statistics Canada, 2019). New Tecumseth is serviced by a Regional Wastewater Treatment Plant located on 14th Line in Alliston.

4.3. Impact Evaluation and Identification of Preferred Alternative Solution

This section evaluates and compares the Alternative Solutions described in **Section 4.1** to determine a preferred solution.

4.3.1. Preliminary Screening of Alternative Solutions

The Alternative Solutions outlined in **Section 4.1** were screened against criteria adapted from the MECP's Preparing and Reviewing Terms of Reference for Environmental Assessments in Ontario (Ministry of the Environment, Conservation and Parks, 2022). The requirements for an Alternative Solution are that it is feasible, viable, and makes efficient use of existing wastewater treatment resources, which is a requirement of the PPS. Only Alternative Solutions meeting these criteria were advanced for further comparison and consideration. If only one (1) option meets the criteria, this option would become the preferred option. The screening of Alternative Solutions is presented in **Table 3**.

Table 3: Preliminary Screening of Alternative Solutions

	Alternative						
Criteria	**1 "Do Nothing"**	**2 Increased Water Efficiency/Extraneous Flow Reduction**	**3a Upgrade/Exp and WPCP**	**3b Upgrade/Exp and WPCP**	**4 New second WPCP for Additional Flow**	**5 New Replacement WPCP**	**6 New Pipeline**
Do they provide a viable solution to the problem?	No	No	Yes	Yes	Yes	Yes	Yes
Are they proven technologies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Are they technically feasible?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Are they consistent with planning objectives?	No	No	Yes	Yes	Yes	Yes	Yes
Are they consistent with provincial government priority initiatives?	No	No	Yes	Yes	Yes	Yes	Yes
Do they avoid potential impacts to sensitive environmental features?	Yes	Yes	Yes	Yes	Yes	Yes	Depends on route selection
Are they practical, financially realistic, and economically viable?	Yes	Yes	Yes	Yes	Yes	Yes	No
Are they within the ability of the Town to implement?	Yes	Yes	Yes	Yes	Yes	Yes	No

Based on the above screening criteria, the following alternatives were "screened out" and will not be considered further:

- The "Do Nothing" Option
- The Increased Water Efficiency / Extraneous Flow Option
- The New Pipeline Option.

The "Do Nothing" option is not viable, since it does not address the problem that the existing WPCP is at capacity and cannot meet planned population growth. This Alternative Solution is also not consistent with planning objectives, because areas of planned growth cannot be developed until there is additional wastewater treatment capacity. Accordingly, this option is not consistent with the Provincial Policy Statement (PPS), which requires that wastewater servicing accommodate forecasted growth in a manner that promotes the efficient use and optimization of existing municipal water services. Furthermore, without considering the need to increase the WPCP capacity, there are upgrades and repairs to ageing equipment that are required for the facility to meet current demand and current effluent discharge limits. These repairs and upgrades would need to be included in any option that continues the use of the WPCP. Based on these considerations this option was not considered to be a feasible option.

The Alternative Solution of increasing water efficiency and extraneous flow is not considered viable because it will not significantly reduce wastewater reporting to the WPCP given the improvements already made. The residential per capita flow rate has generally decreased since 2012 largely due to the following initiatives:

1. Universal water metering completed in July 2011:
    - Approximate Capital Investment of $1.3 Million.
2. Sewer refurbishment program initiated in 2011 on "Sister Streets" (Jane and Marie) in Shelburne:
    - Approximately $2 Million invested for each Reconstruction Project.
3. System wide identification and repair of infiltration leaks or inputs:
    - Annual Maintenance Budget of between $100,000 to $200,000 per year.

Similarly, water conservation on its own, would not provide adequate reduction in wastewater reporting to the WPCP. As an example, if 50% of the population did not currently have low flow toilets, and if these were converted to low flow toilets, this would only result in a 162 m^3/day[2] reduction, compared to the predicted shortfall of 1,680 m^3/day. Accordingly, while meeting the requirement of the PPS to encourage conservation, this option does not accommodate forecasted growth and therefore does not meet the requirements of the PPS and it is therefore not considered to be a feasible option.

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[2] Assumes a per capita wastewater generation rate of 0.265 m^3/day for a population of 8,126, 50% of whom would convert from conventional to low flow toilets. Assumes that 30% of wastewater generated is from toilets and that conversion would result in a 54% savings in wastewater generated.

The new pipeline option has an installation cost of $100 Million, which does not include water treatment costs that would be passed on to the Town by the neighbouring municipality. This option is not financially realistic for the Town and is therefore not considered within the ability of the Town to implement.

The remaining options that were not "screened out" and will be further evaluated include:

- Upgrade / expand WPCP to 4,400 m^3/day
- Upgrade / expand WPCP to 5,100 m^3/day
- Add a new second WPCP for additional flow
- Construction of a new replacement WPCP

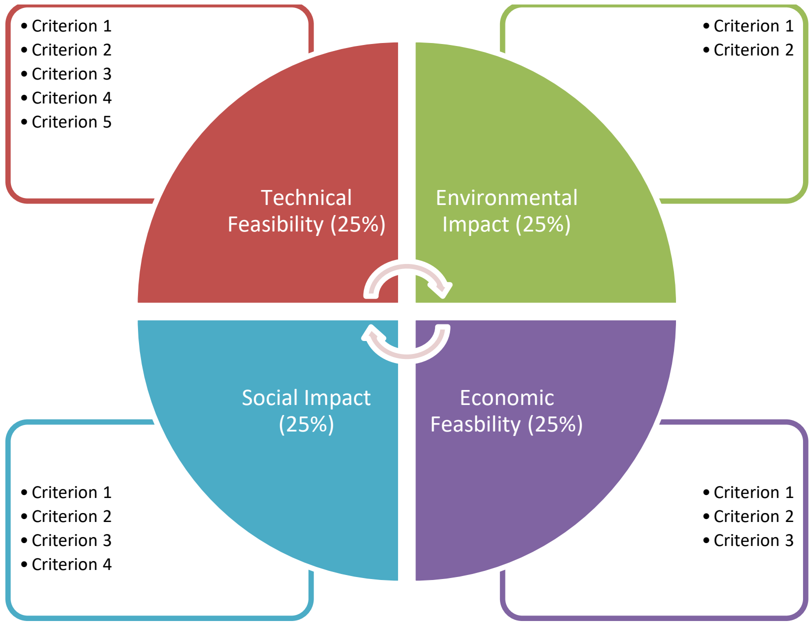
4.3.2. Evaluation Method

Evaluating the alternatives for increasing current wastewater treatment capacity was based on the following Evaluation Categories:

- Technical feasibility
- Environmental Impacts (i.e., those that would result from the implementation of the alternative)
- Economic Feasibility
- Social impacts

As shown in **Figure 5**, each evaluation category was assigned an equal overall weighting totalling 100%, given that no category was deemed more important in selecting the preferred Alternative Solution. These relative weightings were used in conjunction with the Evaluation Criteria to assess and compare Alternative Solutions. As illustrated in **Figure 5**, there may be different number of Evaluation Criteria for each Evaluation Category.

Figure 5: Example of Unequal Criterion Across Evaluation Categories



For each Evaluation Criterion, a Criterion Importance Ranking was assigned, based on environmental regulations, technical expertise, and input from the Town of Shelburne and the current WPCP operator. Criterion Importance Rankings were assigned as follows:

- **5** Is the most important criterion or is equally important;
- **2** Is slightly less important than the most important criterion;
- **1** Is significantly less important than the most important criterion.

Once each Evaluation Criterion is assigned a Criterion Importance Ranking, the Critical Importance Rankings were summed to provide a Criterion Importance Total. In the example provided in

Table 4, the Criterion Importance Total is "8". Given that each Evaluation Category was weighted equally as 25%, each Criterion Importance Ranking was divided by the Criteria Importance Total (i.e., "8") and then multiplied by 25 to calculate a Relative Criterion Weight. Once the Relative Criterion Weighting is established, each Alternative Solution is scored for each criterion according to the following scoring scheme:

- **1** Solution completely meets criterion, or Alternative Solution is not applicable to the criterion
- **0.5** Solution partially meets criterion
- **0** Solution does not meet criterion.

The score is multiplied by the Relative Criterion Weighting and summed to Total Score for each Alternative Solution. Given the relative weighting assigned, each Alternative Solution can score up to 25% for each of the four (4) Evaluation Categories.

Table 4: Example of Criterion Scoring for an Alternative Solution in One Evaluation Category

Criterion	Criterion Importance Ranking	Relative Criteria Weighting[1]	Alternative Solution Scores			
			Option 1		Option 2	
			Score	Relative Score	Score	Relative Score
1	**5**	**5** ÷ 8 x 25 = 15.63 %	**1**	15.63% X **1** = 15.63%	**0.5**	15.63% x **0.5** = 7.82%
2	**1**	**1** ÷ 8 x 25 = 3.12%	**1**	3.12% X **1** = 3.12%	**1**	3.12% x **1** = 3.12%
3	**2**	**2** ÷ 8 x 25 = 6.25 %	**0**	6.25% x **0** = 0%	**1**	6.25% x **1** = 6.25%
Total	**8**	**25% (Criteria Category Total)**		15.63% + 3.12% + 0% = **18.75%**		7.82% + 3.12% + 6.25% = **17.19%**

In the example in the table above, Alternative Solution "Option 1" received a total score of 18.75% out of a possible 25%, while Option 2 scored 17.19%. Therefore, Option 1 is the preferred Alternative Solution for this Evaluation Category. The scores of each Evaluation Category are summed to arrive at the overall preferred Alternative Solution score.

For the "Economic Evaluation Category", the lowest cost estimate received a "1" score, and the most expensive option was scored as a "0". Alternative Solutions within 30% of the lowest and highest scores received the same scores, respectively. All other costs received a score of "0.5".

4.3.3. Assessment of Screened Alternative Solutions

The Alternative Solutions that were not "screened out" in the preliminary screening of alternatives found in **Section 4.3.1** are evaluated in the following sections.

4.3.3.1. Technical Assessment

Alternative Solutions were evaluated in terms of technical criteria to consider technical suitability and other engineering considerations. A summary of the evaluation is shown below in **Table 5**.

Table 5: Technical Criteria Scoring for Alternative Solutions

Criterion	Criterion Importance Ranking	Relative Criterion Weighting	Alternative Solution Scores (Relative Score)			
			3a Upgrade/Expand WPCP	3b Upgrade/Expand WPCP	4 New Second WPCP for Additional Flow	5 New Replacement WPCP
Results in effluent that consistently meets effluent requirements	5	4.8%	1 (4.8%) Upgrades will be designed to consistently meet effluent requirements for a growing population.	1 (4.8%) Upgrades will be designed to consistently meet effluent requirements for a growing population.	1 (4.8%) The new WPCP will be designed to work with the existing WPCP to consistently meet effluent requirements for a growing population.	1 (4.8%) The new WPCP will be designed to consistently meet effluent requirements for a growing population.
Is reliable and efficient	5	4.8%	1 (4.8%) Design upgrades will be engineered to be reliable and efficient.	1 (4.8%) Design upgrades will be engineered to be reliable and efficient.	0.5 (2.4%) Although upgrades to the existing WPCP and the new WPCP will be engineered to be reliable, operating two plants will be less efficient.	1 (4.8%) The new WPCP will be engineered to be reliable and efficient.
Is easy to operate and maintain	2	1.9%	0.5 (0.85%) The older equipment will be increasingly more difficult to operate and	0.5 (0.85%) The older equipment will be increasingly more difficult to operate	0 (0%) It will not be easy to operate and maintain two separate facilities.	1 (1.9%) A new WPCP will be relatively easy to operate and maintain, as it will

			maintain as it ages. There may also be difficulties with how new equipment interacts with older equipment.	and maintain as it ages. There may also be difficulties with how new equipment interacts with older equipment.		have entirely new modern equipment.
Allows for easy connection to the existing system	1	1%	1 (1%) No additional connections required.	1 (1%) No additional connections required.	0.5 (0.5%) The new WPCP will be constructed close to where population increase is occurring to facilitate interconnection.	0 (0%) A new connection will be required, and a new pump installed to pump sewage to the new WPCP.
Is flexible in terms of its ability to address unforeseen growth rates/processing demands.	2	1.9%	0 (0%) This option is designed for average flows of 4,400 m^3/d and a population of 12, 941. As this is lower than the maximum predicted population, it does not provide flexibility for unforeseen growth.	0.5 (0.85%) This option is designed for average flows of 5,100 m^3/d and a population of 15,000 (maximum predicted). This leaves some flexibility for unforeseen growth.	1 (1.9%) The new WPCP could be constructed using a modular approach that provides flexibility for unforeseen growth.	1 (1.9%) The new WPCP could be constructed using a modular approach that provides flexibility for unforeseen growth.

Meets site specific requirements (e.g., space requirements, geotechnical)	5	4.8%	1 (4.8%) There is sufficient space at the WPCP to accommodate the required upgrades and there are no geotechnical limitations.	1 (4.8%) There is sufficient space at the WPCP to accommodate the required upgrades and there are no geotechnical limitations.	1 (4.8%) It is assumed that the new site would meet space and geotechnical requirements.	1 (4.8%) It is assumed that the new site would meet space and geotechnical requirements.
Provides flexibility to adapt to climate change.	2	1.9%	1 (1.9%) Upgrades will ensure that the WPCP can manage flows from storm events caused by climate change.	1 (1.9%) Upgrades will ensure that the WPCP can manage flows from storm events caused by climate change.	1 (1.9%) The new WPCP design will ensure that the WPCP can manage flows from storm events caused by climate change.	1 (1.9%) A new facility design will ensure that the WPCP can manage flows from storm events caused by climate change.
Is simple in terms of construction	2	1.9%	0.5 (0.85%) The upgrades will be undertaken while having to maintain wastewater treatment for the Town.	0.5 (0.85%) The upgrades will be undertaken while having to maintain wastewater treatment for the Town.	1 (1.9%) Upgrades to the existing WPCP, such as replacing the clarifiers, will be simple in terms of constructability as will the construction of the second WPCP.	1 (1.9%) Construction of a new facility on a greenfield property has few limitations and will be relatively easy to construct.
Implementation timeline	2	1.9%	1 (1.9%)	1 (1.9%)	0 (0%)	0 (0.0%)

			Would only require amendment of the existing Certificate of Approval.	Would only require amendment of the existing C of A.	Authorization of a new discharge point would likely require additional study of the receiving water body, which would delay construction. Land acquisition and environmental studies would also increase the implementation timeline.	Authorization of a new discharge point would likely require additional study of the receiving water body, which would delay construction. Land acquisition and environmental studies would also increase the implementation timeline.
TECHNICAL TOTAL	**26**	**25%**	**21.1%**	**22.1%**	**18.2%**	**22.0%**

Based on the evaluation of technical criteria, the option of expanding/upgrading the existing WPCP to a 5,100 m^3/day capacity (Alternative Solution No. 3b) and replacing the existing WPCP with a new facility (Alternative Solution No. 5) are the preferred options. Operating two (2) separate WPCPs (Alternative Solution No. 4) is the less desirable option from a technical consideration.

4.3.3.2. Environmental Assessment

Alternative Solutions were evaluated in terms of environmental criteria that consider potential impacts to aquatic and terrestrial wildlife and compliance with applicable regulations. A summary of the evaluation is shown below in **Table 6**.

Table 6: Environmental Criteria Scoring for Alternative Solutions

Criterion	Criterion Importance Ranking	Relative Criterion Weighting	Alternative Solutions Scores (Relative Score)			
			3a Upgrade/Expand WPCP	**3b Upgrade/Expand WPCP**	**4 New Second WPCP for Additional Flow**	**5 New Replacement WPCP**
Does not result in short-term impacts to water quality and aquatic life	2	1.70%	1 (1.7%) Improvements to the WPCP will be designed to avoid exceedances of effluent limits set to protect water quality and aquatic life.	1 (1.7%) Improvements to the WPCP will be designed to avoid exceedances of effluent limits set to protect water quality and aquatic life.	1 (1.7%) Improvements to the WPCP and the second WPCP will be designed to avoid exceedances of effluent limits set to protect water quality and aquatic life.	1 (1.7%) The new WPCP will be designed to keep is below limits set to avoid exceedances of effluent limits set to protect water quality and aquatic life.
Does not result in long-term impacts to water quality and aquatic life	5	4.30%	1 (4.3%) Improvements to the WPCP will be designed to keep effluent below limits set to protect water quality and aquatic life.	1 (4.3%) Improvements to the WPCP will be designed to keep effluent below limits set to protect water quality and aquatic life.	1 (4.3%) Improvements to the WPCP and the second WPCP will be designed to keep effluent below limits set to protect water quality and aquatic life.	1 (4.3%) The new WPCP will be designed to keep is below limits set to protect water quality and aquatic life.

Does not result in short-term impacts to terrestrial wildlife	2	1.70%	0.5 (0.85%) Construction noise may result in a short-term disturbance to terrestrial wildlife.	0.5 (0.85%) Construction noise may result in a short-term disturbance to terrestrial wildlife.	0.5 (0.85%) Construction noise may result in a short-term disturbance to terrestrial wildlife.	0.5 (0.85%) Construction noise may result in a short-term disturbance to terrestrial wildlife.
Does not result in long-term impacts to terrestrial wildlife	5	4.30%	1.0 (4.3%) Upgrades contained within existing WPCP footprint.	1.0 (4.3%) Upgrades contained within existing WPCP footprint.	0.5 (2.15%) Depending on its location, the second WPCP construction could result in the loss of wildlife habitat.	0.5 (2.15%) Depending on its location, the new WPCP construction could result in the loss of wildlife habitat.
Complies with environmental regulations	5	4.30%	1 (4.3%) Will comply with all environmental regulations.	1 (4.3%) Will comply with all environmental regulations.	1 (4.3%) Will comply with all environmental regulations .	1.0 (4.3%) Will comply with all environmental regulations.
Does not impact species of conservation concern	5	4.30%	1.0 (4.3%) Upgrades contained within existing WPCP footprint.	1.0 (4.3%) Upgrades contained within existing WPCP footprint.	0.5 (2.15%) Depending on its location, the second WPCP construction could result in the loss of wildlife habitat.	0.5 (2.15%) Depending on its location, the new WPCP construction could result in the loss of wildlife habitat.

Does not impact migratory birds	5	4.30%	1 (4.3%) Upgrades contained within existing WPCP footprint.	1 (4.3%) Upgrades contained within existing WPCP footprint.	0.5 (2.15%) Depending on its location, the second WPCP construction could result in a small loss of habitat used by migratory birds.	0.5 (2.15%) Depending on its location, the second WPCP construction could result as small loss of habitat used by migratory birds.
ENVIRONMENTAL TOTAL	**29**	**25%**	**24.1%**	**24.1%**	**19.8%**	**19.8%**

Based on the evaluation of environmental criteria, the options of expanding / upgrading the existing WPCP (Alternative Solutions No. 3a and No. 3b) are the preferred options because they occur entirely on previously disturbed lands.

4.3.3.3. Economic Assessment

Alternative Solutions were evaluated in terms of economic criteria to consider their cost implications. A summary of the evaluation is shown below in **Table 7**.

Table 7: Economic Criteria Scoring for Alternative Solutions

Criteria	Criterial Importance	Relative Criteria Weighting	Alternative Solutions Scores (Relative Score)			
			3a Upgrade/Expand WPCP	3b Upgrade/Expand WPCP	4 New Second WPCP for Additional Flow	5 New Replacement WPCP
Capital and Site-Specific Costs *	5	10.4%	1.0 (10.4%) $25,000,000 to $35,000,000 (average $30,000,000)	1 (10.4%) $33,000,000 to $46,000,000 (average $39,500,000)	0.5 (5.7%) $45,000,000 (includes land cost, new sanitary sewer trunk, but does not include upgrades to existing WPCP)	0 (0%) $70,000,000 (includes new sanitary sewer trunk and decommissioning of existing WPCP)
Operation and Maintenance Costs	2	4.2%	1 (4.2%) $1,300,000	1 (4.2%) $1,500,000	0.5 (2.1%) $2,000,000	1 (4.2%) $1,500,000
Life Cycle Cost Analysis	5	10.4%	1 (10.4%)	0.5 (5.7%)	0 (0%)	0 (0%)
ECONOMIC TOTALS	**12**	**25%**	**25.0%**	**19.8%**	**7.3%**	**4.2%**

*Capital and site-specific costs were increased from PIC 1 when the pricing was updated as a part of the Phase 4 EA Stage.

Based on the evaluation of economic criteria, the option of expanding the WPCP to a capacity of 4,400 m^3/day (Alternative Solution No. 3a) is the preferred option, followed by expanding the WPCP to 5,100 m^3/day (Option 3B). The remaining options scored significantly lower from an economic consideration.

4.3.3.4. Social Assessment

Alternative Solutions were evaluated in terms of social criteria to consider their implications on the residents of Shelburne. A summary of the evaluation is shown below in **Table 8**.

Table 8: Social Criteria Scoring for Alternative Solutions

Criteria	Criterial Importance	Relative Criteria Weighting	Alternative Solutions Scores (Relative Scores)			
			3a Upgrade/Expand WPCP	3b Upgrade/Expand WPCP	4 New Second WPCP for Additional Flow	5 New Replacement WPCP
Conformity to local planning provisions	5	3.2%	1 (3.2%) No changes to zoning would be required for the WPCP upgrades. Increased WPCP capacity would support planned community growth identified in the Official Plan.	1 (3.2%) No changes to zoning would be required for the WPCP upgrades. Increased WPCP capacity would support planned community growth identified in the Official Plan.	0.5 (1.6%) Increased WPCP capacity would support planned community growth identified in the Official Plan. There is no current plan for a new WPCP location, and it cannot be determined if a suitable location zoned as "development" or "institutional" is available. Increased WPCP capacity would support planned community growth identified in the Official Plan.	0.5 (1.6%) Increased WPCP capacity would support planned community growth identified in the Official Plan. There is no current plan for a new WPCP location, and it cannot be determined if a suitable location zoned as "development" or "institutional" is available. Increased WPCP capacity would support planned community growth identified in the Official Plan.
Impacts on quality of life	5	3.2%	1 (3.2%)	1 (3.2%)	1 (3.2%)	1 (3.2%)

			WPCP upgrades will lead to a reduction in odours emanating from the existing facility.	WPCP upgrades will lead to a reduction in odours emanating from the existing facility.	WPCP upgrades will lead to a reduction in odours emanating from the existing facility.	Replacement of the existing WPCP will result in a reduction in odours emanating from the existing facility.
Financial implication for residents	5	3.2%	0.5 (1.6%) Would allow limited new development, and development charges to developers would partially cover WPCP upgrades, with additional costs passed on to homeowners.	1 (3.2%) Allows for sufficient development to allow development charges to cover the costs of WPCP upgrades.	0 (0.5%) Would allow for same level of development as 3b, but given high capital costs, would require additional costs passed on to homeowners.	0 (0%) Would allow for same level of development as 3b, but given highest capital cost of all options, would require highest additional costs passed on to homeowners.
Short-term impacts to Adjacent land uses	2	1.3%	0.5 (0.65%) Adjacent landowners may experience increased daytime noise levels during construction.	0.5 (0.65%) Adjacent landowners may experience increased daytime noise levels during construction.	0 (0%) Adjacent landowners may experience increased daytime noise levels and minor traffic delays during a longer construction period than option 3a or 3b.	0 (0%) Adjacent landowners may experience increased daytime noise levels and minor traffic delays during a longer construction period than option 3a or 3b.

Long-term impacts to Adjacent land uses	5	3.2%	1 (3.2%) Odours from existing facility will be eliminated by addressing undersized components.	1 (3.2%) Odours from existing facility will be eliminated by addressing undersized components.	0.5 (1.6%) Odours from existing facility will be eliminated by addressing undersized components. Owners adjacent to the new WPCP could experience reduced property values due to concerns about living beside a new WPCP.	0.5 (1.6%) Owners adjacent to the new WPCP could experience reduced property values due to perceived concerns about living beside a new WPCP.
Impacts to archaeological resources	5	3.2%	1 (3.2%) All construction will occur in previously disturbed areas and no impacts to archaeological resources are anticipated.	1 (3.2%) All construction will occur in previously disturbed areas and no impacts to archaeological resources are anticipated.	0.5 (1.6%) For the existing WPCP, all construction will occur in previously disturbed areas and no impacts to archaeological resources are anticipated. Additional archaeological assessment would be required at the new	0.5 (1.6%) Additional archaeological assessment would be required at the new WPCP location to ensure that archaeological resources are identified, and potential impacts mitigated.

					WPCP location to ensure that archaeological resources are identified, and potential impacts mitigated.	
Short-term impacts on local businesses	2	1.3%	0.5 (0.65%) Adjacent landowners may experience increased daytime noise levels during construction.	0.5 (0.65%) Adjacent landowners may experience increased daytime noise levels during construction.	0.5 (0.65%) Adjacent landowners may experience increased daytime noise levels and minor traffic delays during construction.	0.5 (0.65%) Adjacent landowners may experience increased daytime noise levels and minor traffic delays during construction.
Long-term impacts on local businesses	5	3.2%	1 (3.2%) The increased WPCP capacity will allow population growth than will benefit local businesses.	1 (3.2%) The increased WPCP capacity will allow population growth than will benefit local businesses.	1 (3.2%) The increased WPCP capacity will allow population growth than will benefit local businesses.	1 (3.2%) The increased WPCP capacity will allow population growth than will benefit local businesses.
First Nations land rights or traditional land use	5	3.2%	1 (3.2%) Consultation undertaken as part of the Class EA has confirmed that updating the existing	1 (3.2%) Consultation undertaken as part of the Class EA has confirmed that updating the existing	1 (3.2%) Consultation undertaken as part of the Class EA has confirmed that updating the existing	1 (3.2%) Consultation undertaken as part of the Class EA has confirmed that updating the existing

			WPCP would not infringe on First Nations land rights or traditional land use.	WPCP would not infringe on First Nations land rights or traditional land use.	WPCP would not infringe on First Nations land rights or traditional land use. Should this option be identified as the preferred alternative, consultation under a separate Class EA for the new WPCP would ensure the same applied to the new WPCP.	WPCP would not infringe on First Nations land rights or traditional land use. Should this option be identified as the preferred alternative, consultation under a separate Class EA for the new WPCP would ensure the same applied to the new WPCP.
SOCIAL TOTALS	**39**	**25%**	**17.3%**	**23.7%**	**18.3%**	**16.7%**

Based on the evaluation of social criteria, the option of expanding the WPCP to a capacity 5,100 m^3/day (Alternative Solution No. 3b) is the preferred option, followed by construction of a new WPCP (Alternative Solution No. 5).

4.3.4. Recommended Alternative Solution

The assessment of Alternative Solutions is summarized below in **Table 9** to determine the overall preferred solution. The highest-ranking Alternative Solution, or any preferred solution within 0.5%, for each criterion, is highlighted in green.

Table 9: Summary of Assessment of Alternative Solutions

Evaluation Category Score Total	Evaluation Category Weighted Percentage (%)	Alternative Solutions (%)			
		3a Upgrade/Expand WPCP	3b Upgrade/Expand WPCP	4 New second WPCP for Additional Flow	5 New Replacement WPCP
Technical	25	21.1	22.1	18.2	22.0
Environmental	25	24.1	24.1	19.8	19.8
Economic	25	25.0	19.8	7.3	4.2
Social	25	17.3	23.7	18.3	16.7
TOTALS	**100**	**87.5**	**89.7**	**63.6**	**62.7**

Based on the assessment, summarized above in **Table 9**, the preferred Alternative Solution is to expand / upgrade the existing WPCP to a rated capacity of 5,100 m^3/day (Alternative Solution No. 3b). This Alternative Solution has both the highest overall score and scored highest in three (3) of the four (4) Evaluation Categories (i.e., Technical, Environmental, and Social).

4.4. Consultation on Problem / Opportunity and Alternative Solutions

A second Public Information Centre (PIC2) was held on June 24, 2020, from 6:30 p.m. to 7:30 p.m. Due to health and safety considerations arising from the COVID-19 virus, PIC2 was conducted as a video conference using the Zoom platform. Additionally, the meeting was livestreamed on the Town's YouTube Channel to create a meeting record and to allow viewing at other times for anyone who could not participate at the designated time. Notification for PIC2 appeared in the Shelburne Free Press on May 28, 2020. Additionally, a stakeholder list was developed, consisting of agencies, neighbouring municipalities, First Nations and Metis communities and organizations, provided in **Appendix C**. Stakeholders on the list were invited to participate in PIC2 by email on May 28, 2020, and again on June 15, 2020. PIC2 attendees were instructed to contact the Town of Shelburne to register for the meeting, 12 stakeholders registered for PIC2, with eight (8) attending.

The PIC2 presentation is included in **Appendix C** and covered the following topics:

- Project background
- The Municipal Class EA process
- Studies completed to date
- Alternative Solutions
- Next steps

A PDF version of the presentation slides was provided to all registrants the day of the meeting. Within an hour of the conclusion of PIC2, an electronic survey was emailed to stakeholders that had registered. The survey provided an opportunity to comment on the meeting, on the recommended Alternative Solution, or to provide other feedback.

One survey respondent indicated they were unable to ask questions. Through follow-up by email on June 25, 2020, it was confirmed that the respondent inadvertently viewed the live streaming on YouTube instead of registering and participating in the Zoom meeting. The respondent was provided the opportunity to ask any questions and provide additional feedback beyond what they provided in the survey.

Table 10 provides a summary of comments from the survey when respondents were asked if they had any concerns with expanding the WPCP to 5,100 m^3/day being selected as the preferred Alternative Solution.

Table 10: Survey Comments Received Regarding Selection of Preferred Alternative Solution

Name	Comment	How Comment was Addressed in this ESR Report
Anonymous	No comment. MECP has already confirmed the results of the Assimilative Capacity Study and proposed effluent criteria.	The MEC-approved effluent criteria are provided in the Appendix E: S. Burnett and Associates Revised Assimilative Capacity Technical Memorandum, March 2020.
Anonymous	Best option.	n/a
Anonymous	On behalf of the Flato team we are supportive of improvements to the Town's WPCP to accommodate future growth. Thank you for confirming during the PIC that the Flato lands are included as part of the study drainage boundary, included within the estimated 2041-year max-build-out population of 15,000, and included within the average day flow of 5,100 m^3/d. Once available please confirm the estimated cost to upgrade / expand the existing WPCP.	The cost of the preferred option was provided in Slide 6 of the PIC3 presentation (Appendix C), and the economic assessment of alternative solutions in **Section 4.3.3.3**.

Questions at PIC2 centered around population projections in the EA, and whether they included proposed developments on the west side of the Town. Representatives from the developer wanted to ensure that the population projection of 15,000 by 2041, included the proposed development and this was confirmed. A question was also asked regarding the cost of the WPCP upgrade and expansion, and it was communicated that this would be provided at PIC3.

4.5. Climate Change

The Provincial Policy Statement contains several policies that require land use planning and infrastructure projects consider their impact on climate change. Some of the applicable policies require that land use planning and infrastructure projects:

- Policy 1.6.6.1 (b4): prepare for the impacts of a changing climate.
- Policy 1.8.1: support energy conservation and efficiency, improved air quality, reduced greenhouse gas emissions, and preparing for the impacts of a changing climate through land use and development patterns.
- Policy 3.1.3: prepare for the impacts of a changing climate that may increase the risk associated with natural hazards.

None of the alternatives will have an appreciable impact on climate change, nor would there be any appreciable differences in climate change impacts between the alternatives. Although a location for a 2nd WPCP for Alternatives 4 and 5 has not yet been determined, it is possible that these locations could require vegetation clearing, that unless mitigated, would lead to a slightly worse climate change impact.

All options require additional equipment that will increase the electricity demand of water treatment in Shelburne, however, most electricity in Ontario is derived from non-greenhouse gas (GHG)-generating sources with less than 10% of Ontario's forecasted electricity production resulting in GHG emissions (Independent Electricity System Operator, 2023)

Climate change is already resulting in more high-intensity weather events around the world, and this is expected to continue. Increased numbers of high intensity rainfall events will mean higher flows of stormwater reporting to the WPCP and requiring treatment. The equalization tanks will be appropriately sized during detailed design in consideration of climate change. Additionally, as part of the Town's anticipated 2022 Stormwater Master Servicing Plan (SWMSP), the Town will assess opportunities to divert clean groundwater away from the WPCP and storm drains and have it redirected to streams. Specifically, the SWMSP will also look at whether there is an opportunity to divert groundwater from entering the stormwater pond in the Northwest of Shelburne and towards Walter's Creek.

4.6. Source Water Protection

The WPCP is located within the South Georgian Bay Lake Simcoe Protection Region, approximately, 400 metres from the nearest wellhead protection area **(Figure 6)**. Given that the WPCP is located outside of all wellhead protection areas, this means that there would be a time of travel of greater than 25 years from the WPCP to the nearest water supply well. In terms of surface water conveyance, the Besley Drain flows northeasterly away from wellhead protection areas, so in the event of a spill, no surface water conveyance to a wellhead protection area is anticipated.

The WPCP underlying aquifer is not a highly vulnerable aquifer (Ministry of the Environment, Conservation and Parks, 2023), which is an aquifer that is particularly susceptible to contamination due its proximity to the ground surface, or because of the type of materials around it.

The WCPC and WPCP effluent discharge outlet is located with the Nottawasaga Valley Source Protection Area and the Nottawasaga Valley Conservation Authority (NVCA) provides services as a Risk Management Official (RMO) and Risk Management Inspector (RMI) under the *Clean Water Act, 2006.* NVCA reviewed the Assimilative Capacity Study Technical Memorandum (**Appendix E)** and provided review comments on September 21, 2020. A response was provided on October 15, 2020. Following subsequent meetings with NVCA, the Boyne River Adaptive Monitoring and Stewardship was developed, which is outlined in **Section 7.** The plan will be administered through a partnership between the Town of Shelburne and the NVCA.

4.7. Selection of Preferred Solution

Based on the input received from PIC2, the Alternative Solution of increasing the capacity of the existing WPCP to 5,100 m^3/day was confirmed as the preferred solution.

5.0 Phase 3: Alternative Designs Concepts for Preferred Solution

5.1. Design Criteria

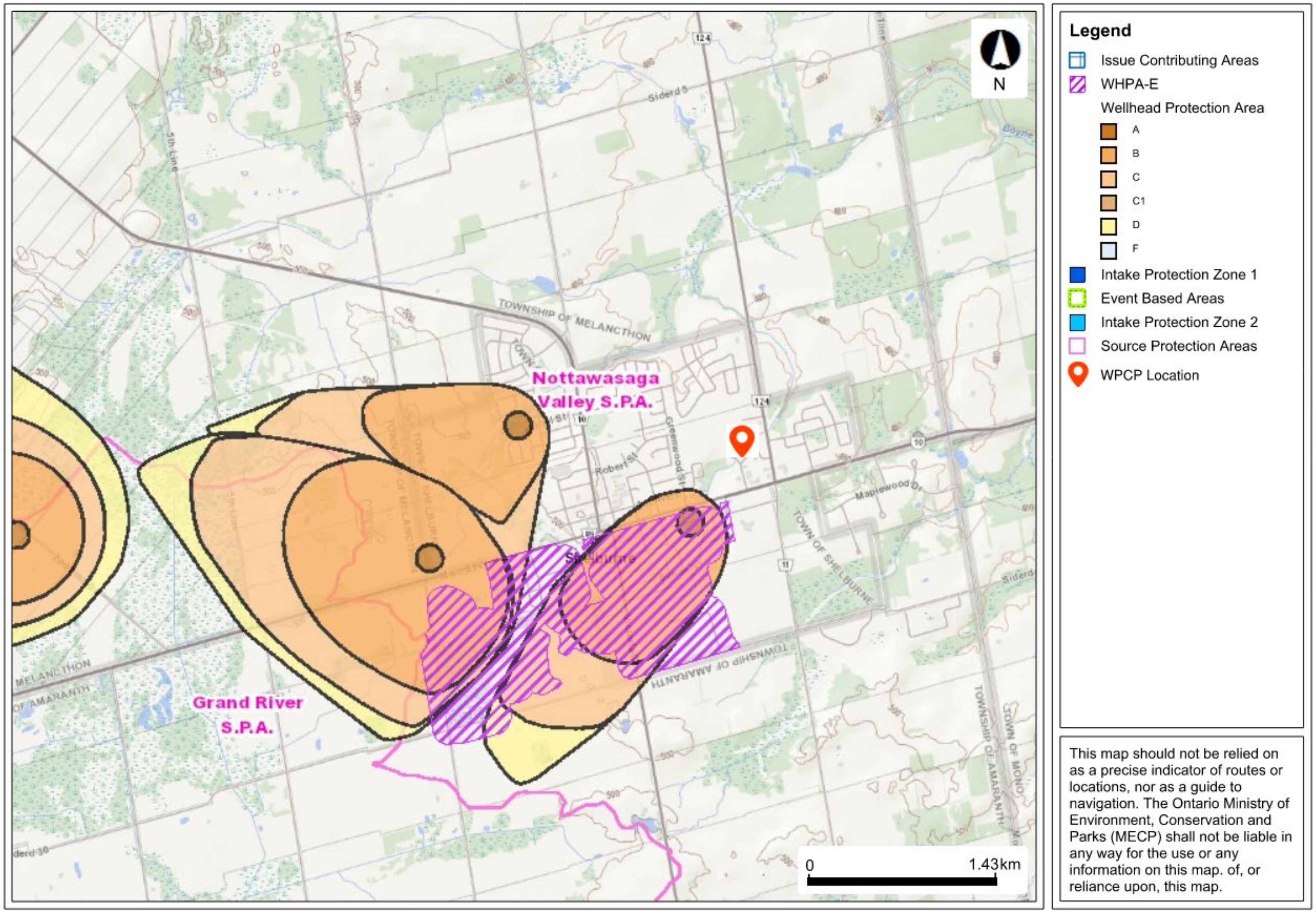
This section evaluates different design concepts to upgrade and expand the existing WPCP from a rated capacity of 3,420 m^3/day to 5,100 m^3/day. Based on this evaluation, a recommended design concept will be identified and presented to stakeholders for feedback prior to confirming this as the preferred design concept that will advance to the detailed design phase. The design took into consideration the Design Guidelines for Sewage Guidelines (Ministry of the Environment, Conservation, and Parks, 2019) (Ministry of the Environment, Conservation, and Parks, 2008).

The current WPCP components are summarized in **Table 11**and shown in **Figure 7**. A process flow diagram showing the current stages of treatment at the WPCP is included as **Figure 8** below.

Table 11: Current Treatment Processes at the Water Pollution Control Plant

Peak Flow Management:	• Two (2) Storm Holding Ponds
Inlet Works:	• Bar screens • Vortex Degritter • Grit Channels
Secondary Treatment:	• Extended Aeration • Secondary Clarification
Tertiary Treatment:	• Cloth Filters • UV Disinfection

Figure 6: Source Water Protection Mapping.



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Map Created: 10/18/2023
Map Center: 44.08336 N, -80.21186 W

Figure 7: Waste Pollution Control Plant Component Locations

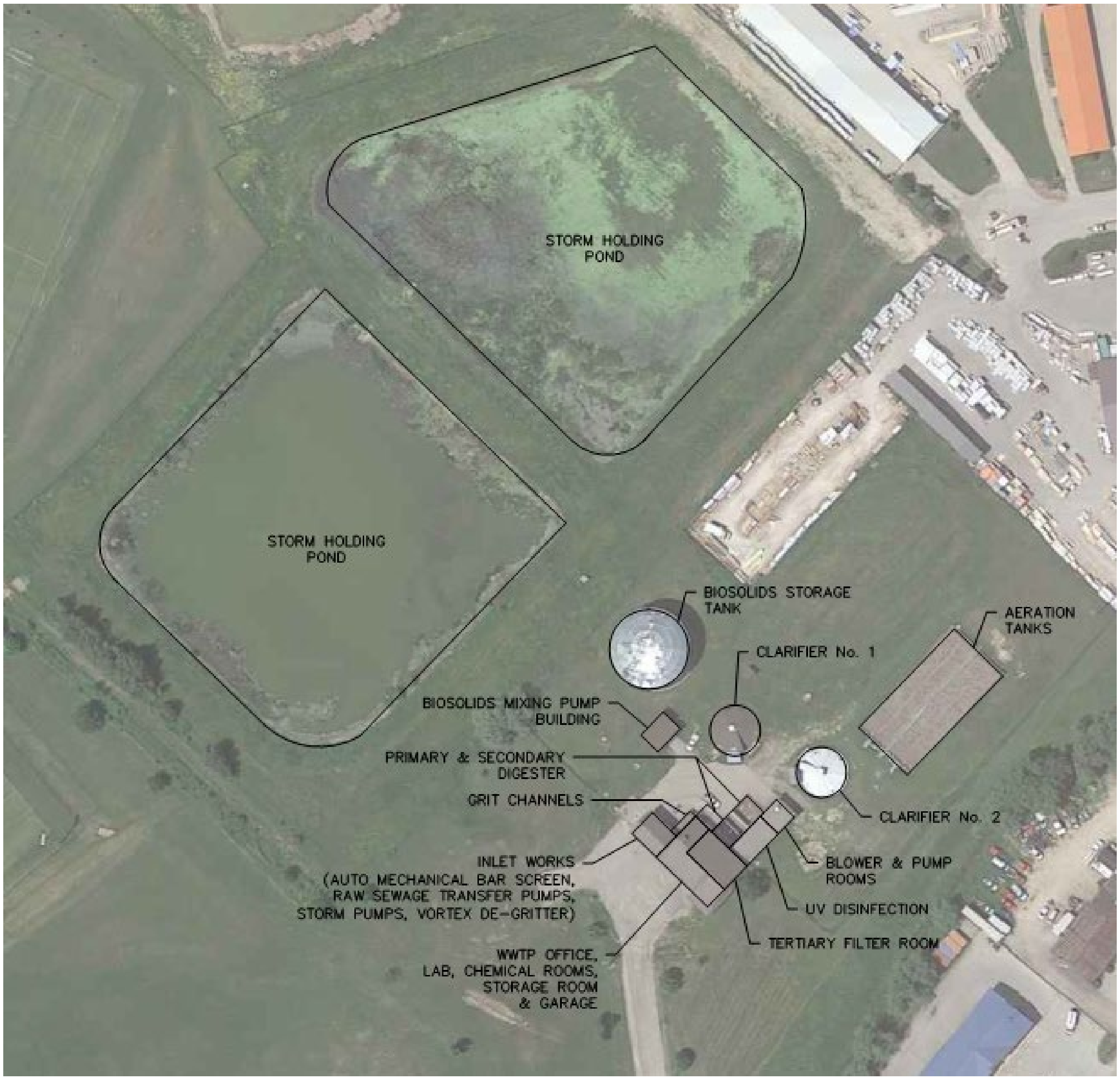
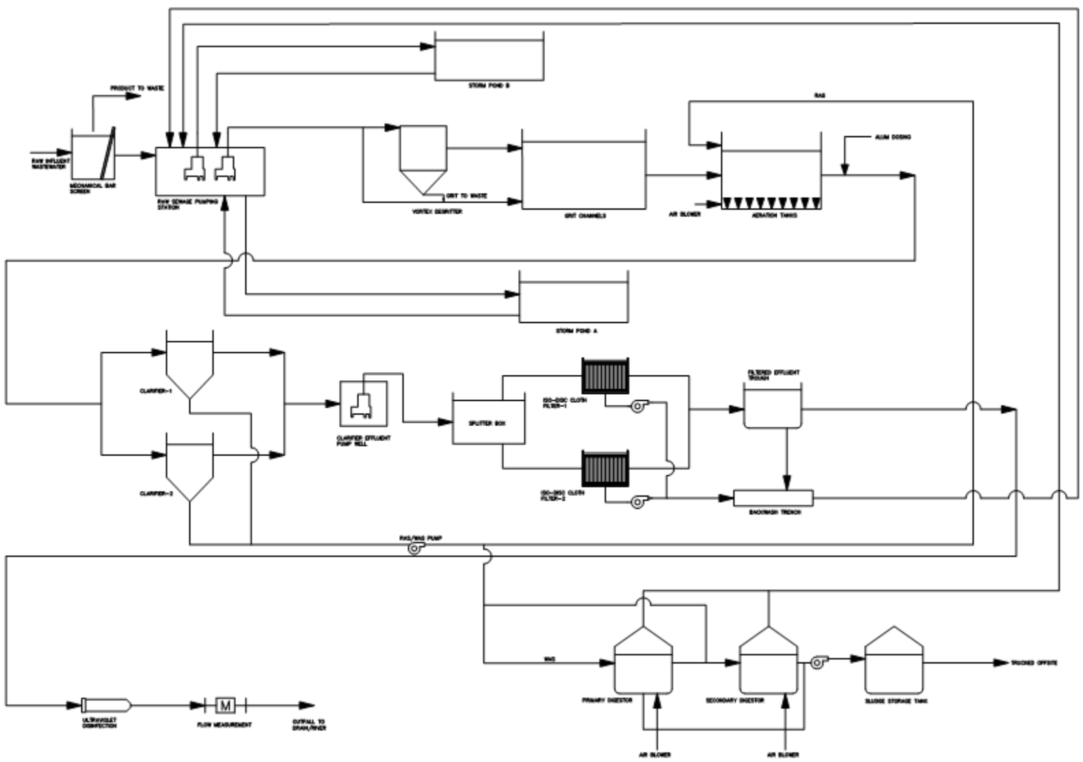


Figure 8: Current Process Flow Diagram of the WPCP



5.1.1. Wastewater Flows

5.1.1.1. Average Day Flow

Table 12 summarizes data collected from 2007 to 2022 for population, average flow, and corresponding per capita sewage generation. It should be noted that these values include both residential and industrial, commercial, and institutional (ICI) waste generation rates and therefore the per capita flow is equivalent of residential, and ICI combined.

Table 12: Population and Sewage Flow Rates

Year	Population[1]	Average Daily Sewage Flow (m^3/d)	Average Per Capita Sewage Flow ($m^3/p/d$)
2007	5281	1,967	0.372
2008	5417	2,354	0.435
2009	5556	2,590	0.466
2010	5699	2,268	0.398
2011	5846	2,390	0.409
2012	6244	2,112	0.338
2013	6669	2,154	0.323
2014	7123	2,282	0.320
2015	7608	2,200[2]	0.289
2016	8126	2,349[2]	0.289
2017	8155	2,540[2]	0.311
2018	8176	2,554[2]	0.312
2019	8354	2,454[2]	0.294
2020	8639	2,758[2]	0.319
2021	8994	2,641[2]	0.294
2022	9384	2,623[2]	0.280

1. *Reference - Sewage Capacity Allocation Report (Year End 2022)*
2. *Average Daily Flow calculated using the formula discussed in section 6.1.1.2. Max Day Flow*

As shown in **Table 12**, wastewater average daily flow rates have generally trended downward from 2009 to 2013 and stabilized from 2014 to 2016, despite the population steadily increasing. The 2017 data showed a significant increase in average daily flow rates as well as in per capita flows. The increases seen in 2017 were partially attributed to above average precipitation, however, the increased average flows and per capita demand have continued through to 2020. The increased per capita flow from 2017 to 2020 is generally in line with per capita rates experienced in 2013 and 2014 and is still much lower than the per capita flows experienced from 2007 to 2011. This reduction points to the success of the water metering program and sewage system infiltration improvements that included new infrastructure being installed in the newer portions of Town and rehabilitation work in the older sections to reduce infiltration and extraneous flows.

The increase in wastewater average daily flow from 2019 to 2020 is attributed to the increase in population but has also been impacted by COVID-19. Although the full effect of COVID-19 cannot be easily determined, the increased per capita flows is consistent with an increase in the number of residents working from home. Hence, the 2020 data is considered an outlier and accordingly is not concluded when averaging daily flows over periods of several years. The increased per capita demand factor seen from 2017 to 2020 suggests increased water consumption rates. This may be indicative of reduced effectiveness of the water metering program encouraging conservation of water amongst consumers.

Averaging the data from 2007 to 2020 results in a per capita sewage flow of 0.347 m^3/p/d and a current five (5)-year average (2015 to 2019) of 0.299 m^3/p/d excluding 2020 data. A factor of safety of 12% was added to the five (5)-year average basis for wastewater flows. Thus, the per capita sewage flow rate basis to be used for estimating future wastewater flow rates is 0.340 m^3/p/d (340 L/p/d).

Thus, the average day flow rate for the design of the WPCP was established by multiplying the population of 15,000 estimated in 2041 with the per capita sewage flow rate basis of 340 L/p/d, resulting in an average day flow of 5,100 m^3/day.

5.1.1.2. Max Day Flow

While completing this Class EA, it was discovered that the flow meter on the incoming line to the wastewater treatment plant was not working. Hence, the raw wastewater flows were calculated using a formula based on the flows recorded by other flow meters in the plant.

The formula used for calculating the incoming wastewater flow to the plant is:

$$Actual\ Raw\ Sewage\ Flow\ = Parshall\ Flume\ Flow\ + Waste\ Sludge\ Flow\ + Storm\ Water\ Flow\ to\ the\ Ponds\ - Storm\ Pond\ Return$$

Based on the flows recorded by the other flow meters in the plant and the above formula, wastewater flows to the WPCP were calculated for a five (5)-year duration (2015 to 2019) and are summarized in **Table 13.**

Table 13: Historical Average and Max Day Wastewater Flows for the Shelburne WPCP

	Raw Annual Average								Effluent Annual Average					Current ECA Limit
Parameter	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2015**	**2016**	**2017**	**2018**	**2019**	
Average Flow (m^3/d) [calculated]	2,200	2,349	2,540	2,554	2,454	2,758	2,641	2,623	2,094	2,259	2,564	2,474	2,279	3,420
Max Day Flow (m^3/d) [calculated]	5,241	8,094	7,578	7,876	6,376	8,228[1]	6,489[1]	6,485[1]	4,150	4,285	4,922	4,468	6,376[1]	
Peak Max Day Factor [calculated]	2.38	3.45	2.98	3.08	2.60	2.98	2.45	2.47		1.9	1.92	1.81	2.79	

1 *The OCWA operations staff has developed a new methodology to calculate raw water flows entering the WPCP more accurately. This methodology was used to determine the maximum day sewage flow for 2019 onward and explains the significant increase from 2018.*

As shown in **Table 13** the peak max day factor from 2015 to 2019 was 3.45. **Table 14** below shows the historical peak flow frequencies.

Table 14: Historical Peak Flow Frequencies

Year		No. Daily Flows Exceeding 2.06 PF	No. Daily Flows Exceeding 2.5 PF	No. Daily Flows Exceeding 3.0 PF
2015		1	0	0
2016		5	2	2
2017		3	1	0
2018		3	1	1
2019		2	1	0
2020		2	2	1
2021		2	1	0
2022		2	1	0

It can be seen in **Table 14** that flows exceeding a peak factor 2.5 were observed at a maximum of two (2) times a year whereas the frequency of flows exceeding a peak factor of 2.06 were observed at a maximum of five (5) times a year in the last five (5) years. Due to the reduced frequency of flows exceeding a peak factor of 2.5, it was decided to use a max day factor of 2.5 for designing the WPCP.

Flows in exceedance of a max day factor of 2.5 would be stored and be released slowly to the treatment plant during lower flow periods. Thus, the max day flow rate for the design of the WPCP was established by multiplying the average flow capacity of 5,100 m^3/day by the peak factor of 2.5, resulting in a max day flow of 12,750 m^3/day.

5.1.1.3. Peak Wet-Weather Flow

Currently, there are two (2) stormwater pumps at the WPCP that are used to divert excess flow to two (2) stormwater ponds with respective storage volumes of 19,900 m^3 and 16,800 m^3.

Based on a review of the historical flows received at the WPCP included in **Table 14**, flowrates greater than a peak factor of 2.5 were observed at least once per year from 2016 to 2019. Similarly, flowrates greater than a peak factor of 3 were observed twice in 2016 and once in 2018. Flows above a peak factor of 3 were not observed in 2015, 2017 and 2019.

Detailed discussion on selection of peak factor is included under **Section 5.2.1.3.**

5.1.2. Water Quality

5.1.2.1. Influent Loading

Annual Performance Reports for the WPCP were reviewed to determine the influent loading to the plant in terms of carbonaceous biochemical oxygen demand (cBOD5), total suspended solids (TSS), total phosphorus (TP) and ammonia-nitrogen (NH3-N). The monthly daily averages for each of these parameters for the period 2015-2019 were plotted and are shown below.

The influent cBOD5 concentration generally ranged between 100-400 mg/L (**Figure 9)**. The influent TSS concentrations ranged between 100-500 mg/L (**Figure 10**). TSS loadings greater than 500 mg/L were observed in 2018 and 2019. This was believed to be due to the diffusers in the aeration tank being clogged. The total phosphorus concentrations in the influent ranged between 2-10 mg/L (**Figure 11**). The total kjeldahl nitrogen (TKN) in the influent ranged between 15-65 mg/L (**Figure 12**).

Figure 9: Influent cBOD5 Concentration to the WPCP for 2015-2019

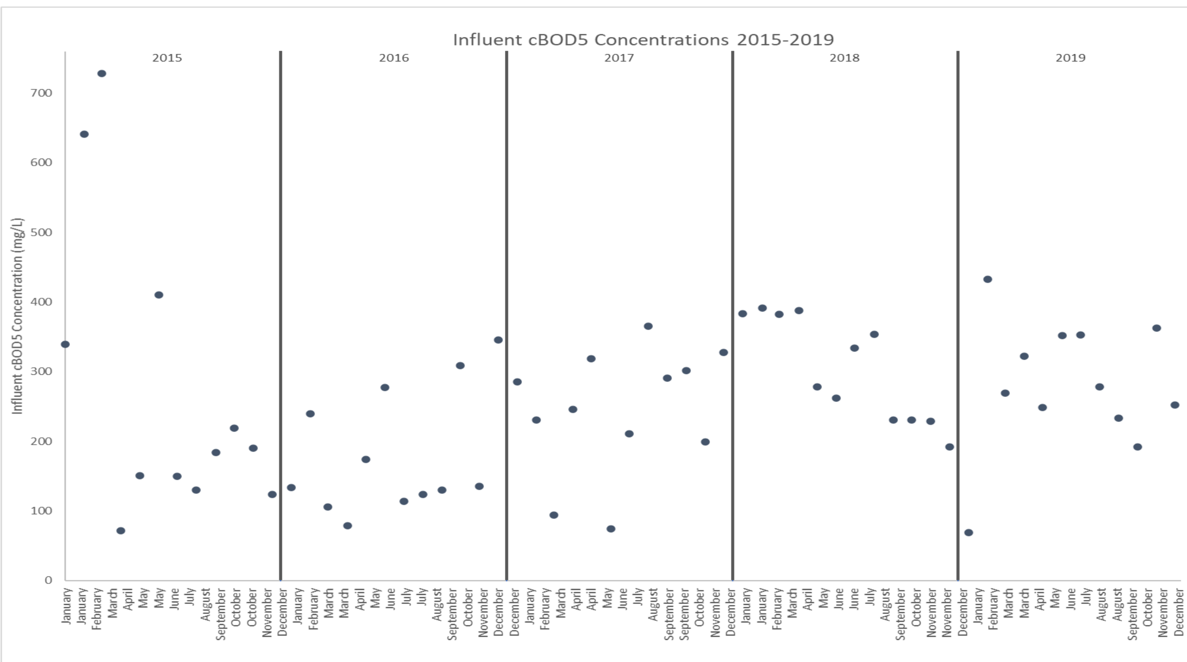


Figure 10: Influent TSS Concentration to the WPCP for 2015-2019

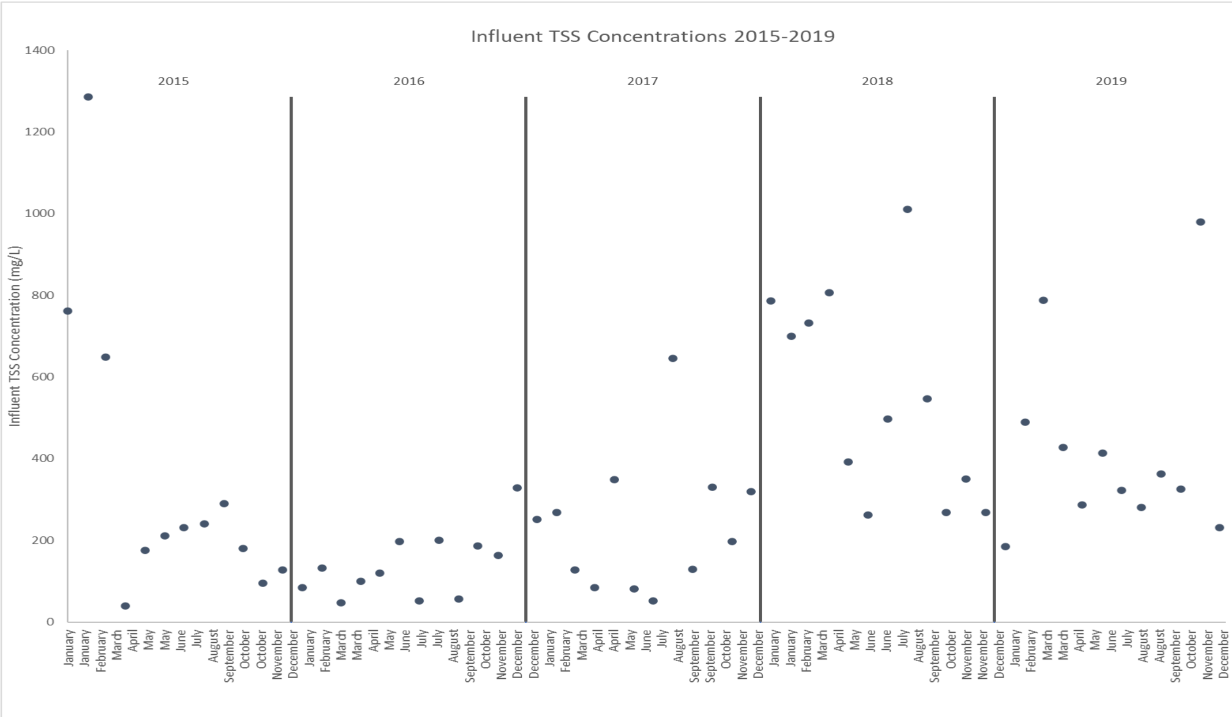


Figure 11: Influent TP Concentration to the WPCP for 2015-2019

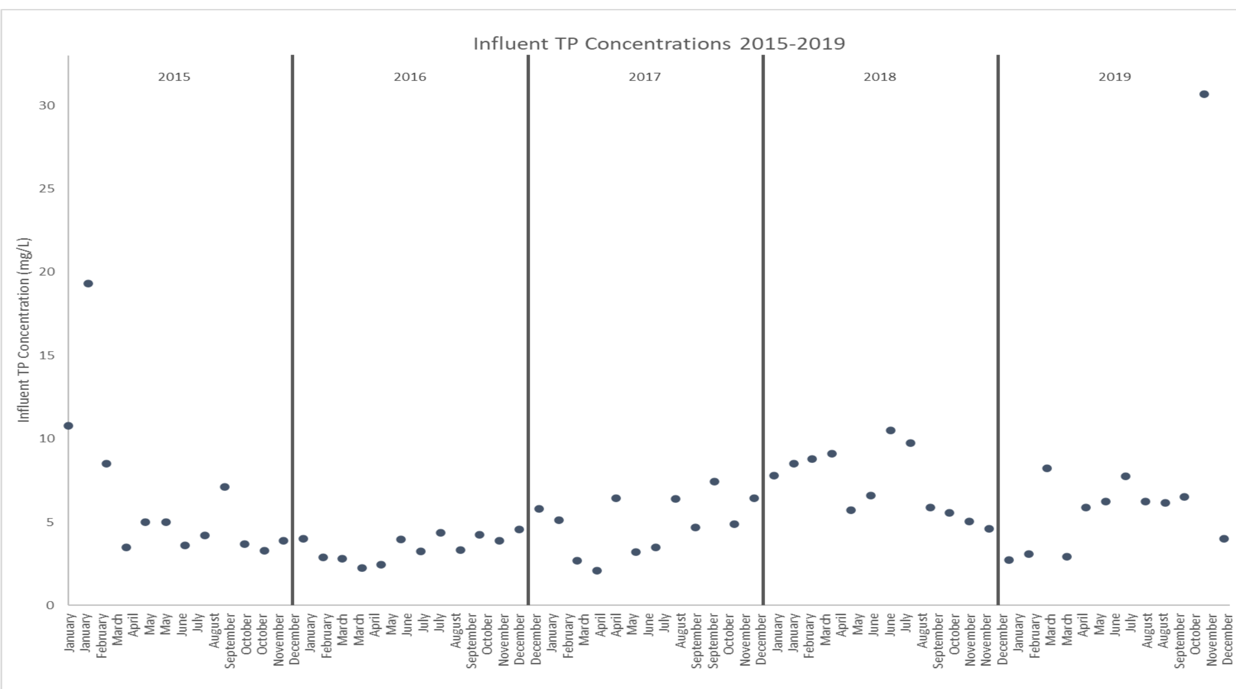
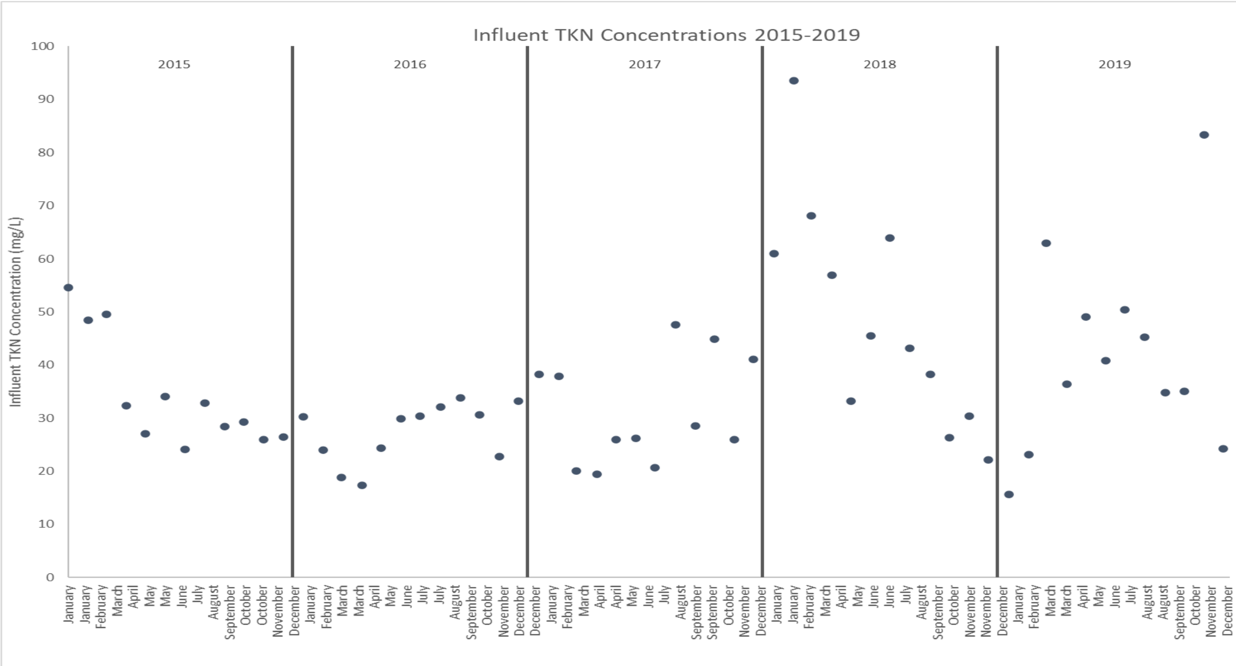


Figure 12: Influent TKN Concentration to the WPCP for 2015-2019



Based on the historic influent concentrations, the following influent wastewater characteristics will be used for the design of the future WPCP.

Table 15: Summary of Influent Wastewater Characteristics

Parameter	Average Concentration	Average Daily Influent Loading
$cBOD_5$	251 mg/L	1,280 kg/day
TSS	408 mg/L	2,081 kg/day
TKN	37 mg/L	189 kg/day
TP	6 mg/L	31 kg/day
Temperature	7 – 20 (deg C)	-
pH	6 - 9	-

5.1.2.2. Effluent Water Quality

The monthly average cBOD5 and TSS concentrations of the effluent are in the range of 0 – 5 mg/L with some exceedance in 2019 (**Figure 13** and **Figure 14**). The monthly average TP and NO3-N concentrations of the effluent are in the range of 0-0.13 mg/L, 0-20 mg/L respectively (**Figure 15** and **Figure 16**). Some exceedances above 0.13 mg/L in TP concentrations were observed in 2019. Also, higher NO3-N concentrations in the effluent were observed in 2015 and 2019. The monthly average NH3-N concentrations of the effluent are in the range of 0-2 mg/L (**Figure 17**) with some exceedances in 2019.

Figure 13: Monthly Average Effluent cBOD Concentrations for 2015-2019

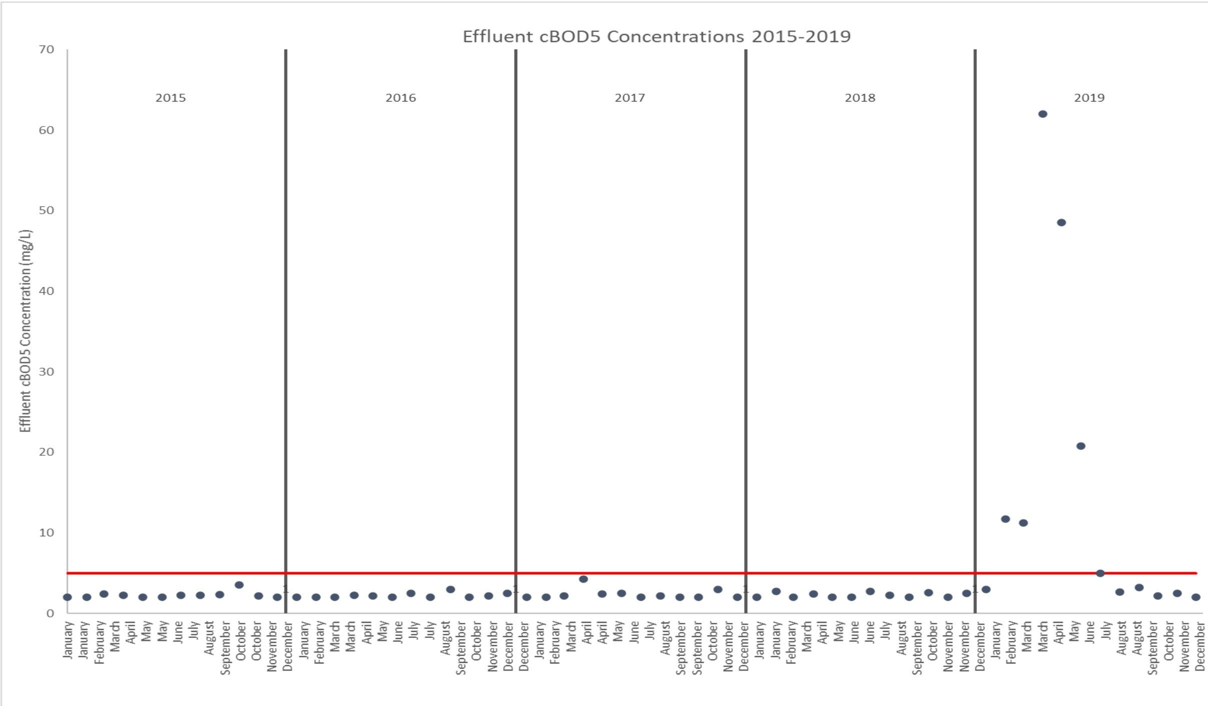


Figure 14: Monthly Average Effluent TSS Concentrations for 2015-2019

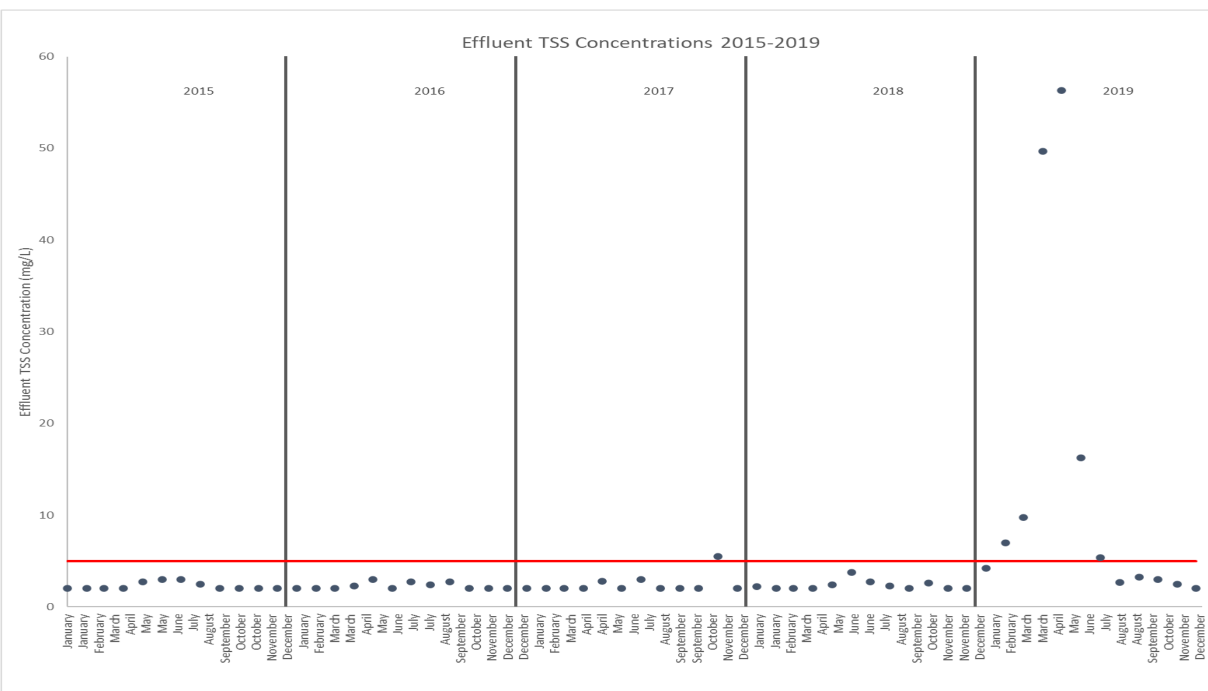


Figure 15: Monthly Average Effluent TP Concentrations for 2015–2019

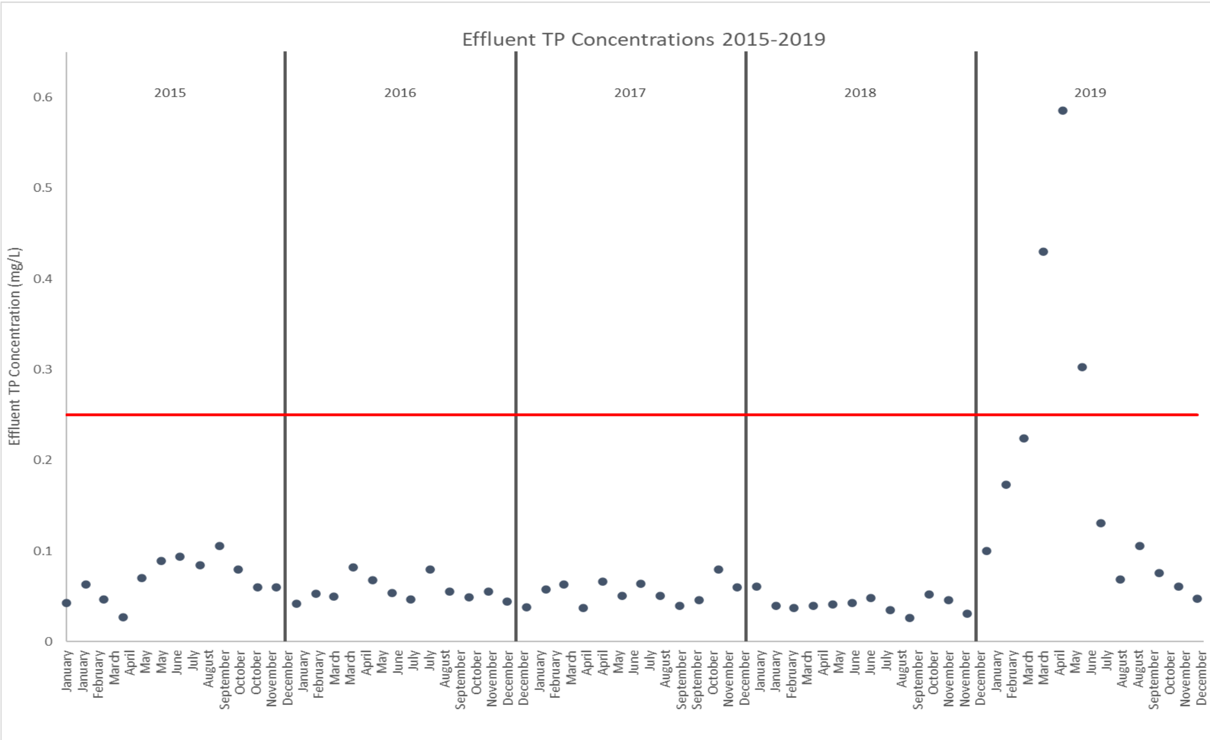


Figure 16: Monthly Average Effluent NO3-N Concentrations for 2015–2019

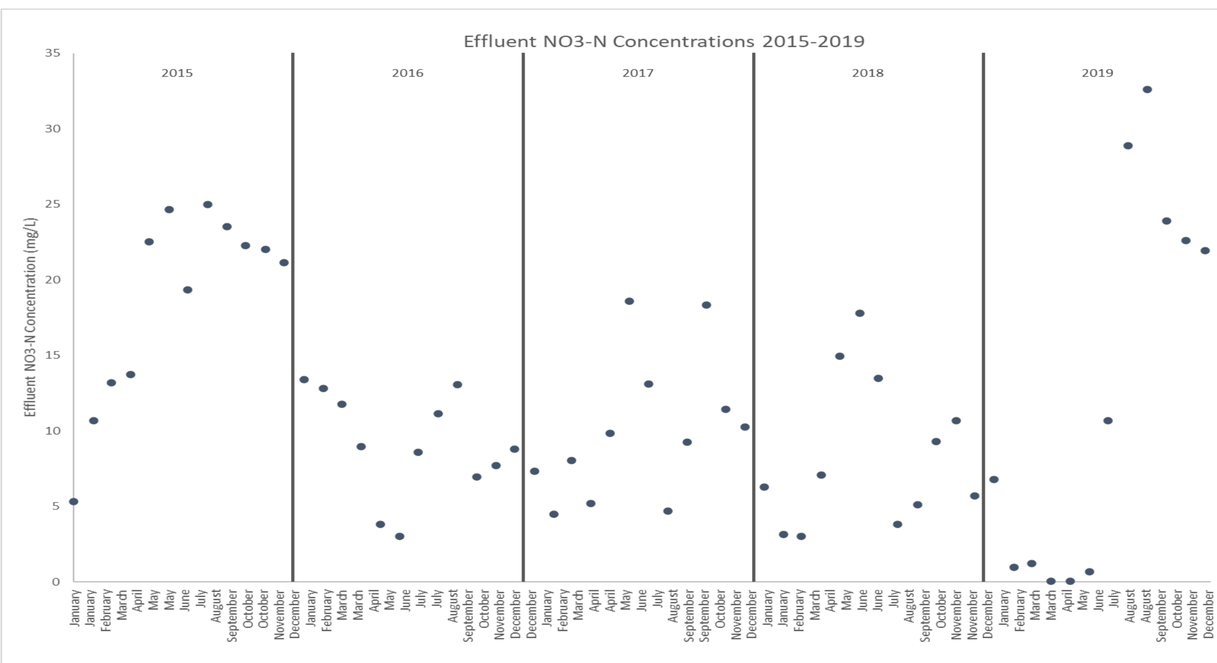
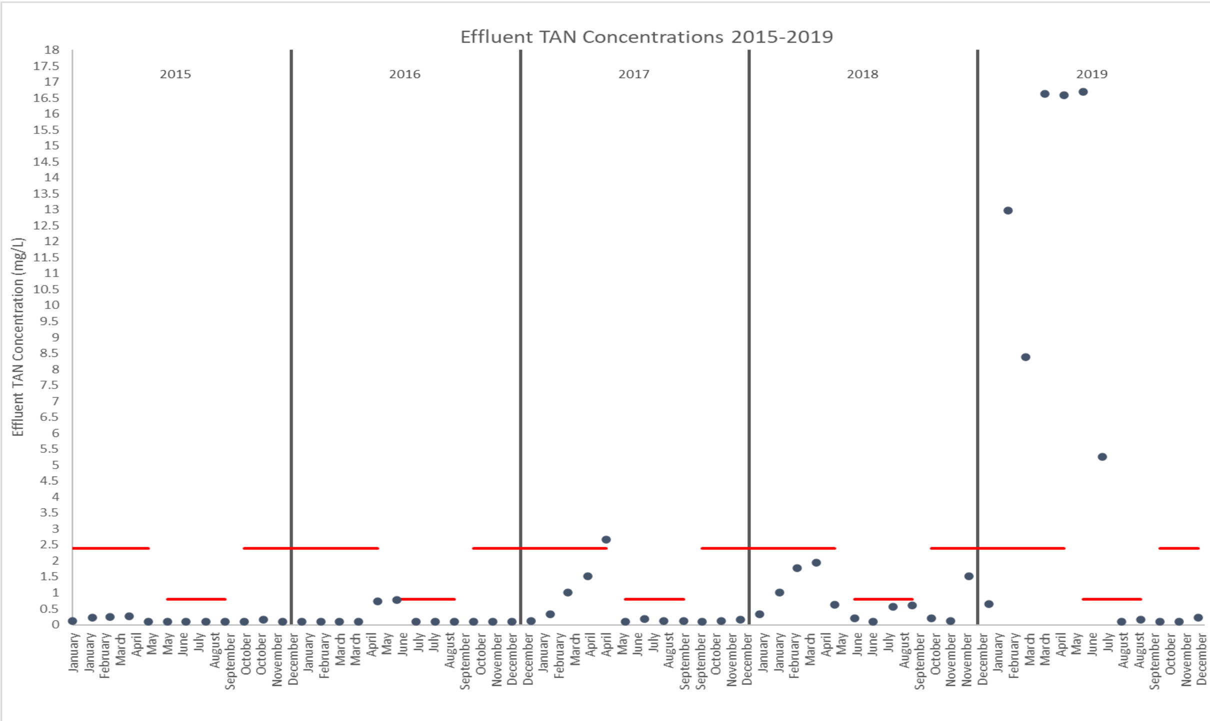


Figure 17: Monthly Average Effluent TAN Concentrations for 2015–2019



The future effluent design parameters for the WPCP were based on the limits established through an Assimilative Capacity Study (ACS), which is provided in **Appendix E**. The ACS used the QUAL2K model to predict the concentrations of dissolved oxygen, cBOD5, total phosphorous, ammonia, and nitrate that would occur in the Boyne River when the WPCP discharged its maximum 5,100 m^3/day. Target concentrations for these parameters were then established that are protective of aquatic species and aquatic habitat in the Boyne River. These targets and the rationale for their selection are shown in **Table 16**.

Table 16: Rationale for Parameter Target Concentration in Boyne River

Parameter	Target Concentration (mg/L)	Rationale
Dissolved Oxygen	>4.0	Provincial Drinking Water Quality (PWQO) limit at temperatures of 20 and 25°C
$cBOD_5$	<2.5	75th percentile background based on half of the lab detection limit of 5 mg/L
Total Phosphorous	<0.030	PWQO limit
NO3-N	<3.0	Long-term Canadian Water Quality Guideline for Protection of Aquatic Life
Unionized NH3-N	<0.0165	PWQO limit

The QUAL2K model was calibrated with water quality monitoring data and known flow rates. Once calibrated, the model was run using the current maximum discharge rate of 3,420 m^3/day to determine the distance after the confluence of the Besley Drain with the Boyne River where parameters concentrations were below the Target Concentration.

Because the maximum discharge rate of the upgraded WPCP will increase to 5,100 m^3/day, maintaining the current permitted discharge limits for parameters would increase the distance required for parameter concentrations to meet the Target Concentration. As a result, the model was run repeatedly to determine parameter concentration limits that at a discharge rate of 5,100 m^3/day, would result in the same, or shorter distances after the confluence of the Besley Drain with the Boyne River where parameters concentrations were below the Target Concentration. These parameter concentration limits are shown below in **Table 18,** and are compared to those previously in place for the current maximum discharge rate of 3,420 m^3/day, shown in **Table 17.**

Table 18 also shows effluent discharge objectives that the operator will endeavour to meet, and if not met, will require corrective action. Although there are no nitrate effluent limits or objectives currently in place, objectives and limits are proposed for the new effluent discharge limit to ensure protection of aquatic life and habitat.

Table 17: Current WPCP Effluent Objectives & Limits for a Maximum Discharge Rate of 3,420 m^3/day

Effluent Parameter	Effluent Objectives	Effluent Limits[1]	
	Concentrations (mg/L)	Average concentrations (mg/L)	Average loadings (kg/d)
$cBOD_5$	4	5	17.1
Total Suspended Solids	4	5	17.1
Total Phosphorus	0.12	0.25	0.86
NO3-N	—	—	—
Total Ammonia as N (Oct 1 – May 31)	0.5	0.8	2.7
Total Ammonia as N (June 1 to Sept 30)	2.0	2.4	8.2
E. coli[2]	100 organisms / 100 mL	—	—
pH[3]	—	6-9.5	

1 Based on weekly composite average, unless otherwise noted
2 Based on weekly grab sample
3 Based on weekly grab sample or probe measurement

Table 18: Future WPCP Effluent Objectives & Limits for a Maximum Discharge Rate of 5,100 m^3/day

Effluent Parameter	Effluent Objectives		Effluent Limits[1]	
	Concentrations (mg/L)	Loadings (kg/d)	Average concentrations (mg/L)	Average loadings (kg/d)
$cBOD_5$	4	20.40	5	25.50
Total Suspended Solids	4	20.40	5	25.50
Total Phosphorus	0.09	0.46	0.12	0.61
NO3-N	10	51	13	66.30
Total Ammonia as N (Oct 1 – May 31)	0.35	1.79	0.4	2.04
Total Ammonia as N (June 1 to Sept 30)	1.1	5.61	1.2	6.12
E. coli[2]	100 organisms / 100 mL	—	200 organisms / 100 mL	—
pH[3]	6.5-8.5		6-9	

1 Based on weekly composite average, unless otherwise noted
2 Based on weekly grab sample
3 Based on weekly grab sample or probe measurement

Due to the new compliance limit for NO3-N and lower compliance limit for total ammonia as nitrogen, additional treatment will need to be added to the WPCP. Currently, the NO3-N concentrations in the effluent range from 0-20 mg/L. The new effluent limits require the NO3-N concentration to be 10 mg/L (objective).

5.1.3. Sludge Production, Digestion and Storage

Increasing the WPCP effluent capacity from 3,420 m^3/day 5,100 m^3/day will result in increased sludge production and generation of biosolids. Inadequate storage and digestion capacity is partly responsible odour that has led to complaints from adjacent landowners. A detailed discussion of the estimated future sludge generation rate and the options for treatment and storage will be discussed in **Section 5.2.4**.

5.1.4. Other WPCP Improvements

In addition to the required increase in WPCP capacity, the plant operator has identified operational issues at the WPCP which could be addressed as a part of the expansion / upgrade. Additional deficiencies were also identified through an evaluation of each existing treatment process. These upgrade opportunities are as follows:

Inlet Works / Headworks

- Flowmeter on the incoming raw sewage line to be replaced.

Primary Treatment

- The WPCP does not have primary treatment.

Secondary Treatment

- There is no separate return sludge line for each aeration cell.
- There doesn't seem to be enough aeration provided to the aeration tanks and the main blower does not have a large operating range.
- Dissolved oxygen in the aeration tank is not being continuously recorded and controlled with SCADA.
- The clarifier mechanism is old, rusted, is frequently breaking and has obsolete parts.

Tertiary Treatment

- The effluent clarifier total suspended solid concentration is typically in the range of 15-20 mg/L in the winter. This causes an increased total suspended load on the tertiary filters.
- Provision for diverting flow from the filters to storm ponds would provide flexibility to the operators when the plant is struggling to meet the effluent water quality.
- Access to influent and effluent filter trough for maintenance and monitoring TSS is required.

Sludge Treatment

- Large amounts of decant water ends up at the biosolids storage tank resulting in the tank being fuller more quickly.
- Currently there is no aeration provided in the biosolids storage tank.

Stormwater Ponds

- Current operation of the stormwater holding ponds is partly responsible for odour that has led to complaints from adjacent landowners.

The items listed above will be considered in developing design concepts for upgrading the existing WPCP. There are other maintenance / repair / safety issues included that were provided by the plant operators, and these are included as part of **Appendix G**. Although these items will impact the cost of the WPCP upgrade, they will be required regardless of the design concept, and therefore do not affect the comparison of design concepts to determine a preferred design concept.

5.2. Identification of Alternative Design Concepts

To identify alternative design concepts, treatment processes of the existing WPCP were evaluated to determine options for upgrading each process to meet the WPCP upgrade design requirements described in **Section 5.1**. Only options that meet the design criteria, and that are technically and economically feasible are considered further in **Section 5.4**.

5.2.1. Inlet Works

The inlet works, or head works, is the initial area in the WPCP that receives the gravity fed sewage from the community's sanitary collection system.

5.2.1.1. Bar Screens

Raw sewage from the sanitary sewer system is received in a screen chamber. The WPCP has one (1) mechanically cleaned bar screen that can handle flows up to 13,000 m^3/day. The screen has a bar spacing of 19 mm and is installed in the screen channel to remove materials from the incoming wastewater. There is also a manually cleaned bar rack for emergency or maintenance bypass.

Based on operator feedback, it seems that the screen opening is larger than required which is causing rags to pass through and have negative impacts on the rest of plant process and equipment. Also, when the bar screen is down, the wastewater bypasses the mechanical screen and passes through the manual screen.

The rake arm of the mechanical bar screen has been repaired many times over the years due to alignment issues and was recently completely remade and seems to be operating fine since.

The following three (3) options were considered for mechanical bar screen upgrades at the WPCP:

- Option 1: Replace existing bar screen with a new bar screen capable of handling a flowrate of 15,300 m^3/day (Peak Factor 3). Use manual bar screen as back-up.
- Option 2: Keep the existing bar screen and add a new bar screen capable of handling the same flow as existing (13,000 m^3/day).
- Option 3: Replace existing bar screen with a new bar screen capable of handling a flowrate of 15,300 m^3/day and add new bar screen capable of handling the same flowrate.

Option 1 is based on a max day flow rate plus the equalization storage volume. With this option, there will be no redundancy when maintenance of the bar screen is required, and the manual screen will have to be used as back-up. Based on the limited information included in the as-built drawings, the existing manual bar screen may not have the capacity to handle the future peak flows. Moreover, the operator has also noted that the manual bar screen gets clogged within 20 minutes when the main bar screen is down. The bar screen chamber will need to be reconstructed to accommodate a larger manual bar screen. Additionally, maintenance of a manual bar screen is more labour intensive. Hence, option 1 is not preferred.

Option 2 will allow the operator to use the new bar screen as primary during average and max day flows. Both the bar screens can be utilized during peak flows and will be capable of handling peak flows up to 26,000 m^3/day. The old bar screen can be utilized during peak flow events. This will reduce dependence of the operator on the old bar screen. However, there will be no redundancy at peak flows.

The existing bar screen is quite old, and the parts are obsolete, making it difficult to get parts replaced when they break down. The existing bar screen also has larger openings which is causing rags to pass through. Hence, option 2 is not the preferred option.

Option 3 is the more expensive option out of the three (3) since it may require construction of an additional screen chamber and two (2) new bar screens. However, the second mechanical screen will provide redundancy at peak flow. If one (1) screen is offline for repair, the other screen could be used to avoid rags from passing through and affecting the vortex degritter performance downstream. Both the screens will have the same opening size.
Moreover, the MECP guidelines require that where two (2) or more screens are present, the capacity should be provided to treat peak flow with one (1) unit out of service. Therefore, based on the pros and cons of each option and discussions with the OCWA Operations group and MECP criteria, option 3 is the preferred option. Since the openings of the existing bar screen were considered too large, bar screens with 12 mm opening or 6 mm opening will be considered for the proposed new bar screens.

Table 19 below shows the existing bar screen specifications and the proposed bar screen design requirements:

Table 19: Bar Screen Design Parameters

Parameter	Existing Bar Screen Specifications	Proposed Bar Screen Design Requirements
Type	Mechanical Coarse Bar Screen	Mechanical Coarse Bar Screen
Number	1	2
Size	19 mm	6 mm or 12 mm
Capacity (each)	13,000 m^3/d	15,300 m^3/d
No. of Manual Bar Racks	1	0
Channel Width/Screen Width	600 mm/540 mm	To be specified by supplier
Channel Depth	3550 mm	3550 mm
Bar Width	40 X 6 flat bars	To be specified by supplier

Note: Existing Bar Screen Specification was obtained from the R. J. Burnside Design Brief Report for the Shelburne WPCP Upgrades and Re-rating project, May 2008, File No: MSO12871.2

5.2.1.2. Raw Sewage Pumps

The raw sewage is then conveyed to the sewage pumping chamber. The pumping station is comprised of one (1) wet well and two (2) submersible pumps (one (1) duty and one (1) standby), each with variable frequency drive (VFD) and rated at 34.4 to 103.3 L/s at 10.2 to 12.0 m total dynamic head (TDH). The raw sewage pumps, each have a peak flow capacity of 8,925 m^3/d. To meet the future daily max flow of 12,750 m^3/d, at least 3,825 m^3/d additional capacity is required.

Replacing two (2) submersible pumps (one (1) duty and one (1) standby) with larger capacity pumps is not the preferred option since the flow range from average day to max day will be quite large and could make pump selection difficult.

It is recommended to have two (2) duty and one (1) standby pump with VFD, each capable of pumping a flowrate of 6,375 m^3/d (74 L/s). This will allow the operator to use one (1) pump for ADF and two (2) pumps during MDF. The increased flow that will be received at the WPCP in future will reduce the emergency storage volume in the pump well. Hence, an expansion of the pump well will be required for more storage volume and an additional pump.

The pumping station also consists of two (2) storm pumps which convey peak flows to the storm holding ponds. One (1) of the pumps is rated at 81 L/s, 8.53 m TDH and the other pump is rated at 152 L/s, 16 m TDH. The stored peak flows are reintroduced to the raw sewage wet well during lower flow periods. The future use of these pumps, and evaluation of their capacity will depend on how future wet-weather flow is managed, which is discussed in the following section.

5.2.1.3. Wet-Weather Flow Management

Wet-weather flows can present challenges to wastewater treatment plants, not only due to the increase in flow rate that can exceed plant capacity, but also because biological treatment requires a certain concentration on pollutants to operate effectively.

The WPCP currently has stormwater ponds which were being used during periods of high hydraulic flow. The stormwater ponds have a capacity of 19,900 m^3 and 16,800 m^3. Under high flow conditions, operators would divert the additional volume of influent into these ponds for storage, where it is gradually sent back under lower hydraulic flow conditions to achieve a consistent average flow over an entire 24-hour period.

However, there is an odour issue associated with the storage of raw wastewater in the stormwater holding pond and there have been complaints from adjacent property owners.

Hence, it is proposed to store the excess wastewater is closed equalization tanks instead of ponds that are open to atmosphere.

Three (3) options could be considered for designing the equalization storage as mentioned below:

- Option 1: Continuing to use the storm holding ponds.
- Option 2: Design the equalization for a raw wastewater flow peak factor of 3 and a storage volume of 2,550 m^3 with one (1) tank.
- Option 3: Design the equalization for a raw wastewater flow peak factor of 3.5 and a storage volume of 5,100 m^3 with one (1) or two (2) tanks.

Considering one (1) of the reasons for installing a closed equalization tank with aeration is to eliminate odours experienced by residents living near the storm holding ponds, continued used of these ponds to store untreated wastewater is not considered to be a viable option and it is not considered further.

The frequency of flows above a peak factor of 3 is greatly reduced and was observed twice in 2016 and once in 2018. Flows above a peak factor of 3 were not observed in 2015, 2017 and 2019. Hence, the third option of designing the equalization storage at the WPCP for a peak factor of 3.5 is not considered economically feasible currently. Equalization could be designed for a peak factor of 3 and a storage volume of 2,550 m^3.
With the second option, if flows above a peak factor of 3 are received at the WPCP, the storage volume in one (1) of the storm ponds will need to be utilized as an emergency situation. Such a situation is anticipated to occur twice a year at maximum based on the historical data. Not only will the storage be utilized in an emergency situation, but the quantity of wastewater stored will be much less compared to the first option due to increased capacity of the WPCP and proposed equalization storage.

Also, additional equalization storage could be considered in the future to completely eliminate the usage of the storm ponds if increased frequency of peak flows is observed. Thus, designing an equalization tank for a storage volume of 2,550 m^3 (peak factor of 3) is considered the more preferred among all the three (3) options.

Two (2) additional options were looked at for equalization storage as mentioned below:

- Option 1: Installing a new above-ground equalization tank.
- Option 2: Installing a new below-ground equalization tank.

The installation of an above ground storage tank was selected as it was considered the more cost- effective option.

The existing storm pumps could be utilized to pump wastewater flows above max day flows to the equalization tank and storm pond (under emergency) if required. The condition of the pumps would need to be evaluated to see if they can be utilized in the future. For the purposes of this EA report, we have assumed new storm pumps to be installed.

The storm pond having a storage volume of 16,800 m^3 could be utilized for emergency storage of raw wastewater and the other pond could be used to store treated effluent post secondary treatment prior to discharge into the Besley Drain. Any connections between the two (2) ponds will need to be removed and it shall be ensured that mixing of raw sewage and treated wastewater shall not occur.

If in the future it is determined that the stormwater pond is not required for storage for raw wastewater due to it not being utilized or the addition of another equalization tank, both the ponds can be utilized for storage of treated effluent prior to discharge. This will provide flexibility to the operators when the plant is not able to meet effluent water quality.

5.2.1.4. Vortex Degritter

Grit removal is currently provided by a 2.1 m diameter vortex grit degritter, capable of handling a peak flow capacity of 8,790 m^3/day.

An additional vortex degritter will be required to be able to handle flows up to 12,750 m^3/d. Three (3) options that could be considered for the design of the new vortex degritter are as mentioned below:

- Option 1: Design the new vortex degritter for a capacity of 5,100 m^3/d.
- Option 2: Design the new vortex degritter for a capacity of 8,790 m^3/d (same as existing).
- Option 3: Design the new vortex degritter for a capacity of 12,750 m^3/d.

Option 1 will allow for 100% redundancy at average day flow but if the average day flow and max day flow increases in the future, a new vortex degritter will need to be installed for redundancy at ADF. Both the old and the new vortex degritters will need to be utilized at max day flow. This option has increased dependence on the old vortex degritter.

Option 2 will allow for 100% redundancy at average day flow and will also provide additional capacity in the case of future expansion. Both the old and the new vortex degritters will need to be utilized at max day flow.

Option 3 will allow the operator to use the new vortex degritter as primary during average and max day flows. The old vortex degritter will only be utilized when the new one is offline for maintenance or repair and will be used to treat average day wastewater flows. This will reduce dependence of the operator on the old vortex degritter. However, this option will be more expensive than the other two (2) options.

In speaking with OCWA Operations group, it was determined that option 3 is the preferred option since the existing vortex degritter is approximately 15 years old and requires frequent maintenance.

The new vortex degritter shall have similar design specifications as the existing equipment except that the operator prefers a vortex degritter without cover which is less labour intensive than a covered one.

5.2.1.5. Grit Channels / Fine Screens

The existing grit channels can be used to provide grit removal when the vortex degritter system is offline for servicing. However, when the degritter is operational, the grit channels do not provide any additional removal. Also, redundant vortex degritters are proposed as a part of the WPCP expansion. Hence, it is proposed to re-purpose the grit channels into fine screen chambers.

Two (2) options that were considered for the design of fine screens are mentioned below:

- Option 1: One (1) fine screen to handle max day flow of 12,750 m^3/day.
- Option 2: Two (2) fine screens to handle 50% of max day flow (6,375 m^3/day) at each screen.

With Option 1, based on the hydraulic calculations, the available side water depth (SWD) in the existing grit channels is not sufficient for the proposed fine screen and hence a new chamber would need to be constructed.

Hence it is preferred to retrofit the three (3) existing grit channels into two (2) fine screen chambers capable of handling 50% of the max day flow. This option would also provide redundancy at average day flow.

Different screen spacing depending on the type of secondary treatment system used by the WPCP, which is considered further in **Section 5.2.2**. was selected.

Perforated (fine) screens with 6 mm spacing are recommended downstream of the degritter for the extended aeration and IFAS secondary treatment options to block larger particles that pass through the bar screens.

For the MBR secondary treatment option, 1 mm perforated fine screens are preferred to prevent clogging of the membranes.

Since the grit channels are raised above ground, freezing issues could arise impeding the operation of the fine screen in winter. Hence, a potential cover for the grit channels should be considered during detailed design to reduce impacts of the weather on the operation of the fine screens in winter.

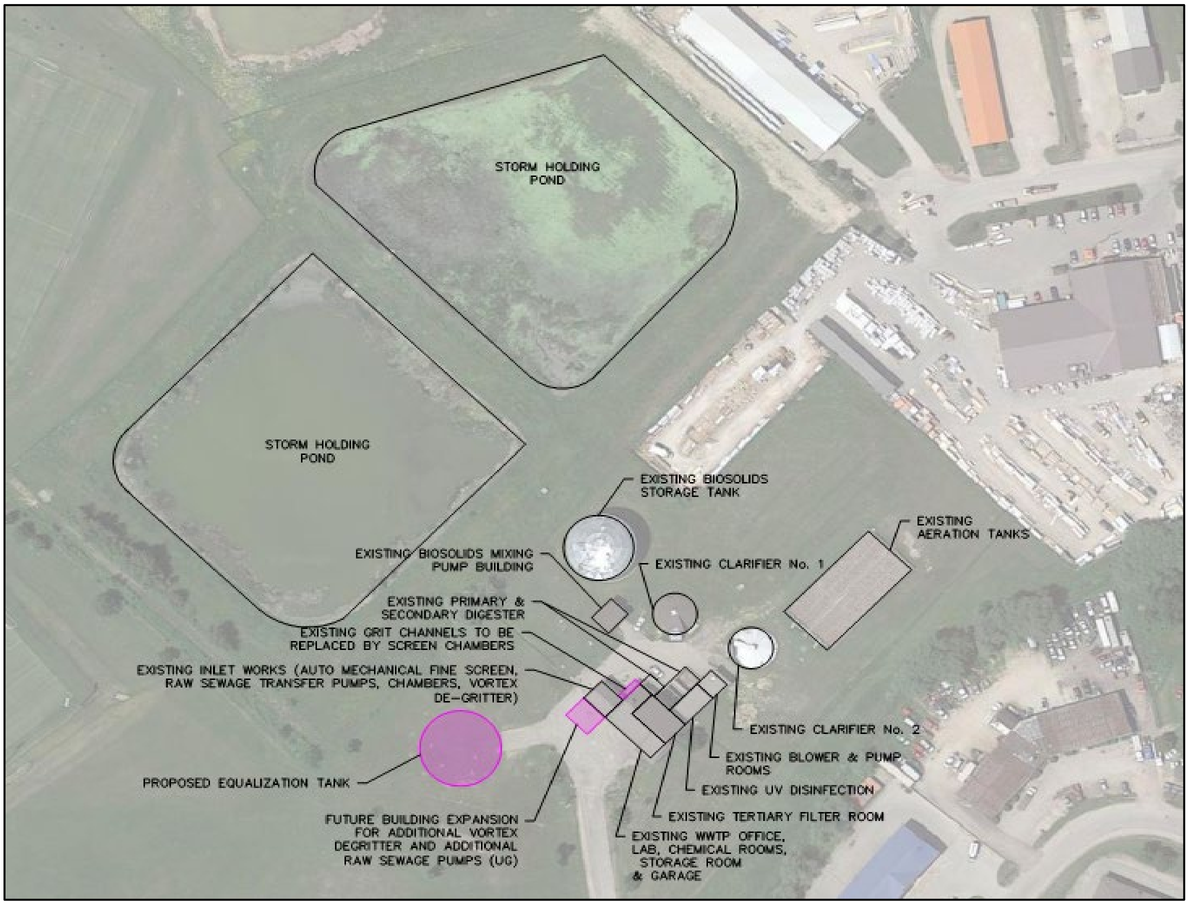
Table 20 below includes the design requirements for the proposed fine screen option:

Table 20: Fine Screen Design Requirements

Parameter	Existing Grit Channels	Fine Screen Design Requirements	
		Extended Aeration/IFAS	MBR
Chamber Dimensions			
Length (m)	5.7	5.7	5.7
Width (m)	0.6	0.6	0.6
Height (m)	1.0	1.0	1.0
No of chambers	3	2	2
Screen opening (mm)	Do not exist	6	1
No of Fine Screens	Do not exist	2	2
Flow through each screen (m^3/d)	Do not exist	6,375	6,375

A layout showing the proposed improvements for the inlet works is included in **Figure 18** below:

Figure 18: Proposed Future Improvements for Inlet Works



5.2.2. Secondary Treatment

Secondary treatment uses biological processes, typically in an aerobic habitat, to remove dissolved and suspended organic compounds from the process water. Typically, secondary treatment also includes additional settling using clarifiers. Clarifiers are settling tanks that remove settled solids from the bottom of the tanks using a mechanical scrapper mechanism. Additionally, particles that float to the surface form a "scum" that is removed by a rotating mechanical arm.

Existing secondary treatment at the WPCP will need to be expanded to meet the 5,100 m^3/day design requirement. Additionally, nitrification / denitrification processes will need to be added to meet effluent objectives and limits. Domestic wastewater contains ammonia and ammonium which must first be converted to nitrate under aerobic conditions before it can be converted to nitrogen gas under anoxic conditions. Nitrifying bacteria are utilized in the aerobic process to convert the ammonia into nitrates. Denitrifying bacteria utilize the biological oxygen demand (BOD) in the wastewater as a food source and convert nitrates into nitrogen gas.

In consideration of these design requirements, the following four (4) secondary treatment options were considered:

- Option A: Additional extended aeration capacity with nitrification / denitrification.
- Option B: Replacement of extended aeration using sequencing batch reactor (SBR) treatment with nitrification / denitrification.
- Option C: Replacement of extended aeration using membrane bioreactor (MBR) treatment with nitrification / denitrification.
- Option D: Replacement of extended aeration using Integrated Fixed-Film Activated Sludge (IFAS) treatment with nitrification / denitrification.

Each of these options are described further in the following sections.

Option A: Extended Aeration with Nitrification / Denitrification

Extended aeration is the process currently used at the WPCP, where following treatment in the headworks, the wastewater is pumped to open-air aeration chambers that have air diffusers installed at the bottom which inject air into the wastewater to facilitate biological treatment of the wastewater.

Extended aeration treatment with nitrification and denitrification has the following advantages and disadvantages:

Table 21: Advantages & Disadvantages of Extended Aeration with Nitrification / Denitrification

Advantages	Disadvantages
• Easier to operate • Known to current operator	• More space requirement • Higher capital cost • Uncertainty around being able to meet effluent water quality with this technology

The following upgrades will be required for this option:

- Two (2) additional aeration tanks each with a volume of 1,840 m^3 (40 m X 10 m X 4.6 m) with two (2) cells each will be required for aeration. Anoxic conditions would need to be maintained in a portion of the tanks for denitrification. Anoxic zones shall be created in the new tanks and the existing tanks shall be retrofitted with anoxic zones. These anoxic zones are anticipated to occupy not more than 25% of the total aeration tank volume. The actual volume requirement for the anoxic zones shall be determined using detailed calculations during the design phase.

Projected operational parameters of the aeration tank are presented in **Table 22** below:

Table 22: Aeration Tank Future Operational Parameters

Parameter	Design Requirement	Typical Design Guideline
Total Aeration Volume (m^3)	5,520	N/A
ADF (m^3/d)	5,100	N/A
Operating MLSS (mg/L)	3,536	3,000-5,000
Estimated MLVSS:MLSS ratio	0.65	N/A
HRT (hours)	27	15
F/M (kg BOD/Kg.MLVSS.d)	0.104	0.05-0.15
OLR (kg BOD/m^3.d)	0.24	0.17-0.24
RAS flow (m^3/d)	5,100	50%-200%
RAS SS (mg/L)	8,000-10,000	N/A
SRT (days)	10 (Note 1)	15

Note 1: SRT can be increased by increasing the recirculation rate.

- New blowers shall be designed such that either they have a large operating range or there would be one (1) blower dedicated to each of the four (4) cells. Existing blowers shall be assessed during detailed design to see if they can be utilized as standby blowers.
- The diffuser system in the existing aeration tanks was replaced recently in 2018. Hence modifying the existing diffuser system to provide air only to the aeration zone shall be considered during detailed design. If that is not possible new diffuser system shall be added to the aeration zone only.
- Depending on the size, one (1) or two (2) additional clarifiers will be required in addition to the two (2) existing clarifiers to be able to handle the future flows. In this EA, two (2) clarifiers of the same size as existing was considered for costing purposes. The mechanisms in the existing clarifiers would need to be replaced with newer mechanisms eliminating the square weir trough design. The feasibility of modifications to the existing clarifiers will need to be evaluated during detailed design if this secondary treatment option is selected.

The following design parameters were considered for the design of the new clarifiers:

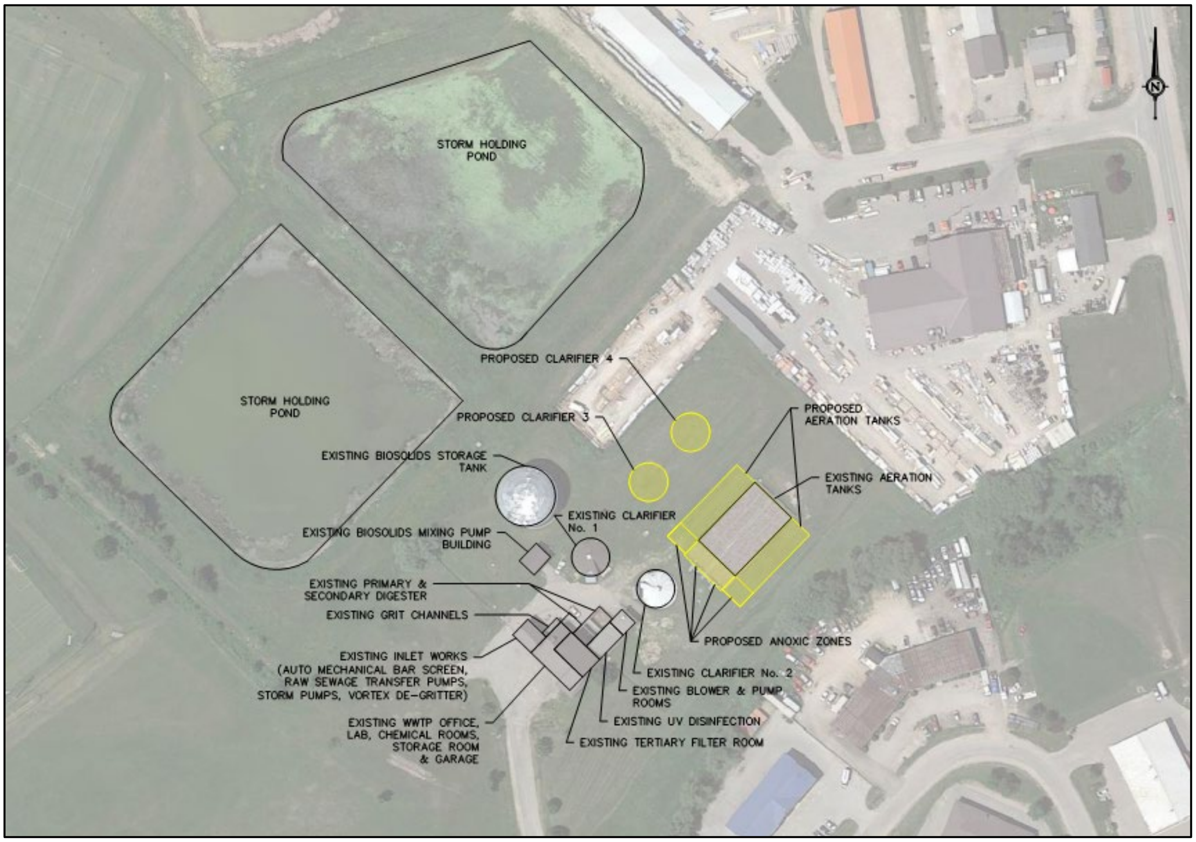
Table 23: Secondary Clarifier Design Parameters

Parameter	Design Parameters	Typical Design Guideline
# of New Secondary Clarifiers	2	N/A
# of Existing Clarifiers	2	N/A
Total # of Secondary Clarifiers	4	N/A
Total Clarifier Surface Area (m^2)	671	N/A
MDF (m^3/d)	12,750	N/A
Peak Daily SOR (m^3/m^2.d)	19	40
Max Daily SLR (kg/m^2.d)	122	170
Weir Loading (m^3/m.d)	<375	375

- A recycle stream from the clarifier will carry nitrates to the anoxic zone. Some of the sludge from the clarifier, Return Activated Sludge (RAS), is recycled back to the anoxic / aerobic tank and the other sludge, Waste Activated Sludge (WAS), is pumped directly to the sludge treatment system. Upgrades to the RAS/WAS pumping is required to ensure the pumps have the capability of pumping 50% to 200% of ADF. Four (4) pumps each pumping at 50% ADF can be utilized. The existing RAS pumps shall be assessed during detailed design to determine if they can be utilized as standby RAS and WAS pumps. New pumps were considered for costing purposes in this EA.
- Alum is added as coagulant to the effluent channel of the aeration tank to aid the settling of particulate phosphorus in the clarifier. To achieve further removal of phosphorus, tertiary filters will be utilized. Additional new alum dosing pumps and tanks shall be provided to meet the future design requirements.
- WAS pumps to pump the waste sludge to the thickener (if required, to be determined during detailed design if this option is selected).

A design of the site layout for the additional extended aeration with nitrification / denitrification design alternative is shown below in **Figure 19.**

Figure 19: WPCP Layout for Option A



Option B: Sequence Batch Reactor (SBR) with Nitrification/Denitrification

Aeration and clarification can be achieved using a single batch reactor using a time-controlled sequence. To optimize the performance of the system, two (2) or more batch reactors are used in a predetermined sequence of operations. This could result in lesser space requirement and lower capital costs. The performance of SBRs is typically comparable to conventional biological treatment systems.

SBRs have a higher level of maintenance (compared to conventional systems) associated with more sophisticated controls, automated switches, automated valves. Potential issues like plugging of aeration devices and discharging of sludge could arise if not operated correctly.

O&M costs associated with an SBR system may be like a conventional activated sludge system. Typical cost items associated with wastewater treatment systems include labor, overhead, supplies, maintenance, operating administration, utilities, chemicals, safety and training, laboratory testing, and solids handling. Labor and maintenance requirements may be reduced in SBRs because clarifiers, clarification equipment, and RAS pumps may not be necessary. On the other hand, the maintenance requirements for the automatic valves and switches that control sequencing may be more intensive than for a conventional biological treatment system.

SBR treatment with nitrification and denitrification has the following advantages and disadvantages.

Table 24: Advantages and Disadvantages of SBR Technology

Advantages	Disadvantages
• Less space requirement than extended aeration • Potential capital cost savings by eliminating clarifiers and other equipment. • Operating flexibility and control • No RAS pumps required	• Comparatively difficult to operate. • More automation is required compared to extended aeration. • Higher maintenance requirement compared to extended aeration. • Potential plugging of aeration devices during selected operating cycles • Potential discharging of floating or settled sludge during decant phase. • Potential requirement for equalization after the SBR

Since this option provides similar effluent water quality to the extended aeration option and is comparatively difficult to operate when compared to extended aeration, this option is not considered further. This technology was also not a preference for the WPCP operators.

Option C: MBR Treatment with Nitrification / Denitrification

Membrane biological reactors (MBRs) consists of a biological reactor (bioreactor) with suspended biomass and solids separation by microfiltration or ultrafiltration membranes. The membrane filtration system essentially replaces the solids separation function of secondary clarifiers and tertiary sand filters used in conventional biological treatment processes.

The membranes can be designed for and operated in small spaces and with high removal efficiency of contaminants such as nitrogen, phosphorus, bacteria, biochemical oxygen demand and total suspended solids. Membrane filtration allows a higher biomass concentration to be maintained, thereby allowing smaller bioreactors to be used.

MBRs operate at higher volumetric loading rates which results in lower hydraulic retention times, which result in a smaller space requirement. The effluent from MBRs contains low concentrations of biochemical oxygen demand (BOD), total suspended solids (TSS), bacteria and phosphorus. This facilitates higher level of disinfection and effluent can be readily discharged into surface streams. The high-quality effluent produced by MBRs makes them particularly applicable to surface water discharge applications requiring extensive nutrient (nitrogen and phosphorus) removal.

The primary disadvantage of MBR systems is typically higher capital and operating costs than conventional systems. O&M cost includes membrane cleaning and fouling control, and eventual membrane replacement. Energy costs are also higher because of the need for air scouring to control bacterial growth on the membranes.

Table 25: Advantages and Disadvantages of MBR with Nitrification/Denitrification

Advantages	Disadvantages
• Smaller space requirement • Better effluent quality • Ease of automation	• Higher maintenance requirement • Higher capital and operating cost

The bioreactor would consist of an anoxic and aerobic zone. The anoxic zone is designed for denitrification and the aerobic zone is designed for nitrification and BOD reduction.

The site layout for the MBR design alternative is shown below in **Figure 21**. An MBR supplier was contacted to provide conceptual level sizing for the WPCP expansion, and this formed the basis for costing this option. If this option is selected as part of the preferred design, the actual specifications may vary depending on the MBR supplier. Aeration and membrane tank requirements are summarized below in **Table 26** and **Table 27**.

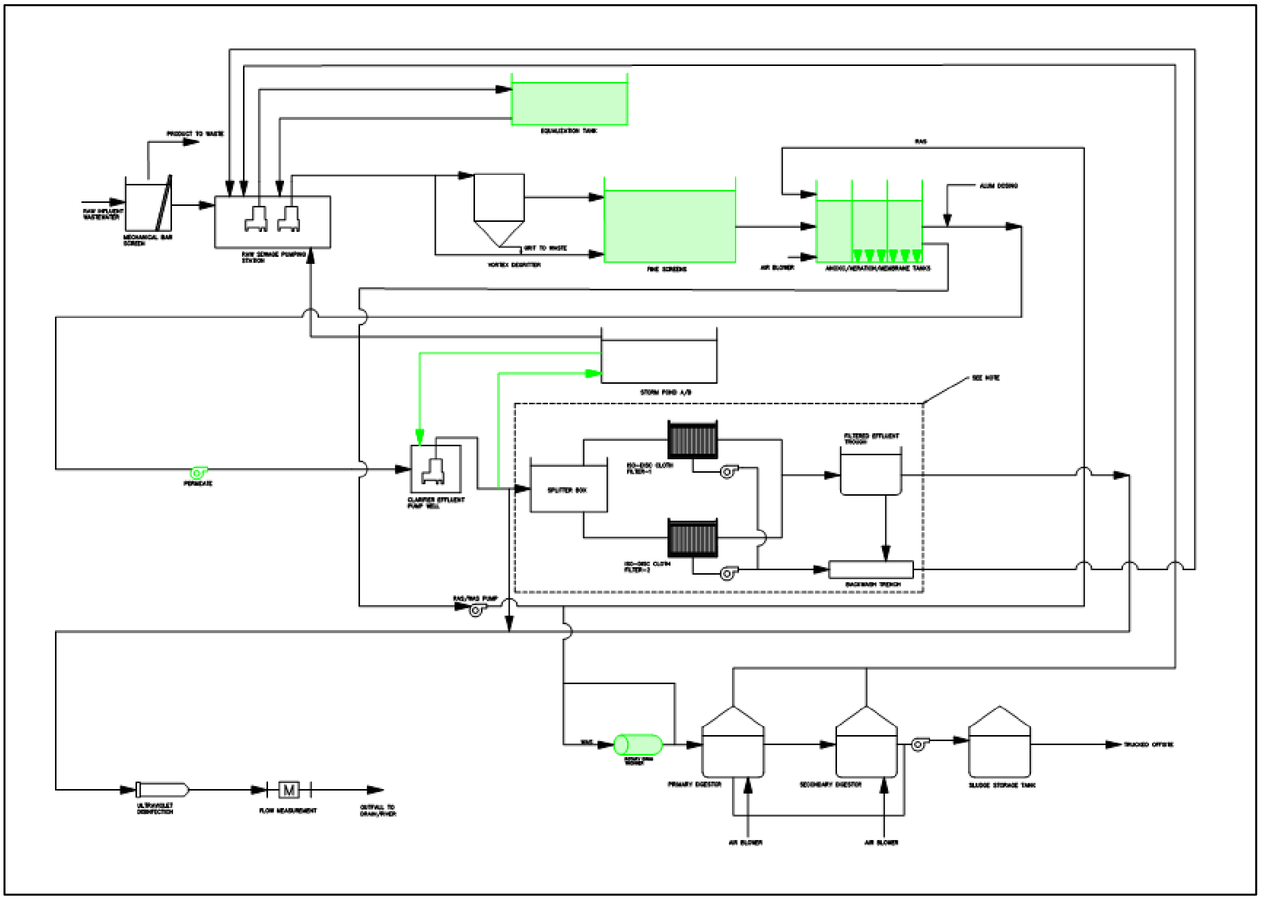
Table 26: MBR Aeration Tank Design Requirements

Parameter	Design Requirement	Typical Design Guideline
# Of New Aeration Tanks	0	N/A
Total Anoxic Tank Volume (m^3)	504	N/A
Total Aeration Volume (m^3)	2,876	N/A
ADF (m^3/d)	5,100	N/A
Operating MLSS (mg/L)	8,500-9,300	8,000-10,000
SRT (days)	16	>15

Table 27: Membrane Tank Design Requirements

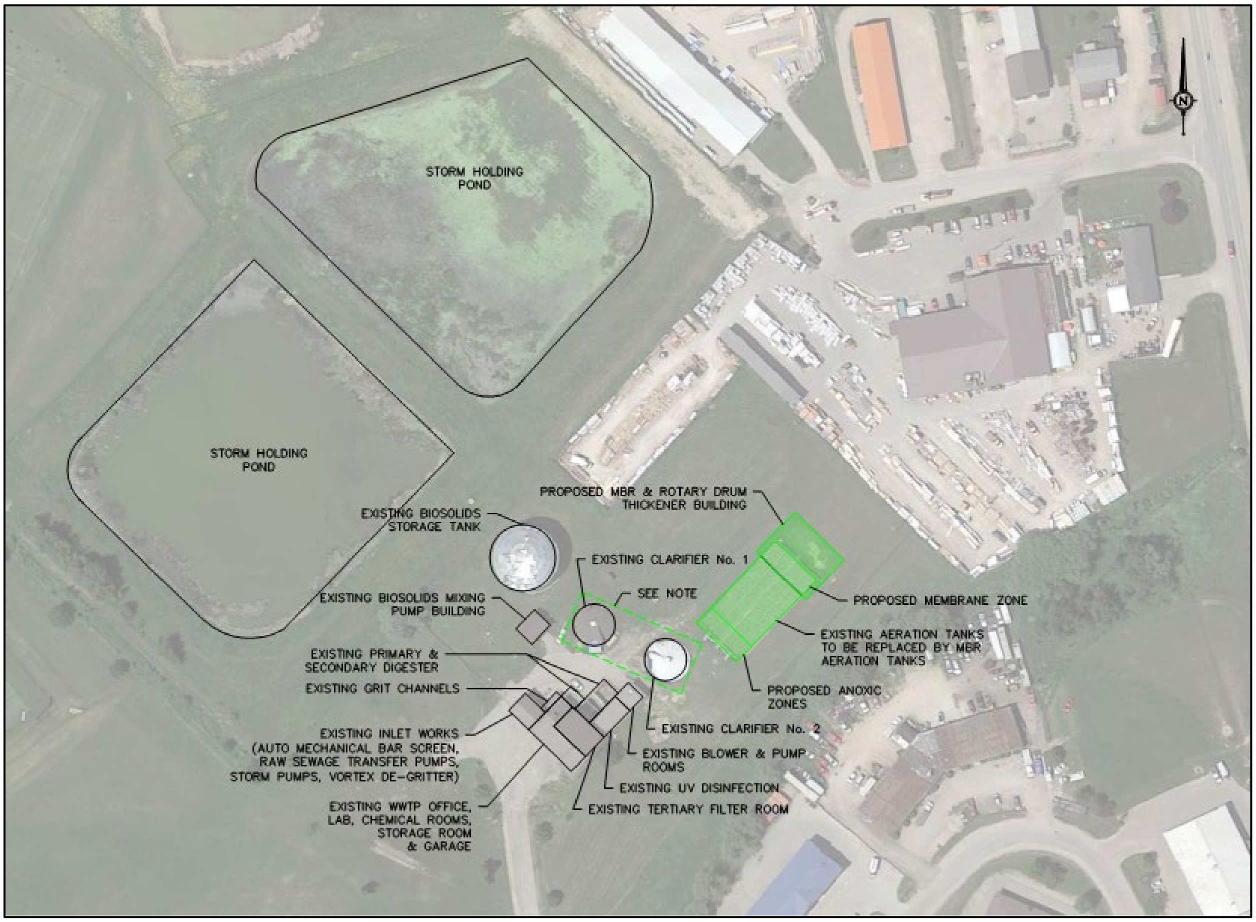
Parameter	Design Requirement	Typical Design Guideline
MMF	6,120	N/A
Peak flow through secondary treatment (m^3/d)	13,000	N/A
# Of Membrane Tanks	4	N/A
Total Membrane Tank Volume (m^3)	164	N/A
# Of Modules per Rack	12	N/A
# Of Racks per Tank	12	N/A
# Of Modules per Tank	144	N/A

Figure 20: Process Flow Diagram for Option C: Membrane Batch Reactor



Note: Existing tertiary filter system shall be removed.

Figure 21: WPCP Layout for Option C: Membrane Batch Reactor



Note: Clarifiers are not required for this option.

The following upgrades will be required for this option:

- The four (4) existing aeration cells could be modified and used as anoxic, aerobic and membrane tanks by dividing the tanks into three (3) sections with a building over the membrane section. It is preferred that the membrane section be covered for ease of performing maintenance on the membranes and to protect from harsh weather conditions. The other alternative is to utilize the existing aeration tanks as anoxic and aerobic tanks and the membranes can be installed as separate tanks located in an MBR building.
- Four (4) permeate pumps (three (3) duty + one (1) standby at ADF) to transfer the filtered water to the clarified effluent pump well.
- Two (2) new positive displacement aeration blowers (one (1) duty + one (1) standby) for aeration. The existing blowers will be assessed to determine if they can be utilized as standby blowers. If deemed suitable, the existing fine bubble diffuser system would be modified so that only the aeration zone was aerated.

- Four (4) new blowers (three (3) duty + one (1) standby at ADF) for membrane air scour.
- Four (4) mixed liquor RAS pumps (three (3) duty + one (1) standby at ADF) to transfer mixed liquor from the membrane tanks to the bioreactor.
- Sodium hypochlorite and citric acid membrane cleaning systems.
- Additional new alum dosing pumps and tanks shall be provided to meet the future design requirements.
- Waste activated sludge (WAS) pumps to pump the waste sludge to the thickener (if required, to be determined during detailed design).

With the MBR treatment alternative, clarifiers will no longer be required, and the clarifiers could be re-purposed as digestors or sludge storage tanks.

Option D: IFAS Treatment with Nitrification / Denitrification

Integrated Fixed-Film Activated Sludge (IFAS) is a hybrid process, which combines fixed-film and conventional suspended-growth activated sludge treatment process.

The difference between MBBR and IFAS is that MBBR does not incorporate a RAS and thus it is a pure fixed-film process. The IFAS process does have a return sludge and maintains mixed-liquor concentrations that are typical of a conventional activated sludge process.

The basic intent of the IFAS process typically is to provide additional biomass within the reactor volume of an activated sludge process, for the purpose of increasing the capacity of the system or upgrading its performance. Increased capacity is also possible because the clarifiers are not subjected to the increased mixed-liquor concentration, although there would be hydraulic limits to an increase in capacity. Thus, IFAS offers a practical and often cost-effective approach to upgrade treatment facilities that are located on tight sites and must improve their level of performance.

Table 28: Advantages and Disadvantages of IFAS with Nitrification / Denitrification

Advantages	Disadvantages
• Lesser space requirement than extended aeration. • Improved settling characteristics compared to extended aeration. • Lower capital cost compared to extended aeration and lower operating cost compared MBR.	• Additional operating appurtenances. • Existing clarifiers cannot be eliminated and will be hydraulically limited. New clarifiers will be required. • Uncertainty around being able to meet effluent water quality with this technology. • Technology not known to operator.

The site layout for the IFAS design alternative is shown below in **Figure 22**. A supplier was contacted to provide conceptual level sizing for the WPCP expansion, and this formed the basis for costing this option. If this option is selected as part of the preferred design, the actual specifications may vary depending on the supplier. Aeration tank and clarifier requirements are summarized below in **Table 29** and **Table 30**.

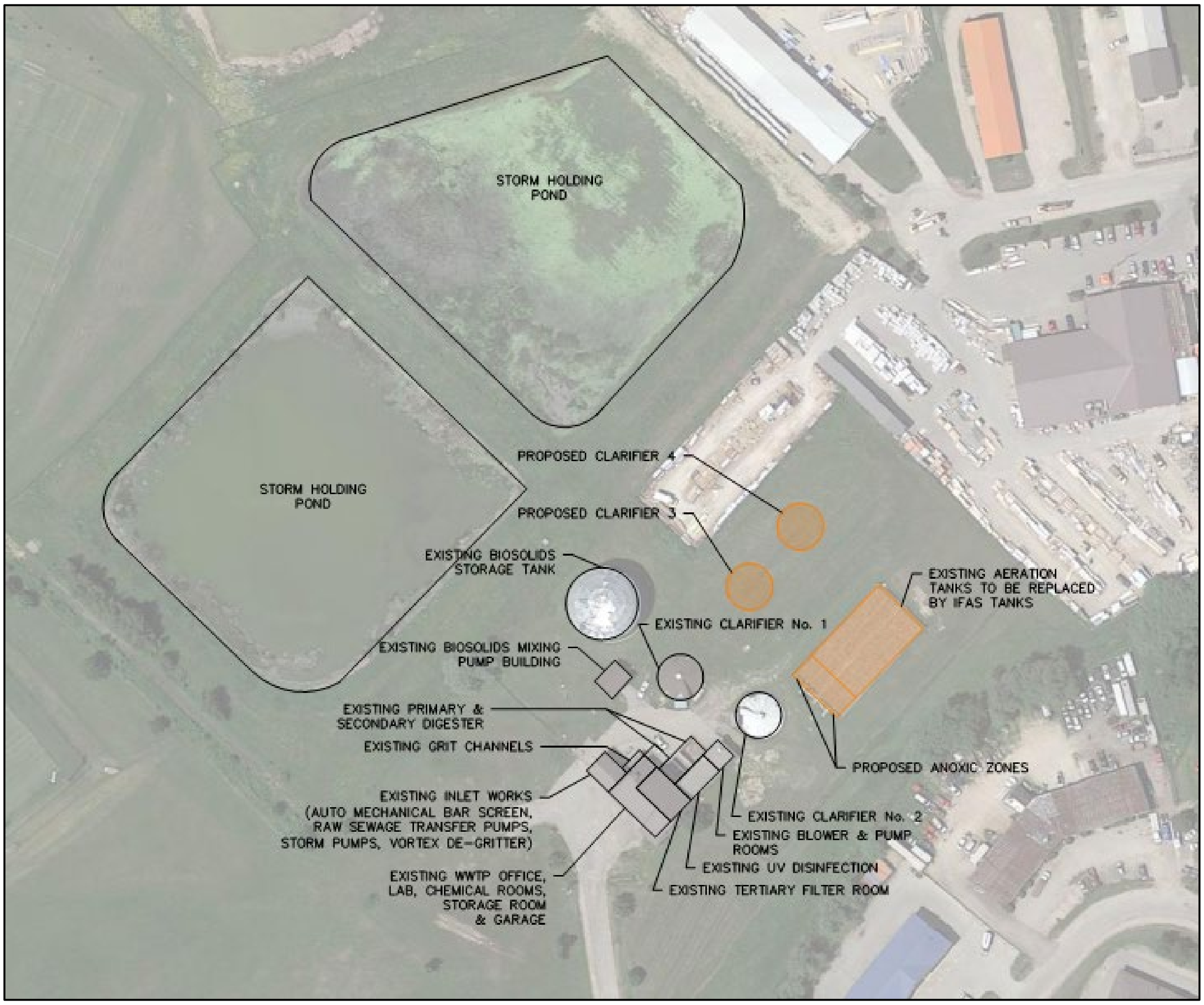
Table 29: IFAS Aeration Tank Design Requirements

Parameter	Design Requirement	Typical Design Guideline
# Of New Aeration Tanks	0	N/A
Total Anoxic Tank Volume (m^3)	736	N/A
Total Aeration Volume (m^3)	2,994	N/A
ADF (m^3/d)	5,100	N/A
Operating MLSS (mg/L)	2,900-3,700	3000-5000
SRT (days)	6.8	6

Table 30: Clarifier Design Requirements

Parameter	Design Requirement	Typical Design Guideline
# Of New Secondary Clarifiers	2	N/A
# Of Existing Clarifiers	2	N/A
Total # of Secondary Clarifiers	4	N/A
Total Clarifier Surface Area (m^2)	671	N/A
MDF (m^3/d)	12,750	N/A
Peak Daily SOR (m^3/m^2.d)	19	40
Max Daily SLR (kg/m^2.d)	122	170

Figure 22: WPCP Layout for Option D: IFAS with Nitrification/Denitrification



The following upgrades will be required for this option:

- New blowers shall be designed such that either they have a large operating range or there would be one (1) blower dedicated to each of the four (4) tanks. Existing blowers shall be assessed during detailed design to see if they can be utilized as standby blowers.
- Modifications or replacement of air diffusers to provide air to aeration tank only may be required.
- One (1) or two (2) additional clarifiers may be required in addition to the two (2) existing clarifiers to be able to handle the future flows. For costing purposes, two (2) additional clarifiers were considered. Like the extended aeration option, the mechanisms in the existing clarifiers would need to be replaced with newer mechanisms eliminating the square weir trough design. The feasibility of modifications to the existing clarifiers shall be evaluated during detailed design.
- Some of the sludge from the clarifier RAS will be recycled back to the anoxic / aerobic tank and the other sludge (Waste Activated Sludge – WAS) is pumped directly to the sludge treatment

system. Like the extended aeration treatment option, upgrades to the RAS/WAS pumping are required to ensure the pumps have the capability of pumping 50% to 200% of ADF. Four (4) pumps each pumping at 50% ADF can be utilized. The existing RAS pumps shall be assessed during detailed design to see if they can be utilized as standby RAS and WAS pumps. For the purposes of the EA Report all new duty pumps and blowers were considered.

- Additional new alum dosing pumps and tanks shall be provided to meet the future design requirements.
- Waste activated sludge (WAS) pumps to pump the waste sludge to the thickener (if required, to be determined during detailed design).

5.2.3. Tertiary Treatment

Currently at the WPCP, the effluent from the clarifiers flows by gravity to a clarifier effluent pump well and is pumped from the well to the tertiary filters. The clarifier effluent pump well location is not ideal due to its proximity to the digestors and the raw sewage pumping wet well.

New location for the digestors is proposed as a part of the upgrades at the WPCP and are discussed in detail in **Section 5.2.4** below for all the three (3) secondary treatment options. The existing digestors could be used for sludge storage in the future. Once this is confirmed during detailed design and the based on the selected secondary treatment option, the requirement for the effluent wet well shall be evaluated and designed accordingly.

For costing purposes in the EA, a new below ground 50 m^3 effluent wet well was considered for all the three (3) secondary treatment options.

Tertiary Filtration

Currently, there are two (2) Alfa Laval Iso-Disc Cloth Filters at the WPCP, each rated for an average daily flow of 4,400 m^3/d and a peak design flow of 13,000 m^3/d. These filters are designed to treat the load of influent water quality parameters shown in **Table 31** and were commissioned in 2016.

Table 31: Design Loads for WPCP Tertiary Cloth Filters

Parameter	Daily load	Design Average Monthly Effluent (Concentration)
BOD5	17.6 kg/d	4 mg/L
TSS	17.6 kg/d	4 mg/L
TP	0.4 kg/d	0.09 mg/L
TAN – Summer	2.2 kg/d	0.5 mg/L
TAN – Winter	8.8 kg/d	2 mg/L
E Coli		100 E Coli organisms/100 ml

Since these filters are just about seven (7) years old, for the extended aeration technology (Option A) and IFAS (Option D), the existing Iso-Disc Cloth filters would be utilized for treatment. However, the increased loadings in the future could impact effluent water quality produced from the filters.

For the MBR technology (Option C), the existing Iso-Disc Cloth filters would not be required since the treated water produced from membranes along with disinfection would be able to meet the required effluent standards. Hence, the filters could be removed.

UV Disinfection

The existing UV system is a Trojan UV 3000 unit installed in an 8 m long X 610 mm wide X 1,067 mm deep channel with two (2) banks. The equipment supplier mentioned that this system was retired by Trojan in 2014 and a retirement bulletin was sent to all the UV 3000 customers. Trojan now provides modernized offerings which would be considered as part of the upgrade. The design requirements for UV disinfection required for extended aeration (Option A), MBR (Option C) and IFAS (Option D) are considered the same for the purpose of the EA and are summarized below in **Table 32**.

Table 32: UV System Design Requirements

Parameter	UV System Design Specifications
Model	UV3000Plus or approved equivalent
# of UV Trains	One (1) duty + one (1) standby
Chamber Dimensions (m)	8 X 0.61 X 1.067
Average Flow (m^3/d)	5,100
Peak Flow (m^3/d)	12,750
UV Transmittance	65%
UV Dose	35,000 $\mu Ws/cm^2$
Disinfection Limit	100 EColi/100 ml

A UV3000Plus system is recommended by the supplier over a UV3000B since the later would require channel modifications, with no additional benefit.

While performing the MBR Pilot study, the E. Coli concentration was measured in the MBR effluent. The E. Coli concentration was noted to be below 5 cfu/100 ml for the duration of the test. Hence, there is a possibility that disinfection may not be required post MBR treatment. Thus, the requirement of the UV system shall be evaluated further during detailed design if the MBR secondary treatment option is selected for treatment.

Parshall Flume

The existing parshall flume is an open channel flow metering device that is rated for a flow of 21,588 m^3/day, hence the unit should be capable of handling future maximum daily flows. No additional options for effluent measurement were considered.

5.2.4. Waste Sludge Management

Design raw waste sludge generation rates were developed based on the design raw wastewater loadings presented in **Table 33**. A typical WAS generation rate of 0.85 grams of Volatile Suspended Solid per gram of Carbonaceous Biochemical Oxygen Demand (cBOD)and a typical Volatile Suspended Solid to Total Suspended Solid (TSS) ratio of 0.65 was assumed for sludge generation from the extended aeration process. These rates were based on historical data from 2006-2007 included in the R. J. Burnside Shelburne Wastewater Treatment Plant Upgrades and Re-rating report prepared in 2008.

Design raw waste sludge generation rates, at a future design ADF of 5,100 m^3/d are presented in **Table 33** below. WAS generation rates will be confirmed during detailed design.

The sludge estimated to be produced in the next 20-years is around 394 m^3/d at a maximum.

The estimated sludge is based on the extended aeration process. For the IFAS and the MBR secondary treatment options, the estimated sludge provided by the technology suppliers was used. The quantity of sludge estimated for the IFAS and MBR option was approximately 20% lower than the extended aeration option.

Table 33: Design Raw Waste Sludge Generation Rates

Parameter	Future Design Values	Historical Recorded Value (5-year average)
Influent BOD Loading (kg/d)	1,290	-
Influent TSS Loading (kg/d)	2,098	-
BOD Sludge (kg/d)	1,653	-
TSS Sludge (kg/d)	1,188	-
Alum Sludge (kg/d)	315	-
Total Sludge (kg/d)	3,155	-
% TS	0.8	-
Total Sludge (m^3/d)	394	99.27

Note: Historical 5-year average is based on daily sludge flow data recorded by the plant operator.

Sludge Thickening

To reduce the quantity of sludge being treated in the aerobic digestors, a thickener could be used to reduce the moisture content. The options considered for sludge thickening at the Shelburne WPCP are Gravity Thickening with Polymer Addition, Gravity Belt Thickeners and Rotating Drum Thickeners.

Gravity Thickening with Polymer Addition

Gravity thickening is like sedimentation in a conventional clarifier. Dilute sludge is dosed with polymer and fed to a central well in a gravity thickening tank where it is allowed to settle and compact. Supernatant is drawn off the top and thickened sludge is pumped from the bottom of the unit. Gravity thickening can achieve concentrations of 2-4% for both raw and digested WAS.

The advantages and disadvantages of the gravity thickening option are mentioned in **Table 34** below.

Table 34: Advantages and Disadvantages of Gravity Thickening

Advantages	Disadvantages
• Easy to operate • Low power requirement	• Odor potential • Less thickening of sludge • Polymer is required for effective operation. • Higher space requirement

Gravity Belt Thickeners

With gravity belt thickeners (GBT), polymer conditioned sludge is distributed evenly across the width of a moving fabric belt. Free water drains through the belt, while suspended solids are retained on the surface. Plough blades ride on the belt surface and turn the sludge to release additional water. A high-pressure wash is used to clean polymer and suspended solids from the pores of the fabric belt. Filtrate is collected and returned to the head of the plant. A sludge concentration of 4-9% can be achieved when thickening raw WAS, and 4-6% when thickening digested WAS.

The advantages and disadvantages of the Gravity Belt Thickener option are mentioned in **Table 35** below.

Table 35: Advantages and Disadvantages of Gravity Belt Thickeners

Advantages	Disadvantages
• More thickening of sludge • Low space requirement • Low power requirement • Low maintenance requirement • High operating flexibility	• Odour potential • Higher operation requirements • Polymer is required for effective operation

<u>Rotating Drum Thickeners</u>

With rotating drum thickeners (RDT), polymer conditioned sludge is fed into one end and is distributed onto the internal surface of a rotating drum screen. Flocculated sludge solids are retained on the inner surface, while free water drains through the screen. Filtrate is collected in a trough and is returned to the head of the plant, or to the secondary plant. Sludge solids are conveyed towards the outlet end of the drum by flights or an internal screw conveyor. The inside and outside drum surfaces are periodically rinsed to flush trapped solids from the screen. Like gravity belt thickener, sludge concentrations of 4-9% can be achieved when thickening raw WAS, and 4-6% when thickening digested WAS.

The advantages and disadvantages of the Rotating Drum Thickener option are mentioned in **Table 36** below.

Table 36: Advantages and Disadvantages of Rotating Drum Thickeners

Advantages	Disadvantages
• More thickening of sludge • Low space requirement • Low power requirement • Low maintenance requirement • High operating flexibility • Lower odour potential	• Higher operation requirements • Polymer is required for effective operation

Since the RDT can thicken the WAS up to 4-6%, has lower potential for odour issues and has a lower space requirement it is considered as the preferred option for sludge thickening.

Prior to thickening the WAS in Rotating Drum Thickeners, polymer is added to enhance the thickening process and improve performance.

The RDT system will be made up of the following components:

- Two (2) 50% thickener units
- One (1) flocculation tank
- Polymer dosing system

Two (2) thickeners designed for half the sludge flow rate can be designed for operational flexibility. The thickener shall be installed in a closed room to protect from harsh weather conditions. The thickener design requirements are summarized below in **Table 37**.

Table 37: Design Requirements (Maximum) for a Thickener

Parameter	Design Values	Typical Design Guideline
# of Thickeners	2 @ 50%	N/A
Sludge Rate per Thickener (kg/d)	1,578	N/A
Sludge flow rate per Thickener (m^3/d)	197	
% TS Thickener Outlet	4	4-5
Sludge Flow Rate to Digestors (m^3/d)	63	N/A

The thickener system will be located next to the biosolids storage tank for the extended aeration option (Option A) and the IFAS secondary treatment option (Option D). For the MBR option (Option C), the thickener system can be placed above ground in the MBR building.

<u>Sludge Stabilization</u>

There are a number of sludge stabilization alternatives available including aerobic digestion, anaerobic digestion, lime stabilization, composting and pelletization.

Anaerobic digestion has a high capital cost and is rarely, if ever used for small or medium wastewater treatment plants.

Lime stabilization could potentially be used however there are certain disadvantages associated with this technology which include high odour potential and difficulties with storage of dewatered, lime stabilized, sludge cake.

Composting is capital intensive and has a high odour potential. Moreover, the current compost guidelines are very restrictive and hence this option is not preferred.

Pelletization is very capital intensive and best suited for large wastewater treatment plants.

Aerobic digestion is recommended because it is suitable for small / medium sized wastewater treatment plants and require less maintenance and operator attention than other technologies. This option also offers an operational advantage since the plant staff is very familiar with the operation of this technology. Currently, aerobic digestors are being utilized for sludge stabilization at the WPCP. Sludge thickening prior to treatment in digestors is proposed for the future. This will reduce the volume of sludge to be treated in the digestors in the future and thus reduce the space requirement and capital cost.

Thickened WAS from the RDT will be discharged to a hopper and then flow by gravity to the proposed aerobic digestors.

The existing digestors on site have a storage volume of 480 m^3 and 170 m^3 respectively, are undersized for future sludge flow and are proposed to be decommissioned and utilized for additional sludge storage if required in the future. The location of the existing primary and secondary digestors restricts the possibility of expansion of the basins due to the proximity of other plant piping, access road and headworks building on the different sides of the digestor tank. Hence, new locations for the digestors are recommended for each of the secondary treatment options.

Table 38 presents the tankage requirement for the aerobic digestion process for the extended aeration, IFAS and MBR options.

Table 38: Design Requirements for Primary and Secondary Digester

Parameter	Design Requirements Extended Aeration/IFAS/MBR	Typical Design Guideline
Existing Digestor Volume (m^3)		
Primary	480	-
Secondary	170	-
Total	650	-
Existing Digestor SRT (d)	12	-
Estimated WAS Flow (m^3/d)	63	-
Digestor Volume Required (m^3)		
Primary	824	-
Secondary	364	-
Total	1188	-
Digester SRT (d)	35	-
Total SRT (d) (including biological treatment)	45	45

From the table above, the existing primary and secondary digestors have an SRT of 12-days and hence are undersized for the stabilization of the current as well as future WAS. The required primary and secondary aerobic digestor volume for future WAS is greater than one and a half times the current digestor volumes.

The future primary and secondary aerobic digestor design will provide an SRT of 45-days in total including the SRT in the aeration tank.

For the extended aeration option (Option A) and IFAS option (Option D), the digestors are proposed to be installed next to the biosolids storage tank as shown in **Figure 23**. The digestor blowers and sludge transfer pumps are proposed to be in the thickener building.

For the MBR option (Option C), the digestors are proposed to be located next to the MBR building at northeast side of the plant as shown **Figure 24.** The digestor blowers and sludge transfer pumps are proposed to be in the MBR building. New pumps and blowers are considered for the digestors for costing purposes. Existing pumps and blowers shall be assessed during detailed design to see if they can be utilized as standby.

Below ground construction for digestors is preferred to minimize freezing issues during winter.

Biosolids Storage Tank

The existing biosolids storage tank has a volume of 4433 m^3. Per the O. Reg. 267/03, a minimum of 240-days of biosolids storage is required and can be a combination of a permanent biosolids nutrient storage facility, a temporary field nutrient storage site (dewatered municipal sewage biosolids only) or a combination of such facilities and sites that can store generated sewage biosolids during a period of at least 240-days.

Table 39 presents the tankage requirements to provide 240-days of storage of future biosolids produced at the WPCP.

A layout showing the proposed improvements for sludge treatment for Option A and Option D, as well as Option C is included in **Figure 23** and **Figure 24** below, respectively.

Figure 23: Proposed Future Improvements for Sludge Treatment (Option A and D)

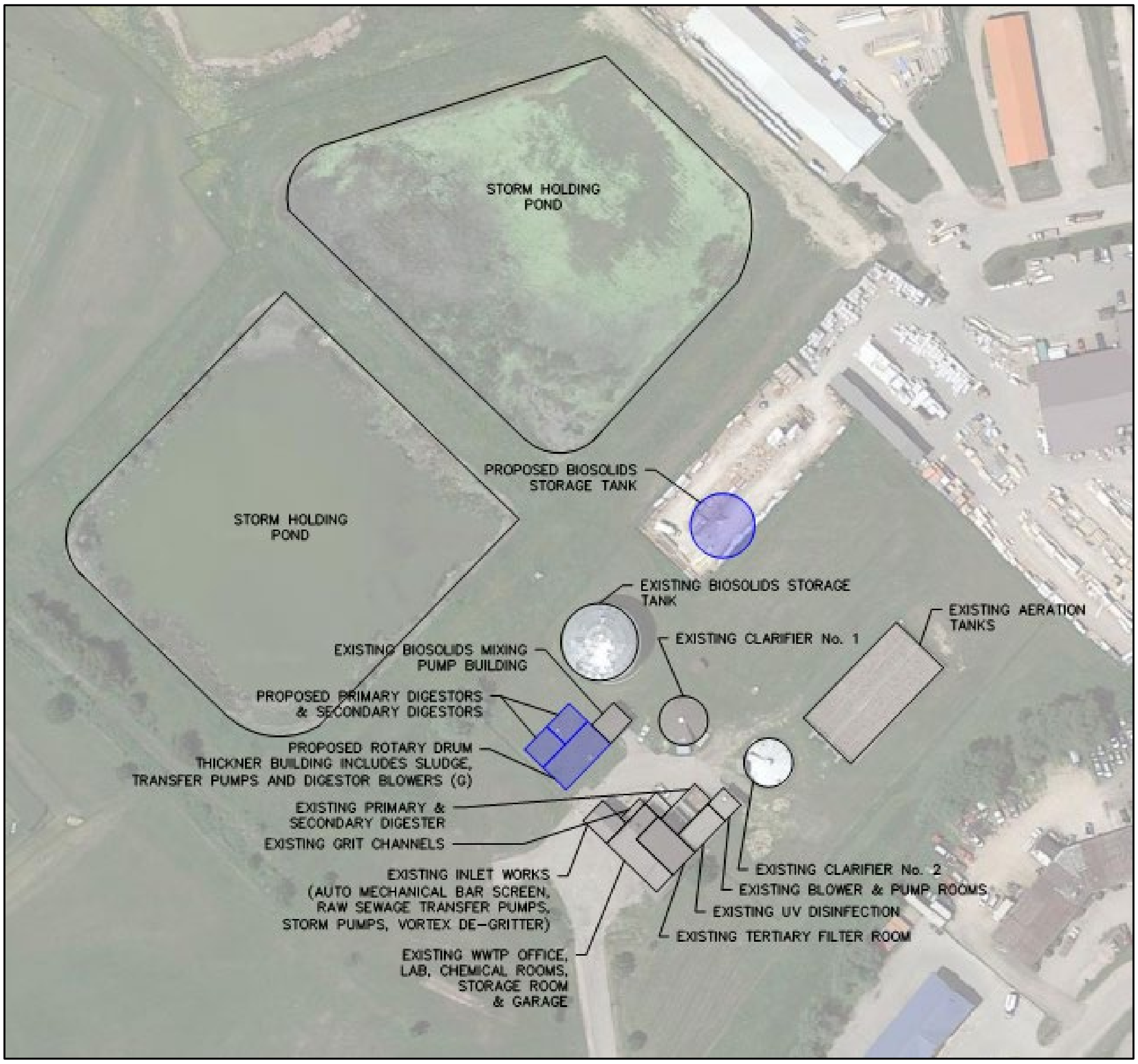


Figure 24: Proposed Future Improvements for Sludge Treatment (Option C)

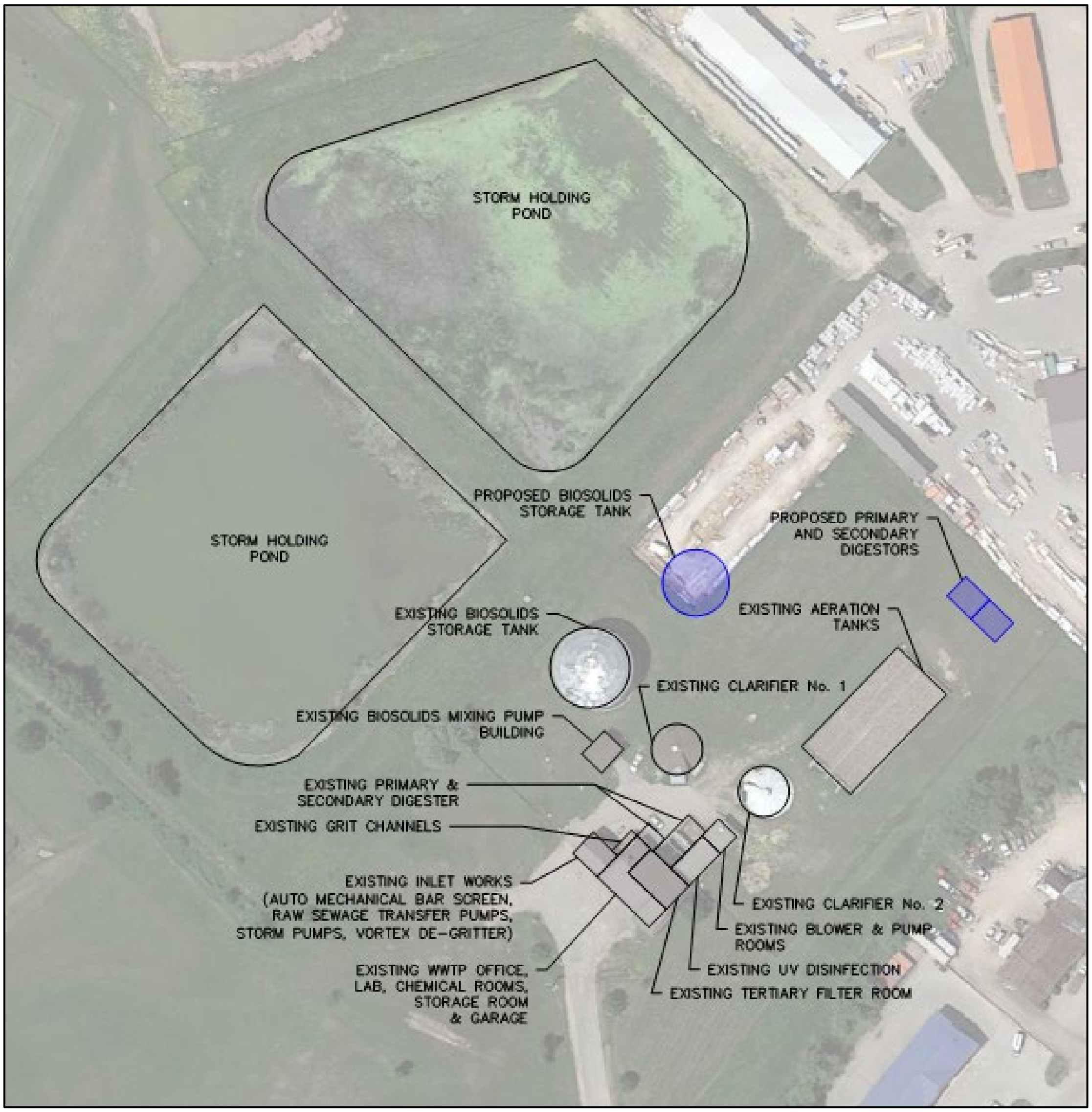


Table 39: Design Requirements for Biosolids Storage Tank

Parameter	Future Design Requirements Extended Aeration/IFAS/MBR	Typical Design Guideline
Average Biosolids Generation (m^3/d)	34	N/A
Total Storage Required (m^3)	8094	N/A
Total Existing Storage (m^3)	4433	N/A
Total Additional Storage Required (m^3)	3661	N/A
Total Additional Storage Proposed (m^3)	4433	N/A
HRT (days)	263	240

An additional biosolids storage tank of the same size as existing is proposed to provide additional storage to meet the 240-storage requirement for all the three (3) secondary treatment options.

5.3. Detailed Design Environmental Inventory

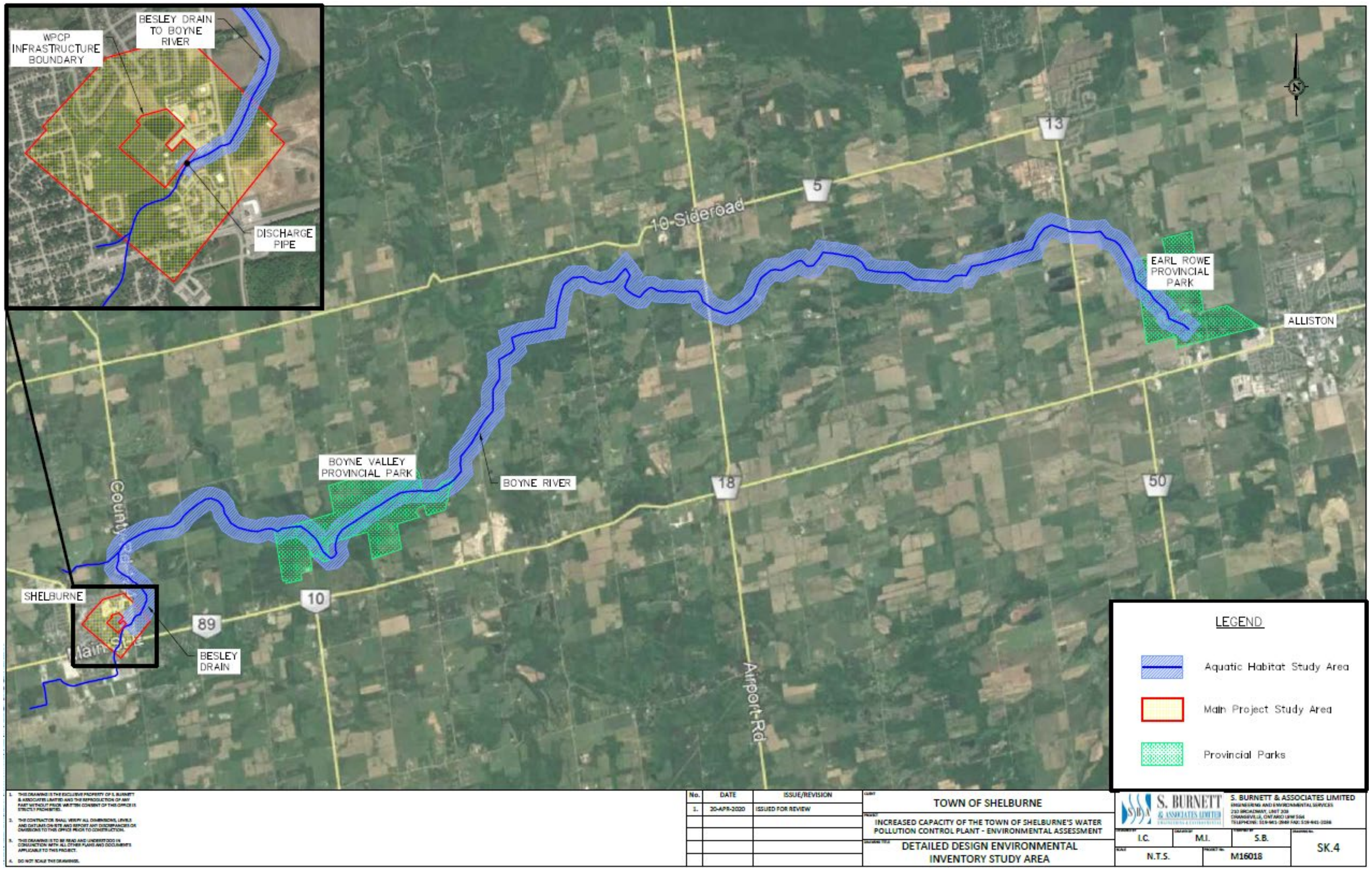
The following inventory of environmental features will be used to assess the impacts associated with each of the alternative design concepts, which will be used in the evaluation of alternative design concepts. A study area was determined based on the possible environmental effects from the different design concepts. As shown, in **Figure 25**, the Study Area includes the WPCP property and a 300-metre buffer. The Aquatic Habitat Study Area begins 10 m upstream of the Besley Drain / Boyne River confluence, includes the Besley Drain and extends approximately 32 km downstream of the Besley Drain / Boyne River to the Environment Canada Water Monitoring Station at Earl Rowe Park near Alliston. The Study Area includes a 10 m section of the Boyne River above the Besley Drain confluence to establish background parameter concentrations and flow rates. The effluent discharged from the WPCP contributes to 82% of the flow rate of the Besley Drain and therefore dilution in this drain is considered negligible.

5.3.1. General Environmental Context

The Town is located within Ecodistrict 6E-5 (Mount Forest). The Mount Forest Ecodistrict is characterized by a gently rolling topography with deep, calcareous, fine-textured morainal material overlying Paleozoic bedrock (Webster, Henson, Crins, Uhlig, & Gray, 2018).

Settlement and associated infrastructure accounts for approximately 1% percent of the Ecodistrict and includes the communities of Hanover, Listowel, Walkerton, Mount Forest, and Shelburne. Agriculture, business and industry, hydroelectric and wind power generation, aggregate and petroleum extraction, and services associated with resource-based activities occur throughout the Ecodistrict (Webster, Henson, Crins, Uhlig, & Gray, 2018).

Figure 25: Detailed Design Environmental Inventory Study Area



5.3.2. WPCP and 120 m Buffer

5.3.2.1. Terrestrial Habitat

The WPCP property is not considered to have any significant terrestrial habitat. The property is heavily disturbed, contains no natural vegetation and the areas surrounding the WPCP structures is landscaped grass. Therefore, the construction, operation and decommissioning of the alternative design solutions will not result in impacts to terrestrial habitat.

5.3.2.2. Species at Risk

The Natural Heritage Information Centre (NHIC) database was searched to identify species at risk that are potentially present at the property and the Study Area. The NHIC search results showed that the bobolink (*Dolichonyx oryzivorus*) and eastern meadowlark have previously been identified within 2 km^2 of the property. The bobolink is a threatened bird species that forages and nests in meadows and hayfields (Ministry of the Environment Conservation and Parks, 2014a). The eastern meadowlark (*Sturnella magna*) is a threatened bird species that lives in grasslands, pastures, and hayfields (Ministry of the Environment Conservation and Parks, 2014b). Both species are threatened by habitat loss, lack of suitable habitat and farming practices (Ministry of the Environment Conservation and Parks, 2014a) (Ministry of the Environment Conservation and Parks, 2014b). The preferred habitat of these species at risk is not present on the WPCP property and it is unlikely that these species would be found on the property. Moreover, the property has been described as highly disturbed, with landscaped areas within an urbanized area. Therefore, the presence of species at risk and species at risk habitat is not a concern for the WPCP property.

5.3.2.3. Archaeological Resources

Due to the disturbed nature of the site, no archaeological sites are anticipated to occur on, or within 300 m of the WPCP site. This was confirmed by the Ministry of Heritage, Sports, Tourism, and Culture Industries (now the Ministry of Citizenship and Multiculturalism (MCM). confirmed by email on April 20, 2020 (**Appendix F**). Additionally, the Criteria for Evaluating Archaeological Potential - A Checklist for the Non-Specialist Form was completed and is provided in **Appendix F**.

5.3.2.4. Zoning and Adjacent Land Uses

Several primarily automotive businesses are located to the south and southeast of the WPCP. Within the same "employment" zoned area, a home hardware is located to the east / northeast. Greenwood Park is located to the west / northwest of the WPCP in a "Open Space Recreational" zoned area. The park includes soccer fields, a basketball court, BMX park, ice rink in winter months, children's recreation area, and indoor washrooms. Residential areas are located to the west and north of the WPCP on Rintoul Crescent and Morden Drive.

Residents have complained of odours emanating attributed to the WPCP, with complaints being reported to at least one (1) of the Canadian Broadcasting Corporation, Orangeville Banner, the Record, Bayshore Broadcasting, and Orangeville today in September 2016, March 2017, April, May, and June 2019.

5.3.3. Aquatic Habitat

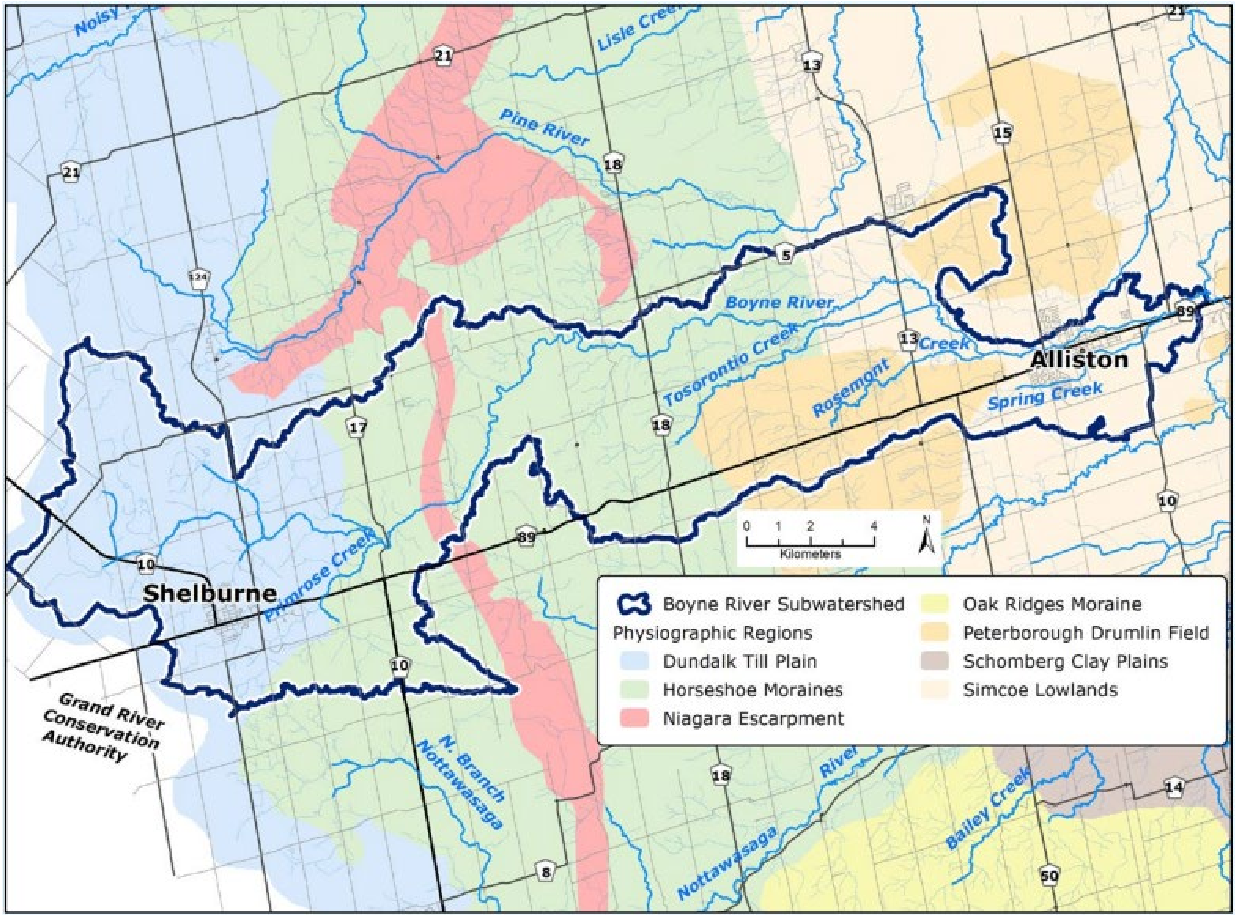
The Aquatic Habitat portion of the Study Area is located within the Boyne River sub watershed, which is managed by the Nottawasaga Valley Conversation Authority. The WPCP outfall discharges to the Besley Drain, which travels generally to the north for approximately 2 km prior to its confluence with the Boyne River, as shown in **Figure 26**.

Figure 26: WPCP Discharge to the Besley Drain

The Boyne River, a cold-water habitat, begins as a series of tributaries from headwater wetlands northwest of Shelburne. Many of the stream sections between wetlands have been altered to drain agricultural lands and in doing so has introduced agriculture runoffs to these streams. These tributaries flow eastward through a gently rolling headwater landscape, joining to form the main branch of the Boyne River northeast of Shelburne (Nottawasaga Conservation Authority, 2018). After its confluence with the Besley Drain, the Boyne River meanders in a generally easterly direction. Along this 9 km-stretch, the Boyne River passes through the Boyne River Wetland Complex, a provincially significant wetland, and several unevaluated wetlands.

Figure 27: Photograph of the Boyne River Looking West from its Confluence with the Besley Drain

Figure 28: Map of the Boyne River Sub Watershed (Nottawasaga Conservation Authority, 2018)



Approximately 23% of the Boyne River Sub watershed has forest cover, compared to 33% for the NVCA Watershed, and accordingly the NVCA characterizes it as a disturbed environment (Nottawasaga Conservation Authority, 2018). According to Environment and Climate Change Canada, 30% forest cover is needed to support healthy wildlife habitat (Environmental Commissioner of Ontario, 2018). The Boyne River Sub watershed also has levels of forest interior cover and riparian habitat that are below those of the NVCA Watershed and are characterized as highly disturbed and disturbed, respectively.

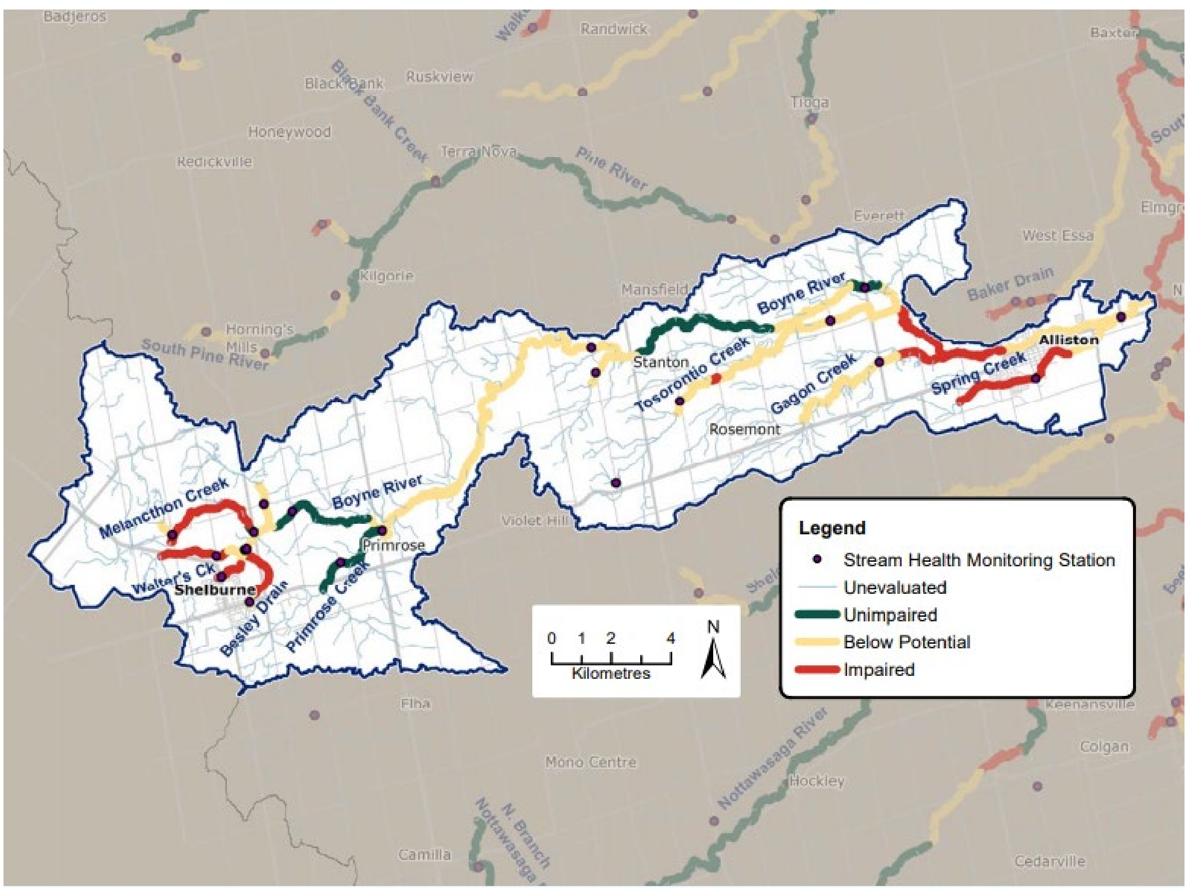
As shown below in **Figure 29,** the NVCA has evaluated the Besley Drain as "impaired". Immediately upstream of the confluence of Besley Drain with the Boyne River has a substrate comprised of sand, cobble, and gravel, which is in a meadow marsh wetland habitat, dominated by tall forb and grass species (WSP, 2016).

Before the Boyne River's confluence with the Besley Drain, it's health ranges from "impaired" to "below potential as it moves through farm fields, online ponds, and wetlands. Riparian vegetation is limited, and agricultural drainage impacts stream health through these headwaters. Through Shelburne, urban impacts from stormwater ponds and discharge from the WPCP result in lower water quality (Nottawasaga Conservation Authority, 2018).

Just before its confluence with the Besley Drain, the Boyne River has a sand and cobble substrate located within the same meadow marsh wetland habitat, as shown in **Figure 27** (WSP, 2016).

After the confluence, NVCA considers it "below potential for a short distance, before it becomes "unimpaired" for approximately 3 km. From this point to Alliston, river health is predominantly "below potential" with two (2) "unimpaired" sections and one (1) "impaired" section (Nottawasaga Conservation Authority, 2018). In this section, the Boyne River increases in size and possesses a well-defined riffle-pool structure with a sand and gravel structure. Although channel degradation and undercutting and algae levels are less than upstream of the confluence, they continue to impact the benthic community (Nottawasaga Valley Conservation Authority, 2012).

Figure 29: River Health in the Boyne River Sub Watershed (Nottawasaga Conservation Authority, 2018)



The flow rate just before the Boyne River / Besley Drain is shown in **Table 40** for 2014 to 2015. Winter months where the river was frozen are not shown.

Table 40: Rate of Flow along the Boyne River from 2014 to 2015 (WSP, 2016)

Station	Flow Rate (m^3/s)									
	Aug-14	Sep-14	Oct-14	Nov-14	Apr-15	May-15	Jun-16	Aug-15	Sep-15	Average
Boyne/Besley Confluence	1.80	2.00	1.68	2.41	3.89	1.21	3.33	1.76	0.83	0.67

5.4. Evaluation of Alternative Design Concepts

Each of the secondary treatment alternative design concepts presented in **Section 5.2** were evaluated in terms of the following considerations:

- Technical:
  - Process complexity
  - Ease of construction
  - Reliability
- Environmental:
  - Ability to meet effluent quality requirements
- Economic:
  - Capital Cost
  - O&M costs
  - Lifecycle net present value
- Social:
  - Impacts to adjacent residents
  - Impacts to adjacent business

As with the evaluation of alternative design concept, each category of considerations received equal weighting. For each relative criteria category (i.e., technical), evaluation criteria were selected, of which the most important evaluation criteria was selected. Criteria Importance was then assigned as follows:

- 5 – Is the most important criteria or is equally important
- 2 – Is slightly less important than the most important criteria
- 1 – Is significantly less important than the most important criteria

These numbers were then totaled and used to create a Relative Criteria Weighting for each criterion by dividing the Criteria Importance by the Total Criteria Importance and multiplying by the Criteria Category Total.

Each alternative design concept is then given a score for each criterion according to the following scoring scheme:

- 1 – Is the best design concept in terms of the criterion or is equal
- 0.5 – Is the second-best option or equal
- 0 – Is the least preferred option

For the "Economic Evaluation Category", the lowest cost estimate received a "1" score, and the most expensive option was scored as a "0". Alternative Solutions within 30% of the lowest and highest scores received the same scores, respectively. All other costs received a score of "0.5".

The score is multiplied by the Relative Criteria Weighting and summed to Total Score for each alternative design concept.

Based on the identification of secondary alternative design concepts, as outlined in **Section 5.2**, the following sections will evaluate design alternatives for secondary treatment options.

5.4.1. Secondary Treatment

The identified secondary alternative design concepts, as outlined in **Section 5.2**, included the following:

- Option A: Additional extended aeration capacity with nitrification / denitrification
- Option C: Replacement of extended aeration using membrane batch reactor (MBR) treatment with nitrification / denitrification
- Option D: Replacement of extended aeration using Integrated Fixed-Film Activated Sludge (IFAS) treatment with nitrification / denitrification

Option B Replacement of extended aeration using sequencing batch reactor (SBR) treatment with nitrification / denitrification, was previously removed from further consideration in **Section 5.2.2**.

5.4.1.1. Technical Assessment

Alternative design concepts were evaluated in terms of technical criteria to consider technical suitability and other engineering considerations. This can be seen in **Table 41** below.

Table 41: Technical Criteria Scoring for Main Treatment Technologies

Criteria	Criterial Importance (0-low, 2 med, 5 high)	Relative Criteria Weighting	Alternative Design Concept Scores		
			Extended Aeration	MBR	IFAS
Maintenance requirements	5	5%	1 (5%) Requires only regular maintenance of equipment (tanks, pumps, blowers etc.).	0.5 (2.5%) In addition to regular maintenance of equipment, membranes will require cleaning and maintenance.	1 (5%) Requires only regular maintenance of equipment (tanks, pumps, blowers etc.).
Ease of construction	5	5%	0 (0%) More tankage – additional aeration tanks, clarifiers.	1 (5%) Less tankage – No additional aeration tanks and clarifiers required. Existing aeration tanks will be re-purposed as anoxic, aeration and membrane tanks.	0.5 (2.5%) Less tankage requirement than extended aeration. Additional clarifier will be required. Existing aeration tanks will be re-purposed as anoxic and IFAS aeration tanks.
Operator familiarity with technology	5	5%	1 (5%) Current technology used for biological treatment at WPCP. Operator is	0.5 (2.5 %) A pilot project was conducted on site to familiarize the operator with this technology.	0.5 (2.5%) No familiarity with technology. A pilot can be conducted if this option is deemed suitable.

			familiar with technology.		
Ease of maintaining operation during construction	5	5%	1 (5%) Existing two (2) tanks (four (4) cells) can be used when the new tanks are being built.	0.5 (2.5%) Requires retrofitting existing tanks. Only one (1) tank (two (2) cells) can be used while retrofitting.	0.5 (2.5%) Requires retrofitting existing tanks. Only one (1) tank (two (2) cells) can be used while retrofitting.
Space requirement / future expansion	5	5%	0 (0%) Additional aeration tanks and clarifiers are required.	1 (5%) No additional aeration tanks and clarifiers required. Least space requirement.	0.5 (2.5%) Additional clarifier will be required. More space requirement than MBR.
Technical Totals	**25**	**25%**	**15%**	**17.5%**	**15%**

Based on the evaluation of technical criteria, the option of MBR is the preferred main treatment technology. Extended Aeration is the less desirable option from a technical consideration.

5.4.1.2. Environmental Assessment

Alternative design concepts were evaluated in terms of environmental criteria to determine if one of the alternatives would provide more reliability in terms of meeting effluent quality requirements.

Table 42: Environmental Criteria Scoring for Main Treatment Technologies

Criteria	Criterial Importance (0-low, 2 med, 5 high)	Relative Criteria Weighting	Alternative Solution Scores		
			Extended Aeration	MBR	IFAS
Ability to meet effluent quality requirements	5	25%	0.5 (12.5%) There is uncertainty around being able to meet effluent criteria. Dependant on performance of tertiary filter to meet effluent quality.	1 (25%) Meets effluent criteria based on pilot. No dependence on performance of tertiary filter to meet effluent quality.	0.5 (12.5%) There is uncertainty around being able to meet effluent criteria. Dependant on the performance of tertiary filter to meet effluent quality.
Environmental Totals	**5**	**25%**	**12.5%**	**25%**	**12.5%**

Based on the evaluation of environmental criteria, the option of MBR is the preferred main treatment technology. Extended Aeration and IFAS are the less desirable option from an environmental consideration.

5.4.1.3. Economic Assessment

Table 43: Economic Criteria Scoring for Main Treatment Technologies

Criteria	Criterial Importance (0-low, 2 med, 5 high)	Relative Criteria Weighting	Alternative Design Concept Scores		
			Extended Aeration	MBR	IFAS
Capital Cost*	5	10.4%	0 (0%) $46 million including engineering and contingency	1 (10.4%) $33 million including engineering and contingency	1 (10.4%) $38 million including engineering and contingency
O&M Costs	2	4.2%	1 (4.2%) $1.58 million/year	1 (4.2%) $1.85 million/year	1 (4.2%) $1.62 million/year
Lifecycle Net Present Value	5	10.4%	1 (10.4%) $79 million	1 (10.4%) $71.5 million	1 (10.4%) $72 million
Economic Totals	**12**	**25%**	**14.6%**	**25%**	**25%**

*Capital cost estimates are 2022 estimates. A 5% increase in capital cost estimates is anticipated for all the three options for 2023. The 2023 capital cost estimate for the MBR option is in the $36,000,000 range.

Based on the evaluation of economic criteria, the option of MBR and IFAS are comparable and preferred treatment technology. Extended Aeration is the less desirable option from an economic consideration.

5.4.1.4. Social Assessment

Table 44: Social Criteria Scoring for Main Treatment Technologies

Criteria	Criterial Importance (0-low, 2 med, 5 high)	Relative Criteria Weighting	Alternative Design Concept Scores		
			Extended Aeration	MBR	IFAS
Impacts to adjacent residents	5	12.5%	1 (12.5%) Option addresses previously identified odour concerns.	1 (12.5%) Option addresses previously identified odour concerns.	1 (12.5%) Option addresses previously identified odour concerns.
Impacts to adjacent business	5	12.5%	1 (12.5%) Option addresses previously identified odour concerns.	1 (12.5%) Option addresses previously identified odour concerns.	1 (12.5%) Option addresses previously identified odour concerns.
Social Totals	**10**	**25%**	**25%**	**25%**	**25%**

Based on the evaluation of social criteria, all three (3) options are comparable.

5.5. Summary of Preferred Alternatives

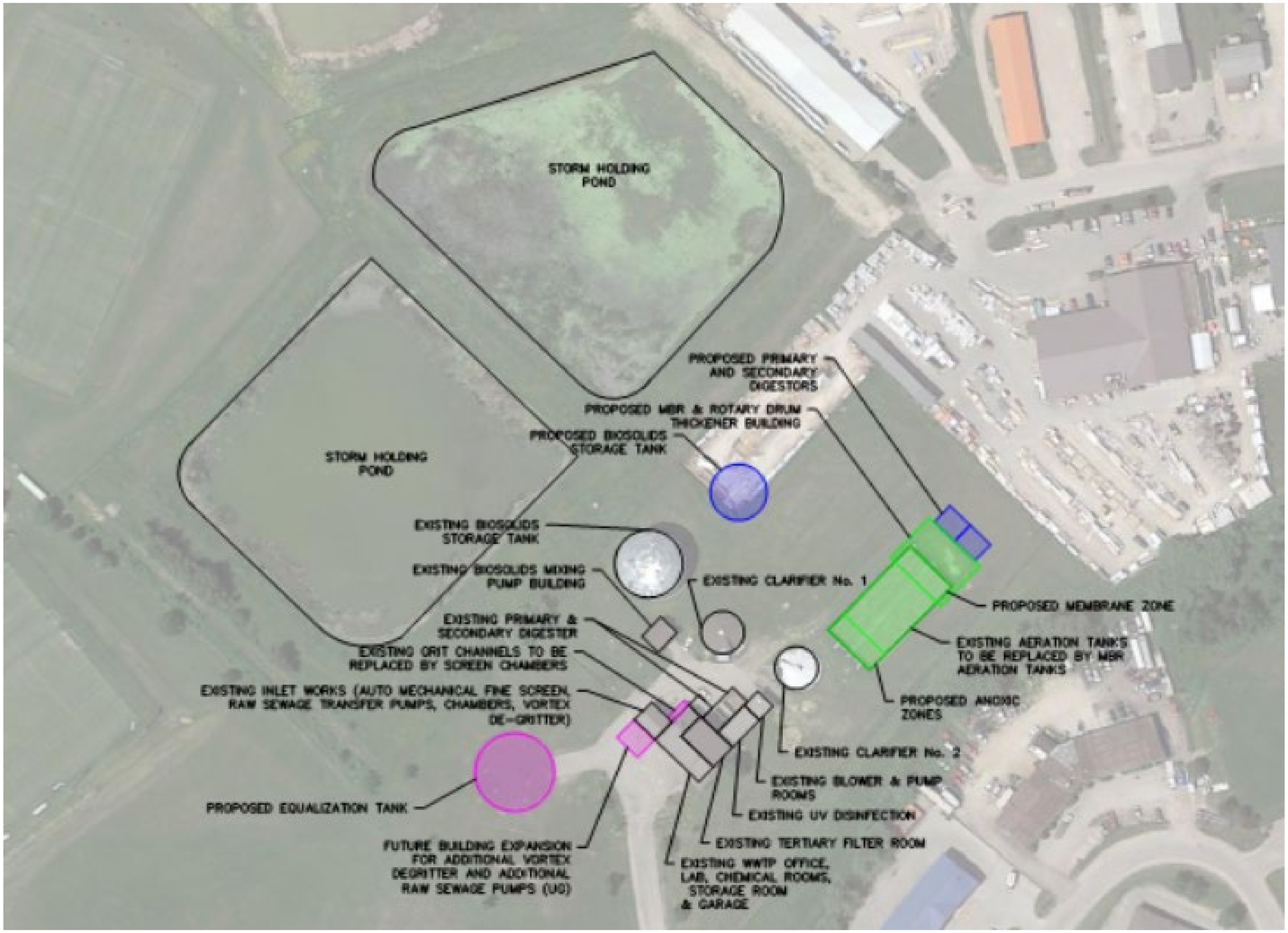
The recommended alternative designs that form the preferred solution are summarized in **Table 45** below.

Table 45: Summary of Preferred Design Alternative

Process	Preferred Option
Bar Screen	Two (2) bar screens capable of handling a flowrate of 15,300 m^3/d each
Raw Sewage Pumping	Three (3) New Pumps (two (2) duty + one (1) standby with VFD, 6,375 m^3/d each)
Wet Weather Management	Equalization based on peak factor of 3 and 2,550 m^3 storage
Vortex Degritter	New Degritter – 12,750 m^3/d capacity
Primary Treatment/Fine Screen	Two (2) Fine Screens – 6,375 m^3/day each
Secondary Treatment	MBR with nitrification/denitrification
Tertiary Treatment	New UV System
Sludge Thickening	Rotating Drum Thickener
Sludge Digestion	Aerobic Digestion
Sludge Storage	Additional Sludge Storage Tank
Storm Ponds	Will be utilized mainly as effluent storage ponds. One (1) of the ponds can be utilized for emergency raw sewage storage.

Figure 30 below shows a preliminary site layout of the recommended design concept.

Figure 30: Layout of Recommended Design Concept



5.6. Primary Treatment Discussion

Primary treatment is not being proposed as part of the WPCP upgrades as the preliminary treatment processes (i.e., bar screens, vortex degritter and fine screens) will be able to sufficiently treat the wastewater prior to entering the proposed MBR (secondary treatment) system. SBA has already worked with the selected MBR supplier on a pilot system which confirmed that the current upstream treatment processes (i.e., bar screens and vortex degritter) along with 2 mm fine screens will be sufficient for proper secondary treatment using their proposed system at the design flow rates. This is in accordance with page 10-5 of the *Design Guidelines for Sewage Works*, where it is noted that "*fine screens should not be considered equivalent to primary sedimentation but may be used in lieu of primary sedimentation where subsequent treatment units are designed on the basis of anticipated screen performance*" (MECP, 2008).

Furthermore, SBA has confirmed with Ontario Clean Water Agency (OCWA) operators that the total suspended solids (TSS) concentrations do not decrease noticeably when wastewater that is held in the storm ponds is added to the system which may be indicative of settling of solids in the storm ponds and the ponds acting as primary clarifiers. Typically, the wastewater is sent to the ponds in fall / spring and brought back during summer / winter. The reasons for having the flow diverted to the ponds are mainly rain, snow melts, maintenance of certain equipment at the plant and if there are any operational issues at the plant. The raw wastewater sample is collected from one (1), out of the three (3), grit channels. The raw wastewater TSS data from 2018-2023 is included below in **Table 41**.

Table 46: Raw Wastewater TSS Concentration (mg/L)

2018		2019		2020		2021		2022		2023	
January	786	January	185	January	304	January	537	January	542	January	307
February	700	February	490	February	459	February	411	February	661	February	349
March	732	March	788	March	140	March	468	March	483	March	415
April	807	April	427	April	140	April	972	April	350	April	363
May	392	May	287	May	452	May	509	May	915	May	376
June	262	June	413	June	587	June	480	June	408	June	445
July	497	July	322	July	777	July	2530	July	194	July	575
August	1010	August	281	August	430	August	7860	August	1160	August	1020
September	546	September	363	September	504	September	990	September	719	September	357
October	269	October	326	October	2150	October	669	October	669	October	928
November	350	November	979	November	611	November	330	November	1330	November	1230
December	268	December	232	December	118	December	433	December	309	December	623

Higher TSS concentration observed during the summer months seems to be mainly due to the recreational vehicles dumping waste at Fiddle Park and the operator collecting a 24-hour composite sample after a long weekend.

Overall, it is expected that the proposed preliminary treatment processes will be sufficient to ensure that the downstream treatment processes (MBR, UV system) will produce effluent of acceptable quality without any primary treatment.

5.7. Project Phasing

Recognizing that the projected population growth will occur over several years, we evaluated whether there was an advantage to constructing the WPCP upgrades in two separate phases. The potential advantage is that cost of the upgrades would be spread across the two (2) phases, resulting in lower upfront capital costs for the Town. Project phasing is not anticipated to have any impact of environmental or social factors technical factors and is entirely an economic decision for the Town, with both options being viable recommended options.

For phased construction, the first phase would provide treatment capacity for the current population, and known developments planned within the next 5-years, which include:

- Flato Development Phase 1-4
- IK World Development
- John Street Development.

These developments have a combined estimated average day wastewater production of 1,243 m^3/d. The 2020 population of Shelburne was approximately 8,639. Assuming a conservative per capita demand of 340 L/day, a current average day wastewater production of 2,937 m^3/day was established. To accommodate the current population and the above noted developments, a minimum average day treatment capacity of 4,180 m^3/d is required. For Phase 1, an average day flow criterion of 4,400 m^3/d is proposed to service the current population, the proposed developments and allow 220 m^3 in buffer treatment capacity. The 220 m^3 buffer capacity would allow for approximately 215 additional homes to be serviced (assuming three (3) people per home).

This established the following Phase 1 design criteria:

<u>Phase 1 Proposed Design:</u>

- Average Day Flow: 4,400 m^3/d
- Max Day Flow: 11,000 m^3/d

Phase 2 would then bring the treatment capacity up to 5,100 m^3/day, which would accommodate a population of 15,000.

This phased approach evaluation was completed in January 2021 for both extended aeration and MBR technology. These were the only two (2) options that were being considered for secondary treatment at that time. Also, the current estimates for the two (2) options are higher than the 2021 estimates as they account for increase in construction costs in the last year and increase in scope of work.

A technical memorandum was prepared, and the results of the evaluation were summarized and presented to Council in 2021.

	Estimated Upgrade Costs Full Build-Out	Estimated Phase 1 Upgrade Costs	Estimated Phase 2 Upgrade Costs	Phase 1 and 2 Upgrades Total
Extended Aeration	$33,781,950.00*	$28,185,075.00*	$6,436,406.25*	$34,621,481.25*
Membrane Bioreactor (MBR)	$26,028,000.00*	$25,652,316.04*	$431,250.24*	$26,083,566.28*

*Early 2021 Estimates

With the extended aeration technology, the phased approach would comprise of roughly 81% of the total project cost with Phase 2 involving the remaining 19%.

Similarly, with the MBR option, Phase 1 would comprise of roughly 98% of the total project cost with Phase 2 involving the remaining 2%.

The overall cost for Phase 1 and Phase 2 for both options is increased compared to the single build-out cost, because of duplicated contractor costs such a mobilization / demobilization, bonding, insurance etc. Since the phased approach would cost more than full build-out and since a major portion of the costs would be incurred in Phase 1, it was decided by the Town to proceed with full build-out rather than phased approach.

5.8. Consultation of Preferred Design Concept

A third Public Information Centre (PIC3) was held on May 5, 2022, from 6:30 p.m. to 7:30 p.m. to obtain input on the preferred design concept. Due to health and safety considerations arising from the COVID-19 virus, PIC2 was conducted as a video conference using the Zoom platform. Additionally, the meeting was livestreamed on the Town's YouTube Channel to create a meeting record and to allow viewing at other times for anyone who could not participate at the designated time. Notification for PIC2 appeared in the Shelburne Free Press on April 21, 2022. Additionally, a stakeholder list was developed, consisting of agencies, neighbouring municipalities, First Nations and Metis communities and organizations, provided in **Appendix C**. Stakeholders on the list were invited to participate in PIC2 by email on April 1, 2022. PIC2 attendees were instructed to contact the Town of Shelburne to register for the meeting. No participants registered for the presentation; however, the presentation went ahead and was recorded. A copy of the presentation is also included in **Appendix C.** No comments were received.

5.9. Pilot Study

A pilot study for MBR technology was conducted by Suez in collaboration with the OCWA operations team and innovations group for a 10-week period including installation, commissioning, seeding, training, and decommissioning of the pilot plant. The pilot study commenced on May 14, 2021, and ended on July 30, 2021. The study was extended by one (1) week due to process upsets at the plant which also upset the pilot performance.

One (1) of the main objectives of the pilot study was to demonstrate that the finished water quality from the MBR process will meet and / or exceed the future limits established by the ACS for the Shelburne WPCP.

The details of the pilot study are mentioned in the final pilot study report submitted by Suez.

Overall, the report concluded that the MBR technology was able to meet all the effluent objectives outside of periods of major process upsets.

Effluent targets for cBOD, TSS and total ammonia nitrogen were consistently met. Effluent targets for total phosphorus and nitrate-N were met barring periods of process upsets. It was noted in the report that such upsets were linked to specific operational challenges of the pilot's setup, predominantly the challenges related to feed screening and consistent provision of feed and were atypical of the standard full-scale MBR system operation.

6.0 Effects Assessment for Preferred Design

The effects assessment of the preferred design in outlined in **Table 47**. Potential effects are identified, and mitigation measures implemented to avoid or reduce the effect. Residual effects, the effect that remains after mitigation, is then assessed. Monitoring commitments are documented.

Table 47: Effects Assessment of the Preferred Design

Potential Effect	Mitigation	Residual Effect	Monitoring
Natural Environment			
Site clearing, excavation, grading, and stockpiling of soil could result in sediment entering the Boyne River, which could impact aquatic life	• Installation of sediment control fencing prior to commencing construction activities • Material to be stockpiled at least 30 m from a watercourse	None anticipated	Regular monitoring of sediment control fencing and the Boyne River to ensure mitigation measures are working as expected
Aeolian erosion of disturbed or stockpiled soils during construction.	• Dust control measures to be employed based on comprehensive list of dust suppressants and considering best management practices listed in "Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities" (Cheminfo Services Inc., 2005). • Non-chloride dust suppressants to be applied.	None anticipated	Regular inspection during construction, especially on days with high winds
Contamination of Boyne River or groundwater due to accidental spills or leaks	• Refueling and vehicle maintenance to occur in designated areas, at least 30 m from a watercourse. • Spill protection measures in designated areas	None anticipated	Monitoring to ensure that refueling is not occurring within 30 m of a watercourse and to ensure that spill protection and

	• Contingency plan in place for cleaning up spills		clean-up measures are implemented according to plan
Change in aquatic habitat due to unanticipated discharge from WPCP that exceeds discharge limits.	• Regular effluent monitoring • Regular inspection of equipment to detect leaks. • Implementation of Boyne River Stewardship and Monitoring Plan • Implementing corrective action if Boyne River concentrations exceed parameter concentrations established in consultation with the NVCA	None anticipated	Monitoring of Boyne River physical and chemical water parameters, amphibians, fish, and benthic macroinvertebrates as outlined in the Boyne River Stewardship and Monitoring Plan
Discharge of warmer effluent to the Boyne River, which is a cold-water watercourse	• Implementation of the Boyne River Stewardship and Monitoring Plan, which includes tree planting to maintain cold water habitat in the Boyne River	None anticipated	Boyne River Stewardship and Monitoring Plan
Disruption of groundwater flow resulting from flow regime being altered during construction	• A detailed hydrological study will be conducted as part of detailed design	None anticipated	As per hydrological study
Mixing of topsoil with subsoil	• Topsoil and subsoil to be stockpiled separately	None anticipated	
Contamination through improper waste disposal.	• All waste generated during construction will be disposed of in accordance with ministry requirements, including the *Environmental Protection Act* Regulation *On-Site and Excess Soil Management (O. Reg. 406/19)* and the guidance document Management of Excess Soil – A Guide for Best Management Practices.	None anticipated	
Socio-Economic Environment			

Disruption of undiscovered archaeological resources during construction activities such as grading and excavation	• Any archaeological resources will be		
Disturbance of nearby residents resulting from construction-related noise	• Adherence to Town of Shelburne noise by-law No. 45-2004 by prohibiting construction noise between 23:00 and 7:00 the next day. • Provide advanced notification to adjacent residences and businesses advising of construction schedule and to provide a contact for any noise concerns. • Maintain construction equipment in proper working order	None anticipated	
Presence of odours resulting in annoyance of nearby businesses and residents			

In addition to the proposed mitigation measures, all waste generated during construction will be disposed of in accordance with ministry requirements, including the *Environmental Protection Act* Regulation *On-Site and Excess Soil Management (O. Reg. 406/19)* and the guidance document Management of Excess Soil – A Guide for Best Management Practices.

7.0 Monitoring

7.1. Influent and Effluent Monitoring

The WPCP operator will monitor influent and effluent as per the conditions of the Amended Environmental Compliance approval and based on requirements provided by MECP in their approval of the Assimilative Capacity Technical Memorandum, as outlined in **Table 48** and **Table 49.**

Table 48: Raw Sewage Monitoring (Upstream of the Treatment System).

Frequency	Once per month
Sample Type	24-hour composite
Parameters	BOD5, Total Suspended Solids, Total Phosphorus, Total Ammonia Nitrogen, Total Kjeldahl Nitrogen, pH and Temperature

Table 49: Final Effluent Monitoring (Post Treatment before Discharging to the Environment).

Frequency	Weekly
Sample Type	24-hour composite
Parameters	pH, temperature, cBOD5, Total Suspended Solids, Total Phosphorus, Nitrate Nitrogen, Nitrite Nitrogen, Total Ammonia Nitrogen, Total Kjeldahl Nitrogen, Unionized Ammonia Nitrogen (calculated), E.coli and Alkalinity

All monitoring procedures and reporting requirements will be consistent with requirements outlined in the Amended Environmental Compliance Approval.

7.2. Downstream Monitoring

In partnership with the NVCA, the Town has developed the Boyne River Stewardship and Monitoring Plan. The goals of this adaptive monitoring plan are to:

- To better understand the current health of the Boyne River following its confluence with the Besley Drain to establish "baseline conditions."

- To develop monitoring protocols that would identify changes in the water quality of the Boyne River, resulting from the increase in WPCP discharge capacity.
- Establish a process for setting water quality "triggers" that, if exceeded, result in consultation between the Town and NVCA to address the issue

7.2.1. Monitoring Schedule

To achieve the goals of the Plan, a monitoring program is anticipated to begin in March 2022 and continue to the end of February 2023 to establish a full year of baseline conditions. Further monitoring would then occur for a full year after the WPCP begins operating at its increased capacity and every subsequent five (5) years.

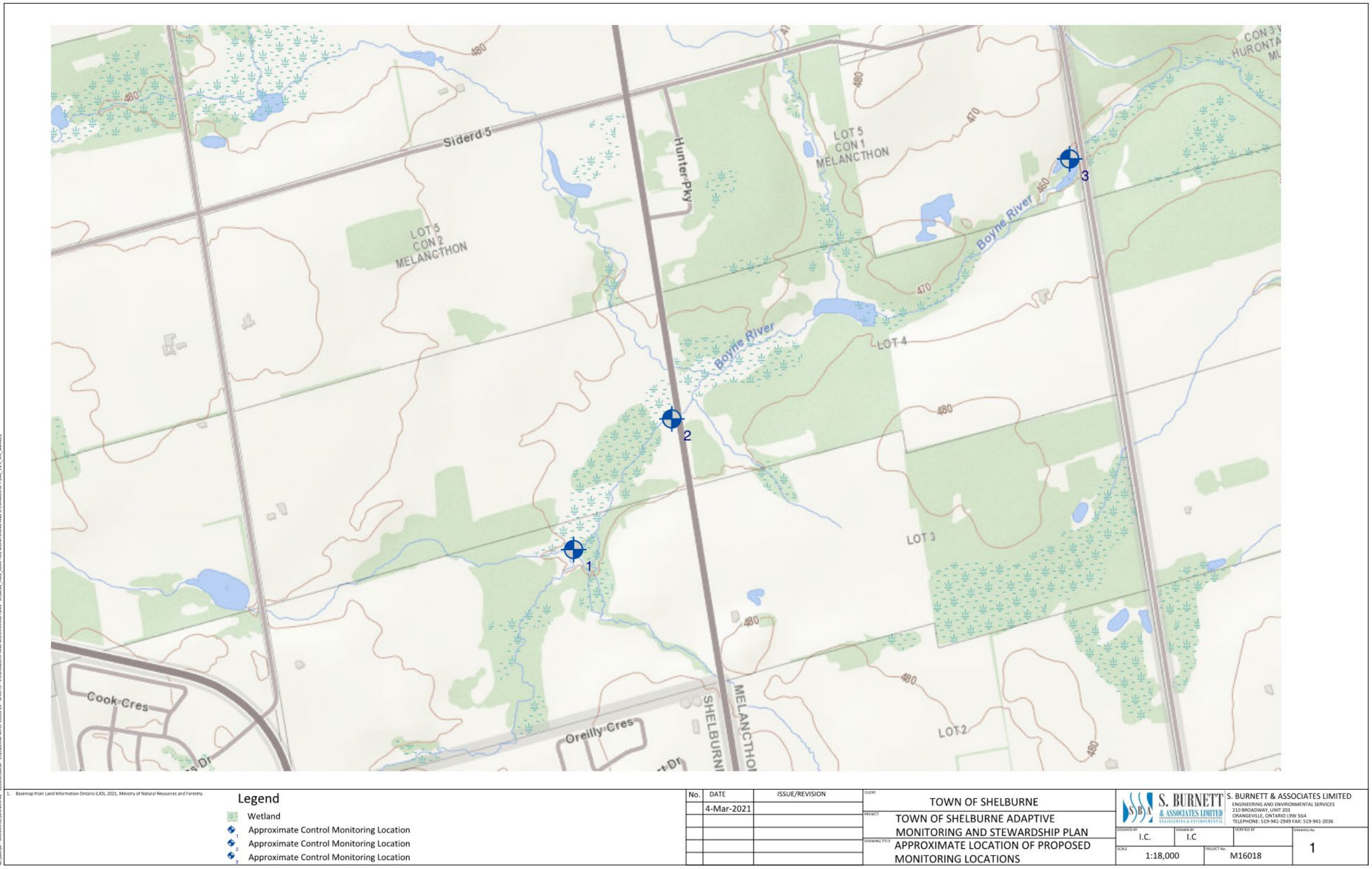
7.2.2. Stations

To facilitate the monitoring program the following monitoring stations will be established in co-ordination with the NVCA:

- **Control Station:** located upstream of the Besley Drain-Boyne River confluence but downstream of the Boyne River-Walter's Creek confluence.
- **Impact Station:** located at least 100 m downstream of the Besley-Boyne confluence.
- **Far-Field:** located at the Boyne River crossing of the Mulmur-Melancthon Townline

Additionally, amphibian monitoring would occur at the Boyne-Besley Confluence wetland and the CR124 wetland, and at a local control station that will be determined. Additionally, a flow monitor would be installed at CR124, or if not feasible at that location, at Mulmur-Melancthon Township Line. **Figure 31** provides the approximate locations where the monitoring stations will be located.

Figure 31: Proposed Monitoring Station Locations



7.2.3. Parameters

Table 50 identifies the parameters that will be sampled at each representative location. The sampling will be performed by one (1) representative from the Town and one (1) representative from the NVCA.

Table 50: Summary of Monitoring Program

Parameter(s)	Sampling Method	Sampling Location(s)	Sampling Frequency per Monitoring Period
Flow	Flow Gauge	CR124 or Mulmur-Melancthon Townline	Continuous
Temperature, dissolved oxygen, pH	Data loggers	Control, impact, and far-field stations	Continuous
Phosphorous, nitrate, ammonia, chlorides	Grab samples	Control, impact, and far-field stations	Monthly
Benthic macroinvertebrates	Net	Control, impact, and far-field stations	Once
Fishes	Electrofishing	Control[1], impact, and far-field stations	Once
Amphibian	Frog call survey (three (3) visits)	Control[1], impact, and far-field stations	Once

[1] Control locations will be determined in consultation with NVCA before the end of 2021.

7.2.4. Triggers

After evaluating the monitoring data from the baseline year, the Town and NVCA will meet to discuss establishing triggers for each parameter. These triggers would represent thresholds, that if exceeded, would result in the consultation between the Town and NVCA to determine the best means of addressing the issue. Triggers will be established before the upgraded WPCP is online.

7.2.5. Data Analysis and Reporting

Collected monitoring data will be interpreted by the Town, who will issue a report within three (3) months of the last collected data. The report will summarize the monitoring data and flag any exceedance of triggers.

7.3. Stewardship

The Town is committed to working with the NVCA on a variety of stewardship projects to enhance the health of the Boyne River and to increase its assimilative capacity, thereby reducing the likelihood of exceeding the predetermined triggers. The following sections outline stewardship projects that the Town will endeavor to implement in partnership with the NVCA when feasibly and financially possible.

7.3.1. Enhanced Riparian Vegetation

Increasing the amount of riparian vegetation along the Boyne River, Besley Drain, and Water's Creek would help maintain the cold-water status of the Boyne Headwaters and reduce impacts from the warmer water discharged from the WPCP. Reduced temperatures will result in less algal growth and a higher dissolved oxygen content.

The NVCA will provide the Town with a prioritized list of areas suitable for planting as well as estimated costs and time required to complete each planting. The Town will then commit to a funding timeline, with plantings occurring in stages over several years. NVCA will be responsible for leading the plantings, including providing necessary equipment and expertise. NVCA will explore the idea of having volunteers participate in the tree plantings, with the Town providing support as appropriate.

7.3.2. Maintaining Existing Riparian Zones

There is an opportunity to work with existing landowners to ensure that riparian vegetation along Walter's Creek is not removed or mowed. The NVCA and the Town will work together to educate landowners on the importance and benefits of maintaining riparian vegetation.

7.3.3. Stormwater Management

As part of the Town's anticipated 2022 Stormwater Master Servicing Plan (SWMSP), the Town will identify opportunities for improving the thermal mitigation of stormwater ponds outlets. The plan will also assess opportunities to divert clean groundwater away from the WPCP and storm drains and have it redirected to streams.

The SWMSP will also look at whether there is an opportunity to divert groundwater from entering the stormwater pond in the Northwest of Shelburne and towards Walter's Creek.

7.3.4. 3rd Line Pond

The 3rd Line Pond creates a stagnant area where water temperatures increase due to solar heat before returning to the Boyne River. The Town will commit to reaching out to the landowner to arrange up to three (3) meetings to discuss possibilities for reducing the pond's impact on temperature in the downstream Boyne River. These meetings would also require attendance by NVCA and if additional meetings are required, they would be added to this plan.

7.3.5. Boyne River Improvements

The Town will arrange a field visit with the NVCA to assess opportunities for habitat improvement in the Boyne River, downstream of its confluence with the Besley Drain. One (1) example of habitat improvement would be adding rocks to create riffles, which would increase oxygen content in the river. Further plans will be committed to, as appropriate, following this initial site visit.

7.3.6. Other Improvement Opportunities

The Town will continue to review opportunities in Natural Environment zones and Open Space Recreational zones, as well as through new developments to improve the aquatic habitat in the Boyne River and its tributaries. As an example, the Town will continue to require new developments adjacent to Walter's Creek and the Besley Drainage Works to provide improvements and enhancements to the watercourses.

8.0 Review of Environmental Significance and Class EA Schedule

Based on the assessment undertaken in the ESR, the expansion and upgrading of the WPCP to a capacity of 5,100 m^3/day from 3,420 m^3/day will not result in any significant adverse environmental impacts. As detailed in **Section 7**, a comprehensive monitoring program will be implemented to ensure that predicted parameter concentrations in the Boyne River are as anticipated, and that if threshold concentrations that are established in consultation with the NVCA are exceeded, that mitigation measures are implemented to bring parameter concentrations back below the threshold concentrations. No reasons to change the Class EA Schedule were determined.

9.0 Draft Report Consultation

A draft version of this ESR was provided to MECP on September 14, 2023, with comments returned on October 5, 2023. A list of comments provided and a summary of how each comment was resolved in this version of the ESR is provided in **Appendix C.**

10.0 Notice of Completion

The Town issued a Notice of Completion on **[insert date]** the Town's website, in the Shelburne Free Press, and to all project stakeholders on our stakeholder list. The Notice of Completion and stakeholder letters are provided in **Appendix C.** As indicated in the Notice of Completion, the Town has made this report available at Shelburne Town Hall, located at 203 Main Street East in Shelburne, for a period of 30 days for public, First Nation and Métis, and agency review.

During this period, members of the public, First Nations, or agencies can submit a Section 16(6) Order if they believe that the Town of Shelburne Increased Capacity of the Town of Shelburne's Water Pollution

Control Plant Project may result in an adverse impact on constitutionally protected Aboriginal and treaty rights and that completing an Individual Environmental Assessment may prevent, mitigate, or remedy this impact.

To submit your Section 16(6) Order request, you should provide the following:

- your name, address, and email address.
- project name.
- proponent name.
- what kind of Order is being requested.
- a request for additional conditions.
- a request for an individual environmental assessment,
- details about your concerns about potential adverse impacts on constitutionally protected Aboriginal or treaty rights and how the proposed Order may prevent, mitigate, or remedy the identified adverse impacts.
- whether you belong to, represent or have spoken with an Indigenous community who's constitutionally protected Aboriginal, or treaty rights may be adversely impacted by the proposed project.
- whether you have raised your concerns with the proponent, the proponent's response (if any) and why the concerns could not be resolved with the proponent.
- any other information to support your request.

Requests that are made after the 30-day review period, may not be considered by the Minister. Upon review of any Section 16 Orders, the Minster of the Environment, Conservation and Parks has the authority and discretion to require the proponent of a project to:

1. Deny the request,
2. Complete a more rigorous study, referred to as an Individual Environmental Assessment,
3. Fulfill additional conditions in addition to the Class EA that could include further study, monitoring, or
4. Refer the matter to mediation.

In making their decision, the Minister will consider factors set out in Section 16(5) of the *Environmental Assessment Act*.

Members of the public having concerns about the potential environmental effects of a project, or the planning process being followed, have a responsibility to bring their concerns to the attention of the proponent early in the planning process.

Should no Section 16 Order requests be received, or if they are rejected by the Minister, then the project will have met all the requirements of the Schedule C Municipal Class EA process. At this time the project can proceed to the design and ultimately construction phase at the discretion of the Town of Shelburne.

It is estimated that project design will take one (1) year, followed by two (2) years of construction. Upon completion of detailed design estimated for the end of 2024, a request to amend the existing Environmental Compliance Approval will be submitted to the Ministry of the Environmental, Conservation and Parks. Construction would then proceed for 2025 and 2026. It should be noted that this schedule is contingent on the Town's ability to secure funding for the project, and delays in securing funding will directly impact this proposed timeline.

Work to establish baseline conditions for the monitoring plan has already begun and will continue throughout the operational life of the WPCP.

11.0 Conclusion

The purpose of the Schedule 'C' Class EA Environmental Study Report was to determine the means of meeting the wastewater treatment requirements for the Town of Shelburne for the next 20-years. Based on technical, environmental, social, and economic considerations evaluated in this ESR, the preferred Alternative Solution is to expand/upgrade the existing WPCP from 3,420 m^3/day to 5,100 m^3/day.

The preferred design concept consists of converting the existing extended aeration system to a membrane batch reactor secondary treatment system. The design concept includes upgrades to every treatment process at the existing WPCP and includes upgrades to the currently undersized primary and secondary sludge digestors that have resulted in historic plant odour concerns from adjacent landowners. The upgrades also include construction of a new equalization tanks that will significantly reduce instances where the one (1) of the existing stormwater ponds are used to store untreated wastewater during peak flow events. The second existing pond will only be used to store treated wastewater that does not meet effluent discharge limits in an emergency.

The preferred design concept is estimated to cost $33 Million, (2023 Estimate: $36 Million) which includes upgrades to the headworks, secondary treatment, tertiary treatment, solids management, miscellaneous upgrades, and engineering and contingency.

The preferred alternative design, once constructed and operational, is not anticipated to result in any significant adverse environmental impacts and a comprehensive monitoring program will be implemented to monitor physical and chemical water quality parameters in the Boyne River.

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