



REPORT

**REGIONAL MUNICIPALITY OF WATERLOO
CAMBRIDGE EAST WATER SUPPLY CLASS
ENVIRONMENTAL ASSESSMENT
Project File Report**

Submitted to:

The Regional Municipality of Waterloo
Transportation and Environmental Services Department
Water Services Division
150 Frederick St., 7th Floor
Kitchener, ON N2G 4J3

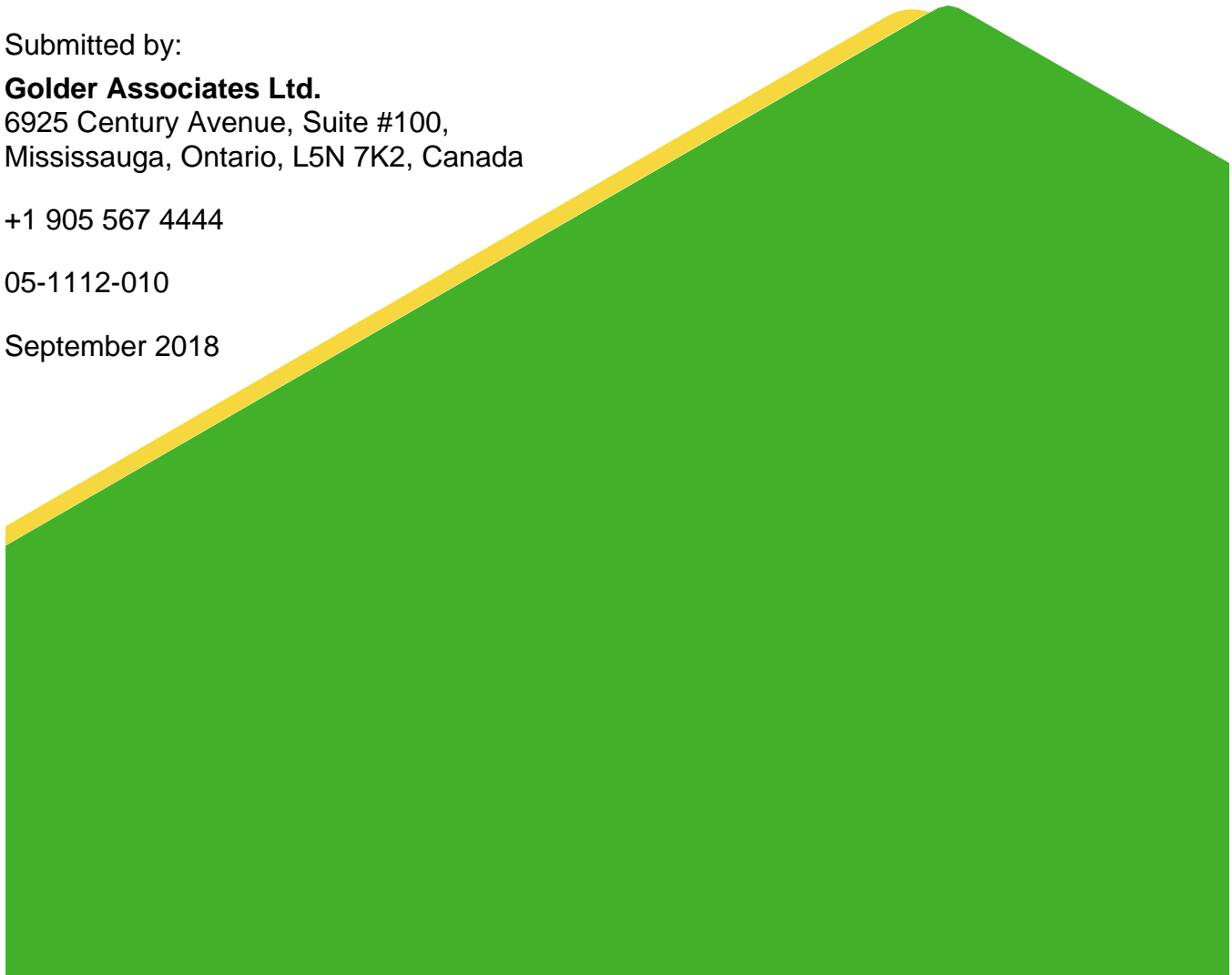
Submitted by:

Golder Associates Ltd.
6925 Century Avenue, Suite #100,
Mississauga, Ontario, L5N 7K2, Canada

+1 905 567 4444

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Executive Summary

Introduction and Background

The Regional Municipality of Waterloo (the Region) has conducted this municipal Class Environmental Assessment (EA) to identify the preferred alternative for optimizing municipal groundwater supply taking in Cambridge East. This Class EA is a component of a larger project; the Integrated Urban System Groundwater Supply Optimization and Expansion Project (IUS Project) that was initiated in 2005 and directed to develop additional supplies in select areas across the Region. The Region's Water Supply Master Plan has recommended making use of the existing water treatment plants (WTPs) in Cambridge East to help supply future water needs. The Class EA is focused on assessing options for optimizing the Region's municipal well supplies to meet existing treatment capacity at the Pinebush, Turnbull (Clemens Mill) and Shades Mill Water Treatment Plants (WTPs).

Class EA

The study process followed the procedures set out in the Municipal Class Environmental Assessment document, (MEA, October 2000, as amended in 2007, 2011 and 2015). This project is classified as a Schedule B project and must proceed through a screening process (Phases 1 and 2 of the Municipal Class EA process), involving mandatory contact with directly affected public and with relevant government agencies, to ensure that they are aware of the project and that their concerns are addressed. If there are no outstanding concerns, the project may proceed to implementation. Phase 1 involves the identification of the problem or opportunity to be addressed through the project and the needs and justification for it. Phase 2 involves identifying alternative solutions to address the problem by taking into consideration the existing natural, social and economic environment, and establishing the preferred solution taking into account public and agency review and input.

At the end of Phase 2 for a Schedule B project, a Project File Report (this report) is completed documenting the planning and consultation process followed through Phases 1 and 2 and is available for public and agency review for a period of 30 days.

Water Supply Alternative Solutions

The Region plans their water supply for long-term growth through two planning processes consisting of the Water Supply Master Plan (WSMP) and the Water Supply Distribution and Operations Master Plan (WSDOMP). The WSMP predicted that additional water supply will be needed for future growth in Cambridge East, and identified possible sources based on availability and efficiency. There is available treatment capacity already in this part of the Region, making use of nearby groundwater sources the most efficient approach. The WSDOMP evaluated alternative supply scenarios with different combinations of supply wells, including temporary shutdowns of sources for repair or maintenance. The Cambridge East WTP facilities are crucial in several scenarios, due to their central location on the east side which allows water to be pumped north or south as required.

A website link to the WSMP and WSDOMP documents and public consultation materials is provided below, along with information for water supply projects taking place elsewhere in the Region (www.regionofwaterloo.ca/MasterPlansandProjects).

The Region has undertaken several projects to restore the capacity of existing well fields and maximize the use of the WTPs in Cambridge East. As part of this Class EA, alternative solutions were developed to help meet the projected water supply requirements, from wells in Cambridge East, including increased pumping from existing wells, increased pumping from wells at existing sites that have been modified to provide for higher pumping rates, increased pumping from new wells at existing sites, and increased pumping from new well sites. This analysis screened and evaluated various well pumping configurations that could be used to help meet the projected 2031 water supply requirements and to maximize the use of the Cambridge East WTPs, as recommended in the WSMP/ WSDOMP.

The alternative solutions identified for evaluation as part of this Class EA included:

Alternative 1: Do Nothing

Alternative 2A: Increased Supply from Deepened Well G16

Alternative 2B: Increased supply from Pinebush new wells at existing site: P10A, P10B, PBTW1-10

Alternative 3A: Increased supply from Clemens Mill new well: Cedarbrook well

Alternative 3B: Increased supply from Clemens Mill new well: Portuguese Club well

Alternative 4: Increase Supply from existing wells (G16) and new wells in Pinebush (P10 site) and Clemens Mill (Cedarbrook Well).

Each alternative solution was evaluated in terms of impacts to: natural environment, social/cultural considerations, economic/financial, technical considerations and the ability to meet the Region's water supply requirements and provide operational flexibility. Based upon the evaluation and public/agency feedback received during Phase 1 and 2 of this Class EA, the Preferred Solution identified was Alternative 4 – Increase Supply from existing wells (G16) and new wells in Pinebush (P10 site) and Clemens Mill (Cedarbrook Well).

The reasons for selecting this Preferred Solution are summarized as follows:

- Provides good quality groundwater from multiple deep bedrock aquifer sources with low degree of interaction with surface water features;
- Meets the increased water supply requirement of 38 L/s by 2031 from both the Pinebush and the Clemens Mill WTPs;
- Provides greater operational flexibility;
- Provides flexibility for pumping between wells if monitoring shows potential impacts; and
- Although this option has the greatest estimated cost, it ranks better in terms of the other criteria for the reasons listed above.

To ensure sustainability of the Preferred Solution this requires an expanded monitoring network and the development of environmental thresholds and an adaptive management plan, as is further described in this Project File Report. The pumping would be increased gradually to meet the Region's water supply requirements with monitoring data reports and adaptive management plan reports completed and made available to the public. The total increased supply of 38 L/s is not needed until 2031.

Next Steps

This Project File Report will be posted for public and agency review for a period of 30 days. The Preferred Solution will be confirmed based on comments received during the 30 day review period.

Design of the Preferred Solution, permitting of new wells and construction of the watermains, well houses and plant modifications will follow along with implementation of an expanded monitoring network and an adaptive management plan.

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1.0 INTRODUCTION

1.1 General

The Regional Municipality of Waterloo (the Region) is undertaking a municipal Class Environmental Assessment (EA) to identify the preferred alternative for optimizing municipal groundwater supply taking in Cambridge East. This Class EA is a component of a larger project; the Integrated Urban System Groundwater Supply Optimization and Expansion Project (IUS Project) that was initiated in 2005 and directed to develop additional supplies in select areas across the Region. The Cambridge East Class EA Study Area, as shown on Figure 1, includes the Pinebush, Clemens Mill and Shades Mill well fields. It is approximately bounded on the west by Franklin Boulevard and extends east of Townline Road to include portions of the Townships of Puslinch and North Dumfries. It is approximately bounded on the north by Highway 401 and extends to Clyde Road in the south.

The Class EA is focused on assessing options for optimizing the Region's municipal well supplies to meet existing treatment capacity at the Pinebush, Turnbull (Clemens Mill) and Shades Mill Water Treatment Plants (WTPs). Golder Associates Ltd. (Golder), in association with Triton Engineering Services Ltd. (Triton), was retained by the Region to carry out the Class EA. S.S. Papadopoulos & Associates Inc. (SSPA) and Matrix Solutions Inc. (Matrix) were retained by the Region to complete groundwater modelling to support the hydrogeological assessment for the EA.

The study process followed the procedures set out in the Municipal Class Environmental Assessment document, (MEA, October 2000, as amended in 2007, 2011 and 2015). The purpose of this report is to document the Class EA process followed for this project.

1.2 Municipal Class EA Process

1.2.1 Overview

The Municipal Class Environmental Assessment (Class EA) planning process provides Municipalities with an approved framework to fulfil the requirements of the Environmental Assessment Act for municipal sewage (sanitary and storm), potable water and transportation projects. To ensure that a degree of standardization in the planning process is followed across the Province, the Environmental Assessment Act (EAA) includes the use of Class EA's for municipal projects that are carried out routinely and have predictable environmental effects that can be mitigated. Projects that fall into these categories do not warrant an Individual Environmental Assessment (IEA). As described above, this project is planned to use the Municipal Class Environmental Assessment document.

In addition to providing Municipalities with an approved planning procedure, the Class EA serves as a public statement of the decision-making process under which municipal projects can be planned, designed and implemented to protect the environment

The Municipal Class EA process reflects the following five key principles for successful environmental assessment planning under the EAA:

- Consultation with affected parties early in and throughout the process, such that the planning process is a cooperative venture;
- Consideration of a reasonable range of alternatives, both the functionally different “alternatives to” and the “alternative methods” of implementing the solution;
- Identification and consideration of the effects of each alternative on all aspects of the environment;
- Systematic evaluation of alternatives in terms of their advantages and disadvantages to determine their net environmental effects; and
- Provision of clear and complete documentation of the planning process followed, to allow “traceability” of decision-making with respect to the project.

Class EA projects are categorized into four different schedules:

- **Schedule A – Pre-Approved Project:** This Schedule includes activities that are limited in scale, have minimal adverse environmental effects and include a number of maintenance and operation activities. As a pre-approved project, it may proceed to implementation without following the full Class EA planning process. Schedule A projects generally include normal or emergency operational and maintenance activities.
- **Schedule A+ – Pre-Approved Project with Public Consultation Prior to Implementation:** Activities under this Schedule require the Municipality to inform the public of what is to be undertaken in their local area prior to implementation. There is no appeal mechanism to the Ministry of Environment, Conservation and Parks (MECP) on these projects for a Part II Order under the EAA and the manner in which the public is advised is to be determined by the Municipality.
- **Schedule B – Projects Subject to Public Screening:** Schedule B projects have the potential for some adverse environmental effects. The Municipality is required to undertake a screening process involving mandatory contact with directly affected public and relevant review agencies to ensure that they are aware of the project and that their concerns are addressed. A project file must be prepared and filed for review by the public and review agencies. Activities under this Schedule generally include improvements and minor expansions to existing facilities. There is an appeal mechanism for a Schedule B project called a Part II Order Request.
- **Schedule C – Project Subject to the Full Class EA Planning Process:** Activities under this Schedule have the potential for significant environmental effects and must proceed under the full planning and documentation procedures specified in the Class EA document. An Environmental Study Report (ESR) must be prepared and filed for review by the public and review agencies. Schedule C projects generally include the construction of new facilities and major expansions to existing facilities. There is an appeal mechanism for a Schedule C project called a Part II Order Request.
- The planning and design process for each Schedule varies. Figure 2 outlines the five phased planning process. A description of each of the Phases is provided below:

- **Phase 1:** The problem statement that is to be addressed by the project is developed. Notification of the project undertaking to the public, review agencies and interested parties is optional in this Phase.
- **Phase 2:** Alternatives to address the problem are identified and evaluated in the context of potential natural, social and environmental impacts resulting in the selection of a preferred planning alternative. Consultation with the Public, review agencies and interested parties is mandatory in Phase 2 to solicit input and comment. Schedule B projects typically end following the completion of Phase 2 following the filing of a Project File and a minimum 30-day review period.
- **Phase 3:** Alternative design concepts for the implementation of the preferred solution identified in Phase 2 are developed and evaluated, including additional mandatory consultation with the public, review agencies and interested parties.
- **Phase 4:** This is the culmination of the planning and design process for Schedule C projects in which all project activities, including the consultation process and results, are documented and published in an Environmental Study Report (ESR).
- **Phase 5:** Implementation of the preferred alternative including applicable mitigation measures as identified through the Class EA process.
- The Municipal Class EA is a self-assessment process, completed by the Municipality, which places emphasis on project evaluation and public involvement.

G:\Projects\2005\05-112-010_IUS_Groundwater_Waterloo\GIS\MXDs\Draft\Cambridge\Cambridge_East_WaterSupplyClass_EA_2018\Fig1_Cambridge_East_Study_Area.mxd



LEGEND

- Municipal Supply Well to System
- Municipal Supply Well to Water Treatment Plant
- Rahman's Reservoir
- Treatment Plant
- Railway
- Watercourse
- Waterbody
- Municipality



REFERENCE

Base Data - MNRF LIO obtained 2016
 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources and Forestry, © Queens Printer 2016
 GRCA Wetlands - Produced using information under License with the Grand River Conservation Authority © Grand River Conservation Authority, obtained 2016
 Datum: NAD 83 Projection: UTM Zone 17N



PROJECT
CAMBRIDGE EAST WATER SUPPLY CLASS ENVIRONMENTAL ASSESSMENT

TITLE
CAMBRIDGE EAST STUDY AREA

	PROJECT NO. 05-1112-010	SCALE 1:25,000	REV. 1
	DESIGN CGG 10 Mar. 2005	FIGURE: 1	
	GIS PR 12 Apr. 2018		
	CHECK JLH 12 Apr. 2018		
	REVIEW JAP 12 Apr. 2018		

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EXHIBIT A.2

MUNICIPAL CLASS EA PLANNING AND DESIGN PROCESS

NOTE: This flow chart is to be read in conjunction with Part A of the Municipal Class EA

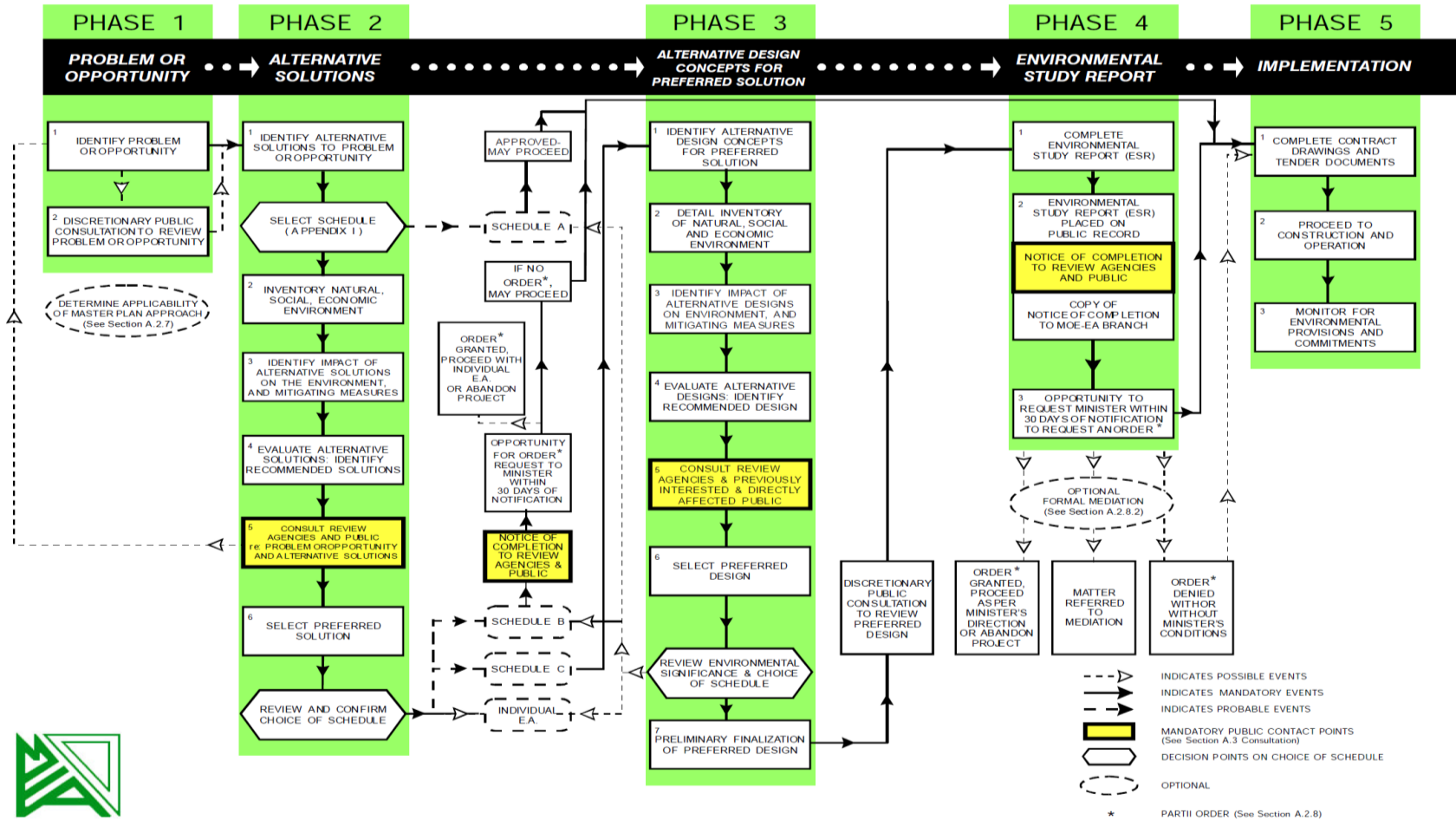


Figure 2: Municipal Class EA Planning and Design Process

1.2.2 Project Classification and EA Process

This project is classified as a Schedule B project and involves improvements and minor expansions to existing facilities. This Class EA undertaking is similar in nature to many other municipal projects where municipalities require improvements to a municipal water supply and distribution system. As a result, the range of environmental effects is known and typically the solutions to such problems involve mitigating measures. The establishment of new wells is considered a Schedule B project under the Municipal Class EA.

- This Schedule B project must proceed through a screening process (Phases 1 and 2 of the Municipal Class EA process), involving mandatory contact with directly affected public and with relevant government agencies, to ensure that they are aware of the project and that their concerns are addressed. If there are no outstanding concerns, the project may proceed to implementation.

The steps for this Schedule B Class EA project are further described below:

Phase 1 - Problem or Opportunity:

- Identification of the problems or opportunities to be addressed as well as the needs and justification.
- Notification of the project undertaking to the public, review agencies and interested parties is optional in this Phase.

Phase 2 - Alternative Solutions:

- Identification of alternative solutions to the problem.
- Inventory the natural, social and economic environment.
- Identification of the impacts of the alternative solutions on the environment and mitigating measures.
- Evaluation of alternative solutions and identification of recommended solutions.
- Consultation with review agencies and public on the problem/opportunity and alternative solutions.
- Selection of the preferred solution.
- Notification of completion to review agencies and public for Schedule B project.

At the end of Phase 2 for a Schedule B project, a Project File documenting the planning process followed through Phases 1 and 2 is finalized and made available for public and agency review. The Project File, which can alternatively be called the Class EA Phase 1 and 2 Report, provides a complete account of the planning procedures followed for the project. The Project File documents the project's history and purpose, the project approach, evaluates the existing environment and evaluates alternative solutions that resolve the identified problem.

Upon completion, the Project File is filed for public review for a period of 30 calendar days with the Municipal Clerk. When the Project File is filed, a Notice of Completion is published which

advises the public, particularly those who have expressed an interest in the project, where the File may be seen and reviewed and the manner in which public comment is to be received. The Notice of Completion advises the public of their rights with regard to Part II Order requests.

Under the terms of the Class EA, the requirement to prepare an individual environmental assessment for approval is waived. However, if it is found that a project going through the Class EA process results in significant environmental impacts, a person/party may request that the Municipality voluntarily elevate the project to a higher level of environmental assessment. If the Municipality declines, or if it is believed that the concerns are not properly dealt with, any individual or organization has the right to request that the MECP make an order to the project to comply with Part II of the Environmental Assessment Act which is referred to as a Part II Order request. A Part II Order is the legal mechanism whereby the status of an undertaking can be elevated from an undertaking within a Class EA to a higher level of review, including an Individual EA. This request must be submitted to the Minister within 30 days of the publication of the Notice of Completion for the Class EA process.

If concerns are raised within the 30-calendar day period that cannot be resolved between the concerned party and the proponent, the objecting party may request the Minister of Environment and Climate Change to require a proponent to comply with Part II of the EA Act before proceeding with the project. The Minister determines whether or not this is necessary with the Minister's decision being final.

An elevated review and an Individual EA require more extensive study. The Ministry of the Environment, Conservation and Parks Environmental Assessment and Approvals Branch (MECP EAAB) has a minimum target of 45 calendar days from the day the 30-day public review period lapses to review the information and prepare a report for the Minister's consideration. The Minister must then make a decision on the Part II Order request. The Minister may make one of the following decisions:

- a) Region may proceed with the project with conditions;
- b) Region must do further study under an elevated Class EA Schedule or Individual EA;
- c) Region must engage a mediator to resolve issues, with a report by the mediator back to the Minister within 60 days following appointment; and
- d) Region may proceed with the project without conditions.

If the Minister receives no Part II Order requests, the project proceeds to Phase 5 – Implementation which includes detailed design and construction.

1.2.3 Consultation

The Region initiated this Class EA in 2005 and immediately began consultation with approval agencies and the public. The consultation completed as part of the project is described in Section 7.0 of this report, including letters sent by the Region to potentially affected members of the public and approval agencies and responses from these stakeholders as the project

progressed through the Class EA process. First Nations identified by the Region and the Crown through both provincial and federal agencies were similarly consulted.

1.3 Class EA Objectives and Problem Statement

The EA objective is to assess options for optimizing groundwater supply capacity to the Pinebush, Turnbull (Clemens Mill) and Shades Mill Water Treatment Plants (WTPs) located in Cambridge East.

As shown on Figure 1, existing municipal wells supplying the WTPs include wells P10, P11 and P17 (Pinebush WTP), wells G16, G17 and G18 (Turnbull WTP) and wells G7, G8, G38, G39 and G40 (Shades Mill WTP). System wells that do not supply the treatment plants and pump directly into the distribution system following chlorination include wells G5/G5A, P9 and P15/P15A (Pinebush well field) and well G6 (Clemens Mill well field). Wells G40 and P15A are permitted with a permit to take water (PTTW) but not yet connected to the system. Well P15A is a replacement well for P15, which will be decommissioned once well P15A is online.

The wells that pump to the WTPs have aesthetic water quality issues due to the presence of iron and/or manganese and therefore require treatment beyond disinfection. The wells that do not pump to the WTPs do not have these water quality issues and as a result, they pump directly to the distribution system following disinfection.

In April 2005, as part of the project initiation, the following problem statement was developed for the Cambridge East Water Supply Schedule B Class EA:

The Regional Municipality of Waterloo is currently re-evaluating existing groundwater supplies throughout the Region's Integrated Urban System (IUS) including the Pinebush, Clemens Mill and Shades Mill well fields in the area of Cambridge East. The Region has confirmed that these well fields are currently producing 272 L/s which is significantly below the extraction rates permitted by the Ministry of Environment, Conservation and Parks permits to take water of 516 L/s and the existing infrastructure treatment capacity of 390 L/s.

The purpose of this study is to undertake an investigation to assess the overall aquifer capacity, to restore the capacity of existing well fields and to optimize groundwater extraction in the Cambridge East area, recognizing that the Strategic Plan Option in the Region's Long-term Water Strategy/Master Plan includes maximizing the use of water treatment facilities in Cambridge East.

1.4 Project Overview and Relevant Studies

In 1991, the Region initiated the Long-Term Water Strategy (LTWS), which included development of a Water Supply Master Plan (WSMP) to ensure adequate future supply of water to the Region. In May of 2000, the Region approved this WSMP, which provided a strategy for the long-term water supply to the Region until 2041. A key component of the WSMP is meeting the water demand requirements for the Integrated Urban System (IUS), a distributed network of production wells, a surface water intake, reservoirs, pumping stations and trunk water mains servicing the urban areas of the Region (i.e., municipalities of Waterloo, Kitchener and Cambridge as well as the communities of Elmira, St. Jacobs, New Hamburg and

Baden). This network controls how water is distributed throughout the broader IUS and into the specific pressure zones established within it.

The Region initiated the IUS Project in 2005, with the initial objective of developing an additional 265 L/s of groundwater supply from new wells and underutilized wells within the Region's existing well fields, and a further 265 L/s from new areas. Task B of the IUS Project consisted of the Cambridge East Water Supply Class EA to investigate alternatives to supply the underutilized capacity of the Pinebush, Clemens Mill and Shades Mill WTPs in the area of Cambridge East. Figure 3 provides an overview of the timeline of the Cambridge East Class.

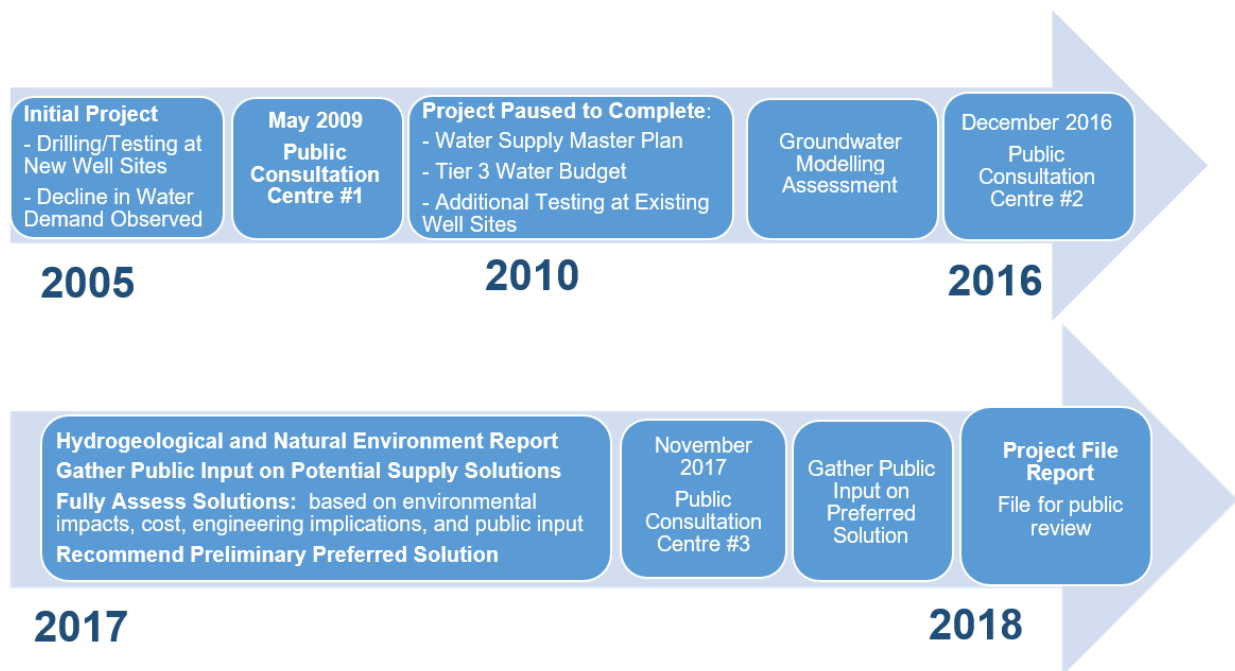


Figure 3: Project Background and Timeline

Golder conducted field investigations between 2005 and 2009, including test well drilling and long-term pumping tests, and identified options to optimize supply capacity to the treatment plants from new well sites. The results of the field-testing program were presented at the first Public Consultation Centre (PCC) in May 2009.

The May 2000 WSMP was updated in 2007 and concluded that the 2000 plan was still valid. Following the completion of this assessment, the Region determined that water demands in the Region's IUS system had declined since the middle 2000s, due in part to water conservation and efficiency efforts, intensification and economic factors. As a result, this Class EA project timeline was extended to allow the Region to update water supply strategies and demand projections and conduct additional investigations/studies comprising the following:

- Well Field Optimization Investigations at Existing Well Sites (2007 to 2016);

- The Tier 3 Water Budget and Local Area Risk Assessment (2008 to 2017);
- Master planning including: The Water Supply Master Plan (WSMP), Water Supply and Distribution Operations Master Plan (WSDOMP) and the Water Efficiency Master Plan (2011 to 2015);
- After these studies were completed, the Class EA for Cambridge East resumed, and a second PCC was completed in December 2016 to update the public on the additional studies completed and the groundwater supply alternatives identified;
- Comprehensive analysis of all test data and groundwater modelling was completed to assess long-term aquifer yields and potential effects on nearby sensitive environmental features and groundwater users. A draft Hydrogeological and Natural Environment Report was completed in April 2017;
- A third PCC was held in November 2017 to gather input on the project and the recommended preferred alternative solution; and
- The additional relevant investigations/studies completed by the Region are described below in Sections 1.4.1 to 1.4.3.

1.4.1 Well Field Optimization Investigations at Existing Well Sites (2007 to 2016)

The IUS project Class EA field program focused on the investigation of areas located more than 500 m from existing supply wells, as earlier efforts at rehabilitating wells to restore capacity had not proven successful. In 2007, the Region initiated and implemented a multi-year supply-well upgrade program within the IUS which included a further evaluation of opportunities to restore well capacities and optimize takings at existing well sites in the Pinebush, Clemens Mill and Shades Mill well fields. Typically, the work entailed drilling replacement or new deeper wells located either on the existing well sites, or on adjacent Region owned lands, with the expectation that these wells could be readily permitted under existing PTTWs. At well sites supplying the WTPs, these investigations included:

- The deepening and installation of a steel well casing liner in production well G16 at the Clemens Mill well field (Lotowater, 2011);
- The construction and testing of new test production wells P10A, P10B, PBTW1-10, the installation of a steel well casing liner in existing production well P17, and the re-drilling and re-construction of existing production well P11, at the Pinebush well field (Burnside 2010b, 2011; Stantec, 2013a); and
- The construction and testing of a new test production well SMPW1-11 (later to be renamed G40) at the Shades Mill well field (Stantec, 2013b).

The results of these investigations, which are considered as part of this Class EA, are described in more detail in Appendix A of this report. Elsewhere in these well fields, additional investigations and supply well upgrades have also been completed, including construction and testing of new test production wells G5A (Burnside, 2010) and P15A (Stantec, 2015c), and

installation of steel well casing liners in wells G6 (Lotowater, 2014a) and P9 (Lotowater, 2014b).

1.4.2 The Tier 3 Assessment (2008 to 2017)

The Region completed a Tier 3 Water Budget and Local Area Risk Assessment (Tier 3 Assessment) of the Region's groundwater supplies in the IUS and selected rural areas, as part of the source water protection process under the Clean Water Act (Matrix and SSPA, 2014). The Tier 3 Assessment included a characterization of existing municipal well fields, development of two 3-dimensional numerical groundwater flow models and an assessment of sustainable municipal well pumping strategies to meet future water demands for the IUS. The results from the Tier 3 Assessment were used to determine the sustainable long-term average day pumping rates from existing municipal wells for the WSMP update.

1.4.3 Water Supply Master Planning (2011 to 2015)

The updated WSMP was finalized in 2015 (Stantec, 2015a) and included optimizing supply capacity at the Cambridge East WTPs as part of the plan. The primary objective of the plan was to optimize the existing and planned water supply sources within the IUS for the medium-term planning horizon (20 years or 2031 based on initiation of the study in 2011) and to determine the water supply required for the long-term planning horizon (40 years or 2051) in order to meet demands, while maintaining a factor of safety in supply capacity. The results of the Tier 3 Assessment and several other studies including the WSDOMP (Stantec, 2015b) and the Water Efficiency Master Plan (Lura and Econics, 2014) were incorporated into the WSMP. The WSDOMP was completed to optimize the operating efficiency of the IUS distribution system. The solution of utilizing available capacity of the Cambridge East WTP facilities was selected as one of the preferred solutions of the WSDOMP to: 1) reduce reliance on the Middleton WTP; 2) help the Cambridge East pressure zone become more self-sufficient in terms of water supply sources; 3) provide more operational flexibility; and 4) reduce costs by optimizing use of existing facilities that are currently under capacity rather than building new treatment facilities. The WSDOMP also included planned improvements to more efficiently store and distribute water in these areas.

The water supply requirements from the various sources under consideration for the Cambridge East Class EA were developed from both the updated WSMP and the WSDOMP.

1.5 Report Outline

This report is organized as follows:

Section 1: Provides the background to the project, the Class EA objectives and Problem Statement and a summary of Region water supply strategies and relevant studies.

Section 2: Provides an overview of the Study Area including the existing well systems and the natural, social and cultural environment. This section also includes a summary of the hydrogeological investigations carried out in the Study Area and the potential additional groundwater supplies identified.

Section 3: Provides a summary of the future water supply requirements for the well systems and treatment plants that are part of this EA.

Section 4: Presents the water supply alternatives identified as part of this Class EA.

Section 5: Provides an evaluation of the alternatives including the evaluation criteria, the environmental impacts, the advantages and disadvantages, the preferred solution and public feedback.

Section 6: Provides recommended monitoring and mitigation measures.

Section 7: Provides an overview of the project communications and consultation program including the stakeholder contact list, project notices, consultation centres and additional consultation and meetings conducted as part of the project.

Section 8: Provides an overall summary.

Section 9: Provides a list of references.

This report is also supported by the following technical appendices:

Appendix A: Hydrogeology and Natural Environment Documentation:

- Hydrogeological and Natural Environment Report;
- Groundwater Modelling Report; and
- Natural Environment Inventory Technical Memorandum.

Appendix B: Cultural Heritage and Archaeological Documentation:

- Cultural Heritage Screening Technical Memorandum; and
- Stage 1 Archaeological Screening Technical Memorandum.

Appendix C: Source Water Protection Information.

Appendix D: Public Consultation Documentation.

2.0 OVERVIEW OF STUDY AREA

2.1 Natural Environment

This section provides a summary of the environmental conditions in the Study Area. Further information on the Study Area existing natural environment can be found in the attached Hydrogeology and Natural Environment Report (Appendix A). The environmentally sensitive features in the Study Area are shown on Figure 4 and are described below.

2.1.1 Physiography

Quaternary deposits, consisting primarily of glacial tills, kames and outwash sands, overlie the bedrock in most of the Cambridge East area. The most prominent topographic features in the area, the Paris and Galt moraines, are marked by broad northeast-southwest trending topographic ridges throughout most of the Study Area with irregular, hummocky topography and numerous closed depressions and small kettle lakes including Puslinch Lake. The Speed River and Mill Creek, which flow in a southwesterly direction through the Study Area to the Grand River, receive much of their baseflow from these moraines. Poorly drained soils occur in the north central portion of the Study Area at the Portuguese Swamp, with smaller areas generally to the south and east along Townline Road.

2.1.2 Surface Water Features

Surface water drainage in Cambridge East is generally toward the Speed River in the north, the Grand River in the west and Mill Creek in the south. Cedarbrook Creek, in the Clemens Mill area, conveys drainage south to Mill Creek and into the Shades Mill Reservoir. Locally within the Pinebush well field, surface drainage is toward Portuguese Swamp and easterly toward Puslinch Lake. Natural surface drainage in the Cambridge East area has been largely modified by land development and constructed stormwater management facilities.

Puslinch Lake

Puslinch Lake, the largest kettle basin in southern Ontario, is essentially a closed shallow basin with intermittent seasonal outflow during high water conditions to Puslinch Lake Creek and Irish Creek via a swampy area on the north side of the lake. The kettle depressions were formed during deglaciation and resulted from melting of ice blocks from retreating glaciers. Kettle lakes gradually develop into bogs and fens when organic matter accumulates in oxygen depleted waters. Average depths over most of the basin during low-water phases in midsummer are less than two metres (Harden, 1999).

Puslinch Lake was characterized by Harden (1999) as part of a study to assess potential rehabilitation options to improve the lake's deteriorating conditions from eutrophication and the resulting infilling. This characterization included the assessment of a basic water balance for the lake and the collection of 40 cores through the lake bottom to characterize the depth of the water, the underlying lake bed organic sediment thickness, composition and chemistry. The catchment area of the Lake is 9.73 km² (Harden, 1999).

The lake receives input from precipitation primarily and also surface water runoff. Localized areas of groundwater discharge springs are reported to have been observed during lake dredging. The program to dredge Puslinch Lake was initiated in 2000 by the Puslinch Lake Conservation Association (PLCA) and is on-going with a permit to take water limit of 132 L/s for dredging during the months of July and August.

2.1.3 Terrestrial and Aquatic Habitat

This section summarizes existing terrestrial and aquatic habitat conditions in the Cambridge East Study Area. A technical memorandum describing the environmental inventory completed to support the Cambridge East Class EA is included in Appendix A. The features in the Study

Area that have provincial or federal designations based on their ecological importance and sensitivity are described in this section. These include four provincially significant wetlands (PSWs) and three regionally significant Areas of Natural Scientific Interest (ANSI) as shown on Figure 4. These features are based on Land Information Ontario (LIO) mapping from the Ontario Ministry of Natural Resources and Forestry (MNRF) (LIO, 2016).

2.1.3.1 Wetlands

The PSWs in the Study Area include the following.

- **Puslinch Lake – Irish Creek Complex** - This PSW of about 3.7 km² in area is located to the east of Townline Road and south of Highway 401, with Puslinch Lake, a large kettle basin, within the centre of the wetland complex. Surrounding wetland is composed of four wetland types (2% bog, 2% fen, 47% swamp and 49% marsh), including the McCormick Point Wetland, a peatland bog that has been studied extensively by the University of Waterloo (Currie, 1995; Warner, 2010). Ecological functions of the Puslinch Lake-Irish Creek Complex include an active feeding area of nesting water birds, winter cover for wildlife with local significance for deer and regional significance for waterfowl staging.
- **Mill Creek Wetland Complex** – This PSW partially overlaps with the Galt Creek and Forest ANSI described below, totalling 5.4 km² in area.
- **Portuguese Swamp** – This PSW is located immediately south of municipal supply wells P11 and P17 and is also classified as an Environmentally Sensitive Policy Area (ESPA) by the Region. It is approximately 0.6 km² in area and consists of two wetland types (95% swamp and 5% marsh). Its ecological functions include an active feeding area for nesting waterbirds and winter cover for wildlife.
- **Moffat Creek Swamp** is a PSW located in the southern portion of the Study Area that is approximately 1.5 km² in area.

2.1.3.2 Areas of Natural and Scientific Interest (ANSI)

The areas designated as having Natural and Scientific Interest (ANSI) in the Study Area include:

- **Puslinch Lake Bog and Wetlands** – This is a regionally significant life science ANSI that largely corresponds with the Puslinch Lake – Irish Creek Complex PSW. It is noted that much of this area is designated as Core Greenlands in the Wellington County Official Plan (2015).
- **Galt (Mill) Creek and Forest** is a regionally significant life science ANSI located to the east of Townline Road and to the north of Concession 1. It is comprised of lowland mixed and coniferous swamp forest with some upland forest.
- **Puslinch Tract (Paris Moraine)** is designated as an earth science ANSI and is located to the northeast of Puslinch Lake and south of Highway 401.

2.1.3.3 Streams

The named watercourses in the Study Area and their thermal designations are as follows (LIO, 2016):

- Cedarbrook Creek (Cold water) - a small tributary to Mill Creek;
- Mill Creek (Cold water);
- Moffat Creek (Cold water); and
- Irish Creek (Warm water).

Warm water aquatic features are generally considered to be more robust and tolerant to external effects. Fish species occupying warm water are likewise considered to be more tolerant to changes in groundwater discharge. In contrast, cold water systems are supported by significant groundwater inputs and are considered to be capable of supporting cold water fish species, which may be sensitive to reductions in groundwater discharge.

Fish species reported in watercourses within the Study Area include a range of cold to warm water species. There are approximately 83 native and non-native fish species present in waterbodies of the Study Area. Coldwater species such as brook trout and mottled sculpin and top predator warm water species such as largemouth bass, northern pike and walleye are resident in many areas, but the more dominant and common fish groups are represented by baitfish (i.e., minnows) (Wright and Imhof, 2001).

A fish inventory of Cedarbrook Creek was conducted by Golder in 2006 prior to the 28-day aquifer test. Based on the results of the inventory, 108 fish were caught consisting of 16 species. One adult brook trout was observed, and Cedarbrook Creek was assessed to provide potential spawning habitat for this species. Although two brown trout were observed, habitat characteristics of the creek indicated it was not suitable spawning habitat for brown trout. Other common species observed included creek chub, blacknose dace, fathead minnow, and bluntnose minnow.

Sixteen species of fish are known to occur in Puslinch Lake, including northern pike, white sucker, brown bullhead, yellow perch, smallmouth bass and largemouth bass. In addition, walleye have been stocked historically in the lake (Bonter et al., 2000) but their current status and success of the stocking efforts are not well documented.

2.1.3.4 Species at Risk

Based on the desktop assessment, 30 species designated as special concern, threatened or endangered under the Endangered Species Act (ESA) or the Species at Risk Act (SARA) were assessed to have moderate or high potential to occur within the Study Area (Appendix A). Of these, 18 have been designated as threatened or endangered under the ESA and receive individual and habitat protection. The other species with moderate or high potential, as indicated in the Natural Environmental Inventory Technical Memorandum included in Appendix A, do not have regulatory protection. However, habitat for these species must still be considered under the Significant Wildlife Habitat criteria of the Provincial Policy Statement (PPS) in the impact assessment for the EA:

- Six (6) birds (bank swallow, barn swallow, bobolink, chimney swift, eastern meadowlark, whip-poor-will);
- Four (4) mammals (small-footed myotis, little brown myotis, northern myotis, and tri-colored bat);
- Two (2) fish (reidside dace and silver shiner);
- One (1) mollusc (wavy-rayed lampmussel);
- One (1) reptile (Blanding's turtle); and
- Four (4) vascular plants (American columbo, butternut, eastern flowering dogwood, and false hop sedge).

The majority of potential suitable habitat for these Species at Risk (SAR) is concentrated in the woodlands, wetlands and lakes in the Study Area. Some species, such as chimney swift, may also use anthropogenic structures for habitat. Based on the results of surveys conducted for another project that overlapped the southern end of the EA Study Area, three bird SAR have been recently observed (Savanta, 2015). These include barn swallow, bobolink, and eastern meadowlark. Surveys completed in the Puslinch Tract Conservation Area have also identified several SAR, including little brown myotis, barn swallow, and eastern meadowlark (GRCA, 2004).

2.1.4 Hydrogeology

The hydrogeology of the Study Area is described in detail in the Hydrogeology and Natural Environment Report (Appendix A). This section provides a summary of the Study Area existing well systems, the hydrogeological setting, the hydrogeological investigations completed as part of this project and the identified groundwater supply potential from existing and new well sites.

2.1.4.1 Existing Well Systems

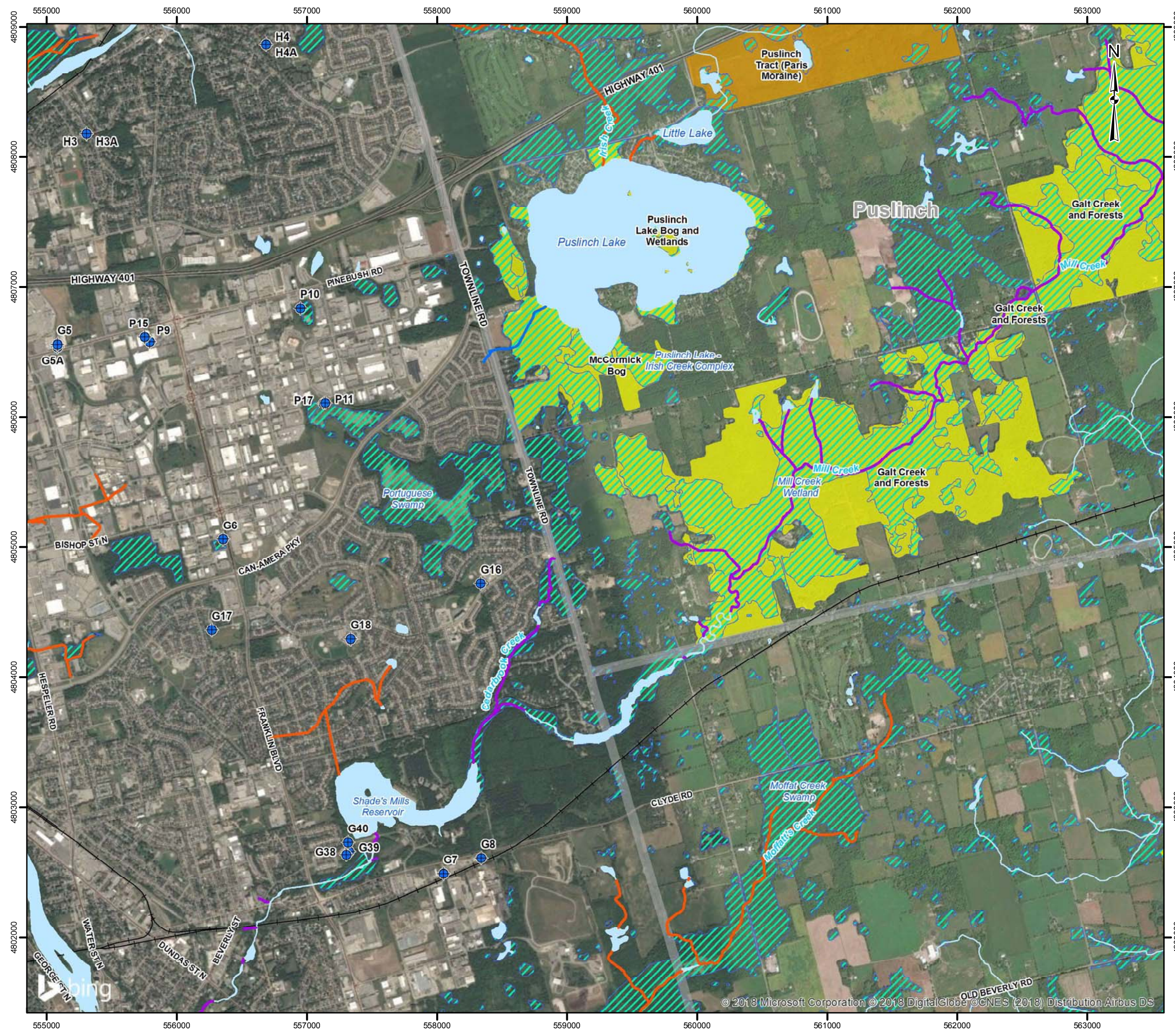
The City of Cambridge comprises the southern urban centre of the Tri-Cities of the Region of Waterloo, the largest municipality in Canada reliant on groundwater for the bulk of its water supplies. The City of Cambridge is an amalgamation of the former municipalities of Hespeler, Preston and Galt that each developed a water supply system based on groundwater pumping primarily from the bedrock aquifer. The treatment plants that are the focus of this Class EA are shown on Figure 1 and include the Pinebush, Turnbull (Clemens Mill) and Shades Mill plants.

Within the Cambridge East Class EA well fields, the Region of Waterloo now operates the following existing municipal wells at the locations shown on Figure 1:

- Pinebush Well Field - Three bedrock wells that supply the Pinebush WTP (P10, P11, and P17) and five additional bedrock wells (G5, G5A, P9, P15 and P15A) that do not supply the WTP. Well P15A is a replacement well for P15 that has been drilled but is not yet connected to the system. P15 will be decommissioned when P15A comes online. Well P10 was constructed prior to the Ontario Water Resources Act and therefore does not require a PTTW. Three new wells (P10A, P10B, PBTW1-10) have been constructed at the P10 well

site. These wells were constructed as replacement wells for P10 but have not yet been connected to the system and are currently being evaluated as part of this EA.

- Clemens Mill Well Field - Three bedrock wells (G16, G17 and G18) that supply the Turnbull WTP and one bedrock well (G6) that does not supply the WTP; and
- Shades Mill Well Field - Five overburden wells (G7, G8, G38, G39 and G40) that supply the Shades Mill WTP. Well G40 was recently constructed to help supply the Shades Mill WTP; it is permitted but not yet connected.



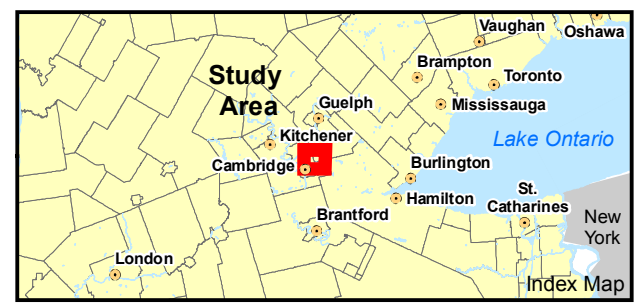
LEGEND

- Municipal Supply Well
- Railway

Watercourse Thermal Regime

- Unknown
- Cold
- Cool
- Warm

- Provincially Significant Wetlands
- ANSI, Earth Science
- ANSI, Life Science
- Municipalities



REFERENCE

Base Data - MNR LIO, obtained 2016
 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2016
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17

0.5 0 0.5 1 1.5 2
 Kilometres

PROJECT		CAMBRIDGE EAST WATER SUPPLY CLASS ENVIRONMENTAL ASSESSMENT	
TITLE		STUDY AREA SENSITIVE ENVIRONMENT FEATURES	
PROJECT No. 05-1112-010	SCALE 1:30,000	REV. 2	
DESIGN CGG	10 Mar. 2005		
GIS PR	12 Apr. 2018		
CHECK JLH	12 Apr. 2018		
REVIEW JAP	12 Apr. 2018		



FIGURE: 4

The permitted details and capacities for wells that supply the WTPs are shown in Table 1.

Table 1: Well Details and Permits to Take Water

Well Name	Date Constructed	Top Screen / Open Hole (mbgs)	Bottom Screen / Open Hole (mbgs)	Status	Permit Number	Maximum Permitted Water Taking (L/s)	Drinking Water License Rates (L/s)	WSMP Average Daily Rate (L/s)	WSMP Maximum Daily Rate (L/s)
Pinebush Well Field - Treatment Plant Wells									
P10	24-Feb-59	31.1 (casing depth)	64.3	Active	Permit Not Required	Note 1	120	36	40
P10A	13-Apr-10	58.0 (casing depth)	121.0	Test Well	Not permitted	NA ²		Note 3	Note 3
P10B	25-May-11	26.2 (casing depth)	33.5	Test Well	Not permitted	NA ²		Note 3	Note 3
PBTW1-10	02-Sept-10	49.2 (casing depth)	107.0	Test Well	Not permitted	NA ²		Note 3	Note 3
P11	29-Oct-58	44.0 (casing depth)	83.8	Active	7343-9FFJBX	60		20	26
P17	19-Apr-94	48.2 (liner depth)	110.6	Active		60			
Clemens Mill Well Field - Water Treatment Plant Wells									
G16	18-Aug-92	57.9 (liner depth)	126.5	Active	8842-9FDJUC	38	120	34	38

Well Name	Date Constructed	Top Screen / Open Hole (mbgs)	Bottom Screen / Open Hole (mbgs)	Status	Permit Number	Maximum Permitted Water Taking (L/s)	Drinking Water License Rates (L/s)	WSMP Average Daily Rate (L/s)	WSMP Maximum Daily Rate (L/s)
G17	25-Mar-94	61.7 (casing depth)	120.7	Active		50		25	35
G18 ⁴	25-Jul-91	37.9 (casing depth)	92.7	Active		37.8		15	25
Shades Mill Well Field Water Treatment Plant									
G7	03-Sep-58	14.6	17.7	Active	3004-A9GHYU	174.5 ⁵	150	20	27
G8	01-Jan-65	14.5	17.5	Active				10	15
G38	20-Dec-94	36.2	39.2	Active				15	25
G39	13-Jan-95	36.9	43.3	Active				30	50
G40	29-Jul-11	33.6	40.5	Not Yet Connected			Note 6	Note 7	Note 7

NOTES:

- 1) Well is grandfathered - permit is not required.
- 2) Wells P10A, P10B and PBTW1-10 do not currently have a PTTW and are intended as replacements for Well P10, which would be decommissioned once these new wells are permitted and brought online.
- 3) Recommended Daily Rate not provided in WSMP.
- 4) Existing well G18 is located on the Clemens Mill Public School property, not Region owned land, and this site may not continue to be suitable/accessible in the long term.

- 5) The maximum permitted daily rate for the Shades Mill well field is 174.5 L/s, but the annual daily average shall not exceed 150 L/s.
- 6) G40 not included in the Drinking Water License dated May 18, 2016.
- 7) Recommended Daily Rate not provided in WSMP.

Table 2 presents a summary of the existing condition pumping rates for wells supplying the WTPs, along with pumping from other wells in Cambridge East. This table also identifies the individual wells supplying the respective WTP in each well field, the average and maximum recommended rates from the WSMP, the total permitted pumping limit as provided on the PTTWs for these wells, along with the licenced limit of each of the WTPs in Cambridge East.

Table 2: Summary of Existing Well Pumping Rates and Capacities

	Existing Condition- (Tier 3) pumping rates (L/s)	WSMP Average Daily Rate (L/s)	WSMP Maximum Daily Rate (L/s)	PTTW permit total (L/s)	WTP Licenced Capacity (L/s)
Pinebush WTP (Wells P10, P11, P17)	56	56	65	120	120
Turnbull (Clemens Mill) WTP (Wells G16, G17, G18)	54	74	98	126	120
Shades Mill WTP (Wells G7, G8, G38, G39 and G40)	77	75	119	175	150
Total - Cambridge East WTP Wells	187	205	282	421	390
Other Wells in Cambridge East (Pinebush and Clemens Mill well fields)	63	55	70	94	N/A
Total – All Wells in Cambridge East	250	260	352	515	N/A

As noted in Section 1.4.2, the Region developed a regional scale 3-dimensional numerical model of the groundwater system that was used to assess water availability to meet projected 2031 demands for the Region's IUS. The Tier 3 assessment used the average day municipal well pumping rates for year 2008 as the "existing condition" on which to evaluate the sustainability of supply sources due to changes in future land uses, pumping rates and drought conditions. The 2008 rates were used for all the municipal wells in the IUS, with the exception of wells G38 and G39, for which the 2005/2006 average day pumping rates were assigned, as these wells were offline in 2007/2008.

The following provides a summary of the existing capacities of the wells that supply the WTPs:

- For the existing wells providing water to the Pinebush WTP, the 2015 WSMP recommended an average daily pumping rate of 56 L/s (4,834 m³/day) and a maximum daily pumping rate of 65 L/s (5,616 m³/day), which is less than the WTP capacity of 120 L/s (10,368 m³/day).
- For the wells providing water to the Turnbull WTP, the 2015 WSMP recommended an average daily pumping rate of 74 L/s (6,394 m³/day) and a maximum daily pumping rate of 98 L/s (8,467 m³/day), which is less than the WTP capacity of 120 L/s (10,368 m³/day).
- All of the Shades Mill wells supply the WTP and the 2015 WSMP recommended average and maximum daily total pumping rates are 75 L/s (6,480 m³/day) and 117 L/s (10,109 m³/day), respectively. The current permitted rate from the Shades Mill well field is 175 L/s (15,080 m³/day). The permit indicates that the annual daily average taking in this well field shall not exceed 150 L/s (12,690 m³/day). It is noted that while permitted, well G40 has not yet been used to supply the system.

2.1.4.2 Hydrogeological Setting

The hydrogeology of the Study Area is described in detail in the Hydrogeology and Natural Environment Report (Appendix A). This section provides a summary of the hydrogeology in the Study Area. Figure 5 shows the conceptual hydrogeology in the Study Area.

Municipal groundwater supplies in Cambridge East are derived primarily from the Paleozoic bedrock formations, which comprise a regionally extensive bedrock aquifer system. The Quaternary overburden sediments consist primarily of glacial tills, kames and outwash sands and overlie the bedrock in most of the Cambridge East area with a thickness generally ranging from about 15 to 40 m. The overburden deposits provide some municipal supply in the Shades Mill well field of Cambridge, although these deposits are localized in extent and generally less productive than the regional bedrock aquifer system. Shallow groundwater flow in the overburden generally follows topographic variations. Groundwater flow contours in the deep overburden, developed during numerical modelling, simulate flow from the Study Area converging on the river valleys in the area; the Speed River to the north, the Grand River to the southwest and Mill Creek to the south. Within the eastern area of the Pinebush and Clemens Mill well fields, there is a local easterly component to groundwater flow in the deep overburden.

Bedrock formations in Cambridge East consist of limestone, dolostone and shale sequences that form an active groundwater flow system that is generally about 100 m in thickness. These Paleozoic bedrock formations comprise one of the most extensive bedrock aquifers in Ontario that is the principal source of drinking water supplies for a number of municipalities and domestic water supply. The underlying bedrock geology generally consists of the following sequence in Cambridge East from youngest to oldest: Guelph Formation (Shallow Bedrock Aquifer), Eramosa Formation (Reformatory Quarry and Vinemount Members) (Intermediate Bedrock), Goat Island and Gasport Formations (Deep Bedrock Aquifer) and Cabot Head Formation. The upper weathered/fractured bedrock and overlying coarse materials typically form a thin aquifer (Contact Aquifer) that is able to support domestic water wells and some municipal wells. This unit includes the coarse granular materials overlying bedrock at the base of the Catfish Creek Till that are identified in many boreholes in the Study Area.

Regional groundwater flow in the deep bedrock (Gasport Formation) and the shallow bedrock (Guelph Formation) Formations in the area of Cambridge well fields is generally to the southwest toward the Grand River. The regional pattern of groundwater flow in the bedrock aquifer is strongly influenced by municipal pumping.

Groundwater elevations are lower in the deep bedrock (Gasport Formation) relative to the overlying Guelph Formation, indicating downward vertical hydraulic gradients over much of the Cambridge area, with the strongest downward gradients observed in the higher elevation upgradient areas to the northeast, extending into the Township of Puslinch. Upward hydraulic gradients occur in the lower elevation areas in the south of the Study Area in Shades Mill, and to the east in North Dumfries and the area surrounding Mill Creek in Puslinch. The strong upward gradients in the Shades Mill and North Dumfries areas occur across the Vinemount Member of the Eramosa Formation, which is only present in the southern and eastern portions of the Study Area.

The bedrock municipal wells in the area are cased through the overburden and upper bedrock and draw the majority of their water from producing zones in the deep aquifer. The deep bedrock municipally pumped zones have a limited connection to the shallower bedrock and overburden aquifers where the majority of the private wells are pumping from.

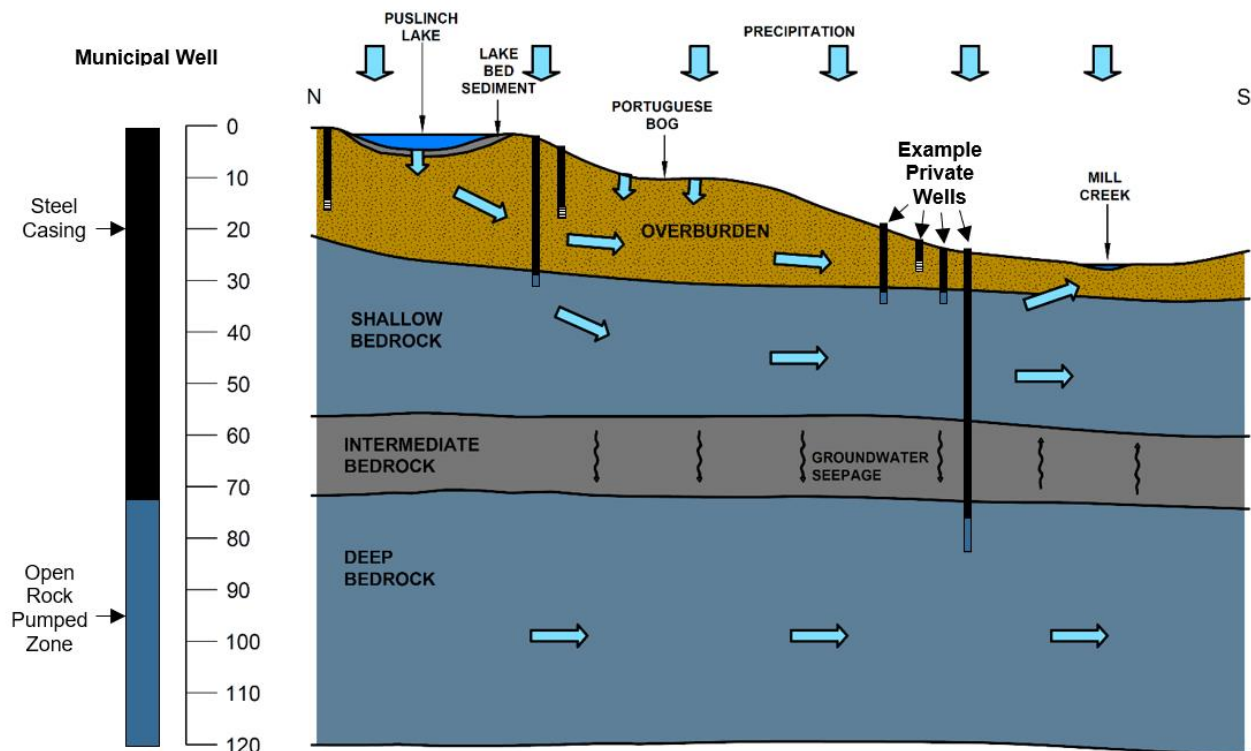


Figure 5: Conceptual Hydrogeological Model

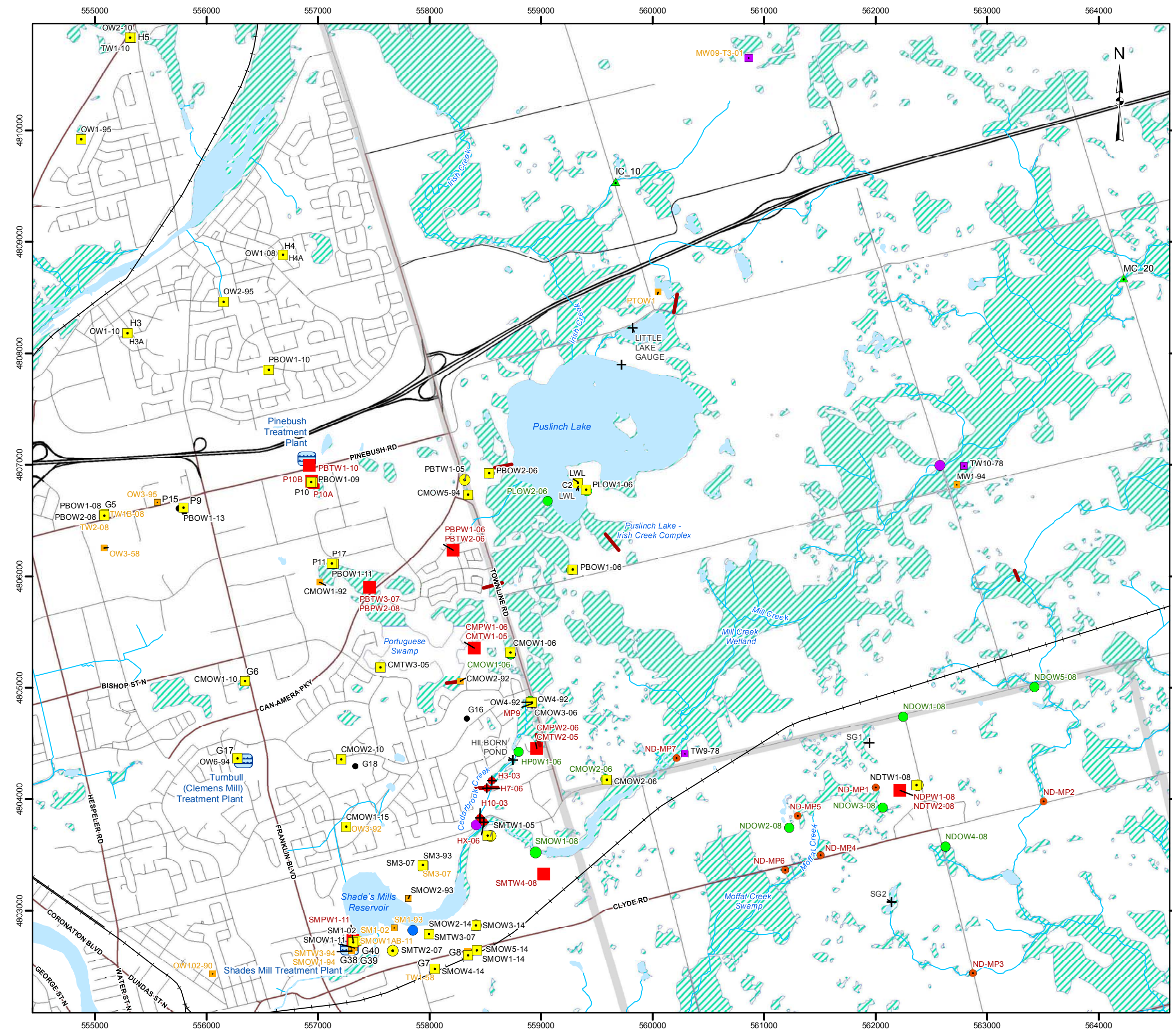
2.1.4.3 Hydrogeological Investigations

The Hydrogeological and Natural Environment Report (Appendix A) presents a characterization of existing environmental conditions, interpretation of the field study results and an evaluation of potential effects from optimized pumping scenarios in the Cambridge East Study Area to meet future water demands. The test wells and monitoring wells installed as part of these hydrogeological investigations are shown on Figure 6.

The main activities of the IUS project Class EA hydrogeological program included:

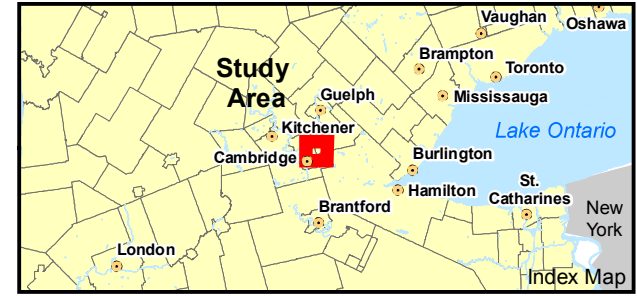
- Review of available background information including: geological, hydrogeological and hydrological information such as previous study reports, borehole groundwater levels, regional climate data, groundwater pumping records and the Region's groundwater monitoring program results;
- Review of available information and testing data for the existing Cambridge East municipal wells including: well construction, pumping tests, operational history, water quality and well rehabilitation activities;
- An extensive test drilling program to assess hydrogeological conditions to the base of the bedrock aquifer including:
 - Drilling, installing and step testing twelve (12) 152 mm (6-inch) diameter test wells;
 - Drilling, installing and step testing five 305 mm (12-inch) diameter test production wells at the five most favourable test well sites. These wells included CMPW2-06 (Cedarbrook Well), PBPW1-06 (Witmer Park Well), CMPW1-06 (Portuguese Club well), PBPW2-08 (Can-Amara Pky Well) and NDPW1-08 (Clyde Park Well); and
 - Monitoring well drilling and installation at 20 sites, including multi-level monitoring wells (72 piezometers) completed in the bedrock and overburden at locations up to about 1 km from the test wells.
- Geophysical logging and flow profiling of boreholes that were completed as test wells and monitoring wells;
- The development of comprehensive monitoring programs in support of a long-term pumping test including: shallow water table piezometers located in environmentally sensitive areas and cold-water streams, private wells, multi-level monitoring well nests, staff gauges in lakes and ponds, stream flow measuring stations and ecological monitoring transects;
- A 28-day long-term pumping test with a staggered start of pumping from three test production wells (Cedarbrook, Witmer Park and Portuguese Club wells);
- Three additional constant rate pumping tests, ranging from 3 to 6 days in duration, at other test wells and test production wells;
- Sampling for water quality;

- Communication with the public and public meetings focused on the field-testing program; and
- Comprehensive analysis of all test data and groundwater modelling to assess long-term aquifer yields and potential effects on nearby sensitive environmental features and groundwater users.
- The IUS project Class EA field program focused on the investigation of areas located more than 500 m from existing supply wells, as earlier efforts at rehabilitating wells to restore capacity had not proven successful. Additional optimization projects were carried out by the Region to drill replacement or new deeper wells located either on the existing well sites, or on adjacent Region owned lands. At well sites supplying the WTPs, these additional investigations included:
 - The deepening and installation of a steel well casing liner in production well G16 at the Clemens Mill well field (Lotowater, 2011);
 - The construction and testing of new test production wells P10A, P10B, PBTW1-10, the installation of a steel well casing liner in existing production well P17, and the re-drilling and re-construction of existing production well P11, at the Pinebush well field (Burnside 2010b, 2011; Stantec, 2013a). A 15-day constant rate pumping test at P10A, P10B, PBTW1-10 and P17 was conducted in 2011 to evaluate sustainable aquifer yield, potential well interference and well field optimization. The total combined pumping rate for the test was as high as approximately 156 L/s; and
 - The construction and testing of a new test production well SMPW1-11 (later to be renamed G40) at the Shades Mill well field (Stantec, 2013b).



LEGEND

- Ongoing Township of Puslinch Monitoring Locations
- Ongoing Region GMP Monitoring Location
- IUS Project Monitoring Well
- Municipal Supply Well
- Test Well/Test Production Well
- IUS Project Test Well
- Monitoring Well (not including IUS project wells)
- Monitored Private Well
- Mini-Piezometer
- + Surface Water Level Station
- Rain Gauge Station
- Stream Flow Station
- ▲ Baseflow Monitoring Locations
- Treatment Plant
- Railway
- Ecological Monitoring Station
- Watercourse
- Waterbody
- Provincially Significant Wetlands
- Municipalities



REFERENCE
 Base Data - MNR/LIO obtained 2016
 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources and Forestry, © Queens Printer 2016
 GRCA Wetlands - Produced using information under License with the Grand River Conservation Authority © Grand River Conservation Authority, obtained 2016
 Datum: NAD 83 Projection: UTM Zone 17N



PROJECT	CAMBRIDGE EAST WATER SUPPLY CLASS ENVIRONMENTAL ASSESSMENT		
TITLE	TEST WELL AND MONITORING LOCATIONS		
	PROJECT NO. 05-1112-010	SCALE 1:35,000	REV. 1
	DESIGN CGG 10 Mar. 2005		
	GIS PR 12 Apr. 2018		
	CHECK JLH 12 Apr. 2018		
REVIEW JAP 12 Apr. 2018			

FIGURE: 6

2.1.4.4 Groundwater Supply Potential

As described in the Hydrogeological and Natural Environment Report (Appendix A), with optimization of pumping strategies at existing and new well sites, the Cambridge East area is capable of supplying the Region's IUS with additional water. The results of the optimization investigations and groundwater exploration studies are summarized below.

Pinebush WTP

- A combined sustainable capacity of 126 L/s was identified from wells P10A, P10B and P11/P17 and new well PBTW1-10 to meet the capacity of the WTP (Stantec, 2013a). This optimized scenario included a slightly reduced pumping rate from shallower well P10B (replacement for P10) and increased pumping from deeper wells P10A and PBTW1-10.
- New wells at the Witmer Park and Can-Amara Parkway locations were identified with estimated capacities of 75 L/s and 38 L/s, respectively. As further described in Section 4.0, the Witmer Park and Can-Amara Parkway wells were not carried forward in the Class EA since the WTP capacity can be met by wells at existing sites and water supply requirements identified in the WSMP do not necessitate going beyond the WTP capacity at Pinebush.

Clemens Mill (Turnbull) WTP

- Additional capacity of 20 L/s was obtained through the deepening and testing of well G16 as part of the optimization investigations and the well was confirmed to be able to meet its permitted rate of 38 L/s. Based on the results of the testing, the well has potential to pump up to 75 L/s for short periods of time.
- New wells at the Cedarbrook and Portuguese Club locations were drilled, tested and identified as alternatives to provide additional supply capacity to the WTP. These wells would require watermain installation and connections to the existing watermain on Townline Road as well as watermain installation/upgrades on Saginaw Parkway from Townline Road to well G18 to convey the water to the WTP.
- As further described in Section 4.0 and in detail in Appendix A, the Cedarbrook well draws water from a deeper and more confined aquifer zone, is further from sensitive features (i.e., Puslinch Lake and Portuguese Bog) and has a greater yield than the Portuguese Club well. Therefore, the Class EA impact assessment focused on long-term pumping increases from the Cedarbrook well to supply the Clemens Mill WTP. The Cedarbrook well was tested at a rate of 38 L/s and the testing and modelling showed that this rate was sustainable over the long term. Based on the results of the testing, for short periods of time the wells are capable of pumping up to 75 L/s and 50 L/s for the Cedarbrook well and Portuguese well, respectively.

Shades Mill WTP

- As part of the Region's well optimization investigations, new well G40 was constructed at the WTP site.

- Poor water quality (high sulphate) and poor yield was found from test wells constructed in the bedrock aquifer in the Shades Mill area during test drilling at locations away from the WTP site.
- Further east in the village of Clyde, a bedrock well was drilled and tested with an estimated capacity of 50 L/s. The Clyde Park well is located approximately 5 km from the nearest watermain for the Shades Mill WTP. As further described in Section 4.0, the Clyde Park well was not carried forward in the Class EA assessment of alternatives since additional supply capacity can be found more readily, and more cost-effectively, in the Clemens Mill and Pinebush well fields and updated predicted demands do not necessitate maximizing capacity at all three WTPs, as is further described in Section 4.0.

2.2 Social and Cultural Environment

2.2.1 Land Use

Much of the Study Area has been developed in the last 25 years, with a mix of residential subdivisions and industrial/commercial development. Prior to this recent development, some older industrial and commercial sites were present along Franklin Boulevard and Pinebush Road, while rural residential development on private services was distributed along some sections of Avenue and Townline Roads in the southeast and east portions of this area. Some of these residences are still on private services while the remainder of the area is now municipally serviced. In the adjacent rural lands in Puslinch, east of Townline Road as well as to the southeast along Avenue Road, land use is primarily agricultural and rural residential. These residences are not serviced and rely on private wells for domestic water supplies. The main natural areas of undeveloped lands in Cambridge East include the Portuguese Swamp, an extensive wetland located in the east central portion of the area, and the Shades Mill Reservoir and Conservation Area, located in the south (Figure 4).

2.2.2 Heritage/Cultural

Golder conducted a cultural heritage screening to determine if the evaluated alternative well sites and associated watermain construction in the east-central portion of the City of Cambridge would potentially impact cultural heritage resources. Two of the well sites are west of Townline Road (Portuguese Club and Cedarbrook wells), while the third site is at the existing P10 well site and the Pinebush WTP site on Pinebush Road. The watermain construction/replacement would follow Saginaw Parkway from existing well G18 to Townline Road and connect the Portuguese Club and Cedarbrook Club wells from existing watermains on Townline Road.

Following the Ministry of Tourism, Culture and Sport Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes checklist (2016), a range of sources were consulted for the desktop study, including the City of Cambridge Heritage Properties Register, Canadian Register of Historic Places, Ontario Ministry of Government and Consumer Services Database of Registered Cemeteries, historical topographic maps, and other published or online sources. Golder also consulted with the City of Cambridge heritage planner. From the information compiled, Golder concluded that there are no cultural heritage resources at risk of impact at the evaluated well sites or associated watermain construction

and recommended that no further cultural heritage studies be required. A technical memorandum describing the cultural heritage screening is provided in Appendix B.

2.2.3 Archaeology

Prior to drilling the test wells, the project team contacted the Ministry of Tourism, Culture and Sport to determine if the well sites had archaeological potential and whether they required an archaeological assessment. The Shades Mill test well sites (SMTW1-05, SMTW2-07 and SMTW3-07) and the Clyde Park site (NDTW1-08) were the only sites identified at the time by the Ministry to have archaeological potential and archaeological assessments were completed at these sites (Parker Archaeological Consulting 2005; 2007 and 2008). No archaeological sites were identified as part of these studies and no further study was deemed necessary at the time. The Shades Mill and Clyde Park sites were not carried forward as part of the Class EA evaluation.

Golder completed a Stage 1 archaeological assessment for the alternative wells sites that were carried forward and evaluated as part of the Class EA. The Stage 1 archaeological assessment technical memorandum is provided in Appendix B and was completed following the Standards and Guidelines for Consultant Archaeologists (MTCS, 2011).

The background research determined the archaeological potential of the Project Area based on the proximity of various archaeological features. To determine if the Project Area retains its archaeological potential classification, an on-site property inspection was undertaken. The property inspection identified parts of the Project Area as having no and low archaeological potential based on previous disturbances and steeply sloping terrain. The undisturbed portions of the Portuguese Club and Cedarbrook Well site areas were identified as retaining archaeological potential and a Stage 2 Archaeological assessment would be required for the undisturbed portions of these sites prior to construction.

3.0 FUTURE WATER SUPPLY REQUIREMENTS

The WSMP and the WSDOMP recommended the optimization of groundwater supplies to the WTPs in Cambridge East to help meet medium-term (2031) and long-term (2051) projected IUS water demands, as noted in Section 1.5. The Cambridge East WTP facilities are crucial in the WSDOMP, due to their central locations on the east side, which would allow water to be pumped north or south as needed to help meet IUS water demands and in the event of short-term supply shutdowns at other sources.

Figure 7 illustrates the existing conditions, the potential future supply rates for all of the Cambridge East WTP supply wells and the total capacity of the WTPs. While this figure shows the average day rates, actual daily pumping rates vary considerably, and daily maximum rates can typically be about one-third higher than average day rates. The engineered components of the water supply system, including the water treatment plants (WTPs), are typically sized to accommodate daily maximum pumping rates, which is why the total licenced capacity of the WTPs is considerably greater than the average daily pumping rates presented on Figure 7. Average daily pumping rates are used herein as the basis for the Class EA evaluations.

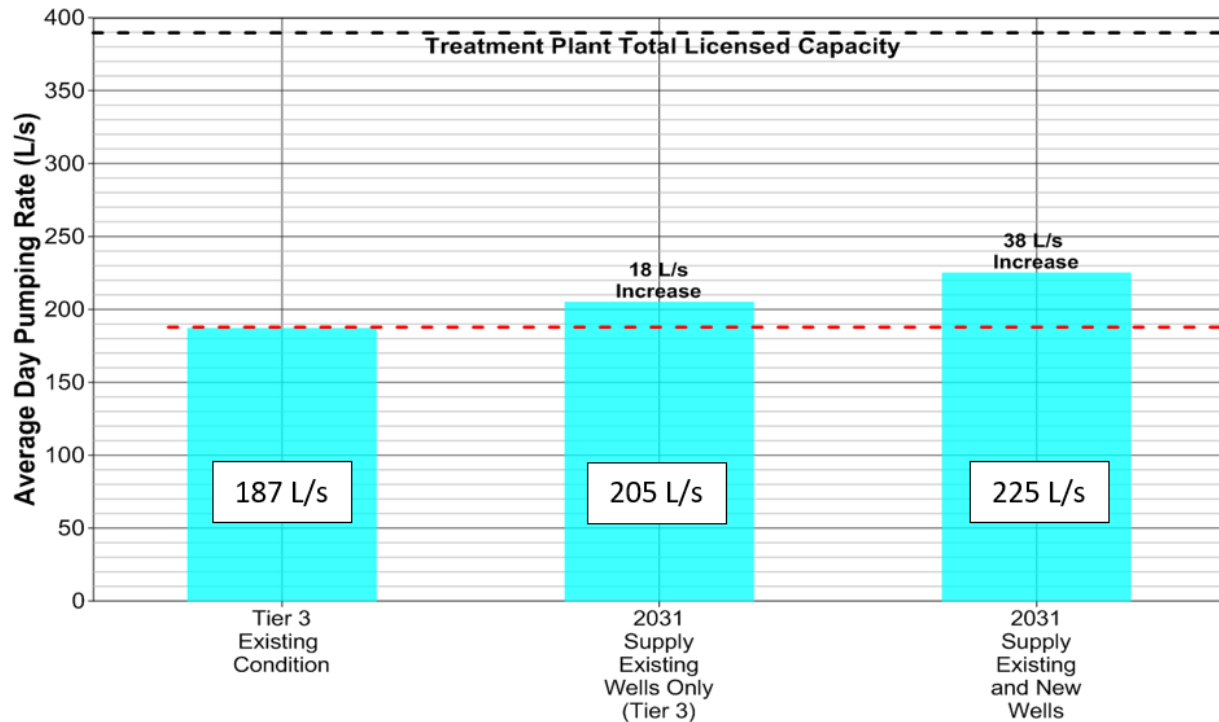


Figure 7: Cambridge East WTPs – Long-Term Water Supply Requirements

It is important to note that the proposed pumping increases in Cambridge East would be implemented gradually over the next 15 years as IUS water demands increase. This extended time period allows for monitoring and evaluating the effects of these increases over time.

The specific options evaluated included:

- Existing Pumping Conditions;
- 2031 Supply from Existing Wells Only; and
- 2031 Supply from Existing and New Wells.

The water supply rate options considered as part of the Cambridge East Class EA are further described below.

3.1 Existing Pumping Conditions

As noted in Section 1.4.2, the Region developed two regional scale 3-dimensional numerical models of the groundwater flow systems that were used to assess water availability to meet projected 2031 demands for the Region's IUS. This included a portion of the increases in supply coming from the Cambridge East well systems and WTPs. The Tier 3 assessment used the average day municipal well pumping rates for year 2008 as the "existing conditions" on which to evaluate the sustainability of supply sources due to changes in future land uses, pumping rates and drought conditions. The 2008 rates were used for all the municipal wells in the IUS, with the exception of wells G38 and G39, for which the 2005/2006 average day

pumping rates were assigned, as these wells were offline in 2007/2008. These same “existing conditions” rates were used in this Class EA to compare other options for optimizing the supply of water to the three WTPs in Cambridge East. This represented a total supply to Cambridge East WTPs of 187 L/s.

3.2 2031 Supply from Existing Wells Only

As part of the Tier 3 Assessment, pumping rates were optimized in the models for existing municipal supply wells to represent how the Region could meet the projected IUS 2031 water demands with existing supply wells. These rates represented only one possible set of rates that could be used across the IUS. For Cambridge East, this included an additional 18 L/s from existing wells supplying the Cambridge East WTPs with the increase obtained from deepened well G16. The remaining additional water (20 L/s for a total of 38 L/s) needed in Cambridge to help meet the 2031 demands, was assumed to be supplied by wells located elsewhere in Cambridge in this scenario. This resulted in a total average day supply of 205 L/s for the three Cambridge East WTPs. Although this scenario helped to meet the overall IUS 2031 supply requirements, it did not meet the objectives of the WSMP and WSDOMP, which recommended increased utilization of the Cambridge East WTPs existing capacity due to their optimal locations on the east side of Cambridge, as discussed previously.

3.3 2031 Supply from Existing and New Wells

As part of this Class EA, both existing and some of the new wells installed as part of this Class EA, or other related projects, were simulated to increase the average day water supply from the Cambridge East WTPs by a total of 38 L/s. This rate represented all the water that was needed to meet 2031 demands in Cambridge, to be supplied from these wells, which is consistent with the overall objectives of the WSDOMP. This represented a total average day supply requirement of 225 L/s for the WTPs.

The options assessed for this Class EA reflect how the water supply system for the Cambridge East WTPs could be operated to help meet the average day projected IUS 2031 demands. The Region also undertook modelling evaluations to assess how the water supply to Cambridge could be maintained on a short-term basis during a period when a large water source was unavailable, to facilitate well replacement or equipment upgrades. This could require temporary increased pumping at other Cambridge wells to offset this short-term reduction in pumping at a specific facility. Groundwater pumping strategies to meet this hypothetical short-term shutdown were also evaluated, as a contingency planning measure, and are presented in the Hydrogeology and Groundwater Modelling Reports in Appendix A.

4.0 ALTERNATIVE SOLUTIONS

Alternative solutions developed to help meet projected IUS 2031 supply requirements, from wells in Cambridge East, included increased pumping from existing wells, increased pumping from wells at existing sites that have been modified to provide for higher pumping rates, increased pumping from new wells at existing sites, and increased pumping from new well sites.

The following sections identify the production wells that could be utilized for each of the alternative water supply solutions to be evaluated as part of the Cambridge East Class EA. This analysis evaluated various well pumping configurations that could be used to help meet the projected IUS 2031 demands and to maximize the use of the Cambridge East WTPs, as recommended in the WSMP/ WSDOMP.

4.1 Screening of Alternative Solutions

4.1.1 Pinebush Well Field Alternative Solutions

The alternative solutions under consideration for the Pinebush well field are summarized in Table 3.

Table 3: Pinebush (PB) Well Field Alternative Solutions

Alternative Solutions		Maximizes Use of Treatment Plant
PB-1	Do Nothing: Use existing wells: <ul style="list-style-type: none"> ■ P10, P11, P17 	No
PB-2	Apply Alternative Solution PB-1 and construct new wells at existing sites: <ul style="list-style-type: none"> ■ P10A, P10B, PBTW1-10 	Yes
PB-3A	Apply Alternatives PB-1 and PB-2 and use well at new site: <ul style="list-style-type: none"> ■ PBTW1-06 (Witmer Park) 	Yes (Provides more water than is needed in 2031 so is not carried forward)
PB-3B	Apply Alternatives PB-1 and PB-2 and use well at new site: <ul style="list-style-type: none"> ■ PBTW2-08 (Can-Amera Parkway) 	Yes (Provides more water than is needed in 2031 so is not carried forward)

For the Pinebush well field, the investigations have shown that through constructing new wells at existing sites, the use of the Pinebush WTP can be maximized (alternative PB-2). In order to minimize potential effects in new areas as well as operational complexity, this solution would be preferred compared to moving to new sites, so the new wells (Witmer Park – alternative PB-3A and Can-Amera Parkway- alternative PB-3B) were not carried forward for further evaluation in the Class EA.

4.1.2 Clemens Mill Well Field Alternative Solutions

The alternative solutions under consideration for the Clemens Mill well field are summarized in Table 4.

Table 4: Clemens Mill (CM) Well Field Alternative Solutions

Alternative Solutions		Maximizes Use of Treatment Plant
CM-1	Do Nothing: Use existing wells only: <ul style="list-style-type: none"> ■ G16, G17, G18 	No
CM-2	Apply Alternative CM-1 and adapt and modify wells at existing sites: <ul style="list-style-type: none"> ■ Increase pumping from deepened G16 	No
CM-3A	Apply Alternatives CM-1 and CM-2 and use well at new site: <ul style="list-style-type: none"> ■ CMPW2-06 (Cedarbrook) 	Yes
CM-3B	Apply Alternatives CM-1 and CM-2 and use well at new site: <ul style="list-style-type: none"> ■ CMPW1-06 (Portuguese Club) 	Yes

As mentioned previously, existing well G18 is located on the Clemens Mill Public School property, not Region owned land, and this site may not continue to be suitable / accessible in the long term. This potential situation will be considered in the evaluation of alternative solutions.

4.1.3 Shades Mill Well Field Alternative Solutions

The alternative solutions under consideration for the Shades Mill well field are summarized in Table 5.

Table 5: Shades Mill (SM) Well Field Alternative Solutions

Alternative Solutions		Maximizes Use of Treatment Plant
SM-1	Do Nothing: Use existing wells: <ul style="list-style-type: none"> ■ G7, G8, G38 and G39 	No
SM-2	Apply Alternative SM-1 and construct new well at existing site: <ul style="list-style-type: none"> ■ G40 	No

Alternative Solutions		Maximizes Use of Treatment Plant
SM-3	Apply Alternatives SM-1 and SM-2 and use well at new site: <ul style="list-style-type: none"> ■ NDPW1-06 (Clyde Park) 	Yes (As supplies can be more cost effectively provided at Pinebush and Clemens Mill, this alternative is not carried forward)

There are several combinations of alternative solutions at the three well fields that enable the Region to meet 2031 supply scenarios for the WTPs. As noted previously, while increased pumping at the Shades Mill well field can provide the required supply for the Shades Mill WTP (SM-3), the much greater distance between the new well at Clyde Park and the WTP make this alternative cost prohibitive compared to options for either the Pinebush and/or Clemens Mill well field(s) and WTPs. Therefore, this alternative solution (SM-3) was not carried forward in the Class EA. Alternative SM-2 is carried forward with pumping at the Tier 3 existing conditions rates for the Shades Mill wells maintained with the connection of well G40, which already has a PTTW.

4.2 Identification of Alternative Solutions for Evaluation

Following the screening described in Section 4.1, the set of alternative solutions shown in Table 6 was developed to help meet projected IUS 2031 supply requirements from wells supplying the WTPs in Cambridge East:

Table 6: Alternative Solutions Identified for Evaluation

Alternative Solutions	
Do Nothing	Use existing wells. Maintain pumping at recent average rates
Upgrades at Existing Sites	2A) Increase supply from existing wells only: Deepened Well G16 (<i>well alternative CM-2 as per Section 4.1.1</i>)
	2B) Increased supply from Pinebush new wells at existing P10 site: P10A, P10B, PBTW1-10 (<i>well alternative PB-2 as per Section 4.1.2</i>)
New wells at New sites	3A) Increased supply from Clemens Mill new well: Cedarbrook well (<i>well alternative CM-3A as per Section 4.1.3</i>)
	3B) Increased supply from Clemens Mill new well: Portuguese Club well (<i>well alternative CM-3B as per Section 4.1.3</i>)

Alternative Solutions	
Upgrades at Existing Sites and New wells at New sites	4) Increase Supply from existing wells (G16) and new wells in Pinebush (P10 site) and Clemens Mill (Cedarbrook Well). (<i>Combination of alternative solutions 2A, 2B and 3A</i>)

A description and evaluation of these alternative solutions is provided in Section 5.0.

5.0 EVALUATION OF ALTERNATIVES

5.1 Evaluation Criteria

The evaluation criteria used to assess the Alternative Solutions is summarized in Table 7.

Table 7: Alternative Solution Evaluation Criteria

Criteria	Description
Technical	<ul style="list-style-type: none"> ■ Water quality suitability ■ Constructability and operation / maintenance requirements ■ Reliability of equipment and processes ■ Approval requirements
Meets Supply Requirement	<ul style="list-style-type: none"> ■ Provides sufficient additional capacity to meet additional 38 L/s average day supply by 2031 ■ Meets objectives of WSMP and WSDOMP
Provides Operational Flexibility	<ul style="list-style-type: none"> ■ Provides flexibility to accommodate well shutdowns and / or higher than expected demands ■ Provides flexibility to shift pumping to different locations in the event of unexpected environmental effects using an adaptive management approach to well operation
Natural Environment	<ul style="list-style-type: none"> ■ Potential effects on groundwater: well interference ■ Potential effects on lakes, streams and wetlands ■ Potential effects on aquatic and terrestrial vegetation and wildlife
Social / Cultural	<ul style="list-style-type: none"> ■ Impact of the proposed construction and operation on the surrounding residents and the public

Criteria	Description
	<ul style="list-style-type: none"> ■ Property acquisition impacts ■ Aesthetic issues of appearance, noise, or odours ■ Traffic Impacts
Cost	<ul style="list-style-type: none"> ■ Estimated costs

The alternatives were assessed in terms of their advantages and disadvantages for each of the evaluation criteria and ranked on a scale from most preferred / least impact to least preferred / greatest impact for each of the evaluation criteria.

5.2 Assessment of Potential Effects

The potential effects were assessed based on comprehensive analyses of all testing and monitoring data and groundwater modelling. The assessment of effects is described in detail in the Hydrogeological and Natural Environment Report (Appendix A) and is summarized in the following sections.

The main pumping tests completed included a 28-day test at a rate increased by 114 L/s and a 15-day test at a rate increased by 72 L/s. Existing wells supplying the system continued to operate under normal pumping conditions during the testing of the additional / new wells. It should be noted that the proposed increase in pumping from the Cambridge East well fields (38 L/s) is about one third of the pumping rate used during the 28-day constant rate pumping test conducted on these wells in 2006. This comparison of increased pumping rates is presented on Figure 8. No measurable effects were observed on Puslinch Lake, wetlands, or nearby creeks, and no adverse effects on private wells were observed during the pumping tests.

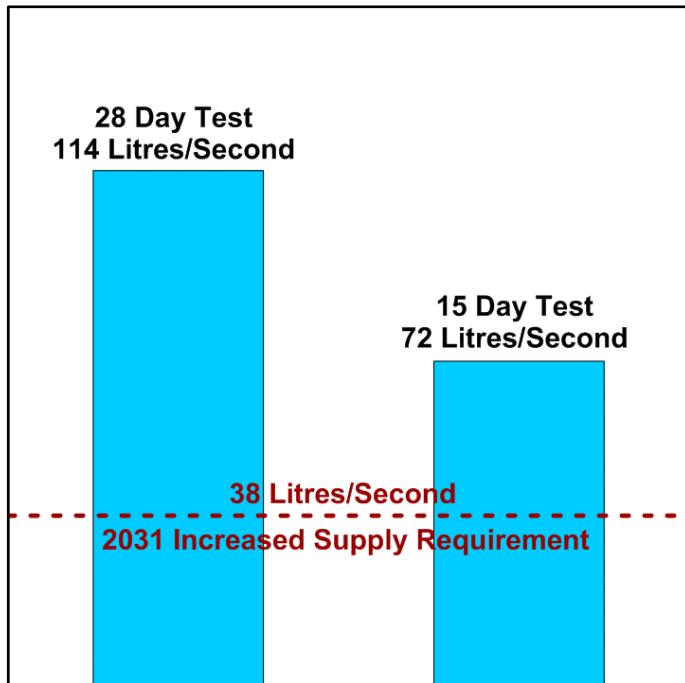


Figure 8: Pumping Test Increased Rates Compared to the 2031 Increased Supply Requirement

The groundwater modelling scenarios that were completed to assess the impacts of future pumping rates included:

- Scenario 1: Existing Wells only (Alternative 2A- with an increase in pumping from deepened well G16);
- Scenario 2: Increase from new Wells in Pinebush (Alternative 2B- new wells P10A, P10B, PBTW1-10); and
- Scenario 3: Increase from new wells in Clemens Mill (Alternative 3A- new Cedarbrook well).

Of the two new wells in the Clemens Mill well field, the Cedarbrook well was more productive than the Portuguese Club well, and was further away from sensitive surface water features, so the Portuguese Club well (alternative solution CM-3B), was not considered in these groundwater modelling simulations.

5.2.1 Potential Well Interference

The assessed future pumping increases are not expected to adversely affect private wells.

The pumping tests completed with the new wells did not affect the use and functioning of existing private supply wells. During the 28-day pumping test in 2006, while drawdowns in groundwater levels were measured in 10 private supply wells, the wells were not adversely affected. Two private wells, one overburden and one bedrock, were monitored during the 15-day pumping test in 2011; no drawdown was observed in these wells during testing.

The simulated drawdowns for the scenarios are presented on Figure 9. The simulated zones of influence from the increased pumping scenarios were more extensive in the deeper (Gasport) Aquifer; however, wells completed in this zone likely have sufficient depth of water column, such that their operation would not be affected by small groundwater level declines.

As shown on Figure 9, the simulated zones of water level decline in the Contact Aquifer were less extensive than in the deeper Aquifer. The majority of the wells completed in this aquifer are deep enough that they would not be impacted by the simulated small declines in groundwater levels. However, shallow wells with a small amount of water available for drawdown within the simulated zone of water level decline in the Contact Aquifer, could be impacted by additional pumping.

Based on the results from the modelling scenarios, simulated groundwater level changes in the Contact Aquifer for Alternative 2A (G16 increase) would be limited to the immediate vicinity of well G16. The simulated zone of influence in the Contact Aquifer for Alternative 2B, with increased pumping in the Pinebush well field, extended to the east of Townline Road and to the western edge of Puslinch Lake. The zone of influence in the Contact Aquifer for Alternative 3A, with increased pumping from the Cedarbrook well, was localized in the vicinity of Portuguese Swamp and extended only slightly east of Townline Road. The simulated scenarios indicated the potential for well interference would primarily be at the properties without municipal servicing in the Township of Puslinch, to the east of Townline Road and west of Puslinch Lake.

5.2.2 Potential Effects on Terrestrial and Aquatic Features

There were no measurable effects observed in the streams, wetlands and creeks that were monitored during the 28-day pumping test in 2006 or the 15-day pumping test in 2011. However, effects on springs and surface water may have been too small to measure or distinguish from natural seasonal variations.

Effects on surface water baseflow simulated by the steady-state model scenarios indicated that surface water effects would primarily occur in the Irish Creek Subwatershed, which includes the following sensitive features: Irish Creek (warm water creek), the Puslinch Lake Wetland Complex and the Portuguese Swamp (provincially significant wetlands).

- The long-term simulated effects on surface water features of increased pumping in the Pinebush area (Alternative 2B) were similar to the effects of increased pumping in the Clemens Mill area (Alternative 3A) and included a simulated reduction in baseflow to Irish Creek (14% reduction) and an increase in net outflow of groundwater from Puslinch Lake (6% increase). The 2031 pumping scenario completed in the Tier 3 Assessment (Alternative 2A), which included increased pumping only from existing well G16, simulated that baseflows in Irish Creek would be reduced by approximately 11% and the net outflow of groundwater from Puslinch Lake would increase by 3%.

The simulated changes in groundwater discharge to Irish Creek are assigned a high level of uncertainty. Limited data are currently available to characterize conditions in Irish Creek. Data on the properties of the streambed of Irish Creek and continuous stream flow data are not

available. Similarly, the modelled changes to the Puslinch Lake water balance also have a high degree of uncertainty, as further described in the groundwater modelling report (Appendix A).

Simulation of long-term pumping increases did not identify significant effects on the Irish Creek baseflow and vertical groundwater gradients and groundwater balance around Puslinch Lake. Irish Creek and Puslinch Lake are not considered coldwater aquatic habitat and therefore, similar to the findings of the Tier 3 Assessment, the minor simulated changes in groundwater discharge may be too small to measure and are not expected to significantly affect aquatic habitat. Long-term operational testing and enhanced monitoring are needed to confirm if effects on surface water features would actually occur with increased pumping.

5.2.3 Source Water Protection Assessment

The Region delineated a set of wellhead protection areas (WHPAs) in 2010 (AQR, 2009) for their existing water supply wells and these WHPAs were included in the Grand River Conservation Authority (GRCA) approved Assessment Report (Lake Erie Source Protection Committee, 2015). Updated WHPAs and vulnerability scoring for the Region's existing water supply wells were completed (Matrix, 2017a and 2017c) and will be included in the future amended Assessment Report and Source Protection Plan. The updated WHPA and vulnerability scoring figures for the Region's existing wells are included in Appendix C (Figures 14c, 18c and 19c from Matrix 2017c).

The implications for landowners located within source protection areas are related to the policy areas in the source protection plan that were developed based on the vulnerability scores for the respective areas. The updated vulnerability score areas, with applicable policies for these scenarios, have been delineated, including the following policy areas:

- Vulnerability of 10 (red on Figures in Appendix C). These are areas where chemical handling including fuel, certain industrial chemicals and wastes policies will require spill containment and implementation of response measures. Also, within these areas, salting of parking lots will be required to be conducted in accordance with right time / right place / right amount principles; and
- Vulnerability of 8 (orange on Figures in Appendix C). These are areas where handling of certain industrial chemicals and wastes will require spill containment and implementation of response measures.
- For WHPA-A, WHPA-B and WHPA-C (on Figures in Appendix C), handling of Dense Non-Aqueous Phase Liquids (DNAPL) will require a risk management plan, including spill containment and response measures. For existing uses within the Region of Waterloo, a risk management plan will only be required where the vulnerability is 8 or 10.
- In WHPA-A areas, DNAPL handling will be prohibited for future uses. Within the Region of Waterloo only, DNAPL handling will also be prohibited in WHPA-B for future uses where the vulnerability is equal to 10 and will also be prohibited for existing uses within WHPA-A areas.

Effects of EA Alternatives on Source Water Protection Policy Areas

To assess the implications for source water protection of pumping from new wells in the Cambridge East EA area, a series of wellhead protection areas were delineated for the Class EA alternative solutions (Matrix, 2017b).

Figure C1 in Appendix C shows a comparison of the extent of these areas between the various scenarios. It is apparent that there is little difference in the source protection policy implications between Alternative Solutions 2B and 3A, which include pumping from new wells, and the current protection areas. This is due to the fact that the areas are largely influenced by the intrinsic vulnerability of the aquifers, which doesn't change between the different pumping scenarios. Intrinsic aquifer vulnerability describes the degree of natural protection of groundwater from contamination due to the physical characteristics of the land and subsurface.

Prior to implementation of the Preferred Alternative Solution, final WHPAs and vulnerability scoring will need to be completed for inclusion in an updated Assessment Report and Source Protection Plan taking into account new wells and proposed pumping increases.

5.2.4 Climate Change

Climate change and the increased frequency of extreme weather events such as droughts need to be taken into account in the long-term planning of water supply systems. To mitigate and reduce vulnerability to climate change, a system with multiple supply sources, including sources such as deep productive groundwater aquifers that are less sensitive to short-term climate variability, are preferable. As part of the Tier 3 Assessment, the Region's existing wells were assessed for their ability to meet future demands under drought conditions. The Cambridge East wells were completed in the deep Aquifer, have sufficient available drawdown, and can be expected to accommodate future drought conditions.

Extreme weather events and climate variability have a more direct affect on the lakes, streams and wetlands that are heavily influenced by precipitation and evapotranspiration. Enhanced long-term monitoring of surface water and groundwater features is needed to better understand the effects of climate change and to better separate the effects of climate from the effects of pumping changes.

The Region is leading the development of a Community Climate Adaptation Plan to assess local vulnerability and risks to climate change and extreme weather events. The plan will also encourage community collaboration to help reduce the severity or likelihood of these risks. The Region also has a corporate greenhouse gas emissions action plan. The plan has a target to reduce corporate greenhouse gas emissions by 10 per cent below 2009 levels by 2019.

5.2.5 Conceptual Level Cost

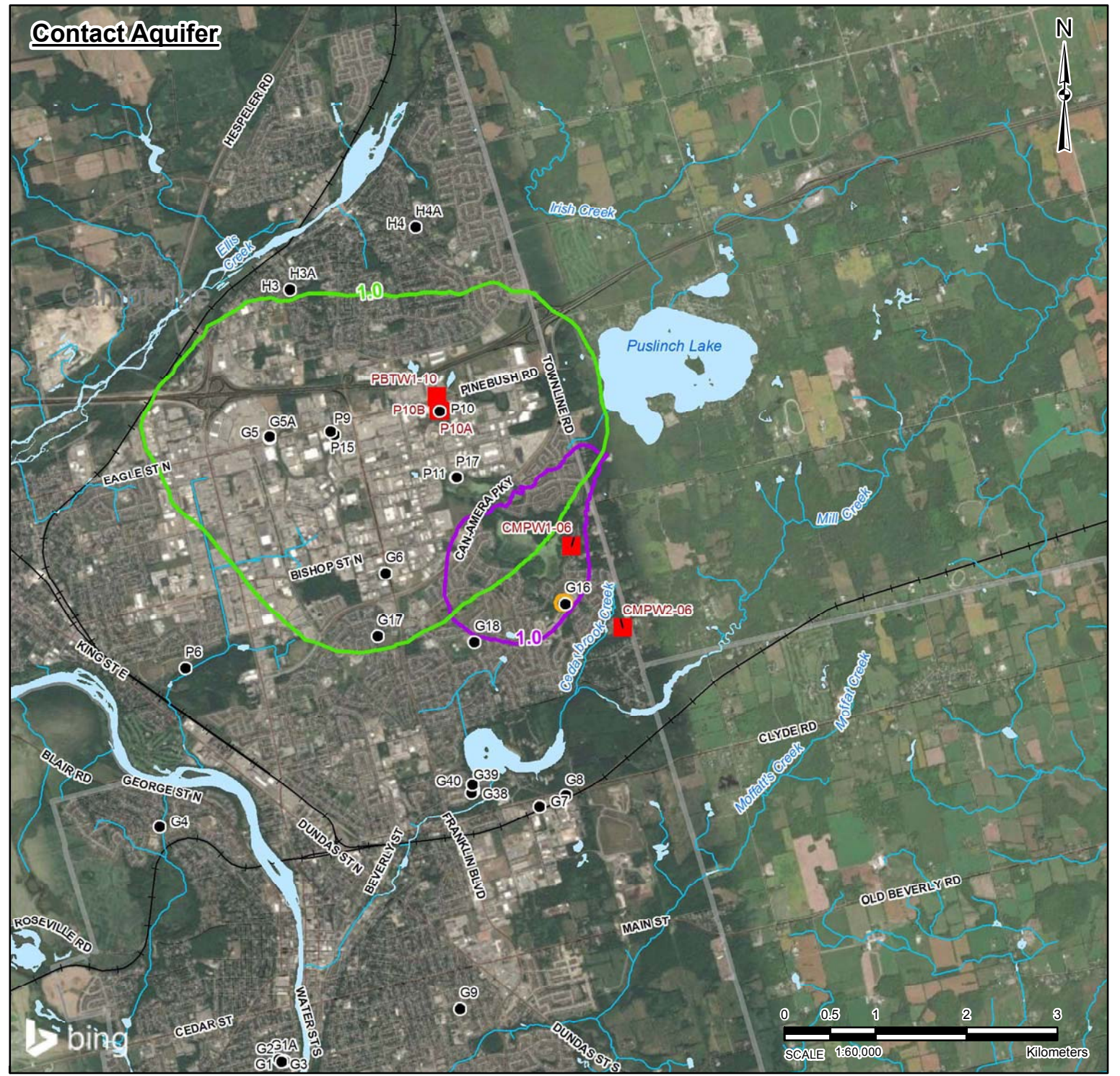
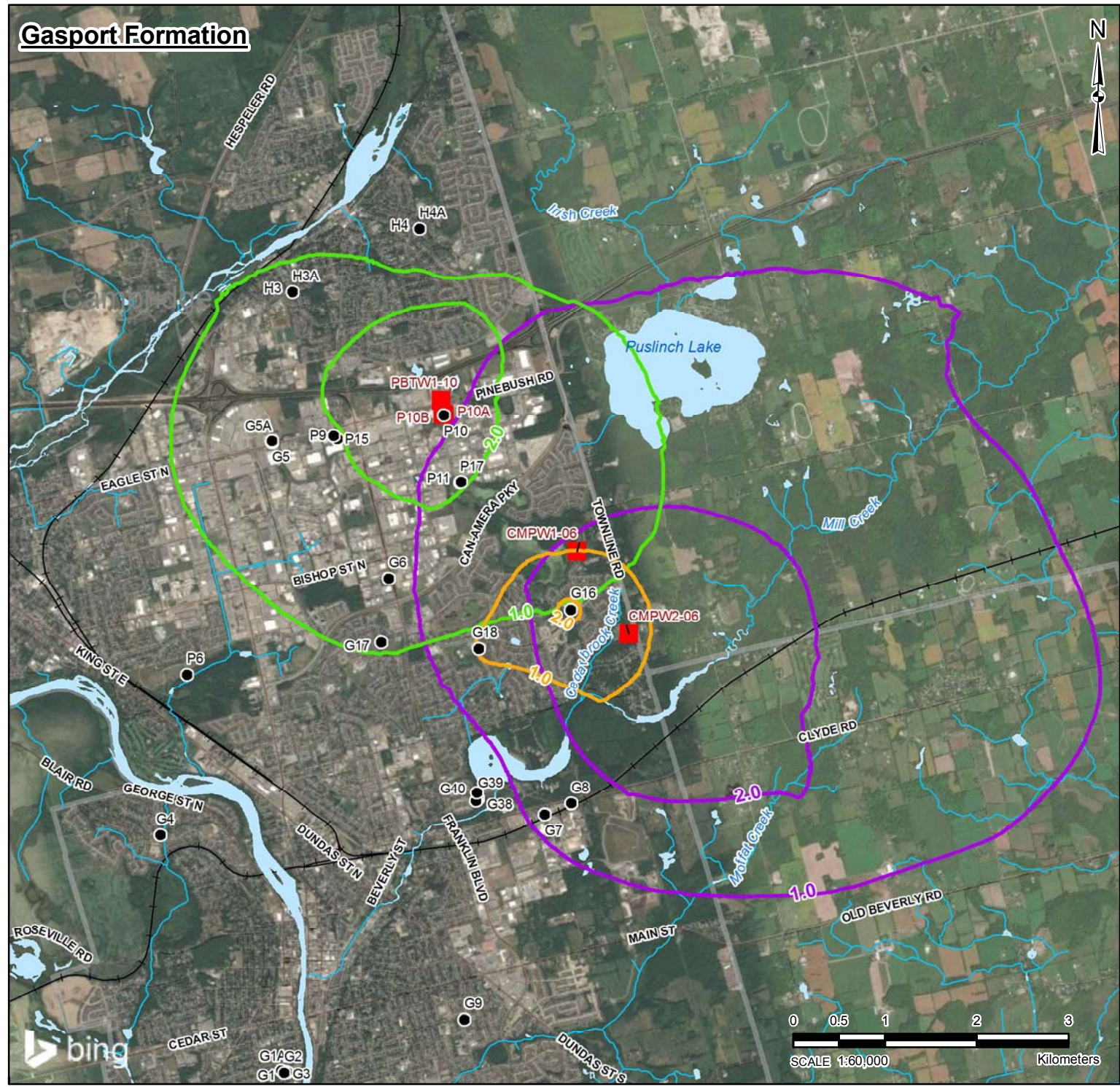
Conceptual level capital costs have been estimated for alternatives and are shown in Table 8.

These costs have been estimated on a conceptual level of design only and are provided in a range including 20 to 50% estimating contingency. For the new well site Alternatives 3A, 3B and 4, the costs include construction of a well house and costs to construct watermain /

connections to the existing watermain on Townline Road and watermain construction / replacement costs along Saginaw Parkway to convey the water to the WTP. The costing assumptions are outlined in more detail in a technical memo prepared by Triton (2018).

Table 8: Conceptual Level Cost Estimate of Alternatives

Alternative Solution	Conceptual Level Cost Estimate for Capital Costs
Alternative 1: Do Nothing	No Cost
Alternative 2A: Increased Supply from Deepened Well G16	Minimal
Alternative 2B: Increased supply from Pinebush new wells at existing site: P10A, P10B, PBTW1-10	<\$500,000
Alternative 3A: Increased supply from Clemens Mill new well: Cedarbrook well	\$3M to \$5M
Alternative 3B: Increased supply from Clemens Mill new well: Portuguese Club well	\$4M to \$5.5M
Alternative 4: Increase Supply from existing wells (G16) and new wells in Pinebush (P10 site) and Clemens Mill (Cedarbrook Well).	\$4M to \$6M



- LEGEND**
- Municipal Supply Well
 - Scenario 1 (Alternative 2A)
 - Scenario 2 (Alternative 2B)
 - Scenario 3 (Alternative 3A)
 - Test Production Wells
 - Waterbody
 - Watercourse
 - Railway

REFERENCE
 Base Data - MNRF LIO obtained 2016
 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources and Forestry, © Queens Printer 2016
 Datum: NAD 83 Projection: UTM Zone 17N

PROJECT		CAMBRIDGE EAST WATER SUPPLY CLASS ENVIRONMENTAL ASSESSMENT	
TITLE		MODELLED EXTENT OF DRAWDOWN	
PROJECT No. 05-1112-010		SCALE AS SHOWN	REV. 0.0
		DESIGN PR 2 Feb. 2017	FIGURE: 9
		GIS PR 12 Apr. 2018	
		CHECK JLH 12 Apr. 2018	
		REVIEW JAP 12 Apr. 2018	

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5.3 Evaluation of Alternatives

The alternative solutions were each evaluated following the criteria and methods described in Section 5.1 to determine its advantage and disadvantages and taking into consideration its effects on the natural, social, cultural, and economic environments and technical considerations. The results of these evaluations were used to help determine the preferred alternative solution for the Cambridge East Study Area.

Figure 10 provides a summary of the evaluations completed for each alternative solution.

Alternative Solutions	Technical	*Meets Supply Requirement	*Provides Operational Flexibility	Natural Environment	Social / Cultural	Cost	Ranking
1) Do Nothing							5
2A) Increase supply from existing wells only: deepened well G16							4
2B) Increase supply from Pinebush new wells at existing site: P10A, P10B, PBTW1-10							2
3A) Increase supply from Clemens Mill new well: Cedarbrook							3
3B) Increase supply from Clemens Mill new well: Portuguese Club							6
4) Increase supply from existing wells (G16) and new wells in Pinebush (P10 Site) and Clemens Mill (Cedarbrook well). (Combine solutions 2A, 2B & 3A)							1 Preferred Solution

Most Preferred ----- Least Impact				Least Preferred ----- Greatest Impact
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Figure 10: Evaluation of Alternative Solutions

The evaluations of each alternative solution are described in the following sections.

5.3.1 Alternative 1: Do Nothing

The Do Nothing option would consist of continuing to pump the existing wells at the recent average (existing conditions) rates. There would be no additional cost or effects to the environment; however, this does not meet the objective of the WSMP and WSDOMP to increase use of the Cambridge East WTPs and does not provide any additional water supply for future growth.

5.3.2 Alternative 2: Upgrades at Existing Sites:

5.3.2.1 Alternative 2A: Increase supply from existing wells only: Deepened Well G16

For this alternative solution optimized pumping rates were used for the existing wells in Cambridge East, including an additional 18 L/s from existing wells supplying the Cambridge East WTPs. These rates represented only one possible set of rates that could be used across the IUS. The increase in pumping was supplied by deepened well G16 in this case. The remaining additional water (20 L/s for a total of 38 L/s) needed in Cambridge to help meet the 2031 demands, would need to be supplied by wells located elsewhere in Cambridge. This results in a total average day supply of 205 L/s for the three Cambridge East WTPs.

Although this increased pumping from well G16 would help to meet the overall IUS 2031 supply requirements, it would not meet the objectives of the WSMP and WSDOMP, which recommended increased utilization of the Cambridge East WTPs existing capacity due to their optimal locations on the east side of Cambridge, as discussed previously.

As mentioned previously, existing well G18 is located on the Clemens Mill Public School property, not Region owned land, and this site may not continue to be suitable / accessible in the long term. This potential situation could further reduce the supply to the WTP if existing wells alone are relied upon, which is a disadvantage of this alternative. Also although this alternative provides some additional water for the Turnbull WTP, it does not provide additional water for the Pinebush WTP.

This alternative is low cost since the well has already been deepened and the infrastructure is in place. However, there would still be costs to obtain additional supply capacity elsewhere to meet the supply requirements.

For Alternative 2A, the predicted groundwater level declines in the Contact Aquifer were limited to the immediate vicinity of well G16. This area is municipally serviced. The modelling of long-term effects simulated some minor reductions in baseflows in Irish Creek and groundwater discharge to Puslinch Lake; however, adverse impacts to these features are not expected. If any impacts are observed through long-term monitoring, they could be mitigated as discussed in Section 6.0. Since the pumping increase is lower and well G16 is further away from these surface water features, the likelihood of environmental effects is lower for this alternative relative to alternatives 2B, 3A and 3B.

5.3.2.2 Alternative 2B: Increased supply from Pinebush new wells at existing site: P10A, P10B, PBTW1-10

A combined sustainable capacity of 126 L/s was identified from wells P10A, P10B and P11/P17 and new well PBTW1-10 to meet the capacity of the Pinebush WTP. This alternative included a slightly reduced pumping rate from shallower well P10B (replacement for P10) and increased pumping from deeper wells P10A and PBTW1-10. This alternative can provide an additional 38 L/s to meet the 2031 supply requirements from the Pinebush WTP.

With the increased pumping in the Pinebush well field for Alternative 2B, model simulations suggest there will be more extensive groundwater drawdown in the Contact Aquifer relative to Alternative 2A. The predicted drawdown for Alternative 2B extends to the east of Townline Road and to the western edge of Puslinch Lake; however, effects will be negligible on the eastern side of the lake. Adverse effects to private wells and surface water features are not expected. The simulated long-term effects on Irish Creek and Puslinch Lake were slightly greater for this Alternative than for Alternative 2A. Adverse impacts to the surface features are not expected and if any impacts are observed through long-term monitoring they could be mitigated, as discussed in Section 6.0.

The addition of deep Aquifer wells P10A and PBTW1-10 allow for reduced reliance on pumping from shallower well P10B, which is an advantage for this Alternative as the deep Aquifer is less connected to the shallow surface water features.

The wells are already constructed and this alternative would involve outfitting the wells with pumping equipment and connecting the wells to convey water to the WTP. The estimated conceptual level costs for this alternative are less than \$500,000, which is considerably less than the costs associated with new wells at new sites (Clemens Mill Alternatives 3A and 3B) since these Pinebush wells are located on Region property at the existing P10 well site and the Pinebush WTP site.

5.3.3 Alternative 3: New wells at New Sites:

5.3.3.1 Alternative 3A: Increased supply from Clemens Mill new well: Cedarbrook well

The Cedarbrook well was tested at a rate of 38 L/s and the testing and modelling showed that this rate was sustainable over the long term. This alternative can provide an additional 38 L/s to meet the 2031 supply requirements from the Clemens Mill WTP. However, this alternative alone does not provide any additional capacity to the Pinebush WTP.

As previously described in Section 4.0, the Cedarbrook well draws water from a deeper and more confined aquifer zone, is further from sensitive features (i.e., Puslinch Lake and Portuguese Bog) and has a greater capacity than the Portuguese Club well Alternative 3B. Therefore Alternative 3A is preferable over 3B based on the technical and environmental criteria. It is also slightly preferable over the Pinebush Alternative 2B in terms of potential environmental impacts since the Cedarbrook well is further away from Puslinch Lake and Irish Creek and pumps from a confined zone in the deep Aquifer. The simulated drawdown in the Contact Aquifer was less extensive from the Cedarbrook well Alternative 3A increase, relative to the Pinebush Alternative 2B increase, as shown on Figure 9. The long-term simulated

changes in the Puslinch Lake and Irish Creek water balance were similar for Alternatives 2B and 3A, since these alternatives involve the same amount of increased pumping (38 L/s).

Also mentioned previously, existing well G18 is located on the Clemens Mill Public School property, not Region owned land, and this site may not continue to be suitable / accessible in the long term. Due to this potential situation a new well site / additional source in the Clemens Mill well field is an advantage in terms of providing operational flexibility and meeting the objectives of the WSMP and WSDOMP.

The Cedarbrook well would need a well house and watermain connections from the well to the existing watermain on Townline Road and watermain construction / replacement from Townline Road to well G16 along Saginaw Parkway. The conceptual level cost estimate for this work is \$3.0 million to \$5.0 million, which is significantly more expensive than Pinebush Alternative 2B, but less expensive than the Portuguese Club well Alternative 3B.

5.3.3.2 Alternative 3B: Increased supply from Clemens Mill new well: Portuguese Club well

The Portuguese Club well was tested at a rate of 38 L/s and the testing and modelling showed that this rate was sustainable over the long term. This alternative can provide an additional 38 L/s to meet the 2031 supply requirements from the Clemens Mill WTP. Similarly to the Cedarbrook well Alternative 3A, this alternative alone does not provide any additional capacity to the Pinebush WTP.

The Portuguese Club well has a lower specific capacity that the Cedarbrook well, is closer to Puslinch Lake and Irish Creek and was found during testing to be more hydraulically connected to the shallow bedrock Aquifer than the Cedarbrook well. Therefore, Alternative 3B is less preferred than Alternative 3A in terms of technical and environmental considerations.

The Portuguese Club well is the only Alternative located on private land and agreements would need to be arranged with the land owner for this well to be used for municipal supply, which is a disadvantage for this alternative.

The Portuguese Club well would need a well house and watermain connections from the well to the existing watermain on Townline Road and watermain construction / replacement from Townline Road to well G16 along Saginaw Parkway. The conceptual level cost estimate for this work is \$4.0 million to \$5.5 million, which is significantly more expensive than Pinebush Alternative 2B. This alternative is slightly more expensive than the Cedarbrook well Alternative 3A, due primarily to a greater watermain distance required.

5.3.4 Alternative 4: Increase Supply from existing wells (G16) and new wells in Pinebush (P10 Site) and Clemens Mill (Cedarbrook Well).

This alternative solution involves a combination of the three best ranking individual alternatives including:

- **Alternative 2A:** Increase supply from existing wells only: Deepened Well G16;
- **Alternative 2B:** Increased supply from Pinebush new wells at existing site: P10A, P10B, PBTW1-10; and

- **Alternative 3A:** Increased supply from Clemens Mill new well: Cedarbrook well.

Alternative 4 can provide an additional total of 38 L/s to meet the 2031 supply requirements from either the Pinebush WTP or the Clemens Mill WTP. Although this solution has a higher cost, it best meets the objectives of the WSMP and WSDOMP, providing operational flexibility to meet the 2031 additional supply requirements from the Pinebush and Clemens Mill WTPs and to shift takings between wells if monitoring shows potential for environmental impacts. Alternative 4 has been selected as the preferred solution, as further described in Section 5.4, taking into account input received during the public consultation program.

5.4 Preferred Solution

The Recommended Preferred Solution is:

Alternative 4: Increase supply from existing wells (G16), new wells in Pinebush (existing P10 site) and Clemens Mill (Cedarbrook well)

The reasons for selecting this Preferred Solution are summarized as follows:

- Provides good quality groundwater from multiple additional deep bedrock aquifer sources with low degree of interaction with surface water features;
- Meets the water supply requirement for increase of 38 L/s by 2031 from both the Pinebush and the Clemens Mill WTPs;
- Provides greater operational flexibility;
- Provides flexibility for pumping between wells if monitoring shows potential impacts;
- Although this option has the greatest estimated conceptual cost (\$4 million to \$6 million), it ranks better in terms of the other criteria for the reasons listed above; and
- To ensure sustainability of the Preferred Solution this requires an expanded monitoring network and the development of environmental thresholds and an adaptive management plan, as is further described in Section 6.0.

6.0 RECOMMENDED MONITORING AND MITIGATION

6.1 Monitoring Program

Earlier in the Class EA process, it was recommended that the Region incorporate the following IUS monitoring locations into their ongoing groundwater monitoring program (GMP): PBOW1-06, PBOW2-06, CMOW1-06, CMOW2-06 and PLOW1-06. These locations, as well as other monitoring wells, have since been added into the GMP, as listed in Table 9. This table shows the monitoring wells currently required to be monitored as part of the Region's PTTWs, as well as on-going monitoring at other nearby wells that are recommended to be included in a long-term monitoring program associated with the operational testing and an adaptive management program. These monitoring locations are shown on Figure 6.

Table 9: Recommended Monitoring Locations

Well Field	Monthly Water Level Currently Required by PTTW	Wells Currently being Monitored by Region. (Potential Additions to Long Term Monitoring Program)
Pinebush	OW1-92, OW3-95, PBOW1B-08, G5-TW2-08, PBOW1-11, PBOW1-13	PBOW1-06, PBOW2-06, PLOW1-06, P10-TW1-09, OW5-94, LWL (Puslinch Lake), P10, P11, P17
Clemens Mill	OW4-92, OW6-94, CMOW3-06, CMOW1-10, CMOW2-10	CMOW1-06, CMOW2-06, CMTW3-05, CMOW1-15
Shades Mill	SM1A-02, SM3-07, SMOW1-11, SMOW4A-14, SMOW5A-14	SMTW1-05, NDTW1-08, SMOW1-14, SMOW2-14, SMOW3-14

In addition to these wells, monitoring has been on-going at Puslinch Township wells TW9-78, TW10-78 and MW09-T3-01.

The following are general recommendations for enhancement of the long-term monitoring program:

- On-going groundwater level monitoring is limited to the area west of Puslinch Lake. Additional monitoring wells are recommended to the east of the lake to better define groundwater gradients and monitoring of groundwater level changes in this area, as follows:
 - A multi-level deep monitoring well nest should be installed near Irish Creek north of Puslinch Lake.
 - An additional multi-level deep monitoring well nest should be installed to the northeast/east of Puslinch Lake.
 - Additional shallow overburden monitoring wells and mini-piezometers should be installed in accessible locations in the vicinity of the Puslinch Lake shoreline.
 - A deep monitoring well nest should be installed further east of PB-OW1-06 along Concession 1, in the vicinity of Mill Creek, to better define the eastern limits of the zone of influence of the pumping.
- Shallow overburden wells and a mini-piezometer are recommended east of CM-OW2-06 along Gore Road in the vicinity of Mill Creek.
- Water levels in Puslinch Lake should be monitored at a higher frequency (datalogger for continuous measurement during ice-free conditions).

- A stream gauging station is recommended on Irish Creek for continuous flow gauging, during ice-free conditions.
- Additional spot baseflow measurements are recommended for Irish Creek.
- Mini-piezometers are recommended to be installed adjacent to Irish Creek to assess shallow groundwater gradients.
- Monitoring of existing mini-piezometers at Cedarbrook Creek should be included in the program.

A detailed monitoring program considering the above recommendations should be developed prior to permitting new wells as part of an operational testing and adaptive management program.

6.2 Well Interference Policy

The proposed pumping increase is not expected to cause adverse effects on private wells.

If pumping from the municipal wells negatively affects private wells the Region is required, as per Regional Council's approved well interference policy and as a condition of the Region's PTTWs, to respond to and address well interference complaints. Procedures could include provision of temporary water supply, investigation of well complaint, lowering of pump in a well to increase the amount of available water column, or installation of a replacement well (ROW, 2015). The Region's well interference policy can be found on their website at www.regionofwaterloo.ca/protectwater.

Figure 11 shows the proposed revised well interference Policy Areas taking into account the new wells. Although impacts to private wells are not expected from the increased taking, an enhanced level of response will be given to any well complaints within these policy areas.



Figure 11: Proposed Well Interference Policy Area

6.3 Operational Testing and Adaptive Management

Long-term operational testing with enhanced monitoring is needed to confirm the results of the pumping tests and the model simulations. Prior to permitting of the new wells carried forward in this Class EA (i.e., P10A, P10B, PBTW1-10 and Cedarbrook well), it is recommended that an operational testing and adaptive management plan be developed. The adaptive management plan should provide a framework for assessing the environmental effects of the well field operation and provide a mechanism for making adjustments based on the results of long-term operational testing and monitoring.

To ensure that the optimized pumping rates are sustainable, an operational testing program should be developed, which is recommended to include the following steps:

- Continue pumping of only the existing wells with expanded monitoring to collect baseline data for several years;
- Increase pumping from new wells at existing well sites (P10A, P10B and PBTW1-10); and
- Increase pumping from new wells at existing well sites (P10A, P10B and PBTW1-10) and new Cedarbrook well site.

After each step, a report will be completed with an updated adaptive management plan. Quarterly data reports at key monitoring locations will also be completed.

The reports will be available to the public and will be provided to the Township of Puslinch.

This program would allow for pumping over a longer period than the pumping tests completed to date, with the water supplied to the WTPs. The pumping period could be on the order of 3 to 5 years, during which existing and new wells would be pumped in configurations similar to the scenarios assessed in this Class EA. The total supply increase of 38 L/s is not required until the year 2031 and the Region would have the flexibility to gradually increase the takings in the period leading up to this time.

The adaptive management plan could be developed in detail, documented and referenced as a condition of the Region's PTTW as has been done in at other municipal well fields in Ontario.

7.0 CONSULTATION AND COMMUNICATIONS

This section provides a summary of the project consultation and communications program with additional documentation materials provided in Appendix D.

7.1 Stakeholder Contact List and Project Website

A stakeholder contact list was developed and maintained throughout the project. The list included government agencies, First Nations, groups and individuals that could be impacted or have interest in alternatives, potential stakeholders and those who expressed interest in the Study through consultation with the Region. The list was continuously updated throughout the

project as requests from the public were received. Lists of stakeholder contacts as developed through the project are provided in Appendix D. The main review agencies included were:

- The Ontario Ministry of the Environment, Conservation and Parks (MECP);
- The Grand River Conservation Authority;
- The Township of Puslinch;
- The Ministry of Natural Resources and Forestry;
- First Nations including: Six Nations, Six Nations of the Grand River, Haudenosaunee Development Institute, Credit First Nation, Mississauga of the New Credit First Nation Department of Consultation and Accommodation;
- Ontario Ministry of Agriculture, Food and Rural Affairs;
- Ministry of Tourism, Culture and Sport; and
- Wellington County Source Water Protection Risk Management Official.

Notices, Public Consultation Centre (PCC) materials and project publications were made available on the Region of Waterloo's website at www.regionofwaterloo.ca/water.

7.2 Notices

7.2.1 Notice of Commencement

The Notice of Commencement was mailed to stakeholders and published in the Waterloo Region Record Newspaper on April 22, 2005. A copy of the notice is provided in Appendix D.

7.2.2 Notice of Public Consultations

A total of three PCC meetings were held as part of the Class EA. For these PCC meetings notices were mailed to stakeholders, they were advertised through newspapers and were posted on the Region's website. Copies of these notices can be found in Appendix D.

7.2.3 Notice of Completion

The Notice of Completion of the Project File Report will be mailed to stakeholders, published in newspapers and posted on the Region website upon completion of this report. The 30-day public review period will commence on the day the Notice is advertised in the Wellington Advertiser Newspaper.

7.3 Public Consultation Centres

Three EA PCC meetings were held as part of this project and the presentation materials, participant sign in sheets and input/comment sheets from the meetings are included in Appendix D. The meetings are summarized in the sections that follow.

7.3.1 Public Consultation Centre #1

The first Public Consultation Centre meeting for the project was held on May 5, 2009 at the Grand River Conservation Authority headquarters located at 400 Clyde Road in Cambridge. The meeting included presentation of the problem statement, the project progress, the results

of the testing programs completed between 2005 and 2009 and to outline additional project tasks planned to be completed.

7.3.2 Public Consultation Centre #2

The second PCC was held on December 5, 2016 at the Grand River Conservation Authority headquarters located at 400 Clyde Road in Cambridge. The Class EA had been put on hold since the 2009 PCC meeting to allow for the completion of the Region's Water Supply Master Plan. The Class EA resumed, and this meeting was scheduled to update stakeholders on the progress of the project, including background studies and remaining tasks.

7.3.3 Public Consultation Centre #3

The third PCC was held on November 2, 2017 at the Portuguese Club of Cambridge. This PCC provided an evaluation of options and the proposed recommended solution to utilize existing and new wells for the long-term supply of water in Cambridge East.

7.4 Additional Consultation and Meetings

Throughout the course of the project additional information and consultation meetings were held with residents.

This included a series of three meetings with residents to present the methods and results of the project pumping tests and receive comments and input from the public on the testing programs. These meetings are described in more detail in the Hydrogeological and Natural Environment Report and are summarized as follows:

- **Test Production Well Program - Public Meeting July 2006.** This meeting was held at the Clifford Evans Training Centre in Puslinch on July 6, 2006 and attended by about 100 residents. Representatives from the Region presented an overview of the IUS water supply program and the background to municipal groundwater pumping in the Cambridge East area. Representatives from Golder presented details of the program including the rationale for the monitoring well nests that were then being installed in Puslinch, the monitoring program that included extensive monitoring of water levels in private wells and environmentally sensitive areas (ESAs) and the planned 28-day pumping test of the three test production wells located in Cambridge East.
- **Results from Long-Term Pumping Test - Public Meeting January 2007.** This meeting was held on January 29, 2007 at the Clifford Evans Training Centre and attended by about 50 residents (see Appendix A for list of attendees). The monitoring results from the long-term testing program were presented on a number of graphs from representative monitoring locations across the Study Area.
- **North Dumfries Groundwater Investigation - Public Meeting September 2008.** Prior to drilling and testing of wells in North Dumfries, a public meeting was held on September 11, 2008. The meeting was held at Clyde Park to inform residents of the testing program and to answer questions.
- In February 2017, a meeting was held with the Region, Golder, Stan Denhoed of Harden Environmental and members of the Puslinch Lake Conservation Association (PLCA) to

review information and observations from lake dredging activities being carried out by PLCA for incorporation into the assessment and the Hydrogeological and Natural Environment report.

Some people who attended the project PCC2 meeting indicated that they would like to participate in a separate meeting for Puslinch residents where a formal presentation was given, followed by a question and answer period, instead of the PCC “Open House” format with display boards and one on one discussion. In consultation with the Township of Puslinch, a series of meetings with Puslinch residents were scheduled as described below:

- **Puslinch Residents Meetings June 2017.** Information meetings were held for residents of Puslinch that live in the area around Puslinch Lake bounded by Townline Road, Gore Road, and Wellington County Roads 34 and 35. This area was recommended to the Region by the Township of Puslinch. Property owners within this area and people who were previously on the project contact list were notified of the meeting. Three 90-minute meetings were held on June 13 and attended by a total of 59 people, allowing more time to answer questions from residents.

Throughout the course of the project, additional meetings were held with the Township of Puslinch, GRCA, Centre Wellington Source Protection and MECP. Correspondence with these and other agencies is included in Appendix D.

7.5 Incorporating Consultation Feedback

The comments and input received during the course of the project are provided in Appendix D, along with the project team responses to questions. This includes the following key materials:

- Handout documents and presentations providing information and responses to key questions raised by stakeholders.
 - July 2006 public meeting;
 - January 2007 public meeting; and
 - September 2008 public meeting.
- Handout documents and presentations provided with responses to key questions stakeholders had raised during the public consultation centre periods.
 - PPC#1 - May 2009;
 - PPC#2 - December 2016; and
 - PPC#3 - November 2017.
- Handout documents and presentations provided during the three residents’ meetings held in June 2017. Meeting minutes documenting the responses to questions raised at the meetings.
- A response to July 17, 2017 letter from Harden Environmental addressing summarized public concerns and questions posed by Harden on behalf of the Township of Puslinch.
- Specific responses to individual and agency comments provided during the Public Consultation Centre periods.

The following summarizes key input that was incorporated into the development and implementation of the testing program:

- The Township of Puslinch provided input on the selection of private water wells for inclusion in the monitoring plan that was expanded to include locations at distances of more than 1 km from the test pumping wells;
- Contingency plans for possible disruption to well water supplies were augmented and communicated; this included a clear protocol for an emergency response contact and for the timely provision of water;
- Since the discharge of pumped water within the watershed could compromise monitoring of the elevation of the water table at environmentally sensitive areas and shallow water wells, the pumped water was discharged outside the watershed;
- The public was concerned that the testing program might impact water levels in Puslinch Lake, environmentally sensitive areas, wetlands, Mill Creek and constructed ponds;
- Regular updates of water level monitoring data obtained during the pumping test were provided to the Township of Puslinch and private well owners during the testing;
- Water level monitoring data from private wells obtained during the pumping test was provided to the private well owners after completion of the testing;
- An overview of the testing program was documented and made available to local residents who could not attend the resident's meeting; and
- A follow-up meeting was held in January 2007 to present the results of the testing program.

The following activities were completed to address these concerns:

- Two site visits were conducted with the Township of Puslinch's hydrogeologist, Mr. Stan Denhoed, (July 28 and August 17, 2006) to select additional locations for inclusion in the monitoring program; including private wells, existing monitoring wells, a location adjacent to Hilborn Pond and two locations immediately adjacent to Puslinch Lake, were identified for the installation of shallow monitoring well nests. Discussions addressed the following: private wells preferred for the installation of data loggers; installation of staff gauges at private ponds, and Puslinch and Little Lakes; private wells that potentially would be most at risk during the pumping test; provision of emergency water supplies; locations for the discharge of pumped water and provision of regular updates of the water level monitoring data during testing;
- A detailed contingency plan was developed. The Region's emergency call centre number was provided to all residences served with a private water well located within 1 km of the test pumping wells. A water supply contractor was retained to provide water on an emergency basis to any residents whose well water supply was disrupted during the test. Also, five nearby residences with shallow (<10 m deep) water wells were visited and offered the installation of a temporary water storage tank to facilitate the timely provision of

an emergency water supply if requested. Only two residents felt this measure was warranted. No calls were received at the emergency call centre in relation to the pumping test program.

- The plan for the discharge of pumped water was modified as follows:
 - For CMPW2-06, discharge water was piped to the storm sewer at Saginaw Parkway that in turn reported to Hilborn Pond, with overflow to Cedarbrook Creek, a tributary of Mill Creek;
 - For PBPW1-06, discharge water was directed to the sanitary sewer system;
 - For CMPW1-06, discharge water was directed to Hilborn Pond as per the original plan;
 - The monitoring program for Cedarbrook Creek was enhanced to ensure that the combined discharge from two test wells did not compromise fish habitat; and
 - The program included considerable monitoring in the vicinity of environmentally sensitive areas including at eight wetland transects for monitoring of water levels and vegetation stress. The program was expanded to include additional private wells, additional monitoring wells nests installed at three key locations, staff gauges installed in private ponds and extensive use of data loggers to collect water level measurements.
- A Question and Answer handout was prepared and provided to the Township of Puslinch Office for local distribution. This handout contained responses to a number of concerns expressed at the residents' meeting, including an overview of the revised monitoring program, the process for addressing water supply disruptions and advising of the provision of water level monitoring data from representative locations during the testing program.

The following provides a summary of key input received from stakeholders and incorporated into the identification and selection of the preferred solution and the monitoring and mitigation plans:

- Test well sites in close proximity to clusters of private wells and environmental features were avoided and screened out from being carried forward in the Class EA where possible (e.g., the highly productive Witmer Park well (PBPW1-06) and test well PBTW1-05).
- The project was put on hold to allow completion of the WSMP and WSDOMP to ensure a clear justification of the need for the additional water supply in the Cambridge East Area.
- The Region carried out additional projects to optimize water takings at existing sites and avoid moving to new areas where possible.
- Producing zones were targeted in the deep Aquifer to allow pumping to be shifted deeper where there is less potential for connection / interaction with surficial environmental features and shallow private wells.
- The recommended preferred solution includes multiple sources to give flexibility for pumping to be shifted between wells if monitoring shows potential impacts.

- The recommended preferred solution was selected to provide groundwater from multiple additional deep bedrock aquifer sources with a lower degree of interaction with surface water features and shallow private wells;
- The recommended monitoring program was expanded based on input from residents and from the Township of Puslinch's hydrogeologist;
- An adaptive management type approach was proposed to provide a framework for assessing the environmental effects of the well field operation and to provide a mechanism for making adjustments based on the results of long-term operational testing and monitoring;
- For improved communication with the public, monitoring reports will be completed every two years with an updated adaptive management plan. This will include recommended monitoring thresholds and refinements to the adaptive management plan. Quarterly data reports at key monitoring locations will also be completed. The reports will be available to the public and will be provided to the Township of Puslinch;
- Residents in the immediate vicinity of the new well sites will be consulted further during the detailed design phase of the project when specifics on the construction scheduling and well house design details have been developed; and
- The Region's well interference policy was updated to include areas outside of the Region of Waterloo. Draft revised Well Interference Policy Areas were provided at PCC3, including areas delineated in Cambridge and the Township of Puslinch, where an enhanced level of response will be provided should a well complaint occur.

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Signature Page

Golder Associates Ltd.



Jennifer Hancox, M.Sc., P.Geo.
Hydrogeologist



John Piersol, M.Sc., P.Geo.
Associate, Senior Hydrogeologist

JH/JP/img/mp

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