County of Brant

FINAL
ST. GEORGE WATER SERVICING ENVIRONMENTAL STUDY REPORT SCHEDULE C CLASS ENVIRONMENTAL ASSESSMENT STUDY

VOLUME 1

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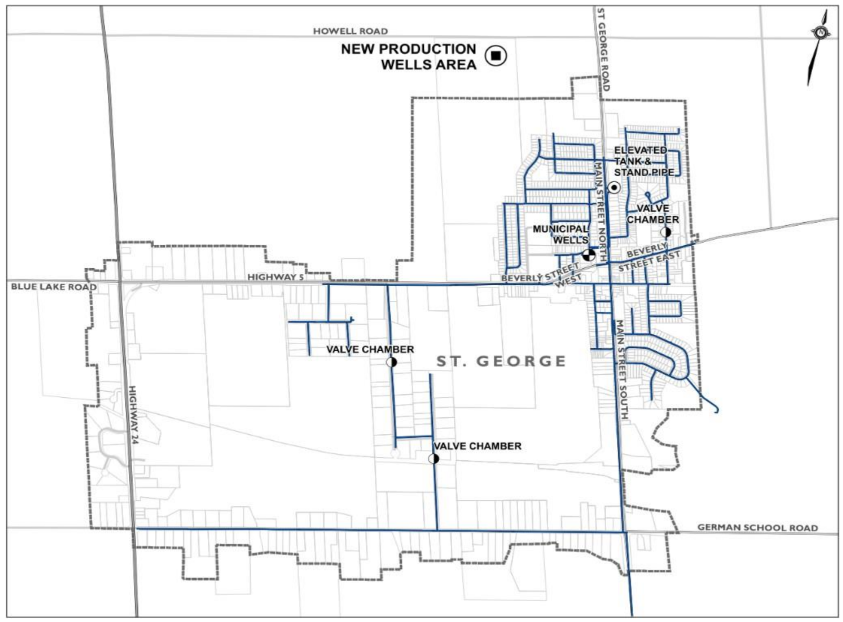
September 2023

T000280A

COUNTY OF Brant Simply Grand

Notice of Study Completion

Municipal Class Environmental Assessment, St. George Water Servicing



Introduction

The County of Brant has completed a Municipal Class Environmental Assessment study for water servicing upgrades required in the community of St. George to provide long-term and sustainable water supply and treatment capacity for existing customers and proposed development in the settlement area.

The Study

The Study recommends construction of two (2) new production wells with its own dedicated treatment facility on-site, to provide the required supply and treatment capacity to the existing St. George Drinking Water System. The general area where the new production wells will be located is shown on the map above.

Alternative water servicing solutions and preliminary servicing concepts were identified and evaluated as part of the study. Measures to alleviate any adverse effects that may result from the construction of the proposed works have been recommended.

Other Information

The Study Report, detailing the planning process, findings, and recommendations for the study will be available for public review for 30 calendar days from October 5, 2023, to November 10, 2023. The report will be available for public review on the County website at www.brant.ca/plans. Hard copies will also be available for review at the following locations during the 30-day review period.

County of Brant
Paris Customer Service
66 Grand River Street North
Paris, ON
Open Monday through Friday,
8:30 am to 4:30 pm

County of Brant
Burford Customer Service
26 Park Avenue
Burford, ON
Open Monday through Friday,
8:30 am to 4:30 pm

Comments and Information

Interested persons may provide written comments to our project team on or before November 10, 2023. All comments and concerns should be sent directly to Joe Murphy at the County of Brant and Sandra Rodriguez at CIMA+.

Joe Murphy, C.E.T
Corporation of the County of Brant 26 Park Avenue, P.O. Box 160 Burford ON N0E 1A0
Phone: (519)449-2451 Ext. 2209
Email: Joe.Murphy@brant.ca

Sandra Rodriguez, P.Eng. CIMA+
5935 Airport Road, Suite 500
Mississauga, ON, L4v 1W5 Phone: 905-695-1005 Ext. 6704
Email: Sandra.rodriguez@cima.ca

In addition, a request may be made to the Ministry of the Environment, Conservation and Parks for an order requiring a higher level of study or that conditions be imposed, only on the grounds that the requested order may prevent, mitigate or remedy adverse impacts on constitutionally protected Aboriginal and treaty rights. Requests on other grounds will not be considered. Requests should include the requester contact information and full name.

Requests should specify what kind of order is being requested, how an order may prevent, mitigate or remedy potential adverse impacts on Aboriginal and treaty rights, and any information in support of the statements in the request. This will ensure that the ministry is able to efficiently begin reviewing the request. The Section 16 Order request should be sent to the Minister of Environment, Conservation and Parks **and** the Director of Environmental Assessment Branch. You can submit your request by mail, email, fax or hand deliver it to:

Minister
Ministry of the Environment, Conservation and Parks 777 Bay Street, 5th Floor
Toronto ON M7A 2J3
Minister.mecp@ontario.ca

AND

Director
Environmental Assessment Branch
Ministry of the Environment, Conservation and Parks 135 St. Clair Avenue West, 1st Floor
Toronto ON M4V 1P5
EABDirector@ontario.ca

Requests should also be copied to the County of Brant by mail or by e-mail. Please visit the ministry's website for more information on requests for orders under section 16 of the *Environmental Assessment Act* at: https://www.ontario.ca/page/class-environmental-assessments-part-ii-order.

All personal information included in your request – such as name, address, telephone number and property location – is collected, under the authority of section 30 of the Environmental Assessment Act and is collected and maintained for the purpose of creating a record that is available to the general public. As this information is collected for the purpose of a public record, the protection of personal information provided in the Freedom of Information and Protection of Privacy Act does not apply (s.37). Personal information you submit will become part of a public record that is available to the general public unless you request that your personal information remain confidential.

County of Brant

Environmental Study Report

St. George Water Servicing
Municipal Class Environmental Assessment
Schedule C

Project no T000280A

Prepared by : Sandra Rodriguez, M.Eng., P.Eng.

Verified by : Troy Briggs, P.Eng.

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September 2023

VOLUME 1

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Executive Summary

Introduction and Background

The community of St. George in the County of Brant (the County) is currently serviced by a municipal groundwater supply system comprised of three (3) municipal wells, located on the same site and adjacent to each other. Having only one (1) primary source of water for the community has been identified as a security concern. Projected planned growth in the community will increase water demand beyond the supply capacity of the existing water system and exacerbate the water security concern related to having only one (1) primary source of groundwater. To this end, the County undertook a Schedule C Class Environment Assessment (Class EA) study to determine the preferred long-term, secure, and sustainable water servicing solution for the St. George settlement area.

Municipal Class Environmental Assessment

All municipal infrastructure projects in Ontario must follow the Municipal Class Environmental Assessment (Class EA) process (Municipal Engineers Association, as amended in 2023, to meet the requirements of the *Environmental Assessment Act* (*EA Act*).

The Municipal Class EA process is a planning and consultation process that covers all aspects of the environment that should be considered during the planning and implementation phases of a project. Projects are put into categories depending on their degree of environmental impact.

Increasing the capacity of the water supply system and identifying a new water source is considered a Schedule C project under the Municipal Class EA process. Schedule C projects typically have greater potential to impact the environment and must complete all five (5) phases of the Municipal Class EA planning process. The five (5) phases are described below:

- Phase 1 Define the problem or opportunity
- Phase 2 Identify and evaluate alternative solutions to determine a preferred solution
- Phase 3 Examine alternative methods of implementation of the preferred solution
- Phase 4 Document the planning, rationale, design and consultation process
- Phase 5 Implementation of the preferred alternative design concept and monitoring

Phases 1 to 3 of the Class EA process for this project have been completed and summarized in this report. Completion of this report, also referred to as the Environmental Study Report (ESR), fulfills Phase 4 of the Class EA process. This ESR will be placed on the public record for at least 30 calendar days for review by the general public. Notification to the public, stakeholders and government agencies will take place through the issuance of a Notice of Project Completion.

The 30-day review period gives individuals additional opportunities to raise additional concerns regarding the project with the County. Any outstanding concerns are to be addressed directly to the County.

In addition, a request may be made to the Ministry of the Environment, Conservation and Parks (MECP) for an order requiring a higher level of study (i.e., requiring an individual/comprehensive EA approval before being able to proceed), or that conditions be imposed (e.g., require further studies), only on the grounds that the requested order may prevent, mitigate, or remedy adverse impacts on constitutionally protected Indigenous and treaty rights. The request, also known as a Section 16 Order, must be submitted in writing to the Minister of the Environment, Conservation and Parks, and should be submitted to the Director of the Environmental Assessment Branch and the County.

Provided that no additional concerns or Section 16 Order requests are received within the 30-day review period, the project will proceed through the detailed design and construction phases as outlined in this ESR.

Problem/Opportunity Statement

The problem/opportunity statement for the St. George Water Servicing Class EA Study was defined as follows:

Water supply system infrastructure improvements are required for the St. George settlement area in the County of Brant, to address:

- *Security of the St. George Water Supply System, because there is only one (1) primary source of groundwater in the system*

The preferred strategy water servicing strategy will include:

- *A secondary supply source for redundancy purposes*
- *Upgrades to the existing water supply source to provide long-term reliability.*

Development and Evaluation of Alternative Water Servicing Solutions

A long list of potential alternative solutions was developed during the early stages of the Class EA Study. Preliminary screening of these alternative solutions was completed based on defined screening criteria, which included compliance with the project objectives and applicable drinking water regulations and standards, technical and economic feasibility, and ability for each alternative solution to provide the required capacity. The results of the preliminary screening and a further hydrogeological assessment provided the basis for the selection of the preferred alternative solution – *Expansion of the existing St. George Water Supply System by developing a new well field in the area of test well TW 4/09.*

The long list of potential alternative solutions and the results of the preliminary screening were presented to the public and agencies for feedback during a Public Information Centre (PIC) held on

September 25, 2014. No major comments or feedback were received regarding the information presented at the PIC.

Development and Evaluation of Water Servicing Design Concepts

Alternative design concepts or methods for implementing the preferred alternative solution were developed with consideration to potential location of the treatment facility and types of wells available for construction in the area. Four (4) different alternative design concepts and sub-options were identified and evaluated in the next stages of the Class EA Study.

Each alternative design concept was assessed relative to other options and evaluated against a set of criteria to identify the preferred design concept. Evaluation criteria and scores were developed and assigned, respectively, in consultation with the County. Supporting studies and investigations were completed as part of this Class EA study to substantiate the development and evaluation of alternative water servicing solutions and design concepts. Individual studies and assessments included a Hydrogeological Investigation, a Natural Heritage Investigation, a Cultural Heritage Assessment, and Stage 1 Archaeological Assessment. The findings and recommendations of these studies were considered in the relative evaluation of the water servicing design concepts and the identification of available mitigation measures.

The alternative design concept that achieved the highest score was considered the preferred option that provides the most “Benefits” to this project.

Preferred Alternative Design Concept

The preferred water servicing design concept for the community of St. George has been selected based on a relative evaluation of options, cost benefit analysis and sensitivity analysis. The preferred water servicing design concept includes – *Onsite treatment with bedrock well(s) development at MW 1/14 site*.

The proposed works includes the following major components:

- Two (2) new bedrock wells, spaced about 20 m apart, each with a capacity of about 22.5 L/s on the new MW 1/14 site, to provide back-up yield of 45.1 L/s. A new water treatment facility will be built at the new well site to accommodate the required pumping and treatment equipment. The new treatment facility will have the capacity to treat the design average daily water supply demands at 45.1 L/s.
  - Based on water quality information gathered during the Class EA Study, treatment for the control/removal of iron, manganese, and arsenic, as well as disinfection is expected at the new onsite treatment facility.
  - Based on preliminary raw water quality data obtained during the 2016 testing of the Test Wells at the new bedrock well site, it is anticipated that greensand filtration systems be used for the removal of iron/manganese and arsenic. Consideration should be given to further testing of the test wells to identify the source/zones of higher arsenic concentration as there may be a possibility to reduce arsenic levels by sealing the production zones from which the higher arsenic containing in Test Well TW 2/16 was drawn during the 2016 tests.

The specific water treatment processes/treatment train at the new water treatment facility will be confirmed during detailed design.

- Treated water will be conveyed from the new on-site water treatment facility directly into the existing St. George's distribution system, at the north end of Hampton Court.

- The existing St. George overburden production wells and treatment facility at Church Avenue will continue to operate and meet water demands up to the permitted annual daily average rate of 69.8 L/s.

A simplified process schematic of the preferred recommended water servicing design concept is shown in **Figure ES-1**. The proposed water servicing design concept has been developed based on the information available at a conceptual design level in the Class EA Study and may be subject to modifications and/or refinement during the detailed design phases.

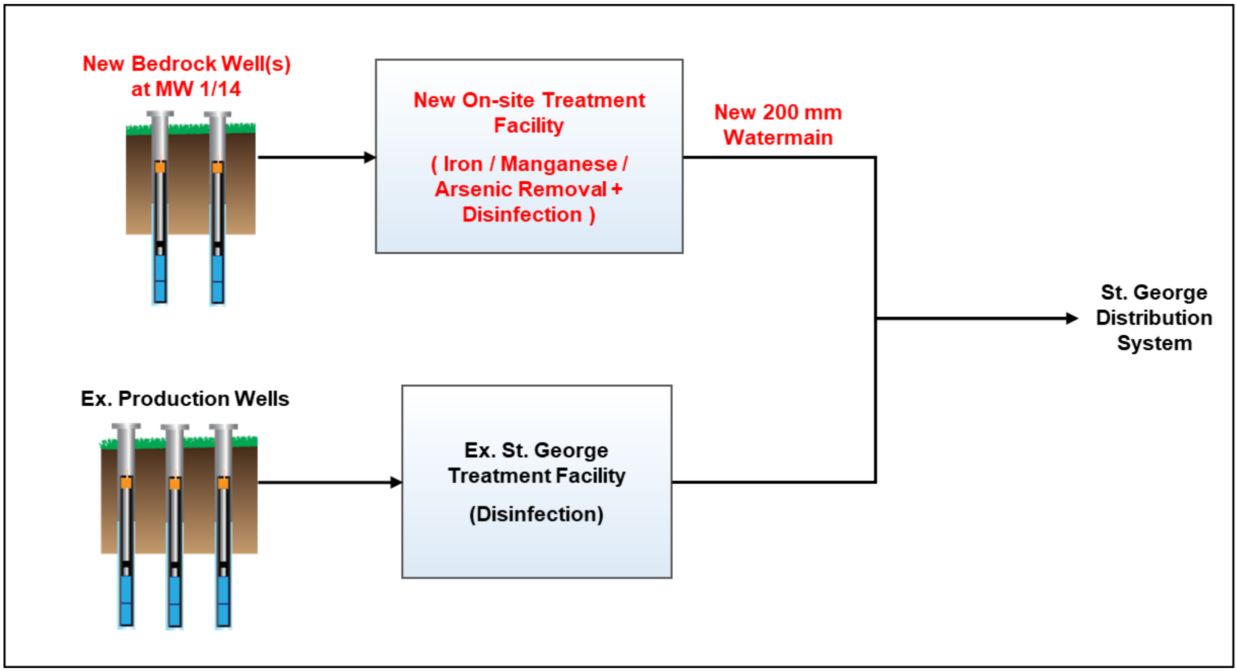

Figure ES-1 Preferred Water Servicing Design Concept for St. George

Alternative water servicing design concepts and the preliminary preferred water servicing alternative were presented to the public and agencies for feedback at a Public Information Centre held on November 21, 2017. No major comments or feedback were received regarding the information presented at the PIC.

Proposed Mitigation of Potential Impacts

Implementation of the preferred alternative design concept, as outlined in this report, is not expected to have significant impacts on the existing natural and economic environments, and cultural heritage resources; however, as with any other construction project, there will be some temporary potential impacts to the public and environment during construction in areas such as noise, dust, vibration and visuals during the construction period. However, these will be of short-term duration and expected to occur only during construction.

In general, public health and safety is a priority to the County and as such, all design and construction related to the St. George Water Servicing design concept will adhere to strict safety guidelines and all applicable codes and standards. All construction work must be carried out in accordance with the Occupational Health and Safety Act (OHSA) and other local regulations.

An assessment of potential impacts that may result from implementation of the proposed works was completed as part of the Class EA Study process and specific mitigation measures, as described below, have been identified to address potential short-term construction related impacts.

Water Quality and Quantity

Groundwater from all production wells, existing and proposed new wells, will meet the Ontario Drinking Water Quality Standards (ODWQS), Objectives and Guidelines.

The proposed bedrock wells at MW 1/14 will be approximately 100 m south of the proposed overburden wells at TW 4/09. The limits of the Wellhead Protection Area "A" for the new bedrock wells, at the expected pumping rates of 45.1 L/s, are not expected to include the existing residences along Howell Road. The proposed location of the new production wells was strategically selected to minimize impacts on private wells.

To reduce potential upsets in the water quality within distribution system due to blending of two (2) different water sources, separate treatment of each water source will be provided to create a uniform water quality before the new 200 mm watermain connects to the existing distribution system. Ultimately, treated water from the existing and new water treatment facilities in St. George will be in full compliance with all ODWQS, Objectives and Guidelines, before connecting to the distribution system, to ensure that adequate water quality conditions are maintained throughout the distribution system and reduce upsets from mixing.

Disturbance to Natural Environmental Features

No significant impacts to the existing natural heritage features are anticipated because of construction of the proposed works; however, a number of general mitigation options can be employed to avoid potential impacts, as follows:

There is potential for hedgerow loss due to construction of the proposed new supply wells and treatment facility. Although no aquatic habitat and communities and no wildlife or wildlife habitat were identified in proximity to the preferred well and treatment facility site, consideration for tree retention and tree protection measures is recommended.

As part of the proposed works, a new 200 mm watermain will run along a county road that is one block west of St. George Road to connect to the existing distribution system at the north end of Hampton Court. The proposed watermain alignment is anticipated to largely occur in agricultural fields; however, it would involve crossing a deciduous forest community that is reported as a Significant Woodland (NRSI 2013) and in proximity to the provincially rare Pignut Hickory. No significant wildlife habitat in the vicinity of the proposed works was identified during the natural investigation completed during this Class EA study; however, consideration for avoidance of vegetation removal through trenchless or minor shifts in the alignment is recommended. In addition, adherence to timing windows for Migratory Birds may be required in accordance with the Migratory Birds Convention Act.

In order to minimize potential for clearing of anthropogenic and natural vegetation communities due to site clearing, grubbing and grading, restoration of the sites to existing conditions or better post-construction is recommended through replanting with native and non-invasive species.

Two crossings of the Fairchild Creek are also expected with the watermain construction; one unclassified first order and one unclassified second order; however, aquatic habitat is not anticipated to be sensitive. In general, the following is recommended:

- That an effective erosion and sediment control (ESC) plan is prepared for future construction activities to ensure all entrained silt or sediment is contained and managed on-site and not permitted to migrate into the adjacent vegetation communities or eventually to the aquatic habitat.
- The ESC measures must be maintained in working order throughout the life of construction. Ensure monitoring of the ESC measures is carried out and that actions are taken to repair or remedy any deficiencies.
- Ensure that ESC materials are removed from the site post-construction and restoration.
- Any stabilized soils must be restored as soon as possibly post-construction or during long periods of inactivity.

Should the construction footprint extend outside of the existing road right of ways, additional screening for Species at Risk (SAR) may be required.

Climate Change

Based on a preliminary concept identified during the Class EA study, the proposed new infrastructure will be located outside of floodplain areas, thus, reducing potential effects to water infrastructure from possible flooding events resulting from climate change conditions.

In addition, provision of a secondary source of water supply and treatment would significantly reduce the short-term disruption of municipal water services potentially caused by problems with the existing water system resulting from extreme climate events.

The construction of the new water supply infrastructure, mostly related to the new supply wells and pump house/treatment facility, on a site currently used for agricultural uses, could have potential effects on climate change. The construction and operation of a new on-site treatment facility would generate additional greenhouse gas emissions due to heating, lighting, electrical requirements as well as chemical delivery needs. In addition, the existing landscape of the area surrounding the MW 1/14 site would need to be altered to accommodate new infrastructure. Although the existing site does not have significant vegetation species, it is used for agricultural purposes.

Implementation of the following climate mitigation measures should be considered to reduce the long-term generation of carbon emissions arising mainly from operation of the new treatment facility and to enhance carbon storage due to proposed changes in the landscape:

- Use of energy efficiency features within the new treatment facility as LED lighting fixtures and insulation to reduce the energy needs.
- Chemical delivery is expected to be minimal; however, delivery could be scheduled on a monthly/bi-monthly basis in order to reduce the number of delivery trucks to/from the new treatment facility.
- Implementation of an adequate landscape plan, comprising planting of new trees and local non-invasive vegetation species within the new site.

Source Water Protection Areas

The location of the proposed works is found within the Grand River Source Protection Area (watershed) under the Lake Erie Source Protection Region. Based on a review of the Lake Erie Source Protection Region Policy Mapping Tool, Source Protection policies related to Issue Contributing Areas (ICAs) for Nitrate as well as Wellhead Protection Areas (WHPAs) were identified on proposed areas for construction of the components of the preferred design concept. The proposed works, including short-term construction and long-term operation of new supply wells, treatment facility and distribution watermain, are not considered a prescribed drinking water threat activity in a Nitrate ICA.

Activities and land use within the St. George WHPAs should be managed in accordance with the policies of the Lake Erie Source Protection Plan. Based on the consultation records obtained from GRCA and the Lake Erie Source Protection Region resulting from consultation with the landowners in the vicinity of the St. George WHPAs, no current activities that may be considered as threat to the St. George drinking water system have been identified.

Disturbance to Cultural Heritage Features

There will be permanent physical and visual disruption affects to the agricultural land surrounding MW 1/14 area, which includes the area for the proposed supply wells, treatment facility and connecting watermain. This agricultural land has been identified as a cultural heritage resource; however, it does not have Heritage Recognition as per the County of Brant Heritage Register.

No potential direct impacts to existing cultural heritage resources are anticipated; however, a few indirect impacts were identified to include the potential for temporary physical, visual, audible and atmospheric affects during construction activities to three (3) identified cultural heritage resources, namely, Howell Road, a roadscape; and farm complexes at 197 Howell Road and 179 Howell Road. The two farm complexes on Howell Road are included on the County of Brant Heritage Register, and thus, have Heritage Recognition.

The following mitigation recommendations are provided with regard to the potential adverse effects described above:

- Construction noise and vibration should be monitored and kept to a minimum in the vicinity of the identified built heritage resources within and in the vicinity of MW 1/14 site.
- The County of Brant may request the completion of Cultural Heritage Evaluation Reports (CHERs) and/or Heritage Impact Statement (HIS) for the farm complexes identified at 179 and 197 Howell Road, which are listed properties on the Brant Heritage Inventory.
- Construction laydown areas for the potential design concepts for the proposed 200 mm watermain should avoid being located adjacent to or abutting sites identified as #197 Howell Road (farm complex), #179 Howell Road (farm complex) and #257 Main Street North (cemetery).

Disturbance to Archaeological Features

The proposed location of the new pump house and alignment of the new 200 mm watermain are identified as a moderate to high archaeological potential that requires a Stage 2 Archaeological Assessment (AA). The entirety of the potential well site, as well as all of the immediate area lying south of Howell Road, remains as cultivated farmland. The only disturbances in the area around the well site consist of the paved Howell Road alignment and the extant residential structures. With no evidence of previous disturbance, or any physical features indicating low or no archaeological potential, the proposed well site and watermain alignment will require a Stage 2 pedestrian survey at five (5) metre intervals to determine the presence or absence of archaeological resources. Should project plans include construction in any of the adjacent high-potential areas (marked in red in Map 16 of Archeoworks Inc., 2014 report), a Stage 2 test pit survey or pedestrian survey, at standard five-metre intervals will be required.

Truck Traffic

Most of the construction activities will be limited to the construction area in the vicinity of the MW 1/14 site. Increased truck traffic on Howell Road will be experienced during the duration of construction from the delivery of construction equipment, construction materials and potential removal of excavated material from the site. The proposed mitigation measures include the following:

- Appropriate hours of work will be specified in the contract.
- Any lane closures will be completed in accordance with best practices to protect safety to the workers and to the public.
- Residents in the area will be kept informed ahead of time of any road closures and anticipated timing, as well as the overall schedule of construction.
- All standard best practices for vehicle and pedestrian safety will be employed throughout the construction areas. All construction will adhere to strict safety guidelines.

Noise and Vibration

Most of the construction activities associated with the on-site treatment and bedrock well(s) development at MW 1/14 site will be localized within the well site, affecting the few neighbouring property owners. The proposed location of the new pump house / treatment facility is located approximately 100 m away from the adjacent residential neighbourhood. The distance of the new pump house and existing private residences is anticipated to have a low impact from potential disturbances from operations and maintenance activities. Potential noise impacts resulting from watermain installation through undisturbed area is anticipated.

Although minimal, some potential noise effects may occur due to construction traffic and construction equipment. Noise during operation of the new wells and treatment facility is not expected to be significantly different from the existing conditions. The proposed mitigation measures include the following:

- Ensuring all vehicles and construction equipment are equipped with effective muffling devices and are operated in a fashion to minimize noise in the project area.
- Throughout the construction period, the County will ensure the contractors undertake measures to reduce noise disturbances as much as possible.

Dust/Mud

Construction traffic could create additional dust and mud. The proposed mitigation measures include the following:

- Dust control measures such as the application of water to be implemented as required.
- The County will ensure that the contractor maintain public roadways clean and free of mud on a consistent basis.

Visual/Architectural

The architectural design of the new pump house/treatment facility will be architecturally designed, as much as possible, to blend-in with the existing rural character of the neighbouring area. Due to the physical distance between the new pump house and existing private residences, visual impacts on private properties and potential disturbances from operational and maintenance activities are anticipated to be minimized. Landscaping of the new site will be implemented, as necessary, to reduce potential for visual disturbances.

Landscaping

The proposed site for the new pump house/treatment facility will be landscaped following construction of the proposed works. It is proposed to provide landscaping that will blend into the natural surrounding environment and require minimal maintenance. After fine grading of the landscape areas with topsoil, the open areas will be sodded. A landscape plan detailing proposed tree plantings, will be developed during the detailed design phases of the project, as required.

Fuel Spills

Spills could potentially occur when refueling construction equipment. The proposed mitigation measures include the following:

- Proper construction techniques will be applied to reduce the risk of spills.

- A contingency plan for cleaning up fuel spills will be developed and ready for implementation, particularly when working in proximity to existing watercourses.
- Equipment required to clean up a spill will be contractually required to be on-site at all times.

Geotechnical Considerations

Construction activities will include topsoil stripping, excavations for the new pump house and watermains, and stockpiling of select native materials on-site for backfilling and grading. Any surplus material generated from grading operations that is not required for filling or fine grading, will be removed and disposed off-site.

A detailed geotechnical investigation will be carried during the design phase to assist in the design and construction of the preferred alternative design concept.

Public Consultation

A Schedule C undertaking under the Municipal Class Environmental Assessment planning process requires that members of the public, interest groups and review agencies are given opportunities to provide input and comments from the early stages of the Class EA Study. The project team met this requirement by providing a Notification of Study Commencement and public notices for three (3) separate public meetings. The public notices were placed for two (2) consecutive publications in local newspapers. Information regarding the progress of the St. George Water Servicing Class EA Study was provided at each public meeting. Public feedback was incorporated as part of the evaluation process and considered during the selection and confirmation of the recommended water servicing design concept.

As a result of the modified size and shape of the Well Head Protection Areas (WHPAs) associated with the existing overburden wells and the new proposed bedrock wells for the St. George Well Supply System, the Lake Erie Region Source Protection Committee undertook additional consultation with the property owners whose properties would either be or no longer located in a vulnerable area that would restrict the occurrence of a number of activities. Individual property notification letters were mailed out in early February 2019 to residents identified as potentially impacted by the changes to the St. George WHPAs and the Issue Contributing Area. The letter outlined that their property(ies) may be affected by changes made to the vulnerable area(s) around the St. George Welly Supply and provided information about when and how to comment on the proposed revisions.

A public consultation period for amendments to the Grand River Assessment Report and Source Protection Plan (AR and SPP), which included the St. George Well Supply, was held. The draft updated AR and SPP was posted on the Lake Erie Region's website during the entire length of the public consultation period and hard copies were made available at the GRCA and the Brant Development Services Office. The public consultation period was also advertised in the Brantford Expositor. A public open house was hosted at the Brant Sports Complex during which time impacted residents could come and review the proposed changes with Lake Erie Region and County of Brant staff. A few residents participated in the public open house. Discussions with a few property owners took place to review the possible applicability of source water protection policies based on existing activities.

A Notice of Study Completion will be published in the local newspapers and distributed to all in the project contact list. The Notice of Study Completion will include enough information to advice the public and review agencies of the locations where the Environmental Study Report will be filed for public review, the time period to provide comments, and the opportunities to raise any major concerns to the Ontario Minister of the Environment, Conservation and Parks (MECP), and the Director of the Environmental Assessment and Permissions Branch with the MECP, if such concerns cannot be resolved with the County during the review period.

The County will continue to inform the public during the project design and construction phases. Project updates will be issued, as necessary, and notices will include a dedicated contact person from the County to respond to issues or concerns that may arise.

Conclusions and Recommendations

Through completion of a Municipal Class EA study, the onsite treatment with bedrock well development at MW 1/14 site has been identified as the preferred recommended design concept to service the projected growth and meet the long-term water supply needs of the St. George community.

Individual assessments of the natural, socio-cultural, archaeological, and cultural heritage conditions were conducted to inventory and evaluate the existing conditions of the project area. Potential impacts associated with the implementation of the recommended alternative design concept were identified as well as available mitigation measures.

Due to the nature of this project, some inevitable effects in terms of dust, noise, and truck traffic will be felt around the construction areas. However, potential effects can be further reduced by implementation of mitigation measures outlined in this report. Therefore, no significant environmental, socio-cultural, archaeological or heritage resource impacts are anticipated because of this project.

It is recommended that the County proceed with the detailed design and construction of the preferred design concept, as outlined in this report, subject to receiving the necessary approvals. This ESR is being filed for a 30-day public review period. Provided that no major objections or Section 16 Orders are received during the review period, the project will proceed through the design and construction phases as outlined in this ESR.

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1. Introduction

1.1 Background

The community of St. George in the County of Brant (County) is currently serviced by a municipal groundwater supply system comprised of three (3) overburden groundwater wells, located on the same site and adjacent to each other. Having only one (1) primary source of groundwater for the community has been identified as a security concern. Planned growth in the community will increase water demand beyond the supply capacity of the existing system and exacerbate the water security concern related to having only one primary source of groundwater.

A new groundwater supply source is required to provide the necessary redundancy in the St. George Drinking Water System (DWS). To this end, the County undertook a Schedule C Class Environmental Assessment (Class EA) study to determine the best long-term, secure and sustainable water servicing solution for the St. George settlement area. CIMA Canada Inc. (CIMA+) was retained by the County to undertake the Class EA Study.

1.2 Objectives of the Class EA Study

The main objective of this Class EA Study is:

To evaluate water servicing alternatives and design concepts and identify the preferred water servicing solution to provide the necessary redundancy and associated infrastructure improvements to the St. George Drinking Water System, in the County of Brant. The preferred water servicing design concept should be sustainable, technically, and environmentally sound and economically mindful in terms of capital and operating costs.

Other Class EA objectives include:

- To provide appropriate consultation with all affected and interested parties, including participation of a broad range of stakeholders to allow for the sharing of ideas, education, testing of creative solutions and developing alternatives; and
- To document the study process in compliance with all phases of the Municipal Class EA planning process.

This Environmental Study Report (ESR) completes Phase 4 of the Municipal Class EA process requirements and provides a description of the preferred water servicing design concept for water servicing solution for the St. George settlement area.

1.3 Objectives of the Environmental Study Report

This ESR describes the planning and decision-making process followed during the Class EA Study for the St. George Water Servicing. The ESR describes the following:

- Various alternative solutions and design concepts considered for water servicing in the St. George area,
- Evaluation methodology and evaluation criteria used to assess the different alternatives,
- Anticipated potential impacts,
- Proposed mitigation measures associated with the alternatives,
- Rationale for the selection of the preferred solution and implementation plans, and
- Public and agency consultation records and feedback.

The Class EA process provides an opportunity for members of the public, interest groups and review agencies to review the ESR during a 30-day review period. The 30-day review period gives individuals additional opportunities to raise additional concerns regarding the project with the County. Any outstanding concerns are to be addressed directly to the County.

In addition, a request may be made to the Ministry of the Environment, Conservation and Parks (MECP) for an order requiring a higher level of study (i.e., requiring an individual/comprehensive EA approval before being able to proceed), or that conditions be imposed (e.g., require further studies), only on the grounds that the requested order may prevent, mitigate or remedy adverse impacts on constitutionally protected Indigenous and treaty rights. The request, also known as a Section 16 Order, must be submitted in writing to the Minister of the Environment, Conservation and Parks, and should be submitted to the Director of the Environmental Assessment Branch and the Region.

Provided that no additional concerns or Section 16 Order requests are received within the 30-day review period, the project will proceed through the detailed design and construction phases as outlined in this ESR.

1.4 Report Outline

This report was prepared to meet the requirements of the Ontario Municipal Engineer's Association (MEA) Municipal Class EA Planning Process (Amended, March 2023). This report combines all phases of the planning process under one cover and includes steps that are considered essential for meeting the requirements of the *Environmental Assessment Act* (EAA). The report includes the following sections:

- **Section 1: Introduction** – Provides background information leading to the initiation of this study, provides the objectives of both the Class EA Study and the ESR, and describes the format of this report.
- **Section 2: Class Environmental Assessment Process** – Provides a summary description of the framework and activities to be completed to meet the Municipal Class EA process requirements.

- **Section 3: Public and Agency Consultation Process** – Describes the consultation program with the public and agencies, and public engagement activities
- **Section 4: Study Area Overview** – Presents an overview of the study area and its social and environmental characteristics
- **Section 5: Existing St. George Water System** – Presents a review of the existing water system and water quality
- **Section 6: Water Servicing Design Criteria** – Presents the design criteria for water servicing
- **Section 7: Class EA Phase 1 – Identification of Problem/Opportunity** – Presents the problem/opportunity statement for this Class EA Study
- **Section 8: Class EA Evaluation Methodology** – Presents the evaluation methodology used for the St. George Class EA to select the preliminary preferred water servicing alternatives from a long-list of alternatives
- **Section 9: Class EA Phase 2 – Development and Evaluation of Water Servicing Alternative Solutions** – Presents a comprehensive review of water supply strategies by providing information on a long list of alternatives and identifies a short list of feasible alternatives for the St. George water supply based on a set of must-meet criteria. For the short-listed alternatives, production capacity of the groundwater wells and other hydrogeological conditions is assessed
- **Section 10: Treatment Requirement Results** – Describes the alternative water treatment technologies considered for removal and arsenic, iron, and manganese, and disinfection
- **Section 11: Class EA Phase 3 – Development and Evaluation of Water Servicing Design Concepts –** Presents the design concept and high-level cost estimate for the short-listed alternatives
- **Section 12: Preferred Water Servicing Design Concept –** Summarizes the preliminary preferred water servicing alternative for the St. George settlement area
- **Section 13: Proposed Mitigation of Potential Impacts and Monitoring –** Identifies potential impacts and the recommends mitigation measures
- **Section 14: Class EA Phase 4 – Class EA Report Conclusions and Recommendations** – Presents the conclusion of the ESR and the recommendations
- **Section 15: References –** Lists the key sources of information and reports that were used and consulted during the Class EA study process and in the preparation of the Class EA Report.

2. Class Environmental Assessment Process

2.1 Municipal Class Environmental Assessment

The St. George Water Servicing Class EA Study has been undertaken in accordance with the requirements of the Ontario Environmental Assessment Act (October 2000, as amended in 2007, 2011 & 2015). The Class EA is an approved decision-making and planning process to ensure that potential effects of a project are identified and managed prior to implementation. It applies to public sector projects that have predictable and manageable environmental effects, including municipal water and wastewater projects.

The Class EA process includes five (5) phases that must be followed to ensure that the best approach is identified to address a specific problem, requiring the evaluation of possible solutions, design concepts, and recommends the best approach based on a comprehensive evaluation of environmental effects and how to minimize them. As shown in Figure 1, the process includes five (5) phases:

- Phase 1 – Define the Problem
- Phase 2 – Identify and Evaluate Alternative Solutions to Determine a Preferred Solution
- Phase 3 – Examine Alternative Methods of Implementation of the Preferred Solution
- Phase 4 – Document the Planning, Design, and Consultation Process
- Phase 5 – Implementation and Monitoring

Public and agency consultation is an important part of the Class EA planning process. Gaining input from individuals and groups can help identify project concerns early, and to find ways to address concerns wherever possible. Public consultation is carried out at key stages of the Class EA process to allow time to review and provide input related to the project.

Projects subject to the Class EA process are classified into three (3) possible “schedules” (or categories), depending on the degree of expected impacts:

- Schedule A projects represent minor operational and maintenance activities and are approved without the need of further assessment.
- Schedule A+ projects also represent minor activities and are pre-approved but require public notification prior to project implementation.
- Schedule B projects require screening of alternative solutions based on their environmental impacts. Phases 1 and 2 must be completed and are typically presented in a report with a Notice of Completion from the project proponent, followed by a 30-day public review period. If no significant impacts are identified and there are no requests for an Order by the Minister under Part II for an Individual EA, then the Schedule B projects are approved and may proceed to Phase 5. Any party may request the Minister of the Environment consider a Part II Order if any outstanding issues remain after the public review period.
- Schedule C projects typically have greater potential to impact the environment and must complete all five phases of the Class EA planning process. In addition to Phases 1 and 2, Phase

3 involves the assessment of alternative solutions followed by a public consultation of the preferred design concept. Phase 4 typically entails the preparation of the Environment Study Report (ESR) to be filed for public review. If no significant impacts are identified and no Section 16 Order is received from the Minister, then Schedule C projects are approved and proceed to Phase 5.

This Class EA study was carried out as a Schedule C Class EA undertaking with completion of Phases 1 through 3. Preparation of this report completes Phase 4 of the Class EA process.

2.2 The St. George Water Servicing Class Environmental Assessment Process

The planning and development of water servicing for the St. George area has been conducted as a Schedule C undertaking under the Municipal Class EA process. Phase 1 (Identify the Problem), Phase 2 (Identify and Assess Alternative Solutions) and Phase 3 (Identification and Assessment of Alternative Methods/Design Concepts and Selection of Preferred Alternative) have been carried out accordingly for this Class EA study. Review agencies and the public were consulted at several points in this project to solicit input and comments.

This document comprises Phase 4 (completion of an ESR) of the Class EA process. The ESR will be placed on the public record for at least 30 calendar days for review by the public. Notification to the public and the agencies will be through the issuing of a Notice of Completion.

2.2.1 Project Team Members

A project team was established to guide the planning decisions that drove the St. George Water Servicing Class EA study. Key members of the Project Team are:

- Joe Murphy, County of Brant (2014 – 2023)
- Alex Davidson, County of Brant (2015 – 2023)
- Lee Robinson, County of Brant (2014 – 2015)
- Eric Tuson, CIMA+ (2015 – 2019)
- Sandra Rodriguez, CIMA+ (2014 – 2023)
- Troy Briggs, CIMA+ (2017 – 2022)
- Erin Longworth, CIMA+ (2014 – 2018)
- Deborah Ross, CIMA+ (2014 – 2015)

2.3 Information on Section 16 Order Requests

Under the Class EA planning process, there is an opportunity for the Minister or delegate to review the status of a project. A request may be made to the MECP for an order requiring a higher level of study (i.e., requiring an individual/comprehensive EA approval before being able to proceed), or that conditions be imposed (e.g., require further studies), only on the grounds that the requested order may prevent, mitigate or remedy adverse impacts on constitutionally protected Indigenous and treaty rights. Requests on other grounds will not be considered. Requests should include the requester contact information and full name for the ministry.

Requests should specify what kind of order is being requested (request for additional conditions or a request for an individual/comprehensive environmental assessment), how an order may prevent, mitigate, or remedy those potential adverse impacts, and any information in support of the statements in the request. This will ensure that the ministry is able to efficiently begin reviewing the request. The requests should also be sent to the Proponent by mail or email. The request should be sent in writing or by email to:

Minister of the Environment, Conservation and Parks
Ministry of Environment, Conservation and Parks
777 Bay Street, 5th Floor
Toronto ON M7A 2J3
minister.mecp@ontario.ca;
and,
Director, Environmental Assessment Branch
Ministry of Environment, Conservation and Parks
135 St. Clair Ave. W, 1st Floor
Toronto ON, M4V 1P5
EABDirector@ontario.ca

Other comments and concerns about the proposed works related to the preferred recommended water servicing alternatives or the Class EA study should be dealt directly with the County. Interested persons may provide written comments to the project team, within the established review period.

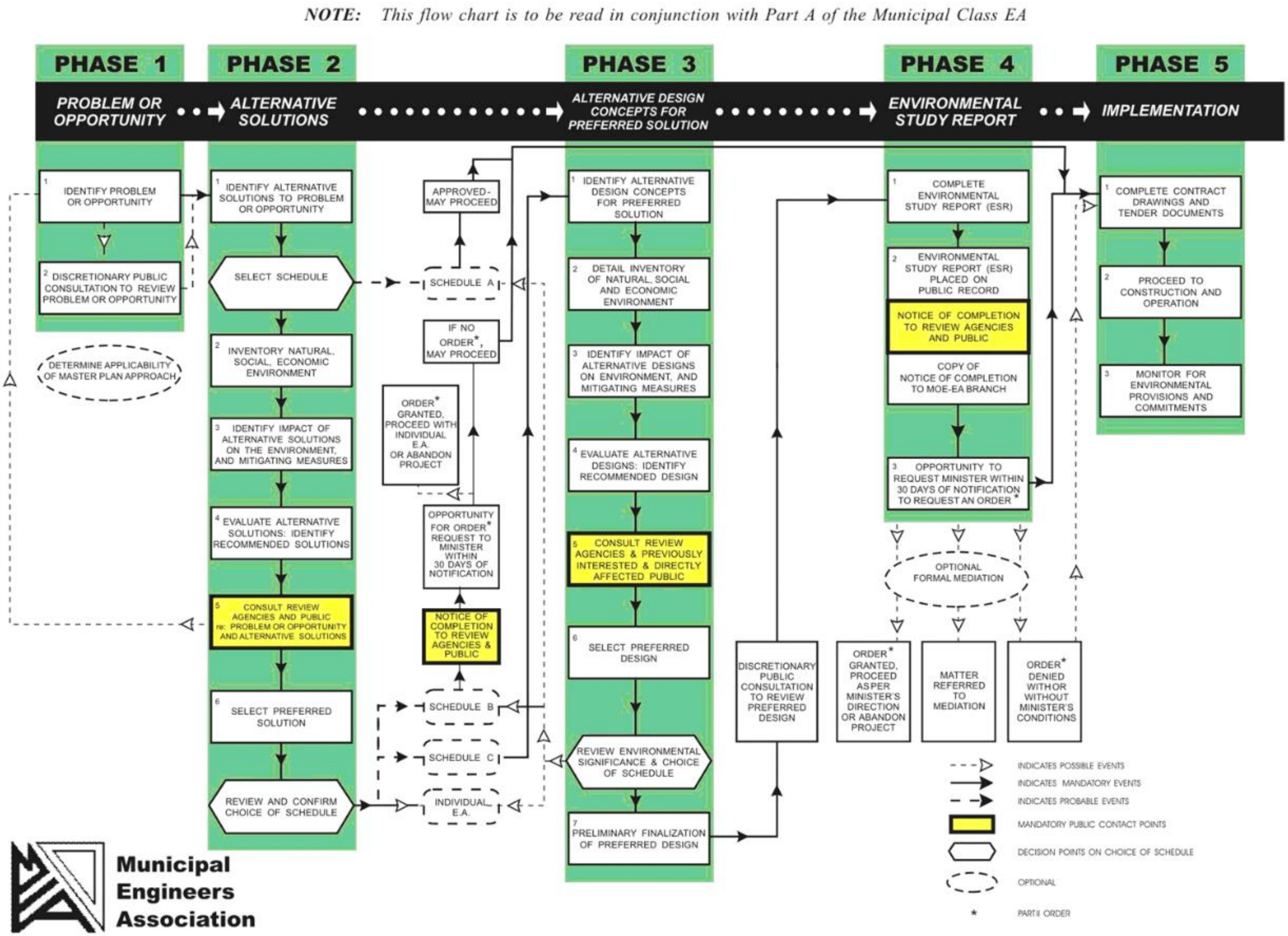

Figure 1 **Municipal Class Environmental Assessment (EA) Planning and Design Process**

3. Public and Agency Consultation Process

Public consultation is an integral component of the Class EA study process. Successful public consultation programs build and maintain community trust and credibility, improve project decision-making, and identify community issues far enough in advance so that they can be effectively addressed. A common public and agency consultation program was developed and implemented for both the St. George Water Servicing Class EA Study and the St. George Wastewater Servicing Class EA Study. Although both Class EA Studies were undertaken simultaneously by CIMA+, on behalf of the County, the processes were considered separate Class EA studies. For the purpose of the public and agency consultation program, common project notices and public information centres were distributed and held, respectively for both Class EA studies.

This section provides a summary of public and agency consultation activities undertaken at key stages of the St. George Water Servicing Class EA Study. Letters, comments, and feedback received throughout the course of the Class EA studies, from review agencies and the public, related to the St. George Wastewater Servicing Class EA Study, have been excluded from this section. Only comments, feedback and relevant information related to the St. George Water Servicing Class EA study are described in the following sections. For further reference, detailed information regarding public and agency consultation can be found in Appendices A to E.

3.1 Goals and Objectives of Public Consultation

The project team firmly believed that the quality of decisions made regarding the preferred alternative solution for implementation of water servicing in St. George would be improved by soliciting and acting on input from the public and stakeholders. Specifically, the objectives of public consultation in this project were to:

- Inform the public, stakeholders, and Aboriginal and First Nations of the project
- Offer educational information regarding the project
- Obtain input on project components at key decision-making points
- Meet or exceed the consultation requirements of the Class EA process

3.2 Stakeholders

Several primary stakeholders were considered to have an interest in the St. George Water Servicing Class EA Study, as outlined below.

- Residents: includes all St. George area residents, comprising those currently serviced by existing municipal water and wastewater systems, as well as residents serviced by private groundwater wells and septic systems. This also includes the property owners of the lands where potential groundwater supply sources have been found.
- St. George Landowners Group
- Local Ward Councillors

- Environmental stakeholders/Conservation Authorities: such as the Grand River Conservation Authority, and Ministry of the Environment, Conservation and Parks (MECP). Pre-consultation with the MECP has taken place throughout the course of the study to discuss the proposed scope of work, preliminary results of the hydrogeological investigations and to review the Draft Environmental Study Report.
- Review agencies such as Provincial Ministries and Agencies, Federal Departments and Agencies, local area municipalities, district and planning boards, emergency services (fire, police, ambulance), school boards, transit, utilities (natural, gas, cable, telephone, etc.). Specific Agencies identified in the Master Project Contact List are included in Appendix A.
- Aboriginal and first nations groups such as the Metis Nation of Ontario, Six Nations of the Grand River Territory, the Mississaugas of the New Credit First Nation, Six Nations Council Public Works, Haudenosaunee Confederacy Chiefs Council and Metis Nation of Ontario.

3.2.1 Public Consultation, Communication Strategies and Tactics

The following outlines the specific consultation activities undertaken to support the St. George Water Servicing Class EA study.

- **Project Mailing List:** A project contact list, including residents, members of community groups, and several technical review agencies and organizations, was developed. Interested members of the public were added to the project mailing list if requested and kept informed of project developments via written notifications. All individuals on the project list were contacted at the appropriate stages of the study to inform them of meetings and events.
- **Notice of Study Commencement:** A Notice of Commencement was advertised simultaneously with Public Information Centre (PIC) No.1. The notice was placed on the County's municipal webpage and sent to all in the project mailing list. A copy of the Notice is provided in Appendix B.
- **Three (3) PICs were held throughout the study.** The purpose of the PICs was to provide opportunities for interested members of the public, agencies, and other stakeholders to learn more about the project and the decisions made throughout the study and consult with the project team. At the PICs, display boards were set up around the room to present information on the project, and comment sheets were provided to facilitate PIC attendees to provide any written input on the project. Technical staff and specialists from the County and the consulting team were also available to answer questions, provide updates on the project and encourage dialogue. The PICs were scheduled in a location within the community and ran extended hours through the afternoon and evening to give a wide window of opportunity to accommodate work and school hours.
  - **PIC No.1** was held on May 1, 2014, at the South Dumfries Community Centre in the County of Brant. All relevant agencies and members of the public were invited. The first PIC was advertised on a few local newspapers and through the County's website. In addition, emails and formal invitation letters were sent out to all in the project mailing list to notify them of the date and location of PIC No.1. The purpose of this PIC No.1 was to introduce the project to the public, learn why the study is necessary, understand the study processes and

timelines, and to receive public and agency comments and suggestions on the information presented. The first PIC was attended by approximately 9 people, which included the Mayor, a local councillor, a representative of the Grand River Conservation Authority, the Ministry of Citizenship and Immigration, Empire Community and members of the general public. No major comments or completed comments sheets were received during or after the PIC in relation to the St. George Water Servicing Class EA Study. A copy of the formal invitation letter and the notice of the PIC is provided in Appendix B. The information presented at PIC No.1 is included in Appendix C.

- **PIC No. 2** was held on September 25, 2014, at the South Dumfries Community Centre in the County of Brant. All relevant agencies and members of the public were invited. The second public meeting was advertised on a few local newspapers and through the County's website. In addition, emails and formal invitation letters were sent out to all in the project mailing list to notify them of the date and location of PIC No.2. The purpose of PIC No.2 was to present detailed information on each of the water servicing alternatives for consideration as well as the proposed evaluation framework and evaluation criteria to be used in the assessment of the alternatives. The second PIC was attended by approximately 13 people which included the Mayor, a representative of the Grand River Conservation Authority, the Landowners Group and members of the general public. No major comments or completed comments sheets were received during or after the PIC in relation to the St. George Water Servicing EA. A copy of the formal invitation letter and the notice of the PIC is provided in Appendix B. The information presented at PIC No.2 is included in Appendix C.
- **PIC No. 3** was held on November 21, 2017, at the South Dumfries Community Centre in the County of Brant. All relevant agencies and members of the public were invited. The second public meeting was advertised on a few local newspapers and through the County's website. In addition, emails and formal invitation letters were sent out to all in the project mailing list to notify them of the date and location of PIC No.3. The purpose of PIC No.3 was to present an overview of the activities completed to date, the alternative design concepts considered for provision of water servicing in the St. George area, the results of the evaluation processes, the preliminary preferred water servicing concept, and the potential anticipated impacts and mitigation measures for the preliminary preferred water servicing concept. The third public meeting was attended by approximately 49 people. No major comments were received during or after the PIC in relation to the St. George Water Servicing EA. A copy of the formal invitation letter and the notice of the PIC is provided in Appendix B. The information presented at PIC No.3 is included in Appendix C.

+ **Notice of Study Completion:** A Notice of Study Completion has been prepared and will be advertised to the public of the commencement of the 30-day review period and the opportunities to provide additional comments before obtaining approval. A copy of the Notice will be sent out to all required agencies, local associations and interested residents. A copy of the Notice of Study Completion is included in Appendix B.

In addition to the above, a separate consultation and communication program was undertaken collaboratively by the Lake Erie Source Protection Region and the Grand River Conservation Authority (GRCA) to address changes to the limits of the Wellhead Protection Areas (WHPAs) for the St. George supply wells. Poperty owners in the vicinity of the proposed new wells were provided with opportunities to review the proposed updates to the Grand River Source Protection Plan, which resulted from changes to the vulnerable areas surrounding the existing and proposed new production wells for the St. George Well Supply System. Specific consultation activities for this component included:

- **Public Consultation Period:** A public consultation period for amendments to the Grand River Assessment Report and Source Protection Plan (AR and SPP), which included the St. George Well Supply was held from February 12 to March 18, 2019. Individual property notification letters were mailed out in early February 2019 to residents identified as potentially impacted by the changes to the St. George WHPAs and the Issue Contributing Area. Copies of the Letters are included in Appendix C. The letters outlined whether their property(ies) may or may not be affected by changes made to the vulnerable area(s) around the St. George Welly Supply and provided information about when and how to comment on the proposed revisions. The draft updated AR and SPP was posted on the Lake Erie Region's website during the entire length of the public consultation period and hard copies were made available at the GRCA and the County of Brant Development Services Office. The public consultation period was also advertised in the Brantford Expositor in the February 11, 2019 publication. Phone conversations with a number of property owners that received the outreach letter took place during the month of February 2019. Most of the telephone discussions were about the reason for private properties receiving the outreach letter, and the possible applicability of source water protection policies based on existing activities. A summary of the phone discussions with private property owners was receieved by the Source Protection Program on January 9, 2020 and is included in Appendix D for completeness purposes.
- **Open House:** A public open house was held at the Brant Sports Complex on February 21, 2019, during which time impacted residents could come and review the proposed changes with Lake Erie Region and County of Brant staff. Display boards were set up at the open house to present information on the source protection program, existing water system and its vulnerable areas, drinking water threats and policy updates, as well as proposed changes to the wellhead protection areas. Comment sheets were also provided to facilitate attendees to provide any written input on the information presented. Staff from the Lake Erie Source Protection Program, the Grand River Conservation Authority and the County of Brant were available to discuss and answer questions. The Open House was attended by approximately 10 people which included representatives from the County, the Source Protection Committee, and a few property owners. No major comments or completed comments sheets were received during or after the Open House.

All material related to the Open House and public consultation program carried out by the Lake Erie Source Protection Region and the GRCA is included in Appendix D for further reference.

3.3 Summary of Public Issues, Comments and Concerns

At the three (3) PICs, comment sheets were distributed for attendees to provide feedback. No concerns or issues were noted by the attendees regarding the St. George Water Servicing Class EA Study, at any of the three (3) PICs. Only one comment was received regarding the preferred water servicing design concept presented at PIC No.3, and the comment was positive (the resident agreed with the proposed preferred design concept). Completed comment sheets filled out by PIC attendees are attached in Appendix C.

3.4 Agency Consultation

Consultation with government review agencies and the public is a necessary and important component of the Class EA process. In conformance with the consultation for this Class EA Study, the County ensured that similarly to the public, appropriate review agencies were informed and given a chance to contribute during the study. This section outlines the agency consultation component of the study.

A list of agencies was prepared at the start of the project that included all relevant County departments, federal agencies, Provincial Ministries, local municipalities and agencies, as well as local associations and utilities. Opportunities for these agencies to participate in the project were provided through the distribution of the Notice of Study Commencement and PICs via direct letter mailing or through email if specified, which also served as a direct invitation to participate in the formal PICs. Specific Agencies identified in the Master Project Contact List are included in Appendix C, and agency consultation information is included in Appendix E.

3.4.1 Ontario Ministry of the Environment, Conservation and Parks (MECP)

Consultation with the Ontario Ministry of the Environment, Conservation and Parks (MECP) was undertaken as part of the St. George Water Servicing Class EA Study. Major comments received from the MECP and a description of how these comments were incorporated or addressed throughout completion of different activities or investigations are summarized in Table 1 below.

Table 1 MECP Summary Key Comments

Date	Comment / Issue Description	Resolution Description
April 30, 2014	MECP provided the following comments in a response letter to the Notice of Study Commencement: • MECP requested to be involved throughout the process and encourages the County to seek their review of technical assessments to be undertaken as part of the study. Consultation with the MECP is strongly recommended to ensure that the resulting studies are found to be acceptable. • An Aboriginal Consultation Information document along with a Preliminary Assessment Checklist were provided for reference and use in the study as part of Aboriginal Consultation and the Crown's duty to consult First Nation and Metis Communities.	• Well Testing/Program Protocol, PTTW applications and Hydrogeological Reports were submitted to the MECP for review and comments at the appropriate stages. • Aboriginal and first nations consultation was carried out as part of the Class EA study. No additional consultation requirements with these groups/communities were identified.
September 2, 2014	MECP requested additional information to support a proposed pumping test for the St. George Well TW 4/09 and a Category 2 PTTW Application.	• A memorandum was submitted to the MECP on September 12, 2014, with clarification on 1.) A description of the mitigation strategy to ensure no disruption on private wells during testing, 2.) A list of domestic wells to be monitored during testing and, 3.) A list and location of monitoring wells to be instrumented for the test and monitoring frequency.

Date	Comment / Issue Description	Resolution Description
		• The Category 2 PTTW for the pumping test was granted on September 29, 2014. TW 4/09 pumping test was completed in December 2014.
April 4, 2016	MECP provided, via email, the following major comments regarding the *St. George Water Servicing Class EA Study, Results of Hydrogeological Testing Program Report, Tim Lotimer & Associates Inc. December 2015*: • Their review was limited to determining whether the 2014 testing program was adequate for confirming a backup water supply source and confirming the source's ability to provide 45 L/s on a sustainable basis. • MECP cannot confirm that the new supply source can provide the required 45 L/s, as the pumping test was conducted for 72 hours at a lesser rate of 25 L/s. Therefore, additional hydrogeological investigations will be required if a backup water supply is to be placed in an aquifer other than the municipal aquifer (Upper Eire Phase Aquifer). • Additional hydrogeological work is expected to include additional data on vertical hydraulic gradients under pumping and non-pumping conditions to evaluate the magnitude of downward leakage from the Grand River Aquifer through the Port Bruce Phase Aquitard into the municipal overburden aquifer (Upper Eire Phase Aquifer) or to evaluate the magnitude of recharge from the bedrock aquifer through the Catfish Creek Till into the municipal overburden aquifer. • The monitoring network was found to be inadequate in providing adequate spatial coverage for water quantity impact monitoring. Construction details of the monitoring wells are recommended to be submitted for MECP review prior to commencement of any pump test of a larger diameter well.	• MECP comments were incorporated in the work plan to drill two bedrock wells within the vicinity of a new monitoring site MW 1/14. The recommendation to drill new bedrock wells was based on the results of the testing program undertaken in December 2014. • CIMA+'s hydrogeologist also met with the hydrogeologist with the MECP Technical Support Section prior to the aquifer testing to discuss the hydrogeological study program findings to date and the proposed next steps (implementation of a 72-hour aquifer test of the bedrock test wells at 45 L/s). It was explained that a key purpose of the aquifer test was to determine if there would be unacceptable impacts to private well users, within the radius of influence, from the pumping of the new bedrock wells (to determine if mitigation would be necessary) and to confirm that the water quality meets the Ontario Drinking Water Standards. MECP's hydrogeologist acknowledged that this was a reasonable next step in this on-going groundwater source investigation but that ultimately pumping of all wells together (both existing and proposed) at the design maximum day demand (124 L/s) may be required when an application for a PTTW to use the final well configuration is submitted for review. • The proposed work plan for the new bedrock wells included the following: – Completion of aquifer testing at the required back-up yield of 45 L/s to confirm the capacity of the new back-up water supply and the location of the new well(s). – Enhanced development of the new bedrock wells to achieve their maximum efficiency prior to aquifer testing. – Installation of a new monitoring well installed between the bedrock test well site and the municipal well site and more concentrated monitoring of water levels from the existing monitoring well network to collect additional hydrogeological data. • A PTTW application was submitted to the MECP in June 2016 for a maximum pumping rate of 50 L/s. • The Category 2 PTTW for the aquifer testing test was granted on August 18, 2016. Bedrock and aquifer testing was completed in December 2016.
August 30, 2019	MECP provided, via email, the following comments in a response letter to the Draft Environmental Study Report (ESR):	A response letter to the MECP was issued on January 23, 2020, with the following clarifications/ responses:

<table>
<tr><th>Date</th><th>Comment / Issue Description</th><th>Resolution Description</th></tr>
<tr><td></td><td>The ESR should be revised to include a discussion of potential new wellhead protection areas for each well location and consider the impact of applying new policies to these areas. The ESR should also include a discussion on changes to the existing WHPAs for the St. George system and consultation with potentially affected property owners.
MECP agrees that from a water quantity perspective, an adverse impact on the private bedrock water supply wells is unlikely; however, a long-term pumping test combining the new bedrock wells and the existing municipal wells at a combined rated capacity of at least 90.9 L/s has not been completed and will be required to amend the existing water taking permit for the system.
The conclusion that the bedrock aquifer can meet a rate of 124 L/s and that no negative impact on the existing municipal water supply system at this rate, is premature and cannot be independently confirmed.
The suggestion for additional testing to identify the production zone(s) with higher arsenic concentration for sealing could improve water quality; however, it could also negatively affect the wells' yields and long-term sustainability.
MECP concurs that proposed mitigation measures outlined in the draft ESR will prevent measurable surface water impacts in and around the area.</td><td>The Lake Erie Source Protection Region completed an update of the Grand River Source Protection Plan which includes the new WHPAs for the existing overburden and proposed new bedrock wells for the St. George System, at the proposed water taking of 45 L/s. Significant Drinking Water Quality Threats were also identified and the Significant Drinking Water Threat Policy Applicability was developed. A separate public consultation program was carried out to discuss potential implications with the potentially affected property owners. This information has been included in Sections 3.2.1 and 13.4.1 of the ESR.
No adverse impact on nearby surface water features is expected based on the results of the hydrogeological program and the presence of a thick unit with low conductivity that isolates existing surface water features in the vicinity of the proposed new bedrock wells from the bedrock aquifer. Also, previous testing showed no response to pump well testing in the contact aquifer, at monitoring wells completed adjacent to nearby surface water features.
Impacts from steady state pumping were estimated using both analytical and model simulations and showed that the rates were sustainable. Additional confirmatory testing of the new bedrock production wells, once drilled, are considered necessary if they are to be pumped at rates significantly higher than 45 L/s, however, it is the consultant's hydrogeologist's opinion, that a combined aquifer test involving pumping both the new wells and the existing municipal wells would be very difficult and costly to implement. Test data from a previous tests of the existing municipal wells combined with recent model simulations could be utilized to support an application for a new PTTW.
The feasibility to reduce arsenic levels is recommended to be explored during detailed design through further testing along with an assessment of all pros and cons.
The ESR was revised to address the MECP comments. A copy of the final ESR will be provided to the MECP when the report is filed for the 30-day review period.</td></tr>
<tr><td>July 27, 2020</td><td>MECP provided the following comments, via email, to the County's response letter dated January 23, 2020:
The County has not conducted further work to evaluate the hydraulic connection between the overburden and bedrock aquifers due to cost and operational challenges, which is considered unacceptable. A long-term pumping test</td><td>A phone discussion took place on September 23, 2020, between MECP, the County, CIMA+ and Tim Lotimer to discuss the next steps.
A memo was prepared by the Project Team, outlining the proposed scope for additional hydrogeological work to address MECP concerns. The memo was submitted to the MECP for review and commets on January 20, 2021.</td></tr>
</table>

Date	Comment / Issue Description	Resolution Description
	involving permitted wells in both aquifers at a combined system rated capacity of 90.9 L/s or more is necessary to gather technical data for a long-term PTTW. • The consultant's response is not reasonable for a long-term PTTW approval, and actual well hydraulic testing at the system rated capacity is necessary to support increased water taking from the municipal wells. The bedrock aquifer's ability to sustainably yield 124 L/s has not been confirmed. • The County's response does not clarify their plan for addressing potential arsenic issues in the bedrock aquifer. Options such as blending or chemical treatment should be further explored during the drinking water system licensing process.	

January 29, 2021	The following comments were received from MECP, via email, on the proposed hydrogeological work plan, submitted ib January 20, 2021:
	• The MECP indicated that the Stage 1 work plan alone would not address the current Permit to Take Water study requirements and continued to advise that a "long-term pumping test involving all municipal wells operating at or close to the system capacity of 90.9 L/s" would be necessary to confirm the water supply.
	• Additionally, The MECP also expressed their opinion that utilizing modeling derived simulations to confirm the source capacity and its effects on the natural environment for a flow rate higher than that of the pump testing is an unacceptable approach.
		• CIMA's noted that work would proceed with Stage 1 of the proposed work plan and consultation with the MECP would occur once preliminary analysis results were available.
		• Information was exchanged between the County and MECP via email between August 2022 and November 2022. An updated response letter to the MECP comments dated August 30, 2019, was issued by the County on August 26, 2022, with the following responses:
		  • A numerical groundwater flow model and hydrologic model were used to delineate WHPAs for the St. George Drinking Water System, which included both the existing and proposed new wellfield. SPPP's were developed by the County for the new WHPA's in cooperation with the Source Protection Authority, and the WHPA's and SPPP's were incorporated into the Approved Grand River Source Protection Plan in February 2022.
		  • The County has been monitoring nitrate levels in existing production wells and nearby monitoring wells. Nitrate concentrations have been fluctuating around or slightly below 5 mg/L (MAC:10 mg/L) with no clear trend. Further analysis and evaluation will be carried out through MECP funding provided to the Lake Erie Source Protection Area, and monitoring of nitrate concentrations will be part of the start-up and operational plan for the new wellfield. Nitrate concentrations in the water from the bedrock aquifer are not expected to be a concern, and if they remain low, it will decrease the overall nitrates in the water distributed to consumers.
		  • The new wellfield is intended to provide redundancy to the water supply, not to increase the total quantity of water supplied to

<table>
<tr><th>Date</th><th>Comment / Issue Description</th><th>Resolution Description</th></tr>
<tr><td></td><td></td><td>the water distribution system. Since both well fields will not be operated simultaneously at permitted capacity, a long-term pumping test involving all existing and test wells is not required.
Based on the County's latest estimation, the projected design criteria/maximum day demand for the system is 4,189 m3/d (48.5 L/s).
The new PTTW should include both the existing and new wellfields, with the conditions that the terms for the existing wellfield remain the same, the terms for the new wellfield be for the capacities in the ESR, both wellfields can operate simultaneously if the conditions for each well are met and the total taking does not exceed 6,030 m^3/day.
Further investigation needed to determine if arsenic levels change with sustained pumping.</td></tr>
<tr><td>October 4, 2022 – February 22, 2023</td><td>MECP provided, via email, the following comments in response to the County's letter dated August 26, 2022:
MECP suggested updating the 2018 Draft ESR to reflect the new information on predicted future water demand, based on the County's Memorandum, dated August 22, 2022.
As the bedrock well field (TW1/16 and TW2/16) are located approximately 1.5 km northwest of the existing St. George well field (i.e., overburden aquifer), the source of groundwater (bedrock verses overburden) and zone of influence are different in these two well fields, the impacts on water well users and other receptors are considered different in each well field, and monitoring requirements are considered different for these two separate well fields, a separate PTTW for this bedrock well field is preferred.
A separate PTTW for the bedrock well field (TW1/16 and TW2/16) is preferred as it is located 1.5 km northwest of the existing St. George well field and has a different source of groundwater and zone of influence, leading to different impacts on water well users and other receptors. The monitoring requirements for these two separate well fields are also considered different.
The Draft ESR should be revised to include information on the treatment of arsenic in bedrock groundwater and speciation of dissolved arsenic. It should also identify potential zones of arsenic-</td><td>A vitual meeting was held on February 28, 2023, between the MECP, the County, CIMA+ and Tim Lotimer to review outsdtanding comments and a path moving forward. Main outcome items from the discussion are:
It was clarified the the new proposed bedrock wells are intended to provide security of supply and redundancy in the system, which is currently lacking with the three (3) production wells sitting on the same aquifer and adjacent to each other. MECP noted that a separate PTTW would be issued for the new production wells.
The ESR would be revised to relect the new max. day demand projections for the St. George settlement area, as per County's 2022 latest projections. Section 6.1 of this ESR has been revised accordingly.
CIMA noted that selection of the preferred treatment technologies is out of the scope of the Class EA study. However, a preliminary treatment recommendation can be made based on the water quality data obtained from the test wells drilled as part of the EA study. Accordingly, and based on the theoretical iron to arsenic ratios observed, greensand filtration is deemed a highly suitable technology for the new production wells. It was agreed by all that additional discussion on the preliminary recommendation for viable treatment technologies would be added to the ESR and that the need for pilot testing would be deferred to the design phase since the production wells are still to be built. Section 10.11 of this ESR has been revised accordingly.
It was also agreed that bench-scale testing is</td></tr>
</table>

Date	Comment / Issue Description	Resolution Description
	rich bedrock and characterize its mobilization mechanism, if considered. Bench-scale laboratory testing may also be required to determine the feasibility of the preferred treatment method, and to evaluate any changes in water quality and system performance resulting from the mixing of treated water from the bedrock and existing overburden wells.	not feasible at this time since the production wells are not built, nor the treatment equipment installed. It was noted that both well fields will produce treated water quality in full compliance with the Ontario Drinking Water Quality Standards (OODWQS), Objectives and Guidelines, therefore minimizing any potential upsets in the distribution system for mixing of different source water quality.

3.4.2 Ontario Ministry of Tourism, Culture, and Sport (MTCS)

The responsibility for the administration of the Ontario Heritage Act and matters related to cultural heritage have been transferred to the Ministry of Citizenship and Multiculturalism (MCM). However, at the time of consultation, it was under the purview of MTCS.

Email correspondence was received from the Ontario Ministry of Tourism, and Sport (MTCS) on October 8, 2014, and December 6, 2017 in response to their review to the materials presented in PIC No.2 and No.3, respectively. The 2014 correspondence provided some recommendations for additional screening documentation to be undertaken as part of a Schedule C Class EA in terms of archaeological resources, built heritage resources and cultural heritage landscapes. Furthermore, all technical heritage studies and their recommendations are to be addressed and incorporated into EA projects, with copies of these studies provided to MTCS before issuing a Notice of Completion for their review. The 2017 email acknowledges that archaeology and cultural heritage was incorporated within the Class EA evaluation of the alternatives and further reiterated their general comments from the 2014 correspondence.

A Stage 1 Archaeological Assessment and a Cultural Heritage Impact Assessment were prepared in association with the St. George Water Servicing Class EA Study. The findings and recommendations of these assessments were incorporated in the development and evaluation of water servicing design concepts, as described in subsequent sections of this report. A copy of the Stage 1 Archaeological Assessment Report was originally submitted to the MTCS on April 1, 2015. Copies of the Stage 1 Archaeological Assessment and a Cultural Heritage Impact Assessment Reports were submitted electronically to the MTCS on February 23, 2018 for their review.

3.4.3 Grand River Conservation Authority (GRCA)

The Grand River Conservation Authority (GRCA) was in the process of initiating some modelling work to update the delineation of the Well Head Protection Areas in St. George and Lynden in Hamilton. Although this work was not directly related to the St. George Water Servicing Class EA Study, the County provided GRCA with information on the location of the proposed new bedrock wells and well construction records for those wells, for GRCA's review and use in their further work. GRCA, in collaboration with the Lake Erie Source Protection Region, completed an update of the Grand River Assessment Report and Source Protection Plan (AR and SPP), which included the St. George Well Supply. This update was carried out as a separate assignment to the St. George Water

Servicing Class EA Study; however, applicable information resulting from the update exercise has been included in the ESR, as requested by the MECP.

No comments were received from GRCA in association with the St. George Water Servicing Class EA Study.

3.4.4 Other Agencies

Early on in the Class EA Study, standard response letters or emails were received from some of the provincial and federal review agencies, including the Canadian Environmental Assessment Agency, Aboriginal Affairs and Northern Development Canada, Transport Canada, the Minister of Fisheries and Oceans Canada, the Ministry of Transportation, in response to the Notice of Study Commencement and PIC No.1. Copies of the correspondence are included in Appendix D. General comments from these agencies included the need for the proponent to determine the applicability of their regulations or their involvement in the St. George Class EA Study based on the location of the project and the potential features to be impacted as a result of the project. Copies of the material presented at PIC No.1 were provided to some of these agencies as requested in their initial correspondence. No major comments or additional feedback was received from these agencies.

3.5 First Nations and Aboriginal Groups

Based on a series of Supreme Court rulings over the last decade, First Nations and other Aboriginal communities are increasingly being consulted to a greater degree on development projects that may impact their traditional territory and the resources upon which their cultures and livelihoods depend. The following First Nations have been consulted during this Class EA study to determine their interest and desired level of communication:

- Six Nations of the Grand River Territory
- Mississaugas of the New Credit First Nation
- Six Nations Council Public Works
- Haudenosaunee Confederacy Chiefs Council
- Metis Nation of Ontario.

Public notices and invitations to the project PICs were distributed to the groups noted above. Individual invitation letters were prepared and mailed to the Six Nations of the Grand River in anticipation of the public meetings. Copies of the PIC Notice and PIC boards were attached to the invitation letters. In addition, the letters requested the Six Nations of the Grand River to advise if a separate individual meeting was necessary to discuss the projects. A phone call to the Six Nations of the Grand River took place on June 25, 2014, where they indicated that they did not have any issues with the St. George Water and Wastewater Servicing Class EA studies but would like to be kept informed. No correspondence or response was received from the Six Nations of the Grand River or any of the other First Nations and Aboriginal Groups contacted.

A log documenting the consultation activities that took place with the First Nations and Aboriginal Groups as part of the St. George Water Servicing Class EA Study is included in Appendix E.

4. Study Area Overview

The County was created in 1999 as a single-tier municipality under the name of the Corporation of the County of Brant. The County is in southwestern Ontario and is bordered by the City of Hamilton, Haldimand County, Norfolk County, the Townships of Blanford, Blenheim and Norwich in the County of Oxford, the Township of North Dumfries in the Region of Waterloo, Six Nations of the Grand River and the Mississaugas of the New Credit First Nations, and the encircles the City of Brantford.

4.1 Study Area Location and Site Features

The County includes a number of areas of Urban Settlement including St. George which is the area of interest for the purpose of this project. The boundaries of the study area, shown in Figure 2, coincide, for the most part, with the Primary Urban Settlement Area Boundary for the settlement of St. George.

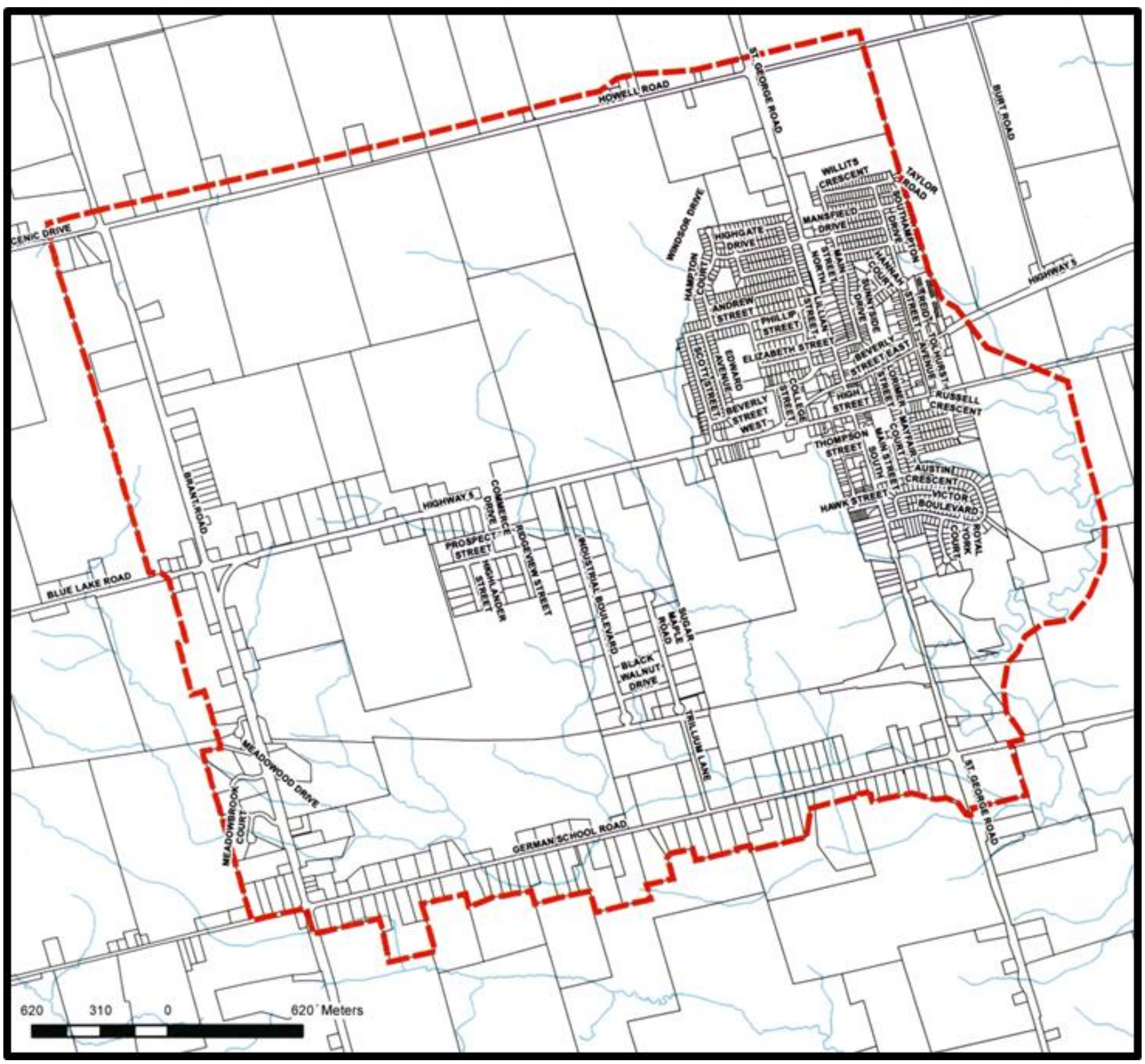

Figure 2 St. George Study Area

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The study area of St. George is generally bounded by Highway 5 and Howell Road to the north, Burt Road to the east, German School Road to the south and Highway 24 to the west. The limits of the St. George study area cover 831 hectares, which include a combination of agricultural fields and developed areas, as well as natural features including woodlands, wetlands, meadows and watercourses.

4.2 Existing Socio-Cultural Environment

4.2.1 Land Uses

The dominant land uses within the study area are agricultural and natural features. The agricultural areas found within the study area include farms and rural low density residential properties which are on partial municipal services. The primary urban settlement receives full County water and sanitary sewage systems.

The 2012 County's Official Plan (OP) has designated the lands within the study area for various types of land uses, as shown in Figure 3.

The St. George area encompasses two existing built-up areas. Generally, residential and other community uses are located in and around St. George and the majority of employment uses are in the west end of the study area extending south of Highway 5, as shown in Figure 3.

St. George is mostly designated as a "Primary Urban Settlement Area" and has access to full County services with a land supply that can accommodate new development. Urban Residential designations are provided in locations within the surrounding and existing built-up area of the historical settlement of St. George, and extend north, west and southwest up to the existing employment lands along Industrial Boulevard and Trillium Lane.

In general, the land uses within the study area in terms of size and proportion with respect to the total study area lands include:

- Urban residential uses account for approximately 378 ha or approximately 42% of the St. George study area
- What was previously known as "Estate Residential" as seen in Figure 5, along German School Road and Highway 24 is identified as "Suburban Residential" and accounts for 126 ha or 14% of the study area lands
- "Core Area" uses account for 9 ha and just over 1% of the study area lands
- "General Commercial" take up 28 ha or 3% of the study area lands
- "Recreational" uses occupy 55 ha of the study area or 6% of the study area lands
- The large "Natural Heritage System" is approximately 123 ha and 14% of the study area lands
- "Institutional" uses comprise a small portion of the land at 5.5 ha and 1% of the study area lands
- "Employment" lands account for 167 ha or 19% of the study area lands.

The county's Growth Plan does not specifically project growth within the St. George settlement study area, but it does project the total population of the County to reach 47,000 by 2031. The 2011 Census anticipated a population of 35,638 by 2031. Similarly, the County's employment projection for 2031 was 19,000 jobs.

4.2.2 Archaeological Features

The 2012 County's OP indicates that a number of archaeological remnants and important archaeological evidence of historic activities exists within the County. This includes the presence of marine archaeological remains including remains of ships, boats and vessels. Artifacts from the contents of boats and belongings of crew or passengers are also included and may be currently under water. Areas of potential archaeological resources, as presented in the County's OP, are identified in Figure 4. It can be seen from the figure that the St. George study area has locations of potential archaeological resources and should be handled accordingly. The location of St. George, with respect to the County, is circled in red on Figure 4.

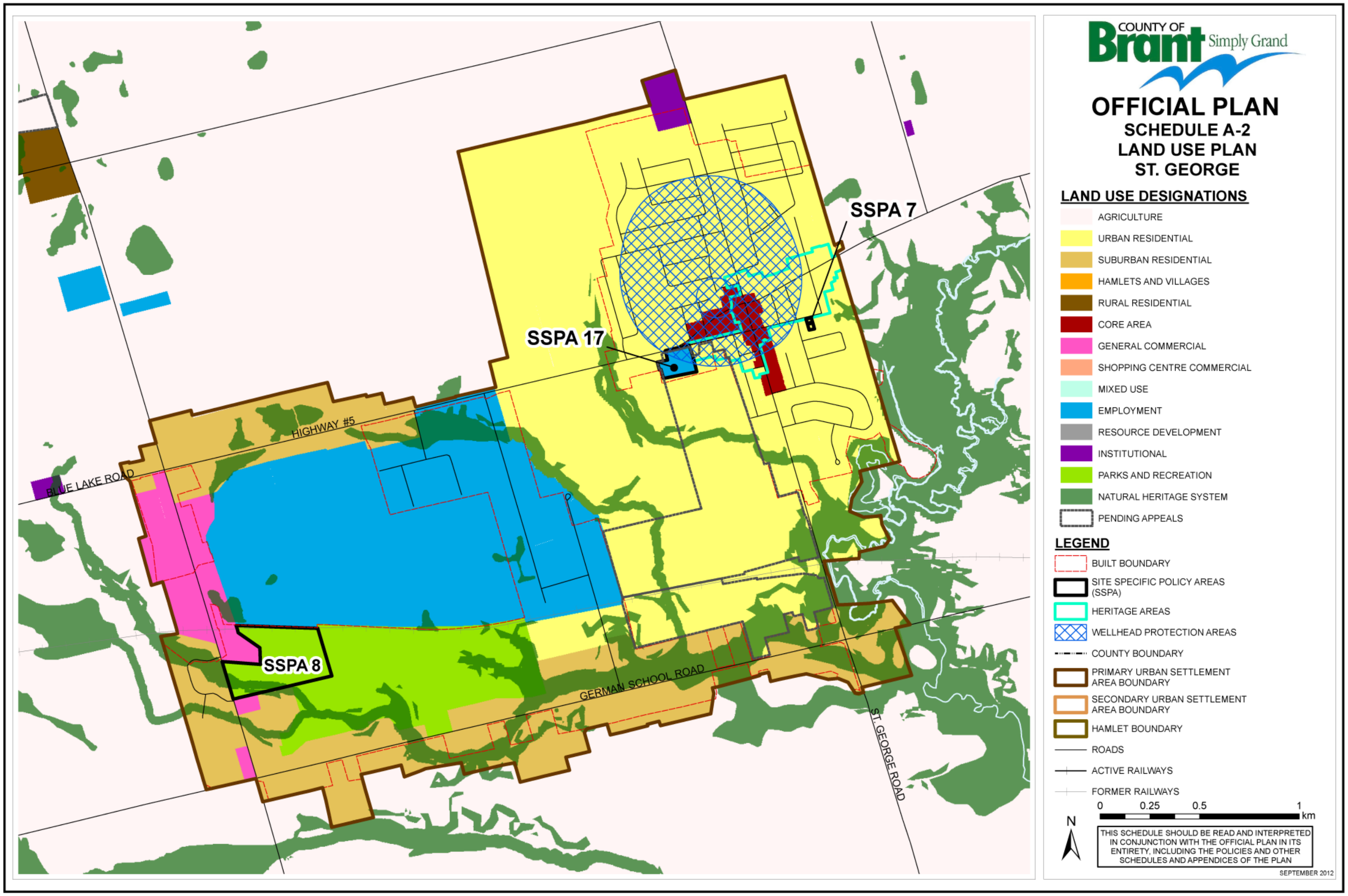

Figure 3 St. George Land Use Designations

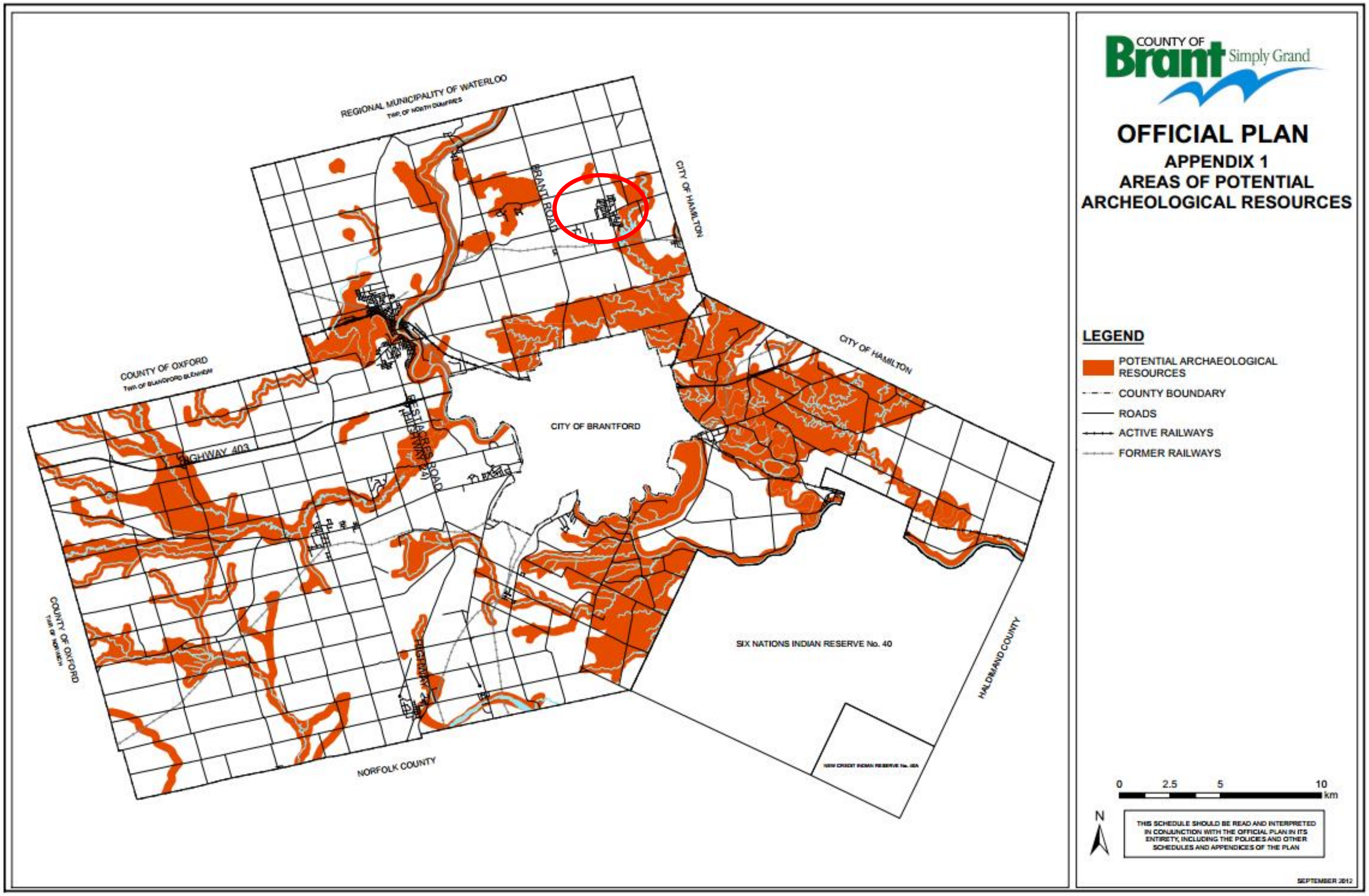

Figure 4 Areas of Potential Archaeological Resources

4.3 Existing Natural Environment

4.3.1 Overview

Background information on the existing natural heritage features in the St. George area has been previously gathered and documented in the St. George Area Study Natural Heritage Report, completed by Natural Resource Solutions Inc. in July 2013, on behalf of the St. George Landowners Group (LOG). The following sections provide a description of the major natural features within the study area.

4.3.2 Designated Natural Areas and Features

St. George is located within the Grand River Watershed and the Fairchild Creek Sub-watershed with significant natural features within these areas and the surrounding vicinity. There are several designated significant natural areas and features within the study area and vicinity, including significant wetlands and woodlands. The overall location of these features is shown in Figure 5, and described in the following paragraphs.

Fairchild Creek Wetland Complex

Approximately 9.5 ha of the Fairchild Creek Wetland Complex overlaps with the southeastern side of the study area, as shown in Figure 5. The Fairchild Creek Wetland Complex is considered a Provincially Significant Wetland (PSW) because it contains significant species, nesting of colonial water birds and active feeding area, winter cover for wildlife and presence of fish spawning and rearing habitat for brown trout and northern pike. The wetland complex is comprised of 88% swamp and 12% marsh with all of these wetland units being riverine, mean they have a permanent surface water inlet and outlet.

The wetland soils are most clays, loams or silts with a smaller portion (approximately the remaining 5%) being organic. The wetlands within the study area are mostly cattail and common reed shallow marshes and small pockets of poplar mineral deciduous swamp wand white cedar-hardwood mixed mineral swamp communities.

St. George Forest Environmentally Significant Area

The 104 ha St. George Forest, located just east of the study area, is listed as an Environmentally Sensitive Area (ESA). This ESA is composed of upland deciduous forest, sedge and rush meadow, secondary deciduous forest, floodplain forest and old fields. It has been listed as an ESA for the following reasons:

- It consists of Pleistocene deposit, which is only found in this location within the County
- It contains regionally significant vegetation communities such as floodplain forest
- It contains regionally significant plant and wildlife species
- The site is easy to access and contains a high diversity of habitats which makes it suitable for conservation and educational purposes.

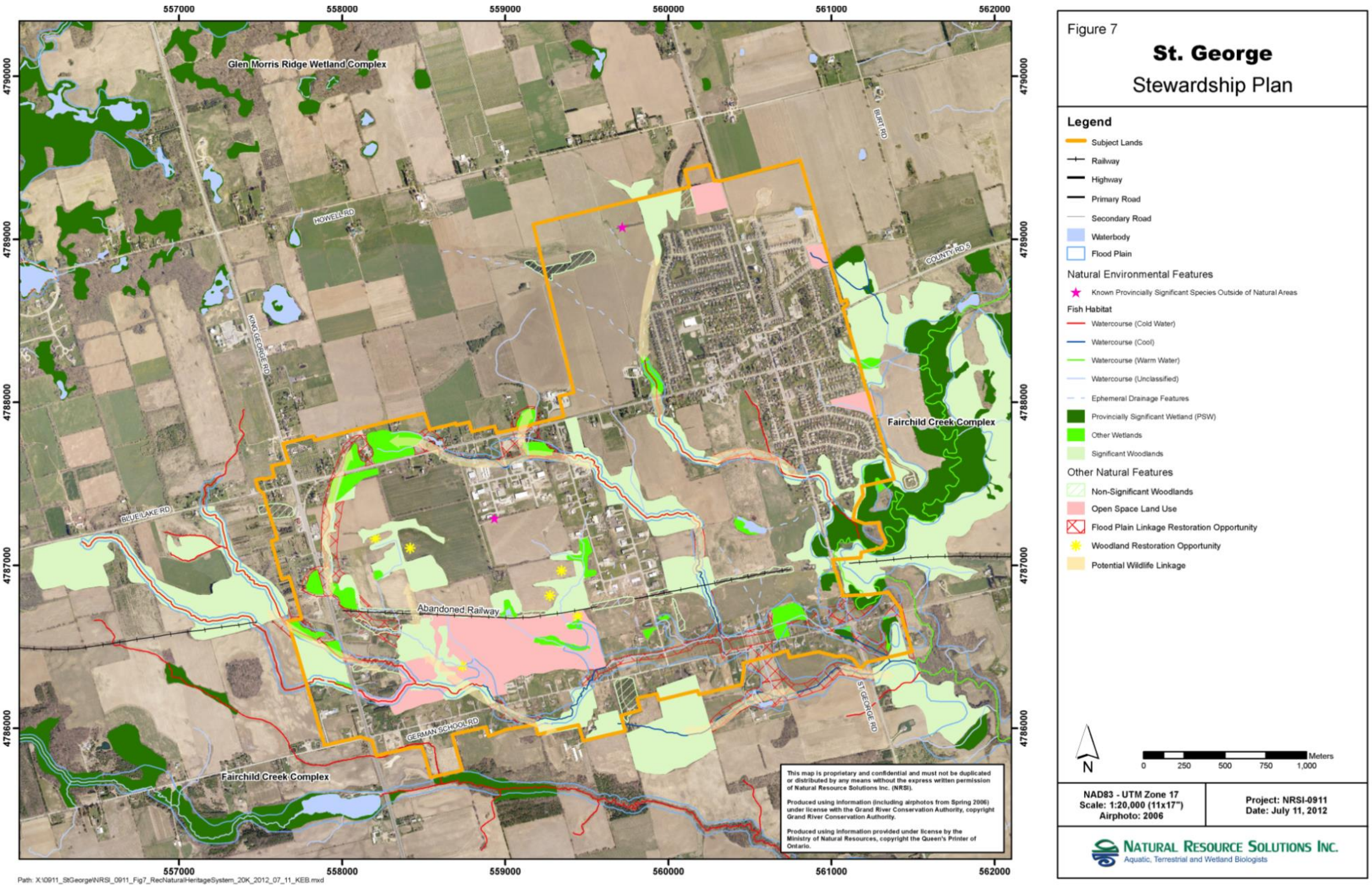

Figure 5 Overall Location of Designated Natural Areas and Features

Areas of Natural and Scientific Interest

There are no Areas of Natural and Scientific Interest in the St. George study area (MNR 2012).

4.3.3 Vegetation Resources

Vascular Flora

A total of 235 species of vascular flora were identified within the study area by NRSI biologists. The list of vascular flora species was limited to the areas where access was possible. The most significant vascular plants found within the area are presented in Table 2.

Table 2 Study Area – Significant Vascular Plants

Common Name	Description / Observations	Source
Northern Pin Oak	Not protected under the provincial or federal Species at Risk Act Observed in several locations in the centre of the study area Considered regionally rare S3 - Vulnerable Provincial Status	MNR/NRSI
Fern-leaved False Foxglove	Not protected under the provincial or federal Species at Risk Act Known to grown on sandy soils in forest openings Not observed in the study area during 2009 field services but the study area is a suitable habitat Known associated species are present in the area S2 - Imperiled Provincial Status	MNR
Pignut Hickory	Not protected under the Species at Risk Act An upland species that occurs on well-drained sites with other broad-leaf trees Observed during work on the Empire Communities lands and within the woodlands immediately east of the Empire Community Lands Considered regionally rare S3 - Vulnerable Provincial Status	NRSI/MNR/ Ecoplans
Butternut	Considered provincially and national endangered due to fungal disease that has destroyed one third of the Ontario population Several of those observed in the study area appeared to be infected and some were dead, standing snags S3 - Vulnerable Provincial Status END - Endangered as per OMNR and COSEWC	NRSI/ Ecoplans
American Chestnut	Provincially and nationally Endangered species Reported in the north of the study area Occurs on a variety of sites, growing best on well-drained sands and gravels It is usually found mixed with other broadleaf trees and was once prominent in southern Ontario END - Endangered as per OMNR and COSEWC	MNR
Hamlock Parsley	Reported southwest of the study area in 1993 Suitable habitat for this species includes cold swamps, wet woods and riverbanks This type of habitat is present, but limited, within the study area S2 - Imperiled Provincial Status	MNR

Vegetation Communities

The landscape within the study area is mostly flat to gently sloping. Vegetation communities include deciduous forests, coniferous plantations, cultural meadows, swamp and marsh. Descriptions of these communities are provided in Table 3 with location shown in Figure 6.

Significant vegetation communities such as prairie, savannah and oak woodland types are known to occur in the County of Brant and the local area. During background data collection in 2013, the Ministry of Natural Resources indicated that there was the potential for significant oak woodland and prairie communities to be present within the study area.

Table 3 Study Area – Significant Vegetation Communities

Common Name	Classification	Description / Observations
Dry to Moist Old Field Meadow (CUM1-1)	Cultural	Is the result of cultural-based disturbance, mainly agriculture Vegetation has recolonized agricultural fields taken out of production Consists of a large population of non-native plants
Coniferous Plantation (CUP3, CUP3-2)m CUP3-6)	Cultural	These communities are found dispersed throughout the study area Mostly a mix of species
Mineral Cultural Wetland (CUW1)	Cultural	This community is present within the residential and developed areas Primarily private, wooded lots and consist o f a variety of trees
Deciduous Forest (FOD)	Forest	Dominated by sugar maple and/or white ash
Dry-Fresh White Ash Deciduous Forest (FOD4-2)	Forest	Dominated by white ash with small numbers of white pine and sugar maple
Dry-Fresh Sugar Maple Deciduous Forest (FOD5)	Forest	Dominated by sugar maple with small numbers of black cherry, American elm, black walnut and white ash Several dead butternut trees, a species at risk, were observed from the old rail line, indicating more live butternuts could be present within the woodlot A tributary of Fairchild Creek runs through this forested community Majority of the forest has groundcover consisting of white trillium, false Solomon's seal and jack-in-the-pulpit
Dry-Fresh Sugar Maple-Beech Deciduous Forest (FOD 5-2)	Forest	This vegetation community borders the eastern edge of the study area
Sugar Maple-White Ash Deciduous Forest (FOD 5-8)	Forest	A portion of a cold water tributary runs through this vegetation community with likely contributes to the cooling of the stream
Fresh-Moist Lowland Deciduous Forest (FOD7)	Forest	Relatively abundant throughout the study area and typically associated with riparian and floodplain areas
Fresh-Moist Poplar Deciduous Forest (FOD8-1)	Forest	Three poplar dominated forests exist within the study area One is within the Riverview Holdings Lands The other two are located at the northern end of the study area west of the cemetery
Dry-Fresh White Pine-Sugar Maple Forest (FOM2-2)	Forest	There is a network of trails through this community used by local residents

Common Name	Classification	Description / Observations
Reed-Canary Grass Mineral Marsh (MAM2-2)	Wetland	Comprised almost entirely of reed-canary grass
Mineral Shallow Marsh (MAS2)	Wetland	Vegetation community dominated by common reed or cattails
Mineral Deciduous Swamp (SWD)	Wetland	The majority of mineral swamps in the study area are deciduous, dominated by poplars including trembling aspen and balsam poplar with smaller numbers of eastern cottonwood and large-toothed aspen

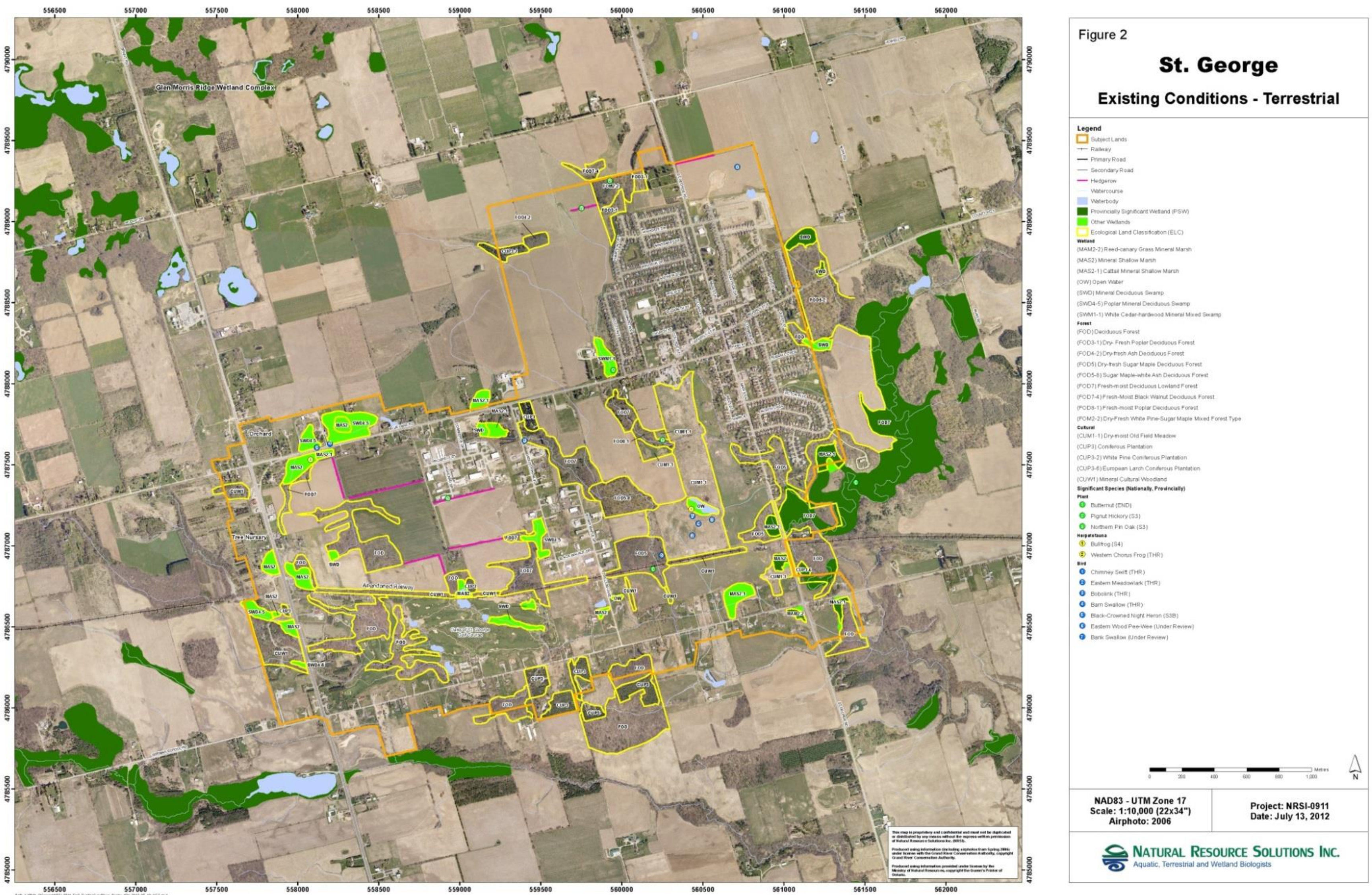

Figure 6 Location of Vegetation Resources

Wetlands

The wetlands in the study area of St. George are all a part of the Fairchild Creek subwatershed so it was appropriate to study all of them as one complex. The location of the wetlands in the study area is shown in Figure 7. There is one very small wetland in the study area that was unevaluated and lacks significant ecological functions.

All other wetland polygons in the study area are within 750 m of each other and can be considered as a stand-alone complex, with a total complex size of 22 ha. The wetland complex in the study area is considered non-significant based on the scoring achieved. The large wetland complex in the study area can be identified as the core area, while the smaller wetlands perform valuable functions with the potential to be incorporated into the natural heritage system based on factors such as location, association with other natural vegetation types and presence of significant species and habitats.

Woodlands

The County has 13% woodland or forest cover with 25% of all woodland found in five (5) forests within the County. Most of the woodland is found in association with other natural environmental features such as swamps and wetland complexes. Figure 7, shows the woodlands found within the study area. Woodlands and vegetation have been identified and delineated by the County as a constraint to development.

In its Official Plan (2012), the County defined significant woodlands as "an area which is ecologically important in terms of features such a species composition, age of trees and stand history; functionally important due to its contribution to the broader landscape because of its location, size or due to the amount of forest cover in the planning area; or economically important due to site quality, species composition or past management history."

There are a number of woodlands within the St. George study area which are considered significant. Significant woodlands are recommended to be included in the Natural Heritage System and are protected by policies.

4.3.4 Wildlife Resources

Currently, no regional lists for rare species exist for the County of Brant; however, there are regionally significant species lists for neighbouring counties including Waterloo and Hamilton. There are a total of 116 local bird species known to be present in the local area. According to the Ontario Breeding Bird Atlas, size provincially and nationally significant species have been observed in the vicinity of the study area.

There were 58 species of birds were observed by NRSI biologists during breeding bird point counts and an additional nine (9) species were observed over the duration of other field surveys. The highest level of diversity was 24 species and the lowest diversity of species was 16. The NRSI biologists observed five provincially significant bird species within the study area. Four (4) recently listed provincially and nationally threatened species of birds were also observed in the study area:

1. Chimney swift
2. Bobolink
3. Eastern Meadowlark
4. Barn Swallow

All four (4) of these bird species prefer agricultural lands, open meadows or grassland habitat which are all present within the study area. In addition to bird species, the following summarizes the major wildlife resources found within the subject area:

- Twenty-nine herpetofauna species (reptiles and amphibians) are known to occur in the vicinity of the study area according to the Ontario Herpetofaunal Atlas. Nine species have been observed by the NRSI within the study area, including 1 turtle and 8 amphibian species. The study area provides a less than ideal habitat for amphibians due to the lack of wetlands and open water. A number of amphibians' survival relies on the temporary nature of wetlands as they prevent the establishment of fish and other predators. The majority of wetlands within the study area are seasonal, making them suitable for these types of amphibians.
- A number of manmade ponds are also found in the study area and are suitable for turtles as well as amphibians that require permanent water. The habitat in the study area is also suitable in parts for a number of snake species to exist.
- A total of eight (8) species in the study area are known to be Species at Risk (SAR), all of them nationally and 7 of them provincially. The SAR found within the study area include Black-crowned Night-heron, Red-headed Woodpecker, Hooded Warbler, Chimney Swift, Bobolink, Eastern Meadowlark and Barn Shallow.
- 23 mammal species are known to be based in the study area with NRSI biologists recording evidence of nine of these species, all of which are common in Ontario. None of the mammal species in the study area are considered to be SAR.
- There are 50 species of butterflies known to be living in the vicinity of the study area with 15 of them being observed by biologists. These 15 included the monarch butterfly which is considered a SAR. Two (2) common dragonflies were also observed within the boundaries of the study area.

4.3.5 Significant Species

There are a number of nationally and provincially significant species documented in the study area and the NRSI observed several significant species during field studies. Included in these are a number of species that are protected under the Endangered Species Act and/or the Species at Risk Act. Significant plant, fish and wildlife species have been identified and these species may be found in significant natural habitats such as woodlands and wetlands.

SAR open country birds are known to inhabit the study area and make use of meadows and agricultural lands as well as built structures. These habitats are not included in the Natural Heritage System but must be assessed on a site specific basis. Habitat for all levels of significant species exists within the study area and should be protected and enhanced as development planning in St. George progresses.

4.3.6 Aquatic Habitat and Water Resources

Watercourses within the study area are tributaries of Fairchild Creek, which eventually turns into the Grand River downstream of the City of Brantford. The main portion of Fairchild Creek is located to the east of the study area and is classified as a warm body of water, but there are a number of tributaries in the study area which are classified as cool water or cold water streams. Cold water and cool water streams have the potential to support sensitive species such as brook trout. The aquatic habitats in the study area range from agricultural drains and manmade ponds to cold water streams. Fairchild Creek accepts the outfall from the St. George Water Pollution Control Plant (WPCP).

Watercourses in the study area are classified by their temperature. Warm water, cool water, cold water, ephemeral drainage features and unclassified habitats are shown Figure 7.

In general, the cold and cool water tributaries flowing through the study area contribute to the thermal regime of Fairchild Creek and provide habitat and potential habitat for species such as brook trout, which require coldwater temperatures and groundwater for survival. Tributaries classified as cold water include portions of tributary B, the wooded corridors of tributary F, and tributary I downstream of Blue Lake Road. These portions of these reaches are naturally vegetated and relatively undisturbed habitats that contribute to the thermal regime of the tributaries by providing shade from the sun.

Fish Species

The Ministry of Natural Resources maintains a number of fish data and aquatic habitat observations recorded within the St. George study area that dates back to 17 years prior. There is a total of 35 species of warm, cool and cold water habitats known to exist within the study area with no SAR listed. One significant fish species found in the Fairchild Creek is the Greater Redhorse which is identified as provincially vulnerable. Other fish species of interest located in the study area include Brook Trout, Northern Pike and Largemouth Bass.

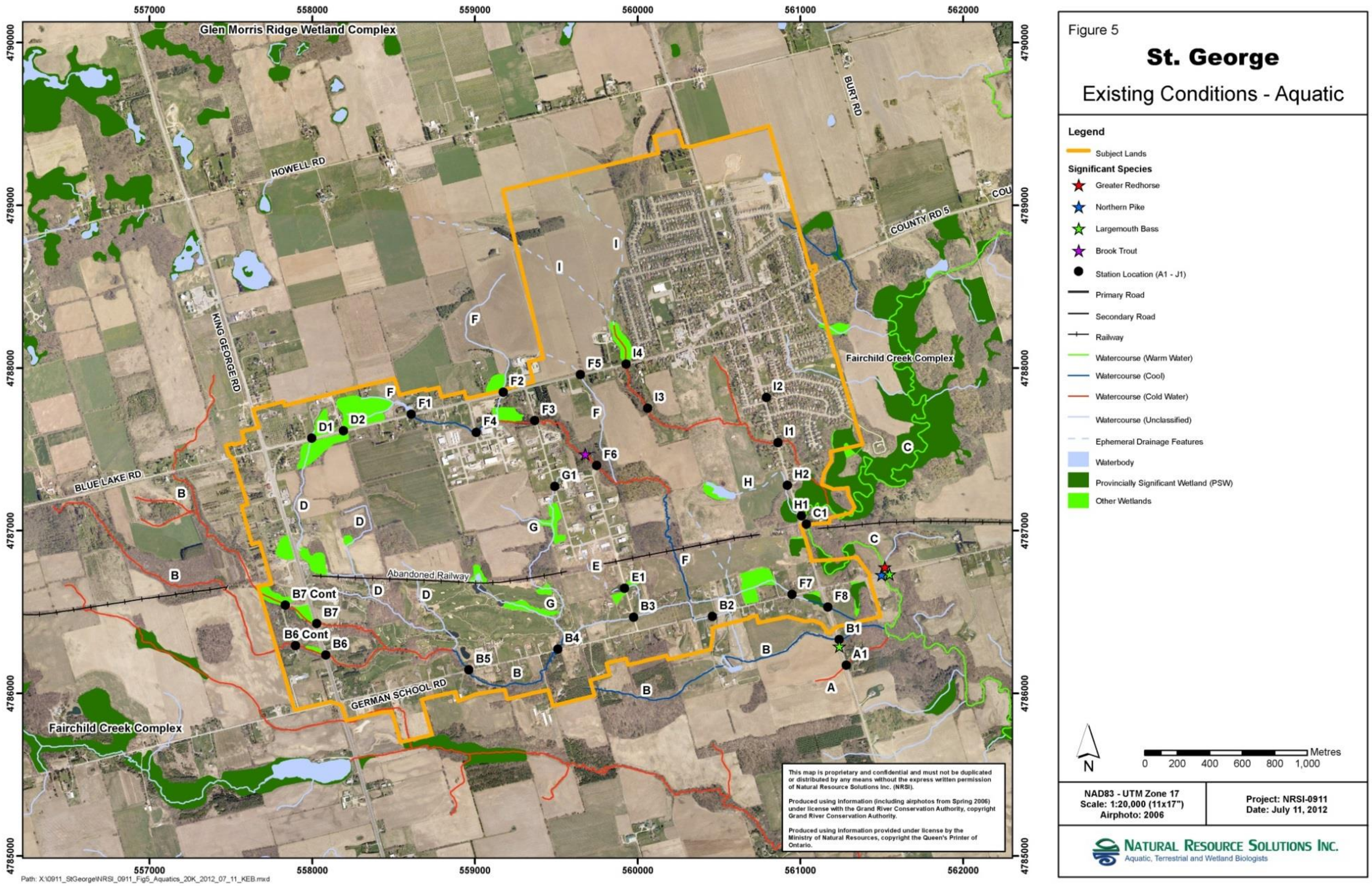

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Figure 7 Location of Aquatic Habitat and Water Resources

4.4 Source Water Protection Areas

A portion of the project study area is found within the Grand River Source Protection Area (watershed) under the Lake Erie Source Protection Region. The Drinking Water Source Protection Plan for the Grand River Source Protection Area (watershed) came into effect on July 1, 2016. The interactive web mapping portal provided by the Lake Erie Source Protection Region was used for identification of the potential vulnerability of the proposed project in Well Head Protection Areas (WHPAs), Intake Protection Zones, Highly Vulnerable Aquifers and Significant Ground Recharge Areas. A screenshot taken from the interactive map tool illustrating the limits of the WHPAs for the St. George Well System is presented in Figure 8. The St. George vulnerability scoring for the WHPAs is presented in Figure 9.

The pink shaded areas shown in Figure 8 are reported to be an Issue Contributing Area (ICA) specifically for Nitrates, where activities and conditions as a result of past activities have or are likely to contribute to elevated concentrations of nitrates for existing wells in the area. Source Protection policies related to Issue Contributing Areas (ICAs) for Nitrate were identified for the entire WHPA for the St. George wellfield. Therefore, any threat-related activity that may contribute to this issue is considered a significant drinking water threat.

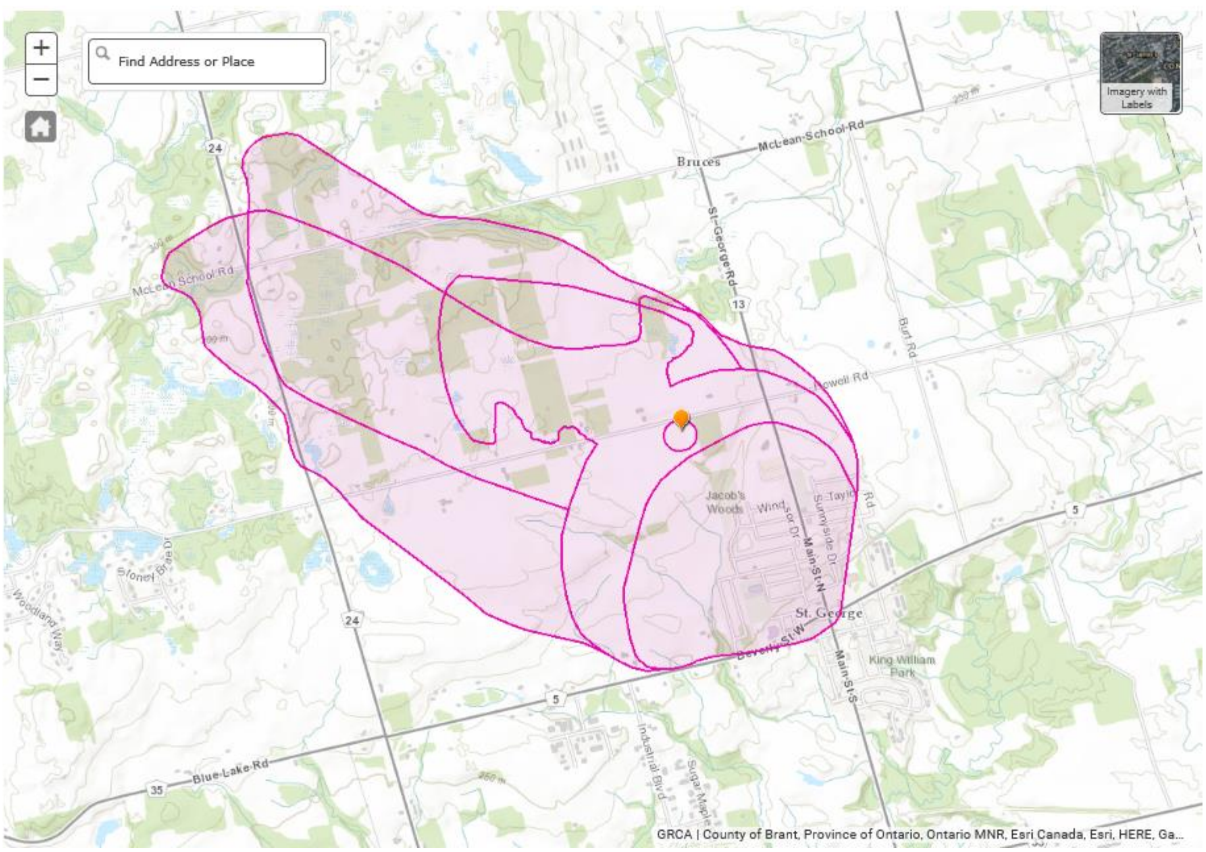

Figure 8 Study Area within the Source Water Protection Areas – Source: Lake Erie Source Protection Region Interactive Mapping Tool

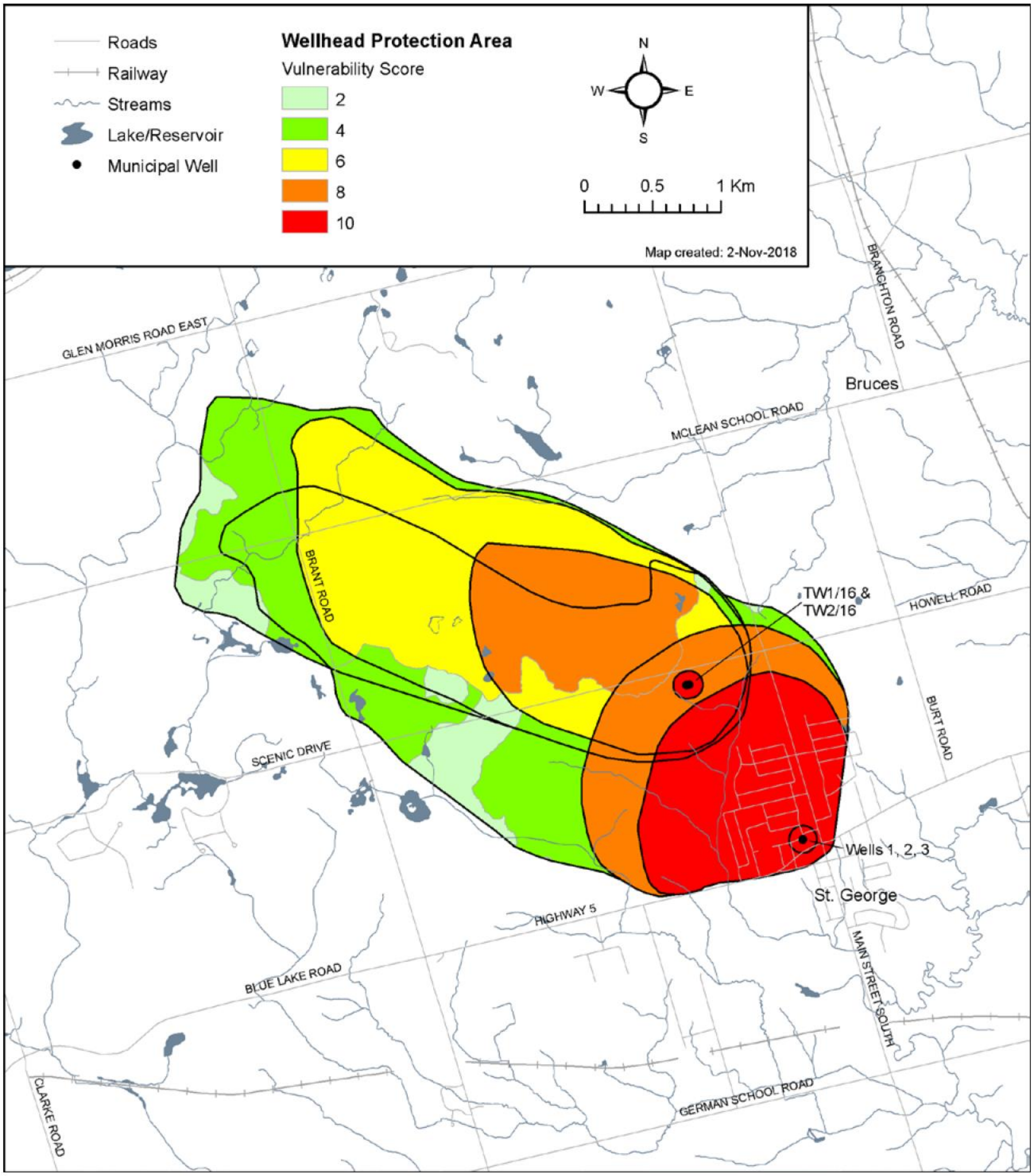

Figure 9 St. George Wellhead Protection Area Vulnerability Scoring – Source: Grand River Source Protection Area Approved Assessment Report, August 16, 2019

4.4.1 Drinking Water Threats for the St. George Overburden Well Supply System

Activities and conditions within the St. George WHPAs that are or could be potential significant drinking water threats for the St. George Well Supply System have also been identified in the Grand

River Source Protection Area Approved Assessment Report, August 16, 2019. These activities are summarized in Table 4.

Table 4 Existing St. George Overburden Well Supply Significant Drinking Water Quality Threats (current to December 2018)

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
1	Waste Disposal Site- Storage of wastes described in clauses (p), (q), (r), (s), (t) or (u) of the definition of hazardous waste	4	WHPA-A
2	Sewage system of Sewage Works – Onsite Sewage Systems	65	WHPA-B ICA
	Sewage System or Sewage Works – Sanitary Sewers and related wastewater collection systems	2	WHPA-A WHPA-B
3	Application of Agricultural Source Material (ASM) to Land	29	ICA
4	Storage of Agricultural Source Material (ASM)	21	WHPA-B ICA
8	Application of Commercial Fertilizer to Land	39	ICA
9	Storage of Commercial Fertilizer	17	ICA
10	Application of Pesticide to Land	3	WHPA-B
11	Storage of A Pesticide	3	WHPA-B
15	Storage of Fuel	9	WHPA-A WHPA-B
16	Storage of A Dense Non Aqueous Phase Liquid (DNAPL)	3	WHPA-A
17	Storage of Organic Solvent	3	WHPA-A
21	Management or Handling Of Agricultural Source Material – Agricultural Source Material (ASM) Generation (Grazing and pasturing)	12	WHPA-B ICA
22	The establishment and operation of a liquid hydrocarbon pipeline	1	WHPA-B
Condition	Off-site contamination of BTEX and F1-F4 that exceed the potable groundwater standards as set out in Table 2 of the Soil, Groundwater and Sediment Standards	2	WHPA-A WHPA-B
Total Number of Activities		**209**	
Total Number of Conditions		**2**	
Total Number of Properties		**84**	

1. *Prescribed Drinking Water Threat Number refers to the prescribed drinking water threat listed in O.Reg 287/07s 1.1.(1).*
2. *Where applicable, waste, sewage, and livestock threat numbers are reported by sub-threat; fuel and DNAPL by Prescribed Drinking Water Threat category*

Note: Certain types of activities on residential properties that are incidental in nature and that are significant drinking water threats are not enumerated. These threats include the application of commercial fertilizer on residential properties, the

storage of organic solvents (dense non-aqueous phase liquids) on residential properties, and the storage of fuel (e.g., heating fuel tanks) on residential properties in natural gas serviced areas. *Note: County of Brant does not consider storm sewer distribution piping and other associated networks such as ditches or unlined trenches to be part of a storm water management facility.*

The large majority of these significant threats are associated with rural/agricultural land use activities within the WHPA-A and WHPA-B high and medium vulnerability zones. Significant threats related to an oil pipeline and a contaminated site were also identified in the St. George vulnerable area.

Existing policies in the Grand River Source Protection Plan may affect activities on vulnerable lands if they are identified as Significant Drinking Water Threats. Under the Ontario Clean Water Act, 2006, it is the person engaged in a Significant Drinking Water Threat activity that may be subject to policies include within the Source Protection Plan.

4.5 Floodplain Areas

Overall location and extent of the floodplain areas within the project Study Area are shown in Figure 10, as per the blue hatched areas. As per Figure 10, the location of the existing St. George supply wells, treatment and storage facilities are outside of the floodplain areas, which can generally be found on the southern limits of the Study Area.

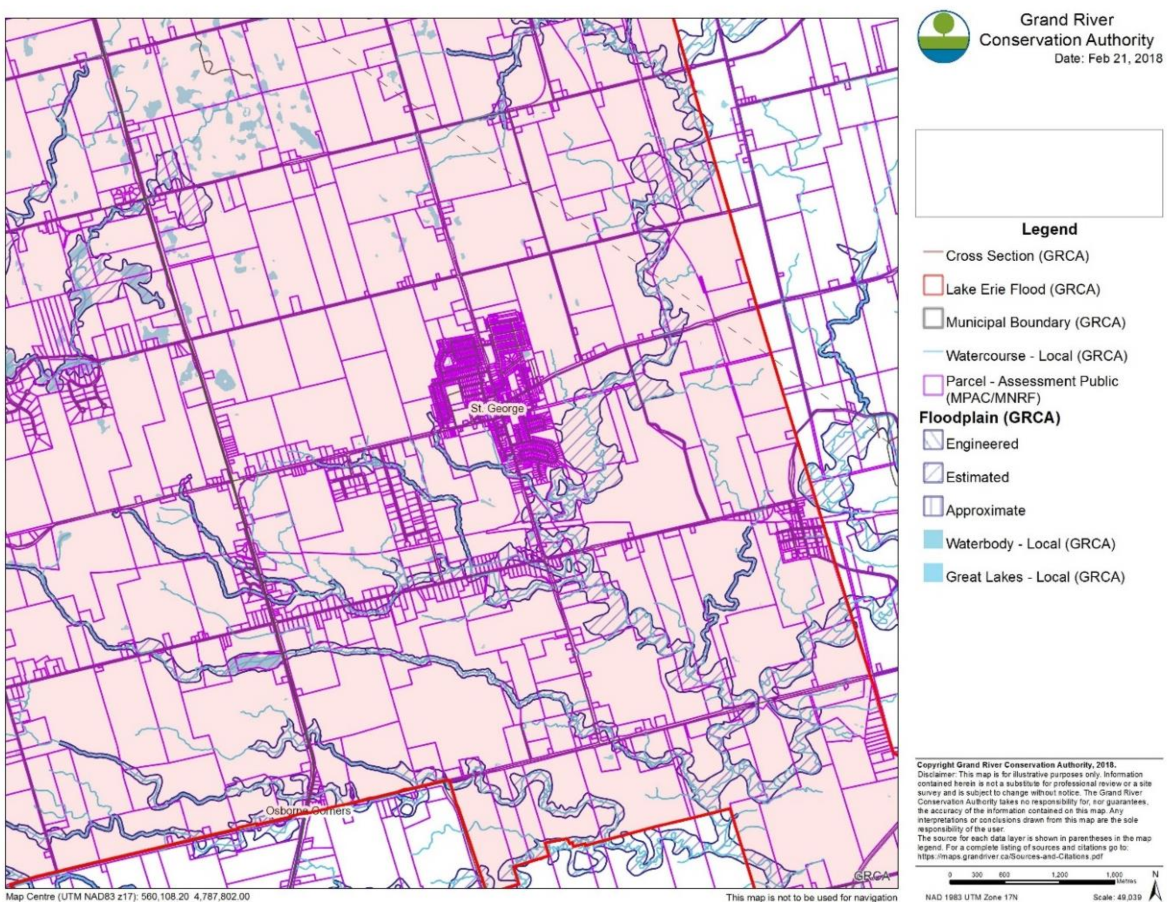

Figure 10 Floodplain Areas – Source: GRCA Interactive Mapping Tool

4.6 Existing Geotechnical and Hydrogeological Conditions

Available hydrogeological information of the study area, including MECP well records and hydrogeological reports were reviewed and compiled by Armstrong Hunter and Associates during a phased exploration program completed between 2010 and 2012, on behalf of the St. George LOG, in support of the St. George Area Study.

The following paragraphs provide a summary of the surficial geology characteristics of the study area, based on the hydrogeological information documented in the past.

The St. George study area was found to have a complex surficial geology with a variety of surficial materials. Surficial materials within this area are dominated by sand and gravel outwash deposits that resulted from a melting glacial ice front to the north. These materials are permeable and have high groundwater infiltration potential. There are also topographically low areas within the outwash channel that are occupied by wetland features and are mostly found in the east central portion of the study area along Highway 5. A small kettle lake also occurs within the area east of Highway 24 and south of Howell Road.

The southern and eastern part of the study area has mostly fine grained glacial lake deposits consisting primarily of silt and clay with some minor sand. The study area drains in a general south easterly direction via tributaries emptying to Fairchild Creek. The underlying bedrock in the area is mostly dolostones of the Guelph Formation and occurs between 180 mASL and 220 in the study area. An east west bedrock valley cuts across the south of the study area with the deepest part occurring south of German School Road and crossing at Highway 24 (Ontario Department of Mines, 1963).

There are three major aquifer sequences occurring within the study area:

- Unconfined outwash sand and gravel deposits
- Buried sand and gravel deposits
- Shallow bedrock – bedrock is encountered at depths of between 25 m to 50 m from surface

The surficial sand and gravel deposits represent an unconfined aquifer which has variable thickness and locally has limited thickness. These types of deposits are found throughout the study area but are more abundant within the northern and central portion of the study area. They will generally be found beneath fine grained confining units or aquitards at depths ranging from 5 to 15 m with varying thickness of 5 and 20 m. Most wells in the area are dug into these deposits.

In areas where the buried granular deposits are of a low thickness or absent, the bedrock is utilized as an aquifer. Most of the wells along German School Road are completed into bedrock. Wells buried in the sand and gravel aquifer yield between 0.076 L/s to 8.4 L/s with most testing between 0.38 L/s and 1.52 L/s. This indicates that there is generally more than adequate groundwater available for most private domestic wells. Most of the water use is reported for domestic use although some minor industrial and commercial use and stock water is also reported.

Water quality is generally reported to be fresh, but a small number of wells south of the study area have reported sulphurous water and in a few cases wells have been reported dry. A number of wells within the study area are considered to be completed into an aquifer of moderate to high aquifer (i.e., well yield) potential.

4.7 Existing Development Constraints

The 2012 County's OP includes development constraints for areas where naturally occurring environmental features exist and human made features or conditions occur. There are specific policies in the County's OP that restrict development on lands and uses that have the potential to be a hazard as a result of human activity, including waste disposal sites, potentially contaminated sites, and the creation of noise, dust and emissions.

The main natural heritage system features and development constraints with the St. George study area, are shown in Figure 11. As shown in the figure, the St. George study area contains significant wetlands as well as hazardous lands and sites.

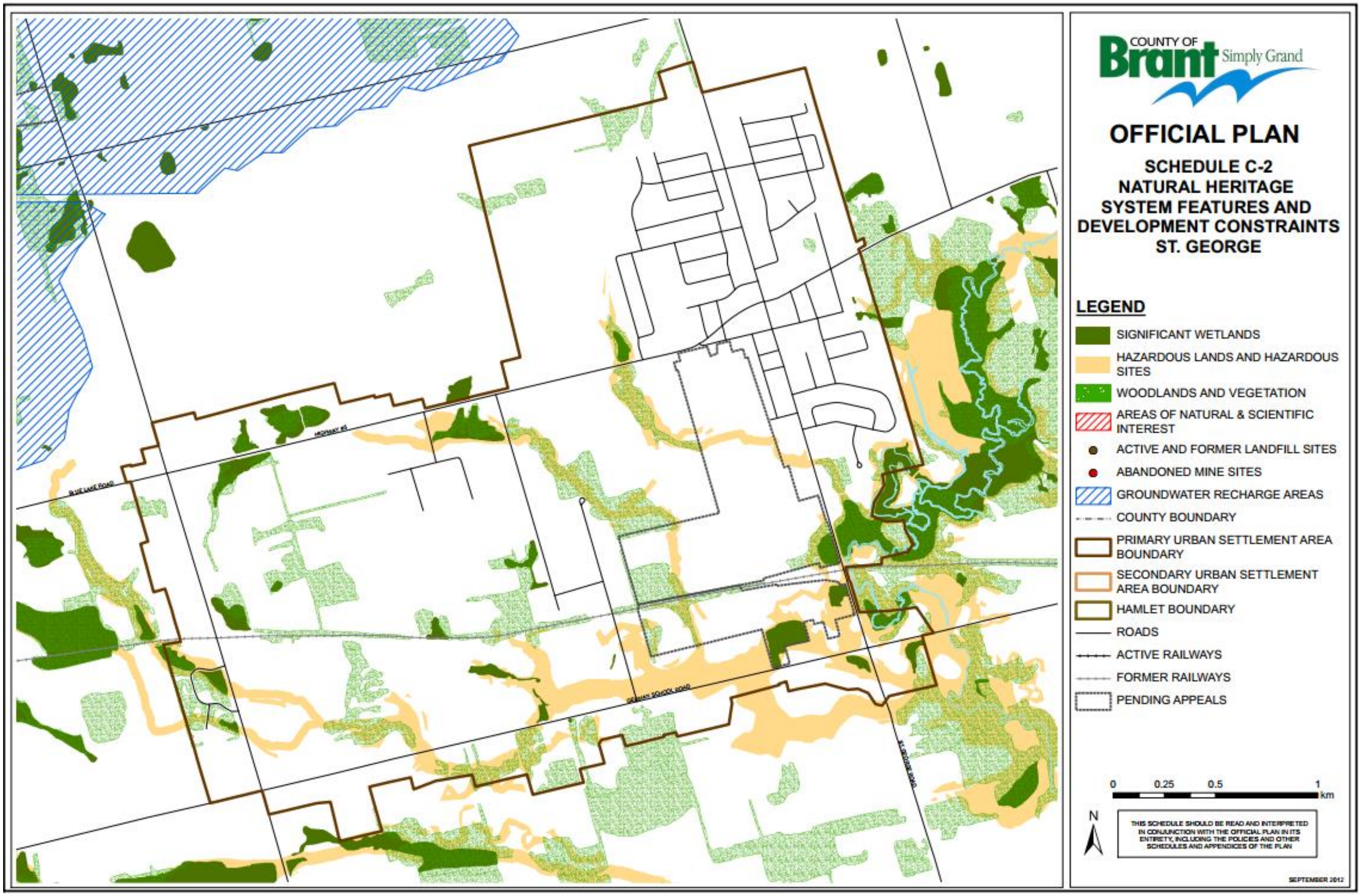

Figure 11 St. George Existing Development Constraints

5. Existing St. George Water System

5.1 System Overview

The existing St. George water Supply System is owned and operated by the County. The water production facilities (i.e., supply wells, treatment and pumping facilities) are located at 20 Church Avenue, while the water storage facilities; elevated water storage tank and standpipe are located at 54 Main Street. A general map showing the overall location of the major components of the St. George water supply system within the St. George settlement boundaries is shown in Figure 12.

The St. George Water Supply System draws its water from three (3) groundwater wells and pumps. Water is disinfected with chlorine and pumped to the distribution system. The rated capacity of the St. George treatment system is 7,855 m^3/d (90.9 L/s) as per Municipal Drinking Water License 062-104 Issue Number 1; however, treated flows at the facility are limited to annual daily average rate of 69.8 L/s, which is dictated by the Ministry of the Environment and Climate Change through the facility's Permit to Take Water (PTTW).

The main components of the St. George water supply system include:

- A Well Pumping Facility Servicing Pressure Zone Nos. 1 and 2, located at the intersection of Church Street and Lillian Street. The facility includes the following:
  - Three (3) drilled groundwater wells completed in the overburden. Two (2) wells, MW1 and MW2 are equipped with vertical turbine pumps, each capable of pumping 45.5 L/s. Well MW3 is equipped with a submersible pump capable of pumping 24.3 L/s. All three (3) wells are non-GUDI (Groundwater Under the Direct Influence of surface water) and located on the same site.
  - A sodium hypochlorite system to provide for disinfection via chlorination. The sodium hypochlorite system includes two chemical storage tanks and two chemical feeding pumps.
  - Two (2) 51.3 m^3 baffled chlorine contact chambers, connected in parallel, for provision of adequate contact time for disinfection.
  - One (1) standby generator capable of powering one of the larger well pumps and treatment.
- Water Storage Facilities consisting of:
  - A 2,876 m^3 elevated water storage tank, which is supplied with treated water from the well pumping facility.
  - A 437 m^3 standpipe supplied with treated water from the elevated water storage tank, and capable of supplying equalization and emergency storage requirements for Pressure Zone No. 1.
- A bulk water depot located within service Zone No. 1 to load trucks for resale to residential customers with cisterns, swimming pools, etc.
- All associated trunk watermains and smaller distribution pipes that service approximately 1,203 residences and 109 commercial accounts.

The rated capacity of the treatment facility and supply wells and the corresponding permit/license number are presented in Table 5.

Table 5 St. George Water Supply System – Permitted Rated Capacities

Source	Rated Capacity[1]		Permit / License Number	Renewal Date
	(m^3/d)	(L/s)		
St. George Drinking Water System	7,855	90.9	MDWL 062-104 Issue No.1	May 2, 2014
Well 1	3,931	45.5	PTTW 2203-8VEGUX[1]	May 31, 2022
Well 2	3,931	45.5		
Well 3	2,099	23.3		

Notes:
1. The existing PTTW 2203-8VEGUX notes that combined daily taking from the three wells shall not exceed an annual daily average of 6,031 m^3/day (69.8 L/s).

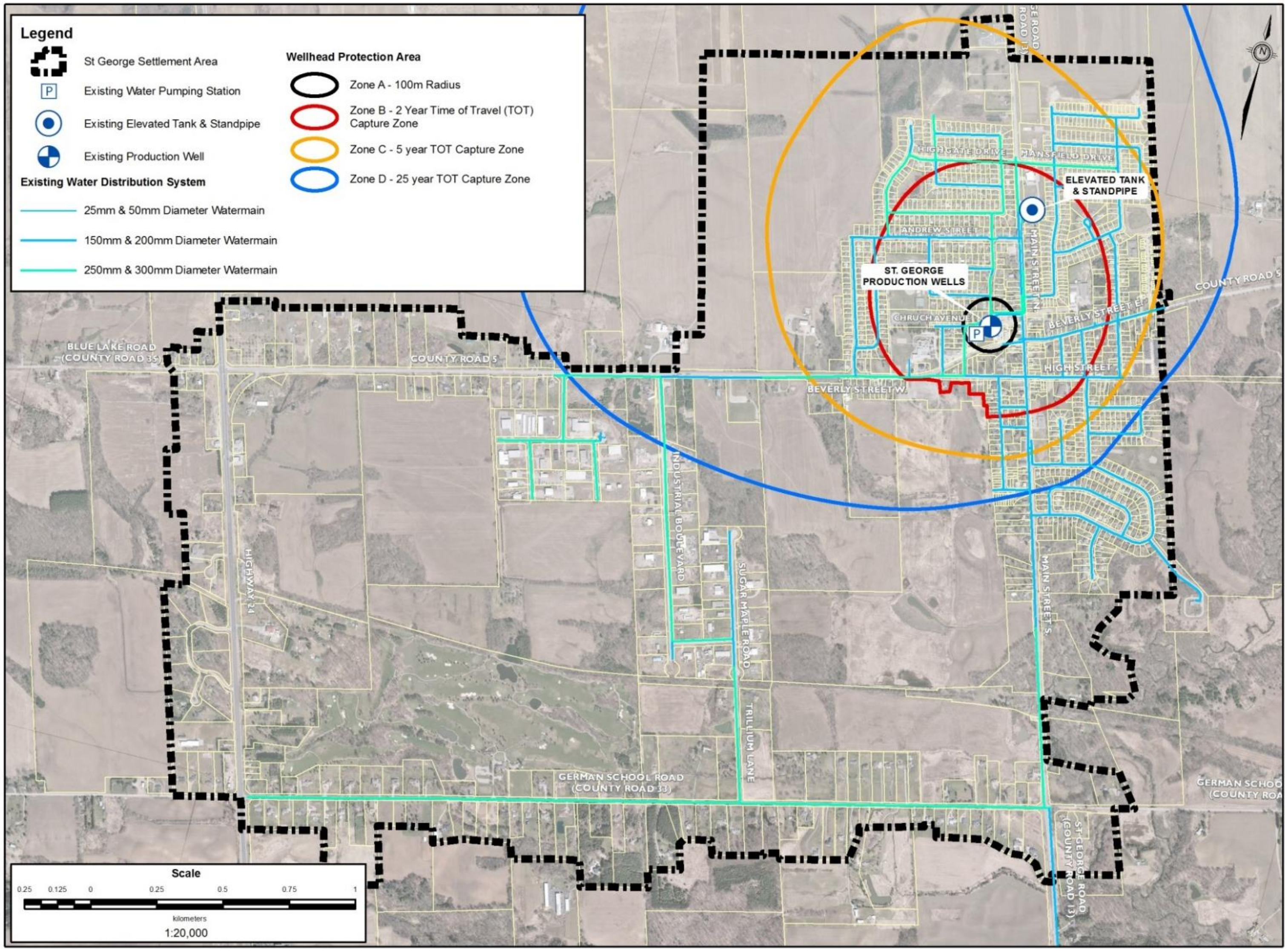

Figure 12 Existing St. George Water Servicing Infrastructure

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5.2 Overall Functional Overview

The area of St. George is divided into two (2) service pressure zones, Zone 1 which encompasses the northern portion of the area and Zone 2 which encompasses the southern portion of the area. Both service pressure zones supply water to residential and industrial and commercial areas.

The three (3) well pumps ultimately provide water to the Zone 1 and 2 distribution system. The pumps are designed to pump raw water from the wells, through the chlorine contact chambers, to the Zone 2 distribution system and the elevated water tank. The elevated water tank supplies treated water to the standpipe and eventually to the Zone 1 distribution system.

All three (3) well pumps draw groundwater from an overburden underground aquifer system through a well and discharge the water into the respective well pump's discharge header. The headers extend to a common discharge header in the pump control room of the facility's building, where the groundwater is dosed with sodium hypochlorite for disinfection. Following chemical dosing, the treated water continues through the common header pipe where the flow is directed to the two (2) chlorine contact chambers. The dual contact chambers operate in parallel, with half the flow entering chamber No.1, and the remaining half entering chamber No.2. Treated water is discharged from each chlorine contact chamber into the distribution system.

A simplified process schematic of the St. George Water Treatment System is shown in Figure 13.

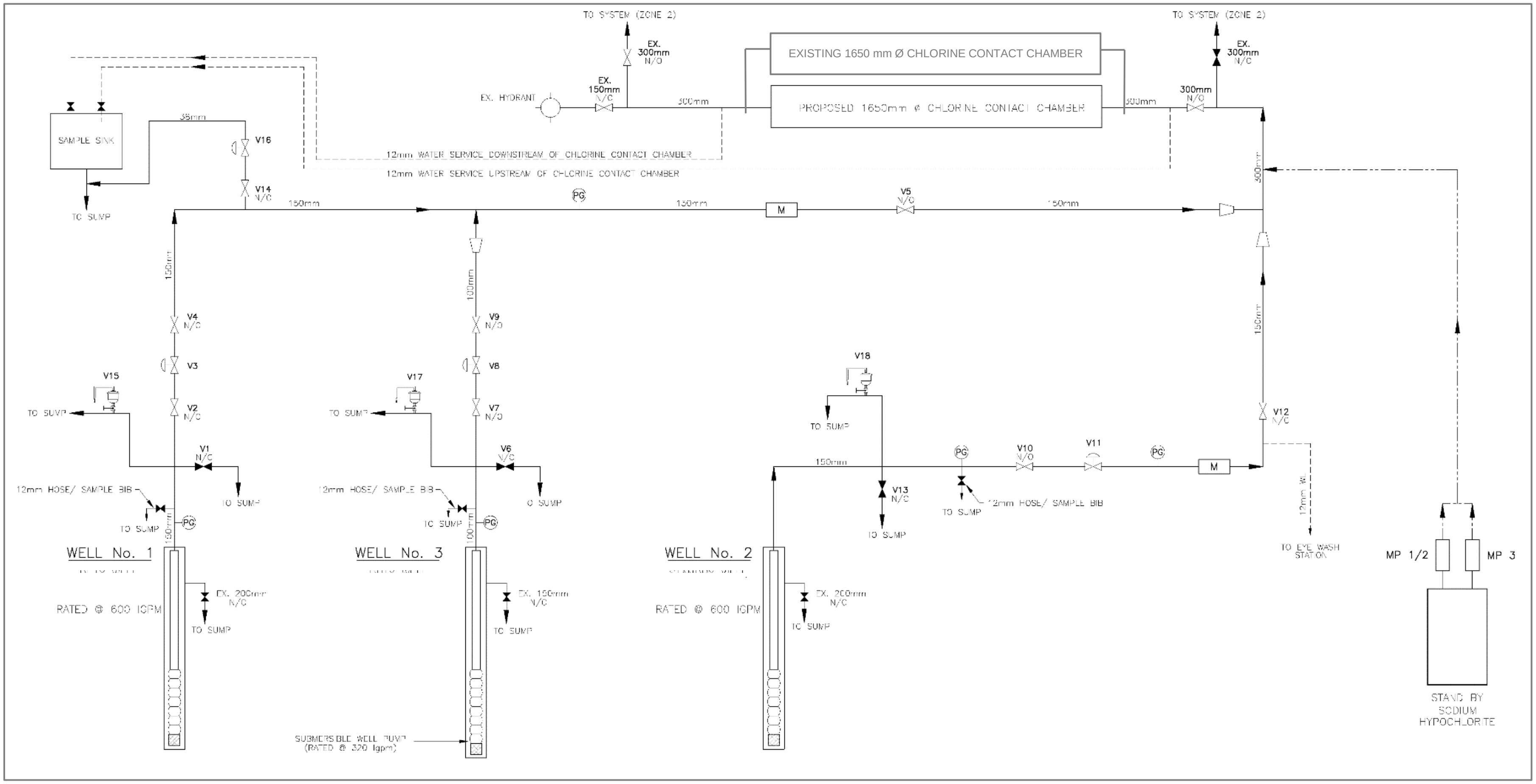


Figure 13 Existing Process Schematic – St. George Water Treatment System

5.3 Water Treatment Process Review

5.3.1 Supply Wells

The three production wells referred to as PW1 (Well No.1), PW2 (Well No. 2) and TW1-68 (Well No. 3), were constructed in a similar manner in an overburden aquifer system. Characteristics of all three wells are presented in Table 6.

Table 6 St. George Supply Wells Characteristics[1]

Description	Units	Well No. 1 (PW1)	Well No.2 (PW2)	Well No. 3 (TW1-68)
Well Pump Rated Capacity	L/s	45.5	45.5	24.3
Pump TDH	m	79.0	79.0	79.9
Depth of Well	m	23.1	23.3	23.2
Inner Casing Diameter	mm	300	300	150
Source		Groundwater	Groundwater	Groundwater

Notes:
1. Wells characteristics as per 2014 St. George Drinking Water System Operations Manual.

There is no water well records, hydrogeological reports or "as constructed details" available for PW1 and PW2. PW1 and PW2 are the primary production wells and Well 3 is a back-up well (the original test well at this site).

The operating level in each well head is monitored by individual ground water level sensors, which provide operations staff with an easy way to monitor the static level as well as the operating level in each well, as required by the PTTW.

The existing rated capacity of the St. George Drinking Water Treatment System is 7,855 m^3/d (90.9 L/s), as per the Municipal Drinking Water License 062-104 Issue No.1. The maximum taking capacity from the three (3) production wells is 9,962 m^3/d (115 L/s); however, Section 3.3 of the PTTW requires the annual daily average of water taking not to exceed 6,031 m^3/d (69.8 L/s). In order to ensure that the allowable maximum daily average water taking is never exceeded, well pumps for PW1 and PW2 are set up to never operate simultaneously.

Well No.1

PW1 was constructed in 1970. The well and pump performance have been tested over the years as part of the routine maintenance and testing program in the County. The last performance test on Well No.1, reviewed as part of the Class EA study, was conducted on November 2013 by Lotowater. The results of the 90-minute step test indicated that the well performance was essentially identical to the last tests completed in 2002 and 2008, and the test when the original pump and motor were put into service in 1991. A new pump was installed on January 6, 2014 as the pump inspection completed in 2013 revealed that the pump impeller along with all of the normal wearing parts, the column pipe and the original shafting were in need of repair or no longer serviceable. The pump is expected to be serviced next in 5 to 10 years.

Well No.2

PW2 was constructed in 1970. The well and pump performance have been tested over the years as part of the routine maintenance and testing program in the County. The last performance test on Well No.2, reviewed as part of the Class EA study, was conducted in November and December 2011 by Lotowater. Video inspection of the well revealed black staining and minor buildup on the bottom of the well, which were addressed by a minor mechanical well rehabilitation. A new pump was installed on December 12, 2011, as the pump inspection showed significant impeller degradation. The well inspection report notes that the well performance appears to be satisfactory, and the well can be easily operated at its normal flow rate of 38 L/s. The pump is expected to be serviced next in 10 years.

Well No.3

TW1-68 was drilled as a test well in 1968. The last performance test on this well, reviewed as part of the Class EA study, was conducted on April 2011 by Lotowater. The results of the 90-minute step test indicated that the pump and the motor are operating satisfactorily. Minor replacements were made to some well pump components that appeared to be worn or corroded. The inspection report recommends that the pumping water level for Well No. 3 be maintained above 13.7 m.

Another work program was undertaken in 2012 to address reported motor overloading and vibration. A backup pump, which had been stored on site for 18 years was reinstalled in September 2012 and the well and column pipe were disinfected. The pump appeared to be operating satisfactorily.

Capacity Assessment

An aquifer test was conducted in 2005 by Lotowater to demonstrate the capacity of the existing St. George wells. PW1 and PW2 were pumped together at 51 L/s and 40 L/s, respectively (a total of 91 L/s) continuously during the six (6) day test. Water levels were monitored in an array of monitoring wells during the test. Projection of the drawdown trends in the production wells supported a long-term aquifer yield of 91 L/s.

Lotimer and Associates Inc. completed a review of water levels and pump operating data as part of this Class EA study. The review of available information indicated that the existing wells should be able to produce their PTTW capacity.

The following points present a summary of the important features about the water supply wells servicing St. George:

- PW1 and PW2 are both equipped with well pumps with a rated capacity of 45.5 L/s; however, these two pumps are set up to never operate simultaneously. In 2013, PW1 pumped at an average rate of 36.99 L/s, while PW2 pumped at an average rate of 36.33 L/s, both below their maximum permitted flow of 45.5 L/s.
- TW1-68 pumped in 2013 at an average rate of 17.8 L/s, below its maximum permitted flow of 24.3 L/s.

- All three (3) production wells have been recently tested and maintained/replaced as part of their routine service program. The most recent inspections and tests indicate that all three wells and well pumps are operating satisfactorily, with the next inspection expected to occur in 5 to 10 years. However, based on the relatively old age of the wells, a structural condition assessment of PW1 and PW2 is warranted. Similarly, due to the original development of TW1-68 as a test well and its old age, this well is not considered a reliable back-up well and it is recommended that it be retired.

- Water takings from the St. George production wells has generally declined, from a peak of about 650,000 m^3/year in 2002 to an average of about 350,000 m^3/year from 2008 to 2013. Through conversations with the County, it was identified that the significant decline in water demand has been the result of water metering at the County, which was implemented in 2002.

- The total volume of water produced by the St. George water supply system in 2013 was 346,808 m^3/year for an average flow rate of 950 m^3/day (11 L/s). The maximum daily supply was 3,198 m^3/day (37 L/s), recorded on March 13, 2013.

5.3.2 Disinfection System

St. George raw water supply is disinfected using sodium hypochlorite, which is added prior to entering the distribution system.

The disinfection system consists of the following:

- Two (2) sodium hypochlorite metering pumps (1 duty, 1 standby) providing chemical to the single injection point, located on the 300 mm diameter common well discharge header, immediately prior to the dual chlorine contact chambers.

- Two (2) chemical storage tanks to supply sodium hypochlorite solution to the chemical feed system. A 12% sodium hypochlorite solution is used for disinfection of the water. The storage tanks are provided within a larger plastic tank capable of containing the entire contents of both storage tanks in the event of a spill/rupture.

- Two (2) chlorine contact chambers with characteristics shown in Table 7.

- One (1) online chlorine analyzer used for regulatory purposes.

- One (1) online chlorine analyzer used as non-regulatory analyzer to monitor the free chlorine residual.

- An emergency eyewash and shower station, situated within the northeast corner of the diesel generator room.

Table 7 St. George Chlorine Contact Chambers Characteristics[1]

Description	Units	Value
Total Number of Contact Chambers		2
Contact chamber diameter, each	mm	1,650
Contact chamber length, each	m	24
Contact chamber volume, each	m^3	51.3
Total contact chamber volume	m^3	102.6

Notes:
1. Contact chambers characteristics as per 2014 St. George Drinking Water System Operations Manual.

Capacity Assessment

The theoretical capacity of the existing chlorine contact chambers was calculated with consideration to the design conditions listed in Table 8. The capacity of the existing chlorine contact chambers is 9,072 m^3/day (105 L/s), slightly above the rated capacity of the existing system of 7,855 m^3/day (90.9 L/s), as per current MDWL.

Table 8 Chlorine Contact Chambers Design Conditions[1]

Design Conditions	Units	Value
Required Log inactivation of viruses	Log	2
Lowest design water temperature[1]	°C	5
Highest design water pH[1]	-	8.5
Minimum free chlorine residual to be maintained[2]	mg/L	0.35
Minimum Ct required	mg/L*min	4.0
T10/T (serpentine baffles)	-	0.7

Notes:
1. Assumed values as per typical groundwater conditions. No other water quality data is available.
2. As per 2014 St. George O&M manual

5.3.3 Water Storage

The St. George Drinking Water System has two (2) separate storage facilities; an elevated water storage facility and an elevated standpipe, each servicing a different pressure zone.

The elevated storage tank maintains pressure in the St. George Zone 2 distribution system, provides equalization and emergency storage for pressure Zone No. 2 and supplies treated water to the Zone 1 standpipe. The standpipe stores and distributes treated water to the St. George Zone 1 distribution system. Water levels in the elevated tank are maintained within the desired working range through the operation of the three (3) raw water well pumps at the St. George Water Pumping Facility.

The storage facilities in the St. George Water Supply System and their respective storage volumes are shown in Table 9.

Table 9 St. George Water Storage Facilities

Water Storage Facility	Total Usable Volume[1] (m^3)
St. George Elevated Storage Tank	2,876
St. George Standpipe	437

Notes:
1. Volumes obtained from the St. George Drinking Water Works Permit, Permit Number: 062-204, Issue No.1, issued on November 2, 2009.

Capacity Assessment

Water storage requirements for the St. George area have been primarily based upon the *MOE Guidelines for the Design of Water Storage Facilities*, where:

Total Storage Requirement, S = A + B + C

Where: A = Fire Storage (based on population numbers)

B = Equalization Storage (25% Maximum Day Demand)

C = Emergency Storage (25% of A + B)

Preliminary storage requirements for St. George was calculated based on existing water demands conditions. To estimate the total water storage requirement for the St. George area, the storage volume was calculated based on the County's fire flow requirements for industrial, commercial, and institutional (ICI) areas, which is more stringent than that for residential areas. The existing water demand used in the calculations are shown in Table 10.

Table 10 Existing St. George Storage Requirements

Year	3-Year Average Max. Day Demand (m^3/day)	Storage Components			Minimum Storage Required (m^3)	Total Storage Available (m^3)
		Fire Storage[1] (m^3)	Equalization Storage[2] (m^3)	Emergency Storage[3] (m^3)		
2011 - 2013	3,252	409	813	305	1,527	3,313

Notes:
1. Based on minimum fire flow conditions of 56.8 L/s for 2 hours as per County's design criteria for General ICI areas.
2. Based on 25% of calculated maximum day demands
3. Based on 25% of fire storage + equalization storage

The minimum required storage volume for the existing system (1,527 m^3) was calculated using the maximum day demands in the St. George water system from 2011 to 2013 and the County's design criteria for fire flow requirements.

5.4 Historic Water Quality Data Review

Relevant raw and treated water quality data were extracted from the St. George Drinking Water Annual Reports for 2011, 2012 and 2013, prepared by the County of Brant, and presented and discussed in the following sections.

5.4.1 Raw Water Quality

Production Wells

Raw water quality data from the three (3) production wells are shown in Table 11. The limits set out in the Ontario Drinking Water Quality (ODWQ) Standards, Objectives and Guidelines are also included in the table. These standards, objectives and guidelines apply only to treated/distribution water and do not apply directly to raw water; however, the limits have been included to provide an indication of the treatment requirements at the plant.

Table 11 Production Wells Water Quality Data 2011-2013

Parameter[1]	Unit	Well PW1			Well PW2			Well TW1-68			ODWQS AO/OG or MAC
		2013	2012	2011	2013	2012	2011	2013	2012	2011	
Turbidity	NTU	0.04 - 0.15	0.05 - 0.15	0.07 - 0.17	0.06-0.17	0.05 - 0.14	0.06 - 0.16	0.05 - 0.11	0.04 - 0.2	0.07 - 0.16	5 (at point of consump-tion)
Sulphate	mg/L	47.5	45	45.8	46.3	43	46.3	45.5	43.5	44.7	500
Chloride	mg/L	19.5	20	21.3	20.8	20	21.3	19.3	19.8	20.7	250
Nitrite[3]	mg/L	N/A	<0.01	N/A	N/A	<0.01	N/A	N/A	<0.01	N/A	1
Nitrate[3]	mg/L	4.3	4.7	5.0	4.6	5.0	5.1	4.5	5.0	5.3	10
Nitrate + Nitrite[3]	mg/L	N/A	5.0	N/A	N/A	5.2	N/A	N/A	5.1	N/A	10

Notes:
1. Water quality data as per Annual Reports for 2011, 2012 and 2013, unless indicated otherwise.
2. From O. Reg. 169/03 and Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines (June 2003). AO/OG: Aesthetic Objective / Operational Guideline. MAC: Maximum Acceptable Concentration
3. Where both nitrate and nitrite are present, the total of the two should not exceed 10 mg/L

As shown in Table 11, all three (3) production wells provide good water quality that is below the ODWQ Standards, Objectives and Guidelines for the years between 2011 and 2013.

Soils contaminated with gasoline and diesel oil products have been reported in the vicinity of the St. George municipal wells. To ensure the protection of its groundwater source, the County implemented in 2003 a routine sampling and testing of the production wells for a comprehensive list of hydrocarbon parameters to monitor for potential impacts to the municipal water supply resulting from impacted soils. All tested hydrocarbon parameters have reported concentrations lower than the detection limit of the device used to perform the analysis. None of the tested parameters provided results that suggest impacts to the municipal supply from the known soil contamination in the vicinity of the production wells, at the current pumping rates.

As all three (3) production wells are located adjacent to each other, the current St. George Water Supply System technically relies on a single groundwater supply source, which creates concerns in terms of the security of the supply for the system.

Although nitrate levels in the production wells have decreased over time, the source(s) of the nitrate should be determined, and measures taken to mitigate this issue to ensure that nitrate levels do not result in the loss of the existing production wells.

5.4.2 Monitoring Wells

A network of overburden monitoring wells has been established within the vicinity of the well field to monitor water level fluctuations as well as groundwater quality. The water quality data for the monitoring wells reported in 2011 to 2013 are summarized in Table 12.

Table 12 Monitoring Wells Water Quality Data 2011-2013

Monitoring Well	Well Location	Parameter[1]		
		Sulphate (mg/L)	Chloride (mg/L)	Nitrate (mg/L)
MW1/02-1	Tower	22-24	<1-1	<0.1
MW1/02-2	Tower	36-40	37-45	6.7-9.8
MW2/02-1	Scott & Andrew	23-26	<1-1	<0.1
MW2/02-2	Scott & Andrew	51-56	11-12	3.6-4.2
MW2/02-3	Scott & Andrew	35-43	9-12	4.7-6.7
MW2/02-4	Scott & Andrew	42-60	130-190	4.3-8
MW3/02-1	Beverly Street	26-29	<1-2	<0.1
MW3/02-2	Beverly Street	80-91	9-13	<0.1
MW3/02-3	Beverly Street	51-65	5-8	<0.1
TW 1/85	Lilian Street	38-46	20-24	4.3-5.8

Notes:
1. Water quality data as per Monitoring Well Sample Results for 2011, 2012 and 2013 provided by the County, unless indicated otherwise. Concentrations expressed in ranges.

The presence of sulphate in drinking water above levels of 150 mg/L may result in noticeable taste and levels above the ODWQ Aesthetic Objective of 500 mg/L can produce a laxative effect. As shown in Table 11, sulphate concentrations in the monitoring wells were in the range of 22 to 91 mg/L, well below 500 mg/L.

Chloride is a common non-toxic material present in small amounts in drinking water and causes a detectable salty taste at concentrations above the ODWQ Aesthetic Objective of 250 mg/L. With the exception of Monitoring Well MW2/02-4, all other monitoring wells reported chloride concentrations below 45 mg/L. It is speculated that winter road salting could cause the elevated chloride levels on this well as it is the shallowest of all monitoring wells in St. George with a thin upper aquitard.

The Maximum Acceptable Concentration (MAC) for nitrate in drinking water is 10 mg/L as nitrogen. Plant or animal material decay, use of agricultural fertilizers, sewage contamination or geological formations containing soluble nitrogen compounds are responsible for the presence of nitrates in groundwater. All monitoring wells produced nitrate levels below the MAC limit; however, Monitoring Wells MW1/02-2 and MW2/02-4 consistently reported higher levels of nitrate with respect to the other wells, with maximum levels closed to the MAC of 10 mg/L. As noted previously, it is recommended that the source(s) of the nitrate be determined, and measures taken to mitigate this issue to ensure that nitrate levels do not result in the loss of the existing production wells.

5.4.3 Treated Water Quality

The summarized treated water quality data are shown in Table 13.

Table 13 St. George Treated Water Quality Data 2011-2013

Parameter[1]	Unit	Range			ODWQS AO/OG or MAC
		2013	2012	2011	
Free Chlorine – treated online	mg/L	0.38 - 1.00	0.42 - 1.05	0.37 - 0.95	-
Total Trihalomethanes (THMs) (distribution)	µg/L	0.97 – 10.3	0.8 - 4.54	1.5 - 5.6	100[2]

Notes:
1. Water quality data as per Annual Reports for 2011, 2012 and 2013, unless indicated otherwise.
2. The maximum acceptable concentration of THMs in drinking water is 100 ug/L based on a running annual average of quarterly samples measured at points reflecting the maximum residence time in the distribution system.

Ontario Regulation 170 / 03 requires that a minimum chlorine residual concentration of 0.05 mg/L be maintained throughout the distribution system. If the residual falls below 0.05 mg/L within the distribution system, the MDWL requires that the District Office of the Ministry of the Environment and Medical Officer of Health be notified. These Regulatory Agencies may require that consumers boil the water depending on the results of bacteriological testing.

The Procedure for Disinfection of Drinking Water in Ontario states that the chlorine residual should not exceed 4.0 mg/L (free) at any point in the distribution system. Consumers will normally complain of chlorine taste and odour and will refuse to drink the water at levels where health would be affected.

As shown in Table 12, the free chlorine residual measured at the water treatment facility effluent is within the ranges prescribed in the regulations. Similarly, the THM concentrations found within the distribution system are well below the MAC of 100 µg/L.

The 2011 to 2013 annual drinking water reports for the St. George Water Supply System indicate that all other microbiological, inorganic and organic parameters tested in the treated water and distribution system have been below their respective ODWQ Standards, Objectives and Guidelines with no exceedances reported.

6. Water Servicing Design Criteria

6.1 Previous Studies – 2015

An initial analysis was completed in 2015, at the project outset, to estimate projected water demands for the ultimate buildout of the St. George settlement area. Preliminary water demands were reviewed based on available water usage and water consumption data from 2011 to 2013. Ultimately, a design average water supply capacity of 3,900 m^3/d (45.1 L/s) for the St. George Water Servicing Class EA study was selected to align with the proposed wastewater treatment capacity in St. George, which was primarily based on maintaining a wastewater discharge to Fairchild's Creek. A projected maximum day demand for the ultimate build-out of 124 L/s was also originally established. Original design criteria are summarized in Table 14.

Table 14 Original Water Supply Capacity Criteria (Developed in 2015)

Item	Value
Proposed Design Average Day Demand	45 L/s
Maximum Day Factor	2.75
Proposed Maximum Day Demand	124 L/s

6.2 Revised Design Criteria – 2022

A more recent analysis of water demands was completed by the County in 2022 to reflect more up-to-date operational data. Key findings from the County's analysis are summarized below, with new design criteria summarized in Table 16:

- The estimated population of the St. George Urban Settlement Area in 2021 was around 3,500 people, projected to increase to 7,500 by 2051.
- Anticipated water demands were calculated by applying the residential growth rate to the 2021 water consumption, assuming that the ratio of residential, ICI, and maintenance water consumption remains the same over the growth period. However, this estimation may be conservative as water conservation efforts are reducing per capita water consumption. Moreover, the implementation of a humpback rate structure by the County in 2021 is expected to have a significant positive impact in the future. This trend is demonstrated in Figure 14, which depicts the total annual water takings from the three (3) existing production wells from 2002 to 2021.
- Water production follows a similar pattern each year, as shown in Figure 15 depicting monthly pumping data 2006 to 2021, and Figure 16 showing the 2021 Daily Pumping Data.
- Using the 2021 maximum day production of 1,955 m^3 on June 4 yields a predicted maximum day in 2051 of 4,189 m^3 (48.5 L/s), as shown in **Table 15.**
- This is approximately 2/3 of the existing wellfield's permitted capacity (6,030 m^3/d), which indicates that the existing well field has enough capacity to satisfy the projected water demands through 2051. The new well field is necessary to provide redundancy in

case the existing wellfield is out of service. Having two (2) well fields will also extend the life expectancy of each.

Table 15 Proposed Water Supply Capacity Criteria (2022)

Design Value	Existing (2021)	Future (2051)
Serviced Population	3,500	7,500
Maximum Day Demand	1,955 m^3/d [1] (22.6 L/s)	4,189 m^3/d [1] (48.5 L/s)

Notes:
1. Based on a maximum day production of 1,955 m^3 on June 4, 2021

In 2021, the County implemented a humpback rate structure as a financial incentive to increased water conservation. As this strategy has been recently implemented (2021), the actual effects have not been fully empirically analysed, however, intuitively, a significant positive result is expected.

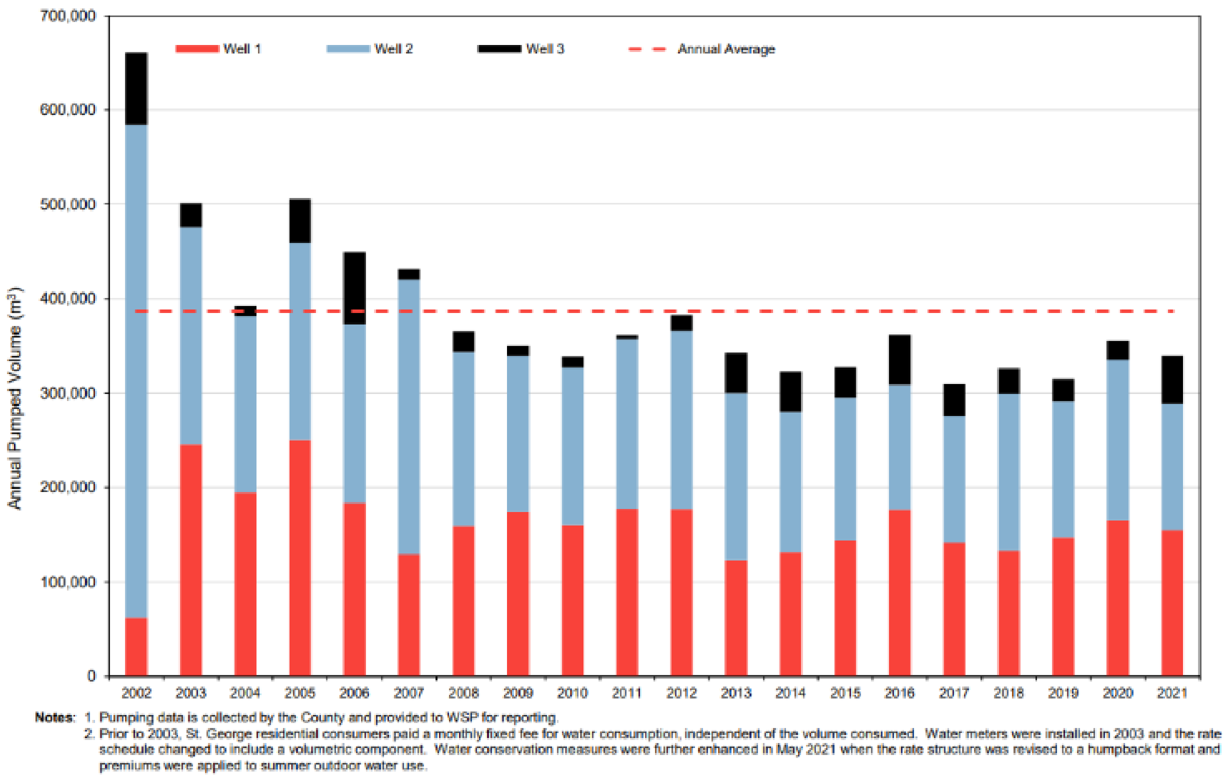
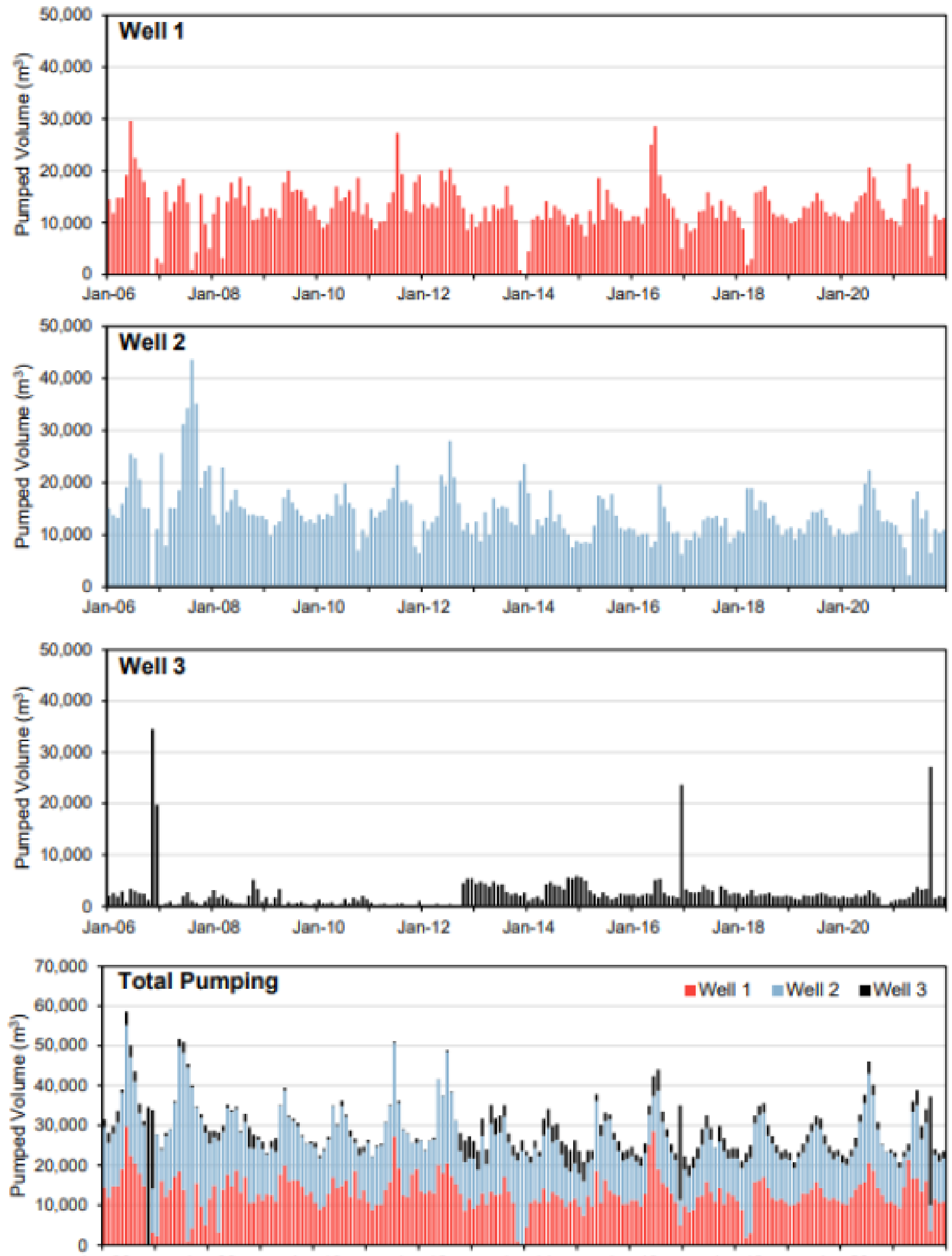
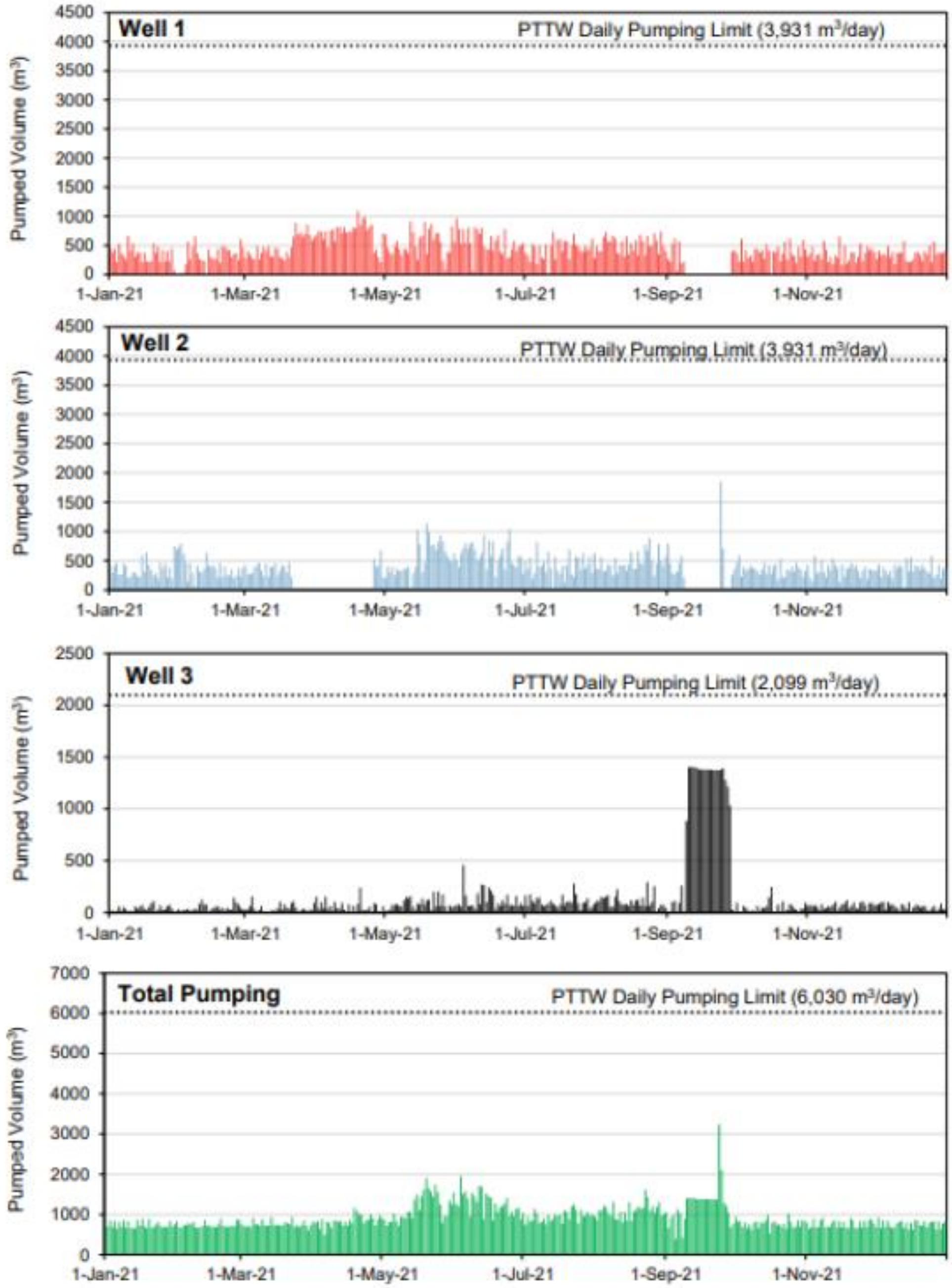


Figure 14 Annual Pumping Data (2002 to 2021) St. George Drinking Water (Source: Response to Comments by MECP, County of Brant, August 26, 2022)



Note: 1. Pumping data is collected by the County and provided to WSP for reporting.
2. When the St. George Elevated Tank was offline in September 2021 for coating repairs, Well 3 only was used for production. The majority of the high flows on Septemebr 24 and 25, 2021 were used to refill the elevated tank after completion of the repairs to the coatings.

Figure 15 Monthly Pumping Data 2006 to 2021 St. George Drinking Water System (Source: Response to Comments by MECP, County of Brant, August 26, 2022)



Note: 1. Pumping data is collected by the County and provided to WSP for reporting.
2. When the St. George Elevated Tank was offline in September 2021 for coating repairs, Well 3 only was used for production. The majority of the high flows on Septemebr 24 and 25, 2021 were used to refill the elevated tank after completion of the repairs to the coatings.

Figure 16 2021 Daily Pumping Data St. George Drinking Water System (Source: Response to Comments by MECP, County of Brant, August 26, 2022)

7. Class EA Phase 1 – Identification of Problem / Opportunity

Phase 1 of the Municipal Class EA planning process requires the proponent of an undertaking to first document factors leading to the conclusion that the improvement is needed and develop a clear statement of the problem/opportunity to be investigated.

The problem/opportunity statement for the St. George Water Servicing Class EA Study was defined as follows:

Water supply system infrastructure improvements are required for the St. George settlement area in the County of Brant, to address:

- *Security of the St. George Water Supply System, because there is only one (1) primary source of groundwater*

The preferred strategy will include:

- *A secondary supply source for redundancy purposes*
- *Upgrades to the existing water supply source to provide long-term reliability*

8. Class EA Evaluation Methodology

8.1 Overview of Evaluation Methodology

A broad range of alternative solutions for providing the required level of water servicing in the St. George area presented many complex choices. Experience in projects of similar nature has shown that development of a systematic, stepwise method for making decisions at the start of the project helps to focus and clarify decision-making. A comprehensive evaluation methodology provided the basis for a decision making that is sound, defensible, traceable, and consistent with the specific objectives of the project.

The evaluation methodology included the following major sequential steps:

1. Identification and Evaluation of the Alternative Solutions – The project team identified all potential alternative solutions and selected only those that were considered feasible for this project and eliminated the alternatives that are not. This first step in the evaluation process led to the preliminary identification of a recommended alternative solution and avoided the need to carry unrealistic alternatives through the detailed evaluation step.
2. Development of Alternative Design Concepts – Following the preliminary identification of a recommended alternative solution, alternative design concepts were developed for the preferred solution and evaluated in detailed against a set of evaluation criteria to include technical, natural environment, socio-cultural and economic considerations.
3. Selection and Confirmation of the Preferred Design Concept

8.2 Preliminary Screening

Once a long list of alternative solutions was developed, they were screened to identify only those alternatives considered feasible for this project. This avoided the need to carry unrealistic alternatives through the detailed evaluation step. Preliminary screening was accomplished by assessing alternative solutions with respect to:

- their ability to satisfy the current issues with the St. George Drinking Water System,
- their ability to accommodate the projected water demands for the St. George area,
- any major technical or financial considerations that would affect the project implementation, and,
- their ability to meet the Problem / Opportunity Statement.

Alternative solutions that were not considered viable for implementation were not recommended for further evaluation in the process and were eliminated. The alternative solutions that were considered viable were further subjected to a more detailed comparative evaluation in the next phase of the Class EA study.

8.3 Detailed Evaluation

A preliminary set of evaluation criteria was developed to represent a Triple Bottom Line approach that will enable a comparative evaluation of the alternative design concepts in terms of three (3) primary goals for this project consisting of:

- Minimizing environmental impacts.
- Minimizing social impacts; and,
- Minimizing economic impacts.

Each of the three (3) main categories listed above was assigned a weighting factor, shown in Table 16, which aims to represent the importance of each individual category within the overall evaluation scheme.

Detailed evaluation criteria or sub-criteria were identified within each main category. The sub-criteria were developed with the objective of representing issues and considerations most relevant to this project. The evaluation methodology was used as a basis to compare the features of each alternative design concept, relative to each other, and their ability to perform under each evaluation criterion.

For each sub-criterion, the project team compiled sufficient information and assigned a score unique to each alternative design concept, relative to the other design concepts. Scores from 0 to 5 were available to score each alternative design concept being evaluated, with the higher score (5) given to the better performing options. The score represents how well the specific alternative design concept meets the criterion under consideration, or in other words, the potential residual impact (i.e., the net impact after mitigation). Therefore, the alternative design concepts were rated such that the higher the ability to perform or meet the criterion, the higher the score (5) assigned.

The final score for each alternative design concept was calculated as the sum of: the score of each criterion across all categories multiplied by the value weight assigned to that criterion. The alternative design concept that had scored the highest at the end of the evaluation process was considered the option that provided the most overall benefits to this project and thus, was selected as the preliminary preferred alternative design concept.

Weighting factors (shown in Table 16) that correspond to the degree of importance of each main category within the overall evaluation scheme were assigned in consultation with the project team. The evaluation criteria that were used during the comparative assessment of the alternative design concepts, as well as the criterion's objective and the relative performance scales used when assigning scores, are shown in Table 16.

Table 16 Evaluation Criteria, Objectives and Performance Scales

Category	Criteria	Performance Scales
Environmental Indicators (40%)	**Water Quality / Quantity Protection –** Minimize the potential for surface water or groundwater contamination, includes potential effects to existing private groundwater wells, impacts to well head protection areas and potential upsets to water quality resulting from mixing two different water sources.	• Potential for surface water or groundwater contamination or well interference is minor or negligible, no mitigation is required – 5 • Potential for surface water or groundwater contamination or well interference is moderate, with some potential for mitigation – 3 • Potential for surface water or groundwater contamination or well interference is significant, with limited mitigation available – 0
	System Redundancy and Flexibility – Maximize the ability to continue to provide water supply during emergency situations based on provision for redundant equipment, connections, emergency storage, etc.	• Potential for system redundancy and flexibility is significant, no mitigation is required – 5 • Potential for system redundancy and flexibility is moderate, with some potential for mitigation – 3 • Potential for system redundancy and flexibility is minor or negligible, with limited mitigation available – 0
	Security of Supply – Maximize the ability to provide for the safety and security of the water supply system through protection of water assets and emergency preparedness	• Potential for safety and security of the water supply system is significant, no mitigation is required – 5 • Potential for safety and security of the water supply system is moderate, with some potential for mitigation – 3 • Potential for safety and security of the water supply system is minor or negligible, with limited mitigation available – 0
	Operational Complexity – Minimize the need for treatment requirements and maximize the ability to decrease current operational complexity, while achieving desired treated water quality objectives	• Low level of treatment requirements with significant opportunity(ies) to decrease current operational complexity, no mitigation is required – 5 • Moderate level of treatment requirements and some opportunity(ies) to decrease current operational complexity – 3 • High level of treatment requirements with limited or no opportunity(ies) to decrease current operational complexity – 0
	Ease of Implementation – Maximize the ability to facilitate construction without interfering with the uninterrupted supply of water and within the most reasonable timeframe.	• Potential impact on existing operations is minor, no mitigation is required – 5 • Potential impact on existing operations is moderate, with some potential for mitigation – 3 • Potential impact on existing operations is major or significant, with limited mitigation available – 0
	Need for New Infrastructure – Maximize the ability to use existing infrastructure	• Potential to use existing infrastructure is significant with minimum requirements for new infrastructure, no mitigation is required – 5 • Potential to use existing infrastructure is moderate with some requirements for new infrastructure, with some potential for mitigation – 3 • Potential to use existing infrastructure is minimal with significant requirements for new infrastructure, with limited mitigation available – 0

Category	Criteria	Performance Scales
	Natural Environment and Archaeological Heritage – Minimize the potential impact to existing terrestrial habitats/features, vegetation communities, including watercourse crossings as well as archaeological heritage features. Minimize potential contributions to climate change	• Potential impact from construction, operation and maintenance to natural, archaeological heritage and climate change is minimal or negligible, no mitigation is required – 5 • Potential impact from construction, operation and maintenance to natural, archaeological heritage and climate change is moderate, with some potential for mitigation – 3 • Potential impact from construction, operation and maintenance to natural, archaeological heritage and climate change is significant, with limited mitigation available – 0
	Regulatory Approvals – Minimize the need and time spent to obtain permits and approvals	• Required infrastructure is compatible with existing land uses and permits and approvals can be easily obtained, no mitigation is required – 5 • Required infrastructure can be compatible with existing land uses and some effort is expected to obtain permits and approvals, with some potential for mitigation – 3 • Required infrastructure is not compatible with existing land uses and significant effort is expected to obtain permits and approvals, with limited mitigation available – 0
Social Indicators (40%)	**Public Health and Safety –** Minimize the potential risk to community health and safety from a source, treatment and distribution perspective	• Potential ability to provide a multi-barrier approach is significant so there is an extremely small potential risk to public health and safety, no mitigation is required – 5 • Potential ability to provide a multi-barrier approach is moderate so there is minor potential risk to public health and safety, with some potential for mitigation – 3 • Potential ability to provide a multi-barrier approach is minimal so there is moderate potential risk to public health and safety, with limited mitigation available – 0
	Noise and traffic (during construction) – Minimize the potential for noise and traffic during construction	• Potential for noise and traffic during construction is minor or negligible, no mitigation is required – 5 • Potential for noise and traffic during construction is moderate, with some potential for mitigation – 3 • Potential for noise and traffic during construction is significant, with limited mitigation available – 0
	Public Perception – Maximize the potential for alternative to receive public support and acceptance	• Potential to receive a high level of support and endorsement from the public, no mitigation is required – 5 • Potential to receive a moderate level of support and endorsement from the public, with some potential for mitigation – 3 • Potential to receive a low level of support and endorsement from the public, with limited mitigation available – 0
	Aesthetics and Operational Impacts – Minimize potential visual, noise and odour impacts from water	• Potential for visual, noise and odour impacts from water supply infrastructure and disturbance due to

Category	Criteria	Performance Scales
	supply infrastructure on private properties and potential public disturbance due to operation & maintenance activities	O&M activities is minor or negligible, no mitigation is required – 5 • Potential for visual, noise and odour impacts from water supply infrastructure and disturbance due to O&M activities is moderate, with some potential for mitigation – 3 • Potential for visual, noise and odour impacts from water supply infrastructure and disturbance due to O&M activities is significant, with limited mitigation available – 0
	Land Use – Maximize compatibility with existing or proposed land uses as per County's Official Plan and Source Water Protection Policies	• Potential compatibility with existing or proposed land uses and source water protection policies is significant, no mitigation is required – 5 • Potential compatibility with existing or proposed land uses and source water protection policies is moderate, with some potential for mitigation – 3 • Potential compatibility with existing or proposed land uses and source water protection policies is negligible, with limited mitigation available – 0
	Construction Duration – Minimize duration of project construction	• Potential impact on existing private well users and road users during project construction is negligible, no mitigation is required – 5 • Potential impact on existing private well users and road users during project construction is moderate, with some potential for mitigation – 3 • Potential impact on existing private well users and road users during project construction is significant, with limited mitigation available – 0
Economic Indicators (20%)	**Life Cycle Cost –** Minimize life cycle cost	A proportional scale between 5 and 0 based on a relative difference in 20-year life cycle cost of each alternative, relative to the others

9. Class EA Phase 2 – Development and Evaluation of Alternative Water Servicing Solutions

9.1 Identification of Alternative Water Servicing Solutions

In accordance with Phase 2 of the Municipal Class EA process, alternative solutions were identified to address existing concerns associated with the security of the St. George Water Supply System and the need to provide additional water supply capacity to service proposed development in the St. George area. The following general alternative solutions were identified:

- Do Nothing
- Limit Community Growth
- Implement Water Efficiency Measures
- Expand or Upgrade the Existing St. George Water Supply System
- Obtain Additional Supply Capacity from an Existing Water Supply System
- Develop a New Water Supply System

Some of the above listed alternative solutions were further broken down into sub-options, representing different potential water supply scenarios. Each of the alternative solutions were considered as a stand-alone alternative or in combination with other alternatives. A description of each alternative solution and their sub-options is provided in the following sections.

9.1.1 Alternative 1 – Do Nothing

The "Do Nothing" alternative assumes that the St. George Water Supply System will maintain its existing configuration, and no improvements or changes would be made to address the existing concerns with the security of supply.

The "Do Nothing" alternative would allow for some development to occur in the area until the demands approach the existing available system's production capacity of 69.8 L/s. The St. George Water Supply System will continue to rely on a single groundwater source and the associated concerns with security of supply and the potential effects from contaminated soils surrounding the existing production wells will persist.

9.1.2 Alternative 2 – Limit Community Growth

The Limit Community Growth alternative assumes that ultimate growth in St. George will be limited so that the total demands will not exceed the existing production capacity of the St. George supply wells of 69.8 L/s.

Anticipated growth in the community could potentially be phased or scheduled until the demands approach the existing available system's production capacity. The St. George Water Supply System will continue to rely on a single groundwater source and the associated concerns with security of supply and the potential effects from contaminated soils surrounding the existing production wells will persist.

9.1.3 Alternative 3 – Implement Water Efficiency Measures

The County currently enforces a water conservation by-law to restrict water use through the County. In addition, the installation of individual water meters across the County in 2002 and the use of water efficiency fixtures and appliances have resulted in consistently reduced water consumption in the St. George area since 2003.

Based on existing water demands for the St. George area and the historical reduction in water system demands since 2003, it is expected that additional water supply capacity will still be required to meet the ultimate system demands for St. George. In addition, only implementing water efficiency measures will not address existing concerns with the security of supply in the St. George system.

This alternative solution was considered in combination with the preferred alternative solution(s).

9.1.4 Alternative 4 – Expand or Upgrade the Existing St. George Water Supply System

The design average and maximum day demands for the St. George area are projected to be 45.1 and 48.5 L/s, respectively. The existing rated capacity of the St. George Drinking Water System is 90.9 L/s, as per the Municipal Drinking Water License 062-104 Issue No.1. Although the total taking capacity for the system is 115 L/s, the maximum allowable annual daily average of water taking from the existing production wells is restricted to 69.8 L/s.

Based on existing water demands for St. George and the current system capacity, there is some spare capacity from a supply and treatment perspective remaining in the system that could accommodate some growth in the area.

The Expand or Upgrade the Existing St. George Water Supply System consists of making the necessary upgrades and modifications to the existing system to address the existing concerns with the security of supply and to add sufficient supply capacity to meet the projected average and maximum day demands in the St. George area. The sub-options developed under this alternative solution are described as follows.

Alternative 4A – Development of Additional Wells on Existing Well Site

This sub-option involves development of additional wells on the same well site where the existing production wells exist. The additional wells would be required to provide, in combination with the existing supply wells, the system's design maximum demand of 48.5 L/s, during peak hour scenarios. Additional investigations would need to be completed in order to confirm the capacity of the existing aquifer and the number of additional wells to be developed.

Although additional capacity would potentially be provided through the additional wells, subject to confirmatory investigations, the St. George Water Supply System will continue to rely on a single groundwater source and the associated concerns with security of supply and the potential effects from contaminated soils surrounding the existing production wells will persist.

Alternative 4B – Development of New Well Field on TW 4/09 site

A previous groundwater exploration program, completed by a group of landowners proposing development in St. George, identified and developed two (2) test wells that are considered to be completed into an aquifer of moderate to high aquifer potential (i.e., well yield). Previous testing completed on the two (2) test wells, referenced to as TW 3/09 and TW 4/09, suggests that these wells could potentially provide additional supply capacity to the St. George system.

One of these test wells, TW 4/09, was developed at the edge of a corn field, on the south side of Howell Road, approximately 600 m east of the intersection between Howell Road and St. George Road. The nearest residential well is located about 80 m away from the well, across the street at 191 Howell Road.

Test Well TW 4/09 was originally developed as a test well and in a separate location from the existing well field where the St. George production wells are located. Although TW 4/09 was only tested at 9.5 L/s, the results of the pumping tests suggest that, for peaking purposes, this well may produce up to 40 L/s, subject to additional well development and further confirmatory testing.

This sub-option was developed to comprise of an expansion of the existing St. George Water Supply System by developing a new well field and supply facility on the TW 4/09 well site, as well as the upgrading the existing supply and treatment components in the St. George Water Supply System. The total water production at the TW 4/09 well site from multiple wells would also have to be confirmed through additional testing to properly evaluate the feasibility of this alternative solution.

As test well TW 4/09 is located in a separate well field from the existing production wells, this alternative would provide a secondary source of supply for the St. George water system and an additional supply capacity in the system.

Alternative 4C – Development of New Well Field on TW 3/09 site

Test well TW 3/09 was also identified during the previous groundwater exploration program, as a potential groundwater supply source for the St. George system. Test Well TW 3/09 was originally developed as a test well and in a separate location from the existing well field where the St. George production wells are located. Although TW 3/09 was only tested at 9.5 L/s, the results of the pumping tests suggest that the long-term capacity of this well could be about 15 to 19 L/s, subject to additional well development and further confirmatory testing.

This sub-option was developed to comprise an expansion of the existing St. George Water Supply System by developing a new well field and supply facility on the TW 3/09 well site, as well as the upgrading the existing supply and treatment components in the St. George Water Supply System. The total water production at the TW 3/09 well site from multiple wells would also have to be confirmed through additional testing to properly evaluate the feasibility of this alternative solution.

As test well TW 3/09 is located in a separate well field from the one housing the existing production wells, this alternative would provide a secondary source of supply for the St. George water system and additional supply capacity in the system.

9.1.5 Alternative 5 – Obtain Additional Supply Capacity from an Existing Water Supply System

The Obtain Additional Supply Capacity from an Existing Water Supply System alternative consists of providing for an extension of watermains to connect the St. George distribution system to an existing water supply system, while keeping the existing St. George Water Supply System in operation. The sub-options developed under this alternative solution are described as follows.

Alternative 5A – Connection to Existing Paris Water Supply System

This sub-option comprises a connection from the St. George distribution system to the Paris Water Supply System in the County of Brant, providing the additional supply capacity to the area of St. George. Both water supply and distribution systems are operated by the County. The existing St. George production wells will continue to be used to supply the St. George area.

The Paris Water Supply System, located on the west side of the Grand River, consists of four (4) well fields called Gilbert, Telfer, and Bethel. The Gilbert well field is the primary water supply with the Telfer field used as a back-up during periods of high demand or system maintenance. The Bethel Well field, recently put in production, mainly supplies water to a business park and the south end of Paris. The Scott well field has been decommissioned.

Based on 2013 water flow data, the Gilbert water system currently produces about 50% of its total combined water taking capacity of 127 L/s. The groundwater from the two bedrock wells has extremely high levels of sulfate - either close or exceed the aesthetic objective of 500 mg/L, while the groundwater from the six overburden wells has nitrate concentrations close or higher than 5 mg/L.

The Telfer water system currently produces about 15% of its total combined water taking capacity of 87 L/s (this includes the capacity of Well P36, not currently connected to the system). The groundwater well completed in the bedrock presents high level of sulfate, while the groundwater from the well completed in the overburden presents very high nitrate concentrations close to the maximum acceptable concentration of 10 mg/L.

The Bethel water system was put in operation in May 2013. Based on water flow data produced from one of the three production wells in this field, the system produced about 32% of its total water taking capacity of 30 L/s. The groundwater from well #3 presents extremely high concentrations of nitrate just below the maximum acceptable concentration of 10 mg/L.

The current system demands exerted by the Paris Water Supply System are lower than their respective water taking capacity. However, there may be some water quality considerations that may impose restrictions to the amount of water that can be produced from each well field.

The sub-option to connect to the existing Paris Water Supply System was developed under the premise that additional water supply capacity would be provided from the primary Gilbert water supply well field. New infrastructure would be needed as part of this option, including a 13 km watermain connection between Paris and St. George, a new booster pumping station and potentially a booster disinfection system.

This alternative would provide a secondary source of supply for the St. George water system as well as additional supply capacity to meet the projected average and maximum day demands in the St. George area.

Alternative 5B – Connection to Existing Brantford Water Supply System

This sub-option comprises a connection from the Brantford Water Supply System, in the City of Brantford to the St. George distribution system, providing the additional supply capacity to the area of St. George. Water will need to be purchased from the City of Brantford and the distribution system in St. George will continue to be operated by the County. The existing St. George production wells will continue to be used to supply the St. George area.

The City of Brantford and two (2) municipal drinking water systems in the County (i.e., Cainsville and King George distribution systems) are supplied with drinking water by the Holmedale Water Treatment Plant (WTP) in the City of Brantford. The City's raw water supply is drawn from the Grand River, at the Holmedale Canal. The WTP is permitted to produce water up to 100 ML/d. The major treatment processes at the Holmedale WTP include screening, coagulation, sand ballasted flocculation (Actiflo™), sedimentation, ozonation, biological filtration, UV disinfection, fluoridation, chlorination and chloramination.

The level of treatment and existing operational practices in the Brantford and St. George water systems is considerably different due to the nature of the water sources supplying each system (i.e., surface water for Brantford and groundwater for St. George). The Holmedale WTP in Brantford uses chloramination for secondary disinfection and fluoridation to help prevent tooth decay, whereas the St. George water system uses chlorination for primary disinfection and fluoride is naturally occurring in the aquifer.

The option to connect to the existing Brantford Water Supply System assumes that additional water supply capacity would be provided from the Holmedale WTP. New infrastructure would need to be provided as part of this option including a 10 km watermain connection between Brantford and St. George, a new booster pumping station and potentially a booster disinfection system.

This alternative would provide a secondary source of supply for the St. George water system and additional supply capacity to meet the projected average and maximum day demands in the St. George area.

Alternative 5C – Connection to Existing Cambridge Water Supply System

This sub-option comprises a connection from the Cambridge Water Supply System, in the Region of Waterloo to the St. George distribution system, providing the additional supply capacity to the area of St. George. Water will need to be purchased from the Region of Waterloo and the distribution system in St. George will continue to be operated by the County. The existing St. George production wells will continue to be used to supply the St. George area.

The existing Cambridge Water Supply System is part of the Integrated Urban System (IUS) in the Region of Waterloo servicing the communities of Cambridge (including Brown's subdivision in the

Township of North Dumfries), Kitchener, Waterloo, Elmira and St. Jacobs. The IUS is considered and treated as a single system as there are permanent interconnections of the water systems servicing these communities. The remaining capacity of the IUS is approximately 838 L/s, which accounts for additional servicing commitments in the services areas, as per the 2013 Region of Waterloo Water and Wastewater Monitoring Report.

The Cambridge Water Supply System is comprised of multiple municipal groundwater wells, pumping stations, reservoirs, and distribution watermains supplying municipal drinking water to five different service pressure zones across the city.

From a preliminary review of the geographical location of existing infrastructure assets in the City of Cambridge and the relative topography and groundwater elevations in St. George, a potential connection could be provided from the distribution systems within the Cambridge pressure zones 1, 1A or 3 to the St. George area. The well fields supplying the Middleton and Shades Mill reservoirs are equipped with multiple wells and have an existing rated capacity of 467 L/s and 150 L/s, respectively. The existing production rate from these well fields is about 60% of their respective rated capacity, providing an opportunity to supply the additional capacity to the St. George area. New infrastructure would need to be provided as part of this option including a 14 km watermain connection between Cambridge and St. George, and potentially a booster disinfection system.

Preliminary investigations have revealed that the Region of Waterloo does not supply water to areas outside of their current service areas and it is not expected to be a consideration in the short to medium terms. In addition, the Region is currently facing water supply challenges for the long term and the opportunity to connect to the Great Lakes pipeline was deferred to beyond 2050.

This alternative would provide a secondary source of supply for the St. George water system as well as additional supply capacity to meet the projected average and maximum day demands in the St. George area.

9.1.6 Alternative 6 – Develop a New Water Supply System

The Develop a New Water Supply System alternative consists of the decommissioning and abandonment of the existing St. George Water Supply System, including existing supply wells and treatment facility, as well as the development of a new water supply system that meets the projected design demands for the St. George area.

The sub-options developed under this alternative solution are described as follows.

Alternative 6A – Development of a New System through a New Groundwater Source

This sub-option comprises the development of a new groundwater system, including construction of new supply wells, treatment and pumping facility with adequate capacity to meet the projected design demands in the St. George area, as well as decommission of the existing St. George groundwater system.

A previous groundwater supply investigation completed for the community of St. George identified potential locations for additional groundwater supply sources. Test Wells TW 3/09 and TW 4/09 were developed in areas of St. George and were believed to have moderate to high aquifer potential. Development of these test wells was evaluated as part of the sub-options developed under “Expand or Upgrade the Existing St. George Water Supply System”, described earlier.

The existing St. George Water Supply System is operating adequately and there are no current concerns from a water production perspective, given the existing system demands. Development of a new groundwater supply system will need to ensure that current concerns with security of supply and lack of redundancy are addressed through development of new well fields and the necessary treatment equipment.

Alternative 6B – Development of a New System through a New Surface Water Source

The community of St. George is situated approximately 5 km from the Grand River. The Grand River is the water source for many municipalities, including the Region of Waterloo and the City of Brantford.

This sub-option comprises the development of a new surface system supplied with raw water from the Grand River, as well as the decommissioning and abandonment of the existing St. George groundwater system. The new surface water system would include a new intake pipe, treatment facility equipped with screening, filtration, primary and secondary disinfection processes, new clearwell and pumping station facilities. Additional treatment processes for removal of organic material and taste and odour may also be necessary. A characterization of the source water would need to be completed to confirm the treatment requirements.

As a water source, the Grand River should be able to provide the necessary water requirements to meet the projected design demands for the St. George area. In addition, system security, redundancy and flexibility will be provided through the treatment processes and equipment to be installed at the water treatment facility. The existing St. George Water Supply System is operating adequately and there are no current concerns from a water production perspective, given the existing system demands.

A general schematic, depicting the alternative solutions and the sub-options under consideration is included in Figure 17.

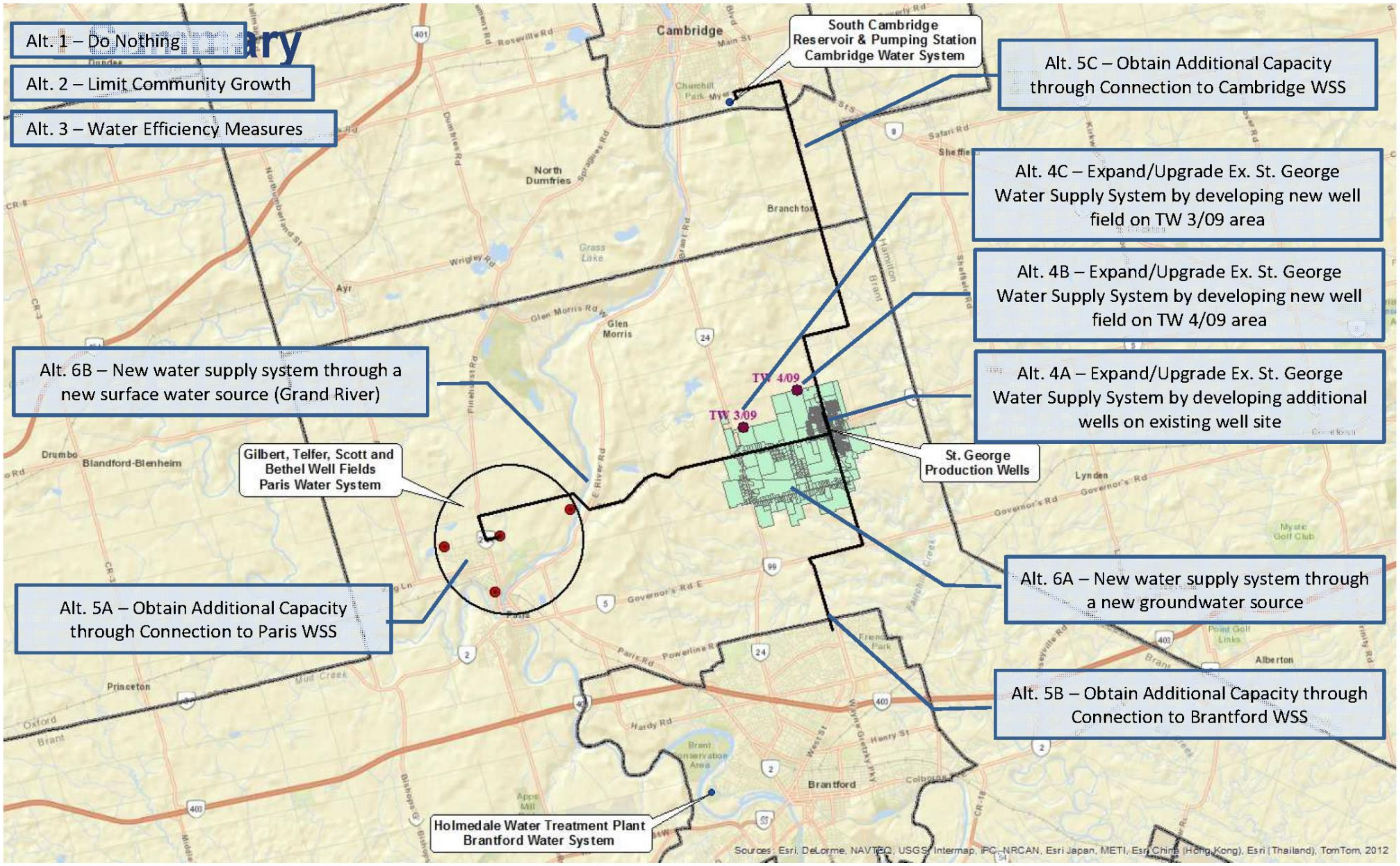


Figure 17 Water Supply Alternative Solutions – General Schematic

9.2 Evaluation of Alternative Water Servicing Solutions

A preliminary screening of the alternative solutions described in Section 9.1 was carried out in accordance with the methodology described in Section 8.2. The rationale used during the preliminary screening of the water servicing alternative solutions included an assessment of the major advantages and disadvantages of each alternative solution.

9.2.1 Screening Results

The screening results of the water servicing alternative solutions are summarized in Table 17. The alternative solutions that were not considered viable for implementation were not recommended for further evaluation in the process and were eliminated. The alternative solutions that were considered viable were further developed and subjected to a detailed evaluation in the next phase of the Class EA study.

Table 17 Alternative Water Servicing Solutions – Screening Results

Alternative Solution	Preliminary Screening Observations and Comments	Recommendation Short-listed for further Evaluation
1 – Do nothing	**Advantages:** • No immediate capital investment **Disadvantages:** • It would not address existing issues with security of supply • It would not accommodate design demands in St. George • Growth in St. George would be limited once demands reach existing system capacity • Inconsistent with growth projections in the Official Plan	Not recommended for further evaluation
2 – Limit community growth	**Advantages:** • No major capital investment **Disadvantages:** • It would not address existing issues with security of supply • Option alone would not accommodate design demands in St. George • Growth in St. George would be limited once demands reach existing system capacity • Inconsistent with growth projections in the Official Plan	Not recommended for further evaluation
3 – Implement water efficiency measures	**Advantages:** • Further reduction of water consumption would contribute to lower water demands **Disadvantages:** • It would not address existing issues with security of supply • Option alone would not accommodate design demands in St. George • Growth in St. George would be limited once demands reach existing system capacity • Inconsistent with growth projections in the Official Plan	Water efficiency measures will continue to be promoted in combination with the preferred water supply solution(s)
4A – Expand existing St. George Water Supply System by developing of additional wells	**Advantages:** • Maximizes the use of treatment and pumping infrastructure assets on existing well field **Disadvantages:** • As new wells will be developed on existing well field, option would not provide a secondary source nor address existing concerns with security of supply	Not recommended for further evaluation

Alternative Solution	Preliminary Screening Observations and Comments	Recommendation Short-listed for further Evaluation
on existing well field	• Capital investment will be required for development of new well(s) • Additional field testing needs to be completed to confirm aquifer production capacity	
4B – Expand existing St. George Water Supply System by developing a new well field and supply facility in the area of TW 4/09	**Advantages:** • Would provide a secondary source of water supply and address existing concerns with security of supply • Would provide additional capacity for future growth in St. George and potentially accommodate design demands • Would increase system redundancy by having multiple well sites and treatment facilities • Uses existing supply and treatment infrastructure assets by keeping existing groundwater system **Disadvantages:** • Capital investment will be required for new well(s) and associated treatment facility • Additional field testing needs to be completed to confirm well(s) and aquifer production capacity and treatment requirements	Recommended for further evaluation
4C – Expand existing St. George Water Supply System by developing a new well field and supply facility around TW 3/09	**Advantages:** • Would provide a secondary source of water supply and address existing concerns with security of supply • Would provide additional capacity for future growth in St. George • Would increase system redundancy by having multiple well sites and treatment facilities • Uses existing supply and treatment infrastructure assets by keeping existing groundwater system **Disadvantages:** • Capital investment will be required for new well(s) and associated treatment facility • Additional field testing needs to be completed to confirm well(s) and aquifer production capacity and treatment requirements	Recommended for further evaluation
5A – Obtain additional supply capacity from Paris Water Supply System	**Advantages:** • Would provide a secondary source of water supply and address existing concerns with security of supply • Would provide additional capacity for future growth in St. George and potentially accommodate design demands • Would increase system redundancy by having multiple water supply sources (Paris and St. George) • Uses existing supply and treatment infrastructure assets by keeping existing groundwater system **Disadvantages:** • Provision of water supply capacity from Paris to St. George will significantly reduce Paris' opportunities to accommodate projected growth in the area, which is inconsistent with growth projections in the Official Plan • Existing production wells at the Gilbert well site have historically shown high levels of nitrate and sulphate. Groundwater quality may potentially deteriorate at increased pumping rates, requiring modification of operational practices or restricting the well usage and thus, water production capacity • Potential water quality deterioration in the transmission main between Paris and St. George due to long distance (>10km) • Potential need for additional treatment in St. George to ensure adequate chlorine residual in water obtained from Paris Water Supply System	Not recommended for further evaluation

Alternative Solution	Preliminary Screening Observations and Comments	Recommendation Short-listed for further Evaluation
	• Need for Grand River crossing with transmission main, resulting in additional investigations and studies to support the crossing and additional timing and consultation with GRCA to secure permits and approvals for crossing • Significant capital and maintenance costs for watermain connection and booster pumping station	
5B – Obtain additional supply capacity from Brantford Water Supply System	**Advantages:** • Would provide a secondary source of water supply and address existing concerns with security of supply • Would provide additional capacity for future growth in St. George and accommodate design demands • Would increase system redundancy by having multiple water supply sources (Brantford and St. George) • Uses existing supply and treatment infrastructure assets by keeping existing groundwater system **Disadvantages:** • Incompatibility in source of water and treatment processes between the Brantford and St. George water systems. Brantford distributes chloraminated and fluoridated water through their distribution system, while St. George supplies chlorinated water and does not introduce fluoride as part of the treatment. • Reliance on a different local municipality for the provision of additional water supply. The County would need to purchase water from the City of Brantford • Need for a legal servicing agreement between Brantford and the County, which may include limitations to the water supply and restrict development in St. George • Potential water quality deterioration in the transmission main between Brantford and St. George due to long distance (approx. 8.5 km) • Potential need for additional treatment in St. George to ensure adequate chlorine residual in water obtained from Brantford Water Supply System • High capital and maintenance costs for watermain connection and booster pumping station	Not recommended for further evaluation
5C – Obtain additional supply capacity from Cambridge Water Supply System	**Advantages:** • Would provide a secondary source of water supply and address existing concerns with security of supply • Would provide additional capacity for future growth in St. George and accommodate design demands • Would increase system redundancy by having multiple water supply sources (Cambridge and St. George) • Uses existing supply and treatment infrastructure assets by keeping existing groundwater system **Disadvantages:** • Region of Waterloo does not have any plans to supply water to areas outside of their current service areas. • Reliance on a different local municipality for the provision of additional water supply. The County would need to purchase water from the Region of Waterloo • Potential water quality deterioration in the transmission main between Cambridge and St. George due to long distance (>18km)	Not recommended for further evaluation

Alternative Solution	Preliminary Screening Observations and Comments	Recommendation Short-listed for further Evaluation
	• Potential need for additional treatment in St. George to ensure adequate chlorine residual in water obtained from Cambridge Water Supply System • Potential need for Grand River crossing with transmission main if water is supplied from Cambridge pressure zone 3, resulting in additional investigations and studies to support the crossing and additional timing and consultation with GRCA to secure permits and approvals for crossing • Significant capital and maintenance costs for watermain connection	
6A – Develop and new water supply system through a new groundwater source	**Advantages:** • Water quality concerns associated with existing production wells in St. George will no longer exist **Disadvantages:** • Eliminates use of existing supply and treatment infrastructure assets in St. George which are in good operational condition, which is unjustifiable from a technical and social perspective • Significant capital expenditure in construction of brand new water supply system, supply wells and treatment facility	Not recommended for further evaluation
6B – Develop and new water supply system through a new surface water source (Grand River)	**Advantages:** • Water quality concerns associated with existing production wells in St. George will no longer exist • Would provide required capacity to accommodate design demands projected for St. George • System security, redundancy and flexibility will be provided through the treatment processes and equipment to be installed at the new water treatment facility **Disadvantages:** • Additional treatment processes for removal of organic material and taste and odour may be necessary • A characterization of the source water would be required to confirm the treatment requirements • Eliminates use of existing supply and treatment infrastructure assets in St. George which are in good operational condition, which is unjustifiable from a technical and social perspective • Significant capital expenditure in construction of brand new water supply system, including intake, treatment processes, clearwell and pumping station facilities	Not recommended for further evaluation

9.2.2 Screening Summary

Based on the preliminary screening presented in Table 17, the following alternative water servicing solutions were considered feasible and given further consideration either as stand-alone water servicing solution or in combination with each other:

- Alternative Solution 4B – Expand existing St. George Water Supply System by developing a new well field and supply facility around TW 4/09; and,
- Alternative Solution 4C – Expand existing St. George Water Supply System by developing a new well field and supply facility around TW 3/09

Both options assumed that the existing St. George production wells and treatment facility will continue to operate and meet water demands up to its permitted annual daily average rate of 69.8

L/s. In addition, it is anticipated that the new well(s) alone would be able to provide a yield of 45 L/s as a second independent source for most of the 25-year design period. The test wells for each alternative (TW 4/09 for Alternative Solution 4B and TW 3/09 for Alternative Solution 4C) were further assessed to determine the preferred groundwater source. The methodology and results of such assessment in described in the following section.

9.3 Assessment of Feasible Water Servicing Alternative Solutions – Hydrogeological Context

Further development and consideration of either of the feasible water servicing alternative solutions would require additional testing to confirm the production capacity of the test well(s) and the aquifer.

The Project Team determined that for practicality purposes, a comparative evaluation of the two potential new groundwater sources, Test Wells TW 4/09 and TW 3/09, needed to be completed to determine major opportunities and possible constraints associated with each well and well site, before starting any additional testing. An overall location of both wells, with respect to the St. George area is shown in Figure 18.

The key findings related to the review of test wells TW 3/09 and TW 4/09 are summarized:

- Well TW 3/09
  - The long-term capacity of well TW 3/09 is about 15 to 19 L/s, subject to confirmatory testing. The well efficiency is relatively low, and the peaking capacity is not expected to be much greater than the long-term capacity. The production capacity at this location may be higher, from a larger diameter well or from multiple wells; however, this cannot be determined without testing.
  - The high iron level of 0.86 mg/L, compared to the aesthetic objective of ≤0.3mg/L, indicates that the performance of the well will reduce over time because of well plugging and that the frequency of well rehabilitation will be more than normal.
  - At higher pumping rates, the steady state drawdown cone may extend beneath the Glen Morris Ridge Wetland Complex located just east of the well. Evaluation of the hydraulic connection between these two features is required.
- Well TW 4/09
  - The estimated long term pumping capacity of well TW 4/09 is about 15 to 19 L/s, subject to confirmatory testing. Based on past testing, it appears that the peak production capacity of this well may be as high as 40 L/s at this site. Normally, a municipal well with a capacity in the range of 20 to 40 L/s is constructed with a nominal inside diameter of at least 300 mm with materials of construction that minimize the risk of corrosion. TW 4/09 was constructed with a small diameter of 150 mm ID. Therefore, the production capacity at this location may be higher, from a larger diameter well or from multiple wells; however, this cannot be determined without additional pump testing.
  - The iron level of 0.41 mg/L, greater than the aesthetic objective of 0.3 mg/L, suggests that the performance of the well will also be impacted over time more rapidly than normal, but less than that which would likely occur at TW 3/09.

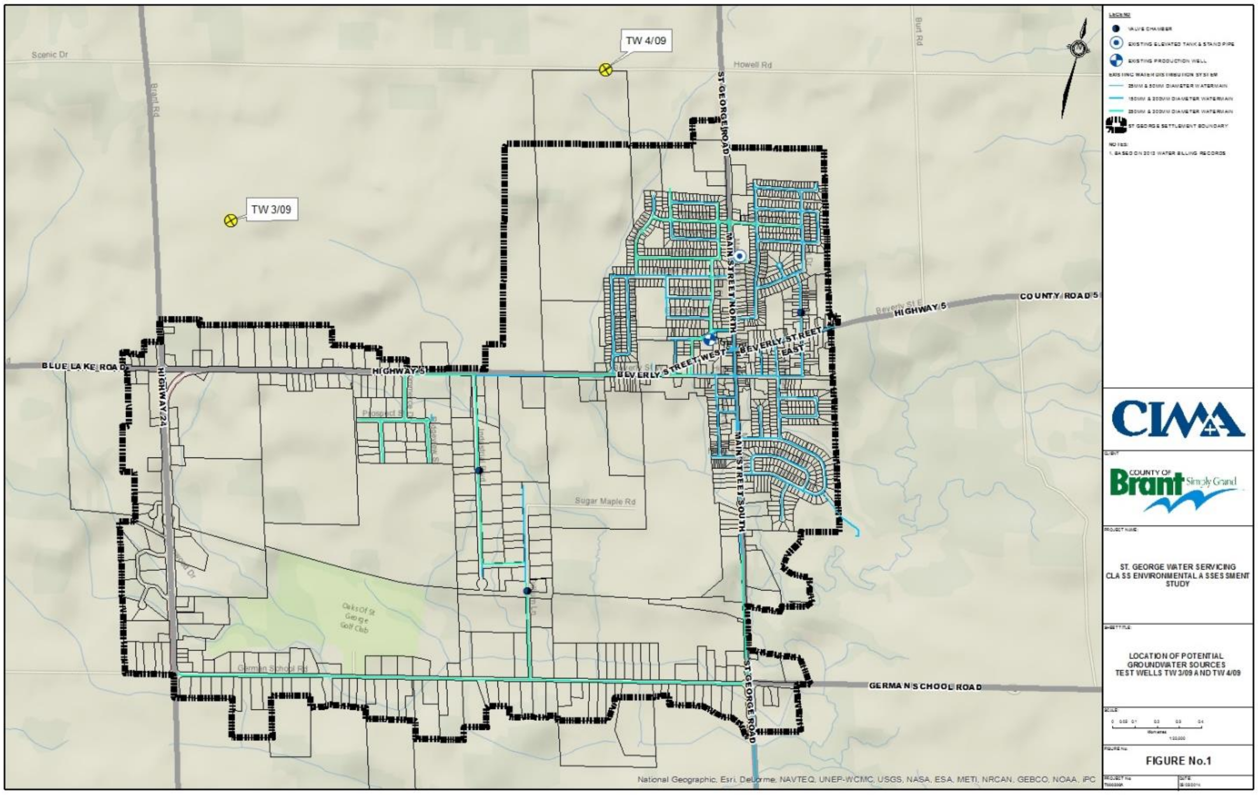


Figure 18 Location of Potential New Groundwater Sources – TW 3/09 and TW 4/09

9.3.1 GUDI or Non GUDI Characterization

To characterize the potential new wells (TW 3/09 and TW 4/09) as true 'groundwater' or 'groundwater under direct influence' (GUDI), both wells were subjected to the criteria established in the Procedure for Disinfection of Drinking Water in Ontario (MOE 2006) and the criteria in the Terms of Reference (TOR) for Hydrogeological Study to Examine Groundwater Sources Potentially Under Direct Influence of Surface Water (MOE 2001).

Currently, the Procedure for Disinfection of Drinking Water in Ontario (MOE 2006), as adopted by reference by Ontario Regulation 170/03 under the Safe Drinking Water Act sets out the criteria for determining if a well supply should be managed, from a treatment perspective, as either true "Groundwater" or GUDI. Six (6) criteria for identifying a GUDI supply are described in the Procedure. Applicability of these criteria for test wells TW 3/09 and TW 4/09 has been assessed, with the results shown in Table 18.

Table 18 GUDI or Non-GUDI Assessment – Procedure for Disinfection of Drinking Water in Ontario

ID	Criteria Description	Well TW 3/09	Well TW 4/09
1	A well that is not drilled or does not have a watertight casing to a depth of 6 m	Criterion not met	Criterion not met
2	A well that is an infiltration gallery	Criterion not met	Criterion not met
3	A well that is not capable of producing water at a rate greater than 0.58 L/s, any part of which is within 15 m of surface water	Criterion not met	Criterion not met
4	A well that can produce water at a rate greater than 0.58 L/s, any part of which is within 100 m of surface water	Criterion not met although there are surface water features within 150 m of this well	Criterion not met
5	A well that exhibits evidence of contamination by surface water	Criterion not met. Nitrate[1] and *E-Coli* was not detected during 72-hour aquifer test.	Criterion not met. Nitrate[1] and *E-Coli* was not detected during 72-hour aquifer test.
6	A well that a qualified professional concludes is GUDI	See discussion below	See discussion below

Notes:
1. Laboratory detection limit for nitrate analysis was 0.01 mg/L.

To try to determine whether there are any reasons for a qualified professional to conclude whether wells TW 3/09 and TW 4/09 are GUDI, a further review of the criteria in the Terms of Reference for Hydrogeological Study to Examine Groundwater Sources Potentially Under Direct Influence of Surface Water (MOE 2001) document was completed based on analysis of available information for wells TW 3/09 and TW 4/09. Applicability of these additional criteria for test wells TW 3/09 and TW 4/09 has been assessed, with the results shown in Table 19.

Based on the disinfection procedure criteria assessment, it is unlikely that either of these supply wells are GUDI, but as shown in Table 19, additional information is required to make a definitive statement.

Table 19 GUDI or Non-GUDI Assessment – GUDI Study TOR (MOE 2001)

ID	Criteria Description	Well TW 3/09	Well TW 4/09
1	Well exhibits physical evidence of surface water contamination and/or surface water organisms	Criterion not met	Criterion not met
2	Well regularly contains Total Coliforms or *E-Coli*	Criterion not met	Criterion not met
3	Well is located within approximately 50 days horizontal saturated travel time from surface water	Data unavailable to accurately confirm this criterion	Data unavailable to accurately confirm this criterion
4	Well is an overburden well within 100 m of surface water	Criterion not met	Criterion not met
5	Well may be drawing water from an unconfined aquifer	Criterion not met	Criterion not met
6	Well may be drawing water from formations within about 15 m of surface	Criterion not met	Criterion not met
7	Well is part of an enhanced recharge/infiltration project	Criterion not met	Criterion not met
8	When well is pumped, water levels in surface water rapidly change or hydraulic gradients beside surface water significantly increase in a downward direction	Data unavailable to accurately confirm this criterion	Data unavailable to accurately confirm this criterion
9	Chemical water quality parameters are more consistent with surface water than groundwater	Criterion not met	Criterion not met

9.3.2 Preferred New Groundwater Source

The results from recent testing at wells TW 3/09 and TW 4/09 were evaluated based on quantity, quality, and potential interference impacts. The rationale for the assessment of both wells is summarized in Table 20.

Table 20 Comparative Evaluation of Wells TW 3/09 and TW 4/09

Considerations	TW 4/09	TW 3/09	Preferred Well Site	Overall Preferred Well
Well Interference				
Outside of Existing WHPA	No	No[1]	TW 3/09	TW 3/09
Impacts to surface water features	No data	No data	unknown	
Nearest Wetland	~375 m north	~220 m northwest	TW 4/09	
Impacts to shallow groundwater monitors noted during 72-hour test	No	No[2]	Neither[2]	
Impact in Domestic Wells During pumping	Yes	Yes	Neither	
# of private wells within 500 m of well site	~7	0	TW 3/09	
# of private wells within 1 km of site	~22	~43	TW 4/09	

Considerations	TW 4/09	TW 3/09	Preferred Well Site	Overall Preferred Well
Highest drawdown at a domestic well during 72-hour pumping test	1.29 m (at 568 L/min)	0.08 m (at 680 L/min)	TW 3/09	
Closest domestic well[3]	80 m north	380 m west	TW 3/09	
Estimated Well Interference to nearby domestic wells at higher pumping rates (Woerns, 2012)	<4.0 m (at 900 to 1136 L/min)	<1.0 m (at 900 to 1136 L/min)	TW 3/09	
Concerns at higher pumping rate	Impact on domestic wells	Connection to nearby wetland	Unknown until further testing	
Groundwater Quantity				
Aquifer Thickness	8.8 m	8.8 m	Neither	TW 4/09
Drawdown in pumping well during 72-hour aquifer test	7.4 m	19.7 m	TW 4/09	
% of available drawdown used at PW	32%	54%	TW 4/09	
72 hour Pumping Test rate	9.5 L/s	11.2 L/s	n/a	
Predicted available pumping rate[4] (Woerns, 2012)	≥1140 L/min	906 to 1134 L/min	TW 4/09	
Specific Capacity from 72-hour test[4]	1.3 L/s per m	0.6 L/s per m	TW 4/09	
Groundwater Quality				
Potential Groundwater quality threats within 500 m	Agricultural land use	Agricultural land use	Neither	TW 4/09
Nitrate Levels	Non-Detect	Non-Detect	Neither	
Health Related ODWS Guidelines Exceeded	None	None	Neither	
Aesthetic ODWS Guidelines Exceeded	Hardness and Iron	Hardness and Iron	TW4 since Iron is lower	
Preliminary Evidence of "GUDI"	No	No	Neither	
Risk of greater than Category 2 GUDI Treatment Needed	Low	Low	Neither	
Frequency of Well Maintenance due to elevated iron	Moderate	High	TW 4/09	

Notes:
1. The current WHPA was delineated at 13.2 L/s. This rate is still significantly lower than the permitted rate for existing production wells. It is expected that if the limits of the WHPA were updated to an appropriate rate, it would encompass TW3.
2. Although 0.16 m of drawdown was observed at shallow well MW3B/09 this well is in the upper portion of the production aquifer and is not within a shallow aquifer unit. In addition, although this well is in an agricultural field it has a nitrate concentration of zero and as such there is strong evidence that it is not connected to surface.
3. Wells where the highest drawdown was noted
4. Specific capacity and the available pumping rate determined by Woerns (2012) from the 72-hour pumping test results were confirmed. It should be noted that the results presented by Woerns (2012) above are an extrapolation of data that has not been confirmed in the field; however, the approach used was found to be reasonable for the purposed of the relative comparison.

As shown in Table 20, a comparative evaluation of the two (2) sites suggests that TW 4/09 would provide better opportunities as a secondary supply source based on:

- A higher potential production capacity
- Better water quality characteristics mainly related to lower iron concentrations, likely requiring less treatment with a longer frequency between routine maintenance
- Lower potential to cause ecological impacts to adjacent wetlands
- Its proximity to existing municipal infrastructure resulting in less operational and maintenance requirements and capital costs.

From a disinfection perspective, it is anticipated that TW 4/09 will require treatment in accordance with Category 3a or 3b of the new TOR, requiring a 4-log or 2-log virus inactivation, respectively. In addition, iron removal may be necessary to reduce levels to below the aesthetic objective.

9.4 Confirmatory Well Testing at TW 4/09 – 2014/2015

A comprehensive field test program, complemented by groundwater modelling, was carried out in 2014 / 2015 to confirm the well and aquifer production potential of Well TW 4/09 and provide the basis for further development of alternative design concepts for the preferred water servicing solution being recommended. A separate report, Results of Hydrogeological Testing Project (July 2015) was completed by Lotimer and Associates, to document the methodology, findings and recommendations of the field test program and groundwater modelling. The Results of Hydrogeological Testing Project is attached in Appendix F.

TW 4/09 was originally developed as a test well and in a separate location from the existing well field where the St. George production wells are located. TW 4/09 is located at the edge of a corn field, on the south side of Howell Road, approximately 600 m west of the intersection between Howell Road and St. George Road.

The Well Head Protection Area (WHPA) “A” for TW 4/09 would include several residences along Howell Road. In order to reduce the vulnerability of the well site with respect to potential anthropogenic activities, a new potential well site 100 m south of the existing TW 4/09 was identified and recommended for evaluation. This location was selected so that the limits of the WHPA “A” would not include the existing residences along Howell Road. A monitoring well MW 1/14 was also installed at this site to further monitoring and understanding the stratigraphy and aquifer system. The overall location of wells TW 4/09 and MW 1/14 is shown in Figure 19.

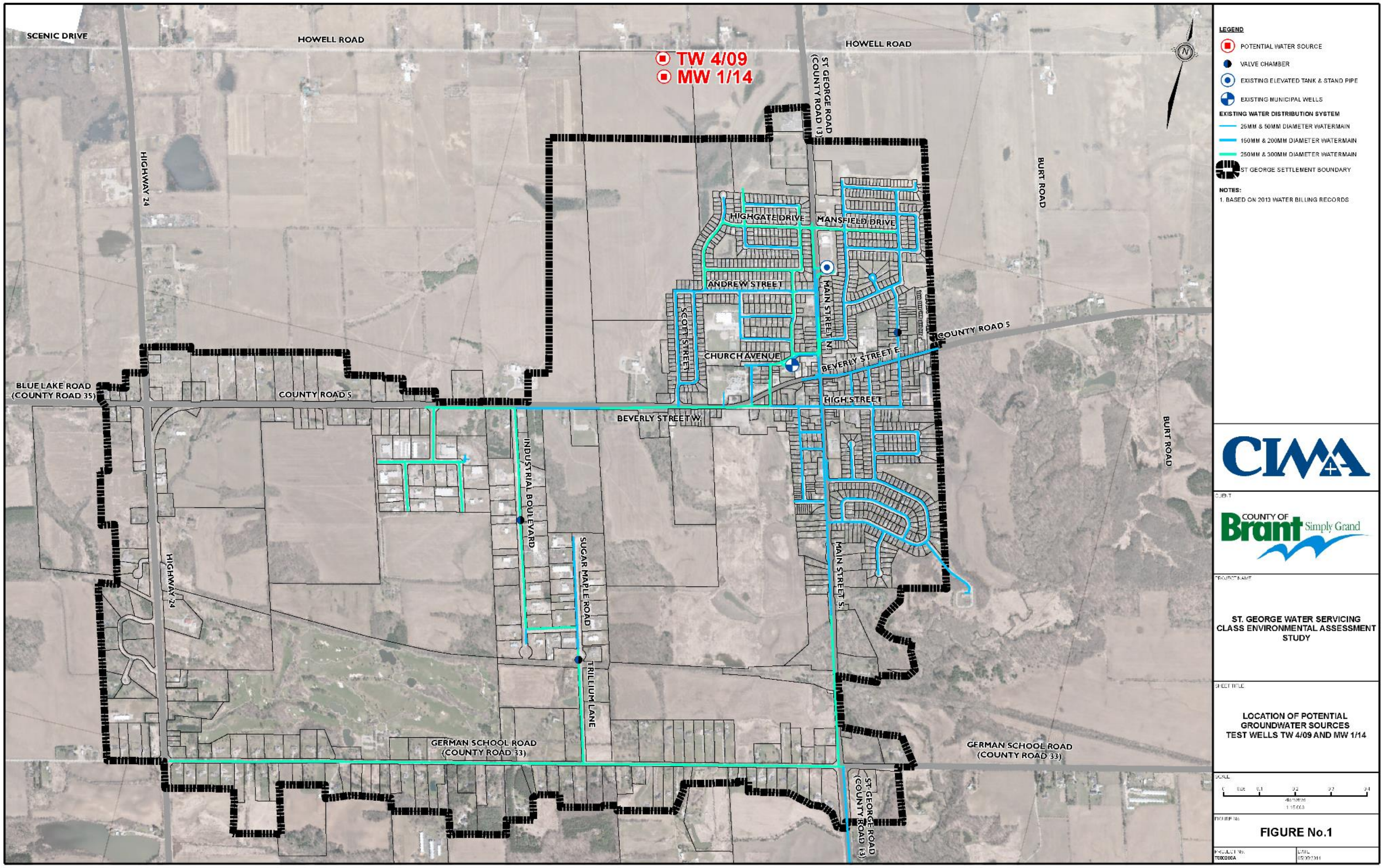


Figure 19 Location of Well TW 4/09 and MW 1/14

9.4.1 Estimated Capacity and Preliminary Design of New Wells

The sand and gravel aquifer (overburden) in which well TW 4/09 is screened appears to be a localized unit and is essentially absent at the monitoring well MW 1/14 to the south. The widespread drawdown cone obtained during both aquifer tests (2009 and 2014) suggests that the bedrock aquifer at well MW 1/14 conveys significant quantities of water to the sand and gravel aquifer at well TW 4/09, and these two units should be considered as a single aquifer.

Two (2) alternatives for preliminary well design were considered:

- **Overburden Well at TW 4/09 Site** – An overburden well with a design capacity of 45.1 L/s should be possible at the TW 4/09 site. The well would be cased, with nominal 350 mm diameter Schedule 40 stainless steel pipe, to a depth of about 49 meters below ground level (m bgl) and equipped with a nominal 300 mm diameter stainless steel well screen set from 49 to 57 m bgl. The well screen would be surrounded with silica filter sand and the annular space from the top of the well screen to surface sealed with a Portland Cement based sealant. The possibility of constructing a bedrock well at TW 4/09 site is subject to further investigation.
- **Bedrock Well at MW1/14 Site** – The sand and gravel aquifer is absent at MW 1/14 site. However, it is possible to construct a bedrock well at a design capacity of 45.1 L/s. The well would be cased, with nominal 350 mm diameter Schedule 40 stainless steel pipe, to a depth of about 56 m bgl. The annular space from the base of the casing to the surface would be sealed with a Portland Cement based sealant. The well would be completed as an open hole in the bedrock, with a nominal diameter of 300 mm to a depth of about 70 m bgl.

Based on the field test results and preliminary design of wells, a single overburden well or single bedrock well should be capable of producing 45.1 L/s, sufficient to meet the projected average design day demands in St. George. However, until a pilot hole is drilled to confirm capacity to enable final design, it is recommended to consider two (2) wells, about 20 m apart, each with a capacity of 22.5 L/s to obtain the back-up yield of 45.1 L/s.

9.4.2 Raw Water Quality Data

Water samples were collected during the aquifer test at Well TW 4/09 every 24 hours for three (3) consecutive days. Water quality analysis was completed every 24 hours for major indicator parameters (i.e., calcium, magnesium, sodium, potassium, chloride, bicarbonate, sulphate, iron, manganese, nitrate, turbidity, dissolved organic carbon and UV transmittance). A comprehensive water quality analysis was completed for the water sample collected at the end of the testing (72 hours) in accordance with Tables 1, 2, 3 and 4 of the Technical Support Document for Ontario Drinking Water Quality Standards, Objectives and Guidelines (June 2003, Revised June 2006).

For the purpose of this report, data for selected physical and chemical parameters of the groundwater quality collected from TW 4/09 during the aquifer test are compared to water quality from samples collected from the monitoring wells MW 1/14 (bedrock well) and MW 4/098-B (shallow overburden well), as per Table 21. Data for microbiological parameters sampled from Well TW 4/09 are shown in Table 23. The limits set out in the Ontario Drinking Water Quality (ODWQ) Standards, Objectives and Guidelines are also included in Table 21 and Table 24. These standards, objectives and guidelines apply only to treated / distribution water and do not apply directly to raw water;

however, the limits have been included in the tables to provide an indication of potential treatment requirements

Table 21 2014 Raw Water Quality Data (Selected Physical and Chemical Parameters)

Parameter	Units	TW 4/09 (12/11/2014 – 72 Hrs)	MW 1/14 (03/25/2014)	MW 4/09B (03/25/2014)	Ontario Drinking Water Standards, Objectives & Guidelines[1]	
					AO/OG[2]	Health-based Standard
Alkalinity (as CaCO3)	mg/L	250	240	200	30-500	
Dissolved Chloride	mg/L	5	5	18	250[3]	
Dissolved Organic Carbon (DOC)	mg/L	0.37	0.37	0.54	5	
Dissolved Sulfates	mg/L	38	44	43	500[4]	
Fluoride	mg/L	0.65	N/A	N/A	0.5 – 0.8	
Hardness (as $CaCO_3$)	mg/L	290	300	300	80-100	
Iron	mg/L	0.38	0.17	0.17	0.3	
Lead	mg/L	0.0037	N/A	N/A		0.01 (at point of consumption)
Manganese	mg/L	0.0091	0.041	Not detectable	0.05	
Nitrate	mg/L	Not detectable	Not detectable	8.21	10	
Organic Nitrogen	mg/L	0.1	N/A	N/A	0.15	
pH		7.39 - 7.44	7.5	7.5	6.5-8.5	
Sodium	mg/L	5.8	17	3.3	200[5]	
Temperature	°C	9.5	9.9	10.1	15	
Total Dissolved Solids	mg/L	310	340	350	500	
Turbidity	mg/L	2.6	N/A	N/A	5 (at point of consumption)	1 (Adverse Water Quality Level)

Notes:
1. From O. Reg. 169/03 and Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines (June 2003, Revised June 2006).
2. AO/OG – Aesthetic Objective or Operational Goal (not health-based)
3. The Aesthetic Objective for Chloride is 250 mg/L. Water quality data for chloride noted in the table represents dissolved chloride
4. The aesthetic objective for sulfate in drinking water is 500 mg/L. Water quality data for sulfates noted in the table represents dissolved sulfate
5. The aesthetic objective for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use. with patients on sodium restricted diets.

As shown in Table 21, the values for hardness and iron exceeded their respective aesthetic objective for the samples collected in 2014. Hardness in drinking water is not substantially affected by conventional treatment. Hardness values greater than 200 mg/L (as CaCO3) are considered poor but tolerable. The reported hardness concentrations are not considered to potentially cause operational challenges from a treatment perspective. However, due to the level of hardness being reported, domestic water softeners at point-of-use may be required, on individual preference.

The iron concentration measured in 2014 from testing well TW 4/09 of 0.38 mg/L was slightly above the aesthetic objective of 0.3 mg/L. The presence of iron in groundwater can be associated with mineral deposits and chemically reducing underground conditions. High levels of iron in drinking water do not pose any known adverse health risks; however, high iron levels can result in discolored water, stained plumbing fixtures, and an unpleasant taste to the water. The precipitation of iron can also result in iron-deposit buildup in pressure tanks, storage tanks, water heaters, and pipelines, which in turn may decrease capacity, reduce pressure, and increase maintenance. From a well performance perspective, the iron levels encountered in TW 4/09 were indicative that the performance of the well will reduce over time as a result of well plugging and that more frequent than normal well rehabilitation will be necessary. Treatment for iron control or iron removal may be required at the treatment facility.

Other physical and chemical parameters that help to characterize the groundwater quality for drinking water purposes such as chloride, dissolved organic carbon, fluoride, manganese, nitrates, sulfates, temperature, total dissolved solids, and turbidity are all well within the limits of the aesthetic objectives and operational guidelines, as shown in Table 21.

Table 22 2014 Raw Water Quality Data (Microbiological Parameters)

Parameter	Units	TW 4/09 (12/11/2014 – 72 Hrs)	Ontario Drinking Water Standards, Objectives & Guidelines[1]
			MAC[3]
Escherichia coli (E.coli)	CFU/100 mL	0	Not detectable
Total coliforms	CFU/100 mL	0	Not detectable
Total Coliform Background	CFU/100 mL	0	200 CFU/100 mL

Notes:
1. From O. Reg. 169/03 and Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines (June 2003, Revised June 2006).
2. MAC is the Maximum Acceptable Concentration established for parameters which when present above certain concentration, have known or suspected adverse health effects. The length of time the MAC can be exceeded without health effects will depend on the nature and concentration of the parameter.

As per Table 25, the raw water quality data from the samples collected in 2014 from TW 4/09 at the end of the pumping test (72 hours) met all microbiological, chemical and radionuclide standards, in accordance with the limits set out in the ODWQ Standards, Objectives and Guidelines.

9.4.3 GUDI Characterization

Currently, Ontario Regulation 170/03 under the Safe Drinking Water Act sets out the criteria for determining if a well supply should be managed, from a treatment perspective, as either “true” groundwater or “Groundwater Under the Direct Influence of Surface Water” (GUDI).

To determine if there are any reasons for a qualified professional to conclude whether TW 4/09 is GUDI, a review of the criteria in the *Terms of Reference for Hydrogeological Study to Examine Groundwater Sources Potentially Under Direct Influence of Surface Water (MOE 2001)* document was completed based on analysis of the recent well testing information. This analysis was completed as part of the hydrogeological testing program completed by Lotimer and Associates in 2014 / 2015.

The GUDI characterization assessment concluded that a drinking water system utilizing the overburden aquifer at which TW 4/09 is completed or the bedrock aquifer at which MW 1/14 is completed should not be considered as GUDI, as this water system can be classified as “true groundwater” and would not be vulnerable to contamination by protozoa. From a disinfection perspective, it is anticipated that TW 4/09 and MW 1/14 will require treatment in accordance with Category 3a or 3b of the new TOR, requiring a 4-log or 2-log virus inactivation, respectively.

9.5 Development and Testing of Bedrock Test Wells – 2016

The 2015 confirmatory well testing program provided a high level of certainty that the aquifer at the preferred alternative well site would be able to support the required backup supply, at either TW 4/09 or MW 1/14 well site. However, the hydrogeological characteristics of the aquifer resulted in a fairly high level of uncertainty that a specific location will produce an acceptable yield. As a result, drilling and testing of additional test wells was recommended to confirm the location, water quality and sustainable yield of the new back-up wells.

Development of bedrock test wells at the monitoring well site MW 1/14 was recommended on the premise that the WHPA-A for MW 1/14 would not include the existing residences along Howell Road and that bedrock wells will likely have lower capital cost to construct, and perhaps lower maintenance cost, than sand and gravel wells. Both types of wells will likely have similar operating costs.

The proposed work plan comprised drilling two (2) test wells as open holes in the bedrock, video surveying, preliminary step testing, 72-hour aquifer testing and water quality analysis. The overall location of the two bedrock test wells, referred to as TW 1/16 and TW 2/16, is shown in Figure 20.

In May 2016, the results of the preliminary step testing confirmed that the capacity of the bedrock test well site MW 1/14 was better than the existing TW 4/09 site located along Howell Road. In addition, it was revealed that both bedrock wells, would have similar capacities and either of the wells should be able to produce the average design capacity for the back-up supply of 45 L/s. In addition to great aquifer potential, water quality in the bedrock wells was also found to be good with treatment requirements expected at this point only for disinfection, under current regulations.

Subject to comments received from the MECP in regards to the need to demonstrate that the new well site is able to provide the required yield of 45 L/s on a sustainable basis and any connectivity between the existing and the new well site, the testing program was modified. Accordingly, the aquifer testing was completed at the required back-up yield of 45 L/s (each well to be tested at 22.5 L/s for a combined pumping rate of 45 L/s) and new monitoring wells were installed south of the new bedrock test wells to collect additional hydrogeological data. One monitor well (MW 1/16) was completed in the bedrock. The other monitor well (MW 2/16) was completed in sandy sediments just below coarse sediments of the Grand River aquifer system, in which the existing St. George municipal wells were completed. The location of monitoring wells MW 1/16 and MW 2/16 is shown in Figure 20.

Figure 20 Overall Location of Bedrock Test Wells TW 1/16 and TW 2/16 and Monitoring Wells

9.5.1 Hydrogeological Study Program Results 2016 / 2017

Key findings of the 2016 hydrogeological testing program are briefly summarized as follows:

- The aquifer in which the new bedrock test wells, TW 1/16 and TW 2/16, are constructed, can safely produce 45 L/s of water on a sustainable basis. The test wells should be converted to municipal production wells with a larger diameter. The ultimate diameter of the wells would depend on their required yield.
- Groundwater modelling simulations suggest that the new bedrock aquifer alone can produce average and maximum day demands of 45 L/s and 124 L/s, respectively. Further testing of the bedrock wells will be necessary to confirm that the wells can produce yields of up to 124 L/s.
- Unacceptable impacts to existing private wells completed either in the contact aquifer or the bedrock aquifer are not expected from long-term pumping from the two (2) new bedrock wells at 45 L/s.
- As per the MECP water well record data, there are a few wells along Howell Road and St. George Road considered to be shallow (completed in the Grand River aquifer). As this point, it is unknown if the performance of these wells could be affected by the combined drawdown in these wells (the normal operation of the wells plus pumping of the new bedrock wells). Should this be the case, mitigation measures would need to be implemented by either connecting the wells to the municipal supply or drilling deeper wells for the affected homeowners. Private well testing could be implemented to assess this risk.
- Should the new bedrock wells be used to produce yields of up to 124 L/s, private wells along Howell Road and St. George Road, within several kilometres of the bedrock, wells may be adversely impacted. However, this pumping scenario is not anticipated based on the projections for the 2051 plannig period. Any unacceptable impacts to private wells can likely be mitigated by drilling new wells into either the deep sand and/or gravel aquifer or the bedrock aquifer. Some of the older wells in the area may require maintenance to restore their original capacity.
- There is a significant degree of hydraulic separation between the bedrock aquifer and the Grand River aquifer. Although water level monitoring data suggest that there was a slight response in the Grand River aquifer due to pumping from the bedrock, interpretation of the available drawdown at the municipal production wells, combined with results from previous testing and recent groundwater modelling, suggests that the capacity of the existing St. George wells would not be adversely impacted by the combined pumping of the existing wells and the bedrock wells at combined flows of up to 124 L/s.
- The water quality is generally stable throughout the aquifer. Data collected supports the interpretation that the bedrock groundwater supply would be considered “true” groundwater. Water samples from bedrock wells TW 1/16 and TW 2/16 indicate that in general, the water produced by the bedrock wells meets the Ontario Drinking Water Quality Standards, Objectives and Guidelines except for a few parameters. A separate section of water quality follows.

9.5.2 Water Quality Results and Treatment Requirements

Water samples were collected during the aquifer test at bedrock Well TW 1/16 and TW 2/16 after 1 hour, 18 hours, 42.5 hours, and 64.5 hours. Water quality analysis was completed for major indicator parameters, as shown in Table 23 and Table 27.

Table 23 2016 Raw Water Quality Data (Selected Physical and Chemical Parameters)

Parameter	Units	Bedrock Test Well TW 1/16 (12/17/2017 – 64.5 Hrs)	Bedrock Test Well TW 2/16 (12/17/2017 – 64.5 Hrs)	Ontario Drinking Water Standards, Objectives & Guidelines[1]	
				AO/OG[2]	Health-based Standard
Alkalinity (as CaCO3)	mg/L	250	260	30-500	
Arsenic	mg/L	0.008	0.011		0.01[3]
Dissolved Chloride	mg/L	7.8	2.7	250[4]	
Dissolved Sulfates	mg/L	38	33	500[5]	
Hardness (as $CaCO_3$)	mg/L	280	270	80-100	
Iron	mg/L	0.32	0.35	0.3	
Manganese	mg/L	0.009	0.007	0.05	
Nitrate	mg/L	Not detectable[6]	Not detectable[6]		10[7]
pH		7.79	7.92	6.5-8.5	
Sodium	mg/L	5.6	6.0	200[8]	
Temperature	°C	9.5	9.4	15	
Total Dissolved Solids	mg/L	320	310	500	

Notes:

1. From O. Reg. 169/03 and Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines (June 2003, Revised June 2006).
2. AO/OG – Aesthetic Objective or Operational Goal (not health-based)
3. The Interim Maximum Acceptable Concentration (IMAC) for arsenic in drinking water was lowered from 0.025 to 0.01 mg/L in 2017
4. The Aesthetic Objective for Chloride is 250 mg/L. Water quality data for chloride noted in the table represents dissolved chloride
5. The Aesthetic Objective for sulfate in drinking water is 500 mg/L. Water quality data for sulfates noted in the table represents dissolved sulfate
6. As per actual water data reports by the analytical laboratory, nitrate levels were Not Detected “ND”. The reportable detection limits for Nitrate as per actual water data reports was 0.1 mg/L.
7. Where both nitrate and nitrite are present, the total of the two should not exceed the Maximum Acceptable Concentration (MAC) of 10 mg/L (as nitrogen).
8. The aesthetic objective for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets.

Table 24 2016 Raw Water Quality Data (Microbiological Parameters)

Parameter	Units	TW 1/16 (12/17/2017 – 64.5 Hrs)	TW 2/16 (12/17/2017 – 64.5 Hrs)	Ontario Drinking Water Standards, Objectives & Guidelines[1]
				MAC[2]
Escherichia coli (E.coli)	CFU/100 mL	-	0	Not detectable
Total coliforms	CFU/100 mL	-	0	Not detectable

Notes:
1. From O. Reg. 169/03 and Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines (June 2003, Revised June 2006).
2. MAC is the Maximum Acceptable Concentration established for parameters which when present above certain concentration, have known or suspected adverse health effects. The length of time the MAC can be exceeded without health effects will depend on the nature and concentration of the parameter.

As shown in Table 23, the values for arsenic, hardness and iron found in the raw water in 2016 were at or slightly above their respective recommended limit. Below is a brief discussion of the potential implications of the presence of these parameters in drinking water:

- In 2017, the Canadian drinking water guideline for arsenic was lowered from 0.025 mg/L to 0.01 mg/L. The arsenic concentration found in bedrock well TW 1/16 of 0.008 mg/L in 2016 was below the new limit, while the arsenic concentration found in bedrock well TW 2/16 of 0.011 mg/L was slightly above the new reduced limit of 0.01 mg/L. Arsenic is often found at higher levels in groundwater in hard rock areas (e.g., Canadian Shield) in Ontario through natural dissolution of arsenic containing minerals, in some mine drainage waters and in some mine leachates. In this specific case, the occurrence of arsenic is interpreted to be a result of naturally occurring processes, due to the presence of pyrite within the bedrock, rather than of anthropogenic origin. Treatment for removal of arsenic to below the recommended limits will be required at the treatment facility, should the bedrock wells be used as the source of supply.
- The reported hardness concentrations are not considered to potentially cause operational challenges from a treatment perspective. However, due to the level of hardness reported, domestic water softeners at point-of-use may be required, on individual preference. Hardness levels between 270 and 280 mg/L, encountered in the water from both bedrock wells in 2016, were below the reported hardness concentration in the existing St. George water supply system of 382 mg/L.
- The iron concentrations found in both bedrock wells TW 1/16 and TW 2/16 in 2016, as shown in Table 23, were slightly above the aesthetic objective of 0.3 mg/L. From a well performance perspective, the iron levels encountered may be indicative that the performance of the wells will reduce over time as result of well plugging and that more frequent than normal well rehabilitation will be necessary. Treatment for iron control or iron removal may be required, should the bedrock wells be used as the source of supply.
- Other physical and chemical parameters that help to characterize the groundwater quality for drinking water purposes such as chloride, dissolved organic carbon, fluoride, manganese, nitrates, sulfates, temperature, total dissolved solids, and turbidity were all well within the limits of the aesthetic objectives and operational guidelines, as shown in Table 23.

As per Table 24, the raw water quality data from the sample collected from TW 4/09 in 2016 at the end of the pumping test (72 hours) met all microbiological, chemical and radionuclide standards, in accordance with the limits set out in the ODWQ Standards, Objectives and Guidelines.

9.6 Summary of Evaluation of Water Servicing Alternative Solutions

Completion of Phase 2 of the Class EA study identified two feasible water servicing alternative solutions:

- Alternative Solution 4b – Expand the existing St. George Water Supply System by developing a new well field and supply facility around TW 4/09; and,
- Alternative Solution 4c – Expand the existing St. George Water Supply System by developing a new well field and supply facility around TW 3/09

Both alternative solutions 4b and 4c assume that the existing St. George production wells and treatment facility will continue to operate and meet water demands up to the permitted annual daily average rate of 69.8 L/s. The development of new well(s) in the areas of TW 4/09 and/or TW 3/09, would provide adequate supply and treatment capacity to meet the projected maximum design demands in St. George of 48.5 L/s.

A comparative evaluation of the two (2) potential new groundwater sources, Test Wells TW 4/09 and TW 3/09 suggested that developing a new well field and supply facility around TW 4/09 would provide better opportunities as a secondary supply source based on potential production capacity, water quality characteristics and proximity to existing municipal infrastructure. Consequently, Alternative Solution 4c was eliminated from further consideration.

The hydrogeological investigation completed in 2015/2016 provided additional supporting information to further develop design concepts for the preferred Alternative Solution 4b – Expand the existing St. George Water Supply System by developing a new well field and supply facility around TW 4/09. A summary of key results gathered from the hydrogeological investigation completed as part of this Class EA study is as follows:

- There are two (2) potential alternatives for preliminary well design that include overburden wells at the Test Well TW 4/09 Site or bedrock wells at Monitoring Well MW 1/14 Site (located approximately 100 m south of TW 4/09 site).
- Preliminary testing confirmed the feasibility of developing a new groundwater supply around TW 4/09 as a second, independent source. It was presumed that a single overburden well should be capable of producing 45.1 L/s, sufficient to meet the projected 2051 demands in St. George. However, until a pilot hole is drilled to confirm capacity to enable final design, it is recommended to consider 2 overburden wells, each with a capacity of 22.5 L/s.
- Preliminary analysis of raw water quality data from overburden well TW 4/09 indicate that this site is a good water supply source and suitable for development as a municipal well. From a treatment perspective, iron control/removal process may be necessary in addition to a disinfection process. Although manganese levels were reported to be below the respective aesthetic objective, provision for manganese control/removal is recommended.
- Analysis of raw water quality data from bedrock test wells, TW 1/16 and TW 2/16, indicate that this site is a good water supply source and suitable for development as a municipal well. From a treatment perspective, arsenic removal, iron control / removal process may be necessary in addition to a disinfection process. Although manganese levels were reported to be below the respective aesthetic objective, provision for manganese control / removal is recommended.

- Additional testing completed in 2016-2017 confirmed that the new bedrock test wells, TW 1/16 and TW 2/16, drilled in the vicinity of the Monitoring Well MW 1/14 Site can safely produce 45 L/s of water on a sustainable basis. Groundwater modelling simulations suggest that the new bedrock aquifer alone can produce the design maximum day demands of 48.5 L/s.
- The new projected maximum day demand of 48.5 L/s is slightly higher than the tested pumping volume of 45 L/s of the two (2) new bedrock wells. Although testing of the bedrock wells only reached 45 L/s, there is minimal doubt that the two (2) bedrock wells could produce the County's 2051 projected maximum day demand of 48.5 L/s.

Interpretation and analysis of the hydrogeological information collected as part of the Class EA study was considered in the development of potential alternative design concepts for the preferred water servicing solution.

10. Treatment Requirements Considerations

Based on the raw water quality data obtained from the recent testing program, it is anticipated that treatment processes for aersenic removal, iron control / removal and disinfection will be required for the new production well(s). A number of alternative process technologies are available to provide the level of treatment required. A brief description of available technologies is provided in this section.

10.1 Arsenic Removal

In 2018, the Ontario Drinking Water Standards were modified to establish a new maximum acceptable concentration (MAC) for arsenic. As a result, the treatment of arsenic became an important factor, as it affected one of the proposed bedrock wells (TW2/16). The speciation of arsenic is critical for the selection of a treatment technology for arsenic removal. Soluble, inorganic arsenic exists in either one of two valence states depending on local oxidation conditions. Typically, groundwater has anoxic conditions and arsenic is found in its arsenite form As(III), while surface water has aerobic conditions and arsenic is found in its arsenate form As(V).

Studies have shown that As(V) is more easily removed from source waters than As(III), and thus the selection of the appropriate treatment technology for arsenic removal depends on the oxidation state of the arsenic present in the water.To increase the removal efficiency when As(III) (arsenite) is present, pre-oxidation to the As(V) (arsenate) species is required for more effective removal. Effective oxidants include chlorine, potassium permanganate and ozone.

Many treatment options exist for the removal of arsenic from surface and groundwaters, including:

- Reverse Osmosis (RO): a pressure-driven physical separation process capable of removing arsenic from water by means of particle size. RO is relatively insensitive to pH, although pH adjustment may be required to protect the membrane from fouling. Extensive pretreatment for particle removal and often for dissolved contaminants can make the process very costly. Overall, RO is capable of achieving finished water arsenic concentrations below 0.002 mg/L when arsenic is in the form of As(V). As(III) rejection is not as significant, thus, pre-oxidation is important to convert As(III) to As(V). Waste stream management from an RO system adds complexity and cost to operations. The liquid waste stream from this process contains high levels of arsenic and other constituents rejected from the source water that must be treated before disposal or sent to a sanitary sewer.
- Activated Alumina (AA): a physical / chemical process by which ions in the feed water are combined to the oxidized AA surface. AA is used as the media in packed beds. Feed water is continuously passed through to the bed to remove contaminants. The contaminant ions in the water are exchanged with the surface hydroxides on the alumina. When adsorption sites on the AA surface are filled, the bed must be regenerated. Regeneration is accomplished through a sequence of rinsing with regenerant, flushing with water and neutralizing with acid, typically sulfuric acid. The regenerant is a strong base, typically sodium hydroxide. The liquid waste water from this process contains high levels of arsenic that must be treated before disposal or sent to a sanitary sewer.
- Ion Exchange (IX): a physical/chemical process by which an ion on the solid phase is exchanged by an ion in the feed water. The solid phase is typically a synthetic resin which has been chosen to absorb the particular contaminants of concern. The IX process is achieved by continuously

feeding water to the bed of ion exchange resin in a downflow or upflow mode until the resin is exhausted. Once the bed is exhausted, the bed must be regenerated by rinsing the IX column with a regenerant. The number of bed volumes (BV) that can be treated before the bed is regenerated varies with resin type and influent water quality. IX is not effective for AS (III) removal.

- Lime softening (LS): a precipitative process commonly used to remove calcium and magnesium cations from solution. To remove arsenic, lime is added to increase the pH above 10.5 to form magnesium hydroxide. In this pH range, magnesium hydroxide and As(V) is removed by co-precipitation. The semi-liquid residual from this process contains arsenic and other removed constituents and must be treated before disposal or sent to a sanitary sewer. Oxidation of As(III) to As(V) prior to treatment will increase removal efficiencies.
- Iron Removal Processes: by utilizing the adsorptive capacity of natural iron particles that are formed when Fe(II) is oxidized to Fe(III), iron removal processes can also act as effective arsenic removal processes through adsorption and coprecipitation mechanisms. The basic process for iron removal includes oxidation, contact time, and filtration. Several different types of iron removal treatment options are available including chemical oxidation followed by media filtration (with options including sand, dual media, and synthetic filtration media), solid oxidizing media filtration and manganese greensand filtration. The capacity of iron removal processes to remove arsenic depends on the amount of arsenic and natural iron in the source water, and a screening guide is available for selection. A strong chemical oxidant is required to achieve arsenic removal through iron removal processes.

10.2 Iron & Manganese Control / Removal

Iron control / removal may be necessary to reduce levels to below the aesthetic objective. Some of the most common available treatment options include:

- Sequestration: A sequestering agent is added at the source to mask the effects of elevated iron concentrations in the distribution system. The iron ion is surrounded by a chain of molecules from the sequestering agent and is not allowed to precipitate in the water. Sodium phosphate and sodium silicate are common sequestering agents; however, sodium phosphate in low concentrations is considered a very effective sequestering agent. This process is generally effective when the water contains less than 0.3 mg/L of iron or 0.1 mg/L of manganese. The proper dosage, type of phosphate and phosphate feeding points should be carefully selected and with consideration to other treatment processes in the system. The total detection time in the distribution system also plays an important role in sequestration.
- Removal of Iron and Manganese by Filtration: Removing iron and manganese from drinking water is generally recommended if the water contains more than 0.3 mg/L of iron or 0.05 mg/L of manganese. These elements are commonly removed in a two-stage process that includes filtration after oxidation (with air, potassium permanganate, or chlorine). In the first stage, the dissolved iron is oxidized and transformed from soluble form to insoluble ferric form, where the small, oxidized iron particles (rust) become suspended in the water. In the second stage, the suspended particles are removed from the water. This process is regularly done through filtration by gravity and pressure filters, with pressure filters being the most popular. Complete iron oxidation is paramount to prevent iron passing through the filter and ending up in the treated water.

- In oxidation with chlorine, it is important to consider the total organic carbon or natural organic material concentrations in the source water as this affects the likelihood of creating disinfection by-products (DBPs) after the addition of chlorine.
- When oxidizing with potassium permanganate, the operation of the filters becomes very important as the reaction continues to take place in the filter media. The type of filter media depends on the concentrations of these elements in the raw water. Potassium permanganate is often used with manganese greensand filters.

Selection of the most appropriate and cost-effective iron control / removal alternative depends on the concentration and form of iron, water chemistry, and how much water needs to be treated. It should be noted that based on operational experience, the County is not in favour of sequestration as the iron will come out of the water in time (often measured in days) and when the water is heated.

10.3 Disinfection (Pathogen Inactivation)

From a disinfection perspective, it is anticipated that TW 4/09 will require treatment in accordance with the new Terms of Reference requiring a 4-log virus inactivation (Terms of Reference for Hydrogeological Study to Examine Groundwater Sources Potentially Under Direct Influence of Surface Water (MOE 2001)), respectively. The alternatives available for disinfection include:

- Chlorination (Free chlorine): Chlorine has been used as an effective disinfectant in drinking water for many years. Chlorine is a powerful oxidant that works quickly on bacteria, viruses, and Giardia but is not effective for inactivating Cryptosporidium.
- Ultraviolet disinfection (UV): UV is the most common type of non-chemical inactivation. UV is a physical process that uses ultraviolet irradiation to prevent the cellular replication of organisms so that they cannot reproduce and as thus inactivated. UV light is emitted through a series of lamps located in enclosed contactors. UV is not effective for all viruses and a short chlorine contact time would still be required for virus inactivation.
- Ozone is another chemical disinfection alternative, but compared to UV, it has high capital and operating costs for the disinfection application.

10.4 Preliminary Recommendation

Among the treatment options discussed in the previous section, co-precipitation/filtration with iron and manganese is the most common technology used for arsenic removal in water treatment as it has several advantages such as low cost and ease of operation. Since many arsenic-containing groundwaters may also contain significant levels of iron and manganese due to natural geochemistry, greensand/manganese dioxide filters are a popular example of this technology as they can effectively remove both iron and manganese from water, along with arsenic. The active material in “greensand” is glauconite, a green, iron-rich, clay-like mineral that has ion exchange properties. The glauconite sand is treated with potassium permanganate until the sand grains are coated with a layer of manganese oxides, particularly manganese dioxide.

Studies have shown that the sorption of arsenic is affected by many factors, including the amount and form of As(III) and As(V) present; pH; water chemistry; amount and form of iron present; and the existence of competing ions, such as phosphate, silicate, and natural organic matter. The point of chemical oxidant addition is also important in achieving optimal arsenic removal, as research has shown that iron particles formed in the presence of As(V) have greater capacity to remove As(V) than pre-formed iron particles. Therefore, oxidation of both iron and arsenic should occur simultaneously to achieve optimal arsenic removal.

The most critical factor in technology selection and the ability to treat a given water source is the presence of iron in the raw water. Studies have shown that iron removal processes are typically effective where high iron levels (>0.3 mg/L) and high iron to arsenic ratios (20:1 or greater) exist (US EPA). A guide for the selection of arsenic treatment strategy, as per the US EPA, is shown in Figure 21.

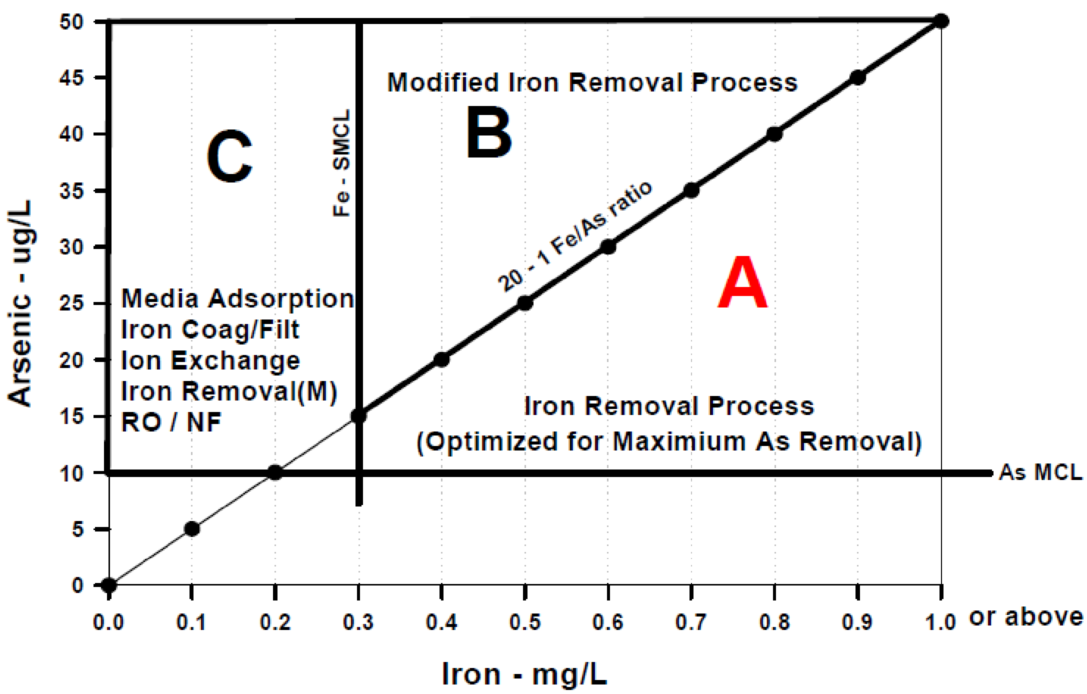


Figure 21 Arsenic Treatment Selection Strategy Guide (Source: Design Manual, Removal of Arsenic from drinking Water Supplies by Iron Removal Process, US EPA, 2006)

Based on the theoretical ratio of iron/arsenic concentrations observed for the bedrock test wells, TW 1/16 and TW 2/16, this source water can be considered a good candidate for arsenic removal through an iron removal process. In the case of TW2/16, where the iron level was found to be 0.35 mg/L and the iron to arsenic ratio was in the order of 32:1; the high iron to arsenic ratio in the water suggests that there is sufficient iron present for the effective removal of both iron and arsenic. Guidance documents indicate that iron/manganese filters are likely to be adequate for arsenic removal as the iron and manganese dioxide in the filter media can effectively remove arsenic through co-precipitation and adsorption.

11. Class EA Phase 3 – Development and Evaluation of Water Servicing Design Concepts

11.1 Overview

Phase 3 of the Municipal Class EA process examined alternative concepts/methods for implementing the preferred solution, based upon the existing environment, public and review agency input, anticipated environmental effects and methods of minimizing negative effects and maximizing positive effects. This section focuses on the identification of alternative design concepts for the preferred water servicing solution chosen in the previous steps.

The preferred water servicing alternative solution recommended for further development and evaluation in the Class EA process is:

- Alternative 4b – Expand the existing St. George Water Supply System by developing a new well field around test well TW 4/09.

Based on the 2014 aquifer testing, an overburden well at TW 4/09 site can produce 45.1 L/s to meet the projected water demands in the St. George settlement area to 2051. The testing results also suggest that a bedrock well at the site of MW 1/14 may have a capacity similar to the overburden well but is subject to in-situ testing.

The treatment components of a water system will typically comprise a water treatment facility within which incoming water is treated and pumped into the distribution system. Treatment may occur at a central pumping station or may occur at other points throughout the system where water is added (i.e., at individual wells).

The location of the treatment facility and types of well are the main considerations for development and design of the preferred alternative solution. The following alternative design concepts and sub-options have been identified:

- Option 1 – Installation of New On-site Water Treatment Facility
  - Option 1A – Bedrock Well Development at MW 1/14 Site
  - Option 1B – Overburden Well Development at TW 4/09 Site
- Option 2 – Connection to existing St. George Water Treatment Facility
  - Option 2A – Bedrock Well Development at MW 1/14 Site
  - Option 2B – Overburden Well Development at TW4/09 Site

A general schematic showing the water servicing alternative design concepts is presented in Figure 22. A description of each alternative design concept and their sub-options is provided in the following sections.

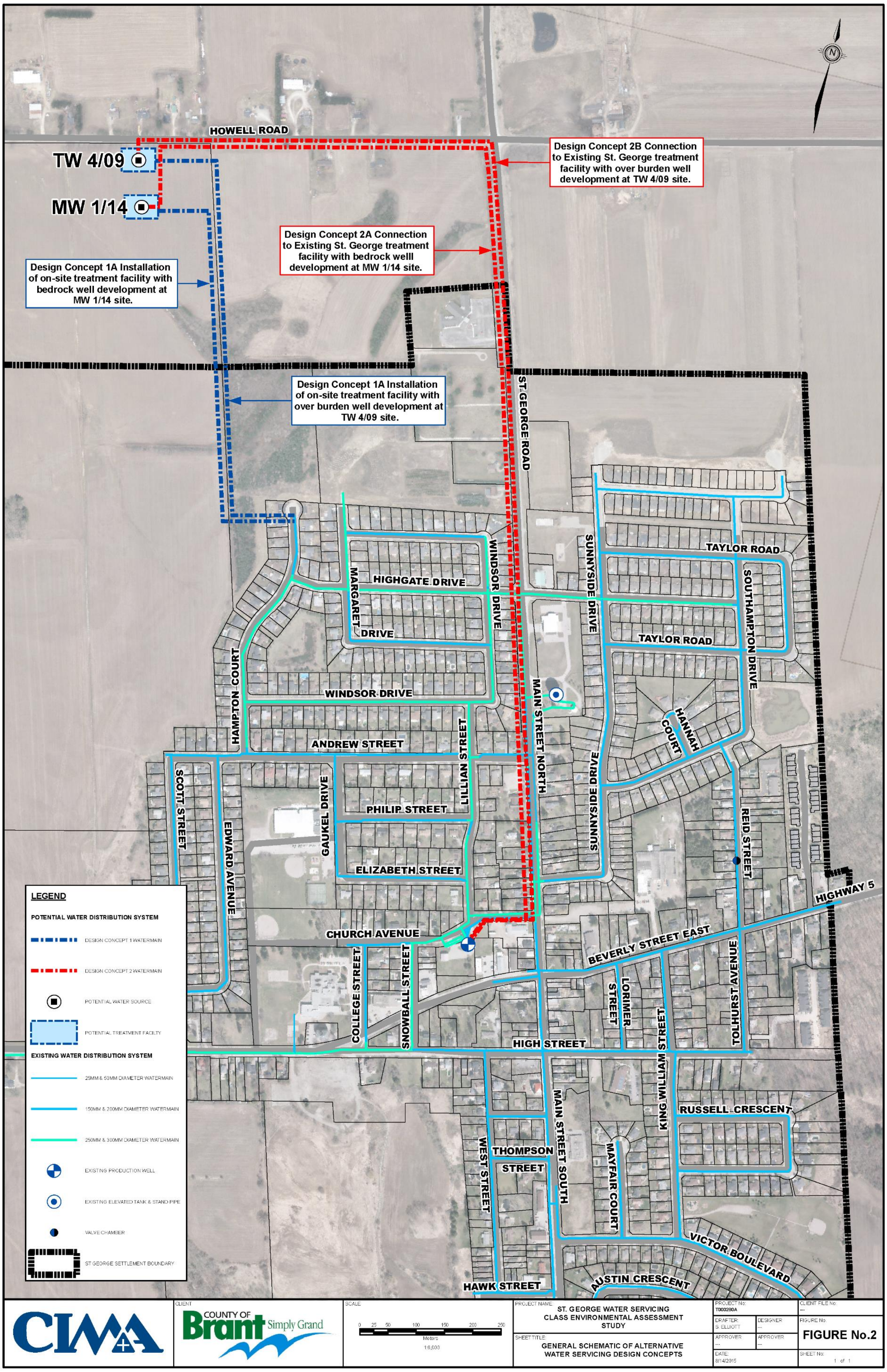


Figure 22 Water Servicing Alternative Design Concepts – General Schematic

11.2 Identification of Water Servicing Design Concepts

11.2.1 Option 1 – Installation of a New On-site Treatment Facility

Option 1 was developed based on available information to-date and under the assumption that two (2) new wells, spaced about 20 m apart, each with a capacity of about 22.5 L/s would be developed on the new site, to provide the back-up yield of 45 L/s. The existing production wells and treatment facility at Church Avenue will continue to operate and meet water demands up to the permitted annual daily average rate of 69.8 L/s.

A new water treatment facility would be built at the new well site to accommodate the required pumping and treatment equipment. The new treatment facility will have a treatment capacity of 45 L/s. Treated water, in full compliance with the ODWQS, Objectives and Guidelines, will then be conveyed from the new on-site water treatment facility directly into the existing St. George's distribution system. A connection into the existing St. George distribution system would be provided at the north end of Hampton Court, as shown in Figure 22.

Two (2) sub-options, Options 1a and 1b, were developed to capture the potential for either bedrock or overburden well development. Based on available groundwater quality data, it was assumed that Option 1a, comprising bedrock wells, would require some level of iron, manganese and arsenic control/removal in addition to disinfection.

Development of Option 1b has taken into consideration the testing results obtained during the aquifer test of the TW 4/09 overburden well completed in 2014, the hydrogeological characteristics of the area and the most recent water quality results collected at the bedrock well test sites. A brief overview of the hydrogeological context providing the basis for the conceptual development of Option 1b is provided below.

- At TW 4/09, completed in the contact sand and gravel aquifer, there is about 5 m of diamicton separating the contact aquifer from the bedrock. The diamicton can be expected to behave as a confining layer at this location and other locations where it is present. As a result, at this site, the contact aquifer in which TW 4/09 is completed is not necessarily in "direct' hydraulic contact with the bedrock.
- During the 2014 aquifer testing of TW 4/09, the arsenic concentration in the groundwater ranged from 4.9 to 5.4 µg/L after 24, 48 and 72 hours of pumping at 25 L/s. It is unknown whether the source of the arsenic in TW 4/09 is the result of geochemical processes within the sand and gravel aquifer, in which the well is completed, or from the bedrock. The water level response to pumping stabilized during the first day of aquifer testing at TW 4/09, indicative of steady state conditions. As a result, it is reasonable to expect arsenic concentration to be stable during longer pumping at 25 L/s.
- At other location, such as at the TW 1/16 and TW 2/16 bedrock test well sites, drilling indicates that the contact sand and gravel aquifer in which TW 4/09 is completed, overlies the bedrock directly, without the confining diamicton layer present.
- Based on the 2016 raw water quality data (Table 23), arsenic concentrations in TW 1/16 (8.5 µg/L) and TW 2/16 (11 µg/L) were slightly different. These concentrations were observed during

simultaneous pumping of each of these wells at 22.5 L/s for a total of 45 L/s during the aquifer test completed in 2016. Based on a video inspection, there was a difference in the nature and depth of the water production zones in these wells. As such, it is presumed that TW 2/16 may be drawing some proportion of water from a greater depth of from a different zone than TW 1/16, which in turn may be the cause of the higher arsenic concentration in TW 2/16. As there is uncertainty in terms of the source of the arsenic for overburden and bedrock wells in this area, it is currently unknown if arsenic levels in TW 4/09 will increase with higher pumping rates.

Based on the above, and in the absence of confirmatory test data for TW 4/09, Option 1b has been developed under the assumption that treatment for arsenic removal will be required. Some level of iron and manganese control/removal and disinfection will be required for the overburden wells.

If overburden wells would present similar arsenic concentrations to those reported for TW 1/16 and TW 2/16 and considering the iron concentration reported for TW 4/09, it is presumed at this point that the source water from TW 4/09 can be considered to be a good candidate for arsenic removal through an iron removal process. As such, should the need to remove arsenic from the overburden wells be confirmed through testing, a chemical treatment process can be added upstream of the iron and manganese control/removal treatment unit for effective arsenic removal.

A simplified schematic of Option 1a and Option 1b is shown in Figure 23 and Figure 24, respectively.

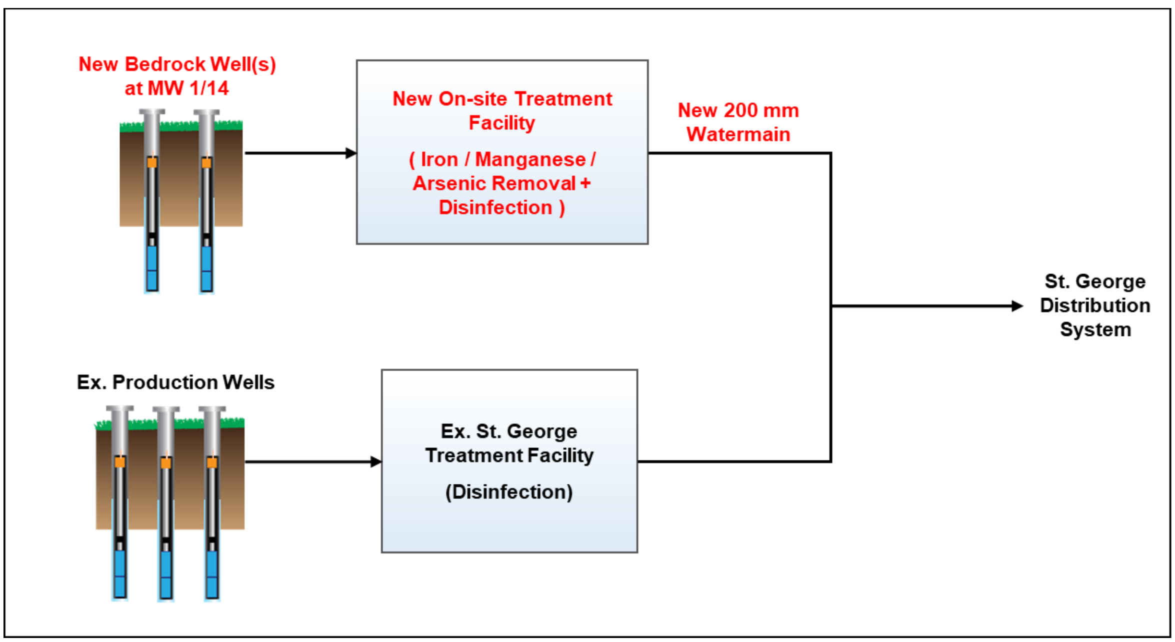


Figure 23 Option 1a – Onsite Treatment with Bedrock Well Development at MW 1/14 Site

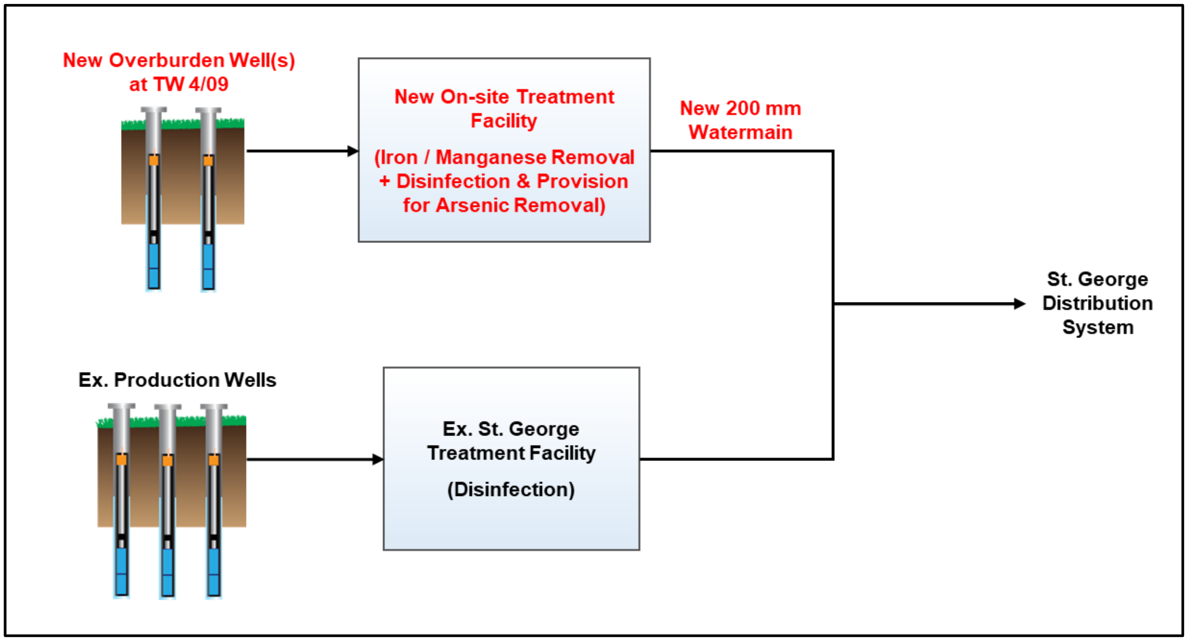


Figure 24 Option 1b – Onsite Treatment with Overburden Well Development at TW 4/09 Site

A summary of the major infrastructure requirements for each option is provided in Table 25.

Table 25 Infrastructure / Process Requirements – Options 1a and 1b

Area	Option 1a	Option 1b
Supply	• Bedrock well development at monitoring well MW 1/14 site • Two (2) wells, each with capacity of 22.5 L/s, located approximately 20 m apart	• Overburden well development at testing well TW 4/09 site • Two (2) wells, each with capacity of 22.5 L/s, located approximately 20 m apart
Treatment	New on-site treatment system to include: • sodium hypochlorite system for pre-oxidation • filtration system for control/removal of iron, manganese and arsenic • sodium hypochlorite system for primary disinfection • Two (2) new 1650 mm diameter contact chambers to provide adequate chlorine contact time for disinfection. Second contact chamber provided for redundancy.	New on-site treatment system to include: • filtration system for control / removal of iron and manganese • sodium hypochlorite system for primary disinfection • provision for sodium hypochlorite system for pre-oxidation (if arsenic removal is necessary) • Two (2) new 1650 mm diameter contact chambers to provide adequate chlorine contact time for disinfection. Second contact chamber provided for redundancy.
Pumping (Common to both options)	• Two (2) new well pumps at rated capacity of 22.5 L/s each. Both well pumps to be equipped with pitless adaptors for connection to new well pump house, as well as associated motors, instrumentation and controls • Well pumps to have adequate head to pump up to the existing St. George elevated tank. This eliminates the need for booster pumps	
Building Footprint (Common to both options)	• New pump house building to house pumping and treatment equipment, and associated piping, valves, instrumentation, and control equipment. New pump house building will have an approximate footprint of 20 x 15 m	

Area	Option 1a	Option 1b
Electrical and Mechanical (Common to both options)	• New emergency standby generator, service entrance, controls and automation. Standby generator will be located outside of the new pump house. • New HVAC system, lighting for new building	
Conveyance	• New 900 m of 200 mm diameter watermain for connection to Hampton Court	• New 1,000 m of 200 mm diameter watermain for connection to Hampton Court

11.2.2 Option 2 – Connection to the Existing St. George Water Treatment Facility

Option 2 was developed based on available information to-date and under the assumption that two (2) new wells, spaced about 20 m apart, each with a capacity of about 22.5 L/s would be developed on the new site, to provide the back-up yield of 45.1 L/s. The existing production wells and treatment facility at Church Avenue will continue to operate and meet water demands up to the permitted annual daily average rate of 69.8 L/s. Raw groundwater would be conveyed from the new wells to the existing St. George treatment facility at Church Avenue, where appropriate treatment would be provided prior to distribution. The existing 150 kW standby power generator would need to be replaced by a new generator of a larger power capacity in order to support the existing loads from the St. George facility plus the new electrical loads from the new iron and manganese removal system.

Two (2) sub-options, Options 2a and 2b, were developed to capture the potential for either bedrock or overburden well development. Similar to the potential treatment requirements assumed for Options 1a and 1b, it was established that Option 2a, comprising bedrock wells, would require some level of iron, manganese and arsenic control/removal in addition to disinfection.

Option 2b, comprising overburden wells, would require some level of iron and manganese control/removal and disinfection, as well as provisional treatment for arsenic removal. Under the assumption that overburden wells would present similar arsenic concentrations to those reported for TW 1/16 and TW 2/16 and considering the iron concentration reported for TW 4/09, it is presumed at this point that the source water from TW 4/09 can be a good candidate for arsenic removal through an iron removal process. As such, should the need to remove arsenic from the overburden wells be confirmed through testing, a chemical treatment process can be added upstream of the iron and manganese control / removal treatment unit for effective arsenic removal.

A simplified schematic of Option 2a and Option 2b is shown in Figure 25 and Figure 26, respectively.

Both Options 2a and 2b assume that the existing chlorine contact chambers would continue to be used for disinfection purposes up to their treatment capacity of 105 L/s. For future flows exceeding 105 L/s, two (2) new larger chlorine contact chambers would be needed, with one (1) chamber providing 100% treatment redundancy. The new contact chambers would be installed within the asphalt area to minimize conflict with the existing chambers during construction. Provision of the additional treatment equipment would require a physical expansion of the existing St. George treatment facility. The new filtration system would be required for treatment of water from the new production wells only. Treatment for water from the existing wells will continue to be only for disinfection through chlorination.

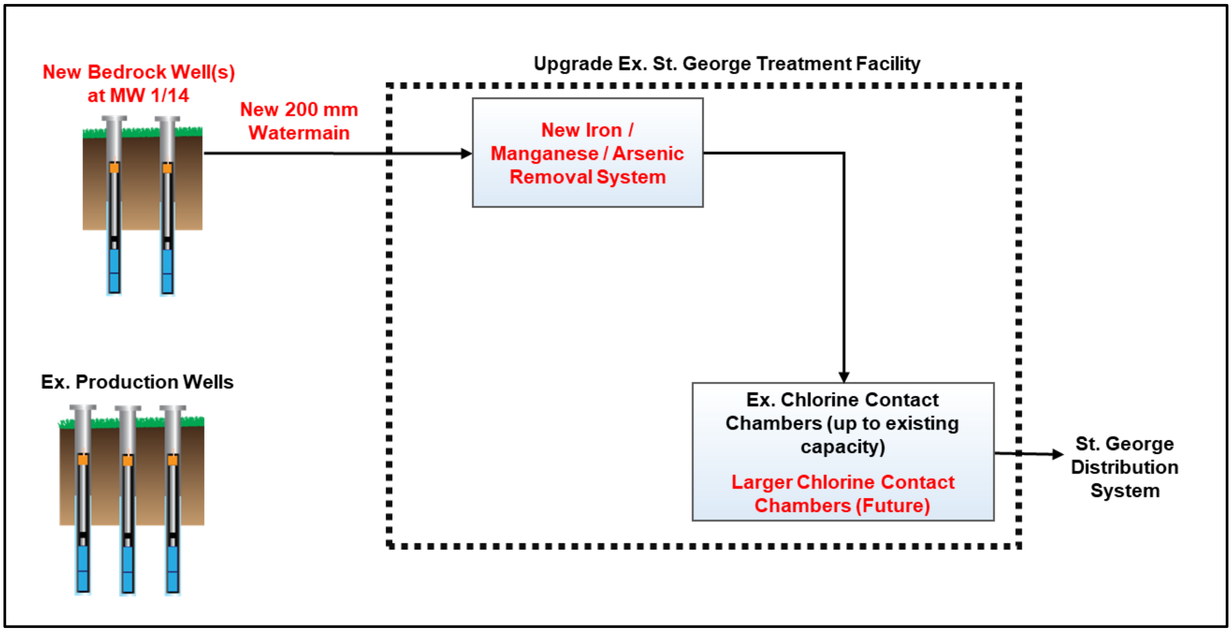


Figure 25 Option 2a – Connection to Existing St. George Treatment System with Bedrock Well Development at MW 1/14 Site

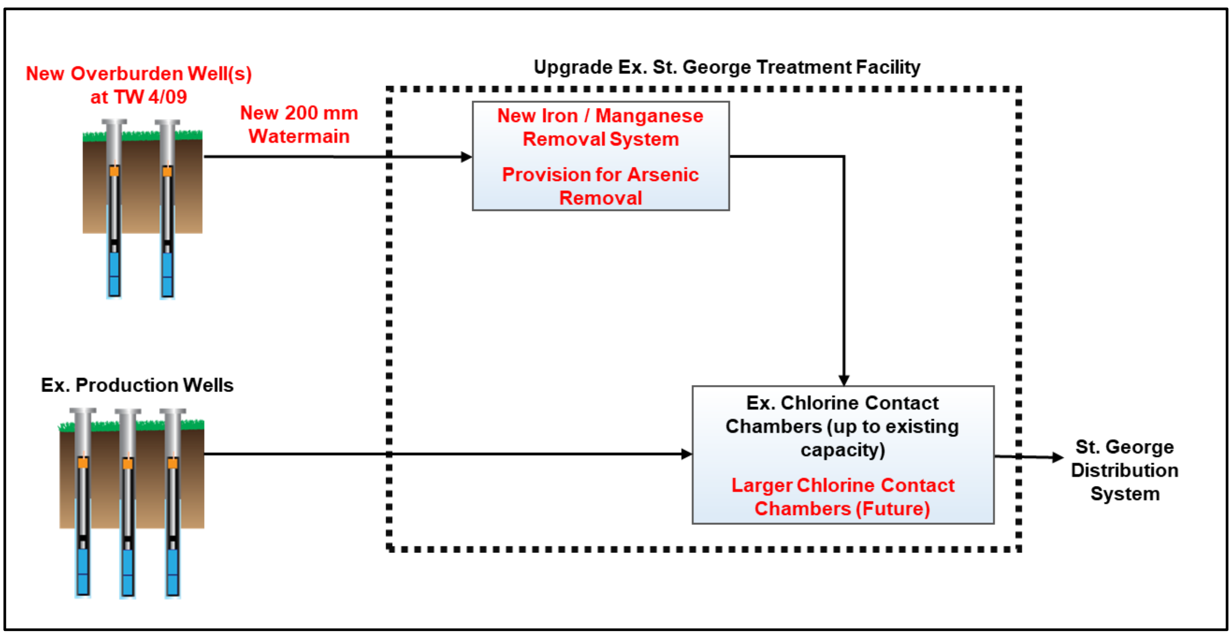


Figure 26 Option 2b – Connection to Existing St. George Treatment System with Overburden Well Development at TW 4/09 Site

A summary of the major infrastructure requirements for each option is provided in Table 29.

Table 26 Infrastructure / Process Requirements – Options 2a and 2b

Area	Option 2a	Option 2b
Supply	• Bedrock well development at monitoring well MW 1/14 site • Two (2) wells each with capacity of 22.5 L/s and located 20 m apart	• Overburden well development at testing well TW 4/09 site • Two (2) wells each with capacity of 22.5 L/s and located 20 m apart
Treatment	Upgrades to existing St. George treatment facility to include: • New sodium hypochlorite system for pre-oxidation • New filtration system for control / removal of iron, manganese and arsenic for water from new wells only • Upgrades to existing sodium hypochlorite storage tanks and containment area • Two new 1650 mm diameter contact chamber to provide adequate chlorine contact time for disinfection. Second contact chamber provided for redundancy.	Upgrades to existing St. George treatment facility include: • New filtration system for control / removal of iron and manganese for water from new wells only • Upgrades to existing sodium hypochlorite storage tanks and containment area • Provision for sodium hypochlorite system for pre-oxidation (if arsenic removal is necessary) • Two new 1650 mm diameter contact chambers to provide adequate chlorine contact time for disinfection. Second contact chamber provided for redundancy.
Pumping (Common to both options)	• Two (2) new well pumps at rated capacity of 22.5 L/s each. Both well pumps to be equipped with pitless adaptors for connection to new sheds housing major equipment (i.e., valve, flow meter, transformer). New sheds to be built at the same site of the new production wells. • Well pumps to have adequate head to pump up to the existing St. George elevated tank. This eliminates the need for booster pumps	
Building Footprint (Common to both options)	• Two (2) new sheds for enclosure of well pumps, valves, flowmeter and one transformer • The existing St. George treatment facility would be expanded to accommodate new filtration system.	
Electrical and Mechanical (Common to both options)	• A new larger generator to be located outside of the existing St. George treatment facility. • A new transformer will be provided at the new well site to deliver the required load for both new well pumps	
Conveyance	• New 2.3 km of 200 mm diameter watermain to convey raw water from new wells to upgraded St. George treatment system	• New 2.2 km of 200 mm diameter watermain to convey raw water from new wells to upgraded St. George treatment system

11.3 Cost Estimates

Estimates of probable capital, operating and maintenance costs and life cycle costs were developed for each alternative design concept. Capital costs include development of two (2) new wells, construction of new facilities or expansion of existing building, major process and treatment equipment such as pumps, piping and valves, instrumentation, treatment equipment, standby power supply and watermain installation. Operating and maintenance costs accounted for include power, chemical usage, regulatory requirements and other replacement and labour costs. Life cycle costs were calculated based on a 20-year life expectancy.

The following general assumptions were made when developing the costs for the four (4) alternative design concepts:

- Cost estimates are based on 2023 construction costs. Inflation and escalation to account for actual expected prices at the time of construction cannot be accounted for at this time.
- Estimates of probable capital costs have been developed on a conceptual design level and based on prices and data in CIMA's possession, as well as previous experience from projects of similar nature and scope.
- There is capital expenditure associated with the upkeep and maintenance of water facilities every ten years that include major maintenance and rehabilitation to existing infrastructure, supply wells, grounds and parking lots, for every water facility that remains operational.
- There is capital expenditure associated with the replacement of major pumping and treatment equipment every 30 years for water facilities.
- All taxes (including the 13% HST) have been excluded.

Life cycle costs have been estimated based on:

- A 20 year amortization period
- An inflation rate of 2% and an interest rate of 6% to give a market/discount rate of 4%

Estimates of capital costs for studies or feasibility purposes such as Class EAs are typically developed in accordance with Class 4 estimates as defined by the AACE International Cost Framework (AACE International Recommended Practice No. 18R-97 Cost Estimate Classification System – as applied in Engineering, Procurement, and Construction for the Process Industries, TCM Framework: 7.3 – Cost Estimating and Budgeting, 2005). The accuracy of the capital cost estimates inline with the AACE Framework for **Class 4 estimates is -30% and +50%** and include **20% contingency**. Estimates for probable capital, operating and life cycle costs for the four (4) alternative design concepts are summarized in Table 27. Detailed costs calculations are included in Appendix G.

Table 27 Alternative Design Concepts – Opinion of Probable Costs

Alternative Design Concepts	Capital Cost $ Millions	Annual Operating & Maintenance Cost $ Millions	20-Year Life Cycle Costs $ Millions
Option 1a – Onsite Treatment with Bedrock Well(s) Development at MW 1/14 Site	$9.6 MM	$222,900	$12.8 MM
Option 1b – Onsite Treatment with Overburden Well(s) Development at TW 4/09 Site	$10 MM	$217,400	$13.2 MM
Option 2a – Connection to Existing St. George Treatment System with Bedrock Well(s) Development at MW 1/14 Site	$11.2 MM	$197,100	$14.0 MM
Option 2b – Connection to Existing St. George Treatment System with Overburden Well(s) Development at TW 4/09 Site	$11.9 MM	$191,620	$14.5 MM

11.5 Evaluation of Water Servicing Design Concepts

The detailed evaluation process followed in this step is consistent with the evaluation methodology developed for this project, as described in Section 9.3. Each alternative design concept was assessed under each criterion and assigned a score out of 5 points. The scores were totaled for each option. The alternative design concept that scored the highest is considered to provide the most overall benefits to this project and thus, has been selected as the preliminary preferred water servicing design concept for the St. George settlement area.

In addition to the hydrogeological investigations, other supporting studies were completed as part of this Class EA study to substantiate the development and evaluation of water servicing alternative solutions and design concepts. Individual studies and assessments included a Natural Heritage Investigation, a Cultural Heritage Assessment, and Stage 1 Archaeological Assessment. The findings and recommendations of these studies were considered in the relative evaluation of the water servicing design concepts and the identification of available mitigation measures. Copies of the stand-alone reports for each study can be found in the appendices.

A summary of the overall scores obtained for each alternative design concept, and the ranking based on such scores are summarized in Table 28. The complete evaluation of the alternative design concepts, including the scoring rationale and individual scores are shown in detail in Table 29.

Table 28 Summary of Evaluation Scoring and Ranking

Alternative Design Concepts	Overall Score	Overall Ranking
Option 1a – Onsite Treatment with Bedrock Well(s) Development at MW 1/14 Site	85	1
Option 1b – Onsite Treatment with Overburden Well(s) Development at TW 4/09 Site	78	2
Option 2a – Connection to Existing St. George Treatment System with Bedrock Well(s) Development at MW 1/14 Site	75	3
Option 2b – Connection to Existing St. George Treatment System with Overburden Well(s) Development at TW 4/09 Site	70	4

As shown in Table 28 and Table 29, the results of detailed evaluation indicate that Option 1a – Construction of New Onsite Treatment with Bedrock Well(s) Development at MW 1/14 Site is the highest scoring option and therefore ranked in first. Consistently, Option 1a has been selected as the preferred water servicing concept for the St. George settlement area.

Table 29 Detailed Evaluation Scoring, Rationale and Results

Category	Weight	Criteria	Option 1a - Onsite Treatment with Bedrock Well(s) Development at MW 1/14 Site			Option 1b - Onsite Treatment with Overburden Well(s) Development at TW 4/09 Site			Option 2a - Connection to Existing St. George Treatment System with Bedrock Well(s) Development at MW 1/14 Site			Option 2b - Connection to Existing St. George Treatment System with Overburden Well(s) Development at TW 4/09 Site		
			Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score
Environmental Indicators	40	**Water Quality / Quantity** - Minimize the potential for surface water or groundwater contamination, includes potential effects to existing private groundwater wells, impacts to well head protection areas, and potential upsets to water quality resulting from mixing two different water sources.	Groundwater from all wells will meet and/or exceed the ODWQS, Objectives and Guidelines for all options. Proposed bedrock wells at MW 1/14 will be approximately 100m south of proposed overburden wells at TW 4/09. The limits of the WHPA "A" for the bedrock wells, at the expected pumping rates of 45.1 L/s, are not anticipated to include the existing residences along Howell Road, so the impacts on private wells would be significantly less than those expected from overburden wells at TW 4/09. Separate treatment of each water source will be provided to create a uniform water quality (before the connection to the ex. distribution system) in order to reduce potential upsets in the water quality within distribution system due to blending of two different water types.	4.5	4.5	Groundwater from all wells will meet and/or exceed the ODWQS, Objectives and Guidelines for all options. The limits of the WHPA "A" for the proposed overburden wells at TW 4/09, at the expected pumping rates of 45.1 L/s, could potentially have measurable impacts on existing private groundwater wells in the area. Separate treatment of each water source will be provided to create a uniform water quality (before the connection to the ex. distribution system) in order to reduce potential upsets in the water quality within distribution system due to blending of two (2) different water types.	3.5	3.5	Groundwater from all wells will meet and/or exceed the ODWQS, Objectives and Guidelines for all options. Proposed bedrock wells at MW 1/14 will be approximately 100m south of proposed overburden wells at TW 4/09. The limits of the WHPA "A" for the bedrock wells, at the expected pumping rates of 45.1 L/s, are not anticipated to include the existing residences along Howell Road, so the impacts on private wells would be significantly less than those expected from overburden wells at TW 4/09. Blending of raw water and partially treated water at the ex. St. George water treatment facility may cause upsets to the treatment equipment and potential impacts to the water quality in the distribution system.	3.5	3.5	Groundwater from all wells will meet and/or exceed the ODWQS, Objectives and Guidelines for all options. The limits of the WHPA "A" for the proposed overburden wells at TW 4/09, at the expected pumping rates of 45.1 L/s, could potentially have measurable impacts on existing private groundwater wells in the area. Blending of raw water and partially treated water at the ex. St. George water treatment facility may cause upsets to the treatment equipment and potential impacts to the water quality in the distribution system.	2.5	2.5
		System Redundancy and Flexibility – Maximize the ability to continue to provide water supply during emergency situations based on provision for redundant equipment, connections, emergency storage, etc.	Option provides a true independent secondary supply source to St. George. Individual treatment facilities contribute to system redundancy and flexibility for emergency situations with either of the treatment facilities or required operation / maintenance at one of the facilities. A separate treatment facility at the new wells site provides more flexibility to address potential changes in water quality in the future. This configuration also allows for opportunity for looping.	5.0	5.0	Option provides a true independent secondary supply source to St. George. Individual treatment facilities contribute to system redundancy and flexibility for emergency situations with either of the treatment facilities or required operation / maintenance at one of the facilities. A separate treatment facility at the new wells site provides more flexibility to address potential changes in water quality in the future. This configuration also allows for opportunity for looping.	5.0	5.0	Although the new wells will provide a secondary raw water supply to the St. George system, full treatment is still required at the existing St. George water treatment facility before distribution. In the case of emergency or failure of the central treatment equipment at the St. George facility, the new well system would not be able to supply water to St. George distribution system. Option provides significantly less redundancy and flexibility in operation compared to Options 1a and 1b.	2.5	2.5	Although the new wells will provide a secondary raw water supply to the St. George system, full treatment is still required at the existing St. George water treatment facility before distribution. In the case of emergency or failure of the central treatment equipment at the St. George facility, the new well system would not be able to supply water to St. George distribution system. Option provides significantly less redundancy and flexibility in operation compared to Options 1A and 1B.	2.5	2.5
		Security of Supply - Maximize the ability to provide for the safety and security of the water supply system through protection of water assets and	Although new fencing would be provided to enclose the new facility and all equipment at the new well site, a rural setting in a remote location is less protected and more vulnerable to vandalism, which could compromise the system security.	3.5	3.5	Although new fencing would be provided to enclose the new facility and all equipment at the new well site, a rural setting in a remote location is less protected and more vulnerable to vandalism, which could compromise the system security.	3.5	3.5	The existing fencing and lighting at the St. George treatment facility, within a residential area, provides less opportunities for vandalism and threats to the water infrastructure than a rural setting in a remote location.	4.5	4.5	The existing fencing and lighting at the St. George treatment facility, within a residential area, provides less opportunities for vandalism and threats to the water infrastructure than a rural setting in a remote location.	4.5	4.5

Category	Weight	Criteria	Option 1a - Onsite Treatment with Bedrock Well(s) Development at MW 1/14 Site			Option 1b - Onsite Treatment with Overburden Well(s) Development at TW 4/09 Site			Option 2a - Connection to Existing St. George Treatment System with Bedrock Well(s) Development at MW 1/14 Site			Option 2b - Connection to Existing St. George Treatment System with Overburden Well(s) Development at TW 4/09 Site		
			Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score
		emergency preparedness												
		Operational Complexity – Minimize the need for treatment requirements and maximize the ability to decrease current operational complexity, while achieving desired treated water quality objectives	This option introduces a brand-new water system that will need to be operated in conjunction with the existing St. George water treatment facility. Although the proposed treatment processes are similar to the existing ones at the St. George facility, with the exception of the new iron / manganese /arsenic control and removal equipment, additional operational requirements are expected. Bedrock wells are expected to require less frequent routine maintenance than overburden wells as the water producing zones in the bedrock are typically much larger than the equivalent pore spaces in overburden wells.	3.5	3.5	This option introduces a brand-new water system that will need to be operated in conjunction with the existing St. George water treatment facility. Although the proposed treatment processes are similar to the existing ones at the St. George facility, with the exception of the new iron and manganese control equipment and provision for arsenic removal, additional operational requirements are expected. Overburden wells are expected to require more frequent routine maintenance, as the relatively smaller pore spaces within an aquifer and screen slot openings tend to plug due to physical, chemical and biological causes.	3.0	3.0	This option utilizes existing treatment processes at the St. George water treatment facility for the treatment of the two (2) separate water sources; however, new iron / manganese /arsenic control and removal systems still need to be installed at the existing St. George water treatment facility for treatment of water from new wells. Bedrock wells are expected to require less frequent routine maintenance than overburden wells as the water producing zones in the bedrock are typically much larger than the equivalent pore spaces in overburden wells.	3.5	3.5	This option utilizes existing treatment processes at the St. George water treatment facility for the treatment of the two (2) separate water sources; however, new iron / manganese control and removal system and provision for arsenic removal still need to be installed at the existing St. George water treatment facility for treatment of water from new wells. Overburden wells are expected to require more frequent routine maintenance, as the relatively smaller pore spaces within an aquifer and screen slot openings tend to plug due to physical, chemical and biological causes.	3.0	3.0
		Ease of Implementation – Maximize the ability to facilitate construction without interfering with the uninterrupted supply of water and within the most reasonable timeframe.	Two (2) new bedrock test wells have been already constructed as part of the 2016/2017 HydroG program. Existing testing wells need to be converted into production wells but this process will be faster than developing new overburden wells. In addition, development of overburden wells requires longer time than bedrock wells since there is less formation damage during drilling. Construction of new wells and treatment facility will be completely independent of existing St. George water treatment system and therefore, not expected to interrupt the provision of water supply in the system during construction. The proposed watermain alignment from the new treatment facility to the connection point within the distribution system, largely occurs on agricultural fields, so traffic interruption or interferences with existing underground utilities is not anticipated.	5.0	5.0	Overburden wells usually take longer time to develop than bedrock wells because of the time to remove formation damage caused by drilling fluid and fines in the filter pack / native formation. Construction of new wells and treatment facility will be completely independent of existing St. George water treatment system and therefore, not expected to interrupt the provision of water supply in the system during construction. The proposed watermain alignment from the new treatment facility to the connection point within the distribution system, largely occurs on agricultural fields, so traffic interruption or interferences with existing underground utilities is not anticipated.	4.0	4.0	Two (2) new bedrock test wells have been already constructed as part of the 2016/2017 HydroG program. Existing testing wells need to be converted into production wells but this process will be faster than developing new overburden wells. In addition, development of overburden wells requires longer time than bedrock wells since there is less formation damage during drilling. Option requires upgrade / expansion of the existing St. George treatment facility, which include building expansion to house the new treatment systems and future replacement of existing chlorine contact chambers with larger ones (before ex. capacity is reached). Additional coordination and planning are needed to minimize water supply interruption during the upgrades and expansion of the existing St. George facility. The proposed raw watermain connecting the new wells to the existing St. George treatment facility is expected to be installed within the right of way along Howell Rd. and St. George Rd., so planning and phasing must be considered to minimize traffic interruptions. Careful consideration must be given during the design and installation of the new raw	1.5	1.5	Overburden wells usually take longer time to develop than bedrock wells because of the time to remove formation damage caused by drilling fluid and fines in the filter pack / native formation. Option requires upgrade / expansion of the existing St. George treatment facility, which include building expansion to house the new treatment systems and future replacement of existing chlorine contact chambers with larger ones (before ex. capacity is reached). Additional coordination and planning are needed to minimize water supply interruption during the upgrades and expansion of the existing St. George facility. The proposed raw watermain connecting the new wells to the existing St. George treatment facility is expected to be installed within the right of way along Howell Rd. and St. George Rd., so planning and phasing must be considered to minimize traffic interruptions. Careful consideration must be given during the design and installation of the new raw water pipe in an already congested utility corridor that includes 2 separate existing distribution watermains, each dedicated to each pressure zone.	1.0	1.0

Category	Weight	Criteria	Option 1a - Onsite Treatment with Bedrock Well(s) Development at MW 1/14 Site			Option 1b - Onsite Treatment with Overburden Well(s) Development at TW 4/09 Site			Option 2a - Connection to Existing St. George Treatment System with Bedrock Well(s) Development at MW 1/14 Site			Option 2b - Connection to Existing St. George Treatment System with Overburden Well(s) Development at TW 4/09 Site		
			Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score
									water pipe in an already congested utility corridor that includes 2 separate existing distribution watermains, each dedicated to each pressure zone.					
		Need for Existing Infrastructure – Maximize the ability to use existing infrastructure	Option requires construction of all new infrastructure for supply and treatment.	3.0	3.0	Option requires construction of all new infrastructure for supply and treatment.	3.0	3.0	Although a new watermain conveying raw water from new wells to the existing St. George treatment facility is required, this option relies on the use of majority of existing treatment processes at the St. George water facility. This option requires upgrade / expansion of the existing treatment facility, replacement of existing generator and chlorine contact chambers with larger ones.	3.5	3.5	Although a new watermain conveying raw water from new wells to the existing St. George treatment facility is required, this option relies on the use of all existing treatment processes at the St. George water facility. This option requires upgrade / expansion of the existing treatment facility, replacement of existing generator and chlorine contact chambers with larger ones.	3.5	3.5
		Natural and Archaeological Heritage – Minimize the potential impact from construction, operation and maintenance to existing terrestrial habitats/features and vegetation communities, including watercourse crossings as well as archaeological heritage features. Minimize the potential impact to existing terrestrial habitats/features, vegetation communities, including watercourse crossings as well as archaeological heritage features. Minimize potential contributions to climate change	The proposed watermain alignment connecting the new treatment facility to the existing distribution system is expected to cross a heavily wooded area that is reported as Significant Woodland and in proximity to a provincially rare species (i.e., Pignut Hickory). The alignment would also cross a first and second order headwater tributary of Fairchild Creek. From a natural heritage perspective, the proposed alignment is considered low-medium sensitivity and may require more archaeological work. Appropriate mitigation measures will be implemented to minimize or avoid any potential impacts. Proposed new infrastructure would be located outside of floodplain areas, thus, reducing potential effects to water infrastructure from potential flooding events resulting from climate change conditions. Construction and operation of a new on-site treatment facility would generate additional greenhouse gas emissions due to heating, lighting, electrical requirements and chemical delivery; however, energy efficiency measures such as LED lighting fixtures and insulation can be implemented at the new facility	3.5	3.5	The proposed watermain alignment connecting the new treatment facility to the existing distribution system is expected to cross a heavily wooded area that is reported as Significant Woodland and in proximity to a provincially rare species (i.e., Pignut Hickory). The alignment would also cross a first and second order headwater tributary of Fairchild Creek. From a natural heritage perspective, the proposed alignment is considered low-medium sensitivity and may require more archaeological work. Appropriate mitigation measures will be implemented to minimize or avoid any potential impacts. Proposed new infrastructure would be located outside of floodplain areas, thus, reducing potential effects to water infrastructure from potential flooding events resulting from climate change conditions. Construction and operation of a new on-site treatment facility would generate additional greenhouse gas emissions due to heating, lighting, electrical requirements and chemical delivery; however, energy efficiency measures such as LED lighting fixtures and insulation can be implemented at the new facility	3.5	3.5	No major impacts to existing natural heritage features expected from upgrading existing treatment facilities as works will be constrained within existing St. George well pumping station boundaries. From a natural heritage perspective, the proposed watermain alignment on Howell Road and St. George Road is considered low sensitivity due to the proposed alignment largely situated within the urban area of St. George. Installation of the raw watermain may potentially affect City and privately owned trees. Appropriate mitigation measures will be implemented to minimize or avoid any potential impacts. Proposed new infrastructure, including new wells and expansion of existing St. George treatment facility would be located outside of floodplain areas, thus, reducing potential effects to water infrastructure from potential flooding events resulting from climate change conditions. Additional greenhouse gas emissions would be generated due to the required expansion of the existing St. George treatment facility and installation of new treatment equipment; however, option requires operation of only one treatment facility which results in overall less long-term greenhouse gas emissions than those generated by a new treatment facility required in Options 1A and 1B. Option does not provide a secondary source of treatment which could result in short-term disruption of municipal water services potentially caused by problems	4.5	4.5	No major impacts to existing natural heritage features expected from upgrading existing treatment facilities as works will be constrained within existing St. George well pumping station boundaries. From a natural heritage perspective, the proposed watermain alignment on Howell Road and St. George Road is considered low sensitivity due to the proposed alignment largely situated within the urban area of St. George. Installation of the raw watermain may potentially affect City and privately owned trees. Appropriate mitigation measures will be implemented to minimize or avoid any potential impacts. Proposed new infrastructure, including new wells and expansion of existing St. George treatment facility would be located outside of floodplain areas, thus, reducing potential effects to water infrastructure from potential flooding events resulting from climate change conditions. Additional greenhouse gas emissions would be generated due to the required expansion of the existing St. George treatment facility and installation of new treatment equipment; however, option requires operation of only one treatment facility which results in overall less long-term greenhouse gas emissions than those generated by a new treatment facility required in Options 1A and 1B. Option does not provide a secondary source of treatment which could result in	4.5	4.5

Category	Weight	Criteria	Option 1a - Onsite Treatment with Bedrock Well(s) Development at MW 1/14 Site			Option 1b - Onsite Treatment with Overburden Well(s) Development at TW 4/09 Site			Option 2a - Connection to Existing St. George Treatment System with Bedrock Well(s) Development at MW 1/14 Site			Option 2b - Connection to Existing St. George Treatment System with Overburden Well(s) Development at TW 4/09 Site		
			Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score
			to reduce the energy needs and reduce long-term carbon emissions. Chemical delivery is expected to be minimal and could be schedule on a monthly/bi monthly basis. Provision of a secondary source of water supply and treatment would significantly reduce the short-term disruption of municipal water services potentially caused by problems with the existing water system from extreme climate events. Existing landscape of the area surrounding the MW 1/14 site would need to be altered to accommodate new infrastructure. Although the existing site does not have significant vegetation species, it is used for agricultural purposes. Effects on greenhouse gases through changes in landscape can be reduced through implementation of an adequate landscape plan, comprising planting new trees and vegetation within the new site.			to reduce the energy needs and reduce long-term carbon emissions. Chemical delivery is expected to be minimal and could be schedule on a monthly/bi monthly basis. Provision of a secondary source of water supply and treatment would significantly reduce the short-term disruption of municipal water services potentially caused by problems with the existing water system from extreme climate events. Existing landscape of the area surrounding the MW 1/14 site would need to be altered to accommodate new infrastructure. Although the existing site does not have significant vegetation species, it is used for agricultural purposes. Effects on greenhouse gases through changes in landscape can be reduced through implementation of an adequate landscape plan, comprising planting new trees and vegetation within the new site.			with the existing water system from extreme climate events. The current landscape surrounding the existing St. George treatment facility would need to be altered to accommodate expansion of existing building. Effects on greenhouse gases through changes in landscape can be reduced through implementation of an adequate landscape plan, however, there are limited areas within the existing site boundaries that can be used for planting of additional trees.			short-term disruption of municipal water services potentially caused by problems with the existing water system from extreme climate events. The current landscape surrounding the existing St. George treatment facility would need to be altered to accommodate expansion of existing building. Effects on greenhouse gases through changes in landscape can be reduced through implementation of an adequate landscape plan, however, there are limited areas within the existing site boundaries that can be used for planting of additional trees.		
		Regulatory Approvals – Minimize the need and time spent to obtain permits and approvals	Existing bedrock test wells have been tested for a combined rate of 45 L/s, so no additional permits will be required for testing. A permanent PTTW would be required for the new production bedrock well(s). Any permits related to construction of watermain will be common to all options.	4.5	4.5	A PTTW would be required for the installation of the new overburden well(s), as well as a temporary PTTW for the testing at higher pumping rates. Any permits related to construction of watermain will be common to all options.	4.0	4.0	Existing bedrock test wells have been tested for a combined rate of 45 L/s, so no additional permits will be required for testing. A permanent PTTW would be required for the new production bedrock well(s). Any permits related to construction of watermain will be common to all options.	4.5	4.5	A PTTW would be required for the installation of the new overburden well(s), as well as a temporary PTTW for the testing at higher pumping rates. Modifications to the existing MDWL and DWWPs will be required. Any permits related to construction of watermain will be common to all options.	4.0	4.0
Subtotal Score – Technical & Natural Environment					**32.5**			**29.5**			**28.0**			**25.5**
Social Indicators	40	**Public Health and Safety** – Minimize the potential risk to community health and safety from a source, treatment and distribution perspective	Adequate treatment will be provided to ensure that treated water quality meets and/or exceeds the ODWS, Objectives and Guidelines at all times. Potential temporary upsets in water quality may occur due to the introduction of two different treated water sources in the distribution system; however, the upsets are expected to be more of aesthetic nature.	4.0	5.3	Adequate treatment will be provided to ensure that treated water quality meets and/or exceeds the ODWS, Objectives and Guidelines at all times. Potential temporary upsets in water quality may occur due to the introduction of two (2) different treated water sources in the distribution system; however, the upsets are expected to be more of aesthetic nature.	4.0	5.3	Adequate treatment will be provided to ensure that treated water quality meets and/or exceeds the ODWS, Objectives and Guidelines at all times. Potential temporary upsets in water quality may occur due to the introduction of two different treated water sources in the distribution system; however, the upsets are expected to be more of aesthetic nature.	3.0	4.0	Adequate treatment will be provided to ensure that treated water quality meets and/or exceeds the ODWS, Objectives and Guidelines at all times. Potential temporary upsets in water quality may occur due to the introduction of two different treated water sources in the distribution system; however, the upsets are expected to be more of aesthetic nature.	3.5	4.7

Category	Weight	Criteria	Option 1a - Onsite Treatment with Bedrock Well(s) Development at MW 1/14 Site			Option 1b - Onsite Treatment with Overburden Well(s) Development at TW 4/09 Site			Option 2a - Connection to Existing St. George Treatment System with Bedrock Well(s) Development at MW 1/14 Site			Option 2b - Connection to Existing St. George Treatment System with Overburden Well(s) Development at TW 4/09 Site		
			Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score
		Noise and Traffic (during Construction) – Minimize the potential for noise and traffic during construction	Short-term noise impacts during construction will be localized within the well site, affecting the few neighboring property owners. The bedrock well is located 100 m away from the residences, reducing the impacts of noise during construction. Standard construction mitigation measures will be implemented to conform to the requirements specified in the local by-laws. Potential temporary noise impacts resulting from watermain installation through undisturbed area will be less than Option 2. No traffic impacts expected from watermain installation.	4.5	6.0	Short-term noise impacts during construction will be localized within the well site, affecting the few neighboring property owners. The overburden well is located close to Howell Road, impacts of noise during well construction is expected to be slightly higher than development of bedrock wells. Standard construction mitigation measures will be implemented to conform to the requirements specified in the local by-laws. Potential temporary noise impacts resulting from watermain installation through undisturbed area will be less than Option 2. No traffic impacts expected from watermain installation.	4.0	5.3	Short-term noise impacts during construction will be localized within the well site, affecting the neighboring property owners. The bedrock well is located 100 m away from the residences, reducing potential impacts of noise during construction. Standard construction mitigation measures will be implemented to conform to the requirements specified in the local by-laws. Temporary noise and traffic impacts to local traffic and road users on St. George Road resulting from watermain installation are expected. A traffic management plan will need to be developed and implemented to mitigate impacts to traffic during construction.	3.0	4.0	Short-term noise impacts during construction will be localized within the well site, affecting the neighboring property owners. The overburden well is located close to Howell Road, noise impacts to neighboring residential properties, during well construction, are expected to be slightly higher than development of bedrock wells. Standard construction mitigation measures will be implemented to conform to the requirements specified in the local by-laws. Temporary noise and traffic impacts to local traffic and road users on St. George Road resulting from watermain installation are expected. A traffic management plan will need to be developed and implemented to mitigate impacts to traffic during construction.	2.5	3.3
		Public Perception – Maximize the potential for alternative to receive public support and acceptance	Existing groundwater systems will continue to obtain their supply from groundwater sources so no public objections are expected. As bedrock wells at MW 1/14 are located further away from private residences on Howell Street, public perception on potential impacts on private groundwater wells will be more positive than having overburden wells. The need for the removal of arsenic in bedrock wells may present some public objection with the use of this wells. It would be important to communicate to the public the reasons for the need to remove arsenic as they relate to new drinking water standards.	4.0	5.3	Existing groundwater systems will continue to obtain their supply from groundwater sources so no public objections are expected. As overburden wells at TW 4/09 are located closer to private residences on Howell Street, public perception on potential impacts on private groundwater wells will be less positive than having bedrock wells. The potential need for the removal of arsenic in overburden wells may present some public objection with the use of this wells. It would be important to communicate to the public the reasons for the need to remove arsenic as they relate to new drinking water standards.	4.0	5.3	Existing groundwater systems will continue to obtain their supply from groundwater sources so no public objections are expected. As bedrock wells at MW 1/14 are located further away from private residences on Howell Street, public perception on potential impacts on private groundwater wells will be more positive than having overburden wells. The need for the removal of arsenic in bedrock wells may present some public objection with the use of this wells. It would be important to communicate to the public the reasons for the need to remove arsenic as they relate to new drinking water standards.	4.0	5.3	Existing groundwater systems will continue to obtain their supply from groundwater sources so no public objections are expected. As overburden wells at TW 4/09 are located closer to private residences on Howell Street, public perception on potential impacts on private groundwater wells will be less positive than having bedrock wells. The potential need for the removal of arsenic in overburden wells may present some public objection with the use of this wells. It would be important to communicate to the public the reasons for the need to remove arsenic as they relate to new drinking water standards.	4.0	5.3
		Aesthetics and Operational Impacts - Minimize potential visual impacts from water supply infrastructure on private properties and potential public disturbance due to operation & maintenance activities	The new pump house will be located approximately 100 m south of Howell Road. The new building will be architecturally designed to blend-in with the existing character of the neighboring area. Due to the physical distance between new building and existing private residences, visual impacts on private properties and potential disturbance from O&M activities are expected to be less than Option 1b where the building will be located closer to Howell Road	3.5	4.7	The new pump house will be located immediate south of Howell Road. The new building will be architecturally designed to blend-in with the existing character of the neighboring area; however, due to the proximity between new building and existing private residences, visual impacts on private properties and potential disturbance from O&M activities are expected to be more than Option 1a where the building will be located further away from	3.0	4.0	Bedrock wells will be located away from Howell Road and associated infrastructure for the new wells will comprise two (2) well casings and two (2) small sheds to house basic piping and electrical and instrumentation equipment, which will result in significantly lower visual effects on neighboring properties than those expected from Options 1a and 1b. The building expansion of the existing St. George treatment facility may result in temporary visual impacts in the surrounding neighborhood during construction; however potential disturbance from O&M activities is not	4.5	6.0	Overburden wells will be located closer to Howell Road and associated infrastructure for the new wells will comprise two (2) well casings and two (2) small sheds to house basic piping and electrical and instrumentation equipment, which will result in significantly lower visual effects on neighboring properties than those expected from Options 1a and 1b, but slightly higher than those from Option 2a. The building expansion of the existing St. George treatment facility may result in temporary visual impacts in the surrounding neighborhood during construction; however potential	4.0	5.3

Category	Weight	Criteria	Option 1a - Onsite Treatment with Bedrock Well(s) Development at MW 1/14 Site			Option 1b - Onsite Treatment with Overburden Well(s) Development at TW 4/09 Site			Option 2a - Connection to Existing St. George Treatment System with Bedrock Well(s) Development at MW 1/14 Site			Option 2b - Connection to Existing St. George Treatment System with Overburden Well(s) Development at TW 4/09 Site		
			Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score	Rationale	Score 0 to 5	Weighted Score
			and thus, existing private residences.			Howell Road and from existing private residences.			expected to be any different from existing conditions.			disturbance from O&M activities is not expected to be any different from existing conditions.		
		Land Use - Maximize compatibility with existing or proposed land as per County's Official Plan and Source Water Protection Policies	Construction of all new infrastructure will occur within an area currently designated as "Agricultural" under the Official Plan. Development of new water infrastructure is allowed to occur in agricultural areas, subject to completion and approval of area studies that justify the need for the new infrastructure; however, the area to be occupied by the proposed infrastructure will not serve for agricultural activities in the future. Development of new bedrock wells would require delineation of new wellhead protection areas and potential changes to the existing wellhead protection areas. Activities on vulnerable areas would be subject to existing source water protection policies.	3.5	4.7	Construction of all new infrastructure will occur within an area currently designated as "Agricultural" under the Official Plan. Development of new water infrastructure is allowed to occur in agricultural areas, subject to completion and approval of area studies that justify the need for the new infrastructure; however, the area to be occupied by the proposed infrastructure will not serve for agricultural activities in the future. Development of new overburden wells would require delineation of new wellhead protection areas and potential changes to the existing wellhead protection areas. Activities on vulnerable areas would be subject to existing source water protection policies.	3.5	4.7	Well development and installation of two (2) small sheds will occur within an area currently designated as "Agricultural" under the Official Plan. Development of new water infrastructure is allowed to occur in agricultural areas, subject to completion and approval of area studies that justify the need for the new infrastructure; however, the small area to be occupied by the new well casings and sheds will not serve for agricultural activities in the future. Construction of other required infrastructure will occur within existing local roads and existing treatment facility site which is in accordance with existing land uses. Development of new bedrock wells would require delineation of new wellhead protection areas and potential changes to the existing wellhead protection areas. Activities on vulnerable areas would be subject to existing source water protection policies.	4.5	6.0	Well development and installation of two (2) small sheds will occur within an area currently designated as "Agricultural" under the Official Plan. Development of new water infrastructure is allowed to occur in agricultural areas, subject to completion and approval of area studies that justify the need for the new infrastructure; however, the small area to be occupied by the new well casings and sheds will not serve for agricultural activities in the future. Construction of other required infrastructure will occur within existing local roads and existing treatment facility site which is in accordance with existing land uses. Development of new overburden wells would require delineation of new wellhead protection areas and potential changes to the existing wellhead protection areas. Activities on vulnerable areas would be subject to existing source water protection policies.	4.5	6.0
		Construction Duration - Minimize duration of project construction	As construction of new wells and treatment facility will be on a new site and completely independent of the existing water system, the overall construction duration is expected to be shorter than that for Options 2a and 2b. Development of ex. test wells into production wells would be less onerous than developing overburden wells (e.g., test wells, testing and production wells).	4.5	6.0	As construction of new wells and treatment facility will be on a new site and completely independent of the existing water system, the overall construction duration is expected to be shorter than that for Options 2a and 2b. Development of overburden wells (e.g., test wells, testing and production wells) will require longer duration than converting ex. bedrock test wells into production wells.	3.5	4.7	Modifications to the existing St. George treatment facility will require a significant building expansion for the installation of the new treatment systems. Planning and coordination are needed to allow construction of the new works while minimizing operation of existing facility and water supply interruption, the overall construction duration is expected to be shorter than that for Options 2a and 2b. Development of ex. test wells into production wells would be less onerous than developing overburden wells (e.g., test wells, testing and production wells).	2.5	3.3	Modifications to the existing St. George treatment facility will require a significant building expansion for the installation of the new treatment systems. Planning and coordination are needed to allow construction of the new works while minimizing operation of existing facility and water supply interruption, the overall construction duration is expected to be shorter than that for Options 2a and 2b. Development of overburden wells (e.g., test wells, testing and production wells) will require longer duration than converting ex. bedrock test wells into production wells.	2.0	2.7
Sub-total Score – Community/Social					**32.0**			**29.3**			**28.7**			**26.7**
Economic	20	**Life Cycle Cost** – Minimize life cycle cost	Calculated 20-year LCC $10.0 M	5.0	20.0	Calculated 20-year LCC $10.3 M	4.9	19.5	Calculated 20-year LCC $10.8 M	4.6	18.4	Calculated 20-year LCC $11.3 M	4.4	17.7
Sub-total Score – Economic					**20.0**			**19.5**			**18.4**			**17.7**
		Total Overall Maximum Weighted Score (out of 100)			**85**			**78**			**75**			**70**

11.5.1 Sensitivity Analysis

To gain more confidence in the preferred recommended water supply solution selected in the previous step, a sensitivity analysis was completed for different time periods for the life cycle costs (20-year, 40-year and 60-year) for each option. The purpose of this test is to evaluate the impacts of the life cycle costs within the evaluation process. Since the options under consideration include the construction of watermains, which are known to have a life expectancy of up to 75 years, a 60-year life cycle cost is deemed to provide a good indication of the replacement cost of process equipment over the expected life of the watermains. The calculated life cycle costs for each alternative design concepts are summarized in Table 30.

Table 30 Life Cycle Costs Summary

Alternative Design Concepts	20-Year LCC $ Million	40-Year LCC $ Million	60-Year LCC $ Million
Option 1a – Onsite Treatment with Bedrock Well(s) Development at MW 1/14 Site	$12.8	$14.7	$15.6
Option 1b – Onsite Treatment with Overburden Well(s) Development at TW 4/09 Site	$13.2	$15.0	$15.9
Option 2a – Connection to Existing St. George Treatment System with Bedrock Well(s) Development at MW 1/14 Site	$14.0	$15.6	$16.3
Option 2b – Connection to Existing St. George Treatment System with Overburden Well(s) Development at TW 4/09 Site	$14.5	$16.0	$16.8

The sensitivity analysis exercise was completed assuming that all other scores assigned within the environmental and social categories remain unchanged, and the scores assigned within the economic category are adjusted to reflect the changes in the life cycle costs for each scenario. The results of the evaluation process, assuming the different time periods for the life cycle costs in addition to the original 20-year life cycle costs, are summarized in Table 31.

Table 31 Additional Life Cycle Costs – Evaluation Summary Results

Alternative Design Concepts	20-Year LCC		40-Year LCC		60-Year LCC	
	Overall Score	Overall Ranking	Overall Score	Overall Ranking	Overall Score	Overall Ranking
Option 1a Onsite Treatment with Bedrock Well(s) Development at MW 1/14 Site	85	1	85	1	85	1
Option 1b Onsite Treatment with Overburden Well(s) Development at TW 4/09 Site	78	2	78	2	78	2
Option 2a Connection to Existing St. George Treatment System with Bedrock Well(s) Development at MW 1/14 Site	75	3	76	3	76	2
Option 2b Connection to Existing St. George Treatment System with Overburden Well(s) Development at TW 4/09 Site	70	4	71	4	71	4

As shown in Table 31, the overall ranking remains unchanged regardless of the life cycle cost period. The results of the sensitivity analysis demonstrate that Option 1a – Construction of New Onsite Treatment with Bedrock Well(s) Development at MW 1/14 Site, continues to achieve the highest score under the three (3) different planning periods.

12. Preferred Water Servicing Design Concept

Based on the results of the detailed comparative evaluation and sensitivity analysis, the preliminary preferred alternative design concept for the St. George settlement area is:

- Option 1a – Construction of New Onsite Treatment with Bedrock Well(s) Development at MW 1/14 Site

This option includes the following major components:

- Two (2) new bedrock wells, spaced about 20 m apart, each with a capacity of about 22.5 L/s on the new MW 1/14 site, to provide the back-up yield of 45.1 L/s. A new water treatment facility would be built at the new well site to accommodate the required pumping and treatment equipment. The new treatment facility will have a treatment capacity of 45.1 L/s.
  - Treatment for the control/removal of iron, manganese and arsenic, as well as disinfection will be provided at the new facility. Based on available water quality data for the test wells, it is anticipated that a filtration technology be highly suitable for the removal/treatment of iron, manganese and arsenic from the raw water. Selection of the preferred treatment technology will be completed during detailed design. The need and scope for pilot testing will be confirmed in the next stages of the project. In addition, further testing at the new production wells can be carried out to identify the source or the zones of higher arsenic concentration. There may be a possibility to reduce arsenic levels by sealing the production zones from which the higher arsenic containing in TW 2/16 was drawn during the 2016 testing.
- The existing St. George production wells and treatment facility at Church Avenue will continue to operate and meet water demands up to the permitted annual daily average rate of 69.8 L/s.
- Treated water will be conveyed from the new on-site water treatment facility directly into the existing St. George's distribution system, at the north end of Hampton Court.

A general process schematic of the preliminary preferred option is shown in Figure 27. An overall layout is shown in Figure 24.

From a comparative evaluation, Option 1a provides the following major advantages:

- It provides a true independent secondary supply and treatment source to the St. George settlement area, which contributes to the overall system redundancy and provides operational flexibility for emergency situations. A separate treatment facility at the new wells site also allows more flexibility in terms of treatment requirements, should changes in water quality from the new wells arise in the future.
- By providing separate treatment of the two (2) different groundwater sources before introducing treated water into the distribution system, potential problems in water quality or upsets to treatment equipment resulting from blending different raw water sources is reduced.
- The proposed bedrock wells at MW 1/14 are strategically located to ensure that the anticipated limits of the Wellhead Protection Areas "A" exclude the existing private residences along Howell Road. Being 100 m further away from existing private residences on Howell Road reduces the impacts on private wells.

- In terms of construction, bedrock wells usually take shorter time to develop than overburden wells as there is less formation damage during drilling. Similarly, bedrock wells are expected to require less frequent routine maintenance than overburden wells. As development of new wells and construction of a brand-new treatment facility will be completely independent of the existing St. George water supply and treatment system, provision of water supply in the system can be maintained and uninterrupted at all times during construction of new infrastructure.
- This option eliminates the need to install a 2.0 km watermain, conveying untreated water, in an already congested utility corridor which already has two (2) separate feedermains conveying treated water to pressure zones 1 and 2.
- The proposed watermain alignment connecting the new treatment facility to the connection point within the distribution system largely occurs on agricultural fields, which results in significantly lower traffic impacts, negligible interferences with existing underground utilities and lower capital costs for watermain installation.

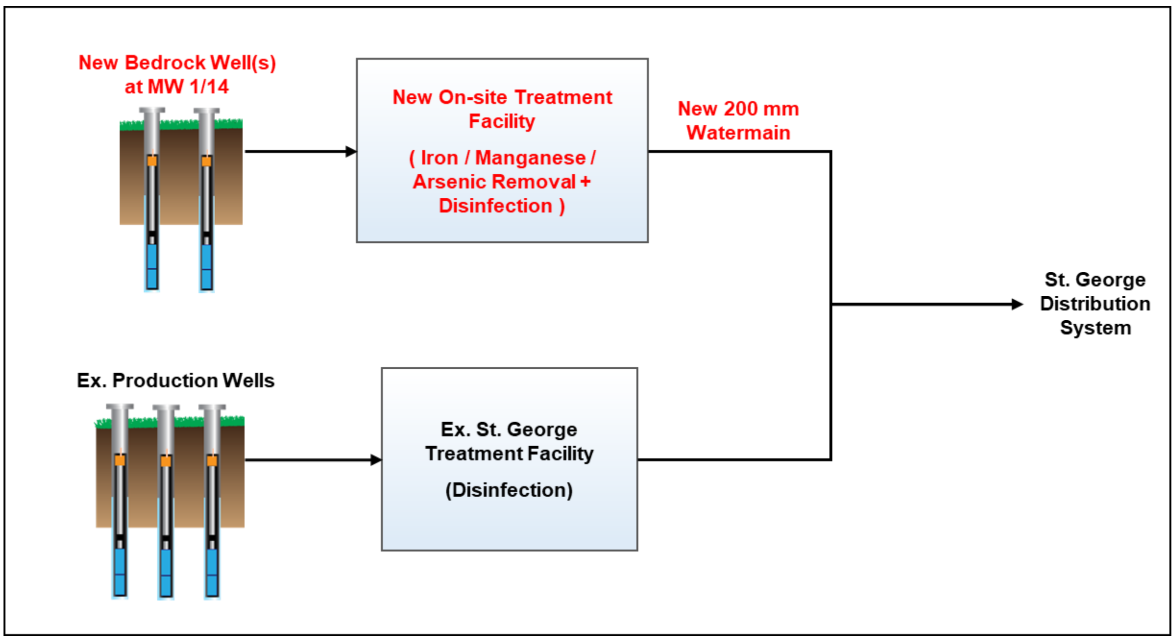


Figure 27 Preliminary Preferred Alternative Design Concept – Option 1a – Onsite Treatment with Bedrock Well Development at MW 1/14 Site

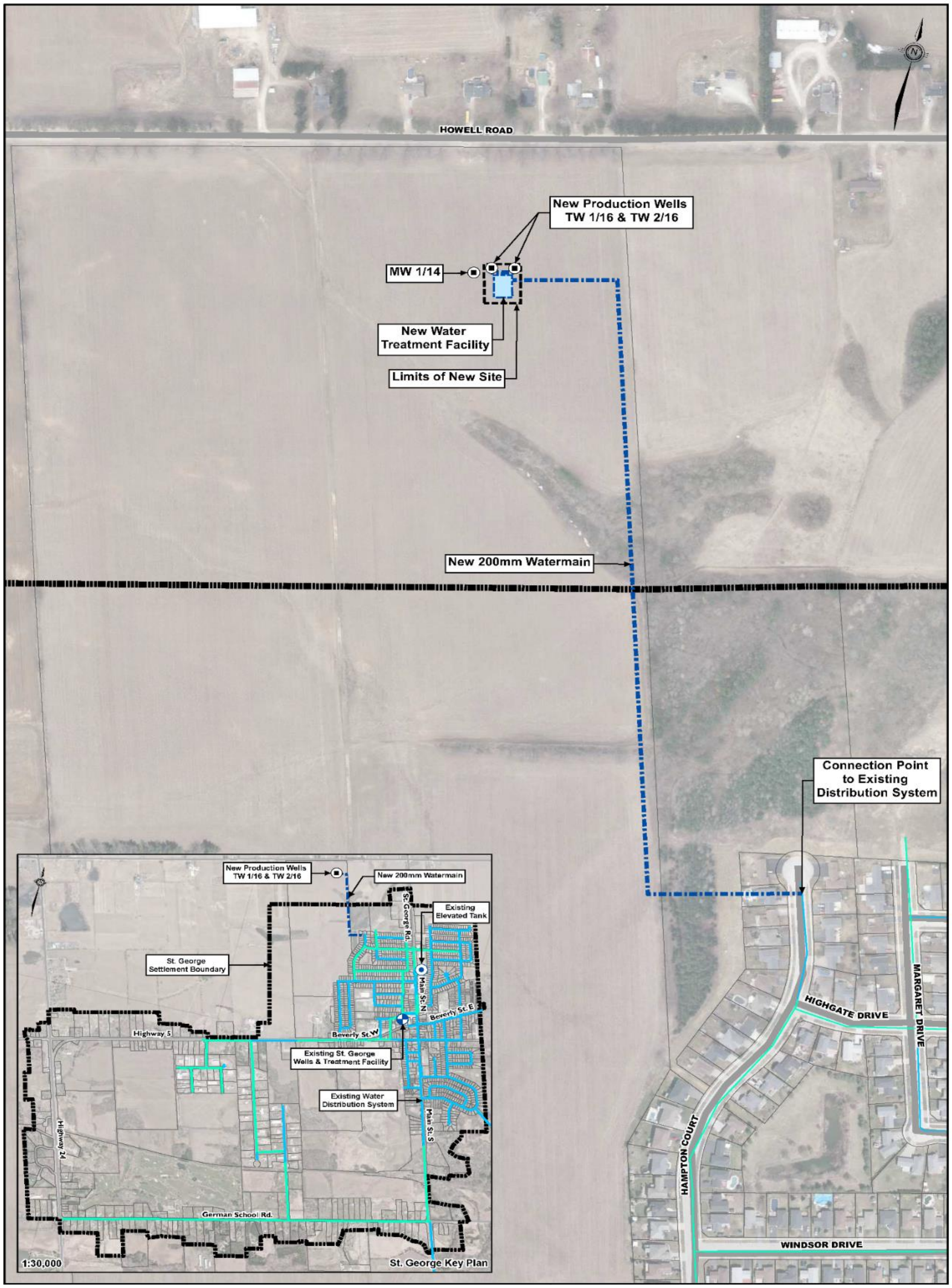


Figure 28 Preliminary Preferred Alternative Design Concept – General Layout

12.1 Required Permits and Approvals

Permits and approvals required for the proposed works are shown in Table 34.

Table 32 Preferred St. George Water Servicing Design Concept – Permits and Approvals

Approval Agency	Permit/Approval Required
Ministry of the Environment, Conservation and Parks (MECP)	• Temporary PTTW for new wells (if additional testing is to be conducted) • Permanent PTTW for construction of new wells • Amendment to Municipal Drinking Water Works Permit • Amendment to Municipal Drinking Water License
County of Brant	• Site Plan Approval • Building Permit
Utility Companies	• As required. • ESA

13. Proposed Mitigation of Potential Impacts and Monitoring

The following section provides a description of the potential impacts anticipated as a result of the implementation of the preferred alternative design concept, as outlined in this report, as well as some mitigation measures proposed to minimize or avoid such anticipated impacts.

Implementation of the preferred alternative design concept is not expected to have significant impacts on the existing natural and economic environments, and cultural heritage resources; however, as with any other construction project, there will be some temporary potential impacts to the public and environment during construction in areas such as noise, dust, vibration and visuals during the construction period; however, these will be of short-term duration and expected to occur only during construction.

In general, public health and safety is a priority to the County and as such, all design and construction related to the St. George Water Servicing design concept will adhere to strict safety guidelines and all applicable codes and standards. All construction work must be carried out in accordance with the Occupational Health and Safety Act (OHSA) and other local regulations.

Specific mitigation measures, as described below, are recommended for implementation to reduce anticipated potential impacts.

13.1 Water Quality and Quantity

Groundwater from all wells, existing and proposed new wells, will meet the Ontario Drinking Water Quality Standards, Objectives and Guidelines. A complete water quality characterization should be completed during development and testing of the new production wells to confirm water treatment requirements.

Further testing at the new production wells can be carried out to identify the source or the zones of higher arsenic concentration. There may be a possibility to reduce arsenic levels by sealing the production zones from which the higher arsenic containing in TW 2/16 was drawn during the 2016 testing.

The proposed bedrock wells at MW 1/14 will be approximately 100 m south of the proposed overburden wells at TW 4/09. The limits of the Wellhead Protection Area "A" for the bedrock wells, at the expected pumping rates of 45.1 L/s, are not expected to include the existing residences along Howell Road, which is anticipated to minimize impacts on private wells.

To reduce potential upsets in the water quality within distribution system due to blending of two (2) different water sources, separate treatment of each water source will be provided to create a uniform water quality before the new 200 mm watermain connects to the existing distribution system. Ultimately, treated water from the existing and new water treatment facilities in St. George will be in full compliance with all ODWQS, Objectives and Guidelines, before connecting to the distribution system, to ensure that adequate water quality conditions are maintained throughout the distribution system and reduce upsets from mixing.

13.2 Disturbance to Natural Environmental Features

LGL Limited (LGL) was retained as a sub-consultant to provide natural sciences services in support of St. George Water Servicing Class EA Study. LGL's findings and recommendations are documented in the "*St. George Water Servicing Schedule C Class Environmental Assessment, Alternative Water Servicing Options – Natural Science Report*" (dated February 2016), and is attached in Appendix H.

No significant impacts to the existing natural heritage features are anticipated as a result of construction of the proposed works; however, a number of general mitigation options can be employed to avoid potential impacts, as follows:

There is potential for hedgerow loss due to construction of the proposed new supply wells and treatment facility. Although no aquatic habitat and communities and no wildlife or wildlife habitat were identified in proximity to the preferred well and treatment facility site, consideration for tree retention and tree protection measures is recommended.

As part of the proposed works, a new 200 mm watermain will run along a county road that is one block west of St. George Road to connect to an existing distribution system at the north end of Hampton Court. The proposed watermain alignment is anticipated to largely occur in agricultural fields; however, it would involve crossing a deciduous forest community that is reported as a Significant Woodland (NRSI 2013) and in proximity to the provincially rare Pignut Hickory. No significant wildlife habitat in the vicinity of the proposed works was identified; however, consideration for avoidance of vegetation removal through trenchless or minor shifts in the alignment is recommended. In addition, adherence to timing windows for Migratory Birds may be required in accordance with the Migratory Birds Convention Act.

In order to minimize potential for clearing of anthropogenic and natural vegetation communities due to site clearing, grubbing and grading, restoration of the sites to existing conditions or better post-construction is recommended through replanting with native and non-invasive species.

Two crossings of the Fairchild Creek are also expected; one unclassified first order and one unclassified second order; however, aquatic habitat is not anticipated to be sensitive. In general, the following is recommended:

- That an effective erosion and sediment control (ESC) plan is prepared for future construction activities to ensure all entrained silt or sediment is contained and managed on-site and not permitted to migrate into the adjacent vegetation communities or eventually to the aquatic habitat.
- The ESC measures must be maintained in working order throughout the life of construction. Ensure monitoring of the ESC measures is carried out and that actions are taken to repair or remedy any deficiencies.
- Ensure that ESC materials are removed from the site post-construction and restoration.
- Any stabilized soils must be restored as soon as possibly post-construction or during long periods of inactivity.

- Identify Species at Risk (SAR) plants and trees and avoid impact during the removal of vegetation, including impact to the root zone.
- Ensure ESC for potential aquatic SAR.
- Survey areas of impact for potential nesting of SAR turtles and use by SAR snakes and avoid during sensitive timing.
- Survey areas with potential for barn swallow prior to any disturbance.

Should the construction footprint extend outside of the existing road right of ways, additional screening for SAR may be required.

13.3 Climate Change

Based on a preliminary concept identified during the Class EA study, the proposed new infrastructure will be located outside of floodplain areas, thus, reducing potential effects to water infrastructure from possible flooding events resulting from climate change conditions.

In addition, provision of a secondary source of water supply and treatment would significantly reduce the short-term disruption of municipal water services potentially caused by problems with the existing water system resulting from extreme climate events.

The construction of the new water supply infrastructure, mostly related to the new supply wells and pump house/treatment facility, on a site currently used for agricultural uses, could have potential effects on climate change. The construction and operation of a new on-site treatment facility would generate additional greenhouse gas emissions due to heating, lighting, electrical requirements as well as chemical delivery needs. In addition, the existing landscape of the area surrounding the MW 1/14 site would need to be altered to accommodate new infrastructure. Although the existing site does not have significant vegetation species, it is used for agricultural purposes.

Implementation of the following climate mitigation measures should be considered to reduce the long-term generation of carbon emissions arising mainly from operation of the new treatment facility and to enhance carbon storage due to proposed changes in the landscape:

- Use of energy efficiency features within the new treatment facility as LED lighting fixtures and insulation to reduce the energy needs.
- Chemical delivery is expected to be minimal; however, delivery could be scheduled on a monthly/bimonthly basis in order to reduce the number of delivery trucks to/from the new treatment facility.
- Implementation of an adequate landscape plan, comprising planting of new trees and local non-invasive vegetation species within the new site.

13.4 Source Water Protection

Earthfx was retained as a sub-consultant to conduct a wellhead protection area (WHPA) and vulnerability and threats analysis for the new supply wells for the Town of St. George (TW1/16, TW2/16). Earthfx's findings are documented in the "*Wellhead Protection Area Delineation,* *Vulnerability Scoring and Threats Assessment for the St. George and Lynden Municipal Supply Wells"* report (dated May 25, 2018) and is attached in Appendix I.

13.4.1 Source Protection Areas

As part of the scope of the update of the Grand River Assessment Report and Source Protection Plan (AR and SPP), the Grand River Conservation Authority completed on behalf of the Lake Erie Source Protection Region a delineation of the WHPAs, vulnerability and threats analysis for the St. George Municipal Supply Wells. The report is titled Wellhead Protection Area Delineation, Vulnerability Scoring and Threats Assessment for the St. George and Lynden Municipal Supply Wells, Earthfx Incorporated, May 2018. Updated WHPAs for the existing St. George supply wells, the proposed new supply wells, as well as a composite WHPA based on a range of operational conditions for the St. George wells by varying pumping rates and porosity were developed, with results shown in Figure 25.

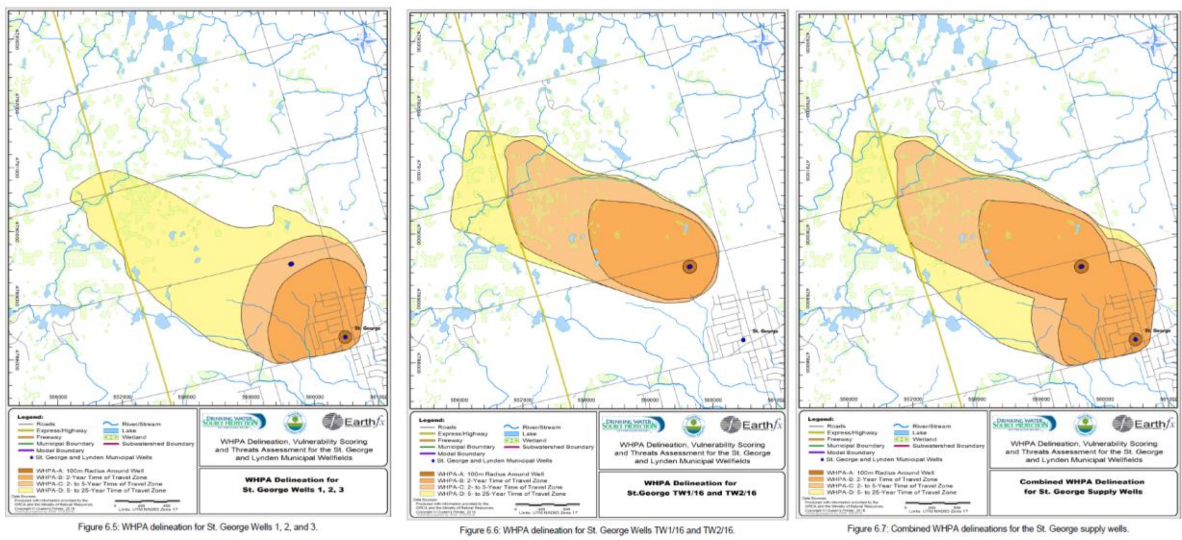


Figure 29 (Left to Right) WHPAs for the existing St. George Wells; WHPAs for the new St. George Wells; Composite WHPAs for existing and new St. George Wells

Groundwater vulnerability scores were assigned to the subzones within each WHPA for both the new and existing St. George supply wells, with vulnerability indices (High, Medium, and Low) based on surface to well time of travel (i.e. 2, 5, and 25 years). The results are graphically shown in Figure 26. The vulnerability tends to be slightly lower upgradient of the new wells because the time of travel tends to be longer due to vertical confinement. The most vulnerable areas correspond to the WHPA-As and the WHPA-B of the existing supply wells, which are screening in an overburden aquifer.

Significant Drinking Water Quality Threats specific to the St. George new proposed bedrock supply wells were identified in the Grand River Source Protection Area Approved Assessment Report, as summarized in Table 36. None of the drinking water quality threats listed in Table 36 are associated with the short-term construction and long-term operation of proposed new supply wells, treatment facility and distribution watermain, as described in this report.

Activities and land uses within the St. George WHPAs should be managed in accordance with the policies of the Lake Erie Source Protection Plan. Based on the consultation records obtained from GRCA and the Lake Erie Source Protection Region resulting from consultation with the landowners in the vicinity of the St. George WHPAs, no current activities that may be considered as threat to the St. George drinking water system were identified.

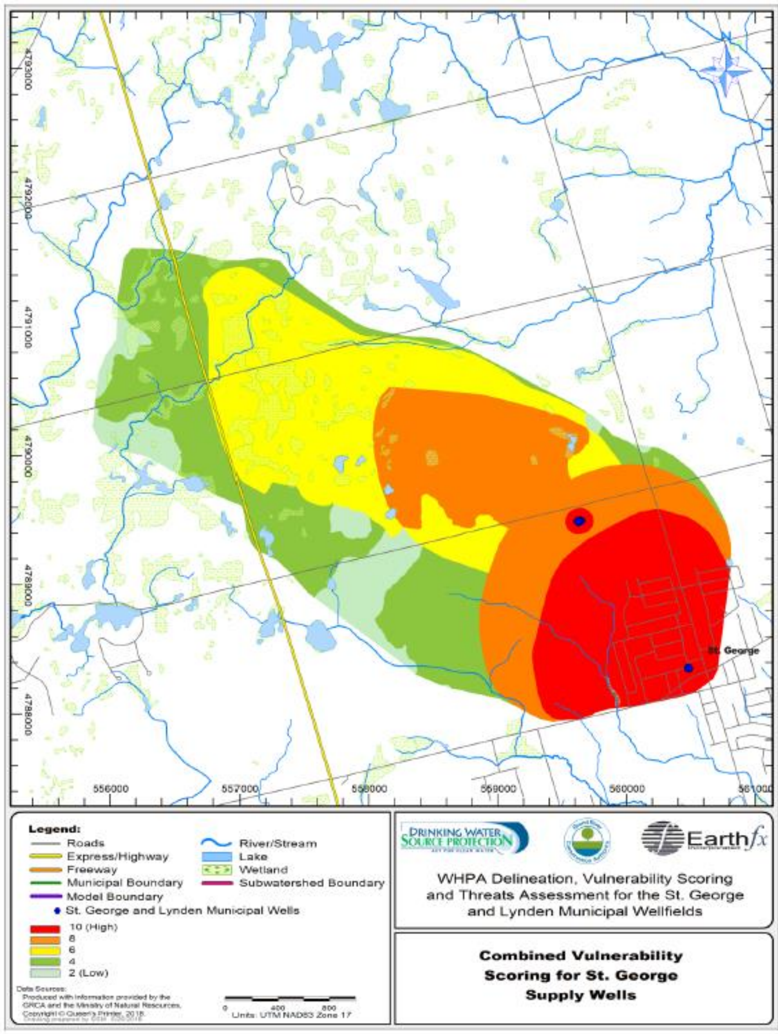


Figure 6.20: Combined vulnerability scoring for the St. George supply wells.

Figure 30 St. George Supply Wells Vulnerability Scoring

Table 33 New St. George Bedrock Well Supply Significant Drinking Water Quality Threats (current to December 2018)

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
2	Sewage System or Sewage Works – Onsite Sewage Systems	1	WHPA-A
3	Application of Agricultural Source Material to Land	2	WHPA-A
10	Application of Pesticide to Land	3	WHPA-A

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
			WHPA-B
11	Storage of Pesticide	1	WHPA-B
15	Handling and Storage of Fuel	3	WHPA-A WHPA-B
Total Number of Activities		**10**	
Total Number of Properties		**3**	

1. *Prescribed Drinking Water Threat Number refers to the prescribed drinking water threat listed in O.Reg 287/07s 1.1.(1).*
2. *Where applicable, waste, sewage, and livestock threat numbers are reported by sub-threat; fuel and DNAPL by Prescribed Drinking Water Threat category*

Note: Certain types of activities on residential properties that are incidental in nature and that are significant drinking water threats are not enumerated. These threats include the application of commercial fertilizer on residential properties, the storage of organic solvents (dense non-aqueous phase liquids) on residential properties, and the storage of fuel (e.g., heating fuel tanks) on residential properties in natural gas serviced areas.

Note: County of Brant does not consider storm sewer distribution piping and other associated networks such as ditches or unlined trenches to be part of a storm water management facility.

13.5 Disturbance to Cultural Heritage Features

Unterman McPhail Associates (Unterman) was retained as a sub-consultant to conduct a Cultural Heritage Resource Assessment (CHAR) of the built heritage recourses and cultural heritage landscapes in support of the St. George Water Servicing Class EA Study. Unterman's findings and recommendations are documented in the "*Cultural Heritage Assessment Report*" (dated November 2015) and is attached in Appendix J.

The assessment identified that there will be permanent physical and visual disruption affects to the agricultural land surrounding MW 1/14 area, which includes the area for the proposed supply wells, treatment facility and connecting watermain. This agricultural land has been identified as a cultural heritage resource; however, it does not have Heritage Recognition as per the County of Brant Heritage Register.

No potential direct impacts to existing cultural heritage resources are anticipated; however, a few indirect impacts were identified to include the potential for temporary physical, visual, audible and atmospheric affects during construction activities to three (3) identified cultural heritage resources, namely, Howell Road, a roadscape; and farm complexes at 197 Howell Road and 179 Howell Road. The two farm complexes on Howell Road are included on the County of Brant Heritage Register, and thus, have Heritage Recognition.

The following mitigation recommendations are provided with regard to the potential adverse effects described above:

- Construction noise and vibration should be monitored and kept to a minimum in the vicinity of the identified built heritage resources within and in the vicinity of MW 1/14 site.

- The County of Brant may request the completion of Cultural Heritage Evaluation Reports (CHERs) and/or Heritage Impact Statement (HIS) for the farm complexes identified at 179 and 197 Howell Road, which are listed properties on the Brant Heritage Inventory.
- Construction laydown areas for the potential design concepts for the proposed 200 mm watermain should avoid being located adjacent to or abutting sites identified as #197 Howell Road (farm complex), #179 Howell Road (farm complex) and #257 Main Street North (cemetery).

13.6 Disturbance to Archaeological Features

Archeoworks was retained as a sub-consultant to conduct a Stage 1 Archaeological Assessment (AA) in support of the St. George Water Servicing Class EA Study. Archeoworks' findings and recommendations are documented in the "*Stage 1 Archeological Assessment for the St. George Water and Wastewater Servicing Municipal Class Environmental Assessments Report*" (dated March 31, 2015) and is attached in Appendix K.

The proposed location of the new pump house and alignment of the new 200 mm watermain have been identified as a moderate to high archeological potential that requires a Stage 2 Archeological Assessment (AA). The entirety of the potential well site, as well as all of the immediate area lying south of Howell Road, remains as cultivated farmland. The only disturbances in the area around the well site consist of the paved Howell Road alignment and the extant residential structures. With no evidence of previous disturbance, or any physical features indicating low or no archaeological potential, the proposed well site and watermain alignment will require a Stage 2 pedestrian survey at five metre intervals to determine the presence or absence of archaeological resources. Should project plans include construction in any of the adjacent high-potential areas (marked in red in Map 16 of Archeoworks Inc., 2014 report), a Stage 2 test pit survey or pedestrian survey, at standard five-metre intervals will be required.

13.7 Truck Traffic

Most of the construction activities will be limited to the construction area in the vicinity of the MW 1/14 site. Increased truck traffic on Howell Road will be experienced during the duration of construction from the delivery of construction equipment, construction materials and potential removal of excavated material from the site. The proposed mitigation measures include the following:

- Appropriate hours of work will be specified in the contract.
- Any lane closures will be completed in accordance with best practices to protect safety to the workers and to the general public.
- Residents in the area will be kept informed ahead of time of any road closures and anticipated timing, as well as the overall schedule of construction.
- All standard best practices for vehicle and pedestrian safety will be employed throughout the construction areas. All construction will adhere to strict safety guidelines.

13.8 Noise and Vibration

Most of the construction activities associated with the on-site treatment and bedrock well(s) development at MW 1/14 site will be localized within the well site, affecting the few neighbouring property owners. The proposed location of the new pump house / treatment facility is located approximately 100 m away from the neighbouring residential neighbourhood. The distance of the new pump house and existing private residences is anticipated to have a low impact from potential disturbances from operations and maintenance activities. Potential noise impacts resulting from watermain installation through undisturbed area is anticipated.

Although minimal, some potential noise effects may occur due to construction traffic and construction equipment. Noise during operation of the new wells and treatment facility is not expected to be significantly different from the existing conditions. The proposed mitigation measures include the following:

- Ensuring all vehicles and construction equipment are equipped with effective muffling devices and are operated in a fashion to minimize noise in the project area.
- Throughout the construction period, the County will ensure the contractors undertake measures to reduce noise disturbances as much as possible.

13.9 Dust/Mud

Construction traffic could create additional dust and mud. The proposed mitigation measures include the following:

- Dust control measures such as the application of water to be implemented as required.
- The County will ensure that the contractor maintain public roadways clean and free of mud on a consistent basis.

13.10 Visual/Architectural

The architectural design of the new pump house/treatment facility will be architecturally designed to blend-in with the existing rural character of the neighbouring area. Due to the physical distance between the new pump house and existing private residences, visual impacts on private properties and potential disturbances from operational and maintenance activities are anticipated to be minimized. Landscaping of the new site will be implemented, as necessary, to reduce potential for visual disturbances.

13.11 Landscaping

The proposed site for the new pump house/treatment facility will be landscaped following construction of the proposed works. It is proposed to provide landscaping that will blend into the natural surrounding environment and require minimal maintenance. After fine grading of the landscape areas with topsoil, the open areas will be sodded. A landscape plan detailing proposed tree plantings, will be developed during the detailed design phases of the project, as required.

13.12 Fuel Spills

Spills could potentially occur when refueling construction equipment. The proposed mitigation measures include the following:

- Proper construction techniques will be applied to reduce the risk of spills.
- A contingency plan for cleaning up fuel spills will be developed and ready for implementation, particularly when working in proximity to existing watercourses.
- Equipment required to clean up a spill will be contractually required to be on-site at all times.

13.13 Geotechnical Considerations

Construction activities will include topsoil stripping, excavations for the new pump house and watermains, and stockpiling of select native materials on-site for backfilling and grading. Any surplus material generated from grading operations that is not required for filling or fine grading, will be removed and disposed off-site.

A detailed geotechnical investigation will be carried to assist during the design and construction of the preferred alternative design concept.

13.14 Public Consultation

Schedule C of the Class Environmental Assessment planning process requires that members of the public, interest groups and review agencies are given opportunities to provide input and comments from the early stages of the Class EA Study. The project team met this requirement by providing a Notification of Study Commencement and public notices for three separate public meetings. The public notices were placed for two consecutive publications in local newspapers.

Information regarding the progress of the St. George Water Servicing Class EA Study was provided at each public meeting. Public feedback was incorporated as part of the evaluation process and considered during the selection and confirmation of the recommended water servicing design concept.

A Notice of Study Completion will be published in the local newspapers and distributed to all in the project contact list. The Notice of Study Completion will include enough information to advice the public and review agencies of the locations where the Environmental Study Report will be filed for public review, the time period to provide comments, and the opportunities to raise any major concerns to the Ontario Minister of the Environment, Conservation and Parks, and the Director of Environmental Assessment and Permissions Branch, if such concerns cannot be resolved with the County during the review period.

The County will continue to inform the public during the project design and construction phases. Project updates will be issued, as necessary, and notices will include a dedicated contact person from the County to respond to issues or concerns that may arise.

14. Class EA Phase 4 – Class EA Report Conclusions and Recommendations

Through completion of a Municipal Class EA study, the on-site treatment with bedrock well(s) development at MW1/14 site has been identified as the preferred alternative design concept to service the projected growth and meet the long-term servicing needs of the St. George community. Individual assessments of the natural, technical, archaeological, and cultural heritage conditions were conducted as part of the Class EA study process to inventory and evaluate the existing conditions of the study area.

Public and agency input was sought at key stages of the Class EA process to provide the public with opportunities to comment on the project. Through the consultation process, no major public concerns or issues were raised associated with the preferred water servicing design concept.

Potential impacts associated with the implementation of the recommended alternative solution were identified as well as available mitigation measures. Due to the nature of this project, some inevitable effects in terms of dust, noise, and truck traffic will be felt around the construction areas. However, potential effects can be further reduced or avoided by implementation of mitigation measures outlined in this report. As such, no significant impacts to the existing natural, socio-cultural, archaeological, or cultural heritage environments are anticipated from implementation of this project.

It is recommended that the County proceed with the detailed design and construction of the preferred alternative design concept, as outlined in this ESR, subject to receiving the necessary approvals. This ESR is being filed for a 30-day public review period. Provided that no major objections or Section16 Orders are received during the review period, the project will proceed through the detailed design and construction phases as outlined in this ESR.

15. References

- Archeoworks, "Stage 1 Archeological Assessment for the: St. George Water and Wastewater Servicing Municipal Class Environmental Assessments", March 31, 2015
- Armstrong Hunter & Associates, "St. George Area Study Natural Heritage Study Report", October 2013
- County of Brant, "St. George Drinking Water System Operations Manual", May 2013, March 2014
- County of Brant, "County of Brant Official Plan 2012", September 4, 2012
- County of Brant, "County of Brant Municipal Comprehensive Review", September 2008
- Earthfx, "Wellhead Protection Area Delineation, Vulnerability Scoring and Threats Assessment for the St. George and Lynden Municipal Supply Wells", May 2018
- KMK Consultants Limited, "St. George Water Pollution Control Operations Manual", March 2005
- Lake Erie Region Source Protection Committee, "Grand River Source Protection Area – Approved Assessment Report", August 2019
- LGL Limited, "St. George Water Servicing Schedule C Class Environmental Assessment, Alternative Water Servicing Options- Natural Science Report", February 2016
- Lotowater, "St. George Well 1 Inspection and Pump Service", January 2014
- Lotowater, "St. George Well 3 Pump Replacement", October 2013
- Lotowater, "St. George Well 2 Pump and Well Servicing", December 2011
- Lotowater, "St. George Well 3 Investigation and Pump Maintenance", June 2011
- Ministry of Environment, "St. George Water Pollution Control Plant Amended Environmental Compliance Approval, Number 7620-97CPND", June 2013
- Ministry of Environment, "St. George Permit to Water, Permit Number 2203-8VEGUX", July 2012
- Ministry of Environment, "Municipal Drinking Water License, License Number: 062-104, Issue Number 1", November 2009
- MTE, "Village of St. George Preliminary Water Supply and Distribution Study", September 2012
- Tim Lotimer & Associates Inc., "St. George Water Servicing Class EA Study, Results of Hydrogeological Testing Program", July 2014
- Unterman McPhail Associates, "Cultural Heritage Assessment Report, St. George Water and Wastewater Servicing Municipal Class Environmental Assessment, County of Brant, Ontario, Part II: St. George Water Servicing", November 2015
- Walker, Nott, Dragicevic Associates Limited, "Updated Background Area Study", October 2013
- Woerns, Norbert, "Community of St. George Water Supply Investigation Phase 1", October 11, 2012

- Watson and Associates Economist Limited, “Brant County Official Plan review, Growth Analysis Study, 2006 to 2031”, June 2008.