Appendix A
Technical Memoranda

Appendix A-1
Technical Memorandum No. 1

Technical Memorandum 1

Version Number: Final

Wallaceburg Water Treatment Servicing Class Environmental Assessment
Chatham-Kent Public Utilities Commission

Document Number: PPS1110221334KWO

August 10, 2022

Technical Memorandum 1

Client Name:	Chatham-Kent Public Utilities Commission
Project Name:	Wallaceburg Water Treatment Servicing Class Environmental Assessment
Document Number:	PPS1110221334KWO
Project Number:	CE788300
Project Manager:	Tom Mahood, P.Eng.
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1	July 22, 2021	Water Supply Excerpt for Client Review	J. Philpott	R. Yu	R. Yu T. Mahood	T. Mahood
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Executive Summary

Introduction

The Wallaceburg Water Treatment Plant (WTP) is a critical part of the existing Wallaceburg Drinking Water System (DWS). The plant has been susceptible to frequent failures and repairs due to aging infrastructure and increasing wet weather impacts. The WTP was originally constructed in 1946 and has undergone major upgrades in 1948, 1980, and 2009. In 2016, the Chatham-Kent (CK) Public Utilities Commission (PUC) completed a Schedule B Class Environmental Assessment (EA) to assess the various water supply alternatives to service Wallaceburg and the surrounding area. The preferred solution from the 2016 EA was to maintain and rehabilitate the existing WTP, raw water intake, and low-lift pumping station (LLPS). However, upon implementation of the recommended solution, it was determined that this solution may not be a sustainable approach due to the deterioration of plant assets and high costs associated with repairs and upgrades.

In June 2020, the CK PUC retained Jacobs to complete a Schedule C Class EA to determine a defensible, long-term solution for the Wallaceburg WTP to reliably meet current and anticipated future water quality regulations and enhance system safeguards against water quality anomalies.

In February 2021, the scope of the Class EA was expanded to investigate the potential of the Wallaceburg DWS to supply water to the Community of Dresden (currently serviced by the Chatham WTP), as well as to allow for future greenhouse development between Wallaceburg and Dresden.

The purpose of Technical Memorandum (TM) 1 is to document Phase 2 of this EA. Phase 2 includes an inventory of existing conditions, the assessment of potential future conditions, and the development and evaluation of alternative solutions. This TM also presents the preferred solution for this EA, which will be carried forward to Phase 3 of this EA.

Problem and Opportunity Statement

The problem and opportunity statement for this Class EA is as follows:

The Wallaceburg WTP and the raw water intake LLPS equipment and structures have reached the end of their life expectancy and require frequent repairs and replacement. In addition, the raw water quality from the WTP intake, located on the shore of Chenal Écarte, has suffered from turbidity spikes, low pH, and nitrate changes during wet weather events. Also, toxic spills in the Sarnia Chemical Valley and zebra mussel invasion have forced the intake to be shut down temporarily on several occasions. There is also a forecast of expanded water servicing area, industrial growth and greenhouse development for the Wallaceburg DWS.

The Water Treatment Servicing EA study represents an opportunity to evaluate alternatives for the WTP and raw water intake that will provide for current and future water demand of the Wallaceburg DWS, an opportunity to review the condition of the interconnection between the Lambton Area Water Supply System (LAWSS) and the Wallaceburg DWS, and to investigate options for additionally meeting the forecast increased industrial water demands. The study also represents an opportunity to examine the alternatives for a water transmission main to meet the water supply demand in a new pressure zone of the Dresden Water Distribution System, which is currently supplied by the Chatham WTP. The planning horizon for this study extends to 2070.

Figure ES-1 presents the specific study area for the Wallaceburg WTP, and Figure ES-2 presents the overall study area for this EA.

Figure ES-1. Wallaceburg Water Treatment Plant Study Area

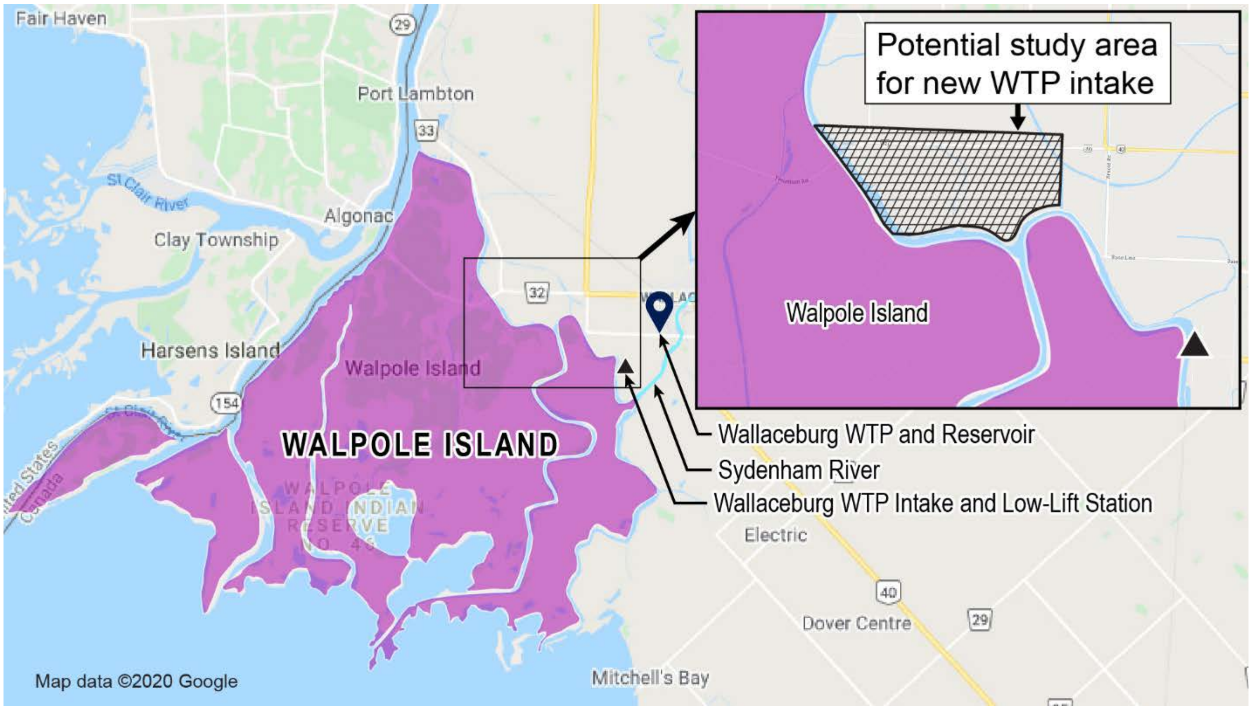
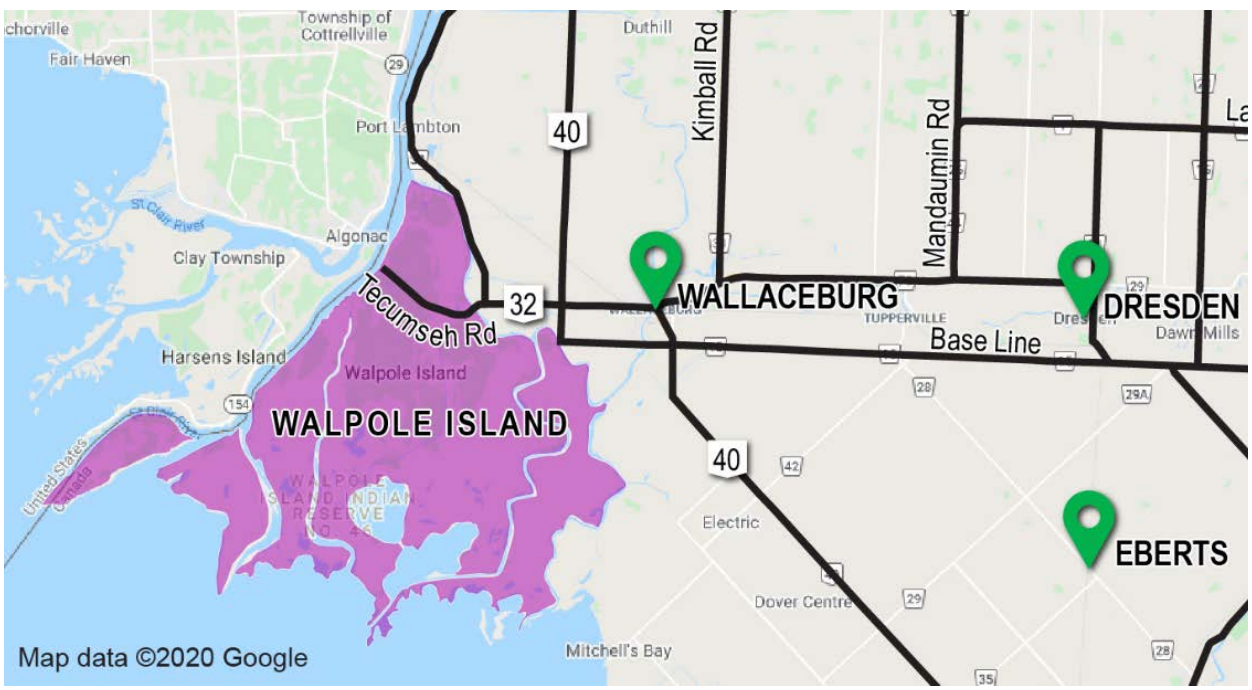


Figure ES-2. Study Area for the Class Environmental Assessment



Inventory of Existing Conditions

Wallaceburg Water Treatment Plant, Low-lift Pumping Station, and Intake

The Wallaceburg WTP was originally constructed in 1946 and has undergone major upgrades in 1948, 1980, and 2009. It is located at 6750 Baseline Road in Wallaceburg Ontario, and is rated at 13.6 megalitres per day (ML/day) (rated capacity). Raw water is drawn from Chenal Écarte, which receives water from the St. Clair River. The intake is located approximately 2 kilometres (km) from the WTP. The raw water drawn through a raw water intake, passes through the manual bar screens and is seasonally chlorinated for zebra mussel control. The raw water is then pumped to the plant by the low-lift pumping station (LLPS) through a 400-millimetre-diameter, 2-kilometres-long raw water transmission main. According to the current Permit to Take Water, the Wallaceburg WTP can take up to 18.2 ML/day of raw water, while the LLPS has a nominal firm capacity of 24 ML/day. The Wallaceburg WTP, the LLPS, and intake locations are displayed on Figure ES-3.

The Wallaceburg WTP is reaching the end of its service life, requiring frequent maintenance. To provide reliable service in the future, it requires substantial upgrades. While continuing to maintain the Wallaceburg WTP was selected as the preferred option in the previous Wallaceburg and Area Water Supply EA (Stantec 2016), maintenance and repairs have been much more frequent, costly, and labour intensive than anticipated. The LLPS is also reaching the end of its service life, requiring substantial upgrades to remain in service. It is also vulnerable to flooding.

Flow analysis was completed for the Wallaceburg WTP from 2015 to 2020. Flows increased during this period from 3.9 ML/day average day demand (ADD) in 2015 to 4.5 ML/day ADD in 2020. The ADD in 2020 represents 30% of the plant's rated capacity. The maximum day demand (MDD) followed a similar trend as the ADD, increasing from 5.4 ML/day in 2015 to 7.6 ML/day in 2020. The MDD in 2020 represents 55% of the plant's rated capacity. The ADD typically ranged from 80% to 90% of the MDD, with an average ratio of 82.8% from 2015 to 2020.

The peak flow remained relatively constant during this period, ranging from 11.0 ML/day in 2015 to 13.0 ML/day in 2018.

Of note, the average winter flows (October to April) were only 10% lower than the average summer flows (May to September), which represent a low seasonal variation.

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Figure ES-3
Wallaceburg WTP, LLPS and Intake Location
Technical Memorandum 1
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

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Dresden Water Supply and Storage

The community of Dresden currently receives its water supply from the Chatham WTP via the Eberts Booster Pumping Station (BPS). There is currently one pressure zone (North Kent pressure zone) supplied by the Eberts BPS, which in addition to Dresden, includes the community of Thamesville. Dresden has a dedicated water storage system, with 5,430 cubic metres of storage provided by the Dresden Elevated Tanks (ET), located on McCreary Line. Water is distributed directly to Dresden from the Eberts BPS, with the Dresden ET providing water equalization in addition to storage. The MDD in Dresden has remained relatively consistent in recent years, approximately 8.8 ML/day.

The Chatham WTP has a rated capacity of 68 ML/day, with a current MDD of 41.5 ML/day that is expected to increase in the future. Existing flow data was obtained from the Chatham Water Distribution System Modelling Report (AECOM 2020a). This EA studies the feasibility of supplying water to Dresden from the Wallaceburg WTP in the future should Dresden be split from the existing North Kent pressure zone into its own pressure zone. This would reduce the demand at the Chatham WTP and potentially delay requirements for a capacity expansion.

The existing transmission main between Wallaceburg and Dresden is a 200/250-millimetre watermain that extends along Base Line for approximately 16 kilometres from Murray Street in Wallaceburg to the railroad tracks located west of North Street in Dresden. This transmission main is currently used for emergency purposes only and is only able to convey flows less than 4 ML/day, based on a maximum velocity of 2.0 metres per second as recommended in the Ministry of Environment, Conservation and Parks (MECP) Design Guidelines for Drinking Water Systems (MECP 2008a). This capacity would not be able to supply the existing/future MDD in Dresden of 8.8 ML/day.

Future Water Demand Projections

Future water demand projections were developed for the Wallaceburg WTP, forming the basis for alternative solution development. Water demand projections were developed for Wallaceburg and Dresden, as well as potential future greenhouses on Base Line that may be serviced by the Wallaceburg WTP in the future. The future water demand projections are presented in Table ES-1 under various water supply scenarios.

Table ES-1. Future Water Demand Projections – Wallaceburg WTP

Year	Wallaceburg Demands, ML/day	Dresden Demands, ML/day	Greenhouse Demands, ML/day	Wallaceburg WTP Demands, ML/day: Wallaceburg, Dresden and Greenhouses	Wallaceburg WTP Demands, ML/day: Wallaceburg and Greenhouses	Wallaceburg WTP Demands, ML/day: Wallaceburg only
2019	8.0	8.8	0	25.4	16.6	8.0
2039	9.9	8.8	8.6	27.4	18.5	9.9
2050	9.9	8.8	8.6	27.4	18.5	9.9
2070	9.9	8.8	8.6	27.4	18.5	9.9

Water demand projections were also developed for the Chatham WTP (by the CK PUC) to determine the impacts of supplying water to Dresden from the Wallaceburg WTP versus continuing to supply water to Dresden from the Chatham WTP. The following conclusions were drawn related to the Chatham WTP:

- If Dresden is serviced by the Wallaceburg WTP, the Chatham WTP will require a major expansion by 2046 and conveyance infrastructure (transmission mains, Eberts BPS) will require major upgrades within the planning horizon.
- If Dresden is serviced by the Chatham WTP, the Chatham WTP will require a major expansion by 2041 and conveyance infrastructure (transmission mains, Eberts BPS) will require major upgrades within the planning horizon.

While the benefit of 5-year delay in the Chatham WTP expansion is not significant, supplying water from Wallaceburg to Dresden would achieve more evenly distributed water supply between the Chatham WTP and the Wallaceburg WTP, and increase overall water supply security within Chatham-Kent.

The impacts of supplying the future greenhouses on Base Line from the Chatham WTP were also assessed. The major expansion of the Chatham WTP would be required in 2036, further advancing the timeline for expansion by 5 years.

Alternatives Development and Evaluation

To help identify a comprehensive solution to address the problems and opportunities, alternative development and evaluations were completed, respectively, for three project components, each of which focuses on a different aspect of a complete water supply system, as follows:

- **Overall Water Supply Strategy:** Relating to various future supply scenarios to meet the water demand projections in the service areas presented in the previous section.
- **Raw Water Supply**: Relating to the future location of the LLPS and intake. In addition to the existing location, two locations upstream of the existing LLPS are being considered. The size of the LLPS and intake was determined based on the preferred overall water supply strategy.
- **Water Transmission**: Relating to the alignment of the proposed transmission main between Wallaceburg and Dresden, if the supply of water from Wallaceburg to Dresden becomes a part of the preferred overall water supply strategy.

Overall Water Supply Strategy

Water supply alternatives were developed to address the overall water supply strategy as reflected in the Problem and Opportunity Statement in Section ES-2, and to meet the future water demands presented in Section ES-4. The alternative solutions were compared against the "Do Nothing" baseline alternative (continue maintaining and rehabilitation the existing Wallaceburg WTP). Water supply alternatives are based on two main factors, as follows:

- Ultimate (at the end of the planning horizon) flow of water supply required at the Wallaceburg WTP. The required water supply flow depends on the areas to be supplied by Wallaceburg in the future. There is an opportunity for Wallaceburg to supply Dresden and the future greenhouse developments. Alternatively, Dresden or the future greenhouse could be supplied by the Chatham WTP.

- Source of water supply. The potential sources of water supply include the Wallaceburg WTP, Chatham WTP, and LAWSS.

Multiple water supply alternatives were developed and are presented in Table ES-2.

Table ES-2. Water Supply Alternatives and Sub-Alternatives

Alternative Number	Water Supply Scenario	Water Supply Volume Required, ML/day
1	"Do Nothing" baseline alternative	9.9
2	Wallaceburg to supply Wallaceburg, Dresden and future greenhouse developments	28
2a	▪ Build a new Wallaceburg WTP – rated capacity of 28 ML/day	
2b	▪ Build a new Wallaceburg WTP – rated capacity of 14 ML/day ▪ Upgrade the existing Wallaceburg WTP – rated capacity of 14 ML/day	
2c	▪ Build a new Wallaceburg WTP – rated capacity of 16.5 ML/day ▪ Supplement water supply from LAWSS – 11.5 ML/day	
2d	▪ Obtain all water supply from LAWSS – 28 ML/day	
3	Wallaceburg to supply Wallaceburg and future greenhouse developments. Chatham WTP to continue supplying Dresden.	18.6
3a	▪ Build a new Wallaceburg WTP – rated capacity of 18.6 ML/day	
3b	▪ Upgrade the existing Wallaceburg WTP – rated capacity of 14 ML/day ▪ Supplement supply with water from the Chatham WTP – 4.6 ML/day	
3c	▪ Upgrade the existing Wallaceburg WTP – rated capacity of 14 ML/day ▪ Supplement water supply from LAWSS – 4.6 ML/day	
4	Wallaceburg to supply Wallaceburg only. Chatham WTP to supply Dresden and future greenhouse developments.	9.9
4a	Upgrade the existing Wallaceburg WTP – rated capacity of 14 ML/day	
4b	Build a new Wallaceburg WTP – rated capacity of 14 ML/day	

Based on the evaluation and sensitivity analysis of the previously described alternatives, **Alternative 2a: Build a new Wallaceburg WTP with a rated capacity of 28 ML/day to supply Wallaceburg, Dresden and future greenhouses along Base Line** was selected as the preferred solution for water supply. The new Wallaceburg WTP would be constructed on the site of the existing Wallaceburg WTP. Differentiating advantages for this alternative include the following:

- The alternative would significantly reduce the occupational health and safety concerns due to the aging water treatment equipment and facilities of the existing WTP.
- The PUC would retain autonomy of its water supply, given that the new WTP will supply sufficient capacity to meet the future demands.
- The new Wallaceburg WTP will serve the expanded areas and accommodate the maximum potential to support future development, as well as reducing stress on the Chatham WTP.
- The alternative would help to relieve the public's concern regarding the water quality of the raw water sources.
- The alternative provides an opportunity to adopt a modern and advanced water treatment technology (such as low-pressure membrane filtration), which would provide superior treated water quality and meet the potentially more stringent regulatory requirements in the future.
- This alternative can be implemented in phases and contain provisions for future expansion.

The estimated capital cost for the preferred solution for water supply is $46,433,000. The preferred solution for water supply has the following implications for raw water supply and water transmission development:

- **Raw Water Supply:** The raw water demand would be 34 ML/day in the future to account for process wastage within the Wallaceburg WTP. Therefore, the LLPS and intake must be able to convey 34 ML/day to the Wallaceburg WTP. This serves as the basis for raw water supply alternative development.
- **Water Transmission:** The projected future water demand for Dresden and the potential greenhouses along Base Line is 17.4 ML/day. Therefore, the conveyance system between Wallaceburg and Dresden must be able to convey 17.4 ML/day in the future. This serves as the basis for water transmission alternative development.

Raw Water Supply

Given the estimated 34 ML/day raw water demand as well as the deteriorating conditions, the existing LLPS and intake with a firm capacity of 24 ML/day can no longer meet the requirement. Therefore, constructing a new LLPS and intake became the main focus of development of alternatives. A new raw watermain is also required given the age and condition of the existing raw watermain.

Constructing a new LLPS and intake also presents the opportunity to review the location of the LLPS and intake. At the existing location along the Chenal Écarte, the raw water quality suffers from seasonal turbidity spikes during wet weather events, up to 1,000 nephelometric turbidity units. The effect of the turbidity spike is reduced upstream of where the Johnston Channel branches from the Chenal Écarte. In addition to the existing site, intake and LLPS locations upstream of the turbidity spiking section of the Chenal Écarte are also considered in the alternative development.

Raw water supply alternatives were developed based on the potential sites as shown on Figure ES-4, as follows:

- “Do Nothing” Baseline Alternative
- Alternative 1: Build a new LLPS and intake with a rated capacity of 34 ML/day at the existing site
- Alternative 2: Build a new LLPS and intake with a rated capacity of 34 ML/day at the first upstream location (5844 Bluewater Line)
- Alternative 3: Build a new LLPS and intake with a rated capacity of 34 ML/day at the second upstream location (5724 Bluewater Line)

Each alternative also requires a new raw watermain to the new Wallaceburg WTP. The new raw watermain will be twinned to allow for phasing and for increased security of supply.

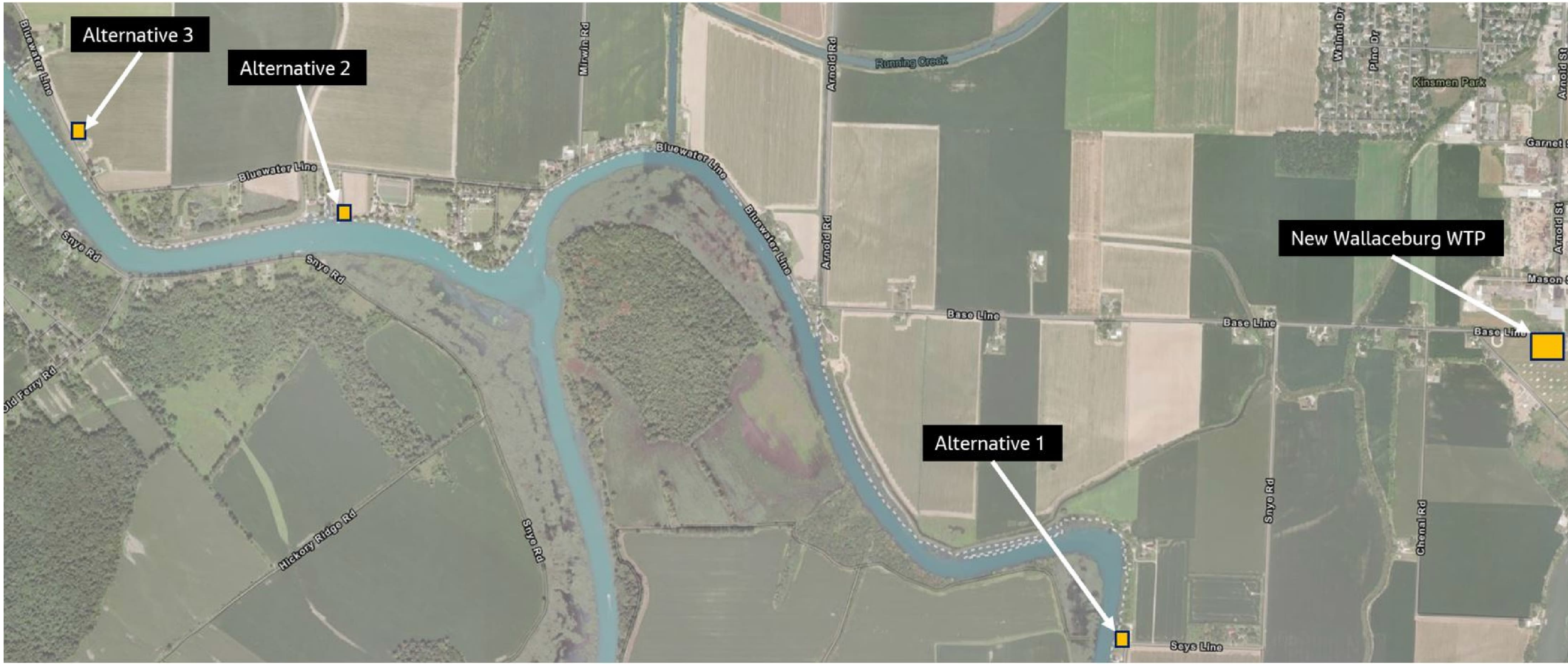

Figure ES-4
Alternative Solutions for Raw Water Supply
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Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
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Alternative 3: Build a new LLPS and intake with a rated capacity of 34 ML/day at the second upstream location was selected as the preferred solution for raw water supply, based on the triple bottom analysis and relevant sensitivity analysis. Benefits of this alternative are as follows:

- This location would eliminate raw water quality concerns (turbidity spikes) at the LLPS and intake.
- The construction methods (open cut installation) are relatively simple for this location
- Intake equipment is relatively simple to access and maintain.
- There are no footprint restrictions at this site.
- The estimated capital cost for the preferred solution for raw water supply is $17,924,000.

Water Transmission

Water transmission alternatives were developed to supply treated water from Wallaceburg to Dresden and the future greenhouses on Base Line. The existing transmission main on Base Line between Wallaceburg and Dresden is 200/250 millimetres diameter and has an approximate capacity of 4 ML/day based on design guidelines (MECP 2008a). Therefore, a new water transmission main is required to convey 17.4 ML/day between Wallaceburg and Dresden.

Constructing a new water transmission main between Wallaceburg and Dresden also presented the opportunity to review the alignment of the water transmission main. Water transmission alternatives were developed based on alternate alignments, which were determined through consultation with the CK PUC. Considerations were also given to the pumping configuration, such as constructing a new BPS, or installing dedicated pumps for Dresden and future greenhouses in the new Wallaceburg WTP high-lift pumping station (HLPS). Three alternative alignments, in addition to the “Do Nothing” baseline alternative, were developed for evaluation as follows:

- “Do Nothing” Baseline Alternative
- Alternative 1: Construct a new water transmission main and BPS along Base Line between Wallaceburg and Dresden.
- Alternative 2: Construct a new water transmission main and BPS along McCreary Line between Wallaceburg and Dresden.
- Alternative 3: Construct a new water transmission main with dedicated high lift pumps (HLPs) along Baldoon Road, Border Road, Elbow Line, and Base Line between Wallaceburg and Dresden.

Water transmission requirements for each alternative were determined through hydraulic analysis based on the status of existing water transmission mains in the area and a set of developed criteria.

Alternative 3: Construct a new water transmission main with dedicated HLPs along Baldoon Road, Border Road, Elbow Line, and Base Line between Wallaceburg and Dresden was selected as the preferred solution for water transmission, with main advantages, including the following:

- This alternative is the most energy-efficient water transmission solution among all alternatives.
- The transmission main alignment for this alternative would cause less disruption during construction than the other alternatives, as it avoids construction in the congested section of Base Line in Wallaceburg urban area.

- The alternative provides ease of operation than other alternatives, as all pumps are installed in one pumping station.
- The transmission main alignment is a corridor that contains the utilities that are required for greenhouse construction (hydro, natural gas, sewer), while at the same time not being expected to conflict with existing utilities in the right-of-way along Base Line.

The estimated capital cost for the preferred solution for water transmission is $32,800,000.

Summary of Preferred Solution

Table ES-3 summarizes the integrated preferred solution for the Wallaceburg Water Treatment Servicing Class EA, and the estimated capital costs.

Table ES-3. Summary of Preferred Solutions for the Wallaceburg Water Treatment Servicing Class EA

Category	Preferred Solution	Capital Cost
Overall Water Supply (Cost of WTP Only)	Build a new Wallaceburg WTP with a rated capacity of 28 ML/day to supply Wallaceburg, Dresden, and future greenhouses along Base Line	$46,433,000
Raw Water Supply	Build a new LLPS and intake with a rated capacity of 34 ML/day at the second upstream location	$17,924,000
Treated Water Transmission	Construct a new water transmission main with dedicated HLPs along Baldoon Road, Border Road, Elbow Line and Base Line between Wallaceburg and Dresden	$32,800,000
Total		$97,157,000

Figure ES-5 presents the integrated preferred solution for the Wallaceburg Water Treatment Servicing Class EA.

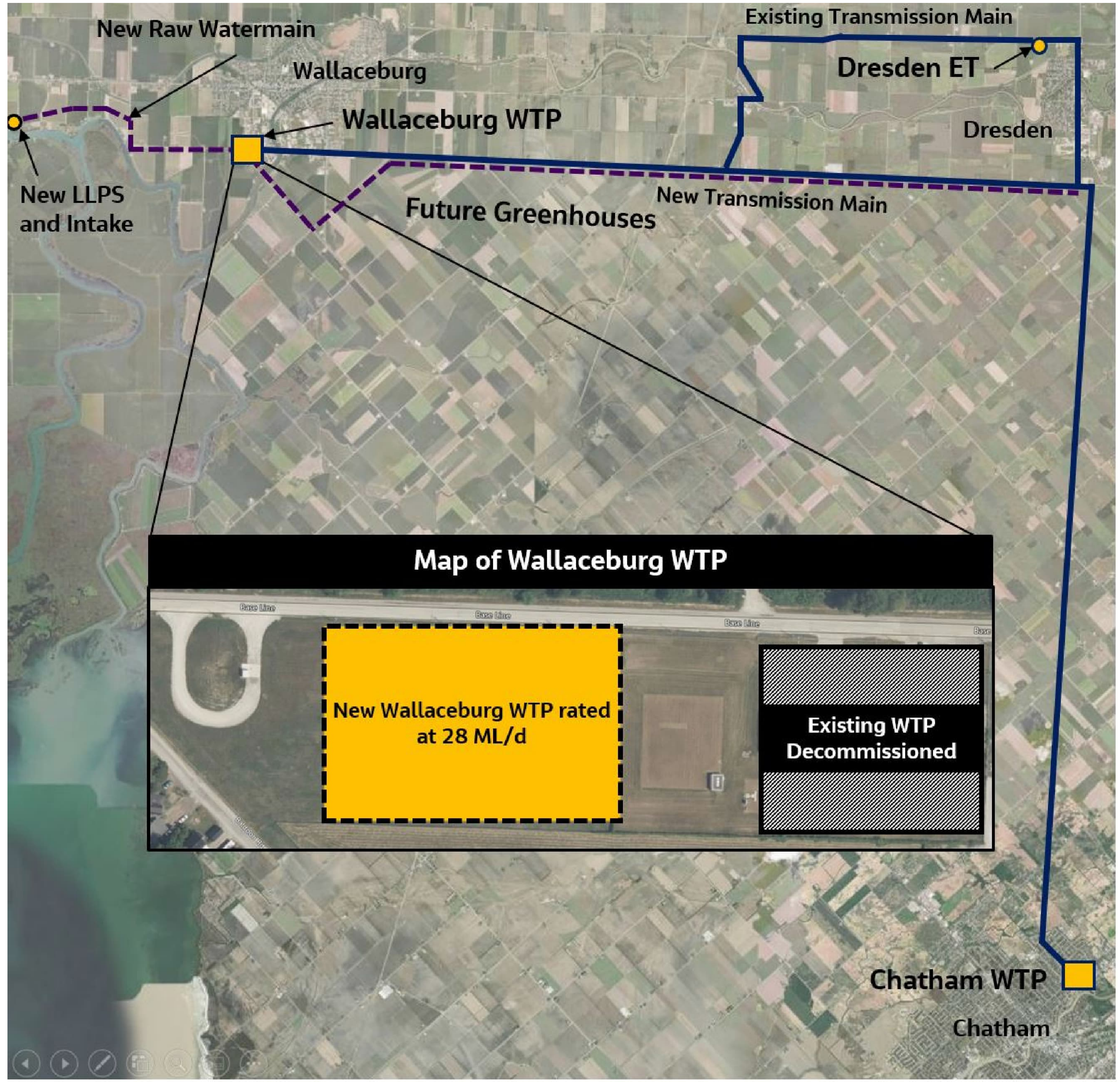

Figure ES-5
Preferred Solution for Wallaceburg Water Treatment Servicing Class EA
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Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

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Next Steps

This TM documents the development and evaluation of alternative solutions, completing Phase 2 of the Class EA process. The next steps are to develop and evaluate alternative design concepts for the preferred solution presented in this TM and to develop an implementation plan for the preferred design concepts, which will be documented in TM 2.

Contents

Appendices

Tables

Figures

Acronyms and Abbreviations

Acronym	Definition
ADD	average day demand
BPS	booster pumping station
BWW	backwash waste
CCT	chlorine contact tank
CIP	clean-in-place
CK	Chatham-Kent
CPES	Conceptual and Parametric Engineering System
CT	contact time
DFO	Department of Fisheries and Oceans
DWS	Drinking Water System
DWWP	Drinking Water Works Permit
EA	Environmental Assessment
ET	Elevated Tank
GHG	greenhouse gas
HADD	harmful, alteration, disruption or destruction
HFSA	hydrofluorosilicic acid
HLPS	High-lift pumping station
LAWSS	Lambton Area Water Supply System
LLPS	low-lift pumping station
LPM	low-pressure membrane
MDD	maximum day demand
MDWL	Municipal Drinking Water License
MECP	Ministry of Environment, Conservation and Parks
ML/day	megalitres per day
O&M	operations and maintenance
PACl	polyaluminum chloride

Acronym	Definition
PRV	pressure reducing valve
PTTW	Permit to Take Water
PUC	Public Utilities Commission
RMF	residuals management facility
SAR	species at risk
SCRCA	St. Clair Region Conservation Authority
TDH	total dynamic head
TM	technical memorandum
VFD	variable frequency drive
WDS	water distribution system
WTP	water treatment plant
WWTP	wastewater treatment plant

1. Introduction

Section 1 describes the project background, purpose, and objectives.

1.1 Background

The Wallaceburg Water Treatment Plant (WTP) is a critical part of the existing Wallaceburg Water Supply System. The plant has been susceptible to frequent failures and repairs because of aging infrastructure and increasing wet weather impacts. The WTP was originally constructed in 1946 and has undergone major upgrades in 1948, 1980, and 2009. In 2016, the Chatham-Kent (CK) Public Utilities Commission (PUC) completed a Schedule B Class Environmental Assessment (EA) to assess the various water supply alternatives to service Wallaceburg and the surrounding area. The preferred solution from the 2016 EA was to maintain and rehabilitate the existing WTP, raw water intake, and low-lift pumping station (LLPS). However, upon implementation of the recommended solution, it was determined that this solution may not be a sustainable approach because of the deterioration of plant assets and high costs associated with repairs and upgrades.

In June 2020, CK PUC retained Jacobs to complete a Schedule C Class EA and preliminary design to determine a defensible, long-term solution to revitalize and renew the Wallaceburg WTP to reliably meet current and anticipated future water quality regulations and enhance system safeguards against water quality anomalies.

In February 2021, the scope of the Class EA was expanded to investigate the potential of the Wallaceburg Drinking Water System (DWS) to provide water supply service to the Community of Dresden (currently serviced by the Chatham WTP), as well as to allow for future greenhouse development between Wallaceburg and Dresden.

1.2 Purpose and Objectives

The purpose of Technical Memorandum (TM) 1 is to document Phase 2 of this EA., which includes an inventory of existing conditions, the assessment of potential future conditions, and the development and evaluation of alternative solutions. This TM also presents the preferred solution for this EA, which will be carried forward to Phase 3 of this EA.

2. Problem and Opportunity Statement

The problem and opportunity statement for this Class EA is as follows:

The Wallaceburg WTP and the raw water intake LLPS equipment and structures have reached the end of their life expectancy and require frequent repairs and replacement. In addition, the raw water quality from the WTP intake, located on the shore of Chenal Écarte, has suffered from turbidity spikes, low pH, and nitrate changes during wet weather events. Also, toxic spills in the Sarnia Chemical Valley and zebra mussel invasion have forced the intake to be shut down temporarily on several occasions. There is also a forecast of expanded water servicing area, industrial growth, and greenhouse development for the Wallaceburg DWS.

The Water Treatment Servicing EA study represents an opportunity to perform the following:

- Evaluate alternatives for the WTP and raw water intake that will provide for current and future water demand of the Wallaceburg DWS.
- Review the condition of the interconnection between the Lambton Area Water Supply System (LAWSS) and the Wallaceburg DWS.
- Investigate options for additionally meeting the forecast increased industrial water demands.
- Examine the alternatives for a water transmission main to meet the water supply demand in a new pressure zone of the Dresden Water Distribution System (WDS), which is currently supplied by the Chatham WTP.

The planning horizon for this study extends to 2070.

Figure 2-1 presents the specific study area for the Wallaceburg WTP and Figure 2-2 presents the overall study area for this EA.

Figure 2-1. Wallaceburg Water Treatment Plant Study Area

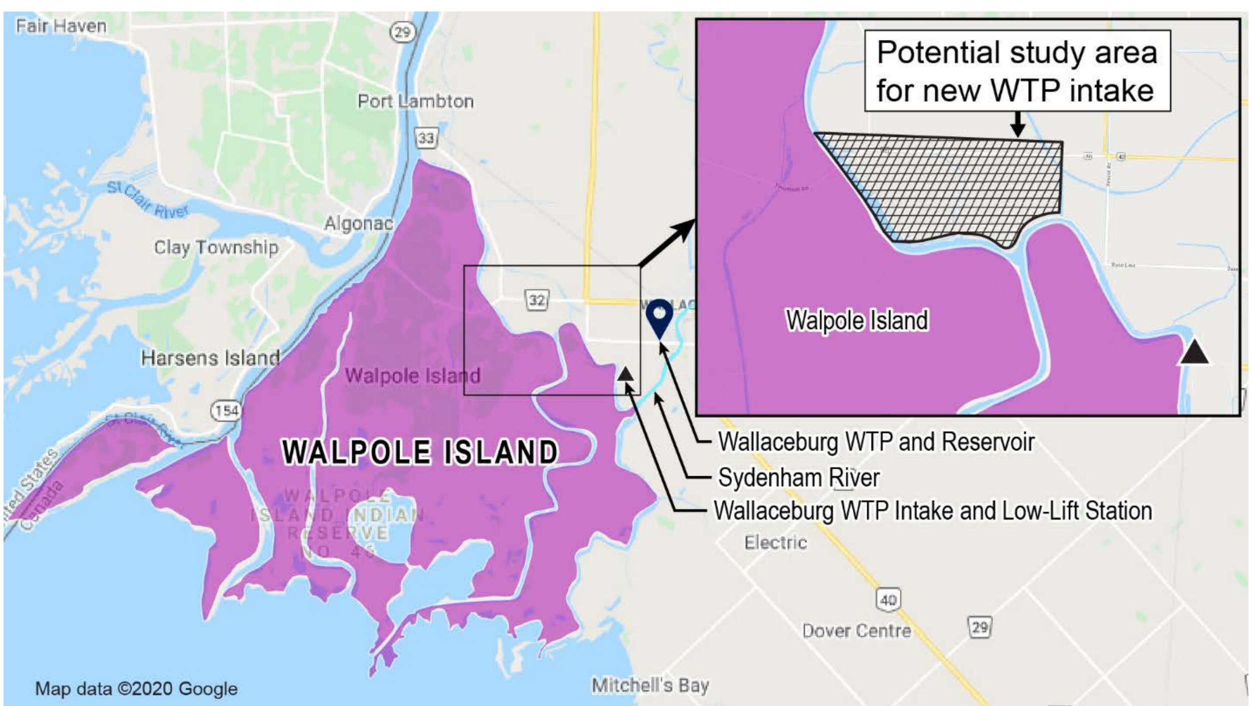
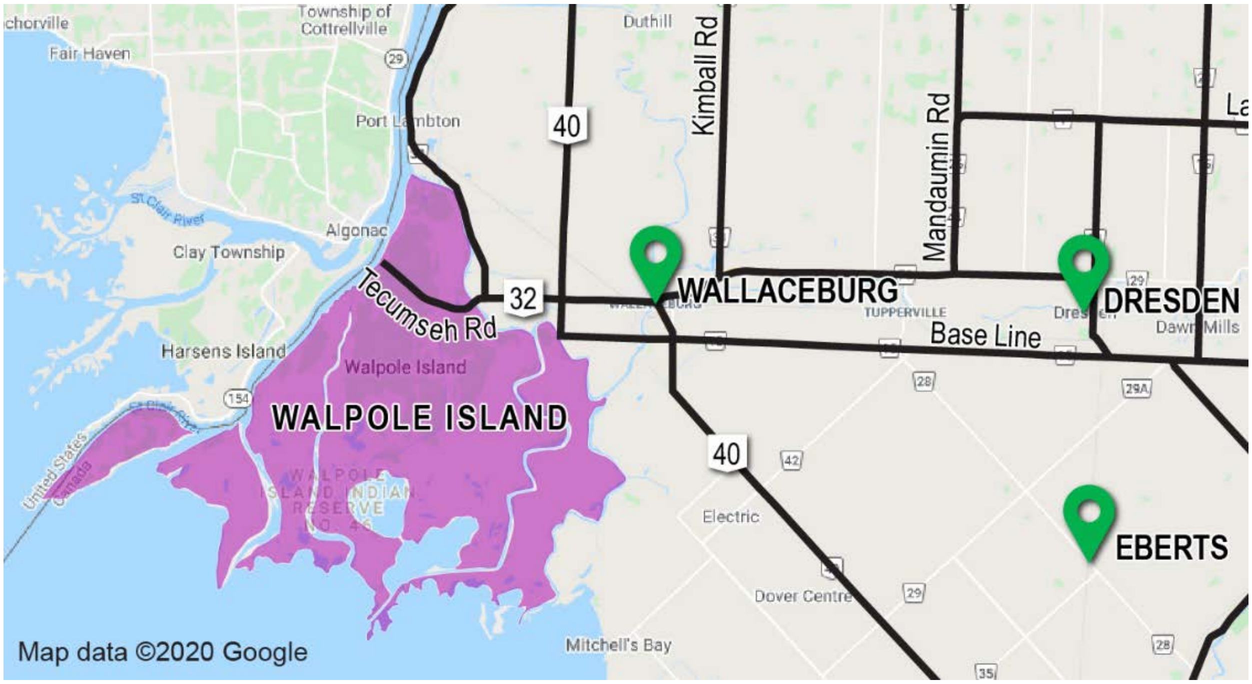


Figure 2-2. Study Area for the Class Environmental Assessment



3. Background Information Review

The following information sources were used to document the existing conditions in the study area, to develop the future conditions, and to support the development of the alternative solutions for this EA:

- Chatham-Kent Official Plan (2018)
- Chatham-Kent Water and Wastewater Master Plan (Dillon 2012)
- Addendum to the Chatham-Kent Water and Wastewater Master Plan (Dillon 2018)
- Drinking Water Works Permit 027-202 Issue 5 for the Chatham-Kent Drinking Water System (2020)
- Historical operational data (water quality and flows) obtained from CK PUC's SCADA system (2017 to 2020)
- Historical plant drawings
- Municipal Drinking Water Licence 027-102 Issue 6 for the Chatham-Kent Drinking Water System (2020)
- Permit To Take Water (PTTW) P-300-4083191560 (2020)
- Utility and chemical usage bills for the Wallaceburg WTP
- Wallaceburg and Area Water Supply Municipal Class EA (Stantec 2016)
- Wallaceburg Drinking Water System Modelling (AECOM 2020b)
- Chatham Drinking Water System Modelling (AECOM 2020a)

4. Inventory of Existing Conditions

In accordance with the Phase 1 requirements of the Class EA process, the existing conditions within the study area were inventoried to establish a baseline condition for this Class EA study. This section provides a high-level description of the established baseline condition, which is used as the foundation for alternative development.

4.1 Technical Environment

4.1.1 Wallaceburg WTP and Intake/LLPS

The Wallaceburg WTP was originally constructed in 1946 and has undergone major upgrades in 1948, 1980, and 2009. It is located at 6750 Baseline Road in Wallaceburg, Ontario, and is rated at 13.6 ML/day (rated capacity), as defined by the Municipal Drinking Water License (MDWL). Raw water is drawn from Chenal Écarte, which receives water from the St. Clair River. The intake is located approximately 2 kilometres from the WTP. The raw water drawn through a raw water intake, passes through the manual bar screens and is seasonally chlorinated for zebra mussel control. The raw water is then pumped to the plant by the LLPS through a 400-millimetre-diameter, 2-kilometre-long raw water transmission main. According to PTTW Number P-300-4083191560, the Wallaceburg WTP can take up to 18.2 ML/day of raw water, while the LLPS has a nominal firm capacity of 24 ML/day (with the largest diesel pump out of service). The Wallaceburg WTP, the LLPS, and intake locations are displayed on Figure 4-1

Figure 4-1
Wallaceburg WTP, LLPS and Intake Location
Technical Memorandum 1
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

Jacobs

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4.1.1.1 Existing Processes

Once raw water reaches the plant, it receives pre-treatment through two pre-treatment tanks to reduce the raw water turbidity. Polyaluminum chloride (PACl) is used as the coagulant for this process. The raw water from Chenal Écarte experiences high turbidity typically during the spring season, which imposes operational and maintenance challenges to the plant.

Pre-treatment is followed by flocculation, sedimentation, and filtration. The flocculation and sedimentation process is divided into four process trains. Flocculation occurs in baffled mixing chambers, located upstream of the sedimentation tanks. The existing sedimentation tanks do not have a sludge removal mechanism, so the settled sludge needs to be manually cleaned out periodically. The four filters are equipped with dual media (gravel/sand and anthracite) and surface agitators. Filtered water is then discharged to the two storage reservoirs in series (1.14 megalitres, then 4.54 megalitres). The water is conveyed to Reservoir 1 from Reservoir 2 via a transfer pumping station. The water production capacity of the plant is currently limited by the transfer pumping station capacity, which is currently 13.6 ML/day in accordance with the Drinking Water Works Permit (DWWP). The usable volume in Reservoir 2 is currently limited by its distance from the high-lift pumping station (HLPS). When the water level in Reservoir 2 drops below 1.9 metres, the high-lift pumps begin to cavitate. In addition to water storage, the reservoirs are also used to provide chlorine contact time (CT) for primary disinfection. Treated water is then discharged to the WDS by the HLPS with a firm capacity of 18 ML/day. Treated water is also stored in the Wallaceburg Elevated Tank (ET).

Chlorine is dosed at the discharge pipe from the pre-treatment tank and at the inlet pipe to the HLPS for pre-chlorination and post-chlorination, respectively. Hydrofluorosilicic acid (HFSA) is dosed at the reservoir discharge pipe for fluoridation.

All plant residuals, including pre-treatment tank sludge, sedimentation tank sludge, filter-to-waste water, and filter backwash wastewater, are discharged to the plant's residue management system. Flows are diverted through a gravity sewer to the process waste pumping station, which discharges to the process waste flow equalization tank. Process wastewater is then discharged to the municipal sanitary sewer.

Treatment processes are displayed on Figure 4-2.

The Wallaceburg WTP is reaching the end of its service life, requiring frequent maintenance. To provide reliable service in the future, it requires substantial upgrades. While continuing to maintain the Wallaceburg WTP was selected as the preferred option in the previous Wallaceburg and Area Water Supply EA (Stantec 2016), maintenance and repairs have been much more frequent, costly, and labour-intensive than anticipated. The LLPS is also reaching the end of its service life, requiring substantial upgrades to remain in service. It is also vulnerable to flooding.

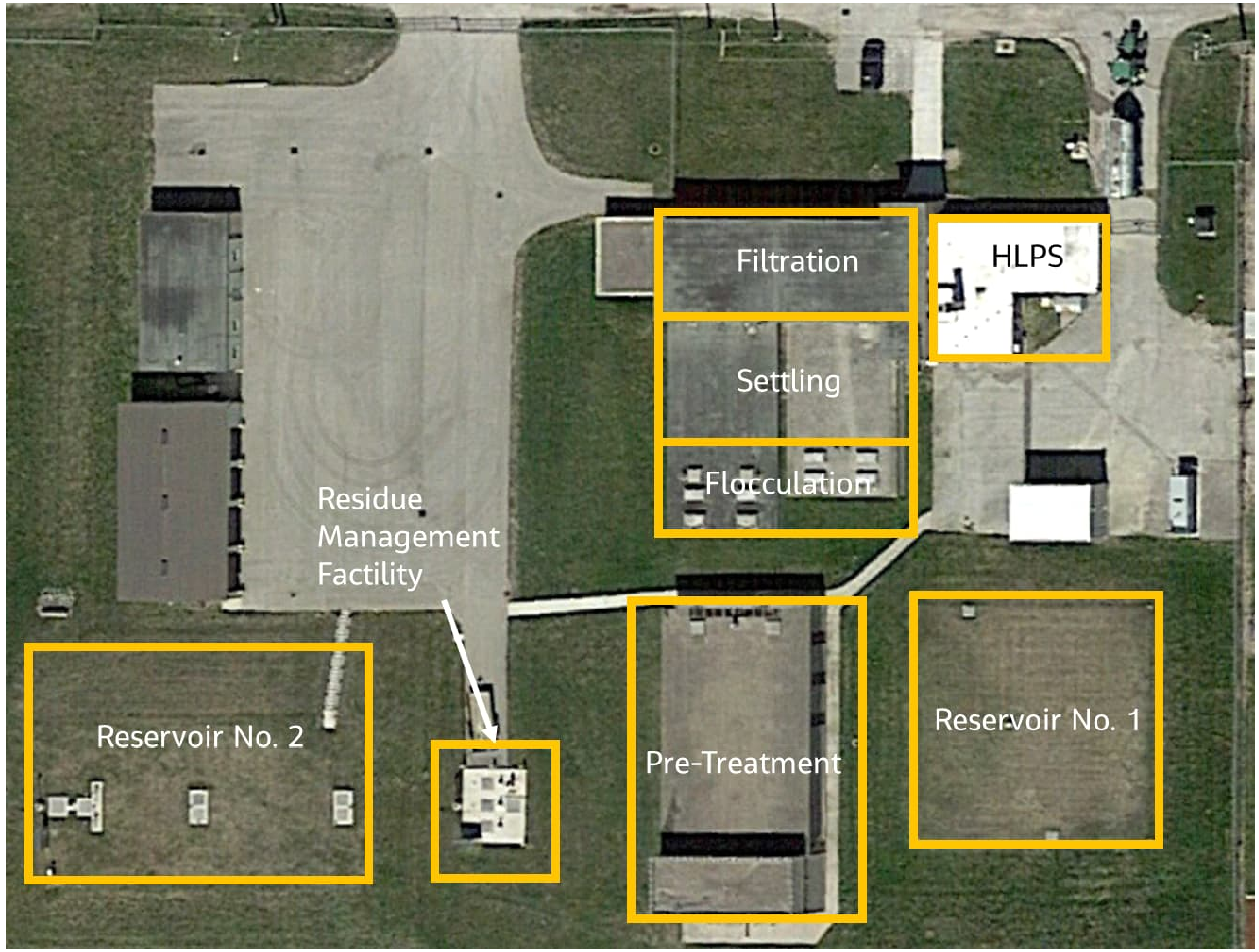

Figure 4-2
Wallaceburg WTP Treatment Processes
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Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

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4.1.1.2 Flow Analysis

Figure 4-3 presents the average day demand (ADD), maximum day demand (MDD), and peak flows (presented for each month) at the Wallaceburg WTP from 2015 to 2020, compared against the plant's rated capacity (14 ML/day).

Flows increased during this period from 3.9 ML/day ADD in 2015 to 4.5 ML/day ADD in 2020. The ADD in 2020 represents 30% of the plant's rated capacity. The MDD followed a similar trend as the ADD, increasing from 5.4 ML/day in 2015 to 7.6 ML/day in 2020. The MDD in 2020 represents 55% of the plant's rated capacity. The ADD typically ranged from 80% to 90% of the MDD, with an average ratio of 82.8% from 2015 to 2020. Based on this information, an ADD to MDD ratio of 80% will be used as a design criterion for alternative development.

The peak flow remained relatively constant during this period, ranging from 11.0 ML/day in 2015 to 13.0 ML/day in 2018.

Of note, the average winter flows (October to April) were only 10% lower than the average summer flows (May to September), which represents a low seasonal variation. This will be considered for the conceptual design phase of this EA.

4.1.2 Dresden Water Supply and Storage

The community of Dresden currently receives its water supply from the Chatham WTP via the Eberts Booster Pumping Station (BPS). There is currently one pressure zone (North Kent pressure zone) supplied by the Eberts BPS, which in addition to Dresden, includes the community of Thamesville. Dresden has a dedicated water storage system, with 5,430 cubic metres of storage provided by the Dresden ET, located on McCreary Line. Water is distributed directly to Dresden from the Eberts BPS, with the Dresden ET providing water equalization in addition to storage.

The Chatham WTP has a rated capacity of 68 ML/day, with a current MDD of 41.5 ML/day that is expected to increase in the future (future projections are presented in Section 5). Existing flow data was obtained from the Chatham WDS Modelling Report (AECOM 2020a). This EA will explore the feasibility of providing water supply to Dresden from the Wallaceburg WTP in the future should Dresden be split from the existing North Kent pressure zone into its own pressure zone. This would reduce the demand at the Chatham WTP and potentially delay requirements for a capacity expansion.

4.1.2.1 Existing Flows

The MDD in Dresden has remained relatively consistent in recent years, approximately 8.8 ML/day as indicated by the CK PUC. Similar to Wallaceburg, this is due to the limited recent growth in Dresden.

4.1.2.2 Existing Transmission Main – Wallaceburg to Dresden

The existing transmission main between Wallaceburg and Dresden is a 200/250-millimetre watermain that extends along Base Line for approximately 16 kilometres from Murray Street in Wallaceburg to the railroad tracks located west of North Street in Dresden. This transmission main is currently used for emergency purposes only and is only able to convey flows less than 4 ML/day, based on a maximum velocity of 2 metres per second, as recommended in the Ministry of Environment, Conservation and Parks (MECP) Design Guidelines for Drinking Water Systems (M.E.C.P. 2008a). This capacity would not be able to supply the existing/future MDD in Dresden of 8.8 ML/day. The existing transmission main route is presented on Figure 4-3.

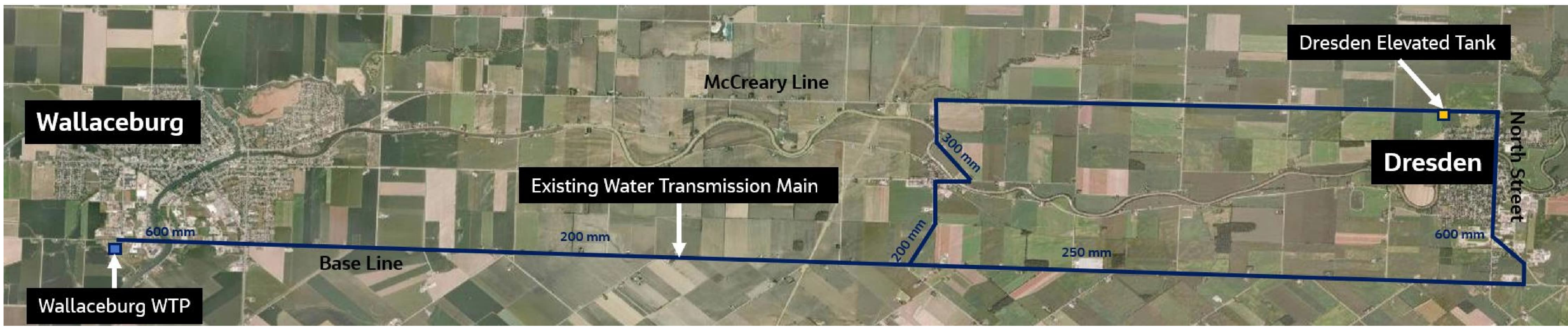

Figure 4-3
Existing Transmission Main between Wallaceburg and Dresden
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4.2 Socio-Economic Environment

The study area, consisting of Wallaceburg and Dresden, is located in both urban and rural areas within the Municipality of Chatham-Kent, which is a single-tier municipality responsible for providing all municipal services. The Municipality is the result an amalgamation of many communities in 1998.

4.2.1 Wallaceburg

4.2.1.1 Study Area Zoning

The Chatham-Kent Comprehensive Zoning By-Law was reviewed to identify the land use zones of relevant properties within the study area (Municipality of Chatham-Kent 2019). The existing Wallaceburg WTP site is zoned for General Industrial land use. This property also includes the land that would be used for a new Wallaceburg WTP. The existing LLPS site is currently zoned for agricultural land use. Two potential LLPS locations were identified upstream of the existing LLPS (with one being the historical LLPS site), with both being zoned for agricultural land use.

A potential raw water main alignment from the upstream LLPS location to the Wallaceburg WTP site was provided by the CK PUC. The raw water main would mainly be within the right-of-way on Bluewater Line; however, a portion of the alignment would require an easement through properties that are zoned for agricultural land use. This alignment will be discussed in more detail in Section 8.

4.2.1.2 Future Growth Planning

The Chatham-Kent Official Plan (Municipality of Chatham-Kent 2018) and Ministry of Finance Population Projections (Ontario Ministry of Finance 2021) were reviewed to determine future growth plans in Wallaceburg, with findings summarized as follows:

- Chatham-Kent Official Plan: From 2011 to 2031, no growth is expected in Wallaceburg.
- Ministry of Finance Population Projections: From 2020 to 2041, the population in Chatham-Kent is expected to grow by 2.4%. Based on the Chatham-Kent Official Plan, it is assumed that this growth will occur in other areas.

Future growth and associated water demands will be discussed in further detail in Section 5.

4.2.2 Dresden

4.2.2.1 Study Area Zoning

The new infrastructure associated with Dresden (water transmission main between Wallaceburg and Dresden) is expected to occur within existing right-of-ways and an easement within agricultural land, so there are no associated changes to land use zoning designations.

4.2.2.2 Future Growth Planning

The Chatham-Kent Official Plan (Municipality of Chatham-Kent 2018) and Ministry of Finance Population Projections (Ontario Ministry of Finance 2021) were reviewed to determine future growth plans in Dresden, with findings summarized as follows:

- Chatham-Kent Official Plan: From 2011 to 2031, the population in Dresden is expected to grow by 2.4%.
- Ministry of Finance Population Projections: From 2020 to 2041, the population in Chatham-Kent is expected to grow by 2.4%. This is in line with the growth anticipated in Dresden from the Chatham-Kent Official Plan.

Future growth and associated water demands will be discussed in further detail in Section 5.

4.3 Social/Cultural Environment

4.3.1 Stage 1 Archaeological Study

To support this Class EA, a Stage 1 Archaeological Assessment was completed within the study area. Key findings are summarized as follows (Golder 2021c):

- No archaeological resources were identified at this stage.
- The study area for the upstream LLPS location and new Wallaceburg WTP were found to have archaeological potential, as they were not subjected to previous disturbances.
- Stage 2 assessments (test pit surveys) are recommended for these areas during detailed design.

4.3.2 Cultural Heritage Study

A cultural heritage study was undertaken to identify any potential cultural heritage resources within the study area that may be impacted by the alternative solutions in this Class EA. No protected heritage properties designated under Part IV or Part V of the *Ontario Heritage Act* were identified. Overall, 286 properties with buildings more than 40 years old of potential cultural heritage value or interest were identified. The preliminary recommendation is to site and route infrastructure to avoid these properties; however, one of the raw water main routes would pass through one of these properties, based on the alignment provided by the CK PUC (29108 Mirwin Road). Should this raw water main alignment be the preferred solution, a Cultural Heritage Evaluation Report may be required (Golder 2021a).

4.4 Natural Environment

4.4.1 Natural Features Study

A natural features assessment was completed in spring 2021 for the original study area, which includes potential locations for the LLPS and intake, Wallaceburg WTP, and raw watermains. The raw watermain alignments and LLPS locations are discussed in further detail in the alternatives development sections of this TM (Sections 7, 8, and 9). The natural features assessment for the water transmission alternatives was completed in late summer and fall 2021. One alternative alignment for the water transmission alternative was adjusted late in 2021 and as such, only a desktop level evaluation is currently completed for that alignment. The following subsections present the conclusions from the natural features study. More details are found in the Wallaceburg Water Treatment Servicing Class EA Natural Features Study (Jacobs 2022).

4.4.1.1 Water Supply and Raw Water Supply Alternatives

From the field work and background information reviews, the study area (mainly focused on potential LLPS sites and raw watermain alignments) was found to contain numerous natural features. Conclusions from the study relating to the existing site and alternative solutions are summarized as follows:

- It is expected that the raw watermain alignments (detailed in Section 8) will transect water crossings. Agricultural zones dominate the area. To minimize impacts, the new raw watermain should follow an alignment within the agricultural communities/road right-of-way and avoid the agricultural drain crossings to the extent that is possible.
- The existing LLPS site is within an existing disturbed and residential area. However, this area is proximal to Chenal Écarte and the watercourse could be impacted from the proposed works. As the site is disturbed, this site has the least potential for impacts to the natural environment (on land).
- Based on a desktop investigation, both of the upstream LLPS locations (detailed in Section 8) occur within open agricultural zones and therefore, are not expected to have significant or unacceptable impacts to terrestrial receptors.
- Construction of a new intake will require in-water works within the Chenal Écarte. Construction methods and mitigation measures should be selected to minimize impacts where possible. Each intake location is not expected to have any unacceptable impacts to the aquatic environment.
- If wastewater from a new Wallaceburg WTP is discharged to a sanitary sewer, which is expected (i.e., residuals and wastewater generated by plant staff), an assessment of impacts on the wastewater treatment plant (WWTP) should be undertaken. Impacts to the Wallaceburg WWTP from a treatment capacity perspective for each water supply alternative are detailed in Section 7.2.6. Further investigation would include wastewater quality analysis (i.e., influent total solids and inorganic content, potential impacts to biological treatment processes).

A new raw watermain will likely result in a permitting effort with St. Clair Region Conservation Authority (SCRCA), and potentially the MECP under the Ecologically Significant Area and Department of Fisheries and Oceans (DFO). All the LLPS locations carried forward for further evaluation will likely require a permit from SCRCA. In addition, in-water works will require permitting with DFO. While the work may be able to be isolated, to protect death of fish and avoid harmful, alteration, disruption, or destruction (HADD), a *Species at Risk Act* permit may be required by DFO due to the presence of aquatic species at risk (SAR) within the Chenal Écarte. A new WTP would likely require a permit from SCRCA, and as noted earlier, a discharge effluent assessment may be required in consideration for potential impacts to fish and fish habitat. A Natural Features Impact Assessment Report will be provided once preferred solutions for this Class EA are selected. The report will also further define the likelihood of permitting required with SCRCA, MECP and DFO.

4.4.1.2 Water Transmission Alternatives

The alternatives discussed in this section are described in further detail in Section 9. Based on a combination of field work and desktop review, both Alternatives 1 and 2 could have impacts on terrestrial receptors, including SAR. Alternative 1 is approximately 17.3 kilometres long and Alternative 2 is approximately 19.7 kilometres long. Therefore, Alternative 1 consists of a reduced linear area in comparison to Alternative 2. In addition, Alternative 1 could have less impacts on the terrestrial environment due to a large portion of the proposed alignment occurring within an area already containing an existing watermain. Alterative 2 could also use a disturbed area from the existing watermain.

Both Alternatives 1 and 2 are proposed to cross the Sydenham River, proximal to Wallaceburg, which could have an impact on SAR fish and mussels. As well, Alternative 1 crosses Maxwell Creek and Alternative 2 crosses Drummond Creek. As mentioned earlier, Alternative 2 also has a larger linear footprint.

As discussed, Alternative 3 was an option added to the study after the field season. As such, the only field data currently available for this new alignment is the area proximal to Alternative 1. Alternative 3 only appears to require one crossing, at the Sydenham River, whereas Alternatives 1 and 2 require multiple crossings. As such, Alternative 3 would likely have a lesser impact on wildlife and vegetation due to a possibly reduced impact on fish habitat, given there is only one crossing. However, the right-of-way for Alternative 3 appears to occur nearby existing agricultural drains, which appear to be hydrologically connected to the Sydenham River and additional fish bearing habitat to the south. Work in proximity to the hydrologically connected drains could result in a greater impact to the Sydenham River and fish habitat. At the detailed design stage, planning should include avoidance of these areas and appropriate construction techniques and mitigation to avoid offsite impacts. The natural features associated with Alternative 3 should be verified as part of in-season field surveys. However, based on the desktop investigation, Alternate 3 may have a lesser likelihood of potential adverse effects to the natural environment in comparison to Alternatives 1 and 2. As such, Alternative 3 may be the preferred alternative form an ecological perspective.

The Sydenham River, Drummond Creek, Maxwell Creek, and the agricultural drains could be impacted from the proposed alternatives for example by sedimentation, changes in timing or frequency of flows, water quality adverse effects, and direct degradation of habitat. At this stage, it is unknown whether the crossings will require an open-cut or trenching method. An assessment may need to be carried out by a qualified aquatic biologist at the detailed design stage. The assessment could conclude whether there is a risk that death of fish, impacts to aquatic SAR, or harmful, alteration, disruption, or destruction (HADD) of fish habitat could occur to ensure compliance with the *Fisheries Act* and to outline permitting next steps. Both alternatives will likely require a Request for Review to be submitted to DFO for any proposed in-water works and possibly for near water works (i.e., within the ordinary high-water mark).

A Natural Features Impact Assessment report will provide preliminary mitigation recommendations and a discussion of likely natural environment permitting requirements and recommendations for additional ecology surveys at the detailed design stage once a preferred alternative is selected.

4.4.2 Surface Water Study

As some water supply alternatives would require substantially more water-taking than is currently allowed by the existing PTTW for the Wallaceburg WTP, and it is likely that a Category 3 PTTW application is required, a surface water study was completed to assess the potential to increase the volume of water that can be taken from the Chenal Écarte. This surface water study will also be used in support of an application for a new PTTW if required. The study was completed in two stages, as follows:

- **Stage 1:** Comprising of a high-level, desktop-based feasibility study to determine if increasing the raw water demand to 34 ML/day would generate any unacceptable risks or impacts to the surface water and aquatic environments.
- **Stage 2:** Completion of a detailed surface water study, consisting of field survey program, desktop and modelling analysis to assess the potential changes to the surface water environment at the intake location as a result of the water taking and in turn, determine the potential effects on stream processes, water quality, aquatic habitat, and fish passage.

4.4.2.1 Stage 1 Results

Based on the results from the Stage 1 Surface Water Study, no significant impacts to the surface water and aquatic environments of the Chenal Ecarte are expected from an increase in water taking from 18.2 ML/day to 34 ML/day (Golder 2021d). The increase in water taking would produce only nominal reductions to flow volumes, water levels, flow velocities, and water quality loads. Therefore, at this stage, no unacceptable risks were identified associated with the increase in water taking.

4.4.2.2 Stage 2 Results

At the time of writing this TM, the Stage 2 Surface Water Study is currently underway.

5. Future Water Demand Projections

This section presents the future water demand projections for the Wallaceburg WTP, which are used as the basis for alternative solution development. Water demands in Wallaceburg and Dresden were considered, as well as water demands for potential greenhouse development in the area. Future water demands at the Chatham WTP were also considered to assess the impacts of different water supply alternatives on the Chatham WTP and associated water transmission infrastructure.

The planning horizon for this Class EA is 50 years, to 2070. While Class EA planning horizons are typically shorter (20 to 30 years), 50 years was selected as this is the typical service life for a new WTP.

5.1 Wallaceburg

Future water demands in terms of MDD in Wallaceburg are presented in Table 5-1 and on Figure 5-1 and were obtained from the Wallaceburg WDS Modelling Report (AECOM 2020b), which is based on the Chatham-Kent Official Plan and the Chatham-Kent Comprehensive Municipal Review. There is little to no growth anticipated in Wallaceburg within the planning horizon, with a 3.4% decrease in population expected from 2016 to 2039 (AECOM 2020b). However, Whyte's Foods' water usage is expected to increase in the future. It is anticipated that an additional 25 litres per second, or 2.1 ML/day, of water will be required by 2039 by Whyte's Foods, which is the source of the projected water demand increase in Wallaceburg within the planning horizon. This increase is displayed as a gradual increase between 2019 and 2039. In reality, the increase will be a step up of 2.1 ML/day in the year that Whyte's Foods begins taking water, which is currently unknown.

Water demand projections were only provided to 2039. For the remainder of the planning horizon, it is assumed that there will be no population growth to provide a conservative water demand estimate. As no additional large industrial, commercial, and institutional users have been identified at this time, it is also assumed that there will be no additional industrial, commercial, and institutional growth, with constant water demands from 2039 to 2070.

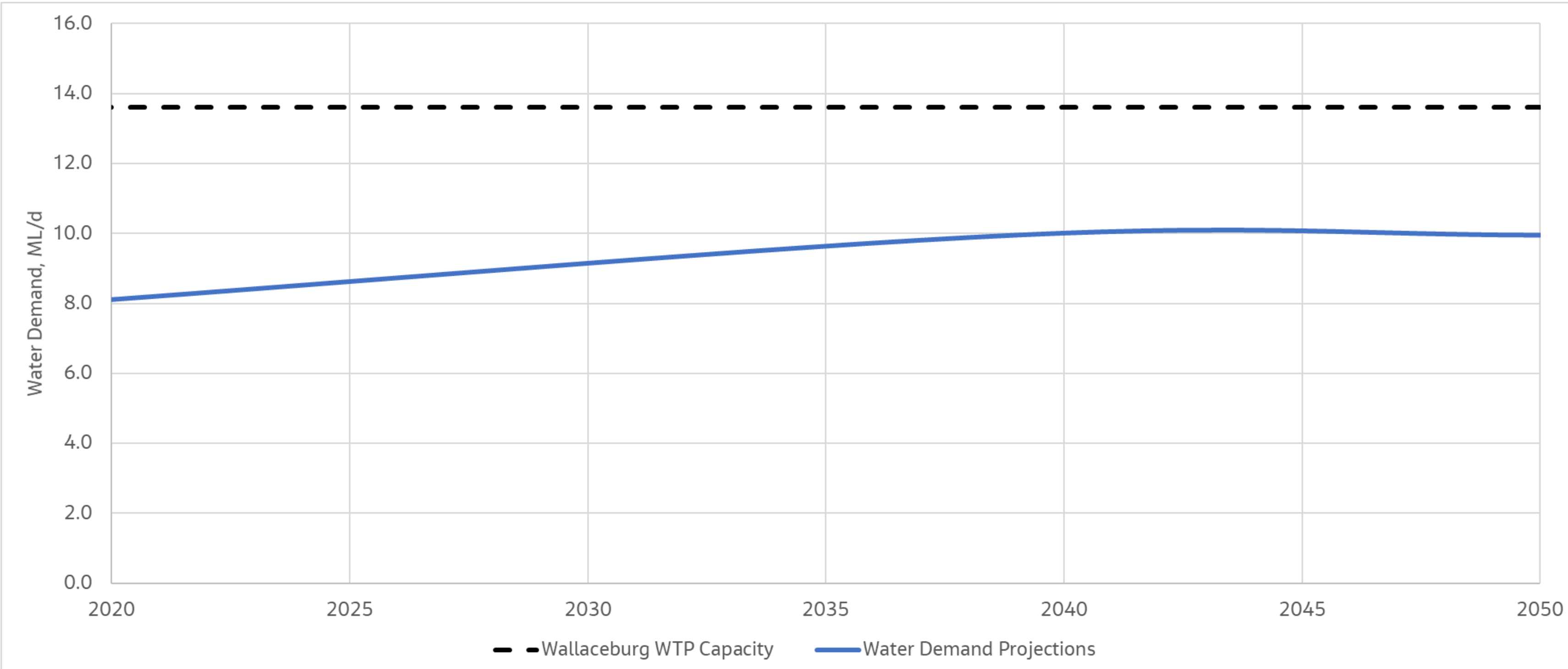
Table 5-1. Future Water Demands in Wallaceburg

Year	Population	Population Demand, ML/day	Whyte's Foods Demand, ML/day	Water Demand – MDD, ML/day
2019	10,080	8.0	0	8.0
2039	9,740	7.8	2.1	9.9
2050	9,740	7.8	2.1	9.9
2070	9,740	7.8	2.1	9.9

5.2 Dresden

As discussed, there is little growth expected in Dresden over the planning horizon. As indicated by the CK PUC, the future MDD in Dresden is expected to remain constant throughout the planning horizon at 8.8 ML/day, equivalent to current conditions.

Figure 5-1. Future Water Demands in Wallaceburg



5.3 Future Greenhouse Developments

The CK PUC has indicated that future greenhouse growth is expected along Base Line between Wallaceburg and Dresden, which would be serviced by the Wallaceburg WTP. The anticipated demand for these future greenhouses is 100 litres per second or 8.6 ML/day. As the timing of this development is currently unknown, it is assumed that the greenhouses will be online by 2039.

5.4 Summary of Future Water Demands – Wallaceburg WTP

Table 5-2 presents a summary of the future water demands (MDD) to the Wallaceburg WTP, both with and without the projected future demands in Dresden. While the greenhouse demands are shown as a linear increase from 2019 to 2039, this increase in demand will be shown as a step in the year that the greenhouses come online, similar to the increased demand from Whyte's Foods.

Considering the demands in Dresden, the ultimate MDD at the Wallaceburg WTP will be 27.4 ML/day in 2070. Considering only the demands from Wallaceburg and future greenhouses (if Dresden continues to be serviced by the Chatham WTP), the ultimate MDD at the Wallaceburg WTP will be 18.5 ML/day. As the current rated capacity of the Wallaceburg WTP is 13.6 ML/day, an expansion of the existing WTP or construction of a new WTP is required to meet future demands. Of note, the demand in both scenarios exceeds the existing PTTW limit. Therefore, a new PTTW would be required.

5.5 Chatham WTP

Water demand projections for the Chatham WTP were provided by the CK PUC. Table 5-3 presents a breakdown of future water demands at the Chatham WTP within the planning horizon. These demands are presented relative to the rated capacity of the Chatham WTP on Figure 5-3.

The following conclusions were made based on the water demand projections presented previously.

- If Dresden is serviced by the Wallaceburg WTP, the Chatham WTP will require a major expansion by 2046 and the conveyance infrastructure (transmission mains, Eberts BPS) will require major upgrades within the planning horizon.
- If Dresden is serviced by the Chatham WTP, the Chatham WTP will require a major expansion by 2041,and the conveyance infrastructure (transmission mains, Eberts BPS) will require major upgrades within the planning horizon.

While the benefit of 5-year delay in the Chatham WTP expansion is not significant, supplying water from Wallaceburg to Dresden would achieve more evenly distributed water supply between the Chatham WTP and the Wallaceburg WTP and increase overall water supply security within Chatham-Kent. The impacts of supplying the future greenhouses on Base Line from the Chatham WTP were also investigated. Under this scenario, a major expansion of the Chatham WTP would be required in 2036, further advancing the timeline for expansion by 5 years. However, these upgrades are required during the planning horizon regardless of which scenario is selected.

Table 5-2. Future Water Demand Projections: Wallaceburg WTP

Year	Wallaceburg Demands, ML/day	Dresden Demands, ML/day	Greenhouse Demands, ML/day	Wallaceburg WTP Demands: Wallaceburg, Dresden, and Greenhouses, ML/day	Wallaceburg WTP Demands: Wallaceburg and Greenhouses, ML/day	Wallaceburg WTP Demands: Wallaceburg only, ML/day
2019	8.0	8.8	0	25.4	16.6	8.0
2039	9.9	8.8	8.6	27.4	18.5	9.9
2050	9.9	8.8	8.6	27.4	18.5	9.9
2070	9.9	8.8	8.6	27.4	18.5	9.9

Figure 5-2. Future Water Demand Projections: Wallaceburg WTP

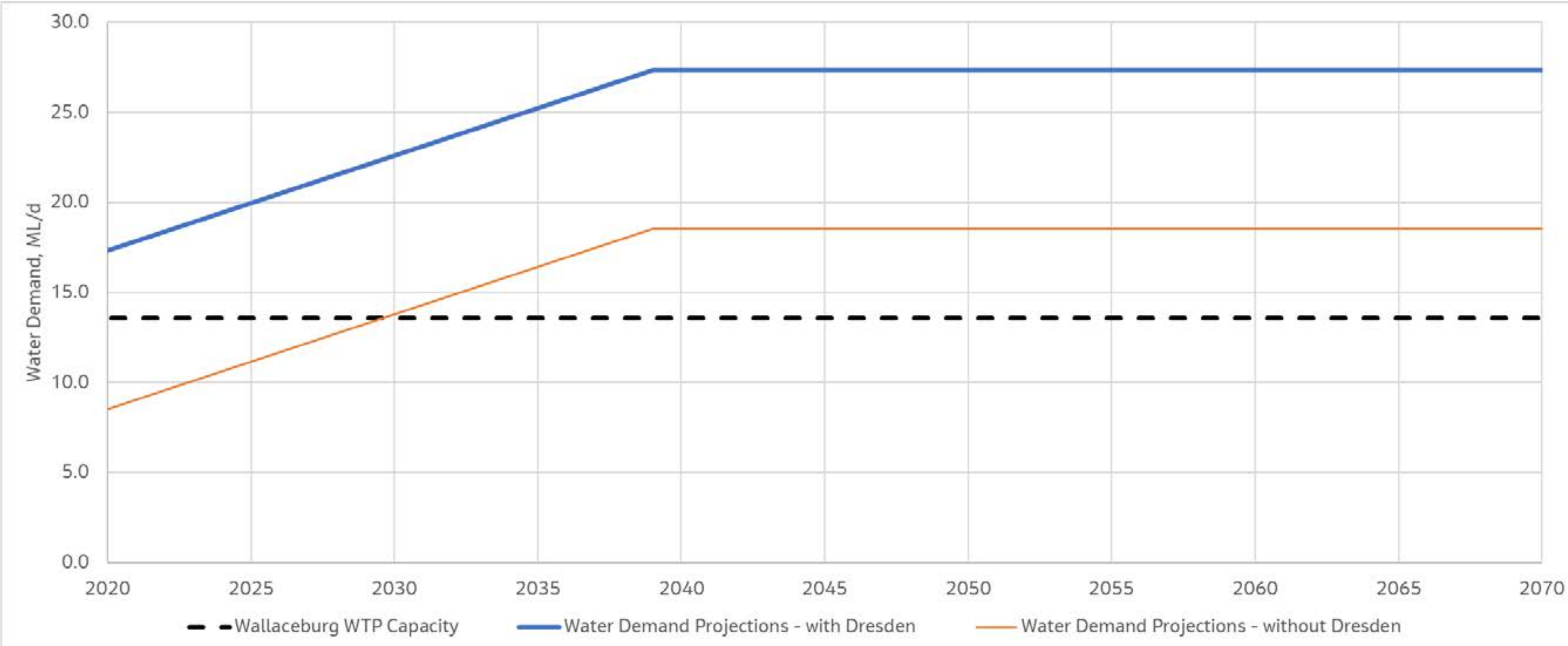


Table 5-3. Future Water Demand Projections - Chatham WTP

Year	Residential Demand, ML/day [a]	Other Large Users in Chatham, ML/day [b]	Greenhouse Demand in Chatham, ML/day [c]	Proposed Greenhouse Demand in Northeast Chatham-Kent, ML/day [d]	Conagra, ML/day [e]	Chatham WTP Demand with Dresden, ML/day	Chatham WTP Demand With Dresden and Future Greenhouses, ML/day [f]	Chatham WTP Demand Without Dresden, ML/day [g] Without Dresden [g]
2019	29.6	6.0	5.4	0.0	6.5	47.6	56.2	38.7
2039	31.4	8.3	7.6	10.4	6.5	64.1	72.8	55.3
2050	31.7	9.7	20.2	22.9	6.5	91.0	99.6	82.2
2070	32.3	12.1	41.1	43.8	6.5	135.8	144.4	127.0

[a] Annual increase of 0.32% per year (provided by the CK PUC).

[b] Increase of 6.1 ML/day by 2070. Increase assumed to be linear (provided by the CK PUC).

[c] An additional 12.5 ML/day is expected to be online by 2039. 12.1% growth per year assumed from 2039 to 2070 (provided by the CK PUC).

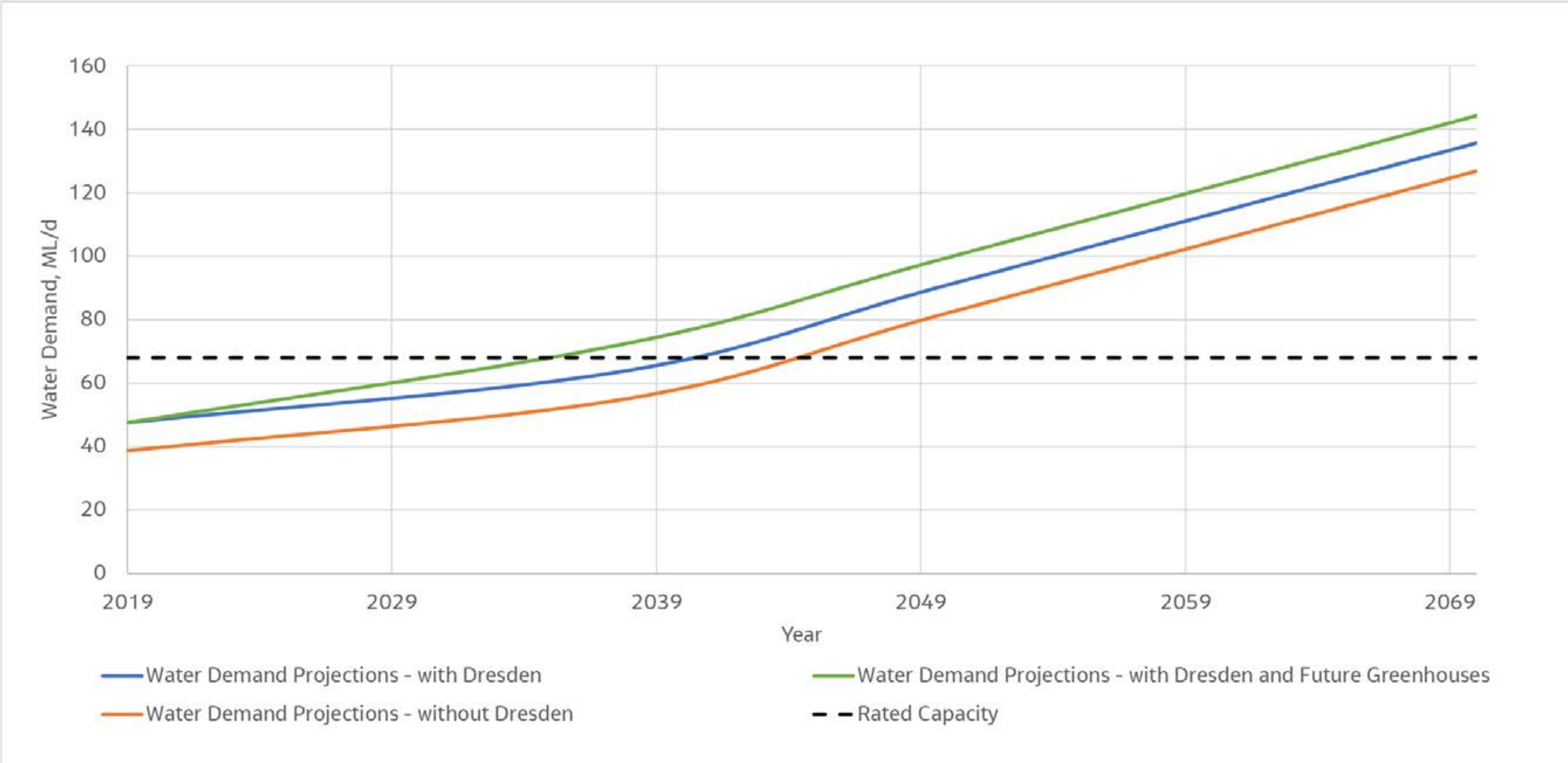
[d] An additional 10.4 ML/day is expected to be online by 2039. 12.1% growth per year assumed from 2039 to 2070 (provided by the CK PUC).

[e] No demand increase anticipated (provided by the CK PUC).

[f] 8.6 ML/day (future projected demand for future greenhouses on Base Line between Wallaceburg and Dresden) added to the total demand.

[g] 8.8 ML/day (future projected demand in Dresden) subtracted from the projected demand.

Figure 5-3. Future Water Demand Projections: Chatham WTP



6. Alternatives Development and Evaluation Methodology

This section presents the methodology for developing and evaluating the alternative solutions for this Class EA.

6.1 Alternative Development Methodology

To help identify a comprehensive solution to address the problems and opportunities as stated in Section 2, alternative development and evaluations were completed, respectively, for three project components, each of which focuses on a different aspect of a complete water supply system. Alternative solutions were developed and evaluated for the following:

- **Overall Water Supply Strategy –** relating to various future supply scenarios to meet the water demand projections in the service areas as presented in Section 5.
- **Raw Water Supply –** relating to the future location of the LLPS and intake. In addition to the existing location, two locations upstream of the existing LLPS are being considered. The size of the LLPS and intake was determined based on the preferred overall water supply strategy.
- **Water Transmission –** relating to the alignment of the proposed transmission main between Wallaceburg and Dresden, if the supply of water from Wallaceburg to Dresden becomes a part of the preferred overall water supply strategy.

The three alternative project components were evaluated in a stepwise manner; first, the alternative solutions for overall water supply strategy were evaluated, which provides a basis for the future raw water supply and water transmission needs. Then, the raw water supply and water transmission alternatives were evaluated. The preferred solutions from these three sets of alternative form the overall preferred solution for the Wallaceburg Water Treatment Servicing Class EA.

To identify the preferred solution from each set of alternatives, an evaluation methodology was developed, aligned with the Class EA evaluation framework, to allow for a comparative assessment of each set of alternative solutions. A unique set of evaluation criteria, reflecting four overarching categories of environment: natural, socio-cultural, technical, and economic, was established for evaluating each set of alternatives.

6.2 Cost Estimation Methodology

This section presents the cost estimating methodology that was used to develop capital costs, operations and maintenance (O&M) costs, and lifecycle costs for each alternative.

6.2.1 Capital Cost Estimation Basis

Capital cost estimates were developed for each alternative solution. Capital costs for new infrastructure were developed using Jacobs' Conceptual and Parametric Engineering System (CPES). CPES uses a database of project data and quantity take-offs to develop conceptual estimates. Unit process modules within CPES are based on actual construction costs from Jacobs' projects and supplemented by Means and Richardson's cost data. The Jacobs database of material and equipment costs is adjusted based on Engineering News Record indexes for location and monthly cost index updates to reflect real market conditions and local labour costs. For the purposes of this project, unit costs are adjusted for the Southwestern Ontario and Greater

Toronto Area construction markets. The generated cost estimates include allowances to reflect the risks and contingency factors associated with predicting future costs. Where applicable, capital cost estimates may be developed based on vendor quotations for specific equipment or technologies and by using reference projects of similar scope to obtain high-level estimates.

The construction capital costs developed using CPES are approximately plus 50% to minus 30%, including the following mark-ups and adjustment factors, unless otherwise specified:

- 2% of process total for instrumentation and controls
- 10% contractor overhead
- 3% project staff overhead (Owner)
- 4% general conditions
- 3% mobilization and demobilization
- 1% insurance
- 1% bond
- 10 % contractor profit
- 30 % estimating contingency
- 10 % engineering fees

Where rehabilitation was required in an alternative, the U.S. Environmental Protection Agency drinking water treatment cost models (E.P.A. 2007) were used to complete capital cost estimates. Costs were escalated to 2021 using the Engineering News Record Construction Cost Index and converted to Canadian dollars. The previously described mark-ups and adjustment factors were also used for these capital cost estimates.

6.2.2 Operations and Maintenance Cost Basis

The O&M costs were developed based on the future water demand projections (ADD) for each alternative, which are assumed to be 80% of MDD based on the historical flow analysis presented in Section 4.1.1.2. The O&M cost estimates for each set of alternatives required specific considerations not common to all sets of alternatives (water demand considerations, chemical consumption, and specific maintenance requirements), which are discussed in further detail in Sections 6.3, 8, and 9. This section documents the general basis for O&M cost development.

O&M costs were developed considering the following conditions:

- **Electricity:** The average electricity cost at the Wallaceburg WTP in dollars per kilowatt hour between 2017 and 2020 was used when developing annual operating costs, as this period is the most representative of the electricity usage patterns at the Wallaceburg WTP. Jacobs' CPES tool was used to estimate electricity consumption for new infrastructure. For existing infrastructure, historical electricity consumption at the Wallaceburg WTP was used as the basis, prorated to estimate the consumption for future flows. Electricity consumption was estimated for average daily flows.

- **Chemicals:** Chemical costs can be affected by macroeconomics and local supply and demand; therefore, it is difficult to project the chemical cost in the long-term future. For the purpose of this study, costs for chemicals were based on recent bills as provided by the CK PUC or on previous Jacobs projects in the area. While citric acid is not currently used at the Wallaceburg WTP, it would be required for membrane cleaning if a new membrane WTP is selected as the preferred solution. For comparison purposes, disinfection O&M costs were developed with chlorine gas as the chemical of choice. It was also assumed that sodium hypochlorite will continue to be used for zebra mussel control at the raw water intake in the future. Chemical consumption was estimated for average daily flows.

The basis of annual O&M cost estimates is presented in Table 6-1.

Table 6-1. O&M Cost Basis for Evaluation of Alternative Solutions

Item	Unit Cost	Source/Basis
Electricity	$0.15 per kilowatt hour	PUC billing data
Coagulant (PACl)	$0.60 per kilogram	PUC billing data
Sodium Hypochlorite	$0.18 per cubic metre	Previous Jacobs projects
Chlorine Gas	$1.10 per kilogram	PUC billing data
Hydrofluorosilicic Acid	$0.80 per kilogram	Previous Jacobs projects
Citric Acid [a]	$2.70 per kilogram	Previous Jacobs projects
Labour	$50 per hour	Previous Jacobs projects
Maintenance	2% of equipment costs	Previous Jacobs projects

[a] Not currently used. Required for membrane cleaning in a new WTP.

6.2.3 Lifecycle Cost Basis

Lifecycle costs (50-year) estimates were developed by calculating the net present value of the capital costs and annual O&M costs to the year 2070. Table 6-2 summarizes the basis for lifecycle cost estimate for this study.

Table 6-2. Lifecycle Cost Basis for Evaluation of Alternative Solutions

Item	Value	Source/Basis
Lifecycle Duration	50 years	The planning horizon is 50 years.
Discount Rate	5%	Similar Jacobs projects in Ontario.
Inflation Rate	2%	Similar Jacobs projects in Ontario; general inflation rate to be applied on annual O&M costs for utilities, chemicals, labour, and maintenance

6.3 Greenhouse Gas Emissions Estimation Methodology

Greenhouse gas (GHG) emissions were evaluated for each alternative in terms of their impact on the CK PUC system only. GHG emissions by the other water utility (LAWSS) related to supply of water to Wallaceburg in some of the alternatives were not considered.

GHG emissions were estimated based on the consumption of purchased electricity, consistent with the International Organization for Standardization 14064 for GHG verification and accounting (ISO 2006). Natural gas consumption is also typically considered, however, would be expected to have a minimal impact compared to electricity consumption at a WTP and as such, was assumed to have a negligible impact. Only Scope 1 and Scope 2 emissions were considered in developing GHG emission projections, which is a typical GHG emission reporting practice in municipalities. Scope 1 and Scope 2 emissions are defined as follows by the International Panel on Climate Change (IPCC 2006):

- Scope 1: Direct GHG emissions
- Scope 2: Indirect GHG emissions due to electricity, heat, or steam usage

The emission factors are published in the National Inventory Report (ECCC 2020), updated to publish new annual emission factors for up to 2 years before the report year (the 2020 report updates the emission factors up to the year 2018). To estimate the GHG emissions due to electricity consumption, an emission factor of 30 grams of carbon dioxide equivalent per kilowatt hour was used. For WTPs, Scope 1 emissions are minimal in comparison to Scope 2 impacts.

6.4 Evaluation Methodology

To identify the preferred solution from each set of alternatives described in Sections 7, 8, and 9, an evaluation methodology was developed, aligned with the Class EA process evaluation framework, to allow for a comparative assessment of each set of alternative solutions. A unique set of evaluation criteria was established for each set of alternatives, reflecting four overarching categories of environment: natural, socio-cultural, technical, and economic. Criteria were tailored for each set of alternatives such that the analysis was focused on the objectives necessary to make a decision based on the four categories.

Alternative solutions were scored for each of the criteria using the following scoring methodology, with a rationale provided to support each score:

- 10 = highest score
- 5 = moderate score
- 1 = lowest score

To make sure that categories with a higher number of criteria did not skew the evaluation results, each category was given an equal weighting of 25%. Sensitivity analyses were then completed by giving each category a higher weighting to determine the impact of certain categories on the selection of preferred solution. The category weightings for the alternatives evaluation and the sensitivity analyses are presented in Table 6-3.

Table 6-3. Category Weightings for Water Supply Alternatives Evaluation and Sensitivity Analyses

Category	Evaluation	Sensitivity Analysis 1 (for Natural Environment)	Sensitivity Analysis 2 (for Social/Cultural Environment)	Sensitivity Analysis 3 (for Technical Environment)	Sensitivity Analysis 4 (for Economic Environment)
Natural Environment	25%	40%	20%	20%	20%
Social/Cultural Environment	25%	20%	40%	20%	20%
Technical Environment	25%	20%	20%	40%	20%
Economic Environment	25%	20%	20%	20%	40%

Once evaluation scores and rationales were provided for each alternative, the scores were totaled and normalized to an overall score out of 100 based on the category weightings.

7. Development and Evaluation of Water Supply Alternatives

7.1 Water Supply Alternatives

Water supply alternatives were developed to address the overall water supply strategy as reflected in the Problem and Opportunity Statement in Section 2, and to meet the future water demand projections related to the service areas presented in Section 5. The alternative solutions were compared against the “Do Nothing” baseline alternative (continue maintaining and rehabilitation the existing Wallaceburg WTP). Water supply alternatives are based on two main factors, as follows:

- Ultimate (at the end of the planning horizon) flow of water supply required at the Wallaceburg WTP. The required water supply flow depends on the areas to be supplied by Wallaceburg in the future. There is an opportunity for Wallaceburg to supply Dresden and the future greenhouse developments. Alternatively, Dresden or the future greenhouse could be supplied by the Chatham WTP.
- Source of water supply. The potential sources of water supply include the Wallaceburg WTP, Chatham WTP, and LAWSS.

Multiple water supply alternatives were developed, with the ultimate water supply requirement (MDD) from Wallaceburg for each alternative presented in Table 7-1.

Table 7-1. Water Supply Alternatives – Ultimate Volume Requirements

Alternative Number	Water Supply Alternatives	Ultimate Water Supply Demand from Wallaceburg, ML/day
1	“Do Nothing” baseline alternative	9.9
2	Wallaceburg to supply Wallaceburg, Dresden, and future greenhouse developments	28
3	Wallaceburg to supply Wallaceburg and future greenhouse developments. Chatham WTP to continue supplying Dresden	18.6
4	Wallaceburg to supply Wallaceburg only. Chatham WTP to supply Dresden and future greenhouse developments	9.9

Following establishment of the overall water supply alternatives, the three water supply sources (Wallaceburg WTP, Chatham WTP, LAWSS) were considered to develop the sub-alternatives under each alternative. The complete alternative list is shown in Table 7-2. Additional requirements for the alternatives (LLPS, intake) are presented in the following sections.

Table 7-2. Water Supply Alternatives and Sub-alternatives

Alternative Number	Water Supply Scenario	Water Supply Volume Required, ML/day
1	"Do Nothing" baseline alternative	9.9
2	Wallaceburg to supply Wallaceburg, Dresden, and future greenhouse developments	28
2a	▪ Build a new Wallaceburg WTP – rated capacity of 28 ML/day	
2b	▪ Build a new Wallaceburg WTP – rated capacity of 14 ML/day ▪ Upgrade the existing Wallaceburg WTP – rated capacity of 14 ML/day	
2c	▪ Build a new Wallaceburg WTP – rated capacity of 16.5 ML/day ▪ Supplement water supply from LAWSS – 11.5 ML/day	
2d	▪ Obtain all water supply from LAWSS – 28 ML/day	
3	Wallaceburg to supply Wallaceburg and future greenhouse developments. Chatham WTP to continue supplying Dresden	18.6
3a	▪ Build a new Wallaceburg WTP – rated capacity of 18.6 ML/day	
3b	▪ Upgrade the existing Wallaceburg WTP – rated capacity of 14 ML/day ▪ Supplement supply with water from the Chatham WTP – 4.6 ML/day	
3c	▪ Upgrade the existing Wallaceburg WTP – rated capacity of 14 ML/day ▪ Supplement water supply from the LAWSS – 4.6 ML/day	
4	Wallaceburg to supply Wallaceburg only. Chatham WTP to supply Dresden and future greenhouse developments	9.9
4a	▪ Upgrade the existing Wallaceburg WTP – rated capacity of 14 ML/day	
4b	▪ Build a new Wallaceburg WTP – rated capacity of 14 ML/day	

The following sections present concept development and costing for each sub-alternative.

7.2 Design Concepts

7.2.1 Storage Analysis

A storage analysis was completed for each alternative to determine additional storage requirements, if any.

In each alternative, it is assumed that Reservoir 1 would be decommissioned because of its age (more than 70 years). Reservoir 2 would be rehabilitated to remain in service. The usable volume of Reservoir 2 is currently limited by hydraulic grade line between the reservoir and HLPS (HLPs tend to cavitate at the reservoir water level of 1.9 metres). This limitation would be addressed with the construction of a new HLPS close to Reservoir 2. Reservoirs are also used to achieve chlorine CT currently, which will not be required for alternatives that include new, dedicated clearwells. For alternatives that require Reservoir 2 to achieve CT (i.e., alternatives where the existing Wallaceburg WTP is rehabilitated), the required volume for CT is considered in the storage analysis. The volume of the Wallaceburg ET was also considered in the storage analysis.

For alternatives that include Wallaceburg supplying Dresden, the Dresden ET was not considered to be usable storage for Wallaceburg or the future greenhouses on Base Line. The Dresden ET will continue to provide sufficient storage for Dresden. Therefore, only the MDD from Wallaceburg (and future greenhouses for some alternatives) was considered for the storage analysis.

Additional storage requirements were calculated based on the MECP Design Guidelines for Pumping Facilities and Treated Water Storage (MECP 2008b) (Equation 1), considering the existing available storage at the Wallaceburg WTP and Wallaceburg ET, where:

$$Storage = A + B + C \tag{1}$$

A = Fire Flow (based on MECP recommendations for equivalent population size, Table 8-1 from the design guidelines)

B = 25% of MDD

C = 25% of (A + B)

7.2.1.1 Fire Flow

Fire flow was selected based on an equivalent population size of 13,000, which is the next equivalent population interval provided by the MECP in Table 8-1 (MECP 2008b). While the future population in Wallaceburg is projected to be 9,740, the MECP also recommends considering fire flow for industrial and commercial users, with an equivalent population that is based on the area occupied by the facilities and the population density in surrounding lands. The population density in the 2016 census was determined to be 1,143.9 persons per square kilometre (Statistics Canada 2017a) and the industrial/commercial area was measured to be approximately 0.9 square kilometres. Based on this, the equivalent industrial/commercial population is 1,030, yielding a total equivalent population of 10,770. Rounding up, the nearest equivalent population value in Table 8-1 of the design guidelines is 13,000, with a recommended fire flow of 220 litres per second for 3 hours (MECP 2008b).

It was also necessary to consider the equivalent population of the future greenhouses when selecting the fire flow value for the alternatives where Wallaceburg will supply the greenhouses. At this time, the area of the future greenhouses is unknown. To be conservative, a total equivalent population of 17,000 (the next value provided in Table 8-1 in the guidelines) was selected. This corresponds to a fire flow of 250 litres per second for 4 hours (MECP 2008a).

The fire flow values selected are summarized as follows:

- **Wallaceburg to supply Wallaceburg only:**
  - Equivalent population of 13,000; fire flow of 220 litres per second for 3 hours
- **Wallaceburg to supply Wallaceburg and greenhouses:**
  - Equivalent population of 17,000; fire flow of 250 litres per second for 4 hours

7.2.1.2 Contact Time Requirements

This section presents the reservoir volume required for CT for alternatives where the existing Wallaceburg WTP is upgraded and no dedicated clearwell is constructed (Alternatives 3b, 3c, and 4a, described in the following sections). For a surface water source (i.e., the Chenal Écarte), the following log removals are required (MECP 2016):

- 4-log virus removal
- 3-log *Giardia* cyst removal
- 2-log *Cryptosporidium* oocyst removal

For a conventional WTP (the existing Wallaceburg WTP), the following physical barrier credits are achieved (MECP 2016):

- 2-log virus removal
- 2.5-log *Giardia* cyst removal
- 2-log *Cryptosporidium* oocyst removal

Therefore, the following removals must be achieved by chlorination:

- 2-log virus inactivation
- 0.5-log *Giardia* cyst inactivation

The reservoir volume required for CT at the plant's rated capacity (14 ML/day) is presented in Table 7-3 and is subtracted from the available storage volume for these alternatives.

Table 7-3. Contact Time Requirements in Existing Reservoirs

Parameter	Cold Water Temperature	Warm Water Temperature
Design Flow, ML/day	12 [a]	14
Free Chlorine Residual, milligrams per litre [b]	1.5	1.5
Water Temperature, degrees Celsius [c]	0.5	23
CT Required, milligrams per millilitre per minute [d,e,f]	45	12
Volume Required to Achieve CT, megalitres	0.9	0.9
T_{10}/T [g]	0.3	0.3

Parameter	Cold Water Temperature	Warm Water Temperature
CT Available, milligrams per millilitre per minute	45.9	39.3
CT, minutes	102.0	87.4

[a] Projected winter flow based on historical flow trends at the Wallaceburg WTP.

[b] Target chlorine residual based on discussions with PUC operations staff.

[c] Minimum and maximum water temperatures based on historical operating data.

[d] Based on MECP Procedure for Disinfection (MECP 2016).

[e] pH = 7.5.

[f] Values interpolated from the values in Tables of CT values for inactivation of Giardia cysts by free chlorine at 0.5 degree Celsius or lower (pH = 7.5) in MECP Procedure for Disinfection (MECP 2016).

[g] Baffle factor based on tank configuration (assume unbaffled tank)

Therefore, when conducting the storage volume analysis, it is assumed that the entire volume of Reservoir 2 minus the 0.9 megalitre required for CT will be available following rehabilitation and construction of a new HLPS (for alternatives that do not have a dedicated clearwell).

For the alternatives that a new, dedicated clearwell for CT will be constructed for, the following log-inactivation requirements were assumed, regardless of treatment technology:

- 4-log virus inactivation
- 0.5-log *Giardia* cyst inactivation

This is a conservative assumption at this stage of the study. These requirements will be refined during the design phase based on treatment technology testing by the vendor and through discussions with the MECP.

7.2.1.3 Summary of Storage Availability and Requirements

Table 7-4 summarizes the storage availability for alternatives that will have dedicated clearwells for CT and for alternatives without clearwells, requiring reservoir volume for CT, based on the available volume in Reservoir 2 and the Wallaceburg ET. The storage availability shown in Table 7-4 is used to determine additional storage requirements for each alternative.

Table 7-4. Summary of Storage Availability

Storage Component	Alternatives with New Clearwells [a]	Alternatives Requiring Reservoir Volume for CT [b]
Reservoir 2 Volume, megalitres	4.6	4.6
Wallaceburg ET Volume, megalitres	4.5	4.5
Reservoir Volume required for CT, megalitres	-	0.9
Available Storage, megalitres	9.1	8.2

[a] Alternatives 2a, 2b, 2c, 3a, and 4b

[b] Alternatives 3b, 3c, and 4a

Table 7-5 summarizes the storage requirements for each alternative, based on Equation 1 and the ultimate MDD (2070). As each sub-alternative for Alternative 2 has the same storage requirements, requirements were presented in one column. Alternatives 3b and 3c also have the same storage requirements and as such, were presented in one column. The ultimate demand for Alternative 2 does not consider the demand in Dresden, as storage requirements for Dresden are fulfilled by the Dresden ET.

Based on the analysis presented in Table 7-5, additional storage requirements are summarized as follows:

- Alternative 2a: 1.2 megalitres
- Alternative 2b: 1.2 megalitres
- Alternative 2c: 1.2 megalitres
- Alternative 2d: 1.2 megalitres
- Alternative 3a: 1.2 megalitres
- Alternative 3b: 2.1 megalitres
- Alternative 3c: 2.1 megalitres
- Alternative 4a: No additional storage requirements
- Alternative 4b: No additional storage requirements

7.2.2 Alternative 1: Do Nothing

In this alternative, the existing Wallaceburg WTP will continue to be maintained and rehabilitated as outlined in the previous Wallaceburg Water Servicing Class EA (Stantec 2016). High-priority items include pre-treatment and filtration upgrades. The key components of this alternative are summarized as follows:

- Replacement of filter media and underdrain laterals
- Rehabilitation of the pre-treatment building
- Rehabilitation of the settling tanks/filters/high lift building
- Rehabilitation of the reservoirs

Table 7-5. Additional Storage Requirements for each Alternative

Parameter	Alternative 2	Alternative 3a	Alternatives 3b and 3c	Alternative 4a	Alternative 4b
Ultimate MDD, megalitres per day	18.6 [a]	18.6	18.6	9.9	9.9
Available Storage, megalitres	9.1	9.1	8.2	8.2	9.1
A – Fire Flow, megalitres	3.6 [b]	3.6 [b]	3.6 [b]	2.4 [c]	2.4
B – 25% MDD, megalitres	4.6	4.6	4.6	2.5	2.5
C – 25% (A+B), megalitres	2.1	2.1	2.1	1.2	1.2
Storage Required (A+B+C), megalitres	10.3	10.3	10.3	6.1	6.1
Additional Storage Requirement, megalitres	1.2	1.2	2.1	N/A	N/A

[a] Ultimate MDD for Wallaceburg and greenhouses only. Dresden is not considered as part of the storage analysis, as its storage needs are satisfied by the Dresden ET.

[b] Based on a population equivalent of 17,000.

[c] Based on a population equivalent of 13,000.

7.2.3 Alternative 2: Wallaceburg to supply Wallaceburg, Dresden, and Future Greenhouse Developments

This section presents the sub-alternatives for Alternative 2, which involves Wallaceburg supplying Wallaceburg, Dresden, and future greenhouse developments in the area, with a total future water demand of 28 ML/day from Wallaceburg.

7.2.3.1 Alternative 2a

In Alternative 2a, a new Wallaceburg WTP would be constructed with a rated capacity of 28 ML/day to supply water to Wallaceburg, Dresden, and future greenhouse developments along Base Line between Wallaceburg and Dresden. The key components of this alternative are summarized as follows:

- The new Wallaceburg WTP would have the following major processes:
  - Coagulation, flocculation, and high-rate (Inclined Plate) sedimentation with four process trains, each rated at 7 ML/day, to provide pre-treatment upstream of the membrane filtration process.
  - Low-pressure membrane (LPM) filtration rated at 32.1 ML/day to account for process wastage, including 4 trains rated at 10.7 ML/day (3 duty, 1 standby) with 62 membrane modules per train, 3 horizontal centrifugal feed pumps rated at 14.3 ML/day and a clean-in-place (C.I.P.) system using sodium hypochlorite, caustic, and citric acid.
  - Primary disinfection of the LPM permeate provided by gas chlorine and dedicated chlorine contact tank (CCT) (i.e., clearwell), with an effective volume of 700 cubic metres and an additional 1,200 cubic metres for storage.
  - A new residuals management facility (RMF), including 2 gravity thickeners (1 duty, 1 standby), each sized for a sludge flow rate of 900 cubic metres per day based on a high-level estimate of residuals production. At this stage, the gravity thickeners are sized conservatively; further investigation (residual total solids analysis) is required to refine the facility sizing.
  - Other chemical systems including a chlorine gas dosing system, PACl dosing system, and fluoridation system.
- A new HLPS with 3 pumps, each rated at 14 ML/day, providing a firm capacity of 28 ML/day.
- The existing Wallaceburg WTP, Reservoir 1, and HLPS would be decommissioned.

Figure 7-1 presents an overview of Alternative 2a.

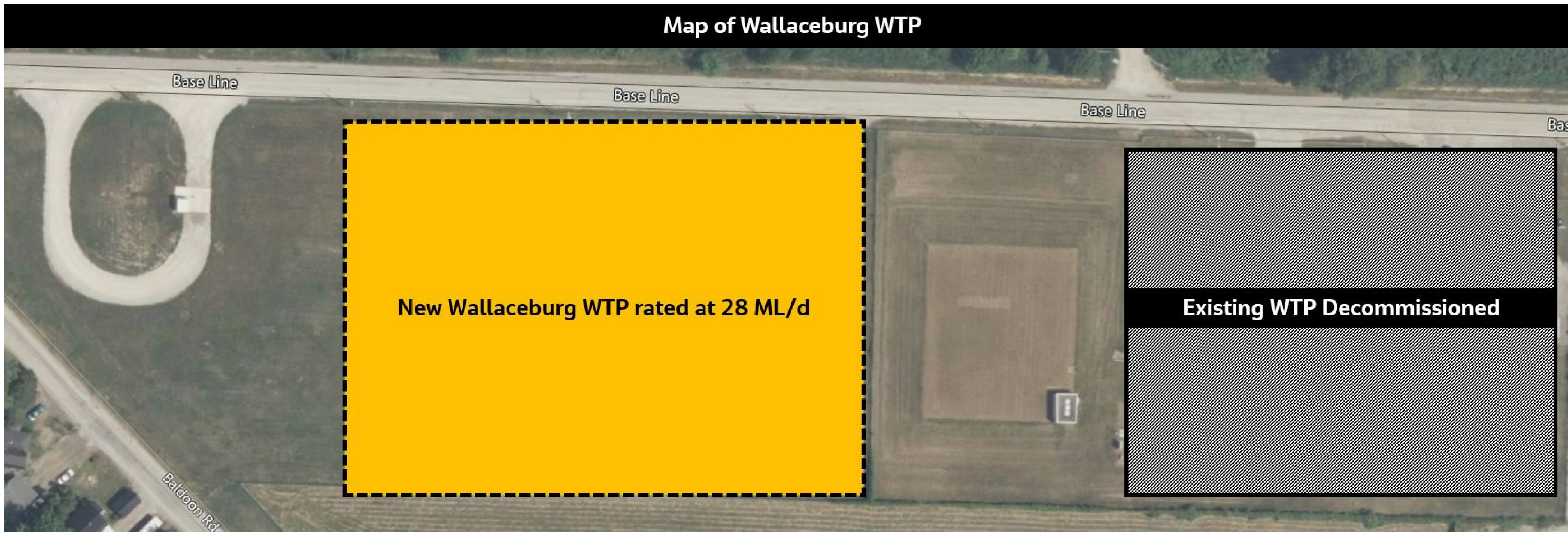


Figure 7-1
Alternative 2a for Water Supply
Technical Memorandum 1
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

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7.2.3.2 Alternative 2b

In Alternative 2b, the existing Wallaceburg WTP would be upgraded to restore its rated capacity to 14 ML/day and a new Wallaceburg WTP would be constructed to provide the additional 14 ML/day, for a total rated capacity of 28 ML/day to supply water to Wallaceburg, Dresden, and future greenhouse developments along Base Line between Wallaceburg and Dresden. The key components of this alternative are summarized as follows:

- The new Wallaceburg WTP would have the following major processes:
  - Coagulation, flocculation, and high-rate (Inclined Plate) sedimentation with two process trains, each rated at 7 ML/day, to provide pre-treatment upstream of the conventional filtration process.
  - Conventional filtration with two process trains, each rated at 7 ML/day.
  - Primary disinfection of filter effluent provided by gas chlorine, and dedicated CCT, with an effective volume of 700 cubic metres and an additional 1,200 cubic metres for storage.
  - A new RMF, including 2 gravity thickeners (1 duty, 1 standby), each sized for a sludge flow rate of 1,340 cubic metres per day based on a high-level estimate of residuals production. At this stage, the gravity thickeners are sized conservatively; further investigation (residual total solids analysis) is required to refine the facility sizing.
  - Other chemical systems including a chlorine gas dosing system, PACl dosing system, and fluoridation system.
- A new HLPS with 3 pumps, each rated at 14 ML/day, providing a firm capacity of 28 ML/day.
- The existing Reservoir 1 and HLPS would be decommissioned.
- The existing Wallaceburg WTP would be upgraded as follows:
  - Retrofit of the existing sedimentation tanks with lamellar plates for high-rate sedimentation
  - Rehabilitation of the existing filters, with filter media, piping, valving, and underdrains to be replaced
  - Additional items beyond the pre-treatment, clarification, and filtration processes that require upgrades as identified in the previous Class EA.

Figure 7-2 presents an overview of Alternative 2b.

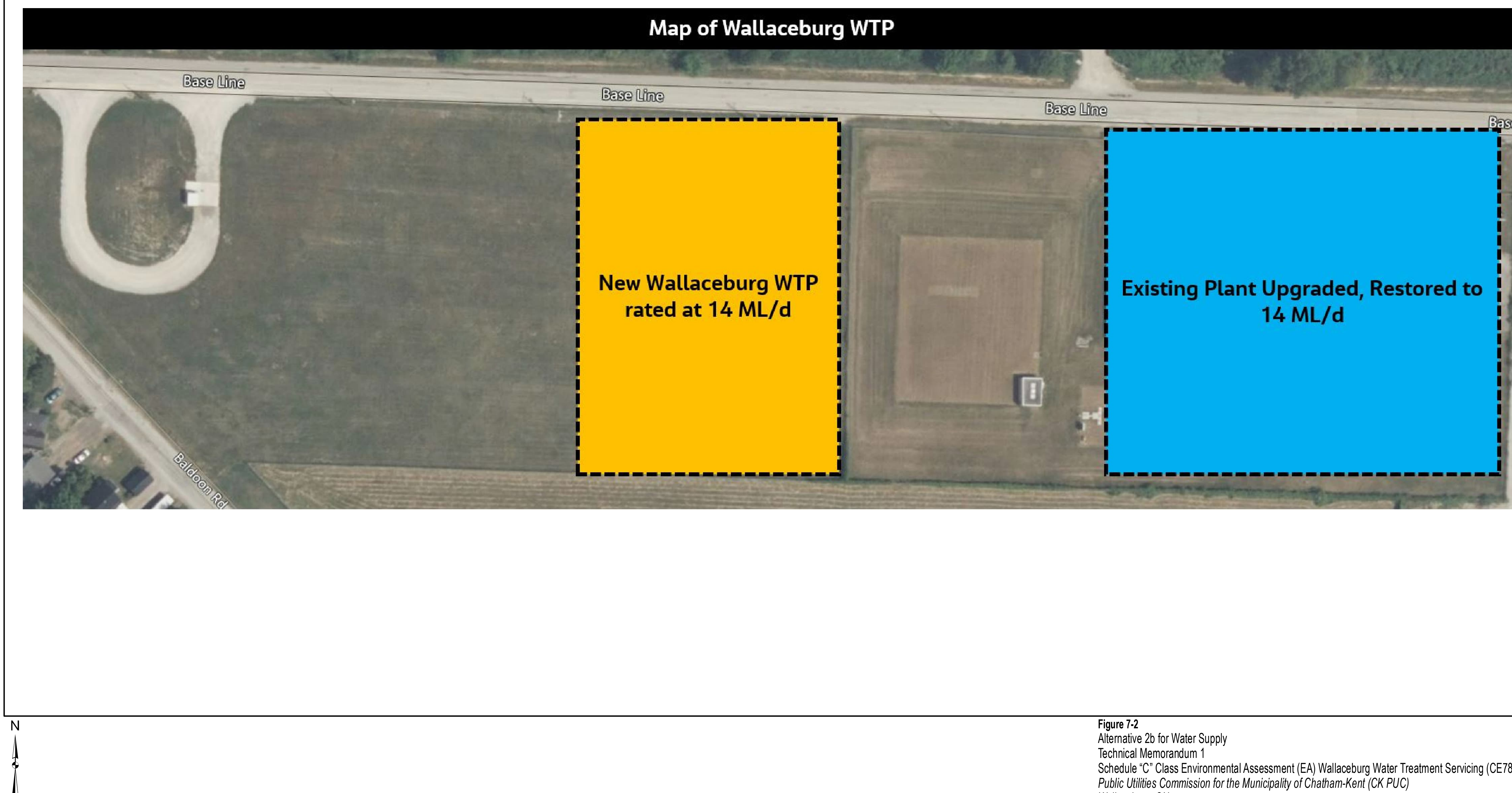

Figure 7-2
Alternative 2b for Water Supply
Technical Memorandum 1
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

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7.2.3.3 Alternative 2c

In Alternative 2c, a new Wallaceburg WTP would be constructed with a rated capacity of 16.5 ML/day. This capacity was selected because a maximum of 18.2 ML/day raw water can be taken from Chenal Écarte without an amendment to the existing PTTW limit. This is also accounting for 15% process wastage. The remaining 11.5 ML/day required to meet the total demand of 28 ML/day would be supplied by LAWSS. The existing Wallaceburg WTP would be decommissioned. The treatment processes at the new Wallaceburg WTP in Alternative 2c are the same as described in Alternative 2a. The key components of this alternative are summarized as follows:

- The new Wallaceburg WTP would have the following major processes:
  - Coagulation, flocculation, and high-rate (Inclined Plate) sedimentation with four process trains, each rated at 4.1 ML/day, to provide pre-treatment upstream of the membrane filtration process.
  - LPM Filtration, rated at 19.0 ML/day to account for process wastage, including 4 trains rated at 6.3 ML/day (3 duty, 1 standby) with 36 membrane modules per train, 3 horizontal centrifugal feed pumps rated at 8.3 ML/day and a C.I.P. system using sodium hypochlorite, caustic, and citric acid.
  - Primary disinfection of the LPM permeate provided by gas chlorine, and dedicated CCT, with an effective volume of 440 cubic metres and an additional 1,200 cubic metres for storage.
  - A new RMF, including 2 gravity thickeners (1 duty, 1 standby), each sized for a sludge flow rate of 660 cubic metres per day based on a high-level estimate of residuals production. At this stage, the gravity thickeners are sized conservatively; further investigation (residual total solids analysis) is required to refine the facility sizing.
  - Other chemical systems, including a chlorine gas dosing system, PACl dosing system, and fluoridation system.
- A new HLPS with 3 pumps, each rated at 14 ML/day, providing a firm capacity of 28 ML/day.
- The existing Wallaceburg WTP, Reservoir 1, and HLPS would be decommissioned.

The LAWSS distribution system hydraulic model was reviewed to determine infrastructure upgrade requirements (AECOM 2021). It is noted that the costs for these upgrades do not include any “buy-in” fees or any fees that are required to expand the LAWSS WTP. This alternative would result in the LAWSS WTP demands being greater than 85% of its rated capacity in 2041, which is a typical trigger for initiating a Class EA to determine plant upgrade requirements. The upgrades required for supplying water from the LAWSS to Wallaceburg are described as follows:

- LAWSS System
  - Install a new 500-millimetre-diameter transmission main along Baseline Road, White Line, and Highway 40 from St. Clair Parkway to Whitebread Line, approximately 16.1 kilometres in length.
- Wallaceburg System
  - Install a new 500-millimetre-diameter transmission main along Highway 40, Dufferin Avenue, Arnold Street, Mason Street, and Old Glass Road from Whitebread Line to the Wallaceburg HLPS discharge, approximately 8.3 kilometres in length.
  - Install a new BPS near the intersection of Whitebread Line and Highway 40, with a rated capacity of 11.5 ML/day.

Figure 7-3 presents an overview of Alternative 2c.

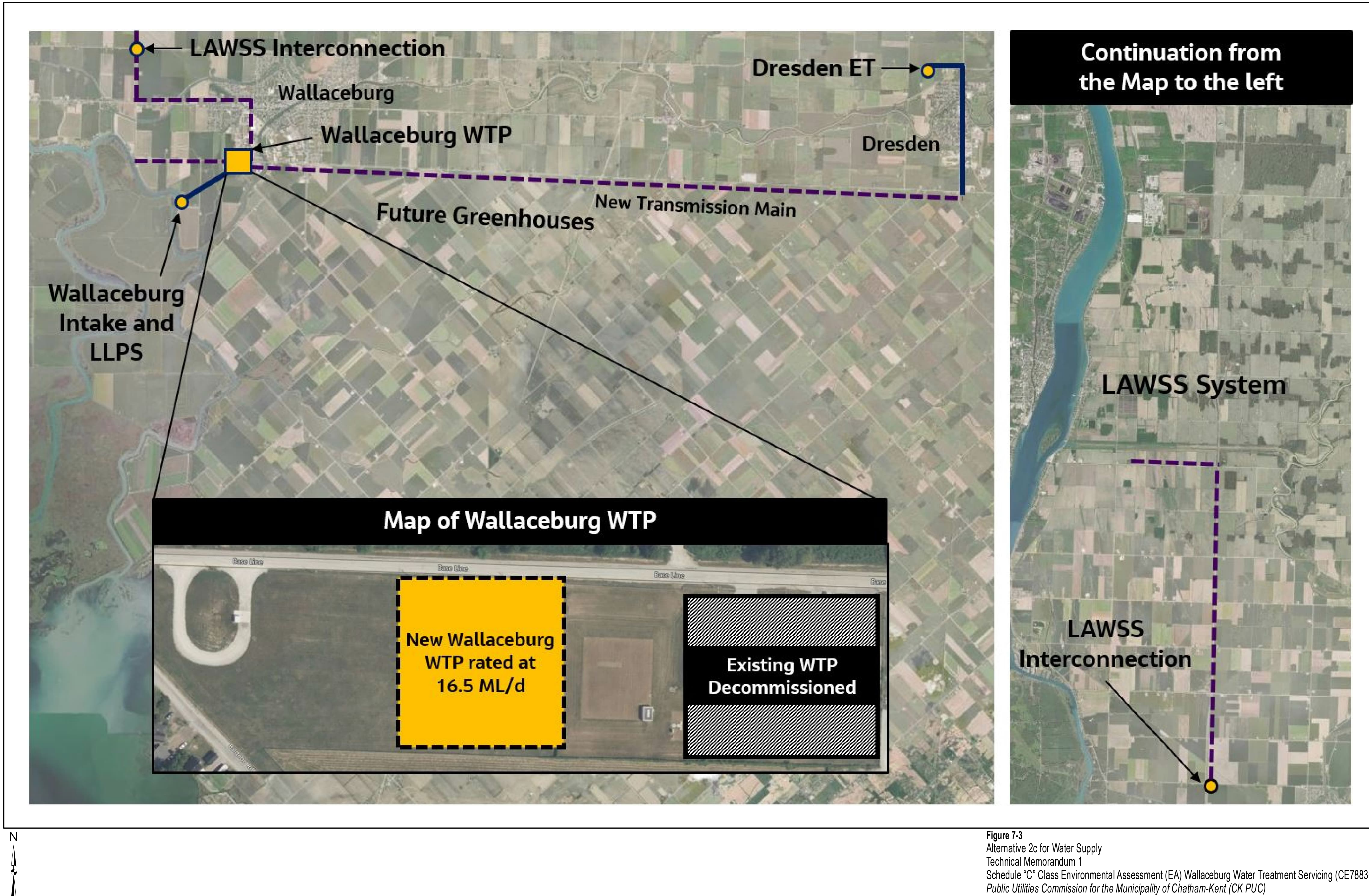

Figure 7-3
Alternative 2c for Water Supply
Technical Memorandum 1
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

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7.2.3.4 Alternative 2d

In this alternative, LAWSS would supply 28 ML/day to Wallaceburg, Dresden, and the future greenhouse developments. The Wallaceburg WTP would be decommissioned, and a new BPS would be constructed at the Wallaceburg WTP site. Fluoridation is not required, as fluoridation is currently used at the LAWSS WTP. The key components of this alternative are summarized as follows:

- A new reservoir with 1,200 cubic metres of storage volume.
- A new HLPS with 3 pumps, each rated at 14 ML/day, providing a firm capacity of 28 ML/day.
- The existing Wallaceburg WTP would be decommissioned.

The required upgrades to the LAWSS and Wallaceburg systems for LAWSS to provide 28 ML/day to Wallaceburg are described as follows:

- LAWSS System
  - Install a new 750-millimetre-diameter transmission main along Greenfield Road, Bickford Line, St. Clair Parkway, Baseline Road, White Line, and Highway 40 from Courtright Line to Whitebread Line, approximately 25.1 kilometres in length.
- Wallaceburg System
  - Install a new 600-millimetre-diameter transmission main along Highway 40, Dufferin Avenue, Arnold Street, Mason Street, and Old Glass Road from Whitebread Line to the existing Wallaceburg WTP site, approximately 8.3 kilometres in length.

Figure 7-4 presents an overview of Alternative 2d.

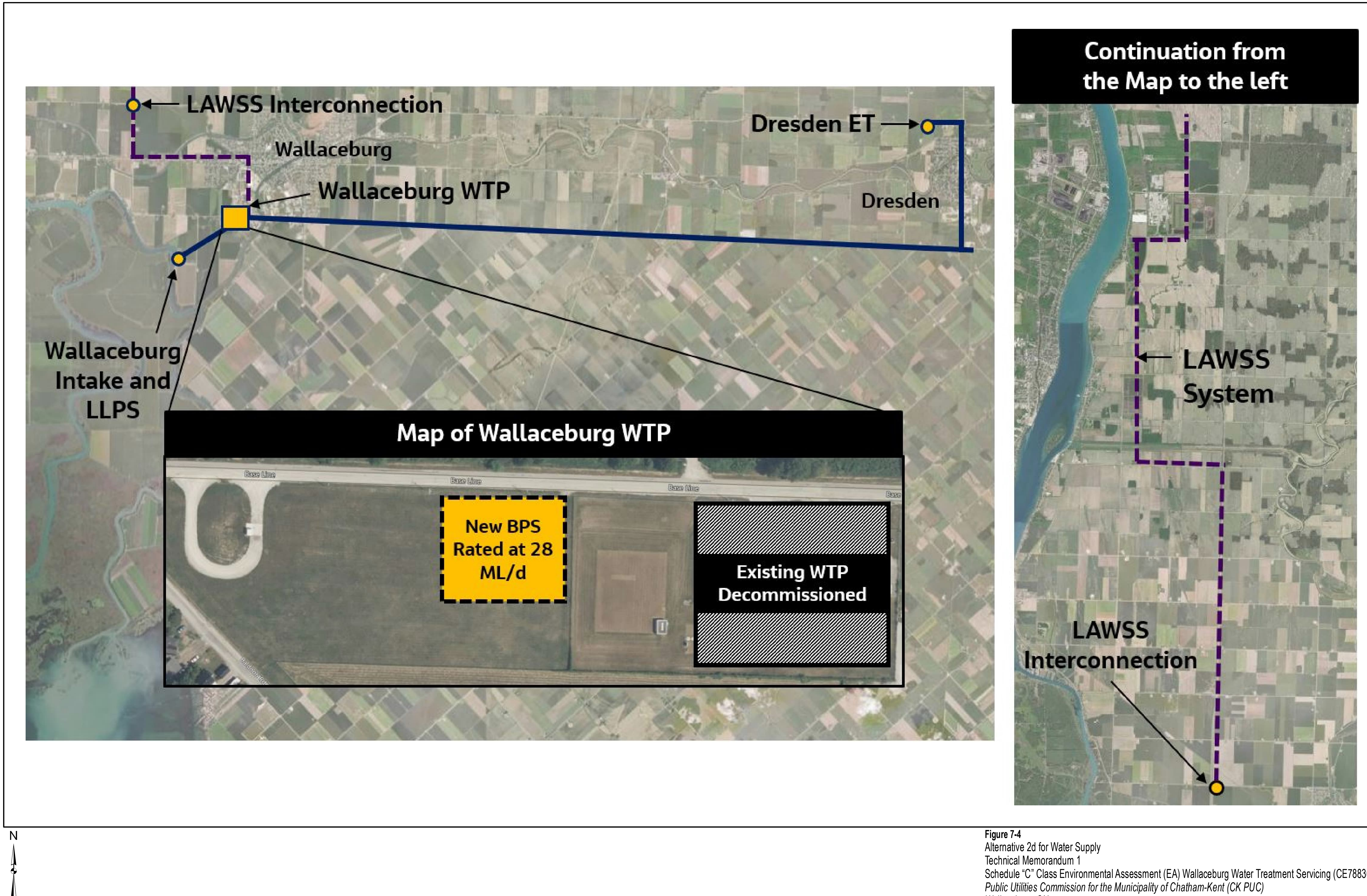

Figure 7-4
Alternative 2d for Water Supply
Technical Memorandum 1
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
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7.2.4 Alternative 3: Wallaceburg to supply Wallaceburg and future greenhouse developments, Chatham to continue supplying Dresden

This section presents the sub-alternatives for Alternative 3, which involves Wallaceburg supplying Wallaceburg and future greenhouse developments in the area, with a total future water demand of 18.6 ML/day. Dresden would continue to be supplied by the Chatham WTP in this alternative.

Section 5.5 discusses the impacts from the Chatham WTP supplying water to different areas, including Dresden and/or the future greenhouse developments between Wallaceburg and Dresden. It was found that continuing to supply Dresden from the Chatham WTP would not substantially impact the expansion needs of the Chatham WTP. Servicing these areas from the Wallaceburg WTP would only delay the expansion of the Chatham WTP by approximately 5 years. Therefore, the upgrade/expansion requirements at the Chatham WTP have not been included in these sub-alternatives.

7.2.4.1 Alternative 3a

In Alternative 3a, a new Wallaceburg WTP would be constructed with a rated capacity of 18.6 ML/day to supply water to Wallaceburg and future greenhouse developments along Base Line between Wallaceburg and Dresden. The key components of the new Wallaceburg WTP in this alternative are summarized as follows:

- The new Wallaceburg WTP would have the following major processes:
  - Coagulation, flocculation, and high-rate (Inclined Plate) sedimentation with four process trains, each rated at 4.7 ML/day, to provide pre-treatment upstream of the membrane filtration process.
  - LPM Filtration, rated at 21.4 ML/day to account for process wastage, including 4 trains rated at 7.1 ML/day (3 duty, 1 standby) with 41 membrane modules per train, 3 horizontal centrifugal feed pumps rated at 9.4 ML/day and a C.I.P. system using sodium hypochlorite, caustic, and citric acid.
  - Primary disinfection of the LPM permeate provided by gas chlorine, and dedicated CCT, with an effective volume of 500 cubic metres and an additional 1,200 cubic metres for storage.
  - A new RMF, including 2 gravity thickeners (1 duty, 1 standby), each sized for a sludge flow rate of 600 cubic metres per day based on a high-level estimate of residuals production. At this stage, the gravity thickeners are sized conservatively; further investigation (residual total solids analysis) is required to refine the facility sizing.
  - Other chemical systems including a chlorine gas dosing system, PACl dosing system, and fluoridation system.
- A new HLPS with 3 pumps, each rated at 9.3 ML/day, providing a firm capacity of 18.6 ML/day.
- The existing Wallaceburg WTP, Reservoir 1, and HLPS would be decommissioned.

Figure 7-5 presents an overview of Alternative 3a.

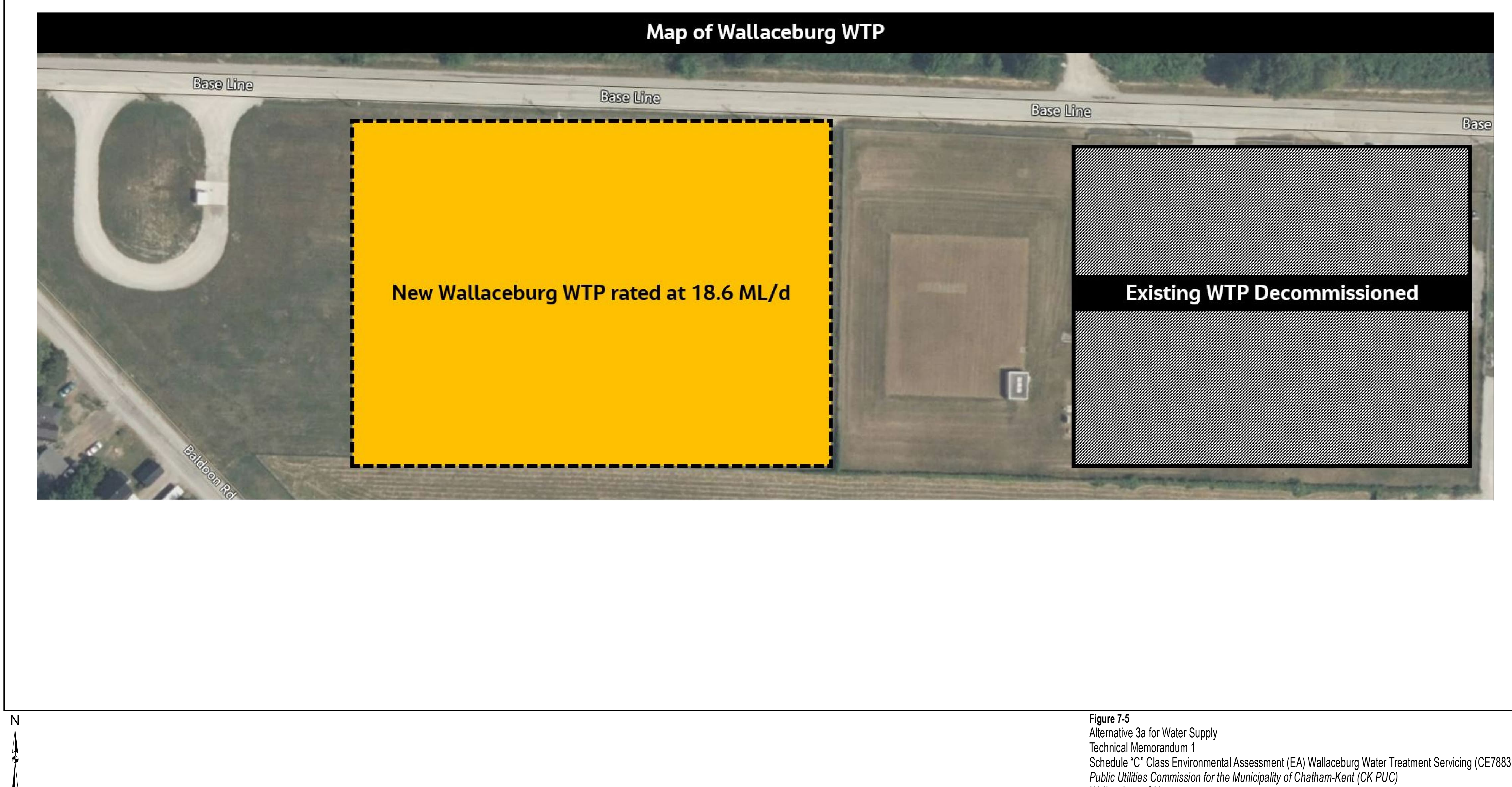

Figure 7-5
Alternative 3a for Water Supply
Technical Memorandum 1
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
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7.2.4.2 Alternative 3b

In Alternative 3b, the existing Wallaceburg WTP would be upgraded to restore its rated capacity to 14 ML/day, with the remaining 4.6 ML/day required provided by the Chatham WTP via the transmission main along Base Line. The existing transmission main would need to be twinned with an additional 300-millimetre-diameter transmission main on Base Line between Wallaceburg and Dresden to be able to convey 4.6 ML/day. However, water transmission main requirements will be reviewed as part of the water transmission alternatives evaluation; this additional component is not required for the development of these sub-alternatives. The capacity of the transmission main between the Eberts BPS and Dresden was also reviewed and was found to be sufficient to convey the additional 4.6 ML/day required. Under current conditions, the Eberts BPS also has sufficient capacity to convey these flows. However, it is noted that the potential to supply additional communities in Northeast Chatham-Kent, such as Bothwell, is currently being investigated. It is recommended that the Eberts BPS be assessed following confirmation of the preferred solution for the associated project.

The key components of this alternative are summarized as follows:

- A new HLPS with 3 pumps, each rated at 9.3 ML/day, providing a firm capacity of 18.6 ML/day.
- A new reservoir with 2,100 cubic metres of storage volume.
- The existing Reservoir 1, and HLPS would be decommissioned.
- The existing Wallaceburg WTP would be upgraded as follows:
  - Retrofit of the existing sedimentation tanks with lamellar plates for high-rate sedimentation
  - Rehabilitation of the existing filters, with filter media, piping, valving, and underdrains to be replaced
  - Additional items beyond the pre-treatment, clarification, and filtration processes that require upgrades as identified in the previous Class EA.

Figure 7-6 presents an overview of Alternative 3b.

Map of Wallaceburg WTP

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Figure 7-6
Alternative 3b for Water Supply
Technical Memorandum 1
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

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7.2.4.3 Alternative 3c

In Alternative 3c, the existing Wallaceburg WTP would be upgraded to restore its rated capacity to 14 ML/day. The remaining 4.6 ML/day required to meet the total demand of 18.6 ML/day would be supplied by LAWSS.

Upgrades to the existing Wallaceburg WTP would be the same as those described in Alternative 3b. The required upgrades to the LAWSS and Wallaceburg systems for LAWSS to provide 4.6 ML/day to Wallaceburg are described as follows:

- LAWSS System
  - Install a new 350-millimetre-diameter transmission main along Baseline Road, White Line, and Highway 40 from St. Clair Parkway to Whitebread Line.
- Wallaceburg System
  - Install a new 300-millimetre-diameter transmission main along Highway 40 and Dufferin Avenue from Whitebread Line to Forhan Street.
  - Install a new BPS near the intersection of Whitebread Line and Highway 40 with a rated capacity of 4.6 ML/day

Figure 7-7 presents an overview of Alternative 3c.

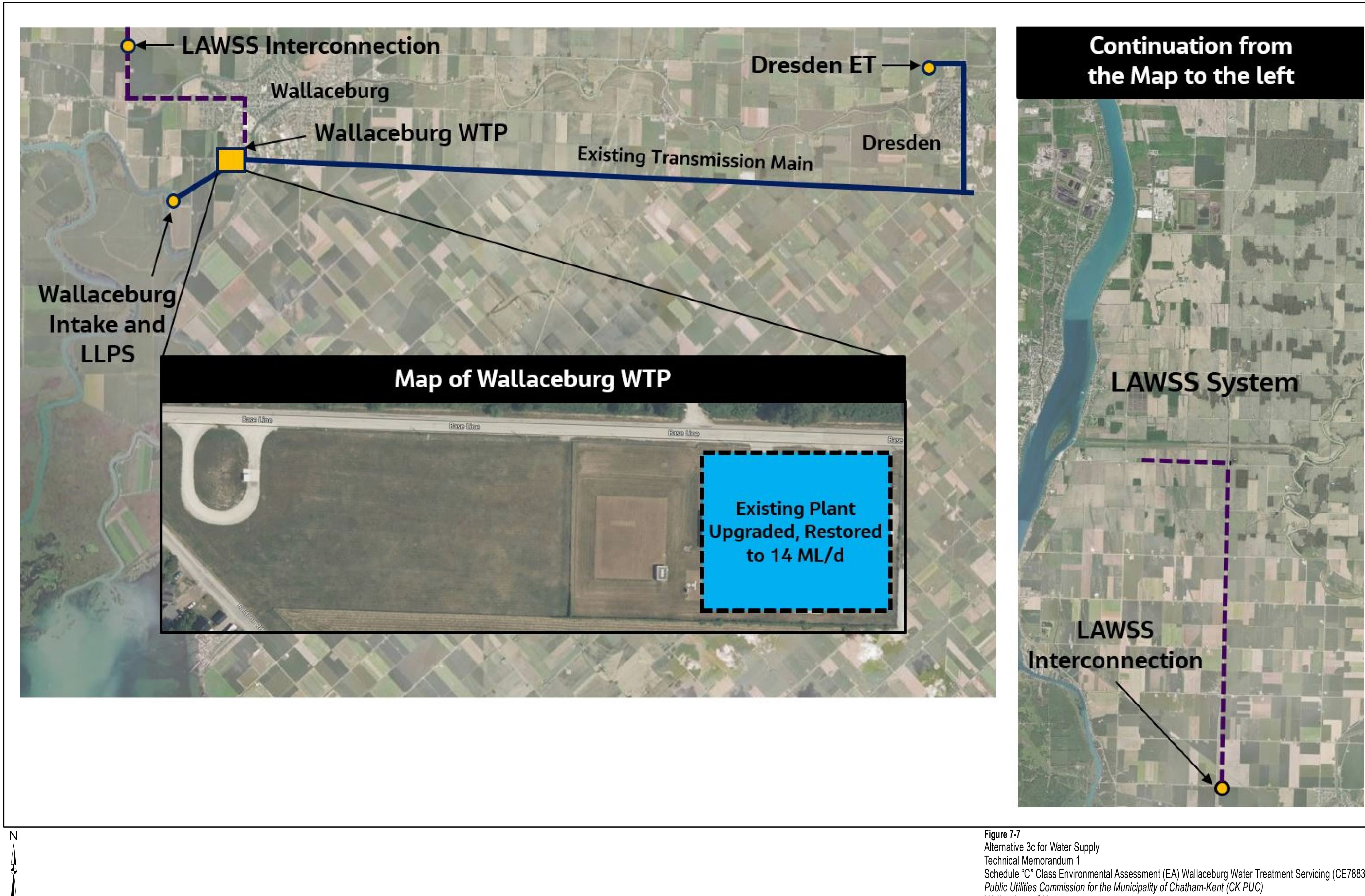

Figure 7-7
Alternative 3c for Water Supply
Technical Memorandum 1
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
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7.2.5 Alternative 4: Wallaceburg to supply Wallaceburg only. Chatham WTP to supply Dresden and future greenhouse developments

This section presents the sub-alternatives for Alternative 4, which involves Wallaceburg WTP continuing to supply Wallaceburg only. The Chatham WTP would continue to supply Dresden and would also provide water supply to the future greenhouse developments on Base Line between Wallaceburg and Dresden. To supply these greenhouses, a new transmission main is required between Wallaceburg and Dresden, parallel to the existing water main. As the exact locations of the future greenhouses is currently unknown, it is assumed that the transmission main would extend the full distance between Wallaceburg and Dresden. However, water transmission main requirements will be reviewed as part of the water transmission alternatives evaluation; this additional component is not required for the development of these sub-alternatives. Supplying Dresden and the future greenhouses from the Chatham WTP would have no significant impact on the need of Chatham WTP's expansion. This alternative would only advance the expansion of the Chatham WTP by 5 years. Therefore, no costs related to upgrades at the Chatham WTP have been included in the cost estimates for these sub-alternatives.

The capacity of the transmission main between the Eberts BPS and Dresden was also reviewed and was found to be sufficient to convey the 17.4 ML/day required, provided that the remainder of the North Kent pressure zone is supplied through the new transmission main that will be constructed on Brook Line from the Eberts Standpipe to Kent Bridge Road, as proposed in the Chatham DWS Modelling report (AECOM 2020a). Based a review of the hydraulic model, the Eberts BPS also has sufficient capacity to convey an additional flow of 8.6 ML/day to service the future greenhouse development. However, it is noted that the potential to supply additional communities in Northeast Chatham-Kent, such as Bothwell, is currently being studied by the Northeast Chatham-Kent WDS Class EA. The Eberts BPS capacity should be re-evaluated once future demands in this area are confirmed.

7.2.5.1 Alternative 4a

In Alternative 4a, the existing Wallaceburg WTP would be upgraded to restore its capacity to 14 ML/day. A new HLPS would also be constructed as part of this alternative.

The key components of this alternative are summarized as follows:

- A new HLPS with 3 pumps, each rated at 7 ML/day, providing a firm capacity of 14 ML/day.
- The existing Reservoir 1 and HLPS would be decommissioned.
- The existing Wallaceburg WTP would be upgraded as follows:
  - Retrofit of the existing sedimentation tanks with lamellar plates for high-rate sedimentation
  - Rehabilitation of the existing filters, with filter media, piping, valving, and underdrains to be replaced
  - Additional items beyond the pre-treatment, clarification, and filtration processes that require upgrades as identified in the previous Class EA.

Figure 7-8 presents an overview of Alternative 4a.

Map of Wallaceburg WTP

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Figure 7-8
Alternative 4a for Water Supply
Technical Memorandum 1
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

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7.2.5.2 Alternative 4b

In Alternative 4b, a new Wallaceburg WTP would be constructed with a rated capacity of 14 ML/day to supply water to Wallaceburg. The key components of this alternative are summarized as follows:

- A new Wallaceburg WTP including the following:
  - Coagulation, flocculation, and high-rate (Inclined Plate) sedimentation with four process trains, each rated at 3.5 ML/day, to provide pre-treatment upstream of the membrane filtration process.
  - LPM Filtration, rated at 16.1 ML/day to account for process wastage, including four trains rated at 5.4 ML/day (3 duty, 1 standby) with 31 membrane modules per train, 3 horizontal centrifugal feed pumps rated at 7.1 ML/day and a C.I.P. system using sodium hypochlorite, caustic, and citric acid.
  - Primary disinfection of the LPM permeate provided by gas chlorine, and dedicated CCT, with an effective volume of 375 cubic metres.
  - A new RMF including 2 gravity thickeners (1 duty, 1 standby), each sized for a sludge flow rate of 320 cubic metres per day based on a high-level estimate of residuals production. At this stage, the gravity thickeners are sized conservatively; further investigation (residual total solids analysis) is required to refine the facility sizing.
  - Other chemical systems including a chlorine gas dosing system, PACl dosing system, and fluoridation system.
- A new HLPS with 3 pumps, each rated at 7 ML/day, providing a firm capacity of 14 ML/day.
- The existing Wallaceburg WTP, Reservoir 1, and HLPS would be decommissioned.

Figure 7-9 presents an overview of Alternative 4b.

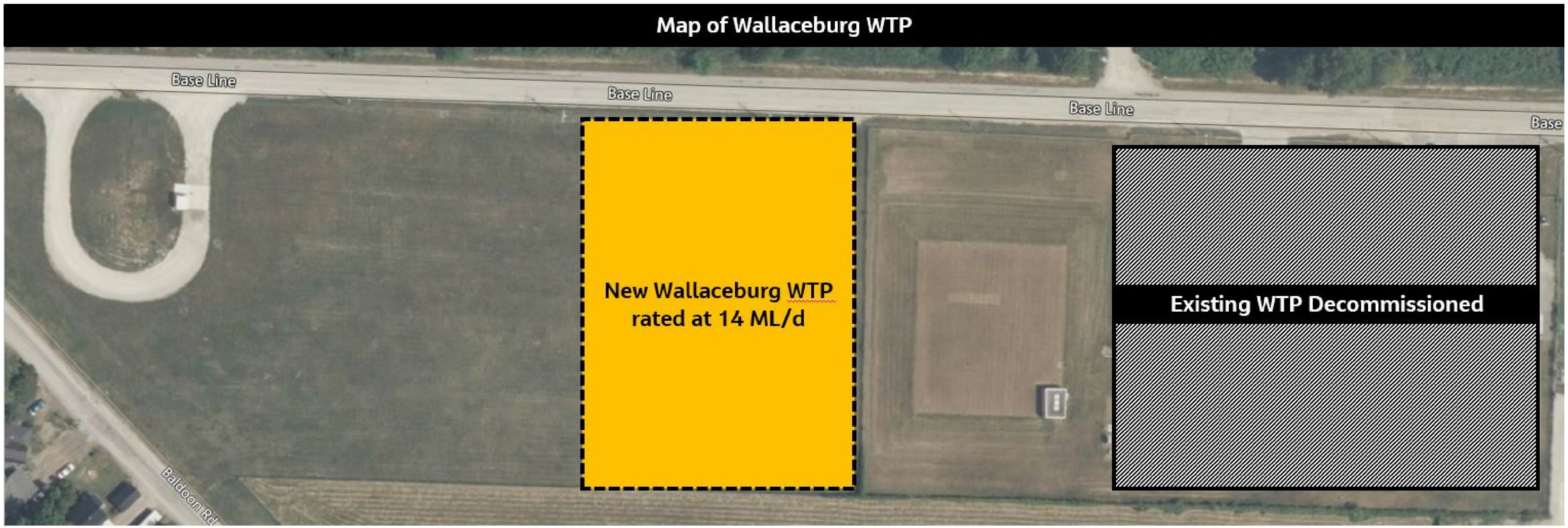

Figure 7-9
Alternative 4b for Water Supply
Technical Memorandum 1
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
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7.2.6 Wallaceburg Wastewater Treatment Plant Impacts

The increased water production associated with the alternatives would have an impact on the Wallaceburg WWTP at different degrees due to the increase in WTP wastewater discharges, which are mainly attributed to increased sludge production and backwash waste (BWW) flows. Sludge and BWW are currently conveyed to a process waste facility. According to the CK PUC, at this time, all contents from the facility are discharged to the sanitary sewer. Impacts to the Wallaceburg WWTP were evaluated under this condition; that all sludge and BWW are discharged to the sanitary sewer for each alternative.

Operational data from the Wallaceburg WTP was reviewed to determine the average sanitary discharge as a percentage of the plant flow, which was found to be approximately 6%. Sanitary discharges were then estimated for each alternative using the following basis:

- Conventional filtration: sanitary discharge equal to 6% of plant flows, based on historical data. From data, backwash flows are equal to approximately 4% of plant flows. There is no data available relating to sludge flow from the pre-treatment system and clarifiers, so a value of 2% of plant flows has been assumed.
- Membrane filtration: sanitary discharge equal to 4% of plant flows, based on Jacobs' experience from similar LPM WTPs.

Table 7-6 presents the estimated sanitary discharge for each alternative at the corresponding ADD. As discussed in Section 4.1.1.2, the ADD is assumed to be equal to 80% of the MDD for each alternative. Where the ADD for a scenario is greater than the rated capacity of the Wallaceburg WTP, the rated capacity of the Wallaceburg WTP was used to project sanitary discharges. For example, in Alternative 2c the projected ADD is 22.4 ML/day for Wallaceburg, Dresden and greenhouses. the Wallaceburg WTP could be operated at its rated capacity of 16.5 ML/day, with additional water supplied from LAWSS under the ADD conditions. For more details of this approach, refer to Table 7-7.

The Wallaceburg WWTP is currently rated to treat an average daily flow of 10.8 ML/day. From the 2020 Wallaceburg WWTP Annual Report, the average daily flow in 2020 was 8.9 ML/day, or 82% of the plant's rated capacity. Based on the estimates in Table 7-6 and the current plant flows, the Wallaceburg WWTP would have sufficient capacity to treat additional WTP wastewater flows. It is noted that the average daily wastewater flow increase due to its users' discharges to the Wallaceburg WWTP is not considered within this EA. Upon selection of the preferred solution for this EA, future flows to the Wallaceburg WWTP should be reviewed in another study.

Table 7-6. Estimated Average Daily Sanitary Discharges to the Wallaceburg WWTP

Alternative Number	Filtration Type	Wallaceburg WTP ADD, ML/day	Sanitary Discharge, Percentage of ADD	Sanitary Discharge, ML/day	Percent Increase from Base Case
1	Conventional	7.9	6%	0.48	-
2a	Membrane	22.4	4%	0.90	89%
2b	Conventional	22.4	6%	1.34	183%
2c	Membrane	16.5	4%	0.66	39%
2d	N/A [a]	-	-	-	-
3a	Membrane	14.9	4%	0.60	25%
3b	Conventional	14	6%	0.84	77%
3c	Conventional	14	6%	0.84	77%
4a	Conventional	7.9	6%	0.48	-
4b	Membrane	7.9	4%	0.32	-33%

[a] All water is produced by LAWSS. Therefore, there is no sanitary discharge to the Wallaceburg WWTP.

7.3 Cost Estimation

Capital cost estimates, O&M cost estimates, and lifecycle cost estimates were developed for each alternative presented in Section 7.2, based on the methodology presented in Section 6.2. O&M cost estimate considerations that are specific to the water supply alternatives are detailed further in this section.

The O&M cost estimates were developed based on the future water demand projections (ADD) for each alternative, which are assumed to be 80% of MDD based on the historical flow analysis presented in Section 4.1.1.2. It is noted that for alternatives where water supply is supplemented by LAWSS or the Chatham WTP, the ADD at the Wallaceburg WTP is not equal to 80% of the overall MDD. Table 7-7 presents the MDD for each alternative, the ADD for each alternative, and the ADD to the Wallaceburg WTP for each alternative, which was used as the O&M cost estimation basis. Where the overall ADD is greater than the capacity of the Wallaceburg WTP (Alternative 2c), it is assumed that the Wallaceburg WTP will provide the maximum amount of water possible before supplementing with water from LAWSS or the Chatham WTP.

Table 7-7. Summary of Wallaceburg WTP ADD for each Alternative

Alternative	Ultimate MDD, ML/day	Ultimate ADD, ML/day	Wallaceburg WTP Rated Capacity, ML/day	Wallaceburg WTP ADD, ML/day [a]
Alternative 2a	28	22.4	28	22.4
Alternative 2b	28	22.4	28	22.4
Alternative 2c	28	22.4	16.5	16.5
Alternative 2d	28	22.4	N/A	N/A
Alternative 3a	18.6	14.9	18.6	14.9
Alternative 3b	18.6	14.9	14	14
Alternative 3c	18.6	14.9	14	14
Alternative 4a	9.9	7.9	14	7.9
Alternative 4b	9.9	7.9	14	7.9

[a] The values in this column were used to estimate Wallaceburg WTP O&M costs.

All O&M costs related to water supply from LAWSS are assumed to be incurred by LAWSS. Where the Chatham WTP supplies water to Wallaceburg under ADD conditions, O&M costs were prorated on a per ML/day basis, as these costs are incurred by the CK PUC.

The dosages and strengths used to estimate chemical consumption are summarized in Table 7-8. Citric acid and sodium hypochlorite requirements for membrane cleaning are estimated by Jacobs' CPES tool. The dosages listed are as product, i.e. as chorine, PACl, and hydrofluorosilicic acid.

Table 7-8. Chemical Dosages and Strengths

Item	Dosage as Product	Strength	Source/Basis
Chlorine Gas (pre-dosage)	0.3 milligam per litre	100%	PUC Operational Data
Chlorine Gas (post-dosage)	2 milligams per litre	100%	PUC Operational Data
PACl (conventional filtration)	30 milligams per litre	40%	P.U.C. Operational Data
PACl (membrane filtration)	2 milligams per litre	40%	Previous Jacobs Projects
Hydrofluorosilicic Acid	0.5 milligam per litre	20%	PUC Operational Data

Membrane or granular filter media replacements are assumed to be required every 10 years for the alternatives that involve membrane filtration and conventional filtration, respectively. The costs were developed in Jacobs' CPES tool.

Table 7-9 presents a summary of the water supply alternatives and their associated costs. Details are presented in Appendix A.

Table 7-9. Water Supply Alternatives Summary and Cost Estimate

Alternative Number	Description	Total Capital Cost	O&M Cost Net Present Value	50-year Lifecycle Cost
1	"Do Nothing" baseline alternative	$34,894,000	$30,535,000	$65,429,000
2	Wallaceburg to supply Wallaceburg, Dresden and future greenhouse developments			
2a	▪ Build a new Wallaceburg WTP – rated capacity of 28 ML/day	$46,433,000	$25,079,000	$71,512,000
2b	▪ Build a new Wallaceburg WTP – rated capacity of 14 ML/day ▪ Upgrade the existing Wallaceburg WTP – rated capacity of 14 ML/day	$53,246,000	$30,884,000	$84,130,000
2c [a]	▪ Build a new Wallaceburg WTP – rated capacity of 16.5 ML/day ▪ Supplement supply with water from LAWSS – 11.5 ML/day	$85,914,000	$23,848,000	$109,762,000
2d [a]	▪ Obtain all water supply from LAWSS – 28 ML/day	$118,749,000	$8,314,000	$127,063,000
3	Wallaceburg to supply Wallaceburg and future greenhouse developments			
3a	▪ Build a new Wallaceburg WTP – rated capacity of 18.6 ML/day	$38,087,000	$18,199,000	$56,286,000
3b	▪ Upgrade the existing Wallaceburg WTP – rated capacity of 14 ML/day ▪ Supplement supply with water from the Chatham WTP – 4.6 ML/day	$27,896,000	$22,187,000	$50,083,000
3c [a]	▪ Upgrade the existing Wallaceburg WTP – rated capacity of 14 ML/day ▪ Supplement supply with water from the LAWSS – 4.6 ML/day	$66,176,000	$21,761,000	$87,937,000

Alternative Number	Description	Total Capital Cost	O&M Cost Net Present Value	50-year Lifecycle Cost
4	Wallaceburg to supply Wallaceburg only. Chatham WTP to supply Dresden and future greenhouse developments			
4a	▪ Upgrade the existing Wallaceburg WTP – rated capacity of 14 ML/d	$26,117,000	$15,429,000	$41,546,000
4b	▪ Build a new Wallaceburg WTP – rated capacity of 14 ML/d	$31,896,000	$12,943,000	$44,839,000

[a] Costs do not include user rates (cost per cubic metre of water transferred). Only capital improvements are considered.

7.4 Greenhouse Gas Emissions

GHG emissions were estimated for the water supply alternatives using the methodology presented in Section 6.3. The following assumptions were made for this analysis that are specific to water supply alternatives:

- Chatham WTP electricity consumption was estimated on a per megalitre basis based on historical energy usage at the Wallaceburg WTP. From historical billing, the electrical consumption is equal to approximately 826 kilowatt hours per megalitre.
- GHG emissions from LAWSS were not considered. For alternatives that require LAWSS supply, only energy requirements for pumping facilities under PUC operation were considered.
- GHG emission estimates are based on the ultimate ADD for each scenario, considering water produced by PUC facilities only.
- Based on the additional head required to pump water to Dresden and future greenhouses from the Chatham WTP HLPS versus the Wallaceburg WTP HLPS, it is estimated that pumping from Chatham requires an additional 0.176 kilowatts. This was considered in the "Additional Energy Requirements from Chatham WTP" column.

Table 7-10 presents the estimated GHG emissions for each alternative.

In general, Alternative 2 provides the highest efficiency in terms of GHG emissions versus water production. Alternative 3 provides moderate efficiency in terms of GHG emissions, while Alternative 4 provides the lowest efficiency. The general observation from this analysis is that it is more efficient to supply water from the Wallaceburg WTP than the Chatham WTP.

7.5 Evaluation Criteria

Each water supply alternative was evaluated using the methodology presented in Section 6.4. The evaluation criteria for the water supply alternatives and their scoring measures are presented in Table 7-11.

Table 7-10. GHG Emission Estimates for Water Supply Alternatives

Alternative	Wallaceburg WTP Energy Consumption, kilowatt hours per year	ADD in PUC Systems, ML/day	Unit Energy Consumption, kilowatt hours per year per megalitre	Additional Water Supply from Chatham WTP (ADD), ML/day [a]	Additional Energy Requirements from Chatham WTP, kilowatt hours per year [b,c]	Net Energy Consumption in PUC Systems, kilowatt hours per year	Net PUC GHG Emissions, tonnes of carbon dioxide equivalent per year
Do Nothing (Base Case)	1,633,260	7.9	566.4	-	-	1,633,260	49.0
Alternative 2a	2,959,000	22.4	361.9	(7.0)	(1,457,000)	1,502,000	45.1
Alternative 2b	2,721,000	22.4	332.8	(7.0)	(1,457,000)	1,264,000	37.9
Alternative 2c	3,373,000	16.5	560.1	(7.0)	(1,457,000)	1,916,000	57.5
Alternative 2d	1,796,000	0.0	N/A	(7.0)	(1,457,000)	339,000	10.2
Alternative 3a	2,097,000	14.9	386.1	-	-	2,097,000	62.9
Alternative 3b	2,554,000	14.9	470.2	0.9	151,000	2,705,000	81.2
Alternative 3c	2,552,000	14.0	499.4	-	-	2,552,000	76.6
Alternative 4a	1,699,000	7.9	587.7	6.9	1,424,000	3,123,000	93.7
Alternative 4b	1,418,000	7.9	490.5	6.9	1,424,000	2,842,000	85.3

[a] Based on 80% of MDD.

[b] Based on 566 kilowatt hours per megalitre, which includes energy consumed for treated water production and transmission but does not include the power requirements for low lift pumping of raw water (considered separately under raw water supply alternatives).

[c] Negative energy requirements from the Chatham WTP are based on shifting water supply to Dresden from the Chatham WTP to the Wallaceburg WTP.

Table 7-11. Evaluation Criteria and Scoring Measures for Water Supply

Category	Criterion	Description	Measure – Score of 10	Measure – Score of 5	Measure – Score of 1
Natural Environment	Impacts to Surface Water Quality	The potential for the alternative to have a negative impact on surface water quality (focus is WTP residuals discharge) that would result in harm to the aquatic environment.	The alternative will have no substantial impact on surface water quality that may impact aquatic environments.	The alternative has some potential to change surface water quality that may negatively impact aquatic habitats.	The alternative has a high potential to change surface water quality that may negatively impact aquatic habitats.
	Impacts to Surface Water Quantity	The potential for the alternative to have an impact on surface water quantity that would result in negative impacts to other users or the aquatic environment.	The alternative will have no substantial impact on surface water quantity that would result in negative impacts to other users or the aquatic environment.	The alternative will have some potential impact on surface water quantity that would result in negative impacts to other users or the aquatic environment.	The alternative will have a high-potential impact on surface water quantity that would result in negative impacts to other users or the aquatic environment.
	Impacts on Terrestrial Environment	The potential for the alternative to have a long-term negative impact on the viability of terrestrial habitats in terms of density and diversity of species.	The alternative will have no substantial long-term impact on the viability of terrestrial habitats in terms of density and diversity of species.	The alternative has some potential for long-term impact on the viability of terrestrial habitats in terms of density and diversity of species.	The alternative has high potential for long-term impact on the viability of terrestrial habitats in terms of density and diversity of species.
	Impacts on Aquatic Environment	The potential for the alternative to have a long-term negative impact on the viability of aquatic habitats in terms of density and diversity of species.	The alternative will have no substantial long-term impact on the viability of aquatic habitats in terms of density and diversity of species.	The alternative has some potential for long-term impact on the viability of aquatic habitats in terms of density and diversity of species.	The alternative has high potential for long-term impact on the viability of aquatic habitats in terms of density and diversity of species.
	GHG Emissions	The potential for the alternative to increase or decrease GHG emissions from the current condition related to Wallaceburg to water servicing (based on 30 grams of carbon dioxide per kilowatt hour, 2020 National Inventory Report [ECCC 2020]).	GHG emissions less than 50 tonnes of carbon dioxide equivalent per year.	GHG emissions 50-100 tonnes of carbon dioxide equivalent per year.	GHG emissions more than 100 tonnes of carbon dioxide equivalent per year.
	Impacts to Fluvial Geomorphic Stability	The potential of the alternative to impact the geomorphic stability of the watercourse (based on stream crossings).	The alternative will have no substantial impact on the fluvial geomorphic stability of the watercourse.	The alternative will somewhat reduce the fluvial geomorphic stability of the watercourse.	The alternative will substantially reduce the fluvial geomorphic stability of the watercourse.
	Potential Impacts to Groundwater Quality and Quantity	The potential for the alternative to have a negative long-term impact on groundwater quality or quantity.	The alternative will have no substantial impact on groundwater quality and quantity over long term.	The alternative will somewhat reduce groundwater quality and quantity over long term.	The alternative will substantially reduce the quality and quantity of groundwater over long term.
Social/Cultural Environment	Occupational Health and Safety	The potential of the alternative to minimize risk or liability regarding occupational health and safety for construction period and ongoing O&M.	The alternative poses very little risk to occupational health and safety.	The alternative poses moderate risk to occupational health and safety; construction and O&M safety measures may be required to address specific health and safety concerns.	The alternative poses high risk to occupational health and safety; personal injury may be expected; construction and O&M safety measures will be required to address a number of health and safety concerns.
	Autonomy of Water Supply	The level to which the PUC relies on other governing bodies for water supply.	The alternative allows the PUC to not rely on any other governing bodies for their water supply.	The alternative requires the PUC to rely on other governing bodies for a small percentage of their water supply.	The alternative requires the PUC to rely on other governing bodies for a large percentage of their water supply.
	Archaeological Impacts	The degree of impact that the alternative has on documented archaeologically significant features.	The alternative has little or no impact on documented archaeologically significant features.	The alternative has a moderate impact on documented archaeologically significant features.	The alternative has a large impact on documented archaeologically significant features.

Category	Criterion	Description	Measure – Score of 10	Measure – Score of 5	Measure – Score of 1
Social/Cultural Environment	Cultural Heritage Impacts	The degree of impact that the alternative has on areas with documented cultural heritage resources.	The alternative represents little or no potential for disturbance of documented cultural heritage features.	The alternative represents a moderate potential for disturbance of documented cultural heritage features.	The alternative represents a significant potential for disturbance of documented cultural heritage features.
	First Nations Cultural Heritage Impacts	The degree of impact that the alternative has on cultural heritage resources recognized by First Nations.	The alternative represents little or no potential for disturbance of cultural heritage resources recognized by First Nations.	The alternative represents a moderate potential for disturbance of cultural heritage resources recognized by First Nations.	The alternative represents a significant potential for disturbance of cultural heritage resources recognized by First Nations.
	Public land Use Impacts (parks, open spaces)	The ability of the alternative to maintain or enhance character of the public lands in the community.	The alternative will enhance the character of the public lands in the area.	The alternative will maintain the character of the public lands in the area.	The alternative will decrease the character of the public lands in the area.
	Private Lands Impacts	Impact of the alternative on private lands (Industrial, Commercial, Institutional, including farm operations) in regard to short term disturbance or long-term use including easements.	The alternative will have no impact on private lands in regard to short term disturbance or long-term use.	The alternative will have a moderate impact on private lands in regard to short term disturbance or long-term use. Impacts can be mitigated.	The alternative will have significant impact on private lands in regard to short term disturbance or long-term use. Impacts cannot be mitigated.
	Public Acceptability	The level of public acceptability for the alternative based on public consultation results.	The alternative may exceed the public's expectation technically and be accepted by the public.	The alternative may be acceptable to the public as it continues to provide treated water in compliance.	The alternative may not be accepted by the public.
	Residential and Industrial Growth	Ability to support identified residential and industrial growth by meeting anticipated demand.	The alternative will meet projected demands with additional future capacity.	The alternative will meet projected demands.	The alternative will not meet future demands.
	Disruption during Construction	The potential for the alternative to temporarily disrupt local traffic and or use of the area by the public during construction including noise and traffic.	The alternative will not result in disruption to traffic during construction.	The alternative will result in some disruption to traffic and use of the area by the public during construction.	The alternative will result in significant disruption to traffic and use of the area by the public construction.
Technical Environment	Adaptability	The ability of the alternative to adapt to increasing water demands beyond the planning horizon.	The alternative is able to adapt to significant increases in water demands beyond the planning horizon.	The alternative is able to adapt to moderate increases in water demands beyond the planning horizon.	The alternative is not able to adapt to increases in water demands beyond the planning horizon.
	Ease of Approvals and Permitting	The relative difficulty in acquiring the necessary approvals/permits for the alternative from regulatory agencies and other jurisdictions.	Acquiring the permits for this alternative is relatively simple.	Acquiring the permits for this alternative is moderately difficult.	Acquiring the permits for this alternative is difficult.
	Ability for Phased Implementation	The ability of the alternative to increase treatment capacity in phases.	Increased capacity can be implemented in phases with limited new infrastructure/equipment and minimal interruption to water production.	Increased capacity can be implemented in phases with moderate addition of new infrastructure/equipment and some interruption to water production.	Increased capacity cannot be implemented in phases or require significant addition of new infrastructure/equipment or substantial interruption to water production.
	Improvement to Water Conveyance	The ability of the alternative to convey demand flows and improve the capacity of the conveyance system.	The alternative substantially improves water demand transmission and capacity.	The alternative achieves some improvement in water demand transmission and capacity.	The alternative provides limited, if any, improvement in water demand transmission and capacity.

Category	Criterion	Description	Measure – Score of 10	Measure – Score of 5	Measure – Score of 1
Technical Environment	Constructability, Implementation, and Work Scope	The ability of the alternative to be constructed and implemented on a technical and practical basis; within a reasonable scope of work.	The alternative is easy to implement with limited constructability issues; reasonable construction work scope.	The alternative can be implemented with some difficult constructability issue or some constraints; or moderate scope of construction work.	The alternative has many challenges with respect to implementation and construction; or complex and large work scope.
	Operational and Maintenance Complexity	The degree of complexity associated with operating and maintaining the alternative.	The alternative is simple to operate and easy to maintain.	The alternative is moderately difficult to operate, requires extensive and continuous operator trainings, and the maintenance is somewhat difficult and requires higher skills.	The alternative is complex to operate and requires frequent/complex maintenance.
	Risk/Reliability	The level of risk associated with the alternative relating to probability of failure, water supply, and regulatory compliance.	There are limited to no risks associated with the alternative.	There is a moderate level of risk associated with the alternative.	There is a high level of risk associated with the alternative.
	Impact of Changing Raw Water Quality	Technical capability of an alternative to respond to rapid change of raw water quality (turbidity).	The alternative is able to manage a range of water quality above that anticipated.	The alternative is able to manage the range of anticipated raw water quality.	The alternative is not able to manage the range of anticipated raw water quality.
	Impacts on Treated Water Quality	Capability of an alternative to meet more stringent water quality regulatory requirements in the future.	The alternative produces treated water superior in water quality to the existing WTP and provides high degree of protection from certain emerging contaminants.	The alternative produces treated water superior in water quality to the existing WTP and provides a moderate degree of protection from certain emerging contaminants.	The alternative produces treated water with a similar water quality to the existing WTP and provides a moderate degree of protection from certain emerging contaminants.
	Balanced Water Supply Within PUC	Temporary or long-term ability to limit the water stress on other PUC-owned WDSs by being integrated based on a long-term water supply strategy.	The alternative fulfils all the requirements of a long term PUC water supply strategy.	The alternative fulfils some of the requirements of a long-term PUC water supply strategy.	The alternative fulfils very few of the requirements of a long-term PUC water supply strategy.
	Infrastructure Sustainability	The degree of sustainability associated with the alternative in terms of appropriate technology and O&M.	The alternative has a high degree of sustainability.	The alternative has a moderate degree of sustainability.	The alternative has a low degree of sustainability.
Economic Environment	Capital Cost	Estimated capital cost.	Capital costs are less than $20M.	Capital costs are $40M to $60M.	Capital costs are more than $60M.
	Lifecycle Cost	Total annual capital and operational costs amortized over 45 years.	Lifecycle costs are less than $50M.	Lifecycle costs are $50M to $100M.	Lifecycle costs are more than $100M.

7.6 Evaluation Results and Preferred Solution

The evaluation results for water supply are presented in Table 7-12. Detailed scoring and rationales of the evaluation and sensitivity analyses for each category are presented in Appendix B.

Alternative 2a: Build a new Wallaceburg WTP with a rated capacity of 28 ML/day to supply Wallaceburg, Dresden, and future greenhouses along Base Line was selected as the preferred solution for water supply. It was the highest scoring alternative for the evaluation, as well as for three of the four sensitivity analyses. Differentiating advantages for this alternative include the following:

- The alternative would significantly reduce the occupational health and safety concerns due to the aging water treatment equipment and facilities, as the existing WTP would be fully replaced with a new WTP.
- The PUC would retain autonomy of its water supply.
- The new Wallaceburg WTP will serve the expanded areas, and accommodate the maximum potential to support future development, as well as reducing stress on the Chatham WTP.
- The alternative would help to relieve the public's concern regarding the water quality of the raw water sources.
- The alternative provides an opportunity to adopt a modern and advanced water treatment technology (such as LPM filtration), which would provide superior treated water quality and meet the potentially more stringent regulatory requirements in the future.
- This alternative can be implemented in phases and contain provisions for future expansion.
- The Surface Water Study (Golder 2021d) supports the increased water-taking from the Chenal Écarte for a new and larger WTP in Wallaceburg.

The estimated capital cost for the preferred solution for water supply is $46,433,000. The preferred solution for water supply has the following implications for raw water supply and water transmission development due to the increased water demand and expanded service area for the Wallaceburg WTP compared to the existing condition:

- **Raw Water Supply:** The raw water demand will be 34 ML/day in the future to account for process wastage within the Wallaceburg WTP. Therefore, the LLPS and intake must be able to convey 34 ML/day to the Wallaceburg WTP. This will serve as the basis for raw water supply alternative development.
- **Water Transmission:** The projected future water demand for Dresden and the potential greenhouses along Base Line is 17.4 ML/day (8.8 ML/day and 8.6 ML/day for Dresden and the greenhouses, respectively). Therefore, the conveyance system between Wallaceburg and Dresden must be able to convey 17.4 ML/day in the future. This will serve as the basis for water transmission alternative development.

Table 7-12. Evaluation Results for Water Supply Alternatives

Category	Do Nothing	Alternative 2a	Alternative 2b	Alternative 2c	Alternative 2d	Alternative 3a	Alternative 3b	Alternative 3c	Alternative 4a	Alternative 4b
Natural Environment	21.4	17.9	17.9	17.9	21.4	16.1	16.1	16.1	16.1	17.9
Social/Cultural Environment	17.5	20.0	17.5	13.8	12.5	20.0	16.3	12.5	15.0	16.3
Technical Environment	5.7	23.9	15.9	17.0	11.4	22.7	11.4	9.1	9.1	15.9
Economic Environment	18.8	12.5	12.5	0.0	0.0	12.5	12.5	6.3	18.8	18.8
Total	63.4	74.2	63.8	48.7	45.3	71.3	56.2	43.9	58.9	68.8
Sensitivity Analysis -1	67.8	73.7	65.3	53.2	53.4	69.9	57.8	48.0	60.0	69.3
Sensitivity Analysis -2	64.7	75.4	65.0	49.9	46.2	73.0	57.9	45.1	59.1	68.0
Sensitivity Analysis -3	55.2	78.5	63.7	52.6	45.3	75.2	54.0	42.4	54.4	67.7
Sensitivity Analysis -4	65.7	69.4	61.0	38.9	36.2	67.0	54.9	40.1	62.1	70.0

8. Development and Evaluation of Raw Water Supply Alternatives

8.1 Raw Water Supply Alternatives

Raw water supply alternatives were developed considering the raw water demand from the preferred solution for water supply. Considering process wastage, the LLPS and intake were conceptually sized to convey 34 ML/day to the new Wallaceburg WTP rated at 28 ML/day. The existing LLPS and intake have a firm capacity of 24 ML/day and therefore, cannot supply the required amount of water. Also, given their age and size, it would be very difficult to expand the capacity of the existing LLPS and intake without substantially disturbing the normal water supply from the Wallaceburg WTP. Therefore, the more feasible solution is to construct a new LLPS and intake. A new raw watermain is also required given the age and condition of the existing raw watermain.

Constructing a new LLPS and intake also presents the opportunity to review the location of the LLPS and intake. At the existing location along the Chenal Écarte, the raw water quality suffers from seasonal turbidity spikes during wet weather events, up to 1,000 nephelometric turbidity units. An example of these turbidity spikes is presented on Figure 8-1, which shows the condition of the Chenal Écarte during a wet weather event in February 2018. As shown on the figure, the effect of the turbidity spike is reduced upstream of where the Johnston Channel branches from the Chenal Écarte. This has historically challenged robust water production at the Wallaceburg WTP. While membrane technology is more robust than the conventional filtration process, these spikes would inevitably increase the membrane maintenance requirements (such as more frequency backwashes and cleaning). For this reason, in addition to the existing site, intake and LLPS locations upstream of the turbidity spiking section of the Chenal Écarte are also considered in the alternative development.

Raw water supply alternatives were developed based on the future location of the intake and LLPS. Through surveying vacant lands and consulting with landowners, two potential upstream locations were identified, in addition to the existing LLPS and intake location.

Raw water supply alternatives were developed based on the potential sites as shown on Figure 8-2, as follows:

- "Do Nothing" Baseline Alternative
- Alternative 1: Build a new LLPS and intake with a rated capacity of 34 ML/day at the existing site
- Alternative 2: Build a new LLPS and intake with a rated capacity of 34 ML/day at the first upstream location (5844 Bluewater Line)
- Alternative 3: Build a new LLPS and intake with a rated capacity of 34 ML/day at the second upstream location (5724 Bluewater Line)

Alignments for the new raw watermain are discussed in more detail in Section 8.2.

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Figure 8-1
Chenal Écarte Condition During a Wet Weather Event in February 2018
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Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

Jacobs

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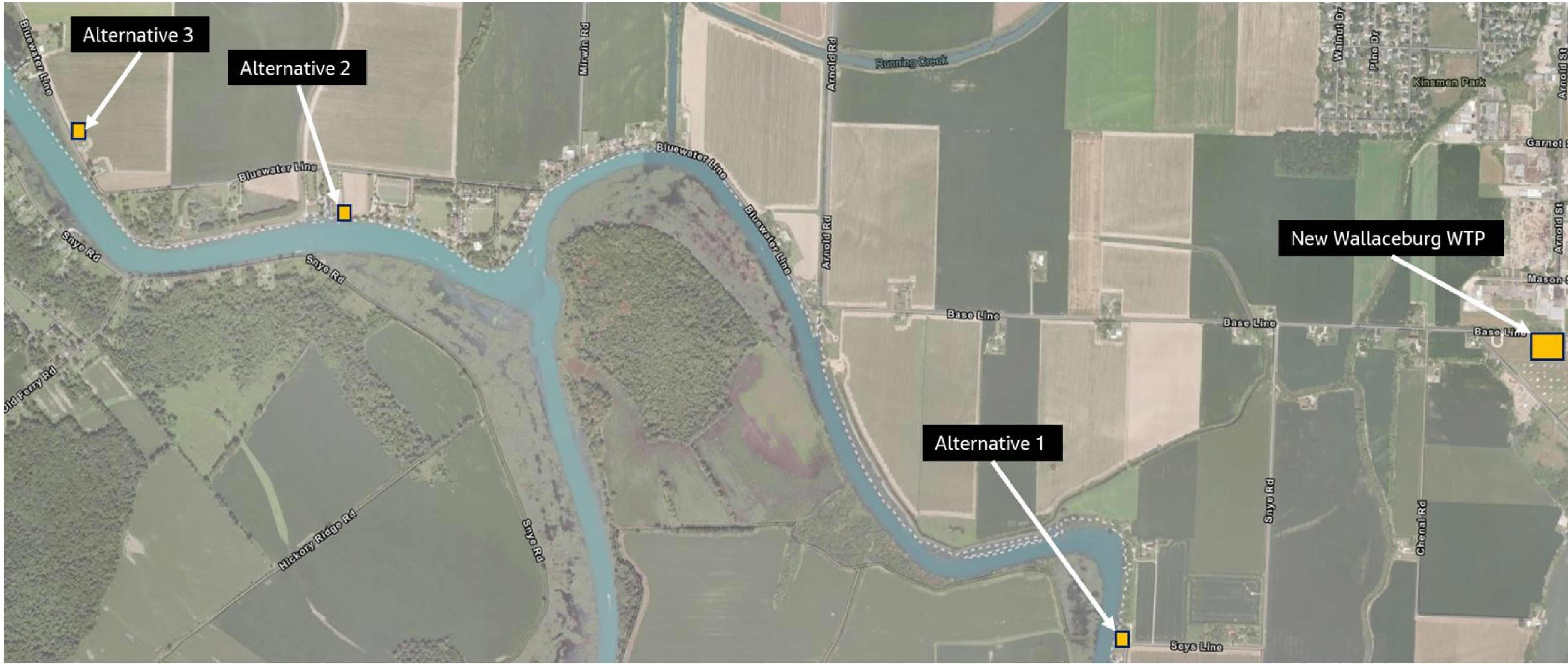

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Figure 8-2
Alternative Solutions for Raw Water Supply
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8.2 Design Concepts

8.2.1 Common LLPS and Intake Design Concept

A common design concept for the new LLPS and intake was developed that can be applied at each location. The design concept provides a base level of equipment and facility configuration for the LLPS and intake at each site. Slight modifications were then made to the base configuration to suit the specific site condition. Constructability considerations and total dynamic head (TDH) requirements for each alternative were also considered for each site and are discussed in each alternative's section.

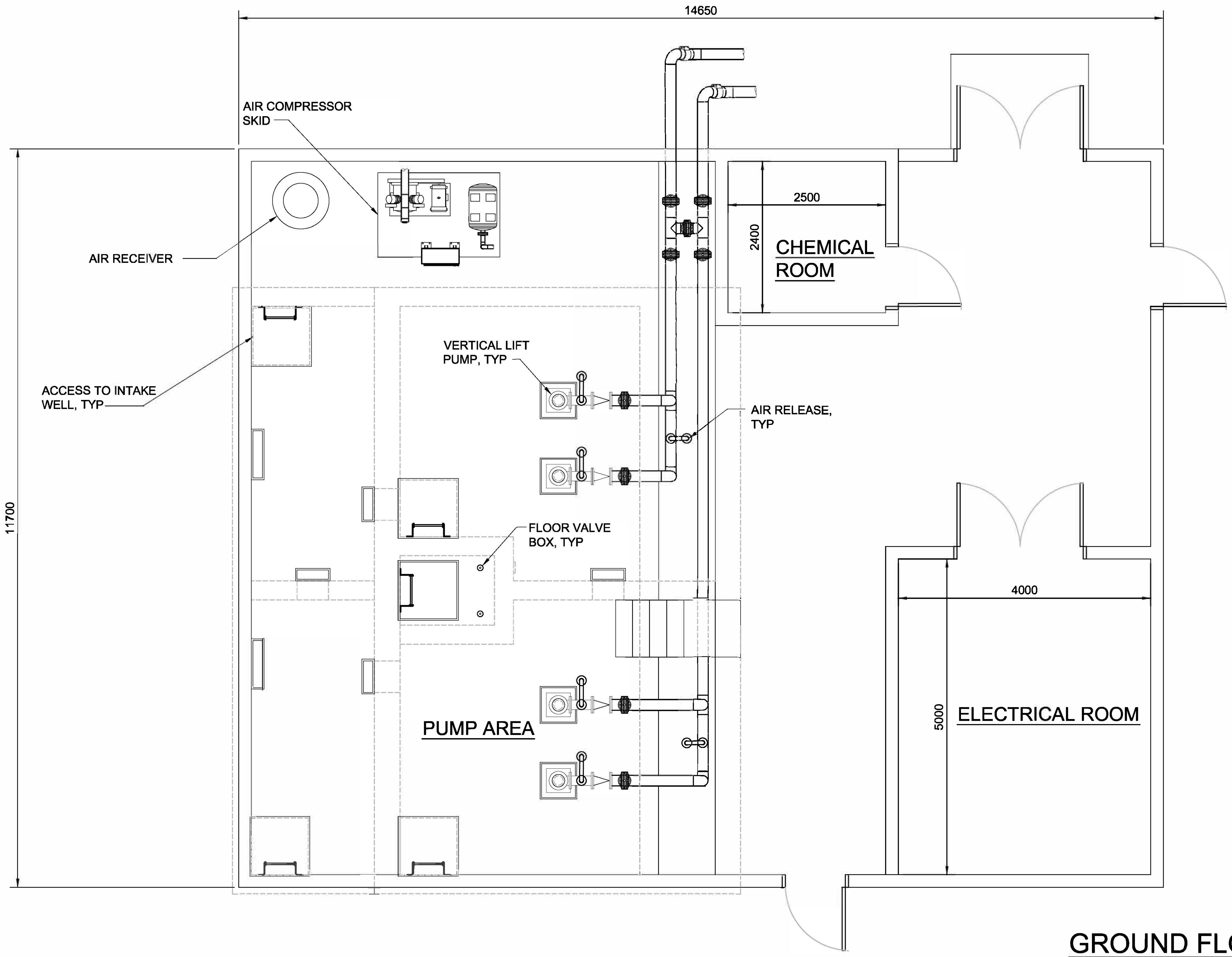
For each location, the LLPS will have the following key components:

- Split wet well to allow for ease of phased implementation and maintenance
- Two duty and two standby vertical turbine pumps, each rated to pump 17 ML/day for a firm LLPS capacity of 34 ML/day
- Outdoor diesel standby generator (power requirements to be determined for individual alternatives)
- A pumping station building with a footprint of 100 square metres

The intake will have the following key components:

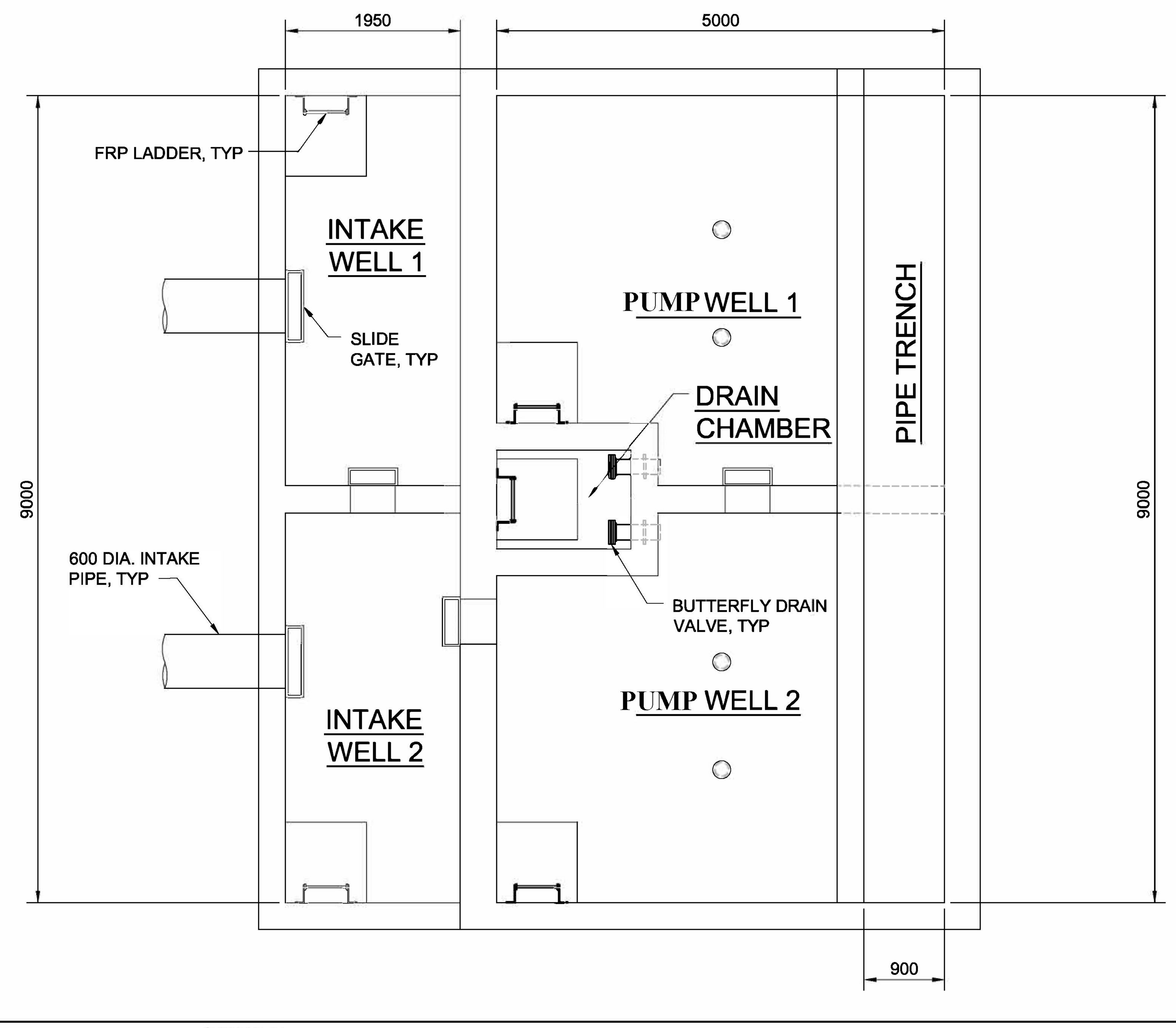
- Twinned 533-millimetre welded steel intake pipes
- Mechanically cleaned cylindrical tee screens to meet fish protection requirement
- Seasonal sodium hypochlorite dosing (6 months per year assumed) at 0.1 milligram per litre for zebra mussel control at the intake

Figure 8-3 presents a preliminary concept of the wet well and ground level floors for the LLPS. Figure 8-4 presents an example of the intake screens installed in a dewatered pit (photo taken during construction).



GROUND FLOOR LEVEL

1 : 50



PUMP WELL LEVEL

1 : 50

Jacobs

General

Low Lift Pumping Station
Preliminary Plans
with In River Screens

Wallaceburg Low Lift Pumping Station
Wallaceburg, Ontario
Chatham-Kent Public Utilities Commission

NO.	DATE	REVISION	BY	APVD

DSGN J. PHILPOTT DR C. PURNEY CHK APVD

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Figure 8-4. Example Installation for Intake Screens

8.2.2 "Do Nothing" Baseline Alternative

In this alternative, the existing LLPS and intake will continue to be maintained and rehabilitated as outlined in the previous Wallaceburg and Area Water Supply Class EA (Stantec 2016). The key components of this alternative are summarized as follows:

- Pump replacement
- Intake pipe replacement
- Suction piping and valve replacement
- Electrical upgrades
- Raw watermain replacement

A contingency was also added to the cost estimate due to the age of the LLPS. This alternative will not be able to meet the required flow for a new Wallaceburg WTP with a rated capacity of 28 ML/day.

8.2.3 Alternative 1

In this alternative, a new LLPS and intake with a rated capacity of 34 ML/day would be constructed adjacent to the existing LLPS and intake. A new raw watermain would be constructed within the right-of-way along the Seys Line, Snye Road and Base Line to the new Wallaceburg WTP, approximately 2.6 kilometres in length. While the existing raw watermain alignment, approximately 2 kilometres in length, passes through an easement in agricultural land, the easement passes through a scrap metal yard that was constructed after the raw watermain. This portion could present constructability issues if the easement passes through an existing building. To avoid these issues, an alignment was selected that passes through the right-of-way.

With this alignment, it is estimated that the new LLPS would have a rated capacity of 34 ML/day at 15 metres of TDH. With this configuration, it is estimated that a 200 kilowatts diesel standby generator is required. As the existing diesel standby generator is 250 kilowatts, it was assumed that it would remain in service for the new LLPS, and therefore, the cost for a new diesel standby generator was not included.

The location of the LLPS and the raw watermain alignment are presented on Figure 8-5.

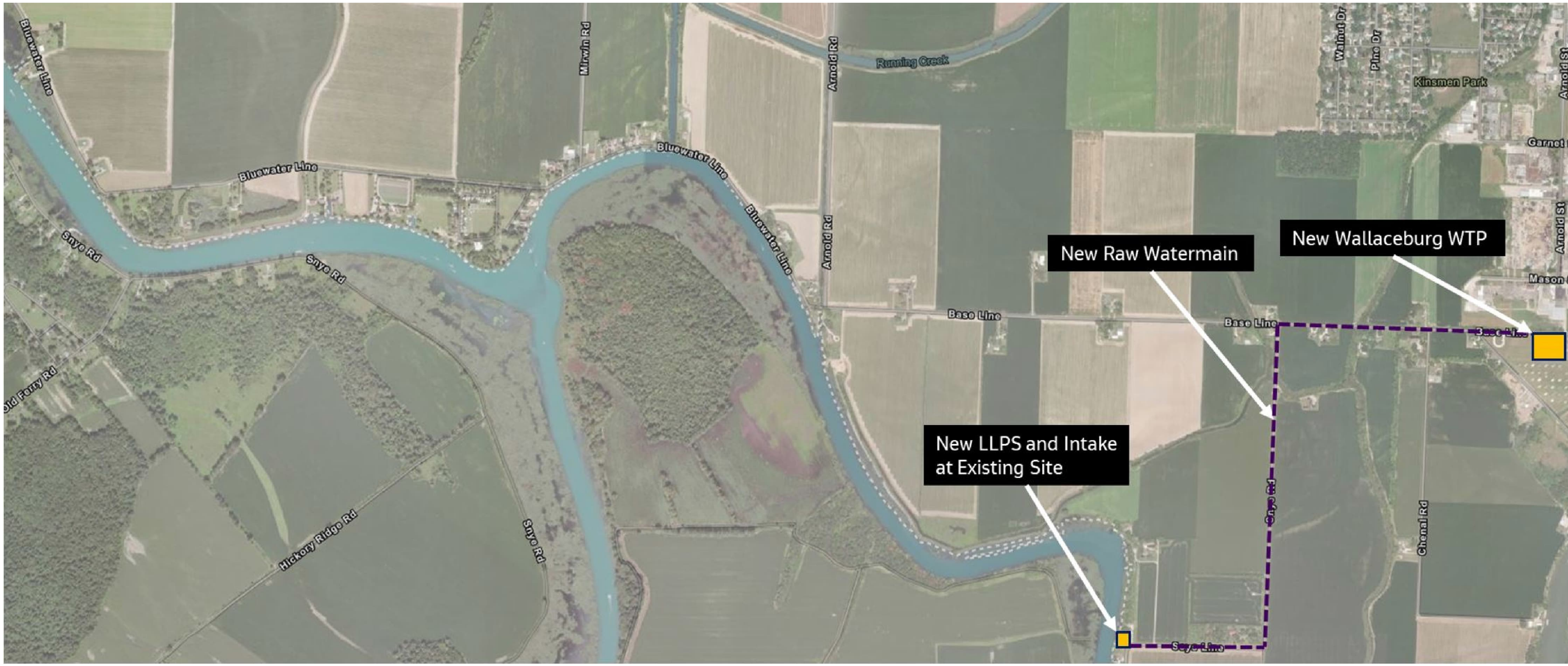

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Figure 8-5
LLPS Location and Raw Watermain Alignment for Alternative 1
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At this location, the new intake can be constructed via a bulkhead formed by open cut and sheet piling. The preliminary site plan for Alternative 1 is presented on Figure 8-6.

Figure 8-6. Preliminary Site Plan for Alternative 1

8.2.4 Alternative 2

In this alternative, a new LLPS and intake would be constructed at the first upstream location. This location is currently privately owned and as such, would require land acquisition. A new raw watermain would be constructed within the right-of-way along Bluewater Line, through an easement in the agricultural land to the north of Bluewater Line, along Arnold Road and Base Line to the new Wallaceburg WTP, approximately 5.5 kilometres in length.

With this alignment, it is estimated that the new LLPS would be rated with a rated capacity of 34 ML/day at 31 metres of TDH. A new 250 kilowatts diesel standby generator will be required.

The location of the LLPS and the alignment of the raw watermain are presented on Figure 8-7. This raw watermain alignment was selected to avoid potential impacts due to road erosion from rising water levels in the future.

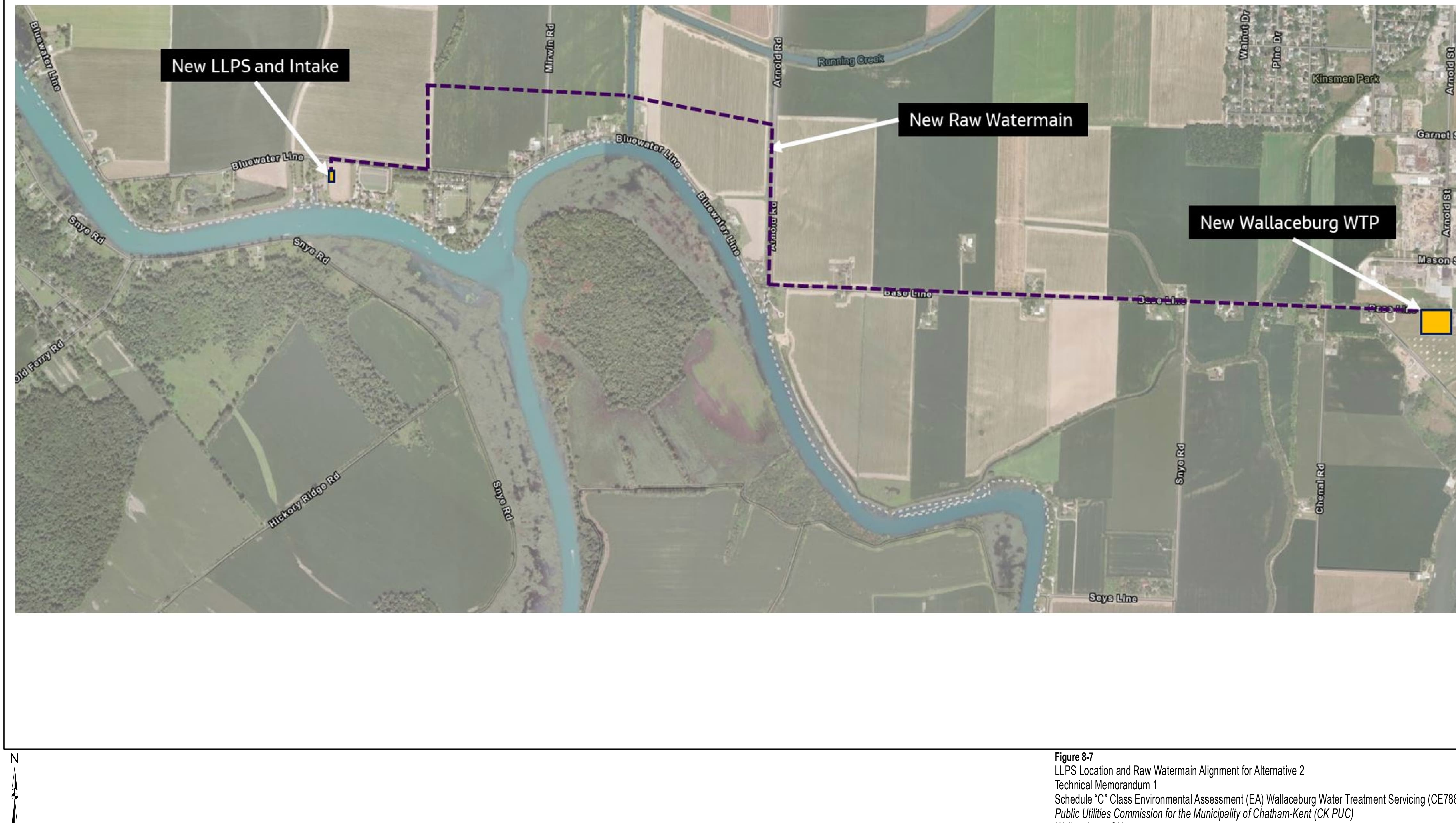

Figure 8-7
LLPS Location and Raw Watermain Alignment for Alternative 2
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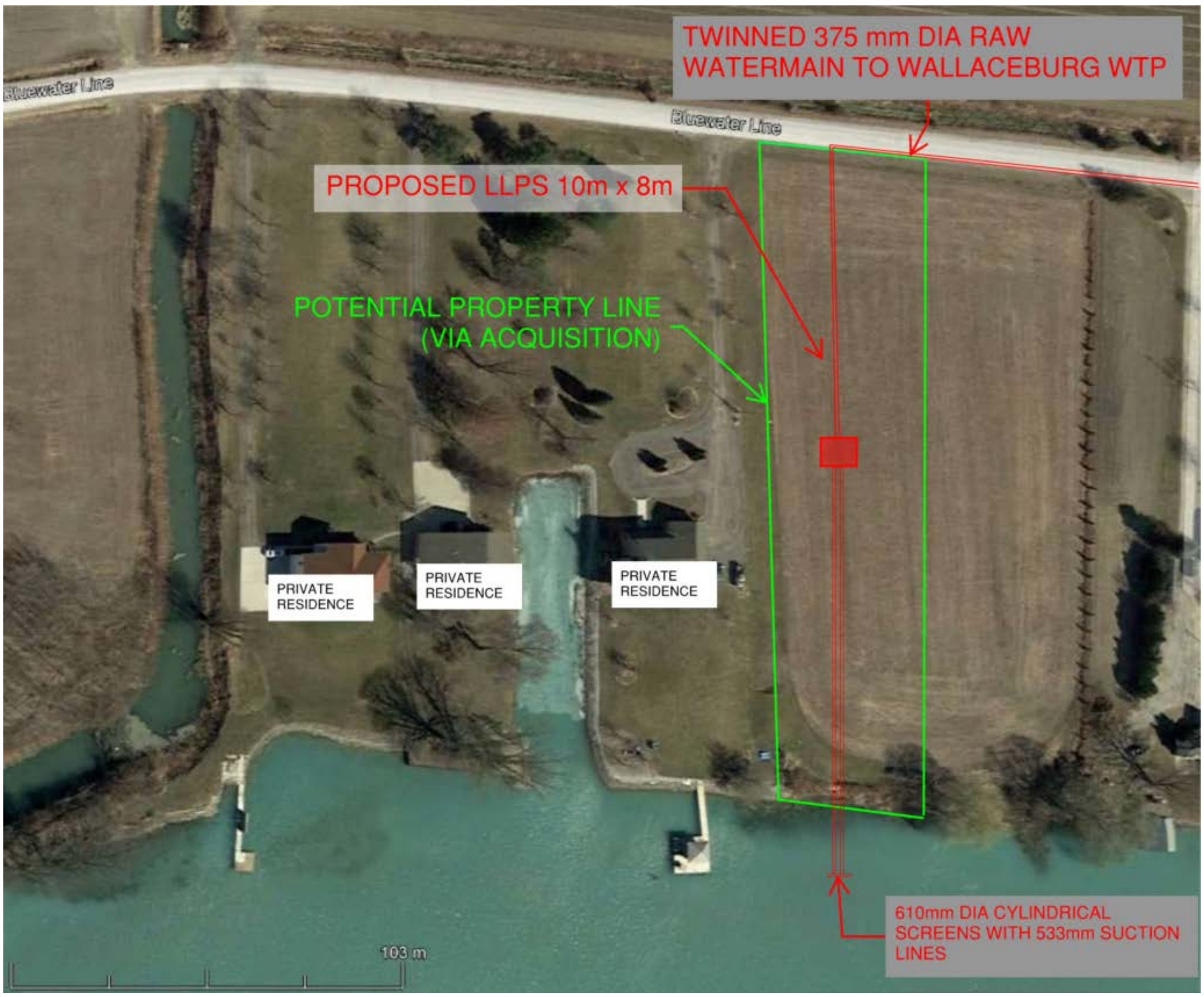
At this location, the new intake can be constructed via open cut (on land) and sheet piling (in water). The preliminary site plan for Alternative 2 is presented on Figure 8-8. It is noted that the setback of the LLPS from the Chenal Écarte was selected based on discussions with the landowner. Due to the setback from the shore and the requirement for the intake pipe to be sloped downwards towards the LLPS (0.2% slope), this alternative would require a deeper wet well than those that are constructed closer to the shore.

Figure 8-8. Preliminary Site Plan for Alternative 2



8.2.5 Alternative 3

In this alternative, a new LLPS and intake would be constructed at the first upstream location. This land is currently privately owned and as such, would require land acquisition. A new raw watermain would be constructed within the right-of-way along Bluewater Line, through an easement in the agricultural land to the north of Bluewater Line, along Arnold Road and Base Line to the new Wallaceburg WTP, approximately 6.7 kilometres in length.

With this alignment, it is estimated that the new LLPS would have a rated capacity of 34 ML/day at 37 metres of TDH. A new 300 kilowatts diesel standby generator will be required.

The location of the LLPS and the alignment of the raw watermain are presented on Figure 8-9. Similar to Alternative 2, the raw watermain alignment was selected to avoid potential impacts due to road erosion from rising water levels in the future.

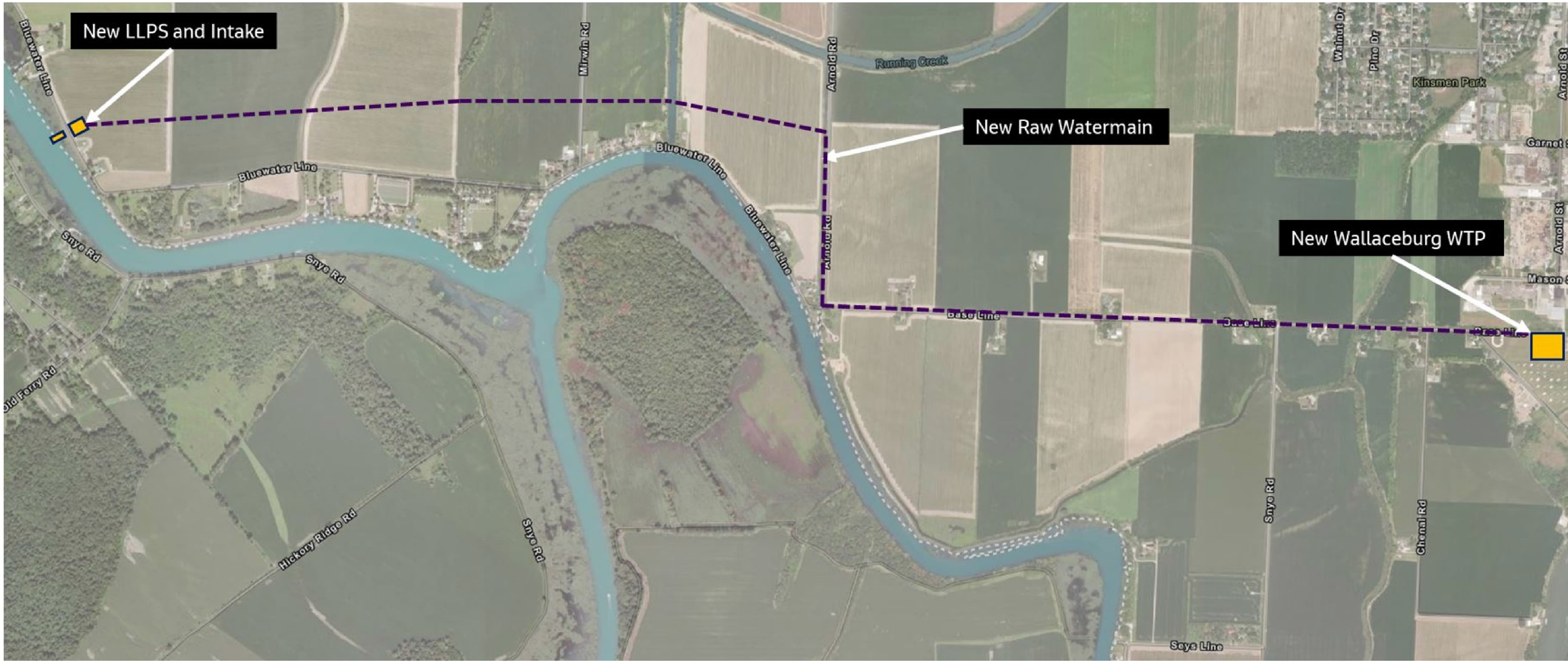


Figure 8-9
LLPS Location and Raw Watermain Alignment for Alternative 3
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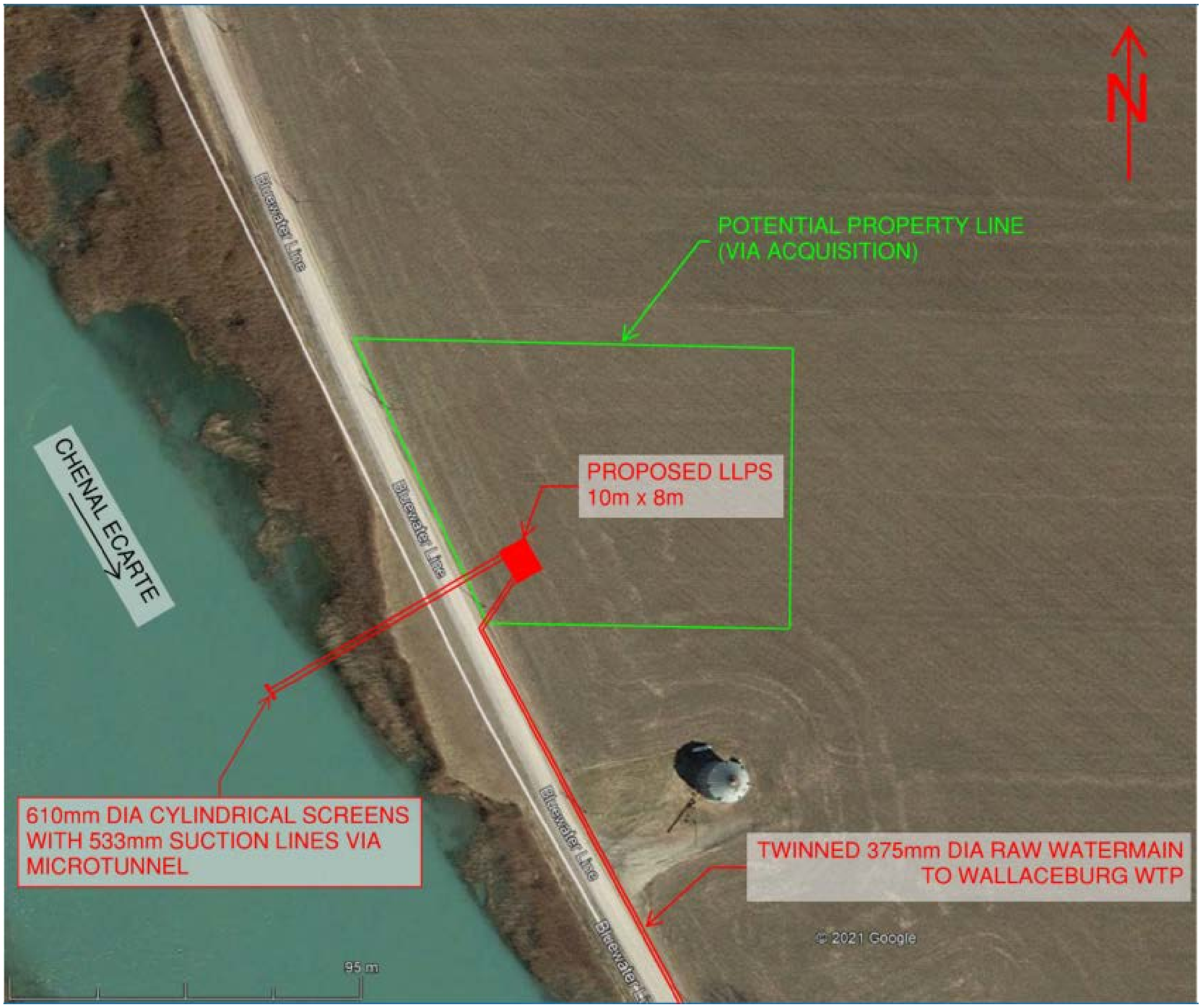
At this location, the intake would be constructed using trenchless technologies to reduce potential impacts on the wetland between Bluewater Line and the Chenal Écarte, and to avoid the disruption to the traffic on Bluewater Line. The preliminary site plan for Alternative 3 is presented on Figure 8-10.

Figure 8-10. Preliminary Site Plan for Alternative 3



8.3 Cost Estimation

Capital cost estimates, O&M cost estimates and lifecycle cost estimates were developed for each alternative presented in Section 8.2 based on the methodology presented in Section 6.2. In addition to the general O&M cost estimate basis, a diver allowance was included for annual intake screen maintenance. Where required, land acquisition was included in the capital cost at $200,000/acre, based on the cost per acre of similar vacant land parcels in the area that were listed for sale at the time of writing this TM.

Table 8-1 presents a summary of the raw water supply alternatives and their associated costs. Details of the cost estimate are presented in Appendix C.

Table 8-1. Raw Water Supply Alternatives Summary and Cost Estimate

Alternative	Description	Capital Cost	O&M Cost Net Present Value	50-year Lifecycle Cost
Do Nothing	Continue to maintain and rehabilitate the LLPS and intake as outlined in the previous Wallaceburg Water Servicing Class EA	$10,330,000	$5,940,000	$12,400,000
Alternative 1	Build a new LLPS and intake with a rated capacity of 34 ML/day at the existing site	$10,260,000	$3,600,000	$13,900,000
Alternative 2	Build a new LLPS and intake with a rated capacity of 34 ML/day at the first upstream location	$15,230,000	$5,600,000	$20,900,000
Alternative 3	Build a new LLPS and intake with a rated capacity of 34 ML/day at the second upstream location	$17,924,000	$6,100,000	$24,000,000

8.4 Greenhouse Gas Emissions

GHG emissions were estimated for the raw water supply alternatives using the methodology presented in Section 6.3. For the Do Nothing alternative, the historical power consumption from 2017 to 2020 at ADD (approximately 4 ML/day) was prorated to 24 ML/day, which is the maximum flow that the LLPS can convey.

Table 8-2 presents the estimated GHG emissions for each raw water supply alternative.

Table 8-2. GHG Emissions for Raw Water Supply Alternatives

Alternative	Energy Consumption, kilowatt hour per year	Unit Energy Consumption, kilowatt hour per year per megalitre	GHG Emissions, tonnes of carbon dioxide equivalent per year
Do Nothing	2,268,000	94,500	68.0
Alternative 1	706,000	26,000	21.2
Alternative 2	1,082,000	39,800	32.5
Alternative 3	1,186,000	43,600	35.6

In general, for the new LLPS alternatives, it is more efficient to pump raw water to the Wallaceburg WTP over a shorter distance, as expected.

8.5 Evaluation Criteria

Each raw water supply alternative was evaluated using the methodology presented in Section 6.4. The evaluation criteria for the water supply alternatives and their scoring measures are presented in Table 8-3.

Table 8-3. Evaluation Criteria and Scoring Measures for Raw Water Supply

Category	Criterion	Description	Measure – Score of 10	Measure – Score of 5	Measure – Score of 1
Natural Environment	Impacts to Surface Water Quality	The potential for the alternative to have a negative impact on surface water quality that would result in harm to the aquatic environment.	The alternative will have no substantial impact on surface water quality that may impact aquatic environments.	The alternative has some potential to change surface water quality that may negatively impact aquatic habitats.	The alternative has a high potential to change surface water quality that may negatively impact aquatic habitats.
	Impacts to Surface Water Quantity	The potential for the alternative to have an impact on surface water quantity that would result in negative impacts to other users or the aquatic environment.	The alternative will have no substantial impact on surface water quantity that would result in negative impacts to other users or the aquatic environment.	The alternative will have some potential impact on surface water quantity that would result in negative impacts to other users or the aquatic environment.	The alternative will have a high potential impact on surface water quantity that would result in negative impacts to other users or the aquatic environment.
	Impacts to Wetlands	The potential for the alternative to have a negative impact on wetlands that would result in harm to species in the environment.	The alternative will have no substantial long-term impact on wetlands that would negatively impact species in the environment.	The alternative has some potential for long-term impacts on wetlands that would negatively impact species in the environment.	The alternative has high potential for long-term impacts on wetlands that would negatively impact species in the environment.
	Impacts on Terrestrial Environment	The potential for the alternative to have a long-term negative impact on the viability of terrestrial habitats in terms of density and diversity of species.	The alternative will have no substantial long-term impact on the viability of terrestrial habitats in terms of density and diversity of species.	The alternative has some potential for long-term impacts on the viability of terrestrial habitats in terms of density and diversity of species.	The alternative has high potential for long-term impacts on the viability of terrestrial habitats in terms of density and diversity of species.
	Impacts on Aquatic Environment	The potential for the alternative to have a long-term negative impact on the viability of aquatic habitats in terms of density and diversity of species.	The alternative will have no substantial long-term impact on the viability of aquatic habitats in terms of density and diversity of species.	The alternative has some potential for long-term impact on the viability of aquatic habitats in terms of density and diversity of species.	The alternative has high potential for long-term impact on the viability of aquatic habitats in terms of density and diversity of species.
	GHG Emissions	The potential for the alternative to increase or decrease GHG emissions from the current condition related to Wallaceburg raw water supply (based on 30 grams of carbon dioxide per kilowatt hour, 2020 National Inventory Report [ECCC 2020]).	The alternative would decrease GHG emissions relative to current conditions.	The alternative would maintain GHG emissions relative to current conditions.	The alternative would increase GHG emissions relative to current conditions.
	Impacts to Air Quality	The potential for the alternative to negatively impact air quality in the area.	The alternative will have no substantial impact on air quality in the area.	The alternative will have a moderate impact on air quality in the area.	The alternative will have a significant impact on air quality in the area.
	Impacts to Fluvial Geomorphic Stability	The potential of the alternative to impact the geomorphic stability of the watercourse (based on stream crossings) and intake location.	The alternative will have no substantial impact on the fluvial geomorphic stability of the watercourse.	The alternative will somewhat reduce the fluvial geomorphic stability of the watercourse.	The alternative will substantially reduce the fluvial geomorphic stability of the watercourse.
	Potential Impacts to Groundwater Quality and Quantity	The potential for the alternative to have a negative long-term impact on groundwater quality or quantity.	The alternative will have no substantial impact on groundwater quality and quantity over long term.	The alternative will somewhat reduce groundwater quality and quantity over long term.	The alternative will substantially reduce the quality and quantity of groundwater over long term.

Category	Criterion	Description	Measure – Score of 10	Measure – Score of 5	Measure – Score of 1
Social/Cultural Environment	Occupational Health and Safety	The potential of the alternative to minimize risk or liability regarding occupational health and safety for construction period and ongoing O&M.	The alternative poses very little risk to occupational health and safety.	The alternative poses moderate risk to occupational health and safety; construction and O&M safety measures may be required to address specific health and safety concerns.	The alternative poses high risk to occupational health and safety; personal injury may be expected; construction and O&M safety measures will be required to address a number of health and safety concerns.
	Archaeological Impacts	The degree of impact that the alternative has on documented archaeologically significant features.	The alternative has little or no impact on documented archaeologically significant features.	The alternative has a moderate impact on documented archaeologically significant features.	The alternative has a large impact on documented archaeologically significant features.
	Cultural Heritage Impacts	The degree of impact that the alternative has on areas with documented cultural heritage resources.	The alternative represents little or no potential for disturbance of documented cultural heritage features.	The alternative represents a moderate potential for disturbance of documented cultural heritage features.	The alternative represents a significant potential for disturbance of documented cultural heritage features.
	First Nations Cultural Heritage Impacts	The degree of impact that the alternative has on cultural heritage resources recognized by First Nations.	The alternative represents little or no potential for disturbance of cultural heritage resources recognized by First Nations.	The alternative represents a moderate potential for disturbance of cultural heritage resources recognized by First Nations.	The alternative represents a significant potential for disturbance of cultural heritage resources recognized by First Nations.
	Public land Use Impacts (parks, open spaces)	The ability of the alternative to maintain or enhance character of the public lands in the community.	The alternative will enhance the character of the public lands in the area.	The alternative will maintain the character of the public lands in the area.	The alternative will decrease the character of the public lands in the area.
	Private Lands Impacts	Impact of the alternative on private lands (Industrial, Commercial, Institutional, including farm operations) in regard to short-term disturbance or long-term use including easements.	The alternative will have no impact on private lands in regard to short-term disturbance or long-term use.	The alternative will have a moderate impact on private lands in regard to short-term disturbance or long-term use. Impacts can be mitigated.	The alternative will have significant impact on private lands in regard to short-term disturbance or long-term use. Impacts cannot be mitigated.
	Public Acceptability	The level of public acceptability for the alternative based on public consultation results.	The alternative may exceed the public's expectation technically and be accepted by the public.	The alternative may be acceptable to the public.	The alternative may not be accepted by the public.
	Disruption during Construction	The potential for the alternative to temporarily disrupt local traffic and or use of the area by the public during construction including noise and traffic.	The alternative will not result in disruption to traffic during construction.	The alternative will result in some disruption to traffic and use of the area by the public during construction.	The alternative will result in significant disruption to traffic and use of the area by the public construction.
Technical Environment	Adaptability	The ability of the alternative to adapt to increasing water demands beyond the planning horizon.	The alternative is able to adapt to significant increases in water demands beyond the planning horizon.	The alternative is able to adapt to moderate increases in water demands beyond the planning horizon.	The alternative is not able to adapt to increases in water demands beyond the planning horizon.
	Ease of Approvals and Permitting	The relative difficulty in acquiring the necessary approvals and permits for the alternative from regulatory agencies and other jurisdictions, including easements. Relevant permits include PTTW, municipal, DFO, SCRCA and Transport Canada permits.	Acquiring the permits for this alternative is relatively simple.	Acquiring the permits for this alternative is moderately difficult.	Acquiring the permits for this alternative is difficult.

Category	Criterion	Description	Measure – Score of 10	Measure – Score of 5	Measure – Score of 1
Technical Environment	Ability for Phased Implementation	The ability of the alternative to increase pumping capacity in phases.	Increased capacity can be implemented in phases with limited new infrastructure/equipment and minimal interruption to raw water supply.	Increased capacity can be implemented in phases with moderate addition of new infrastructure/equipment and some interruption to raw water supply.	Increased capacity cannot be implemented in phases or require significant addition of new infrastructure/equipment or substantial interruption to raw water supply.
	Constructability, Implementation, and Work Scope	The ability of the alternative to be constructed and implemented on a technical and practical basis; within a reasonable scope of work.	The alternative is easy to implement with limited constructability issues; reasonable construction work scope.	The alternative can be implemented with some difficult constructability issue or some constraints; or moderate scope of construction work.	The alternative has many challenges with respect to implementation and construction; or complex and large work scope.
	Operational and Maintenance Complexity	The degree of complexity associated with operating and maintaining the alternative.	The alternative is simple to operate and easy to maintain	The alternative is moderately difficult to operate, requires extensive and continuous operator trainings, the maintenance is somewhat difficult and requires higher skills.	The alternative is complex to operate, and requires frequent/complex maintenance.
	Compatibility with the Preferred Solution for Water Supply	The degree of compatibility with the new Wallaceburg WTP (preferred solution for Water Supply), relating to capacity and raw water quality.	The alternative provides sufficient raw water supply as required for the preferred solution for water supply and provides consistent raw water quality, reducing maintenance requirements.	The alternative provides sufficient raw water supply as required for the preferred solution for water supply but experiences changes in raw water quality, increasing maintenance requirements.	The alternative does not provide sufficient raw water supply as required for the preferred solution for water supply.
	Construction Schedule	The duration of construction activities relative to other alternatives.	Construction for this alternative would have a relatively long duration.	Construction for this alternative would have a relatively moderate duration.	Construction for this alternative would have a relatively short duration.
	Proximity to Utilities	The proximity of the site to utilities, i.e. natural gas and industrial hydro.	The site is in close proximity to the required utilities.	The site is somewhat close to the required utilities and would require further coordination with utility companies.	The site is not close to the required utilities.
	Risk/Reliability	The level of risk associated with the alternative relating to probability of failure, water supply and regulatory compliance.	There are limited to no risks associated with the alternative.	There is a moderate level of risk associated with the alternative.	There is a high level of risk associated with the alternative.
	Impacts on Raw Water Quality from Wet Weather Events	The degree of change to raw water quality (i.e., turbidity, ammonia spikes) resulting from wet weather events.	Raw water quality is not impacted by wet weather events.	Raw water quality is slightly impacted by wet weather events, with increases to key parameters such as turbidity and ammonia.	Raw water quality is significantly impacted by wet weather events, with large increases to key parameters such as turbidity and ammonia.
	Infrastructure Sustainability	The degree of sustainability associated with the alternative in terms of appropriate technology and O&M.	The alternative has a high degree of sustainability.	The alternative has a moderate degree of sustainability.	The alternative has a low degree of sustainability.
Economic Environment	Capital Cost	Estimated capital cost.	Capital costs are less than $10M.	Capital costs are $10M to $20M.	Capital costs are more than $20M.
	Lifecycle Cost	Total annual capital and operational costs amortized over 50 years.	Lifecycle costs are less than $15M.	Lifecycle costs are $15M to $30M.	Lifecycle costs are more than $30M.

8.6 Evaluation Results and Preferred Solution

Table 8-4 presents the evaluation results for raw water supply. Detailed scoring and rationales for base evaluation and sensitivity analyses are presented in Appendix D.

Table 8-4. Evaluation Results for Raw Water Supply

Category	Do Nothing	Alternative 1	Alternative 2	Alternative 3
Natural Environment	22.2	22.2	22.2	20.8
Social/Cultural Environment	18.8	14.1	14.1	14.1
Technical Environment	4.5	13.6	18.2	21.6
Economic Environment	12.5	12.5	12.5	12.5
Total	58.0	62.4	67.0	69.0
Sensitivity Analysis -1	64.2	67.7	71.4	71.9
Sensitivity Analysis -2	61.4	61.2	64.8	66.4
Sensitivity Analysis -3	50.1	60.9	68.1	72.5
Sensitivity Analysis -4	56.4	59.9	63.6	65.2

Alternative 3: Build a new LLPS and intake with a rated capacity of 34 ML/day at the second upstream location was selected as the preferred solution for raw water supply. It was the highest scoring alternative for the overall evaluation and for each sensitivity analysis that was completed. Differentiating factors for this alternative include the following:

- This location would eliminate raw water quality concerns at the LLPS and intake.
- The construction methods (open-cut installation) are relatively simple for this location.
- Intake equipment is relatively simple to access and maintain.
- There are no footprint restrictions at this site. The existing LLPS site and Alternative 2 have footprint availability concerns.

The estimated capital cost for the preferred solution for raw water supply is $17,924,000.

9. Development and Evaluation of Water Transmission Alternatives

9.1 Water Transmission Alternatives

Water transmission alternatives were developed to supply treated water to Dresden and the future greenhouses on Base Line. The water transmission main will be able to convey 17.4 ML/day between Wallaceburg and Dresden. The existing transmission main on Base Line between Wallaceburg and Dresden is 200/250 millimetres diameter and has an approximate capacity of 4 ML/day based on design guidelines (MECP 2008a). It was originally constructed for emergency purposes. Therefore, a new water transmission main is required between Wallaceburg and Dresden.

Constructing a new water transmission main between Wallaceburg and Dresden also presented the opportunity to review the alignment of the water transmission main.

Water transmission alternatives were developed based on alternate alignments, which were determined through consultation with the PUC. Considerations were also given to the pumping configuration, i.e., constructing a new BPS that receives water from the Wallaceburg WTP HLPS and is dedicated to Dresden and future greenhouses, or installing dedicated pumps for Dresden and future greenhouses in the new Wallaceburg WTP HLPS. Three alternative alignments, as follows were developed for evaluation:

- "Do Nothing" Baseline Alternative
- Alternative 1: Construct a new water transmission main and BPS along Base Line between Wallaceburg and Dresden.
- Alternative 2: Construct a new water transmission main and BPS along McCreary Line between Wallaceburg and Dresden.
- Alternative 3: Construct a new water transmission main with dedicated HLPs along Baldoon Road, Border Road, Elbow Line and Base Line between Wallaceburg and Dresden.

Water transmission main diameter requirements for each alternative were determined through hydraulic analysis, hydraulic analysis, design guidelines for flow velocity (less than 2 metres per second) (MECP 2008a) and status of existing water transmission mains in the area.

9.2 Design Concepts

9.2.1 "Do Nothing" Baseline Alternative

In this alternative, 17.4 ML/day of treated water would be conveyed through the existing 200/250 millimetres diameter transmission main along Base Line.

Through hydraulic analysis, it was determined that 1,438 metres of TDH would be required to convey 17.4 ML/day through the existing transmission main due to extremely high head loss within the pipe. It is anticipated that the water pressure will be far beyond the existing pipe rating. Therefore, this alternative is not technically feasible but was developed for comparison purposes. This analysis was completed to develop theoretical pumping and electricity requirements, which were used to develop capital costs (based on dollars per kilowatts required for the pumps) and O&M costs.

9.2.2 Alternative 1

In this alternative, a new transmission main would be constructed along Base Line between Wallaceburg and Dresden. A new BPS near the intersection of Murray Street and Base Line will create a separate pressure zone for Dresden and the future greenhouses. The BPS would consist of three horizontal centrifugal pumps (two duty, one standby), each with a rated capacity of 8.7 ML/day at 12.5 metres TDH for a total rated capacity of 17.4 ML/day. The BPS would be operated based on the level of the Dresden ET. In this scenario, the Wallaceburg WTP HLPs (two duty, one standby) would each be rated for 14 ML/day at 70 metres TDH for a total rated capacity of 28 ML/day. Land acquisition may be required for the construction of new BPS.

The new transmission main can be broken down into the following sections:

- New 400 millimetres diameter trunk watermain along Base Line from the Wallaceburg WTP HLPS to the proposed BPS at Murray Street (1.3 kilometres in length). This new trunk watermain will also be connected to the Wallaceburg WDS at Gillard Street (existing 300 millimetres diameter watermain).
- New 600 millimetres diameter trunk watermain along Base Line from the proposed BPS in Murray Street to North Street in Dresden (16 kilometres in length). This will be connected to the existing 600 millimetres diameter watermain near Base Line and North Street and also to the 200 millimetres diameter watermain at Centre Side Road.
- New 300 millimetres diameter watermain at the intersection of Cemetery Road and Base Line to connect the proposed 600 millimetres diameter trunk watermain on Base Line to the existing 200 millimetres diameter watermain on Base Line

As reported by the PUC, the existing Wallaceburg water distribution mains are subject to frequent breaks and sensitive to elevated pressure. To mitigate the increase of system pressure due to transmit more flows in the future, this alternative considers installation of two pressure-reducing valves (PRVs): one on the 600 millimetres diameter transmission main leaving the Wallaceburg WTP HLPS and one at the intersection of Gillard Street and Base Line. The Wallaceburg WTP HLPs would also be operated with variable frequency drives (VFDs) for improved pressure management.

This alternative also requires a valve closure in the existing 200 millimetres transmission main west of the 300 millimetres diameter connection between the new 600 millimetres diameter transmission main and the existing 200 millimetres diameter transmission main at the intersection of Cemetery Road and Base Line. The transmission main section to the west of this closure along Base Line will continue to be supplied by the Wallaceburg WTP HLPS, while the section to the east will be supplied by the new BPS as part of the new pressure zone.

Valve chambers are required at the following locations:

- The PRV chamber at the Wallaceburg WTP HLPS discharge.
- The PRV/interconnecting chamber at the intersection of Gillard Street and Base Line.
- The valve chamber on the new water transmission main to the existing Dresden WDS near the intersection of Base Line and North Street, allowing for the connection from Eberts BPS to be maintained for supply in emergency scenarios.
- The valve chamber (valve normally closed) near the intersection of Base Line and Elbow Line.

Alternative 1 is presented on Figure 9-1. Details about flow direction during future MDD conditions are presented in the hydraulic modelling TM prepared for the water transmission alternatives (Appendix E).

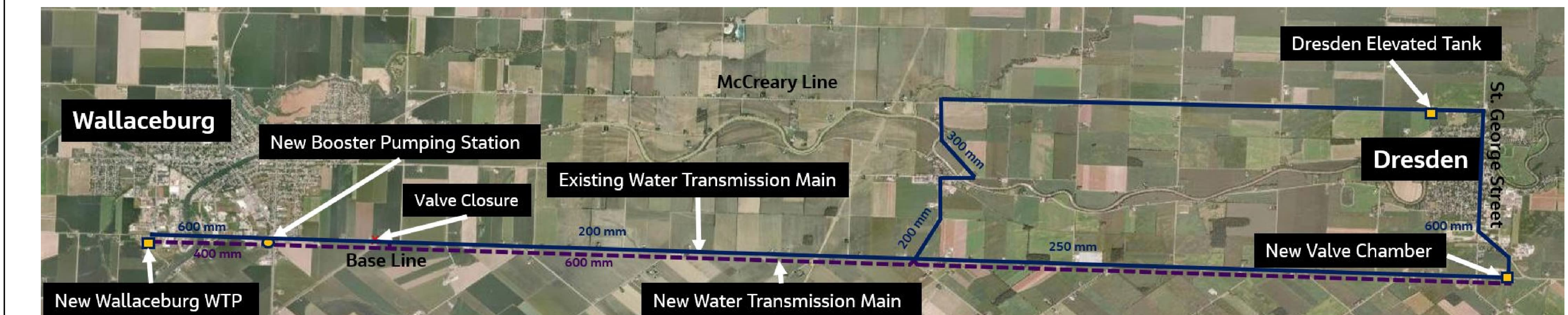


Figure 9-1
Alternative 1 for Water Transmission
Technical Memorandum 1
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

Jacobs

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Following these upgrades, water will be supplied to Dresden directly via the new transmission main on Base Line and via the existing transmission main through Tupperville and along McCreary Line, which feeds the Dresden ET.

9.2.3 Alternative 2

In this alternative, a new transmission main would be constructed along McCreary Line between Wallaceburg and Dresden. This alternative also requires a new BPS near the intersection of Kimball Road and McCreary Line, which will create a separate pressure zone for Dresden and the future greenhouses. The new BPS will require land acquisition. The BPS would consist of three horizontal centrifugal pumps (two duty, one standby), each with a rated capacity of 8.7 ML/day at 30 metres TDH for a total rated capacity of 17.4 ML/day, and would be operated based on the level of the Dresden ET. In this alternative, the Wallaceburg WTP HLPs with VFDs (two duty, one standby) would each be rated for 14 ML/day at 70 metres TDH for a total rated capacity of 28 ML/day.

The new transmission main can be broken down into the following sections:

- New 400 millimetres diameter trunk watermain (2.2 kilometres in length) along Base Line, Gillard Street, Queen Street and Murray Street from an existing 350-millimetre-diameter watermain at Base Line west of Gillard Street to an existing 300-millimetre-diameter watermain that crosses the North Sydenham River at Wallace Street and Murray Street. This watermain would service both the Wallaceburg DWS and Dresden DWS.
- New 400-millimetre-diameter trunk watermain (2.3 kilometres in length) along Margaret Avenue and McCreary Line from an existing 350-millimetre-diameter watermain that crosses the North Sydenham River at Margaret Avenue and Main Street to the proposed BPS on McCreary Line.
- New 600-millimetre-diameter trunk watermain along McCreary Line from Kimball Road in Wallaceburg to the existing 300 millimetre at Tupperville Road in Tupperville (7.1 kilometres in length).
- New 350 millimetres diameter twin watermain along McCreary Line from Tupperville Road to the Dresden ET (6.7 kilometres in length).
- New 300 millimetres diameter twin watermain along Base Line from west of Murray Street to Cemetery Road (1.4 kilometres in length).
- Upgrade existing 250-millimetre-diameter watermain to 300 millimetres on Base Line and Beattie Street (16 metres in length) to reduce flow velocity.

Valve chambers are required at the following locations for this alternative:

- A valve chamber between the new 600 millimetres diameter transmission main, the existing 300-millimetre-diameter transmission main and the new 350-millimetre-diameter transmission main at the intersection of McCreary Line and Tupperville Road.
- A valve chamber at the Dresden ET site to allow water to be conveyed directly into the Dresden WDS, while the Dresden ET remains as an offline storage tank.

Alternative 2 is presented on Figure 9-2. Details about flow direction during future MDD conditions are presented in the hydraulic modelling TM prepared for the water transmission alternatives (Appendix E).

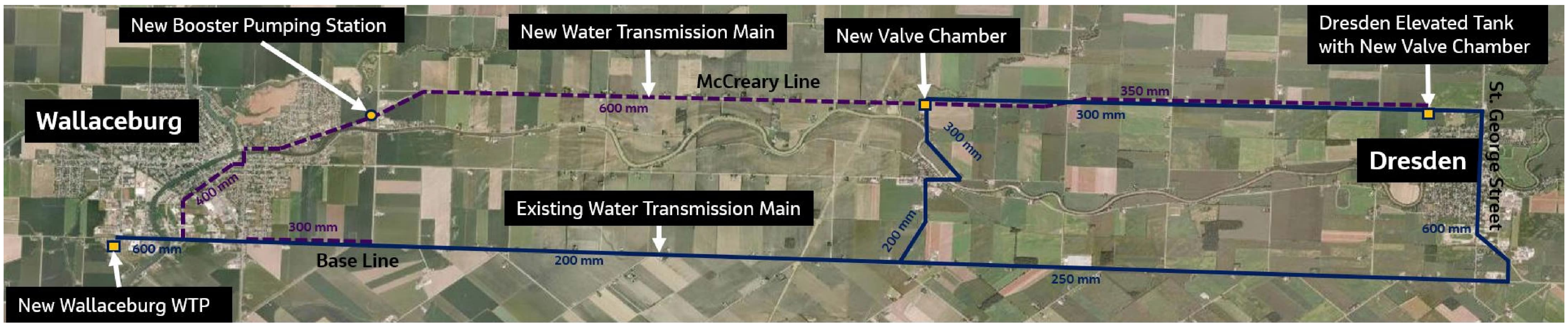

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Figure 9-2
Alternative 2 for Water Transmission
Technical Memorandum 1
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

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9.2.4 Alternative 3

In this alternative, a new transmission main would be constructed along Baldoon Road, Border Road, Elbow Line and Base Line between Wallaceburg and Dresden. The new transmission main would be fed by a set of pumps dedicated to Dresden at the Wallaceburg WTP HLPS, creating a new pressure zone for Dresden and the future greenhouses. The HLPs (two duty, one standby) would be rated for 8.7 ML/day at 70 metres TDH, for a total capacity of 17.4 ML/day for the Dresden WDS. The Wallaceburg WDS would be serviced by another set of HLPs (two duty, one standby), each rated for 5 ML/day at 57 metres TDH, for a total capacity of 10 ML/day for the Wallaceburg WDS. All HLPs would be operated with VFDs.

The new transmission main can be broken down into the following sections:

- New 600 millimetres diameter transmission main along Baldoon Road, Border Road, Elbow Line and Base Line (18.5 kilometres in length) from the Wallaceburg WTP HLPS. This will be connected to the existing 600 millimetres diameter watermain near Base Line and North Street and also to the 200 millimetres diameter watermain at Centre Side Road.
- New 300 millimetres diameter watermain at Cemetery Road to connect the proposed 600 millimetres diameter trunk watermain on Base Line to the existing 200 millimetres diameter watermain on Base Line

This alternative requires a valve closure in the existing 200 millimetres transmission main west of the 300 millimetres diameter connection between the new 600 millimetres diameter transmission main and the existing 200 millimetres diameter transmission main at the intersection of Cemetery Road and Base Line.

Valve chambers are required at the following locations for this alternative:

- A valve chamber to connect the new water transmission main to the existing Dresden WDS near the intersection of Base Line and North Street. This chamber would allow for the connection from Eberts BPS to serve as emergency supply.
- A valve chamber (valve normally closed) near the intersection of Base Line and Elbow Line.

Alternative 3 is presented on Figure 9-3. Details about flow direction during future MDD conditions are presented in the hydraulic modelling TM prepared for the water transmission alternatives (Appendix E).

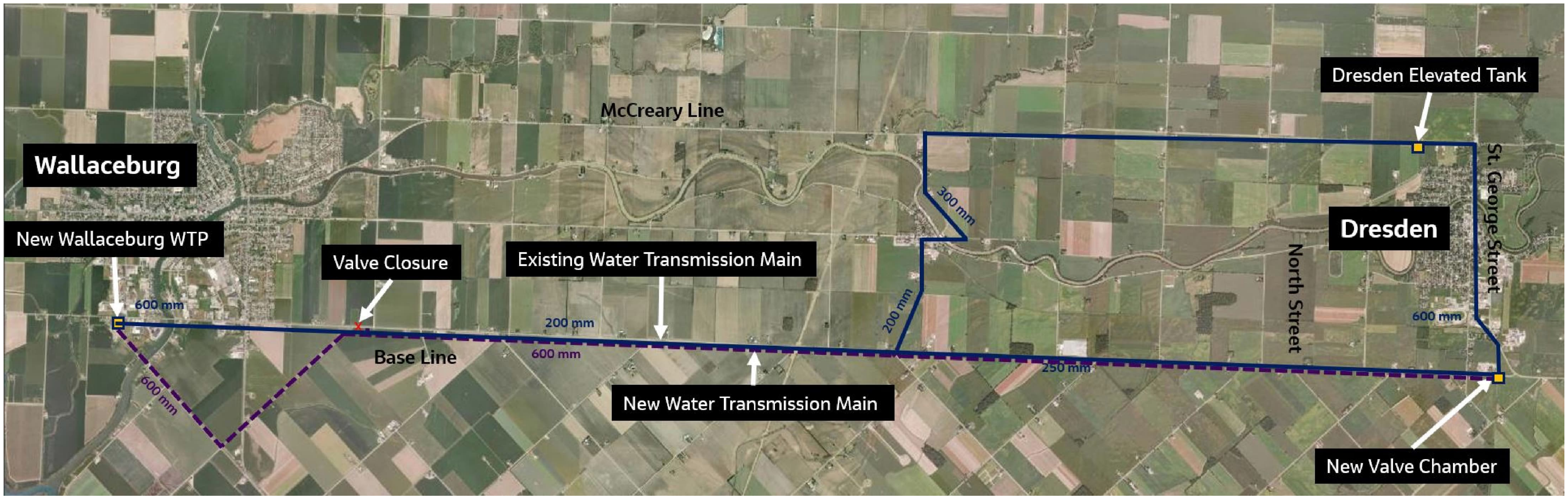

Figure 9-3
Alternative 3 for Water Transmission
Technical Memorandum 1
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

Jacobs

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9.3 Hydraulic Analysis

The viability of all water transmission alternatives, except for "Do Nothing" were evaluated through hydraulic modelling, which was documented in a separate TM (Appendix E). Each alternative was assessed based on the following:

- Whether a set of design criteria are met under the current and future conditions.
- Whether the current level of service at Wallaceburg and Dresden will be maintained or even improved, based on the number of hydrants with insufficient fire flow.
- Whether each alternative would be able to maintain or have least positive impact to the maximum system pressure in Wallaceburg under current or future conditions. The objective was to reduce the probability of main breaks due to increased pressure.

The following conclusions were made from the hydraulic analysis, and were factored into the transmission alternative evaluation:

- **Alternative 1**
  - All design criteria were met for this alternative.
  - The level of service would be maintained in Wallaceburg and slightly increased in Dresden.
  - The minimum and maximum system pressures would increase and decrease, respectively relative to the existing conditions. Therefore, this alternative satisfies the goal of maintaining or decreasing the maximum system pressure in the Wallaceburg WDS.
- **Alternative 2**
  - All design criteria were met for this alternative.
  - The level of service would be slightly increased in both Wallaceburg and Dresden compared to the existing condition.
  - The minimum and maximum system pressures would both increase relative to the existing condition. The increase of maximum system pressure is not desired due to the increased concern of main breaks.
- **Alternative 3**
  - All design criteria were met for this alternative.
  - The level of service would be maintained in Wallaceburg and slightly increased in Dresden.
  - The minimum and maximum system pressures would increase and decrease relative to the existing condition, respectively. Therefore, this alternative satisfies the goal of maintaining or decreasing the maximum system pressure in the Wallaceburg WDS.

In general, the hydraulic modelling demonstrated that Alternatives 1 and 3 satisfy all conditions listed earlier in this section.

9.4 Cost Estimation

Capital cost estimates, O&M cost estimates, and lifecycle cost estimates were developed for each alternative presented in Section 9.2, based on the methodology presented in Section 6.2. Where required, land acquisition was included in the capital cost at $200,000 per acre, based on the cost per acre of similar vacant land parcels in the area that were listed for sale at the time of writing this TM.

For Alternatives 1 and 2, the capital costs of the pumping facilities were estimated based on a new BPS, as described in Section 9.2. To evaluate the economical factor among all three alternatives equally, for Alternative 3, the capital cost of the pumping facility was the difference between a larger HLPS (six pumps) as described in Section 9.2.4 and the "base case" HLPS (three pumps) as described in Section 7.2.3.1. This quantified the impact of constructing a HLPS with two sets of dedicated pumps versus an HLPS with one set of pumps and provided a cost that could be applied to the overall capital cost for Alternative 3.

The O&M costs for the HLPS in Alternative 3 were developed in a similar manner; electrical consumption was estimated for the "base case" HLPS design concept and for the Alternative 3 HLPS design concept, and the difference was taken to quantify the impact of Alternative 3 on the electrical consumption and cost at the Wallaceburg WTP HLPS. The difference in these costs was used as the basis for the O&M costs for Alternative 3.

Table 9-1 presents a summary of the water transmission alternatives and their associated costs. Details of the cost estimate are presented in Appendix F.

Table 9-1. Water Transmission Alternatives Summary and Cost Estimate

Alternative	Description	Capital Cost	O&M Cost Net Present Value	50-year Lifecycle Cost
Do Nothing	Convey 17.4 ML/day through the existing water transmission main on Base Line.	$7,790,000	$129,250,000	$137,040,000
Alternative 1	Construct a new water transmission main and BPS along Base Line between Wallaceburg and Dresden.	$31,660,000	$2,830,000	$34,490,000
Alternative 2	Construct a new water transmission main and BPS along McCreary Line between Wallaceburg and Dresden.	$33,870,000	$3,270,000	$37,140,000
Alternative 3	Construct a new water transmission main with dedicated HLPs along Baldoon Road, Border Road, Elbow Line, and Base Line between Wallaceburg and Dresden.	$32,800,000	$2,430,000	$35,220,000

9.5 Greenhouse Gas Emissions

GHG emissions were estimated for the water transmission alternatives using the methodology presented in Section 6.3. Table 9-2 presents the estimated GHG emissions for each raw water supply alternative.

Table 9-2. GHG Emissions for Water Transmission Supply Alternatives

Alternative	Energy Consumption, kilowatt hour per year	Unit Energy Consumption, kilowatt hour per year per megalitre	GHG Emissions, tonnes of carbon dioxide equivalent per year
Do Nothing	31,356,000	1,802,070	940.7
Alternative 1	676,000	38,850	20.3
Alternative 2	784,000	45,060	23.5
Alternative 3	523,000	30,060	15.7

In general, this analysis shows that it is more energy-efficient to build a larger HLPS with two sets of HLPs at the Wallaceburg WTP than to construct separate HLPS and BPS.

9.6 Evaluation Criteria

Each water transmission alternative was evaluated using the methodology presented in Section 6.4. The evaluation criteria for the water supply alternatives and their scoring measures are presented in Table 9-3.

Table 9-3. Evaluation Criteria and Scoring Measures for Raw Water Supply

Category	Criterion	Description	Measure – Score of 10	Measure – Score of 5	Measure – Score of 1
Natural Environment	Impacts to Surface Water Quality	The potential for the alternative to have a negative impact on surface water quality that would result in harm to the aquatic environment and other users.	The alternative will have no substantial impact on surface water quality that may impact other users or the aquatic environment.	The alternative has some potential to change surface water quality that may negatively impact other users or the aquatic environment.	The alternative has a high potential to change surface water quality that may negatively impact other users or the aquatic environment.
	Impacts to Surface Water Quantity	The potential for the alternative to have an impact on surface water quantity that would result in negative impacts to other users or the aquatic environment.	The alternative will have no substantial impact on surface water quantity that would result in negative impacts to other users or the aquatic environment.	The alternative will have some potential impact on surface water quantity that would result in negative impacts to other users or the aquatic environment.	The alternative will have a high potential impact on surface water quantity that would result in negative impacts to other users or the aquatic environment.
	Impacts on Terrestrial Environment	The potential for the alternative to have a short term or long-term negative impact on the viability of terrestrial habitats in terms of density and diversity of species.	The alternative will have no substantial short- or long-term impact on the viability of terrestrial habitats in terms of density and diversity of species.	The alternative has some potential for short- or long-term impact on the viability of terrestrial habitats in terms of density and diversity of species.	The alternative has high potential for short- or long-term impact on the viability of terrestrial habitats in terms of density and diversity of species.
	Impacts on Aquatic Environment	The potential for the alternative to have a short term or long-term negative impact on the viability of aquatic habitats in terms of density and diversity of species.	The alternative will have no substantial short- or long-term impact on the viability of aquatic habitats in terms of density and diversity of species.	The alternative has some potential for a short- or long-term impact on the viability of aquatic habitats in terms of density and diversity of species.	The alternative has high potential for a short- or long-term impact on the viability of aquatic habitats in terms of density and diversity of species.
	GHG Emissions	The potential for the alternative to increase or decrease GHG emissions from the current condition related to Wallaceburg raw water supply (based on 30 grams of carbon dioxide per kilowatt hour, 2020 National Inventory Report [ECCC 2020]).	GHG emissions less than 20 tonnes of carbon dioxide equivalent per year.	GHG emissions 20 to 40 tonnes of carbon dioxide equivalent per year.	GHG emissions more than 40 tonnes of carbon dioxide equivalent per year.
	Impacts to Fluvial Geomorphic Stability	The potential of the alternative to impact the geomorphic stability of watercourses (based on stream crossings).	The alternative will have no substantial impact on the fluvial geomorphic stability of the watercourse.	The alternative will somewhat reduce the fluvial geomorphic stability of the watercourse.	The alternative will substantially reduce the fluvial geomorphic stability of the watercourse.
	Impacts to Wetlands	The potential for the alternative to have a negative impact on wetlands that would result in harm to species in the environment.	The alternative will have no substantial long-term impact on wetlands that would negatively impact species in the environment.	The alternative has some potential for long-term impacts on wetlands that would negatively impact species in the environment.	The alternative has high potential for long-term impacts on wetlands that would negatively impact species in the environment.
	Impacts to Air Quality	The potential for the alternative to negatively impact air quality in the area.	The alternative will have no substantial impact on air quality in the area.	The alternative will have a moderate impact on air quality in the area.	The alternative will have a significant impact on air quality in the area.
	Potential Impacts to Groundwater Quality and Quantity	The potential for the alternative to have a negative short- or long-term impact on groundwater quality or quantity.	The alternative will have no substantial impact on groundwater quality and quantity over the short or long term.	The alternative will somewhat reduce groundwater quality and quantity over the short or long term.	The alternative will substantially reduce the quality and quantity of groundwater over the short or long term.

Category	Criterion	Description	Measure – Score of 10	Measure – Score of 5	Measure – Score of 1
Social/Cultural Environment	Occupational Health and Safety	The potential of the alternative to minimize risk or liability regarding occupational health and safety for construction period and ongoing O&M.	The alternative poses very little risk to occupational health and safety.	The alternative poses moderate risk to occupational health and safety; construction and O&M safety measures may be required to address specific health and safety concerns.	The alternative poses high risk to occupational health and safety; personal injury may be expected; construction and O&M safety measures will be required to address a number of health and safety concerns.
	Archaeological Impacts	The degree of impact that the alternative has on documented archaeologically significant features.	The alternative has little or no impact on documented archaeologically significant features.	The alternative has a moderate impact on documented archaeologically significant features.	The alternative has a large impact on documented archaeologically significant features.
	Cultural Heritage Impacts	The degree of impact that the alternative has on areas with documented cultural heritage resources.	The alternative represents little or no potential for disturbance of documented cultural heritage features.	The alternative represents a moderate potential for disturbance of documented cultural heritage features.	The alternative represents a significant potential for disturbance of documented cultural heritage features.
	First Nations Cultural Heritage Impacts	The degree of impact that the alternative has on cultural heritage resources recognized by First Nations.	The alternative represents little or no potential for disturbance of cultural heritage resources recognized by First Nations.	The alternative represents a moderate potential for disturbance of cultural heritage resources recognized by First Nations.	The alternative represents a significant potential for disturbance of cultural heritage resources recognized by First Nations.
	Public land Use Impacts (parks, open spaces)	The ability of the alternative to maintain or enhance character of the public lands in the community.	The alternative will enhance the character of the public lands in the area.	The alternative will maintain the character of the public lands in the area.	The alternative will decrease the character of the public lands in the area.
	Private Lands Impacts	Impact of the alternative on private lands (Industrial, Commercial, Institutional, recreational, including farm operations) in regard to short-term disturbance or long-term use including easements and acquisition	The alternative will have no impact on private lands in regard to short-term disturbance or long-term use.	The alternative will have a moderate impact on private lands in regard to short-term disturbance or long-term use. Impacts can be mitigated.	The alternative will have significant impact on private lands in regard to short-term disturbance or long-term use. Impacts cannot be mitigated.
	Public Acceptability	The level of public acceptability for the alternative based on public consultation results.	The alternative may exceed the public's expectation technically and be accepted by the public.	The alternative may be acceptable to the public.	The alternative may not be accepted by the public.
	Residential and industrial growth.	Ability to support identified residential and industrial growth by meeting anticipated demand.	The alternative will meet projected demands with additional future capacity.	The alternative will meet projected demands.	The alternative will not meet future demands.
Technical Environment	Adaptability	The ability of the alternative to adapt to increasing water demands beyond the planning horizon.	The alternative is able to adapt to significant increases in water demands beyond the planning horizon.	The alternative is able to adapt to moderate increases in water demands beyond the planning horizon.	The alternative is not able to adapt to increases in water demands beyond the planning horizon.
	Ease of Approvals and Permitting	The relative difficulty in acquiring the necessary approvals and permits for the alternative from regulatory agencies and other jurisdictions.	Acquiring the permits for this alternative is relatively simple.	Acquiring the permits for this alternative is moderately difficult.	Acquiring the permits for this alternative is difficult.
	Constructability, Implementation, and Work Scope	The ability of the alternative to be constructed and implemented on a technical and practical basis; within a reasonable scope of work.	The alternative is easy to implement with limited constructability issues; reasonable construction work scope.	The alternative can be implemented with some difficult constructability issue or some constraints; or moderate scope of construction work.	The alternative has many challenges with respect to implementation and construction; or complex and large work scope.

Category	Criterion	Description	Measure – Score of 10	Measure – Score of 5	Measure – Score of 1
Technical Environment	Operational and Maintenance Complexity	The degree of complexity associated with operating and maintaining the alternative.	The alternative is simple to operate and easy to maintain	The alternative is moderately difficult to operate, requires extensive and continuous operator trainings, the maintenance is somewhat difficult and requires higher skills.	The alternative is complex to operate, and requires frequent/complex maintenance.
	Level of Service	The level of service provided to Wallaceburg and Dresden relative to the existing condition, considering system pressure under ADD, MDD, and fire flow.	The alternative will improve the level of service to Wallaceburg and Dresden, reducing the number of zones that experience low or high pressure.	The alternative will maintain the level of service to Wallaceburg and Dresden.	The alternative will reduce the level of service to Wallaceburg and Dresden, increasing the number of zones that experience low or high pressure.
	Compatibility with New Service Areas	The degree of compatibility with the new Wallaceburg WTP (preferred solution for Water Supply), relating to new service areas.	The alternative provides sufficient water transmission capacity as required for the preferred solution for water supply, with the potential for further expansion.	The alternative provides sufficient water transmission capacity as required for the preferred solution for water supply.	The alternative does not provide sufficient water transmission capacity as required for the preferred solution for water supply.
	Construction Schedule	The duration of construction activities relative to other alternatives.	Construction for this alternative would have a relatively long duration.	Construction for this alternative would have a relatively moderate duration.	Construction for this alternative would have a relatively short duration.
	Proximity to Existing Utilities	The proximity of the proposed transmission main alignment to various utilities (gas, hydro), allowing for growth along the alignment.	The alternative is in close proximity to utilities along the entire alignment.	The alternative is in close proximity to utilities along portions of the alignment.	The alternative is not close to any utilities.
	Risk/Reliability	The level of risk associated with the alternative relating to probability of failure, water supply, and regulatory compliance.	There are limited to no risks associated with the alternative.	There is a moderate level of risk associated with the alternative.	There is a high level of risk associated with the alternative.
	Water Age	The age of the water (relating to transmission main length), increasing the possibility of disinfection byproduct formation during transmission.	The transmission main is relatively short, with a low potential for additional disinfection byproduct formation.	The transmission main has a moderate length, with a moderate potential for additional disinfection byproduct formation.	The transmission main is long, with a high potential for additional disinfection byproduct formation.
Economic Environment	Capital Cost	Estimated capital cost.	Capital costs are less than $15M.	Capital costs are $20M to 40M.	Capital costs are more than $400M.
	Lifecycle Cost	Total annual capital and operational costs amortized over 50 years.	Lifecycle costs are less than $25M.	Lifecycle costs are $25M to $50M.	Lifecycle costs are more than $50M.

9.7 Evaluation Results and Preferred Solution

The evaluation results for water transmission are presented in Table 9-4. Detailed scoring and rationales of the base evaluation and sensitivity analyses for each category are presented in Appendix G.

Table 9-4. Evaluation Results for Water Transmission

Category	Do Nothing	Alternative 1	Alternative 2	Alternative 3
Natural Environment	16.7	22.2	22.2	22.2
Social/Cultural Environment	13.9	16.7	16.7	18.1
Technical Environment	7.5	18.8	13.8	21.3
Economic Environment	12.5	12.5	12.5	12.5
Base Evaluation Total Score	50.6	70.1	65.1	74.0
Sensitivity Analysis – 1	53.8	73.9	69.9	77.0
Sensitivity Analysis – 2	51.6	69.4	65.4	73.7
Sensitivity Analysis – 3	46.4	71.1	63.1	76.2
Sensitivity Analysis – 4	50.4	66.1	62.1	69.2

Alternative 3: Construct a new water transmission main with dedicated HLPs along Baldoon Road, Border Road, Elbow Line and Base Line between Wallaceburg and Dresden was selected as the preferred solution for water transmission. It was the highest scoring alternative for both the base evaluation and all the sensitivity analysis. Differentiating advantages for this alternative include the following:

- This alternative is the most energy efficient water transmission solution among all alternatives.
- The transmission main alignment for this alternative would cause less disruption during construction than the other alternatives, as it avoids construction in the congested section of Base Line in Wallaceburg urban area.
- The alternative provides ease of operation than other alternatives, as all pumps are installed in one pumping station.
- The transmission main alignment is a corridor that contains the utilities that are required for greenhouse construction (hydro, natural gas, sewer), while at the same time not being expected to conflict with existing utilities in the right-of-way along Base Line.

The estimated capital cost for the preferred solution for water transmission is $32,800,000.

10. Summary of Preferred Solutions

10.1 Preferred Solutions

Sections 7, 8, and 9 present the development and evaluation of alternatives for overall water supply strategy, raw water supply, and treated water transmission. Table 10-1 summarizes the integrated preferred solution for the Wallaceburg Water Treatment Servicing Class EA, and the estimated capital costs.

Table 10-1. Summary of Preferred Solutions for the Wallaceburg Water Treatment Servicing Class EA

Category	Preferred Solution	Capital Cost
Overall Water Supply (Cost of WTP Only)	Build a new Wallaceburg WTP with a rated capacity of 28 ML/day to supply Wallaceburg, Dresden and future greenhouses along Base Line	$46,433,000
Raw Water Supply	Build a new LLPS and intake with a rated capacity of 34 ML/day at the second upstream location.	$17,924,000
Treated Water Transmission	Construct a new water transmission main with dedicated HLPs along Baldoon Road, Border Road, Elbow Line, and Base Line between Wallaceburg and Dresden.	$32,800,000
Total		$97,157,000

Figure 10-1 presents the integrated preferred solution for the Wallaceburg Water Treatment Servicing Class EA.

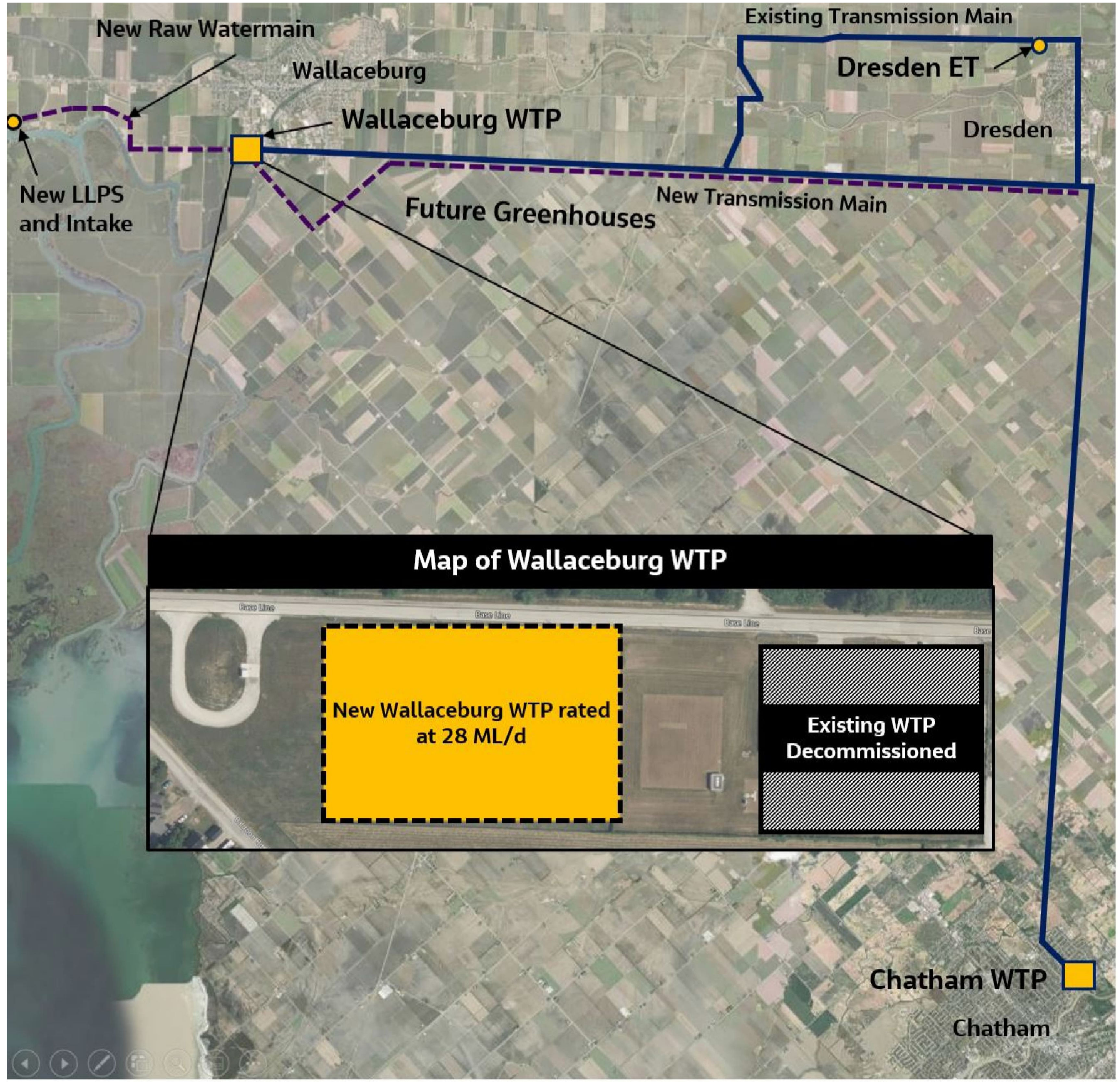

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Figure 10-1
Preferred Solution for Wallaceburg Water Treatment Servicing Class EA
Technical Memorandum 1
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

Jacobs

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10.2 Long-term Benefits

The preferred solutions described in Section 10.1 are expected to provide the following long-term benefits for the Municipality of Chatham-Kent:

- Replacing aging, unreliable infrastructure with new, modern and sustainable infrastructure that will increase the security and reliability of water supply in Wallaceburg and the expanded service areas.
- Reducing the electricity consumed per megalitre of treated water produced, and thus reducing the GHG emissions.
- Improving the quality of treated water with capability to meet more stringent regulatory requirements.
- Avoiding the concern of deteriorated raw water quality currently experienced at the LLPS and intake during wet weather events.
- Enhancing raw water supply security by implementing redundancy (i.e., split wet well) in the new LLPS and raw watermain (twinned watermain).
- Improving compliance with DFO guidelines for fish protection by adoption of the modern intake screen technology.
- Achieving a more balanced water supply within the PUC by reducing the stress and potentially delaying a capacity expansion at the Chatham WTP.
- Providing a reliable water supply for potential future greenhouses on Base Line, which will ultimately provide a positive economic contribution to the Municipality of Chatham-Kent.

11. Next Steps

This TM documents the development and evaluation of alternative solutions for this Class EA, completing Phase 2 of the Class EA process. The next steps of the Wallaceburg Water Treatment Servicing Schedule C Class EA are to develop and evaluate alternative design concepts for the preferred solution presented in this TM and to develop an implementation plan for the preferred design concepts. These next steps will be documented in TM 2.

12. References

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Appendix A
Cost Estimates for Water Supply Alternatives

Water Supply Alternative 1 - Do Nothing

Main Components		**Cost (2021)**
Isolation Valves		$ 91,200.00
Filter Tank 1, 2, 3 and 4 (incl. filter media and laterals)		$ 638,400.00
Chlorine (HL PS)		$ 2,850.00
Primary Electrical		$ 114,000.00
Transfer Pumping Station Pump 1		$ 68,400.00
Transfer Pumping Station Pump 2		$ 68,400.00
Screen		$ 17,100.00
Eye Wash/Shower Station		$ 18,810.00
Roofing		$ 22,800.00
Flow Element (backwash)		$ 17,100.00
LLPS		$ 1,117,998.00
Pre-treatment building		$ 981,084.00
Settling tanks/filter/high lift building		$ 4,228,374.00
Reservoirs		$ 9,109,740.00
Residue Management		$ 200,526.00
Chemical Storage and Other		$ 112,860.00
Subtotal Project Costs		**$ 16,810,000**
Additional Project Costs		**$ 337,000**
Decommissioning (Existing)		$ -
Plant I&C	2%	$ 337,000
Total Direct Project Costs		**$ 17,147,000**
Contractor Overhead	10%	$ 1,715,000
Sub-Total		**$ 18,862,000**
Project Staff Overhead	3%	$ 565,860
Sub-Total		**$ 19,427,860**
General Conditions	4%	$ 777,114
Sub-Total		**$ 20,204,974**
Mobilization/Demobilization	3%	$ 607,000
Insurance	1%	$ 203,000
Bond	1%	$ 203,000
Sub-Total		**$ 21,217,974**
Contractor Profit	10%	$ 2,121,797
Sub-Total		**$ 23,339,772**
Estimating Contingency	30%	$ 7,002,000
Total Construction Cost		**$ 30,341,772**
Engineering/SDC	15%	$ 4,552,000
Total Construction Cost Including Engineering		**$ 34,893,772**

Lifecycle Cost Estimate for Alternative 1			
Current Year	2021		
Discount	5%		
Inflation	2%		
Year	**ADD** m^3**/year**	**Annual O&M** **$/y**	**O&M NPV** **$/y**
2021	9,900	$ 1,140,000	$ 1,140,000
2022	9,900	$ 1,140,000	$ 1,107,429
2023	9,900	$ 1,140,000	$ 1,075,788
2024	9,900	$ 1,140,000	$ 1,045,051
2025	9,900	$ 1,140,000	$ 1,015,192
2026	9,900	$ 1,140,000	$ 986,187
2027	9,900	$ 1,140,000	$ 958,010
2028	9,900	$ 1,140,000	$ 930,638
2029	9,900	$ 1,140,000	$ 904,049
2030	9,900	$ 1,140,000	$ 878,219
2031	9,900	$ 1,140,000	$ 853,127
2032	9,900	$ 1,140,000	$ 828,752
2033	9,900	$ 1,140,000	$ 805,073
2034	9,900	$ 1,140,000	$ 782,071
2035	9,900	$ 1,140,000	$ 759,726
2036	9,900	$ 1,140,000	$ 738,020
2037	9,900	$ 1,140,000	$ 716,933
2038	9,900	$ 1,140,000	$ 696,450
2039	9,900	$ 1,140,000	$ 676,551
2040	9,900	$ 1,140,000	$ 657,221
2041	9,900	$ 1,140,000	$ 638,443
2042	9,900	$ 1,140,000	$ 620,202
2043	9,900	$ 1,140,000	$ 602,482
2044	9,900	$ 1,140,000	$ 585,268
2045	9,900	$ 1,140,000	$ 568,546
2046	9,900	$ 1,140,000	$ 552,302
2047	9,900	$ 1,140,000	$ 536,522
2048	9,900	$ 1,140,000	$ 521,193
2049	9,900	$ 1,140,000	$ 506,302
2050	9,900	$ 1,140,000	$ 491,836
2051	9,900	$ 1,140,000	$ 477,783
2052	9,900	$ 1,140,000	$ 464,132
2053	9,900	$ 1,140,000	$ 450,871
2054	9,900	$ 1,140,000	$ 437,989
2055	9,900	$ 1,140,000	$ 425,475
2056	9,900	$ 1,140,000	$ 413,319
2057	9,900	$ 1,140,000	$ 401,510
2058	9,900	$ 1,140,000	$ 390,038
2059	9,900	$ 1,140,000	$ 378,894
2060	9,900	$ 1,140,000	$ 368,069
2061	9,900	$ 1,140,000	$ 357,552
2062	9,900	$ 1,140,000	$ 347,337
2063	9,900	$ 1,140,000	$ 337,413
2064	9,900	$ 1,140,000	$ 327,772
2065	9,900	$ 1,140,000	$ 318,407
2066	9,900	$ 1,140,000	$ 309,310
2067	9,900	$ 1,140,000	$ 300,473
2068	9,900	$ 1,140,000	$ 291,888
2069	9,900	$ 1,140,000	$ 283,548
2070	9,900	$ 1,140,000	$ 275,447
		Total	**$ 30,534,811**

Alternative 2a: Build a new Wallaceburg WTP with a rated capacity of 28 ML/d

Main Components	Description	Capacity	Unit	Cost
Coagulation	New inline rapid coagulant mixing	28	ML/d	$ 693,000
Flocculation	New - Flocculation tank	28	ML/d	$ 2,660,000
Clarification	New - high rate (inclined plate) sedimentation	28	ML/d	$ 5,898,000
Filtration	New - Low pressure membrane filtration	28	ML/d	$ 8,836,000
Disinfection	New - Clearwell and additional storage	28	ML/d	$ 1,087,000
HLPS	New - HLPS	28	ML/d	$ 2,735,000
RMF	New - Gravity Thickener	28	ML/d	$ 832,000
Subtotal				**$ 22,741,000**
Additional Project Costs				**$ 1,115,000**
Decommissioning (Existing)				$ 660,000
Plant I&C			2%	$ 455,000
Total Direct Project Costs				**$ 23,856,000**
Contractor Overhead			10%	$ 2,386,000
Sub-Total				**$ 26,242,000**
Project Staff Overhead			3%	$ 787,000
Sub-Total				**$ 27,029,000**
General Conditions			4%	$ 1,081,000
Sub-Total				**$ 28,110,000**
Mobilization/Demobilization			3%	$ 844,000
Insurance			1%	$ 282,000
Bond			1%	$ 282,000
Sub-Total				**$ 29,518,000**
Contractor Profit			10%	$ 2,952,000
Sub-Total				**$ 32,470,000**
Estimating Contingency			30%	$ 9,741,000
Total Construction Cost				**$ 42,211,000**
Engineering/SDC			10%	$ 4,222,000
Total Construction Cost Including Engineering				**$ 46,433,000**

Lifecycle Cost Estimate for Alternative 2a

Current Year 2021
Discount 5%
Inflation 2%

Year	ADD m^3/year	Electricity $/y	NaOCl $/y	Cl_2 Gas $/y	Citric Acid $/y	PACl $/y	Fluoride $/y	Labour $/y	Maintenance $/y	Membrane Replacement $/y	Annual O&M $/y	O&M NPV $/y
2021	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 910,665
2022	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 884,646
2023	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 859,370
2024	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 834,817
2025	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 810,965
2026	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 787,795
2027	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 765,286
2028	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 743,421
2029	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 722,180
2030	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 701,546
2031	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ 336,330	$ 1,246,995	$ 933,197
2032	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 662,031
2033	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 643,116
2034	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 624,741
2035	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 606,891
2036	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 589,551
2037	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 572,707
2038	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 556,344
2039	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 540,448
2040	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 525,007
2041	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ 336,330	$ 1,246,995	$ 698,364
2042	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 495,435
2043	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 481,280
2044	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 467,529
2045	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 454,171
2046	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 441,195
2047	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 428,589
2048	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 416,344
2049	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 404,448
2050	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 392,893
2051	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ 336,330	$ 1,246,995	$ 522,626
2052	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 370,762
2053	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 360,169
2054	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 349,879
2055	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 339,882
2056	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 330,171
2057	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 320,738
2058	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 311,574
2059	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 302,672
2060	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 294,024
2061	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ 336,330	$ 1,246,995	$ 391,111
2062	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 277,463
2063	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 269,535
2064	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 261,834
2065	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 254,353
2066	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 247,086
2067	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 240,026
2068	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 233,168
2069	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 226,506
2070	22,400	$ 443,850	$ 77	$ 20,685	$ 13,910	$ 23,930	$ 17,213	$ 208,000	$ 183,000	$ -	$ 910,665	$ 220,035
											Total	**$ 25,078,586**

Alternative 2b: Build a new Wallaceburg WTP with a rated capacity of 14 ML/d and upgrade the existing Wallaceburg WTP to restore its capacity to 14 ML/d

Upgrade the Existing Wallaceburg WTP - 14 ML/d

Component	Description	Capacity	Unit	Cost
Pretreatment	Retain the existing pretreatment, replace the building envelop	14	ML/d	$ 2,080,000
	Retrofit existing flocculation with mechanical mixers			
	Retrofit existing Sed. Basins with lamella plates			
	Retrofit existing Sed. Basins with sludge removal mechnism			
	Construct a building envelop over the existing Floc and Sed Basins			
Filtration	Replace filter underdrains	14	ML/d	$ 4,981,000
	Replace surface wash with air scour, and install air blowers			
	Replace filter media			
	Replace all filter piping			
Other items	Items that require replacing as identified in the Stantec EA up to 2050.			$ 2,530,734
	Includes Reservoir 2 rehab			

Build a new Wallaceburg WTP - 14 ML/d

Component	Description	Capacity	Unit	Cost
LLPS and Intake				
Coagulation	New inline rapid coagulant mixing	14	ML/d	$ 824,000
Flocculation	New - Flocculation tank	14	ML/d	$ 1,865,000
Clarification	New - Flash mixing and high rate (inclined plate) sedimentation	14	ML/d	$ 3,753,000
Filtration	New - sand filtration	14	ML/d	$ 5,621,000
Disinfection	New - Clearwell and additional storage	28	ML/d	$ 950,000
HLPS	New - HLPS	28	ML/d	$ 2,735,000
RMF	New - Gravity Thickener	28	ML/d	$ 832,000

Subtotal		**$ 26,172,000**
Additional Project Costs		**$ 1,184,000**
Decommissioning (Existing)		$ 660,000
Plant I&C	2%	$ 524,000
Total Direct Project Costs		**$ 27,356,000**
Contractor Overhead	10%	$ 2,736,000
Sub-Total		**$ 30,092,000**
Project Staff Overhead	3%	$ 903,000
Sub-Total		**$ 30,995,000**
General Conditions	4%	$ 1,240,000
Sub-Total		**$ 32,235,000**
Mobilization/Demobilization	3%	$ 968,000
Insurance	1%	$ 323,000
Bond	1%	$ 323,000
Sub-Total		**$ 33,849,000**
Contractor Profit	10%	$ 3,385,000
Sub-Total		**$ 37,234,000**
Estimating Contingency	30%	$ 11,171,000
Total Construction Cost		**$ 48,405,000**
Engineering/SDC	10%	$ 4,841,000
Total Construction Cost Including Engineering		**$ 53,246,000**

Lifecycle Cost Estimate for Alternative 2b

Current Year	2021
Discount	5%
Inflation	2%

Year	ADD	Electricity	Cl_2 Gas	PACl	Fluoride	Labour	Maintenance	Filter Media Replacement	Annual O&M	O&M NPV
	m^3/year	$/y	$/y	$/y	$/y	$/y	$/y	$/y	$/y	$/y
2021	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 1,123,994
2022	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 1,091,880
2023	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 1,060,684
2024	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 1,030,378
2025	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 1,000,939
2026	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 972,341
2027	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 944,560
2028	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 917,572
2029	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 891,356
2030	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 865,888
2031	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	$ 393,782	$ 1,517,776	$ 1,135,838
2032	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 817,116
2033	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 793,770
2034	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 771,091
2035	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 749,059
2036	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 727,658
2037	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 706,868
2038	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 686,671
2039	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 667,052
2040	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 647,994
2041	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 629,479
2042	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	$ 393,782	$ 1,517,776	$ 825,726
2043	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 594,023
2044	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 577,051
2045	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 560,564
2046	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 544,548
2047	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 528,989
2048	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 513,875
2049	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 499,193
2050	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 484,930
2051	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 471,075
2052	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 457,616
2053	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	$ 393,782	$ 1,517,776	$ 600,282
2054	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 431,840
2055	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 419,502
2056	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 407,516
2057	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 395,873
2058	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 384,562
2059	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 373,575
2060	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 362,901
2061	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 352,532
2062	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 342,460
2063	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 332,675
2064	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	$ 393,782	$ 1,517,776	$ 436,390
2065	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 313,937
2066	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 304,967
2067	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 296,254
2068	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 287,790
2069	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 279,567
2070	22,400	$ 408,150	$ 20,685	$ 358,946	$ 17,213	$ 208,000	$ 111,000	0	$ 1,123,994	$ 271,579
									Total	**$ 30,883,981**

Alternative 2c: Build a new Wallaceburg WTP up to 16.5 ML/d, upgrade the existing intake and LLPS but maintain the capacity at 18.2 ML/d; obtain 11.5 ML/d from LAWSS

Main Component	Description	Capacity	Unit	Cost
Coagulation	New inline rapid coagulant mixing	16.5	ML/d	$ 824,000
Flocculation	New - Flocculation tank	16.5	ML/d	$ 1,955,000
Clarification	New - high rate (inclined plate) sedimentation	16.5	ML/d	$ 3,881,000
Filtration	New - Low pressure membrane filtration	16.5	ML/d	$ 6,084,000
Disinfection	New - Clearwell and additional storage (see table below for requirements)	16.5	ML/d	$ 2,026,000
HLPS	New - HLPS	28	ML/d	$ 2,735,000
RMF	New - Gravity Thickener	16.5	ML/d	$ 780,000
Subtotal				**$ 18,285,000**
Additional Project Costs				**$ 1,026,000**
Decommissioning (Existing)				$ 660,000
Plant I&C			2%	$ 366,000
Total Direct Project Costs				**$ 19,311,000**
Contractor Overhead			10%	$ 1,932,000
Sub-Total				**$ 21,243,000**
Project Staff Overhead			3%	$ 637,000
Sub-Total				**$ 21,880,000**
General Conditions			4%	$ 875,000
Sub-Total				**$ 22,755,000**
Mobilization/Demobilization			3%	$ 683,000
Insurance			1%	$ 228,000
Bond			1%	$ 228,000
Sub-Total				**$ 23,894,000**
Contractor Profit			10%	$ 2,389,000
Sub-Total				**$ 26,283,000**
Estimating Contingency			30%	$ 7,885,000
Total Construction Cost				**$ 34,168,000**
Engineering/SDC			10%	$ 3,417,000
LAWSS System Upgrades	New 500mm watermain	16,100	m	$ 32,683,000
Wallaceburg System Upgrades	New 450mm watermain	8,300	m	$ 15,646,000
Total Construction Cost Including Engineering				**$ 85,914,000**

Lifecycle Cost Estimate for Alternative 2c

Current Year 2021
Discount 5%
Inflation 2%

Year	**ADD** m^3/year	**Electricity** $/y	**NaOCl** $/y	**Cl_2 Gas** $/y	**Citric Acid** $/y	**PACl** $/y	**Fluoride** $/y	**Labour** $/y	**Maintenance** $/y	**Membrane Replacement** $/y	**Annual O&M** $/y	**O&M NPV** $/y
2021	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000		$ 875,244	$ 875,244
2022	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 850,237
2023	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 825,945
2024	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 802,346
2025	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 779,422
2026	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 757,153
2027	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 735,520
2028	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 714,505
2029	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 694,091
2030	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 674,259
2031	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ 198,194	$ 1,073,438	$ 803,315
2032	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 636,281
2033	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 618,101
2034	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 600,441
2035	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 583,286
2036	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 566,621
2037	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 550,431
2038	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 534,705
2039	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 519,427
2040	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 504,587
2041	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ 198,194	$ 1,073,438	$ 601,166
2042	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 476,165
2043	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 462,560
2044	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 449,344
2045	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 436,506
2046	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 424,034
2047	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 411,919
2048	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 400,150
2049	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 388,717
2050	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 377,611
2051	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ 198,194	$ 1,073,438	$ 449,887
2052	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 356,341
2053	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 346,160
2054	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 336,270
2055	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 326,662
2056	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 317,329
2057	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 308,262
2058	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 299,455
2059	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 290,899
2060	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 282,588
2061	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ 198,194	$ 1,073,438	$ 336,676
2062	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 266,670
2063	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 259,051
2064	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 251,650
2065	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 244,460
2066	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 237,475
2067	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 230,690
2068	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 224,099
2069	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 217,696
2070	16,500	$ 505,950	$ 59	$ 15,237	$ 10,692	$ 17,627	$ 12,679	$ 156,000	$ 157,000	$ -	$ 875,244	$ 211,476
											Total	**$ 23,847,888**

Alternative 2d: Wallaceburg to become a part of LAWSS obtaining 28 ML/d from LAWSS; build a BPS of 28 ML/d at Wallaceburg to serve the areas

Main Components	Description	Qty/Capacity	Unit		Cost
Booster Pumping Station	New - BPS	28	ML/d		$ 2,816,000
Storage	New - additional storage (see table below for reqs)	1.5	ML		$ 633,000
Subtotal					**$ 3,449,000**
Additional Project Costs					**$ 729,000**
Decommissioning (Existing)					$ 660,000
Plant I&C				2%	$ 69,000
Total Direct Project Costs					**$ 4,178,000**
Contractor Overhead				10%	$ 418,000
Sub-Total					**$ 4,596,000**
Project Staff Overhead				3%	$ 138,000
Sub-Total					**$ 4,734,000**
General Conditions				4%	$ 189,000
Sub-Total					**$ 4,923,000**
Mobilization/Demobilization				3%	$ 148,000
Insurance				1%	$ 50,000
Bond				1%	$ 50,000
Sub-Total					**$ 5,171,000**
Contractor Profit				10%	$ 517,000
Sub-Total					**$ 5,688,000**
Estimating Contingency				30%	$ 1,707,000
Total Construction Cost					**$ 7,395,000**
Engineering/SDC				15%	$ 1,110,000
LAWSS System Upgrades	New 750mm watermain	25,100	m		$ 90,988,000
Wallaceburg System Upgrades	New 600mm watermain	8,300	m		$ 19,256,000
Total Construction Cost Including Engineering					**$ 118,749,000**

Lifecycle Cost Estimate for Alternative 2d

Current Year	2021
Discount	5%
Inflation	2%

Year	ADD m^3/year	Electricity $/y	Labour $/y	Maintenance $/y	Annual O&M $/y	O&M NPV $/y
2021	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 310,400
2022	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 301,531
2023	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 292,916
2024	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 284,547
2025	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 276,417
2026	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 268,520
2027	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 260,848
2028	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 253,395
2029	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 246,155
2030	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 239,122
2031	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 232,290
2032	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 225,653
2033	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 219,206
2034	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 212,943
2035	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 206,859
2036	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 200,949
2037	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 195,207
2038	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 189,630
2039	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 184,212
2040	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 178,949
2041	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 173,836
2042	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 168,869
2043	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 164,044
2044	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 159,357
2045	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 154,804
2046	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 150,381
2047	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 146,085
2048	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 141,911
2049	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 137,856
2050	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 133,917
2051	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 130,091
2052	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 126,374
2053	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 122,764
2054	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 119,256
2055	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 115,849
2056	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 112,539
2057	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 109,323
2058	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 106,200
2059	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 103,166
2060	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 100,218
2061	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 97,355
2062	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 94,573
2063	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 91,871
2064	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 89,246
2065	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 86,696
2066	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 84,219
2067	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 81,813
2068	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 79,475
2069	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 77,205
2070	22,400	$ 269,400	$ 26,000	$ 15,000	$ 310,400	$ 74,999
					Total	**$ 8,314,040**

Alternative 3a: Build a new Wallaceburg WTP with a rated capacity of 18.6 ML/d

Main Component	Description	Capacity	Unit	Cost
Coagulation	New inline rapid coagulant mixing	18.6	ML/d	$ 868,000
Flocculation	New - Flocculation tank	18.6	ML/d	$ 2,026,000
Clarification	New - Flash mixing and high rate (inclined plate) sedimentation	18.6	ML/d	$ 3,989,000
Filtration	New - Low pressure membrane filtration	18.6	ML/d	$ 6,537,000
Disinfection	New - Clearwell and additional storage (see table below for requirements)	18.6	ML/d	$ 934,000
HLPS	New - HLPS	18.6	ML/d	$ 2,569,000
RMF	New - Gravity Thickener	18.6	ML/d	$ 780,000
Subtotal				**$ 17,703,000**
Additional Project Costs				**$ 1,015,000**
Decommissioning (Existing)				$ 660,000
Plant I&C			2%	$ 355,000
Total Direct Project Costs				**$ 18,718,000**
Contractor Overhead			10%	$ 1,872,000
Sub-Total				**$ 20,590,000**
Project Staff Overhead			3%	$ 618,000
Sub-Total				**$ 21,208,000**
General Conditions			4%	$ 848,000
Sub-Total				**$ 22,056,000**
Mobilization/Demobilization			3%	$ 662,000
Insurance			1%	$ 221,000
Bond			1%	$ 221,000
Sub-Total				**$ 23,160,000**
Contractor Profit			10%	$ 2,316,000
Sub-Total				**$ 25,476,000**
Estimating Contingency			30%	$ 7,643,000
Total Construction Cost				**$ 33,119,000**
Engineering/SDC			15%	$ 4,968,000
Total Construction Cost Including Engineering				**$ 38,087,000**

Lifecycle Cost Estimate for Alternative 3a

Current Year	2021
Discount	5%
Inflation	2%

Year	ADD m^3/year	Electricity $/y	NaOCl $/y	Cl_2 Gas $/y	Citric Acid $/y	PACl $/y	Fluoride $/y	Labour $/y	Maintenance $/y	Membrane Replacement $/y	Annual O&M $/y	O&M NPV $/y
2021	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 662,413
2022	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 643,486
2023	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 625,101
2024	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 607,241
2025	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 589,891
2026	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 573,037
2027	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 556,665
2028	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 540,760
2029	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 525,310
2030	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 510,301
2031	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ 223,419	$ 885,832	$ 662,918
2032	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 481,557
2033	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 467,799
2034	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 454,433
2035	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 441,449
2036	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 428,836
2037	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 416,584
2038	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 404,682
2039	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 393,119
2040	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 381,887
2041	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ 223,419	$ 885,832	$ 496,099
2042	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 360,377
2043	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 350,080
2044	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 340,078
2045	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 330,362
2046	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 320,923
2047	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 311,753
2048	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 302,846
2049	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 294,193
2050	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 285,788
2051	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ 223,419	$ 885,832	$ 371,259
2052	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 269,690
2053	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 261,985
2054	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 254,500
2055	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 247,228
2056	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 240,165
2057	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 233,303
2058	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 226,637
2059	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 220,162
2060	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 213,871
2061	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ 223,419	$ 885,832	$ 277,834
2062	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 201,825
2063	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 196,058
2064	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 190,457
2065	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 185,015
2066	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 179,729
2067	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 174,594
2068	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 169,605
2069	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 164,759
2070	14,880	$ 314,550	$ 54	$ 13,741	$ 9,737	$ 15,896	$ 11,434	$ 156,000	$ 141,000	$ -	$ 662,413	$ 160,052
											Total	**$ 18,198,699**

Alternative 3b: Upgrade the existing Wallaceburg WTP to restore 14 ML/d and obtain 4.6 ML/d from the Chatham system

Main Components	Description	Qty	Unit	Cost	
Pretreatment Upgrades	Retain the existing pretreatment, replace the building envelop Retrofit existing flocculation with mechanicla mixers Retrofit existing Sed. Basins with lamella plates Retrofit existing Sed. Basins with sludge removal mechnism Construct a building envelop over the existing Floc and Sed Basins	14	ML/d	$	2,080,000
Filtration Upgrades	Replace filter underdrains Replace surface wash with air scour, and install air blowers Replace filter media Replace all filter piping	14	ML/d	$	4,981,000
Storage	Additional storage	2.1	ML	$	633,000
HLPS	New - HLPS	18.6	ML/d	$	2,569,000
Other items	Items that require replacing as identified in the Stantec EA up to 2050. Includes Reservoir 2 rehab			$	2,531,000
Subtotal Project Costs				**$**	**12,794,000**
Additional Project Costs				**$**	**916,000**
Decommissioning (Existing)				$	660,000
Plant I&C			2%	$	256,000
Total Direct Project Costs				**$**	**13,710,000**
Contractor Overhead			10%	$	1,371,000
Sub-Total				**$**	**15,081,000**
Project Staff Overhead			3%	$	452,000
Sub-Total				**$**	**15,533,000**
General Conditions			4%	$	621,000
Sub-Total				**$**	**16,154,000**
Mobilization/Demobilization			3%	$	485,000
Insurance			1%	$	162,000
Bond			1%	$	162,000
Sub-Total				**$**	**16,963,000**
Contractor Profit			10%	$	1,696,000
Sub-Total				**$**	**18,659,000**
Estimating Contingency			30%	$	5,598,000
Total Construction Cost				**$**	**24,257,000**
Engineering/SDC			15%	$	3,639,000
Total Construction Cost Including Engineering				**$**	**27,896,000**

Lifecycle Cost Estimate for Alternative 3b

Current Year 2021
Discount 5%
Inflation 2%

Year	ADD m^3/year	Electricity $/y	Cl_2 Gas $/y	PACl $/y	Fluoride $/y	Labour $/y	Maintenance $/y	Filter Media Replacement $/y	Annual O&M $/y	O&M NPV $/y
2021	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 813,334
2022	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 790,096
2023	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 767,522
2024	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 745,593
2025	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 724,290
2026	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 703,596
2027	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 683,493
2028	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 663,965
2029	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 644,994
2030	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 626,566
2031	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ 196,891	$ 1,010,225	$ 756,009
2032	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 591,274
2033	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 574,380
2034	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 557,969
2035	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 542,027
2036	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 526,541
2037	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 511,497
2038	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 496,883
2039	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 482,686
2040	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 468,895
2041	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ 196,891	$ 1,010,225	$ 565,764
2042	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 442,484
2043	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 429,841
2044	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 417,560
2045	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 405,630
2046	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 394,040
2047	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 382,782
2048	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 371,845
2049	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 361,221
2050	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 350,901
2051	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ 196,891	$ 1,010,225	$ 423,394
2052	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 331,136
2053	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 321,675
2054	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 312,484
2055	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 303,556
2056	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 294,883
2057	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 286,458
2058	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 278,273
2059	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 270,322
2060	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 262,599
2061	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ 196,891	$ 1,010,225	$ 316,850
2062	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 247,808
2063	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 240,727
2064	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 233,850
2065	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 227,168
2066	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 220,678
2067	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 214,373
2068	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 208,248
2069	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 202,298
2070	14,880	$ 383,100	$ 13,741	$ 238,443	$ 11,434	$ 104,000	$ 62,616	$ -	$ 813,334	$ 196,518
									Total	**$ 22,186,973**

Alternative 3c: Upgrade the existing Wallaceburg WTP to restore 14 ML/d and obtain 4.6 ML/d from LAWSS

Main Components	Description	Qty	Unit	Cost
Pretreatment Upgrades	Retain the existing pretreatment, replace the building envelop	14	ML/d	$ 2,080,000
	Retrofit existing flocculation with mechanicla mixers			
	Retrofit existing Sed. Basins with lamella plates			
	Retrofit existing Sed. Basins with sludge removal mechnism			
	Construct a building envelop over the existing Floc and Sed Basins			
Filtration Upgrades	Replace filter underdrains	14	ML/d	$ 4,981,000
	Replace surface wash with air scour, and install air blowers			
	Replace filter media			
	Replace all filter piping			
Storage	Additional storage, see table below for reqs	2.1	ML	$ 633,000
HLPS and Storage	New - HLPS	18.6	ML/d	$ 2,569,000
Other items	Items that require replacing as identified in the Stantec EA up to 2050. Includes Reservoir 2 rehab			$ 2,531,000
Subtotal				**$ 12,794,000**
Additional Project Costs				**$ 916,000**
Decommissioning (Existing)				$ 660,000
Plant I&C			2%	$ 256,000
Total Direct Project Costs				**$ 13,710,000**
Contractor Overhead			10%	$ 1,371,000
Sub-Total				**$ 15,081,000**
Project Staff Overhead			3%	$ 452,000
Sub-Total				**$ 15,533,000**
General Conditions			4%	$ 621,000
Sub-Total				**$ 16,154,000**
Mobilization/Demobilization			3%	$ 485,000
Insurance			1%	$ 162,000
Bond			1%	$ 162,000
Sub-Total				**$ 16,963,000**
Contractor Profit			10%	$ 1,696,000
Sub-Total				**$ 18,659,000**
Estimating Contingency			30%	$ 5,598,000
Total Construction Cost				**$ 24,257,000**
Engineering/SDC			15%	$ 3,639,000
LAWSS System Upgrades	New 350mm watermain	16,100	m	$ 23,345,000
Wallaceburg System Upgrades	New 300mm watermain	7,000	m	$ 9,135,000
Wallaceburg System Upgrades	New BPS	4.6	ML/d	$ 5,800,000
Total Construction Cost Including Engineering				**$ 66,176,000**

Lifecycle Cost Estimate for Alternative 3c

Current Year 2021
Discount 5%
Inflation 2%

Year	ADD	Electricity	NaOCl	Cl_2 Gas	PACl	Fluoride	Labour	Maintenance	Filter Media Replacement	Annual O&M	O&M NPV
	m^3/year	$/y	$/y	$/y	$/y	$/y	$/y	$/y	$/y	$/y	$/y
2021	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 797,444
2022	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 774,660
2023	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 752,527
2024	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 731,026
2025	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 710,139
2026	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 689,850
2027	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 670,140
2028	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 650,993
2029	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 632,393
2030	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 614,325
2031	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ 196,891	$ 994,335	$ 744,117
2032	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 579,722
2033	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 563,158
2034	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 547,068
2035	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 531,438
2036	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 516,254
2037	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 501,504
2038	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 487,175
2039	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 473,256
2040	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 459,734
2041	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ 196,891	$ 994,335	$ 556,865
2042	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 433,839
2043	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 421,443
2044	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 409,402
2045	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 397,705
2046	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 386,342
2047	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 375,304
2048	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 364,581
2049	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 354,164
2050	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 344,045
2051	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ 196,891	$ 994,335	$ 416,734
2052	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 324,666
2053	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 315,390
2054	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 306,379
2055	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 297,625
2056	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 289,122
2057	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 280,861
2058	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 272,836
2059	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 265,041
2060	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 257,468
2061	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ 196,891	$ 994,335	$ 311,866
2062	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 242,966
2063	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 236,024
2064	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 229,281
2065	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 222,730
2066	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 216,366
2067	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 210,184
2068	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 204,179
2069	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 198,345
2070	14,000	$ 382,800	$ -	$ 12,928	$ 224,341	$ 10,758	$ 104,000	$ 62,616	$ -	$ 797,444	$ 192,678
										Total	**$ 21,761,352**

Alternative 4a: Upgrade the existing Wallaceburg WTP to restore 14 ML/d

Main Components	Description	Capacity	Unit	Cost
Pretreatment	Retain the existing pretreatment, replace the building envelop	13.6	ML/d	$ 2,049,000
	Retrofit existing flocculation with mechanical mixers			
	Retrofit existing Sed. Basins with lamella plates			
	Retrofit existing Sed. Basins with sludge removal mechnism			
	Construct a building envelop over the existing Floc and Sed Basins			
Filtration	Replace filter underdrains	13.6	ML/d	$ 4,909,000
	Replace surface wash with air scour, and install air blowers			
	Replace filter media			
	Replace all filter piping			
HLPS	New - HLPS	14	ML/d	$ 2,445,000
Other items	Items that require replacing as identified in the Stantec EA up to 2050. Includes Reservoir 2 rehab			$ 2,531,000
Subtotal				**$ 11,934,000**
Additional Project Costs				**$ 899,000**
Decommissioning (Existing)				$ 660,000
Plant I&C			2%	$ 239,000
Total Direct Project Costs				**$ 12,833,000**
Contractor Overhead			10%	$ 1,284,000
Sub-Total				**$ 14,117,000**
Project Staff Overhead			3%	$ 424,000
Sub-Total				**$ 14,541,000**
General Conditions			4%	$ 582,000
Sub-Total				**$ 15,123,000**
Mobilization/Demobilization			3%	$ 454,000
Insurance			1%	$ 152,000
Bond			1%	$ 152,000
Sub-Total				**$ 15,881,000**
Contractor Profit			10%	$ 1,588,000
Sub-Total				**$ 17,469,000**
Estimating Contingency			30%	$ 5,241,000
Total Construction Cost				**$ 22,710,000**
Engineering/SDC			15%	$ 3,407,000
Total Construction Cost Including Engineering				**$ 26,117,000**

Lifecycle Cost Estimate for Alternative 4a

Current Year 2021
Discount 5%
Inflation 2%

Year	ADD m^3/year	Electricity $/y	Cl_2 Gas $/y	PACl $/y	Fluoride $/y	Labour $/y	Maintenance $/y	Filter Media Replacement $/y	Annual O&M $/y	O&M NPV $/y
2021	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 561,039
2022	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 545,009
2023	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 529,438
2024	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 514,311
2025	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 499,616
2026	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 485,341
2027	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 471,474
2028	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 458,004
2029	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 444,918
2030	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 432,206
2031	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ 196,891	$ 757,930	$ 567,202
2032	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 407,861
2033	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 396,208
2034	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 384,888
2035	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 373,891
2036	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 363,209
2037	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 352,831
2038	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 342,750
2039	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 332,957
2040	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 323,444
2041	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ 196,891	$ 757,930	$ 424,470
2042	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 305,226
2043	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 296,505
2044	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 288,034
2045	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 279,804
2046	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 271,810
2047	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 264,044
2048	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 256,500
2049	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 249,171
2050	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 242,052
2051	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ 196,891	$ 757,930	$ 317,655
2052	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 228,418
2053	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 221,892
2054	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 215,552
2055	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 209,393
2056	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 203,411
2057	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 197,599
2058	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 191,953
2059	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 186,469
2060	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 181,141
2061	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ 196,891	$ 757,930	$ 237,719
2062	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 170,938
2063	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 166,054
2064	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 161,310
2065	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 156,701
2066	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 152,224
2067	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 147,874
2068	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 143,649
2069	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 139,545
2070	7,920	$ 254,850	$ 7,314	$ 126,913	$ 6,086	$ 104,000	$ 61,876	$ -	$ 561,039	$ 135,558
									Total	$ 15,429,266

Alternative 4b: Build a new Wallaceburg WTP with a rated capacity of 14 ML/d

Main Components	Description	Capacity	Unit	Cost
Coagulation	New inline rapid coagulant mixing	14	ML/d	$ 824,000
Flocculation	New - Flocculation tank	14	ML/d	$ 1,865,000
Clarification	New - Flash mixing and high rate (inclined plate) sedimentation	14	ML/d	$ 3,753,000
Filtration	New - Low pressure membrane filtration	14	ML/d	$ 5,456,000
Disinfection	New - Chlorine CT contactor	14	ML/d	$ 307,000
HLPS	New - HLPS	14	ML/d	$ 2,445,000
RMF	New - Gravity Thickener	16.5	ML/d	$ 766,000
Subtotal				**$ 15,416,000**
Additional Project Costs				**$ 969,000**
Decommissioning (Existing)				$ 660,000
Plant I&C			2%	$ 309,000
Total Direct Project Costs				**$ 16,385,000**
Contractor Overhead			10%	$ 1,639,000
Sub-Total				**$ 18,024,000**
Project Staff Overhead			3%	$ 541,000
Sub-Total				**$ 18,565,000**
General Conditions			4%	$ 743,000
Sub-Total				**$ 19,308,000**
Mobilization/Demobilization			3%	$ 580,000
Insurance			1%	$ 194,000
Bond			1%	$ 194,000
Sub-Total				**$ 20,276,000**
Contractor Profit			10%	$ 2,028,000
Sub-Total				**$ 22,304,000**
Estimating Contingency			30%	$ 6,692,000
Total Construction Cost				**$ 28,996,000**
Engineering/SDC			15%	$ 2,900,000
Total Construction Cost Including Engineering				**$ 31,896,000**

Lifecycle Cost Estimate for Alternative 4b

Current Year	2021
Discount	5%
Inflation	2%

Year	ADD m^3/year	Electricity $/y	NaOCl $/y	Cl_2 Gas	Citric Acid $/y	PACl $/y	Fluoride $/y	Labour $/y	Maintenance $/y	Membrane Replacement $/y	Annual O&M $/y	O&M NPV $/y
2021	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 470,280
2022	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 456,843
2023	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 443,791
2024	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 431,111
2025	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 418,793
2026	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 406,828
2027	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 395,204
2028	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 383,913
2029	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 372,944
2030	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 362,288
2031	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ 169,680	$ 639,960	$ 478,918
2032	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 341,882
2033	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 332,114
2034	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 322,625
2035	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 313,407
2036	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 304,452
2037	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 295,754
2038	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 287,304
2039	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 279,095
2040	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 271,121
2041	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ 169,680	$ 639,960	$ 358,402
2042	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 255,850
2043	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 248,540
2044	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 241,438
2045	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 234,540
2046	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 227,839
2047	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 221,329
2048	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 215,006
2049	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 208,863
2050	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 202,895
2051	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ 169,680	$ 639,960	$ 268,212
2052	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 191,467
2053	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 185,996
2054	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 180,682
2055	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 175,520
2056	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 170,505
2057	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 165,633
2058	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 160,901
2059	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 156,304
2060	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 151,838
2061	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ 169,680	$ 639,960	$ 200,719
2062	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 143,285
2063	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 139,192
2064	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 135,215
2065	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 131,351
2066	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 127,599
2067	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 123,953
2068	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 120,411
2069	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 116,971
2070	7,920	$ 212,700	$ 43	$ 7,314	$ 7,677	$ 8,461	$ 6,086	$ 104,000	$ 124,000	$ -	$ 470,280	$ 113,629
											Total	**$ 12,942,751**

Appendix B
Detailed Evaluation for Water Supply Alternatives

Criterion	Rank	Alternative 1 - Do Nothing Keep maintaining and rehabilitating the existing WTP using existing intake	Rank	Alternative 2a Build a completely new Wallaceburg WTP rated at 28 ML/d, and a new intake and LLPS rated at 34 ML/d	Rank	Alternative 2b Build a new Wallaceburg WTP rated at 14 ML/d, and upgrade the existing Wallaceburg WTP to restore to 14 ML/d; construct a new intake and LLPS rated at 34 ML/d	Rank	Alternative 2c Build a new Wallaceburg WTP up to 16.5 ML/d, construct a new intake and LLPS but maintain the capacity at 18.2 ML/d; obtain 11.5 ML/d from LAWSS	Rank	Alternative 2d Wallaceburg to become a part of LAWSS obtaining 28 ML/d from LAWSS; build a BPS of 28 ML/d at Wallaceburg to serve the areas
Impacts to surface water quality	5	The alternative will have no change to the current impact on surface water quality, as residuals discharge will not change.	5	The alternative is expected to increase residuals discharge from 0.48 ML/d to 0.90 ML/d. The Wallaceburg WWTP has a rated capacity of 10.8 ML/d, with average daily flows of 8.9 ML/d in 2020. The WTP residuals are inert and have no added nutrient, but anticipate to add suspended solids to the WWTP. As the WWTP has sufficient hydraulic capacity to treat the WTP residuals discharge, little to no impact on surface water quality is expected.	5	The alternative is expected to increase residuals discharge from 0.48 ML/d to 1.3 ML/d. The Wallaceburg WWTP has a rated capacity of 10.8 ML/d, with average daily flows of 8.9 ML/d in 2020. The WTP residuals are inert and have no added nutrient, but anticipate to add suspended solids to the WWTP. As the WWTP has sufficient hydraulic capacity to treat the WTP residuals discharge, little to no impact on surface water quality is expected.	5	The alternative is expected to increase residuals discharge from 0.48 ML/d to 0.53 ML/d. The Wallaceburg WWTP has a rated capacity of 10.8 ML/d, with average daily flows of 8.9 ML/d in 2020. The WTP residuals are inert and have no added nutrient, but anticipate to add suspended solids to the WWTP. As the WWTP has sufficient hydraulic capacity to treat the WTP residuals discharge, little to no impact on surface water quality is expected.	10	This alternative would eliminate residuals discharge to the Wallaceburg WWTP, freeing treatment capacity. Therefore, no impact on surface water quality is expected.
Impacts to surface water quantity	10	The alternative will have no increased impact on surface water quantity, as the water taking volume will not change.	10	The alternative will increase the maximum water taking volume from 18.2 ML/d to 34 ML/d. However, no negative impacts are expected as per Stg 1 Surface Water Study	10	The alternative will increase the maximum water taking volume from 18.2 ML/d to 34 ML/d. However, no negative impacts are expected as per Stg 1 Surface Water Study	10	The alternative will not change the maximum water taking limit. Therefore, no increased impacts are expected.	10	This alternative will eliminate water taking from the Chenal Ecarte, increasing surface water quantity. However, no benefit is demonstrated with reduced water taking.
Impacts on terrestrial environment	10	The alternative will have no substantial long term impact on the viability of terrestrial habitats in terms of density and diversity of species.	5	The alternative has some potential for long term impact on the viability of terrestrial habitats in terms of density and diversity of species due to the potential habitat disruption from the new LLPS. Barn swallows and midland painted turtles were observed within the LLPS study area.	5	The alternative has some potential for long term impact on the viability of terrestrial habitats in terms of density and diversity of species due to the potential habitat disruption from the new LLPS. Barn swallows and midland painted turtles were observed within the LLPS study area.	5	The alternative has some potential for long term impact on the viability of terrestrial habitats in terms of density and diversity of species due to the potential habitat disruption from the new LLPS. Barn swallows and midland painted turtles were observed within the LLPS study area.	5	The alternative will build the water mains along the existing ROW. No impact is anticipated within Wallaceburg. The impact of WM alignment in LAWSS is unknown.
Impacts on aquatic environment	10	The alternative will have no substantial long term impact on the viabaility of aquatic habitats in terms of density and diversity of species, as there will be no changes made.	5	The alternative is not expected to have a substantial long term impact on the viability of aquatic habitats in terms of density and diversity in species. The LLPS may have impacts to the aquatic habitate if being located close to the Syne. The LLPS would be located greater than 30m from fish bearing habitats to reduce impact. There are also natural setbacks from the Snye (Dykeman Drain, constructed berm) that would prevent impacts to the watercourse.	5	The alternative is not expected to have a substantial long term impact on the viability of aquatic habitats in terms of density and diversity in species. The LLPS may have impacts to the aquatic habitate if being located close to the Syne. The LLPS would be located greater than 30m from fish bearing habitats to reduce impact. There are also natural setbacks from the Snye (Dykeman Drain, constructed berm) that would prevent impacts to the watercourse.	5	The alternative is not expected to have a substantial long term impact on the viability of aquatic habitats in terms of density and diversity in species. The LLPS may have impacts to the aquatic habitate if being located close to the Syne. The LLPS would be located greater than 30m from fish bearing habitats to reduce impact. There are also natural setbacks from the Snye (Dykeman Drain, constructed berm) that would prevent impacts to the watercourse.	5	The alternative will build the water mains along the existing ROW. There is the potential for impact at the Running Creek crossing in Wallaceburg. The impact of WM alignment in LAWSS is unknown.
Greenhouse Gas Emissions	5	The alternative will maintain current emissions.	5	This alternative will decrease the GHG emissions in the PUC system (Wallaceburg WTP, Chatham WTP relating to Dresden and GH supply) from 49.0 tonnes CO2 eq/year to 45.1 tonnes CO2 eq/year.	5	This alternative will decrease the GHG emissions in the PUC system (Wallaceburg WTP, Chatham WTP relating to Dresden and GH supply) from 49.0 tonnes CO2 eq/year to 37.9 tonnes CO2 eq/year.	5	This alternative will increase the GHG emissions in the PUC system (Wallaceburg WTP, Chatham WTP relating to Dresden and GH supply) from 49.0 tonnes CO2 eq/year to 57.5 tonnes CO2 eq/year.	10	This alternative will decrease the GHG emissions in the PUC system (Wallaceburg WTP, Chatham WTP relating to Dresden and GH supply) from 49.0 tonnes CO2 eq/year to 10.2 tonnes CO2 eq/year.
Impacts to fluvial geomorphic stability	10	The alternative will have no substantial impact on the fluvial geomorphic stability of the watercourse., as there will be no changes made.	10	The alternative is expected to have no substantial impact on the fluvial geomorphic stability of the watercourse.	10	The alternative is expected to have no substantial impact on the fluvial geomorphic stability of the watercourse.	10	The alternative is expected to have no substantial impact on the fluvial geomorphic stability of the watercourse.	10	The alternative is expected to have no substantial impact on the fluvial geomorphic stability of the watercourse.
Potential Impacts to Groundwater Quality and Quantity	10	The alternative is not expected to have a substantial impact on groundwater quality and quantity over the long term.	10	The alternative is not expected to have a substantial impact on groundwater quality and quantity over the long term.	10	The alternative is not expected to have a substantial impact on groundwater quality and quantity over the long term.	10	The alternative is not expected to have a substantial impact on groundwater quality and quantity over the long term.	10	The alternative is not expected to have a substantial impact on groundwater quality and quantity over the long term.
Normalized Score	***21.4***		***17.9***		***17.9***		***17.9***		***21.4***	

Criterion	Rank	Alternative 3a Build a completely new Wallaceburg WTP rated at 18.6 ML/d, and a new intake and LLPS rated at 20.8 ML/d	Rank	Alternative 3b Upgrade the existing Wallaceburg WTP to restore 14 ML/d, upgrade the existing intake and LLPS (18.2 ML/d); obtain 4.6 ML/d from the Chatham system	Rank	Alternative 3c Upgrade the existing Wallaceburg WTP to restore 14 ML/d, upgrade the existing intake and LLPS (18.2 ML/d); obtain 4.6 ML/d from LAWSS	Rank	Alternative 4a Upgrade the existing Wallaceburg WTP	Rank	Alternative 4b Build a new Wallaceburg WTP at 14 ML/d
Impacts to surface water quality	5	The alternative is expected to increase residuals discharge from 0.48 ML/d to 0.60 ML/d. The Wallaceburg WWTP has a rated capacity of 10.8 ML/d, with average daily flows of 8.9 ML/d in 2020. The WTP residuals are inert and have no added nutrient, but anticipate to add suspended solids to the WWTP. As the WWTP has sufficient hydraulic capacity to treat the WTP residuals discharge, little to no impact on surface water quality is expected.	5	The alternative is expected to increase residuals discharge from 0.48 ML/d to 0.68 ML/d. The Wallaceburg WWTP has a rated capacity of 10.8 ML/d, with average daily flows of 8.9 ML/d in 2020. The WTP residuals are inert and have no added nutrient, but anticipate to add suspended solids to the WWTP. As the WWTP has sufficient hydraulic capacity to treat the WTP residuals discharge, little to no impact on surface water quality is expected.	5	The alternative is expected to increase residuals discharge from 0.48 ML/d to 0.68 ML/d. The Wallaceburg WWTP has a rated capacity of 10.8 ML/d, with average daily flows of 8.9 ML/d in 2020. The WTP residuals are inert and have no added nutrient, but anticipate to add suspended solids to the WWTP. As the WWTP has sufficient hydraulic capacity to treat the WTP residuals discharge, little to no impact on surface water quality is expected.	5	The alternative will have no substantial impact on surface water quality, as residuals discharge will not change.	10	The alternative would slightly reduce impact on surface water quality, as residuals discharge will be reduced from 0.48 ML/d to 0.32 ML/d.
Impacts to surface water quantity	10	The alternative will increase the water taking limit from 18.2 ML/d to 20.8 ML/d. However, no negative impacts are expected as per Stg 1 Surface Water Study	10	The alternative will have no change to impact on surface water quantity, as the water taking volume from the Chenal Ecarte will not change.	10	The alternative will have no change to impact on surface water quantity, as the water taking volume from the Chenal Ecarte will not change.	10	The alternative will have no change to impact on surface water quantity, as the water taking volume from the Chenal Ecarte will not change.	10	The alternative will have no change to impact on surface water quantity, as the water taking volume from the Chenal Ecarte will not change.
Impacts on terrestrial environment	5	The alternative has some potential for long term impact on the viability of terrestrial habitats in terms of density and diversity of species due to the potential habitat disruption from the new LLPS. Barn swallows and midland painted turtles were observed within the LLPS study area.	5	The alternative has some potential for long term impact on the viability of terrestrial habitats in terms of density and diversity of species due to the potential habitat disruption from the new LLPS. Barn swallows and midland painted turtles were observed within the LLPS study area.	5	The alternative has some potential for long term impact on the viability of terrestrial habitats in terms of density and diversity of species due to the potential habitat disruption from the new LLPS. Barn swallows and midland painted turtles were observed within the LLPS study area.	5	The alternative has some potential for long term impact on the viability of terrestrial habitats in terms of density and diversity of species due to the potential habitat disruption from the new LLPS. Barn swallows and midland painted turtles were observed within the LLPS study area.	5	The alternative has some potential for long term impact on the viability of terrestrial habitats in terms of density and diversity of species due to the potential habitat disruption from the new LLPS. Barn swallows and midland painted turtles were observed within the LLPS study area.
Impacts on aquatic environment	5	The alternative is not expected to have a substantial long term impact on the viability of aquatic habitats in terms of density and diversity in species. The LLPS may have impacts to the aquatic habitate if being located close to the Syne. The LLPS would be located greater than 30m from fish bearing habitats to reduce impact. There are also natural setbacks from the Snye (Dykeman Drain, constructed berm) that would prevent impacts to the watercourse.	5	The alternative is not expected to have a substantial long term impact on the viability of aquatic habitats in terms of density and diversity in species. The LLPS may have impacts to the aquatic habitate if being located close to the Syne. The LLPS would be located greater than 30m from fish bearing habitats to reduce impact. There are also natural setbacks from the Snye (Dykeman Drain, constructed berm) that would prevent impacts to the watercourse.	5	The alternative is not expected to have a substantial long term impact on the viability of aquatic habitats in terms of density and diversity in species. The LLPS may have impacts to the aquatic habitate if being located close to the Syne. The LLPS would be located greater than 30m from fish bearing habitats to reduce impact. There are also natural setbacks from the Snye (Dykeman Drain, constructed berm) that would prevent impacts to the watercourse.	5	The alternative is not expected to have a substantial long term impact on the viability of aquatic habitats in terms of density and diversity in species. The LLPS may have impacts to the aquatic habitate if being located close to the Syne. The LLPS would be located greater than 30m from fish bearing habitats to reduce impact. There are also natural setbacks from the Snye (Dykeman Drain, constructed berm) that would prevent impacts to the watercourse.	5	The alternative is not expected to have a substantial long term impact on the viability of aquatic habitats in terms of density and diversity in species. The LLPS may have impacts to the aquatic habitate if being located close to the Syne. The LLPS would be located greater than 30m from fish bearing habitats to reduce impact. There are also natural setbacks from the Snye (Dykeman Drain, constructed berm) that would prevent impacts to the watercourse.
Greenhouse Gas Emissions	0	This alternative will increase the GHG emissions in the PUC system (Wallaceburg WTP, Chatham WTP relating to Dresden and GH supply) from 49.0 tonnes CO2 eq/year to 62.9 tonnes CO2 eq/year.	0	This alternative will increase the GHG emissions in the PUC system (Wallaceburg WTP, Chatham WTP relating to Dresden and GH supply) from 49.0 tonnes CO2 eq/year to 81.2 tonnes CO2 eq/year.	0	This alternative will increase the GHG emissions in the PUC system (Wallaceburg WTP, Chatham WTP relating to Dresden and GH supply) from 49.0 tonnes CO2 eq/year to 76.6 tonnes CO2 eq/year.	0	This alternative will increase the GHG emissions in the PUC system (Wallaceburg WTP, Chatham WTP relating to Dresden and GH supply) from 49.0 tonnes CO2 eq/year to 93.7 tonnes CO2 eq/year.	0	This alternative will increase the GHG emissions in the PUC system (Wallaceburg WTP, Chatham WTP relating to Dresden and GH supply, LAWSS) from 49.0 tonnes CO2 eq/year to 85.3 tonnes CO2 eq/year.
Impacts to fluvial geomorphic stability	10	The alternative is expected to have no substantial impact on the fluvial geomorphic stability of the watercourse.	10	The alternative is expected to have no substantial impact on the fluvial geomorphic stability of the watercourse.	10	The alternative is expected to have no substantial impact on the fluvial geomorphic stability of the watercourse.	10	The alternative is expected to have no substantial impact on the fluvial geomorphic stability of the watercourse.	10	The alternative is expected to have no substantial impact on the fluvial geomorphic stability of the watercourse.
Potential Impacts to Groundwater Quality and Quantity	10	The alternative is not expected to have a substantial impact on groundwater quality and quantity over the long term.	10	The alternative is not expected to have a substantial impact on groundwater quality and quantity over the long term.	10	The alternative is not expected to have a substantial impact on groundwater quality and quantity over the long term.	10	The alternative is not expected to have a substantial impact on groundwater quality and quantity over the long term.	10	The alternative is not expected to have a substantial impact on groundwater quality and quantity over the long term.
Normalized Score	***16.1***		***16.1***		***16.1***		***16.1***		***17.9***	

Criterion	Rank	Alternative 1 - Do Nothing Keep maintaining and rehabilitating the existing WTP using existing intake	Rank	Alternative 2a Build a completely new Wallaceburg WTP rated at 28 ML/d, and a new intake and LLPS rated at 34 ML/d	Rank	Alternative 2b Build a new Wallaceburg WTP rated at 14 ML/d, and upgrade the existing Wallaceburg WTP to restore to 14 ML/d; construct a new intake and LLPS rated at 34 ML/d	Rank	Alternative 2c Build a new Wallaceburg WTP up to 16.5 ML/d, construct a new intake and LLPS but maintain the capacity at 18.2 ML/d; obtain 11.5 ML/d from LAWSS	Rank	Alternative 2d Wallaceburg to become a part of LAWSS obtaining 28 ML/d from LAWSS; build a BPS of 28 ML/d at Wallaceburg to serve the areas
Occupational Health and Safety	5	The alternative poses moderate risk to occupational health and safety due to aging equipment.	10	The alternative poses little to no risk to occupational health and safety, as the risks due to aging equipment would be eliminated.	5	The alternative poses moderate risk to occupational health and safety due to some aging equipment remaining in the existing Wallaceburg WTP.	10	The alternative poses little to no risk to occupational health and safety, as the risks due to aging equipment would be eliminated.	10	The alternative poses little to no risk to occupational health and safety.
Autonomy of Water Supply	10	The PUC would not rely on any other governing bodies for their water supply.	10	The PUC would not rely on any other governing bodies for their water supply.	10	The PUC would not rely on any other governing bodies for their water supply.	5	The PUC would rely on another government body for a percentage of their water supply.	0	The PUC would rely on another government body for all of their water supply.
Archaeological Impacts	10	The alternative has little to no impact on documented archaeologically significant features, as no new areas are impacted.	10	The alternative has little to no impact on documented archaeologically significant features. It is noted that the new WTP area is previously disturbed and requires further investigation.	10	The alternative has little to no impact on documented archaeologically significant features. It is noted that the new WTP area is previously disturbed and requires further investigation.	5	The alternative has little to no impact on documented archaeologically significant features. It is noted that the new WTP area is previously disturbed and requires further investigation. The alternative will build the water mains along the existing ROW (disturbed). No impact is anticipated within Wallaceburg. The impact of WM alignment in LAWSS is unknown.	5	The alternative will build the water mains along the existing ROW (disturbed). No impact is anticipated within Wallaceburg. The impact of WM alignment in LWASS is unknown.
Cultural Heritage Impacts	10	The alternative has little to no impact on documented cultural heritage resources, as no new areas are impacted.	10	The alternative has little to no impact on documented cultural heritage resources, as infrastructure can be routed to avoid those identified in the area.	10	The alternative has little to no impact on documented cultural heritage resources, as infrastructure can be routed to avoid those identified in the area.	5	The alternative has little to no impact on documented cultural heritage resources, as infrastructure can be routed to avoid those identified in the area. However, there is uncertainty related to the impact from the LAWSS transmission main route.	5	The alternative has little to no impact on documented cultural heritage resources, as infrastructure can be routed to avoid those identified in the area. However, there is uncertainty related to the impact from the LAWSS transmission main route.
First Nations Cultural Heritage Impacts	10	The alternative represents little or no potential for disturbance of culural heritage resources recognized by First Nations, as no new areas are impacted.	5	This alternative has little potential to disturb First Nations or Indigenous cultural heritage resources, however, there is some potential for disturbance within the study area where previously disturbed land is present. It is noted that the study area is adjacent to Walpole Island First Nation.	5	This alternative has little potential to disturb First Nations or Indigenous cultural heritage resources, however, there is some potential for disturbance within the study area where previously disturbed land is present. It is noted that the study area is adjacent to Walpole Island First Nation.	5	This alternative has little potential to disturb First Nations or Indigenous cultural heritage resources, however, there is some potential for disturbance within the study area where previously disturbed land is present. It is noted that the study area is adjacent to Walpole Island First Nation.	5	This alternative has little potential to disturb First Nations or Indigenous cultural heritage resources, however, there is some potential for disturbance within the study area where previously disturbed land is present. It is noted that the study area is adjacent to Walpole Island First Nation.
Public land Use Impacts (parks, open spaces)	5	The alternative will maintain the character of the area, as no new areas are impacted.	5	The alternative will maintain the character of public lands in the area.	5	The alternative will maintain the character of public lands in the area.	5	The alternative will maintain the character of public lands in the area.	5	The alternative will maintain the character of public lands in the area.
Private Lands Impacts	5	The alternative will have a moderate impact on private lands relating to future maintenance activities associated with the LLPS and intake.	5	The alternative will have a moderate impact on private lands due to construction of the new LLPS and intake, which would require the acquisition of private lands.	5	The alternative will have a moderate impact on private lands due to construction of the new LLPS and intake, which would require the acquisition of private lands.	5	The alternative will have a moderate impact on private lands due to construction of the new LLPS and intake, which would require the acquisition of private lands.	5	The alternative will build the water mains along the existing ROW. No impact is anticipated within Wallaceburg. The impact of WM alignment in LAWSS is unknown.
Public Acceptability	5	The alternative may be accepted by the public, as it continues to service the existing Wallaceburg area.	10	The alternative may exceed the public's expectation technically and be accepted by the public due to the use of membrane treatment technology.	5	The alternative may be acceptable to the public as it continues to provide treated water in compliance using the current technologies.	5	The alternative may be acceptable to the public due to Wallaceburg receiving a portion of its water from LAWSS, as LAWSS water is taken from Lake Huron.	5	The alternative may be acceptable to the public due to Wallaceburg receiving a portion of its water from LAWSS, as LAWSS water is taken from Lake Huron.
Residential and industrial growth.	0	The alternative will not meet future demands.	10	The alternative will meet projected demands with additional reserve capacity for future greenhouse expansion.	10	The alternative will meet projected demands with additional reserve capacity for future greenhouse expansion.	10	The alternative will meet projected demands with additional reserve capacity for future greenhouse expansion.	10	The alternative will meet projected demands with additional reserve capacity for future greenhouse expansion.
Disruption during Construction	10	The alternative will not result in disruption to traffic.	5	The alternative will result in some disruption to traffic during raw water main transmission main construction.	5	The alternative will result in some disruption to traffic during raw water main transmission main construction.	0	The alternative will result in significant disruption to traffic during raw water main and transmission main construction, due to the additional connection required from the LAWSS system.	0	The alternative will result in significant disruption to traffic and public during raw water main and transmission main construction, due to the additional connection required from the LAWSS system.
Normalized Score	*17.5*		*20.0*		*17.5*		*13.8*		*12.5*	

Criterion	Rank	Alternative 3a Build a completely new Wallaceburg WTP rated at 18.6 ML/d, and a new intake and LLPS rated at 20.8 ML/d	Rank	Alternative 3b Upgrade the existing Wallaceburg WTP to restore 14 ML/d, upgrade the existing intake and LLPS (18.2 ML/d); obtain 4.6 ML/d from the Chatham system	Rank	Alternative 3c Upgrade the existing Wallaceburg WTP to restore 14 ML/d, upgrade the existing intake and LLPS (18.2 ML/d); obtain 4.6 ML/d from LAWSS	Rank	Alternative 4a Upgrade the existing Wallaceburg WTP	Rank	Alternative 4b Build a new Wallaceburg WTP at 14 ML/d
Occupational Health and Safety	10	The alternative poses little to no risk to occupational health and safety, as the risks due to aging equipment would be eliminated.	5	The alternative poses moderate risk to occupational health and safety due to some aging equipment remaining in the existing Wallaceburg WTP.	5	The alternative poses moderate risk to occupational health and safety due to some aging equipment remaining in the existing Wallaceburg WTP.	5	The alternative poses moderate risk to occupational health and safety due to some aging equipment remaining in the existing Wallaceburg WTP.	10	The alternative poses little to no risk to occupational health and safety, as the risks due to aging equipment would be eliminated.
Autonomy of Water Supply	10	The PUC would not rely on any other governing bodies for their water supply.	10	The PUC would not rely on any other governing bodies for their water supply.	5	The PUC would rely on another government body for a percentage of their water supply.	10	The PUC would not rely on any other governing bodies for their water supply.	10	The PUC would not rely on any other governing bodies for their water supply.
Archaeological Impacts	10	The alternative has little to no impact on documented archaeologically significant features. It is noted that the new WTP area is previously disturbed and requires further investigation.	10	The alternative has little to no impact on documented archaeologically significant features.	5	The alternative has little to no impact on documented archaeologically significant features. The impact of WM alignment in LAWSS is unknown.	10	The alternative has little to no impact on documented archaeologically significant features.	10	The alternative has little to no impact on documented archaeologically significant features. It is noted that the new WTP area is previously disturbed and requires further investigation.
Cultural Heritage Impacts	10	The alternative has little to no impact on documented cultural heritage resources, as infrastructure can be routed to avoid those identified in the area.	10	The alternative has little to no impact on documented cultural heritage resources, as infrastructure can be routed to avoid those identified in the area.	5	The alternative has little to no impact on documented cultural heritage resources, as infrastructure can be routed to avoid those identified in the area. However, there is uncertainty related to the impact from the LAWSS transmission main route.	10	The alternative has little to no impact on documented cultural heritage resources, as infrastructure can be routed to avoid those identified in the area.	10	The alternative has little to no impact on documented cultural heritage resources, as infrastructure can be routed to avoid those identified in the area.
First Nations Cultural Heritage Impacts	5	This alternative has little potential to disturb First Nations or Indigenous cultural heritage resources, however, there is some potential for disturbance within the study area where previously disturbed land is present. It is noted that the study area is adjacent to Walpole Island First Nation.	5	This alternative has little potential to disturb First Nations or Indigenous cultural heritage resources, however, there is some potential for disturbance within the study area where previously disturbed land is present. It is noted that the study area is adjacent to Walpole Island First Nation.	5	This alternative has little potential to disturb First Nations or Indigenous cultural heritage resources, however, there is some potential for disturbance within the study area where previously disturbed land is present. It is noted that the study area is adjacent to Walpole Island First Nation.	5	This alternative has little potential to disturb First Nations or Indigenous cultural heritage resources, however, there is some potential for disturbance within the study area where previously disturbed land is present. It is noted that the study area is adjacent to Walpole Island First Nation.	5	This alternative has little potential to disturb First Nations or Indigenous cultural heritage resources, however, there is some potential for disturbance within the study area where previously disturbed land is present. It is noted that the study area is adjacent to Walpole Island First Nation.
Public land Use Impacts (parks, open spaces)	5	The alternative will maintain the character of public lands in the area.	5	The alternative will maintain the character of public lands in the area.	5	The alternative will maintain the character of public lands in the area.	5	The alternative will maintain the character of public lands in the area.	5	The alternative will maintain the character of public lands in the area.
Private Lands Impacts	5	The alternative will have a moderate impact on private lands due to construction of the new LLPS and intake, which would require the acquisition of private lands.	5	The alternative will have a moderate impact on private lands due to construction of the new LLPS and intake, which would require the acquisition of private lands.	5	The alternative will have a moderate impact on private lands due to construction of the new LLPS and intake, which would require the acquisition of private lands.	5	The alternative will have a moderate impact on private lands due to construction of the new LLPS and intake, which would require the acquisition of private lands.	5	The alternative will have a moderate impact on private lands due to construction of the new LLPS and intake, which would require the acquisition of private lands.
Public Acceptability	10	The alternative may exceed the public's expectation technically and be accepted by the public due to the use of membrane treatment technology.	0	The alternative may not be acceptable to the public, as it was communicated during the previous EA that providing Wallaceburg with water from Chatham is not acceptable.	5	The alternative may be acceptable to the public due to Wallaceburg receiving a portion of its water from LAWSS, as LAWSS water is taken from Lake Huron.	0	The alternative may not be acceptable to the public as Chatham would have to provide additional water to greenhouses in the Wallaceburg area.	0	The alternative may not be acceptable to the public as Chatham would have to provide additional water to greenhouses in the Wallaceburg area.
Residential and industrial growth.	10	The alternative will meet projected demands with additional reserve capacity for future greenhouse expansion.	10	The alternative will meet projected demands with additional reserve capacity for future greenhouse expansion.	10	The alternative will meet projected demands with additional reserve capacity for future greenhouse expansion.	5	The alternative will meet projected demands but does not provide reserve capacity for greenhouses in the Wallaceburg system.	5	The alternative will meet projected demands but does not provide reserve capacity for greenhouses in the Wallaceburg system.
Disruption during Construction	5	The alternative will result in some disruption to traffic during raw water main transmission main construction.	5	The alternative will result in some disruption to traffic during raw water main transmission main construction.	0	The alternative will result in significant disruption to traffic during raw water main and transmission main construction, due to the additional connection required from the LAWSS system.	5	The alternative will result in some disruption to traffic during raw water main transmission main construction.	5	The alternative will result in some disruption to traffic during raw water main transmission main construction.
Normalized Score	***20.0***		***16.3***		***12.5***		***15.0***		***16.3***	

Criterion	Rank	Alternative 1 - Do Nothing Keep maintaining and rehabilitating the existing WTP using existing intake	Rank	Alternative 2a Build a completely new Wallaceburg WTP rated at 28 ML/d, and a new intake and LLPS rated at 34 ML/d	Rank	Alternative 2b Build a new Wallaceburg WTP rated at 14 ML/d, and upgrade the existing Wallaceburg WTP to restore to 14 ML/d; construct a new intake and LLPS rated at 34 ML/d	Rank	Alternative 2c Build a new Wallaceburg WTP up to 16.5 ML/d, construct a new intake and LLPS but maintain the capacity at 18.2 ML/d; obtain 11.5 ML/d from LAWSS	Rank	Alternative 2d Wallaceburg to become a part of LAWSS obtaining 28 ML/d from LAWSS; build a BPS of 28 ML/d at Wallaceburg to serve the areas
Adaptability	0	The alternative is not able to adapt to increases in water demands beyond the planning horizon.	10	The alternative is able to adapt to significant increases in water demand beyond the planning horizon, as the new WTP could contain provisions for expansion.	10	The alternative is able to adapt to significant increases in water demand beyond the planning horizon, as the new WTP could contain provisions for expansion.	10	The alternative is able to adapt to significant increases in water demand beyond the planning horizon, as the new WTP could contain provisions for expansion.	0	The alternative is not able to adapt to increases in water demands beyond the planning horizon. Increases in water demands would likely require further substantial upgrades to the LAWSS system, which may not be feasible.
Ease of Approvals and Permitting	10	Acquiring future permits (i.e., PTTW renewal) for this alternative is relatively simple.	5	Acquiring the permits for this alternative is moderately difficult due to the increased water taking limit in the PTTW.	5	Acquiring the permits for this alternative is moderately difficult due to the increased water taking limit in the PTTW.	5	Acquiring approvals for this alternative is moderately difficult, as approval is required from the LAWSS board prior to implementation.	5	Acquiring approvals for this alternative is moderately difficult, as approval is required from the LAWSS board prior to implementation.
Ability for Phased Implementation	0	This alternative does not provide an increase in capacity.	10	Increased capacity can be implemented in phases with limited new infrastructure/equipment and minimal interruption to water production. The new WTP could be constructed in phases based on water demand projections.	10	Increased capacity can be implemented in phases with new infrastructure/equipment being constructed and minimal interruption to water production. The new WTP can be constructed with the old WTP to be upgraded based on water demand projections.	10	Increased capacity can be implemented in phases with limited new infrastructure/equipment and minimal interruption to water production. The new WTP and watermain from LAWSS could be constructed in phases based on water demand projections.	0	Water main from LAWSS must be completed in its entity to enable the water transmission, difficult to implement in phases.
Improvement to Water Conveyance	0	This alternative provides little to no improvement in water transmission capacity.	10	The alternative substantially improves water transmission reliability and capacity.	10	The alternative substantially improves water transmission reliability and capacity.	0	The alternative substantially improves water transmission reliability and capacity. However, there are more potential failure points for this alternative along the LAWSS transmission main, elevating risk.	0	The alternative substantially improves water transmission reliability and capacity. However, there are more potential failure points for this alternative along the LAWSS transmission main, elevating risk.
Constructability, Implementation, and Work Scope	10	The alternative is easy to implement with no major construction required.	10	The alternative is easy to implement with limited constructability issues, as the existing WTP would be maintained during construction.	5	The alternative can be implemented with some constructability issues associated with retrofitting the existing WTP while maintaining service.	5	There is a moderate construction work scope due to the significant upgrades required in the LAWSS system.	5	There is a moderate construction work scope due to the significant upgrades required in the LAWSS system.
Operational and Maintenance Complexity	0	The alternative requires frequent maintenance.	10	The alternative is relatively simple to operate due to the high level of automation in membrane treatment plants. Operation is also less dependent on raw water quality and chemical dosage. The PUC has experience with operating membrane treatment plants through the South CK WTP. While there is more maintenance expected in a membrane plant compared to a conventional filtration plant due to additional instrumentation, valves, etc., a new Wallaceburg WTP is expected to require less maintenance than the existing WTP due to the age of the existing infrastructure.	5	The alternative is moderately difficult to operate, as operation is highly dependent on raw water quality and chemical dosage. It is also moderately difficult to maintain, as there would be increased maintenance requirements in the existing WTP compared to the new WTP.	5	The alternative is relatively simple to operate due to the high level of automation in membrane treatment plants. Operation is also less dependent on raw water quality and chemical dosage. The PUC has experience with operating membrane treatment plants through the South CK WTP. While there is more maintenance expected in a membrane plant compared to a conventional filtration plant due to additional instrumentation, valves, etc., a new Wallaceburg WTP is expected to require less maintenance than the existing WTP due to the age of the existing infrastructure. Increased operation coordination with LAWSS	10	The alternative is relatively simple to operate and maintain, as the only component under PUC operation is a new BPS.
Risk/Reliability	0	There is a high level of risk associated with the alternative.	10	There are limited to no risks associated with the alternative.	5	There is a moderate level of risk associated with this alternative due to continued use of the existing WTP.	5	There is a moderate level of risk associated with this alternative due to the PUC's reliance on LAWSS for a portion of its water supply. The transmission main from LAWSS is very long, with multiple potential failure points.	0	There is a high level of risk associated with this alternative due to the PUC's reliance on LAWSS for all of its water supply. The transmission main from LAWSS is very long, with multiple potential failure points.

Criterion	Rank	Alternative 3a Build a completely new Wallaceburg WTP rated at 18.6 ML/d, and a new intake and LLPS rated at 20.8 ML/d	Rank	Alternative 3b Upgrade the existing Wallaceburg WTP to restore 14 ML/d, upgrade the existing intake and LLPS (18.2 ML/d); obtain 4.6 ML/d from the Chatham system	Rank	Alternative 3c Upgrade the existing Wallaceburg WTP to restore 14 ML/d, upgrade the existing intake and LLPS (18.2 ML/d); obtain 4.6 ML/d from LAWSS	Rank	Alternative 4a Upgrade the existing Wallaceburg WTP	Rank	Alternative 4b Build a new Wallaceburg WTP at 14 ML/d
Adaptability	10	The alternative is able to adapt to significant increases in water demand beyond the planning horizon, as the new WTP could contain provisions for expansion.	0	The alternative is not able to adapt to increases in water demand beyond the planning horizon, as the existing Wallaceburg WTP does not currently have provisions for expansion. New infrastructure would be required, which is beyond the scope of this alternative.	0	The alternative is not able to adapt to increases in water demand beyond the planning horizon, as the existing Wallaceburg WTP does not currently have provisions for expansion. New infrastructure would be required, which is beyond the scope of this alternative.	0	The alternative is not able to adapt to increases in water demand beyond the planning horizon, as the existing Wallaceburg WTP does not currently have provisions for expansion. New infrastructure would be required, which is beyond the scope of this alternative.	0	The alternative is not able to adapt to significant increases in water demand beyond the planning horizon, as water taking would be limited by the PTTW.
Ease of Approvals and Permitting	5	Acquiring the permits for this alternative is moderately difficult due to the increased water taking limit in the PTTW.	10	Acquiring the permits for this alternative is relatively simple.	5	Acquiring approvals for this alternative is moderately difficult, as approval is required from the LAWSS board prior to implementation.	10	Acquiring the permits for this alternative is relatively simple.	10	Acquiring the permits for this alternative is relatively simple.
Ability for Phased Implementation	10	Increased capacity can be implemented in phases with limited new infrastructure/equipment and minimal interruption to water production. The new WTP could be constructed in phases based on water demand projections.	5	Upgrade to the WTP and water transmission from Chatham can be implemented in phase depending on water demand projections. However, it will need to coordinate with Chatham WTP expansion.	10	Increased capacity can be implemented in phases with limited new infrastructure/equipment and minimal interruption to water production. The new WTP and watermain from LAWSS could be constructed in phases based on water demand projections.	0	There is limited opportunity for phased implementation with this alternative. The retrofit of the existing plant would be completed during one period.	0	There is limited opportunity for phased implementation with this alternative, as most of the plant's capacity would be required in the near term.
Improvement to Water Conveyance	10	The alternative substantially improves water transmission reliability and capacity.	5	The alternative substantially improves water transmission reliability and capacity. However, an additional point of failure is introduced at the Eberts pumping station, elevating risk.	0	The alternative substantially improves water transmission reliability and capacity. However, there are more potential failure points for this alternative along the LAWSS transmission main, elevating risk.	5	The alternative substantially improves water transmission reliability but does not increase capacity.	5	The alternative substantially improves water transmission reliability but does not increase capacity.
Constructability, Implementation, and Work Scope	10	The alternative is easy to implement with limited constructability issues, as the existing WTP would be maintained during construction.	5	The alternative can be implemented with some constructability issues associated with retrofitting the existing WTP while maintaining service.	5	The alternative can be implemented with some constructability issues associated with retrofitting the existing WTP while maintaining service.	5	The alternative can be implemented with some constructability issues associated with retrofitting the existing WTP while maintaining service.	10	The alternative is easy to implement with limited constructability issues, as the existing WTP would be maintained during construction.
Operational and Maintenance Complexity	10	The alternative is relatively simple to operate due to the high level of automation in membrane treatment plants. Operation is also less dependent on raw water quality and chemical dosage. The PUC has experience with operating membrane treatment plants through the South CK WTP. While there is more maintenance expected in a membrane plant compared to a conventional filtration plant due to additional instrumentation, valves, etc., a new Wallaceburg WTP is expected to require less maintenance than the existing WTP due to the age of the existing infrastructure.	5	The alternative is moderately difficult to operate, as operation is highly dependent on raw water quality and chemical dosage. It is also moderately difficult to maintain, as there would be increased maintenance requirements in the existing WTP compared to the new WTP.	0	The alternative is moderately difficult to operate, as operation is highly dependent on raw water quality and chemical dosage. It is also moderately difficult to maintain, as there would be increased maintenance requirements in the existing WTP compared to the new WTP. The alternative also needs a BPS at the LAWSS and PUC border, which increases operation and maintainence needs.	5	The alternative is moderately difficult to operate, as operation is highly dependent on raw water quality and chemical dosage. It is also moderately difficult to maintain, as there would be increased maintenance requirements in the existing WTP compared to the new WTP.	10	The alternative is relatively simple to operate due to the high level of automation in membrane treatment plants. Operation is also less dependent on raw water quality and chemical dosage. The PUC has experience with operating membrane treatment plants through the South CK WTP. While there is more maintenance expected in a membrane plant compared to a conventional filtration plant due to additional instrumentation, valves, etc., a new Wallaceburg WTP is expected to require less maintenance than the existing WTP due to the age of the existing infrastructure.
Risk/Reliability	10	There are limited to no risks associated with the alternative.	5	There is a moderate level of risk associated with this alternative due to continued use of the existing WTP.	5	There is a moderate level of risk associated with this alternative due to the PUC's reliance on LAWSS for a portion of its water supply. The transmission main from LAWSS is very long, with multiple potential failure points.	5	There is a moderate level of risk associated with this alternative due to continued use of the existing WTP.	5	There is a moderate level of risk associated with this alternative. If water demands increase, water taking would be limited by the PTTW.

Criterion	Rank	Alternative 1 - Do Nothing Keep maintaining and rehabilitating the existing WTP using existing intake	Rank	Alternative 2a Build a completely new Wallaceburg WTP rated at 28 ML/d, and a new intake and LLPS rated at 34 ML/d	Rank	Alternative 2b Build a new Wallaceburg WTP rated at 14 ML/d, and upgrade the existing Wallaceburg WTP to restore to 14 ML/d; construct a new intake and LLPS rated at 34 ML/d	Rank	Alternative 2c Build a new Wallaceburg WTP up to 16.5 ML/d, construct a new intake and LLPS but maintain the capacity at 18.2 ML/d; obtain 11.5 ML/d from LAWSS	Rank	Alternative 2d Wallaceburg to become a part of LAWSS obtaining 28 ML/d from LAWSS; build a BPS of 28 ML/d at Wallaceburg to serve the areas
Impact of changing raw water quality	5	The alternative is able to manage the range of anticipated raw water quality.	10	The alternative is able to manage the ranges of anticipated raw water quality above what is expected due to the robustness of the membrane treatment process.	5	The alternative is able to manage the range of anticipated raw water quality.	10	The alternative is able to manage the ranges of anticipated raw water quality above what is expected due to the robustness of the membrane treatment process.	10	Water would no longer be taken from the Chenal Ecarte.
Impacts on Treated Water Quality	0	There is no change to treated water quality.	10	The alternative produces treated water superior in water quality to the existing WTP, and provides high degree of protection from certain microbial contaminants.	0	The alternative produces treated water with a similar water quality to the existing WTP	5	The alternative produces treated water superior in water quality to the existing WTP, and provides a high degree of protection from certain microbial contaminants. However, the new Wallaceburg WTP would use membrane treatment, while the LAWSS WTP uses direct filtration.	0	The alternative produces treated water with a similar water quality to the existing WTP, and provides a moderate degree of protection from certain emerging contaminants. The LAWSS WTP uses direct filtration.
Balanced Water Supply Within PUC	0	The alternative fulfils very few of the requirements of a long term PUC water supply strategy.	10	The alternative fulfils all the requirements of a long-term PUC water supply strategy, reducing stress on the Chatham WTP from the current supply to Dresden. This alternative would also delay expansion requirements at the Chatham WTP by ~5 years.	10	The alternative fulfils all the requirements of a long-term PUC water supply strategy, reducing stress on the Chatham WTP from the current supply to Dresden. This alternative would also delay expansion requirements at the Chatham WTP by ~5 years.	10	The alternative fulfils all the requirements of a long-term PUC water supply strategy, reducing stress on the Chatham WTP from the current supply to Dresden. This alternative would also delay expansion requirements at the Chatham WTP by ~5 years.	10	The alternative fulfils all the requirements of a long-term PUC water supply strategy, reducing stress on the Chatham WTP from the current supply to Dresden. This alternative would also delay expansion requirements at the Chatham WTP by ~5 years.
Infrastructure Sustainability	0	The alternative has a low degree of sustainability.	10	The alternative has a high degree of sustainability, as all infrastructure is new.	5	The alternative has a moderate degree of sustainability, as the existing Wallaceburg WTP would still be relied on.	10	The alternative has a high degree of sustainability, as all infrastructure is new.	10	The alternative has a high degree of sustainability, as all infrastructure is new.
Normalized Score	***5.7***		***23.9***		***15.9***		***17.0***		***11.4***	
Capital Cost	10	$ 34,894,000	5.0	$ 46,433,000	5.0	$ 53,246,000	0	$ 85,914,000	0	$ 118,749,000
Life-cycle Cost	5	$ 65,429,000	5.0	$ 71,512,000	5.0	$ 84,130,000	0	$ 109,762,000	0	$ 127,063,000
Normalized Score	***18.8***		***12.5***		***12.5***		***0.0***		***0.0***	
TOTAL	**63.4**		**74.2**		**63.8**		**48.7**		**45.3**	
RANK	**5**		**1**		**4**		**8**		**9**	

Alternative 1 - Do nothing
Alternative 2 - Wallaceburg to supply Wallaceburg, Dresden and Greenhouses
Alternative 3 - Wallaceburg to supply Wallaceburg and Greenhouses
Alternative 4 - Wallaceburg to supply Wallaceburg

Criterion	Rank	Alternative 3a Build a completely new Wallaceburg WTP rated at 18.6 ML/d, and a new intake and LLPS rated at 20.8 ML/d	Rank	Alternative 3b Upgrade the existing Wallaceburg WTP to restore 14 ML/d, upgrade the existing intake and LLPS (18.2 ML/d); obtain 4.6 ML/d from the Chatham system	Rank	Alternative 3c Upgrade the existing Wallaceburg WTP to restore 14 ML/d, upgrade the existing intake and LLPS (18.2 ML/d); obtain 4.6 ML/d from LAWSS	Rank	Alternative 4a Upgrade the existing Wallaceburg WTP	Rank	Alternative 4b Build a new Wallaceburg WTP at 14 ML/d
Impact of changing raw water quality	10	The alternative is able to manage the ranges of anticipated raw water quality above what is expected due to the robustness of the membrane treatment process.	5	The alternative is able to manage the range of anticipated raw water quality.	5	The alternative is able to manage the range of anticipated raw water quality.	5	The alternative is able to manage the range of anticipated raw water quality.	10	The alternative is able to manage the ranges of anticipated raw water quality above what is expected due to the robustness of the membrane treatment process.
Impacts on Treated Water Quality	10	The alternative produces treated water superior in water quality to the existing WTP, and provides high degree of protection from certain microbial contaminants.	0	The alternative produces treated water with a similar water quality to the existing WTP, and provides a moderate degree of protection from certain microbial contaminants.	0	The alternative produces treated water with a similar water quality to the existing WTP, and provides a moderate degree of protection from certain microbial contaminants.	0	The alternative produces treated water with a similar water quality to the existing WTP, and provides a moderate degree of protection from certain microbial contaminants.	10	The alternative produces treated water superior in water quality to the existing WTP, and provides high degree of protection from certain microbial contaminants.
Balanced Water Supply Within PUC	5	The alternative fulfils some of the requirements of a long term PUC water supply strategy by providing additional supply for future greenhouses, but does not reduce the stress on the Chatham WTP.	5	The alternative fulfils some of the requirements of a long term PUC water supply strategy by providing additional supply for future greenhouses, but slightly increases the stress on the Chatham WTP.	5	The alternative fulfils some of the requirements of a long term PUC water supply strategy by providing additional supply for future greenhouses, but does not reduce the stress on the Chatham WTP.	0	The alternative fulfils very few of the requirements of a long term PUC water supply strategy, providing water supply for only Wallaceburg and no additional areas.	0	The alternative fulfils very few of the requirements of a long term PUC water supply strategy, providing water supply for only Wallaceburg and no additional areas.
Infrastructure Sustainability	10	The alternative has a high degree of sustainability, as all infrastructure is new.	5	The alternative has a moderate degree of sustainability, as the existing Wallaceburg WTP would still be relied on.	5	The alternative has a moderate degree of sustainability, as the existing Wallaceburg WTP would still be relied on.	5	The alternative has a moderate degree of sustainability, as the existing Wallaceburg WTP would still be relied on.	10	The alternative has a high degree of sustainability, as all infrastructure is new.
Normalized Score	***22.7***		***11.4***		***9.1***		***9.1***		***15.9***	
Capital Cost	5.0	$ 38,087,000	5.0	$ 27,896,000	0	$ 66,176,000	5.0	$ 26,117,000	5.0	$ 31,896,000
Life-cycle Cost	5.0	$ 56,286,000	5.0	$ 50,083,000	5.0	$ 87,937,000	10.0	$ 41,546,000	10.0	$ 44,839,000
Normalized Score	***12.5***		***12.5***		***6.3***		***18.8***		***18.8***	
TOTAL	**71.3**		**56.2**		**43.9**		**58.9**		**68.8**	
RANK	**2**		**7**		**10**		**6**		**3**	

Alternative 1 - Do nothing
Alternative 2 - Wallaceburg to supply W
Alternative 3 - Wallaceburg to supply W
Alternative 4 - Wallaceburg to supply W

Appendix C
Cost Estimate for Raw Water Supply Alternatives

Wallaceburg Water Treatment Servicing Schedule C Class EA
Technical Memorandum 1
Appendix C: Cost Estimates for Raw Water Supply Alternatives
Do Nothing Alternative

	Main Components		Cost (2021)
LLPS	Pump 2		$ 114,000
LLPS	Intake Pipe		$ 342,000
LLPS	Suction Piping		$ 11,400
LLPS	Suction Valves		$ 54,720
LLPS	Discharge Valves old		$ 34,200
LLPS	Control Panels		$ 80,940
LLPS	Primary Electrical		$ 57,000
	Contingency for additional upgrades		$ 2,000,000
Subtotal			$ 1,303,260
Contractor Overhead		10%	$ 131,000
Sub-Total			$ 1,434,260
Project Staff Overhead		3%	$ 44,000
Sub-Total			$ 1,478,260
General Conditions		4%	$ 60,000
Sub-Total			$ 1,538,260
Mobilization/Demobilization		3%	$ 47,000
Insurance		1%	$ 16,000
Bond		1%	$ 16,000
Sub-Total			$ 1,617,260
Contractor Profit		10%	$ 162,000
Sub-Total			$ 1,779,260
Estimating Contingency		30%	$ 534,000
Total Construction Cost			$ 2,313,260
Engineering/SDC		10%	$ 232,000
LLPS	Raw Water Transmission Main - only pre-2050		$ 3,900,000
		TOTAL	**$ 6,445,260**

Lifecycle Cost Estimate for Do Nothing Alternative

Current Year	2021			
Discount	5%			
Inflation	2%			

Year	Maintenance, $/y	Divers Allowance, $/y	Annual O&M, $/y	O&M NPV, $/y
2021	$ 200,000	$ 20,000	$ 220,000	$ 220,000
2022	$ 200,000	$ 20,000	$ 220,000	$ 213,714
2023	$ 200,000	$ 20,000	$ 220,000	$ 207,608
2024	$ 200,000	$ 20,000	$ 220,000	$ 201,677
2025	$ 200,000	$ 20,000	$ 220,000	$ 195,914
2026	$ 200,000	$ 20,000	$ 220,000	$ 190,317
2027	$ 200,000	$ 20,000	$ 220,000	$ 184,879
2028	$ 200,000	$ 20,000	$ 220,000	$ 179,597
2029	$ 200,000	$ 20,000	$ 220,000	$ 174,466
2030	$ 200,000	$ 20,000	$ 220,000	$ 169,481
2031	$ 200,000	$ 20,000	$ 220,000	$ 164,639
2032	$ 200,000	$ 20,000	$ 220,000	$ 159,935
2033	$ 200,000	$ 20,000	$ 220,000	$ 155,365
2034	$ 200,000	$ 20,000	$ 220,000	$ 150,926
2035	$ 200,000	$ 20,000	$ 220,000	$ 146,614
2036	$ 200,000	$ 20,000	$ 220,000	$ 142,425
2037	$ 200,000	$ 20,000	$ 220,000	$ 138,356
2038	$ 200,000	$ 20,000	$ 220,000	$ 134,403
2039	$ 200,000	$ 20,000	$ 220,000	$ 130,562
2040	$ 200,000	$ 20,000	$ 220,000	$ 126,832
2041	$ 200,000	$ 20,000	$ 220,000	$ 123,208
2042	$ 200,000	$ 20,000	$ 220,000	$ 119,688
2043	$ 200,000	$ 20,000	$ 220,000	$ 116,268
2044	$ 200,000	$ 20,000	$ 220,000	$ 112,946
2045	$ 200,000	$ 20,000	$ 220,000	$ 109,719
2046	$ 200,000	$ 20,000	$ 220,000	$ 106,585
2047	$ 200,000	$ 20,000	$ 220,000	$ 103,539
2048	$ 200,000	$ 20,000	$ 220,000	$ 100,581
2049	$ 200,000	$ 20,000	$ 220,000	$ 97,707
2050	$ 200,000	$ 20,000	$ 220,000	$ 94,916
2051	$ 200,000	$ 20,000	$ 220,000	$ 92,204
2052	$ 200,000	$ 20,000	$ 220,000	$ 89,569
2053	$ 200,000	$ 20,000	$ 220,000	$ 87,010
2054	$ 200,000	$ 20,000	$ 220,000	$ 84,524
2055	$ 200,000	$ 20,000	$ 220,000	$ 82,109
2056	$ 200,000	$ 20,000	$ 220,000	$ 79,763
2057	$ 200,000	$ 20,000	$ 220,000	$ 77,484
2058	$ 200,000	$ 20,000	$ 220,000	$ 75,271
2059	$ 200,000	$ 20,000	$ 220,000	$ 73,120
2060	$ 200,000	$ 20,000	$ 220,000	$ 71,031
2061	$ 200,000	$ 20,000	$ 220,000	$ 69,001
2062	$ 200,000	$ 20,000	$ 220,000	$ 67,030
2063	$ 200,000	$ 20,000	$ 220,000	$ 65,115
2064	$ 200,000	$ 20,000	$ 220,000	$ 63,254
2065	$ 200,000	$ 20,000	$ 220,000	$ 61,447
2066	$ 200,000	$ 20,000	$ 220,000	$ 59,691
2067	$ 200,000	$ 20,000	$ 220,000	$ 57,986
2068	$ 200,000	$ 20,000	$ 220,000	$ 56,329
2069	$ 200,000	$ 20,000	$ 220,000	$ 54,720
2070	$ 200,000	$ 20,000	$ 220,000	$ 53,156
2071	$ 200,000	$ 20,000	$ 220,000	$ 51,638
			TOTAL	$ 5,944,321

Wallaceburg Water Treatment Servicing Schedule C Class EA
Technical Memorandum 1
Appendix C: Cost Estimates for Raw Water Supply Alternatives
Alternative 1: Build a new LLPS and intake at the existing LLPS/intake site.

Component	Description	Capacity	Units	Unit Cost	Capital Cost
Low Lift Pumping Station	>Vertical turbine pumps (2 duty, 2 standby) >Split wet well for redundancy/phasing >Reuse existing diesel standby generator (150 kW required)	34	ML/d		$ 2,346,000
Sitework					*$ 24,000*
Building Excavation		464.64	m3	*$ 72*	*$ 34,000*
Concrete					*$ 214,000*
Masonry					*$ 122,000*
Metals					*$ 10,000*
Equipment					*$ 804,000*
I&C					*$ 319,000*
Mechanical					*$ 330,000*
Electrical					*$ 163,000*
Allowances					*$ 326,000*
Intake	>Cylindrical wedge wire screens[1]	34	ML/d		$ 918,000
Sheet Piling		*380*	*m2*	*$ 761*	*$ 289,101*
Tremie Concrete Slab		*26.6*	*m3*	*$ 806*	*$ 21,438*
Dewatering		*90*	*days*	*$ 884*	*$ 79,560*
Intake Pipe		*15*	*m*	*$ 1,850*	*$ 27,750*
Cylindrical Wedge Wire Screens		*2*	*EA*	*######*	*$ 500,000*
Subtotal					$ 3,264,000
Contractor Overhead				10%	$ 327,000
Sub-Total					$ 3,591,000
Project Staff Overhead				3%	$ 108,000
Sub-Total					$ 3,699,000
General Conditions				4%	$ 148,000
Sub-Total					$ 3,847,000
Mobilization/Demobilization				3%	$ 116,000
Insurance				1%	$ 39,000
Bond				1%	$ 39,000
Sub-Total					$ 4,041,000
Contractor Profit				10%	$ 405,000
Sub-Total					$ 4,446,000
Estimating Contingency				30%	$ 1,334,000
Total Construction Cost					$ 5,780,000
Engineering/SDC				10%	$ 578,000
Raw Water Transmission Main	>Raw water main to Wallaceburg WTP	2.6	km	######	$ 3,900,000
				TOTAL	**$ 10,258,000**

Lifecycle Cost Estimate for Alternative 1

Current Year 2021
Discount 5%
Inflation 2%

Year	ADD, ML/d	Electricity, $/y	NaOCl, $/y	Maintenance, $/y	Annual O&M, $/y	O&M NPV, $/y
2021	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 133,221
2022	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 129,415
2023	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 125,717
2024	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 122,125
2025	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 118,636
2026	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 115,246
2027	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 111,954
2028	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 108,755
2029	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 105,648
2030	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 102,629
2031	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 99,697
2032	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 96,848
2033	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 94,081
2034	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 91,393
2035	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 88,782
2036	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 86,245
2037	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 83,781
2038	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 81,387
2039	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 79,062
2040	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 76,803
2041	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 74,609
2042	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 72,477
2043	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 70,406
2044	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 68,395
2045	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 66,441
2046	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 64,542
2047	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 62,698
2048	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 60,907
2049	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 59,167
2050	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 57,476
2051	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 55,834
2052	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 54,239
2053	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 52,689
2054	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 51,184
2055	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 49,721
2056	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 48,301
2057	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 46,921
2058	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 45,580
2059	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 44,278
2060	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 43,013
2061	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 41,784
2062	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 40,590
2063	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 39,430
2064	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 38,304
2065	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 37,209
2066	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 36,146
2067	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 35,113
2068	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 34,110
2069	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 33,136
2070	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 32,189
2071	27.2	$ 105,900	$ 1,241	$ 26,080	$ 133,221	$ 31,269
					TOTAL	$ 3,599,583

Wallaceburg Water Treatment Servicing Schedule C Class EA
Technical Memorandum 1
Appendix C: Cost Estimates for Raw Water Supply Alternatives
Alternative 2: Build a new LLPS and intake at the first upstream location.

Component	Description	Capacity	Units	Unit Cost	Capital Cost
Low Lift Pumping Station	>Vertical turbine pumps (2 duty, 2 standby) >Split wet well for redundancy/phasing >Diesel standby generator	34	ML/d		$ 2,682,000
Sitework					*$ 24,000*
Building Excavation		696.96	m3	*$ 72*	*$ 50,000*
Concrete					*$ 270,000*
Masonry					*$ 119,000*
Metals					*$ 10,000*
Equipment					*$ 867,000*
I&C					*$ 319,000*
Mechanical					*$ 330,000*
Electrical					*$ 157,000*
Allowances					*$ 336,000*
Diesel Standby Generator	>Includes enclosure and fuel tank			250 kW	*$ 200,000*
Intake	>Cylindrical wedge wire screens[1]	34	ML/d		$ 938,000
Sheet Piling		*304.71*	*m2*	*$ 761*	*$ 231,821*
Coffer Dam Excavation		*145*	*m3*	*$ 285*	*$ 41,376*
Dewatering		*90*	*days*	*$ 884*	*$ 79,560*
Intake Pipe		*100*	*m*	*$ 1,850*	*$ 185,000*
Cylindrical Wedge Wire Screens		*2*	*EA*	*$ 200,000*	*$ 400,000*
Subtotal					$ 3,620,000
Contractor Overhead				10%	$ 362,000
Sub-Total					$ 3,982,000
Project Staff Overhead				3%	$ 120,000
Sub-Total					$ 4,102,000
General Conditions				4%	$ 165,000
Sub-Total					$ 4,267,000
Mobilization/Demobilization				3%	$ 129,000
Insurance				1%	$ 43,000
Bond				1%	$ 43,000
Sub-Total					$ 4,482,000
Contractor Profit				10%	$ 449,000
Sub-Total					$ 4,931,000
Estimating Contingency				30%	$ 1,480,000
Total Construction Cost					$ 6,411,000
Engineering/SDC				10%	$ 642,000
Land Acquisition		1	acre	$ 200,000	$ 200,000
Raw Water Transmission Main	>Raw water main to Wallaceburg WTP	5.45	km	$ 1,500,000	$ 8,175,000
				TOTAL	**$ 15,228,000**

Lifecycle Cost Estimate for Alternative 2

Current Ye 2021
Discount 5%
Inflation 2%

Year	ADD, ML/d	Electricity, $/y	NaOCl, $/y	Maintenance, $/y	Divers Allowance, $/y	Annual O&M, $/y	O&M NPV, $/y
2021	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 208,881
2022	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 202,913
2023	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 197,115
2024	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 191,484
2025	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 186,013
2026	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 180,698
2027	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 175,535
2028	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 170,520
2029	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 165,648
2030	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 160,915
2031	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 156,318
2032	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 151,851
2033	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 147,513
2034	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 143,298
2035	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 139,204
2036	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 135,227
2037	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 131,363
2038	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 127,610
2039	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 123,964
2040	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 120,422
2041	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 116,981
2042	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 113,639
2043	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 110,392
2044	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 107,238
2045	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 104,174
2046	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 101,198
2047	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 98,306
2048	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 95,498
2049	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 92,769
2050	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 90,119
2051	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 87,544
2052	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 85,042
2053	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 82,613
2054	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 80,252
2055	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 77,959
2056	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 75,732
2057	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 73,568
2058	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 71,466
2059	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 69,424
2060	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 67,441
2061	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 65,514
2062	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 63,642
2063	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 61,824
2064	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 60,057
2065	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 58,341
2066	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 56,675
2067	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 55,055
2068	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 53,482
2069	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 51,954
2070	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 50,470
2071	27.2	$ 162,300	$ 1,241	$ 25,340	$ 20,000	$ 208,881	$ 49,028
						TOTAL	$ 5,643,889

Wallaceburg Water Treatment Servicing Schedule C Class EA
Technical Memorandum 1
Appendix C: Cost Estimates for Raw Water Supply Alternatives
Alternative 3: Build a new LLPS and intake at the second upstream location.

Component	**Description**	**Capacity**	**Units**	**Unit Cost**	**Capital Cost**
Low Lift Pumping Station	>Vertical turbine pumps (2 duty, 2 standby) >Split wet well for redundancy/phasing >Diesel standby generator	34	ML/d		$ 2,709,000
Sitework					*$ 24,000*
Building Excavation		464.64	m3	*$ 72*	*$ 34,000*
Concrete					*$ 213,000*
Masonry					*$ 119,000*
Metals					*$ 10,000*
Equipment					*$ 902,000*
I&C					*$ 319,000*
Mechanical					*$ 330,000*
Electrical					*$ 166,000*
Allowances					*$ 342,000*
Diesel Standby Generator	>Includes enclosure and fuel tank	300	kW		*$ 250,000*
Intake	>Cylindrical wedge wire screens[1]	34	ML/d		$ 1,411,000
Tremie Concrete Slab		*31*	*m3*	*$ 806*	*$ 24,984*
Dewatering		*180*	*days*	*$ 884*	*$ 159,120*
Receiving Pit		*1*		*$ 678,000*	*$ 678,000*
Intake Pipe		*80*	*m*	*$ 1,850*	*$ 148,000*
Cylindrical Wedge Wire Screens		*2*		*$ 200,000*	*$ 400,000*
Subtotal					$ 4,120,000
Contractor Overhead				10%	$ 412,000
Sub-Total					$ 4,532,000
Project Staff Overhead				3%	$ 136,000
Sub-Total					$ 4,668,000
General Conditions				4%	$ 187,000
Sub-Total					$ 4,855,000
Mobilization/Demobilization				3%	$ 146,000
Insurance				1%	$ 2,000
Bond				1%	$ 2,000
Sub-Total					$ 5,005,000
Contractor Profit				10%	$ 501,000
Sub-Total					$ 5,506,000
Estimating Contingency				30%	$ 1,652,000
Total Construction Cost					$ 7,158,000
Engineering/SDC				10%	$ 716,000
Land Acquisition		1	acre	$ 200,000	$ 200,000
Raw Water Transmission Main	>Raw water main to Wallaceburg WTP	6.7	km	$ 1,500,000	$ 10,050,000
				TOTAL	**$ 17,924,000**

Lifecycle Cost Estimate for Alternative 3

Current Year 2021
Discount 5%
Inflation 2%

Year	ADD, ML/d	Electricity, $/y	NaOCl, $/y	Maintenance, $/y	Divers Allowance, $/y	Annual O&M, $/y	O&M NPV, $/y
2021	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 225,181
2022	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 218,747
2023	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 212,497
2024	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 206,426
2025	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 200,528
2026	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 194,799
2027	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 189,233
2028	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 183,826
2029	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 178,574
2030	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 173,472
2031	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 168,516
2032	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 163,701
2033	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 159,024
2034	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 154,480
2035	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 150,067
2036	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 145,779
2037	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 141,614
2038	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 137,568
2039	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 133,637
2040	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 129,819
2041	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 126,110
2042	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 122,507
2043	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 119,007
2044	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 115,606
2045	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 112,303
2046	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 109,095
2047	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 105,978
2048	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 102,950
2049	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 100,008
2050	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 97,151
2051	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 94,375
2052	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 91,679
2053	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 89,059
2054	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 86,515
2055	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 84,043
2056	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 81,642
2057	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 79,309
2058	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 77,043
2059	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 74,842
2060	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 72,704
2061	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 70,626
2062	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 68,608
2063	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 66,648
2064	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 64,744
2065	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 62,894
2066	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 61,097
2067	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 59,352
2068	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 57,656
2069	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 56,008
2070	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 54,408
2071	27.2	$ 177,900	$ 1,241	$ 26,040	$ 20,000	$ 225,181	$ 52,854
						TOTAL	$ 6,084,309

Appendix D
Detailed Evaluation Results for Raw Water Supply Alternatives

Wallaceburg EA - Raw Water Supply Alternatives Evaluation

Category	Weight	Criterion	Do Nothing Keep maintaining and rehabilitating the existing LLPS and intake	Do Nothing Score	Alternative 1 Build a new LLPS and intake at the existing location with a rated capacity of 34 ML/d	Alternative 1 Score	Alternative 2 Build a new LLPS and intake at the first upstream location with a rated capacity of 34 ML/d	Alternative 2 Score	Alternative 3 Build a new LLPS and intake at the second upstream location with a rated capacity of 34 ML/d	Alternative 3 Score
Natural Environment	**25%**	Impacts to surface water quality	The alternative will have no substantial impact on surface water quality.	10	The alternative will have no substantial impact on surface water quality.	10	The alternative will have no substantial impact on surface water quality.	10	The alternative will have no substantial impact on surface water quality.	10
Natural Environment	**25%**	Impacts to surface water quantity	The alternative will have no substantial impact on surface water quantity.	10	The alternative will increase the maximum water taking limit from 17 ML/d to 34 ML/d. However, the increased water taking is not expected to have a substantial impact on surface water quantity. However, the Stage 2 Surface Water Study is ongoing at this time, which will provide a more definitive evaluation.	10	The alternative will increase the maximum water taking limit from 17 ML/d to 34 ML/d. However, the increased water taking is not expected to have a substantial impact on surface water quantity. However, the Stage 2 Surface Water Study is ongoing at this time, which will provide a more definitive evaluation.	10	The alternative will increase the maximum water taking limit from 17 ML/d to 34 ML/d. However, the increased water taking is not expected to have a substantial impact on surface water quantity. However, the Stage 2 Surface Water Study is ongoing at this time, which will provide a more definitive evaluation.	10
Natural Environment	**25%**	Impacts to wetlands	The alternative will have no impact on wetlands.	10	The alternative will have no impact on wetlands.	10	The alternative will have no impact on wetlands.	10	The alternative has some potential to impact wetlands between the road and Chenal Ecarte. However, construction methods would be selected to minimize impacts and provide mitigation	5
Natural Environment	**25%**	Impacts on terrestrial environment	The alternative will have no impact on the terrestrial environment.	10	The alternative will have no impact on the terrestrial environment, as the site is previously disturbed from construction of the existing LLPS.	10	The alternative has some potential to impact the terrestrial environment on site. However, a mitigation plan would be developed such that there is no long term impact to the density and diversity of species in the area.	10	The alternative has some potential to impact the terrestrial environment on site. However, a mitigation plan would be developed such that there is no long term impact to the density and diversity of species in the area.	10
Natural Environment	**25%**	Impacts on aquatic environment	The alternative will have no impact on the aquatic environment.	10	The alternative has some potential to temporarily impact aquatic habitats during intake construction.	5	The alternative has some potential to temporarily impact aquatic habitats during intake construction.	5	The alternative has some potential to temporarily impact aquatic habitats during intake construction.	5
Natural Environment	**25%**	Greenhouse Gas Emissions	This alternative would result in GHG emissions of 48.2 tonnes CO2 eq/y, assuming that the LLPS operates at its maximum rated capacity of 17 ML/d to partially satisfy the demand of the Wallaceburg WTP.	5	This alternative would result in GHG emissions of 21.2 tonnes CO2 eq/y.	10	This alternative would result in GHG emissions of 32.5 tonnes CO2 eq/y, which is less than the do nothing alternative.	10	This alternative would result in GHG emissions of 35.6 tonnes CO2 eq/y, which is less than the do nothing alternative.	10
Natural Environment	**25%**	Impacts to Air Quality	This alternative would have some impact to air quality due to emissions from the diesel generator, however, emissions would be within provincial limits.	5	This alternative would have some impact to air quality due to emissions from the diesel generator, however, emissions would be within provincial limits.	5	This alternative would have some impact to air quality due to emissions from the diesel generator, however, emissions would be within provincial limits.	5	This alternative would have some impact to air quality due to emissions from the diesel generator, however, emissions would be within provincial limits.	5
Natural Environment	**25%**	Impacts to fluvial geomorphic stability	The alternative would have no impact to fluvial geomorphic stability.	10	The alternative would have little to no impact to fluvial geomorphic stability. Sheet piles and bulkheads would be constructed in a manner that minimizes the impact to the stability of the watercourse. However, the Stage 2 Surface Water Study is ongoing at this time, which will provide a more definitive evaluation.	10	The alternative would have little to no impact to fluvial geomorphic stability. Sheet piles and bulkheads would be constructed in a manner that minimizes the impact to the stability of the watercourse. However, the Stage 2 Surface Water Study is ongoing at this time, which will provide a more definitive evaluation.	10	The alternative would have little to no impact to fluvial geomorphic stability. Bulkheads would be constructed in a manner that minimizes the impact to the stability of the watercourse. However, the Stage 2 Surface Water Study is ongoing at this time, which will provide a more definitive evaluation.	10
Natural Environment	**25%**	Potential Impacts to Groundwater Quality and Quantity	The alternative would have little to no impact to groundwater quality and quantity.	10	The alternative would have little to no impact to groundwater quality and quantity.	10	The alternative would have little to no impact to groundwater quality and quantity.	10	The alternative would have little to no impact to groundwater quality and quantity.	10
Natural Environment	***25***	***Normalized Score***		***22.2***		***22.2***		***22.2***		***20.8***
Social/Cultural	**25%**	Occupational Health and Safety	The alternative poses some risk to occupational health and safety, as the equipment in the LLPS is old and requires frequent maintenance.	5	The alternative poses little to no risk to occupational health and safety.	10	The alternative poses little to no risk to occupational health and safety.	10	The alternative poses little to no risk to occupational health and safety.	10

Wallaceburg EA - Raw Water Supply Alternatives Evaluation

Category	Weight	Criterion	Do Nothing Keep maintaining and rehabilitating the existing LLPS and intake	Do Nothing Score	Alternative 1 Build a new LLPS and intake at the existing location with a rated capacity of 34 ML/d	Alternative 1 Score	Alternative 2 Build a new LLPS and intake at the first upstream location with a rated capacity of 34 ML/d	Alternative 2 Score	Alternative 3 Build a new LLPS and intake at the second upstream location with a rated capacity of 34 ML/d	Alternative 3 Score
Social/Cultural	**25%**	Archaeological Impacts	The alternative has little to no impact on documented archaeologically significant features.	10	The alternative has little to no impact on documented archaeologically significant features. The right-of-way is previously disturbed and requires no further assessment.	10	The LLPS site is not previously disturbed and has archeological potential. A Stage 2 assessment is recommended.	5	The LLPS site is not previously disturbed and has archeological potential. A Stage 2 assessment is recommended.	5
Social/Cultural	**25%**	Cultural Heritage Impacts	The alternative has little to no impact on documented cultural heritage resources.	10	The alternative has little to no impact on documented cultural heritage resources, as infrastructure can be routed to avoid those identified in the area.	10	The alternative has little to no impact on documented cultural heritage resources, as infrastructure can be routed to avoid those identified in the area.	10	The alternative has little to no impact on documented cultural heritage resources, as infrastructure can be routed to avoid those identified in the area.	10
Social/Cultural	**25%**	First Nations Cultural Heritage Impacts	This alternative has little potential to disturb First Nations or Indigenous cultural heritage resources, as the LLPS site is previously disturbed.	10	This alternative has little potential to disturb First Nations or Indigenous cultural heritage resources, however, there is some potential for disturbance within the study area where previously disturbed land is present. It is noted that the study area is adjacent to Walpole Island First Nation.	5	This alternative has little potential to disturb First Nations or Indigenous cultural heritage resources, however, there is some potential for disturbance within the study area where previously disturbed land is present. It is noted that the study area is adjacent to Walpole Island First Nation.	5	This alternative has little potential to disturb First Nations or Indigenous cultural heritage resources, however, there is some potential for disturbance within the study area where previously disturbed land is present. It is noted that the study area is adjacent to Walpole Island First Nation.	5
Social/Cultural	**25%**	Public land Use Impacts (parks, open spaces)	The alternative would maintain the character of public lands within the area.	5	The alternative would maintain the character of public lands within the area.	5	The alternative would maintain the character of public lands within the area.	5	The alternative would maintain the character of public lands within the area.	5
Social/Cultural	**25%**	Private Lands Impacts	The alternative would have no impact to private lands.	10	The alternative would restrict use of the PUC-owned road leading to the Chenal Ecarte for other purposes, negatively impacting the property's utility.	0	The alternative requires the acquisition of private lands, as well as new easements for the raw watermain.	5	The alternative requires the acquisition of private lands, as well as new easements for the raw watermain.	5
Social/Cultural	**25%**	Public Acceptability	The alternative would not be acceptable to the public, as it is not compatible with a new Wallaceburg WTP.	0	The alternative would not be acceptable to the public. Residents have voiced a desire to relocate the LLPS and intake further upstream in the Chenal Ecarte. Storm events have resulted in high raw water turbidities, which residents have expressed concerns about.	0	The alternative would be somewhat acceptable to the public. There would be significant disruption along Bluewater Line and Base Line during construction.	5	The alternative would be somewhat acceptable to the public. There would be significant disruption along Bluewater Line and Base Line during construction.	5
Social/Cultural	**25%**	Disruption during Construction	The alternative would not cause any disruption.	10	The alternative would cause some disruption during construction.	5	The alternative would cause a large amount of disruption along the raw watermain alignment (Bluewater Hwy/Base Line).	0	The alternative would cause a large amount of disruption along the raw watermain alignment (Bluewater Hwy/Base Line).	0
Social/Cultural	***25***	***Normalized Score***		***18.8***		***14.1***		***14.1***		***14.1***
Technical	**25%**	Adaptability	The alternative is not adaptable to increasing water demands beyond the planning horizon.	0	The alternative is adaptable to increasing water demands.	10	The alternative is somewhat adaptable. A slight increase in flow would result in a high increase in headloss within the raw watermain, which would increase energy costs.	5	The alternative is somewhat adaptable. A slight increase in flow would result in a high increase in headloss within the raw watermain, which would increase energy costs.	5
Technical	**25%**	Ease of Approvals and Permitting	A new DWWP would be required for the new Wallaceburg WTP, which may be rejected based on the available LLPS capacity for this alternative.	0	Acquiring permits for this alternative would be relatively simple, given that the LLPS is currently at this site. No easements are required for the new raw watermain.	10	Acquiring permits for this alternative would be moderately difficult. Easements are required for the new raw watermain.	5	Acquiring permits for this alternative would be moderately difficult. Easements are required for the new raw watermain.	5
Technical	**25%**	Ability for Phased Implementation	There is no ability for phased implementation.	0	Capacity can be implemented in phases, compatible with the new Wallaceburg WTP.	10	Capacity can be implemented in phases, compatible with the new Wallaceburg WTP.	10	Capacity can be implemented in phases, compatible with the new Wallaceburg WTP.	10

Wallaceburg EA - Raw Water Supply Alternatives Evaluation

Category	Weight	Criterion	Do Nothing Keep maintaining and rehabilitating the existing LLPS and intake	Do Nothing Score	Alternative 1 Build a new LLPS and intake at the existing location with a rated capacity of 34 ML/d	Alternative 1 Score	Alternative 2 Build a new LLPS and intake at the first upstream location with a rated capacity of 34 ML/d	Alternative 2 Score	Alternative 3 Build a new LLPS and intake at the second upstream location with a rated capacity of 34 ML/d	Alternative 3 Score
Technical	**25%**	Constructability, Implementation, and Work Scope	This alternative cannot be implemented on a practical basis.	0	The alternative would have significant constructability issues, as there is insufficient available space on site for the new LLPS. Phasing would be complicated, considering that the existing LLPS must remain in service during construction.	0	The alternative would have constructability issues due to the berm between the site and the river. There are also setback considerations for the surrounding properties that could create difficulties. The intake would be installed via open cut with a coffer dam, with berm modifications likely required during construction. The berm would be restored post-construction.	0	The alternative can be constructed with limited constructability issues, with a reasonable scope. The topography is flat in the area and the property is surrounded by agricultural fields. The intake would be installed via open cut with a coffer dam.	10
Technical	**25%**	Operational and Maintenance Complexity	The alternative requires frequent maintenance due to age.	0	The alternative would be simple to operate and maintain, as all equipment would be new and modern. However, the raw water turbidity events from this location would increase maintenance requirements at the new Wallaceburg WTP.	0	The alternative would be simple to operate, as all equipment would be new and modern. Access to in water works is somewhat difficult due to the large berm between the site and the river, which would limit accessibility for equipment such as cranes, trucks, etc. Divers would continue to be used for screen maintenance.	5	The alternative would be simple to operate and maintain, as all equipment would be new and modern. The intake would be easily accessible from the shore. Divers would continue to be used for screen maintenance.	10
Technical	**25%**	Compatibility with the Preferred Solution for Water Supply	The alternative is not compatible with the preferred solution for water supply, as it does not provide sufficient raw water pumping capacity.	0	The alternative is compatible with the preferred solution for water supply. However, The LLPS would still experience turbidity spikes during wet weather events, which would increase maintenance requirements at the new Wallaceburg WTP.	0	The alternative is compatible with the preferred solution for water supply. Turbidity spikes during wet weather events would be eliminated.	10	The alternative is compatible with the preferred solution for water supply. Turbidity spikes during wet weather events would be eliminated.	10
Technical	**25%**	Construction Schedule	There is no construction.	10	The alternative requires phasing and careful demolition of the existing LLPS, which would result in a long construction schedule.	0	The alternative has a moderate construction schedule due to the length of the raw watermain.	5	The alternative has a moderate construction schedule due to the length of the raw watermain.	5
Technical	**25%**	Proximity to Utilities	All major utilities required are available in the area.	10	All major utilities required are available in the area.	10	All major utilities required are available in the area, however, more effort is required for utility connection due to the distance between the LLPS and the road.	10	All major utilities required are available in the area.	10
Technical	**25%**	Risk/Reliability	The alternative has a high level of risk due to the age and condition of the LLPS.	0	There are limited to no risks associated with this alternative.	10	There are limited to no risks associated with this alternative.	10	There are limited to no risks associated with this alternative.	10
Technical	**25%**	Impacts on raw water quality from wet weather events	The LLPS would continue to experience turbidity spikes during wet weather events.	0	The LLPS would continue to experience turbidity spikes during wet weather events.	0	The LLPS would no longer experience turbidity spikes during wet weather events, as evidenced by raw water sampling results.	10	The LLPS would no longer experience turbidity spikes during wet weather events, as evidenced by raw water sampling results.	10
Technical	**25%**	Infrastructure Sustainability	The alternative has a low degree of sustainability.	0	The alternative has a high degree of sustainability.	10	The alternative has a high degree of sustainability.	10	The alternative has a high degree of sustainability.	10
Technical	**25%**	***Normalized Score***		***4.55***		***13.6***		***18.2***		***21.6***
Economic	**25%**	Capital Cost	$10.3M	5	$10.3M	5	$15.7M	5	$18.5M	5
Economic	**25%**	Life-cycle Cost	$16.3M	5	$15.5M	5	$23.3M	5	$27.1M	5
Economic	**25%**	***Normalized Score***		***12.5***		***12.5***		***12.5***		***12.5***
TOTAL SCORE				**58.0**		**62.4**		**67.0**		**69.0**
RANK				**4**		**3**		**2**		**1**

Appendix E
Hydraulic Modelling TM for Water Transmission Alternatives

Jacobs

Hydraulic Modelling Technical Memorandum

Version Number: Final

Wallaceburg Water Treatment Servicing Class EA – Transmission Alternatives
Chatham-Kent Public Utilities Commission

Document Number: PPS0112230930KWO

February 3, 2022

Hydraulic Modelling Technical Memorandum

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Acronyms and Abbreviations

Acronym	Definition
ADD	average day demand
BPS	Booster Pumping Station
D.D.	day demand
DWS	Drinking Water System
E.A.	Environmental Assessment
EPS	Extended Period Simulation
E.T.	elevated tank
HLP	high-lift pump
L/s	litres per second
MDD	maximum day demand
ML/day	megalitres per day
PRV	pressure-reducing valve
psi	pounds per square inch
P.U.C.	Public Utilities Commission
TDH	total dynamic head
TM	Technical Memorandum
VFD	variable frequency drive
WDS	water distribution system
WTP	Water Treatment Plant

1. Introduction

1.1 Background

The Chatham-Kent Public Utilities Commission (PUC) is working with Jacobs to complete a Schedule C Class Environmental Assessment (EA) and preliminary design to determine a defensible, long-term solution to revitalize and renew the Wallaceburg Water Treatment Plant (WTP) to reliably meet current and anticipated future water quality regulations and enhance system safeguards against water quality anomalies. The scope of the Class EA includes an assignment to investigate the potential of the Wallaceburg Drinking Water System (DWS) to provide water supply service to the Community of Dresden, which is currently serviced by the Chatham WTP, as well as to allow for future greenhouse development between Wallaceburg and Dresden.

1.2 Purpose and Objectives

The purpose of this Technical Memorandum (TM) is to document the assessment and evaluation of the treated water transmission alternative solutions between Wallaceburg and Dresden through hydraulic modelling in support of TM 1 of the Wallaceburg Water Treatment Servicing Class EA.

2. Existing Water Supply and Storage

2.1 Wallaceburg Water Supply and Storage

The Wallaceburg WTP was originally constructed in 1946 and has undergone major upgrades in 1948, 1980, and 2009. It is located at 6750 Baseline Road in Wallaceburg, Ontario, and is rated at 13.6 megalitres per day (ML/day). Raw water is drawn from Chenal-Écarte, which is a tributary of the St. Clair River. Wallaceburg DWS has a 4,550-cubic metre elevated tank (ET), located on 6500 Otter Line.

2.2 Dresden Water Supply and Storage

The Community of Dresden currently receives its water supply from the Chatham WTP via the Eberts Booster Pumping Station (BPS). There is currently one pressure zone (North Kent pressure zone) supplied by the Eberts BPS, which in addition to Dresden, includes the Community of Thamesville. Dresden has a dedicated water storage system, with 5,430 cubic metres of storage provided by the Dresden ET, located on 10168 McCreary Line. Water is distributed directly to Dresden from the Eberts BPS, with the Dresden ET providing water equalization.

The Chatham WTP has a rated capacity of 68 ML/day, with a current maximum day demand (MDD) of 41.5 ML/day, which is expected to increase in the future (future projections are presented in Section 3). Existing flow data was obtained from the Chatham Water Distribution System (WDS) Modelling Report (AECOM, 2020a). This EA will explore the feasibility of providing water supply to Dresden from the Wallaceburg WTP in the future should Dresden be split from the existing North Kent pressure zone into its own pressure zone. This would reduce the demand at the Chatham WTP and potentially delay the capacity expansion at the Chatham WTP.

2.3 Existing Transmission Main – Wallaceburg to Dresden

The existing transmission main between Wallaceburg and Dresden is a 200/250-millimetre watermain that extends along Base Line for approximately 16 kilometres from Murray Street in Wallaceburg to North Street in Dresden. This transmission main is currently used for emergency purposes only and is only able to convey the water flow less than 4 ML/day, based on a maximum velocity of 1.5 metres per second. This transmission main would not be able to supply the existing/future MDD in Dresden of 8.8 ML/day. The existing transmission main route is presented on Figure 2-1.

Figure 2-1. Existing Transmission Main Between Wallaceburg and Dresden

3. Future Water Demand Projections

This section presents a summary of the future water demand projections for the Wallaceburg WTP, which were used as the basis for alternative solution development as presented in the Wallaceburg Water Servicing Class EA – TM 1 (Jacobs, 2021), which can be referenced for more details on water demand projections.

Water demands in Wallaceburg and Dresden were considered, as well as water demands for potential greenhouse development in the area.

There is little to no growth anticipated in Wallaceburg within the planning horizon, with a slight reduction in the projected residential water consumption to 2039 and beyond (from 8 ML/day or 93 litres per second [L/s] to 7.8 ML/day or 90 L/s). The only increase in the future water demand projections corresponds to an industrial demand which will account for additional 2.1 ML/day or 25 L/s. The increased industrial demand is a result of an anticipated increase in water taking from Whyte's Foods in the future. The exact year that the increase will occur is currently unknown. From discussions with the PUC, this increase may be expected to occur by 2039.

Similarly, there is little growth expected in Dresden over the planning horizon. The future MDD in Dresden is expected to remain constant throughout the planning horizon at 8.8 ML/day or 102 L/s, equivalent to current conditions.

In addition, future greenhouse growth is expected along Base Line between Wallaceburg and Dresden, which would be serviced by the Wallaceburg WTP. The future capacity reserved for future greenhouse demands is 8.6 ML/day, or 100 L/s. The timing of this development is currently unknown. For this EA, it is assumed that the greenhouses would need water by 2039.

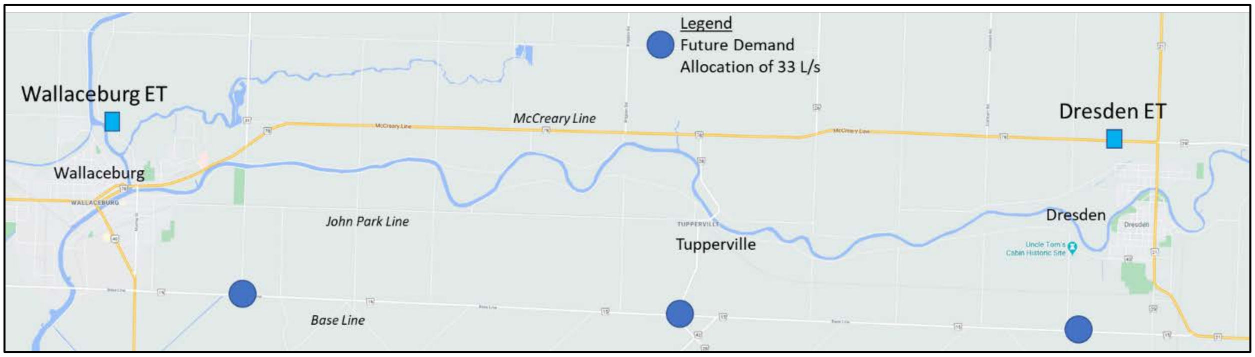
Table 3-1 presents a summary of the future water demands (MDD) to the Wallaceburg WTP.

Table 3-1. Future Water Demand Projections (MDD) – Wallaceburg WTP

Year	Wallaceburg Demands, ML/day	Dresden Demands, ML/day	Greenhouse Demands, ML/day	Total ML/day
2019	8.0	8.8	0	16.8
2039	9.9	8.8	8.6	27.3
2050	9.9	8.8	8.6	27.3
2070	9.9	8.8	8.6	27.3

For the purpose of the alternative assessment analysis, the future greenhouses water demands (100 L/s in total), were distributed in three locations (33 L/s each) between Wallaceburg and Dresden along Base Line at Cemetery Road, Centre Side Road, and Union Line as shown on Figure 3-1 (confirmed with Chatham-Kent PUC on meeting held on March 30, 2021).

Figure 3-1. Proposed Allocation of Greenhouses Water Demand in the Hydraulic Model (33 L/s each)



4. Development of Water Transmission Alternatives

4.1 Design Criteria

The alternatives in the following sections were developed and analyzed based on the performance criteria for system pressure (AECOM, 2020b), flow velocity, and fire flow availability, as follows:

- Minimum system pressure at MDD = 40 pounds per square inch (psi)
- Maximum system pressure at average day demand (ADD) = 100 psi
- Minimum system pressure during fire flow events (MDD+FF) = 20 psi
- Minimum available fire flow at 20 psi residual system pressure = 38 L/s
- Maximum flow velocity = 2 metres per second

4.2 Baseline Conditions

The current system conditions were determined for Wallaceburg based on the Wallaceburg WDS Modelling Report (AECOM, 2020b) and for Dresden based on the hydraulic model developed for the Chatham WDS Modelling Report (AECOM, 2020a). The modelling results reported for Chatham-Kent (AECOM, 2020a) considered the entire service area and do not show Dresden separately. For that reason, the hydraulic model was used to extract the results for Dresden. Refer to Table 4-1 and Figure 4-1 to Figure 4-6.

Table 4-1. Baseline Conditions

System	Demand Scenario	Minimum System Pressure, psi	Average System Pressure, psi	Maximum System Pressure, psi	Watermain Velocity metres per second
Wallaceburg	MDD	56	69	86	1.80
	ADD	63	70	81	1.40
	Minimum DD	66	72	82	1.40
Dresden	MDD	38	59	74	1.84
	ADD	38	61	75	1.72
	Minimum DD	38	62	75	1.10

DD = day demand

The results for fire flow analysis showed that 10.9% of the hydrants at Wallaceburg (52 out of 475) have lower than 38 L/s fire flow available for current MDD conditions (refer to Figure 4-3).

Similarly, the results for fire flow analysis showed that 16.6% of the hydrants at Dresden (25 out of 151) have lower than 38 L/s fire flow available for current MDD conditions (refer to Figure 4-6).

Figure 4-1. Existing Conditions – Wallaceburg System Maximum Pressures under Current Minimum D.D. (minimum hour)

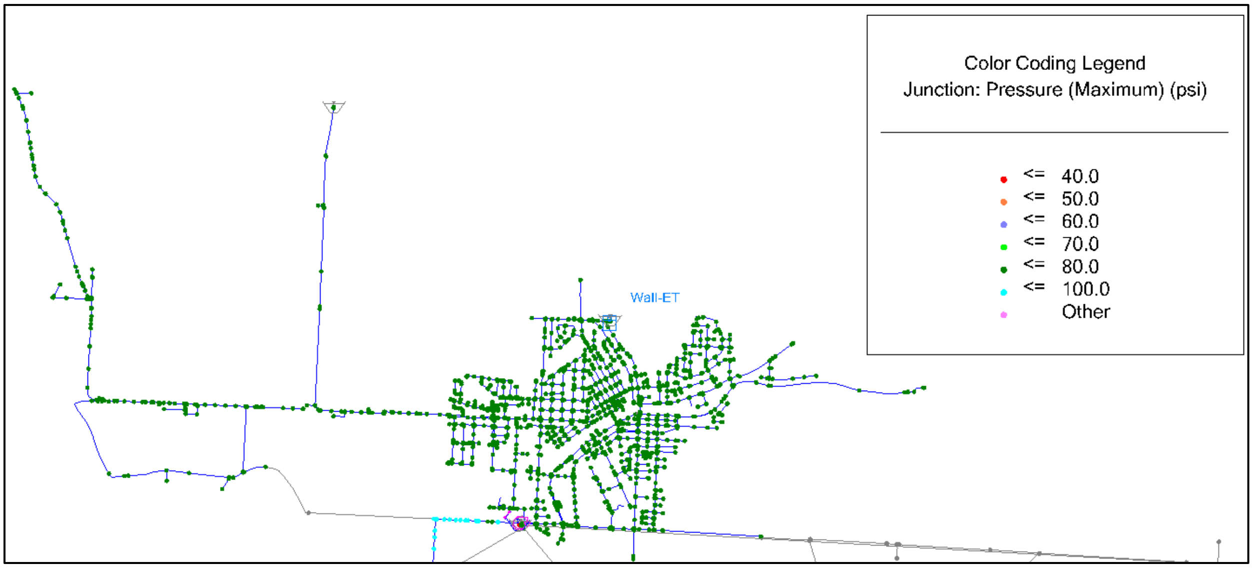


Figure 4-2. Existing Conditions – Wallaceburg System Minimum Pressures under Current MDD (maximum hour)

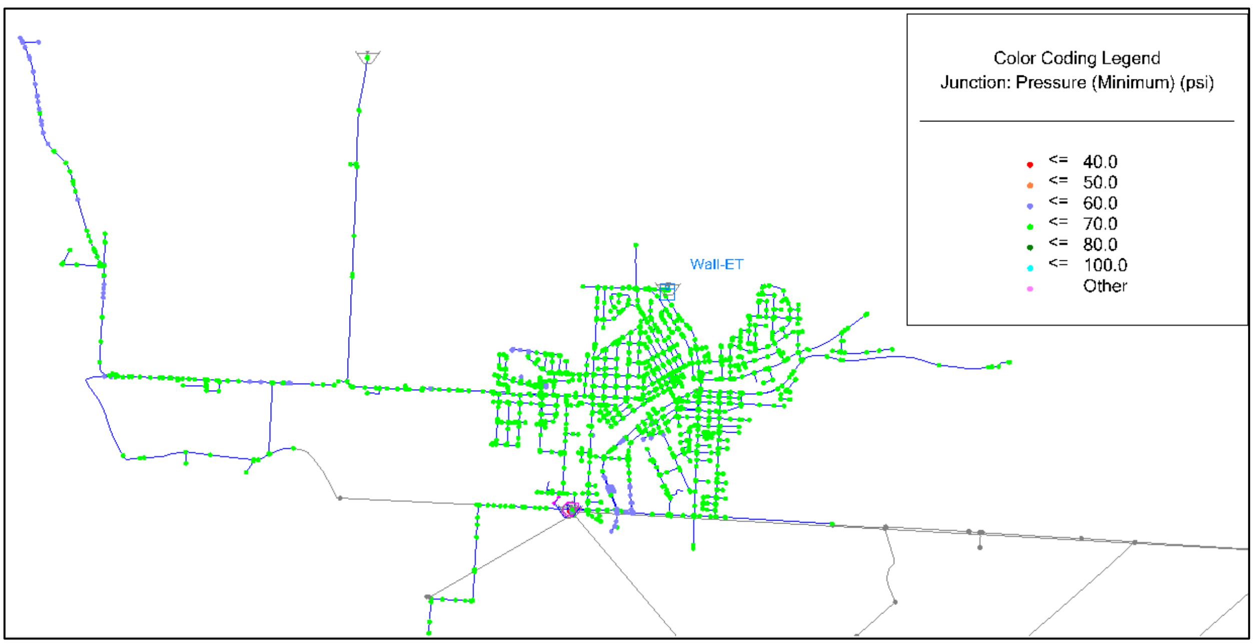


Figure 4-3. Existing Conditions – Wallaceburg System Fire Flow Available under Current MDD

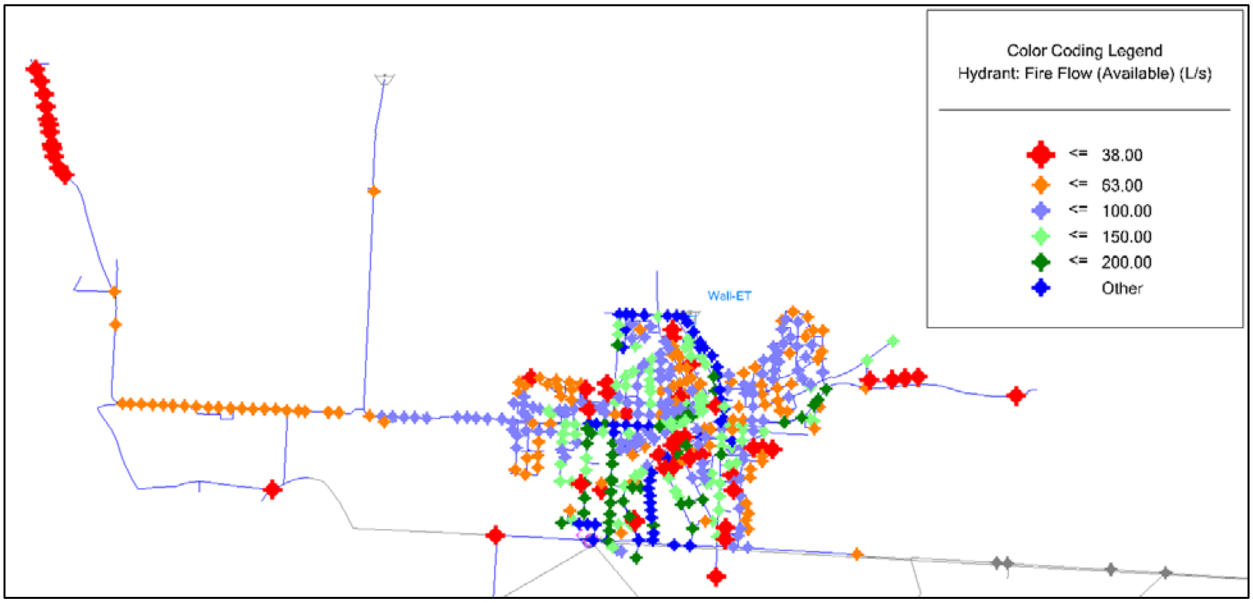


Figure 4-4. Existing Conditions – Dresden System Maximum Pressures under Current Minimum D.D. (minimum hour)

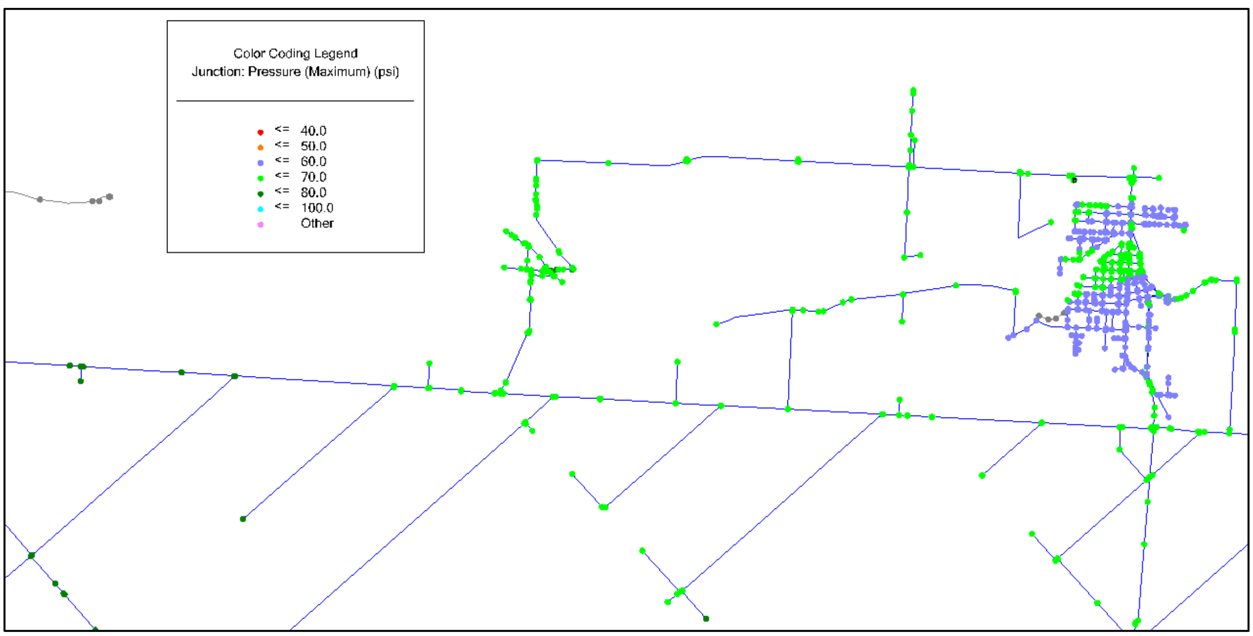


Figure 4-5. Existing Conditions – Dresden System Minimum Pressures under Current MDD (maximum hour)

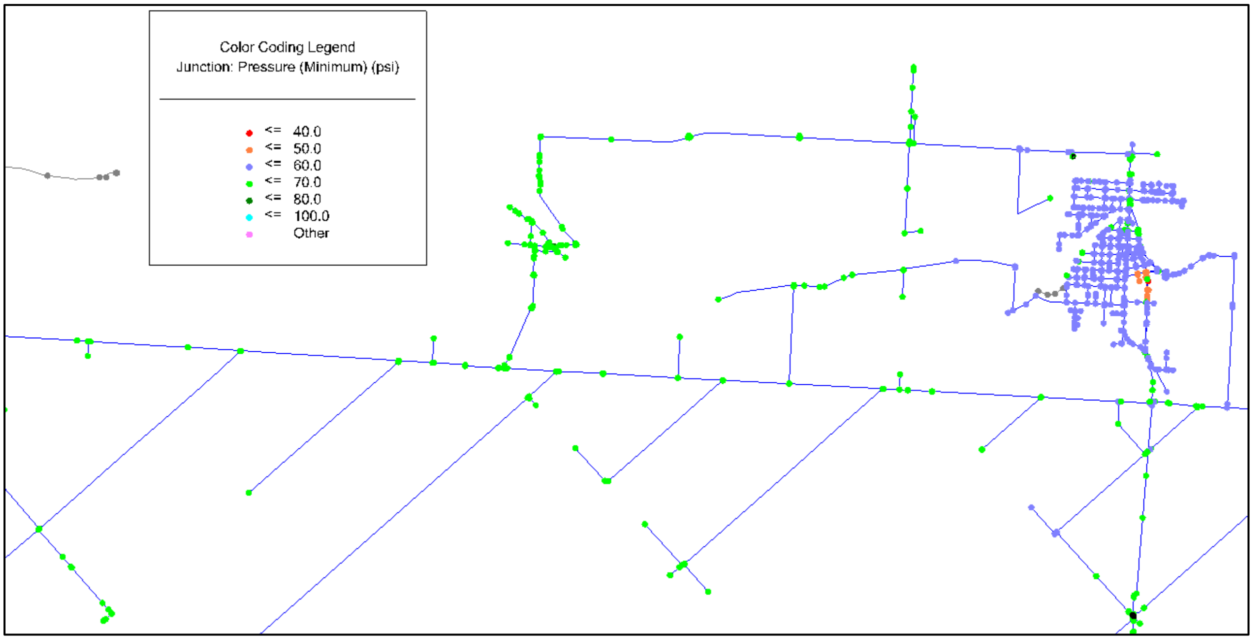
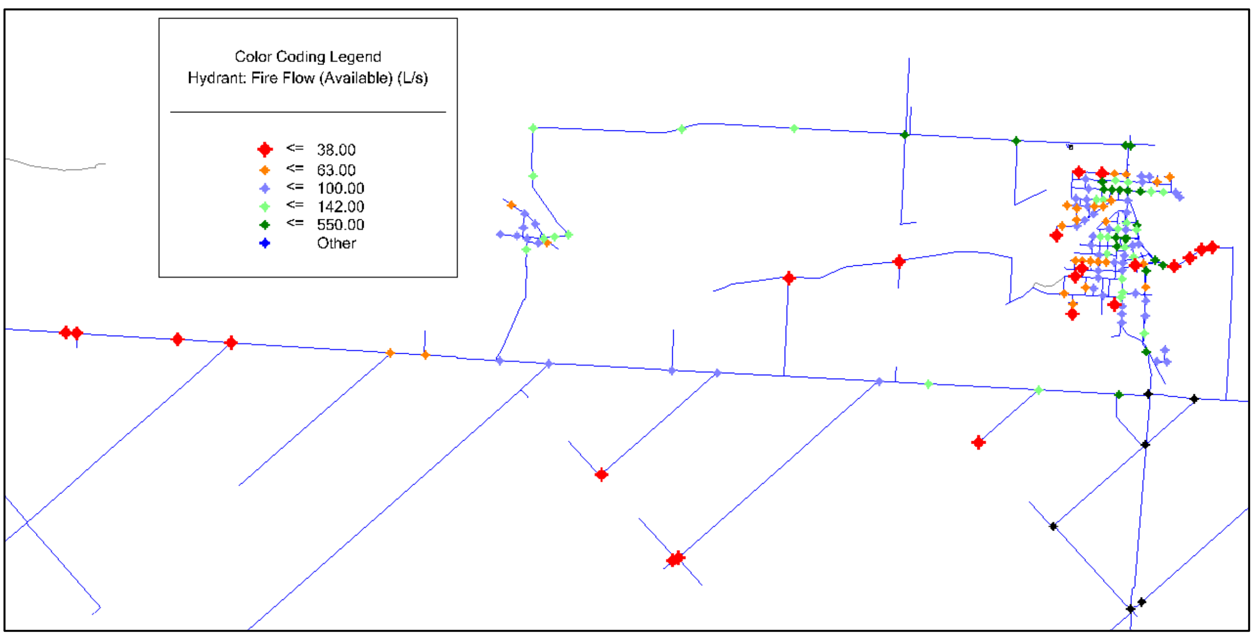


Figure 4-6. Existing Conditions – Dresden System Fire Flow Available under Current MDD



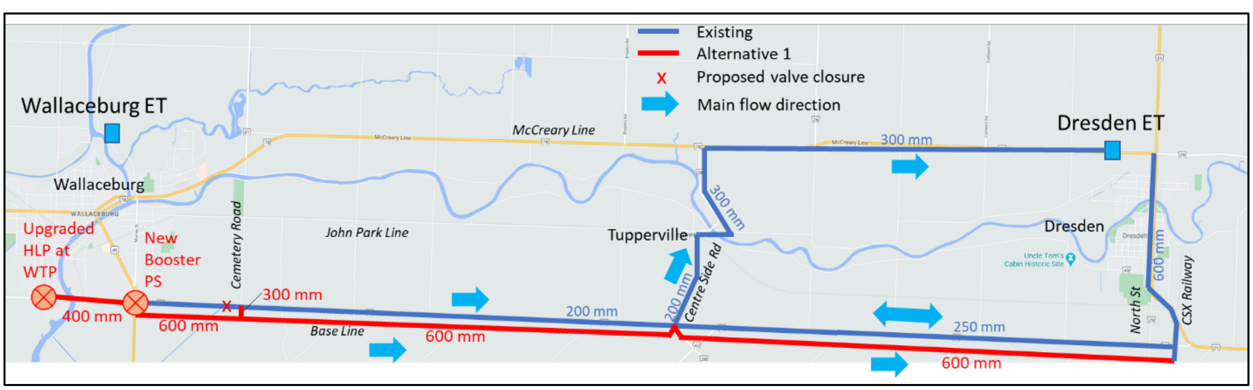
4.3 Transmission Alternatives

4.3.1 Alternative 1

This alternative considers the following major components and is presented on Figure 4-7:

1. Upgraded high-lift pumps (HLPs) at Wallaceburg WTP: three new pumps (two duty, one standby), each rated for 165 L/s (14 ML/day) at 60 metres total dynamic head (TDH) each with a variable frequency drive (VFD).
2. New BPS located at Base Line west of Murray Street: three new pumps (two duty, one standby) rated for 102 L/s at 12.5 metres TDH each.
3. New 400-millimetre-diameter trunk watermain along Base Line from the Wallaceburg WTP HLP to the proposed BPS at Murray Street (1.3 kilometres in length). This new trunk watermain will also be connected to the Wallaceburg WDS at Gillard Street (existing 300-millimetre-diameter watermain).
4. New 600-millimetre-diameter trunk watermain along Base Line from the proposed BPS in Murray Street to the CSX Railway in Dresden (16 kilometres in length). This will be connected to the existing 600-millimetre-diameter watermain at Base Line and CSX Railway and to the 200-millimetre-diameter watermain at Centre Side Road.
5. New 300-millimetre-diameter watermain at Cemetery Road to connect the proposed 600-millimetre-diameter trunk watermain on Base Line to the existing 200-millimetre-diameter watermain on Base Line.
6. Valve closure on the existing 200-millimetre-diameter watermain at Cemetery Road west of the proposed new connection.
7. New pressure-reducing valve (PRV) set at 75 psi located on the existing 400-millimetre-diameter watermain that leaves the Wallaceburg WTP.
8. New PRV set at 75 psi located on the proposed 300-millimetre-diameter watermain on Gillard Street (where the proposed 400-millimetre-diameter watermain will connect to the Wallaceburg WDS).

Figure 4-7. Proposed Alternative 1



The condition of the existing 350/400-millimetre watermain leaving the WTP along Base Line (that is, old cast iron pipes from the 1950s) is poor in terms of roughness (with C-factors as low as 44) and headloss. This watermain produces extremely high headloss gradient (from 30 to 59 metres per kilometre) for the proposed current MDD, adding up to 18 metres of headloss from Wallaceburg WTP HLP to the new BPS at Murray Street.

Jacobs recommends constructing a new 400-millimetre-diameter main from the Wallaceburg WTP HLP to the new BPS at Murray Street to assure system reliability and, increase water supply security to Wallaceburg and reduce the headloss from the Wallaceburg WTP HLP to the new BPS at Murray Street (proposed headloss gradient of 2.6 metres per kilometre and total headloss of 3.6 metres). This new watermain will require to cross the Sydenham River.

In addition, a new 600-millimetre-diameter trunk watermain from the new BPS to Dresden will be required to supply the entire demand for Dresden and the future greenhouses located along Base Line between Wallaceburg and Dresden. This watermain is dedicated to the Dresden WDS, achieved by connecting the existing 200-millimetre-diameter watermain to the proposed 600-millimetre-diameter watermain on Base Line, and installing a valve (normally close) west of the new connection (as shown on Figure 4-7). This configuration will create two separate pressure zones as follows:

- A pressure zone corresponding to Wallaceburg exclusively supplied by the upgraded Wallaceburg WTP HLP
- A pressure zone corresponding to Dresden and the greenhouses along Base Line supplied by the new BPS at Murray Street

Figure 4-7 also shows the main flow direction for future MDD conditions, when the greenhouses need to be supplied. The greenhouses located between Wallaceburg and Tupperville will be supplied by the existing 200-millimetre-diameter watermain which is proposed to be connected to the future 600-millimetre-diameter trunk main. The greenhouses located between Tupperville and Dresden will be supplied by the existing 250-millimetre-diameter watermain which will be fed by the proposed 600-millimetre-diameter trunk main connected at two locations (Centre Side Road and the CSX Railway) as shown on the figure.

4.3.2 Alternative 2

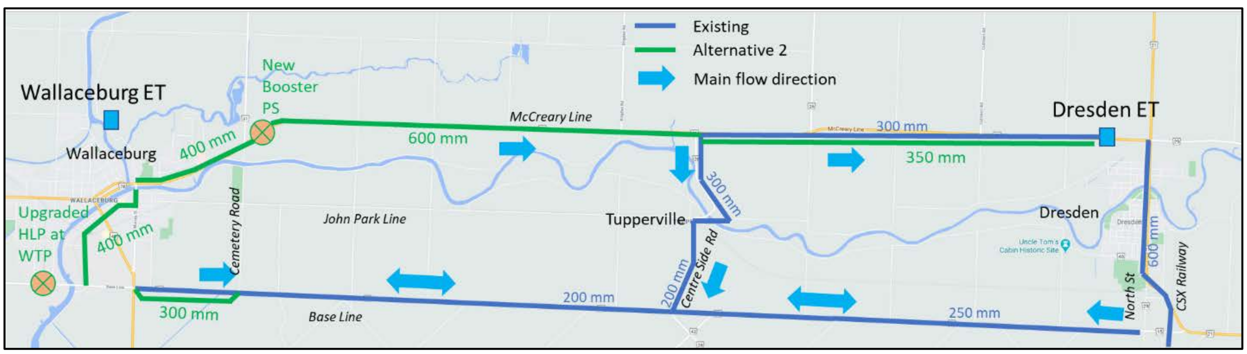
This alternative considers the following major components (refer to Figure 4-8):

1. Upgraded HLPs at Wallaceburg WTP: three new pumps (two duty, one standby) rated for 170 L/s at 70 metres TDH each with a VFD.
2. New BPS located at McCreary Line east of Kimball Road: three new pumps (two duty, one standby) rated for 100 L/s at 30 metres TDH each.
3. New 400-millimetre-diameter trunk watermain (2.2 kilometres in length) along Base Line, Gillard Street, Queen Street, and Murray Street. This new trunk watermain connects to an existing 350-millimetre-diameter watermain at Base Line west of Gillard Street and to an existing 300-millimetre-diameter watermain at Wallace Street and Murray Street that crosses the North Sydenham River.
4. New 400-millimetre-diameter trunk watermain (2.3 kilometres in length) along Margaret Avenue and McCreary Line. This new trunk watermain connects an existing 350-millimetre-

diameter watermain at Margaret Avenue and Main Street that crosses the North Sydenham River and to the proposed BPS in McCreary Line.

5. New 600-millimetre-diameter trunk watermain along McCreary Line from Kimball Road in Wallaceburg to the existing 300-millimetre-diameter watermain at Tupperville Road in Tupperville (7.1 kilometres in length).
6. New 350-millimetre-diameter watermain along McCreary Line from Tupperville Road to the Dresden ET (6.7 kilometres in length) in addition to the existing 300-millimetre-diameter watermain.
7. New 300-millimetre-diameter watermain along Base Line from west of Murray Street to Cemetery Road (1.4 kilometres in length) in addition to the existing 200-millimetre-diameter watermain.
8. Upgrade existing 250-millimetre-diameter watermain to 300-millimetre-diameter watermain on Base Line and Beattie Street (16 metres in length) to reduce flow velocity.

Figure 4-8. Proposed Alternative 2



This alternative services Dresden (and partly the greenhouses) through a new 600/350-millimetre watermain combination along McCreary Line from a new BPS located at McCreary Line east of Kimball Road.

To convey the flow to the Dresden DWS and meet the Wallaceburg demands (and partly the greenhouses), a twin 400-millimetre watermain from the Wallaceburg WTP to the new BPS is required.

The upgraded Wallaceburg WTP HLP supplies not only Wallaceburg, but also the green houses between Wallaceburg and Dresden and the areas of Dresden south of Base Line. This will require a new 300-millimetre-diameter twinned watermain along Base Line to increase the conveyance along the initial section of the Base Line corridor. The twining along Base Line would go as far as Cemetery Road to the location where the most west greenhouse demand is located, as shown on Figure 3-1. The proposed twinned watermain would have the capacity to service the first greenhouse location plus approximately half of the greenhouse demand at the second location at Centre Side Road (that is, 50 L/s). The existing 200-millimetre-diameter watermain can convey half of the greenhouse future demand for the second location (that is, 17 L/s). If the actual future distribution of greenhouse water demands is as uniform as assumed here, the range of flows through the proposed twinned and existing watermains would be similar to the one described earlier.

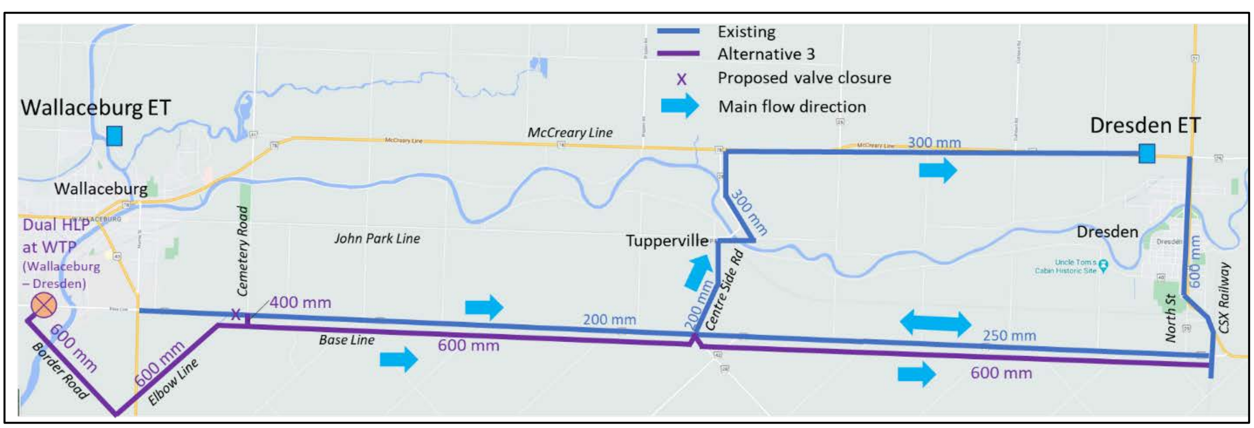
Figure 4-8 also shows the main flow direction for future MDD conditions, when the greenhouses need to be supplied. The greenhouses located between Wallaceburg and Tupperville will be supplied by the existing 200-millimetre-diameter watermain which is fed both by the proposed twinned 300-millimetre-diameter watermain and the existing 300/200-millimetre diameter watermain that runs through Tupperville as shown on Figure 4-8. The greenhouses located between Tupperville and Dresden will be supplied by the existing 250-millimetre-diameter watermain which will be fed both by the existing 300/200-millimetre-diameter watermain that runs through Tupperville and the existing 600-millimetre-diameter watermain along the CSX Railway as shown on Figure 4-8.

4.3.3 Alternative 3

This alternative considers the following major components, presented on Figure 4-9:

1. Upgraded dual HLPs at Wallaceburg WTP:
    a. Pumping to Wallaceburg: Three new pumps (two duty, one standby), each rated for 58 L/s (5 ML/day) at 57 metres total dynamic head (TDH).
    b. Pumping to Dresden and future greenhouses: Three new pumps (two duty, one standby), each rated for 112 L/s (9.7 ML/day) at 70 metres TDH.
2. New 600-millimetre-diameter trunk watermain from the Wallaceburg WTP (Dresden HLPs) along Border Road, Elbow Line, and Base Line to the CSX Railway in Dresden (20 kilometres in length). This will be connected to the existing 200-millimetre-diameter watermain along Base Line at Cemetery Road and to the 200-millimetre-diameter watermain at Centre Side Road. Finally, it will be connected to the 600-millimetre-diameter watermain at the CSX Railway.
3. New 400-millimetre-diameter watermain at Cemetery Road to connect the proposed 600-millimetre-diameter trunk watermain on Base Line to the existing 200-millimetre-diameter watermain on Base Line.
4. Valve closure on the existing 200-millimetre-diameter watermain at Cemetery Road west of the proposed new connection.

Figure 4-9. Proposed Alternative 3



The new 600-millimetre-diameter trunk watermain from Wallaceburg WTP (Dresden HLPs) along Border Road, Elbow Line, and Base Line to Dresden will be required to supply the entire demand for Dresden and the future greenhouses located along Base Line between Wallaceburg and Dresden. This watermain is dedicated to the Dresden WDS, achieved by connecting the existing 200-millimetre-diameter watermain to the proposed 600-millimetre-diameter watermain on Base Line, and installing a valve (normally close) west of the new connection (as shown on Figure 4-9). This configuration will create two separate pressure zones as follows:

- A pressure zone corresponding to Wallaceburg exclusively supplied by the upgraded Wallaceburg WTP (Wallaceburg HLPs)
- A pressure zone corresponding to Dresden and the greenhouses along Base Line supplied by the Wallaceburg WTP (Dresden HLPs)

This new 600-millimetre-diameter watermain will require to cross the Sydenham River.

Figure 4-9 also shows the main flow direction for future MDD conditions, when the greenhouses need to be supplied. The greenhouses located between Wallaceburg and Tupperville will be supplied by the existing 200-millimetre-diameter watermain, which is proposed to be connected to the future 600-millimetre-diameter trunk main. The greenhouses located between Tupperville and Dresden will be supplied by the existing 250-millimetre-diameter watermain, which will be fed by the proposed 600-millimetre-diameter trunk main connected at two locations (Centre Side Road and the CSX Railway) as shown on Figure 4-9.

4.4 Hydraulic Modelling

4.4.1 Model Description

In 2020, an Extended Period Simulation (EPS) WaterGEMS hydraulic model was developed and calibrated for the Chatham WDS (AECOM, 2020a). The model was used to analyze the system performance under different demands and operating conditions and identify infrastructure upgrades required to meet the short-term and long-term needs of the system (AECOM, 2020a).

Similarly, in the same year, an EPS WaterGEMS hydraulic model was developed and calibrated for the Wallaceburg WDS with the same objectives (AECOM, 2020b).

Later in 2021, these two models were integrated for the purposes of the Wallaceburg Water Treatment Servicing Class EA. The objective was to develop an integrated and calibrated modelling tool to analyze the combined system Wallaceburg-Dresden performance under different demands and operating conditions. Moreover, it allowed to identify the transmission upgrades required to meet the short-term and long-term needs of the combined system. The combined model identified two analysis periods: current (2019) and future (2039).

To separate the Dresden WDS from the Chatham WDS, the combined hydraulic model provided the closed pipes at every connection point at the following three locations:

- Base Line and Community Road
- Base Line and the CSX Railway
- Sydenham Street and Hughes Road

4.4.2 Transmission Alternatives Modelling

The model described in Section 4.4.1 was used to assess the alternatives proposed in terms of level of service provided by each one. The following two sections describe how each alternative was set up within the existing combined model.

4.4.2.1 Alternative 1

All the elements described in Section 4.3.1 were incorporated in the combined hydraulic model.

The water demands were not modified with respect to the combined model and are consistent with the summary presented in Section 3. The diurnal curves were not modified either. The following scenarios were used in the current analysis under normal operating conditions:

- Current Maximum Week – Current MDD (includes MDD)
- Current Average Day – Current ADD
- Current Minimum Week – Current Minimum D.D. (includes minimum D.D.)
- Current Maximum Day + Fire Flow - Current MDD + FF

With respect to future greenhouses water demands (100 L/s in total), these were allocated as described in Section 3.

The proposed HLPs at the Wallaceburg WTP are to be operated based on the Wallaceburg ET level. The control set-points for these pumps are presented in Table 4-2.

Table 4-2. Control Set-Points for Wallaceburg HLP for Alternative 1

Duty Pump	Start Level, metres	Stop Level, metres
1	Always Running	Always Running
2	10.5	12.8

The proposed BPS at Murray Street is to be operated based on the Dresden ET level. The control set-points for these pumps are presented in Table 4-3.

Table 4-3. Control Set-Points for Booster Pumping Station at Murray Street

Duty Pump	Start Level, metres	Stop Level, metres
1	9.5	10.5
2	8.5	9.5

4.4.2.2 Alternative 2

All the elements described in Section 4.3.2 were incorporated in the combined hydraulic model.

The water demands were not modified with respect to the combined model and are consistent with the summary presented in Section 3. The diurnal curves were not modified either. The following scenarios were used in the current analysis under normal operating conditions:

- Current Maximum Week – Current MDD (includes MDD)
- Current Average Day – Current ADD
- Current Minimum Week – Current Minimum D.D. (includes minimum D.D.)
- Current Maximum Day + Fire Flow - Current MDD + FF

Future greenhouses water demands (100 L/s in total) were allocated as described in Section 3.

The proposed HLP at the Wallaceburg WTP are to be operated based on the Wallaceburg ET level. The control set-points for these pumps are presented in Table 4-4.

Table 4-4. Control Set-Points for Wallaceburg HLP for Alternative 2

Duty Pump	Start Level m	Stop Level m
1	Always running	Always running
2	10.5	12.8

The proposed BPS at Murray Street would be operated based on the Dresden ET level. The control set-points for these pumps are presented in Table 4-5.

Table 4-5. Control Set-Points for Booster Pumping Station at McCreary Line

Duty Pump	Start Level, metres	Stop Level, metres
1	9.5	10.5
2	8.5	9.5

4.4.2.3 Alternative 3

All the elements described in Section 4.3.3 were incorporated in the combined hydraulic model.

The water demands were not modified with respect to the combined model and are consistent with the summary presented in Section 3. The diurnal curves were not modified either. The following scenarios were used in the current analysis under normal operating conditions:

- Current Maximum Week – Current MDD (includes MDD)
- Current Average Day – Current ADD
- Current Minimum Week – Current Minimum D.D. (includes minimum D.D.)
- Current Maximum Day + Fire Flow - Current MDD + FF

The proposed HLPs to Wallaceburg at the Wallaceburg WTP are to be operated based on the Wallaceburg ET level. The control set-points for these pumps are presented in Table 4-6.

Table 4-6. Control Set-Points for Wallaceburg HLPs for Alternative 3

Duty Pump	Start Level, metres	Stop Level, metres
1	11.2	12.8
2	10.5	12.0

The proposed HLPs to Dresden at the Wallaceburg WTP are to be operated based on the Dresden ET level. The control set-points for these pumps are presented in Table 4-7.

Table 4-7. Control Set-Points for Dresden HLPs for Alternative 3

Duty Pump	Start Level, metres	Stop Level, metres
1	9.5	10.5
2	8.5	9.5

4.4.3 Model Results

The calibrated combined hydraulic model was used to simulate the hydraulics of the proposed Wallaceburg-Dresden WDS. The system performance was evaluated under normal operating conditions for the scenarios listed in Section 4.3 for each alternative. The system pressures and flow velocities were compared with the criteria described in Section 4.1 to ensure the proposed system will perform within the acceptable ranges.

4.4.3.1 Alternative 1 – Current Demands for the Wallaceburg-Dresden Proposed System

Figure 4-10 provides a color-coded representation of maximum system pressures under current minimum D.D. condition, and Figure 4-11 shows a color-coded representation of minimum system pressures under current MDD condition. Both figures demonstrate that with the upgrades proposed in Alternative 1, the distribution system pressure will be maintained between the acceptable range of 40 psi to 100 psi for normal operating conditions under the current (2019) water demands. The only exception is in the areas around Wellington Street and Sydenham Street in Dresden (Conagra Brands), where the system pressures are slightly below 40 psi (38 psi). This area has a considerable high demand (75 L/s) concentrated in one location and further investigation of the Dresden DWS is required to address the high headloss around it due to the high flow.

Figure 4-10. Alternative 1 – Wallaceburg-Dresden System Maximum Pressures under Current Minimum D.D. (minimum hour)

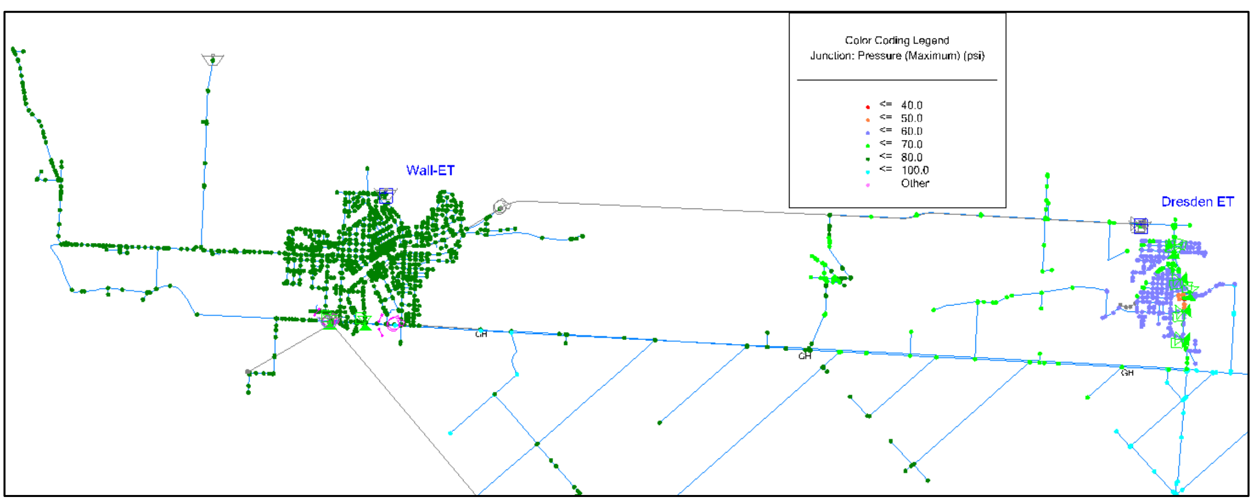
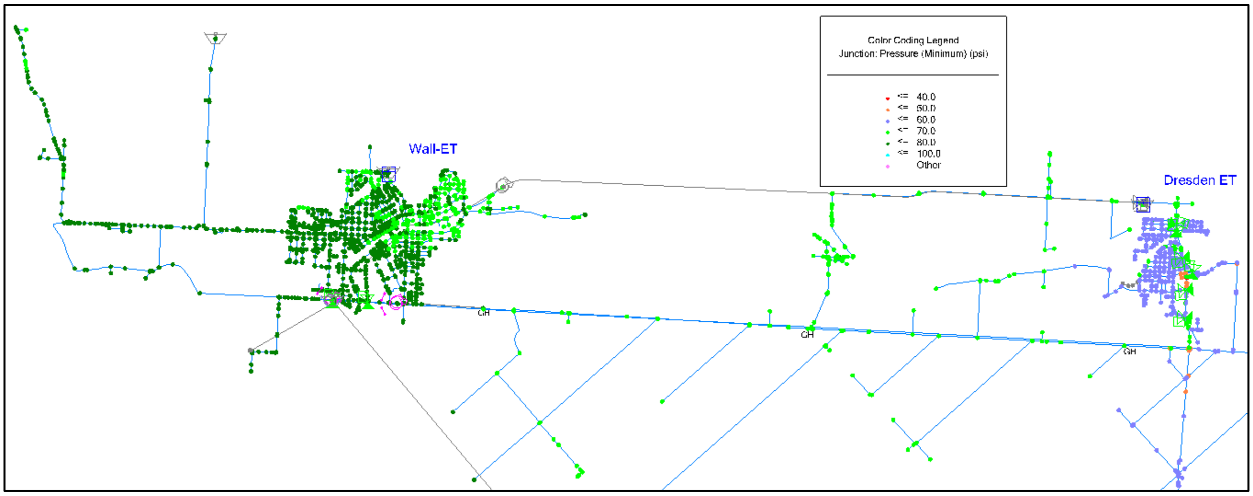


Figure 4-11. Alternative 1 – Wallaceburg-Dresden System Minimum Pressures under Current MDD (maximum hour)



4.4.3.2 Alternative 1 – Future Demands for the Wallaceburg-Dresden Proposed System

Figure 4-12 provides a color-coded representation of maximum system pressures under future minimum D.D. condition, and Figure 4-13 provides a color-coded representation of minimum system pressures under future MDD condition. Both figures show that the distribution system pressure would be maintained between the acceptable range of 40 psi to 100 psi for normal operating conditions under the future (2039) water demands, with the proposed upgrades to the system (with the exception noted in Section 4.4.3.1).

Figure 4-12. Alternative 1 – Wallaceburg-Dresden System Maximum Pressures under Future Minimum D.D. (minimum hour)

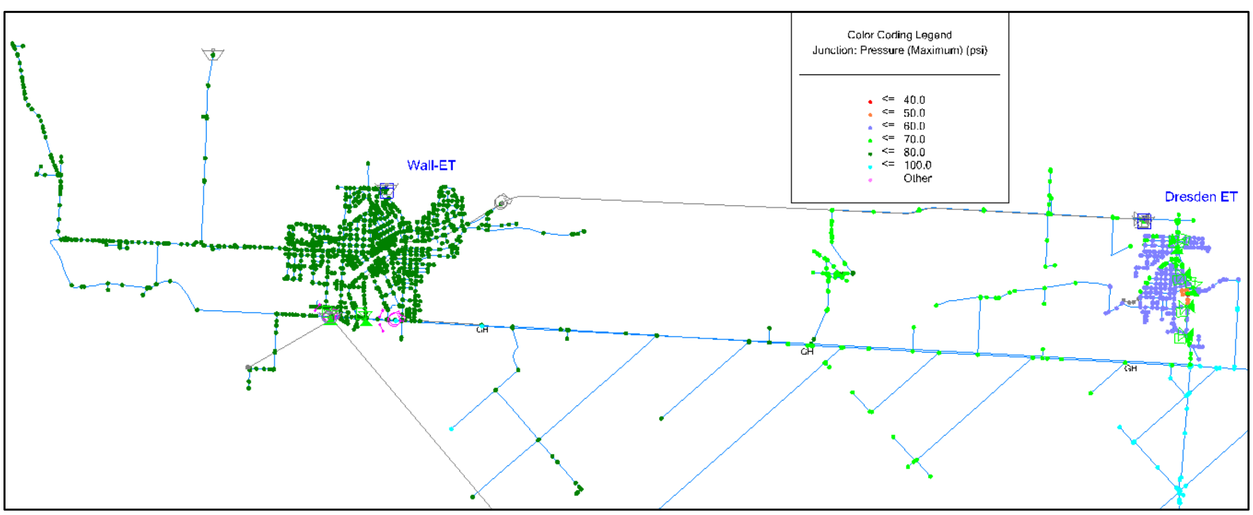
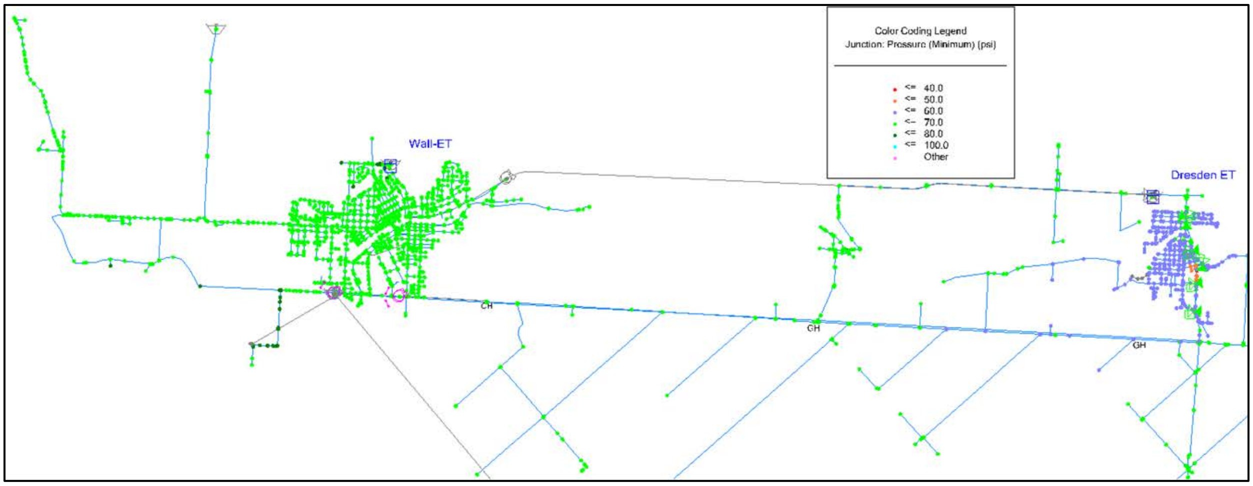


Figure 4-13. Alternative 1 – Wallaceburg-Dresden System Minimum Pressures under Future MDD (maximum hour)



The minimum, average, and maximum pressures and the pipe flow velocities under MDD and ADD and minimum D.D. conditions were reviewed for Alternative 1 and are presented in Table 4-8. The flow velocities for the entire system are under 2 metres per second as shown in Table 4-8 (where, for each demand condition, the maximum velocity during the entire simulation is presented).

Table 4-8. Alternative 1 – System Pressure and Flow Velocity Results Summary

Period	System	Demand Scenario	Minimum System Pressure, psi	Average System Pressure, psi	Maximum System Pressure, psi	Maximum Flow Velocity metres per second
Current	Wallaceburg	MDD	64	71	77	1.43
		ADD	73	75	78	0.76
		Minimum D.D.	73	75	78	0.74
	Dresden	MDD	38	58	73	1.90
		ADD	39	61	75	1.90
		Minimum D.D.	39	61	82	1.73
Future	Wallaceburg	MDD	62	68	72	1.24
		ADD	72	75	78	1.46
		Minimum D.D.	73	75	78	0.88
	Dresden	MDD	38	58	75	1.76
		ADD	39	60	76	1.74
		Minimum D.D.	39	60	81	1.71

4.4.3.3 Alternative 1 – Fire Flow Analysis for the Wallaceburg-Dresden Proposed System

The fire flow runs were carried out using the automated sequential fire flow analysis tool in the WaterGEMS. With this tool, the existing fire hydrants are evaluated on an individual basis to determine the minimum flow available at the hydrant nozzle while maintaining a residual pressure of 20 psi (that is, the minimum acceptable system pressure). Fire flow analyses are conducted as steady state runs rather than EPS runs.

Individual fire flow runs were executed on 475 hydrants at Wallaceburg and 151 hydrants at Dresden under MDD conditions.

Table 4-9 summarizes the results of the individual fire flow runs.

Table 4-9. Alternative 1 – Wallaceburg-Dresden Fire Flow Availability

Period	Wallaceburg Number of hydrants where fire flow available is less than 38 L/s (out of 475)	%	Dresden Number of hydrants where fire flow available is less than 38 L/s (out of 151)	%
Current	52	10.9	20	13.2
Future	52	10.9	21	13.9

Figure 4-14 and Figure 4-15 highlight the hydrants in red that would fail to meet the fire flow criteria under current and future MDD conditions, respectively. These results show the same fire flow availability as for existing conditions in Wallaceburg (that is, 52 hydrants below 38 L/s). For Dresden, the fire flow availability increases (from the current 25 hydrants below 38 L/s to 20 and 21 hydrants below 38 L/s for current MDD and future MDD, respectively).

Most of the low available fire flows hydrants are located at the areas with the single feed dead-end watermains. These hydrants will have low available fire flow regardless of the upgrades proposed in the transmission alternative and are currently deficient in available fire flow.

Figure 4-14. Alternative 1 – Wallaceburg-Dresden System Fire Flow Available under Current MDD

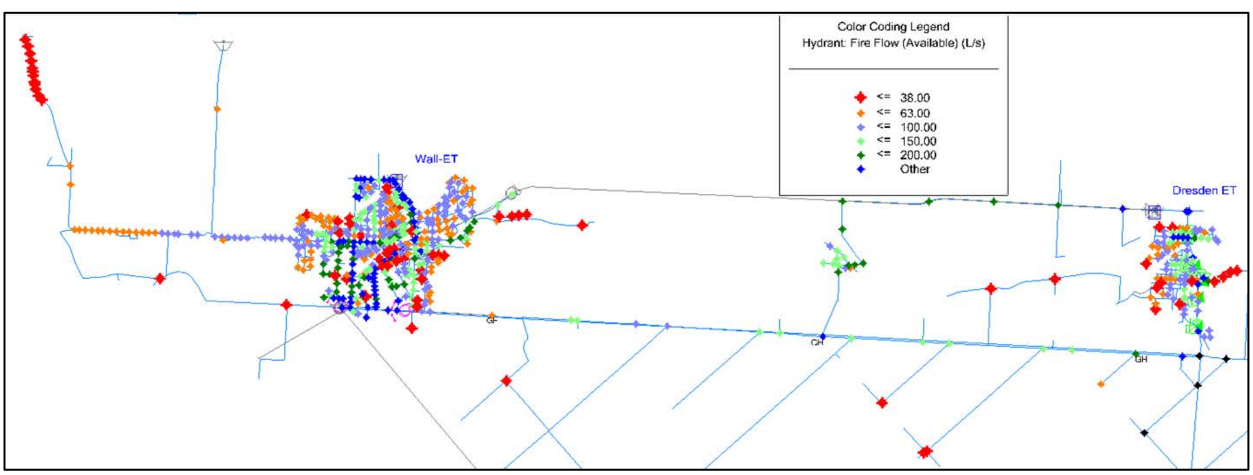
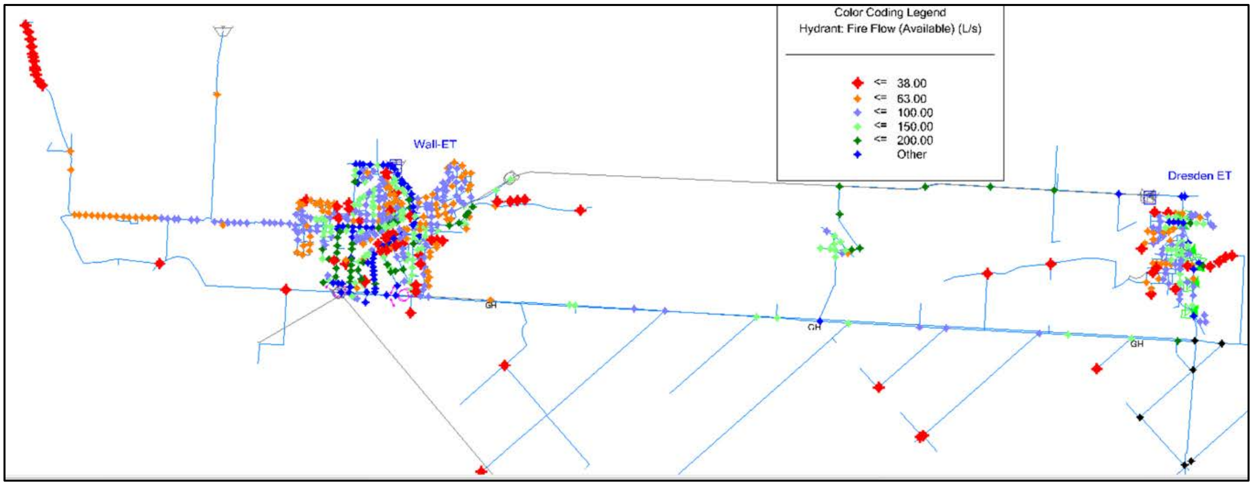


Figure 4-15. Alternative 1 – Wallaceburg-Dresden System Fire Flow Available under Future MDD



4.4.3.4 Alternative 2 – Current Demands for the Wallaceburg-Dresden Proposed System

Figure 4-16 provides a color-coded representation of maximum system pressures under current minimum D.D. demand condition, and Figure 4-17 provides a color-coded representation of minimum system pressures under current MDD condition. Both figures demonstrate that with the proposed upgrades in Alternative 2, the distribution system pressure would be maintained between the acceptable range of 40 psi to 100 psi for normal operating conditions under the current (2019) water demands. The only exception is in the areas around Wellington Street and Sydenham Street in Dresden (Conagra Brands) where the system pressures are slightly below 40 psi (38 psi). This area has a considerable high demand (75 L/s) concentrated in one location and further investigation is required to address the high headloss around it due to the high flow.

Figure 4-16. Alternative 2 – Wallaceburg-Dresden System Maximum Pressures under Current Minimum D.D. (minimum hour)

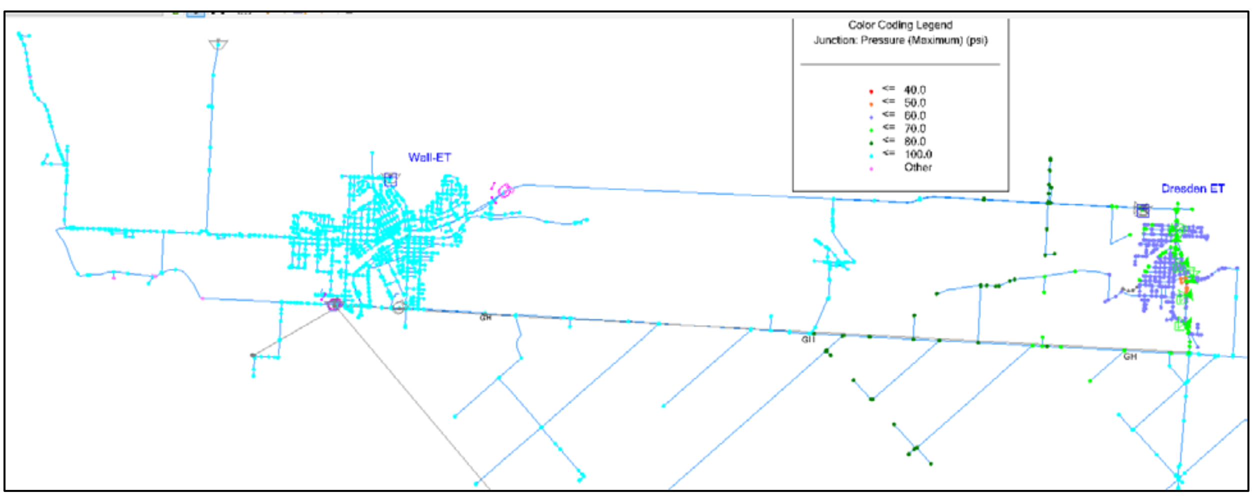
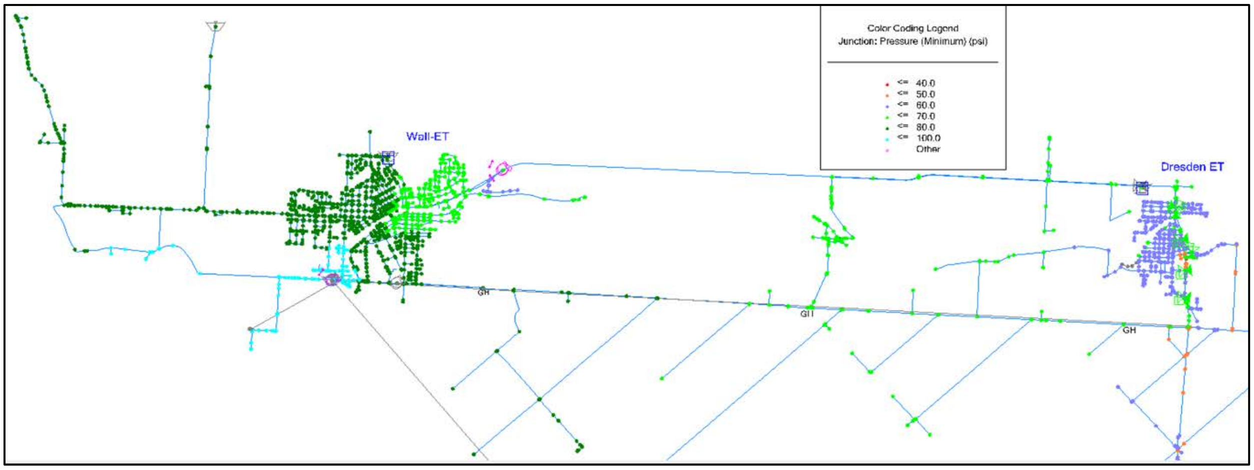


Figure 4-17. Alternative 2 – Wallaceburg-Dresden System Minimum Pressures under Current MDD (maximum hour)



4.4.3.5 Alternative 2 – Future Demands for the Wallaceburg-Dresden Proposed System

Figure 4-18 provides a color-coded representation of maximum system pressures under future minimum D.D. condition, and Figure 4-19 provides a color-coded representation of minimum system pressures under future MDD condition. As shown, the distribution system pressure would be maintained between the acceptable range of 40 psi to 100 psi for normal operating conditions under the current (2039) water demands (with the exception noted in Section 4.4.3.4).

Figure 4-18. Alternative 2 – Wallaceburg-Dresden Maximum System Pressures under Future Minimum D.D. (minimum hour)

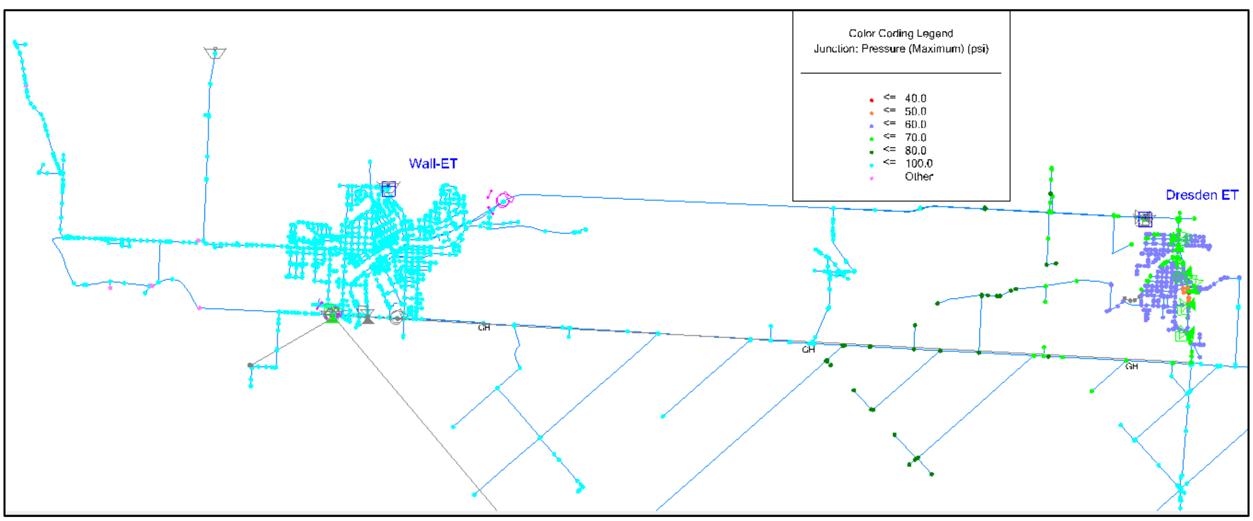
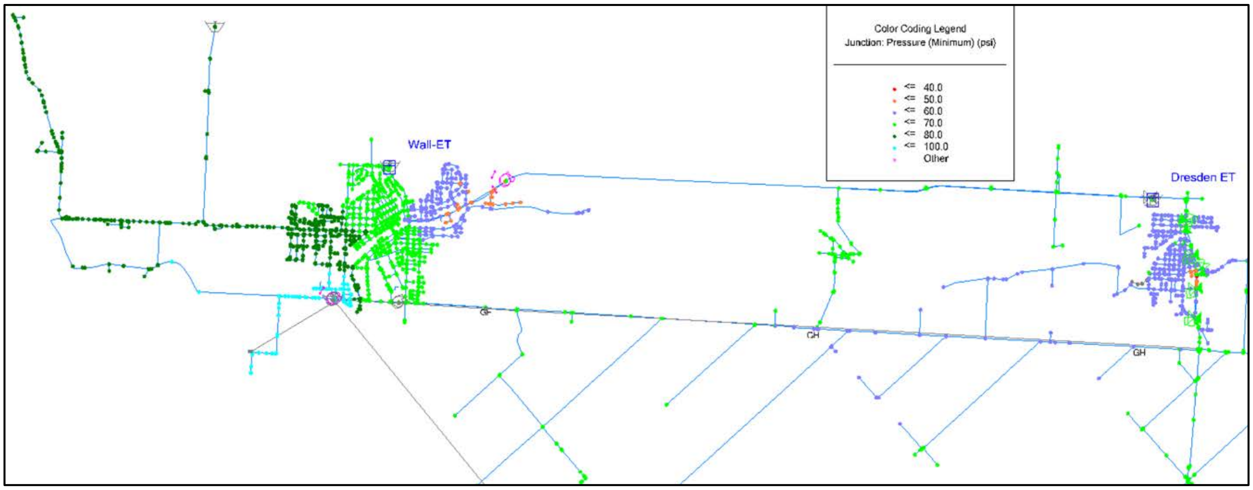


Figure 4-19. Alternative 2 – Wallaceburg-Dresden Minimum System Pressures under Future MDD (maximum hour)



The minimum, average, and maximum pressures and the pipe flow velocities under MDD and ADD and minimum D.D. conditions were reviewed for Alternative 2 and are presented in Table 4-10. The flow velocities for the entire system are under 2 metres per second as presented in Table 4-10 where, for each demand condition, the maximum velocity during the entire simulation is presented).

Table 4-10. Alternative 2 – System Pressure and Flow Velocity Results Summary

Period	System	Demand Scenario	Minimum System Pressure, psi	Average System Pressure, psi	Maximum System Pressure, psi	Maximum Flow Velocity metres per second
Current	Wallaceburg	MDD	58	72	99	1.83
		ADD	96	97	99	1.83
		Minimum D.D.	95	98	101	1.85
	Dresden	MDD	38	57	76	1.85
		ADD	39	61	85	1.86
		Minimum D.D.	39	63	97	1.69
Future	Wallaceburg	MDD	42	64	92	1.90
		ADD	73	81	99	1.64
		Minimum D.D.	92	96	101	1.63
	Dresden	MDD	38	57	68	1.70
		ADD	39	60	75	1.70
		Minimum D.D.	39	61	92	1.66

4.4.3.6 Alternative 2 – Fire Flow Analysis for the Wallaceburg-Dresden Proposed System

The fire flow runs were also carried out using the automated sequential fire flow analysis tool in the WaterGEMS for Alternative 2. Table 4-11 summarizes the results of the individual fire flow runs.

Table 4-11. Alternative 2 – Wallaceburg-Dresden Fire Flow Availability

Period	Wallaceburg Number of hydrants where fire flow available is less than 38 L/s (out of 475)	%	Dresden Number of hydrants where fire flow available is less than 38 L/s (out of 151)	%
Current	51	10.7	20	13.2
Future	52	10.9	21	13.9

Figure 4-20 and Figure 4-21 highlight the hydrants in red that would fail to meet the fire flow criteria under current MDD condition. These results show the same or slightly improved fire flow availability as for existing conditions in Wallaceburg (from the current 52 hydrants below 38 L/s to 51 and 52 hydrants below 38 L/s for current MDD and future MDD, respectively). For Dresden, the fire flow availability increases (from the current 25 hydrants below 38 L/s to 20 and 21 hydrants below 38 L/s for current MDD and future MDD, respectively).

Most of the low available fire flows hydrants are located at the areas with the single feed dead-end watermains. These hydrants will have low available fire flow regardless of the upgrades proposed in the transmission alternative and are currently deficient in available fire flow.

Figure 4-20. Alternative 2 – Wallaceburg-Dresden System Fire Flow Available under Current MDD

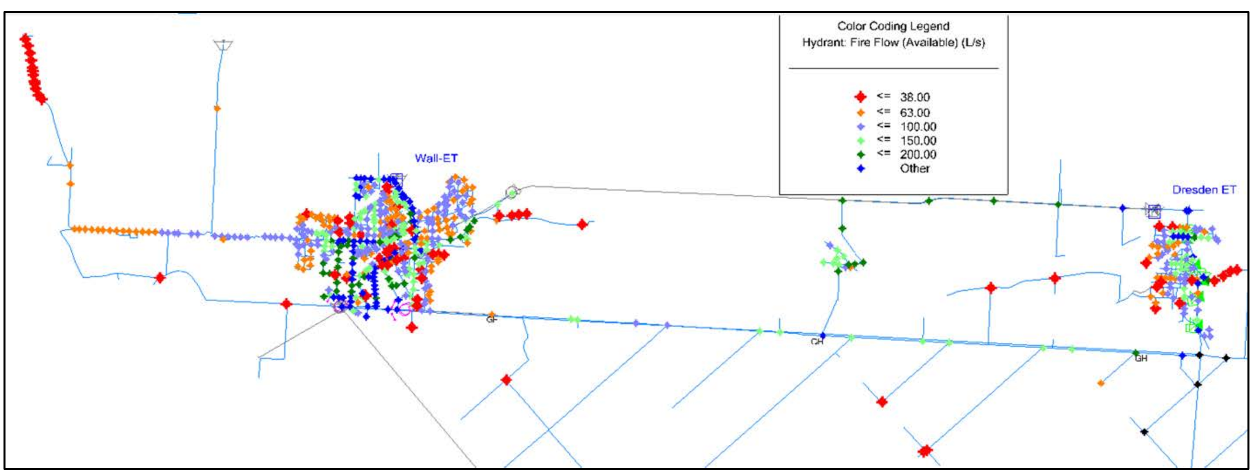
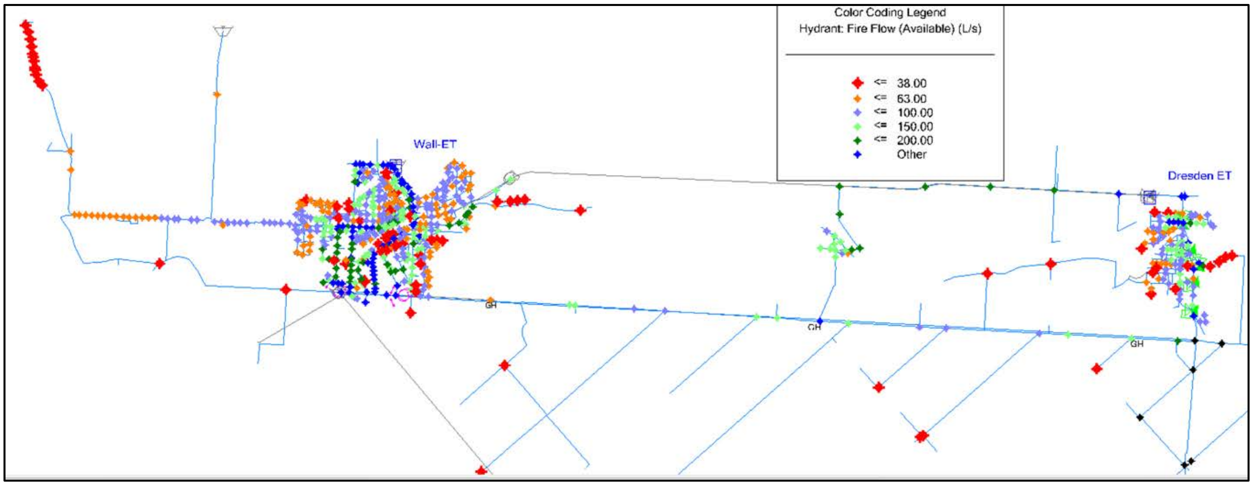


Figure 4-21. Alternative 2 – Wallaceburg-Dresden System Fire Flow Available under Future MDD



4.4.3.7 Alternative 3 – Current Demands for the Wallaceburg-Dresden Proposed System

Figure 4-22 provides a color-coded representation of maximum system pressures under current minimum D.D. condition, and Figure 4-23 shows a color-coded representation of minimum system pressures under current MDD condition. Both figures demonstrate that with the upgrades proposed in Alternative 3, the distribution system pressure will be maintained between the acceptable range of 40 psi to 100 psi for normal operating conditions under the current (2019) water demands. The only exception is in the areas around Wellington Street and Sydenham Street in Dresden (Conagra Brands), where the system pressures are slightly below 40 psi (38 psi). This area has a considerably high demand (75 L/s) concentrated in one location, and further investigation of the Dresden DWS is required to address the high headloss around it due to the high flow.

Figure 4-22. Alternative 3 – Wallaceburg-Dresden System Maximum Pressures under Current Minimum D.D. (minimum hour)

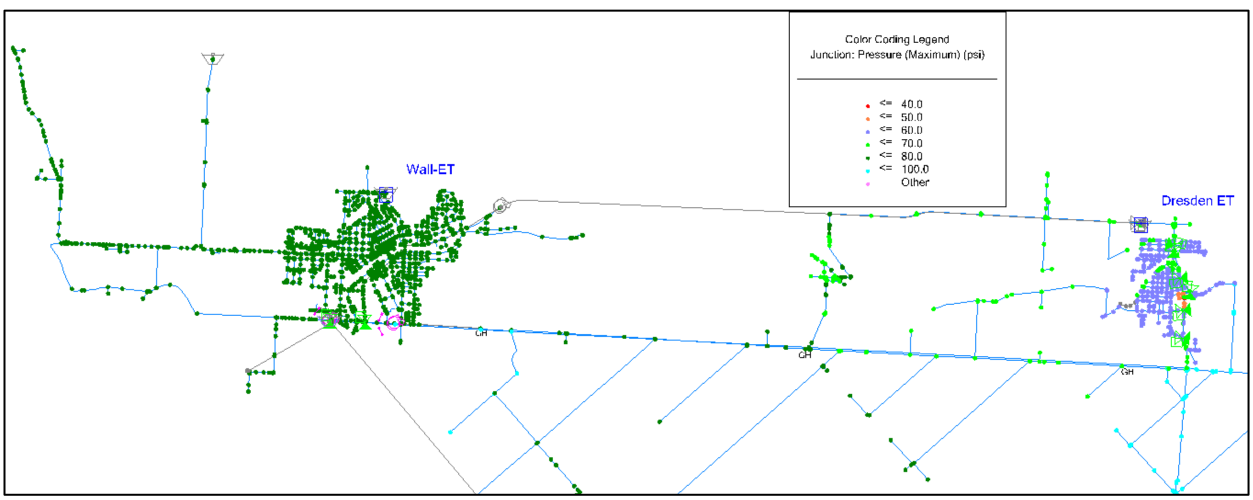
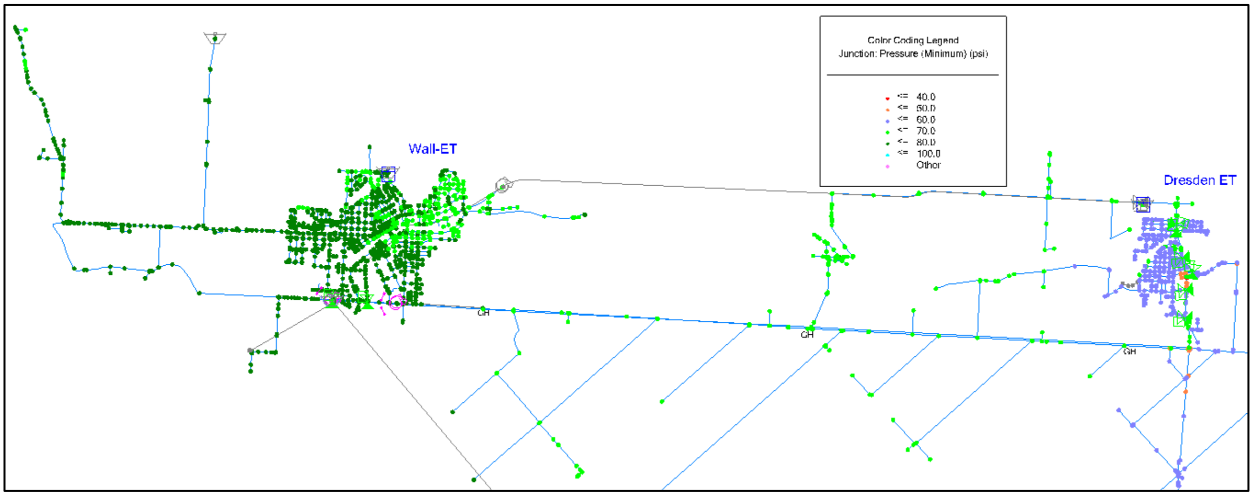


Figure 4-23. Alternative 3 – Wallaceburg-Dresden System Minimum Pressures under Current MDD (maximum hour)



4.4.3.8 Alternative 3 – Future Demands for the Wallaceburg-Dresden Proposed System

Figure 4-24 provides a color-coded representation of maximum system pressures under future minimum D.D. condition, and Figure 4-25 provides a color-coded representation of minimum system pressures under future MDD condition. Both figures show that the distribution system pressure would be maintained between the acceptable range of 40 psi to 100 psi for normal operating conditions under the future (2039) water demands, with the proposed upgrades to the system (with the exception noted in Section 4.4.3.1).

Figure 4-24. Alternative 3 – Wallaceburg-Dresden System Maximum Pressures under Future Minimum D.D. (minimum hour)

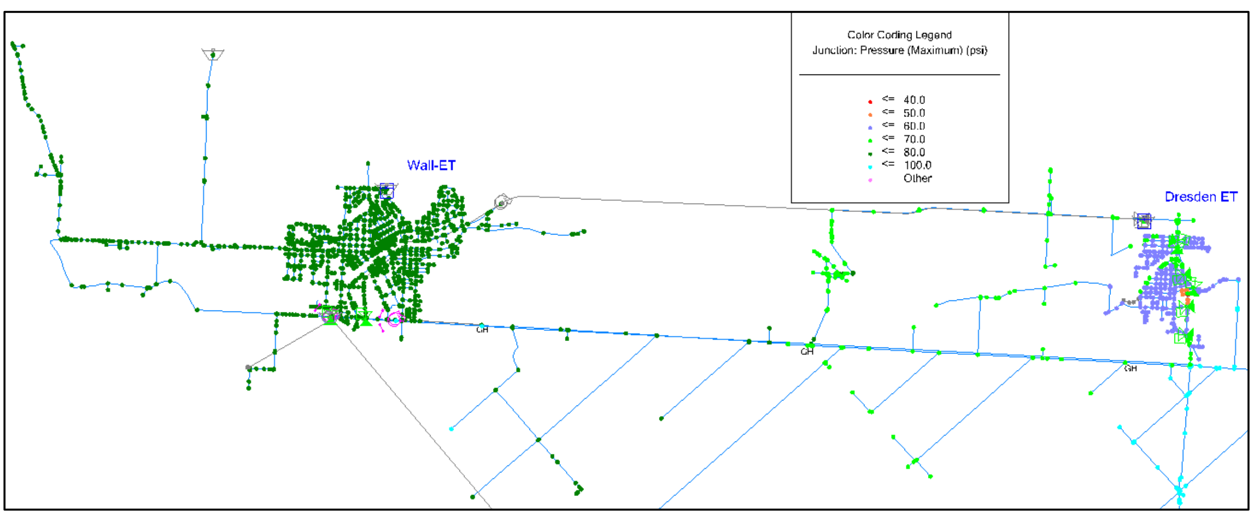
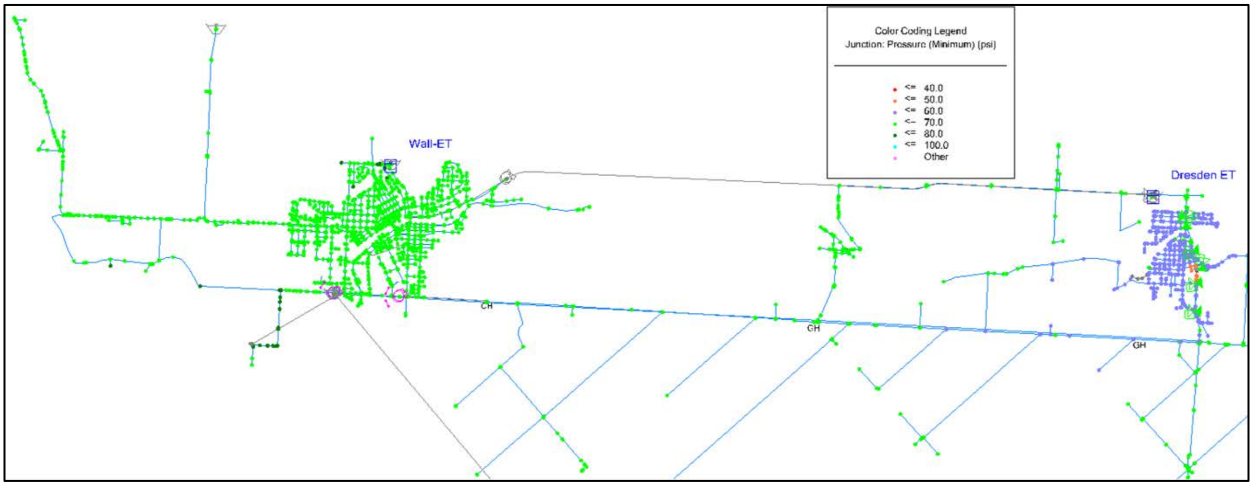


Figure 4-25. Alternative 3 – Wallaceburg-Dresden System Minimum Pressures under Future MDD (maximum hour)



The minimum, average, and maximum pressures and the pipe flow velocities under MDD and ADD and minimum D.D. conditions were reviewed for Alternative 3 and are presented in Table 4-12. The flow velocities for the entire system are under 2 metres per second as shown in Table 4-12 (where, for each demand condition, the maximum velocity during the entire simulation is presented).

Table 4-12. Alternative 3 – System Pressure and Flow Velocity Results Summary

Period	System	Demand Scenario	Minimum System Pressure, psi	Average System Pressure, psi	Maximum System Pressure, psi	Maximum Flow Velocity, metres per second
Current	Wallaceburg	MDD	58	63	68	0.76
		ADD	65	71	78	0.42
		Minimum D.D.	71	73	78	0.32
	Dresden	MDD	39	59	73	1.71
		ADD	39	60	82	1.70
		Minimum D.D.	39	61	81	1.67
Future	Wallaceburg	MDD	64	69	72	1.39
		ADD	68	71	76	1.38
		Minimum D.D.	71	73	77	1.37
	Dresden	MDD	38	58	72	1.57
		ADD	39	59	85	1.57
		Minimum D.D.	39	60	86	1.55

4.4.3.9 Alternative 3 – Fire Flow Analysis for the Wallaceburg-Dresden Proposed System

The fire flow runs were carried out using the automated sequential fire flow analysis tool in the WaterGEMS. With this tool, the existing fire hydrants are evaluated on an individual basis to determine the minimum flow available at the hydrant nozzle while maintaining a residual pressure of 20 psi (that is, the minimum acceptable system pressure). Fire flow analyses are conducted as steady state runs rather than EPS runs.

Individual fire flow runs were executed on 475 hydrants at Wallaceburg and 151 hydrants at Dresden under MDD conditions.

The results of the individual fire flow runs are summarized in Table 4-13.

Table 4-13. Alternative 3 – Wallaceburg-Dresden Fire Flow Availability

Period	Wallaceburg Number of hydrants where fire flow available is less than 38 L/s (out of 475)	%	Dresden Number of hydrants where fire flow available is less than 38 L/s (out of 151)	%
Current	52	10.9	20	13.2
Future	52	10.9	20	13.2

Figure 4-26 and Figure 4-27 highlight the hydrants in red that would fail to meet the fire flow criteria under current and future MDD conditions, respectively. These results show the same fire flow availability as for existing conditions in Wallaceburg (that is, 52 hydrants below 38 L/s). For Dresden, the fire flow availability increases (from the current 25 hydrants below 38 L/s to 20 hydrants below 38 L/s both for current MDD and future MDD).

Most of the low available fire flows hydrants are located at the areas with the single feed dead-end watermains. These hydrants will have low available fire flow regardless of the upgrades proposed in the transmission alternative and are currently deficient in available fire flow.

Figure 4-26. Alternative 3 – Wallaceburg-Dresden System Fire Flow Available under Current MDD

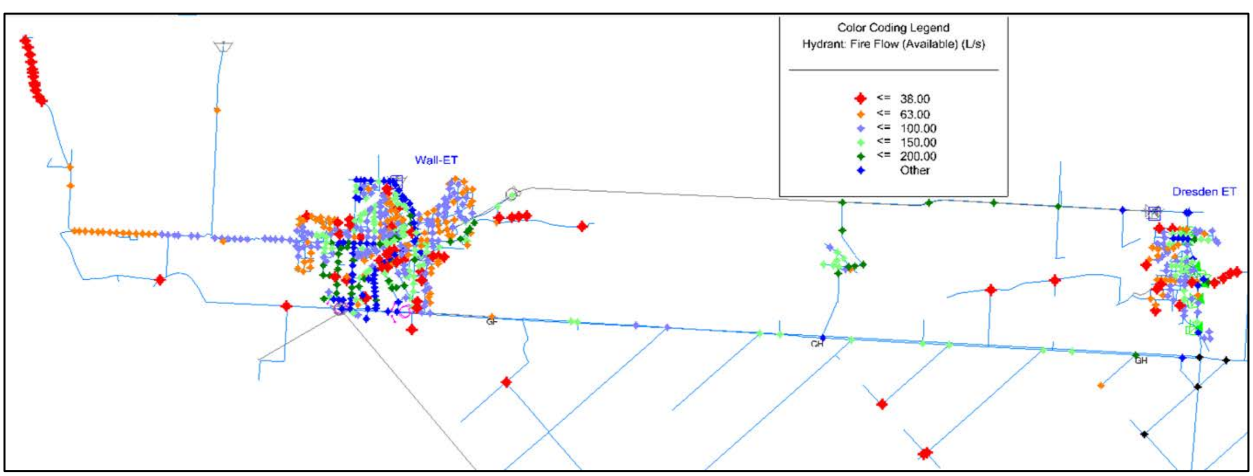
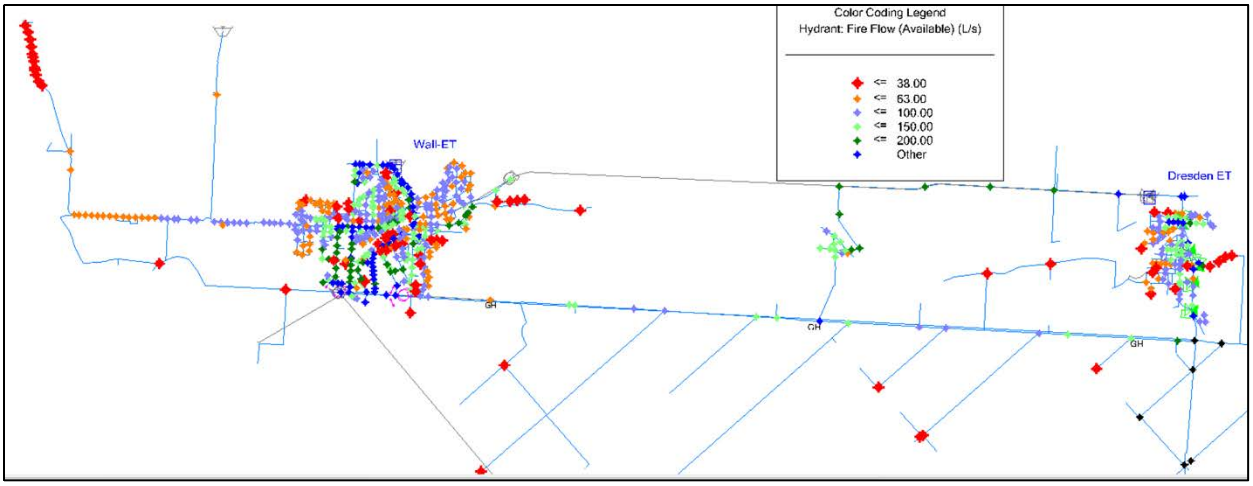


Figure 4-27. Alternative 3 – Wallaceburg-Dresden System Fire Flow Available under Future MDD



4.5 Discussion

4.5.1 Alternative 1

Alternative 1 would provide adequate level of service throughout the Wallaceburg-Dresden combined WDS because the pressures would be maintained within the acceptable range from 40 psi to 100 psi for all the scenarios considered (that is, current and future MDD, ADD and Minimum D.D.) with minor exceptions in the areas of Wellington Street and Sydenham Street in Dresden as noted in Section 4.4.3.1.

Compared with the existing conditions for Wallaceburg, the system pressures would be maintained within a tighter range for all demand conditions for Alternative 1 considering current demands (that is, between 64 psi and 77 psi versus 56 psi and 86 psi for MDD; between 73 psi and 78 psi versus 63 psi and 81 psi for ADD; between 73 psi and 78 psi versus 66 psi and 82 psi for Minimum D.D.). Similarly, the system pressures would be also maintained within a tighter range for all demand conditions for Alternative 1 considering future demands (that is, between 62 psi and 72 psi versus 56 psi and 86 psi for MDD; between 72 psi and 78 psi versus 63 psi and 81 psi for ADD; between 73 psi and 78 psi versus 66 psi and 82 psi for Minimum D.D.). The Wallaceburg HLP operated with VFDs in addition to the PRVs proposed will help maintain the Wallaceburg WDS pressures between these tight ranges, which is favourable from the operational point of view.

Compared with the existing conditions for Dresden, the system pressures would be slightly higher in particular for Minimum D.D. conditions (such as maximum pressure corresponding to minimum hour water demand increases from 75 psi to 82 psi and 81 psi for current demands and future demands respectively). This increase in pressure is deemed acceptable for the purpose of this assessment. For MDD and ADD, there is no change in the range of pressures either for current or future demands with respect to existing conditions (that is, 38 psi to 75 psi).

Under Alternative 1, the fire flow available would be maintained for the Wallaceburg service area compared with existing conditions (at 10.9% of hydrants with less than the required fire flow available) and improved slightly for the Dresden service area (13.9% and 13.2% versus 16.6% of hydrants with less than the required fire flow available for proposed and existing condition respectively).

In Alternative 1, the maximum flow velocity would be below 2 metres per second for all the scenarios considered.

4.5.2 Alternative 2

Alternative 2 would provide adequate level of service throughout the Wallaceburg-Dresden combined WDS because the pressures would be maintained within the acceptable range from 40 psi to 100 psi for all the scenarios considered (that is, current and future ADD and MDD) with minor exceptions in the areas around Wellington Street and Sydenham Street in Dresden as noted in Section 4.4.3.4.

In addition, there are some areas to the west of Wallaceburg where the system pressure is within the acceptable range but just slightly below 100 psi.

Compared with existing conditions for Wallaceburg, the system pressures would be higher in particular for minimum D.D. conditions (such as maximum pressure corresponding to minimum hour water demand increases from 81 psi to 99 psi both for current demands and future demands). This increase in pressure occurs mainly at the areas close to the Wallaceburg WTP and is caused by the significant increase in flow from the Wallaceburg WTP HLP. In Alternative 2, the pumps are rated for 170 L/s at 70 metres TDH; however, for low flows during ADD (between 50 L/s and 100 L/s), the pump moves back on its curve and generates high pressure in excess of 80 metres (114 psi). The pumps equipped with VFDs would mitigate the high pressure but cannot reduce the pressure below 99 psi during low demand periods. At MDD, this alternative would increase the minimum pressure corresponding to maximum hour demand with respect to existing conditions for current demands from 56 psi to 58 psi but reduces it to 42 psi for future demands).

Compared with the existing conditions for Dresden, the system pressures are higher in particular for minimum D.D. conditions (such as maximum pressure corresponding to minimum hour water demand increases from 75 psi to 97 psi and 92 psi for current demands and future demands respectively). This increase in pressure is considerably high. At MDD, there is no significant change in the minimum pressure corresponding to maximum hour demand with respect to existing conditions (that is, 38 psi).

In Alternative 2, the fire flow available would be slightly increased for the Wallaceburg service area compared with existing conditions for current MDD (from 10.9% of hydrants with less than the required fire flow available to 10.7%) and maintained for future MDD conditions (at 10.9% of hydrants with less than the required fire flow available). The fire flow available would improve slightly for the Dresden service area (13.9% and 13.2% versus 16.6% of hydrants with less than the required fire flow available for proposed and existing condition respectively).

In Alternative 2, the maximum flow velocity would be below 2 metres per second for all the scenarios considered.

4.5.3 Alternative 3

Alternative 3 would provide adequate level of service throughout the Wallaceburg-Dresden combined WDS because the pressures would be maintained within the acceptable range from 40 psi to 100 psi for all the scenarios considered (that is, current and future MDD, ADD and

Minimum D.D.) with minor exceptions in the areas of Wellington Street and Sydenham Street in Dresden as noted in Section 4.4.3.1.

Compared with the existing conditions for Wallaceburg, the system pressures would be maintained within a tighter range for all demand conditions for Alternative 3 considering current demands (that is, between 58 psi and 68 psi versus 56 psi and 86 psi for MDD; between 65 psi and 78 psi versus 63 psi and 81 psi for ADD; between 71 psi and 78 psi versus 66 psi and 82 psi for Minimum D.D.). Similarly, the system pressures would be also maintained within a tighter range for all demand conditions for Alternative 3 considering future demands (that is, between 64 psi and 72 psi versus 56 psi and 86 psi for MDD; between 68 psi and 76 psi versus 63 psi and 81 psi for ADD; between 71 psi and 77 psi versus 66 psi and 82 psi for minimum D.D.).

Compared with the existing conditions for Dresden, the system pressures would be slightly higher in particular for minimum D.D. conditions (such as maximum pressure corresponding to minimum hour water demand increases from 75 psi to 81 psi and 86 psi for current demands and future demands respectively). This increase in pressure is deemed acceptable for the purpose of this assessment. For MDD, there is an insignificant reduction in the minimum pressure corresponding to maximum hour demand for current and future demands with respect to existing conditions (that is, 74 psi to 73 psi and 72 psi respectively).

Under Alternative 3, the fire flow available would be maintained for the Wallaceburg service area compared with existing conditions (at 10.9% of hydrants with less than the required fire flow available) and improved slightly for the Dresden service area (13.2% versus 16.6% of hydrants with less than the required fire flow available for both proposed and existing condition).

In Alternative 1, the maximum flow velocity would be below 2 metres per second for all the scenarios considered.

5. Conclusions and Recommendations

The following conclusions can be drawn from the hydraulic modelling assessment:

- Alternatives 1 and 3 would reduce maximum pressures during Minimum D.D. at Wallaceburg compared to the existing conditions. However, Alternative 2 would increase the maximum pressure significantly. The increase of maximum pressure is not desirable due to the concern of aged distribution pipes at Wallaceburg WDS.
- Alternatives 1 and 3 would increase slightly the maximum pressures during Minimum D.D. at Dresden compared to the existing conditions. However, Alternative 2 would increase the maximum pressure significantly.
- Alternatives 1 and 3 would increase the minimum pressures under MDD conditions at Wallaceburg, while Alternative 2 would maintain the minimum pressures under MDD conditions.
- All three alternatives would maintain approximately the same minimum pressures under MDD at Dresden relative to the existing conditions.
- Alternatives 1 and 3 would maintain the same fire flow availability at Wallaceburg compared to the existing conditions, while Alternative 2 would improve it slightly.
- All three alternatives would improve fire flow availability at Dresden relative to the existing conditions.
- Alternative 2 would require more watermain upgrades/twinning than Alternatives 1 and 3. A significant percentage of the watermain upgrades/twinning required for Alternative 2 (corresponding mostly to the new 400-millimetre-diameter trunk watermain) are within the urban area of Wallaceburg.
- Given the results in terms of maximum and minimum pressures, fire flow availability and required upgrades, Alternative 1 is slightly more favourable than Alternative 3 (that is, tighter pressure range for all demand conditions, reduced length of 600-millimetre-diameter trunk watermain upgrades). Both Alternatives 1 and 3 are more favourable than Alternative 2 from a hydraulic point of view.

6. References

AECOM. 2020a. Chatham Drinking Water System Modelling.

AECOM. 2020b. Wallaceburg Drinking Water System Modelling.

Jacobs. 2021. Wallaceburg Water Servicing Class EA - Technical Memorandum No. 1.

Appendix F
Cost Estimate for Water Transmission Alternatives

Wallaceburg Water Treatment Servicing Schedule C Class EA
Technical Memorandum #1
Appendix F: Cost Estimate for Water Transmission Alternatives
Do Nothing Alternative

Component	Description	Capacity	Units		Capital Cost
New High Lift Pumps	>Vertical turbine pumps, 1438 m TDH	17.4	ML/d		$ 4,000,000
Subtotal					$ 4,000,000
Contractor Overhead				10%	$ 400,000
Sub-Total					$ 4,400,000
Project Staff Overhead				3%	$ 132,000
Sub-Total					$ 4,532,000
General Conditions				4%	$ 182,000
Sub-Total					$ 4,714,000
Mobilization/Demobilization				3%	$ 142,000
Insurance				1%	$ 48,000
Bond				1%	$ 48,000
Sub-Total					$ 4,952,000
Contractor Profit				10%	$ 496,000
Sub-Total					$ 5,448,000
Estimating Contingency				30%	$ 1,635,000
Total Construction Cost					$ 7,083,000
Engineering/SDC				10%	$ 709,000
TOTAL					**$ 7,792,000**

Lifecycle Cost Estimate for Do Nothing Alternative

Current Year 2021
Discount 5%
Inflation 2%

Year	ADD, ML/d	Electricity, $/y	Maintenance, $/y	Annual O&M, $/y	O&M NPV, $/y
2021	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 4,783,400
2022	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 4,646,731
2023	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 4,513,968
2024	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 4,384,997
2025	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 4,259,712
2026	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 4,138,005
2027	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 4,019,777
2028	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 3,904,926
2029	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 3,793,357
2030	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 3,684,975
2031	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 3,579,690
2032	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 3,477,413
2033	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 3,378,059
2034	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 3,281,543
2035	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 3,187,784
2036	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 3,096,705
2037	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 3,008,227
2038	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 2,922,278
2039	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 2,838,784
2040	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 2,757,676
2041	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 2,678,886
2042	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 2,602,346
2043	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 2,527,993
2044	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 2,455,765
2045	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 2,385,600
2046	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 2,317,440
2047	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 2,251,228
2048	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 2,186,907
2049	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 2,124,424
2050	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 2,063,726
2051	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 2,004,762
2052	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,947,483
2053	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,891,841
2054	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,837,788
2055	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,785,280
2056	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,734,272
2057	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,684,721
2058	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,636,587
2059	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,589,827
2060	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,544,403
2061	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,500,278
2062	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,457,412
2063	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,415,772
2064	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,375,321
2065	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,336,027
2066	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,297,854
2067	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,260,773
2068	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,224,751
2069	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,189,758
2070	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,155,765
2071	13.92	$ 4,703,400	$ 80,000	$ 4,783,400	$ 1,122,743
				TOTAL	$ 129,245,740

Wallaceburg Water Treatment Servicing Schedule C Class EA

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Appendix F: Cost Estimate for Water Transmission Alternatives

Alternative 1

Component	**Description**	**Capacity**	**Units**	**Unit Cost**	**Capital Cost**
Booster Pumping Station	>Horizontal centrifugal pumps	17.4	ML/d		$ 1,469,000
Sitework					*$ 14,000*
Concrete					*$ 93,000*
Masonry					*$ 409,000*
Metals					*$ 8,000*
Equipment					*$ 166,000*
I&C					*$ 265,000*
Mechanical					*$ 114,000*
Electrical					*$ 85,000*
Allowances					*$ 215,000*
Diesel Standby Generator		150	kW		*$ 100,000*
Valve Chamber - Connection to Dresden					$ 390,000
Concrete Chamber		*1*	*EA*	*$ 250,000*	*$ 250,000*
Check Valves	*>2x 600 mm for Dresden*	*2*	*EA*	*$ 20,000*	*$ 40,000*
Butterfly Valves	*>2x 600 mm for Dresden*	*2*	*EA*	*$ 50,000*	*$ 100,000*
Valve Chamber - Valve Closure on Base Line					$ 310,000
Concrete Chamber		*1*	*EA*	*$ 250,000*	*$ 250,000*
Check Valves	*>2x 200 mm*	*2*	*EA*	*$ 10,000*	*$ 20,000*
Butterfly Valves	*>2x 200 mm*	*2*	*EA*	*$ 20,000*	*$ 40,000*
Pressure Relief Valves					$ 660,000
Concrete Chamber	*>1 per PRV*	*2*	*EA*	*$ 250,000*	*$ 500,000*
PRVs - 300 mm	*>2x 300 mm at Gillard St/Base Line*	*2*	*EA*	*$ 15,000*	*$ 30,000*
PRVS - 400 mm	*>2x 400 mm on new transmission main*	*2*	*EA*	*$ 25,000*	*$ 50,000*
Isolation Valves - 300 mm	*>4x 300 mm at Gillard St/Base Line*	*4*	*EA*	*$ 8,000*	*$ 32,000*
Isolation Valves - 400 mm	*>4x 400 mm on new transmission main*	*4*	*EA*	*$ 12,000*	*$ 48,000*
Subtotal					$ 2,829,000
Contractor Overhead				10%	$ 283,000
Sub-Total					$ 3,112,000
Project Staff Overhead				3%	$ 94,000
Sub-Total					$ 3,206,000
General Conditions				4%	$ 129,000
Sub-Total					$ 3,335,000
Mobilization/Demobilization				3%	$ 101,000
Insurance				1%	$ 34,000
Bond				1%	$ 34,000
Sub-Total					$ 3,504,000
Contractor Profit				10%	$ 351,000
Sub-Total					$ 3,855,000
Estimating Contingency				30%	$ 1,157,000
Total Construction Cost					$ 5,012,000
Engineering/SDC				10%	$ 502,000
Land Acquisition		1	acre	$ 200,000	$ 200,000
Transmission Main	600 mm dia main, Wallaceburg to Dresden	17.3	km	$ 1,500,000	$ 25,950,000
TOTAL					**$ 31,664,000**

Lifecycle Cost for Alternative 1					
Current Year	2021				
Discount	5%				
Inflation	2%				
Year	**ADD, ML/d**	**Electricity, $/y**	**Maintenance, $/y**	**Annual O&M, $/y**	**O&M NPV, $/y**
2021	13.92	$ 101,400	$ 3,320	$ 104,720	$ 104,720
2022	13.92	$ 101,400	$ 3,320	$ 104,720	$ 101,728
2023	13.92	$ 101,400	$ 3,320	$ 104,720	$ 98,821
2024	13.92	$ 101,400	$ 3,320	$ 104,720	$ 95,998
2025	13.92	$ 101,400	$ 3,320	$ 104,720	$ 93,255
2026	13.92	$ 101,400	$ 3,320	$ 104,720	$ 90,591
2027	13.92	$ 101,400	$ 3,320	$ 104,720	$ 88,002
2028	13.92	$ 101,400	$ 3,320	$ 104,720	$ 85,488
2029	13.92	$ 101,400	$ 3,320	$ 104,720	$ 83,046
2030	13.92	$ 101,400	$ 3,320	$ 104,720	$ 80,673
2031	13.92	$ 101,400	$ 3,320	$ 104,720	$ 78,368
2032	13.92	$ 101,400	$ 3,320	$ 104,720	$ 76,129
2033	13.92	$ 101,400	$ 3,320	$ 104,720	$ 73,954
2034	13.92	$ 101,400	$ 3,320	$ 104,720	$ 71,841
2035	13.92	$ 101,400	$ 3,320	$ 104,720	$ 69,788
2036	13.92	$ 101,400	$ 3,320	$ 104,720	$ 67,794
2037	13.92	$ 101,400	$ 3,320	$ 104,720	$ 65,857
2038	13.92	$ 101,400	$ 3,320	$ 104,720	$ 63,976
2039	13.92	$ 101,400	$ 3,320	$ 104,720	$ 62,148
2040	13.92	$ 101,400	$ 3,320	$ 104,720	$ 60,372
2041	13.92	$ 101,400	$ 3,320	$ 104,720	$ 58,647
2042	13.92	$ 101,400	$ 3,320	$ 104,720	$ 56,972
2043	13.92	$ 101,400	$ 3,320	$ 104,720	$ 55,344
2044	13.92	$ 101,400	$ 3,320	$ 104,720	$ 53,763
2045	13.92	$ 101,400	$ 3,320	$ 104,720	$ 52,226
2046	13.92	$ 101,400	$ 3,320	$ 104,720	$ 50,734
2047	13.92	$ 101,400	$ 3,320	$ 104,720	$ 49,285
2048	13.92	$ 101,400	$ 3,320	$ 104,720	$ 47,877
2049	13.92	$ 101,400	$ 3,320	$ 104,720	$ 46,509
2050	13.92	$ 101,400	$ 3,320	$ 104,720	$ 45,180
2051	13.92	$ 101,400	$ 3,320	$ 104,720	$ 43,889
2052	13.92	$ 101,400	$ 3,320	$ 104,720	$ 42,635
2053	13.92	$ 101,400	$ 3,320	$ 104,720	$ 41,417
2054	13.92	$ 101,400	$ 3,320	$ 104,720	$ 40,234
2055	13.92	$ 101,400	$ 3,320	$ 104,720	$ 39,084
2056	13.92	$ 101,400	$ 3,320	$ 104,720	$ 37,967
2057	13.92	$ 101,400	$ 3,320	$ 104,720	$ 36,883
2058	13.92	$ 101,400	$ 3,320	$ 104,720	$ 35,829
2059	13.92	$ 101,400	$ 3,320	$ 104,720	$ 34,805
2060	13.92	$ 101,400	$ 3,320	$ 104,720	$ 33,811
2061	13.92	$ 101,400	$ 3,320	$ 104,720	$ 32,845
2062	13.92	$ 101,400	$ 3,320	$ 104,720	$ 31,906
2063	13.92	$ 101,400	$ 3,320	$ 104,720	$ 30,995
2064	13.92	$ 101,400	$ 3,320	$ 104,720	$ 30,109
2065	13.92	$ 101,400	$ 3,320	$ 104,720	$ 29,249
2066	13.92	$ 101,400	$ 3,320	$ 104,720	$ 28,413
2067	13.92	$ 101,400	$ 3,320	$ 104,720	$ 27,601
2068	13.92	$ 101,400	$ 3,320	$ 104,720	$ 26,813
2069	13.92	$ 101,400	$ 3,320	$ 104,720	$ 26,047
2070	13.92	$ 101,400	$ 3,320	$ 104,720	$ 25,302
2071	13.92	$ 101,400	$ 3,320	$ 104,720	$ 24,580
				TOTAL	$ 2,829,497

Wallaceburg Water Treatment Servicing Schedule C Class EA
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Appendix F: Cost Estimate for Water Transmission Alternatives
Alternative 2

Component	Description	Capacity	Units	Unit Cost	Capital Cost
Booster Pumping Station	>Horizontal centrifugal pumps	17.4	ML/d		$ 1,369,000
Sitework					*$ 14,000*
Concrete					*$ 93,000*
Masonry					*$ 409,000*
Metals					*$ 8,000*
Equipment					*$ 166,000*
I&C					*$ 265,000*
Mechanical					*$ 114,000*
Electrical					*$ 85,000*
Allowances					*$ 215,000*
Diesel Standby Generator		150	kW		*$ 100,000*
Valve Chambers					$ 745,000
Concrete Chamber		*2*	*EA*	*$ 250,000*	*$ 500,000*
Check Valves	*>2x 300 mm, 1x 350 mm for Tupperville connection, 2x 300 mm, 2x 350 mm for Dresden ET*	*7*	*EA*	*$ 20,000*	*$ 140,000*
Butterfly Valves	*>2x 300 mm, 1x 350 mm for Tupperville connection, 2x 300 mm, 2x 350 mm for Dresden ET*	*7*	*EA*	*$ 15,000*	*$ 105,000*
Subtotal					$ 2,114,000
Contractor Overhead				10%	$ 212,000
Sub-Total					$ 2,326,000
Project Staff Overhead				3%	$ 70,000
Sub-Total					$ 2,396,000
General Conditions				4%	$ 96,000
Sub-Total					$ 2,492,000
Mobilization/Demobilization				3%	$ 75,000
Insurance				1%	$ 25,000
Bond				1%	$ 25,000
Sub-Total					$ 2,617,000
Contractor Profit				10%	$ 262,000
Sub-Total					$ 2,879,000
Estimating Contingency				30%	$ 864,000
Total Construction Cost					$ 3,743,000
Engineering/SDC				10%	$ 375,000
Land Acquisition		1	acre	$ 200,000	$ 200,000
Transmission Main	>400 mm dia Section 1	2.2	km	$ 1,500,000	$ 3,300,000
Transmission Main	>400 mm dia Section 2	2.3	km	$ 1,500,000	$ 3,450,000
Transmission Main	>600 mm dia McCreary Line	7.1	km	$ 1,500,000	$ 10,650,000
Transmission Main	>350 mm dia McCreary Line	6.7	km	$ 1,500,000	$ 10,050,000
Transmission Main	>300 mm dia Base Line extension	1.4	km	$ 1,500,000	$ 2,100,000
TOTAL					**$ 33,868,000**

Lifecycle Cost Estimate for Alternative 2

Current Year	2021				
Discount	5%				
Inflation	2%				
Year	**ADD, ML/d**	**Electricity, $/y**	**Maintenance, $/y**	**Annual O&M, $/y**	**O&M NPV, $/y**
2021	13.92	$ 117,600	$ 3,320	$ 120,920	$ 120,920
2022	13.92	$ 117,600	$ 3,320	$ 120,920	$ 117,465
2023	13.92	$ 117,600	$ 3,320	$ 120,920	$ 114,109
2024	13.92	$ 117,600	$ 3,320	$ 120,920	$ 110,849
2025	13.92	$ 117,600	$ 3,320	$ 120,920	$ 107,682
2026	13.92	$ 117,600	$ 3,320	$ 120,920	$ 104,605
2027	13.92	$ 117,600	$ 3,320	$ 120,920	$ 101,616
2028	13.92	$ 117,600	$ 3,320	$ 120,920	$ 98,713
2029	13.92	$ 117,600	$ 3,320	$ 120,920	$ 95,893
2030	13.92	$ 117,600	$ 3,320	$ 120,920	$ 93,153
2031	13.92	$ 117,600	$ 3,320	$ 120,920	$ 90,491
2032	13.92	$ 117,600	$ 3,320	$ 120,920	$ 87,906
2033	13.92	$ 117,600	$ 3,320	$ 120,920	$ 85,394
2034	13.92	$ 117,600	$ 3,320	$ 120,920	$ 82,954
2035	13.92	$ 117,600	$ 3,320	$ 120,920	$ 80,584
2036	13.92	$ 117,600	$ 3,320	$ 120,920	$ 78,282
2037	13.92	$ 117,600	$ 3,320	$ 120,920	$ 76,045
2038	13.92	$ 117,600	$ 3,320	$ 120,920	$ 73,873
2039	13.92	$ 117,600	$ 3,320	$ 120,920	$ 71,762
2040	13.92	$ 117,600	$ 3,320	$ 120,920	$ 69,712
2041	13.92	$ 117,600	$ 3,320	$ 120,920	$ 67,720
2042	13.92	$ 117,600	$ 3,320	$ 120,920	$ 65,785
2043	13.92	$ 117,600	$ 3,320	$ 120,920	$ 63,905
2044	13.92	$ 117,600	$ 3,320	$ 120,920	$ 62,080
2045	13.92	$ 117,600	$ 3,320	$ 120,920	$ 60,306
2046	13.92	$ 117,600	$ 3,320	$ 120,920	$ 58,583
2047	13.92	$ 117,600	$ 3,320	$ 120,920	$ 56,909
2048	13.92	$ 117,600	$ 3,320	$ 120,920	$ 55,283
2049	13.92	$ 117,600	$ 3,320	$ 120,920	$ 53,703
2050	13.92	$ 117,600	$ 3,320	$ 120,920	$ 52,169
2051	13.92	$ 117,600	$ 3,320	$ 120,920	$ 50,679
2052	13.92	$ 117,600	$ 3,320	$ 120,920	$ 49,231
2053	13.92	$ 117,600	$ 3,320	$ 120,920	$ 47,824
2054	13.92	$ 117,600	$ 3,320	$ 120,920	$ 46,458
2055	13.92	$ 117,600	$ 3,320	$ 120,920	$ 45,130
2056	13.92	$ 117,600	$ 3,320	$ 120,920	$ 43,841
2057	13.92	$ 117,600	$ 3,320	$ 120,920	$ 42,588
2058	13.92	$ 117,600	$ 3,320	$ 120,920	$ 41,371
2059	13.92	$ 117,600	$ 3,320	$ 120,920	$ 40,189
2060	13.92	$ 117,600	$ 3,320	$ 120,920	$ 39,041
2061	13.92	$ 117,600	$ 3,320	$ 120,920	$ 37,926
2062	13.92	$ 117,600	$ 3,320	$ 120,920	$ 36,842
2063	13.92	$ 117,600	$ 3,320	$ 120,920	$ 35,789
2064	13.92	$ 117,600	$ 3,320	$ 120,920	$ 34,767
2065	13.92	$ 117,600	$ 3,320	$ 120,920	$ 33,774
2066	13.92	$ 117,600	$ 3,320	$ 120,920	$ 32,809
2067	13.92	$ 117,600	$ 3,320	$ 120,920	$ 31,871
2068	13.92	$ 117,600	$ 3,320	$ 120,920	$ 30,961
2069	13.92	$ 117,600	$ 3,320	$ 120,920	$ 30,076
2070	13.92	$ 117,600	$ 3,320	$ 120,920	$ 29,217
2071	13.92	$ 117,600	$ 3,320	$ 120,920	$ 28,382
				TOTAL	$ 3,267,215

Wallaceburg Water Treatment Servicing Schedule C Class EA

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Appendix F: Cost Estimate for Water Transmission Alternatives
Alternative 3

Component	Description	Capacity	Units	Unit Cost	Baseline HLPS	Alt 3 HLPS	Capital Cost
HLPS Upgrades	>Vertical turbine pumps >Additional pumps dedicated to Dresden	28	ML/d		$ 2,735,000	$ 4,522,000	$ 1,787,000
Sitework					*$ 85,000*	*$ 106,000*	*$ 21,000*
Concrete					*$ 378,000*	*$ 731,000*	*$ 353,000*
Masonry					*$ 358,000*	*$ 469,000*	*$ 111,000*
Metals					*$ 5,000*	*$ 11,000*	*$ 6,000*
Equipment					*$ 778,000*	*$ 1,343,000*	*$ 565,000*
I&C					*$ 321,000*	*$ 587,000*	*$ 266,000*
Mechanical					*$ 123,000*	*$ 198,000*	*$ 75,000*
Electrical					*$ 85,000*	*$ 89,000*	*$ 4,000*
Allowances					*$ 602,000*	*$ 988,000*	*$ 386,000*
Valve Chamber - Connection to Dresden							$ 390,000
Concrete Chamber		*1*	*EA*	*$ 250,000*			*$ 250,000*
Check Valves	*>2x 600 mm for Dresden*	*2*	*EA*	*$ 20,000*			*$ 40,000*
Butterfly Valves	*>2x 600 mm for Dresden*	*2*	*EA*	*$ 50,000*			*$ 100,000*
Valve Chamber - Valve Closure on Base Line							$ 310,000
Concrete Chamber		*1*	*EA*	*$ 250,000*			*$ 250,000*
Check Valves	*>2x 200 mm*	*2*	*EA*	*$ 10,000*			*$ 20,000*
Butterfly Valves	*>2x 200 mm*	*2*	*EA*	*$ 20,000*			*$ 40,000*
Subtotal							$ 2,487,000
Contractor Overhead				10%			$ 249,000
Sub-Total							$ 2,736,000
Project Staff Overhead				3%			$ 83,000
Sub-Total							$ 2,819,000
General Conditions				4%			$ 113,000
Sub-Total							$ 2,932,000
Mobilization/Demobilization				3%			$ 88,000
Insurance				1%			$ 30,000
Bond				1%			$ 30,000
Sub-Total							$ 3,080,000
Contractor Profit				10%			$ 308,000
Sub-Total							$ 3,388,000
Estimating Contingency				30%			$ 1,017,000
Total Construction Cost							$ 4,405,000
Engineering/SDC				10%			$ 441,000
Land Acquisition		1	acre	$ 200,000			$ 200,000
Transmission Main	600 mm dia main, Wallaceburg to Dresden	18.5	km	$ 1,500,000			$ 27,750,000
TOTAL							**$ 32,796,000**

Lifecycle Cost Estimate for Alternative 3

Current Year 2021
Discount 5%
Inflation 2%

Year	ADD, ML/d	Electricity, $/y	Maintenance, $/y	Annual O&M, $/y	O&M NPV, $/y
2021	22.4	$ 78,450	$ 11,300	$ 89,750	$ 89,750
2022	22.4	$ 78,450	$ 11,300	$ 89,750	$ 87,186
2023	22.4	$ 78,450	$ 11,300	$ 89,750	$ 84,695
2024	22.4	$ 78,450	$ 11,300	$ 89,750	$ 82,275
2025	22.4	$ 78,450	$ 11,300	$ 89,750	$ 79,924
2026	22.4	$ 78,450	$ 11,300	$ 89,750	$ 77,641
2027	22.4	$ 78,450	$ 11,300	$ 89,750	$ 75,422
2028	22.4	$ 78,450	$ 11,300	$ 89,750	$ 73,267
2029	22.4	$ 78,450	$ 11,300	$ 89,750	$ 71,174
2030	22.4	$ 78,450	$ 11,300	$ 89,750	$ 69,140
2031	22.4	$ 78,450	$ 11,300	$ 89,750	$ 67,165
2032	22.4	$ 78,450	$ 11,300	$ 89,750	$ 65,246
2033	22.4	$ 78,450	$ 11,300	$ 89,750	$ 63,382
2034	22.4	$ 78,450	$ 11,300	$ 89,750	$ 61,571
2035	22.4	$ 78,450	$ 11,300	$ 89,750	$ 59,812
2036	22.4	$ 78,450	$ 11,300	$ 89,750	$ 58,103
2037	22.4	$ 78,450	$ 11,300	$ 89,750	$ 56,443
2038	22.4	$ 78,450	$ 11,300	$ 89,750	$ 54,830
2039	22.4	$ 78,450	$ 11,300	$ 89,750	$ 53,264
2040	22.4	$ 78,450	$ 11,300	$ 89,750	$ 51,742
2041	22.4	$ 78,450	$ 11,300	$ 89,750	$ 50,263
2042	22.4	$ 78,450	$ 11,300	$ 89,750	$ 48,827
2043	22.4	$ 78,450	$ 11,300	$ 89,750	$ 47,432
2044	22.4	$ 78,450	$ 11,300	$ 89,750	$ 46,077
2045	22.4	$ 78,450	$ 11,300	$ 89,750	$ 44,761
2046	22.4	$ 78,450	$ 11,300	$ 89,750	$ 43,482
2047	22.4	$ 78,450	$ 11,300	$ 89,750	$ 42,239
2048	22.4	$ 78,450	$ 11,300	$ 89,750	$ 41,033
2049	22.4	$ 78,450	$ 11,300	$ 89,750	$ 39,860
2050	22.4	$ 78,450	$ 11,300	$ 89,750	$ 38,721
2051	22.4	$ 78,450	$ 11,300	$ 89,750	$ 37,615
2052	22.4	$ 78,450	$ 11,300	$ 89,750	$ 36,540
2053	22.4	$ 78,450	$ 11,300	$ 89,750	$ 35,496
2054	22.4	$ 78,450	$ 11,300	$ 89,750	$ 34,482
2055	22.4	$ 78,450	$ 11,300	$ 89,750	$ 33,497
2056	22.4	$ 78,450	$ 11,300	$ 89,750	$ 32,540
2057	22.4	$ 78,450	$ 11,300	$ 89,750	$ 31,610
2058	22.4	$ 78,450	$ 11,300	$ 89,750	$ 30,707
2059	22.4	$ 78,450	$ 11,300	$ 89,750	$ 29,830
2060	22.4	$ 78,450	$ 11,300	$ 89,750	$ 28,977
2061	22.4	$ 78,450	$ 11,300	$ 89,750	$ 28,149
2062	22.4	$ 78,450	$ 11,300	$ 89,750	$ 27,345
2063	22.4	$ 78,450	$ 11,300	$ 89,750	$ 26,564
2064	22.4	$ 78,450	$ 11,300	$ 89,750	$ 25,805
2065	22.4	$ 78,450	$ 11,300	$ 89,750	$ 25,068
2066	22.4	$ 78,450	$ 11,300	$ 89,750	$ 24,351
2067	22.4	$ 78,450	$ 11,300	$ 89,750	$ 23,656
2068	22.4	$ 78,450	$ 11,300	$ 89,750	$ 22,980
2069	22.4	$ 78,450	$ 11,300	$ 89,750	$ 22,323
2070	22.4	$ 78,450	$ 11,300	$ 89,750	$ 21,685
2071	22.4	$ 78,450	$ 11,300	$ 89,750	$ 21,066
				TOTAL	$ 2,425,013

Wallaceburg Water Treatment Servicing Schedule C Class EA
Technical Memorandum #1
Appendix F: Cost Estimate for Water Transmission Alternatives
Alternative 2

Component	**Description**	**Capacity**	**Units**	**Unit Cost**	**Capital Cost**
Booster Pumping Station	>Horizontal centrifugal pumps	17.4	ML/d		$ 1,369,000
Sitework					*$ 14,000*
Concrete					*$ 93,000*
Masonry					*$ 409,000*
Metals					*$ 8,000*
Equipment					*$ 166,000*
I&C					*$ 265,000*
Mechanical					*$ 114,000*
Electrical					*$ 85,000*
Allowances					*$ 215,000*
Diesel Standby Generator		150	kW		*$ 100,000*
Valve Chambers					$ 745,000
Concrete Chamber		*2*	*EA*	*$ 250,000*	*$ 500,000*
Check Valves	*>2x 300 mm, 1x 350 mm for Tupperville connection, 2x 300 mm, 2x 350 mm for Dresden ET*	*7*	*EA*	*$ 20,000*	*$ 140,000*
Butterfly Valves	*>2x 300 mm, 1x 350 mm for Tupperville connection, 2x 300 mm, 2x 350 mm for Dresden ET*	*7*	*EA*	*$ 15,000*	*$ 105,000*
				Subtotal	$ 2,114,000
			Contractor Overhead	10%	$ 212,000
			Sub-Total		$ 2,326,000
			Project Staff Overhead	3%	$ 70,000
			Sub-Total		$ 2,396,000
			General Conditions	4%	$ 96,000
			Sub-Total		$ 2,492,000
			Mobilization/Demobilization	3%	$ 75,000
			Insurance	1%	$ 25,000
			Bond	1%	$ 25,000
			Sub-Total		$ 2,617,000
			Contractor Profit	10%	$ 262,000
			Sub-Total		$ 2,879,000
			Estimating Contingency	30%	$ 864,000
			Total Construction Cost		$ 3,743,000
			Engineering/SDC	10%	$ 375,000
Land Acquisition		1	acre	$ 200,000	$ 200,000
Transmission Main	>400 mm dia Section 1	2.2	km	$ 1,500,000	$ 3,300,000
Transmission Main	>400 mm dia Section 2	2.3	km	$ 1,500,000	$ 3,450,000
Transmission Main	>600 mm dia McCreary Line	7.1	km	$ 1,500,000	$ 10,650,000
Transmission Main	>350 mm dia McCreary Line	6.7	km	$ 1,500,000	$ 10,050,000
Transmission Main	>300 mm dia Base Line extension	1.4	km	$ 1,500,000	$ 2,100,000
				TOTAL	**$ 33,868,000**

Lifecycle Cost Estimate for Alternative 2					
Current Year	2021				
Discount	5%				
Inflation	2%				
Year	**ADD, ML/d**	**Electricity, $/y**	**Maintenance, $/y**	**Annual O&M, $/y**	**O&M NPV, $/y**
2021	13.92	$ 117,600	$ 3,320	$ 120,920	$ 120,920
2022	13.92	$ 117,600	$ 3,320	$ 120,920	$ 117,465
2023	13.92	$ 117,600	$ 3,320	$ 120,920	$ 114,109
2024	13.92	$ 117,600	$ 3,320	$ 120,920	$ 110,849
2025	13.92	$ 117,600	$ 3,320	$ 120,920	$ 107,682
2026	13.92	$ 117,600	$ 3,320	$ 120,920	$ 104,605
2027	13.92	$ 117,600	$ 3,320	$ 120,920	$ 101,616
2028	13.92	$ 117,600	$ 3,320	$ 120,920	$ 98,713
2029	13.92	$ 117,600	$ 3,320	$ 120,920	$ 95,893
2030	13.92	$ 117,600	$ 3,320	$ 120,920	$ 93,153
2031	13.92	$ 117,600	$ 3,320	$ 120,920	$ 90,491
2032	13.92	$ 117,600	$ 3,320	$ 120,920	$ 87,906
2033	13.92	$ 117,600	$ 3,320	$ 120,920	$ 85,394
2034	13.92	$ 117,600	$ 3,320	$ 120,920	$ 82,954
2035	13.92	$ 117,600	$ 3,320	$ 120,920	$ 80,584
2036	13.92	$ 117,600	$ 3,320	$ 120,920	$ 78,282
2037	13.92	$ 117,600	$ 3,320	$ 120,920	$ 76,045
2038	13.92	$ 117,600	$ 3,320	$ 120,920	$ 73,873
2039	13.92	$ 117,600	$ 3,320	$ 120,920	$ 71,762
2040	13.92	$ 117,600	$ 3,320	$ 120,920	$ 69,712
2041	13.92	$ 117,600	$ 3,320	$ 120,920	$ 67,720
2042	13.92	$ 117,600	$ 3,320	$ 120,920	$ 65,785
2043	13.92	$ 117,600	$ 3,320	$ 120,920	$ 63,905
2044	13.92	$ 117,600	$ 3,320	$ 120,920	$ 62,080
2045	13.92	$ 117,600	$ 3,320	$ 120,920	$ 60,306
2046	13.92	$ 117,600	$ 3,320	$ 120,920	$ 58,583
2047	13.92	$ 117,600	$ 3,320	$ 120,920	$ 56,909
2048	13.92	$ 117,600	$ 3,320	$ 120,920	$ 55,283
2049	13.92	$ 117,600	$ 3,320	$ 120,920	$ 53,703
2050	13.92	$ 117,600	$ 3,320	$ 120,920	$ 52,169
2051	13.92	$ 117,600	$ 3,320	$ 120,920	$ 50,679
2052	13.92	$ 117,600	$ 3,320	$ 120,920	$ 49,231
2053	13.92	$ 117,600	$ 3,320	$ 120,920	$ 47,824
2054	13.92	$ 117,600	$ 3,320	$ 120,920	$ 46,458
2055	13.92	$ 117,600	$ 3,320	$ 120,920	$ 45,130
2056	13.92	$ 117,600	$ 3,320	$ 120,920	$ 43,841
2057	13.92	$ 117,600	$ 3,320	$ 120,920	$ 42,588
2058	13.92	$ 117,600	$ 3,320	$ 120,920	$ 41,371
2059	13.92	$ 117,600	$ 3,320	$ 120,920	$ 40,189
2060	13.92	$ 117,600	$ 3,320	$ 120,920	$ 39,041
2061	13.92	$ 117,600	$ 3,320	$ 120,920	$ 37,926
2062	13.92	$ 117,600	$ 3,320	$ 120,920	$ 36,842
2063	13.92	$ 117,600	$ 3,320	$ 120,920	$ 35,789
2064	13.92	$ 117,600	$ 3,320	$ 120,920	$ 34,767
2065	13.92	$ 117,600	$ 3,320	$ 120,920	$ 33,774
2066	13.92	$ 117,600	$ 3,320	$ 120,920	$ 32,809
2067	13.92	$ 117,600	$ 3,320	$ 120,920	$ 31,871
2068	13.92	$ 117,600	$ 3,320	$ 120,920	$ 30,961
2069	13.92	$ 117,600	$ 3,320	$ 120,920	$ 30,076
2070	13.92	$ 117,600	$ 3,320	$ 120,920	$ 29,217
2071	13.92	$ 117,600	$ 3,320	$ 120,920	$ 28,382
				TOTAL	$ 3,267,215

Wallaceburg Water Treatment Servicing Schedule C Class EA
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Appendix F: Cost Estimate for Water Transmission Alternatives
Alternative 3

Component	Description	Capacity	Units	Unit Cost	Baseline HLPS	Alt 3 HLPS	Capital Cost
HLPS Upgrades	>Vertical turbine pumps >Additional pumps dedicated to Dresden	28	ML/d		$ 2,735,000	$ 4,522,000	$ 1,787,000
Sitework					*$ 85,000*	*$ 106,000*	*$ 21,000*
Concrete					*$ 378,000*	*$ 731,000*	*$ 353,000*
Masonry					*$ 358,000*	*$ 469,000*	*$ 111,000*
Metals					*$ 5,000*	*$ 11,000*	*$ 6,000*
Equipment					*$ 778,000*	*$ 1,343,000*	*$ 565,000*
I&C					*$ 321,000*	*$ 587,000*	*$ 266,000*
Mechanical					*$ 123,000*	*$ 198,000*	*$ 75,000*
Electrical					*$ 85,000*	*$ 89,000*	*$ 4,000*
Allowances					*$ 602,000*	*$ 988,000*	*$ 386,000*
Valve Chamber - Connection to Dresden							$ 390,000
Concrete Chamber		*1*	*EA*	*$ 250,000*			*$ 250,000*
Check Valves	*>2x 600 mm for Dresden*	*2*	*EA*	*$ 20,000*			*$ 40,000*
Butterfly Valves	*>2x 600 mm for Dresden*	*2*	*EA*	*$ 50,000*			*$ 100,000*
Valve Chamber - Valve Closure on Base Line							$ 310,000
Concrete Chamber		*1*	*EA*	*$ 250,000*			*$ 250,000*
Check Valves	*>2x 200 mm*	*2*	*EA*	*$ 10,000*			*$ 20,000*
Butterfly Valves	*>2x 200 mm*	*2*	*EA*	*$ 20,000*			*$ 40,000*
				Subtotal			$ 2,487,000
		Contractor Overhead		10%			$ 249,000
		Sub-Total					$ 2,736,000
		Project Staff Overhead		3%			$ 83,000
		Sub-Total					$ 2,819,000
		General Conditions		4%			$ 113,000
		Sub-Total					$ 2,932,000
		Mobilization/Demobilization		3%			$ 88,000
		Insurance		1%			$ 30,000
		Bond		1%			$ 30,000
		Sub-Total					$ 3,080,000
		Contractor Profit		10%			$ 308,000
		Sub-Total					$ 3,388,000
		Estimating Contingency		30%			$ 1,017,000
		Total Construction Cost					$ 4,405,000
		Engineering/SDC		10%			$ 441,000
Land Acquisition		1	acre	$ 200,000			$ 200,000
Transmission Main	600 mm dia main, Wallaceburg to Dresden	18.5	km	$ 1,500,000			$ 27,750,000
				TOTAL			**$ 32,796,000**

Lifecycle Cost Estimate for Alternative 3

Current Year	2021
Discount	5%
Inflation	2%

Year	ADD, ML/d	Electricity, $/y	Maintenance, $/y	Annual O&M, $/y	O&M NPV, $/y
2021	22.4	$ 78,450	$ 11,300	$ 89,750	$ 89,750
2022	22.4	$ 78,450	$ 11,300	$ 89,750	$ 87,186
2023	22.4	$ 78,450	$ 11,300	$ 89,750	$ 84,695
2024	22.4	$ 78,450	$ 11,300	$ 89,750	$ 82,275
2025	22.4	$ 78,450	$ 11,300	$ 89,750	$ 79,924
2026	22.4	$ 78,450	$ 11,300	$ 89,750	$ 77,641
2027	22.4	$ 78,450	$ 11,300	$ 89,750	$ 75,422
2028	22.4	$ 78,450	$ 11,300	$ 89,750	$ 73,267
2029	22.4	$ 78,450	$ 11,300	$ 89,750	$ 71,174
2030	22.4	$ 78,450	$ 11,300	$ 89,750	$ 69,140
2031	22.4	$ 78,450	$ 11,300	$ 89,750	$ 67,165
2032	22.4	$ 78,450	$ 11,300	$ 89,750	$ 65,246
2033	22.4	$ 78,450	$ 11,300	$ 89,750	$ 63,382
2034	22.4	$ 78,450	$ 11,300	$ 89,750	$ 61,571
2035	22.4	$ 78,450	$ 11,300	$ 89,750	$ 59,812
2036	22.4	$ 78,450	$ 11,300	$ 89,750	$ 58,103
2037	22.4	$ 78,450	$ 11,300	$ 89,750	$ 56,443
2038	22.4	$ 78,450	$ 11,300	$ 89,750	$ 54,830
2039	22.4	$ 78,450	$ 11,300	$ 89,750	$ 53,264
2040	22.4	$ 78,450	$ 11,300	$ 89,750	$ 51,742
2041	22.4	$ 78,450	$ 11,300	$ 89,750	$ 50,263
2042	22.4	$ 78,450	$ 11,300	$ 89,750	$ 48,827
2043	22.4	$ 78,450	$ 11,300	$ 89,750	$ 47,432
2044	22.4	$ 78,450	$ 11,300	$ 89,750	$ 46,077
2045	22.4	$ 78,450	$ 11,300	$ 89,750	$ 44,761
2046	22.4	$ 78,450	$ 11,300	$ 89,750	$ 43,482
2047	22.4	$ 78,450	$ 11,300	$ 89,750	$ 42,239
2048	22.4	$ 78,450	$ 11,300	$ 89,750	$ 41,033
2049	22.4	$ 78,450	$ 11,300	$ 89,750	$ 39,860
2050	22.4	$ 78,450	$ 11,300	$ 89,750	$ 38,721
2051	22.4	$ 78,450	$ 11,300	$ 89,750	$ 37,615
2052	22.4	$ 78,450	$ 11,300	$ 89,750	$ 36,540
2053	22.4	$ 78,450	$ 11,300	$ 89,750	$ 35,496
2054	22.4	$ 78,450	$ 11,300	$ 89,750	$ 34,482
2055	22.4	$ 78,450	$ 11,300	$ 89,750	$ 33,497
2056	22.4	$ 78,450	$ 11,300	$ 89,750	$ 32,540
2057	22.4	$ 78,450	$ 11,300	$ 89,750	$ 31,610
2058	22.4	$ 78,450	$ 11,300	$ 89,750	$ 30,707
2059	22.4	$ 78,450	$ 11,300	$ 89,750	$ 29,830
2060	22.4	$ 78,450	$ 11,300	$ 89,750	$ 28,977
2061	22.4	$ 78,450	$ 11,300	$ 89,750	$ 28,149
2062	22.4	$ 78,450	$ 11,300	$ 89,750	$ 27,345
2063	22.4	$ 78,450	$ 11,300	$ 89,750	$ 26,564
2064	22.4	$ 78,450	$ 11,300	$ 89,750	$ 25,805
2065	22.4	$ 78,450	$ 11,300	$ 89,750	$ 25,068
2066	22.4	$ 78,450	$ 11,300	$ 89,750	$ 24,351
2067	22.4	$ 78,450	$ 11,300	$ 89,750	$ 23,656
2068	22.4	$ 78,450	$ 11,300	$ 89,750	$ 22,980
2069	22.4	$ 78,450	$ 11,300	$ 89,750	$ 22,323
2070	22.4	$ 78,450	$ 11,300	$ 89,750	$ 21,685
2071	22.4	$ 78,450	$ 11,300	$ 89,750	$ 21,066
				TOTAL	$ 2,425,013

Appendix G
Detailed Evaluation for Water Treatment Alternatives

Wallaceburg WTP EA - Detailed Evaluation Criteria for Water Transmission

Category	Weighting	Criterion	Rank	Do Nothing	Rank	Alternative 1 Construct a new transmission main and BPS along Base Line	Rank	Alternative 2 Construct a new transmission main and BPS along McCreary Line	Rank	Alternative 3 Construct a new transmission main along Base Line w/ dedicated HLPs
Natural Environment	**25%**	Impacts to surface water quality	5	This alternative could negatively impact surface water quality if the transmission main breaks near a stream. This could stir up soils, sediments, etc. and cause turbidity issues in the streams.	10	The alternative will have no substantial impact on surface water quality.	10	The alternative will have no substantial impact on surface water quality.	10	The alternative will have no substantial impact on surface water quality.
		Impacts to surface water quantity	10	The alternative will have no substantial impact on surface water quantity.	10	The alternative will increase the maximum water taking limit from 17 ML/d to 34 ML/d. However, the increased water taking is not expected to have a substantial impact on surface water quantity.	10	The alternative will increase the maximum water taking limit from 17 ML/d to 34 ML/d. However, the increased water taking is not expected to have a substantial impact on surface water quantity.	10	The alternative will increase the maximum water taking limit from 17 ML/d to 34 ML/d. However, the increased water taking is not expected to have a substantial impact on surface water quantity.
		Impacts on terrestrial environment	5	The alternative could negatively impact the terrestrial environment if the existing transmission main on Base Line were to burst due to high pressure. This transmission main is not sufficient to convey the 17.4 ML/d required for greenhouses and D[illegible]d	10	The alternative has the potential for minor impacts to the terrestrial environment. The transmission main would be constructed within the right-of-way and the BPS would be constructed on previously disturbed land.	10	The alternative has the potential for minor impacts to the terrestrial environment. The transmission main would be constructed within the right-of-way and the BPS would be constructed on previously disturbed land.	10	The alternative has the potential for minor impacts to the terrestrial environment. The transmission main would be constructed within the right-of-way, except for a small portion along Border Road.
		Impacts on aquatic environment	5	The alternative could negatively impact the terrestrial environment if the existing transmission main on Base Line were to burst near a stream crossing due to high pressure. This transmission main is not sufficient to convey the 17.4 ML/d required for greenhouses and Dresden.	10	The alternative will have little to no impact on the aquatic environment. There may be fish present (to be determined by field studies), but construction techniques would be selected to mitigate any impact at stream crossings.	10	The alternative will have little to no impact on the aquatic environment. There may be fish present (to be determined by field studies), but construction techniques would be selected to mitigate any impact at stream crossings.	10	The alternative will have little to no impact on the aquatic environment. There may be fish present (to be determined by field studies), but construction techniques would be selected to mitigate any impact at stream crossings.
		Greenhouse Gas Emissions	0	This alternative would result in GHG emissions of 940.7 tonnes CO2 eq/y.	5	This alternative would result in GHG emissions of 20.3 tonnes CO2 eq/y.	5	This alternative would result in GHG emissions of 23.5 tonnes CO2 eq/y.	10	This alternative would result in GHG emissions of 15.7 tonnes CO2 eq/y.
		Impacts to fluvial geomorphic stability	10	The alternative will have no impact on fluvial geomorphic stability.	10	The alternative will have little to no impact on fluvial gemorphic stability at stream crossings, as construction techniques would be selected to maintain stability.	10	The alternative will have little to no impact on fluvial gemorphic stability at stream crossings, as construction techniques would be selected to maintain stability.	10	The alternative will have little to no impact on fluvial gemorphic stability at stream crossings, as construction techniques would be selected to maintain stability.
		Impacts to wetlands	10	The alternative will have no impact on wetlands.	10	The alternative will have no impact on wetlands.	10	The alternative will have no impact on wetlands.	10	The alternative will have no impact on wetlands.
		Impacts to Air Quality	5	The alternative will result in some additional air emissions but would comply with provincial regulations for air quality.	5	The alternative will result in some additional air emissions but would comply with provincial regulations for air quality.	5	The alternative will result in some additional air emissions but would comply with provincial regulations for air quality.	5	The alternative will result in some additional air emissions but would comply with provincial regulations for air quality.
		Potential Impacts to Groundwater Quality and Quantity	10	The alternative would have little to no impact to groundwater quality and quantity.	10	The alternative would have little to no impact to groundwater quality and quantity.	10	The alternative would have little to no impact to groundwater quality and quantity.	5	The alternative would have increased length along agricultural drainage, anticpated increased dewatering during construction
		Normalized Score	***16.67***		***22.22***		***22.22***		***22.22***	

Wallaceburg WTP EA - Detailed Evaluation Criteria for Water Transmission

Category	Weighting	Criterion	Rank	Do Nothing	Rank	Alternative 1 Construct a new transmission main and BPS along Base Line	Rank	Alternative 2 Construct a new transmission main and BPS along McCreary Line	Rank	Alternative 3 Construct a new transmission main along Base Line w/ dedicated HLPs
Social/Cultural	**25%**	Occupational Health and Safety	0	The alternative poses a high risk to occupational health and safety. The existing transmission main between Wallaceburg and Dresden is insufficient to convey the required flows, and has the potential to burst.	10	The alternative poses little to no risk to occupational health and safety.	10	The alternative poses little to no risk to occupational health and safety.	10	The alternative poses little to no risk to occupational health and safety.
		Archaeological Impacts	10	The alternative has little to no impact on documented archaeologically significant features.	10	The alternative has little to no impact on documented archaeologically significant features. The right-of-way is previously disturbed and requires no further assessment.	10	The alternative has little to no impact on documented archaeologically significant features. The right-of-way is previously disturbed and requires no further assessment.	10	The alternative is expected to have little to no impact on documented archaeologically significant features. The right-of-way is previously disturbed. This evaluation will be confirmed during further archaeological assessment.
		Cultural Heritage Impacts	10	The alternative has little to no impact on documented cultural heritage resources.	10	The alternative has little to no impact on documented cultural heritage resources, as infrastructure can be routed to avoid those identified in the area.	10	The alternative has little to no impact on documented cultural heritage resources, as infrastructure can be routed to avoid those identified in the area.	10	The alternative is expected to have little to no impact on documented cultural heritage resources, as infrastructure can be routed to avoid those identified in the area. This evaluation will be confirmed in a further cultural heritage study.
		First Nations Cultural Heritage Impacts	10	The alternative represents little or no potential for disturbance of cultural heritage resources recognized by First Nations, as no new areas are impacted.	5	This alternative has little potential to disturb First Nations or Indigenous cultural heritage resources, however, there is some potential for disturbance within the study area where previously disturbed land is present. It is noted that the study area is adjacent to Walpole Island First Nation.	5	This alternative has little potential to disturb First Nations or Indigenous cultural heritage resources, however, there is some potential for disturbance within the study area where previously disturbed land is present. It is noted that the study area is adjacent to Walpole Island First Nation.	5	This alternative has little potential to disturb First Nations or Indigenous cultural heritage resources, however, there is some potential for disturbance within the study area where previously disturbed land is present. It is noted that the study area is adjacent to Walpole Island First Nation.
		Public land Use Impacts (parks, open spaces)	5	The alternative would maintain the character of public lands within the area.	5	The alternative would maintain the character of public lands within the area.	5	The alternative would maintain the character of public lands within the area.	5	The alternative would maintain the character of public lands within the area.
		Private Lands Impacts	10	The alternative would have no impact to private lands.	5	The alternative requires acquisition of private lands for the new BPS. The new transmission main would be constructed within the right-of-way.	5	The alternative requires acquisition of private lands for the new BPS. The new transmission main would be constructed within the right-of-way.	5	The alternative requires acquisition of private lands for a small section of the transmission main.
		Public Acceptability	0	The alternative would not be acceptable to the public, as it is not compatible with a new Wallaceburg WTP.	5	The alternative would be somewhat acceptable, as although it is compatible with the new Wallaceburg WTP, it would cause disruption in Wallaceburg.	5	The alternative would be somewhat acceptable, as although it is compatible with the new Wallaceburg WTP, it would cause disruption in Wallaceburg.	5	The alternative would be acceptable, as it is compatible with the Wallaceburg WTP and avoids construction in congested areas compared to Alternatives 1 and 2.
		Residential and industrial growth.	0	The alternative would not meet future demands in Dresden and for greenhouses, as the transmission main is insufficient to convey the required water.	10	The alternative would meet future demands in Dresden and for greenhouses.	10	The alternative would meet future demands in Dresden and for greenhouses.	10	The alternative would meet future demands in Dresden and for greenhouses.
		Disruption during Construction	5	This alternative would cause a moderate level of disruption if construction is required due to transmission main breaks.	0	The alternative would cause a relatively high amount of disruption during construction, as it contains a long section of new transmission main within Wallaceburg.	0	The alternative would cause a relatively high amount of disruption during construction, as it contains a longer section of new transmission main within Wallaceburg.	5	The alternative would cause a relatively moderate amount of disruption during construction.
		Normalized Score	***13.89***		***16.67***		***16.67***		***18.06***	

Wallaceburg WTP EA - Detailed Evaluation Criteria for Water Transmission

Category	Weighting	Criterion	Rank	Do Nothing	Rank	Alternative 1 Construct a new transmission main and BPS along Base Line	Rank	Alternative 2 Construct a new transmission main and BPS along McCreary Line	Rank	Alternative 3 Construct a new transmission main along Base Line w/ dedicated HLPs
Technical	25%	Adaptability	0	The alternative is not adaptable to increasing water demands beyond the planning horizon.	5	The alternative is adaptable to increasing water demands.	5	The alternative is adaptable to increasing water demands.	10	The alternative is adaptable to increasing water demands. The alternative also supports further development in an additional rural area close to Wallaceburg that would not be serviced by other alternatives.
		Ease of Approvals and Permitting	0	This alternative would require a DWWP revision, which would likely be rejected by the MECP due to insufficient transmission capacity.	10	Acquiring permits for this alternative would be relatively simple, given that the transmission main would be constructed within the right of way.	10	Acquiring permits for this alternative would be relatively simple, given that the transmission main would be constructed within the right of way.	5	Acquiring permits for this alternative would be relatively simple, given that the transmission main would be constructed within the right of way. Increased dewatering amount along agricultural drain may be of concern.
		Constructability, Implementation, and Work Scope	0	This alternative cannot be implemented on a practical basis.	5	The alternative can be constructed within a reasonable scope. There is one water crossing for this alternative and two valve chambers. However, the right-of-way contains many utilities, which could present issues.	0	The alternative would be constructed with some difficulty due to multiple stream crossings and valve chambers. There is also a long stretch through a heavily congested area of Wallaceburg.	5	The alternative can be constructed within a reasonable scope. There is one water crossing for this alternative and one valve chamber. Trenchless installation is required for one section and the watermain located along an existing agricultural drain may increase dewatering needs during construction.
		Operational and Maintenance Complexity	0	This alternative has high maintenance requirements due to anticipated transmission main breaks.	5	The alternative would include two pump stations and more pressure regulating devices in the system to reduce the pressure impact to Wallaceburg, more O&M intervention is anticipated.	5	The alternative would include two pump stations, more operation & maintaince effort anticipated	10	The alternative would be simple to operate and maintain as two separate pressure zones. All equipment would be new and modern.
		Level of Service	0	The alternative would reduce the level of service to Dresden, as the existing transmission main between Wallaceburg and Dresden is insufficient to supply 17.4 ML/d.	10	The alternative would improve the level of service in Dresden relative to existing conditions based on available fire flow. The maximum pressure in Wallaceburg would also be reduced.	5	The alternative would improve the level of service in Dresden relative to existing conditions based on available fire flow. However, system pressures in Wallaceburg would increase, which could increase leaks and breaks due to the age and condition of the system.	10	The alternative would improve the level of service in Dresden relative to existing conditions based on available fire flow. The maximum pressure in Wallaceburg would also be reduced.
		Compatibility with New Service Areas	0	The alternative is not compatible with the Wallaceburg WTP's new service areas.	10	The alternative is compatible with the Wallaceburg WTP's new service areas.	10	The alternative is compatible with the Wallaceburg WTP's new service areas.	10	The alternative is compatible with the Wallaceburg WTP's new service areas.
		Construction Schedule	10	There is no construction.	5	The construction schedule would be relatively moderate.	0	The construction schedule would be relatively long.	5	The construction schedule would be relatively moderate.
		Proximity to existing utilities	10	The alternative is in close proximity to existing utilities that are required for greenhouse construction.	5	The alternative is in close proximity to existing utilities that are required for greenhouse construction. However, the WM may be conflicting with existing underground utilities on Base Line in Wallaceburg	0	The alternative is in close proximity to some existing utilities that are required for greenhouse construction. The WM will go though Wallaceburg therefore more utility conflicts anticipated.	10	The alternative is in close proximity to existing utilities that are required for greenhouse construction.
		Risk/Reliability	0	There is a high level of risk associated with this alternative, as the existing transmission main is insufficient to convey 17.4 ML/d.	10	There is a low level of risk associated with this alternative.	10	There is a low level of risk associated with this alternative.	10	There is a low level of risk associated with this alternative.
		Water age	10	The alternative has a low potential for DBP formation.	10	The alternative has a low potential for DBP formation beyond the Canadian and USEPA MACs. During pilot testing, DBP formation was tested based on a 7-day distribution retention time and the resulting DBP levels were acceptable. The retention time in this system is expected to be much less than 7 days.	10	The alternative has a low potential for DBP formation beyond the Canadian and USEPA MACs. During pilot testing, DBP formation was tested based on a 7-day distribution retention time and the resulting DBP levels were acceptable. The retention time in this system is expected to be much less than 7 days.	10	The alternative has a low potential for DBP formation beyond the Canadian and USEPA MACs. During pilot testing, DBP formation was tested based on a 7-day distribution retention time and the resulting DBP levels were acceptable. The retention time in this system is expected to be much less than 7 days.
Economic	**25%**	Capital Cost	10	$7.8M	5	$31.7M	5	$33.9M	5	$32.8M
		Life-cycle Cost	0	$137M	5	$34.5M	5	$37.1M	5	$35.2M
Normalized Score			***12.5***		***12.5***		***12.5***		***12.5***	
TOTAL			**50.556**		**70.139**		**65.139**		**74.028**	
RANK			**4**		**2**		**3**		**1**	

Appendix A-2
Technical Memorandum No. 2

Technical Memorandum 2

Version Number: Final

Wallaceburg Water Treatment Servicing Schedule C Class EA
Chatham-Kent Public Utilities Commission

Document Number: PPS1111221410KWO

January 16, 2023

Technical Memorandum 2

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Project Name:	Wallaceburg Water Treatment Servicing Schedule C Class EA
Document Number:	PPS1111221410KWO
Project Number:	CE788300
Project Manager:	Tom Mahood, P.Eng.
Prepared by:	Jared Philpott, EIT, Ray Yu, Ph.D., P.Eng.
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Executive Summary

ES-1. Introduction

The Wallaceburg Water Treatment Plant (WTP) is a critical part of the existing Wallaceburg Water Supply System. The plant has been susceptible to frequent failures and repairs due to aging infrastructure and increasing wet weather impacts. The WTP was originally constructed in 1946 and has undergone major upgrades in 1948, 1980, and 2009. In 2016, the Chatham-Kent (CK) Public Utilities Commission (PUC) completed a Schedule B Class Environmental Assessment (EA) to assess the various water supply alternatives to service Wallaceburg and the surrounding area. The preferred solution from the 2016 EA was to maintain and rehabilitate the existing WTP, raw water intake, and low lift pumping station (LLPS). However, upon implementation of the recommended solution, it was evident that this solution was not sustainable approach because of the fast deterioration of plant assets and high costs associated with repairs and upgrades.

In June 2020, CK PUC retained Jacobs to complete a Schedule C Class EA and preliminary design to determine a defensible, long-term solution to revitalize and renew the Wallaceburg WTP to reliably meet current and anticipated future water quality regulations and enhance system safeguards against water quality anomalies.

In February 2021, the scope of the Class EA was expanded to investigate the potential of the Wallaceburg Drinking Water System (DWS) to provide water supply service to the Community of Dresden (currently serviced by the Chatham WTP), as well as to allow for future greenhouse development between Wallaceburg and Dresden.

The purpose of Technical Memorandum (TM) 2 is to document Phase 3 of this Class EA, which is the development and evaluation of alternative design concepts for the preferred solutions identified in Phase 2 (documented in TM 1). This TM identifies the preferred design concepts that will be carried forward for implementation following completion of the Environmental Study Report (ESR).

ES-2. Summary of Preferred Solutions

Alternative development and evaluations were completed, respectively, for three project components, each of which focuses on a different aspect of a complete water supply system. Alternative solutions were developed and evaluated for the following:

- **Overall Water Supply Strategy.** Relates to various future supply scenarios to meet the projected water demands for identified service areas.
- **Raw Water Supply.** Relates to the future location of the LLPS and intake. In addition to the existing location, two locations upstream of the existing LLPS were considered. The size of the LLPS and intake was determined based on the preferred overall water supply strategy.
- **Water Transmission.** Relates to the alignment of the transmission main between Wallaceburg and Dresden if the supply of water from Wallaceburg to Dresden becomes a part of the preferred overall water supply strategy.

The preferred overall water supply strategy was determined first, which impacts the requirements for raw water supply and water transmission. Then, the raw water supply and water transmission alternatives were developed and evaluated, respectively to identify preferred solutions. The three preferred alternatives formed an overall preferred solution for this Class EA.

This stepwise approach not only demonstrates the priority of the project components but also allows for efficient development and evaluation of alternatives under each project component.

The preferred solutions of these three project components are summarized in the following bullets and form the preferred integrated solution for Phase 2 of the Wallaceburg Water Treatment Servicing Class EA.

- **Overall Water Supply Strategy:** Alternative 2a: Build a new Wallaceburg WTP with a rated capacity of 28 megalitres per day (ML/day) to supply Wallaceburg, Dresden, and future greenhouses along Base Line, was selected as the preferred solution for the future Wallaceburg water supply strategy. The preferred solution for overall water supply strategy had the following implications for raw water supply and treated water transmission alternatives development and evaluation:
  - The raw water demand will be 34 ML/day in the future to account for process wastage within the Wallaceburg WTP. Therefore, the LLPS and intake must be able to convey 34 ML/day to the Wallaceburg WTP.
  - The projected future water demand for Dresden and the potential greenhouses along Base Line is 17.4 ML/day (8.8 ML/day and 8.6 ML/day for Dresden and the greenhouses, respectively). Therefore, the conveyance system between Wallaceburg and Dresden must be able to convey 17.4 ML/day in the future.
- **Raw Water Supply:** Alternative 3: Build a new LLPS and intake with a rated capacity of 34 ML/day at the second upstream location (Bluewater Line, south of Dufferin Avenue) was selected as the preferred solution for raw water supply.
- **Water Transmission:** Alternative 3: Construct a new water transmission main with dedicated high lift pumps along Baldoon Road, Border Road, Elbow Line, and Base Line between Wallaceburg and Dresden was selected as the preferred solution for water transmission.

ES-3. Alternative Design Concept Development and Evaluation

ES-3.1. Design Concept Development Methodology

Phase 3 of the Class EA process is to develop alternative design concepts for the preferred solutions identified in Phase 2 of this Class EA, as summarized in Section ES-2. Table ES-1 summarizes components of the preferred solution from Phase 2 of this Class EA and the corresponding EA schedule for each.

Table ES-1. EA Schedule for Preferred Solution from Phase 2

Preferred Solution Component	EA Schedule [a]
New Wallaceburg WTP	Schedule C
New LLPS and Intake	Schedule C
New Raw Watermain	Schedule B
New Treated Water Transmission Main from Wallaceburg to Dresden	Schedule B

Notes:

[a] Based on Municipal Class Environmental Assessment (Municipal Engineers Association 2019).

Alternative design concept development and evaluation are required for the new Wallaceburg WTP, LLPS, and intake, because these components are Schedule C projects. The new raw watermain and new treated water transmission main from Wallaceburg to Dresden are classified as Schedule B projects and thus do not require further development and evaluation of alternative design concepts. Therefore, the preferred solutions for the new raw watermain and water transmission main will be carried forward and further developed during Phase 5 of the Class EA process (implementation). These solutions will be documented in the ESR for this Class EA.

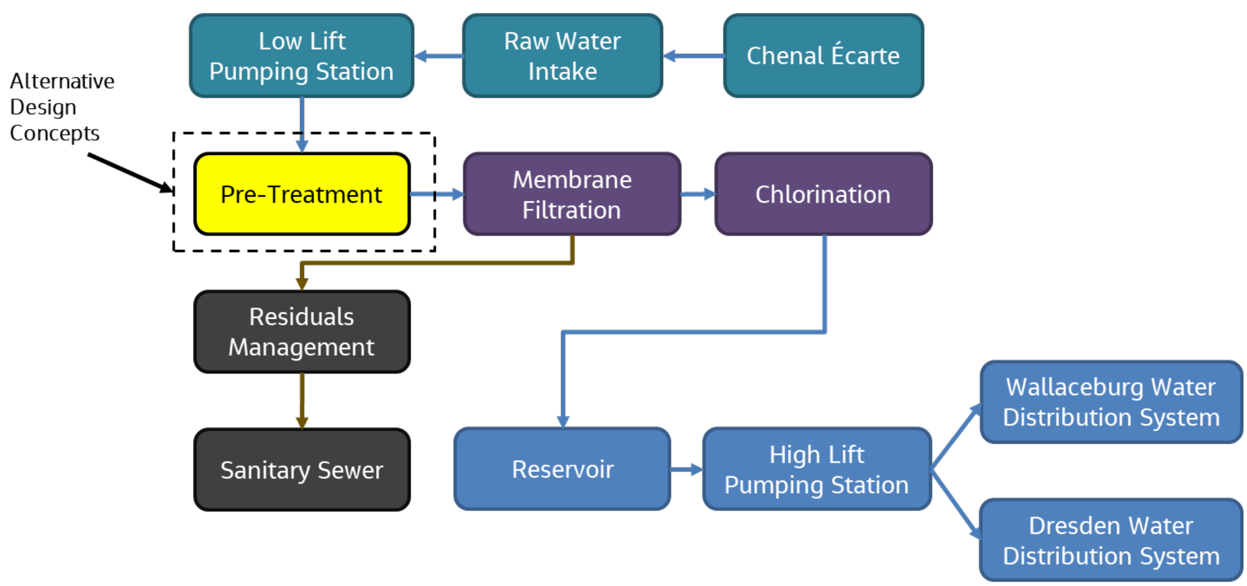
Alternative design concepts were developed for the following categories:

- **New Water Treatment Plant:** Development and evaluation of alternative design concepts focusing on alternative pre-treatment configurations that could be implemented in the new Wallaceburg WTP prior to low-pressure membrane filtration (LPMF), which has been selected as the base technology for the new WTP.
- **New LLPS and Intake:** Development and evaluation of alternative design concepts focusing on alternative raw water intake technologies that could be implemented at the selected location in the Chenal Écarte. The new LLPS concepts, while similar in configuration of pump wells and pumps, would be impacted by different intake technologies.

ES-3.2. Water Treatment

Alternative design concept development focused on the pre-treatment process at the new Wallaceburg WTP. Figure ES-1 presents a general process flow diagram for the new Wallaceburg WTP, with unit processes highlighted that are further investigated in design concepts.

Figure ES-1. Alternative Design Concept Basis for Water Treatment



Through consultation with the CK PUC, it was determined that the base treatment technology for the new Wallaceburg WTP will be LPMF and disinfection by chlorination. Therefore, each design concept has the following common processes:

- LPMF
- Chlorination by dosing Cl_2 gas

- Storage reservoir
- High lift pumping station (HLPS) to supply Wallaceburg, Dresden, and future greenhouses.
- Ancillary chemical systems., including the following:
  - Membrane cleaning systems (citric acid, NaOCl)
  - Fluoridation system
- Residuals management facility (RMF).

Phasing is also an important consideration, as it informs key design criteria, such as number of treatment trains and degree of redundancy. It was determined that the new Wallaceburg WTP will be constructed in two phases:

- **Phase 1:** Construct a new WTP with a rated capacity of 14 ML/day
- **Phase 2:** Expand the Wallaceburg WTP to a rated capacity of 28 ML/day

The following alternative design concepts were developed for water treatment, based on different pre-treatment strategies to LPMF:

- **Alternative Design Concept 1:** Coagulation, flocculation, and clarification
- **Alternative Design Concept 2:** In-line coagulation
- **Alternative Design Concept 3:** Coagulation and flocculation

Alternative Design Concept 3: Coagulation and Flocculation as pre-treatment to LPMF received the highest score and was thus selected as the preferred design concept for water treatment. Advantages for this design concept include the following:

- The pilot study demonstrated that this pre-treatment strategy was able to enhance reliable performance of LPMF during turbidity events. The pilot study was performed using the raw water from the existing intake and LLPS; two turbidity events occurred during the study. LPMF with coagulation and flocculation was proven to produce quality permeate during the events. Note turbidity event frequency is expected to reduce with the new intake being constructed upstream sufficiently on the Chenal Écarte to avoid impacts from seasonal turbidity spikes that occur at the existing LLPS.
- The design concept requires a relatively smaller footprint and has a moderate cost compared to the coagulation-flocculation-clarification option.
- The pre-treatment strategy provides more reliable control and operation relative to in-line coagulation, which would be difficult to control because of the reliance on the remote LLPS (i.e., acting as membrane feed pumps) to control the flow and pressure to membranes.

Based on the preferred water treatment plant concept, the LLPS will only be required to operate with the total dynamic head (TDH) necessary to convey raw water to the flocculation tanks at the new Wallaceburg WTP. This is reflected in the LLPS design concept development.

The estimated capital cost for the preferred water treatment design concept is **$66,200,000**.

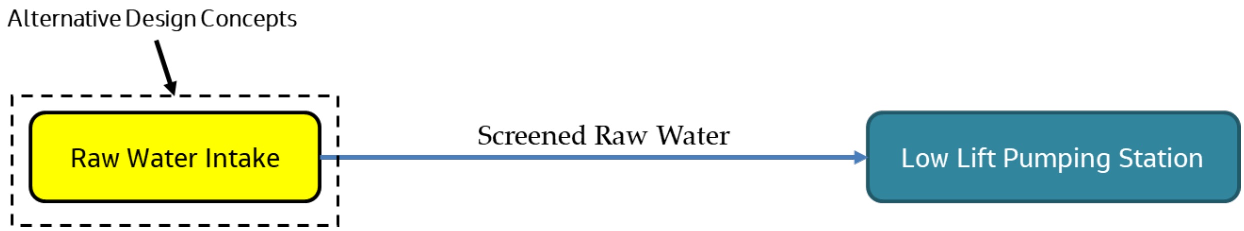
ES-3.3. Raw Water Supply

The preferred solution for raw water supply from Phase 2 consists of three components: (1) intake, (2) LLPS, and (3) raw watermain. As discussed in Section ES-3.1, the raw watermain is a Schedule B project and does not require further design concept development as part of this Class EA. Therefore, the raw water supply design concepts only considered the alternatives for the intake and LLPS.

A common LLPS design concept was developed through consultation with the CK PUC and therefore, alternative design concepts were focused on different configurations of raw water intake. Note that the intake type may impact the LLPS layout at some extent, but this variance can be addressed at the design stage.

Figure ES-2 presents a general process flow diagram and highlights the alternative design concept basis.

Figure ES-2. Alternative Design Concept Basis for Raw Water Supply



The following alternative design concepts were developed for raw water supply, based on various intake technologies:

- **Alternative Design Concept 1:** Submerged Tee Screens Intake
- **Alternative Design Concept 2:** Headwall-Mounted Tee Screens Intake
- **Alternative Design Concept 3:** Flat Panel Fish Screens Intake
- **Alternative Design Concept 4:** Travelling Screens with Bell-mouth Intake

Alternative Design Concept 1: Submerged Tee Screen Intakes received the highest score and thus was selected as the preferred design concept for raw water supply. The advantages for this concept include the following:

- This concept requires the smallest footprint and carries the lowest capital cost.
- This intake technology would have the least impact on the nearby wetland, shoreline, and riparian area because it does not require any additional structures or buildings between the Chenal Écarte and the LLPS.
- This intake technology is proven to be reliable in similar conditions (surface water with agricultural runoff).
- Operation and maintenance of the submerged T-screen intakes are relatively simple and require less effort.
- This screen technology provides an opportunity for a screen that is manufactured with a zebra mussel-resistant coating, which minimizes the control of zebra mussel growth at the screen or intake surface. The tee screen also rejects aquatic species at the point of entry, which is preferred by the Department of Fisheries and Oceans (DFO) for fish management. Screens are designed to meet DFO guidelines.

The estimated capital cost for the preferred raw water supply design concept is **$7,900,000**.

ES-4. Summary of Preferred Design Concepts

Figure ES-3 presents the integrated preferred design concepts, as well as the preferred solutions that were carried forward for the raw watermain and water transmission main identified in TM 1. Table ES-2 summarizes the key parameters. These components form the overall preferred solution and design concepts for this Class EA.

Table ES-2. Preferred Solution and Design Concept Parameters for the Wallaceburg Water Treatment Servicing Class EA

Parameter	Value
New Wallaceburg WTP Ultimate Rated Capacity	28 ML/day
Pre-Treatment Process	Coagulation and Flocculation
Filtration Process	Low-pressure Membrane Filtration
Primary Disinfection Process	Chlorination (Dedicated Chlorine Contact Tank)
Post-Treatment Process	Fluoridation
Ultimate Storage Capacity, megalitres	56 megalitres
New Intake and LLPS Ultimate Capacity	34 ML/day
Intake Screen Type	Submerged Tee Screens
Low Lift Pump Type	Vertical Turbine
Number of Low Lift Pumps	4 (2 duty, 2 standby)
New Twinned Raw Watermain Length	6,300 metres
New Treated Water Transmission Main Length from Wallaceburg to Dresden	18,500 metres

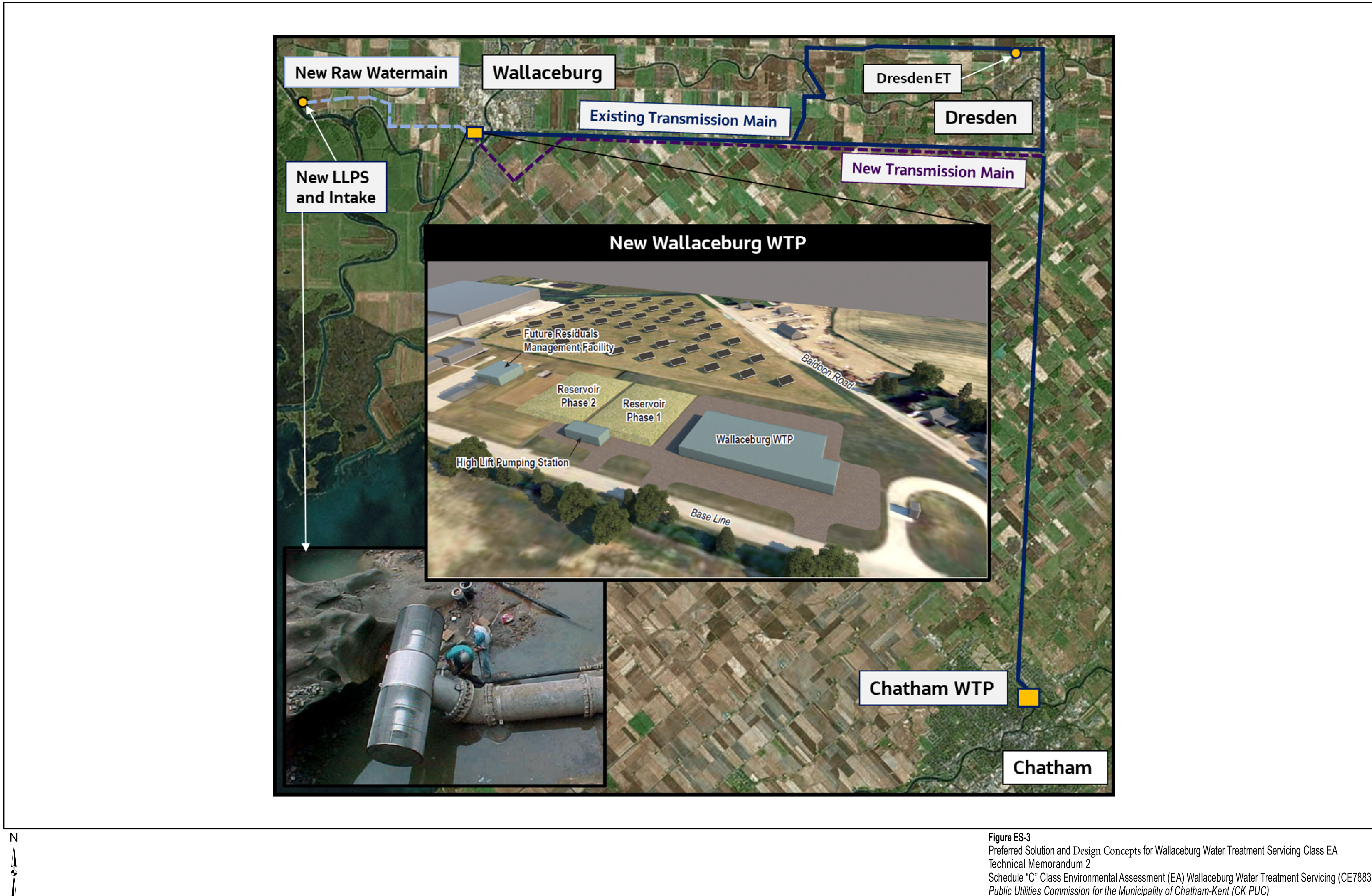


Figure ES-3
Preferred Solution and Design Concepts for Wallaceburg Water Treatment Servicing Class EA
Technical Memorandum 2
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

Jacobs

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Table ES-3 summarizes the components and their associated capital cost estimates.

Table ES-3. Overall Cost Estimate for Preferred Solution and Design Concepts

Component	Capital Cost Estimate
Wallaceburg WTP	$39,300,000
Storage Reservoir (56 megalitres)	$27,600,000
LLPS and Intake	$7,900,000
Raw Watermain	$9,500,000
Treated Water Transmission Main	$32,800,000
Total	$117,100,000

ES-5. Implementation Plan

The preferred solution identified in this Class EA will be implemented in two phases, which are tied to the treatment capacity of the new Wallaceburg WTP. Phasing and timing are based on the preliminary water demand projections developed in conjunction with the CK PUC. It is expected that these water demand projections will be refined, and timing will change following completion of the 2022 Chatham-Kent Water and Wastewater Master Plan.

The phases and their associated projects are described as follows:

- **Phase 1: Construct a new Wallaceburg WTP with a rated capacity of 14 ML/day**
  - Construct a new intake with a rated capacity of 34 ML/day, and an LLPS with a rated capacity of 17 ML/day and provisions to expand to a rated capacity of 34 ML/day. The entire building and all structural assets will be constructed during Phase 1. Additional pumps, electrical, and instrumentation and controls equipment are required in Phase 2 to expand the LLPS capacity from 17 ML/day to 34 ML/day.
  - Construct a new twinned raw watermain from the new LLPS to the new Wallaceburg WTP. Only one raw watermain pipe will be in service at any given time during Phase 1, with the in-service raw watermain changed periodically (cycled through).
  - Construct a new Wallaceburg WTP with a rated capacity of 14 ML/day and provisions to expand to a rated capacity of 28 ML/day. Table 8-1 presents the components that would be constructed in Phase 1 and their associated capacities.
  - Construct a new reservoir with a capacity of 28 megalitres. This includes the volume required based on the Ministry of Environment, Conservation and Parks (MECP) design guidelines, as well as additional redundancy based on municipality-specific requirements. This reservoir will provide 3 days of storage based on the projected average day demand (ADD) during Phase 1. The first phase of the reservoir would be constructed with provisions (structural, process) to connect to the second phase of the reservoir once constructed.
- **Phase 2: Expand the Wallaceburg WTP to provide a rated capacity of 28 ML/day**
  - Expand LLPS to provide a rated capacity of 34 ML/day by installing additional pumps, electrical, and instrumentation and controls equipment.
  - Expand the Wallaceburg WTP to provide a rated capacity of 28 ML/day by providing additional equipment. A new RMF will be constructed during Phase 2. Table 8-2 presents the capacity of each unit process following the Phase 2 expansion.

- Expand the reservoir to provide a capacity of 56 megalitres.
- Construct a new water transmission main from Wallaceburg to Dresden to supply future greenhouses and Dresden.

Table ES-4 presents the cost estimate breakdown for Phase 1 and Phase 2.

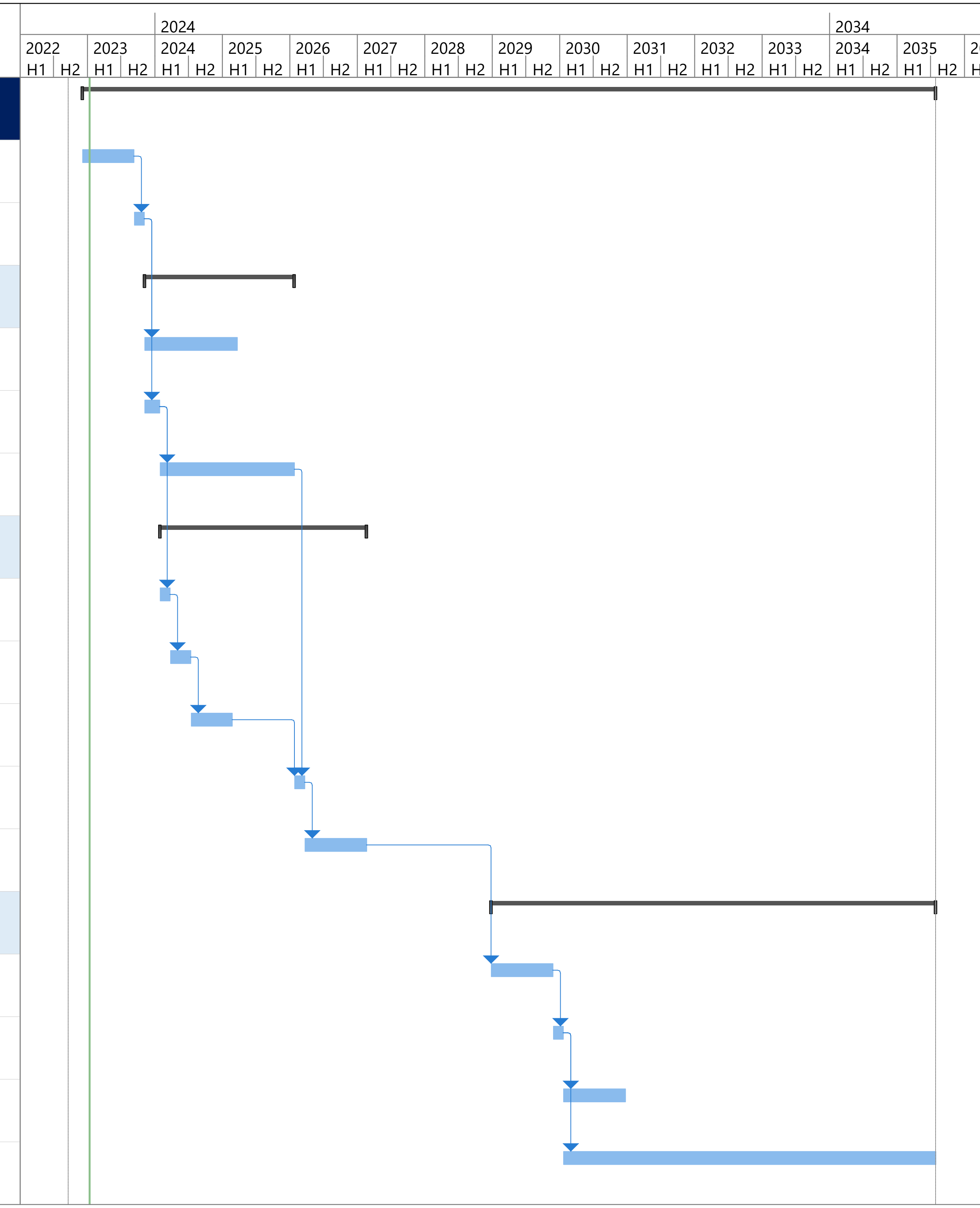
Table ES-4. Cost Estimate Breakdown for Phase 1 and Phase 2 Components

Component	Phase 1 Cost Estimate	Phase 2 Cost Estimate
Wallaceburg WTP	$29,100,000	$10,200,000
Storage Reservoir	$13,800,000	$13,800,000
LLPS and Intake	$6,600,000	$1,300,000
Raw Watermain	$9,500,000	-
Treated Water Transmission Main	-	$32,800,000
Total	$59,000,000	$58,100,000

Figure ES-4 presents the proposed implementation timing for the projects identified in this Class EA.

Figure ES-4: Implementation Plan

ID	Task Name	Duration	Start	Finish
1	**Wallaceburg WTP, Intake/LLPS and New Transmission Main**	**3300 days**	**Mon 12/5/22**	**Fri 7/27/35**
2	Preliminary Design	10 mons	Mon 12/5/22	Fri 9/8/23
3	Consultant Selection	2 mons	Mon 9/11/23	Fri 11/3/23
4	**Contract 1 - Wallaceburg WTP and Intake/LLPS Phase 1**	**580 days**	**Mon 11/6/23**	**Fri 1/23/26**
5	Detailed Design	18 mons	Mon 11/6/23	Fri 3/21/25
6	Tender Period	3 mons	Mon 11/6/23	Fri 1/26/24
7	Construction	26 mons	Mon 1/29/24	Fri 1/23/26
8	**Contract 2 - Old Wallaceburg WTP Decommissioning and Demolition**	**800 days**	**Mon 1/29/24**	**Fri 2/19/27**
9	Consultant Selection	2 mons	Mon 1/29/24	Fri 3/22/24
10	Preliminary Design	4 mons	Mon 3/25/24	Fri 7/12/24
11	Detailed Design	8 mons	Mon 7/15/24	Fri 2/21/25
12	Tender Period	2 mons	Mon 1/26/26	Fri 3/20/26
13	Construction	12 mons	Mon 3/23/26	Fri 2/19/27
14	**Contract 3 - Wallaceburg WTP and Intake/LLPS Phase 2 and New Transmission Main**	**1720 days**	**Mon 12/25/28**	**Fri 7/27/35**
15	Detailed Design	12 mons	Mon 12/25/28	Fri 11/23/29
16	Tender Period	2 mons	Mon 11/26/29	Fri 1/18/30
17	Construction - WTP and LLPS Phase 2	12 mons	Mon 1/21/30	Fri 12/20/30
18	Construction - Transmission Main	72 mons	Mon 1/21/30	Fri 7/27/35



ES-6. Next Steps

The next steps of this Class EA are to document Phases 1 to 3 in an ESR, which will satisfy Phase 4 of the Class EA process. The ESR will be available for public review and comment for a 30-day period, which will be initiated when the Notice of Completion is issued. Preliminary design will begin once the ESR has been approved by the MECP.

Contents

Appendices

Tables

Figures

Acronyms and Abbreviations

Acronym	Definition
ADD	average day demand
CCT	chlorine contact tank
CK	Chatham-Kent
Cl_2	chlorine
CO_2	carbon dioxide
CPES	Conceptual and Parametric Engineering System
DFO	Department of Fisheries and Oceans
DWS	Drinking Water System
DWWP	Drinking Water Works Permit
EA	Environmental Assessment
ESA	*Endangered Species Act*
ESC	erosion and sediment control
ESR	Environmental Study Report
ET	elevated tank
CO_2 eq	carbon dioxide equivalent
GHG	greenhouse gas
HAA	haloacetic acid
km	kilometre
kWh	kilowatt hour
L2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule
LLPS	Low lift pumping station
LMH	litre per square metre per hour
LPMF	low-pressure membrane filtration
LRAA	locational running annual average
m	metre
m^2	square metre

Acronym	Definition
m^3	cubic metre
masl	metres above sea level
MCC	motor control centre
MDD	maximum day demand
MDWL	Municipal Drinking Water Licence
MECP	Ministry of Environment, Conservation and Parks
mg/L	milligram per litre
ML/day	megalitres per day
MNDMNRF	Ministry of Northern Development, Mines, Natural Resources and Forestry
NaOCl	sodium hypochlorite
NTU	nephelometric turbidity unit
O&M	operations and maintenance
PACl	polyaluminum chloride
PUC	Public Utilities Commission
RMF	residuals management facility
SAR	species at risk
SARA	*Species at Risk Act*
SCRCA	St. Clair Region Conservation Authority
TDH	total dynamic head
TM	technical memorandum
TTHMs	total trihalomethanes
WPCP	Water Pollution Control Plant
WTP	Water Treatment Plant

1. Introduction

Section 1 describes the project the background, purpose, and objectives.

1.1 Background

The Wallaceburg Water Treatment Plant (WTP) is a critical part of the existing Wallaceburg Water Supply System. The plant has been susceptible to frequent failures and repairs due to aging infrastructure and increasing wet weather impacts. The WTP was originally constructed in 1946 and has undergone major upgrades in 1948, 1980, and 2009. In 2016, the Chatham-Kent (CK) Public Utilities Commission (PUC) completed a Schedule B Class Environmental Assessment (EA) to assess the various water supply alternatives to service Wallaceburg and the surrounding area. The preferred solution from the 2016 EA was to maintain and rehabilitate the existing WTP, raw water intake, and low lift pumping station (LLPS). However, upon implementation of the recommended solution, it was evident that this solution was not sustainable approach because of the fast deterioration of plant assets and high costs associated with repairs and upgrades.

In June 2020, CK PUC retained Jacobs to complete a Schedule C Class EA and preliminary design to determine a defensible, long-term solution to revitalize and renew the Wallaceburg WTP to reliably meet current and anticipated future water quality regulations and enhance system safeguards against water quality anomalies.

In February 2021, the scope of the Class EA was expanded to investigate the potential of the Wallaceburg Drinking Water System (DWS) to provide water supply service to the Community of Dresden (currently serviced by the Chatham WTP), as well as to allow for future greenhouse development between Wallaceburg and Dresden.

1.2 Purpose and Objectives

The purpose of Technical Memorandum (TM) 2 is to document Phase 3 of this Class EA, which is the development and evaluation of alternative design concepts for the preferred solutions identified in Phase 2 (documented in TM 1). This TM identifies the preferred design concepts that will be carried forward for implementation following completion of the Environmental Study Report (ESR).

2. Summary of Preferred Solutions

This section summarizes the preferred solutions that were identified in Phase 2 of this Class EA. Phase 2 was documented in TM 1.

Alternative development and evaluations were completed, respectively, for three project components, each of which focuses on a different aspect of a complete water supply system. Alternative solutions were developed and evaluated for the following:

- **Overall Water Supply Strategy.** Relates to various future supply scenarios to meet the projected water demands for identified service areas.
- **Raw Water Supply.** Relates to the future location of the LLPS and intake. In addition to the existing location, two locations upstream of the existing LLPS were considered. The size of the LLPS and intake was determined based on the preferred overall water supply strategy.
- **Water Transmission.** Relates to the alignment of the transmission main between Wallaceburg and Dresden if the supply of water from Wallaceburg to Dresden becomes a part of the preferred overall water supply strategy.

The preferred overall water supply strategy was determined first, which impacts the requirements for raw water supply and water transmission. Then, the raw water supply and water transmission alternatives were developed and evaluated, respectively to identify preferred solutions. The three preferred alternatives formed an overall preferred solution for this Class EA. This stepwise approach not only demonstrates the priority of the project components but also allows for efficient development and evaluation of alternatives under each project component.

The preferred solutions of these three project components are summarized in the following bullets and form the preferred integrated solution for Phase 2 of the Wallaceburg Water Treatment Servicing Class EA.

- **Overall Water Supply Strategy:** Alternative 2a: Build a new Wallaceburg WTP with a rated capacity of 28 megalitres per day (ML/day) to supply Wallaceburg, Dresden, and future greenhouses along Base Line, was selected as the preferred solution for the future Wallaceburg water supply strategy. The preferred solution for overall water supply strategy had the following implications for raw water supply and treated water transmission alternatives development and evaluation:
  - The raw water demand will be 34 ML/day in the future to account for process wastage within the Wallaceburg WTP. Therefore, the LLPS and intake must be able to convey 34 ML/day to the Wallaceburg WTP.
  - The projected future water demand for Dresden and the potential greenhouses along Base Line is 17.4 ML/day (8.8 ML/day and 8.6 ML/day for Dresden and the greenhouses, respectively). Therefore, the conveyance system between Wallaceburg and Dresden must be able to convey 17.4 ML/day in the future.
- **Raw Water Supply:** Alternative 3: Build a new LLPS and intake with a rated capacity of 34 ML/day at the second upstream location (Bluewater Line, south of Dufferin Avenue) was selected as the preferred solution for raw water supply.
- **Water Transmission:** Alternative 3: Construct a new water transmission main with dedicated high lift pumps along Baldoon Road, Border Road, Elbow Line, and Base Line between Wallaceburg and Dresden was selected as the preferred solution for water transmission.

Figure 2-1 presents the integrated preferred solution from Phase 2 of the Wallaceburg Water Treatment Servicing Class EA.

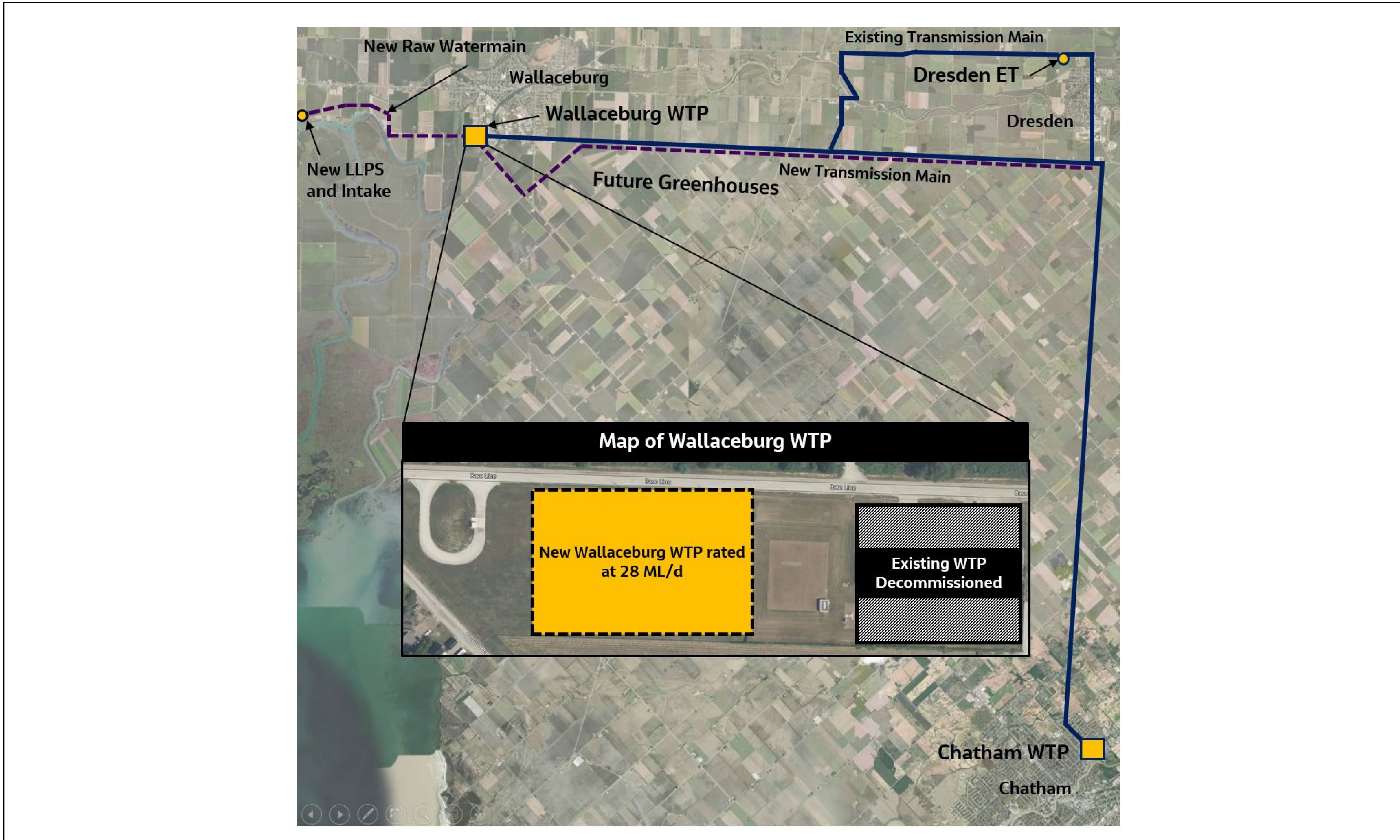


Figure 2-1
Preferred Solution for Wallaceburg Water Treatment Servicing Class EA
Technical Memorandum 2
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

Jacobs

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3. Methodology

This section presents the methodology for developing and evaluating alternative design concepts of the preferred solutions.

3.1 Design Concept Development Methodology

Phase 3 of the Class EA process is to develop alternative design concepts for the preferred solutions identified in Phase 2 of this Class EA, as summarized in Section 2. Table 3-1 summarizes components of the preferred solution from Phase 2 of this Class EA and the corresponding EA schedule for each.

Table 3-1. EA Schedule for Preferred Solution from Phase 2

Preferred Solution Component	EA Schedule [a]
New Wallaceburg WTP	Schedule C
New LLPS and Intake	Schedule C
New Raw Watermain	Schedule B
New Treated Water Transmission Main from Wallaceburg to Dresden	Schedule B

Notes:

[a] Based on Municipal Class Environmental Assessment (Municipal Engineers Association 2019).

Alternative design concept development and evaluation are required for the new Wallaceburg WTP, LLPS, and intake, because these components are Schedule C projects. The new raw watermain and new treated water transmission main from Wallaceburg to Dresden are classified as Schedule B projects and thus do not require further development and evaluation of alternative design concepts. Therefore, the preferred solutions for the new raw watermain and water transmission main will be carried forward and further developed during Phase 5 of the Class EA process (implementation). These solutions will be documented in the ESR for this Class EA.

Alternative design concepts were developed for the following categories:

- **New Water Treatment Plant:** Development and evaluation of alternative design concepts focusing on alternative pre-treatment configurations that could be implemented in the new Wallaceburg WTP prior to low-pressure membrane filtration (LPMF), which has been selected as the base technology for the new WTP.
- **New LLPS and Intake:** Development and evaluation of alternative design concepts focusing on alternative raw water intake technologies that could be implemented at the selected location in the Chenal Écarte. The new LLPS concepts, while similar in configuration of pump wells and pumps, would be impacted by different intake technologies.

An evaluation methodology was developed to allow for a comparative assessment of each set of design concepts and identify the preferred design concepts, aligned with the Class EA evaluation framework. Whereas the Phase 2 alternative solution evaluation focused on natural, socio-cultural, technical, and economic criteria, the alternative design concept evaluation methodology in Phase 3 focuses on the technical and economic criteria because of the technology-driven nature of the design concepts.

The design concept development and evaluations for water treatment and raw water supply are presented in Section 4 and Section 5, respectively.

3.2 Cost Estimation Methodology

This section presents the cost estimating methodology that was used to develop capital costs, operation and maintenance (O&M) costs, and lifecycle costs for each alternative.

3.2.1 Capital Cost Estimation Basis

Capital cost estimates were developed for each alternative design concept. Capital costs for new infrastructure were developed using Jacobs' Conceptual and Parametric Engineering System (CPES™). CPES uses a database of project data and quantity takeoffs to develop conceptual estimates. Unit process modules within CPES are based on actual construction costs from Jacobs' projects and supplemented by Means and Richardson's cost data. The Jacobs database of material and equipment costs is adjusted based on Engineering News Record indexes for location and monthly cost index updates to reflect real marked conditions and local labour costs. For the purposes of this project, unit costs are adjusted for the Southwestern Ontario construction market. The generated cost estimates include allowances to reflect the risks and contingency factors associated with predicting future costs. Where applicable, capital cost estimates may be developed based on vendor quotations for specific equipment or technologies, and by using reference projects of similar scope to obtain high-level estimates.

The construction capital costs developed using CPES are approximately +50 percent to -30 percent, including the following markups and adjustment factors, unless otherwise specified:

- 10 percent contractor overhead
- 3 percent project overhead (Owner)
- 4 percent general conditions (Division 1 costs)
- 1 percent mobilization and demobilization
- 1 percent insurance
- 1 percent bond
- 10 percent contractor profit
- 30 percent estimating contingency
- 10 percent engineering fees

3.2.2 O&M Cost Estimation Basis

O&M costs were developed based on the future average day demand (ADD) projections to 2070, which are assumed to be 80 percent of maximum day demand (MDD) based on the historical flow analysis presented in TM 1. Table 3-2 summarizes the ADD and MDD flow projections for the new Wallaceburg WTP and the new intake and LLPS that were used to develop O&M cost estimates.

Table 3-2. Flow Projections for the Wallaceburg WTP and LLPS in 2070

Component	Projected ADD, ML/d	Projected MDD, ML/d
Wallaceburg WTP	22.4	28
Intake and LLPS	27.2	34

O&M costs were developed considering the following conditions:

- **Electricity:** The average electricity cost at the Wallaceburg WTP in dollars per kilowatt hour between 2017 and 2020 was used when developing annual operating costs, as this period is the most representative of the electricity usage patterns at the Wallaceburg WTP. Jacobs' CPES tool was used to estimate electricity consumption for new infrastructure.
- **Chemicals:** Chemical costs can be affected by macroeconomics and by local supply and demand; therefore, it is difficult to project chemical costs in the long-term. For the purpose of this study, costs for chemicals were based on recent bills as provided by the CK PUC or on previous Jacobs projects in the area. Disinfection O&M costs were developed with chlorine (Cl_2) gas as the chemical of choice. It was also assumed that sodium hyprochlorite (NaOCl) will continue to be used for zebra mussel control at the raw water intake in the future. Chemical consumption was estimated for average daily flows; however, for membrane cleaning chemical usage, estimates provided by Suez as part of the pilot study were used.

The O&M cost estimate basis is presented in Table 3-3.

Table 3-3. O&M Cost Estimate Basis

Item	Unit Cost	Source/Basis
Electricity	$0.15/kilowatt hour	CK PUC billing data
Coagulant (PACl)	$0.60/kilogram	CK PUC billing data
Sodium Hypochlorite (NaOCl)	$0.18/cubic metre	Previous Jacobs projects
Chlorine (Cl_2) Gas	$1.10/kilogram	CK PUC billing data
Hydrofluorosilicic Acid	$0.80/kilogram	Previous Jacobs projects
Citric Acid	$2.70/kilogram	Previous Jacobs projects
Annual Maintenance	2% of equipment costs	Previous Jacobs projects

Note:

PACl = polyaluminum chloride

3.2.3 Lifecycle Cost Estimation Basis

Lifecycle costs (50-year) estimates were developed by calculating the net present value of the capital costs and annual O&M costs to the year 2070. Table 3-4 summarizes the basis for lifecycle cost estimate for this study.

Table 3-4. Lifecycle Cost Estimate Basis

Item	Value	Source/Basis
Lifecycle Duration	50 years	The planning horizon is 50 years.
Discount Rate	5 percent	Similar Jacobs projects in Ontario.
Inflation Rate	2 percent	Similar Jacobs projects in Ontario; general inflation rate to be applied on annual O&M costs for utilities, chemicals, labour, and maintenance

3.3 Greenhouse Gas Emissions

Greenhouse gas (GHG) emissions were estimated for each design concept based on the consumption of purchased electricity, consistent with the International Organization for Standardization 14064 for GHG verification and accounting (ISO 2006). Natural gas consumption is also typically considered but would be expected to have a minimal impact compared to electricity consumption at a WTP; as such, it was assumed to have a negligible impact. Of note, only Scope 1 and Scope 2 emissions were considered in developing GHG emission projections, which is a typical GHG emission reporting practice by municipalities. Scope 1 and Scope 2 emissions are defined as follows by the International Panel on Climate Change (IPCC 2006):

- Scope 1: Direct GHG emissions.
- Scope 2: Indirect GHG emissions from electricity, heat, or steam usage.

The emission factors are published in the National Inventory Report (Environment and Climate Change Canada 2022), updated to publish new annual emission factors for up to 2 years prior to the report year (the 2022 report updates the emission factors up to the year 2020). An emission factor of 28 grams of carbon dioxide equivalent (CO_2 eq) per kilowatt hour was used to estimate the GHG emissions from electricity consumption. Scope 1 emissions are minimal in comparison to Scope 2 impacts for WTPs, because WTPs are not typically expected to release large amount of GHGs, such as carbon dioxide and nitrous oxides directly.

3.4 Evaluation Methodology

An evaluation methodology was developed to allow for a comparative assessment of each set of design concepts and identify the preferred design concepts, aligned with the Class EA evaluation framework. Whereas the Phase 2 alternative solution evaluation focused on natural, socio-cultural, technical, and economic criteria, the alternative design concept evaluation methodology in Phase 3 focused on the technical and economic criteria because of the technology-driven nature of the design concepts.

Alternative solutions were scored for each of the criteria using the following scoring methodology, with a rationale provided to support each score:

- 10 = highest score
- 5 = moderate score
- 1 = lowest score

Each criterion was given an equal weighting for the evaluation. For example, if there were 8 criteria, each would be given a weighting of 12.5 percent. Once evaluation scores and rationales were provided for each alternative, the scores were totalled and normalized to an overall score out of 100 based on the category weightings.

4. Development and Evaluation of Alternative Design Concepts for Water Treatment Plant

Section 4 discusses how the alternative design concepts for the water treatment plant were developed and evaluated.

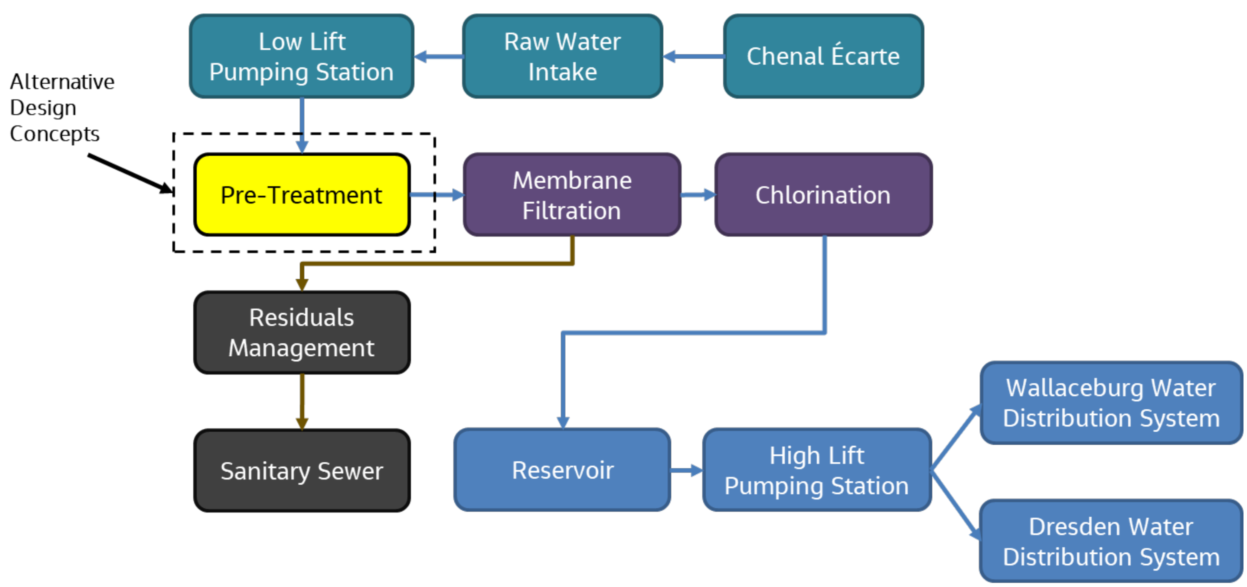
4.1 Water Treatment Design Concepts

Subsection 4.1 describes alternative water treatment design concepts.

4.1.1 Alternative Design Concept Development

Alternative design concept development focused on the pre-treatment process at the new Wallaceburg WTP. Figure 4-1 presents a general process flow diagram for the new Wallaceburg WTP, with unit processes highlighted that are further investigated in later sub-sections.

Figure 4-1. Alternative Design Concept Basis for Water Treatment



In TM 1, the base treatment process for a new Wallaceburg WTP included coagulation, flocculation, and clarification. However, a pilot study for LPMF was completed at the Wallaceburg WTP in 2021 and determined that clarification is not necessary to support satisfactory membrane filtration performance. This is reinforced by the preferred new intake and LLPS location, which will be upstream sufficiently on the Chenal Écarte to avoid impacts from seasonal turbidity spikes that occur at the existing LLPS.

The following pre-treatment strategies to LPMF were considered:

- Coagulation, flocculation, and clarification
- In-line coagulation
- Coagulation and flocculation

These pre-treatment technologies form the basis for the alternative design concepts that are discussed in Sections 4.1.9 to 4.1.11.

4.1.2 Common Elements

Through consultation with the CK PUC, it was determined that the base treatment technology for the new Wallaceburg WTP will be LPMF and disinfection by chlorination. Therefore, each design concept has the following common processes:

- LPMF
- Chlorination by dosing Cl_2 gas
- Storage reservoir (discussed in more detail in Section 4.1.7)
- High lift pumping station (HLPS) to supply Wallaceburg, Dresden, and future greenhouses.

  The pumping strategy described in the following sub-bullets is required based on the preferred solution for water transmission, described in Section 2. The pumping strategy will be further analyzed and optimized during the design phase.

  - Wallaceburg: Two duty pumps and one standby pump, rated to provide 10 ML/day at 57 metres of total dynamic head (TDH)
  - Dresden: Two duty pumps and one standby pump, rated to provide 18 ML/day at 70 metres of TDH
- Ancillary chemical systems., including the following:
  - Membrane cleaning systems (citric acid, NaOCl)
  - Fluoridation system
- Residuals management facility (discussed in more detail in Section 4.1.8).

Phasing is also an important consideration, as it informs key design criteria, such as number of treatment trains and degree of redundancy. It was determined that the new Wallaceburg WTP will be constructed in two phases based on the demand curve developed in TM 1 and through consultation with the CK PUC:

- **Phase 1:** Construct a new WTP with a rated capacity of 14 ML/day
- **Phase 2:** Expand the Wallaceburg WTP to a rated capacity of 28 ML/day

Note that all major building and structural assets would be constructed in Phase 1, with the equipment only being installed to a rated capacity of 14 ML/day. As such, the Phase 2 expansion would be achieved by installing additional equipment (process, electrical, instrumentation), constructing an additional reservoir, and building a new residual management facility (RMF) as needed. This strategy is reflected in the cost estimates for each alternative design concept.

4.1.3 Treatment Objectives

Table 4-1 summarizes the treatment objectives for the new Wallaceburg WTP.

Table 4-1. Wallaceburg WTP Treatment Objectives

Treatment Process	Design Parameter	Basis
Rated Capacity	Phase 1, ML/day	14
	Phase 2, ML/day	28
Treated Water	Treated Water Turbidity [a]	Less than 0.1 NTU 99% of the time Never exceed 0.3 NTU
Primary Disinfection	*Cryptosporidium* Reduction	3-log removal or greater [b,c]
	Giardia Reduction	3-log removal or greater [b,d]
	Virus Reduction	4-log removal or greater [b,e]
Disinfection Byproducts [e]	TTHMs, micrograms per litre	Less than 80 as LRAA
	HAAs, micrograms per litre	Less than 60 as LRAA

Notes:

LRAA = locational running annual average

NTU = Nephelometric turbidity units

TTHMs = total trihalomethanes

HAAs = haloacetic acids

[a] Required per the Procedure for Disinfection of Drinking Water in Ontario (MECP 2016).

[b] Per Long Term 2 Enhanced Surface Water Treatment Rule Documents (L2ESWTR) (EPA 2022a).

[c] Membrane filtration provides a 2-log removal credit for *Cryptosporidium* (MECP 2016). However, membranes will be specified to provide 3.0+-log removal. For reference, membranes provided greater than 4.8-log removal during the pilot study.

[d] Membrane filtration provides a 3+-log removal credit for *Giardia*. However, 0.5-log removal must be provided by the disinfection process at a minimum, and therefore, chlorination must provide 0.5-log *Giardia* removal at the new Wallaceburg WTP.

[e] Membrane filtration provides a 0- to 2+-log removal credit for viruses. The chlorination process at the new Wallaceburg WTP will be designed to provide a 4-log virus removal.

[f] According to the U.S. Environmental Protection Agency (EPA) Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rules (EPA 2022b), which are anticipated to be adopted in Ontario in the future. According to the EPA, disinfectants and disinfection byproduct concentration reporting is completed using the LRAA, which is the average concentration over the last four calendar quarters.

4.1.4 Low-Pressure Membrane Filtration

LPMF was selected as the base treatment technology for the new Wallaceburg WTP. Table 4-2 presents preliminary design parameters for a new LPMF system, as recommended by the vendor based on the results of the pilot study completed in 2021 (Jacobs 2022).

Table 4-2. LPMF Design Parameters

Parameter	Summer Conditions	Winter Conditions
Permeate Production at MDD, ML/day	28	25
Total Number of Membrane Trains (N)	4	4
Firm Number of Membrane Trains (N-1)	3	3
Total Number of Membrane Modules	640	640
Instantaneous Flux (N), LMH	45	40
Instantaneous Flux (N-1), LMH	62	54
Recovery, %	95	95
Backwash Frequency per Train (N), minutes	36.6	41.3
Backwash Frequency per Train (N-1), minutes	27.2	30.8
Membrane Integrity Test Frequency, per day	1	
Maintenance Clean Protocol, per week	6, 250 mg/L NaOCl 1, 500 mg/L citric acid	
Recovery Clean Protocol, per month	1, 500 mg/L NaOCl, 2 grams per litre citric acid	
Coagulant Addition, mg/L [c]	0.5 to 2.0	
Pre-Treatment Hydraulic Retention Time, minutes	7 to 15	

Notes:

[a] "N" refers to operating conditions with all 4 membrane trains in service.

[b] "N-1" refers to operating conditions with 3 membrane trains in service and 1 membrane train out of service.

[c] As neat product.

LMH = litre per square metre per hour

mg/L = milligrams per litre

4.1.5 Primary Disinfection

Primary disinfection will be achieved via chlorination at the new Wallaceburg WTP. A new, dedicated chlorine contact tank (CCT) will be constructed upstream of the new storage reservoir. The following removals must be achieved by disinfection (MECP 2016):

- 4-log virus inactivation
- 0.5-log *Giardia* cyst removal

Table 4-3 presents the basis for CCT sizing.

Table 4-3. CCT Sizing Basis

Parameter	Cold Water Temperature	Warm Water Temperature
Design Flow, ML/day	25 [a]	28
Free Chlorine Residual, mg/L [b]	1.5	1.5
Water Temperature, degrees Celsius [c]	0.5	20
CT Required, mg/L minutes [d,e,f]	45	12
Volume Required to Achieve CT, megalitres	0.8	0.8
T_{10}/T [g]	0.7	0.7
CT Available, mg/mL, minutes	48.4	43.2
Contact Time, minutes	51.8	46.3

Notes:

[a] Projected winter flow based on historical flow trends at the Wallaceburg WTP.

[b] Target Cl_2 residual based on discussions with PUC operations staff.

[c] Minimum and maximum water temperatures based on historical operating data.

[d] Based on Ministry of Environment, Conservation and Parks (MECP) Procedure for Disinfection (MECP 2016).

[e] pH = 7.5.

[f] Values interpolated from the values in Tables of CT values for inactivation of Giardia cysts by free chlorine at 0.5°C or lower (pH = 7.5) in MECP Procedure for Disinfection (MECP 2016).

[g] Assumes a well-baffled tank. Based on the MECP Procedure for Disinfection (MECP 2016).

CT = contact time

mg/ml = milligrams per millilitre

T_{10}/T = baffling factor

4.1.6 High Lift Pumping

The common HLPS concept was developed based on the preferred solution for water transmission, which is to supply water to Wallaceburg, Dresden, and future greenhouses along Base Line. Sections of the Wallaceburg WDS are currently in poor condition and are subject to periodic breakage and leaks; as such, the preferred strategy is to avoid any pressure increases in the system relative to current conditions following construction of the new HLPS. Various pumping scenarios were explored in the hydraulic modelling TM completed by Jacobs as part of TM 1, and the preferred solution was to provide dedicated sets of pumps for Wallaceburg and Dresden (including greenhouse supply), respectively supplying two separate pressure zones. Table 4-4 summarizes the preliminary design criteria for the new HLPS. The pumping strategy (number of pumps and capacity of each pump) will be further optimized during the design stage.

Table 4-4. Preliminary Design Criteria for HLPS

Parameter	Wallaceburg WDS	Dresden WDS
Pump Type	Vertical Turbine	Vertical Turbine
Number of Duty Pumps	2	2
Number of Standby Pumps	1	1
Pump Capacity Each, ML/day	5	8.7
Total Dynamic Head, metres	57	70
Firm Capacity, ML/day	10	18

The HLPS will be constructed as a separate building from the main WTP building, with the pump well(s) adjacent to the new reservoir. The estimated footprint is 10 metres by 21 metres.

4.1.7 Storage Requirements

A storage requirement analysis was completed and documented in TM 1 for the new Wallaceburg WTP. The analysis was based on the MECP Design Guidelines for Drinking-Water Systems (MECP 2008) and considered the existing storage in the Wallaceburg Elevated Tank (ET) and Reservoir 2, assuming that Reservoir 2 would be rehabilitated with the full volume available in the future. The total storage requirement was determined to be 10.3 megalitres, with 9.1 megalitres provided by the Wallaceburg ET and Reservoir 2. Therefore, 1.2 megalitres of additional storage would be required through construction of a new reservoir.

While this analysis followed the MECP design guidelines for treated water storage, there are also system-specific considerations that inform the level of storage redundancy required. A risk-based assessment was completed by the CK PUC to identify additional storage requirements.

Chemical spills from the Sarnia area were an issue in the Chenal Écarte historically and required the CK PUC to close the raw water intake on multiple occasions, halting water production at the Wallaceburg WTP. The longest period that the intake was closed for because of a spill was 3 days. The CK PUC must rely on reservoir and ET storage to supply users during these time periods and would therefore like to include storage redundancy that would provide adequate water supply in the future when the intake is closed for an extended duration because of a chemical spill incident.

The storage analysis was completed by the CK PUC based on providing 3 days of storage for Wallaceburg, Dresden, and future greenhouses at ADD, with the largest storage unit (the Dresden ET) out of service. Table 4-5 documents the storage analysis and future reservoir volume requirements completed by the CK PUC.

Table 4-5. Wallaceburg DWS Storage Requirement Analysis

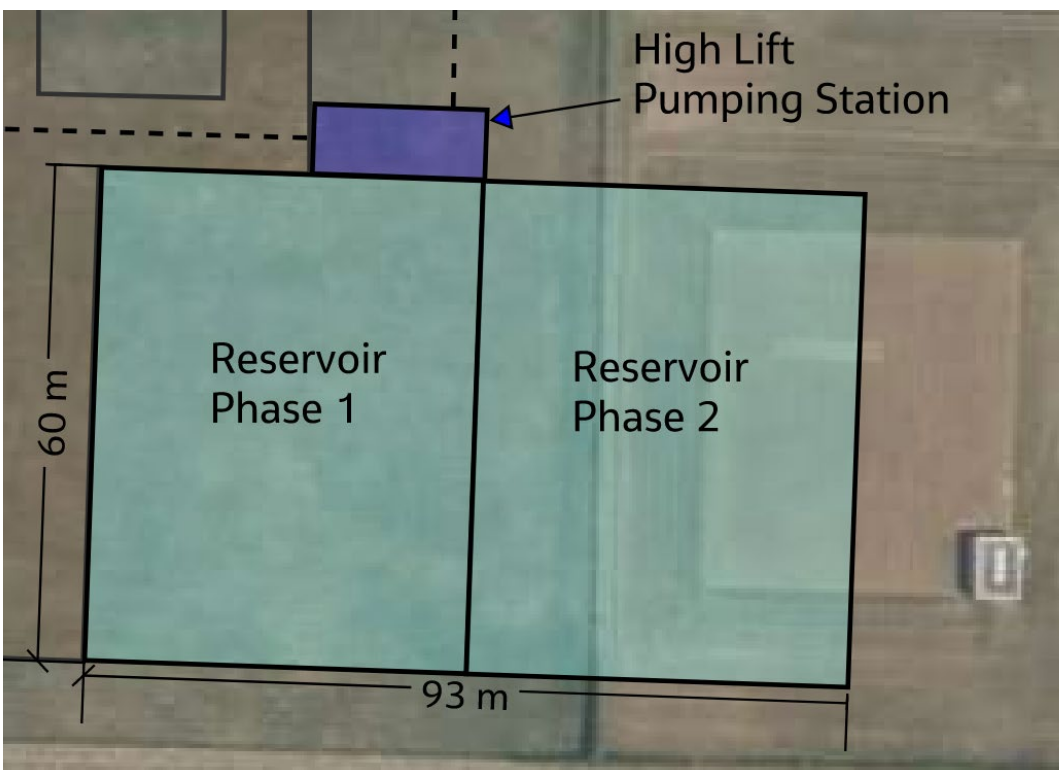
Parameter	Value
Ultimate ADD, Wallaceburg, ML/day	8.9
Ultimate ADD, Dresden, ML/day	2.4
Ultimate ADD, Future Greenhouses, ML/day	8.6
Ultimate ADD for Wallaceburg DWS, ML/day	**19.9**
Wallaceburg ET Available Storage, megalitres	4.5
Dresden ET Available Storage, megalitres	5.4
Total Available Storage, megalitres	10.0
Firm Available Storage, megalitres [a]	4.5
Required Storage (3 times the ADD), megalitres	60
New Reservoir Storage Requirements, megalitres	**56**

Notes:

[a] With largest unit out of service (Dresden ET).

A new 56-megalitre reservoir would be constructed based on the storage analysis. The approximate footprint based on a 12-metre active depth (10 metre below grade, 2 metre above grade) is presented on Figure 4-2. Note that because of potential footprint constraints, the existing Reservoir 2 would have to be demolished to construct the Phase 2 Reservoir. It is therefore assumed that the new Wallaceburg WTP's treated water storage will be constructed in two stages, each with a 28-megalitre reservoir.

Figure 4-2. Preliminary Reservoir Layout



4.1.8 Residuals Management

Residuals are solids and other constituents that are removed from water during the treatment process. Residuals management is typically achieved through treatment (such as settling, thickening, and decanting) to reduce volume and then disposal. The supernatant produced from residual management can either be discharged to the head of the WTP or to a receiving water body, such as a nearby river.

Currently at the Wallaceburg WTP, all residuals are discharged to the sanitary sewer without receiving any treatment. Residuals produced at the existing Wallaceburg WTP are discharged to the on-site RMF, which consists of a crude sedimentation tank. According to communications with the Plant Operations, the tank does not actually provide satisfactory settling performance, and thus, all residuals are discharged to the sanitary sewer on Base Line. Residuals then flow to the Libby Street Sewage Pumping Station and eventually to the Wallaceburg Water Pollution Control Plant (WPCP) for treatment. The existing RMF was constructed in the early 2010s.

There are a number of alternative residuals management strategies that could be employed at the new Wallaceburg WTP:

- Use the existing RMF and discharge all residuals to the sanitary sewer.
- Construct a new RMF, discharge supernatant to the Sydenham River (subject to MECP approval) and discharge thickened residuals to the sanitary sewer and ultimately, the Wallaceburg WPCP.
- Construct a new RMF, discharge supernatant to the Sydenham River (subject to MECP approval), and truck dewatered residuals to a landfill or a treatment facility (such as the Wallaceburg WPCP).

The preferred future residuals management strategy depends on a number of factors, as follows:

- Residual flows
- Receiving sanitary sewer capacity
- Libby Street PS capacity
- Wallaceburg WPCP capacity

A sewer capacity assessment was completed based on geographic information system data provided by the CK PUC. Note, however, that current and future flows in this sewer were not available at the time of analysis. Table 4-6 summarizes the sewer capacity assessment. It was assumed that majority of residuals would come from the LPMF process and that all residuals would be discharged to the sanitary sewer directly. The assessment also assumed that residual flows would be discharged to maintenance hole (MH) 7540, and the capacity assessment was based on the sewer section with the lowest capacity (the limiting capacity).

Table 4-6. Base Line Sewer Capacity Assessment

Parameter	Value
Projected Residual Flows: Phase 1 MDD, ML/day [a]	0.65
Projected Residual Flows: Phase 2 MDD, ML/day [a]	1.31
Base Line Sewer Diameter, millimetres	250
Base Line Sewer Slope, %	0.28
Base Line Sewer Capacity, ML/day	2.7
Residual Flow Percent of Sewer Capacity, Phase 1, %	24
Residual Flow Percent of Sewer Capacity, Phase 2, %	48

Notes:
[a] Value based on membranes operating at 95 percent recovery.

The projected residual flows during Phase 1 (WTP rated capacity of 14 ML/day) and Phase 2 (WTP rated capacity of 28 ML/day) are equivalent to 24 percent and 48 percent of the Base Line sewer capacity, respectively. Considering that the sewer is already receiving flows from the existing Wallaceburg WTP (rated at 13.6 ML/day) with no reported capacity-based issues noted by operations staff, it is likely that the Base Line sewer can accommodate the projected residual flows during Phase 1 with no additional treatment. This should be confirmed as part of the 2022 Chatham-Kent Water and Wastewater Master Plan. However, there may be constraints following the Phase 2 expansion, given that full discharge of the projected residual flows at MDD would take almost 50 percent of the sewer capacity without considering other sewage flows from residential, and industrial, commercial, and institutional services.

According to this analysis, it is anticipated that the existing RMF can continue to be used at Phase 1 of the new Wallaceburg WTP, and a new RMF or upgrades to the existing RMF to incorporate a thickening process will be required for Phase 2. Interconnecting piping will be required between the new WTP and the existing RMF as part of Phase 1.

Rated capacities for the Libby Street Sewage Pumping Station and the Wallaceburg WPCP were obtained from Environmental Compliance Approval number 1739-AXNJMV (MECP 2018). Current and future flows for the Libby Street Sewage Pumping Station were unavailable. Current flows to the Wallaceburg WPCP (2019 to 2021) were obtained from annual reports; however, future flows were unavailable.

Table 4-7 presents a high-level assessment of the Libby Street Sewage Pumping Station and Wallaceburg WPCP capacities based on information in each facility’s Environmental Compliance Approval.

Table 4-7. Libby Street Sewage Pumping Station and Wallaceburg WPCP Capacity Assessment

Parameter	Value
Projected Residual Flows, Phase 1 MDD, ML/day	0.65
Projected Residual Flows, Phase 2 MDD, ML/day	1.31
Libby Street Sewage Pumping Station Capacity, ML/day	7.6
Libby Street Sewage Pumping Station Current Flows, ML/day	Unknown
Libby Street Sewage Pumping Station Future Flows, ML/day	Unknown
Libby Street Sewage Pumping Station Future Reserve Capacity, ML/day	Unknown
Wallaceburg WPCP Capacity, ML/day	10.8
Wallaceburg WPCP Current Flows, ML/day [a]	7.9
Wallaceburg WPCP Future Flows, ML/day	Unknown
Wallaceburg WPCP Future Reserve Capacity, ML/day	Unknown

Notes:

[a] Average daily flows from 2019 to 2021.

Future impacts to the Libby Street Sewage Pumping Station and the Wallaceburg WPCP cannot be determined due to lack of information. Jacobs suggests that further analysis be completed in conjunction with the 2022 Chatham-Kent Water and Wastewater Master Plan.

In summary, it was assumed that the existing RMF would be used during Phase 1 and that a new RMF with enhanced thickening process would be constructed at Phase 2. This component will be a common element for the design concepts described in the following sub-sections. The RMF technology at Phase 2 was assumed to be an equalization basin with a lamellar clarification process for thickening. Further investigation (residuals quality, technology review) will be completed at the design stage.

4.1.9 Alternative Design Concept 1

Alternative Design Concept 1 is to construct a new LPMF WTP with a rated capacity of 28 ML/day, using coagulation, flocculation, and clarification for pre-treatment. Figure 4-3 presents a process flow diagram for Alternative 1.

Figure 4-3. Process Flow Diagram for Alternative Design Concept #1

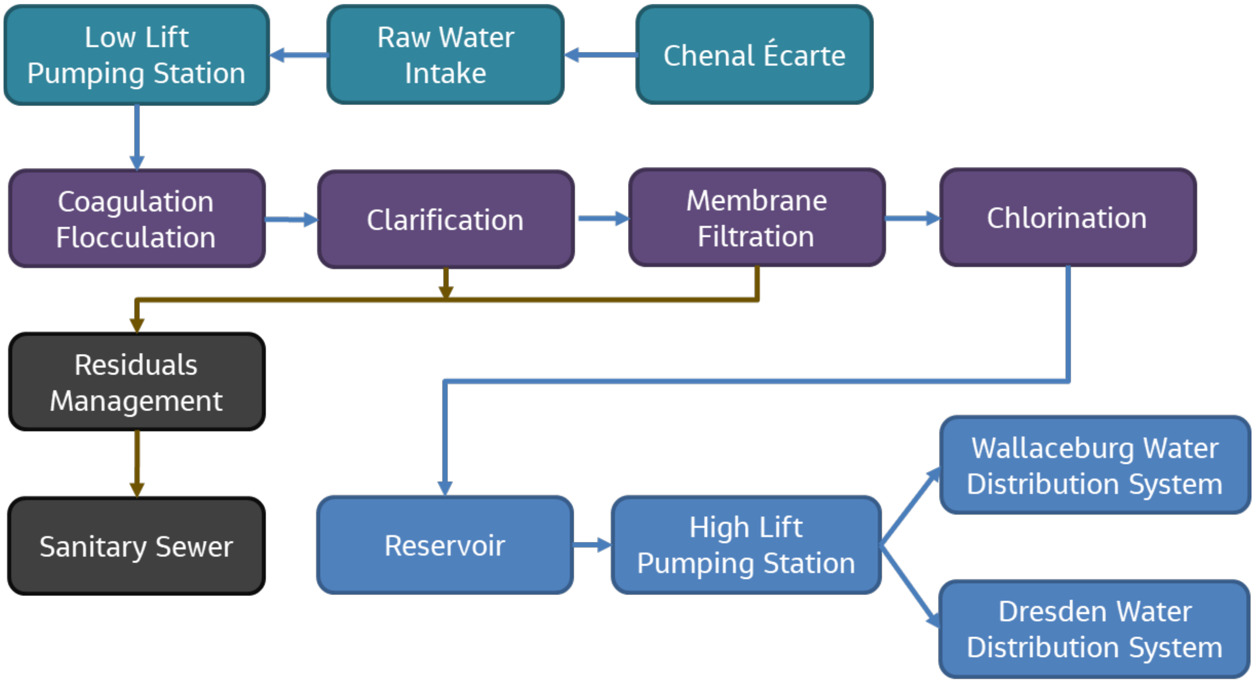


Figure 4-4 presents a preliminary site layout for Alternative Design Concept 1. The pre-treatment processes, LPMF process, and ancillary chemical systems will be housed in one common building. The main building will be one storey and also contain office space, a kitchen, change rooms, etc., and a maintenance shop that is sized to store six pickup trucks. The total footprint estimate for the main WTP building is 3,000 square metres for Alternative Design Concept 1.

The LPMF process will have dedicated feed pumps located inside of the main WTP building to control pressure and flow into the membranes. The pumps will feed a common header upstream of the membranes.

The following bullets summarize key design criteria for the pre-treatment system, which is unique to Alternative Design Concept 1:

- Four process trains, each rated at 7 ML/day to provide pre-treatment upstream of the LPMF process.
- Coagulant dosing (assumed to be PACl at this stage) upstream of the flocculation tank with mechanical flash mixing.
- A 140-cubic metre concrete flocculation tank with mechanical mixers and a minimum hydraulic retention time of 7 minutes. The approximate footprint is estimated to be 90 square metres.
- Lamellar clarifiers downstream of the flocculation tank to provide high-rate sedimentation, with an approximate footprint of 500 square metres.

Per the preliminary phasing plan, the entire building envelope and other structural assets will be constructed during Phase 1 (the building envelope required for a 28 ML/day WTP). Equipment will be installed as required to produce 14 ML/day, with space, piping connections, spare electrical connections, etc. reserved for future expansion.

The existing Wallaceburg WTP, reservoirs, and HLPS would be decommissioned and demolished once the new WTP is commissioned and in operation.

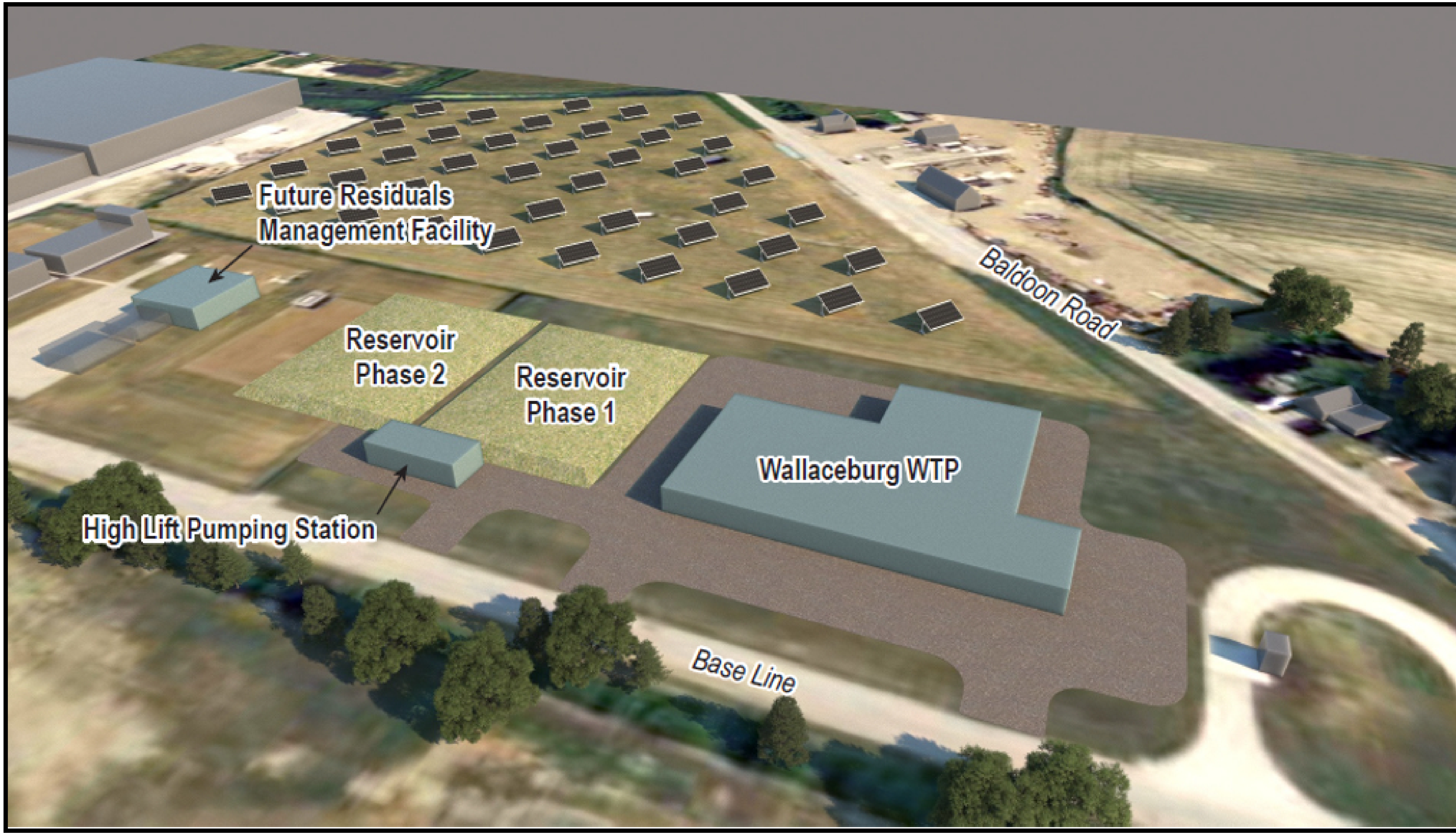


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Figure 4-4
Preliminary Site Layout for Alternative Design Concept #1
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Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
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4.1.10 Alternative Design Concept 2

Alternative Design Concept 2 is to construct a new LPMF WTP with a rated capacity of 28 ML/day, using in-line coagulation as pre-treatment to the membrane process. Figure 4-5 presents a process flow diagram for Alternative 2.

Figure 4-5. Process Flow Diagram for Alternative Design Concept 2

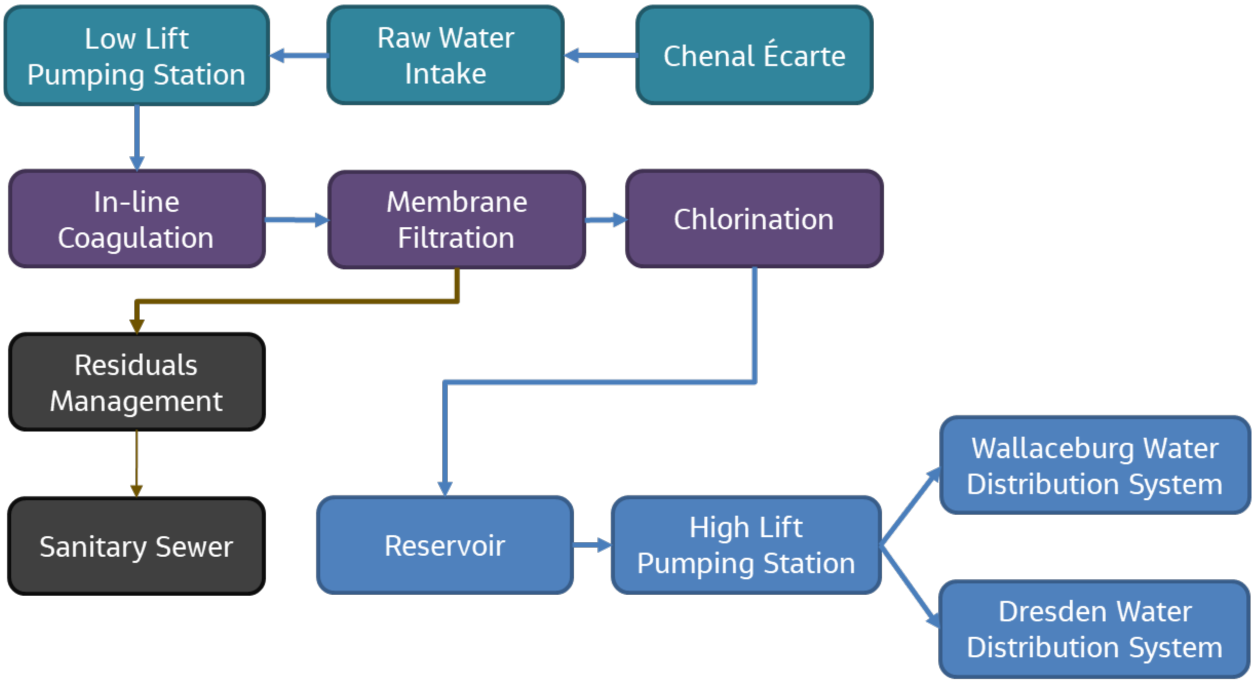

Figure 4-6 presents a preliminary site layout for Alternative Design Concept 2. The LPMF process and ancillary chemical systems will be housed in one common building. The main building will be one storey and also contain office space, a kitchen, change rooms, etc., and a maintenance shop that is sized to store six pickup trucks. The total footprint estimate for the main WTP building is 2,400 square metres for Alternative Design Concept 1.

The LPMF system will be fed directly by the vertical turbine pumps located in the LLPS, approximately 6.5 kilometres (km) away, to control pressure and flow into the membranes. Therefore, the footprint requirement for the LPMF process is smaller compared to Alternative Design Concepts 1 and 3.

The following bullets summarize key design criteria for the pre-treatment system, which is unique to Alternative Design Concept 2:

- In-line coagulant dosing for each raw watermain (assumed to be PACl at this stage), located upstream of LPMF system with in-pipe mechanical flash mixing.
- A 650-metre contact pipe loop (common to both raw watermains) would be installed downstream of the dosing point to allow for a 7-minute hydraulic retention time.

It is noted that this alternative would increase the raw watermain costs because of the additional length required for the pipe loop. It would also increase the TDH required to be supplied by the LLPS pumps because of the additional headloss through the pipe loop, thus increasing O&M costs associated with the LLPS.

There are also operational concerns with this alternative because the membrane feed pumps (the LLPS) are located approximately 6.5 km upstream. The LPMF process is a dynamic system that requires frequent, rapid adjustments to flow and feed pressure to maintain operation. Given the distance between the feed pumps and the membranes, a relatively significant lag is anticipated between the time of a process parameter change directive and the actual response time in the membrane system. Jacobs consulted with various LPMF vendors and concluded that this arrangement is not desirable, and that dedicated feed pumps directly upstream of the LPMF process would provide better process control.

Per the preliminary phasing plan, the entire building envelope and other structural assets will be constructed during Phase 1 (the building envelope required for a 28 ML/day WTP). Equipment will be installed as required to produce 14 ML/day, with space, piping connections, spare electrical connections, etc. reserved for future expansion.

The existing Wallaceburg WTP, reservoirs and HLPS would be decommissioned and demolished once the new WTP is commissioned and in operation.

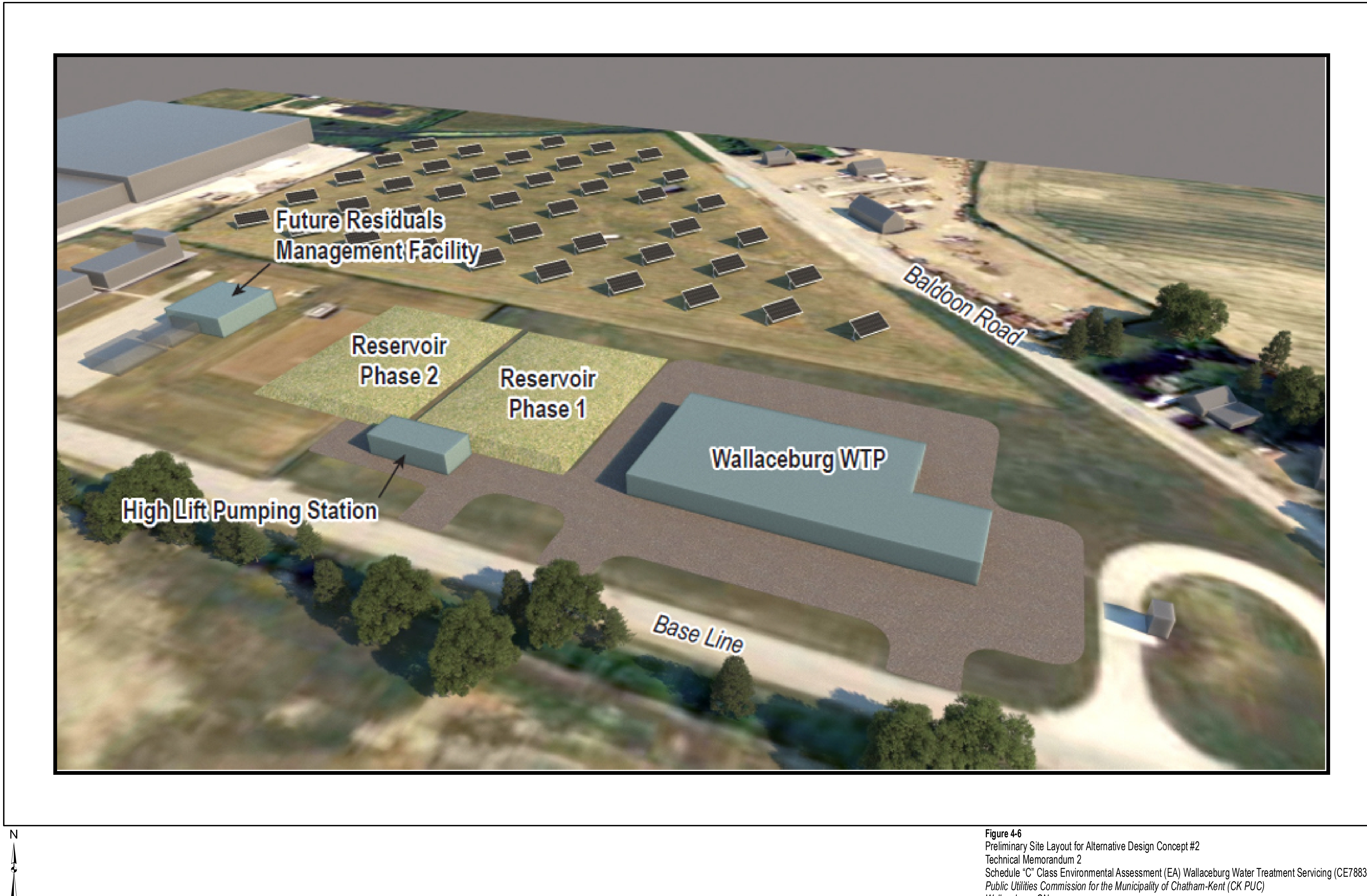

Figure 4-6
Preliminary Site Layout for Alternative Design Concept #2
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4.1.11 Alternative Design Concept 3

Alternative Design Concept 3 is to construct a new Wallaceburg WTP with a rated capacity of 28 ML/d, using coagulation and flocculation as pre-treatment to the LPMF process. Figure 4-7 presents a process flow diagram for Alternative 3.

Figure 4-7. Process Flow Diagram for Alternative Design Concept 3

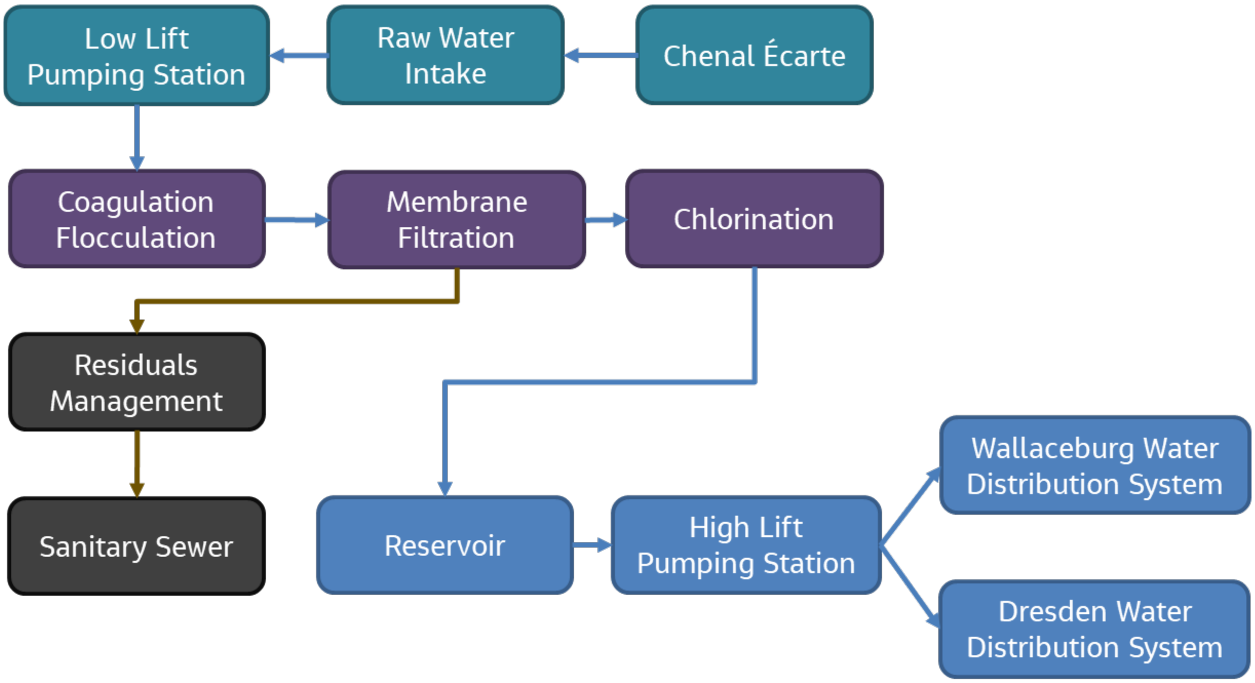

Figure 4-8 presents a preliminary site layout for Alternative Design Concept 3. The pre-treatment processes, LPMF process, and ancillary chemical systems will be housed in one common building. The main building will be one storey and also contain office space, a kitchen, change rooms, etc., and a maintenance shop that is sized to store six pickup trucks. The total footprint estimate for the main WTP building is 2,500 square metres for Alternative Design Concept 3.

The LMPF process will have dedicated feed pumps located inside of the main WTP building to control pressure and flow into the membranes.

The following bullets summarize key design criteria for the pre-treatment system, which is unique to Alternative Design Concept 3:

- Four process trains, each rated at 7 ML/day, to provide pre-treatment upstream of the LPMF process.
- Coagulant dosing (assumed to be PACl at this stage) upstream of the flocculation tank with mechanical flash mixing.
- A 140-cubic metre concrete flocculation tank with mechanical mixers and a minimum hydraulic retention time of 7 minutes. The approximate footprint is estimated to be 90 square metres.

Per the preliminary phasing plan, the entire building envelope and other structural assets will be constructed during Phase 1 (the building envelope required for a 28 ML/day WTP). Equipment will be installed as required to produce 14 ML/day, with space, piping connections, spare electrical connections, etc. reserved for future expansion.

The existing Wallaceburg WTP, reservoirs, and HLPS would be decommissioned and demolished once the new WTP is commissioned and in operation.

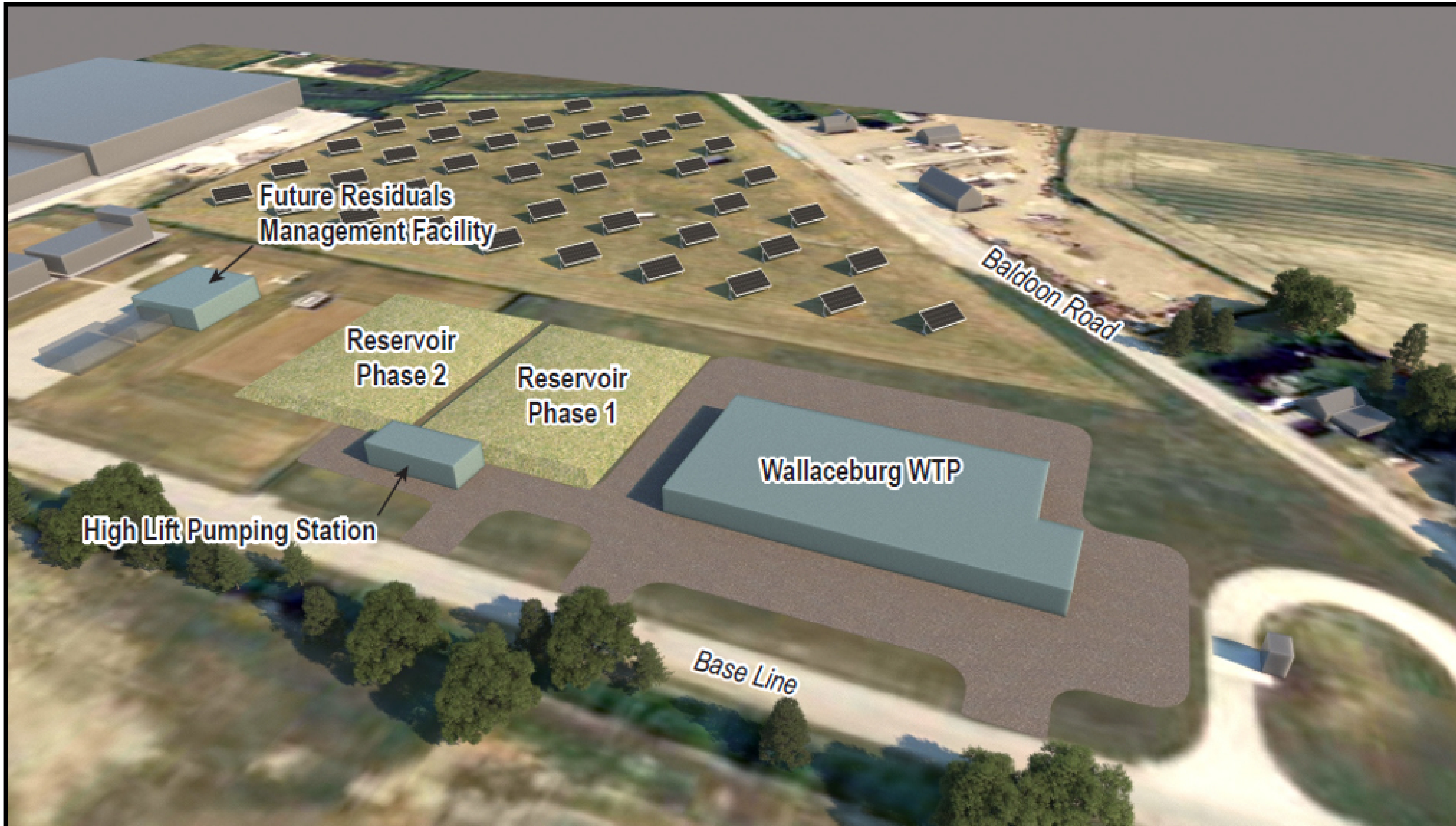

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Figure 4-8
Preliminary Site Layout for Alternative Design Concept #3
Technical Memorandum 2
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
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4.2 Cost Estimation

Capital cost estimates, O&M cost estimates, and lifecycle cost estimates were developed for each alternative presented in Section 4.1, based on the methodology presented in Section 3.2.

O&M cost estimates were developed based on the future water demand projections (ADD), which is assumed to be 80 percent of MDD according to the historical flow analysis presented in TM 1.

The dosages and strengths used to estimate chemical consumption are summarized in Table 4-8. Citric acid and NaOCl requirements for membrane cleaning were provided by Suez following completion of the pilot study. The dosages listed are as product, i.e., as Cl_2, PACl, and hydrofluorosilicic acid.

Table 4-8. Chemical Dosages and Strengths

Item	Dosage as Product	Strength	Source/Basis
Cl_2 Gas	1.8 mg/L	100%	Chlorine demand testing completed for membrane permeate in 2021
PACl [a]	2 mg/L	40%	Pilot Study
Hydrofluorosilicic Acid	0.5 mg/L	20%	CK PUC Operational Data

Notes:

[a] Year-round PACl dosing was assumed as a conservative estimate. Further optimization testing may identify that only seasonal coagulation is required.

Membrane replacements are assumed to be required every 10 years, based on Jacobs' previous experience.

Table 4-9 summarizes the capital cost estimates, annual O&M costs, and lifecycle costs of the alternative design concepts. Cost estimate details are presented in Appendix A.

Table 4-9. Cost Estimates: Alternative Design Concepts for Water Treatment

Alternative	Description	Capital Cost	Annual O&M Costs	50-year Lifecycle Cost
Alternative Design Concept 1	Coagulation, Flocculation and Clarification	$72,100,000	$1,030,000	$100,600,000
Alternative Design Concept 2	In-line Coagulation	$63,000,000	$940,000	$89,200,000
Alternative Design Concept 3	Coagulation and Flocculation	$66,200,000	$990,000	$93,800,000

4.3 Greenhouse Gas Emissions

Table 4-10 presents the GHG emission estimates for each water treatment design concept, based on the methodology presented in Section 3.3. Note that the GHG emission estimates presented in TM 1 considered the offset provided for the Chatham WTP by re-allocating demands, whereas the estimates presented in Table 4-10 are absolute values for the Wallaceburg WTP only.

Table 4-10. Greenhouse Gas Emission Estimates: Alternative Design Concepts for Water Treatment

Alternative	Description	Greenhouse Gas Emissions, tonnes CO_2 eq/year
Alternative Design Concept 1	Coagulation, Flocculation, and Clarification	101.6
Alternative Design Concept 2	In-line Coagulation	94.9
Alternative Design Concept 3	Coagulation and Flocculation	101.0

4.4 Evaluation Criteria

The alternative design concepts were evaluated using the methodology presented in Section 3.4. Table 4-11 presents the evaluation criteria and scoring measures for the water treatment design concepts evaluation.

Table 4-11. Evaluation Criteria – Alternative Design Concepts for Water Treatment

Criterion	Description	Measure: Score of 10	Measure: Score of 5	Measure: Score of 1
Process Robustness	The ability of the alternative to perform with a high degree of reliability and predictability in both process operations and treated water quality. Criterion is based on examples of the treatment train performing well in similar conditions (i.e., raw water quality).	The alternative includes proven technology with a high degree of reliable performance.	The alternative includes newer technology with a growing record of demonstrated performance reliability.	The alternative includes innovative technology with a limited performance record and unconfirmed reliability.
Constructability	The ability of the alternative to be constructed and implemented on a technical and practical basis within a reasonable scope of work.	The alternative is easy to implement with limited constructability issues and a reasonable construction work scope.	The alternative can be implemented with some difficult constructability issues or some constraints, with a moderate scope of construction work.	The alternative has many challenges with respect to implementation and construction, with a complex and large work scope.
Flexibility for Future Expansion	Compatibility to phasing plan, ease of adding treatment trains	Fully compatible with the proposed phasing plan, easy to add additional equipment with minimal construction and interruption to live plant production, expansion without complicating operation and control.	Compatible with the proposed phasing plan, expansion without complicating operation and control, but additional equipment may need building expansion or need large reserve in the new building, or construction may moderately interrupt live plant production.	Low compatibility with the proposed phasing plan, difficult to add additional equipment without minimal construction and interruption to live plant production, or expansion possibly complicating operation and control.
Footprint Requirements	The relative footprint required for the alternative.	The alternative requires a small footprint relative to the other alternatives.	The alternative requires a moderate footprint relative to the other alternatives.	The alternative requires a large footprint relative to the other alternatives.
Ease of Operation	The degree of complexity associated with operating the alternative.	The alternative is simple to operate.	The alternative is moderately difficult to operate, requires extensive and continuous operator trainings.	The alternative is complex to operate.
Maintenance Complexity	The degree of complexity associated with maintaining the alternative.	The alternative is simple to maintain.	Maintenance is somewhat difficult and requires higher skills.	The alternative requires frequent or complex maintenance.
Additional Treatment Capabilities	The relative treatment capabilities of the alternative related to treated water quality and the impacts of raw water quality.	The alternative is able to provide required treatment over a range of raw water quality beyond that anticipated.	The alternative is able to provide required treatment over a range of anticipated raw water quality.	The alternative is not able to provide required treatment over a range of anticipated raw water quality.
Capital Cost	The relative capital cost of the alternative.	The alternative has a relatively high capital cost.	The alternative has a relatively moderate capital cost.	The alternative has a relatively low capital cost.
Lifecycle Cost	The relative lifecycle cost of the alternative.	The alternative has a relatively high lifecycle cost.	The alternative has a relatively moderate lifecycle cost.	The alternative has a relatively low lifecycle cost.

4.5 Evaluation Results and Preferred Water Treatment Plant Design Concept

Table 4-12 presents the evaluation results for alternative water treatment concepts. Detailed scoring and rationales are presented in Appendix B.

Table 4-12. Evaluation Results for Water Treatment Design Concepts

Alternative	Description	Score
Alternative Design Concept 1	Coagulation, Flocculation, and Clarification	61
Alternative Design Concept 2	In-line Coagulation	61
Alternative Design Concept 3	Coagulation and Flocculation	78

Alternative Design Concept 3: Coagulation and Flocculation as pre-treatment to LPMF received the highest score and was thus selected as the preferred design concept for water treatment. Advantages for this design concept include the following:

- The pilot study demonstrated that this pre-treatment strategy was able to enhance reliable performance of LPMF during turbidity events. The pilot study was performed using the raw water from the existing intake and LLPS; two turbidity events occurred during the study. LPMF with coagulation and flocculation was proven to produce quality permeate during the events. Note turbidity event frequency is expected to reduce with the new intake being constructed upstream sufficiently on the Chenal Écarte to avoid impacts from seasonal turbidity spikes that occur at the existing LLPS.
- The design concept requires a relatively smaller footprint and has a moderate cost compared to the coagulation-flocculation-clarification option.
- The pre-treatment strategy provides more reliable control and operation relative to in-line coagulation, which would be difficult to control because of the reliance on the remote LLPS (i.e., acting as membrane feed pumps) to control the flow and pressure to membranes.

Based on the preferred water treatment plant concept, the LLPS will only be required to operate with the TDH necessary to convey raw water to the flocculation tanks at the new Wallaceburg WTP. This is reflected in the LLPS design concept development.

5. Development and Evaluation of Alternative Design Concepts for Raw Water Supply

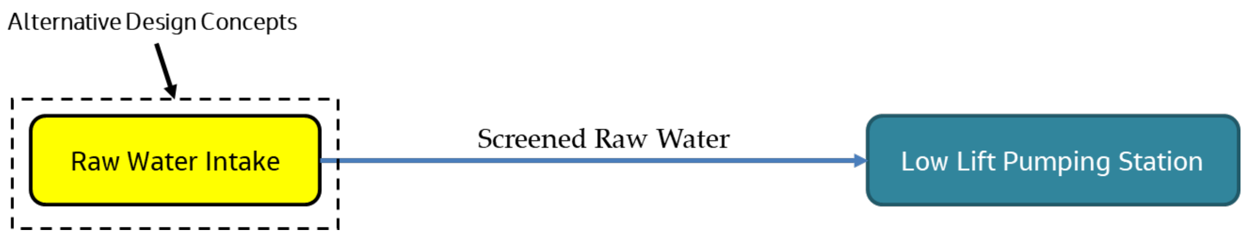
5.1 Raw Water Supply Design Concepts

The preferred solution for raw water supply from Phase 2 consists of three components: (1) intake, (2) LLPS, and (3) raw watermain. As discussed in Section 3.1, the raw watermain is a Schedule B project and does not require further design concept development as part of this Class EA. Therefore, the raw water supply design concepts only considered the alternatives for the intake and LLPS.

A common LLPS design concept was developed through consultation with the CK PUC (described further in Section 5.1.1), and therefore, alternative design concepts were focused on different configurations of raw water intake. Note that the intake type may impact the LLPS layout at some extent, but this variance can be addressed at the design stage.

Figure 5-1 presents a general process flow diagram and highlights the alternative design concept basis.

Figure 5-1. Alternative Design Concept Basis for Raw Water Supply



The following intake technologies were considered for this study:

- Submerged Tee Screens Intake
- Headwall-Mounted Tee Screens Intake
- Flat Panel Fish Screens Intake
- Travelling Screens with Bell-mouth Intake

These technologies are further discussed in Sections 5.1.2 to 5.1.5. The intake concept was based on two intake screens, each with a capacity of 17 ML/day for a total capacity of 34 ML/day (required to account for process wastage in the new WTP, which will be rated to produce 28 ML/day of treated water).

5.1.1 Low Lift Pumping Station Design Concept

The LLPS design concept is summarized as follows:

- 12-metre by 15-metre building envelope
- Two 4.5-metre by 2-metre intake wells receiving screened raw water from the intakes, also allowing operations staff to isolate pump well cells for maintenance
- 9-metre by 5-metre pump well with two cells
- Four vertical turbine pumps, with two duty and two standby (one duty and one standby per pump well cell or raw watermain pipe); each rated to provide 17 ML/day at 39 m TDH

- Sodium hypochlorite dosing system for seasonal zebra mussel control
- 250-kilowatt standby diesel generator

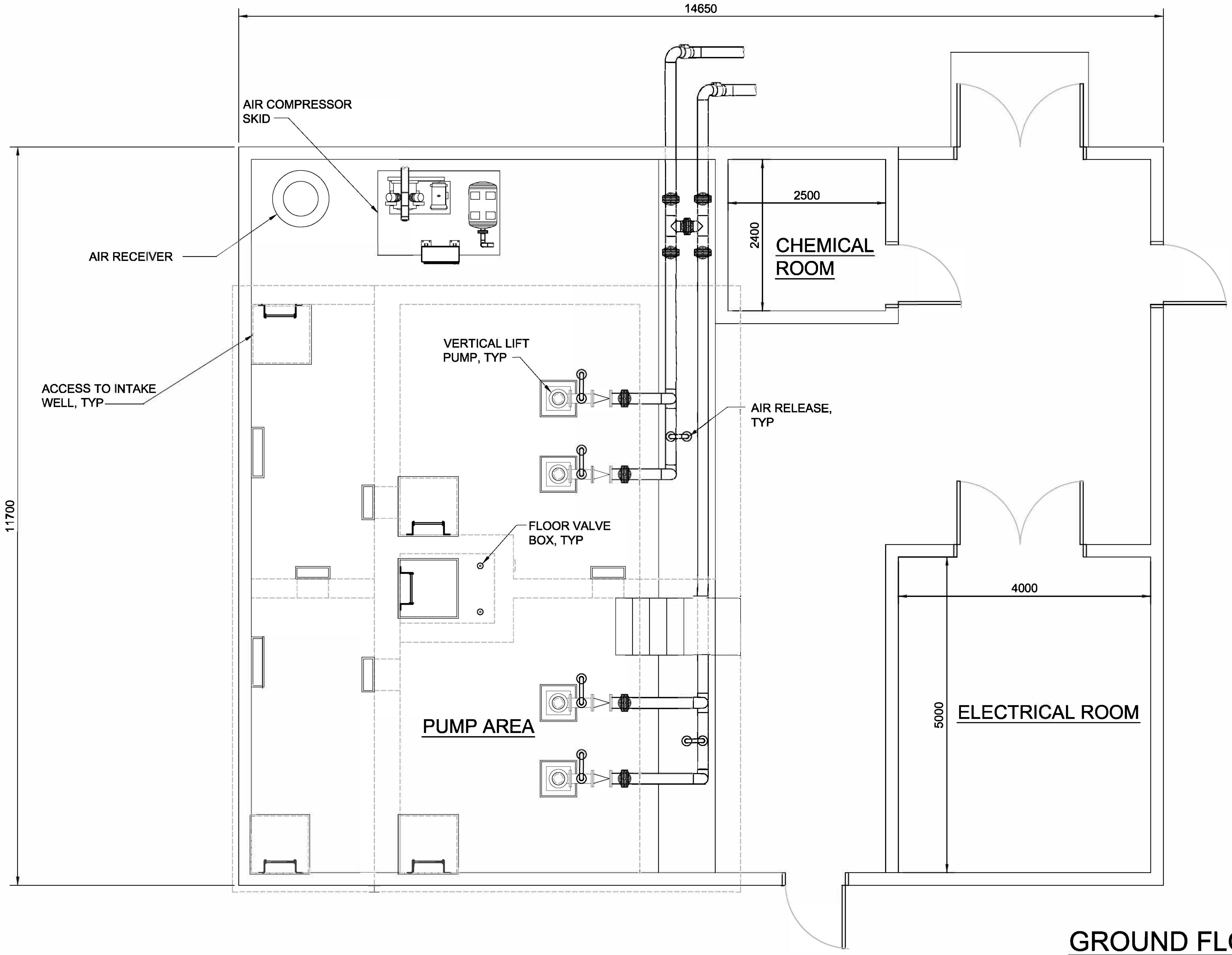
Site topography and flood protection were also considered when developing the preliminary concept. The St. Clair Region Conservation Authority (SCRCA) requires mechanical and electrical components (for example, pumps and motor control centres) within new infrastructure to be constructed at 177 metres above sea level to provide adequate flood protection if located within the floodplain. The selected site is relatively flat and located at approximately 175 metres above sea level (estimated from Google Earth). Therefore, the site will require grading that allows for a ground-level entrance 2 metres above the current site elevation. This also requires a deeper pump well because of the increased ground floor.

Phasing was considered for raw water supply, similar to the new Wallaceburg WTP. The new LLPS will be constructed in two phases:

- **Phase 1:** Construct a new LLPS with a rated capacity of 17 ML/day.
- **Phase 2:** Expand the LLPS (install additional pumps) to provide a rated capacity of 34 ML/day (ultimate demand).

Both intake screens will be installed during Phase 1.

Figure 5-2 presents a preliminary design concept for the new LLPS.



GROUND FLOOR LEVEL
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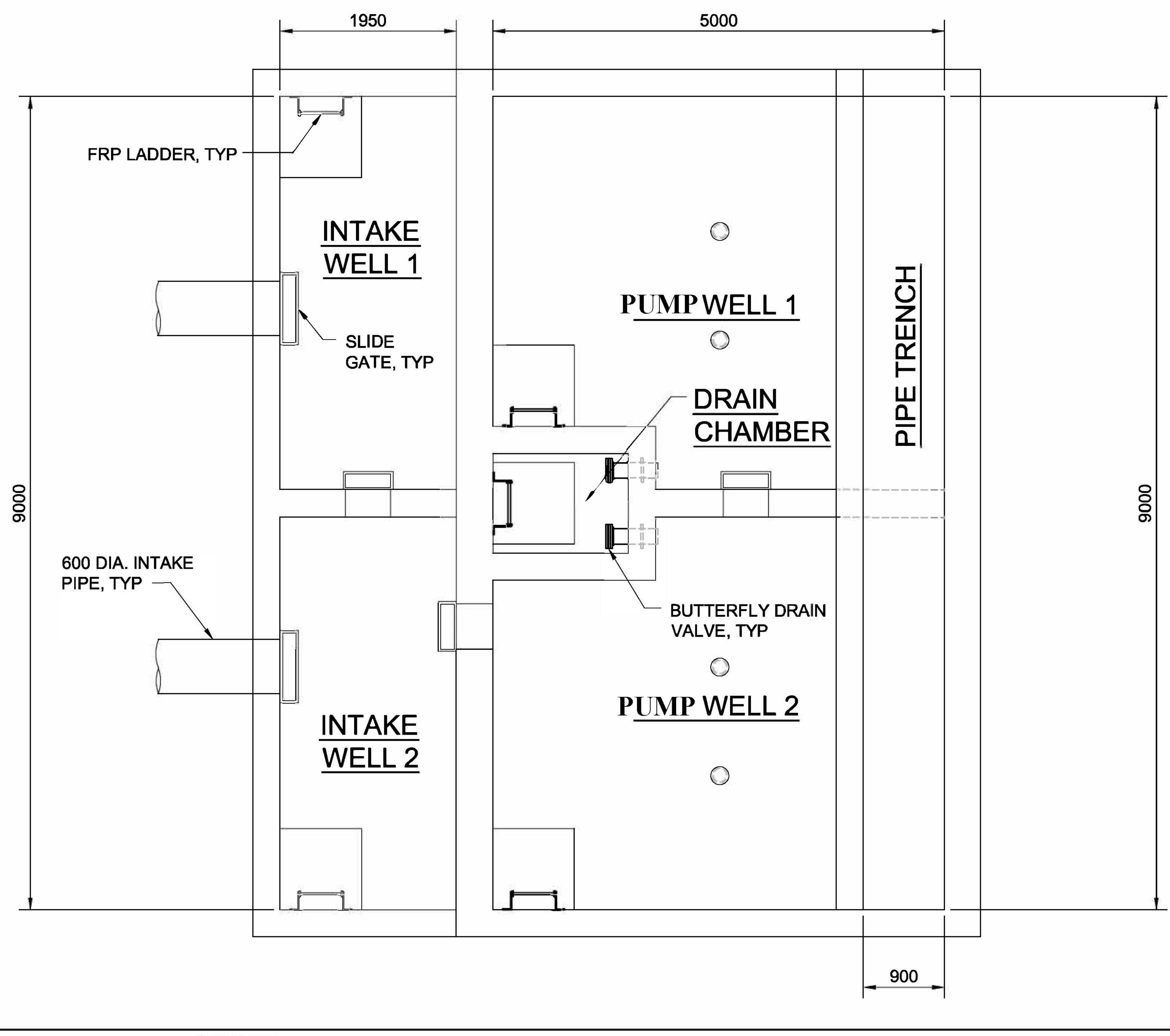

PUMP WELL LEVEL
1 : 50

NO.	DATE	REVISION	BY	APVD

DSGN J. PHILPOTT | DR C. PURNEY | CHK | APVD

Wallaceburg Low Lift Pumping Station
Wallaceburg, Ontario
Chatham-Kent Public Utilities Commission

Jacobs

General
Low Lift Pumping Station
Preliminary Plans
with In River Screens

VERIFY SCALE
BAR IS 25MM ON ORIGINAL DRAWING.
0 25MM

DATE	
PROJ	CE792200
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5.1.2 Alternative Design Concept 1

Alternative Design Concept 1 is to construct a new LLPS and two submerged tee screen intakes with a rated capacity of 34 ML/day. Raw water passively flows through the tee screens through the two intake pipes to the LLPS pump well, with debris and aquatic species rejected at the point of entry. The tee screen intakes are permanently submerged and require a diver for maintenance.

Tee screens are typically equipped with cleaning systems that operate once daily. There are two types of cleaning systems: (1) air burst cleaning and (2) mechanical brush cleaning.

- Air burst cleaning systems use short bursts of compressed air (typically fed by a compressor located in the LLPS) to remove accumulated debris from the screen surface. An air line is installed along the intake pipe from the LLPS. The air burst is visible from the water surface, and the vicinity must be avoided by recreational users at the time of cleaning. The benefit of this system is that there is little to no in-water maintenance required; however, the area surrounding the burst radius must be marked so that recreational users cannot pass over top of the intake.
- Mechanical brush cleaning systems consist of a brush that is mounted on the surface of the screens, rotating around the screen exterior during the cleaning cycle. The brush system is powered by a motor that is mounted to the side of the tee screen. The benefit of this system is that there is no disturbance at the water surface during a cleaning cycle; however, in-water maintenance is required if there are any issues such as motor failure.

Through consultation with the CK PUC, air burst cleaning was selected as the preferred screen cleaning technology for the purposes of developing the alternative design concept. This technology may reduce in-water maintenance, which would be difficult during the winter period when ice formation occurs at the surface.

Figure 5-3 presents a typical submerged tee screen.

Figure 5-3. Submerged Tee Screen Installation (Courtesy of Johnson Screens)

Figure 5-4 presents a preliminary site layout for Alternative Design Concept 1. Jacobs assumed that the intakes and intake pipes would be installed using trenchless technologies to minimize impacts to the nearby wetlands.

Figure 5-4. Preliminary Site Layout for Alternative Design Concept 1

5.1.3 Alternative Design Concept 2

Alternative Design Concept 2 is to construct a new LLPS and two headwall-mounted tee screen intakes with a rated capacity of 34 ML/day. This configuration is similar to Alternative Design Concept 1; however, the tee screens are retrievable and can be hoisted out of the water for maintenance, eliminating the need for divers to perform maintenance. Similar to Alternative Design Concept 1, an air burst system is used for screen cleaning.

Figure 5-5 presents a typical headwall-mounted tee screen configuration.

Figure 5-5. Headwall-Mounted Tee Screens (Courtesy of ISI Screens)

Figure 5-6 presents a preliminary site layout for Alternative Design Concept 2. The intake pipe would be installed using open-cut technologies. However, a headwall structure will have to be constructed from the bank.

Figure 5-6. Preliminary Site Layout for Alternative Design Concept 2

5.1.4 Alternative Design Concept 3

Alternative Design Concept 3 is to construct a new LLPS and a flat-panel fish screen intake with a rated capacity of 34 ML/day.

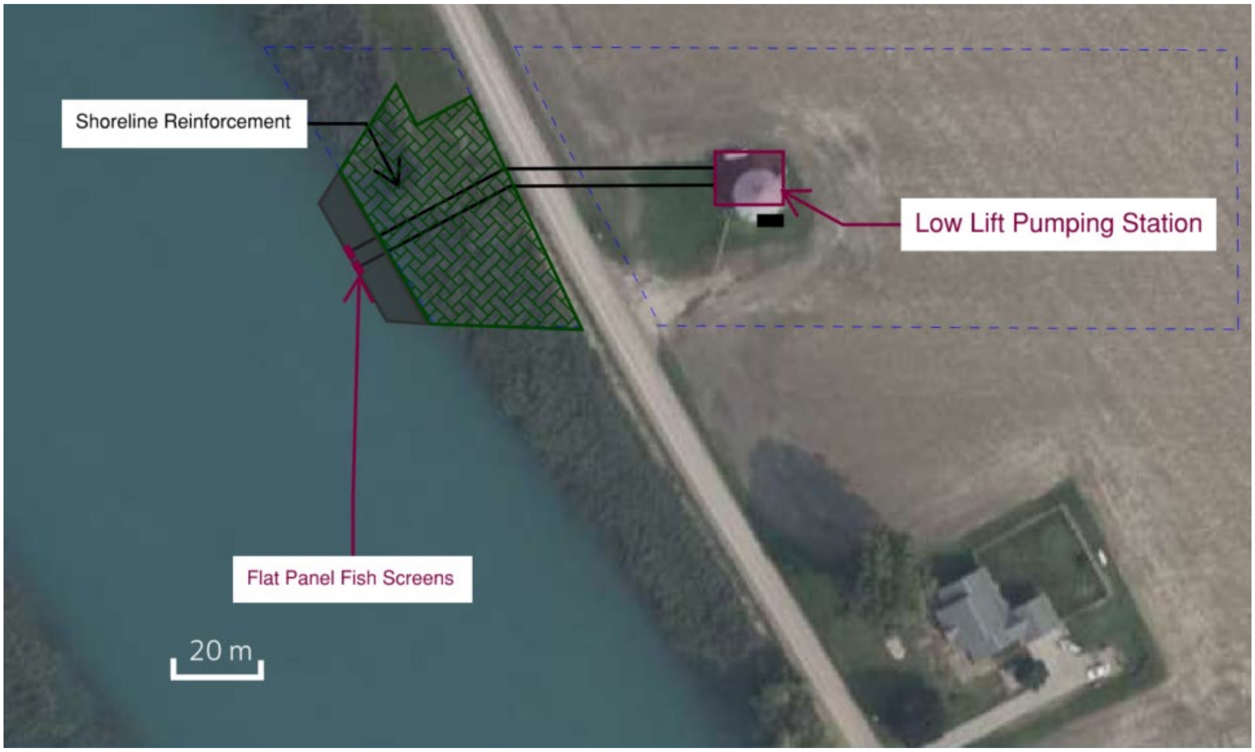
Flat-panel fish screens are typically installed on an angle on the face of a concrete structure, with a portion of the screen submerged and a portion above the water level. Raw water passively flows through the screens into a concrete chamber, with debris and aquatic life rejected at the screen surface. The concrete chamber then feeds the intake pipes, where screened water flows to the LLPS pump well. Similar to tee screens, the flat panel fish screens use an air burst system for removing debris that is lodged in the screen slots.

Figure 5-7 presents a typical flat panel fish screen configuration.

Figure 5-7. Flat Panel Fish Screens (Courtesy of OneFish Engineering)

Figure 5-8 presents a preliminary site layout for Alternative Design Concept 3. The intake pipe would be installed using open-cut technologies. However, the concrete chamber and flat screen would be constructed from the bank.

Figure 5-8. Preliminary Site Layout for Alternative Design Concept 3



5.1.5 Alternative Design Concept 4

Alternative Design Concept 4 is to construct a new LLPS, two bell mouth intakes, and two travelling screens with a rated capacity of 34 ML/day. Travelling screens use a continuously rotating mesh screen to capture debris and aquatic species from raw water. Aquatic species are returned to the Chenal Écarte using a fish return system, typically consisting of a side channel that is flushed with water and facilitates entry back into the river. Debris is deposited into a waste bin, which must be periodically emptied by operations staff. Travelling screens typically use a washdown system for self-cleaning to remove debris into the waste bin.

The main difference between this design concept and the other design concepts is that travelling screens require a building to house the equipment for weather protection and to facilitate maintenance during the winter period.

Figure 5-9 and Figure 5-10 present the interior and exterior of a travelling screen, respectively.

Figure 5-9. Travelling Screen Exterior

Figure 5-10. Travelling Screen Interior Diagram

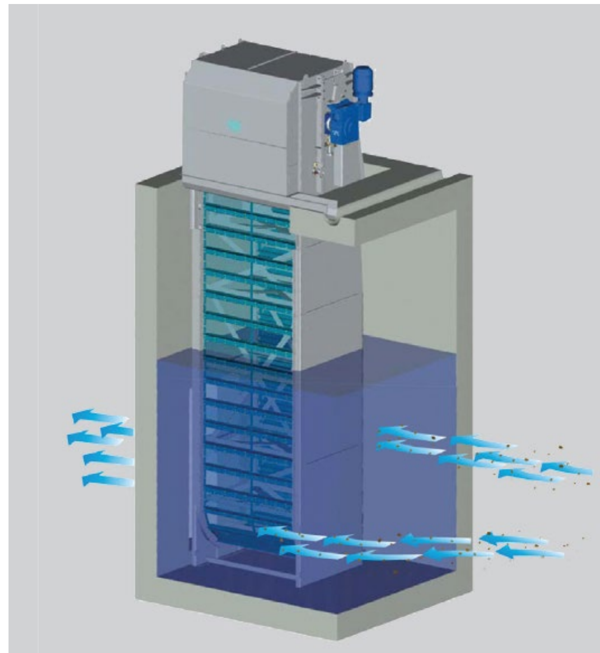
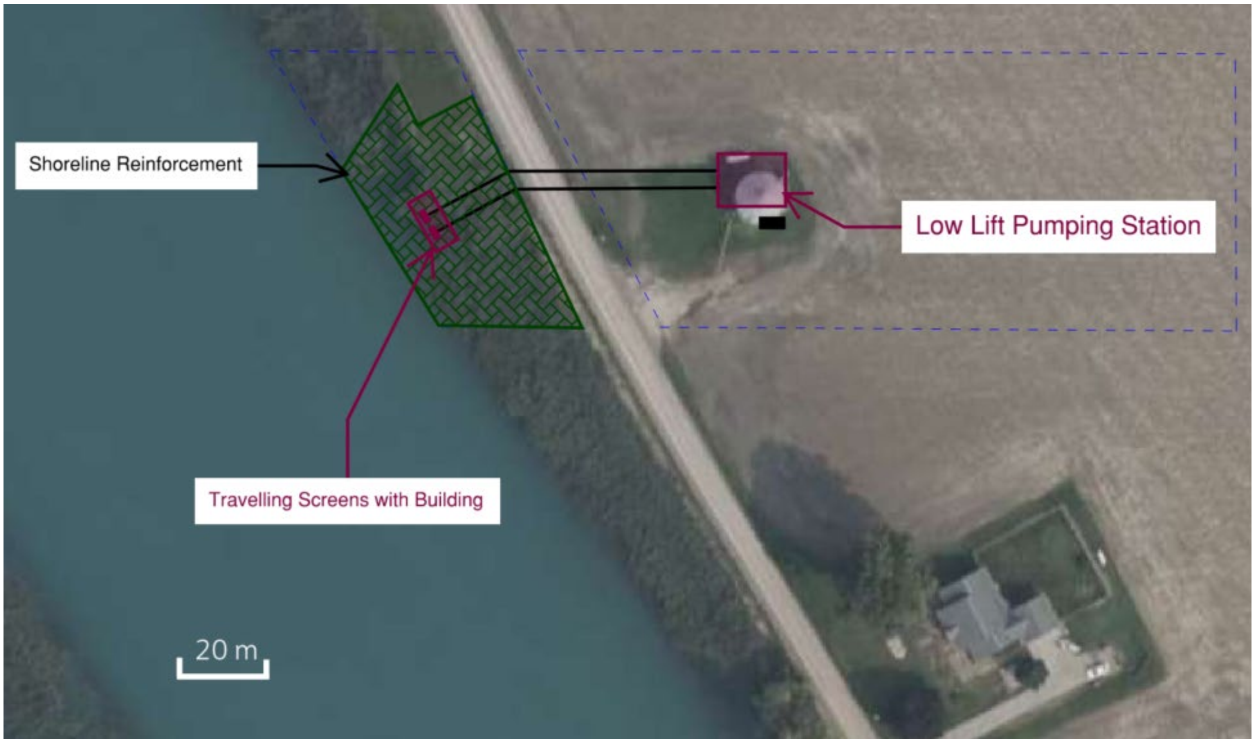


Figure 5-11 presents a preliminary site layout for Alternative Design Concept 4. The travelling screens would be located inside of a separate building on the western side of Bluewater Line. The building would also contain the debris bin. A fish return line would be constructed along the bank to return any aquatic species that are removed by the screens. The return line would have to be flushed with heated water in the winter to avoid freezing.

The screens would be fed from bell-mouth intakes between the screens and the Chenal Écarte and would be installed using trenchless technologies.

Figure 5-11. Preliminary Site Layout for Alternative Design Concept 4



5.2 Cost Estimation

Capital cost estimates, O&M cost estimates, and lifecycle cost estimates were developed for each alternative presented in Section 5.1, based on the methodology presented in Section 3.2.

It is assumed that the CK PUC will continue to dose 0.2 mg/L NaOCl at the intake screen for zebra mussel control, as is currently practiced.

Table 5-1 summarizes the estimated capital costs, annual O&M costs, and lifecycle costs of the alternative design concepts for raw water supply. Details are presented in Appendix C.

Table 5-1. Cost Estimates: Alternative Design Concepts for Raw Water Supply

Alternative	Description	Capital Cost	Annual O&M Costs	50-year Lifecycle Cost
Alternative Design Concept 1	Submerged Tee Screens	$7,900,000	$230,000	$14,000,000
Alternative Design Concept 2	Headwall-Mounted Tee Screens	$8,600,000	$210,000	$14,300,000
Alternative Design Concept 3	Flat Panel Fish Screens	$8,100,000	$220,000	$14,200,000
Alternative Design Concept 4	Travelling Screens	$12,100,000	$270,000	$19,300,000

5.3 Greenhouse Gas Emissions

Table 5-2 presents the greenhouse gas emission estimates for each water treatment design concept, based on the methodology presented in Section 3.3.

Table 5-2. Greenhouse Gas Emission Estimates: Alternative Design Concepts for Raw Water Supply

Alternative	Description	Greenhouse Gas Emissions, tonnes CO_2 eq/year
Alternative Design Concept 1	Submerged Tee Screens	33.9
Alternative Design Concept 2	Headwall-Mounted Tee Screens	33.9
Alternative Design Concept 3	Flat Panel Fish Screens	33.9
Alternative Design Concept 4	Travelling Screens	34.4

5.4 Evaluation Criteria

The alternative design concepts were evaluated using the methodology presented in Section 3.4. Table 5-3 presents the evaluation criteria and scoring measures for the water treatment design concepts evaluation.

Table 5-3. Evaluation Criteria: Alternative Design Concepts for Raw Water Supply

Criterion	Description	Measure: Score of 10	Measure: Score of 5	Measure: Score of 1
Reliability	The ability of the alternative to perform with a high degree of reliability and predictability, based on number of example installations in similar conditions.	The alternative includes proven technology with a high degree of reliable performance.	The alternative includes newer technology with a growing record of demonstrated performance reliability.	The alternative includes innovative technology with a limited performance record and unconfirmed reliability.
Design and Implementation Complexity	The relative design and implementation complexity for the alternative.	The alternative has low design complexity and is easier to implement relative to other alternatives.	The alternative has moderate design and implementation complexity relative to other alternatives.	The alternative has highest complexity in design and implementation relative to other alternatives.
Constructability	The ability of the alternative to be constructed and implemented on a technical and practical basis, within a reasonable scope of work.	The alternative is easy to implement with limited constructability issues and reasonable construction work scope.	The alternative can be implemented with some difficult constructability issue or some constraints, with moderate scope of construction work.	The alternative has many challenges with respect to implementation and construction, with complex and large work scope.
Footprint Requirements	The relative footprint required for the alternative.	The alternative requires smallest footprint relative to the other alternatives.	The alternative requires a moderate footprint relative to the other alternatives.	The alternative requires largest footprint relative to the other alternatives.
Ease of Operation	The degree of complexity associated with operating the alternative.	The alternative is simple to operate.	The alternative is moderately difficult to operate and requires extensive and continuous operator trainings.	The alternative is complex to operate.
Maintenance Complexity	The degree of complexity associated with maintaining the alternative.	The alternative is simple to maintain.	Maintenance is somewhat difficult and requires higher skills.	The alternative requires frequent or complex maintenance.
Sediment and Debris Management	The degree of intervention required from CK PUC staff to manage debris and sediment.	CK PUC operator intervention is frequently required to manage or dispose of debris and sediment.	CK PUC operator intervention is sometimes required to manage or dispose of debris and sediment.	CK PUC operator intervention is rarely required to manage or dispose of debris and sediment.
Zebra Mussel Control	The ability of the alternative to mitigate issues related to zebra mussels.	The alternative has a proven track record of zebra mussel control.	The alternative has a moderate track record of zebra mussel control; some buildup is expected on the intake.	The alternative is not effective in controlling zebra mussels.
Fish Management	The ability of the alternative to meet DFO regulations for fish management and the relative complexity of the fish management system.	The alternative will meet or is designed to meet DFO regulations and has a relatively simple fish management system.	The alternative will meet DFO regulations with some intake design modifications, or it has a moderately complex fish management system.	The alternative will not meet DFO regulations, or it has a highly complex fish management system.
Shoreline and Riparian Area Impacts	The relative impact of the alternative, permanent or temporary, to the shoreline and riparian area.	The alternative will not alter or impact the shoreline or riparian area.	The alternative will temporarily alter the shoreline or riparian area or both.	The alternative will permanently alter the shoreline and riparian area.
Health and Safety Impacts	The relative health and safety impact of the alternative, as well as the degree of mitigation required.	The alternative will have little to no impact on the health and safety of staff or the public.	The alternative will have a moderate impact on the health and safety of the public or operations staff, which requires mitigation.	The alternative will have a severe impact on the health and safety of the public or operations staff, which requires significant mitigation.
Capital Cost	The relative capital cost of the alternative.	The alternative has a relatively high capital cost.	The alternative has a relatively moderate capital cost.	The alternative has a relatively low capital cost.
Lifecycle Cost	The relative lifecycle cost of the alternative.	The alternative has a relatively high lifecycle cost.	The alternative has a relatively moderate lifecycle cost.	The alternative has a relatively low lifecycle cost.

Note:

DFO = Fisheries and Oceans Canada

5.5 Evaluation Results and Preferred Raw Water Supply Design Concept

Table 5-4 presents the evaluation results for raw water supply intake technologies. Detailed scoring and rationales are presented in Appendix D.

Table 5-4. Evaluation Results for Intake Technologies

Alternative	Description	Score
Alternative Design Concept 1	Submerged Tee Screens	88
Alternative Design Concept 2	Headwall-Mounted Tee Screens	69
Alternative Design Concept 3	Flat Panel Fish Screens	65
Alternative Design Concept 4	Travelling Screens	35

Alternative Design Concept 1: Submerged Tee Screen Intakes received the highest score and thus was selected as the preferred design concept for raw water supply. The advantages for this concept include the following:

- This concept requires the smallest footprint and carries the lowest capital cost.
- This intake technology would have the least impact on the nearby wetland, shoreline, and riparian area because it does not require any additional structures or buildings between the Chenal Écarte and the LLPS.
- This intake technology is proven to be reliable in similar conditions (surface water with agricultural runoff).
- Operation and maintenance of the submerged T-screen intakes are relatively simple and require less effort.
- This screen technology provides an opportunity for a screen that is manufactured with a zebra mussel-resistant coating, which minimizes the control of zebra mussel growth at the screen or intake surface. The tee screen also rejects aquatic species at the point of entry, which is preferred by the DFO for fish management. Screens are designed to meet DFO guidelines.

6. Summary of Preferred Design Concepts

Section 6 summarizes the preferred design concepts, long-term benefits, potential impacts and mitigations, and impact assessments.

6.1 Preferred Design Concepts

Figure 6-1 presents the integrated preferred design concepts, as well as the preferred solutions that were carried forward for the raw watermain and water transmission main identified in TM 1. Table 6-1 summarizes the key parameters. These components form the overall preferred solution and design concepts for this Class EA.

Table 6-1. Preferred Solution and Design Concept Parameters for the Wallaceburg Water Treatment Servicing Class EA

Parameter	Value
New Wallaceburg WTP Ultimate Rated Capacity	28 ML/day
Pre-Treatment Process	Coagulation and Flocculation
Filtration Process	Low-pressure Membrane Filtration
Primary Disinfection Process	Chlorination (Dedicated Chlorine Contact Tank)
Post-Treatment Process	Fluoridation
Ultimate Storage Capacity, megalitres	56 megalitres
New Intake and LLPS Ultimate Capacity	34 ML/day
Intake Screen Type	Submerged Tee Screens
Low Lift Pump Type	Vertical Turbine
Number of Low Lift Pumps	4 (2 duty, 2 standby)
New Twinned Raw Watermain Length	6,300 metres
New Treated Water Transmission Main Length from Wallaceburg to Dresden	18,500 metres

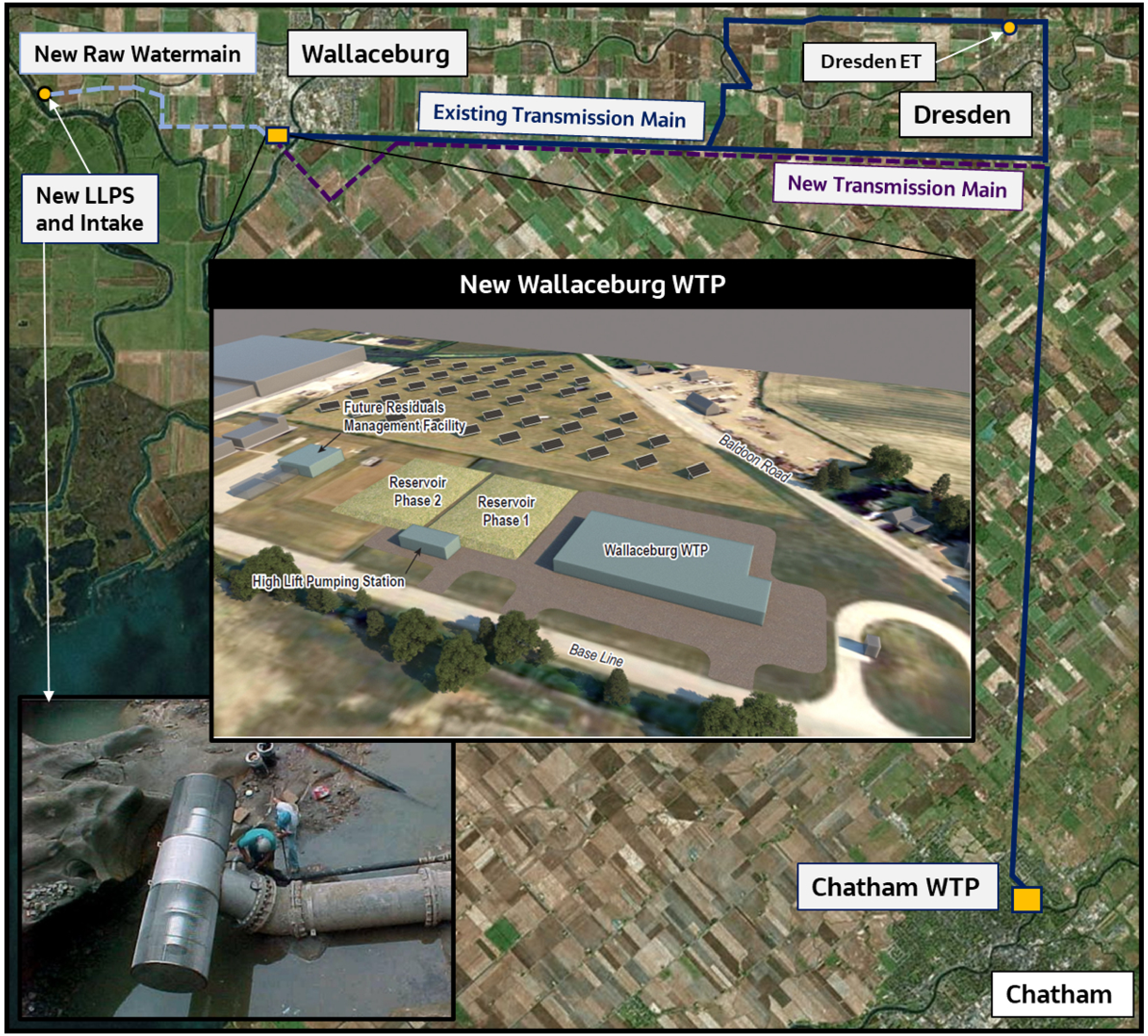


Figure 6-1
Preferred Solution and Design Concepts for the Wallaceburg Water Treatment Servicing Class EA
Technical Memorandum 2
Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

Jacobs

Table 6-2 summarizes the components and their associated capital cost estimates.

Table 6-2. Overall Cost Estimate for Preferred Solution and Design Concepts

Component	Capital Cost Estimate
Wallaceburg WTP	$39,300,000
Storage Reservoir (56 megalitres)	$27,600,000
LLPS and Intake	$7,900,000
Raw Watermain	$9,500,000
Treated Water Transmission Main	$32,800,000
Total	$117,100,000

6.2 Long-term Benefits

The preferred solution and design concepts are expected to provide the following long-term benefits for the Municipality of Chatham-Kent:

- Replacing aging, unreliable infrastructure with new, modern, and sustainable infrastructure that will increase the security and reliability of water supply in Wallaceburg and the expanded service areas.
- Reducing the electricity consumed per megalitre of treated water produced, thus reducing the GHG emissions.
- Improving the quality of treated water with capability to meet more stringent regulatory requirements.
- Avoiding the concern of deteriorated raw water quality currently experienced at the LLPS and intake during wet weather events by constructing the new LLPS and intake further upstream.
- Enhanced raw water supply security by implementing redundancy (split pump well) in the new LLPS and raw watermain (twinned watermain).
- Improved compliance with DFO guidelines for fish protection by adoption of the modern intake screen technology.
- Improved zebra mussel control by using an intake technology that is compatible with zebra mussel-resistant coatings.
- Achieving a more balanced water supply within the CK PUC by reducing the stress and potentially delaying a capacity expansion at the Chatham WTP. This will also allow the CK PUC to re-allocate Dresden's water usage at the Chatham WTP for the expanded service area in Northeast Chatham-Kent.
- Providing a reliable water supply for potential future greenhouses on Base Line, which will ultimately provide a positive economic contribution to the Municipality of Chatham-Kent.
- Addition of 3 days of treated water storage to improve water supply security under an emergency condition of contaminated St. Clair River caused by chemical spills that could lead to a prolonged intake closure.

6.3 Potential Impacts and Mitigation Measures

A Stage 1 Archeological Assessment was completed for the study area as part of this Class EA. Key findings are summarized as follows (Golder 2021b):

- No archaeological resources were identified at this stage.

- The study area for the upstream LLPS location and new Wallaceburg WTP were found to have archaeological potential because they were not subjected to previous disturbances.
- Stage 2 assessments (test pit surveys) are recommended for these areas during detailed design.

Similarly, a cultural heritage study was completed to identify and potential cultural heritage resources within the study area that may be impacted by the preferred solution for this Class EA. No protected heritage properties designated under Part IV or Part V of the *Ontario Heritage Act* were identified. Overall, 286 properties with buildings greater than 40 years old of potential cultural heritage value or interest were identified. The preliminary recommendation is to site and route infrastructure to avoid these properties. Note, however, that the preferred raw watermain routes, while avoiding the building itself, would pass through one of these properties (29108 Mirwin Road). Therefore, a Cultural Heritage Evaluation Report is required prior to constructing the raw watermain (Golder 2021a).

Jacobs completed an impact assessment to identify the preferred solutions' potential impacts to natural features or species at risk (SAR), as well as mitigation measures for these impacts. Table 6-3 summarizes these potential impacts and their mitigation measures.

Table 6-3. Potential Impacts and Mitigation Measures

Potentially Affected Natural Feature or SAR	Project Phase and Activity	Potential Environmental Effect to Natural Feature or SAR	Likelihood, Direct or Indirect?	Mitigation Strategy	Additional Studies, Monitoring, and Contingency Measures Required at the Detailed Design Stage
Fish-bearing habitat: ▪ The Chenal Écarte, Sydenham River, and Maxwell Creek Potential fish-bearing habitat: ▪ Various agricultural drains	Site Preparation ▪ Vegetation removal ▪ Grading ▪ Use of heavy equipment Construction ▪ Open-cut for Raw Watermain, Water Transmission Line, or shaft construction	▪ Site preparation and construction activities, including equipment used, may disturb the adjacent watercourses, cause changes in soil compaction and site drainage, and result in erosion and sedimentation or runoff to enter the watercourses. ▪ Accidental spills from heavy equipment and site vehicles may cause the releases of deleterious material, introduce invasive species, and modify bank and riparian conditions. ▪ Open-cut construction could impact SAR Critical Habitat and Aquatic SAR.	Pending construction methodology and locations, however, in general, ▪ Direct effects are not predicted if trenchless technology is used at the water crossings and shaft locations are setback. If horizontal directional drilling (HDD) or microtunnelling are selected, minimum depths to avoid frac-out should be implemented. Open-cut construction at the Chenal Écarte or Sydenham River may directly result in Harmful Alteration, Disruption and Destruction. Direct effects to aquatic SAR and habitat could occur from open-cut construction. ▪ Indirect effects could occur (such as erosion and sedimentation or runoff from the proposed construction) if mitigation is not applied.	▪ Consider trenchless technology at all water crossings, particularly at known fish habitat, including the Chenal Écarte, Sydenham River, and Maxwell Creek. ▪ Vegetation removal, grading, and heavy equipment use shall only occur within areas that have been previously demarcated and approved to allow construction works. Silt fencing should be erected along the extremities of the excavation limits. ▪ Multibarrier ESC measures (such as filter soxx and heavy-duty silt fencing or similar) should be erected directly adjacent to the proposed works and temporary watercourse crossings. Temporary, multibarrier ESC measures and runoff conveyance structures (such as tile drains and hillside erosion blankets or similar) could be installed as to further protect the watercourses where works are planned along steep slopes or banks. These measures and structures should be maintained and enhanced as needed until construction has been completed and the site has stabilized. ▪ An ESC plan shall be developed by a qualified engineer and be site specific. The ESC plan shall be treated as a live document and updated as required. ▪ Concrete washout pads shall be installed to contain potential leachate as necessary and be setback a minimum 30 metres from any water features if haul trucks do not contain self-washout containers. ▪ If stockpiles are required, the material shall be covered and contained to prevent erosion and potential sedimentation from entering Natural Features. Stockpiles should not occur within the flood line. ▪ Staging and access areas should be planned to be located primarily within existing, open, and disturbed areas.	▪ Where possible follow the applicable DFO Standards and codes of practice (Government of Canada 2021) ▪ Ensure the design and construction follows the relevant sections of DFO's Measures to Protect Fish and Fish Habitat (Government of Canada 2019). ▪ Submit a DFO Request for Review at the detailed design stage. Generally, if in-water works or works within the 2-year flood line (ordinary high-water mark) are prescribed, DFO review is required unless codes of practice and measures to protect fish and fish habitat can be fully adhered to. ▪ Pending the construction methodology selected for the crossings at the Chenal Écarte and Sydenham River, a SARA permit may be required as well as authorization under the ESA. The presence of aquatic SAR and Critical Habitat may trigger a *Fisheries Act Authorization* with SARA considerations. It is recommended that work does not occur within Aquatic SAR Critical Habitat (Government of Canada 2022). Consult with DFO to confirm the mapping of Aquatic SAR Critical Habitat and SAR occurrences. ▪ Confirm the in-water and near water works approved timing window from the agencies for the Chenal Écarte, Sydenham River, Maxwell Creek, and the various agricultural drains where crossings are prescribed. ▪ Retrieve or compute the 2-year flood line (ordinary high-water mark). ▪ Complete an Environmental Impact Study (or similar) at the detailed design stage, which will include a detailed Aquatic Habitat Assessment where construction is proposed within 30 metres of fish-bearing habitat. Fish-bearing habitat is assumed at the various agricultural drains unless otherwise stated from an applicable environmental agency to not occur, or unless detailed fish community sampling is carried out that confirms absence, adhering to DFO guidelines (Mandrak and Bouvier 2014).

Potentially Affected Natural Feature or SAR	Project Phase and Activity	Potential Environmental Effect to Natural Feature or SAR	Likelihood, Direct or Indirect?	Mitigation Strategy	Additional Studies, Monitoring, and Contingency Measures Required at the Detailed Design Stage
				▪ Access and movement of vehicles and equipment must be controlled to limit the introduction and spread of invasive species. Vehicles and equipment shall be inspected prior to entering and leaving the site to verify the equipment is clean and free of invasive species. Equipment shall be inspected and used only if in good working order. The contractor is to follow and implement the *Clean Equipment Protocol for Industry: Inspecting and cleaning equipment for the purposes of invasive species prevention* (Halloran et al. 2016). Install mud mats at site entry and exit points. ▪ If feasible, vegetation removal and grading activities should be scheduled to avoid times of high runoff volumes (spring and fall) to prevent erosion and potential sedimentation. ▪ The construction area shall be revegetated with native species as soon as possible following disturbance. Compensation should also consider riparian habitat improvements and should focus on species selection that could aid in runoff retention and improvements for fish refuge (that is, overhanging bank vegetation). Riparian shrub plantings and live stakes could also be used to improve eroded bank conditions. ▪ A designated and lined refuelling area with appropriate spill containment shall be established a minimum of 30 metres from any watercourse or water feature. This shall then also be setback from the 2-year flood line (ordinary high-water mark). ▪ A spill response team member shall be designated as a point of contact in the case of an accident or spill to verify the proper and timely implementation of Site response controls. Contractor shall provide a spill control plan. ▪ Absorbent materials and equipment required to control and clean up spills of deleterious substances shall be available onsite. Spills and leaks of deleterious substances shall be immediately contained and cleaned up in accordance with regulatory requirements and reported immediately to the Ontario Spills Action Centre at 1.800.268.6060.	▪ Develop a Terms of Reference for the project with the SCRCA and complete geomorphic, hydrology, geotechnical and hydraulic assessments as required. ▪ Retain a License to Collect Fish for Scientific Purposes from the Ministry of Northern Development, Mines, Natural Resources and Forestry (MNDMNRF) for in-water works where fish salvages are required. Relocation of SAR mussels may also be required as part of a SARA permit. Unless otherwise stated by an applicable agency, salvages for mussels shall follow the *Protocol for the Detection and Relocation of Freshwater Mussel Species at Risk in Ontario Great Lakes Area (OGLA), (*Mackie et al. 2008*).* ▪ If erosion is observed, or if sedimentation or runoff or accidental spills occur within the watercourses, stop work immediately and mitigate the releases. Contact the SCRCA, Spills Action Centre, and DFO as required for further direction. ▪ A qualified environmental inspector shall perform ESC pre-construction and construction monitoring. ESC should be left in place until the site has stabilized following construction. ▪ Weekly, and within 24 hours following a rain event, sediment control structures shall be inspected to verify structures are in good working condition and sedimentation is not occurring. ▪ Sediment control structures and surrounding areas shall be replaced, repaired, and modified as required within 48 hours of noted deficiencies. ▪ Weekly monitoring shall be conducted by an environmental inspector during construction to confirm disturbances outside of the construction area are not occurring. If disturbances are observed, activities shall be altered, and affected areas shall be restored as soon as possible. ▪ An environmental inspector shall monitor for sediment plumes and turbidity (against background levels) within the watercourses. If observed, work shall stop immediately. A total suspended solids and turbidity relationship may have to be set-up to monitor for total suspended solids. This shall be carried out as required by the agencies (under a *Fisheries Act Authorization* if required).

Potentially Affected Natural Feature or SAR	Project Phase and Activity	Potential Environmental Effect to Natural Feature or SAR	Likelihood, Direct or Indirect?	Mitigation Strategy	Additional Studies, Monitoring, and Contingency Measures Required at the Detailed Design Stage
					▪ Complete riparian compensation and monitoring of plantings and as required.
Wetland habitat: ▪ PSW, various non-evaluated wetlands and forested areas	Site Preparation ▪ Vegetation removal ▪ Grading ▪ Use of heavy equipment Construction ▪ Trenchless installation of intake pipe	▪ Site preparation and construction activities, including equipment used, may disturb Natural Features and cause changes in soil compaction and site drainage and result in erosion and sedimentation or runoff to wetlands and forested zones. ▪ Construction directly within wetlands or forested areas would result in habitat loss and degradation. ▪ Accidental spills from heavy equipment and site vehicles may cause the releases of deleterious material and introduce invasive species.	▪ Direct impacts are not predicted if the works do not occur directly within the wetlands or forested areas. ▪ Vegetation removals could result only in temporary habitat effects so long as ecosystem compensation is carried out immediately following construction. ▪ Indirect effects could occur (that is, erosion and sedimentation or runoff from the proposed construction without mitigation applied). ▪ Indirect effects to wildlife (for example, noise may occur but can be reduced with mitigation).	▪ Optimize the intake pipe alignment to minimize impacts to the wetland associated shoreline habitat within the Chenal Écarte and hydrologically connected non-evaluated wetland swaths to the southeast. ▪ Select construction methods for intake pipe installation (that is, trenchless installation) to avoid impacts to the wetland. ▪ Erect herptile exclusion fencing as necessary following the MNDMNRF's *Best Management Practices for Mitigating the Effects of Roads on Amphibian and Reptile Species at Risk in Ontario* (MNDMNRF 2016) where works are prescribed within 30 metres of wetlands or unless otherwise stated by the agencies at detailed design. ▪ In lieu of herptile fencing where required, multibarrier ESC measures (for example, filter soxx and heavy-duty silt fencing or similar) should be erected immediately adjacent to forested and wetland areas. These measures and structures should be maintained and enhanced as needed until construction has been completed and the site has stabilized.	▪ Construction schedules should accommodate the nesting season to avoid accidental take of waterfowl or avifauna nesting within the wetland. ▪ If possible, demolition, tree and shrub removal, and vegetation clearing will be avoided from April 1 to August 31, conforming to the Study Areas general nesting period and corresponding to the MBCA (Government of Canada 2018). ▪ An environmental inspector shall complete herptile inspections within the work areas, daily prior construction activities commencing. ▪ If herptiles enter the work area, stop work immediately and allow the species to exit the work area naturally. If the species requires relocation, contact the MNDMNRF. A permit under the *Fish and Wildlife Conservation Act* is required to complete wildlife salvages. ▪ If HDD or microtunnelling are selected, draft a frac-out response plan. Depth of drilling should be below the frac-out; consult with the SCRCA. ▪ Complete ecosystem restoration or planting plans to offset habitat disturbances within forested and wetland areas as required. Compensation should occur proximal to the proposed impacted areas to re-establish the nearby ecological function. Monitoring the success of the restoration is typically completed at years 1, 3 and 5, in which, the project shall consider carrying out.

Potentially Affected Natural Feature or SAR	Project Phase and Activity	Potential Environmental Effect to Natural Feature or SAR	Likelihood, Direct or Indirect?	Mitigation Strategy	Additional Studies, Monitoring, and Contingency Measures Required at the Detailed Design Stage
SAR: ▪ Bobolink (SAR 4), Barn Swallow (SAR 2 and 3) and Monarch (SAR 1) (Figures 2-1 and 2-2) ▪ Migratory birds ▪ Other wildlife	Site Preparation ▪ Vegetation removal ▪ Grading ▪ Use of heavy equipment ▪ Staging and laydown areas Construction ▪ Noise from heavy equipment ▪ Open-cut works	▪ Avifauna species (including SAR) could be impacted from noise, harassment, tree and vegetation removals, incidental nest take and habitat fragmentation. ▪ Many avifauna species are protected under the *MBCA* or *ESA* (or both).	▪ No indirect impacts are predicted through mitigation. ▪ Direct impacts to Bobolink could occur because of habitat loss within agricultural areas. However, this impact shall be further assessed at the detailed design stage once work areas are confirmed, through the results of additional surveys and in consultation with the MECP. ▪ Direct impacts to Monarch could occur because of habitat loss within the cultural meadow (fields) of the existing WTP site, an area where the WTP expansion is planned. ▪ Direct impacts at this time are not predicted to Barn Swallow.	▪ If possible, demolition, tree and shrub removal, and vegetation clearing will be avoided from April 1 to August 31, conforming to the Project Location's general nesting period, corresponding to the *MBCA* (Government of Canada 2018). ▪ Removal of confirmed Bobolink and Monarch habitat shall be compensated for. If impacts to Bobolink habitat is confirmed, consult with the MECP prior to construction; approvals will be required under the *ESA*.	▪ Conduct a SAR and Breeding Bird Surveys at the detailed design stage at the proposed work areas and extending a minimum of 30 metres. Multi-season surveys should be completed during the growing season and peak breeding season from May 24 to July 10 (OBBA 2021) and shall include searches for Barn Swallow nests. ▪ Re-screen the Project at the detailed design stage for SAR occurrences within 120 metres of the proposed works, including a records review and consultation with the MECP, Species at Risk Branch. ▪ If impacts to Bobolink habitat are confirmed at the detailed design stage, consult with the MECP. Per recent changes to the *ESA*, the project may have an option to submit a monetary submittal towards the Species at Risk Conservation Fund for potential impacts to Bobolink habitat. ▪ Complete a Significant Wildlife Habitat assessment against the *Significant Wildlife Habitat Criteria Schedules for Ecoregion 7E* (MNDMNRF 2015), adhering to the *Significant Wildlife Habitat Technical Guide* (MNDMNRF 2000) If the April 1 to August 31 vegetation clearing timing window cannot be adhered to, the following shall be implemented: ▪ Have a qualified avifauna biologist sweep areas of proposed construction and flag any nests observed. Follow-up surveys for SAR avifauna shall also be completed during the peak breeding bird season from May 24 to July 10 (OBBA 2021) during each construction year. ▪ Implement appropriate buffers and timing windows based on type of nests observed per the *MBCA*. ▪ If general construction occurs within the April 1 to August 31 timing window, an environmental inspector shall perform daily audits to ensure birds are not nesting during construction and that birds are not harassed from the work. If any of these observations are made, work is to halt, and a qualified avifauna biologist is to be retained to survey the construction area.

Potentially Affected Natural Feature or SAR	Project Phase and Activity	Potential Environmental Effect to Natural Feature or SAR	Likelihood, Direct or Indirect?	Mitigation Strategy	Additional Studies, Monitoring, and Contingency Measures Required at the Detailed Design Stage
					▪ If nests are observed on-site, prior to or during construction, retain a qualified avifauna biologist to investigate whether the site construction could impact nesting birds protected under the *ESA* or *MBCA*. ▪ Nest sweeps are valid for 1 week from the date of survey. ▪ Monarch are a Special Concern species and not afforded formal protection under the *ESA*. However, through a Significant Wildlife Habitat assessment at the detailed design stage, Monarch habitat at the WTP would likely be protected. Compensate impacts through wildflower pollinator plantings, including Milkweed.

Notes:

ESA = *Endangered Species Act*

ESC = erosion and sediment control

MBCA = *Migratory Bird Convention Act*

SARA = *Species at Risk Act*

6.4 Preliminary Water Resources, Geotechnical and Soil and Groundwater Impact Assessment

Subsection 6.4 describes the impact assessment conducted on preliminary water resources, geotechnical features, and soil and groundwater.

6.4.1 Geotechnical and Hydrogeological Considerations

While a comprehensive geotechnical and hydrogeological assessment will be completed during the preliminary design phase for the new infrastructure, Jacobs reviewed previously completed geotechnical reports for the project area to identify high-level impacts. There were no geotechnical reports available for the new LLPS and intake site. The following geotechnical reports were available for review:

- *Wallaceburg WTP Chlorination Upgrades Geotechnical Report* (Soil & Materials Engineering Inc. 2020)
  - Four boreholes were drilled east of the existing WTP filter building, with a maximum depth of 8.20 metres.
  - Soil samples were a combination of sand, silt, and clay to a depth of approximately 4 metres. Samples were a mixture of firm and soft clay below 4-metre depth. Bedrock was not detected in any of the boreholes.
  - The long-term lowest groundwater level appeared to be approximately 4.1 metres to 4.3 metres below grade.
  - The soil-bearing capacity ranged from 85 to 150 kilopascals depending on depth.
- *Wallaceburg Elevated Water Storage Tank Predesign Report* (CH2M Gore & Storrie 1998).
  - The Wallaceburg ET is located approximately 3 km northeast of the Wallaceburg WTP.
  - Two boreholes were drilled as part of the preliminary design.
  - Bedrock was detected 26.2 metres to 26.4 metres below grade.
  - The water table was 7 metres to 8 metres below grade at the time of testing.
  - The clay layer had insufficient bearing capacity to support the elevated tank, and steel H-piles driven into the bedrock were recommended for support.

The geotechnical information presented in these reports has implications for the LLPS (assuming similar conditions as the WTP site), WTP, and reservoir foundation design and construction. According to the soil-bearing capacities presented and the anticipated loading order of magnitude from each facility, it is likely that the foundations will require piles that are driven into the bedrock. Also, given the proposed reservoir depth of 10 metres below grade, it is likely that sheet piling and caissons and significant dewatering will be required during construction based on the water table depth recorded in previous reports.

Buried infrastructure (such as watermains, process piping, and electrical) is anticipated to be at or below the frost depth of 1.2 metres in Chatham-Kent (Ontario Provincial Standards 2010).

6.4.2 Water Resource Considerations

The new raw watermain and water transmission main are expected to cross the following drains/water bodies:

- Raw Watermain
  - Dykeman Drain
  - Biden Drain
  - Weiser Drain
  - Sutherland Branch Drain
  - McDonald Tap Drain
- Water Transmission Main
  - Sydenham River
  - Townline Drain
  - Elbow Road Drain
  - 18th Concession Drain
  - Manz Drain
  - Prince Albert Drain
  - Leeson Drain
  - Tap Drain
  - Stone & George Drain
  - Creek Drain
  - Daly Drain
  - Kirby Drain
  - Runciman Drain
  - Watson-Baseline Drain
  - Stephen Henson Drain

Note that the raw watermain will likely cross a number of private drains that are not currently mapped by the CK PUC, because a large portion of the watermain will be constructed within easements through privately owned agricultural fields. Jacobs and the CK PUC consulted with the Chatham-Kent Drainage Department, and surveys were recommended along the alignment to identify additional drains. It was also confirmed that the proposed alignments are acceptable from a drainage standpoint, provided that the drains are not adversely impacted. Topographic and subsurface utility investigations along the alignment will be vital in identifying this and informing the necessary construction techniques.

Specific construction methods, such as trenchless installation, will be required at these water crossings to avoid adverse impacts. The selection of the trenchless technology will be considered during the design phase.

Further water resources, geotechnical and soil and groundwater impacts will be identified during the design phase for each project.

6.5 Preliminary Utility Impact Assessment

Subsection 6.5 discusses the preliminary utility impact assessment.

6.5.1 Low Lift Pumping Station Site

The site for the new LLPS is located approximately 6 km west of the existing Wallaceburg WTP in a primarily agricultural area. There is no sanitary sewer connection for the property or within the vicinity. The Wallaceburg sanitary sewer system is limited to the residential areas of the community. Properties west of the Wallaceburg WTP require septic tanks or fields for wastewater management. Given that the LLPS will likely contain amenities, such as an emergency eyewash station and shower, a decentralized wastewater management system will be required on site to dispose of wastewater.

There is a municipal water connection that extends along Bluewater Line west of the LLPS site, which supplies water from the Wallaceburg WTP. It is anticipated that the new LLPS will connect to this watermain to supply amenities, such as the eyewash station and shower.

Power is supplied along Bluewater Line by Hydro One. There is currently a power connection to the silo that is located on the new LLPS site. However, it is unknown whether it is single-phase or three-phase. Regardless, because the silo will be demolished or relocated prior to construction, the CK PUC will have to apply for a new service connection from Hydro One to suit the needs of the LLPS and intake.

6.5.2 Water Treatment Plant Site

The new Wallaceburg WTP will be located on the site of the existing Wallaceburg WTP and will therefore use many of its existing connections. The existing RMF will be maintained during Phase 1 of the WTP (discussed further in Section 8) and will receive backwash waste and clean-in-place waste from the membranes, discharging to the sanitary sewer on Base Line. It is likely that a separate connection will be required from the new WTP to the Base Line sanitary sewer, because there will be sanitary sewage generated within the plant (for example, from washrooms, labs, emergency showers and eye washes, floor drains, and cafeteria).

The new Wallaceburg WTP will also require a new substation and three-phase hydro service connection from Hydro One, which will be sized during the design phase, based on the load assessment results. Consultation with Hydro One is recommended early in the design phase.

A new natural gas connection would also be required for building heating.

6.6 Preliminary Property Impact Assessment

Section 6.6 discusses the preliminary property impact assessment.

6.6.1 Low Lift Pumping Station Site

The preferred site for the new LLPS was private property at the time of evaluation, and as such, it requires land acquisition prior to construction. It is also noted that this property is currently zoned for agricultural use under the municipality's Comprehensive Zoning By-Law (Municipality of Chatham-Kent 2021). A zoning by-law amendment will be required prior to construction to alter the land use type from agricultural to general industrial.

6.6.2 Water Treatment Plant

The new Wallaceburg WTP will be constructed adjacent to the existing Wallaceburg WTP on the same land parcel. This land parcel is owned by the CK PUC and also contains a bulk water station on the western site of the property. According to a preliminary footprint assessment, most of the space that is currently available will be occupied by the new Wallaceburg WTP, primarily because of the area required for the new 56 megalitre reservoir.

The existing Wallaceburg WTP will be decommissioned and demolished once Phase 1 of the new Wallaceburg WTP is commissioned. A portion of the demolished WTP site will be required for the new RMF as part of the Phase 2 expansion; however, it is expected that the eastern portion of the property will be available for future use.

Figure 6-2 presents the anticipated footprint and associated property impacts for the new Wallaceburg WTP.

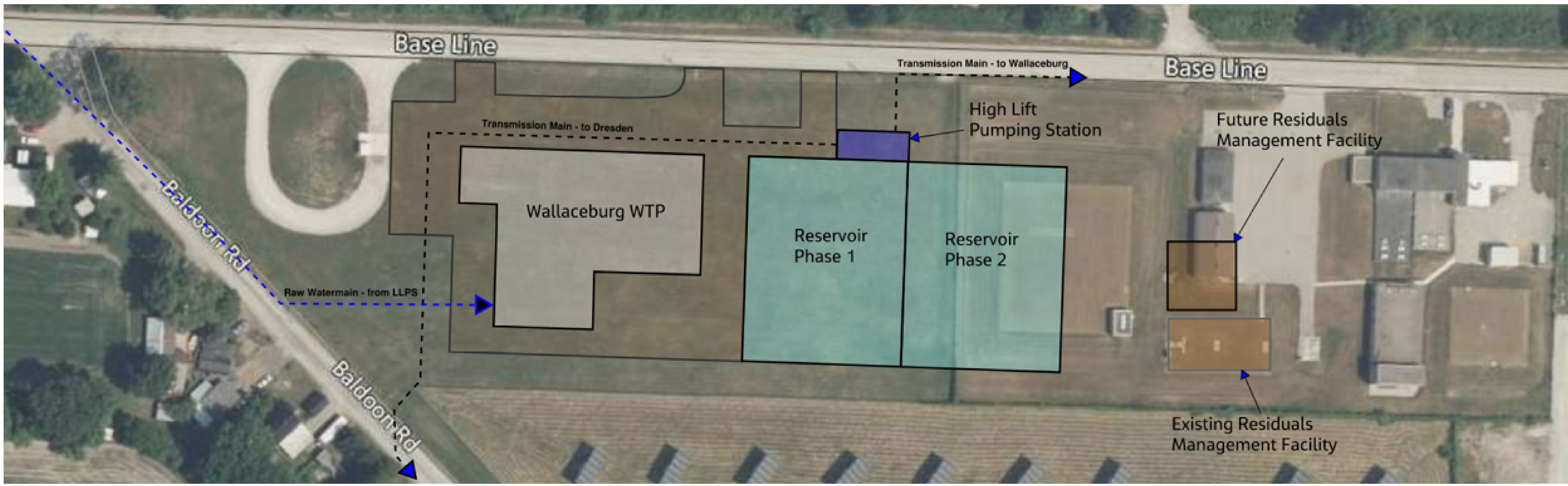


Figure 6-2
New Wallaceburg WTP Footprint Requirements and Property Impacts
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Schedule "C" Class Environmental Assessment (EA) Wallaceburg Water Treatment Servicing (CE788300)
Public Utilities Commission for the Municipality of Chatham-Kent (CK PUC)
Wallaceburg, ON

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6.6.3 Raw Watermain

The new raw watermain will be constructed through agricultural field located north of the Chenal Écarte, along Arnold Road, and along Base Line to the new Wallaceburg WTP.

The portion of the raw watermain that will be constructed through agricultural field will require permanent easements with sufficient width to allow for regular maintenance activities, as well as temporary wider construction easements. The portion that will be constructed along Arnold Road is also expected to require a permanent easement, as the CK PUC has indicated that there may be insufficient space in the right-of-way for new twinned pipes, which would mean that they would have to be installed on private property. This will be verified during detailed design.

The portion of the raw watermain constructed along Base Line will be installed in the right-of-way and will therefore not require any easements.

Figure 6-3 presents the proposed raw watermain route, highlighting portions that require easements and portions that will be constructed in the right-of-way.

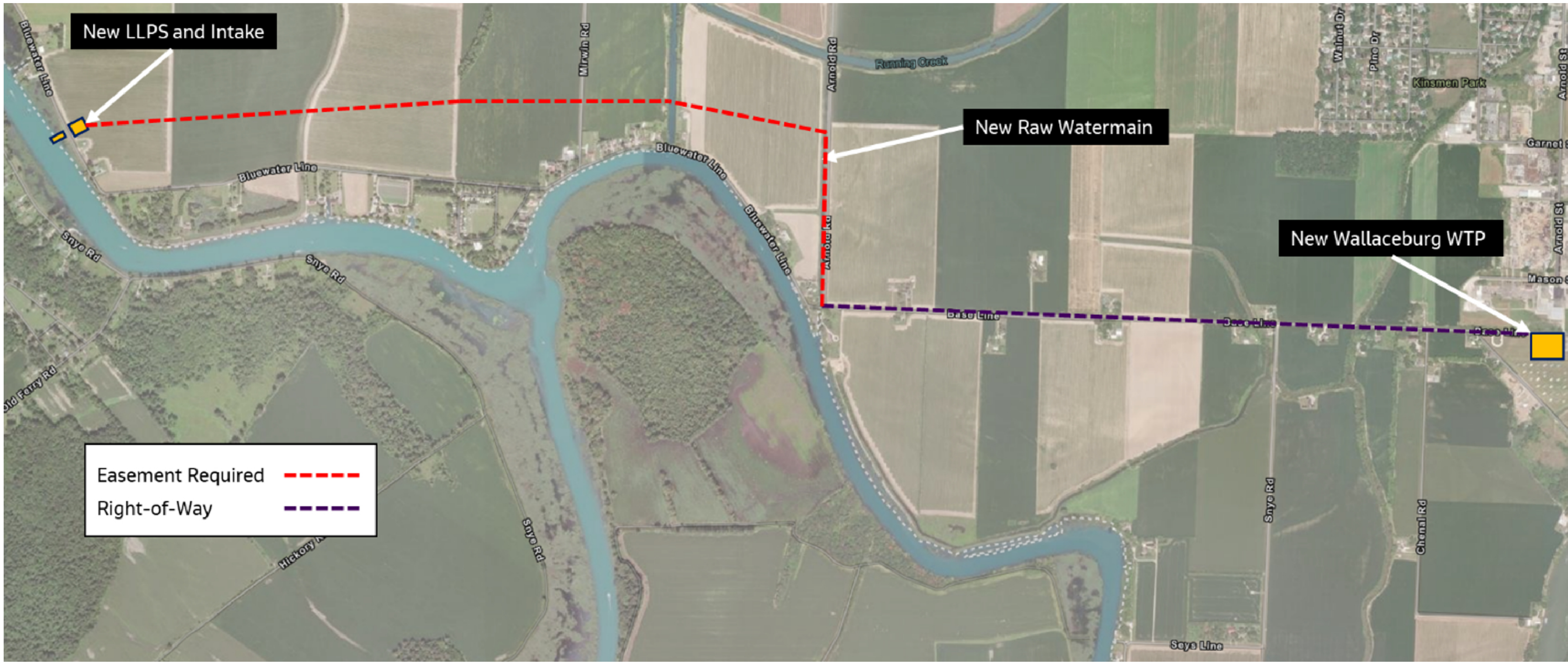

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Figure 6-3
Raw Watermain Alignment Property Ownership
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6.6.4 Treated Water Transmission Main

The new treated water transmission main from Wallaceburg to Dresden will be constructed along Baldoon Road, Border Road, Elbow Line, and Base Line to the existing water transmission main that supplies Dresden, located at Base Line and the railroad tracks east of North Street. The water transmission main will be constructed in the right-of-way for its entire length except for a portion on Elbow Line, which will run through private property. This portion will require a permanent easement and a temporary construction easement.

Figure 6-4 presents the proposed water transmission main route, highlighting the portion that is located on private property and requires easements.

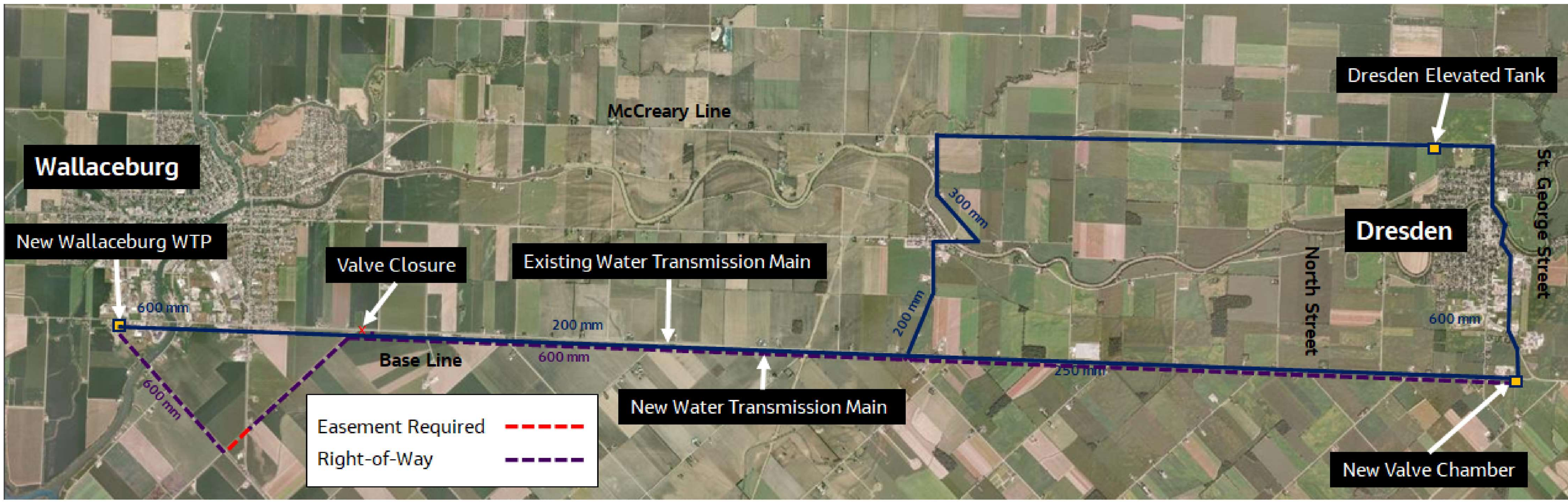

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Figure 6-4
Water Transmission Main Alignment Property Ownership
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7. Permitting Requirements

Table 7-1 summarizes the various project components and anticipated permitting requirements.

Table 7-1. Project Permitting Requirements

Component	Permitting Requirements
Wallaceburg WTP	DWWP Amendment MDWL Amendment Municipal Site Plan Approval Municipal Building Permit SCRCA Permit for Construction Electrical Safety Authority Authorization
Intake	Permit to Take Water DFO Project Authorization Transport Canada approval under the *Canadian Navigable Waters Act* Ministry of Natural Resources and Forestry Work Permit SCRCA for Construction
LLPS	DWWP Amendment MDWL Amendment Municipal Zoning By-law Amendment Municipal Site Plan Approval Municipal Building Permit SCRCA for Construction Electrical Safety Authority Authorization
Raw Watermain	Easement Approval from Private Landowners SCRCA Permit for Construction
Treated Water Transmission Main	Easement Approval from Private Landowners SCRCA Permit for Construction

Notes:

DWWP = Drinking Water Works Permit

MDWL = Municipal Drinking Water Licence

8. Implementation Plan

Section 8 provides details on the project implementation plan.

8.1 Phasing Plan

The preferred solution identified in this Class EA will be implemented in two phases, which are tied to the treatment capacity of the new Wallaceburg WTP. Phasing and timing are based on the preliminary water demand projection curve developed in conjunction with the CK PUC, which is presented on Figure 8-1. It is expected that this demand curve will be refined, and timing will change following completion of the 2022 Chatham-Kent Water and Wastewater Master Plan.

The demand curve has the following assumptions and implications:

- Phase 1 construction will be complete by 2026.
- Greenhouse demands will begin in 2026 and will increase linearly over a 10-year period to the ultimate demand of 8.6 ML/day MDD. Therefore, the treated water transmission main would be constructed in portions as required over the 10-year period based on greenhouse location.
- Dresden would be supplied from the Wallaceburg WTP once the entire treated water transmission main is constructed, which is projected for 2036.
- The Phase 1 treatment capacity of 14 ML/day would be reached by 2031, which means construction of the Phase 2 expansion to 28 ML/day must begin by 2028 and be complete before 2031.

The phases and their associated projects are described as follows:

- **Phase 1: Construct a new Wallaceburg WTP with a rated capacity of 14 ML/day**
  - Construct a new intake with a rated capacity of 34 ML/day, and an LLPS with a rated capacity of 17 ML/day and provisions to expand to a rated capacity of 34 ML/day. The entire building and all structural assets will be constructed during Phase 1. Additional pumps, electrical, and instrumentation and controls equipment are required in Phase 2 to expand the LLPS capacity from 17 ML/day to 34 ML/day.
  - Construct a new twinned raw watermain from the new LLPS to the new Wallaceburg WTP. Only one raw watermain pipe will be in service at any given time during Phase 1, with the in-service raw watermain changed periodically (cycled through).
  - Construct a new Wallaceburg WTP with a rated capacity of 14 ML/day and provisions to expand to a rated capacity of 28 ML/day. Table 8-1 presents the components that would be constructed in Phase 1 and their associated capacities.
  - Construct a new reservoir with a capacity of 28 megalitres. This includes the volume required based on the MECP design guidelines, as well as additional redundancy based on municipality-specific requirements. This reservoir will provide 3 days of storage based on the projected ADD during Phase 1. The first phase of the reservoir would be constructed with provisions (structural, process) to connect to the second phase of the reservoir once constructed.

Figure 8-1. Preliminary Water Demand Curve

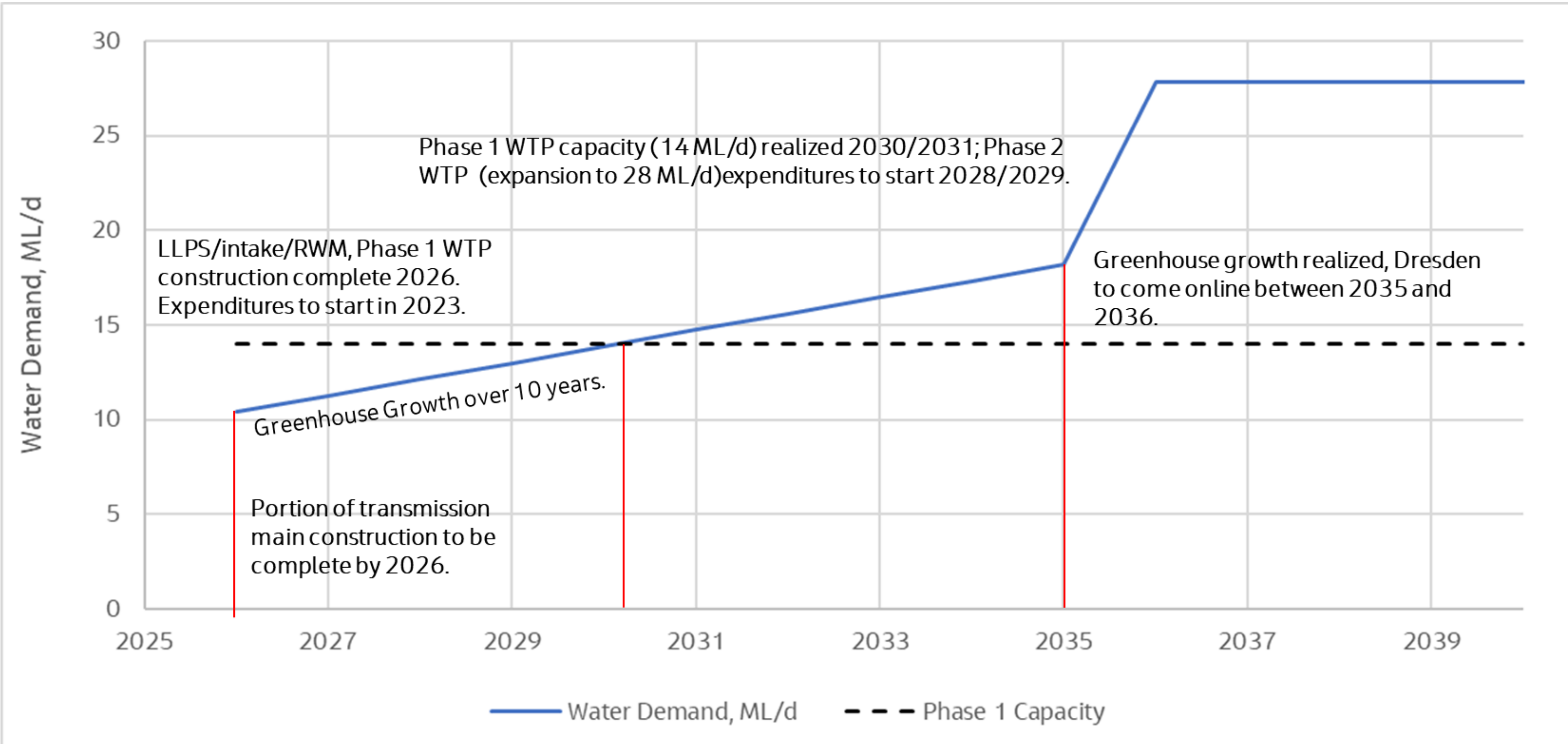

Table 8-1. Wallaceburg WTP Process Capacity: Phase 1

Process	Capacity
Coagulation and Flocculation	14 ML/day
Low-pressure Membrane Filtration	14 ML/day
Primary Disinfection	28 ML/day
High Lift Pumping Station	10 ML/day
Storage	28 megalitres

- **Phase 2: Expand the Wallaceburg WTP to provide a rated capacity of 28 ML/day**
  - Expand LLPS to provide a rated capacity of 34 ML/day by installing additional pumps, electrical, and instrumentation and controls equipment.
  - Expand the Wallaceburg WTP to provide a rated capacity of 28 ML/day by providing additional equipment. A new RMF will be constructed during Phase 2. Table 8-2 presents the capacity of each unit process following the Phase 2 expansion.
  - Expand the reservoir to provide a capacity of 56 megalitres.
  - Construct a new water transmission main from Wallaceburg to Dresden to supply future greenhouses and Dresden.

Table 8-2. Wallaceburg WTP Process Capacity: Phase 2

Process	Capacity
Coagulation and Flocculation	28 ML/day
Low-pressure Membrane Filtration	28 ML/day
Primary Disinfection	28 ML/day
High Lift Pumping Station	28 ML/day
Storage	56 megalitres
Residuals Management Facility	1.4 ML/day

The Wallaceburg WTP will only supply water to Wallaceburg following Phase 1 and will be expanded to supply water to Dresden and future greenhouses on Base Line following Phase 2. Figure 8-2 presents the infrastructure that will be installed in Phase 1 and Phase 2.

Figure 8-2
Phase 1 and Phase 2 Components
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The following sub-sections discuss approaches to design and construction for each phase, as well as the projected timing for each phase of the project.

Table 8-3 presents the cost estimate breakdown for Phase 1 and Phase 2.

Table 8-3. Cost Estimate Breakdown for Phase 1 and Phase 2 Components

Component	Phase 1 Cost Estimate	Phase 2 Cost Estimate
Wallaceburg WTP	$29,100,000	$10,200,000
Storage Reservoir	$13,800,000	$13,800,000
LLPS and Intake	$6,600,000	$1,300,000
Raw Watermain	$9,500,000	-
Treated Water Transmission Main	-	$32,800,000
Total	$59,000,000	$58,100,000

8.2 Implementation Plan

Preliminary design for each component will be completed as part of this project. The CK PUC will then issue a separate request for proposals for the detailed design and services during construction associated with the works.

The most efficient design strategy is for the consultant to complete designs for each project as required. As Phase 2 timing is currently uncertain and will be impacted by multiple factors, this strategy avoids the potential for equipment, devices, etc. included in design to become obsolete by the time of tender. For example, if the Phase 2 upgrades are designed in 2023 but not implemented until 2033, some components may be obsolete and would require additional work for design modification prior to tender.

The preferred solutions and design concepts for this Class EA can be separated into multiple contracts. Contract 1 must, at a minimum, include the following project components:

- Construct a new Wallaceburg WTP with a rated capacity of 14 ML/day and provisions to expand to a rated capacity of 28 ML/day in the future. Equipment will be designed such that there is redundancy at a rated capacity of 14 ML/day.
- Construction of a new 28 megalitre reservoir.
- Construct a new twinned raw watermain from the new LLPS to the new Wallaceburg WTP.
- Construct a new intake with a rated capacity of 34 ML/day, and an LLPS with a rated capacity of 17 ML/day and provisions to expand to a rated capacity of 34 ML/day.

These components must all be complete before the new Wallaceburg WTP can be commissioned. This contract may be expanded to include construction of the new water transmission main from Wallaceburg to Dresden; however, this depends on the water demand projection curve (i.e., when the transmission main is required by) and the maximum contract value that the CK PUC is willing to award to one contractor. If greenhouse expansion along Base Line is not expected in the near future, then construction of the new transmission main may be delayed and completed under a separate contract in the future.

The Phase 2 expansion will include the following upgrades:

- Installation of new equipment (flocculation tank mixing equipment, membrane filters, chemical dosing equipment) required to increase the rated capacity of the Wallaceburg WTP from 14 ML/day to 28 ML/day
- Expansion of the reservoir from 28 megalitres to 56 megalitres
- Construction of a new RMF

The existing Reservoir 2 must be decommissioned in advance of the Phase 2 expansion, because the footprint that Reservoir 2 currently occupies is required to expand the new reservoir from 28 megalitres to 56 megalitres. It is assumed that this will be included in an overall contract to decommission the existing Wallaceburg WTP.

The Phase 2 expansion timing will depend on the water demand curve, similar to the water transmission main. The water transmission main must be constructed before or concurrently with the Phase 2 expansion so that the Wallaceburg WTP is able to supply water to Dresden and future greenhouses immediately following commissioning.

8.3 Implementation Timing

Figure 8-3 presents the proposed implementation timing for the projects identified in this Class EA. Construction of the new water transmission main and the Phase 2 expansion are based on the preliminary water demand curve developed in conjunction with the CK PUC, which is presented on Figure 8-1.

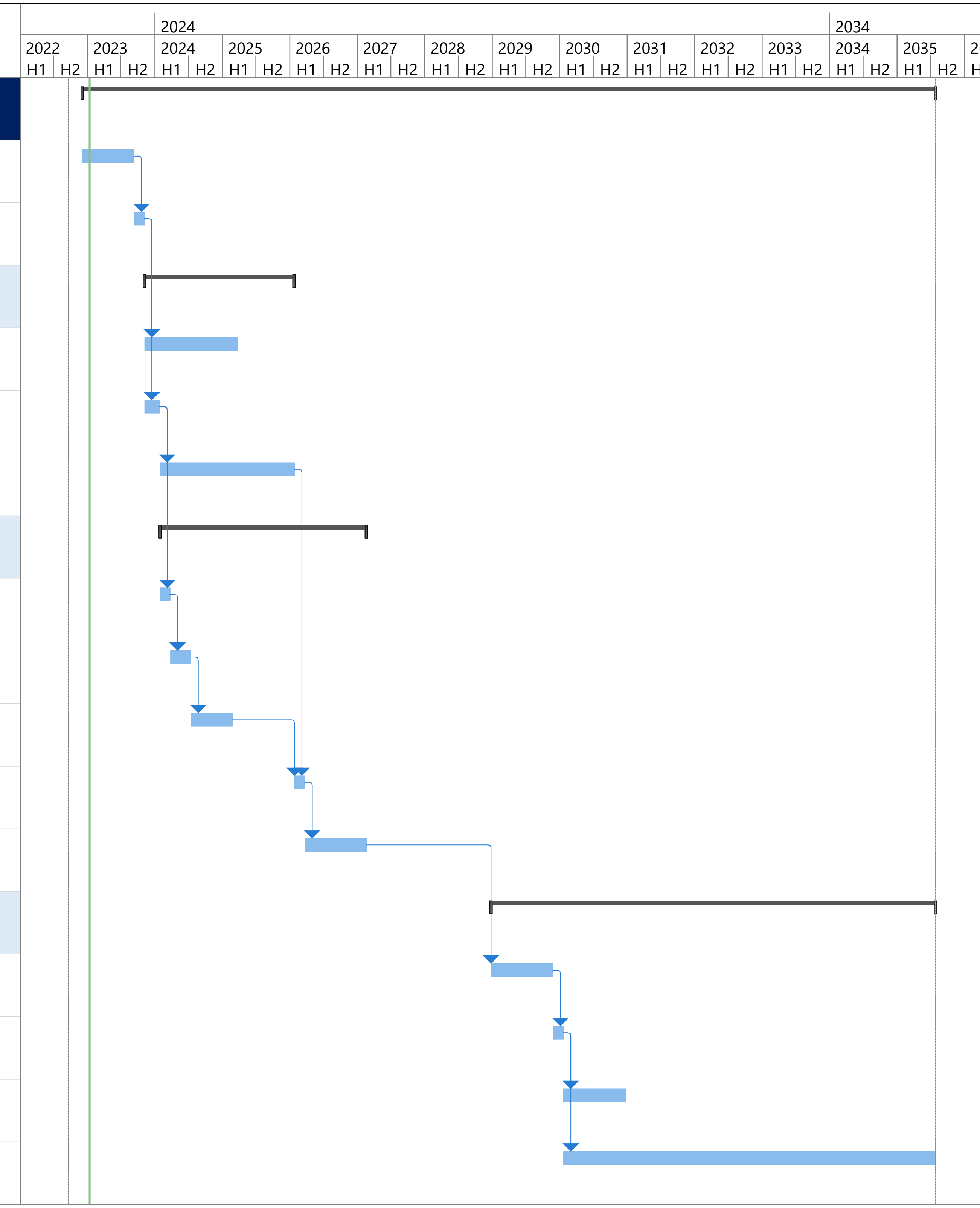
Implementation timing will be impacted by several factors, summarized in the following bullets:

- **Greenhouse Demand Timing**
  - Greenhouse demand timing will have an impact on implementation timing for the Wallaceburg WTP Phase 2 expansion and the new treated water transmission main.
  - If greenhouse demand growth is rapid following completion of the Phase 1 projects, then the Phase 2 expansion may be required sooner than anticipated. Rapid growth may also lead to larger portions of the treated water transmission main being constructed under single contracts.
  - If greenhouse demand growth is slow, then the Phase 2 expansion may be pushed into the future. However, if Dresden must be supplied from the Wallaceburg WTP prior to full greenhouse buildout, the entire treated water transmission main and the Phase 2 expansion will be required.
  - Greenhouse location is also an important consideration for the new treated water transmission main. If greenhouses are located farther east on Base Line, then a larger portion of the new treated water transmission main will need to be constructed initially versus if the greenhouses are located on the western portion of Base Line between Wallaceburg and Dresden.

- **Chatham WTP Water Demand Projections and Expansion Needs**
  - One of the drivers to supply Dresden from the Wallaceburg WTP in the future is to reduce demand at the Chatham WTP, either delaying expansion requirements or re-allocating these demands to other users.
  - Preliminary water demand projections for the Chatham WTP were developed by the CK PUC and are presented in TM 1. Projections indicate rapid growth (primarily greenhouse-driven) in the short term that will require an expansion at the Chatham WTP. The plant's rated capacity (68 ML/day) is projected to be exceeded in 2041 with Dresden being supplied and in 2046 without Dresden.
  - These projections will be revisited and refined as part of the 2022 Chatham-Kent Water and Wastewater Master Plan.
  - Depending on the timing and capacity requirements for expansion, it may make the most sense financially to construct the entire treated water transmission main prior to reaching ultimate greenhouse demands and supply Dresden from the Wallaceburg WTP to alleviate stress on the Chatham WTP.
  - Conversely, if expansion is not required in the near term, then there may be no driver to supply Dresden from the Wallaceburg WTP until later in the planning period.
- **Northeast Chatham-Kent Watermain Construction Timing and Demands**
  - The CK PUC is currently completing the Northeast Chatham-Kent Water Distribution System Class EA, which will identify the preferred solution for supplying water to new service areas in Northeast Chatham-Kent, including Bothwell and Moraviantown of the Thames First Nation. These areas will be supplied by the Chatham WTP in the future.
  - In addition to alleviating stress on the Chatham WTP, one of the drivers for Dresden to be supplied by the Wallaceburg WTP in the future is to re-allocate demands to new areas in Northeast Chatham-Kent.
  - New treated water transmission mains are required to supply these new areas. Construction timing and demands from this area may impact the timing for Dresden to be removed from the Chatham WTP service area. This should be considered in the 2022 Chatham-Kent Water and Wastewater Master Plan.

Figure 8-3: Implementation Plan

ID	Task Name	Duration	Start	Finish
1	**Wallaceburg WTP, Intake/LLPS and New Transmission Main**	**3300 days**	**Mon 12/5/22**	**Fri 7/27/35**
2	Preliminary Design	10 mons	Mon 12/5/22	Fri 9/8/23
3	Consultant Selection	2 mons	Mon 9/11/23	Fri 11/3/23
4	**Contract 1 - Wallaceburg WTP and Intake/LLPS Phase 1**	**580 days**	**Mon 11/6/23**	**Fri 1/23/26**
5	Detailed Design	18 mons	Mon 11/6/23	Fri 3/21/25
6	Tender Period	3 mons	Mon 11/6/23	Fri 1/26/24
7	Construction	26 mons	Mon 1/29/24	Fri 1/23/26
8	**Contract 2 - Old Wallaceburg WTP Decommissioning and Demolition**	**800 days**	**Mon 1/29/24**	**Fri 2/19/27**
9	Consultant Selection	2 mons	Mon 1/29/24	Fri 3/22/24
10	Preliminary Design	4 mons	Mon 3/25/24	Fri 7/12/24
11	Detailed Design	8 mons	Mon 7/15/24	Fri 2/21/25
12	Tender Period	2 mons	Mon 1/26/26	Fri 3/20/26
13	Construction	12 mons	Mon 3/23/26	Fri 2/19/27
14	**Contract 3 - Wallaceburg WTP and Intake/LLPS Phase 2 and New Transmission Main**	**1720 days**	**Mon 12/25/28**	**Fri 7/27/35**
15	Detailed Design	12 mons	Mon 12/25/28	Fri 11/23/29
16	Tender Period	2 mons	Mon 11/26/29	Fri 1/18/30
17	Construction - WTP and LLPS Phase 2	12 mons	Mon 1/21/30	Fri 12/20/30
18	Construction - Transmission Main	72 mons	Mon 1/21/30	Fri 7/27/35



9. Next Steps

The next steps of this Class EA are to document Phases 1 to 3 in an ESR, which will satisfy Phase 4 of the Class EA process. The ESR will be available for public review and comment for a 30-day period, which will be initiated when the Notice of Completion is issued. Preliminary design will begin once the ESR has been approved by the MECP.

10. References

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Appendix A
Water Treatment Plant Design Concept Cost Estimates

Wallaceburg Water Treatment Servicing Schedule C Class EA
Wallaceburg WTP Alternative Design Concepts
Alternative 1

Component	Description		Capital Cost - Phase 1	Capital Cost - Phase 2	Capital Cost - Total
Coagulation	>In-line Rapid Coagulant Mixing		$ 702,000		$ 702,000
Flocculation	>Open Tank Flocculation		$ 802,400	$ 234,600	$ 1,037,000
Clarification	>Lamellar Clarifier		$ 1,832,600	$ 888,400	$ 2,721,000
Filtration	>Low Pressure Membrane Filtration >Feed Pumps Included		$ 5,015,000	$ 2,859,000	$ 7,874,000
Disinfection	>Chlorination System (Cl Gas)		$ 512,050	$ 257,950	$ 770,000
Disinfection	>Chlorine Contact Tank/Reservoir (56 ML)		$ 7,088,000	$ 7,088,000	$ 14,176,000
High Lift Pumping	>High Lift Pumping Station		$ 3,805,000	$ 717,000	$ 4,522,000
WTP Building	>Overall building		$ 2,822,000	$ -	$ 2,822,000
Garage and Maintenance Shop	>3 bay garage		$ 1,733,000		$ 1,733,000
Residuals Management	>Lamellar Clarifier		$ -	$ 1,170,000	$ 1,170,000
Fluoridation	>Fluoride dosing and storage		$ 173,500	$ 47,500	$ 221,000
Subtotal			**$ 24,485,550**	**$ 13,262,450**	**$ 37,748,000**
Contractor Overhead		10%	$ 2,449,000	$ 1,327,000	$ 3,776,000
Sub-Total			$ 26,934,550	$ 14,589,450	$ 41,524,000
Project Staff Overhead		3%	$ 809,000	$ 438,000	$ 1,247,000
Sub-Total			$ 27,743,550	$ 15,027,450	$ 42,771,000
General Conditions		4%	$ 1,110,000	$ 602,000	$ 1,712,000
Sub-Total			$ 28,853,550	$ 15,629,450	$ 44,483,000
Mobilization/Demobilization		1%	$ 289,000	$ 157,000	$ 446,000
Insurance		1%	$ 289,000	$ 157,000	$ 446,000
Bond		1%	$ 289,000	$ 157,000	$ 446,000
Sub-Total			$ 29,720,550	$ 16,100,450	$ 45,821,000
Contractor Profit		10%	$ 2,973,000	$ 1,611,000	$ 4,584,000
Sub-Total			$ 32,693,550	$ 17,711,450	$ 50,405,000
Estimating Contingency		30%	$ 9,809,000	$ 5,314,000	$ 15,123,000
Total Construction Cost			$ 42,502,550	$ 23,025,450	$ 65,528,000
Engineering/SDC		10%	$ 4,251,000	$ 2,303,000	$ 6,554,000
TOTAL			**$ 46,754,000**	**$ 25,328,000**	**$ 72,082,000**

Lifecycle Cost Estimate for Alternative 1

Current Year	2021
Discount	5%
Inflation	2%

Year	**ADD** m^3**/year**	**Electricity** $/y	**NaOCl** $/y	**Cl_2 Gas** $/y	**Citric Acid** $/y	**PACl** $/y	**Fluoride** $/y	**Labour** $/y	**Maintenance** $/y	**Membrane Replacement** $/y	**Annual O&M** $/y	**O&M NPV** $/y
2021	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 1,028,125
2022	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 998,750
2023	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 970,214
2024	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 942,494
2025	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 915,565
2026	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 889,406
2027	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 863,995
2028	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 839,309
2029	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 815,329
2030	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 792,034
2031	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ 484,800	$ 1,512,925	$ 1,132,208
2032	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 747,421
2033	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 726,066
2034	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 705,322
2035	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 685,170
2036	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 665,593
2037	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 646,576
2038	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 628,103
2039	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 610,157
2040	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 592,724
2041	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ 484,800	$ 1,512,925	$ 847,295
2042	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 559,338
2043	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 543,357
2044	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 527,832
2045	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 512,751
2046	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 498,101
2047	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 483,870
2048	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 470,045
2049	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 456,615
2050	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 443,569
2051	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ 484,800	$ 1,512,925	$ 634,079
2052	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 418,584
2053	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 406,625
2054	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 395,007
2055	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 383,721
2056	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 372,758
2057	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 362,107
2058	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 351,761
2059	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 341,711
2060	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 331,948
2061	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ 484,800	$ 1,512,925	$ 474,518
2062	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 313,250
2063	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 304,300
2064	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 295,606
2065	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 287,160
2066	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 278,956
2067	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 270,985
2068	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 263,243
2069	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 255,722
2070	22,400	$ 544,200	$ 2,660	$18,887	$ 4,236	$23,930	$17,213	$ 208,000	$ 209,000	$ -	$ 1,028,125	$ 248,415
											Total	**$ 28,527,792**

Wallaceburg Water Treatment Servicing Schedule C Class EA
Wallaceburg WTP Alternative Design Concepts
Alternative 2

Component	Description		Capital Cost - Phase 1	Capital Cost - Phase 2	Capital Cost - Total
LLPS Addition	>Additional costs due to increased TDH requirements for direct pumping to membranes		$ 192,500	$ 67,500	
Coagulation	>In-line Rapid Coagulant Mixing		$ 702,000		$ 702,000
Filtration	>Low Pressure Membrane Filtration >No Feed Pumps		$ 4,588,000	$ 2,646,000	$ 7,234,000
Disinfection	>Chlorination System (Cl Gas)		$ 512,050	$ 257,950	$ 770,000
Disinfection	>Chlorine Contact Tank/Reservoir (56 ML)		$ 7,088,000	$ 7,088,000	$ 14,176,000
High Lift Pumping	>High Lift Pumping Station		$ 3,545,600	$ 778,400	$ 4,324,000
WTP Building	>Overall building		$ 2,394,000		$ 2,394,000
Garage and Maintenance Shop	>3 bay garage		$ 1,733,000		$ 1,733,000
Residuals Management	>Lamellar Clarifier			$ 1,170,000	
Fluoridation	>Fluoride dosing and storage		$ 173,500	$ 47,500	$ 221,000
Subtotal			**$ 20,928,650**	**$ 12,055,350**	**$ 32,984,000**
Contractor Overhead		10%	$ 2,093,000	$ 1,206,000	$ 3,299,000
Sub-Total			$ 23,021,650	$ 13,261,350	$ 36,283,000
Project Staff Overhead		3%	$ 691,000	$ 398,000	$ 1,089,000
Sub-Total			$ 23,712,650	$ 13,659,350	$ 37,372,000
General Conditions		4%	$ 949,000	$ 547,000	$ 1,496,000
Sub-Total			$ 24,661,650	$ 14,206,350	$ 38,868,000
Mobilization/Demobilization		1%	$ 247,000	$ 143,000	$ 390,000
Insurance		1%	$ 247,000	$ 143,000	$ 390,000
Bond		1%	$ 247,000	$ 143,000	$ 390,000
Sub-Total			$ 25,402,650	$ 14,635,350	$ 40,038,000
Contractor Profit		10%	$ 2,541,000	$ 1,464,000	$ 4,005,000
Sub-Total			$ 27,943,650	$ 16,099,350	$ 44,043,000
Estimating Contingency		30%	$ 8,384,000	$ 4,830,000	$ 13,214,000
Total Construction Cost			$ 36,327,650	$ 20,929,350	$ 57,257,000
Engineering/SDC		10%	$ 3,633,000	$ 2,093,000	$ 5,726,000
TOTAL			**$ 39,961,000**	**$ 23,022,000**	**$ 62,983,000**

Lifecycle Cost Estimate for Alternative 2

Current Year 2021

Year	ADD	Electricity	NaOCl	Cl_2 Gas	Citric Acid	PACl	Fluoride	Labour	Maintenance	Membrane Replacement	Annual O&M	O&M NPV
	m^3/year	$/y	$/y	$/y	$/y	$/y	$/y	$/y	$/y	$/y	$/y	$/y
2021	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 943,275
2022	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 916,324
2023	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 890,143
2024	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 864,711
2025	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 840,005
2026	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 816,005
2027	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 792,690
2028	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 770,042
2029	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 748,041
2030	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 726,668
2031	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ 484,800	$ 1,428,075	$ 1,068,710
2032	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 685,737
2033	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 666,145
2034	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 647,112
2035	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 628,623
2036	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 610,663
2037	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 593,215
2038	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 576,266
2039	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 559,801
2040	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 543,807
2041	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ 484,800	$ 1,428,075	$ 799,776
2042	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 513,176
2043	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 498,514
2044	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 484,271
2045	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 470,435
2046	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 456,994
2047	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 443,937
2048	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 431,253
2049	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 418,931
2050	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 406,962
2051	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ 484,800	$ 1,428,075	$ 598,518
2052	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 384,039
2053	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 373,066
2054	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 362,407
2055	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 352,053
2056	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 341,994
2057	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 332,223
2058	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 322,731
2059	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 313,510
2060	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 304,553
2061	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ 484,800	$ 1,428,075	$ 447,905
2062	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 287,398
2063	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 279,187
2064	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 271,210
2065	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 263,461
2066	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 255,934
2067	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 248,621
2068	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 241,518
2069	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 234,617
2070	22,400	$ 508,350	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 160,000	$ -	$ 943,275	$ 227,914
											Total	**$ 26,255,091**

Wallaceburg Water Treatment Servicing Schedule C Class EA
Wallaceburg WTP Alternative Design Concepts
Alternative 3

Component	Description		Capital Cost - Phase 1	Capital Cost - Phase 2	Capital Cost - Total
Coagulation	>In-line Rapid Coagulant Mixing		$ 702,000		$ 702,000
Flocculation	>Open Tank Flocculation		$ 802,400	$ 234,600	$ 1,037,000
Filtration	>Low Pressure Membrane Filtration		$ 5,015,000	$ 2,859,000	$ 7,874,000
Disinfection	>Chlorination System (Cl Gas)		$ 512,050	$ 257,950	$ 770,000
Disinfection	>Chlorine Contact Tank/Reservoir (56 ML)		$ 7,088,000	$ 7,088,000	$ 14,176,000
High Lift Pumping	>High Lift Pumping Station		$ 3,805,000	$ 717,000	$ 4,522,000
WTP Building	>Overall building		$ 2,469,000		$ 2,469,000
Garage and Maintenance Shop	>3 bay garage		$ 1,733,000		$ 1,733,000
Residuals Management	>Lamellar Clarifier			$ 1,170,000	
Fluoridation	>Fluoride dosing and storage		$ 173,500	$ 47,500	$ 221,000
Subtotal			**$ 22,299,950**	**$ 12,374,050**	**$ 34,674,000**
Contractor Overhead		10%	$ 2,230,000	$ 1,238,000	$ 3,468,000
Sub-Total			$ 24,529,950	$ 13,612,050	$ 38,142,000
Project Staff Overhead		3%	$ 736,000	$ 409,000	$ 1,145,000
Sub-Total			$ 25,265,950	$ 14,021,050	$ 39,287,000
General Conditions		4%	$ 1,011,000	$ 561,000	$ 1,572,000
Sub-Total			$ 26,276,950	$ 14,582,050	$ 40,859,000
Mobilization/Demobilization		1%	$ 263,000	$ 146,000	$ 409,000
Insurance		1%	$ 263,000	$ 146,000	$ 409,000
Bond		1%	$ 263,000	$ 146,000	$ 409,000
Sub-Total			$ 27,065,950	$ 15,020,050	$ 42,086,000
Contractor Profit		10%	$ 2,707,000	$ 1,503,000	$ 4,210,000
Sub-Total			$ 29,772,950	$ 16,523,050	$ 46,296,000
Estimating Contingency		30%	$ 8,932,000	$ 4,957,000	$ 13,889,000
Total Construction Cost			$ 38,704,950	$ 21,480,050	$ 60,185,000
Engineering/SDC		10%	$ 3,871,000	$ 2,149,000	$ 6,020,000
TOTAL			**$ 42,576,000**	**$ 23,629,000**	**$ 66,205,000**

Lifecycle Cost Estimate for Alternative 3

Current Year 2021
Discount 5%
Inflation 2%

Year	ADD	Electricity	NaOCl	Cl_2 Gas	Citric Acid	PACl	Fluoride	Labour	Maintenance	Membrane Replacement	Annual O&M	O&M NPV
	m^3/year	$/y	$/y	$/y	$/y	$/y	$/y	$/y	$/y	$/y	$/y	$/y
2021	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 991,975
2022	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 963,633
2023	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 936,100
2024	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 909,355
2025	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 883,373
2026	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 858,134
2027	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 833,616
2028	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 809,798
2029	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 786,661
2030	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 764,185
2031	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ 484,800	$ 1,476,775	$ 1,105,155
2032	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 721,141
2033	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 700,537
2034	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 680,522
2035	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 661,078
2036	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 642,190
2037	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 623,842
2038	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 606,018
2039	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 588,703
2040	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 571,883
2041	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ 484,800	$ 1,476,775	$ 827,050
2042	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 539,671
2043	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 524,252
2044	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 509,273
2045	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 494,722
2046	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 480,588
2047	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 466,856
2048	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 453,518
2049	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 440,560
2050	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 427,973
2051	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ 484,800	$ 1,476,775	$ 618,928
2052	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 403,866
2053	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 392,327
2054	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 381,118
2055	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 370,229
2056	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 359,651
2057	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 349,375
2058	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 339,393
2059	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 329,696
2060	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 320,276
2061	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ 484,800	$ 1,476,775	$ 463,179
2062	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 302,236
2063	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 293,601
2064	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 285,212
2065	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 277,063
2066	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 269,147
2067	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 261,457
2068	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 253,987
2069	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 246,730
2070	0	$ 541,050	$ 2,660	$ 18,887	$ 4,236	$ 23,930	$ 17,213	$ 208,000	$ 176,000	$ -	$ 991,975	$ 239,681
											Total	**$ 27,559,517**

Appendix B
Water Treatment Plant Design Concept Evaluation

Criterion	Alternative 1 Rank	Alternative 1 Coag/Floc-Clarifier-Membranes-CCT	Alternative 2 Rank	Alternative 2 In-Line Coag-Membranes-CCT	Alternative 3 Rank	Alternative 3 Coag/Floc-Membranes-CCT
Process Robustness	10	The process is robust in terms of handling sudden turbidity spike events and expected to perform with a high degree of reliability in terms of maintaining membrane performance under extreme turbidity events (i.e., >400 NTU).	0	The process may be robust based on the assumption that turbidity spike would not happen as the LLPS and intake is relocated to upstream in the Chenal Écarte. In-line coagulation was not tested in the pilot study.	5	The process is relatively more robust compared to Alternative 2, and expected to perform with a high degree of reliability in terms of treated water quality as proven by the pilot study. Membrane productivity may be impacted at a high turbidity spike event. Although turbidity events with a magnitude similar to historical turbidity events (i.e., >400 NTU) were not experienced while using this treatment train during the pilot study, moving the LLPS upstream in the Chenal Écarte is expected to mitigate and potential
Constructability	10	The alternative can be constructed within a reasonable scope, with a similar degree of constructability as the other alternatives. Potential constuctability concern is associated with support and dewatering of a new 55 ML reservoir, but the concern is same for all alternatives.	10	The alternative can be constructed within a reasonable scope, with a similar degree of constructability as the other alternatives. Potential constuctability concern is associated with support and dewatering of a new 55 ML reservoir, but the concern is same for all alternatives.	10	The alternative can be constructed within a reasonable scope, with a similar degree of constructability as the other alternatives. Potential constuctability concern is associated with support and dewatering of a new 55 ML reservoir, but the concern is same for all alternatives.
Flexibility for Future Expansion	5	This alternative is compitable with the proposal phasing plan. However, Phase 2 will need to build a new clarifier and potential building extension.	10	This alternative is compatible with the proposed phasing plan with minimum expansion needs at Phase 2.	10	This alternative is compatible with the proposed phasing plan with minimum expansion needs at Phase 2.
Footprint Requirements	5	The alternative requires a larger footprint than the other alternatives.	10	The alternative requires the smallest footprint (i.e., similar to Alternative 3).	10	The alternative requires the smallest footprint (i.e., similar to Alternative 2).
Ease of Operation	10	The alternative is simple to operate, as the treatment processes have a high degree of automation.	0	The alternative would be difficult to operate due to the distance between the LLPS and WTP for direct pumping. Membrane treatment is a dynamic process with parameters (i.e., flow, feed pressure) constantly changing. There would be a significant lag between when a process parameter change is required (i.e., increased feed pressure) vs when it actually occurs, due to the raw watermain length.	10	The alternative is simple to operate, as the treatment processes have a high degree of automation.
Maintenance Complexity	5	The alternative is relatively simple to maintain, as all equipment will be new. However, there are more components to maintain when compared to the other alternatives.	10	The alternative is relatively simple to maintain, as all equipment will be new.	10	The alternative is relatively simple to maintain, as all equipment will be new.
Additional Treatment Capabilities	10	The process has the' capability to further reduce natural organic matters and thus help reduce DBPs formation relative to the other alternatives.	5	No additional treatment capability.	5	No additional treatment capability.
Capital Cost	0	Highest capital cost.	5	Moderate capital cost.	5	Moderate capital cost.
Life Cycle Cost	0	Highest life cycle cost.	5	Moderate life cycle cost.	5	Moderate life cycle cost.
TOTAL SCORE	**61.11111111**		**61.11111111**		**77.77777778**	
RANK	**2**		**2**		**1**	

Appendix C
Raw Water Supply Design Concept Cost Estimates

Wallaceburg Water Treatment Servicing Schedule C Class EA

Raw Water Supply Alternative Design Concepts

Alternative 1: Submerged Tee Screens

Component	**Description**	**Capacity**	**Units**	**Unit Cost**	**Capital Cost**
Low Lift Pumping Station	>Vertical turbine pumps (2 duty, 2 standby)	34	ML/d		$ 2,721,000
	>Split wet well for redundancy/phasing				
	>Diesel standby generator				
Sitework					*$ 30,000*
Building Excavation		563.2	m3	*$ 72*	*$ 41,000*
Concrete					*$ 215,000*
Masonry					*$ 107,000*
Metals					*$ 15,000*
Equipment					*$ 992,000*
I&C					*$ 320,000*
Mechanical					*$ 333,000*
Electrical					*$ 141,000*
Allowances					*$ 327,000*
Diesel Standby Generator	>Includes enclosure and fuel tank	250	kW		*$ 200,000*
Intake		34	ML/d		$ 1,291,000
Shoreline Reinforcement					*$ 50,000*
Launch Pit		*1*	*EA*	*$ 500,000*	*$ 500,000*
Dewatering		*90*	*days*	*$ 884*	*$ 79,560*
Intake Pipe		*30*	*m*	*$ 1,850*	*$ 55,500*
Microtunneling		*40*	*m*	*3900*	*$ 156,000*
Tee Screens		*2*	*EA*	*$ 114,000*	*$ 228,000*
Diver Allowance		*1*	*LS*	*$150,000*	*$ 150,000*
Air Burst Cleaning System		*1*	*EA*	*$ 71,000*	*$ 71,000*
Silo Removal		1	LS	$ 50,000	$ 50,000
Subtotal					$ 4,062,000
Contractor Overhead				10%	$ 407,000
Sub-Total					$ 4,469,000
Project Staff Overhead				3%	$ 135,000
Sub-Total					$ 4,604,000
General Conditions				4%	$ 185,000
Sub-Total					$ 4,789,000
Mobilization/Demobilization				3%	$ 144,000
Insurance				1%	$ 48,000
Bond				1%	$ 48,000
Sub-Total					$ 5,029,000
Contractor Profit				10%	$ 503,000
Sub-Total					$ 5,532,000
Estimating Contingency				30%	$ 1,660,000
Total Construction Cost					$ 7,192,000
Engineering/SDC				10%	$ 720,000
Land Acquisition		2	acre	$ 25,000	$ 50,000
Raw Water Transmission Main	>Raw water main to Wallaceburg WTP	6.32	km		$ -
				TOTAL	**$ 7,912,000**

Lifecycle Cost Estimate for Alternative 1

Current Year	2021
Discount	5%
Inflation	2%

Year	**ADD, ML/d**	**Electricity, $/y**	**NaOCl, $/y**	**Maintenance, $/y**	**Divers Allowance, $/y**	**Annual O&M, $/y**	**O&M NPV, $/y**
2021	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 227,455
2022	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 220,956
2023	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 214,643
2024	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 208,510
2025	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 202,553
2026	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 196,766
2027	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 191,144
2028	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 185,682
2029	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 180,377
2030	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 175,224
							$ -
2031	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 170,217
2032	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 165,354
2033	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 160,629
2034	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 156,040
2035	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 151,582
2036	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 147,251
2037	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 143,044
2038	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 138,957
2039	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 134,987
2040	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 131,130
2041	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 127,383
2042	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 123,744
2043	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 120,208
2044	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 116,774
2045	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 113,437
2046	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 110,196
2047	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 107,048
2048	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 103,989
2049	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 101,018
2050	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 98,132
2051	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 95,328
2052	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 92,604
2053	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 89,959
2054	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 87,388
2055	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 84,892
2056	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 82,466
2057	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 80,110
2058	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 77,821
2059	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 75,598
2060	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 73,438
2061	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 71,339
2062	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 69,301
2063	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 67,321
2064	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 65,398
2065	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 63,529
2066	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 61,714
2067	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 59,951
2068	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 58,238
2069	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 56,574
2070	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 54,958
2071	27.2	$ 181,814	$ 1,241	$ 24,400	$ 20,000	$ 227,455	$ 53,387
						TOTAL	$ 6,145,741

Wallaceburg Water Treatment Servicing Schedule C Class EA
Raw Water Supply Alternative Design Concepts
Alternative 2: Headwall-mounted Tee screens

Component	Description	Capacity	Units	Unit Cost	Capital Cost
Low Lift Pumping Station	>Vertical turbine pumps (2 duty, 2 standby) >Split wet well for redundancy/phasing >Diesel standby generator	34	ML/d		$ 2,721,000
Sitework					*$ 30,000*
Building Excavation		563.2	m3	$ 72	*$ 41,000*
Concrete					*$ 215,000*
Masonry					*$ 107,000*
Metals					*$ 15,000*
Equipment					*$ 992,000*
I&C					*$ 320,000*
Mechanical					*$ 333,000*
Electrical					*$ 141,000*
Allowances					*$ 327,000*
Diesel Standby Generator	>Includes enclosure and fuel tank	250	kW		*$ 200,000*
Intake		34	ML/d		$ 1,656,000
Shoreline Reinforcement					*$ 75,000*
Sheet Piling		*300*	*m2*	*$ 761*	*$ 228,238*
Coffer Dam Excavation		*145*	*m3*	*$ 285*	*$ 41,376*
Dewatering		*90*	*days*	*$ 884*	*$ 79,560*
Intake Pipe		*100*	*m*	*$ 1,850*	*$ 185,000*
Tee Screens		*2*	*EA*	*$ 200,000*	*$ 400,000*
Concrete Headwall		*1,200*	*m3*	*$ 538.13*	*$ 646,000*
Air Burst Cleaning System		*1*	*EA*	*$ 71,000*	*$ 71,000*
Silo Removal		1	LS	$ 50,000	$ 50,000
Subtotal					$ 4,427,000
Contractor Overhead				10%	$ 443,000
Sub-Total					$ 4,870,000
Project Staff Overhead				3%	$ 147,000
Sub-Total					$ 5,017,000
General Conditions				4%	$ 201,000
Sub-Total					$ 5,218,000
Mobilization/Demobilization				3%	$ 157,000
Insurance				1%	$ 53,000
Bond				1%	$ 53,000
Sub-Total					$ 5,481,000
Contractor Profit				10%	$ 549,000
Sub-Total					$ 6,030,000
Estimating Contingency				30%	$ 1,809,000
Total Construction Cost					$ 7,839,000
Engineering/SDC				10%	$ 784,000
Land Acquisition		2	acre	$ 25,000	$ 50,000
Raw Water Transmission Main	>Raw water main to Wallaceburg WTP	6.32	km		$ -
TOTAL					**$ 8,623,000**

Lifecycle Cost Estimate for Alternative 2

Current Year	2021
Discount	5%
Inflation	2%

Year	ADD, ML/d	Electricity, $/y	NaOCl, $/y	Maintenance, $/y	Annual O&M, $/y	O&M NPV, $/y
2021	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 210,895
2022	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 204,869
2023	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 199,016
2024	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 193,329
2025	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 187,806
2026	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 182,440
2027	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 177,227
2028	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 172,164
2029	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 167,245
2030	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 162,466
						$ -
2031	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 157,824
2032	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 153,315
2033	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 148,935
2034	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 144,679
2035	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 140,546
2036	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 136,530
2037	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 132,629
2038	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 128,840
2039	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 125,159
2040	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 121,583
2041	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 118,109
2042	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 114,734
2043	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 111,456
2044	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 108,272
2045	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 105,178
2046	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 102,173
2047	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 99,254
2048	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 96,418
2049	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 93,663
2050	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 90,987
2051	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 88,388
2052	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 85,862
2053	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 83,409
2054	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 81,026
2055	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 78,711
2056	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 76,462
2057	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 74,277
2058	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 72,155
2059	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 70,094
2060	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 68,091
2061	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 66,146
2062	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 64,256
2063	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 62,420
2064	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 60,636
2065	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 58,904
2066	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 57,221
2067	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 55,586
2068	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 53,998
2069	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 52,455
2070	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 50,956
2071	27.2	$ 181,814	$ 1,241	$ 27,840	$ 210,895	$ 49,500
					TOTAL	$ 5,698,296

Wallaceburg Water Treatment Servicing Schedule C Class EA
Raw Water Supply Alternative Design Concepts
Alternative 3: Flat Panel Fish Screens

Component	**Description**	**Capacity**	**Units**	**Unit Cost**	**Capital Cost**
Low Lift Pumping Station	>Vertical turbine pumps (2 duty, 2 standby) >Split wet well for redundancy/phasing >Diesel standby generator	34	ML/d		$ 2,721,000
Sitework					*$ 30,000*
Building Excavation		563.2	m3	*$ 72*	*$ 41,000*
Concrete					*$ 215,000*
Masonry					*$ 107,000*
Metals					*$ 15,000*
Equipment					*$ 992,000*
I&C					*$ 320,000*
Mechanical					*$ 333,000*
Electrical					*$ 141,000*
Allowances					*$ 327,000*
Diesel Standby Generator	>Includes enclosure and fuel tank	250	kW		*$ 200,000*
Intake		34	ML/d		$ 1,392,000
Shoreline Reinforcement					*$ 75,000*
Intake Structure	*Includes screens + site work*				*$ 485,159*
Intake Pipe		*100*	*m*	*$ 1,850*	*$ 185,000*
Concrete Headwall		*1,200*	*m3*	*$ 538.13*	*$ 646,000*
Silo Removal		1	LS	$ 50,000	$ 50,000
Subtotal					$ 4,163,000
Contractor Overhead				10%	$ 417,000
Sub-Total					$ 4,580,000
Project Staff Overhead				3%	$ 138,000
Sub-Total					$ 4,718,000
General Conditions				4%	$ 189,000
Sub-Total					$ 4,907,000
Mobilization/Demobilization				3%	$ 148,000
Insurance				1%	$ 50,000
Bond				1%	$ 50,000
Sub-Total					$ 5,155,000
Contractor Profit				10%	$ 516,000
Sub-Total					$ 5,671,000
Estimating Contingency				30%	$ 1,702,000
Total Construction Cost					$ 7,373,000
Engineering/SDC				10%	$ 738,000
Land Acquisition		2	acre	$ 25,000	$ 50,000
Raw Water Transmission Main	>Raw water main to Wallaceburg WTP	6.32	km		$ -
TOTAL					**$ 8,111,000**

Lifecycle Cost Estimate for Alternative 3

Current Year	2021
Discount	5%
Inflation	2%

Year	**ADD, ML/d**	**Electricity, $/y**	**NaOCl, $/y**	**Maintenance, $/y**	**Divers Allowance, $/y**	**Annual O&M, $/y**	**O&M NPV, $/y**
2021	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 223,635
2022	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 217,245
2023	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 211,038
2024	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 205,008
2025	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 199,151
2026	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 193,461
2027	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 187,934
2028	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 182,564
2029	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 177,348
2030	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 172,281
							$ -
2031	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 167,359
2032	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 162,577
2033	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 157,932
2034	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 153,419
2035	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 149,036
2036	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 144,778
2037	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 140,641
2038	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 136,623
2039	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 132,720
2040	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 128,928
2041	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 125,244
2042	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 121,665
2043	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 118,189
2044	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 114,812
2045	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 111,532
2046	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 108,345
2047	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 105,250
2048	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 102,243
2049	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 99,322
2050	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 96,484
2051	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 93,727
2052	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 91,049
2053	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 88,448
2054	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 85,921
2055	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 83,466
2056	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 81,081
2057	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 78,764
2058	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 76,514
2059	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 74,328
2060	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 72,204
2061	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 70,141
2062	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 68,137
2063	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 66,191
2064	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 64,299
2065	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 62,462
2066	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 60,678
2067	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 58,944
2068	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 57,260
2069	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 55,624
2070	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 54,035
2071	27.2	$ 181,814	$ 1,241	$ 20,580	$ 20,000	$ 223,635	$ 52,491
						TOTAL	$ 6,042,527

Wallaceburg Water Treatment Servicing Schedule C Class EA

Raw Water Supply Alternative Design Concepts

Alternative 4: Travelling Screens

Component	**Description**	**Capacity**	**Units**	**Unit Cost**	**Capital Cost**
Low Lift Pumping Station	>Vertical turbine pumps (2 duty, 2 standby)	34	ML/d		$ 2,721,000
	>Split wet well for redundancy/phasing				
	>Diesel standby generator				
Sitework					*$ 30,000*
Building Excavation		563.2	m3	*$ 72*	*$ 41,000*
Concrete					*$ 215,000*
Masonry					*$ 107,000*
Metals					*$ 15,000*
Equipment					*$ 992,000*
I&C					*$ 320,000*
Mechanical					*$ 333,000*
Electrical					*$ 141,000*
Allowances					*$ 327,000*
Diesel Standby Generator	>Includes enclosure and fuel tank			250 kW	*$ 200,000*
Intake		34	ML/d		$ 3,445,000
Launch Pit		*1*	*EA*	*$ 500,000*	*$ 500,000*
Dewatering		*90*	*days*	*$ 884*	*$ 79,560*
Intake Pipe		*100*	*m*	*$ 1,850*	*$ 185,000*
Travelling Screens		*2*	*EA*	*$ 1,059,779*	*$ 2,120,000*
Building for Screens					*$ 435,000*
Shoreline Reinforcement					*$ 125,000*
Silo Removal		1	LS	$ 50,000	$ 50,000
Subtotal					$ 6,216,000
Contractor Overhead				10%	$ 622,000
Sub-Total					$ 6,838,000
Project Staff Overhead				3%	$ 206,000
Sub-Total					$ 7,044,000
General Conditions				4%	$ 282,000
Sub-Total					$ 7,326,000
Mobilization/Demobilization				3%	$ 220,000
Insurance				1%	$ 74,000
Bond				1%	$ 74,000
Sub-Total					$ 7,694,000
Contractor Profit				10%	$ 770,000
Sub-Total					$ 8,464,000
Estimating Contingency				30%	$ 2,540,000
Total Construction Cost					$ 11,004,000
Engineering/SDC				10%	$ 1,101,000
Land Acquisition		2	acre	$ 25,000	$ 50,000
Raw Water Transmission Main	>Raw water main to Wallaceburg WTP	6.32	km		$ -
TOTAL					**$ 12,105,000**

Lifecycle Cost Estimate for Alternative 4

Current Year	2021
Discount	5%
Inflation	2%

Year	**ADD, ML/d**	**Electricity, $/y**	**NaOCl, $/y**	**Maintenance, $/y**	**Divers Allowance, $/y**	**Annual O&M, $/y**	**O&M NPV, $/y**
2021	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 267,681
2022	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 260,033
2023	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 252,603
2024	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 245,386
2025	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 238,375
2026	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 231,564
2027	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 224,948
2028	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 218,521
2029	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 212,278
2030	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 206,213
							$ -
2031	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 200,321
2032	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 194,597
2033	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 189,038
2034	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 183,636
2035	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 178,390
2036	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 173,293
2037	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 168,342
2038	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 163,532
2039	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 158,860
2040	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 154,321
2041	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 149,912
2042	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 145,628
2043	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 141,468
2044	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 137,426
2045	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 133,499
2046	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 129,685
2047	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 125,980
2048	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 122,380
2049	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 118,884
2050	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 115,487
2051	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 112,187
2052	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 108,982
2053	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 105,868
2054	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 102,843
2055	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 99,905
2056	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 97,051
2057	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 94,278
2058	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 91,584
2059	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 88,967
2060	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 86,425
2061	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 83,956
2062	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 81,557
2063	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 79,227
2064	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 76,964
2065	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 74,765
2066	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 72,628
2067	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 70,553
2068	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 68,538
2069	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 66,579
2070	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 64,677
2071	27.2	$ 184,200	$ 1,241	$ 62,240	$ 20,000	$ 267,681	$ 62,829
						TOTAL	$ 7,232,644

Appendix D
Raw Water Supply Design Concept Evaluation

Criterion	Alternative 1 Rank	Alternative 1 Submerged Tee Screens	Alternative 2 Rank	Alternative 2 Headwall-Mounted Tee Screens	Alternative 3 Rank	Alternative 3 Flat Panel Fish Screens	Alternative 4 Rank	Alternative 4 Travelling Screens
Reliability and Performance	10	The intake screening technology used in this alternative is reliable with proven performance, demonstrated by installations in Canada with similar conditions (i.e., surface water in similar climate).	10	The intake screening technology used in this alternative is reliable with proven performance, demonstrated by installations in Canada with similar conditions (i.e., surface water in similar climate).	10	The intake screening technology used in this alternative is reliable with proven performance, demonstrated by installations in Canada with similar conditions (i.e., surface water in similar climate).	10	The intake screening technology used in this alternative is reliable with proven performance, demonstrated by installations in Canada with similar conditions (i.e., surface water in similar climate).
Design and Implementation Complexity	10	The design is relatively simple when compared with the other alternatives. Screen design to be provided by experienced vendor. Moderate shoreline reinforcement is required.	5	The design is moderately complex relative to the other alternatives. Shoreline reinforcement is required, as well as a concrete headwall structure and a screen retrieval system. Screen and retieval system design to be provided by experienced vendor.	5	The design is moderately complex relative to the other alternatives. Shoreline reinforcement is required, as well as a concrete headwall structure. Flat panel design to be provided by consultant.	0	The design for this alternative is highly complex compared to the other alternatives. Shoreline reinforcement is required, as well as a concrete structure and a separate building to house the travelling screens. Screen system design to be provided by experienced vendor, however, fish returning and debris collection to be designed by consultant.
Constructability	10	The alternative can be constructed within a reasonable scope. A coffer dam is required to install the intake piping and screens.	5	The alternative can be constructed within a reasonable scope, with some complexities. A large coffer dam is required to construct the concrete headwall and to install the intake piping and screens.	5	The alternative can be constructed within a reasonable scope, with some complexities. A large coffer dam is required to construct the concrete headwall and to install the intake piping and screens.	0	The alternative can be constructed within a reasonable scope, with some complexities. A coffer dam is required to construct the intake. In addition, an intake screen building will be constructed at the constrained site, dewatering may be required.
Footprint Requirements	10	The footprint required for the LLPS is equal to the other alternatives. This alternative requires the least amount of footprint for the intake screens.	5	The footprint required for the LLPS is equal to the other alternatives. This alternative requires a relatively moderate footprint for the intake screen due to the area required for the concrete headwall.	5	The footprint required for the LLPS is equal to the other alternatives. This alternative requires a relatively moderate footprint for the intake screen due to the area required for the concrete headwall.	0	The footprint required for the LLPS is equal to the other alternatives. However, this alternative needs a separate building for intake screen.
Ease of Operation	10	The alternative is simple to operate with minimal operator intervention required. The screen cleaning system is automatic.	10	The alternative is simple to operate with minimal operator intervention required. The screen cleaning system is automatic.	10	The alternative is simple to operate with minimal operator intervention required. The screen cleaning system is automatic.	10	The alternative is simple to operate with minimal operator intervention required. The screen cleaning system is automatic.
Maintenance Complexity	5	Maintenance is somewhat complex for this alternative, as the screens are permanently submerged and require divers for access.	10	Maintenance is simple for this alternative, as the screens are retrievable and can be accessed from the surface of the headwall.	5	Maintenance is somewhat complex for this alternative, as the screens are partially submerged and require divers for access.	0	Maintenance is somewhat complex for this alternative. The screen components are permanently submerged and required divers for access. There are more moving parts for travelling screen (motor, screen panel, gear box, electrical components, etc.) that require maintenance.
Sediment/Debris Management	10	Debris is rejected at the point of entry. Any sediment that passes through the screens is anticipated to settle in the LLPS wet well due to the slope of the intake pipe. Periodic wet well cleaning is required.	10	Debris is rejected at the point of entry. Any sediment that passes through the screens is anticipated to settle in the LLPS wet well due to the slope of the intake pipe. Periodic wet well cleaning is required.	10	Debris is rejected at the point of entry. Any sediment that passes through the screens is anticipated to settle in the LLPS wet well due to the slope of the intake pipe. Periodic wet well cleaning is required.	5	Debris is collected by the travelling screen and washed off automatically. Disposal of collected debris may be required. Any sediment that passes through the screens is anticipated to settle in the LLPS wet well due to the slope of the intake pipe. Periodic wet well cleaning is required.
Zebra Mussel Control	10	A dual approach to zebra mussel control can be used with this alternative. The screens can be manufactured with a zebra mussel resistant alloy and are compatible with chlorine dosing (currently practiced by the PUC).	10	A dual approach to zebra mussel control can be used with this alternative. The screens can be manufactured with a zebra mussel resistant alloy and are compatible with chlorine dosing (currently practiced by the PUC).	10	A dual approach to zebra mussel control can be used with this alternative. The screens can be manufactured with a zebra mussel resistant alloy and are compatible with chlorine dosing (currently practiced by the PUC).	5	Zebra mussel control is achieved through chlorine dosing at the intake structure.
Fish Management	10	Fish management is relatively simple, as fish are rejected at the point of entry. Screens are designed to satisfy DFO guidelines for slot size and approach velocity.	10	Fish management is relatively simple, as fish are rejected at the point of entry. Screens are designed to satisfy DFO guidelines for slot size and approach velocity.	10	Fish management is relatively simple, as fish are rejected at the point of entry. Screens are designed to satisfy DFO guidelines for slot size and approach velocity.	5	Fish management is moderately complex, as fish are removed from the water and returned through a fish return channel. Screens are designed to satisfy DFO guidelines for slot size and approach velocity.
Shoreline/Riparian Area Impacts	5	The alternative will temporarily impact the shoreline, however a portion will be restored to its prior condition following construction.	0	The alternative will permanently alter the shoreline due to the requirement for a concrete headwall.	0	The alternative will permanently alter the shoreline due to the requirement for a concrete headwall.	0	The alternative will permanently alter the shoreline due to the requirement for a concrete headwall.
Health and Safety Impacts	5	The alternative is expected to have moderate impacts to health and safety due to the air burst technology selected for screen cleaning. This will require the area surrounding the screens to be roped off from public access.	5	The alternative is expected to have moderate impacts to health and safety due to the air burst technology selected for screen cleaning. This will require the area surrounding the screens to be roped off from public access.	5	The alternative is expected to have moderate impacts to health and safety due to the air burst technology selected for screen cleaning. This will require the area surrounding the screens to be roped off from public access.	10	The alternative is expected to have little to no health and safety impacts.
Capital Cost	10	Lowest capital cost.	5	Moderate capital cost.	5	Moderate capital cost.	0	Highest capital cost.
Life Cycle Cost	10	Lowest life cycle cost.	5	Moderate capital cost.	5	Moderate capital cost.	0	Highest life cycle cost.
TOTAL SCORE	**88.46153846**		**69.23076923**		**65.38461538**		**34.61538462**	
RANK	**1**		**2**		**3**		**4**	