A REVIEW OF ONTARIO'S WATER QUANTITY MANAGEMENT FRAMEWORK
WATER BOTTLING STUDY AREAS REPORT

Prepared for:

Government of Ontario
Ministry of the Environment, Conservation and Parks
Standards Development Branch
7th Floor, 40 St Clair Avenue West
Toronto, ON M4V 1M2

Prepared by:

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171 Victoria Street North
Kitchener, ON N2H 5C5

Project Number: 180107
Submission Date: 11 January 2019

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STATEMENT OF QUALIFICATIONS AND LIMITATIONS

This Report has been prepared for the exclusive use of the Ontario Ministry of the Environment, Conservation and Parks (MECP) in accordance with the agreement between BluMetric Environmental Inc. (BluMetric™) and MECP, including the scope of work detailed therein (the "Agreement").

This Report is intended to provide a review and offer opinion based on documents/data/productions provided by MECP and obtained from publicly available information sources (the "Information"). The opinions and recommendations provided by BluMetric in the Report:

- are provided without inspection of Site conditions and testing at or in the vicinity of the Site;
- has relied in good faith on the information provided by others as noted in the report and has not independently verified the accuracy or completeness of such information;
- may be based on information provided to BluMetric which has not been independently verified;
- has assumed that the information provided is factual and accurate;
- must be read as a whole and sections thereof should not be read out of such context;
- are based on our professional judgement and are subject to the limitations noted herein:

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The findings presented in this report are based on the conditions observed and reported by others at specified dates and locations, and for the types of analysis completed. Unless otherwise stated, the findings in this report cannot be extended to previous or future site conditions, portions of the Site that were not investigated directly, or types of analysis not performed.

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GLOSSARY OF TERMS, ACRONYMS AND DEFINITIONS

Application – Means an application to a Director under section 34 of the OWRA for a Permit to Take Water.

Aquifer - A geological formation or structure that stores and/or transmits water, such as to wells and springs. Use of the term is usually restricted to those water-bearing formations capable of yielding water in sufficient quantity to constitute a usable supply for people's uses. Or in Ontario "Aquifer means a water-bearing formation that is capable of transmitting water in sufficient quantities to serve as a source of water supply" (R.R.O. 1990, Reg. 903: WELLS under Ontario Water Resources Act, R.S.O. 1990, c. O.40).

Aquifer (confined) - soil or rock below the land surface that is saturated with water. There are layers of impermeable material both above and below the aquifer. It is under pressure so that when the aquifer is penetrated by a well, the water will rise above the top of the aquifer.

Aquifer (unconfined) - an aquifer whose upper water surface (water table) is at atmospheric pressure, and thus is able to rise and fall.

Aquitard - a geologic formation or stratum that lies adjacent to an aquifer and that allows only a small amount of liquid to pass.

Artesian water - groundwater that is under pressure and is able to rise above the level at which it is first encountered when tapped by a well. It may or may not flow out at ground level. The pressure in such an aquifer is commonly called artesian pressure, and the formation containing artesian water is an artesian aquifer or confined aquifer. See *Flowing well*.

Base flow - sustained flow of a stream in the absence of direct runoff. It includes natural and human-induced stream flows. Natural base flow is sustained largely by groundwater discharge.

Bedrock - the solid rock beneath the soil and superficial rock. A general term for solid rock that lies beneath soil, loose sediments, or other unconsolidated material.

Best Practices – are the practices and approaches being used for water management science in Ontario and other jurisdictions under a variety of conditions that are effective and efficient and produce reasonable results.

Bottled water - potable water that is intended for human consumption and that is packaged in bottles or other portable containers.

CA – Conservation Authority

Cumulative Effects/Impacts - changes to surface water or groundwater resources that are caused or altered by an action in combination with other human or natural actions or conditions. In the context of the Assessment of Water Resources to Support a Review of Ontario's Water Quantity Management Framework (2018), Cumulative Effects include not only consideration of the changes to surface water and groundwater caused by multiple takings of surface or groundwater, but also considers the effects of climate change, population growth and related land use changes. In comparison, Cumulative Impacts only considers changes to surface water or groundwater resources that are caused or altered by multiple takings of surface or groundwater and their impact on other human or natural features.

Discharge - the volume of water that passes a given location within a given period of time. Usually expressed as volume over time (e.g. m^3/s).

Drainage basin - land area where precipitation runs off into streams, rivers, lakes, and reservoirs. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge. Large drainage basins, like the area that drains into the Grand River contain smaller drainage basins or sub-watersheds. See *Watershed*.

Drawdown - a lowering of the groundwater surface caused by pumping.

Drought - a period of below-average precipitation in a given region, resulting in prolonged shortages in the water supply, whether atmospheric, surface water or groundwater. What officially constitutes drought differs from jurisdiction to jurisdiction.

Environmental Setting - the milieu or aggregate of the surroundings including climate, diversity, geographic variability, watershed characteristics, geological and hydrogeological variability and aquifer types.

Environmental Flow Needs - the flows (quantity and timing) and water levels required in a water body to sustain freshwater ecosystems and the ecological function of the flora and fauna present within that water body and its margins.

Flowing well/spring - a well or spring that taps groundwater under pressure so that water rises above ground surface without pumping. See *Artesian water.*

Freshwater - water that contains less than 1,000 milligrams per liter (mg/L) of dissolved solids; generally, more than 500 mg/L of dissolved solids is undesirable for drinking and many industrial uses.

Gauging station - a site on a stream, lake, reservoir or other body of water where observations and hydrologic data are obtained.

Groundwater - (1) water that flows or seeps downward and saturates soil or rock, supplying springs and wells. The upper surface of the saturated zone at atmospheric pressure is called the water table. (2) Water stored underground in rock crevices and in the pores of geologic materials that make up the Earth's crust.

Groundwater recharge - inflow of water to a groundwater reservoir from the surface. Infiltration of precipitation and its movement to the water table is one form of natural recharge. Also used to define the volume of water added by this process. Alternatively, "groundwater recharge" means the replenishment of subsurface water, (a) resulting from natural processes, such as the infiltration of rainfall and snowmelt and the seepage of surface water from lakes, streams and wetlands, and (b) resulting from human intervention, such as the use of storm water management systems (O. Reg. 140/02: OAK RIDGES MORAINE CONSERVATION PLAN under Oak Ridges Moraine Conservation Act, 2001, S.O. 2001, c. 31)

Headwater(s) - (1) the source and upper reaches of a stream; also the upper reaches of a reservoir. (2) the water upstream from a structure or point on a stream. (3) the small streams that come together to form a river. Also may be thought of as any and all parts of a river basin except the mainstream river and main tributaries.

Impermeable layer - a layer of solid material, such as rock or clay, which does not allow water to pass through.

Infiltration - flow of water from the land surface into the subsurface.

MECP –Ontario Ministry of the Environment, Conservation and Parks, the 'ministry'.

MNRF – Ontario Ministry of Natural Resources and Forestry.

Municipal Water Supply – Means the supply of a large municipal residential system or of a small municipal residential system.

OLWR – Ontario Low Water Response Program

Peak flow - the maximum instantaneous discharge of a stream or river at a given location. It usually occurs at or near the time of maximum stage.

Percolation - (1) The movement of water through the openings in rock or soil. (2) the entrance of a portion of the streamflow into the channel materials to contribute to groundwater replenishment.

Permeability - the ability of a material to allow the passage of a liquid, such as water through rocks. Permeable materials, such as gravel and sand, allow water to move quickly through them, whereas impermeable materials, such as clay, do not allow water to flow freely.

Permit Holder – Holder of an active Permit to Take Water.

PGMN – Provincial Groundwater Monitoring Network

Porosity - a measure of the water-bearing capacity of subsurface rock or unconsolidated overburden materials. With respect to water movement, it is not just the total magnitude of porosity that is important, but the size of the voids and the extent to which they are interconnected (effective porosity), as the pores in a formation may be open, or interconnected, or closed and isolated. For example, clay may have a very high porosity with respect to potential water content, but it constitutes a poor medium as an aquifer because the pores are usually so small.

Potentiometric surface/piezometric surface - the imaginary line where a given reservoir of fluid under pressure would rise if allowed to flow, for example if penetrated by wells; a potentiometric surface is based on hydraulic principles.

Precipitation - rain, snow, hail, sleet, dew, and frost.

PTTW/Permit - a permit to take water under the *Ontario Water Resources Act*.

Recharge - water added to an aquifer. For instance, rainfall that seeps into the ground.

Recovery – the hydraulic response at a pumping well or observation well after pumping has stopped.

River - a natural stream of water of considerable volume, larger than a brook or creek.

Setting - the physical, chemical and biological environment (such as climate, geology, soil, and plants and animals living in or on the water) in which a resource is situated and which determine its characteristics and behaviour.

Source Water Protection Authority – A conservation authority or other person or body that is required to exercise and perform the powers and duties of a drinking water source protection authority under the Ontario Clean Water Act.

Specific Capacity – the productivity of a well in terms of discharge rate per unit of drawdown in the well.

Spring – a water body formed when the side of a hill, a valley bottom or other excavation intersects a flowing body of groundwater at or below the local water table, below which the subsurface material is saturated with water.

Stakeholders - people who have a share or an interest in water.

Storativity (or Storage Coefficient) – the volume of water that an aquifer releases from storage per unit surface area of aquifer per unit decline in the component of hydraulic head normal to that surface.

Stream - a general term for a body of flowing water; natural water course containing water at least part of the year. In hydrology, it is generally applied to the water flowing in a natural channel as distinct from a canal.

Streamflow - the water discharge that occurs in a natural channel. A more general term than runoff, streamflow may be applied to discharge whether or not it is affected by diversion or regulation.

Surface water - water that is on the Earth's surface, such as in a stream, river, lake, or reservoir.

Sustainability - development that meets the needs of the present, without compromising the ability of future generations to meet their own needs. There are three spheres of sustainability: the economy, society and the environment. They have a dynamic relationship, which means that any change to one affects the others. It is the reason why we cannot consider our economy or quality of life separately from the well-being of our natural environment.

Sustainable Yield – Means the maximum rate of taking from an aquifer that can be sustained without causing unacceptable impact on other users and natural system functions, and without causing unacceptable degradation of water quality in the aquifer.

Tool – a process, method or computer program / routine used in the implementation of an "approach" as defined for the purposes of this project. For the purposes of this study, a tool does not include a physical device or physical implement.

Transmissivity (T) – the rate at which groundwater is transmitted through a unit width of an aquifer under a unit hydraulic gradient. It is often expressed as the product of hydraulic conductivity and the full saturated thickness of the aquifer and has units of the form m^3/day/m.

Tributary - a smaller river or stream that flows into a larger river or stream. Usually, a number of smaller tributaries merge to form a river.

Water Balance – Means a quantification of water input and output and changes in storage of the various components of the hydrologic cycle

Water bottling facility - any facility that requires a permit for taking ground water for the purpose of producing bottled water.

Water Bottling Study Area and **WBSA** - each of the 7 areas that are being assessed as part of the Assessment of Water Resources to Support a Review of Ontario's Water Quantity Management Framework (2018).

Water Quantity Management Framework - policies, programs and science, information including data collection and assessment tools, used in the management of water use.

Water Resources - any groundwater and surface water source that supplies water to the natural environment and that are useful or potentially useful to study. In the context of the Assessment of Water Resources to Support a Review of Ontario's Water Quantity Management Framework (2018), the Great Lakes are not included in the Water Resources being addressed and the focus is on water resources quantity.

Water Security - the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability. (UN-Water, 2013)

Water table - the top of the water surface in the saturated part of an aquifer that is at atmospheric pressure, also referenced as an unconfined aquifer.

Watershed - land area where precipitation runs off into streams, rivers, lakes, and reservoirs. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge. Large drainage basins, like the area that drains into the Grand River, contain smaller drainage basins or **sub-watersheds**. See *Drainage basin*.

WWIS – Water Well Information System

WTRS – Water Taking Reporting System

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Water Bottling Study Areas Report - Summary of Findings, Information Gaps and Recommendations

1. INTRODUCTION

The Ontario Ministry of the Environment, Conservation and Parks (MECP, "the ministry") is completing a review of Ontario's Water Quantity Management Framework. As part of the review the ministry has requested an independent assessment of water quantity resources and management in seven (7) Water Bottling Study Areas (WBSA) to identify options for enhancement to the Water Quantity Management Framework. The seven (7) WBSAs identified for review are listed below. The location of each WBSA within the Province of Ontario is shown on Figure 1-1.

Permit to Take Water (PTTW) Number	Water Bottler	MECP Region	Municipality
8404-7YBLB2	Gott Enterprises Inc. Alnwick/Haldimand	Eastern	Alnwick/ Haldimand
7535-AQBNX8	Gott Enterprises Inc. Amaranth	West Central	Amaranth
8035-8U5P7F	Gott Enterprises Inc. Grey Highlands	Southwest	Grey Highlands
7541-72ZM8Z	Aquaterra Corp. Cataract Site	Central	Caledon
3122-9ZCQRS	Gold Mountain Springs Inc.	Central	Oro-Medonte
2305-6TDH43	Robins Holdings Inc.	Eastern	Alnwick/ Haldimand
0282-836LBB	Savarin Springs Inc.	Southwest	South Bruce

1.1 OBJECTIVE

The objective of this assessment is to review and summarize the existing available water quantity resource information for each WBSA, assess the potential impact(s) of the taking on the sustainability of the resource(s), identify information gaps that may potentially affect current and future water management decisions for each of the water bottler water takings, and identify options and make recommendations for enhancement to permit and resource management. The report findings will help inform policy, programs and decisions that will enhance water quantity management in Ontario.

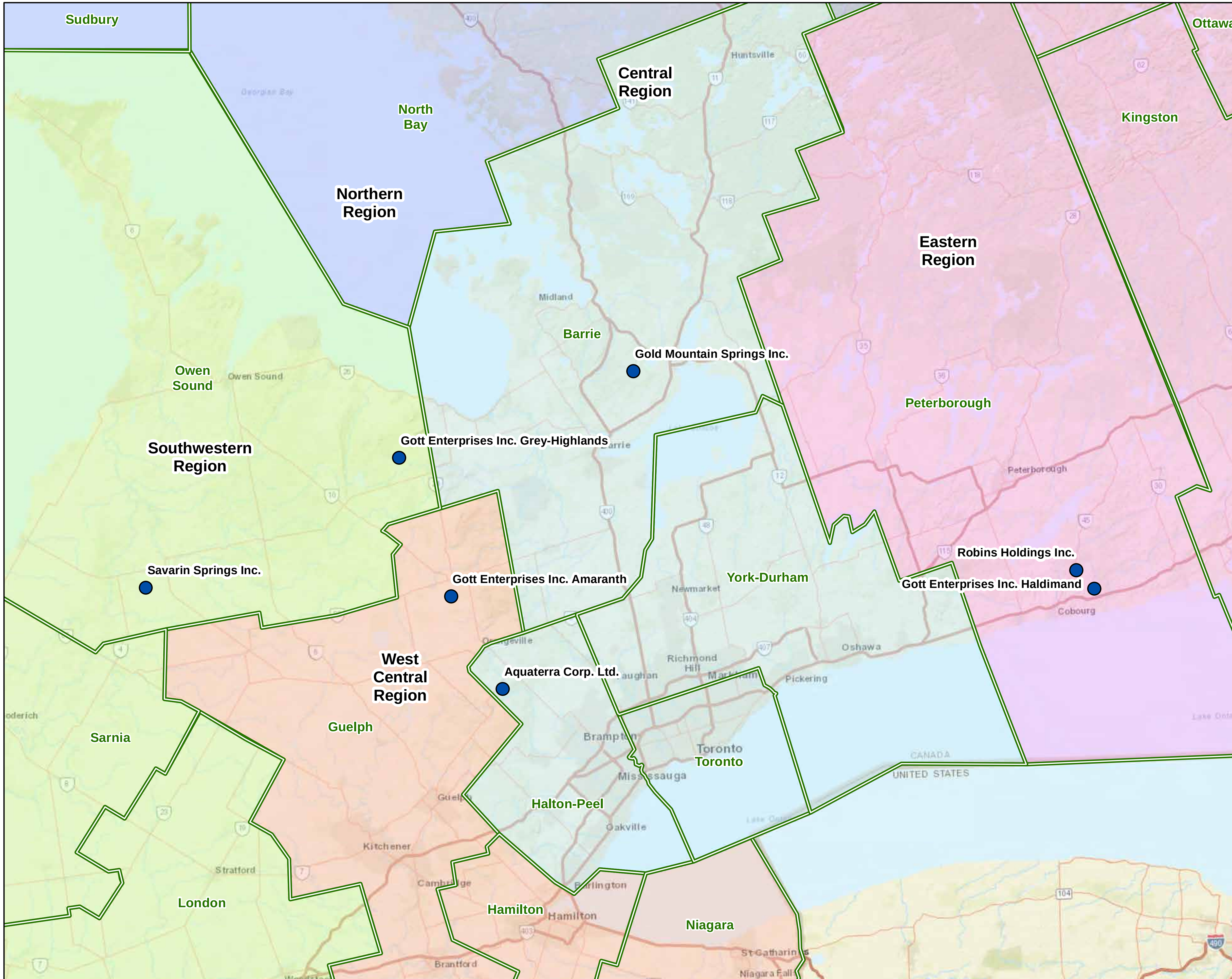
1.2 SCOPE OF WORK

As specified under Task 7 of the Request for Bid (RFB): #6792; For each of the WBSAs collect and review available water quantity information, summarize findings, report on the Sustainability of groundwater in the area, and identify what, if any, impact the water bottler is having on the Sustainability of groundwater, and where relevant connected surface water resources. If it is identified that there is insufficient knowledge (data) available to adequately assess Sustainability or to comment on the potential for impact from the water bottling activity to the groundwater, and where relevant connected surface water, resource(s), identify this in the report and make recommendations on how to address the gaps.

1.3 REPORT OUTLINE

The following outlines the major sections of this report:

Section 1: ***Introduction***
Section 2: ***Assessment Methodology and Approach***
Section 3: ***Gott Enterprises – Alnwick/Haldimand***
Section 4: ***Gott Enterprises – Amaranth***
Section 5: ***Gott Enterprises – Grey Highlands***
Section 6: ***Aquaterra Corp - Cataract Site***
Section 7: ***Gold Mountain Springs***
Section 8: ***Robins Holdings Inc.***
Section 9: ***Savarin Springs Inc.***
Section 10: ***Summary of Gaps and Recommendations***
Section 11: ***References***



LEGEND

- Water Bottling Study Area (WBSA)
- MECP Districts

MECP Regions

- Central Region
- Eastern Region
- Northern Region
- Southwestern Region
- West Central Region

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

0 10 20 40 Kilometers

CLIENT

The Ministry of the Environment, Conservation and Parks

PROJECT

Water Bottling Study Areas Report

TITLE

Water Bottling Study Area Locations

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PROJECT #	DATE		
180107-07	September 21, 2018		
DRAWN	CHECKED	FIG NO.	REV
GM	RH	1-1	0

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2. ASSESSMENT METHODOLOGY AND APPROACH

The assessment methodology and approach herein sets out to characterize the water taking and the regional groundwater and surface water setting for each WBSA. The review of water quantity information available for each WBSA considers the information requirements specified in **Part C - Technical Requirements (Hydrogeological Study)** as stated in the MECP's *"Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to Take Water Applications and Hydrogeological Study Requirements, April 2017."* Specific aspects of the assessment methodology and approach are summarized as follows.

Background / Description of Water Taking

- Site location/address and location of property boundaries for the 'Site'.
- Administrative Setting: Identification of applicable municipality, MECP District/Regional Office, and conservation authority (CA).
- A description of the various water taking sources including well construction/depth and methods used for the water taking.
- Permit to Take Water (PTTW) History: Timeline of development and approval of source(s) including a summary of previous PTTWs and increases/decreases to water taking amounts, changes in ownership, submission of key technical studies, past environmental review tribunals/issues, etc. Current PTTW renewal status.
- A summary of current water quantity management measures as conditions set out in the PTTW.

Primary Information Sources

- A list of key supporting documentation and technical reports provided by the water bottling proponent to MECP during the PTTW application/renewal process.
- A list of key source water protection documentation and other key information sources relevant to water management in the WBSA and obtained from MECP, Ontario Geological Survey (OGS), Ministry of Natural Resources and Forestry (MNRF), conservation authorities (CAs), municipalities, and other available internet-based sources.
- A list of datasets used in characterization of the hydrogeological /hydrological setting.
- Noted existing data/reports not available for BluMetric's review of the WBSA.

Characterization of the Hydrogeological Setting

- Characterization of the hydrogeological setting around the water bottler water taking source. Relevant study areas assessed, as assigned by BluMetric include:
  - Regional Study Area – A 30 x 30 km area centered over the water taking source was used for characterization of regional geology/physiography, regional hydrogeology and for identification of existing municipal water supply systems.
  - Local Study Area – Typically, a maximum 2 km radius around the water taking source (i.e. for a conservative zone of potential hydraulic influence) was used for characterization of

existing land use and planned land use (where zoning information was identified). A maximum 2 km radius around the water taking source was also used for characterization of local hydrogeological conditions (i.e. review of water well construction records). The area was extended to a 5 km radius to identify and characterize other 'active' PTTW that may be drawing from the same aquifer system.

- Assessment of MECP WQMF data and other publicly available datasets for each WBSA: Geographic boundaries for dataset review were assigned by BluMetric based on the nature of the dataset, the water taking resource and the potential zone of influence from the water taking. Dataset review distances from each WBSA water taking were:
  - Water Well Information System (WWIS) – minimum 500 m radius and up to 2000 m radius based on conservative zone of influence, size of WBSA property and density of available data. Water well records were also reviewed for other active PTTW up to 5 km radius and for municipal supply wells located up to 10 km radius.
  - Water Taking Reporting System (WTRS) – 5 km radius for active PPTW.
  - Provincial Groundwater Monitoring Network (PGMN) – A 10 km radius.
  - Water Survey of Canada (WSC) hydrometric monitoring stations (HYDAT) – 15 km radius (further if no stations within this distance).
  - Environment and Climate Change Canada (ECCC) Climate Stations – 15 km radius.
  - Ontario Low Water Response (OLWR) Program notifications and alerts – relevant watershed (i.e. conservation authority), subwatershed or municipality where available.
- Water Well Information System (WWIS) review to identify primary aquifers/resources being utilized by neighbouring water supplies and potentially affected by the water taking.
- Characterize hydrostratigraphic conditions for water taking source based on Permit Holder hydrogeologic assessment. Assess potential for groundwater-surface water interaction. Is the water bottling source the same source as neighbouring well water supplies? For artesian and spring sources, what are the potential impacts to the source/receiving surface water resources? Were environmental flow needs assessed as part of the permitting process?
- Review aquifer testing data/modelling results for the Site. Where aquifer testing data/analysis is absent, generate an opinion on whether further information is necessary.
- Identify any other information gaps in proponent technical studies, including adequate assessment of potential impacts to surface water and natural functions of the ecosystem
- Identify information gaps in MECP datasets and/or regional information and potentially affecting an opinion on water resource sustainability, and potential future impacts from the water taking.
- Identify municipal system well water supplies and associated well head protection areas (WHPAs) where present in the study area. Summarize pertinent hydrogeological information documented for the municipal groundwater system.
- What are the land uses and development growth trends near the Site?
- Summarize findings from assessments of watershed stress conditions from source water protection studies and Tiered water budgets where available.

Water Quantity Data Review

- WTRS data review – Summary/analysis of reported annual/daily water taking amounts relative to the permitted amounts for the existing water bottling PTTW. Identify and summarize WTRS data for neighbouring active PTTW and the status of these water taking amounts relative to the permitted amounts. General assessment of the relative contribution from water bottling water taking to the potential cumulative impacts from all active water takings within 5 km.
- PGMN data review and site specific groundwater level monitoring data review - Assess available PGMN well data for regional groundwater level trends using year over year and season to season monotonic trend analyses provided by MECP. Complete a visual analysis for short term trends in the PGMN data plots. Evaluate site-specific groundwater level monitoring data and trends reported by the Permit Holder, where available.
- Ontario Low Water Response (OLWR) Program data review - Report on available climate-based data and document any recent climate-related concerns specific to the watershed/subwatershed where the Site is located. Review the frequency of Low Water Response Program Notifications issued to the relevant CA/municipality as an indicator of potential stress trends (seasonal and long term) for surface water and possibly shallow groundwater. Review 'declared OLWR Alerts' information and other drought related water quantity information reported for the study area.
- Sites that are within/near Tier 1, Tier 2, and Tier 3 water budget study areas – Identify whether existing water resource stress assessments have been completed for the watershed/subwatershed where the Site is located. Is the potential for cumulative effects, under both current conditions and various climate change or drought scenarios adequately assessed based on existing information? What influence do the water budget findings have on water management decisions for the Site.

Impact Assessment

- Assess impact potential for existing and 'planned' future municipal groundwater uses. (Note: 'Planned' indicates assessment studies in support of the development have been started/completed):
  - Identify existing and/or 'planned' municipal groundwater uses within the area of influence. Does the water bottler water taking have a potential for unacceptable interference with expansion of existing municipal groundwater use and 'planned' new municipal groundwater use?
  - Assessment of Interference Potential - Assessment of interference potential for representative groundwater users within the area of influence based on existing hydrogeologic studies and aquifer testing programs.
  - Evaluation of whether existing PTTW measures/conditions are adequate to avoid unacceptable interference with existing users (i.e. will existing water users be able to maintain their established pattern of water use). If a potential for unacceptable interference is identified, are these impacts adequately quantified through existing assessments? Is additional quantitative prediction through numerical groundwater modelling (such as Modflow or FEFlow) required to fully understand the potential impacts from the water taking?
- Impact to Surface Water and Natural Functions of the Ecosystem -

- ➢ If surface water bodies have been identified within the predicted maximum area of influence of the groundwater taking, have potential impacts to surface water and their related natural functions of the ecosystem been previously identified by MECP and adequately considered by the proponent? Specific considerations include:
  - Evaluation of System Isolation - Are identified surface water features isolated from the aquifer from which water will be taken and in the context of the magnitude of the water taking?
  - Potential Impacts to Surface water - Prediction of how the proposed groundwater taking may change groundwater flux into the surface water features within the study area and the potential risks to natural functions of the ecosystem.
  - If risk(s) to the natural functions of the ecosystem are identified, has a hydro-ecological study been conducted?

Sustainability of Water Resources

- Summarize existing water resource stress concerns that have been identified/reported by MECP or CA and/or based on the characterization of the study area and Site.
- General evaluation of projected future land use growth pressures and the cumulative effects from additional water takings in the study area.
- If insufficient Science is available to address sustainability
  - ➢ What additional information or science is required for a more complete picture?
  - ➢ Indicate challenges in incorporating cumulative effects assessments into water management decisions for the study area.
- Are the water bottler taking and the resource secure and being managed sustainably?

Summary of Information Gaps and Recommended Actions

- For the Chapter, summarize the gaps identified in existing water quantity information for the water bottler Site and indicate recommended actions by the Permit Holder to address each gap.
- Summarize the gaps identified in existing water quantity information for all WBSAs and indicate recommended actions through the water quantity management framework to address each gap.
- Make recommendations with respect to the sustainability of the resource and permit. Are there changes needed to management of the permit to address these or not.

3. GOTT ENTERPRISES INC. – ALNWICK / HALDIMAND

3.1 BACKGROUND AND HISTORY

Gott Enterprises Inc. draws water from five (5) screened overburden wells located at Lot 22 to 25, Concession 2, Geographic Township of Haldimand, Alnwick/Haldimand, County of Northumberland, Ontario. The 88 acre (approximate) property as indicated in AECOM, February 2018, and herein referred to as the 'Site', is also the location of the Ice Water Springs water bottling plant (a subsidiary of Gott Enterprises Inc.). The Gott Enterprises Inc. wells are located approximately 3.3 km north of the community of Grafton. The Ste. Anne's Haldimand Hills Spa is located immediately north of the Site. The Site is located within the jurisdictions of the MECP Peterborough District Office - Eastern Region and the Lower Trent Conservation Authority (CA). The property boundaries and source well locations are indicated on Figure 3-1.

Based on the records provided by MECP the source has been permitted for bottling water since 1992. An approximate timeline of events relevant to the PTTW history of the Gott Enterprises Inc. Alnwick/ Haldimand site is provided in Table 3-1.

Table 3-1: Gott Enterprises Alnwick / Haldimand - PTTW History Summary

YEAR	EVENT
1990	Initial Application for Permit to Take Water filed by Carl Corcoran, dated June 6, 1990, for 2 wells (1 not yet constructed) at a maximum rate of 250000 L/day (800 L/min) for a maximum of 24 hours per day and for 365 days in one year. Ministry correspondence suggests a hydrogeology report was requested at this time. No hydrogeology report is available in the supplied ministry files.
1992	**PTTW No. 92-P-3105** is issued on November 13, 1992 (for a period of 20 years) to Carl Corcoran allowing water to be taken from 4 wells at a maximum rate of 43200 L/day (30 L/min) for Well #1, 14400 L/day (10 L/min) for Well #2, 93600 L/day (65 L/min) for Well #3, and 122400 L/day (85 L/min) for Well #4. The PTTW identifies as a condition: 'Our main concern is that the taking of water under the authority of this permit does not interfere seriously with other water supplies which were in use prior to the date of this permit. If the taking of water should result in serious interference, the permittee will be required to restore the water supplies of those affected in a manner acceptable to the Ministry of Environment or to reduce the rate and amount of taking until any serious interference is eliminated.'
1997	A Hydrogeological Evaluation is prepared for CJC Bottling by Oakridge Environmental Ltd. (ORE, March 1997) in support of an Application for Expansion of the Permit to Take Water. **PTTW No. 97-P-4030** is issued on May 2, 1997 to Corsource Water Corporation and expires May 1, 2017. The PTTW allows water to be taken from 5 wells at a maximum rate of 171,100 L/day (118.8 L/min) for Well #1, 75,900 L/day (52.7 L/min) for Well #3, 154,600 L/day (107.4 L/min) for Well #4, 76,800 L/day (53.3 L/min) for Well #5 and 267,600 L/day (185.8 L/min) for Well #6, for a maximum of 24 hours per day and for 365 days in one year. Special Conditions require surface water monitoring, groundwater monitoring, contingency response planning and annual reporting as specified in Sections 4.1 to 4.9 of the ORE, March 1997 report (See Section 3.3.4.3).

YEAR	EVENT
2002	A Director's Order (Dated January 22, 2002) is issued after a ministry site inspection identifies noncompliance with PTTW No. 97-P-4030. Issues identified include failures to notify the Director of changes in ownership and changes made to the water taking (Well #1 replaced by Well #1B and increased water taking from Well #6). In response to the Order Well #1B was taken off line and water taking rates were adjusted to meet the existing permit limits. Reportedly, an Administrative Amendment request for the existing permit was submitted by CJC Bottling, but was not processed by the ministry due to the absence of technical information in support of the proposed replacement of Well #1 with Well #1B.
2003	An Administrative Amendment request for replacement of Well #1 with Well #1B is submitted by Gartner Lee Limited (GLL, Letter dated July 14, 2003), on behalf of Corsource Water Corporation. GLL expresses the opinion that an administrative amendment is adequate because Well #1B is completed to the same depth and within the same aquifer as Well #1, is located 7.5 m from Well #1 and will be drawing water at the same rate as Well #1.
2004	A Notice of Denial (dated February 16, 2004) is issued by the Director for the Administrative Amendment of PTTW No. 97-P-4030 on the basis of Ontario Regulation 434/04 having imposed a one-year moratorium on the issuance of new water-taking permits for water bottlers. The Notice of Denial indicates that the permit amendment includes a change to the location of the water taking and is thereby subject to Section 5 of Ontario Regulation 434/04. On March 4, 2004 Corsource Water Corporation appeals the Director's decision to the Environmental Review Tribunal. Following further review, the Director determines the water taking from Well #1B does not meet the prohibition found in Section 5 of Ontario Regulation 434/04. On June 11, 2004, the Director issues an amended **PTTW No. 2422-5ZSL6Y** capturing all water taking limits and conditions within the previous permit plus standard conditions now captured in all new permits. Well #1 is replaced with Well #1B with the same permitted water taking limit.
2006	In late 2006, 2113423 Ontario Inc. purchases the property.
2007	**PTTW No. 3461-6Y8K4N** is issued on April 19, 2007 to 2113423 Ontario Inc. and expires May 1, 2017. The PTTW allows water to be taken from 5 wells. The water taking limits are consistent with the permit issued in 2004. Wells are in limited operation throughout 2007.
2008	A new water bottling facility is constructed (Source: https://iceriversprings.com/history/). Bottling operations resume to full operation in April 2008.

YEAR	EVENT
2009	Property is transferred from 2113423 Ontario Inc. to Gott Enterprises Inc. under a corporate restructuring (i.e. same ownership). **PTTW No. 8404-7YBLB2** issued on December 3, 2009 to Gott Enterprises Inc. and expires May 1, 2017. The PTTW allows water to be taken from 5 wells. The water taking limits are consistent with the permit issued in 2007. The PTTW conditions/requirements include: • Maintain a record of dates and times of water taking, the rates of pumping, and an estimated calculation of the total amounts of water pumped per day for each day that water is taken under authorization of the Permit. The Permit Holder shall keep all required records up to date and available at or near the site of the taking and shall produce the records immediately for inspection by a Provincial Officer upon his or her request; • Monitor the surface water as recommended by Oakridge Environmental Ltd. in the Conclusions and Recommendations of their report on the 'Hydrogeological Evaluation Supporting an Application for Expansion of a Permit to Take Water for CJC Bottling', and shall consist of permanent stream-gauging stations to be established along the on-site tributary of Barnhamhouse Creek and at surface water locations along Cranberry Lake Road, or in accordance with modifications to the monitoring program recommended from time to time and accepted by the Director; • Monitor the ground water as recommended by Oakridge Environmental Ltd. in the Conclusions and Recommendations of their report on the 'Hydrogeological Evaluation Supporting an Application for Expansion of a Permit to Take Water for CJC Bottling' and in a letter dated April 16, 1997, from Oakridge Environmental Ltd., and shall consist of the installation of monitoring wells or observation wells around the periphery of the well field, possible monitoring of the Brinkman water supply well, and regular measurement and recording of the water quality testing and of water levels in the production wells, piezometers, and selected neighbouring wells, or in accordance with modifications to the monitoring program recommended from time to time and accepted by the Director; • Hire a consultant who must have a certificate of registration as a Practicing Professional Engineer or Practicing Professional Geoscientist to review the data quarterly from the monitoring of surface water and groundwater resources to assess any impacts or potential impacts and prepare an annual summary and conclusions of findings and distribute the summary and conclusions to interested parties. • Keep a copy of the consultant's annual summary and conclusions and if requested, provide a copy of the annual summary and conclusions to the ministry. • Establish contingency plans as recommended by Oakridge Environmental Ltd. in the conclusions and recommendations of their report on the 'Hydrogeological Evaluation Supporting an Application for Expansion of a Permit to Take Water for CJC Bottling'.
2016	Gott Enterprises Inc. applies for a Permit renewal (September 2016, EBR Registry Number: 012-8535) more than 90 days before the expiry date (May 1, 2017). Per Section 34.1(6) of the Ontario Water Resources Act, the permit is deemed to continue to be in force until the date a decision is made on the permit renewal application.
2018	In Support of the Permit renewal, the report, "Ste. Anne's Well Field Hydrogeological Study — Renewal of Permit to Take Water No. 8404-7YBLB2", is submitted to comply with the MECP's Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to Take Water Applications and Hydrogeological Study Requirements, April 2017.

Gott Enterprises Inc. draws water from a well field consisting of 5 drilled wells completed as screened overburden wells. Well construction information along with current permitted water taking amounts (PTTW No. 8404-7YBLB2) is provided in Table 3-2. The location of each well is shown on Figure 3-1.

Table 3-2: Gott Enterprises Alnwick / Haldimand - Summary of Water Taking Sources

Source Name	Type	Well Record ID	Depth	Completion Unit	Screened Interval	PTTW No. 8404-7YBLB2	
						Max. Taken Per Minute (L)	Max. Taken Per Day (L)
Well #1(b)	Drilled Well	217379	14.0 m bgs (46 ft)	Sand/Gravel	11.6 to 13.4 m (38 to 44 ft)	119	171100
Well #3	Drilled Well	105520	20.7 m bgs (68 ft)	Clay/Sand/Gravel	15.7 to 16.9 m (51.5 to 55.5 ft)	53	75900
Well #4	Drilled Well	105521	11.6 m bgs (38 ft)	Gravel/Sand/Clay	9.2 to 10.5 m (30.3 to 34.3 ft)	107	154600
Well #5	Drilled Well	151254	15.2 m bgs (50 ft)	Coarse Sand	11.9 to 14.3 m (39 to 47 ft)	53	76800
Well #6	Drilled Well	151253	11.7 m bgs (58 ft)	Coarse Sand	14.3 to 16.8 m (47 to 55 ft)	186	267600

As indicated in Table 3-2 the production well depths range from 11.6 m to 20.7 m below ground surface (bgs). The formation screened in the wells consists of sand and/or gravel ranging from 9.2 m to 16.9 m in depth and is referred to as the St. Anne's Aquifer. Water from each well is pumped via an underground pipeline to the Ice River Springs bottling plant located approximately 400 m east of the well field. An additional well at the Site, Well #7, was included in the ORE, 1997 aquifer testing program. Well #7 is also a screened overburden well but the screened interval depth (37.8 m to 40.8 m) is more than twice the depth of all other wells at the Site. File information indicates this well currently serves as the water supply for the Ste. Anne's Haldimand Hills Spa. No explanation is provided in the reviewed ministry files why this well is not included in the PTTW for the Site. Based on the revised property boundaries indicated in the AECOM, February 2018 report, Well #7 may now be located off property.

3.2 PRIMARY INFORMATION SOURCES

The following records were on file with the MECP documenting the PTTW history. PTTW No. 92-P-3105, Carl Corcoran, November 13, 1992.

- PTTW No. 97- P-4030, Corsource Water Corporation, May 2, 1997.
- PTTW No. 3461-6Y8K4N, 2113423 Ontario Inc., April 19, 2007.
- PTTW No. 8404-7YBLB2, Gott Enterprises Inc. December 3, 2009.
- PTTW Renewal Application Ministry Reference No. 1073-ADJJ2Y, Gott Enterprises Inc., September 2016.

The following key technical documents provided to the ministry by the proponent were identified and reviewed herein.

- Hydrogeologic Evaluation Supporting an Application for Expansion of a Permit to Take Water. Prepared By: Oakridge Environmental Ltd. For: CJC Bottling, Grafton, Ontario, March, 1997 (ORE, March 1997).
- GLL 21-080-Grafton PTTW 97-P-4030 Administrative Amendment. Gartner Lee Limited July 14, 2003 (GLL, Letter dated July 14, 2003).

- 2007/2008 Annual Monitoring Report, Permit to Take Water No. 3461-6Y8K4N, prepared for 2113423 Ontario Inc. Prepared by Gartner Lee Limited and dated April, 2008.
- 2008/2009 Annual Monitoring Report - Permit to Take Water No. 3461-6Y8K4N. Prepared by AECOM Canada Limited and dated April 29, 2009.
- 2012 Annual Monitoring Report - Permit to Take Water No. 8404-7YBLB2. Prepared by AECOM Canada Limited and dated April 2013.
- 2013 Annual Monitoring Report - Permit to Take Water No. 8404-7YBLB2. Prepared by AECOM Canada Limited and dated April 2014.
- 2015 Annual Monitoring Report - Permit to Take Water No. 8404-7YBLB2. Prepared by AECOM Canada Limited and dated April 2016.
- 2016 Annual Monitoring Report - Permit to Take Water No. 8404-7YBLB2. Prepared by AECOM Canada Limited and dated April 2017.
- Ste. Anne's Well Field Hydrogeological Study — Renewal of Permit to Take Water No. 8404-7YBLB2. AECOM Canada Ltd. February 13, 2018. (AECOM, February 2018).
- Various ministry review comments, where available.

Other information sources used in this assessment included:

- Approved Trent Assessment Report, Trent Source Protection Areas. Trent Conservation Coalition Source Protection Region (TCCSPR) Approved October 1, 2014, Effective January 1, 2015, Updated February 15, 2018. (TCCSPR, 2018).
- Memo Report to Grafton Water Committee. GeoKamp Limited - 6 Oct 2017. (GeoKamp, October 2017).
- Hamlet of Grafton Production Well Monitoring Program, 2016 Annual Report. GeoKamp Limited. January 16, 2017 (GeoKamp, January 2017).
- NEW Official Plan for the Township of Alnwick/Haldimand, dated December 22, 2015.
- Tier 1 Water Budget and Water Quantity Stress Assessment: Trent River Basin, Lake Ontario and Bay of Quinte tributaries. XCG Consultants Ltd. March 2010 (XCG, March 2010).
- Lower Trent Conservation Map Viewer at: http://www.ltc.on.ca/maps/regulations/
- Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228. Chapman, L.J. and Putnam, D.F. 2007. (Chapman and Putnam, 2007).
- Surficial Geology of Ontario; MNDM File - MRD128-REV. Ontario Geological Survey, 2010. (OGS, 2010).
- Bedrock Geology of Ontario; MNDM File - MRD126-REV1. Ontario Geological Survey, 2011. (OGS, 2011).
- MECP Water Well Information System (WWIS). Available at: https://www.ontario.ca/environment-and-energy/map-well-records.
- MECP on-line Provincial Groundwater Monitoring Network database. Available at https://www.ontario.ca/environment-and-energy/map-provincial-groundwater-monitoring-network.

- Groundwater Levels in Ontario: A Trends Analysis using the Provincial Groundwater Monitoring Network. MECP, Southwest Region. 2018 (MECP, 2018).
- MECP on-line Permit to Take Water database. Available at: https://www.ontario.ca/environment-and-energy/map-permits-take-water.
- MECP Water Taking Reporting System (WTRS) database (Confidential – Used with Permission from MECP).
- Ontario Low Water Response Program (OLWR) notifications and alert levels for Lower Trent Region Conservation Authority (2000 to 2018 data from MNRF).

The following information and data were noted as being missing from the technical documents listed above:

- Borehole instrumentation logs could not be located for the borehole wells (BH1, BH2-A, BH2-B, BH3-A, BH3-B, BH4, and BH5-A) and observation well SAP01-00. These well locations are utilized in the Gott Enterprises Inc. PTTW groundwater level monitoring program. The specific assessment describing the installation of these monitoring wells may be the Hydro Conseil Inc. (August 2000) report, which was not available in the reviewed ministry files. Location of the borehole instrumentation logs is recommended so that the information is available to the ministry for consideration when reviewing the water level data assessment provided for these wells.

3.3 CHARACTERIZATION OF STUDY AREA

This section provides a general characterization of the Site and regional study area. Figure 3-2 presents the assessed regional study area which extends in an approximate 30 km by 30 km area centered on the Gott Enterprises Inc. Alnwick/Haldimand water taking location (Figure 3-1). The regional study area boundaries were set based on an area that captures the municipal groundwater supply system for Grafton to the south and the Oak Ridges Moraine to the north. The majority of the study area falls within the Lower Trent Source Protection Area (SPA), though the boundary with the Ganaraska Region SPA and Ganaraska CA is situated approximately 3 km to the west of the Gott Enterprises Inc. well field.

3.3.1 Land Use Setting

The Gott Enterprises Inc. site is located in the Township of Alnwick/Haldimand which had a 2011 census population of 6,617 (Statistics Canada, 2011 Census). The proposed population growth allocation for the Township for the years 2011 to 2034 is 887 persons (Official Plan of the Township of Alnwick/Haldimand, Dated December 22, 2015). The residential growth policies of the Official Plan focus on growth in Hamlet areas such as the community of Grafton located 4 km south of the Site.

Land use within an approximate 3 km radius of the Gott Enterprises Inc. Site as obtained from the Official Plan of the Township of Alnwick/Haldimand is indicated on Figure 3-3. Neighbouring land use is primarily designated as either agricultural or rural. Land cover on undeveloped lands is generally woodland or wetland. A Provincially Significant Wetland (PSW) is located immediately south of the Gott Enterprises Inc. property and extends on to the Site. As indicated on Figure 3-3, the Grafton municipal well head area is located on the south side of the PSW and immediately north of Highway 401.

Various areas designated as Environmental Protection (EP) transect the Site and generally include the floodplain areas of the Barnhamhouse Creek tributaries and the PSW. As indicated on Figure 3-3, all Gott Enterprises Inc. production wells are located within the EP mapped area. The Official Plan indicates that lands designated as 'Environmental Protection' are primarily intended for preservation and conservation of the natural land and/or environment, and should be managed in such a fashion as to complement adjacent land uses and protect such uses from physical hazards. Uses such as agriculture, nursery and market gardening and forestry may be permitted. However, buildings and structures other than those required for conservation purposes shall generally be prohibited. The Gott Enterprises Inc. Site is located within the area designated in the Township of Alnwick/Haldimand Official Plan as 'Resort'. Section 5.5.9.2 of the Official Plan pertains specifically to the Site and is described as: Haldimand Hills Spa, Lots 22 to 25, Concession II, Former Township of Haldimand. Within the area 'Permitted Uses' include:

1. Tourist accommodation and uses accessory and subordinate to this accommodation.
2. A water bottling plant.
3. Uses in accordance with the policies of Sections 5.10 (Rural designation) and 5.11 (Recreational/Conservation designation).

3.3.2 Physiographic Setting

The physiography of the regional study area as described by Chapman and Putnam, 2007 is provided in Figure 3-4. The regional study area between Highway 401 at the south and the Oak Ridges Moraine 8 km to the north is within the Dummer Moraines Physiographic Region which is described as terminal moraine formed at the edge of a glacier and is frequented by the presence of drumlins. The area south of Highway 401 is located within the Iroquois Plain Physiographic Region which as shown on Figure 3-4 is characterized primarily by sand plains. The entire area within 2 km of the Gott Enterprises Inc. well field is mapped as drumlinized till plain with approximately 10 drumlins indicated within all or part of this 2 km area. The drumlins are often bounded by areas of coarse textured glaciolacustrine deposits. The Oak Ridges moraine is situated approximately 6 km north of the Gott Enterprises Inc. well field and is renowned as an important groundwater recharge area in Southern Ontario. The location of several small eskers is also indicated on Figure 3-4, between 2 and 4 km south and southeast of the Gott Enterprises Inc. well field.

The topography and hydrology of the regional study area is provided in Figure 3-5. The rolling topography is due to the numerous drumlin features in the area. The northeast corner of the Site is associated with a drumlin feature and is a local topographic high at approximately 250 m above sea level (asl). The tributaries of Barnhamhouse Creek are situated at a local topographic low on the Site, at less than 200 m asl. On a regional scale, topography slopes towards the south toward Lake Ontario. As indicated on Figure 3-5, the regional drainage flow directions are mostly pointed towards the south. Both Barnhamhouse (often spelled Barnum House) Creek and the Shelter Valley Creek to the east (Figure 3-1), are cold water creeks (TCCSPR, 2018) that drain into Lake Ontario 6 km south of the Gott Enterprises Inc. well field.

The Gott Enterprises Inc. Site is located within the jurisdictional area of the Lower Trent CA. The Site itself is mapped within the Barnhamhouse (often spelled Barnum House) Creek subwatershed which empties into Lake Ontario. The northern limit of this subwatershed is located between 8 and 10 km north of the Site. The tributaries of Barnhamhouse Creek drain to the southwest across the Site and connect with the main creek located approximately 700 m west of the Site. Cranberry Lake, located immediately north of the Grafton well field, drains to the north through the PSW and then towards the west and ultimately drains into Barnhamhouse Creek. Shelter Valley Creek is located approximately 3 km east of the Site within a separate subwatershed (Shelter Valley Creek subwatershed) that also drains into Lake Ontario.

Only one Water Survey of Canada (WSC) stream gauge (HYDAT) station was identified in proximity of the Barnhamhouse Creek subwatershed. Station 02HD010 (Figure 3-2) is located 4.7 km southeast of the well field and on Shelter Valley Creek. The next closest stream gauge station is at Baltimore, 8.4 km west of the well field on Baltimore Creek and within the boundaries of the Ganaraska Region CA.

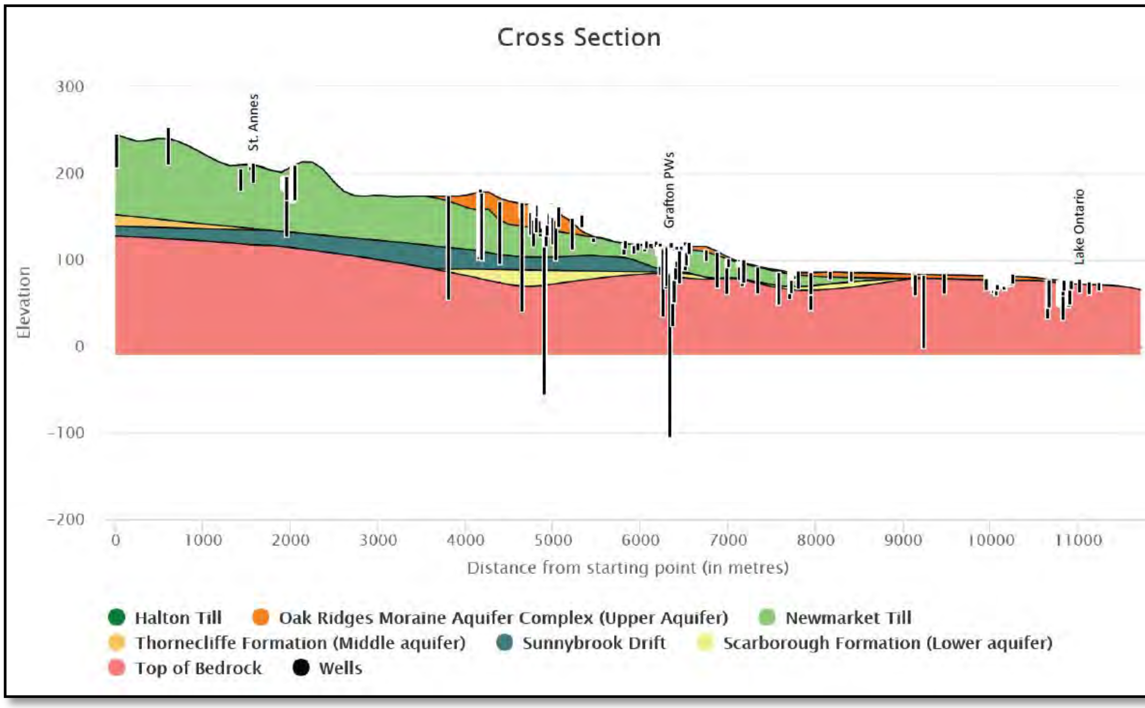
Up to 14 different surface water monitoring stations have been established for the Site since 1997. Based on the 2016 annual monitoring report (AECOM, April 2017), water levels are measured at staff gauges at five stations located on the tributaries of Barnhamhouse Creek (SW8, SW10, SW12, SW14 and SWW3) and at one station (SW13) on a tributary of Shelter Valley Creek. The surface water monitoring station locations are indicated on Figure 3-1.

3.3.3 Geologic Setting

Information on surficial geology and bedrock geology was obtained from published maps and supplemented using information from the 'Approved Trent Assessment Report' (TCCSPR, 2018). Surficial geology for the study area is mapped in Figure 3-6 and bedrock geology is mapped in Figure 3-7.

Surficial geology in the regional study area is dominated by a mixture of modern alluvial deposits and a stone-poor, carbonate-derived silty to sandy till that is often referred to as the 'Newmarket Till' which is also mapped within the greater Toronto area. The occurrence of this Till unit near ground surface is generally associated with the higher elevation 'drumlinized' areas. The drumlinized areas are then bounded by areas of alluvial deposits consisting of clay, silt, sand, gravel, and may contain organic remains. As indicated in Section 3.3.4.2, water well records indicate that overburden thickness over bedrock is in excess of 100 m for the Site and for much of the study area. The GeoKamp, October 2017 memorandum report provides a cross-section (based on water well records) that extends from Lake Ontario at the south through the Grafton municipal well site and then through the Ste. Anne's well field (Gott Enterprises Inc. Site) at the north. This cross-section is re-produced as follows:

Text Figure 3-1: Gott Enterprises Inc. Alnwick / Haldimand - North-South Cross Section



Source: GeoKamp, October 2017

The GeoKamp cross-section indicates the 'Newmarket Till' provides the aquifer utilized by the Gott Enterprises Inc. (Ste. Anne's) wells and ranges in thickness from 75 to 100 m in the vicinity of the Site. The Newmarket Till is underlain by a thin band of 'Sunnybrook Drift' that overlies the bedrock at the Site and pinches out towards the south near the Grafton production wells. The Sunnybrook Drift is characterized as diamicton which contains a wide range of particle sizes ranging from clay to boulders. GeoKamp, October 2017 indicates that the Grafton production wells are 'about 78 m deep' and utilize the Scarborough Formation (Lower aquifer), a basal sand and gravel aquifer located beneath the Newmarket Till and Sunnybrook Drift (where present) and above the bedrock contact.

As indicated in Figure 3-7, the bedrock geology for the entire study area has been mapped as limestone, dolostone, shale, arkose, sandstone of the Ottawa Group / Simcoe Group; Shadow Lake Formation, now considered as Upper Ordovician in age. With the significant depth to bedrock in most areas, the local limestone bedrock is generally not utilized as an aggregate resource.

3.3.4 Hydrogeologic Setting

3.3.4.1 Regional Hydrogeology

The regional hydrogeology and aquifers are described in the 'Approved Trent Assessment Report' (TCCSPR, 2018) which draws information from the 2004 Regional Groundwater Study completed by Morrison Environmental Ltd. Information on the overburden aquifers present in the study area and obtained from both the TCCSPR, 2018 report and from the Oakridge Environmental Ltd. March, 1997 report (ORE, March 1997) is summarized as follows.

The overburden is the primary source of water of interest in the study area given the great thickness of overburden (often >100 m) and the general absence of bedrock water supply wells. The Quaternary overburden provides the greatest volume of groundwater storage (compared to the Paleozoic bedrock aquifers) in the watershed, since overburden deposits are typically able to store more water than fractured bedrock. Recharge areas include the crests of moraines, drumlins, and other glacial deposits in the area. In these highland areas, the groundwater surface is deeper than in the lowland areas, where the groundwater levels are close to the ground surface or discharging as indicated by the many cold water streams in the area. At lower elevations, water flows across the Newmarket Till aquitard and discharges where this layer meets the ground surface, usually in low-lying areas. Many of the local streams have their headwaters located on the slope of the Oak Ridges Moraine and are fed by groundwater discharging to the surface. The deeper confined aquifer, located below the Newmarket Till and utilized by the Grafton municipal wells (referred to by GeoKamp, 2017 as the Scarborough Formation aquifer), exists where basal sand and gravel material and/or bedrock fragments occur above the limestone bedrock surface.

As per ORE, March 1997, the Newmarket Till has low permeability and is capable of yielding only small amounts of water. However, the top few metres of the Till is often weathered and contains fissures and fractures that have improved the permeability. Also in areas where the Till has been reworked by actions of surface water or wind, much of the fine material has been washed away leaving a more sandy and permeable layer. Most shallow dug or bored wells in the study area tap these localized shallow Till aquifers. At greater depths, individual till layers are often separated by thin layers/lenses of coarse granular material which is the remains of outwash streams, braided streams and deltaic fans. If the coarse-grained layers are extensive in area, they can be present as significant local aquifers like the Ste. Anne's aquifer complex used by the Site well field. Further description of the Ste. Anne's aquifer, as described by ORE, March 1997, is provided in section 3.3.4.2.

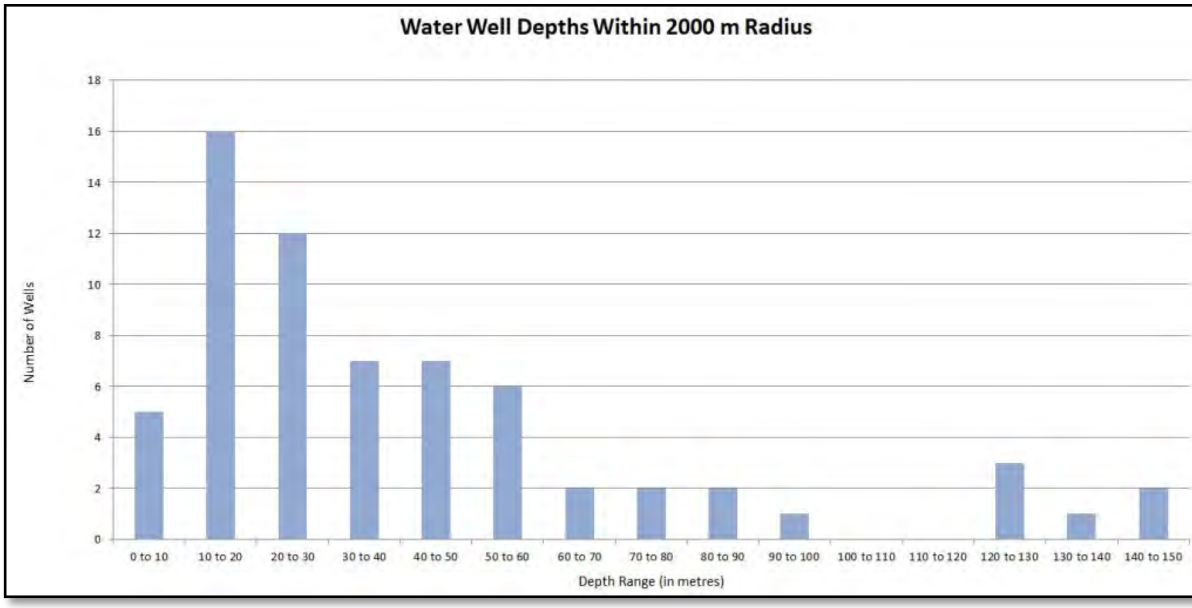
In the areas of Paleozoic bedrock, groundwater flow in the bedrock is south toward Lake Ontario (this pattern is consistent with the slope of the limestone bedrock surface). In the Quaternary overburden aquifer, groundwater primarily flows south toward Lake Ontario, following the slope of the underlying Paleozoic bedrock. There is an exception just above the bedrock surface in the area just south of Rice Lake where there is an east-west trending groundwater divide, which is caused by a sediment wedge of subglacial origin. The sediment wedge is aligned with the axis of the Oak Ridges Moraine, with which it is believed to be associated. This divide causes the upper aquifer flow patterns to travel north and east into Rice Lake, then towards the Trent River. South of the divide the water continues to flow south towards Lake Ontario.

The water quality well head protection areas (WHPA) for the Grafton municipal well field (2 km south of the Gott Enterprises Inc. well field), Baltimore (9.5 km west of the Gott Enterprises Inc. well field) and Colborne communal well systems (12.3 km east of the Gott Enterprises Inc. well field) are reproduced in Figure 3-2. The WHPA mapping outlines time-of-travel (TOT) zones for groundwater captured by the municipal wells as indicators of the relative level of risk for water quality impact from land development activities within each zone. The mapped WHPA areas are a useful indicator of regional groundwater flow conditions for the overburden aquifer utilized by the municipal wells. The Grafton WHPA extends to the north of the municipal well field indicating that regional groundwater flow is towards the south.

3.3.4.2 Local Hydrogeology

The Site is located in a rural setting and all properties are serviced by individual private well water supplies consisting of a mix of standard drilled wells and large diameter 'shallow' wells that were dug or bored. The MECP WWIS database was reviewed for well locations situated within 2000 m of the Gott Enterprises Inc. well field. A 2000 m search radius was considered appropriate based on the observed density for water well records in this search area and in consideration of the large (~200 hectare) size of the Site. Water well record locations as referenced in the WWIS are plotted on Figure 3-1. A total of 66 well construction records for supply wells were identified (i.e. test holes and well abandonment records were omitted) with reported well construction depths ranging from 4.6 to 145.7 m. All but one well is reported as completed in overburden. The single bedrock well (Well ID 4506402) is located 500 m west of the Site, appears to be an exploratory hole constructed for Consumers Gas, and reports that bedrock (Grey rock) was encountered at a depth of 111.6 m (366 ft). The frequency distribution in water well depths within the 2000 meter search radius is shown in the chart below, indicating 53 of the 66 wells are reported as less than 60 meters in depth and the well depths most frequently reported are between 10 and 30 m.

Text Figure 3-2: Gott Enterprises Inc. Alnwick / Haldimand - Local Water Wells Depth Frequency



Overburden materials are most commonly reported in the water well records as a mixture of sand gravel, silt and clay indicative of a glacial till along with apparent interlayers of sand and/or gravel at varying depths. Installed water well screens are reported as ranging from 1 m (3 feet) to 5.5 m (18 feet) in length and using a wide range of screen slot sizes. Reported well pumping rates range from 9 L/minute (2 gallons per minute) to > 150 L/minute (>40 gallons per minute). Reported static water level depths are highly variable and range from 0 to 76.2 m below ground surface.

Ste. Anne's Aquifer Complex

The ORE, March 1997 report provides a hydrogeological assessment of the Ste. Anne's aquifer complex. The Ste. Anne's aquifer complex is characterized within the local aquifer system as follows:

- ***The Shallow Overburden Aquifer** – Granular interbeds and lenses typically overlying clay and fine silt layers within the Newmarket Till. Tapped by shallow dug or bored wells on and near the Site.*
- ***The Intermediate Overburden Aquifers** – The Ste. Anne's Aquifer complex utilized by the Gott Enterprises Inc. production wells at between 9 and 20 m depth at the well field. The aquifer consists of a laterally extensive layer of coarse granular material present within the Newmarket Till. Interpreted as also being the headwater for the creek and wetland at the south end of the Site.*
- ***Basal Overburden Aquifer** – Bedrock/overburden interface aquifer that is utilized by the Grafton municipal wells (Note: Identified previously herein as the Scarborough Formation).*
- ***Limestone Bedrock Aquifer** – Water quality in the deep bedrock aquifer is poor and few, if any, wells in the area use the bedrock aquifer.*

From an analysis of local water well records, the Ste. Anne's aquifer complex was interpreted by ORE, March 1997 to be relatively continuous in the vicinity of the Site, likely extending at least 2 km to the north and northwest of the Gott Enterprises Inc. well field, and potentially extending 5-6 km further northward into the southeastern extension of the Oak Ridges Moraine. With the drop in surface elevation the Ste. Anne's aquifer outcrops to the east in the Shelter Valley Creek watershed, and to the south in the Barnhamhouse Creek watershed. The southern outcrop location is about 800 m to 1,000 m south and down slope of the well field. ORE, March 1997 reported a substantial increase in the flow of the stream at this location and a drop in the stream temperature was detected in the discharge zone. AECOM, February 2018 indicates that the coarse sands and gravels of the Ste. Anne's Aquifer complex is estimated to be 3 to 5 m thick in the vicinity of the well field and appears to thin to the south. AECOM, February 2018 also indicates the Ste. Anne's Aquifer is underlain by Till comprised of clay, sand and stones, possibly correlated with Halton Till (about 20 m to 40 m thick). The hydraulic properties of the Ste. Anne's Aquifer based on aquifer testing of the Gott Enterprises Inc. production wells is discussed in Section 3.3.4.3.

3.3.4.3 Site Hydrogeology

Only one technical report (ORE, March 1997) was identified in MECP files providing aquifer testing program results for the Gott Enterprises Inc. Site wells. Assessments of local hydrology and hydrogeology are provided in ORE, March 1997 and in the AECON, February 2018 Permit Renewal report. Also, annual Site monitoring data for groundwater and surface water has been reported on a near annual basis since 2000. An additional technical document/memorandum was located on-line and provides a peer review prepared in 2017 for the Grafton Water Committee in regards to the Gott Enterprises Inc.'s proposed PTTW renewal for the Ste. Anne's well field. A summary of the key information obtained from the documentation review is provided as follows.

<u>Hydrogeological Report in Support of an Application for Expansion of an Existing Permit to Take Water (ORE, March 1997)</u>

The property boundaries defined at the time of this study cover a 200 hectare (approximate) area that includes the location of the Ste. Anne's Spa. The ORE, March 1997 report provides a detailed hydrogeological assessment of the Ste. Anne's aquifer complex (see Section 3.3.4.2) and the safe yields obtainable for the Site production wells based on aquifer testing. A water quality assessment was also completed for the Ste. Anne's aquifer and Barnhamhouse Creek tributaries and is summarized below in regards to indications of groundwater-surface water interaction on the Site.

A series of short-term pumping tests of individual wells (Wells #3, 5, 6 and 7) and a 72-hour simultaneous pumping test (Well #1 and Wells #3 through 7) were conducted in October 1996 at the Gott Enterprises Inc. Site (owned at the time by CJC Bottling Inc.). The tests and report were prepared in support of a proposed increase in the water taking amounts permitted in PTTW 92-P-3105.

In their characterization of the well field, Oakridge Environmental Limited (ORE) noted the following:

- *Well #1 was a drilled well completed to a depth of approximately 15.87 m; the depth had to be measured on site as no well records were identified for Well #1. The well was located at the northern edge of the discharge zone of a natural spring that flows into the wetland south of the well field. Well #1, thought to have been in use since the 1930s, reportedly had no screen, and sand intrusion into the casing was suspected. The well was normally a flowing artesian well, and the overflow from the casing continually discharged into an adjacent swamp. The well had approximately 14.2 m of available drawdown, not including the excess head associated with the artesian discharge;*
- *Well #2 was a relatively deep well compared to the other production wells, but had recently been abandoned due to its low yield and water quality (iron) concerns. The well tapped an aquifer at a depth of approximately 68.9 m. An outer casing that terminated in an aquifer at a depth of approximately 24.4 m continually discharged a minor amount of water to the adjacent wetland. The casing was also to be abandoned in the near future;*
- *Test wells were drilled in 1994 (Wells #5 and 6) and in mid-1996 (Well #7), in anticipation of the replacement of Well #2;*
- *Wells #5 and 6 are flowing artesian wells extending into the Ste. Anne's aquifer complex. Their overflow continually discharges to the adjacent swamp;*
- *Well #7 (now the Ste. Anne's Spa supply well), located approximately 400 m northeast of the main part of the well field, was believed to extend into an aquifer that is either a continuation of, or slightly above, the Ste. Anne's Aquifer.*

Short-term pumping tests (< 1 day) were conducted for Wells #3, 5 and 7 between October 4 and 15, 1996, to assist in evaluating the likely maximum individual well pumping rates, the timing of drawdown stabilization, and whether significant interference effects would be expected within the well field during the 72-hour, simultaneous pumping test.

The 72-hour pumping test was conducted from October 25 to 28, 1996, during which Well #1 and Wells #3 through 7 were pumped, although Well #7 was taken off-line during the test due to water supply concerns at the nearby inn. The total average pumping rate (excluding water production from Well 7 and water usage at the inn) was 605 L/min (871.2 m^3/day). Drawdown was observed to stabilize within about 300 minutes from the start of pumping (within 20 minutes after pumping began at the last well).

At the end of the 72-hour test, all pumped wells were shut off simultaneously, and the piezometric surface within the well field itself recovered within an average of approximately 57 minutes, after a total of approximately 2,481 m^3 of water had been pumped over 2.8 days. Based on the rapid recovery of the piezometric levels in the wells, it was deduced that the drawdown cone likely did not expand to a very large area, which also supported the expectation that operation of the well field at the proposed pumping rates would not likely create substantial interference with wells on neighbouring properties.

Water levels in 16 domestic wells were monitored for the entire duration of the test; 15 of the wells were shallow dug wells, and 1 was a drilled well. The distances of these wells from the well field are not indicated in the report. However, no impact was noted in any of the off-site wells, and no complaints were received during the test. Based on well records for the shallow wells and observations reported from local residents, it was speculated that the deposits above the Ste. Anne's aquifer are a series of deposits consisting of till sheets, fine grained silts and clays with local seams of sands and gravels. The shallow water table appeared to be controlled by the lower permeable layers.

When the wells in the well field were being pumped simultaneously, it was expected that the additional drawdown from mutual interference would cause the specific capacity of each individual well to be lower compared to what was observed during the individual short-term pumping tests. However, for Wells #3, 5 and 6, the wells experienced an increase in specific capacity compared to the short-term pumping tests. Insufficient information was available to explain the observations.

Based on the results of the 72-hour simultaneous pumping test, the theoretical safe yield of the different wells (#1, #3 to 7) ranged from 75.9 m^3/day at Well #3, to 367.6 m^3/day at Well #6, with a cumulative total of 844.2 m^3/day for the six wells. The radius of influence of the well field was estimated to be approximately 1 km based on MODFLOW computer simulations, as well as from analytical estimates of recharge to the aquifer from direct infiltration and flow-through.

ORE concluded that the proposed cumulative water taking of 844.2 m^3/day from the well field would not likely result in significant impacts on private wells in the vicinity of the Site. Also, as the Ste. Anne's aquifer is separated from deeper aquifers (e.g. the basal aquifer utilized by the Grafton municipal wells) by a thick sequence of low permeability materials (within the lower Newmarket Till unit and Sunnybrook Drift unit), no direct impacts on water levels in the deep aquifers were expected. ORE added that the proposed water taking was expected to have a relatively minor impact on baseflow to the local on-site stream and wetland, though they did not elaborate on this in any detail.

As the well field was capable of supporting a combined pumping rate of 844.2 m^3/day, ORE recommended that the following maximum pumping rates be permitted in a PTTW:

- Well #1: 118.8 L/min
- Well #2: should be removed from the permit
- Well #3: 52.7 L/min
- Well #4: 107.4 L/min
- Well #5: 53.3 L/min
- Well #6: 185.8 L/min
- Well #7: 68.2 L/min (Note: This well was repurposed to supply the Ste. Anne's Spa and has not been included in any PTTW for the Site)

The water quality assessment completed by ORE indicated that water samples collected downstream of the well field appeared to have similar chemistry to the average water chemistry of the Ste. Anne's aquifer. The key indicators of similar water quality were sodium and chloride.

Based on the results of its assessment ORE produced a detailed list of recommendations in the report (Sections 4.1 to 4.9) that were later used as part of the Conditions for PTTW 97-P-4030 and remain as Conditions for all subsequent PTTWs. In brief, the ORE, March 1997 recommendations are summarized as follows:

- Section 4.1 – The pumping rates provided above are recommended.
- Section 4.2 – The Brinkman water supply is identified as a sensitive receptor due to the critical need for maintaining a water supply for the poultry operation. Monitoring provisions and/or guarantees of replacement of the existing system with a suitable source is recommended.
- Section 4.3 – Installation of monitoring wells around the periphery of the well field is recommended. Specifications for monitoring well construction and the need for multilevel installations (levels in both the Ste. Anne's aquifer and the shallow flow zone), especially in the wetland, is indicated.
- Section 4.4 – Specifications for the installation of 2 on-Site stream gauge stations on the tributary of Barnhamhouse Creek are provided. Also, obtaining temporary surface water monitoring points off –Site and along Cranberry Road is recommended.
- Section 4.5 – Implementation of an on-going monitoring program is recommended for the life of the permit. Monitoring should include water levels at the production wells, piezometers and selected neighbouring wells, flow rates at stream gauge stations and determination of general water chemistry. The frequency of monitoring is not specified but indicates it could be monthly or quarterly and adjusted based on the findings.
- Section 4.6 – Recommends on-going data analysis by a qualified hydrogeologist involving a quarterly review of the data to allow for contingency measures to be implemented if needed and an annual summary report with conclusions and recommendations based on the monitoring.
- Section 4.7 – Recommends implementation of a 'contingency and mitigation measures plan' to address any well interference issue(s) should they arise.
- Section 4.8 – Recommends implementation of a 'groundwater management and well head protection strategy' to protect the resource from over-exploitation and water quality deterioration.
- Section 4.9 – Recommends the 'sealing and raising of well casings' to restrict artesian flow from wells #1, 5, and 6. Proper re-sealing around Well #2 (previously abandoned) and inspection of grout seals arounds all wells with re-sealing as needed to 6 m depth, is recommended.

April 16, 1997 Report follow-up Letter Re: Permit to Take Water, Water Bottling (Referenced in Condition 4.6 of PTTW No. 8404-7YBLB2)

This letter prepared by ORE is in response to a ministry request for further information on a 'proposed monitoring program' under the Permit. The letter provides a specific list of 7 domestic water supply wells for periodic water quality testing (Note: this testing was ended in 2003 with ministry approval). The letter indicates water level monitoring will be quarterly for the first two years and then re-evaluated. The letter also provides an update on the schedule for the completion of well casing extensions (to stop artesian flow) and the re-sealing of specific well casings with identified issues.

GLL 21-080-Grafton PTTW 97-P-4030 Administrative Amendment. (GLL, Letter dated July 14, 2003)

In a July 14, 2003 memo to the Ministry of the Environment (now the MECP), Gartner Lee Limited, on behalf of Corsource Water Corporation, requested an administrative amendment to PTTW 97-P-4030. Corsource Water Corporation wished to discontinue the use of well 1A (also called Well 1), which was about 70 years old at the time and in poor condition, and replace it with the nearby Well 1B (constructed in 2000 at a location 7.5 m away from Well 1A).

In the memo, it was noted that both Wells 1A and 1B draw water from the same aquifer, and that Well 1B screens the Ste. Anne's Aquifer at a depth of 9.1 m. The Ste. Anne's Aquifer is confined by a layer of till between 0.3 and 8.2 m, which protects the surface water from drawdown caused by pumping at the well field.

Referencing the two most recent annual monitoring reports, Gartner Lee Limited noted that the surficial aquifer and surface water systems were not affected by the water taking, nor were there off-site effects to either water levels or water quality in neighbouring wells.

Report to Grafton Water Committee. Geo Kamp Limited - 6 Oct 2017. (GeoKamp, October 2017)

The above-titled document is a technical memorandum prepared by Geo Kamp Limited ("Geo Kamp") to the Township of Alnwick/Haldimand, summarizing their review of Gott Enterprises Inc.'s proposed PTTW renewal for the Ste. Anne's well field. The document notes that the two Grafton municipal wells operate at rates up to 870 L/minute, for a maximum allowable taking of 1,252,800 L/day, and are not to operate simultaneously. Both Grafton municipal wells are overburden wells, with an approximate depth of 78 m, completed within the basal till aquifer above the bedrock contact in the Scarborough Formation regional aquifer and referred to as the Grafton Aquifer.

Geo Kamp noted that, due to the decline in elevation from the Gott Enterprises Inc. Site to Lake Ontario, the overburden aquifers at the Gott Enterprises Inc. site are truncated to the south. They concluded that the Gott Enterprises Inc. site and the Grafton municipal wells are drawing water from different water bearing formations that do not appear to be directly connected. A cross-section prepared by GeoKamp that extends from Lake Ontario at the south through the Grafton municipal well site and then through the Ste. Anne's well field (Gott Enterprises Inc. Site) at the north is provided in section 3.3.3.

Geo Kamp further noted that there is an extensive water level monitoring program that is required as part of the Grafton municipal wells PTTW, that has been ongoing since 1996 and which includes quarterly water level monitoring of 18 groundwater locations and 3 surface water monitoring locations. The water level data indicates no significant groundwater level decline immediately beneath Cranberry Lake (located between the Grafton municipal wells and the Gott Enterprises Inc. site) as a result of water withdrawals from the Grafton municipal wells. Geo Kamp inferred that the same applied to the water taking from the Gott Enterprises Inc. site.

Geo Kamp identified no reason to object to the renewal of Gott Enterprises Inc.'s PTTW, provided they are in compliance with their PTTW monitoring conditions.

<u>Standalone Annual Monitoring Reports, Most Recent for 2016 (AECOM, April 2017) and Ste. Anne's Well Field Hydrogeological Study — Renewal of Permit to Take Water No. 8404-7YBLB2. (AECOM, February 2018)</u>

Annual monitoring reports have been prepared for the Site by AECOM (since the 2009 reporting year) providing the following information:

- a water budget for the reporting year,
- a summary of production well extraction rates and reported volumes for the reporting year,
- a summary of surface water monitoring (staff gauge) water levels for the reporting year and an evaluation of data over all years since 2007,
- a summary of groundwater level measurements collected monthly for the production wells, borehole monitors (BH2A, BH2B, BH3A, and BH3B) and observation wells (SAP01-00 and Well 8) and an evaluation of groundwater level data over all years (since 2005 for production wells and borehole monitors and since 2000 for observation wells),
- a summary of water quality analyses for samples collected from neighbouring residential wells (Well 7/1057 Massey Road and Well 65/317 Academy Road),
- a summary of complaints received/addressed, if any, and
- recommended changes to the monitoring program.

The AECOM, April 2017 report for the 2016 reporting year is the most recent standalone annual monitoring report. The AECOM, February 2018 report was submitted to the ministry in support of the renewal application for the PTTW as per the ministry's April 2017 'Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to take Water Applications and Hydrogeological Study Requirements' and provides an 'Impact Assessment' using Site monitoring data (including the 2017 monitoring year). The report includes a property boundary for the Site (an approximate 88 acre area) that was not depicted in previous annual monitoring reports. Information presented in the AECOM, February 2018 report is summarized as follows.

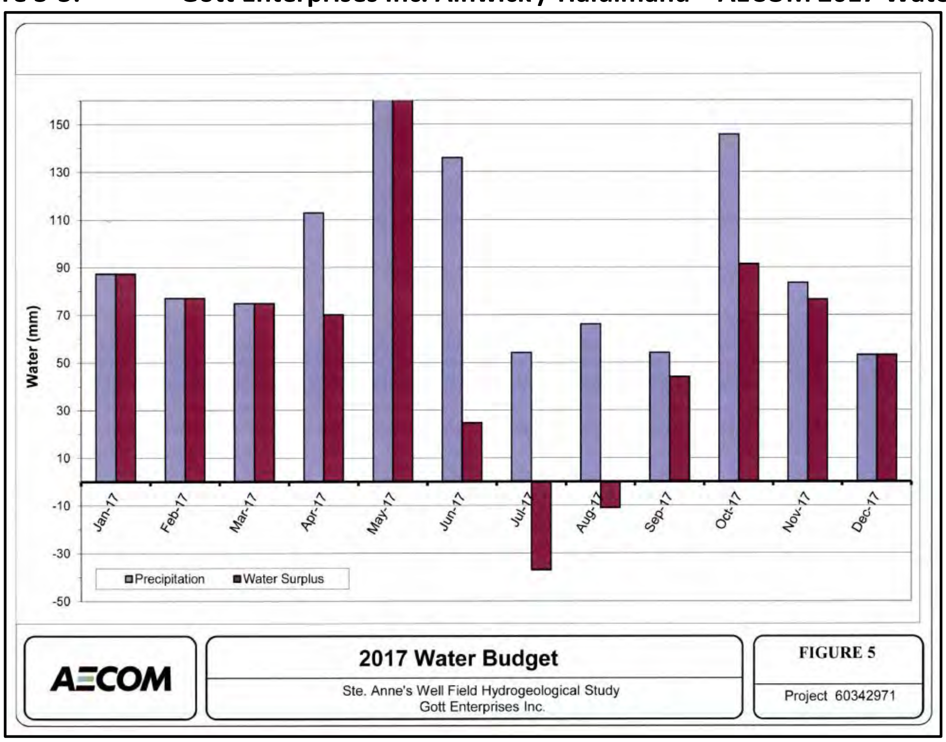
Predictive Modelling Update

The radius of influence for the water taking was reassessed by AECOM by scaling the 3D USGS MODFLOW simulation used by ORE, March 1997 to the current PTTW maximum combined taking rate of 518 L/minute. The updated computer simulation of the radius of influence predicts a drawdown of about 2.1 m within the well field, 1.8 m at a distance of 100 m from the production wells and 0.7 m at a distance of 500 m from the production wells. AECOM indicates based on the long-term water level monitoring on the site, actual water level effects are limited to about 100 m from the production wells (based on data for observation wells SAP01-00 and Well 8) and within the Site boundary.

2017 Water Budget

The 2017 water budget uses the method described by Thornthwaite and Mather (1957), assumes a water holding capacity of 100 mm for soils (rather than obtaining local water holding capacity values available from Environment Canada), and uses 'monthly' mean temperature, total precipitation, total actual evapotranspiration to determine a water surplus. The report indicates that the water budget serves to assess the influence of climate on water levels during the monitoring period. The 2017 Water Budget as depicted in Figure 5 of the report is provided as follows.

Text Figure 3-3: Gott Enterprises Inc. Alnwick / Haldimand – AECOM 2017 Water Budget



Source: Figure 5 of AECOM, February 2018

2017 Extraction Rates

The AECOM, February 2018 report provides a table summarizing the reported annual taking from each of the 5 production wells on a monthly basis in 2017 and indicates the total annual taking was 45% of the Permit limit of 746,000 litres per day. The table summary of reported Maximum Taken per Day (L) in 2017 indicates that at times of peak production each well was taking between 90% and 100% of the respective daily water taking limit. Peak 2017 production occurred in May for Well #1B, Well #3, Well #5 and Well #6 and in January for Well #4. AECOM notes that the reported taking for May 2017 was nearly double the reported volume for December 2017.

Groundwater Monitoring

Groundwater monitoring included water levels for the production wells, borehole monitors, and observation wells. A list of water level monitoring stations is provided in Table 7 of the AECOM, February 2018 report and this is reproduced below in Table 3-3.

Table 3-3: Gott Enterprises Alnwick / Haldimand – Water Level Monitoring Stations

Well Name	Location	Completed Well Depth (m below ground surface)	Screened Aquifer
Production Wells			
Production Well		15.9	Ste. Anne's
Production Well		14.0	Ste. Anne's
Production Well 3		20.7	Ste. Anne's
Production Well 4		11.6	Ste. Anne's
Production Well 5		15.2	Ste. Anne's
Production Well 6		17.7	Ste. Anne's
Borehole Monitors			
BH1*	North of PW1	6.1	Shallow
BH2-A	Near PW4	4.57	Shallow
BH2-B	Near PW4	10.2	Ste. Anne's
BH3-A	Near PW6	4.55	Shallow
BH3-B	Near PW6	10.6	Aquitard unit/Ste. Anne's
BH4*	North of well field	6.1	Shallow
BH5-A*	North of well field	6.1	Shallow
Observation Wells			
Well 7*	(CJC office, N of well field)	41.5	Ste. Anne's
Well 8	(CJC south of PW6)	23.2	Ste. Anne's
SAP01-00	Near PW1		

*Access denied or not available for water level monitoring

Source: Table 7 of AECOM, February 2018 (compiled from Permit to Take Water No. 97-P-4030 Technical Reporting by Hydro Conseil Inc., August 2000, and Water Well Records in Hydrogeological Evaluation Supporting an Application for an Expansion of a Permit to Take Water by Oakridge Environmental Ltd., March 1997).

The locations of the water level monitoring stations are shown on Figure 2 of AECOM, February 2018 and are provided on Figure 3-1 herein. The construction logs for the borehole monitors and the referenced August 2000 technical report by Hydro Conseil Inc. could not be found in the supplied ministry files. A construction log for observation well SAP01-00 was also not identified.

The AECOM, February 2018 report indicates that access for monitoring of a number of off-Site wells was denied as of August 2008, including Well 7 (Note: still accessible for water sampling), SAPW9-00, BH1, BH4, BH5A, 252 Academy Road, 317 Academy Road, 384 Academy Road, 795 Massey Road, 864 Massey Road and 1057 Massey Road. In 2010, access was also denied for 154 Academy Road. Consequently, no off-Site wells are currently monitored for water levels and 'Observation Well' water level monitoring has been limited to on-Site wells SAP01-00 and Well 8, since 2010. The annual off-Site residential well sampling program is currently limited to Well 7 (1057 Massey Road) and Well 65 (317 Academy Road) and these wells were sampled in March, June and September 2017.

In the Impact Assessment evaluation of Site observation well groundwater level data, the AECOM, February 2018 report indicates that water levels generally follow seasonal trends in 'water availability'. In its review of long term data (2000 to 2017) as provided in Figure 15 of the report, AECOM makes note that no long-term water level declining trend is apparent at SAP01-00 and Well 8 and both wells actually show slight increasing trends. AECOM indicates that the monitoring results indicate no observable effect from operation of the production wells on surrounding wells with water level effects limited to about 100 m from the production wells.

In the Impact Assessment evaluation of on-Site borehole monitor groundwater level data as provided in Figure 11 (2017 data) and Figure 14 (2005 to 2017 data) of the AECOM, February 2018 report, AECOM indicates that the wells installed in the Ste. Anne's Aquifer (e.g. BH3B) respond to pumping at adjacent production wells while wells installed in the shallow aquifer (e.g. BH3A) do not, and maintain stable water levels following seasonal trends. AECOM's general conclusion is that the shallow aquifer does not respond to pumping in the Ste. Anne's Aquifer.

In its review of the 2017 groundwater quality data collected for Well 7 (1057 Massey Road) and Well 65 (317 Academy Road), no sampling results exceeded the aesthetic or health-related Ontario Drinking Water Standards (ODWS). Similarly, water samples collected concurrently for the 5 productions wells produced results meeting all aesthetic or health-related ODWS. AECOM notes that the residential sampling program has been conducted for over 15 years with no water quality effects from the water taking apparent and recommends the residential water sampling program be removed from the Permit.
The report indicates that Gott Enterprises Inc. and/or the ministry did not receive any complaints regarding effects on neighbouring wells in 2017 and have not received any complaints since Gott took ownership in 2008. Also, there are no known complaints received by the previous owners of the Site that were attributed to impacts from the well field.

Surface Water Monitoring

The report indicates that water level data was collected in 2017 for staff gauges at SW8, SW10, SW12, SWW3 and SW14. Data is collected monthly using manual measurement methods. Reportedly, no continuous monitoring data has been collected for the creek due to its shallow depth rendering it difficult to instrument with a data logger system. The seasonal variability in surface water levels for 2017 as provided in Figure 7 of the AECOM, February 2018 report was observed to range between about 0.11 m (SW10, SW12, and SW14) to 0.15 m (SW8). The report indicates the lowest overall water levels are in September and the highest water levels are in January and are within typical expected seasonal variation which is highly dependent on climate conditions. The pattern of water fluctuations at SWW3, located 300 m from the well field, were found to be similar to the most distant monitoring point S13 (2 km from wells). The AECOM review of 2007 to 2017 data as provided in Figure 8 and Figure 9 of the AECOM, February 2018 report, indicates similar seasonal fluctuations in water levels from year to year and concludes fluctuations are in response to climactic conditions, not water taking activities and hydraulic isolation exists between the surface water within the tributaries of Barnhamhouse Creek (and associated wetlands) and the Ste. Anne's Aquifer.

Characterization of Hydrogeological Setting

AECOM, February 2018 provides a characterization of the hydrogeological setting using findings from previous studies and an assessment of water well records. AECOM identifies four aquifer systems within the southern portion of Haldimand Township as previously described in the ORE, March 1997 report. The historical pumping tests and predictive modelling results for the Site were reviewed by AECOM and were concluded to be valid and the requested permitted rates and volume for the PTTW renewal remain unchanged since 1997.

Three active PTTW users were identified by AECOM as located within 5 km of the Ste. Anne's well field (Grafton Municipal wells, Enbridge Pipelines short-term construction dewatering, Shelter Valley golf course irrigation from a surface water source). AECOM indicates the Enbridge Pipelines permit was issued for short term water takings associated with construction dewatering activities and expires on December 31, 2018. AECOM also indicates that the Shelter Valley permit is for water taking from a surface water source (irrigation pond) and therefore is taking water from a shallow aquifer and surface runoff that are not connected to the Ste. Anne's aquifer. Since water level impacts from the Gott Enterprises Inc. water taking are confined to within the Gott property boundaries, no impacts to these water takings and no cumulative impacts were expected. Regarding the Grafton municipal wells, AECOM indicates these wells are completed within the deeper confined 'Grafton Aquifer complex' -which does not appear to be impacted by the Gott water taking from the Ste. Anne's Aquifer.

The AECOM, February 2018 report included a review of water well records for a 2 km radius of the well field. The review identified 63 overburden wells, 7 bedrock wells and 5 records without stratigraphy data. A door-to-door well survey was completed for private well owners within 500 m of the production wells to document conditions relating to well construction. Of the 16 properties contacted, only 3 properties, other than the proponent property, participated in the well survey.

Notification and Consultation

Notification of the Permit renewal application was made to area residents, the Township, the CA and the source water protection agency. As of the date of the AECOM report, Indigenous communities were notified and limited consultation had been completed. AECOM indicates the ministry requested a pause on any further engagement with Indigenous communities. The pause was to allow the ministry time to meet with the communities to discuss the new guidance.

Recommended Monitoring Program

Based on its review of the long term monitoring data, AECOM, February 2018 recommended modifications to the PTTW monitoring conditions with the off-Site well sampling program removed from the conditions. AECOM's recommended surface water and groundwater monitoring program is summarized in Table 11 of the February 2018 report and reproduced below in Table 3-4.

Table 3-4: Gott Enterprises Alnwick / Haldimand - AECOM Proposed Monitoring Locations

	Location	Task	Frequency
Surface Water	Tributaries of Barnhamhouse Creek (SW8, SW10, SW12, SW14, SWW3)	Surface water level measurements	Monthly
	Tributary of Shelter Valley Creek (SW13)		
Groundwater	Production Wells (Well 1A, 1B, 3, 4, 5, 6, 8)	Groundwater level measurements	Monthly
	Monitors (BH2A, BH2B, BH3A, BH3B)		
	Observation Well (SAP01-00)		

Source: Table 11 of AECOM, February 2018

3.4 Data Review and State of Groundwater Resources

The following section provides a review of the Ontario Water Quantity Management Framework data that is considered relevant to the Gott Enterprises Inc. Alnwick/Haldimand Site and presently available to MECP for consideration in making water management decisions.

3.4.1 Water Taking Reporting System

The Water Taking Reporting System (WTRS) is the ministry's repository for water taking data for active Permits to Take Water (PTTW). As a requirement of each PTTW the water taking data must be reported on an annual basis and daily water taking data must be entered into the system. The WTRS is not publicly available, but is available for use by ministry staff when assessing the status of a PTTW or addressing potential issues associated with a PTTW. The WTRS data was provided by the ministry for use in the WBSA assessment to be inclusive of all information available to MECP for making water management decisions.

Data on the volume of water taken per year and the number of water taking days per year for the Gott Enterprises Inc. well site was obtained from the MECP WTRS, for review. Table 3-5 below includes annual water taking data for the period from 2009 to 2017.

Table 3-5: Gott Enterprises Alnwick / Haldimand - Reported Water Takings

PTTW No.	Year	Daily Amount Permitted by the PTTW (L)	Annual Amount (i.e. for 365 Days) Permitted by the PTTW (Million L)	Reported Annual Taking (Million L)	Reported Annual Taking (% of permitted amount)
3461-6Y8K4N	2009			2.6947	
8404-7YBLB2	2009			31.6382	
Total	2009	746,000	272.29	34.3329	13%
8404-7YBLB2	2010	746,000	272.29	44.4858	16%
8404-7YBLB2	2011	746,000	272.29	62.5810	23%
8404-7YBLB2	2012	746,000	272.29	85.3183	31%
8404-7YBLB2	2013	746,000	272.29	96.5473	35%
8404-7YBLB2	2014	746,000	272.29	97.1224	36%
8404-7YBLB2	2015	746,000	272.29	109.0198	40%
8404-7YBLB2	2016	746,000	272.29	113,5865	42%
8404-7YBLB2	2017	746,000	272.29	122.8384	45%

As indicated in Table 3-5, the annual water taking amount has steadily increased from year to year with the 2017 annual taking reaching 45% of the permit limit.

The assessed study area for review of other active PTTWs was set at a 5 km radius of the Gott Enterprises Inc. well field (Figure 3-2). The 5 km radius was considered appropriate for review based on the low density of active PTTW in the area and as a conservative distance for any potential contribution from the Site on the cumulative impacts from multiple water takings. A summary of the 2016 and 2017 WTRS data for these permits is provided in Table 3-6.

Table 3-6: Gott Enterprises Alnwick / Haldimand - Neighbouring PTTWs

Permit	Issue Date	End Date	Source	Dist. from Gott Ent. Well Field (Km)	PTTW Limits			2016 WTRS Data		2017 WTRS Data	
					Max. taken per day (Million L)	Taking Days per Year	Annual Taking (Million L)	Reported Annual Taking (Million L)	Reported Annual Taking (% of PTTW Limit)	Reported Annual Taking (Million L)	Reported Annual Taking (% of PTTW Limit)
5086-9BPM4A	Sep. 26, 2013	Sep. 30, 2023	Wells (PW1 and PW2)	2.0	1.2528	365	457.272	73.346	16.0%	75.137	16.4%
6813-7F8RYP	Jul 29, 2008	Mar. 19, 2018	Pond	3.8	0.6308	214	134.985	55.94	41.4%	23.951	17.7%

The Grafton municipal well field (PTTW No. 5086-9BPM4A) is located 2.0 km to the south of the Site near Highway 401. The Corporation of the Township of Haldimand is permitted to take water from two wells (PW1 and PW2) at rates up to 870 litres per minute for a maximum combined daily taking of 1,252,800 litres per day. As per the 'Production Well Monitoring Program, 2016 Annual Report', the two wells are not to operate simultaneously with the second well serving as a backup well (GeoKamp, January 2017). The permit expires on September 30, 2023. The Grafton municipal well(s) reported annual water taking for 2017 (75.137 million L) is approximately 61 % of the volume taken by Gott Enterprises Inc. for 2017 (122.8384 million L). As indicated in Section 3.3.4.3, a peer review completed by Geo Kamp Ltd. in 2017 for the Grafton Water Committee, identified no reason to object to the renewal of Gott Enterprises Inc.'s PTTW based on a different aquifer being utilized and provided they are in compliance with their PTTW monitoring conditions.

PTTW No. 6813-7F8RYP is for Shelter Valley Park & Golf Inc. located 3.8 km to the east of the Gott Enterprises Inc. well field and permits the taking of 630,773 litres per day (214 days/year) from a pond for irrigation of the golf course. This permit was up for renewal in 2018 and, reportedly, PTTW No. 7208-AWCRCD was issued on March 19, 2018 and allows 899,903 L/day (150 days/year). Based on this surface water taking being 3.8 km from the Gott Enterprises Inc. well field and within a different subwatershed, a potential for interference between water takings is not identified.

3.4.2 Provincial Groundwater Monitoring Network

The Provincial Groundwater Monitoring Network (PGMN) is a partnership program with all 36 CAs and 10 municipalities (in areas not covered by a conservation authority) to collect and manage ambient (baseline) groundwater level and quality information from key aquifers located across Ontario. During the spring and summer of 1999, low water conditions in many parts of southern Ontario prompted the formation of an inter-ministerial task force to assess drought conditions, determine trigger levels and develop a response strategy. The PGMN was approved in 2000 and there are currently more than 450 monitoring wells in the network.

The PGMN datasets report on ambient (baseline) groundwater level and chemistry conditions. The PGMN well locations are typically sited to be away from areas where there is a large density of permitted water takings. Consequently, the PGMN wells are typically far too distant from any permitted water taking to be used as an indicator of potential well interference impacts.

Water level data collected for the PGMN wells is of potential value in assessing regional groundwater level trends as an indicator of stress within the watershed/subwatershed. Data has been collected for the PGMN well network since 2001 though some wells were installed more recent than this. Also the data for some wells is not current to 2018. The Provincial Groundwater Monitoring Network database is made available by MECP on-line.

As a recent internal project the MECP has applied the Mann-Kendall (MK) and Seasonal Kendall (SK) tests to analyze the PGMN water level data for monotonic trends (i.e. consistently increases or decreases through time). The statistical analyses were performed using robust and defensible methodologies to look for longer-term trends in groundwater levels. An overall objective is to determine if there is enough data to support the presence of a widespread decrease in groundwater availability.

Shorter trends within the PGMN data record (eg. lasting for a few years) were not considered and the causes of any trends that were identified were not investigated. Both the data plots and preliminary findings for PGMN well locations nearest a WBSA were shared by the ministry and are presented and relied on herein. The data plots indicate data available for the well at the time of the assessment. Further, the MECP has indicated that the methodologies used require that certain values be dropped from the data set if the month/year in question does not have sufficient number of data points. The release of a final report that details the methodology and results from the PGMN data trends analysis is forthcoming from the ministry (MECP, 2018).

Four PGMN wells are located within 10 kilometers of the Gott Enterprises Inc. Site (Figure 3-2). Three wells (412-1, 411-2, and 411-3) are indicated at one location 4.9 km to the north of the well field. The fourth location, 393-1 is situated 5.8 km to the west of the well field. The PGMN well information is summarized below in Table 3-5.

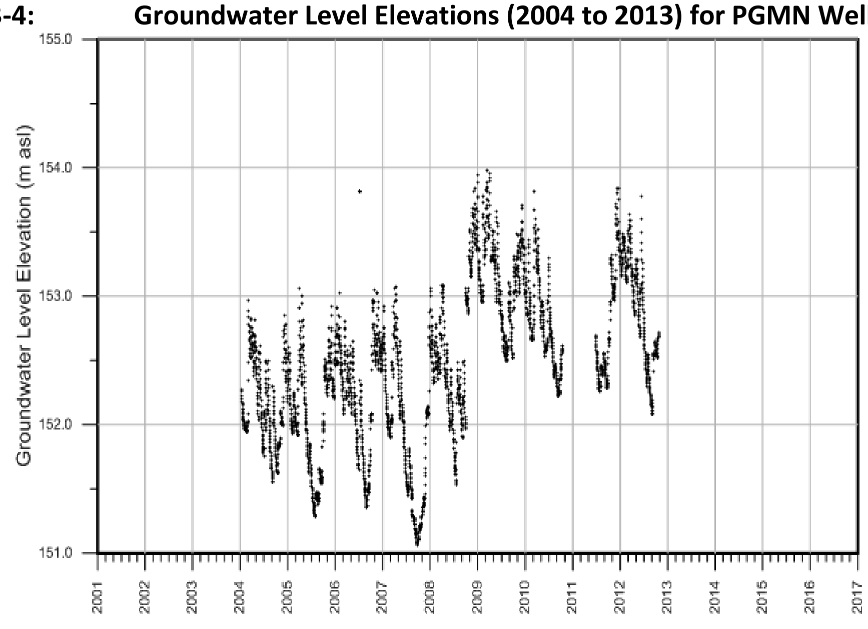
Table 3-7: Gott Enterprises Alnwick / Haldimand - PGMN Wells Summary

PGMN Well ID	Water Well Record ID	Distance from Gott Enterprises Inc. Well Field (km)	Well Depth (m)	Ground Elevation (m asl)	Lithology of Aquifer
W0000393-1	4513604	5.8	21.52	152.83	Overburden (Grey Sand with Gravel)
W0000412-1	4514022	4.9	16.98	299.36	Overburden (Sandy silt to silt)
W0000411-2	4514022	4.9	47.4	299.36	Overburden (sand and silt)
W0000411-3	4514022	4.9	179.8	299.36	Interface (Silt, Sand/Limestone)

Note: m asl denotes m above sea level

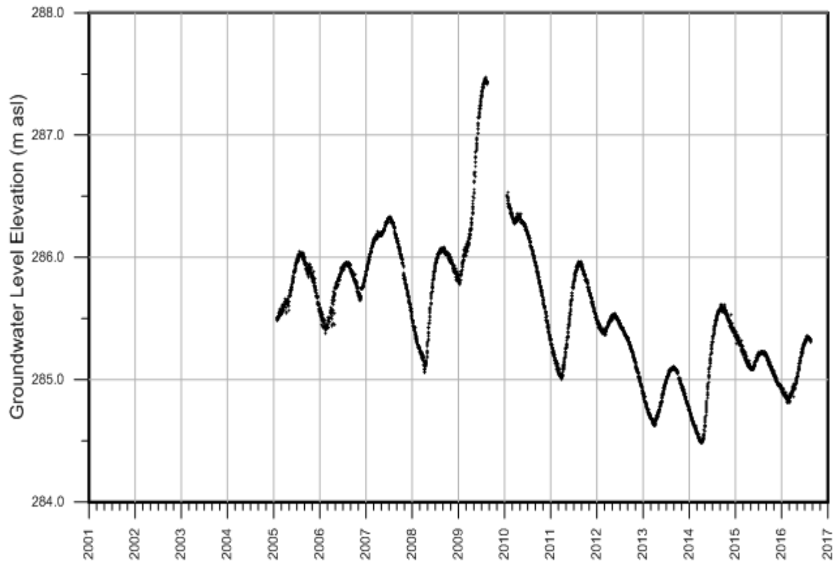
The data plots and trends analyses for the 4 PGMN well installations within 10 km of the Gott Enterprises Inc. Site are provided as follows.

Text Figure 3-4: Groundwater Level Elevations (2004 to 2013) for PGMN Well W0000393-1



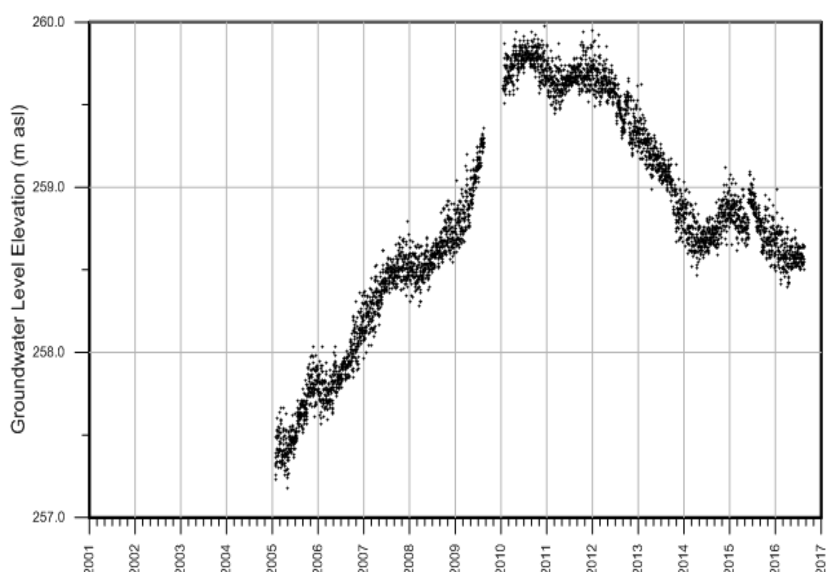
For PGMN Well No. W0000393-1 (shallow overburden well), the MK test (year over year) did not detect a significant trend. The SK test (season to season) detected an upward trend. Visually, it is apparent from the data plot that the seasonal ranges in water level elevations from 2009 to 2013 were higher than observations from 2004 to 2009.

Text Figure 3-5: Groundwater Level Elevations (2005 to 2017) for PGMN Well W0000412-1



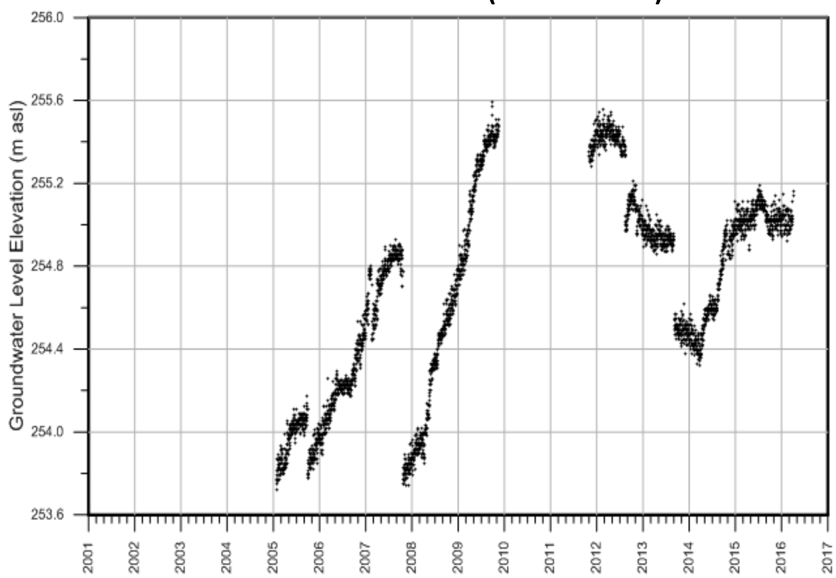
For PGMN Well No. W0000412-1 (shallow overburden well), the MK test (year over year) detected a downward trend. The SK test (season to season) also detected a downward trend. Visually, it is apparent that water levels peaked in 2009, steadily declined until 2014, and remained generally stable over the following 3 years.

Text Figure 3-6: Groundwater Level Elevations (2005 to 2017) for PGMN Well W0000411-2



For PGMN Well No. W0000411-2 (deep overburden well), the MK test (year over year) did not detect a significant trend while the SK test (season to season) identified an upward seasonal trend. Visually, the data plot appears to show similar long term trends as the plot for the shallow overburden well W0000412-1, though 'peak' water levels elevations appear in 2010 as opposed to 2009.

Text Figure 3-7: Groundwater Level Elevations (2005 to 2017) for PGMN Well W0000411-3



For PGMN Well No. W0000411-3 (overburden/bedrock interface), the MK test (year over year) did not detect a significant trend while the SK test identified an upward seasonal trend. The data shows a similar upward trend to W0000412-1, for 2005 to 2010, except for the decline in fall 2008.

Based on the PGMN data trend analyses provided by MECP, only PGMN Well No. W0000412-1, a shallow overburden well completed to 16.98 m depth, indicated a downward water level trend. For the same location both the deep overburden well completed to 47.4 m depth (W0000411-1), and the overburden/bedrock interface well completed to 179.8 m depth (W0000411-3) indicated an upward seasonal trend. All 3 wells are at the same location 4.9 km north from the Gott Enterprises Inc. well field in the general vicinity of the Oak Ridges Moraine, recognized as an important area for groundwater recharge. A potential reason for the downward water level trend for the shallow overburden well has not been investigated.

3.4.3 Ontario Low Water Response (OLWR) Program

The OLWR program was initiated in 2000 and is managed by the Ministry of Natural Resources and Forestry (MNRF). The program relies on the use of real time surface water monitoring data collected through the Surface Water Monitoring Centre and utilizing the Water Survey of Canada (WSC) stream gauge (HYDAT) station network to identify potential drought conditions based on set trigger levels.

Presently, static groundwater level elevation data from the PGMN program is not a component of the OLWR program. Reportedly, this may be added to the program in future.

OLWR notifications are typically (i.e. not always) released in the last week of each month after a review of data for the previous weeks in the month. When trigger levels are identified for a monitoring station, the OLWR submits a notification to the respective CA or municipality. Based on its review of the OLWR data that accompanies the notification, combined with a review of local factors that include recent precipitation and reports of water shortfalls for surface water and well water supplies a Low Water Conditions Alert 'may' be posted by the CA/municipality. A CA or municipality may also choose to post an Alert without any OLWR notification. Decreases in water takings that are triggered by the declaration of Level 1, 2 and 3 Low Water Condition are as follows:

- Level 1 - A voluntary reduction of 10%
- Level 2 – A voluntary reduction of 10%, to achieve a 20% reduction;
- Level 3 – Reduce and manage water use demands to the maximum extent through regulatory measures, if required.

Note: Specific Permits to Take Water may have conditions requiring mandatory reductions of water takings during low water events. Upon renewal of their water bottling permit, the above decreases will be mandatory based on 3-month average actual flow as outlined in the guidance for bottled water renewals (MOECC, 2017).

The frequency of OLWR notifications over time can be a potential indicator of climate stress trends for surface water (and possibly shallow groundwater where directly connected to surface water), and an indicator of watershed/subwatersheds that are sensitive to seasonal drought conditions. However, the existing OLWR program database has not been prepared for this purpose, has inconsistencies that are attributed to different persons updating the database over the years, and the database does not provide notification Levels during the time period where a Low Water Alert has been declared by a CA/municipality. This is only indicated in the database as an 'Update'. Consequently, only a general review of the information in the OLWR database is provided herein for the geographic CA/municipality relevant to the Site.

The OLWR database indicates that a total of 10 Level 1 notifications were sent to the Lower Trent Region CA between 2000 and August 2018 with no notifications issued in 11 of 19 years (2000, 2002 to 2004, 2007 to 2009, 2011, 2013, 2014 and 2018). Only 2010 (3 notifications) and 2015 (2 notifications) had more than 1 Level 1 notification. The OLWR database also indicates that for the same time period the Lower Trent Region CA has posted a Level 1 Alert for a total period of approximately 11 months of which 4 months occurred in 2002 and 3 months occurred in 2012. While no Level 2 notifications have been issued, the Lower Trent Region CA has also posted Level 2 Alerts in 2012 (August to October), 2016 (July to December) and 2017 (January and February). The frequency of OLWR notifications over time does not indicate any specific year over year trends. On a seasonal basis, most have been issued in the summer and fall months. Overall the OLWR database indicates that the CA has found it necessary to declare Level 1 and Level 2 Low Water Condition Alerts for the area, but the frequency of OLWR notifications does not indicate a decreasing trend in the availability of surface water (and possibly shallow groundwater) in the area.

3.4.4 Water Budget Analyses

Tier 1 water budget and water quantity stress assessments were completed by XCG Consultants Ltd. for the subwatersheds of the Lower Trent Region CA (XCG, March 2010). The Tier 1 water budget expands on the findings of the conceptual water budget by calculating water budgets at smaller spatial scales and by assigning water quantity stress levels to each subwatershed in the study area. The Tier 1 Water Budget estimates how much water exists in a subwatershed over a period of time, usually monthly and yearly. It accounts for water that is being added to a watershed, such as precipitation and removed (e.g. rivers flowing out) from a watershed. Water demand estimates included water takings that require a permit and those that do not require a permit. Water demands in the future were also predicted by scaling up existing demand in proportion to the estimated future population as estimated from population projection data by county provided by the Ministry of Finance. Stress levels for surface water and groundwater were calculated based on the net water balance and compared to threshold stress values set by the province.

For the Tier 1 water budget assessment the Barnhamhouse Creek subwatershed and the Shelter Valley Creek subwatershed were assessed together as one subwatershed. A low potential for both surface water and groundwater stress was determined from the Tier 1 assessment and no Tier 2 assessment was required.

Based on the findings from local Water Budget analyses for the Barnhamhouse Creek/Shelter Valley Creek subwatershed, the Gott Enterprises Inc. Site is not identified to be in an area where hydrologic stress poses a concern for the water taking.

3.5 Impact Assessment

The following section provides a general assessment of potential water quantity interference with other groundwater uses and the environment.

3.5.1 Municipal Groundwater Use

The only municipal groundwater system located within 5 km of the Gott Enterprises Inc. well field is the Grafton municipal well field located 2.0 km to the south. The Baltimore municipal system (9.5 km to the west) and the Colborne municipal system (12.2 km to the east) are the next closest systems and are both situated outside of the Lower Trent watershed. As described previously herein, the Grafton municipal wells draw from a basal (overburden/bedrock interface) aquifer identified as the Scarborough Formation while the Gott Enterprises Inc. production wells draw water from the Ste. Anne's Aquifer identified as an intermediate aquifer situated within the Newmarket Till. A low permeability zone comprised of Newmarket Till (and possibly Halton Till) and Sunnybrook Drift is considered to be present between these two aquifer zones, limiting any vertical hydraulic connection. A technical memorandum was prepared by the Township of Alnwick/Haldimand's consultant (GeoKamp Ltd.) that also concludes that the Gott Enterprises Inc. Site and the Grafton municipal wells are drawing water from different water bearing formations and do not appear to be directly connected.

Based on the above, the general assessment of potential water quantity interference with existing or planned municipal water supply systems did not identify any potential for unacceptable well interference and/or impediment to future expansion of existing municipal groundwater systems.

3.5.2 Well Interference Potential

Regular monitoring of water levels in off-site domestic wells and on-site monitoring wells has been a condition of the PTTWs for the Site since 1997 (PTTW No. 97-P-4030). The off-site monitoring program locations were reduced in 2008 and 2010 due to a denial of access to the properties. The AECOM, February 2018 report, which presents the 2017 monitoring data for the Site, indicates that observation well water level monitoring has been limited to SAP01-00 (Located near Well #1 and Well #8 (south of Well #6), since 2010. The AECOM, February 2018 report indicates that the monitoring results for these wells and the Site monitoring wells show 'no observable effect from operation of the production wells on surrounding wells'. The ministry reviews to date for the annual monitoring reports have indicated agreement with these findings.

For the permitting history, no indications of well interference complaints that could be attributed to the Gott Enterprises Inc. water taking were identified in the supplied ministry files. One complaint was received by the ministry in 2003, but the ministry responded to the complaint (letter prepared by Sarah Ryan, Hydrogeologist, dated February 12, 2003) providing the opinion that the 'cone of influence' from the water taking could not cause an interference with the person's well.

Regarding well interference potential with future growth/development, no new high water use activities were identified for the vicinity of the Site. A modest growth rate for the municipality is indicated from available information with new growth focused on the hamlets within the municipality.

3.5.3 Impact to Surface Water and Natural Functions of the Ecosystem

The ORE, March 1997 study concluded that the Ste. Anne Aquifer complex utilized by the production wells (intersected at between 9 and 20 m depth at the well field) was the headwater for the creek and wetland located between 800 m to 1,000 m south and down slope of the well field. This was indicated by a measured drop in water temperature in this area and by similar levels of sodium and chloride for both the Ste. Anne's aquifer and the creek water at this location. No ecosystem studies or environmental flow needs assessments for this area were identified. A surface water monitoring program was recommended in the ORE, March 1997 study and the program was enforced through permit conditions in PTTW No. 97-P-4030. Ministry files indicate the scope of the surface water monitoring program was reduced over time with concurrence from the ministry. The most recent available annual monitoring report (2017 monitoring year) indicates that water level measurements were collected manually on a once a month basis for staff gauges located on the tributaries of Barnhamhouse Creek (SW8, SW10, SW12, and SWW3) and a tributary of Shelter Valley Creek (SW13). SW8 and SW10 are located in the general vicinity of the outcrop for the Ste. Anne Aquifer complex. The variability in water levels at all gauge locations has been assessed to be within typical expected seasonal variation which is highly dependent on climate conditions. The pattern of water level fluctuations for data collected from 2007 to 2017 demonstrated similar seasonal fluctuations in water levels were seen from year to year. The ministry surface water reviews of previous annual reports have acknowledged AECOM's conclusion that the surface water monitoring data, as collected, indicates no affect to surface water in the area from the production wells. The file information also suggests the ministry has accepted previous arguments from AECOM that continuous instream monitoring probes/stations for water levels and general water quality were not necessary given there is no evidence of impact from the production wells.

Based on the above, potential impact to surface water appears to be adequately addressed through the current water level monitoring program which has shown no indications of an impact.

3.6 SUSTAINABILITY OF WATER RESOURCES

Water resources are considered sustainable if the total amount of water entering, leaving, and being stored in the system meet existing needs without compromising the ability to meet the needs in the future. Typical indicators used to assess the sustainability of water quantity include Water Budgets completed at the watershed/subwatershed scale and/or for the specific water taking(s) and the evaluation of water level data for trends over time to ensure resources are remaining in a steady state. The following provides a general assessment of the sustainability of regional water resources and of the potential impact from the Gott Enterprises Inc. Alnwick/Haldimand water taking on sustainability, now and in the future.

<u>Regional Water Resources</u>

The characterization of the regional study area indicates that the Gott Enterprises Inc. Alnwick/Haldimand Site is located in the Barnhamhouse Creek / Shelter Valley Creek subwatershed where both groundwater stress and surface water stress potential was categorized as Low based on a Tier 1 Water Budget analyses (XCG, March 2010). The Water Budget analyses considered existing water demand and projected future water demand. A modest population growth rate is indicated for the municipality with new growth to be focused on the existing hamlets within the municipality. Consequently, existing and future demand are not an identified concern for stress on the sustainability of water resources within the regional study area.

The 'Approved Trent Assessment Report' (TCCSPR, 2018) includes a discussion on the implications of climate change on the report findings that include the XCG, March 2010 Water Budget results. The discussion indicates that climate change (e.g., a decrease in surplus water due to an increase in evapotranspiration) has the potential for increased stress levels for groundwater and surface water in the Great Lakes Basin. The TCCSPR, 2018 Report recommends continual improvement in climate change modeling to capture potential variability between models and their results. The report also recommends further consideration be given to the effects of climate change on the quantity and quality of drinking water sources at a local level.

The OLWR Program uses real time surface water monitoring data collected from the WSC stream gauge (HYDAT) station network to identify potential drought conditions based on set trigger levels. BluMetric's review of the OLWR Program notification data (2000 to August 2018) for the Lower Trent CA did not identify any specific notification data trends indicating the depletion in the availability of surface water (and possibly shallow groundwater where directly connected to surface water) resources. Also, BluMetric's review of PGMN groundwater level data for 4 monitoring network wells located within 10 km of the Gott Enterprises Inc. Alnwick/Haldimand water taking did not identify any specific trends indicating a depletion in the availability of regional groundwater resources.

In summary, based on the information reviewed, no stress concerns were identified for the sustainability of regional water quantity resources.

Gott Enterprises Inc. Alnwick/Haldimand Water Taking

Historical information relating to the Gott Enterprises Inc. Alnwick/Haldimand Site indicates the water taking has been permitted for water bottling since 1992. The current PTTW maximum water taking limits have remained unchanged for 21 years (since 1997). The annual water taking amount reported for 2017 is 45% of the permitted annual limit and has steadily increased by approximately 2.8% per year since 2012.

Aquifer testing programs for the Gott Enterprises Inc. production wells (ORE, March 1997) concluded that a cumulative water taking of 844.2 m3/day from the well field would not likely result in significant impacts on private wells in the vicinity of the Site. Also, the Ste. Anne's aquifer is hydraulically separated from the deeper aquifer utilized by the Grafton Municipal well field, by a thick sequence of low permeability materials, and no potential impact on water levels in the deep aquifer are expected from the Gott Enterprises Inc. Alnwick/Haldimand water taking. The current approved cumulative water taking amount for the Site of 746 m3/day (as per PTTW No. 8404-7YBLB2) is approximately 12% lower than the rate recommended in ORE, March 1997.

Water level monitoring requirements for groundwater and surface water have been in place for the Site for 21 years (since 1997) and monitoring results have been provided to the ministry for review on a near annual basis. A water budget is provided with the annual reports to distinguish the influence of climate versus the influence of production well pumping on water levels during the monitoring period. A gradual decrease in water level monitoring for off-site well water supplies and for surface water has occurred over time based on recommendations from the consultant and with agreement from the ministry in its Annual Monitoring Report review comments. The last annual monitoring report (for the 2017 monitoring year) was received by the ministry in 2018 (AECOM, February 2018). The report provides hydrographs and a review of the long term water level monitoring data (2000 to 2017 for observation well data, 2005 to 2017 for borehole monitor data, and 2007 to 2017 for surface water data). BluMetric's review of the long term water level monitoring data indicates that local groundwater and surface water resources remain in a steady state, subject to seasonal fluctuations due to climate influences. The AECOM, February 2018 report states "drawdown of water levels in the Ste. Anne's Aquifer is restricted to within site boundaries and does not affect any private wells adjacent to the site". Reviewed documentation suggests that the ministry has not received any documented well interference complaints/impacts that could be attributed to the Gott Enterprises Inc. Alnwick/Haldimand water taking.

A review of the WTRS database did not identify any other high volume water taking activities for the Ste. Anne's Aquifer Complex within the study area. The information review also did not identify any other planned water taking activities that might contribute to the overall cumulative effects/impacts on local groundwater resources.

Based on the information reviewed, there are no indicators of the Gott Enterprises Inc. water taking having an impact on the sustainability of existing and future water resources. Consequently, it is BluMetric's opinion that the water taking is being managed sustainably. Since the annual water taking to date has been less than 50% of the PTTW limit and the future impact from climate change cannot be accurately predicted, the monitoring/reporting conditions under the PTTW provide a measure of security to ensure the water resource remains sustainable.

3.7 GAPS AND RECOMMENDATIONS

Gaps in missing reports and documentation are included in Section 3.2. A summary of the gaps identified in the water quantity information for the Site and recommended action(s) to address each gap is provided as follows:

1. Existing PTTW monitoring program requirements were initially developed in 1997 and reference the monitoring recommendations provided in the ORE, March 1997 report. Since he scope of the monitoring program has changed/evolved over time. For a permit renewal, it is recommended that the monitoring program conditions be updated to current requirements. The updated conditions should indicate specific monitoring locations and methods for monitoring.
2. Site property boundaries as indicated in the AECOM, February 2018 report are different than those indicated in the ORE, March 1997 report and inferred in subsequent Site assessment reports which did not show property boundaries on Site drawings. The legal description of the property as provided in the 2016 renewal application appears to be relevant to the 'former' Site boundaries and is not accurate for the AECOM, February 2018 property boundaries. A legal description and/or legal survey of the property boundaries should be provided by Gott Enterprises Inc. to ensure the property boundaries are accurately reflected in a Permit Renewal for the Site.

3.8 FIGURES

Figures are provided in Appendix A-Main Figures

4. GOTT ENTERPRISES INC. - AMARANTH

4.1 BACKGROUND AND HISTORY

Gott Enterprises Inc. (Amaranth) currently draws water from three bedrock wells (PW3, PW4 and PW 5 (replaced PW2)) located in part of Lot 25, Concession 2 within the Township of Amaranth, County of Dufferin (the 'Site'). The Site is located in a rural setting south of Shelburne, southeast of the intersection between 25th Sideroad and County Road 12'. Fernbrook Natural Spring Water Company Limited ("Fernbrook") was the owner of the property and on-Site water bottling facility from 1984 to 2013. The Fernbrook property and the associated water bottling operation were purchased by Gott Enterprises Inc. in late 2013.

The Site falls within the jurisdictions of the MECP Guelph District Office – West Central Region and the Nottawasaga Valley Conservation Authority. The Gott Enterprises Inc. (Amaranth) water source location and Site boundaries are indicated on Figure 4-1.

An approximate timeline of events relevant to the PTTW history of the Gott Enterprises Inc. (Amaranth) Site is provided in Table 4-1.

Table 4-1: Gott Enterprises Inc. Amaranth - PTTW History Summary

YEAR	EVENT
1989	**PTTW 89-P-2004** was issued to Fernbrook Natural Spring Water on **February 3, 1989**, with an expiry date of March 31, 1999. The permit allowed for a maximum withdrawal rate and withdrawal amount of 55 L/minute and 79, 200 L/day, respectively, from Well 1, for commercial purposes.
1994	**PTTW 94-P-2060** was issued to Fernbrook Natural Spring Water Co. Ltd. on **November 9, 1994**, with an expiry date of February 1, 1996. The permit allowed water to be extracted from Well 2 and Well 3 (later known as PW2 and PW3) for the purpose of commercial water bottling. The maximum withdrawal rate and withdrawal amount, for Well 2 and Well 3 combined, was 227 L/minute and 327,000 L/day. The permit also required the holder to submit a detailed study plan designed to measure and quantify the short term and long term impact of the taking on area surface waters, including wetlands; the plan was required to include, at minimum, the installation of streambed piezometers, short term testing, long term monitoring, and reporting.
1996	**PTTW 94-P-2060** expired on **February 1, 1996**, and the permit was temporarily renewed until August 31, 1996, while the Ministry reviewed a surface water impact evaluation report submitted by the proponent in November 1995. Due to ongoing resource shortages, the report had still not been reviewed by September 1996, so the permit was temporarily renewed again until March 31, 1997.
1997	A renewal to **PTTW 94-P-2060** (permit not reviewed by BMEI) was issued on **June 18, 1997**, with an expiry date of March 31, 1999.

YEAR	EVENT
2000	Renewals to **PTTW 94-P-2060** and **PTTW 89-P-2004** were issued to Fernbrook Natural Spring Water Company Ltd. on **January 19, 2000**, each with an expiry date of March 31, 2002. PTTW 94-P-2060 allowed water to be extracted from Well 2 and Well 3 for the purpose of commercial water bottling. The maximum permitted withdrawal rate and withdrawal amount were 227 L/minute and 327,312 L/day (i.e. 72,000 imperial gallons/day), respectively. The PTTW also required: • Quarterly flow monitoring of the Myers Drain; • Maintenance and quarterly monitoring of existing piezometers; • Quarterly monitoring of adjacent domestic wells (the wells are not specifically identified). PTTW 89-P-2004 allowed water to be extracted from Well 1 for the purpose of commercial water bottling. The maximum permitted withdrawal rate and withdrawal amount were 55 L/minute and 79,200 L/day, respectively. The PTTW had the same monitoring requirements as PTTW 94-P-2060.
2001	**PTTW 01-P-2136** was issued to Fernbrook Natural Springwater Company Ltd. on **May 24, 2001**, with an expiry date of March 31, 2003. The permit replaced PTTW no. 89-P-2004, which was cancelled due to Well 1 being taken out of service and replaced with Well 4, constructed in November 2000. The PTTW allowed water to be extracted from Well 4 for the purpose of commercial water bottling. The maximum permitted withdrawal rate and withdrawal amount were 227 L/minute and 327,000 L/day, respectively. The PTTW also required: • The installation of one monitoring well (MW) on the eastern property boundary. Water levels in the MW were to be recorded on a continual basis for the first year, and the pumping rates of the production wells adjusted (if required) to ensure that the water level in the MW does not fall below the first water bearing zone; • A pumping test at Wells 2, 3 and 4, in which water levels are recorded at the MW, Well 1, nearby domestic wells and Myers Drain; • Monthly monitoring of adjacent domestic wells (the wells are not specifically identified); • Monthly flow monitoring of Myers Drain at a location prior to it entering the Fernbrook property, and at the outlet from the property; • Maintenance and monthly monitoring of existing piezometers; • The Permit Holder was to use the monitoring data to update the assessment of the impacts of the water takings on the underlying aquifers and adjacent water interests.
2003	**PTTW 01-P-2136** was issued to Fern Brook Springs Bottled Water Company Limited on **November 24, 2003**, with an expiry date of November 30, 2005. Per the applicant's request, the permitted water takings associated with PTTW 94-P-2060 and the former PTTW 89-P-2004 were consolidated into PTTW 01-P-2136, and the two older permits were cancelled. The PTTW allowed water to be extracted from Wells 2, 3 and 4 for the purpose of commercial water bottling. The maximum permitted withdrawal rate was 227 L/minute (327,000 L/day) for Wells 2 and 3 as a combined total; and 227 L/minute (327,000 L/day) for Well 4. The PTTW also required: • Monthly monitoring of adjacent domestic wells (the wells are not specifically identified); • Monthly flow monitoring of Myers Drain at a location prior to it entering the Fernbrook property, and at the outlet from the property; • Maintenance and monthly monitoring of existing piezometers; • The Permit Holder was to use the monitoring data to update the assessment of the impacts of the water takings on the underlying aquifers and adjacent water interests. No mention was made in the PTTW about monitoring water levels in the monitoring well on the eastern property boundary. However, the monitoring program report for the years 2002-2005 confirms that MW1 (located on the eastern property boundary) was installed in 2001, and had been monitored during this period per the requirements of PTTW 02-P-2136.

<table>
<tr><th>YEAR</th><th>EVENT</th></tr>
<tr><td>2005</td><td>PTTW 2401-6JCLMW was issued to Fern Brook Springs Bottled Water Company Limited on November 25, 2005, with an expiry date of December 31, 2007. The PTTW allowed for the same taking volumes and rates from the same wells and for the same purpose as PTTW 01-P-2136. The PTTW required:

Continuous monitoring of groundwater levels from the three production wells;
Monthly monitoring of groundwater levels at on-site monitoring well MW1 (located at the east property boundary);
Monthly monitoring of groundwater levels at private off-site wells OW1, OW2, OW4, OW5 and OW6 (subject to permission from the owners);
Monthly monitoring of shallow and deep groundwater levels in piezometers GS1 and GS2 installed in Myer Drain;
Monthly flow measurements at SG1 and SG2;
The Permit Holder to identify a bedrock well within the western portion of the capture zone of the production wells, which extended about 1,000 m to the west. The well was to be monitored for water level on a monthly basis, and chemical quality on a quarterly basis.

The PTTW also stated that it is "valid annually between December 1 to January 31 from date of issue to December 31, 2007".

PTTW 4603-6JPLS6 was issued to Fern Brook Springs Bottled Water Company Limited on December 9, 2005, with an expiry date of December 31, 2007. The PTTW cancelled and replaced PTTW 2401-6JCLMV, issued a couple of weeks earlier.
The PTTW is, for the most part, identical to PTTW 2401-6JCLMV, except that the condition regarding the permit being "valid annually" was removed, and the condition regarding maximum allowable taking for Wells 2 and 3 was reworded (likely to improve clarity).</td></tr>
<tr><td>2006</td><td>The ministry was informed of the Permit Holder's unsuccessful attempt to secure a bedrock well location within 1,000 m west of the permitted production wells for the purpose of monitoring water levels and chemical quality. No wells meeting this criterion could be found and the installation of a new well was not an option as the applicant did not own the property to the west of the production wells. In a January 3, 2006 email, the ministry concluded that this monitoring requirement could not be satisfied, and the requirement was therefore waived.</td></tr>
<tr><td>2007</td><td>PTTW 6438-7AAJKP was issued to Fern Brook Springs Bottled Water Company Limited on December 31, 2007, with an expiry date of December 31, 2010. The PTTW allowed water to be taken from the same three wells (renamed as PW2, PW3, PW4) for the same purpose and at the same volumes and rates as in the previous permit.
The PTTW did not include a provision to monitor a bedrock well within the western portion of the capture zone of the production wells for water level and chemical quality. All other monitoring requirements were largely the same as those described for PTTW 4603-6JPLS6, with the addition of another private off-site well (OW3R) for monthly monitoring of groundwater levels.</td></tr>
<tr><td>2011</td><td>PTTW 3406-8D9LCV was issued to Fern Brook Springs Bottled Water Company Limited on January 25, 2011, with an expiry date of July 31, 2021, and cancelled and replaced PTTW 6438-7AAJKP. The permitted takings and monitoring requirements were largely unchanged from those described in PTTW 6438-7AAJKP.</td></tr>
<tr><td>2014</td><td>PTTW 2773-9G2RXX was issued to Gott Enterprises Inc. on February 6, 2014, with an expiry date of July 31, 2021, and cancelled and replaced PTTW 3406-8D9LCV. The permit was issued to reflect the change in ownership of the property. The permitted takings and monitoring requirements were largely unchanged from those described in PTTW 3406-8D9LCV.</td></tr>
<tr><td>2016</td><td>Installation of Well PW5 was completed on August 30, 2016.
An application for a Category 1 permit amendment was submitted to the MECP on September 12, 2016. The application requested an amendment to PTTW 2773-9G2RXX to add PW5 as a source, and to remove PW2 as a source, due to the declining efficiency of the 22 year-old PW2 well. The declining efficiency was reportedly due to conditions within the well bore (i.e. mineral encrustation), and not due to aquifer impacts. PW5 was reported to be approximately 150 m southeast of PW2, and completed in the same bedrock aquifer as PW2, PW3 and PW4.
Note: An amended permit was ultimately issued in 2018.</td></tr>
</table>

YEAR	EVENT
2018	**PTTW 7535-AQBNX8** was issued to Gott Enterprises Inc. on **February 23, 2018**, with an expiry date of July 31, 2021. The PTTW cancelled and replaced PTTW 2773-9G2RXX to reflect the replacement of PW2 with PW5 due to well efficiency issues. No changes were made to permitted volumes or conditions of the PTTW: • The maximum permitted withdrawal rate was 227 L/minute (327,000 L/day) for PW5 and PW3 as a combined total; and 227 L/minute (327,000 L/day) for Well 4; • Continuous monitoring of groundwater levels from the three production wells; • Monthly monitoring of groundwater levels at on-site monitoring well MW1; • Monthly monitoring of groundwater levels at private off-site wells OW1, OW2, OW3R, OW4, OW5 and OW6 (subject to permission from the owners); • Monthly monitoring of shallow and deep groundwater levels in piezometers GS1 and GS2 installed in Myer Drain; • Monthly flow measurements at SG1 and SG2.

General information about the three production wells, a former production well (Well 1), as well as a recently-constructed well (PW5) on the Gott Enterprises Inc. (Amaranth) Site, is provided in Table 4-2.

Table 4-2: Gott Enterprises Inc. Amaranth - Summary of Current Water Taking Sources

Source Name	Type	Well Record ID	Total Well Depth	Depth to Bedrock	Completion Unit [1]	Depth Water Found	PTTW No. 7535-AQBNX8	
							Max. Taken Per Minute (L)	Max. Taken Per Day (m^3)
Well 1 (not active)	Drilled Well	1703688	37.2 m (122 ft)	18.3 m (60 ft)	Limestone	37.2 m (122 ft)	NP (55 L from 1989 to 2001)	NP (79.2 m^3 from 1989 to 2001)
PW2 (not active)	Drilled Well	1704766	78.6 m (258 ft)	14.6 m (48 ft)	Limestone	14.9 – 16.5 m, 33.5 m, 40.5 m, 51.8 m (49 – 54 ft, 110 ft, 133 ft, 170 ft)	NP (replaced by PW5 in Feb. 2018)	NP (replaced by PW5 in Feb. 2018)
PW3	Drilled Well	1704767	42.1 m (138 ft)	21.3 m (70 ft)	Limestone	26.8 m, 30.8 m, 36.6 m (88 ft, 101 ft, 120 ft)	227 (PW3 and PW5 combined)	327 m^3 (PW3 and PW5 combined)
PW5 (replaced PW 2)	Drilled Well	7278056	43.0 m (141 ft)	10.4 m (34 ft)	Limestone	17.7 m, 21.6 m, 24.7 m, 27.4 m (58 ft, 71 ft, 81 ft, 90 ft)		
PW4	Drilled Well	1705572	41.5 m (136 ft)	12.5 m (41 ft)	Limestone [2]	21.3 m, 36.6 m (70 ft, 120 ft)	227	327

[1] The well records indicate that the wells were completed in limestone, but they may in fact be completed in dolostone (Ian D. Wilson Associates Limited, 2001).
[2] The well record for PW4 notes that a one-foot layer of clay with "wood layers" was observed at a depth of 14 m below ground surface, wedged between two layers of limestone.
NP – Denotes not in Permit

As indicated in Table 4-2, all water taking sources (active and inactive) are completed in limestone (or dolostone) bedrock and range in depth from 37.2 to 78.6 m. Water bearing zones for the active wells (PW2, PW3, and PW4) range from 14.9 to 51.8 m depth.

4.2 PRIMARY INFORMATION SOURCES

The following records were on file with the MECP documenting the PTTW history.

- PTTW 89-P-2004, Fernbrook Natural Spring Water, February 3, 1989.
- PTTW 94-P-2060, Fernbrook Natural Spring Water Co. Ltd., November 9, 1994.
- PTTW 89-P-2004, Fernbrook Natural Spring Water Company Ltd., January 19, 2000.
- PTTW 94-P-2060, Fernbrook Natural Spring Water Company Ltd., January 19, 2000.
- PTTW 01-P-2136, Fernbrook Natural Spring Water Company Ltd., May 24, 2001.
- PTTW 01-P-2136, Fern Brook Springs Bottled Water Company Limited, November 24, 2003.
- PTTW 2401-6JCLMW, Fern Brook Springs Bottled Water Company Limited, November 25, 2005.
- PTTW No. 4603-6JPLS6, Fern Brook Springs Bottled Water Company Limited, December 9, 2005.
- PTTW No. 6438-7AAJKP, Fern Brook Springs Bottled Water Company Limited, December 31, 2007.
- PTTW No. 3406-8D9LCV, Fern Brook Springs Bottled Water Company Limited, January 25, 2011.
- PTTW No. 2773-G2RXX, Gott Enterprises Inc., February 6, 2014.
- PTTW Amendment Application, Gott Enterprises Inc., September 12, 2016.
- PTTW No. 7535-AQBNX8, Gott Enterprises Inc., February 23, 2018.

The following key technical documents provided to the ministry by the proponent were identified and reviewed herein.

- Well Evaluation. Fernbrook Natural Spring Water Operation. Township of Amaranth. (Ian D. Wilson Associates Limited, 1988).
- Water Supply Evaluation. Fernbrook Natural Spring Water Co. Ltd. Township of Amaranth (Ian D. Wilson Associates Limited, September 1994).
- Surface Water Impact Evaluation. Phase I. Fernbrook Natural Spring Water Co. Ltd. Township of Amaranth (Ian D. Wilson Associates Limited, April 1995).
- Water Level Monitoring Program. Surface Water Impact Evaluation. Phase II. Fernbrook Natural Spring Water Co. Ltd. Township of Amaranth. Permit to Take Water 94-P-2060 (Ian D. Wilson Associates Limited, November 1995).
- Well Evaluation. Well 4. Fernbrook Natural Spring Water Co. Ltd. Township of Amaranth (Ian D. Wilson Associates Limited, February 2001).
- Well Field Evaluation. Wells 2, 3 and 4. The Fernbrook Natural Spring Water Co. Ltd. Township of Amaranth (Ian D. Wilson Associates Limited, December 2001).
- Application for Permit to Take Water Amendment – PTTW 2773-9G2RXX, Addition of Well 5 and Removal of Well 2, Gott Enterprises Inc. Ian D. Wilson Associates Limited. February 5, 2018 (Wilson, February 2018).

Other information sources used in this assessment included:

- The Hydrogeology of Southern Ontario. Second Edition. S.N. Singer, C.K. Cheng, and M.G. Scafe, 2003 (Singer et al., 2003).
- Township of Amaranth Zoning By-Law 2-2009. Township Consolidation, December 2010.
- Issues Evaluation and Threats Assessment – Pullen Well. Township of Amaranth. R.J. Burnside & Associates Limited, 2010.
- Upper Nottawasaga River 2013 Subwatershed Health Check. Nottawasaga Valley Conservation Authority, 2013 (NVCA, 2013).
- Approved Assessment Report: Nottawasaga Valley Source Protection Area. South Georgian Bay-Lake Simcoe Source Protection Committee, 2015 (SGBLSSPC, 2015).
- Various status reports submitted to the MECP for the monitoring program at the Fernbrook/Gott Enterprises Inc. (Amaranth) site, for the years 1999 (approx.) to 2016.
- Consolidated Official Plan for the Town of Shelburne. December 2017 Consolidation.
- Official Plan for the Township of Amaranth. Office Consolidation, June 2018.
- Waldemar Community, Township of Amaranth, Wastewater Treatment and Effluent Disposal Class Environmental Assessment, Class EA Phases 1 and 2 Report. C.C. Tatham & Associates Ltd., 2018.
- "Orangeville council agrees to swap former Humber lands for future municipal well in Amaranth". Orangeville Banner, March 20, 2018 (Orangeville Banner 2018a). Available at: https://www.orangeville.com/news-story/8340007-orangeville-council-agrees-to-swap-former-humber-lands-for-future-municipal-well-in-amaranth/.
- "Failed Humber lands negotiations force longtime Orangeville business to leave town". Orangeville Banner, October 5, 2018 (Orangeville Banner 2018b). Available at: https://www.orangeville.com/news-story/8947797-failed-humber-lands-negotiations-force-longtime-orangeville-business-to-leave-town/.
- Nottawasaga Valley Conservation Authority Interactive Map. Available at https://maps.simcoe.ca/NVCA/.
- Chapman, L.J. and Putnam, D.F. 2007. Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228. (Chapman and Putnam, 2007).
- Surficial Geology of Ontario; MNDM File - MRD128-REV. Ontario Geological Survey, 2010. (OGS, 2010).
- Bedrock Geology of Ontario; MNDM File - MRD126-REV1. Ontario Geological Survey, 2011. (OGS, 2011).
- MECP Water Well Information System (WWIS) database. Available at https://www.ontario.ca/environment-and-energy/map-well-records.
- MECP on-line Provincial Groundwater Monitoring Network database. Available at: https://www.ontario.ca/environment-and-energy/map-provincial-groundwater-monitoring-network.

- MECP on-line Permit to Take Water database. Available at: https://www.ontario.ca/environment-and-energy/map-permits-take-water.
- MECP on-line Source Protection Information Atlas. Available at: www.applications.ene.gov.on.ca/swp/en/index.php.
- MECP Water Taking Reporting System (WTRS) database (Confidential – Used with Permission from MECP).
- Ontario Low Water Response Program (OLWR) notifications and alert levels for Saugeen Valley Conservation Authority (2000 to 2018 data from MNRF).

4.3 CHARACTERIZATION OF STUDY AREA

This section provides a general characterization of the study area. Figure 4-2 presents the assessed regional study area which is an approximate 30 km by 30 km area centered over the Gott Enterprises Inc. (Amaranth) water taking location. The regional study area boundaries were set to capture the nearest municipal groundwater supply system locations (Shelburne to the north and Orangeville to the southeast). The Gott Enterprises Inc. (Amaranth) water taking location and portions of the two municipal groundwater supply systems are all located within the Nottawasaga Valley Source Protection Area (SPA). Most of the municipal groundwater wells servicing the Town of Shelburne are located within the Nottawasaga Valley SPA, but two of the wells are located within the Grand River SPA. The municipal groundwater wells servicing the Town of Orangeville are located within the Grand River SPA and the Credit Valley SPA. The Shelburne municipal wells (PW7/PW8) are located in the Grand River Watershed but pumped to a drinking water system located in the Credit River Watershed.

4.3.1 Land Use Setting

The Gott Enterprises Inc. (Amaranth) Site is located in the Township of Amaranth, which has a 2016 census population of 4,079. The population is forecast to rise to about 4,680 by the year 2031. The Official Plan for the Township of Amaranth (June 2018) indicates that the communities of Laurel, Waldemar and Farmington, all located more than 9 km south and southwest of the Site, are intended to be the focus for residential and employment growth in the Township, which has seen increased growth pressure as the Greater Toronto Area continues to grow. The Township is largely characterized by rural and agricultural land uses, with agriculture playing an important role in its economy and heritage. The Township has seen increased development for semi-urban and non-residential land uses in recent decades. The Gott Enterprises Inc. (Amaranth) Site is also located approximately 3 km south of the Town of Shelburne, which has a 2016 census population of approximately 7,650, and a forecasted population of 10,000 by 2031.

The Gott Enterprises Inc. (Amaranth) Site is located in the northeastern portion of the Township of Amaranth. The Site is located in an area of predominantly agricultural and rural land uses. The northern portion of the property, where the bottling facility and the wells are located, is zoned as Industrial Exception Zone (M1-1), where the only permitted uses are a spring water bottling facility, a warehouse, a maximum of eight loading spaces, and an accessory single detached dwelling or dwelling unit.

No municipal water services were identified in the vicinity (< 2 km) of the Gott Enterprises Inc. (Amaranth) Site. Within the Township of Amaranth, only the community of Waldemar is reported to be serviced with a municipal water system: C.C. Tatham & Associates Ltd. (2018) reported that over a hundred residential lots in Waldemar (approximately 17.5 km southwest of the Site) are serviced by a municipal groundwater system supplied by three wells. In addition, one of the supply wells (well 5/5A) for the Town of Orangeville is located within the boundaries of the Township of Amaranth. The municipal drinking water system for the Town of Shelburne is serviced by six groundwater wells, located between 4.3 km north and 6.7 km northwest of the Gott Enterprises Inc. (Amaranth) production wells.

No municipal wastewater services were identified in the Township of Amaranth, but the development of communal wastewater treatment facilities is being explored for the community of Waldemar (C.C. Tatham & Associates Ltd., 2018).

In the early 2010s, there were plans to develop another municipal water system using the "Pullen Well" in the southeast corner of the Township, immediately west of Orangeville, to accommodate the planned development of almost one hundred residential lots (R.J. Burnside & Associates Ltd., 2010). However, the plans do not appear to have materialized to date, with a developer in the Township agreeing, in March 2018, to trade 42.41 acres and the Pullen Well to the Town of Orangeville in exchange for the Town's former Humber lands (Orangeville Banner, 2018a). The Town of Orangeville has plans to use the Pullen Well to expand its groundwater supply system (Orangeville Banner, 2018b) and it is understood that the Town of Orangeville has commenced the municipal Class EA process.

The Nottawasaga Valley CA online mapping tool indicates that the majority of the Gott Enterprises Inc. (Amaranth) Site is located within the Ontario Regulation 172/06 screening area, which regulates development, interference with wetlands and alterations to shorelines and watercourses within the jurisdiction of the Nottawasaga Valley CA.

Land use within an approximate 500 m radius of the Gott Enterprises Inc. (Amaranth) site (Figure 4-3), as per Schedule A of the Township of Amaranth Official Plan, is primarily agricultural (to the northwest, west, south and east) and rural (to the north and northeast), with some areas designated as Environmental Protection.

4.3.2 Physiographic Setting

The physiographic landforms of the study area, as described by Chapman and Putnam, 2007, are provided in Figure 4-4. The Gott Enterprises Inc. (Amaranth) Site is in an area characterized by Kame Moraines. The areas within 2 km of the site are characterized by Kame Moraines to the northwest, spillways to the east and southeast, till moraines to the south, and drumlinized till plains to the west. The Gott Enterprises Inc. (Amaranth) Site is also located within the Dundalk Till Plain physiographic region, a gently undulating, fluted plain containing some drumlins and drumlinoidal features (Ian D. Wilson Associates Limited, 2001).

The regional topography and hydrology of the study area is provided in Figure 4-5. The topography is characterized by relatively gentle slopes in the areas of the drumlinized till plains, and comparatively steeper slopes in the areas of the spillways, till moraines and Kame Moraines. As illustrated on Figure 4-5, the Gott Enterprises Inc. (Amaranth) Site is located approximately 950 m southeast of a watershed divide; east of the watershed divide, regional drainage for surface drainage features is towards the southeast (towards the North Branch of the Nottawasaga River) and towards the northeast (towards Primrose Creek, a tributary of the Boyne River, which is in turn a tributary of the Nottawasaga River). West of the watershed divide, surface drainage is towards the Grand River.

A prominent surficial physiographic feature in the area of the Gott Enterprises Inc. (Amaranth) Site is the Orangeville Moraine. Within the Nottawasaga Valley CA watershed, the Orangeville Moraine is present in the Town of Mono and the Township of Amaranth, forming a nearly flat-topped feature that has been strongly dissected by fluvial erosion.

The Gott Enterprises Inc. (Amaranth) Site is located in the headwaters of the Nottawasaga River, in a portion of the Upper Nottawasaga River subwatershed located upstream of the Niagara Escarpment. The Upper Nottawasaga River subwatershed has a drainage area of 338.13 km^2, compared to a total drainage area of 3,147 km^2 for the Nottawasaga River as a whole. The Nottawasaga River has a total elevation drop of 310 m from its headwaters to its outlet into Georgian Bay, with an average gradient of approximately 2.6 m per km. The upper reaches of the river are substantially steeper, reaching as much as 19 m per km.

Surface water drainage in the vicinity of the Gott Enterprises Inc. (Amaranth) Site is in a general east direction towards the North Branch of the Nottawasaga River. The North Branch flows for approximately 20 km before joining the South Branch of the Nottawasaga River near the community of Glen Cross (Township of Mono), approximately 13 km southeast of the Gott Enterprises Inc. (Amaranth) Site. The Nottawasaga River subsequently flows in a general northeast direction until reaching the community of Nicolston (Town of New Tecumseth), and then flows in a general north direction towards Georgian Bay.

The streams in the vicinity of the Gott Enterprises Inc. (Amaranth) Site are categorized as warm watercourses with respect to fisheries habitat. The North Branch of the Nottawasaga River is a cold watercourse, as is the main stem of the Nottawasaga River until it exits the Upper Nottawasaga River subwatershed near the community of Nicolston. Cool and cold water habitats are associated with groundwater discharge areas, such as those along the Niagara Escarpment. Downstream of Nicolston, the Nottawasaga River is a warm watercourse.

Only one Water Survey of Canada (WSC) stream gauge (HYDAT) station is present in the study area, the location of which is shown on Figure 4-2. Station 02GA041 (Grand River near Dundalk) is located 17.4 km northwest of the Gott Enterprises Inc. (Amaranth) Site, in the Grand River watershed. There are no WSC stream gauges upstream of the Site, and the closest gauge downstream is 02ED026 (Nottawasaga River at Hockley), located more than 25 km downstream. Mean annual streamflow at gauge 02ED026 is approximately 1.58 m^3/s, of which the baseflow (groundwater contribution to streamflow) is estimated at 1.07 m^3/s (SGBLSSPC, 2015).

4.3.3 Geologic Setting

Information on surficial geology and bedrock geology in the Nottawasaga River watershed was obtained from published maps and supplemented using information from the "Approved Assessment Report" for the Nottawasaga Valley SPA (SGBLSSPC, 2015). Surficial geology for the study area is mapped in Figure 4-6 and bedrock geology is mapped in Figure 4-7.

Surficial geology of the Nottawasaga Valley watershed consists of glacial sediments deposited in the Quaternary period. The study area is dominated by a mixture of ice-stratified deposits and glaciolacustrine-derived silty to clayey till. The upper overburden is comprised of Tavistock Till (Huron-Georgian Bay lobe) with a sandy silt to silt matrix (Ian D. Wilson Associates Limited, 2001). Overburden beneath the Gott Enterprises Inc. (Amaranth) Site, as reported in water well records, is 12.5 to 21.3 m in thickness, consisting mainly of fine-grained deposits described as silt or clay, with some records reporting discontinuous lenses of coarse-grained materials (i.e. sand) in the area (Ian D. Wilson Associates Limited, 2001). According to the WWIS well record for OW1 (ID 1704176) a sand unit up to 9 m thick was encountered. For Well 3 (ID 1704767), a gravel with sand layer and a gravel with silt layer were found to be approximately 2.4 m and 4.8 m in thick, respectively.

The bedrock geology for the study area (Figure 4-7) is mapped as sandstone, shale, dolostone and siltstone of the Lower Silurian – Lockport Formation. Towards the northeast from the Gott Enterprises Inc. (Amaranth) Site, the bedrock geology is mapped as shale, limestone, dolostone and siltstone of the Upper Ordovician – Queenston Formation, followed by the Georgian Bay Formation. The presence of bedrock at surface is infrequent for the study area, though Figure 4-6 indicates Paleozoic bedrock near surface in areas approximately 9.9 km northeast and 11.6 km southeast of the Gott Enterprises Inc. (Amaranth) Site, in the Town of Mono.

The well records for the wells on the Gott Enterprises Inc. (Amaranth) site indicate that the wells were all completed in limestone, but they may in fact be completed in dolostone (Ian D. Wilson Associates Limited, 2001).

4.3.4 Hydrogeologic Setting

4.3.4.1 Regional Hydrogeology

Regional hydrogeology within the boundaries of the Nottawasaga Valley CA was assessed based on information provided in 'The Hydrogeology of Southern Ontario. Second Edition, (Singer et al, 2003)'. The study notes that of the 19,725 water well records on file (at the time) within the Nottawasaga Valley CA, approximately 14,196 (72%) were overburden wells, and 5,529 (28%) were bedrock wells, indicating that the overburden is more significant than the bedrock as a water supply aquifer. Data related to short-term pumping tests were available for 9,878 of the overburden wells. Of these, 750 wells (7.6%) had specific capacities of less than 1.0 L/min/m, 3,581 wells (36.2%) had specific capacities (i.e. the available pumping rate per unit of drawdown) in the well between 1.0 and 5.0 L/min/m, 2,486 wells (25.2%) had specific capacities between 5.0 and 10 L/min/m, 2,545 wells (25.8%) have specific capacities between 10.0 and 50.0 L/min/m, and 516 wells (5.2%) had specific capacities of more than 50.0 L/min/m.

The Gott Enterprises Inc. (Amaranth) Site is located within the mapped areas of the Amabel/Gasport, Lockport and Guelph Formations. These Formations provide a high-capacity bedrock aquifer source in the Niagara Peninsula and in the area between Hamilton and Owen Sound (Turner, 1976, as cited by Singer et al., 2003). The Amabel, Lockport and Guelph aquifer is described by Turner (1976, as cited by Singer, 2003) as having highly variable permeability, due primarily to a fracturing and chemical dissolution of the upper few metres of dolomite; as such, most domestic wells obtain adequate water supplies at depths of less than 3 m into bedrock and there is good potential for developing high-capacity wells in the aquifer. Areas with the highest well yields in the Amabel/Gasport, Lockport and Guelph aquifer, outside of the major urbanized areas, are located in the vicinity of the towns of Fergus-Elora, Arthur and Dundalk, and in the townships of Puslinch, Erin, Amaranth and East Luther (Sibul et al., 1980, as cited by Singer et al., 2003).

The Orangeville Moraine, present within the Nottawasaga Valley CA watershed in the Town of Mono and Township of Amaranth, forms a regional significant recharge area, and is the headwater area of the Nottawasaga River (SGBLSSPC, 2015).

The well head protection areas (WHPA for water quality) for the municipal well systems located in the regional study area are reproduced in Figure 4-2. The WHPA mapping outlines time-of-travel (TOT) zones for groundwater captured by the municipal wells as indicators of the relative level of risk for water quality impact from land development activities within each zone. The mapped WHPA areas on Figure 4-2 are useful indicators of regional groundwater flow conditions. For Shelburne, north of the Site, the

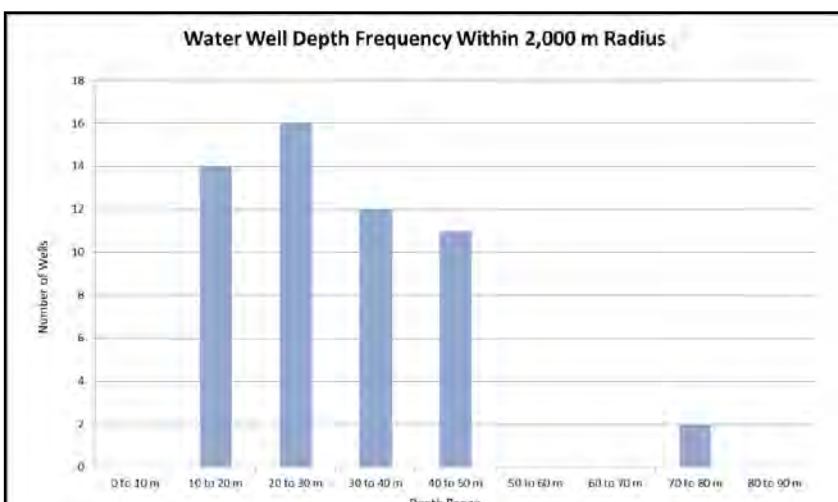
WHPA generally extend to the west or southwest of the municipal wells indicating that regional groundwater flow for the bedrock/overburden contact aquifer and deeper bedrock aquifer utilized by the municipal wells is towards the east. A similar regional groundwater flow direction to the east is indicated by the mapped WHPA for the municipal wells located in the west end of Orangeville (located south of the Site).

4.3.4.2 Local Hydrogeology

Properties in the majority of the Township of Amaranth are serviced by individual private well water supply. The MECP WWIS database was reviewed for well locations situated within 2,000 m of the Gott Enterprises Inc. (Amaranth) production wells. A 2,000 m search radius was considered appropriate based on the observed density for water well records in this search area. Water well record locations as referenced in the WWIS are plotted on Figure 4-1. A total of 55 well construction records for supply wells were identified (i.e. monitoring wells and well abandonment records were omitted) with reported well construction depths ranging from 12.2 to 78.6 m. The database indicates that two of the wells are completed in overburden, 13 are of unknown type, and the remaining 40 are completed in bedrock. Upon review of the original well records, it was determined that one of the 'overburden' wells was completed in bedrock, and 11 of the 13 'unknown type' wells were also completed in bedrock; as such, all but three wells within a 2,000 m radius of the Gott Enterprises Inc. (Amaranth) are reported as being completed in bedrock, and only one well is reported to be completed in overburden.

The frequency distribution in water well depths within the 2,000 m search radius is provided in the chart below, indicating that all but 2 wells are between 10 and 50 m in depth and the majority of wells (30 of 55 wells) are between 10 and 30 m in depth. These wells are inferred to be drawing water from a shallow bedrock aquifer situated less than 20 m into bedrock, similar to wells PW3, PW4, and PW5 at the Gott Enterprises Inc. Site.

Text Figure 4-1: Gott Enterprises Inc. Amaranth - Local Water Wells Depth Frequency



Overburden materials are most commonly described in the well records as consisting primarily of sand, silt, clay and gravel with varying textural descriptions and with reported layer thicknesses ranging from <1 m to >10 m. The overburden well (well ID no. 1702697) is situated approximately 860 m southwest of the Gott Enterprises Inc. (Amaranth) Site, at a location that is a topographic high (i.e. approximately 10 to 20 m higher in elevation than surrounding areas) and likely a drumlin or moraine feature. A gravel and sand aquifer at approximately 14.3 m depth is indicated by the well record for the overburden well.

One of the two wells with depths exceeding 70 m is located on the Gott Enterprises Inc. (Amaranth) Site, and corresponds to former production well PW2 (Well ID No. 1704766). The water well record for PW2 indicates a total well depth of 78.6 m, in which water bearing zones were observed at depths of 14.9 to 16.5 m, 33.5 m, 40.5 m, 51.8 and 62.8 m. A static water level of 5.5 m bgs was reported. The well was pumped for 1.5 hours at 25 gpm; the total drawdown was not specified, but a water level of 8.5 m was reported 15 minutes into the recovery test. The water well record indicates a recommended pumping rate of 95 L/minute (25 gpm).

A second deep well (Well ID. No. 1705250) is reported to be a domestic water supply well located 1 km northwest of the Gott Enterprises Inc. (Amaranth) Site and is constructed to a reported depth of 71.6 m. A water bearing zone was reported at a depth of 70.7 m. The water well record reports a static water level of 10.1 m bgs; the well was pumped for 1.5 hours at 10 gpm, and 1.2 m of drawdown was observed.

Though groundwater is reportedly found in useful quantities within both the overburden and the bedrock in the vicinity of the Gott Enterprises Inc. (Amaranth) Site, the overburden yields are comparatively lower due to fine-grained overburden material (Ian D. Wilson Associates Limited, 2001).

4.3.4.3 Site Hydrogeology

Six technical reports were identified in MECP files providing hydrological and hydrogeological information for the Gott Enterprises Inc. (Amaranth) Site. Salient information derived from these reports is summarized as follows.

<u>Well Evaluation – Well 1 (Ian D. Wilson Associates Limited, 1988)</u>

Well 1, constructed in 1988, was test-pumped in November of that year, at a rate of 55 L/minute for a 24-hour period. During testing, water levels were measured at four off-site private wells on occasion during the test. The water level in the pumping well, Well 1, lowered 1.63 m during the first minute of pumping and then more or less stabilized after 9 hours of pumping and with a drawdown of 3.80 m. The final water level measured at the end of pumping was 9.74 m below ground surface (bgs), and approximately 27.5 m above the water-producing zone in the bedrock. Recovery was relatively rapid, with the water level returned to within 0.24 m of the original static level (5.94 m bgs) in one hour after pump shut off.

During the pump test, water levels in the private wells were observed to have experienced decreases ranging from 0.79 m (at a location 250 m away from the pumped well) to 0.04 m (at a location 350 m away from the pumped well). No complaints of interference with local water supplies were reported during the test.

Well 1 was determined to have a safe perennial yield in excess of 55 L/minute, and the operation of the well was not expected to disrupt other groundwater supplies in the area.

Water Supply Evaluation – PW2 and PW3 (Ian D. Wilson Associates Limited, September 1994)

Wells PW2 and PW3 were constructed in August 1994 to support a planned expansion of Fernbrook's water bottling operation. A pumping test involving the combined pumping of Well 1, PW2 and PW3 was conducted in September 1994. The wells were pumped at rates of 68 L/minute (Well 1), 91 L/minute (PW2), and 136 L/minute (PW3). Well 1 was pumped for 24 hours during which all 3 wells were pumped together for a total of 21.3-hour period. Pumping of Well 1 was initiated on its own first while pumping of PW3 was initiated after 70 minutes into the test followed by PW2 after 160 minutes into the test. Water levels were recorded in all 3 wells on a regular basis while water levels were recorded in 4 nearby off-site private wells on occasion.

During the pumping test, water level drawdown in the private wells were observed to range from 1.81 m (at a location 100 m away from Well 1) to 0.26 m (at a location 350 m away from Well 1). No complaints of interference with local water supplies were reported during the test. The report concluded based on the distance-drawdown curve that zero drawdown or the limit of interference occurred approximately 510 m to the east of the production wells, and possibly 1,100 m to the northwest. Using a radius of 1,100 m the surface area of the cone of influence was determined to be 3.8×10^6 m^2. Ian D. Wilson Associates Limited (1994) noted that, assuming an infiltration rate of 125 mm per year (silty till), a total of approximately 4.75×10^8 L of water could infiltrate the estimated area of the cone of influence, annually. If the three production wells were to operate continuously at 295 L/minute (a higher rate than the permitted withdrawal rate of 227 L/minute), the total annual withdrawal would be 33% of the assumed recharge for the bedrock aquifer.

Ian D. Wilson Associates Limited, September 1994 concluded that the safe perennial yields of Well 1, PW2 and PW3 are 68 L/minute, 91 L/minute, and 136 L/minute, respectively for a total well field yield of 295 L/minute and all three wells can operate together.

Surface Water Evaluation – Myers Drain (Ian D. Wilson Associates Limited, April 1995 and November 1995)

Per the conditions of PTTW 94-P-2060, issued for production wells PW2 and PW3, a study plan was prepared to measure and quantify the short and long-term impacts of the takings at PW2 and PW3 on local area surface waters and wetlands.

The focus of the study plan was the Myers Drain, located in the southern portion of the property (400 m south of the well field), and a wetland located north of Myers Drain. In January 1995, a substrate mapping study was completed, and three nests of streambed and wetland standpipe piezometers were installed: one nest was installed at the west property boundary, where the Myers Drain enters the property, and another nest was installed at the east property boundary, where the drain exits the property. The third nest was installed in the wetland.

Thick organic muck was observed within the drain, with the substrate transitioning (from west to east) from sand to silt. These observations seemed to indicate that little groundwater upwelling occurred in the drain. Water levels in the west standpipe piezometers suggested the presence of an upward hydraulic gradient while little vertical hydraulic gradient was observed at the east piezometer nest location where fine textured overburden materials were more prevalent. To evaluate long term impacts, water levels in the piezometers were monitored from January 23 to October 12, 1995; water levels at the western piezometers were also logged at 5-minute intervals for a period of one week. Over the course of the monitoring program, a consistent upward hydraulic gradient was present during all observations at the western piezometer nest. At the eastern piezometer nest, a neutral or slightly upward hydraulic gradient was present during all observations. At the wetland site, a slight upward hydraulic gradient was observed during the spring, but this changed to a downward gradient during the summer. A slight upward hydraulic gradient was observed at the time of the final observation on October 26. Ponded water was also observed around the piezometers at the beginning of the monitoring program, but the land was completely dry at the surface in September. This was believed to be a natural phenomenon and not the result of well operations. The assessment concluded that the operation of the production wells was not having a measurable impact on the base flow to the Myers Drain or the associated wetlands, and that the shallow groundwater stage in the vicinity of the drain is influenced by diurnal changes and overall climatic variations.

<u>Well Evaluation, PW4 (Ian D. Wilson Associates Limited, February 2001)</u>

PW4 was constructed in November 2000 as a proposed replacement for Well 1. A 24-hour pumping test was conducted in December 2000, during which PW4 was pumped at a rate of 91 L/minute for the first half hour, 155 L/minute for the next 50 minutes, and then 227 L/minute for the remainder of the test. Observation water levels were obtained periodically at PW4, the nearby well PW3, at five off-site domestic wells, and at two sets of streambed piezometers in the Myers Drain. Production wells PW2 and PW3 were in operation prior to, and during most of (but not continuously throughout) the test, to maintain bottling production. As a result, water levels in the off-site wells were under the influence of pumping from PW2 and PW3 prior to and during the PW4 pumping test, and the off-site wells experienced recovery during portions of the test when PW2 and PW3 were not operating.

The water level in PW4 lowered 2.37 m during the first minute of pumping at 91 L/minute. The total drawdown during the test was 10.96 m, representing approximately 58% of the total available drawdown in the well. Following the completion of pumping, the water level in PW4 recovered relatively quickly, returning to 0.18 m below the original static water level (i.e. a 98% recovery) within 60 minutes following the end of pumping. Water levels of only two of the five off-site wells were significantly influenced by the pumping of PW4. Drawdowns of 0.38 m and 0.315 m were observed at wells located 220 m and 175 m (respectively) east of PW4. There were no complaints of water supply disruption during the pumping test, and the risk of adverse off-site water level impacts caused by the operation of PW4 was considered low.

During the pumping test, water levels in the streambed piezometers and streamflow in the Myers Drain were measured at the start of the test, and again 6.58 hours, 16.95 hours and 23.75 hours into the test. All the piezometers froze before or during the test. Before being found frozen 23.75 hours into the test, the shallow piezometer at GS1 (at the west property boundary) did not appear to be impacted by the pumping, with its water level staying within 0.67 and 0.71 m below measuring point. Streamflow at GS1 increased from 73 to 98 L/minute in the first 6.58 hours of pumping, descending to 83 L/minute after 23.75 hours. Streamflow at GS2 (at the east property boundary line) was generally stable at around 162 L/minute, but was observed to temporarily drop to 141 L/minute when measured 16.95 hours into the test. The streamflow returned to 162 L/minute when measured 23.75 hours into the test, so Ian D. Wilson Associates Limited (2001) speculated it was the result of the drop in temperature overnight.

Ian D. Wilson Associates Limited, February 2001 concluded that the risk for adverse impact to the function of the Myers Drain was low for the following reasons:

- At the location of wells PW2, PW3, and PW4, the bedrock aquifer is isolated from surface water resources by 12.5 to 21 m of overburden, consisting mainly of fine-grained deposits of generally low permeability, that would limit the likelihood of direct hydraulic connection with the surface;
- The coefficient of storage of the bedrock aquifer, as calculated for two of the off-site domestic wells, was low, at $5x10^{-5}$, indicative of confined aquifer conditions. It was noted that pumping from a confined aquifer generally has a low probability of impacting the function of surface water bodies; and
- The Myers Drain was estimated to be located at or beyond the limit of the cone of influence of the bedrock wells, where the potential for impact was considered low.

<u>Well Field Evaluation – PW2, PW3 and PW4 (Ian D. Wilson Associates Limited, December 2001)</u>

In accordance with the permit conditions of PTTW 01-P-2136, issued in May 2001, a monitoring well (MW1) was installed on the eastern property boundary, and a simultaneous pumping test was conducted on PW2, PW3 and PW4 in November 2001. By this time, Well 1 was removed from service, and was being used to service a single residence on the Fernbrook property. The wells were pumped at rates of 91 L/minute (PW2), 136 L/minute (PW3), and 227 L/minute (PW4). PW2 was pumped for 24 hours during which all 3 wells were pumped together for a total of 22.7-hour period. Pumping of PW2 was initiated on its own first while pumping of PW3 was initiated after 41 minutes into the test followed by PW4 after 76 minutes into the test.

During the pumping test, water levels were observed continuously in MW1, and on a regular basis in the 3 production wells, the former Well 1, five off-site domestic wells, and in streambed piezometers on the Myers Drain. The off-site domestic well locations range from 90 m (OW4) to 690 m (OW6) from the pumping wells.

The total water level drawdown at PW2 was 20.78 m. In comparison, the total drawdown observed during the 1994 well testing program, where Wells 1, PW2 and PW3 were pumped, was 13.07 m. The increased drawdown was attributed to well deterioration, as the majority of the drawdown occurred before PW3 and PW4 commenced pumping, and relatively minor impact on the water level drawdown trend occurred after pumping from PW3 and PW4 was started.

The total drawdown in PW3 was 14.06 m, less than the drawdown observed in 1994, where it was 17.21 m. The decreased drawdown was deemed to be "likely indicative of well development since construction".

During the pumping test, water level interference in off-site domestic wells ranged from 1.5 m (at a distance of 90 m from the closest production well), to approximately 0.5 m (at a distance of 200 to 250 m from the closest production well). The degree of interference was considered minor in relation to the available drawdown in wells completed in the bedrock aquifer, and was not expected to result in disruptive off-site water level interference, provided pump settings are adequately deep.

With a maximum water level drawdown of 1.28 m, the water level in MW1 remained well above the upper water bearing zone in the bedrock aquifer (located 11.9 m below grade) during the pumping test. There was also no apparent impact on the water level in the streambed piezometers or the surface water level of Myers Drain.

Based on the well field pumping test results the report concluded that the safe yields of PW2, PW3 and PW4 to be 91, 137, and 227 L/minute, respectively.

Monitoring Program Status Report 2011-2015 (Ian D. Wilson Associates Limited, April 2016)

Production Well and Monitoring Well Water Level trends: Variability in water levels for the production wells was attributed to reductions in well efficiency and not due to aquifer impacts. In particular, Well PW4 was observed to have an increased drawdown immediately after pump start-up and prior to the water level stabilizing in the well. The report concluded that water levels in the production wells remained well above the bedrock aquifer system.

Overall, monitoring well water levels (both for off-site domestic wells and on-site well MW1) for the 2011 to 2015 monitoring period were consistent with historical levels, fluctuating seasonally between 1 and 2 m and with no long term trends. One off-site well (OW5) was rendered inaccessible due to modifications by the homeowner's plumber. The report concluded that no off-site water supplies were at risk.

Long Term Trends for Myers Drain: Regular monitoring of water levels in the streambed piezometers, stream stage and streamflow at GS1 and GS2 (at the west and east property boundary lines, respectively) began in 1999 and is ongoing (Ian D. Wilson Associates Limited, April 2016). Monitoring was initially on a quarterly basis, but as of 2001, PTTW requirements increased the frequency of monitoring to monthly.

The condition of Myers Drain within the Gott Enterprises Inc. (Amaranth) Site was reported to have become progressively deteriorated, heavily vegetated and filled in. Water levels at the upstream GS1 station have slowly increased compared to historical levels, though levels at the downstream GS2 have remained relatively consistent with historical levels, possibly the result of the Drain downstream of GS2 being rehabilitated in the mid-2000s (Ian D. Wilson Associates Limited, April 2016).

Stream flow in the Myers Drain generally peaks during snowmelt or high precipitation conditions, with flows significantly exceeding 1,000 L/minute, while baseflow in summer months is normally in the range of 100 L/minute (Ian D. Wilson Associates Limited, April 2016). No long-term trends in the stream flow data were identified that would indicate obvious impacts on the Myers Drain as a result of water withdrawals from the production wells (Ian D. Wilson Associates Limited, April 2016).

<u>Application for Permit to Take Water Amendment – PTTW 2773-9G2RXX, Addition of Well 5 and Removal of Well 2 (Wilson, February 2018)</u>

This letter is submitted in support of replacing Well 2 (i.e. PW2) with Well 5 (i.e. PW5) due to the deterioration in performance of PW2. PW5 was installed 135 m southeast of PW2. The letter indicates that the requested water taking limit for PW5 is identical to PW2, PW5 is completed in the same geological setting as PW2 (upper portions of the Amabel bedrock aquifer), and the water produced from both wells is of similar quality. The letter indicates PW5 (43.0 m deep) is not as deep as PW2 (78.6 m deep) because of the "better-yielding character of the upper bedrock water-bearing zones encountered at PW5."

In response to the Wilson, February 2018 letter PTTW No. 7535-AQBNX8 was issued to Gott Enterprises Inc. on February 23, 2018, with an expiry date of July 31, 2021. The amended Permit specifies a permitted withdrawal rate of 227 L/minute (327,000 L/day) for PW5 and PW3 as a combined total.

4.4 DATA REVIEW AND STATE OF GROUNDWATER RESOURCES

The following section provides a review of the Ontario water quantity management framework data for the Gott Enterprises Inc. (Amaranth) study area that is presently available to MECP for making water management decisions.

4.4.1 Water Taking Reporting System

The Water Taking Reporting System (WTRS) is the ministry's repository for the collection of water taking data for active Permits to Take Water (PTTW). As a requirement of each PTTW, the water taking data must be reported on an annual basis and daily water taking data must be entered into the system. The WTRS is not publicly available, but is available for use by ministry staff when assessing the status of a PTTW or addressing potential issues associated with a PTTW. The WTRS data was provided by the ministry for use in the WBSA assessment to be inclusive of all information available to MECP for making water management decisions.

Data on the volume of water taken per year and the number of water taking days per year for the Gott Enterprises Inc. (Amaranth) well site was obtained from the MECP Water Taking Reporting System (WTRS), for review. Table 4-3 below includes annual water taking data for the period from 2007 to 2017.

Table 4-3: Gott Enterprises Inc. Amaranth - Reported Water Takings

Permit Number	Year	Source Name [1]	Annual amount permitted by the PTTW (Million L)	Reported No. of Days Taken per Year	Reported annual taking (Million L)	Reported annual taking (% of permitted amount)	Average reported volume taken per day (L/day)
4603-6JPLS6	2007	Well 2 & Well 3	119.355	249	72.76	61%	292,224
		Well 4	119.355	226	90.59	76%	400,839
6438-7AAJKP	2008	Well 2 & Well 3	119.355	157	29.44	25%	187,486
		Well 4	119.355	201	65.16	55%	324,170
6438-7AAJKP	2009	Well 2 & Well 3	119.355	See Note A below			
		Well 4	119.355	See Note A below			
6438-7AAJKP	2010	Well 2 & Well 3	119.355	227	85.29	71%	375,714
		PW4	119.355	222	87.66	73%	394,860
3406-8D9LCV	2011	PW2 and PW3	119.355	227	77.50	65%	341,389
		PW4	119.355	225	82.39	69%	366,168
3406-8D9LCV	2012	PW2 and PW3	119.355	235	81.88	69%	348,399
		PW4	119.355	233	85.62	72%	367,470
3406-8D9LCV	2013	PW2 and PW3	119.355	208	73.11	61%	351,505
		PW4	119.355	233	84.60	71%	363,101

Permit Number	Year	Source Name [1]	Annual amount permitted by the PTTW (Million L)	Reported No. of Days Taken per Year	Reported annual taking (Million L)	Reported annual taking (% of permitted amount)	Average reported volume taken per day (L/day)
3406-8D9LCV	2014	PW2 and PW3	119.355	20	10.45	9% [B]	522,380
		PW4	119.355	20	10.27	9% [B]	513,560
2773-9G2RXX	2014	PW2 and PW3	119.355	224	94.02	79%	419,731
		PW4	119.355	224	97.97	82%	437,378
2773-9G2RXX	2015	PW2 and PW3	119.355	364	81.86	69%	224,882
		PW4	119.355	365	90.78	76%	248,712
2773-9G2RXX	2016	PW2 and PW3	119.355	360	80.19	67%	222,741
		PW4	119.355	360	102.00	85%	283,354
2773-9G2RXX	2017	PW2 and PW3	119.355	357	76.88	64%	215,356
		PW4	119.355	348	95.70	80%	275,011

[1] Well 2, Well 3 and Well 4 were later renamed to PW2, PW3 and PW4, respectively.
[A] Information on total water takings for 2009 was not available in the WTRS. However, water takings are known to have occurred that year, as the 2009 Status Report (Ian D. Wilson Associates Ltd., 2010) provides daily water taking volumes and rates for that year.
[B] PTTW 3406-8D9LCV expired on February 6, 2014, and was replaced by PTTW 2773-9G2RXX.

As indicated in Table 4-3, annual water takings during the 2007 to 2017 period often exceeded 60% of the PTTW annual taking limit of 119.355 million litres, reaching as high as 85% for PW4 in 2016. Of note for the period 2007 to 2017, the maximum permitted withdrawal amounts for PW2 and PW3 (combined) was 327,000 L/day and for PW4 was 327,000 L/day; however, the average reported withdrawal amounts repeatedly exceeded the daily limit between 2007 and 2014. In the Permit Holder's annual status reports, they provided a couple of explanations for the reported exceedances in daily withdrawal amounts:

- Up until May 2008, daily withdrawals were manually recorded on regular business days, even though water often continued to be pumped throughout the weekends. Weekend totals were recorded for the following Monday, with "no takings" reported for Saturday and Sunday; and
- In consultation with the ministry, flow recording dataloggers were installed in late May 2008, which would record instantaneous flow rates and cumulative flows. The Permit Holder noted having experienced technical issues with the recording equipment, where discrepancies repeatedly appeared between the instantaneous flow rates (in L/minute) and the cumulative flows (in L); namely, the maximum flow rate of 227 L/minute was apparently never exceeded, but the daily withdrawals repeatedly appeared to exceed 327,000 L/day. Attempts to address the issue in 2010 were not successful.

The average reported daily taking for the period 2011 to 2014, as calculated from WTRS data, consistently exceeded 327,000 L/day. In contrast, the Monitoring Program Status Report for 2011 – 2015 reported no exceedances of maximum daily withdrawals during that same period; a review of the daily withdrawals in the report appendix show that the daily withdrawals were prorated from the instantaneous flow rate, rather than being calculated from cumulative flows as was done in the past.

An explanation for the discrepancy in reporting is not offered in the Status Report, but may be attributed to different calculation methods used by the previous owner (Fern Brook Springs Bottled Water Co. Ltd.) compared to the current owner (Gott Enterprises Inc.), who acquired the property and wells in late 2013. From 2015 to 2017, the average reported daily withdrawals, as calculated from WTRS data, remained below the 327,000 L/day limit.

The assessed study area for review of other active PTTW was set at a 5 km radius of Gott Enterprises Inc. (Amaranth) well field. The 5 km radius was considered appropriate for review based on the density of active PTTW in the area and as a conservative distance for any potential contribution from the Site on the cumulative impacts from multiple water takings. Five other active PTTWs are located within 5 km of the Gott Enterprises Inc. (Amaranth) Site (Figure 4-2). The 2016 and 2017 WTRS data for each of these sites is summarized in Table 4-4.

Table 4-4: Gott Enterprises Inc. Amaranth - Neighbouring PTTWs

Permit Holder (Permit no.)	Issue Date	End Date	Source	Dist. from Gott Wells (Km)	PTTW Limits			2016 WTRS Data [1]		2017 WTRS Data [1]	
					Max. taken per day (L)	Taking Days per Year	Annual Taking (Million L)	Annual Reported Taking (Million L)	Annual Reported Taking (% of PTTW Limit)	Annual Reported Taking (Million L)	Annual Reported Taking (% of PTTW Limit)
Ducks Unlimited Canada (1250-7YDNFU)	Dec. 4, 2009	Sept. 30, 2019	Src01 - Wetland 1	3.8	245,000	365	89.4	-	-	-	-
			Src02 - Wetland 2	4	137,000	365	50.0	-	-	-	-
			Src03 - Wetland 3	3.8	379,000	365	138.3	-	-	-	-
Ducks Unlimited Canada (5135-7YDRUT)	Dec. 4, 2009	Sept. 30, 2019	Src01 - Rosin South Wetland #4	4.9	853,000	365	311.3	-	-	-	-
Kenneth Rosin (5606-8KSKST)	Oct. 31, 2011	Sept. 30, 2021	Src01 - Rosin Pond 1	3.8	245,000	365	89.4	-	-	-	-
			Src02 - Rosin Pond 2	4	137,000	365	50.0	-	-	-	-
			Src03 - Rosin Pond 3	3.8	379,000	365	138.3	-	-	-	-
			Src04 - Rosin Pond 4	4	368,000	365	134.3	-	-	-	-
			Src05 - Rosin Pond 5	4.1	448,000	365	163.5	-	-	-	-

Permit Holder (Permit no.)	Issue Date	End Date	Source	Dist. from Gott Wells (Km)	PTTW Limits			2016 WTRS Data		2017 WTRS Data	
					Max. taken per day (L)	Taking Days per Year	Annual Taking (Million L)	Annual Reported Taking (Million L)	Annual Reported Taking (% of PTTW Limit)	Annual Reported Taking (Million L)	Annual Reported Taking (% of PTTW Limit)
Kenneth Rosin (6700-9EJLMH)	Jan. 8, 2014	Sept 30, 2024	Src01 - Rosin Pond 1	3.8	245,000	365	89.4	-	-	-	-
			Src02 - Rosin Pond 2	4	137,000	365	50.0	-	-	-	-
			Src03 - Rosin Pond 3	3.8	379,000	365	138.3	-	-	-	-
			Src04 - Rosin Pond 4	4	368,000	365	134.3	-	-	-	-
			Src05 - Rosin Pond 5	4.1	448,000	365	163.5	-	-	-	-
			Src06 - Rosin Pond 6	3.6	1,127,000	365	411.3	-	-	-	-
The Corp. of the Town of Shelburne (5632-A4JLLD)[2]	Dec. 3, 2015	May 31, 2018	Src01 - PW1 #17-0845	4.2	1,642,000	365	599.3	99.0	17%	67.4	11%
			Src02 - PW3	5.2	1,309,000	365	477.8	182.5	38%	123.3	26%
			Src03 - PW5 #17-04712	4.5	1,964,000	365	716.9	123.5	17%	101.5	14%
			Src04 - PW6 #17-04107	4.5	1,964,000	365	716.9	133.1	19%	102.8	14%

[1] A hyphen (-) indicates that no taking was reported in the WTRS.

[2] PTTW 5632-A4JLLD was replaced by PTTW 1353-AZHJCQ, issued on June 7, 2018. The new permit allows water to be withdrawn from six sources: PW1, PW3, PW5, PW6, PW7 and PW8.

Four of the neighbouring active PTTWs are surface water takings for the maintenance of wetlands and ponds located between 3.6 and 4.9 km to the south-southeast, for recreational and conservation purposes. As indicated in Table 4-4, no takings were reported for these PTTWs in 2016 and 2017. The fifth active PTTW within a 5 km radius of the Site is for municipal water supply for the Town of Shelburne, which is located approximately 4.5 km to the north-northwest. Under the former permit 5632-A4JLLD, the Town of Shelburne was permitted to take groundwater from four wells; the permit allowed a cumulative withdrawal of up to 6.9 million L/day, or 2.5 billion L/year, from the four wells (the current permit 1353-AZHJCQ allows a cumulative withdrawal of 10.1 million L/day from six wells). In 2016 and 2017, approximately 21.4% and 15.7% (respectively) of the maximum permitted annual volume of water was withdrawn. In comparison, the Gott Enterprises Inc. (Amaranth) Site PTTW taking limit (654,000 L/day for PW2, PW3 and PW4 combined) is about 6.5% of the 2018 permitted taking limit of the Town of Shelburne. Wells PW7 and PW8 are completed into the deeper Gasport Aquifer while PW1, PW3, PW5, and PW6 draw water from the bedrock/overburden contact aquifer, through PW3 draws some water from deeper fractures in the bedrock. As indicated by the mapped WHPA in Figure 4-2, the Shelburne wells are drawing water derived from the west and southwest of the production wells. Since the mapped WHPA for the Shelburne wells are more than 3 km from the Gott Enterprises Inc. Amaranth wellfield, no cumulative impacts from both water takings would be expected.

4.4.2 Provincial Groundwater Monitoring Network

The Provincial Groundwater Monitoring Network (PGMN) is a partnership program with all 36 CAs and 10 municipalities (in areas not covered by a conservation authority) to collect and manage ambient (baseline) groundwater level and quality information from key aquifers located across Ontario. During the spring and summer of 1999, low water conditions in many parts of southern Ontario prompted the formation of an inter-ministerial task force to assess drought conditions, determine trigger levels and develop a response strategy. The PGMN was approved in 2000 and there are currently more than 450 monitoring wells in the network.

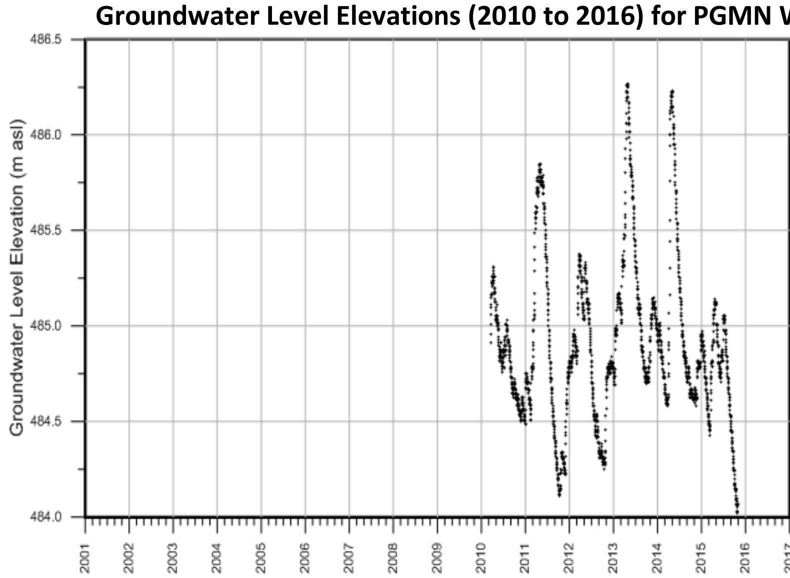
The PGMN datasets report on ambient (baseline) groundwater level and chemistry conditions. The PGMN well locations are typically sited to be away from areas where there is a large density of permitted water takings. Consequently, the PGMN wells are typically far too distant from any permitted water taking to be used as an indicator of potential well interference impacts.

Water level data collected for the PGMN wells is of potential value in assessing regional groundwater level trends as an indicator of stress within the watershed/subwatershed. Data has been collected for the PGMN well network since 2001 though some wells were installed more recent than this. Also the data for some wells is not current to 2018. The Provincial Groundwater Monitoring Network database is made available by MECP on-line.

As a recent internal project the MECP has applied the Mann-Kendall (MK) and Seasonal Kendall (SK) tests to analyze the PGMN water level data for monotonic trends (i.e. consistently increases or decreases through time). The statistical analyses were performed using robust and defensible methodologies to look for longer-term trends in groundwater levels. An overall objective is to determine if there is enough data to support the presence of a widespread decrease in groundwater availability. Shorter trends within the PGMN data record (i.e. lasting for a few years) were not considered and the causes of any trends that were identified were not investigated. Both the data plots and preliminary findings for PGMN well locations nearest a WBSA were shared by the ministry and are presented and relied on herein. The data plots indicate data available for the well at the time of the assessment. Further, the MECP has indicated that the methodologies used require that certain values be dropped from the data set if the month/year in question does not have sufficient number of data points. The release of a final report that details the methodology and results from the PGMN data trends analysis is forthcoming from the ministry (MECP, 2018).

One PGMN well is located within 10 km of the Gott Enterprises Inc. (Amaranth) Site: PGMN well W0000486-1 is an overburden well located approximately 8.6 km to the south-southeast. The Well is completed to a depth of 21.99 m, and is located at an elevation of 197.29 m above sea level (asl). The lithology of the overburden aquifer is described as sand and gravel. The well record ID for PGMN well W0000486-1 is not reported in the PGMN database. At 8.6 km the well location is too distant from the Site to be influenced by the water taking. Also, as an overburden well it is subject to different hydraulic influences than the bedrock aquifer used for the Site. Consequently, the water level data for PGMN well W0000486-1 is only of potential value in assessing regional groundwater level trends within the overburden aquifer of the watershed/subwatershed. The provided data plot and trend analyses for the overburden PGMN well W0000486-1 are provided as follows.

Text Figure 4-2: Groundwater Level Elevations (2010 to 2016) for PGMN Well W0000486-1



For PGMN well No. W0000486-1, the MK test (year over year) did not detect a significant trend, using 5 years of data. The SK test (season to season) also did not detect a significant trend, based on 66 months of data. Visual analysis of the data plot does not identify any specific trends other than it is noted that the seasonal fluctuation in water level has been up to 1.75 m in 3 of 6 years.

Based on the PGMN data review, no existing PGMN wells completed in bedrock were identified for a 10 km radius of the Site. The data trend analyses provided by MECP for PGMN well No. W0000486-1, did not detect any seasonal or year over year trends for this overburden well located 8.6 km from the Site well location.

4.4.3 Ontario Low Water Response (OLWR) Program

The OLWR program was initiated in 2000 and is managed by the Ministry of Natural Resources and Forestry (MNRF). The program relies on the use of real time surface water monitoring data collected through the Surface Water Monitoring Centre and utilizing the Water Survey of Canada (WSC) stream gauge (HYDAT) station network to identify potential drought conditions based on set trigger levels. Presently, static groundwater level elevation data from the PGMN program is not a component of the OLWR program. Reportedly, this may be added to the program in future.

OLWR notifications are typically (i.e. not always) released in the last week of each month after a review of data for the previous weeks in the month. When trigger levels are identified for a monitoring station, the OLWR submits a notification to the respective CA or municipality. Based on its review of the OLWR data that accompanies the notification, combined with a review of local factors that include recent precipitation and reports of water shortfalls for surface water and well water supplies a Low Water Conditions Alert 'may' be posted by the CA/municipality. A CA or municipality may also choose to post an Alert without any OLWR notification. Decreases in water takings that are triggered by the declaration of Level 1, 2 and 3 Low Water Condition are as follows:

- Level 1 - A voluntary reduction of 10%
- Level 2 – A voluntary reduction of 10%, to achieve a 20% reduction;
- Level 3 – Reduce and manage water use demands to the maximum extent through regulatory measures, if required.

Note: Specific Permits to Take Water may have conditions requiring mandatory reductions of water takings during low water events. Upon renewal of their water bottling permit, the above decreases will be mandatory based on 3-month average actual flow as outlined in the guidance for bottled water renewals (MOECC, 2017).

The frequency of OLWR notifications over time can be a potential indicator of climate stress trends for surface water (and possibly shallow groundwater where directly connected to surface water), and an indicator of watershed/subwatersheds that are sensitive to seasonal drought conditions. However, the existing OLWR program database has not been prepared for this purpose, has inconsistencies that are attributed to different persons updating the database over the years, and the database does not provide notification Levels during the time period where a Low Water Alert has been declared by a CA/municipality. This is only indicated in the database as an 'Update'. Consequently, only a general review of the information in the OLWR database is provided herein for the geographic CA/municipality relevant to the Site.

A review of the OLWR database for the Nottawasaga Valley CA indicates that a total of 23 Level 1 notifications and two Level 2 notifications were sent to the Nottawasaga Valley CA between 2000 and August 2018. More than one notification was issued in the same calendar year for 2002 (3 notifications), 2003 (3 notifications), 2006 (3 notifications), 2010 (4 notifications), 2012 (3 notifications), 2015 (3 notifications), and 2016 (3 notifications, including two Level 2 notifications). Between 2000 and August 2018, the Nottawasaga Valley CA posted a Level 1 Low Water Condition Alert for a cumulative total of approximately 25 months; Level 1 Alerts extending for more than 4 consecutive months occurred in 2001 (July to November), 2005 (August to December), and 2007 (June to November). While two Level 2 notifications were issued in September 2016, the Nottawasaga Valley CA has not issued any Level 2 Alerts between 2000 and August 2018. The frequency of OLWR notifications over time do not indicate any specific climate change trends, though Level 2 notifications have only been issued recently in 2016.

4.4.4 Water Budget Analyses

The Assessment Report for the Nottawasaga Valley Source Protection Area (SGBLSSPC, 2015) indicates that a Conceptual/Tier 1 Water Budget was completed for the portion of the Township of Amaranth located within the Nottawasaga River watershed. The Tier 1 water budget expands on the findings of the conceptual water budget by calculating water budgets at smaller spatial scales and by assigning water quantity stress levels to each subwatershed in the study area. The Tier 1 Water Budget estimates how much water exists in a subwatershed over a period of time, usually monthly and yearly. It accounts for water that is being added to a watershed, such as precipitation and removed (e.g. rivers flowing out) from a watershed. Water demand estimates include water takings that require a permit and those that do not require a permit. Water demands in the future are predicted by scaling up existing demand in proportion to the estimated future population as estimated from population projection data. The objective of the Tier 1 is to be conservative to ensure that all possible stress is identified. The further more refined Tier 2 is intended to confirm or negate this stress.

In the Upper Nottawasaga River subwatershed, in which the Gott Enterprises Inc. (Amaranth) site is located, the ground water stress level was determined to be low; the Assessment Report also notes that the portion of the Township of Amaranth located within the Nottawasaga River watershed has no municipal drinking water system.

Surface water stress levels in the Upper Nottawasaga River subwatershed are rated as Significant in July to August; most of the remainder of the Nottawasaga River watershed also experiences significant surface water stress levels in the summer, but over a longer time period (June to September) (SGBLSSPC, 2015). As the Township of Amaranth does not have a municipal drinking water system, it was not recommended for a Tier 2 stress assessment (SGBLSSPC, 2015). Since the water taking for the Site is from a confined bedrock aquifer its contribution as a source for surface water stress within the subwatershed is not considered significant.

4.5 Impact Assessment

The following section provides a general assessment of potential water quantity interference with other groundwater uses and the environment.

4.5.1 Municipal Groundwater Use

Within the Township of Amaranth, only the community of Waldemar is known to be serviced by a municipal groundwater system. Waldemar is located more than 15 km southwest of the Gott Enterprises Inc. (Amaranth) production wells. One of the supply wells for the City of Orangeville is located within the southeastern corner of the Township of Amaranth, with the supply well located approximately 14.5 km south-southeast of the Gott Enterprises Inc. (Amaranth) production wells. Based on the large separation distance the existing municipal groundwater systems are considered too distant for the Gott Enterprises Inc. (Amaranth) Site to be a concern for well interference.

The closest groundwater supply system is located in the neighbouring Town of Shelburne, with the supply wells being located between 4.3 km north to 6.7 km northwest of the Gott Enterprises Inc. (Amaranth) production wells. From the review of records, technical documentation and other sources of information summarized above, no potential concerns for well interference with the Shelburne groundwater supply system have been identified to date.

The Official Plan for the Township of Amaranth (June 2018) indicates that the communities of Laurel, Waldemar and Farmington, all located more than 9 km south and southwest of the study site, are intended to be the focus for residential and employment growth in the Township. The Town of Shelburne Official Plan (December 2017) forecasts a population increase from 7,650 to 10,000, from 2016 to 2031, respectively, and notes that the growth target will be contingent on demonstration of sufficient municipal water supply capacity and municipal wastewater treatment capacity to service this growth. No existing studies in support of development of new municipal water supply systems for the Township of Amaranth were identified though it is understood that the municipal Class EA has been initiated for this project.

In summary, the general assessment of potential water quantity interference with existing or planned municipal water supply systems did not identify any potential for unacceptable well interference and/or impediment to future expansion of existing municipal groundwater systems. The future expansion of the Township of Amaranth system will be based on the outcome of the municipal Class EA and were not available for consideration in this assessment.

4.5.2 Well Interference Potential

Regular monitoring of water levels in off-site domestic wells and one on-site monitoring well has been a condition of the PTTWs for the Gott Enterprises Inc. (Amaranth) Site since the early to mid-2000s; for three of the off-site domestic wells, monitoring data has been collected since 1988. Recent well monitoring data indicate that off-site water levels remain relatively high compared to the elevation of the bedrock aquifer, and the available drawdown in off-site wells completed in the bedrock aquifer remain significant (Ian D. Wilson Associates Ltd., April 2016).

In a simultaneous pumping test of production wells PW2, PW3 and PW4, conducted in November 2001, it was determined that the degree of well interference was considered minor in relation to the available drawdown in the off-site domestic wells, and was not expected to result in disruptive off-site water level interference, provided pump settings are adequately deep (Ian D. Wilson Associates Limited, 2001). One well interference complaint was identified in ministry files over the history of the water taking; in 1999, a landowner to the northwest complained that they were not getting water in their well. Upon investigation by Fernbrook's consultants, it was observed that the landowner was using a shallow well pump and should be using a submersible pump. The well was monitored from 1999 onwards, and corresponds to well OW3R in the current permit 7535-AQBNX8. Further to this, no well interference complaints were identified in ministry files over the history of the water taking.

In summary, the potential for adverse well interference with domestic wells is considered low and the need for additional quantitative prediction is not apparent. The existing groundwater level monitoring program in place serves to identify any possible changes to Site conditions.

4.5.3 Impact to Surface Water and Natural Functions of the Ecosystem

A surface water evaluation was completed in 1994 (Ian D. Wilson Associates Limited, February and November 1995) to assess the impacts of water takings at PW2 and PW3 on local area surface waters and wetlands. Piezometer nests were installed along the Myers Drain at the west and east property boundaries of the Gott Enterprises Inc. (Amaranth) Site, where the drain flows into and exits the property, respectively. It was determined that the Myers Drain exhibits a consistent upward hydraulic gradient at the western piezometer nest, and a neutral or slightly upward hydraulic gradient at the eastern piezometer nest. The hydraulic gradient of the wetland located north of Myers Drain varied from upward in the spring, to downward during the summer, and back up again in the fall; this was interpreted to be a natural phenomenon and not the result of production well operations.

From 1999 onwards, regular monitoring has been conducted for water levels at the stream and streambed piezometers in Myers Drain along with streamflow measurements. Water levels at the western monitoring location have slowly increased compared to historical levels, whereas water levels at the eastern monitoring location have remained relatively constant. These trends were attributed to a gradual deterioration in the efficiency of the drain (i.e. flow through the drain at the Site is being obstructed by the growth of vegetation), combined with the rehabilitation of sections of the drain downstream and east of the Gott Enterprises Inc. (Amaranth) Site. No long-term trends in the streamflow data were identified that would indicate obvious impacts on the Myers Drain as a result of water withdrawals from the production wells (Ian D. Wilson Associates Limited, April 2016). At the location of the pumping wells (PW2, PW3, and PW4 at the time of the assessment) it was identified that the bedrock aquifer is isolated by 12.5 to 21 m of overburden, consisting mainly of fine-grained deposits (mostly clay and silt) of generally low permeability, which would limit the likelihood of direct hydraulic connection with the surface.

Monthly monitoring of shallow and deep groundwater levels in piezometers GS1 and GS2 installed in the Myer Drain and monthly flow measurements at SG1 and SG2 continue under the existing PTTW (No. 7535-AQBNX8). Given the 400 m distance from the production wells, and no apparent impact on the water levels in the streambed piezometers or the surface water level of Myers Drain since monitoring began in 1995, a concern for unacceptable surface water impact from the water taking is not identified.

Based on the findings from the information review, continued water takings at the permitted water taking levels are not expected to impact surface water and natural functions of the ecosystem. The existing monitoring program in place serves to identify any possible changes to these features.

4.6 Sustainability of Water Resources

Water resources are considered sustainable if the total amount of water entering, leaving, and being stored in the system meet existing needs without compromising the ability to meet the needs in the future. Typical indicators used to assess the sustainability of water quantity include Water Budgets completed at the watershed/subwatershed scale and/or for the specific water taking(s) and the evaluation of water level data for trends over time to ensure resources are remaining in a steady state. The following provides a general assessment of the sustainability of regional water resources and of the potential impact from the Gott Enterprises Inc. (Amaranth) water taking on sustainability, now and in the future.

Regional Water Resources

The characterization of the regional study area indicates that the Gott Enterprises Inc. (Amaranth) Site is located in the Upper Nottawasaga River subwatershed where the completed Tier 1 Water Budget analyses (SGBLSSPC, 2015) for groundwater stress was categorized as Low and for surface water was indicated as significant for the months of July to August, but a Tier 2 Water Budget was not recommended. The Water Budget analyses included an estimate of future water demand Existing communities are identified to be the focus for future residential and employment growth, which has seen increased pressure as the Greater Toronto Area continues to grow. The Tier 1 Water Budget analyses results suggest that growth pressures are not an identified concern for the sustainability of water resources within the regional study area. Of note, future simulated water demand scenarios that included drought simulations were only completed for areas advanced to a Tier 2 Water Budget.

The 'Nottawasaga Valley Source Protection Area Approved Assessment Report' (SGBLSSPC, 2015) includes a discussion on the implications of climate change on the report findings, including the Water Budget results and Water Quantity. The discussion indicates that climate change (e.g., a decrease in surplus water due to an increase in evapotranspiration) has the potential for increased stress levels for water quantity resources. The report indicates "The expected severity of this over the next 25 years is currently unavailable, but it is likely that with an increasing population and a decreasing amount of potable water available, water use restrictions could become more frequent".

The OLWR Program uses real time surface water monitoring data collected from the WSC stream gauge (HYDAT) station network to identify potential drought conditions based on set trigger levels. BluMetric's review of the OLWR Program notification data (2000 to August 2018) for the Nottawasaga Valley CA did not identify any specific trends indicating the depletion in the availability of surface water (and possibly shallow groundwater where directly connected to surface water) resources. The issuance of multiple Level 1 Low Water Condition Alerts by the CA and Level 1 and Level 2 Notifications under the OLWR program indicates the region is susceptible to seasonal low water conditions for surface water.

BluMetric's review of PGMN groundwater level data for 1 well located within 10 km of the Gott Enterprises Inc. (Amaranth) water taking did not identify any trends indicating a potential reduction in the availability of regional groundwater resources.

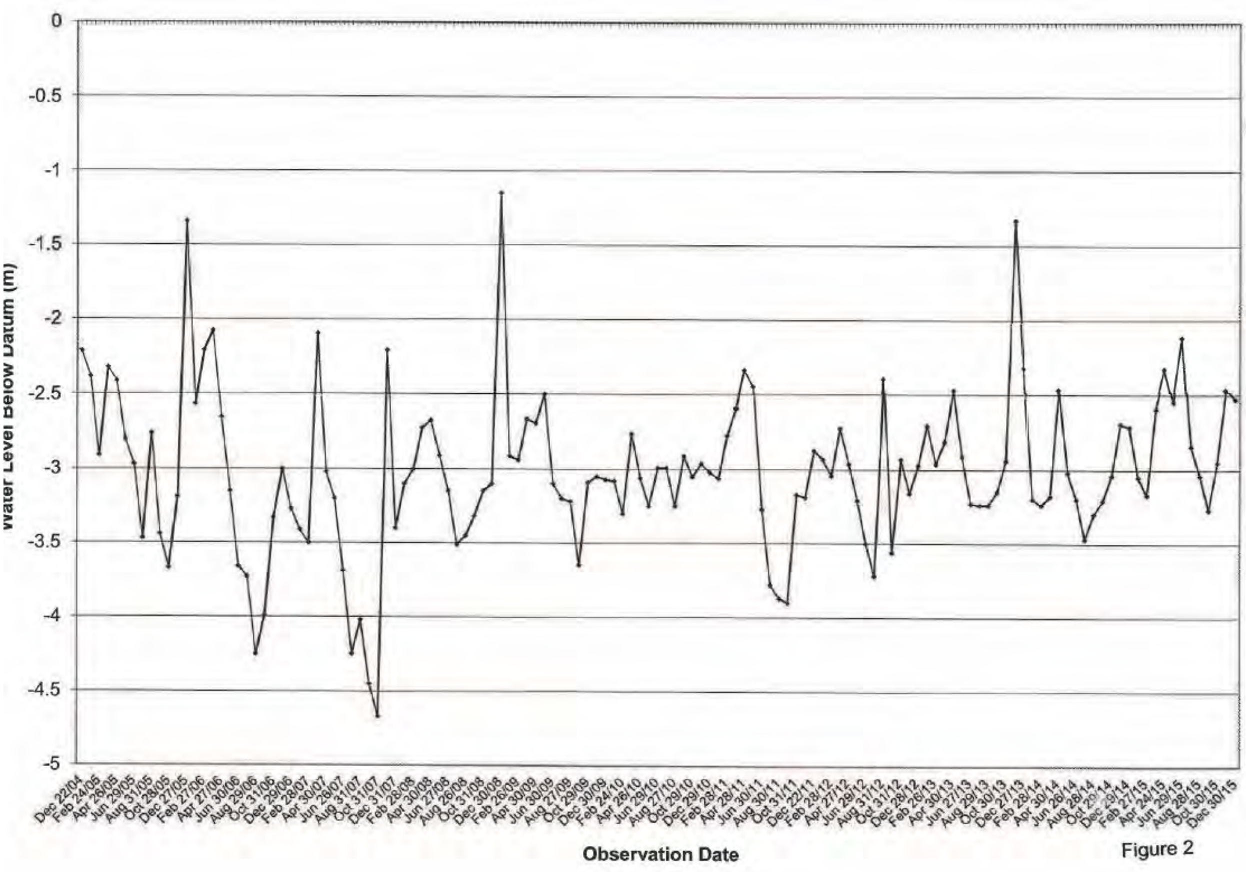
In summary, based on the information reviewed, no stress concerns were identified for the sustainability of regional groundwater quantity resources, though seasonal stress was identified as a potential concern for surface water quantity resources.

Gott Enterprises Inc. (Amaranth) Water Taking

Historical information relating to the Gott Enterprises Inc. (Amaranth) Site indicates it has been permitted for water bottling since at least 1989. The current PTTW maximum water taking limits from all sources (454 L/minute, 654 m^3/day) have remained unchanged since 2001. Annual water taking amounts in 2015, 2016, and 2017 have been between 70 % and 80% of the annual water taking limit.

Aquifer testing programs for the Fernbrook (now the Gott Enterprises Inc. (Amaranth)) wells indicate the presence of a high yield bedrock aquifer source. A monitoring program has generally been in place since 1999. Current monitoring requirements for groundwater and surface water have been in place since 2005. The last monitoring report (for 2011 to 2015) was received by the ministry in 2016 and did not identify any adverse impact from the water taking. The monitoring report identifies the production well pumping signature can be observed in domestic wells located from 90 m (OW4) to 690 m (OW6) away, but the level of influence is not unacceptable. Monitoring well MW1 is used as a sentry well for the aquifer utilized by the well field. The hydrograph for MW1 (December 2004 to December 2015 data) indicating no decreasing trends for the availability of groundwater for the aquifer is reproduced below.

Text Figure 4-3: Gott Enterprises Inc. Amaranth - Groundwater Levels (Dec 2004 to Dec 2015) MW1 – On-Site Observation Well



Source: Wilson, April 2016

Regarding surface water resources at the Site, the Myers Drain crosses the property approximately 400 m south of the production wells. On-going monitoring as a PTTW condition has not provided any indications of increased stress to surface water resources due to the water taking. Since the water taking for the Site is from a confined bedrock aquifer its contribution as a source for surface water stress within the subwatershed is not considered significant.

A review of the WTRS database did not identify any other high volume water taking activities for the bedrock aquifer within the study area. The information review also did not identify any other planned water taking activities that might contribute to the overall cumulative effects/impacts on local groundwater resources.

Based on the information reviewed, there are no indicators of the Gott Enterprises Inc. (Amaranth) water taking having an impact on the sustainability of existing and future water resources. Current

Permit requirements/conditions in place through PTTW No. 2773-9G2RXX appear to be suitable in identifying potential issues should climate change and growth pressures become a larger factor in the sustainability of local water resources.

4.7 Gaps and Recommendations

A summary of information gaps and potential enhancements identified from the assessment of the Gott Enterprise Inc. (Amaranth) Site is provided as follows:

1. No Site cross sections identifying geology and hydrostratigraphic units were identified in the documentation reviewed. Cross sections are a key tool in developing a conceptual model for Site conditions. It is recommended that cross sections be included in future reporting for the Site.

4.8 Figures

Figures are provided in Appendix A-Main Figures

5. GOTT ENTERPRISES - GREY HIGHLANDS

5.1 BACKGROUND AND HISTORY

Gott Enterprises Inc. Grey Highlands draws water from three(3) production boreholes (BH1, BH2, and BH3) located at 468395 Grey Road 31, on Lot 20, Concession 13, Municipality of Grey Highlands (former Osprey Township), Grey County, herein referred to as the 'Site'. Based on the records provided by the ministry, the Site has been permitted for water taking for bottled water use since 1993 and for supply to a fish hatchery since 1977. The Site is located within the jurisdictions of the Ontario Ministry of Environment, Conservation and Parks (MECP) Owen Sound District Office (London Regional Office) and the Grey Sauble Conservation Authority. The Gott Enterprises Inc. Grey Highlands water source locations (New BH1, New BH2, and New BH3) are indicated on Figure 5-1.

An approximate timeline of events relevant to the PTTW history of the Gott Enterprises Inc. site is provided as follows:

Table 5-1: Gott Enterprises Grey Highlands - PTTW History

YEAR	EVENT
1977	**PTTW No. 77-P-1005 (at some point changed to 77-P-1011)** is issued to Aquafarms Canada on May 24, 1977 with a term of 10 years (expiry date of March 31, 1987). The PTTW includes taking from 4 drilled water supply wells: - Well No. 1 - 300 imperial gallons per minute (IGPM) (1,360 liters per minute (LPM)) - Well No. 2 - 175 IGPM (796 LPM) - Well No. 3 - 160 IGPM (727 LPM) - Well No. 4 - 300 IGPM (1360 LPM)) - and from Beaver River - 1200 IGPM (5,455 LPM). Water use is for a fish hatchery.
1987	Renewal of PTTW No. 77-P-1005/1011 is inferred though a copy of the renewal permit was not identified in MECP files.
1993	A spring is constructed on site. Water use for bottling and bulk sales are initiated. **PTTW 93-P-0079** is obtained for water taking from the spring (40 IGPM (180 LPM), 57,600 IGPD (261,900 LPD)). Water taking from the drilled wells and Beaver River continues under PTTW 77-P-1005.
1997	**PTTW No. 77-P-1011 is renewed** and includes taking from 3 wells: - BH1 – 300 IGPM (1,360 LPM) - BH2 - 175 IGPM (796 LPM) - BH3 - 160 IGPM (727 LPM)) - and Beaver River (1200 IGPM (5,455 LPM)). BH4 is excluded from the permit as it is now a domestic well.
1998	Water is no longer taken from Beaver River as of September 12, 1998.
1999	Fish hatchery operation is discontinued.
2000	**PTTW No. 00-P-1365** is issued and consolidates water taking from 3 wells: BH1 - 909 LPM, BH2 - 682 LPM and BH3 - 682 LPM and a maximum amount per day of 1,308,960 (BH1), 982,080 (BH2), and 982,080 (BH3) litres and the spring (182 LPM, 174,720 LPD). This PTTW expires on December 15, 2002.
2001	Monitoring Wells MW1 and MW2 are first equipped with pressure transducers for continuous water level monitoring.

YEAR	EVENT
2002	Gott Enterprises requests the removal of the spring source from the PTTW as it is no longer in use. From 2002 to 2006, Appeal and Environmental Review Tribunal (ERT) for PTTW No. 00-P-1365.
2005	The PTTW No. 00-P-1365 was extended to September 1, 2005 to allow the Appellants to conclude their Appeal to the ERT. A pipeline is constructed to pipe water from the wellfield to the bottling facility in the north end of Feversham, Ontario.
2006	**PTTW 8480-69HSU2** issued to Aquafarms 93 on May 19, 2006. Continuous water level monitoring using pressure transducers is initiated for BH1, BH2, and BH3.
2007	**PTTW 3087-76WP39** is issued on September 20, 2007 to Gott Enterprises and replaces PTTW 8480-69HSU2, incorporating amendments agreed upon in the Settlement from the Environmental Review Tribunal, including: • reduce the term for the PTTW from 10 to 5 years; • ensure that the "test wells" referred to in the PTTW were more accurately described as monitoring wells (Condition 4.3); • provide for the installation of additional monitoring wells (MW3, MW4, and MW5) and stream gauges no later than December 31, 2008 (Condition 4.3(b)); and • require the submission of an interim semi-annual draft data report to the Director (in addition to the annual monitoring report requirement)(Conditions 4.6 and 4.7). The Spring is no longer indicated as a taking source. This PTTW expires May 19, 2011.
2008	New multilevel monitoring wells are installed (MW3S/D, MW4S/D, and MW5S/D) in October 2008 and are equipped with pressure transducers for continuous water level monitoring. Three stream level monitoring stations equipped with pressure transducers for continuous water level monitoring are installed (SG1 and SG3 on the Beaver River and SG2 on the east tributary) in December 2008.
2009	**PTTW 7482-7QVN9K** is issued on April 9, 2009 to Gott Enterprises as an administrative amendment to PTTW 3087-76WP39. This PTTW expires May 19, 2011.
2011	On September 26, 2011, PTTW 7482-7QVN9K expiry is extended to May 12, 2012. In March 2011, the original source well BH3 is sealed and abandoned and replaced by a new source borehole (New BH3) with similar depth of construction.
2012	On May 14, 2012 **PTTW No. 8035-8U5P7F** replaces PTTW No. 7482-7QVN9K and expires May 12, 2022 (10 years). The new PTTW allows water to be taken at a maximum rate of 909 LPM for BH1, 682 LPM for BH2 and 682 LPM for BH3 and a maximum amount per day of 1,308,960 (BH1), 982,080 (BH2), and 982,080 (BH3) litres. In the fall of 2012, the original source BH 1 and BH 2 are sealed and abandoned and replaced by two new source boreholes (New BH1 and New BH2) with similar depths of construction. Requirements under the Permit include: <u>At Taking Sources (BH1, BH. and BH3):</u> • Record total daily taking volume (Condition 4.1). • Continuous water level monitoring at each taking well using pressure transducer or similar device (Condition 4.2). <u>Groundwater Monitoring</u>: • Continuous water level monitoring at 5 MWs using pressure transducer or similar device (Condition 4.3a). <u>Surface Water:</u> • Continuous water level monitoring at 3 monitoring stations using pressure transducers (Condition 4.3b). <u>Reporting:</u> • Download all monitoring data on a monthly basis and review the data (Condition 4.4) • Annual WTRS reporting of daily water taking data (Standard Requirement). • Semi-annual (every 6 months) submission of collected monitoring data to ministry (separate request made by ministry). • Annual Monitoring Report submitted for ministry review (Condition 4.6). <u>Water Resources Management Measures (Triggers)</u> • Complaints/Reported Impacts (Condition 5).

Gott Enterprises Inc. draws water from a wellfield consisting of 3 drilled bedrock wells constructed in 2011 and 2012. Well construction information along with current permit water taking amounts (PTTW No. 8404-7YBLB2) is provided in Table 5-2. The relative location of each well is shown on Figure 5-1.

Table 5-2: Gott Enterprises Grey Highlands - Summary of Water Taking Sources

Source Name	Type	Well Record ID	Total Well Depth	Depth to Bedrock	Completion Unit	Depth Water Found	PTTW No. 8035-8U5P7F	
							Max. Taken Per Minute (L)	Max. Taken Per Day (m^3)
New BH1	Drilled Well	7191671	30.5 m (100 ft)	15.5 m (51 ft)	Limestone	16.5 m, 16.6 m (54.2 ft. 54.5 ft)	909	1308.96
New BH2	Drilled Well	7191670	30.5 m (100 ft)	15.5 m (51 ft)	Limestone	16.8 m, 17.7 m (55 ft. 58 ft)	682	982.08
New BH3	Drilled Well	7181589	25.9 m (85 ft)	8.2 m (27 ft)	Limestone	9.3 m, 13.7 m (30.5 ft. 45 ft)	682	982.08

As indicated in Table 5-2 the source well depths range from 25.9 to 30.5 m. The completion unit for all three wells is limestone and water-bearing zones are reported in the well records as ranging from 9.3 m to 17.7 m depth.

5.2 Primary Information Sources

The following key technical documents were identified in the files provided by the ministry and are summarized and referenced herein:

- Hydrogeological Study Aquafarms Spring/Borehole Feversham. Ontario, Canada, 03 May 1996. Middle Earth Hydrogeology Inc. (MEH, 1996).
- Pumping Test Study, Aquafarms 93, Grey Road 31, Feversham, Ontario. Middle Earth Hydrogeology Inc. July 30, 1999 (MEH, July 1999).
- Application for Permit to Take Water, Aquafarms 93, letter prepared by Middle Earth Hydrogeology Inc. Letter dated January 29, 2000. (MEH, January 2000). Note: Includes some content derived from "Pumping Test Study, Aquafarms 93, Grey Road 31, Feversham, Ontario. Middle Earth Hydrogeology Inc. July 30, 1999 (MEH, July 1999)".
- Hydrogeological Review Aquafarms 93 Feversham, Ontario. Middle Earth Hydrogeology Inc. (MEH, May 2003).
- Report on Aquafarms '93: Additional Hydrogeological and Ecosystem Assessment Feversham, Ontario. Golder Associates Limited June, 2006 (Golder, June 2006).
- Saugeen Valley/Grey Bruce/Northern Bruce Peninsula Tier One Groundwater Budget and Subwatershed Stress Assessment. AquaResource, 2008 (AquaResource, 2008).
- Saugeen Valley, Grey Sauble, and Northern Bruce Peninsula Tier 1 Surface Water Budget and Stress Assessment Report. AquaResource, 2015 (AquaResource, 2015).

- 2015 Annual Report and Monitoring Program Summary, Gott Enterprises Inc. Permit to take Water 8035-8U5P7F, Municipality of Grey Highlands Ian D. Wilson Associates Limited. April 27, 2016. (Wilson, 2016).

Other information sources used in this assessment included:

- Grey and Bruce Counties Groundwater Study. Final Report. Waterloo Hydrogeologic, Inc., July 2003 (Waterloo Hydrogeologic, 2003).
- Groundwater Monitoring Report 2003. Middle Earth Hydrogeology Inc., January 2004 (MEH, 2004).
- Groundwater Monitoring Report 2005 Water-Taking Facility Feversham, Ontario Aquafarms 93. Conestoga-Rovers & Associates, January 2005 (CRA, 2005).
- Groundwater Monitoring Report, 2006 Aquafarms 93. Dillon Consulting Limited, January 31, 2006 (Dillon, 2006).
- Approved Assessment Report for the Grey Sauble Source Protection Area, 2015 (SGSNBPSPR, 2015).
- Annual Monitoring Reports. Ian D. Wilson Associates Limited. Most Recent for 2015. (Wilson, 2016) and associated ministry review comments.
- Vulnerable Areas Mapping Tool. Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2018 (SGSNBPSPR, 2018) at http://home.waterprotection.ca/interactive-map-viewer/.
- Grey County GIS Maps on-line mapping tool at http://maps.grey.ca/
- Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228. Chapman, L.J. and Putnam, D.F. 2007. (Chapman and Putnam, 2007).
- Surficial Geology of Ontario; MNDM File - MRD128-REV. Ontario Geological Survey, 2010. (OGS, 2010).
- Bedrock Geology of Ontario; MNDM File - MRD126-REV1. Ontario Geological Survey, 2011. (OGS, 2011).
- Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to Take Water Applications and Hydrogeological Study Requirements. Ministry of Environment and Climate Change. April 2017. (MOECC, 2017).
- Groundwater Levels in Ontario: A Trends Analysis using the Provincial Groundwater Monitoring Network. Ministry of Environment, Conservation and Parks, Southwestern Region. 2018 pending. (MECP, 2018).
- MECP Water Well Information System (WWIS) database. Available at https://www.ontario.ca/environment-and-energy/map-well-records.
- MECP on-line Provincial Groundwater Monitoring Network database. Available at https://www.ontario.ca/environment-and-energy/map-provincial-groundwater-monitoring-network.

- MECP on-line Permit to Take Water database. Available at https://www.ontario.ca/environment-and-energy/map-permits-take-water.
- MECP Water Taking Reporting System (WTRS) database (Confidential – Used with Permission from MECP).
- Ontario Low Water Response Program (OLWR) notifications and alert levels for Saugeen Valley Conservation Authority (2000 to August 2018 data from MNRF).

Information sources referenced in other documentation but not provided in MECP files:

- Electrical Resistivity Imaging Survey to Profile Depth to Bedrock, Aquafarms 93 Property. Golder Associates Limited, June 2008. (GAL, June 2008).
- Assessment of Groundwater Monitoring Data, 2002 to 2007, Aquafarms 93, Dillon Consulting Limited. July 8, 2008 (Dillon, July 2008).
- Groundwater Monitoring Report 2009, Aquafarms 93, April 9, 2009. Dillon Consulting Limited. (Dillon April 2009).

5.3 CHARACTERIZATION OF STUDY AREA

This section provides a general characterization of the Gott Enterprises Inc. Grey Highlands Site and associated study area. Figure 5-2 presents the assessed regional study area which is an approximate 30 km by 30 km area centred over the Gott Enterprises Inc. Grey Highlands Site. The regional study area boundaries were set based on an area that captures the municipal groundwater supply wells for the Township of Clearview located to the northeast and within the Nottawasaga Valley Source Protection Area (SPA) and Eugenia Lake to the southwest. Eugenia Lake and the Gott Enterprises Inc. Grey Highlands Site are both located within the Grey Sauble SPA.

5.3.1 Land Use Setting

The Gott Enterprises Inc. Grey Highlands Site is located in the Municipality of Grey Highlands which consists of the former Townships of Artemesia, Euphrasia, Osprey and the Village of Markdale. The Municipality of Grey Highlands is located within the Niagara Escarpment and has a 2016 census population of 9,804. The "Municipality of Grey Highlands Official Plan, 2017" indicates a projected population of 12,900 in 2026. Reportedly, the economic activities in the area include tourism, agriculture and commercial and industrial development in settlement areas.

The Site is located on the eastern end of the Municipality of Grey Highlands on the northwest corner of the intersection of Grey Road 31 and Road 55. The area surrounding the Site is comprised mainly of rural residential and agricultural properties. Two adjacent Class A pits licensed under the Aggregate Resources Act are located approximately 1.3 km to the east along Grey Road 31. The closest settlement area to the Site is Feversham located approximately 4 km to the south and is also the location of the Ice River Springs water bottling plant.

Land use within an approximate 1,000 m radius of the Gott Enterprises Inc. source wells (Figure 5-3) is primarily rural with two agricultural properties located approximately 450 m to the southwest of the Site. Neighbouring properties are serviced by individual private well water supply and onsite sewage systems. Hazard Lands consisting of forested areas are located adjacent to the Beaver River which runs through the Site and to the west of the site. Approximately 50% of the Site is designated as 'Hazard Lands' which may be subject to controls on future land development as defined in the Municipality of Grey Highlands Comprehensive Zoning By-Law 2004-50.

5.3.2 Physiographic Setting

The physiography of the study area as described by Chapman and Putnam, 2007 is provided in Figure 5-4. The predominant physiographic regions in the regional study area are the Dundalk Till Plain in the southern half and the Horseshoe Moraines and Niagara Escarpment in the northern half. Within 5 km of the Site, the geomorphology is described as spillways and drumlinized till plains of the Dundalk Till Plain. Five drumlins are indicated to the north northeast of the Site. The till plains are described as a stone-poor, carbonate-derived, silty to sandy deposit. The mapped area of the spillways follows much of the alignment of the Beaver River and extends more than 15 km to the south of the Site. The spillways are described as glacial meltwater drainage channels that may be floored wholly or in part by gravel beds.

The regional topography and hydrology of the study area is provided in Figure 5-5. The Gott site is located on a bedrock plateau with an elevation range of 490 to 540 meters above sea level (masl). The Niagara Escarpment is located to the east, north and west of the plateau (Golder, June 2006). The topography in the area generally consists of rolling hills in drumlinized areas and flat areas in the till plain. The Beaver River, which crosses the Site and flows towards the south is the lowest point of the property with the topography rising from this point in both the east and west directions. As indicated on Figure 5-5 the regional drainage for surface drainage features is towards the southwest with Eugenia Lake (10 km southwest of the Site) being the primary receiving area for surface water flow. Eugenia Lake is reported to be a man-made lake that was created in the early 1900s as a reservoir for a hydro-electric dam on the Beaver River.

The Site is located within the Beaver River watershed, which drains into Georgian Bay at Thornbury. The Beaver River runs through the center of the Gott Enterprises Grey Highlands site and flows south towards Feversham prior to continuing westwards toward Eugenia Lake and then northward to Georgian Bay via the main Beaver River Valley.

Nine Water Survey of Canada (WSC) stream gauge (HYDAT) stations are located in the regional study area and their locations are shown on Figure 5-2. Stations 02FB006 and 02FB012 are located more than 10 km to the northwest of the Site. These stations are located downstream of Eugenia Lake. Stations 02FB001, 02FB003 and 02FB013 are located approximately 14.5 km southwest of the Site on the Beaver

River and located downstream of Eugenia Lake. Stations 02ED025 and 02ED031 are located approximately 15 km to the northeast of the Site and are located in Collingwood and within the Blue Mountains watershed. Station 02FB004 is located on the Beaver River approximately 7 km to the southwest of the Site and is the nearest downstream WSC stream gauge location. No identified WSC gauge are located upstream of the Site. As indicated in Table 5-1, three stream level monitoring stations equipped with pressure transducers for continuous water level monitoring were installed by Gott Enterprises Inc. in 2008 as a condition of the PTTW. SG1 (downstream) and SG3 (upstream) are located on the Beaver River while SG2 is located on the tributary that enters the Site from the east. Stream water level monitoring data is provided to the ministry on a semi-annual basis (every 6 months) and assessed in the annual monitoring report.

5.3.3 Geologic Setting

Information on surficial geology and bedrock geology in the regional study area was obtained from the following Ontario Geological Survey data: Surficial Geology of Ontario, MNDM File - MRD128-REV. (OGS, 2010) and Bedrock Geology of Ontario, MNDM File - MRD126-REV1 (OGS, 2011). Surficial geology for the regional study area is mapped in Figure 5-6 and bedrock geology is mapped in Figure 5-7.

Surficial geology in the southern half of the regional study area is generally dominated by stone-poor, carbonate-derived silty to sandy till (Elma Till) with pockets of Paleozoic bedrock, ice-contact stratified deposits, glaciofluvial deposits, sandy deposits, massive-well laminated and organic deposits. Littoral and foreshore-basinal deposits are located in the northeast corner of the regional study area near Collingwood. As indicated on Figure 5-6, sandy and modern alluvial deposits are located along the Beaver River alignment with stone-poor, carbonate-derived silty to sandy till extending to the edges of the 1000 m radius area surrounding the Gott Enterprises Inc. Site well locations.

The bedrock formations for the regional study area (Figure 5-7) progress from youngest to oldest in a general northeast direction. Sandstone, shale, dolostone, siltstone of the Lower Silurian – Guelph, Lockport and Annabel/Gasport Formations extend over much of the study area including the Site. Golder, June 2006 (discussed further herein) identifies the bedrock intersected by the Gott Enterprises Inc. source wells as dolostone of the Annabel (now called Gasport) Formation. To the north of the Site near the Blue Mountains, the bedrock is mapped as shale, limestone, dolostone, siltstone of the Upper Ordivician – Queenston Formation and Georgian Bay, Blue Mountain, and Billings Formations. Near Collingwood, the bedrock geology is mapped as limestone, dolostone, shale, arkose and sandstone of the Middle Ordovician – Shadow Lake Formation.

5.3.4 Hydrogeologic Setting

5.3.4.1 Regional Hydrogeology

The "Grey and Bruce Counties Groundwater Study" (Waterloo Hydrogeologic, 2003) reports that the Grey and Bruce Counties can be conceptualized as a three-layered hydrogeologic model with, from top to bottom, a fine-grained overburden aquitard layer, a thin weathered bedrock aquifer layer, and a thick unweathered bedrock aquifer. The majority of wells in Grey County obtain groundwater from bedrock aquifers. However, there are some overburden aquifers in poorly-sorted tills and the moraines of the Tara Strands and in the Arran Drumlin Field with typical well yields of less than 0.2 L/s. The limestone and dolostone of the Guelph, Amabel and Fossil Hill formations, encountered in the Bruce Peninsula is reported to have well yields of 0.8 to 3.8 L/s. The fine crystalline dolostone of the Guelph formation is low to moderately permeable having well yields of 0.2 to 0.8 L/s. Low permeability is reported to be generally found for the shale of the Cabot Head, Manitoulin and Queenston formations which have well yields from less than 0.2 to 0.8 L/s. As per Waterloo Hydrogeologic, 2003, shallow groundwater flows generally in a northwest direction across the majority of Grey and Bruce Counties, toward Lake Huron. Local groundwater flow for the Site is inferred to be towards the Beaver and Bighead Valleys.

The municipality of Grey Highlands Kimberley-Amik-Talisman Water Supply system located 14.5 km to the west of the Site at Kimberly (Figure 5-2) is the only municipal system within 15 km of the Site and also within the Grey Sauble watershed. The Kimberley-Amik-Talisman Water Supply system takes water from two springs at a maximum permitted rate of 1,184,000 L/day. The reported WTRS data indicates that only 5 % of the permitted annual volume was taken in 2017. The settlement area of Feversham located 4 km to the south of the Gott Enterprises Inc. Site is serviced by individual private well water supplies. No 2016 or 2017 WTRS data is reported for PTTW No. 96-P-1071 and No. 02-P-1243 both indicated on Figure 5-2 as water supplies at Feversham. The Township of Clearview municipal wells are located approximately 13 km to the northeast of the Site and are within the Nottawasaga Valley watershed.

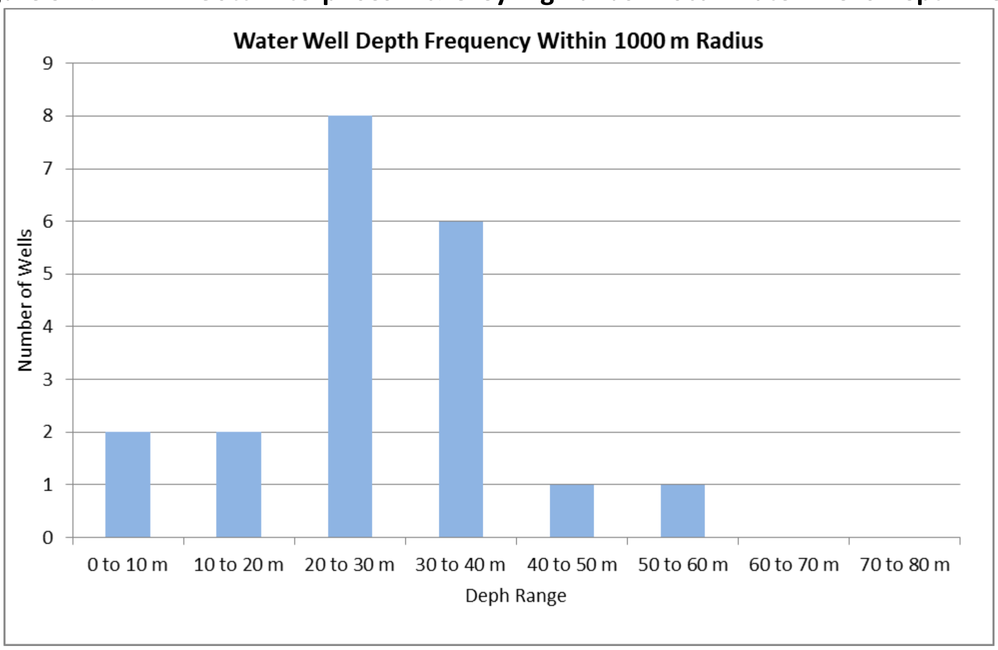
As described by SGSNBPSPR (2015), with existing limited data, it is difficult to delineate groundwater recharge areas in the Grey Sauble SPA. In the southern portion of the watershed, where the Gott site is located, the bedrock aquifer is generally not exposed at the surface, so any recharge is believed to be transient through the overburden deposits.

5.3.4.2 Local Hydrogeology

The MECP WWIS database was reviewed for well locations situated within 1,000 m of the Gott Enterprises Inc. Grey Highlands well field. A 1,000 m search radius was considered appropriate based on the observed low density for water well records in this search area while being representative of conditions at/near the Site. Water well record locations as referenced in the WWIS are plotted on Figure 5-1. A total of 20 well construction records for supply and test wells were identified (i.e. well abandonment records were omitted) with reported well construction depths ranging from

7.0 to 55.5 m. The majority of the wells are located within the Gott site property boundary; six wells are located on neighbouring properties. One well is reported as an overburden well constructed on the Site. The water well record for this well (ID 2507607) indicates the well was constructed in 1981 and completed as an open-ended pipe in gravel at a depth of 9.1 m (30 ft). Five of the wells are reported as unknown type and the remainder of the wells are reported as bedrock wells. A review of original water well records on the MECP 'Map: Well records' website indicates 4 of the 5 unknown wells are bedrock test holes constructed in 2008 and the fifth well (ID 7191672) is a water well abandonment record. The frequency distribution in water well record depths within the 1,000 meter search radius is shown in the chart below, indicating 14 of the 20 wells are between 20 and 40 meters in depth.

Text Figure 5-1: Gott Enterprises Inc. Grey Highlands - Local Water Wells Depth Frequency



The depth to bedrock reported in the assessed water well records range from 0 to 37.8 meters. Overburden materials within the study area, as reported in the well record, includes clay, gravel, silt, loam and sand. Clay is generally reported near surface while coarser textured materials are indicated as overlying bedrock. The reported overburden stratigraphy is generally consistent with the mapped surficial geology shown on Figure 5-6 which indicates sandy deposits and modern alluvial deposits. Bedrock material in most water well records in the 1,000 m radius is described as white or grey limestone, shale and dolostone, generally consistent with the lithology of the Guelph, Lockport and Annabel Formations mapped for the area. The water well records report static water levels ranging from 0.9 to 9.1 metres bgs. As indicated in Table 5-2, the three current source wells (New BH1, New BH2, and New BH3) are completed in limestone bedrock encountered at depths ranging from 8.2 to 15.5 m. The production wells range in depth from 25.9 to 30.5 m and water-bearing zones are reported in the well records for these wells as ranging from 9.3 m to 17.7 m depth.

5.3.4.3 Site Hydrogeology

The following provides a summary of hydrogeological and hydrological information gleaned from studies available within the files provided by the ministry.

Hydrogeological Study Aquafarms Spring/Borehole Feversham, Ontario, Canada (MEH, 1996)

Middle Earth Hydrogeology Inc. (MEH) was retained by Aquafarms to conduct a hydrogeological assessment of the boreholes and spring located on the Aquafarms property. The report indicates that regional groundwater flows in a westerly direction. The Beaver River intercepts this flow as it acts like a subsurface drainage ditch. Water flows along the base of the Beaver River is forced upward to discharge as springs.

Part of the assessment was to determine whether BH1 and the spring are hydraulically connected under the US Food and Drug Administration (FDA) definition of spring water. At the time of the report, there were 5 boreholes on the Aquafarm property completed within the fractured upper (shallow) dolostone bedrock that were used for the trout farm. BH1 was noted to be the most productive well having the highest tested flow rate.

Due to the large separation distance between BH1 and the spring (240 m north of BH1) and the high permeability of the subsurface, a pumping test was considered not practical for use in the assessment. Instead, a desktop review of the geological conditions was conducted to determine that BH1 and the spring are hydraulically connected. The report concludes that BH1 and the spring are located within a regional groundwater discharge zone; have high, constant flowrates; and, produce water of similar chemical composition. As stated in the report, water from the spring and BH1 both come from the Amabel Dolostone aquifer.

Pumping Test Study Aquafarms 93, Grey Road 31 Feversham, Ontario (MEH, July 1999)

Middle Earth Hydrogeology Inc. (MEH) completed a combined pumping test of wells BH1, BH2 and BH3 at the Aquafarms property (now the Gott Site) in April and May 1999 to support a PTTW renewal application. All three wells were shut down to allow for recovery prior to the test. The three boreholes were pumped for 84 hours at a simultaneous total rate of 2,590 L/minute. Eleven off site private wells were monitored for potential well interference. The nearest of these wells are reported with the following distances from the well field; Well 5 – 205 m, Well 6 – 185 m, Well 7 – 260 m, Well 8 – 395 m and Well 10 – 825 m. The well depths of the off-site wells ranged from 9.1 m at Well 5 to 31.7 m at Well 6. Individual average well pumping rates during the test were 1,150 L/min, 670 L/min and 770 L/min for BH1, BH2, and BH3, respectively. The drawdown in off-site wells was reported as a maximum of 0.56 m at Well 5, and 0.20 m at Well 6, 0.27 m at Well 7, 0.06 m at Well 8 and no response at any other wells. The production wells were monitored for 20 hours following the pumping and were reported to have a minimum recovery of 96 %. The radius of influence of the production wells was determined by MEH to be 430 m from the center of the three production wells.

During the pump test, water levels of the spring, river and water table were recorded and showed that was no measurable effect on the water levels as a result of the pumping test.

A second pump test was conducted with only BH3 pumping continuously for 12 days at a rate of 770 L/min followed by monitoring well recovery for 12 hours. Drawdowns were measured in onsite wells and 3 neighbouring wells. A third pump test was conducted with only BH2 pumping for one hour at 664 L/min. Water levels were monitored in BH1 to BH4 and were reported to stabilize in approximately 10 minutes. The lower pumping rate of these tests resulted in smaller drawdowns in off-site wells.

Reportedly, the water taking rate from the production wells for the years 1976 to 1999 was approximately 2,890 L/min (more than the pumping test rate).The report concludes that minimal impact on neighbouring wells would occur as a result of the proposed pumping rate of 2,275 L/min (12 % less than the first pumping test rate) and the estimated radius of influence would be 410 m.

<u>Application for Permit to Take Water, Aquafarms 93, (MEH, January 2000)</u>

This letter was prepared in January 2000 by Middle Earth Hydrogeology Inc (MEH) in response to comments from Mr. Wilf Ruland (document not available) for the report "Pumping Test Study, Aquafarms 93, Grey Road 31, Feversham, Ontario. Middle Earth Hydrogeology Inc. July 30, 1999" (MEH, July 1999). The letter indicates that Mr. Ruland's key issues with the MEH, July 1999 assessment were that the pumping test duration was insufficient to reach equilibrium conditions and the methods used to assess effects of pumping on the overburden and river were incorrect. MEH indicates that 'Pumping Test 1' involved an 84-hour continuous rate pumping test at 2590 L/min with simultaneous pumping from BH1, BH2, and BH3 and observation well water level monitoring at four residential wells, three water table monitoring wells, and one river gauge.. Much of the MEH, January 2000 letter defends the field methods, methods of data analysis and the interpretation of results provided in the MEH, July 1999 report. The MEH, January 2000 letter concludes that the proposed water taking rate of 2275 L/min is sustainable for the Site and would cause minimal impact to the water table, the nearby off-site wells, and would have no measurable effect on the river.

<u>Hydrogeological Review Aquafarms 93 Feversham, Ontario (MEH, May 2003)</u>

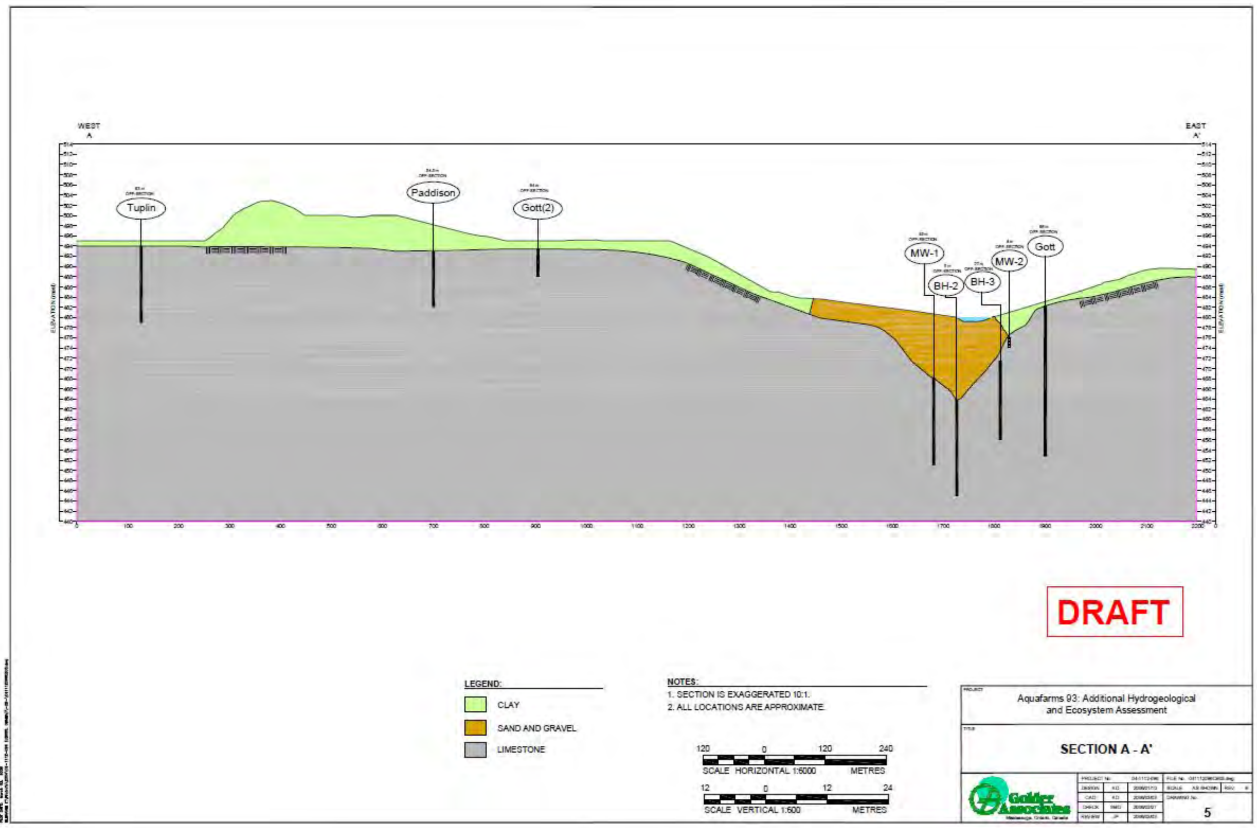
A hydrogeological review was prepared by Middle Earth Hydrogeology Inc. of the monitoring data collected during 2001 to 2003. BH1, BH2 and BH3 were pumped at 1470 L/min for 24 hours in May 2003. Water levels were measured in MW1, MW2 and several off-site wells, resulting in a radius of influence of 335 m. Water levels were reported to be consistent with the 1999 pumping test.

<u>Report on Aquafarms '93: Additional Hydrogeological and Ecosystem Assessment Feversham, Ontario. (Golder, June 2006).</u>

Golder Associates Limited was retained by the Upper Beaver River Study Steering Committee to carry out an independent assessment of hydrogeological and ecosystem conditions in the vicinity of the Gott Enterprises Inc. Site (referred to in the report as the former Aquafarms '93 site). The assessment was a requirement of the Environmental Review Tribunal (ERT) following an appeal of PTTW No. 00-P-1365 made by neighbouring property owners. The primary objectives of the assessment were to determine the recharge and sustainability of the aquifer being pumped under the permit and the potential impact from the groundwater taking on neighbouring wells and natural ecosystem. The background section of the report indicates that groundwater pumping at the Site had decreased nearly 70% from a peak of 1.5 million m^3/year (1500 million L/year) during the 1990s to a current peak (2005) of 0.6 million m^3/year (600 million L/year).

In its assessment of local water well records Golder produced a cross section that extends approximately 1700 m west and 500 m east of the Gott Enterprise Inc. production wells. The cross section is reproduced as follows.

Text Figure 5-2: Gott Enterprises Inc. Grey Highlands – West–East Cross Section



Source: Figure 5 of Golder, June 2006

Golder concluded that there is approximately a 20 m drop in elevation going from the west of the study area to the location of Beaver River on the Gott site. From the low point at the Beaver River, the terrain rises approximately 10 m towards the east. Golder concluded that the overburden thickness in the study area generally remains at approximately 2 m as it follows the bedrock downward slope towards the Site.

There is a sharp drop in the bedrock elevation near the Beaver River where the overburden peaks at a maximum thickness of approximately 15 m on the Gott Enterprises Inc. property.

Findings from a geophysical investigation of the monitoring wells at the Site determined the groundwater source of the production wells is the upper sections of the Anabel Formation which are expected to be weathered and fractured. Golder concluded that layering of the overburden sediments limits the degree of hydraulic connection between the Beaver River and the underlying Annabel Formation.

The Golder monitoring program was completed over three seasons and included measurements of surface water and groundwater elevations as well as a survey of ecological conditions. To develop an improved understanding of the hydraulics of the bedrock aquifer and to establish the zone of influence of the production wells at the site, scheduled shut-downs of the production wells were conducted in September and November 2005. Two existing on-site monitoring wells (MW1 and MW2), two new shallow overburden wells (OW-1 and OW-2), various stream staff gauges (SG), surface water stations (SS), mini piezometers (MP) and 8 local domestic wells were included as monitoring locations and were monitored over various periods of time using water level pressure transducers equipped with data loggers. Monitoring of data began in February 2005 and concluded in December 2005. During the shutdowns, the maximum water level recovery was approximately 1.3 m in the production wells and up to 0.9 m in the two on-site monitoring wells. No noticeable response was observed for the hydrographs produced for data from the off-site domestic well locations. The testing results indicated that daily fluctuations resulting from precipitation had a larger impact on the off-site domestic wells compared to the impacts of production well pumping.

The aquatic habitat monitoring program involved a spring, summer and fall electro shocking program for fish netting/identification at four locations along the Beaver River and at one location on the east tributary. A healthy cold water habitat was consistently observed for the program. No apparent stressors that could adversely affect the health of aquatic habitat were observed. The stream flow and water level data showed that groundwater discharge supplements the surface water flow of the Beaver River through the site, indicating that the production wells had not reversed the vertical groundwater flow direction. The report indicated that this also suggests there is a low degree of vertical hydraulic connection between the bedrock aquifer utilized by the production wells and the Beaver River.

<u>2015 Annual Report and Monitoring Program Summary, Gott Enterprises Inc. Permit to take Water 8035-8U5P7F, Municipality of Grey Highlands Ian D. Wilson Associates Limited. (Wilson, 2016).</u>

This report provides a summary of monitoring data collected since 2001 to the end of 2015. A summary of the Wilson, 2016 findings is provided as follows:

- The 2015 water level monitoring data for the Production Boreholes indicated water levels for 2015 that were generally consistent with those observed since automated monitoring began in 2008. Typical operating water level drawdown throughout the year was indicated as 0.5 m for BH1, up to 0.5 m for BH2, and up to 2.0 m for BH3. Of note, the most recent hydrographs showing long term monitoring data are for data up to 2011.
- The 2015 observation data for MW1 and MW2 indicate water levels and operational drawdown within the range of historical values (0.2 to 0.3 m for MW1 and 0.5 m to 1.0 m for MW2). Monitoring wells MW3S/D, MW4S/D and MW5S/D indicate a continued seasonal water level variance with 2015 levels similar to recent years and with no indicators of influence from the on/off cycling of the production boreholes.
- Water levels in the Beaver River and east tributary continue to appear to vary only seasonally and were slightly lower in 2015, but generally consistent with previous years and with no indicators of influence from the on/off cycling of the production boreholes. Lower precipitation in 2015 (below 1981-2010 normal of 9991.9 mm) was indicated as the primary cause for slightly lower surface water levels.
- Wilson, 2016 concluded that existing and historical withdrawals from the three production boreholes are indicated by long-term monitoring to not be adversely impacting local groundwater and surface water resources. Also, measurable groundwater impacts do not extend past on-site monitoring well MW3S/D, located 230 m northwest of BH1 and this radius of influence is depicted on Figure 1 of the report.

5.4 Data Review and State of Groundwater Resources

The following section provides a review of the Ontario WQMF data for the Gott Enterprises Inc. Grey Highlands Site that is presently available to the MECP for making water management decisions.

5.4.1 Water Taking Reporting System

The Water Taking Reporting System (WTRS) is the ministry's repository for collection of water taking data for active Permits to Take Water (PTTW). As a requirement of each PTTW the water taking data must be reported on an annual basis and daily water taking data must be entered into the system. The WTRS is not publicly available, but is available for use by ministry staff when assessing the status of a PTTW or addressing potential issues associated with a PTTW. The WTRS data was provided by the ministry for use in the WBSA assessment to be inclusive of all information available to the MECP for making water management decisions.

Data on the volume of water taken per year and the number of water taking days per year for the Gott Enterprises Grey Highlands well site was obtained from the MECP Water Taking Reporting System (WTRS), for review. Table 5-3 below includes annual water taking data for the period from 2011 to 2017.

Table 5-3: Gott Enterprises Grey Highlands - Reported Water Takings

PTTW No.	Year	Source	Annual Amount Permitted by the PTTW (Million L)	Reported No. of Days Taken per Year	Reported Annual Taking (Million L)	Reported Annual Taking (% of permitted amount)	Average Reported Volume Taken per Day (L/day)
7482-7QVN9K	2011	BH1	477.77	360	140.86	29%	391,266
		BH2	358.46	360	185.15	52%	514,297
		BH3	358.46	0	0	0%	0
		Total	1194.69		326.01	27%	
8035-8U5P7F	2012	BH1	477.77	293	132.38	28%	451,822
		BH2	358.46	175	119.63	33%	683,617
		BH3	358.46	259	120.23	34%	464,227
		Total	1194.69		372.24	31%	
8035-8U5P7F	2013	BH1	477.77	365	127.27	27%	348,678
		BH2	358.46	365	126.8	35%	347,385
		BH3	358.46	365	229.41	64%	628,523
		Total	1194.69		483.48	40%	
8035-8U5P7F	2014	BH1	477.77	364	118.84	25%	326,496
		BH2	358.46	364	128.39	36%	352,727
		BH3	358.46	364	231.16	64%	635,061
		Total	1194.69		478.39	40%	
8035-8U5P7F	2015	BH1	477.77	365	110.26	23%	302,080
		BH2	358.46	365	120.68	34%	330,617
		BH3	358.46	365	254.66	71%	697,690
		Total	1194.69		485.6	41%	
8035-8U5P7F	2016	BH1	477.77	366	133.41	28%	364,517
		BH2	358.46	366	129.62	36%	354,165
		BH3	358.46	366	255.4	71%	697,808
		Total	1194.69		518.43	43%	
8035-8U5P7F	2017	BH1	477.77	364	119.16	25%	327,353
		BH2	358.46	364	124.3	35%	341,478
		BH3	358.46	360	236.25	66%	656,244
		Total	1194.69		479.71	40%	

Note: Borehole 1 and 2 (BH1 and BH2) were replaced in 2012; BH3 was replaced in 2011.

As indicated in Table 5-2, the annual water taking amounts for the 2011 to 2017 period are relatively consistent from year to year. Borehole 3 (BH3) was replaced in March 2011 and boreholes 1 and 2 (BH1 and BH2) were replaced in October 2012. In the 5 years following the well replacements the reported annual taking has ranged 40% to 43% of the PTTW limit.

The assessed study area for review of other active PTTW was set at a 5 km radius of the Gott Enterprises Inc. (Amaranth) well field. The 5 km radius was considered appropriate for review based on the density of active PTTW in the area and as a conservative distance for any potential contribution from the Site on the cumulative impacts from multiple water takings.

One other active PTTW is located within a 5 km radius of the Gott Enterprises Inc. Grey Highlands site. Durham Stone and Paving Inc. (PTTW No. 0061-8VASBC) is permitted to take water from a source pond at its location approximately 2.7 km to the south. The 2016-2017 annual taking amounts for this active PTTW are summarized in Table 5-3 below. A second PTTW (7533-72ZPXS) was located 2.4 km east of the Site; however, this PTTW registered to Stephen Peter Green and Dale Micheal Hollyoake expired on May 31, 2017 and there were no reported water takings for 2016 and 2017 in the WTRS data. The WTRS data lists the purpose of the taking as being 'bottled water' with an annual permitted groundwater taking of 38.37 million liters from WWR 2511513. A record of this well could not be found in the MECP water well record database.

Table 5-4: Gott Enterprises Grey Highlands - Neighbouring PTTW

Permit Holder	Issue Date	End Date	Source	Dist. from Gott Ent. Inc. Wells (Km)	PTTW Limits			2016 WTRS Data		2017 WTRS Data	
					Max. Taken per Day (Million L)	Taking Days per Year	Annual Taking (Million L)	Annual Reported Taking (Million L)	Annual Reported Taking (% of PTTW Limit)	Annual Reported Taking (Million L)	Annual Reported Taking (% of PTTW Limit)
Durham Stone and Paving Inc.	June 21, 2012	June 30, 2022	Pond	2.7	3.36	275	924	0	0.00%	13.73	1.49%

As indicated in Table 5-3 the reported taking amount for the Durham Stone and Paving Inc. for 2016 and 2017 is less than 14% of the PTTW limit. The Gott Enterprises Inc. Grey Highlands PTTW taking limit (i.e. 3,273,120 litres per day) is comparable to the permitted taking limit for Durham Stone and Paving Inc. (3,360,000 litres per day). Based on the Golder, June 2006 and Wilson, 2016 assessment results for the Site, no cumulative well interference impacts would be expected from these two water takings.

5.4.2 Provincial Groundwater Monitoring Network

The Provincial Groundwater Monitoring Network (PGMN) is a partnership program with all 36 CAs and 10 municipalities (in areas not covered by a conservation authority) to collect and manage ambient (baseline) groundwater level and quality information from key aquifers located across Ontario. During the spring and summer of 1999, low water conditions in many parts of southern Ontario prompted the formation of an inter-ministerial task force to assess drought conditions, determine trigger levels and develop a response strategy. The PGMN was approved in 2000 and there are currently more than 450 monitoring wells in the network.

The PGMN datasets report on ambient (baseline) groundwater level and chemistry conditions. The PGMN well locations are typically sited to be away from areas where there is a large density of permitted water takings. Consequently, the PGMN wells are typically far too distant from any permitted water taking to be used as an indicator of potential well interference impacts.

Water level data collected for the PGMN wells is of potential value in assessing regional groundwater level trends as an indicator of stress within the watershed/subwatershed. Data has been collected for the PGMN well network since 2001 though some wells were installed more recent than this. Also the data for some wells is not current to 2018. The Provincial Groundwater Monitoring Network database is made available by MECP on-line.

As a recent internal project the MECP has applied the Mann-Kendall (MK) and Seasonal Kendall (SK) tests to analyze the PGMN water level data for monotonic trends (i.e. consistently increases or decreases through time). The statistical analyses were performed using robust and defensible methodologies to look for longer-term trends in groundwater levels. An overall objective is to determine if there is enough data to support the presence of a widespread decrease in groundwater availability. Shorter trends within the PGMN data record (e.g. lasting for a few years) were not considered and the causes of any trends that were identified were not investigated. Both the data plots and preliminary findings for PGMN well locations nearest a WBSA were shared by the ministry and are presented and relied on herein. The data plots indicate data available for the well at the time of the assessment. Further, the MECP has indicated that the methodologies used require that certain values be dropped from the data set if the month/year in question does not have sufficient number of data points. The release of a final report that details the methodology and results from the PGMN data trends analysis is forthcoming from the ministry (MECP, 2018).

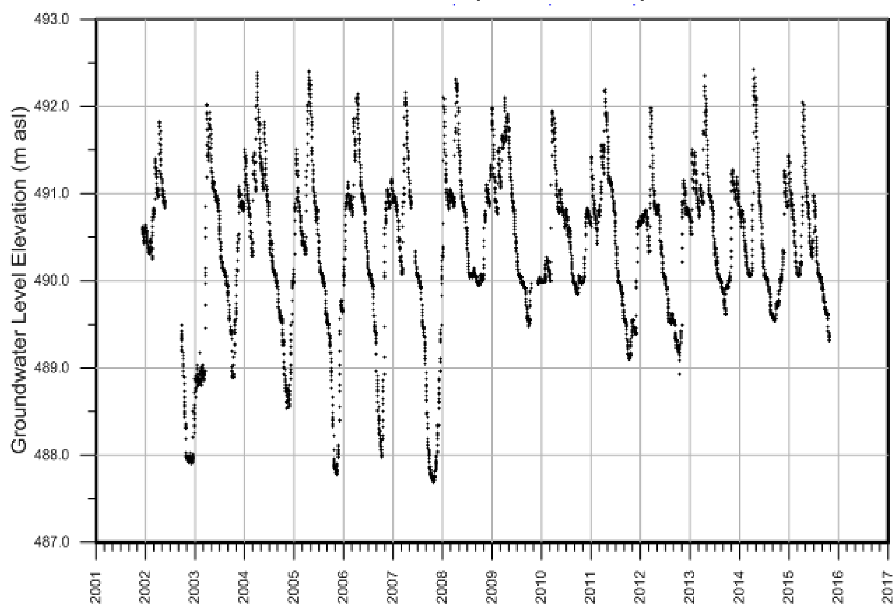
One PGMN well is located within 10 kilometers of the Gott Enterprises Inc. Grey Highland site as shown on Figure 5-2. Bedrock PGMN well W0000066-1 is located 4.4 km to the north. The PGMN well info is summarized below.

Table 5-5: Gott Enterprises Grey Highlands - PGMN Wells Summary

PGMN Well ID	Water Well Record ID	Distance from Gott Source Wells (km)	Well Depth (m)	Ground Elevation (masl)	Lithology of Aquifer
W0000066-1	2503905	4.4	18.5	496	Bedrock (Limestone)

The data plot and trend analysis for PGMN Well W0000066-1 is provided as follows.

Text Figure 5-3: Groundwater Level Elevations (2001 to 2016) for PGMN Well W0000066-1



For PGMN well No. W0000066-1, the MK test (year over year) did not detect a significant trend. The SK test (season to season) also did not detect a significant trend. Visual analysis of the data indicates seasonal fluctuations in water level of more than 4.0 m from 2002 to 2008. Comparatively less seasonal fluctuation in water level (generally less than 3 m) but similar peak annual water levels are apparent from 2008 to 2016. No data trends that might be an indicator of reduced groundwater availability were identified.

5.4.3 Ontario Low Water Response (OLWR) Program

The OLWR program was initiated in 2000 and is managed by the Ministry of Natural Resources and Forestry (MNRF). The program relies on the use of real time surface water monitoring data collected through the Surface Water Monitoring Centre and utilizing the Water Survey of Canada (WSC) stream gauge (HYDAT) station network to identify potential drought conditions based on set trigger levels. Presently, static groundwater level elevation data from the PGMN program is not a component of the OLWR program. Reportedly, this may be added to the program in future.

OLWR notifications are typically (i.e. not always) released in the last week of each month after a review of data for the previous weeks in the month. When trigger levels are identified for a monitoring station, the OLWR submits a notification to the respective CA or municipality. Based on its review of the OLWR data that accompanies the notification, combined with a review of local factors that include recent precipitation and reports of water shortfalls for surface water and well water supplies a Low Water Conditions Alert 'may' be posted by the CA/municipality. A CA or municipality may also choose to post an Alert without any OLWR notification. Decreases in water takings that are triggered by the declaration of Level 1, 2 and 3 Low Water Condition are as follows:

- Level 1 - A voluntary reduction of 10%
- Level 2 – A voluntary reduction of 10%, to achieve a 20% reduction;
- Level 3 – Reduce and manage water use demands to the maximum extent through regulatory measures, if required.

Note: Specific Permits to Take Water may have conditions requiring mandatory reductions of water takings during low water events. Upon renewal of their water bottling permit, the above decreases will be mandatory based on 3-month average actual flow as outlined in the guidance for bottled water renewals (MOECC, 2017).

The frequency of OLWR notifications over time can be a potential indicator of climate stress trends for surface water (and possibly shallow groundwater where directly connected to surface water), and an indicator of watershed/subwatersheds that are sensitive to seasonal drought conditions. However, the existing OLWR program database has not been prepared for this purpose, has inconsistencies that are attributed to different persons updating the database over the years, and the database does not provide notification Levels during the time period where a Low Water Alert has been declared by a CA/municipality. This is only indicated in the database as an 'Update'. Consequently, only a general review of the information in the OLWR database is provided herein for the geographic CA/municipality relevant to the Site.

A review of the OLWR database indicates that a total of 24 Level 1 notifications and 3 Level 2 notifications were sent to the Grey Sauble CA between 2000 and August 2018. Only 2010 (5 Level 1 notifications) and 2012 (4 Level 1 notifications) had more than 2 notifications. Level 2 notifications were sent in October 2002 and September 2016 but a Level 2 Alert has never been declared by Grey Sauble CA. Between 2000 and August 2018 the Grey Sauble CA has posted a Level 1 Alert for a total period of approximately 18 months of which the longest Level 1 Alert periods extended from September 2002 to January 2003, August to December 2005, August to November 2007, and August to October 2016. Based on a general review of the frequency of OLWR notifications, no specific trends that may be an indication of the depletion of surface water resources within the boundaries of the CA are apparent. However, Level 1 Low Water Condition Alerts have been necessary for the late summer and fall months in approximately 1/3 of the years where the OLWR program has been in place.

5.4.4 Water Budget Analyses

The "Grey and Bruce Counties Groundwater Study" (Waterloo Hydrogeologic, 2003) included a desktop level water budget analysis using information on Canadian Climate Normals (1961-1990) from Agriculture and Agri-Food Canada. The assessment concluded that on a regional-scale there appears to be adequate groundwater available to meet current and future needs. However, the analysis did not consider the effects that concentrated water taking may have on the groundwater system or overall ecosystem health. Additional analysis at a watershed or sub-watershed scale was recommended to provide more information about safe groundwater yield and impacts that future development activities may have.

A Water Budget assessment for the Beaver River catchment area up-stream of the Gott site was included in the Golder, June 2006 report. At the time of the report, the Site was taking up to 0.6 million cubic meters (600 million litres) of groundwater per year. The Golder report states that this represents approximately 7% of the calculated infiltration and surface water runoff (water surplus) over the catchment area upstream of the site and pumping at permitted rates would result in 14 % of the water surplus. Sustainability of local groundwater resources is reported to not be affected by the production pumping from the Site.

A Tier 1 Subwatershed Stress Assessment was completed in 2008 for the Saugeen Valley/Grey Bruce/Northern Bruce Peninsula study area. A Tier 1 Water Budget estimates how much water exists in a subwatershed over a period of time, usually monthly and yearly. It accounts for water that is being added to a watershed, such as precipitation and removed (e.g. rivers flowing out) from a watershed. The assessment included the development of a regional-scale FEFLOW model to represent average annual groundwater flow conditions. The assessment included the consumptive groundwater demand from permitted and non-permitted water takings in the study area and excluded the characterization of surface water takings. The results of the assessment indicated that the Site is located within a subwatershed having a maximum 3 % water demand and a low stress potential (AquaResource, 2008).

AquaResource completed a Tier 1 Surface Water Budget and Stress Assessment Report for the Saugeen Valley, Grey Sauble, and Northern Bruce Peninsula in 2015. A GAWSER surface water model was developed for the Beaver River watershed and used to estimate the water budget. Permitted and non-permitted surface water takings were included in the assessment. The assessment determined that the subwatershed where the Site is located is an area of low surface water stress potential (AquaResource, 2015).

The water budget and stress assessment reports indicate that the permitted water takings at the Gott Enterprises Inc. Site have a negligible impact on the water quantity within the local aquifer.

5.5 IMPACT ASSESSMENT

The following section provides a general assessment of potential water quantity interference with other groundwater uses and the environment.

5.5.1 Municipal Groundwater Use

The Municipality of Grey Highlands provides municipal drinking water in some of its settlement areas. Two groundwater production well sites are located within the Village of Markdale which is located more than 15 km west of the Gott Enterprises Inc. Site. Two springs along the Niagara Escarpment are used to provide municipal drinking water to the Village of Kimberley, Amik Subdivision and the Talisman Mountain Springs Inn. The Village of Kimberley is located approximately 14.5 km to the west of the Gott site. The Township of Clearview municipal wells are located approximately 13 km to the northeast of the Site and are located within the Nottawasaga Valley watershed. All existing municipal systems are considered too distant for the Gott Enterprises Inc. Site to be a concern for well interference. Domestic wells are currently used to supply water to properties located in the nearest settlement area at Feversham. No feasibility studies, environmental impact assessments, etc. were identified that would indicate a municipal well water supply system is being actively considered/pursued for Feversham.

The "Municipality of Grey Highlands Official Plan, 2017" predicts a modest growth from 11,500 persons in the year 2016 to 12,900 in 2026. Given the large separation distance (in excess of 14 km) from the municipal water takings and the established PTTW taking limits for Gott Enterprises Inc., a potential for unacceptable well interference and/or impediment to future expansion of 'existing' or 'planned' new municipal groundwater systems is not identified. Furthermore, the "Municipality of Grey Highlands Official Plan, 2017" states that proposed new developments on private services will be required to demonstrate, among other things, that an adequate quantity of water is available.

In summary, the general assessment of potential water quantity interference with existing or planned municipal water supply systems did not identify any potential for unacceptable impact/interference.

5.5.2 Well Interference Potential

As indicated previously herein an assessment of potential well interference with neighbouring well water supplies was completed in 2005 (Golder, June 2006) as an independent assessment required for the ERT for PTTW No. 00-P-1365. Eight local domestic wells were included as monitoring locations and were monitored over various periods of time using water level pressure transducers equipped with data loggers. No noticeable response was observed for the hydrographs produced for data from the off-site domestic well locations. The testing results indicated that daily fluctuations resulting from precipitation had a larger impact on the off-site domestic wells compared to the impacts of production well pumping. Production borehole water taking rates at the time were on the order of 600 million L/year compared to current annual water taking rates of approximately 480 million L/year (Table 5-3). Well interference potential continues to be assessed on an annual basis using water level monitoring data from the production wells and five monitoring well locations. The Wilson, 2016 report for the 2015 monitoring year concluded that existing and historical withdrawals from the three production boreholes are indicated by long-term monitoring to not be adversely impacting local groundwater.

Based on the well interference assessments completed to date, including an independent assessment in 2005, no potential for adverse impact is evident and the existing groundwater level monitoring program in place serves to identify any possible changes to Site conditions.

Regarding well interference potential with future growth/development near the Site, no new high water use activities are apparent in the vicinity of the water taking and a low growth rate for the municipality is indicated from available information. New land development on private wells near the Site and of significant scale are expected to require site specific hydrogeologic assessment studies and well interference assessments in support of the proposed development.

5.5.3 Impact to Surface Water and Natural Functions of the Ecosystem

Historical reports that have been reviewed as part of this study indicate that the permitted water takings at the Site have had no noticeable impact on surface water and natural ecosystem at the site. The aquatic habitat monitoring program completed in 2005 involved a spring, summer and fall electro shocking program for fish netting/identification at four locations along the Beaver River and at one location on the east tributary. A healthy cold water habitat was consistently observed for the program no stressors that could adversely affect the health of aquatic habitat were observed. The stream flow and water level data collected as part of the assessment showed that groundwater discharge supplements the surface water flow of the Beaver River through the site, indicating that the production wells had not reversed the vertical groundwater flow direction. The report indicated that this also suggests there is a low degree of vertical hydraulic connection between the bedrock aquifer utilized by the production wells and the Beaver River.

Further to the Golder, June 2006 assessment, the 2015 AquaResource Surface Water Budget and Stress Assessment showed that that Site is in an area of low surface water stress potential. Water level monitoring has been conducted at SG1 and SG3 on the Beaver River and SG2 on the east tributary since December 2008. Historical data indicates that there is no identifiable impact on the River from the water taking.

Based on the findings from the information review, continued water takings at the permitted water taking levels are not expected to impact surface water and natural functions of the ecosystem.

5.6 SUSTAINABILITY OF WATER RESOURCES

Water resources are considered sustainable if the total amount of water entering, leaving, and being stored in the system meet existing needs without compromising the ability to meet the needs in the future. Typical indicators used to assess the sustainability of water quantity include Water Budgets completed at the watershed/subwatershed scale and/or for the specific water taking(s) and the evaluation water level data for trends over time to ensure resources are remaining in a steady state. The following provides a general assessment of the sustainability of regional water resources and of the potential impact from the Gott Enterprises Inc. Grey Highlands water taking on sustainability, now and in the future.

Regional Water Resources

The characterization of the regional study area indicates that the Gott Enterprises Inc. Grey Highlands Site is located in the Beaver River watershed where both groundwater stress potential (AquaResource, 2008) and surface water stress potential (AquaResource, 2015) was categorized as Low based on the completed Tier 1 Water Budget analyses. The Water Budget analyses included an estimate of future water demand. Population growth is projected to be minimal in the immediate future, with growth centered along the shore of Lake Huron and in existing towns and villages. Consequently, stresses presented by existing and future demand are not an identified concern for the sustainability of water resources within the regional study area.

The OLWR Program uses real time surface water monitoring data collected from the WSC stream gauge (HYDAT) station network to identify potential drought conditions based on set trigger levels. BluMetric's review of the OLWR Program notification data (2000 to August 2018) for the Grey Sauble CA did not identify any specific trends indicating the depletion in the availability of surface water (and possibly shallow groundwater where directly connected to surface water) resources. BluMetric's review of PGMN groundwater level data for 1 bedrock well located within 10 km of the Gott Enterprises Inc. Grey Highlands water taking also did not identify any specific trends indicating a potential depletion in the availability of regional groundwater resources.

The 'Approved Assessment Report for the Grey Sauble Source Protection Area' (SGSNBPSPR, 2015) includes a chapter on climate change and the potential impacts in the future. The report discussion indicates that climate change has the potential for increased stress levels for groundwater and surface water in the Great Lakes Basin. The amount and availability of municipal drinking water in the Grey Sauble SPA is not expected to be significantly impacted by changes in climate in the next few decades. The SGSNBPSPR, 2015 report indicates the largest impact is expected for private overburden wells and Karstic systems; however, very little research is available to estimate the magnitude of these potential impacts.

In summary, based on the information reviewed, no stress concerns were identified for the sustainability of regional water quantity resources.

Gott Enterprises Inc. Grey Highlands Water Taking

Historical information relating to the Gott Enterprises Inc. Grey Highlands Site indicates it has been permitted for water bottling since 1993 and as a fish hatchery since at least 1977. The current PTTW maximum water taking limits from all sources have remained unchanged since 2000. Since 2012 the reported annual taking has ranged between 40% and 43% of the annual water taking limit. This is approximately 30% of the peak annual groundwater taking amounts during the 1990s (up to 1500 million L/year) when the fish hatchery and water bottling were both in operation (i.e. fish hatchery operations were discontinued in 1999). The technical studies indicate the current pumping rates represent approximately 7% of the calculated infiltration and surface water runoff (water surplus) over the catchment area upstream of the Site.

Regular monitoring of the Gott Enterprises Inc. Grey Highlands Site began in 2001 and current monitoring requirements for groundwater and surface water have been in place since 2008. Monitoring reports are received by the ministry on an annual basis and monitoring data is submitted to the ministry on a 6-month basis. The most recent monitoring report provided for review (for 2015) was received by the ministry in 2016. For this annual monitoring report, hydrographs for the reporting year are provided. However, the long term water level monitoring hydrographs do not provide data beyond 2011. It is BluMetric's opinion that the long term water level monitoring data hydrographs need to be updated as they are the key indicator in confirming steady state conditions for the water resources and confirming the water taking is sustainable. BluMetric's general review of the available long term monitoring data did not identify any indications of a potential depletion in the availability of groundwater and surface water resources.

A review of the WTRS database did not identify any other high volume water taking activities for the bedrock aquifer within the study area. The information review also did not identify any other planned water taking activities that might contribute to the overall cumulative effects/impacts on local groundwater resources. Also, no documented well interference complaints/impacts were identified in the ministry files/reports provided for review.

Based on the information reviewed, there are no indicators of the Gott Enterprises Inc. Grey Highlands water taking having an impact on the sustainability of existing and future water resources. Current Permit requirements/conditions in place through PTTW No. 8404-7YBLB2 appear to be suitable in identifying potential issues should climate change and growth pressures become a larger factor in the sustainability of local water resources.

5.7 Gaps and Recommendations

Gaps in missing reports and documentation are included in Section 5.2. A summary of the gaps identified in the water quantity information for the Site and recommended action(s) to address each gap is provided as follows:

1. The most recent annual monitoring report provided for review (for 2015) was received by the ministry in 2016. The long term water level monitoring hydrographs provided in the report do not provide data beyond 2011. It is recommended that the long term water level monitoring data hydrographs be updated for the annual reports as the key indicator in confirming the sustainability of the water taking.

5.8 Figures

Figures are provided in Appendix A-Main Figures.

6. AQUATERRA CORPORATION LTD. – CATARACT SITE

6.1 BACKGROUND AND HISTORY

Aquaterra Corporation Ltd. ("Aquaterra") currently draws water from one overburden well, the Cataract Well, located in the Hamlet of Cataract, Town of Caledon, Ontario, east of the intersection of Cataract Road and Mississauga Road, herein referred to as the 'Site or Cataract Site'. The Site falls within the jurisdictions of the MECP Halton-Peel District Office – Central Region, and Credit Valley Conservation (CVC). The Aquaterra water source location and Site boundaries are indicated on Figure 6-1.

The Aquaterra Cataract Site is located in a rural setting and is situated adjacent to both the Niagara Escarpment and the Credit River. Ownership of the Site dates back to the late 1800s when the J.J. McLaughlin family began using the springs and/or boreholes at the Site for their business, which later became Canada Dry (DWNA, 2000). More recently, Nestlé Enterprises Limited was permitted to take groundwater from the Site between 1984 and 1992 for the purpose of water bottling. Since 1992, the Site has changed ownership several times, shifting to Crystal Springs Inc., Danone Waters of North America Inc. and then to Aquaterra Corporation Limited (the current owner since 2006), but the Site was continuously used for groundwater taking to supply a water bottling plant in Mississauga, Ontario. An approximate timeline of events relevant to the PTTW history of the Aquaterra Cataract Site is provided in Table 6-1.

Table 6-1: Aquaterra Cataract Site - PTTW History Summary

YEAR	EVENT
1984	**PTTW 84-P3041** (permit not reviewed by BluMetric) was issued to Nestlé Enterprises Limited.
1986	**PTTW 86-P-3029** (permit not reviewed by BluMetric) was issued to Nestlé Enterprises Limited. In a piezometric and groundwater survey report (Geomines, 1990) for the Site, it was noted that groundwater was being extracted from two wells on Site for the purpose of water bottling: the "Crystal Springs" well (later known as the Cataract Well) and the "Canada Dry" well. The Canada Dry well ceased normal production sometime before 1996 (Geomines, 1996); the well (well record ID no. 4903950) does not appear have been decommissioned, as it is currently listed in the MECP's well records database. As PTTW 84-P3041 was later replaced by PTTW 92-P-3056, PTTW 86-P-3029 may have authorized the extraction of groundwater from the former Canada Dry well.
1992	The Crystal Springs Division of Nestlé Enterprises Limited is purchased by Crystal Springs Inc. **PTTW 92-P-3056** (not reviewed) was issued to Crystal Springs Inc. on **July 7, 1992**, with an expiry date of March 31, 2002, to reflect the change in ownership. The PTTW cancelled and replaced PTTW 84-P-3041. The PTTW authorized the withdrawal of water from one well; the maximum withdrawal rate was 50,000 imperial gallons per day (igpd) ((227,304.5 L/day). No mention is made in the permit about PTTW 86-P-3029, nor of the former Canada Dry well.
1993	**PTTW 93-P-3055** (permit not reviewed by BluMetric) was issued on **July 15, 1993**, with an expiry date of March 31, 2003. According to information provided in other reports, this PTTW allowed the use of "Well 2" as a standby well. The maximum withdrawal amount for the two wells combined was 50,000 igpd (227,305 L/day).

YEAR	EVENT
1996	**PTTW 96-P-3036** (permit not reviewed by BluMetric) was issued in 1996, allowing for the withdrawal of up to 50,000 igpd (227,305 L/day). The PTTW allowed water to be extracted from the Cataract Springs Well (later called the "Cataract Well") and the Canada Dry well (also referred to as "Well 2") for the purpose of commercial water bottling, subject to the following limits: • Maximum amount of water taken per minute: 100 igpm (455 L/minute) • Maximum amount of water taken per day: 50,000 igpd (227,305 L/day) • Maximum number of hours of taking per day: 8.33 • Maximum number of days of taking per year: 250 The Canada Dry well was authorized as a standby source that may be used when the Cataract Springs well cannot be pumped. Water withdrawal from the well was not to exceed 50,000 igpd (227,305 L/day), and was not to be pumped for more than 7 days in a calendar year.
2000	Crystal Springs Inc. became "Crystal Springs Inc., a Division of Aquaterra".
2001	**PTTW 96-P-3036** (permit not reviewed by BluMetric) is amended to reflect the Permit Holder's name change from Crystal Springs Inc. to Danone Waters of North America Inc. (DWNA).
2002	A temporary, 2-week PTTW **02-P-3109PT** is issued to DWNA to undertake an operational test in support of a requested increase in the maximum withdrawal rate from 50,000 to 80,000 igpd (227,304 to 363,687 L/day).
2003	An amendment to **PTTW 96-P-3036** was issued to DWNA on **June 27, 2003**, with an expiry date of October 31, 2005. The permit allowed water to be extracted from the Cataract Well for the purpose of bottled water production. The permit allowed a maximum withdrawal rate of 455 L/minute (100 igpm), a maximum daily withdrawal amount of 80,000 igpd (approx. 363,680 L/day), and a maximum weekly withdrawal amount of 1,818,400 L/week (400,000 imperial gallons per week) (equivalent to the maximum daily amount being withdrawn 5 days per week); water withdrawal was permitted year-round. If the average daily flow at Culvert 4 (underneath the rail line) in Tributary 4 was equal to or lower than 7.3 L/s (from June 1 to August 31) or 5.8 L/s (during the rest of the year), the maximum permitted taking per day was reduced from 363,680 L to 227,300 L (80,000 to 50,000 igpd). The PTTW also required the Permit Holder to: • Implement the monitoring plan outlined in GLL (2003), consisting of: o Continuous monitoring of water levels and water temperature at various specified groundwater monitoring locations; o Monthly monitoring of flow and water temperature in Tributary 4 and in the tributary near the eastern corner of the property; and o Annual biological assessments (fish habitat, population and spawning surveys) in Tributary 4 and in the tributary near the eastern corner of the property. • Download the monitoring data from the data loggers, and have the data evaluated by a qualified professional on a monthly basis, at minimum; • Implement the mitigation protocol outlined in GLL (2003), where appropriate action is taken (e.g. check/correct loggers, evaluate fish and habitat for effects, notify agencies, reduce pumping) if monitoring data shows that water flow triggers in Tributary 4 are reached: o Early Warning: 10 m^3/s during the summer, or 6.3 m^3/s during the rest of the year; o Action: 7.3 m^3/s during the summer, or 5.8 m^3/s during the rest of the year; o Threshold: 3.0 m^3/s (any time of year); and • Prepare and submit a work plan to the Director, detailing when a telemetry system will be implemented and how it will be used to control water takings if flows in Tributary 4 fall below the applicable average daily flow threshold. *[Note: in a December 2016 application to renew PTTW 7541-72QM8Z, it was reported that a telemetry system was installed and was operational in 2007, but due to mechanical failure, it was taken off-line in 2008, and no replacement system was installed. It was noted in the application that frequent monthly review of data would allow sufficient opportunity to respond in the event an early warning level is triggered, and that a replacement system was not considered necessary.]*
2004	DWNA was renamed to Danone Waters of Canada Inc.

YEAR	EVENT
2006	Danone Waters of Canada Inc. was purchased by Aquaterra Corporation Ltd.
2007	**PTTW 7541-72ZM8Z** was issued to Aquaterra Corporation Ltd. on **July 20, 2007**, with an expiry date of March 31, 2017. The permit allowed water to be extracted from the Cataract Well for the purpose of commercial water bottling. The maximum withdrawal rate and withdrawal amount were 455 L/min and 363,680 L/day, respectively. Water could be taken for a maximum of 18 hours per day, and a maximum of 260 days per year. If the daily average water level in piezometer P8 fell below 382.89 m asl (from June 1 to August 31) or 382.73 m asl (during the rest of the year), no more than 227,300 L/day could be withdrawn. The PTTW also required the Permit Holder to: • Implement the monitoring program outlined in GLL (2007), **see Table 6-3.** • Implement the mitigation protocol outlined in GLL (2007), where appropriate action is taken (e.g. check/correct loggers, conduct a site visit to measure flows and groundwater levels at the monitoring locations, reduce pumping) if monitoring data shows that water level triggers in piezometer P8 are reached: o Early Warning: 383.12 m asl during the summer, or 382.79 m asl during the rest of the year; and o Action: 382.89 m asl during the summer, 382.73 m asl during the rest of the year.
2016	In December 2016, Aquaterra submitted an application to renew PTTW 7541-72ZM8Z.

General information about the source well (Cataract Well) on the Aquaterra Cataract Site is provided in Table 6-2.

Table 6-2: Aquaterra Cataract Site - Summary of Water Taking Source

Source Name	Type/Date of Install	Well Record ID	Total Well Depth	Completion Unit	Screened Interval	PTTW No. 7541-72ZM8Z		
						Max. Taken Per Minute (L)	Max. Num. of Hours Taken per Day	Max. Taken Per Day (m^3)
Cataract Well	Drilled Well/ Nov 14, 1977	4905439	12.8 m (42 ft)	Overburden – Gravel-sand	8.5 to 12.5 m (28 to 41 ft)	455	18	363,680 (combined)
Canada Dry Well	Drilled Well/ Sept 7, 1972	4903950	14.3 m (47 ft)	Overburden - Gravel	10.7 to 11.6 m (35 to 38 ft)	Not included in Permit (previously used as a standby well for the Cataract Well)		

As indicated in Table 6-2, the Cataract Well water taking source is completed in gravel with a screen intake interval from 8.5 to 12.5 m depth. Water taking from the well is recorded from the number of truckloads that are removed each day. Each truckload is based on tank capacity which is 36,368 L. The only structures reported to be located on the Site are the two well security enclosures and the on-Site observation wells.

Under PTTW 7541-72ZM8Z, the Permit Holder must implement a monitoring program incorporating groundwater monitoring, surface water monitoring, and biological assessments, in addition to the documentation of pumping records. The monitoring program is summarized in Table 6-3, and the locations of the different monitoring components are illustrated on Figure 6-1.

Table 6-3: Aquaterra Cataract Site - Summary of Monitoring Program under PTTW 7541-72ZM8Z

Location	Monitoring Completed	Monitoring Objectives	Monitoring Frequency and Logger Report	
			Manual	Data Logger
Groundwater Monitors				
P8	Water Level + Temperature	Effect of pumping within zone of influence	N/A	Hourly
P5, P6, P11	Water Level	Baseline data and to confirm early warning trigger levels	Quarterly	N/A
Mini-Piezometers DWNA 1-5	Water Level	Baseline data and to demonstrate groundwater upwelling at base of Escarpment at early warning trigger	September, December	N/A
Tributary 4 (Surface Water Monitors)				
Xs8	Flow	Flow in Tributary 4 assessment of habitat conditions	September, December	N/A
Biological Assessments				
Tributary 4	Fish habitat, population (electrofishing, visual inspect.)	Assessment of fish and fish habitat conditions	Annually	N/A
Water Taking				
Crystal Springs Well [1]	Pumping well	Pumping records	Monthly; per load for logs	N/A

[1] **Crystal Springs Well corresponds to the Cataract Well**

6.2 PRIMARY INFORMATION SOURCES

The following records were on file with the MECP documenting the PTTW history:

- PTTW No. 84-P-3041 Amendment Application, Crystal Springs Inc., May 29, 1992.
- PTTW No. 92-P-3056 Amendment Application, Crystal Springs Inc., January 28, 1993.
- PTTW No. 93-P-3055 Amendment Application, Crystal Springs Inc., March 8, 1994.
- PTTW No. 96-P-3036 Renewal Application, Crystal Springs Inc., a Division of Aquaterra, April 6, 2000.
- PTTW No. 96-P-3036 Amendment Application, Danone Waters of North America Inc., November 7, 2000.
- Application for a Temporary PTTW, Danone Waters of North America Inc., October 29, 2002.
- PTTW 96-P-3036, Danone Waters of North America Inc., June 27, 2003.
- PTTW No. 96-P-3036 Renewal Application, Reference No. 2726-6K9LL8, Danone Waters of Canada, December 13, 2005.
- PTTW 7541-72ZM8Z, Aquaterra Corporation Ltd., July 20, 2007.
- PTTW Renewal Application, Reference No. 6184-AGVJRT, Aquaterra Corporation Ltd., December 19, 2016.

The following key technical documents provided to the ministry by the proponent/Permit Holder were identified and reviewed herein:

- Piezometric and Conductivity Survey on Crystal Springs Property and Surrounding Area. Caledon, Ontario (Geomines Ltd., June 1990).
- Hydrogeological Impact of Proposed Armbro Pit on the Crystal Springs Well, Cataract, Ontario (Gartner Lee Limited (GLL), August 4, 1994).
- Hydrogeological Evaluation of an Increase in Discharge Rate at Crystal Springs' Property – Caledon, Ontario (Geomines Ltd., October 1996).
- Request for the Increase of the Discharge Rate. Additional Information (Tecsult Inc., October 1998).
- Request for the increase of the discharge rate – Crystal Springs Well (Tecsult Inc., July 14, 1999).
- Request for the increase of the discharge rate – Crystal Springs Well (Agritecsult Inc., September 22, 1999).
- Data Compilation for Crystal Springs, Inc. Property – Cataract, Ontario (Danone Waters of North America and Gartner Lee Limited (DWNA & GLL), 2000).
- Brook Trout Spawning Survey of the Crystal Springs Property (Gartner Lee Limited (GLL), December 4, 2000).
- Danone Waters of North America Inc./Crystal Springs. Permit to Take Water 96-P-3036 (DWNA & GLL, August 30, 2001).
- Crystal Springs, Cataract Source – Resolution of Upwelling Issues (GLL, September 26, 2001).
- Crystal Springs Caledon Operational Test Results and Assessment (GLL, January 2003).
- GLL 20-377 – Danone Waters of North America Inc./Crystal Springs Cataract Site. Permit to Take Water 96-P-3036 (GLL, June 2, 2003).
- Cataract Spring Source PTTW Amendment Supplementary Information (GLL, March 2007).
- Various status reports submitted to the MECP for the monitoring program at the Aquaterra Cataract Site, for the years 2003 to 2016 (GLL, AECOM)

Other information sources used in this assessment included:

- Caledon Creek and Credit River Subwatershed Study (Subwatersheds 16 & 18). Phase I: Characterization Report. Blackport Hydrogeologic, Credit Valley Conservation, Environmental Water Resources Group, Water Systems Analysts and Parish Geomorphic, 1999 (Blackport Hydrogeologic et al., 1999).
- Zoning By-Law 2006-50, as amended (Town of Caledon, 2006).
- Approved Updated Assessment Report: Credit Valley Source Protection Area. Credit Valley Conservation Authority, July 27, 2015 (CVSPA, 2015).
- Hydrogeological Impact Assessment. Aggregate License Application. Lots 11 – 13, Concession 6 West Side. Town of Caledon, Regional Municipality of Peel. (Harden Environmental Services Limited, December 16, 2016).

- 2017 Water Quality Report. Brampton, Mississauga and South Caledon (South Peel Drinking Water System). (Region of Peel, 2017).
- Town of Caledon Official Plan. Consolidated in April 2018.
- Wastewater in Peel. Region of Peel, undated. Available at: https://www.peelregion.ca/pw/water/sewage-trtmt/.
- Chapman, L.J. and Putnam, D.F. 2007. Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228. (Chapman and Putnam, 2007).
- Surficial Geology of Ontario; MNDM File - MRD128-REV. Ontario Geological Survey, 2010. (OGS, 2010).
- Bedrock Geology of Ontario; MNDM File - MRD126-REV1. Ontario Geological Survey, 2011. (OGS, 2011).
- MECP water well information system (WWIS) database. Available at: https://www.ontario.ca/environment-and-energy/map-well-records.
- MECP on-line Provincial Groundwater Monitoring Network database. Available at: https://www.ontario.ca/environment-and-energy/map-provincial-groundwater-monitoring-network.
- MECP on-line Permit to Take Water database. Available at: https://www.ontario.ca/environment-and-energy/map-permits-take-water.
- MECP on-line Source Protection Information Atlas. Available at: www.applications.ene.gov.on.ca/swp/en/index.php.
- Ministry of Natural Resources and Forestry on-line Natural Heritage Areas mapping. Available at: https://www.ontario.ca/page/make-natural-heritage-area-map.
- MECP Water Taking Reporting System (WTRS) database (Confidential – Used with Permission from MECP).
- Ontario Low Water Response Program (OLWR) notifications and alert levels for Credit Valley Conservation (2000 to August 2018 data from MNRF).

Technical information sources referenced in other documentation but not provided in MECP files:

- Hydrogeological Investigation, Caledon, Ontario. January 1987. Geomines Ltd.
- Follow-up Hydrogeological Study After Completion of an Observation Well Network Construction Program at Crystal Springs Property, Caledon, Ontario. February 1988. Geomines Ltd.
- Notice Presenting the Protection Area Required in the Recharge Area of the Cataract Source by Crystal Springs. January 1994. Geomines Ltd.

6.3 Characterization of Study Area

This section provides a general characterization of the study area. Figure 6-2 presents the assessed regional study area which covers an approximate 30 km by 30 km area centered over the Aquaterra water taking location (Figure 6-1). The regional study area boundaries were set based on an area that captures the municipal groundwater supply systems for Orangeville (approximately 13 km to the northwest), Hillsburgh (approx. 10 km to the west), Alton and Caledon Village (approx. 6 km to the north), Erin and Bel-Erin (approx. 6 km to the southwest), Inglewood (approx. 7 km to the east), Cheltenham (approx. 11 km to the southeast), and Caledon East (approx. 14 km to the northeast). On Figure 6-2, the municipal groundwater supply systems are distinguishable from the other active PTTWs by having designated Wellhead Protection Areas (WHPA). With the exception of the Caledon East groundwater supply system (located in the Humber River watershed, just east of the Credit River watershed boundary), the Aquaterra water taking location and the municipal groundwater supply systems are all located within the Credit Valley Source Protection Area (SPA). The Town of Caledon is serviced by the groundwater supply systems at Alton, Caledon Village, Caledon East, Inglewood and Cheltenham, although one of the groundwater supply wells for the Town of Orangeville (Well 10) falls within the municipal boundaries of the Town of Caledon (CVSPA, 2015).

6.3.1 Land Use Setting

The Aquaterra Cataract Site is located in the Town of Caledon, one of the three municipalities constituting the Regional Municipality of Peel. The Town is described as exhibiting the characteristics of a distinct rural area under increasing pressure from expanding urban areas from Toronto, located to the southeast of the Town (Town of Caledon, 2018). The Town of Caledon has a 2016 census population of 66,502, and the population is forecast to rise to about 87,000 and then 108,000 by the years 2021 and 2031, respectively. The primary growth areas are designated to occur in Rural Service Centres, i.e. compact, well-integrated rural towns on full piped water and sewer services. Within the Town of Caledon, the Rural Service Centres are Mayfield West, Bolton and Caledon East, located 13.5 km northeast, 22.9 km east-northeast, and 17.9 km southeast of the Aquaterra Cataract Site, respectively.

The Town of Caledon is characterized by large areas of rural and agricultural land uses. Land use on the Aquaterra Cataract Site is designated predominantly as General Agricultural Area, with the eastern boundary near the Credit River being designated as Environmental Policy Area (Town of Caledon, 2018). The Site is zoned as the Niagara Escarpment Development Control Area, pursuant to the Niagara Planning and Development Act (Town of Caledon, 2006).

No municipal water services were identified in the vicinity (< 2 km) of the Aquaterra Cataract Site. Parts of the Town of Caledon are serviced by the Region of Peel's South Peel Drinking Water System, which pumps water from Lake Ontario into its two surface water treatment plants (Region of Peel, 2017). The Region of Peel is also the operating authority of four well-based municipal drinking water systems in

Caledon, namely, Caledon Village – Alton, Cheltenham, Inglewood, and Palgrave – Caledon East (Region of Peel, 2017). Wastewater services for the Town of Caledon, including the Caledon Groundwater Treatment Plants, are operated and maintained by the Region of Peel (Region of Peel, undated).

The Ministry of Natural Resources and Forestry's (MNRF) Natural Heritage Areas mapping shows the Aquaterra Cataract Site as being just outside of the Forks of the Credit River Provincial Park, which is located on the opposite side of the rail line, approximately 130 m east of the Site. The mapping also shows the Site as being located within an Earth Sciences Area of Natural and Scientific Interest (ANSI), the Caledon Meltwater Deposits – Forks of the Credit. ANSIs are areas of land and water containing unique natural landscapes or features; Earth Sciences ANSIs have been scientifically identified as having earth science values related to protection, scientific study or education, and are geological in nature, containing significant examples of bedrock, fossils, landforms or ongoing geological processes. The Caledon Meltwater Deposits ANSI consists of glacial meltwater deposits, forming thick sequences of well-sorted sand and gravel, and includes kettle lakes and deep erosional features formed by meltwater (Harden Environmental Services Ltd., 2016).

Land use within an approximate 500 m radius of the Aquaterra Cataract Site (Figure 6-3), as per Schedule A of the Town of Caledon Official Plan, consists of Extractive Industrial Area to the west, General Agricultural Area to the north, Environmental Policy Area to the east, and Open Space Policy Area and Environmental Policy Area to the south.

6.3.2 Physiographic Setting

The physiographic landforms of the study area, as described by Chapman and Putnam, 2007, are provided in Figure 6-4, and show the Aquaterra Cataract Site to be within an area of spillways. The physiographic region in which the Site is located is the Guelph Drumlin Field, an area of low rolling drumlins located between the Singhampton Moraine and the Orangeville Moraine (Chapman and Putnam, 1984, as cited by CVSPA, 2015). The Guelph Drumlin Field is characterized by a series of streamlined drumlins separated from one another by interconnected meltwater channels. The Niagara Escarpment is located within 540 m east of the Site, extending in a general north-south direction. The Oak Ridges Moraine is located approximately 1.4 km east of the Site, beyond the Niagara Escarpment.

The regional topography and hydrology of the study area is provided in Figure 6-5. The topography is characterized by relatively gentle slopes in the areas of the drumlinized till plains and spillways, and comparatively steeper slopes in the areas of the escarpments. As illustrated on Figure 6-5, the Aquaterra Cataract Site is located approximately 2.9 km upstream of the deep valleys characterizing the Forks of the Credit. Regional drainage is in a general eastern direction towards the Credit River.

The Aquaterra Cataract Site is located on hilly terrain. About two-thirds of the property is on a plateau overlooking the Credit River valley, and one-third (the northeastern portion of the property) is on the sloping sides of the valley (Geomines, 1996).

The Credit River is located approximately 350 m northeast of the Cataract Well, and is 40 m lower than the bottom elevation of the Cataract Well. This portion of the Credit River is also referred to as the Main Credit River, and at a point 2.9 km downstream, it is joined by the West Credit River at the Forks of the Credit. Both the Main Credit River and the West Credit River flow through deep, re-entrant valleys in the Niagara Escarpment. Downstream of the Forks of the Credit, the river valley forms a wide alluvial plain, and is joined by the East Credit River at Inglewood.

The Aquaterra Cataract Site is located in the upper half of the Credit River watershed, within the "Melville to Forks of the Credit" subwatershed. The subwatershed covers an area of approximately 39.19 km^2 and extends from the Community of Melville located 8.6 km to the north-northwest of the Site to the Hamlet of Belfountain located 1.8 km south of the Site.

In the immediate vicinity of the Aquaterra Cataract Site, several downgradient springs and seeps flow from the face of the Niagara Escarpment, and coalesce to form small tributaries to the Credit River. Four such tributaries are present on or adjacent to the Aquaterra Cataract Site: one tributary receives flow from the neighbouring property to the south of the Aquaterra Cataract Site and from a small stream that flows along the Canadian Pacific rail line near the eastern boundary of the Aquaterra Cataract Site. Two other tributaries receive flow from several seepage faces located on the Aquaterra property near the rail line; these two tributaries were observed to be intermittent and/or poorly-defined, seeping back into the ground before reaching the Credit River (DWNA & GLL, 2000). Another tributary, identified as Tributary 4 in technical documentation and PTTW records for the Aquaterra Cataract Site, receives flow from several seepage faces located on the adjacent property to the north of the Site, which converge to form a well-defined meandering channel.

Nearby Water Survey of Canada (WSC) stream gauges on the Credit River include 02HB001 (located near Cataract, approximately 2.8 km upstream of the Aquaterra Cataract Site), and 02HB018 (located in Boston Mills, approximately 14 km downstream of the Aquaterra Cataract Site); the locations of the gauges are illustrated on Figure 6-2. DWNA and GLL (2000) noted that the Credit River gains, on average, 1.82 to 4.56 m^3/s of flow between these stations from baseflow and from tributaries. The withdrawal amount from the Cataract Well at the time (50,000 ipgm, or 227,305 L/day) represented approximately 0.06 to 0.14% of this total gain in flow. Mean annual streamflow at gauge 02HB001, for the period 1915 to 2017, is approximately 1.8 m^3/s. Mean annual streamflow at gauge 02HB018, for the period 1982 to 2017, is approximately 4.5 m^3/s.

The Credit River near the Aquaterra Cataract Site is characterized as cold water fish habitat (CVSPA, 2015). Tributary 4, to the east of the Site, also supports cold water fish habitat with baseflow contributing to its cold water conditions. Among the tributaries in the vicinity of the Aquaterra Cataract Site, only Tributary 4 and another nearby tributary were identified as having good quality fish habitat, which were restricted to their lower reaches, where they meander along the floodplain of the Credit River (DWNA & GLL, 2000). The steep slope of the Niagara Escarpment presents a permanent barrier to fish, which was supported by the results of fish surveys, which identified no fish for 120 m along Tributary 4 upstream of the drop at the Escarpment (DWNA & GLL, 2000). Neither tributary had substrate in their lower reaches that would be considered ideal for spawning (DWNA & GLL, 2000).

6.3.3 Geologic Setting

Information on surficial geology and bedrock geology in the Credit River watershed was obtained from published maps and supplemented using information from the technical documents listed in Section 6.2. Surficial geology for the study area is mapped in Figures 6-6 and bedrock geology is mapped in Figure 6-7.

The geology of the Cataract region is characterized primarily by glaciofluvial outwash sands and gravels, overlying grey sandstone of the Silurian Whirlpool Formation and red shales and sandstone of the Ordovician Queenston Formation. Both formations are exposed at the waterfalls in the region along the Niagara Escarpment. The underlying bedrock is incised with erosional channels of glaciofluvial origin, which became filled in and buried with glacial outwash deposits. The outwash deposits are an important source of sand and gravel in the region, and are heavily used by the aggregate extraction industry.

The materials underlying the Aquaterra Cataract Site are characterized by a series of layered glacial outwash deposits and till, possibly with lacustrine clay-silts and/or clay till deposits at depth (Geomines, 1996). Overburden thickness on the property ranges from 35 m near the Cataract Well, to 90 m at the southern limit of the property; underneath the unconsolidated deposits, the bedrock consists of a series of thick beds of red and green shale underlain by limestone (Geomines, 1996).

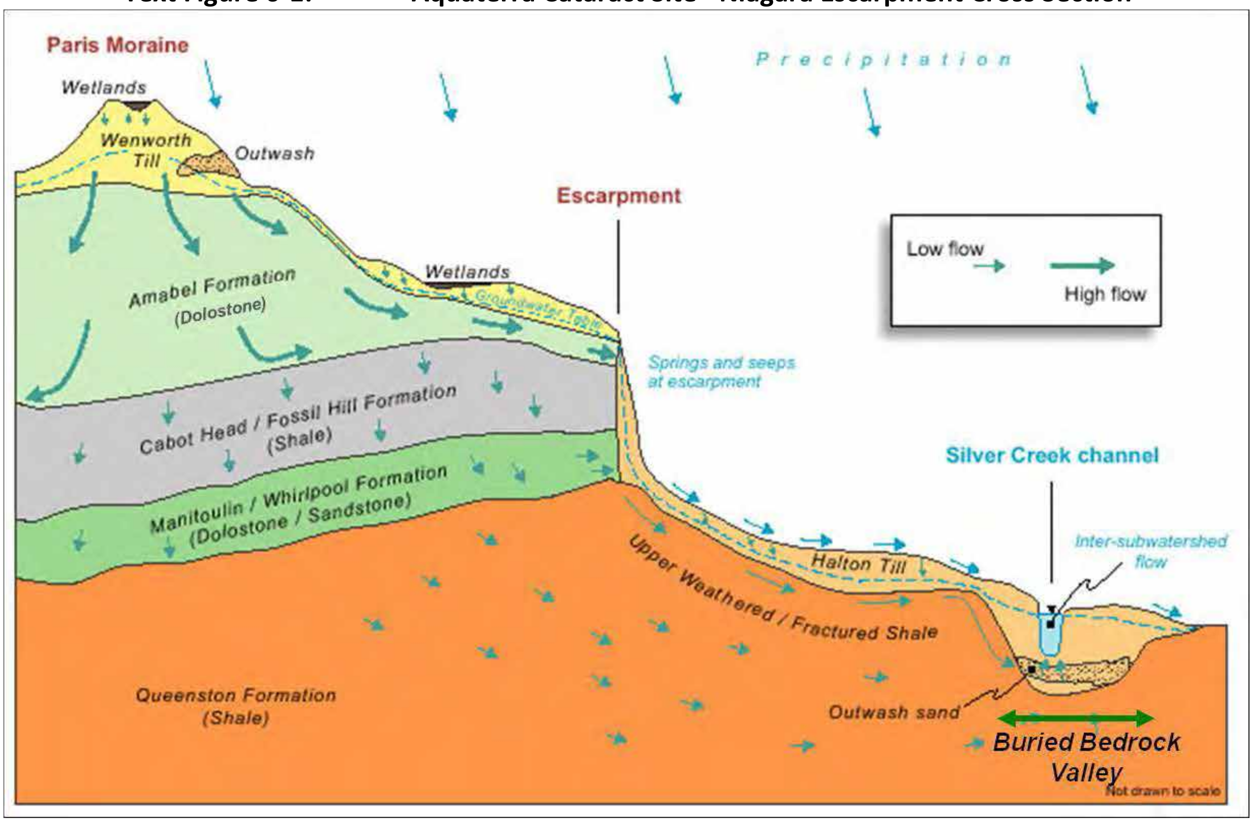
Within the Melville to Forks of the Credit subwatershed, the Credit River follows the glacial spillway between the Orangeville and Paris moraines. The glacial spillway exhibits broad, flat plains formed by meltwater during glacial melt. The channel becomes significantly more constricted as the Credit River leaves the upland plateau, passing through a deep notch in the Niagara Escarpment at Cataract (Blackport Hydrogeologic et al., 1999).

6.3.4 Hydrogeologic Setting

6.3.4.1 Regional Hydrogeology

The glaciofluvial outwash deposits characterizing the regional geology provide a porous media for the prolific aquifers in the region (DWNA and GLL, 2000). The extent of the local aquifer used by the Cataract Well, the Caledon-Upper Credit Aquifer, is defined by a large glaciofluvial spillway channel (currently an overburden channel) that extends to the west/northwest of the Aquaterra property (DWNA and GLL, 2000). The water table drops over 100 m across the slope of the Niagara Escarpment. Groundwater discharge occurs along the face of the Escarpment, and forms the headwaters of several tributaries flowing into the Credit River between Inglewood and Georgetown (both downstream of the Aquaterra Cataract Site). The discharge of groundwater as seeps and springs along the Escarpment creates an abrupt break in continuity in shallow groundwater flow (see conceptual cross-section below).

Text Figure 6-1: Aquaterra Cataract Site - Niagara Escarpment Cross Section



Source: Figure 3.3 of 'Approved Updated Assessment Report: Credit Valley Source Protection Area. Credit Valley Conservation Authority, July 27, 2015 (CVSPA, 2015)'.

The regional, deep groundwater flow generally follows the bedrock topography and the groundwater flow in the shallow overlying system (CVSPA, 2015). The greatest amount of groundwater recharge in the Credit River watershed occurs in the upper zone, where coarse-grained moraine sediments lie at ground surface, whereas limited recharge occurs below the Niagara Escarpment, due to the lower permeability of the Halton Till and associated glaciolacustrine silts and clays (CVSPA, 2015).

The well head protection areas (WHPA for water quality) for the communal well systems in the regional study area are reproduced in Figure 6-2. The WHPA mapping outlines time-of-travel (TOT) zones for groundwater captured by the municipal wells as indicators of the relative level of risk for water quality impact from land development activities within each zone. The mapped WHPA areas on Figure 6-2 are useful indicators of regional groundwater flow conditions for the bedrock aquifers utilized by the municipal wells. As indicated in Figure 6-2 the Credit River has significant influence on regional groundwater flow creating a divide between municipal wells located on the west side of the river (flow to the east or southeast) and municipal wells located on the east side of the river (flow to the west or southwest). This is most obvious for the municipal wells at Erin (Approximately 6 km southwest of the Site) and at Alton (approximately 5 km northwest of the Site).

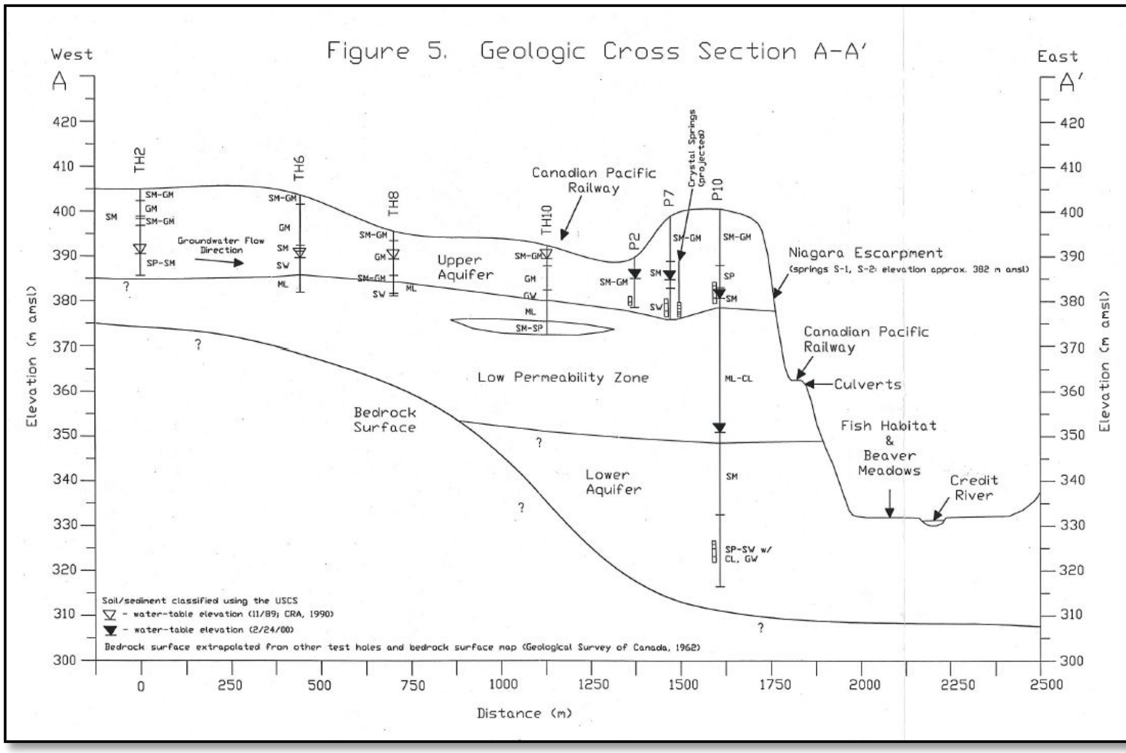
A high proportion of the flow in the Credit River is attributed to groundwater discharge, particularly in the upper portion of the watershed. A large portion of this baseflow originates from the discharge areas along the flanks of moraines (such as the Orangeville Moraine and the Paris Moraine) just west of the Niagara Escarpment, as well as the significant discharge areas associated with the Escarpment itself. At stream gauge 02HB001 (approximately 2.8 km upstream of the Aquaterra Cataract Site), with a mean annual flow of 1.83 m^3/s, CVCA (2015) estimated that 1.36 m^3/s (75%) of the mean annual flow comes from baseflow. Similarly, at stream gauge 02HB018 (approximately 14 km downstream of the Aquaterra Cataract Site), with a mean annual flow of 4.5 m^3/s, approximately 3.26 m^3/s (73%) is attributed to baseflow. This indicates that a theoretical reduction in shallow groundwater flow, if significant, could impact surface water flows in the Credit River, particularly during summer low flows that are mostly driven by baseflow.

6.3.4.2 Local Hydrogeology

In the vicinity of the Credit River above the Forks of the Credit, shallow groundwater flow is towards the river (CVSPA, 2015). Water well information from three private water wells immediately northwest of the Aquaterra Cataract Site indicates that bedrock rises sharply, limiting the thickness of the aquifer; a groundwater flow divide is estimated to be present near Highway 24 (approximately 1.2 km northwest of the Aquaterra Cataract Site), in an area characterized by thin overburden (GLL, 1994).

DWNA and GLL (2000) described three main water-bearing horizons in and around the Hamlet of Cataract: the upper portion of the Upper Credit Aquifer, the lower portion of the Upper Credit Aquifer, and the bedrock aquifer. The upper portion of the Upper Credit Aquifer occurs primarily under unconfined conditions in the shallow sand and gravel deposits, located between ground surface (located at approximately 388 to 400 m above sea level (asl)) and 370 m asl. The water table across the Aquaterra Cataract Site typically ranges in elevation from approximately 388 to 377 m asl. The lower portion of the Upper Credit Aquifer is located within the lower silt, sand and gravel deposits occurring between approximately 360 m asl and the bedrock surface (between approximately 310 to 330 m asl). The upper and lower portions of the Upper Credit Aquifer are separated by at least one layer of gray clay marl, most likely of lacustrine origin. The lower portion of the Upper Credit Aquifer extends to and intersects the floodplain of the Credit River and the lower reaches of the adjacent tributaries. A west to east cross-section through the Site is provided below.

Text Figure 6-2: Aquaterra Cataract Site - West-East Site Cross Section



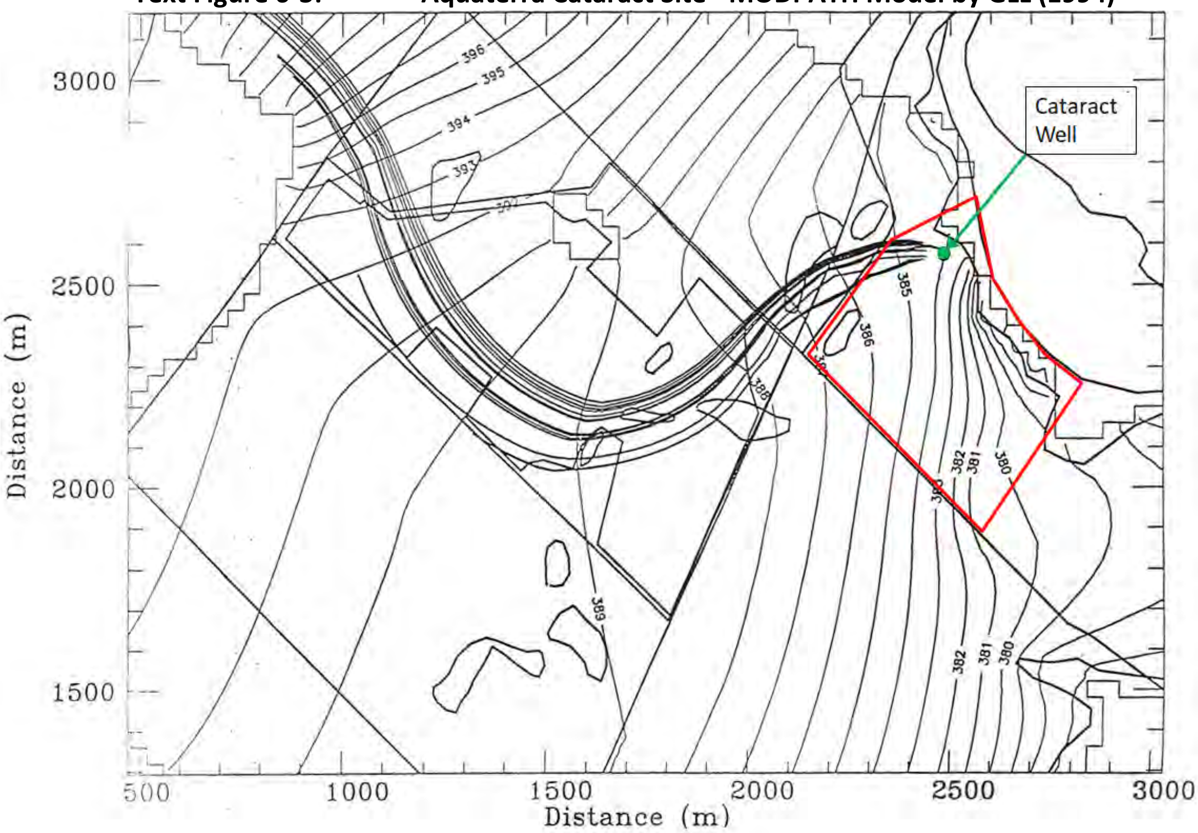
Source: Figure 5 of 'Data Compilation for Crystal Springs, Inc. Property – Cataract, Ontario (Danone Waters of North America and Gartner Lee Limited (DWNA & GLL), 2000)'.

Domestic water supply wells in the area are completed in the overburden materials of the Caledon-Upper Credit Aquifer, as well as in the underlying bedrock, which serves as an additional source of potable groundwater (DWNA and GLL, 2000).

The local overburden aquifer sediments in the vicinity of the Aquaterra Cataract Site were reported to consist of glaciofluvial outwash gravels and gravelly sand, overlying dolostone bedrock of the Amabel Formation (GLL, 1994). An earlier study by Geomines (1988, as cited by GLL, 1994) identified two overburden sand and gravel units on the Aquaterra Cataract Site, separated by a clay layer up to 40 m thick. The local overburden aquifer is located in a kettle lake channel that is 400 m wide in the area of the Cataract Well (Tecsult Inc., 1999).

Use of the MODPATH model by GLL (1994) indicated that the capture zone of the aquifer tapped by the Cataract Well forms a band extending towards the northwest (represented by the striations in the figure below; the property boundaries and location of the Cataract Well are denoted by the red polygon and the green point, respectively). The predicted time of travel to the Cataract Well from a point approximately 0.5 km to the southwest was estimated to be approximately one year. From a point approximately 1.6 km west of the Cataract well, the time of travel was estimated to be nine years.

Text Figure 6-3: Aquaterra Cataract Site - MODPATH Model by GLL (1994)

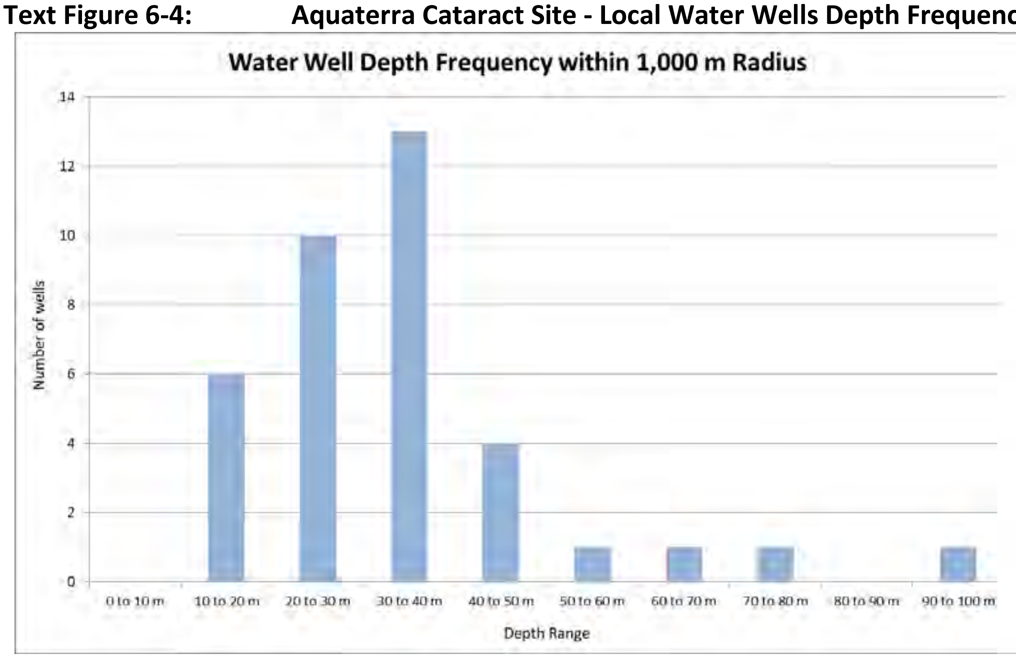


Source: Adapted from Figure 8 of 'Hydrogeological Impact of Proposed Armbro Pit on the Crystal Springs Well, Cataract, Ontario (GLL, 1994)'.

Properties in the Town of Caledon are serviced by a mixture of private well water supply, municipal groundwater supply, and surface water pumped from Lake Ontario. The MECP WWIS database was reviewed for well locations situated within 1,000 m of the Aquaterra Cataract Site production well. A 1,000 m search radius was considered appropriate based on the observed density for water well records in this search area and the local conditions. Water well record locations as referenced in the WWIS are plotted on Figure 6-1. A total of 37 well construction records for supply wells were identified (i.e. monitoring wells and well abandonment records were omitted), with reported well construction depths range from 13.7 to 97.8 m. With the exception of well record 4903950 (corresponding to the Canada Dry Well), the well records indicate that all wells within 1,000 m of the Aquaterra Cataract Site production well are used for domestic water supply. The database indicates that five of the wells are completed in overburden, two are of unknown type, and the remaining 30 are completed in bedrock (note: in addition to these 37 wells, three wells are listed as being of an "unknown" type, but were confirmed in the well records to be decommissioned or abandoned, and are therefore excluded from this discussion). Upon review of the original well records, it was determined that one of the "unknown type" wells, located on Mississauga Road just outside the southwestern boundary of the Aquaterra Cataract Site, was completed in overburden. The other "unknown type" well, located among the cluster of bedrock wells along Cataract Road to the north of the Aquaterra Cataract Site, was completed in bedrock. As such, 31 of the 37 wells within a 1,000 m radius of the Aquaterra Cataract Site are indicated as being completed in bedrock and the remaining six are reported as being completed in overburden. In addition, all bedrock wells are located north of the Aquaterra Cataract Site production well; the majority of the bedrock wells are concentrated along Cataract Road, and four bedrock wells are located along Mississauga Road, to the northwest of the Cataract Well. All 37 wells, as well as the Cataract Well, are located on the same side (on top) of the escarpment, which is located approximately 540 m east of the Site.

The frequency distribution in water well depths within the 1,000 m search radius is provided in the chart below, indicating that all but four wells are between 10 and 50 m in depth, and the majority of wells (29 of 37 wells) are between 10 and 40 m in depth.

Text Figure 6-4: Aquaterra Cataract Site - Local Water Wells Depth Frequency



Overburden materials are most commonly described in the well records as consisting of sand, clay and gravel. The two deepest wells within 1,000 m of the Cataract Well (well ID no. 4909523 and 4905864) with depths of 78.6 m and 97.8 m, respectively, are both overburden wells located south of the

Aquaterra Cataract Site. A sand aquifer at approximately 77.1 m and 96.9 m depth are indicated by the well records for Well no. 4909523 and 4905864, respectively.

Reported static water level depths ranged from 2.4 to 24.1 m bgs for all but the two deepest wells, which reported static water level depths of 51.2 m bgs (well no. 4905864) and 51.8 m bgs (well no. 4909523).

6.3.4.3 Site Hydrogeology

Eight technical reports were identified in MECP files providing hydrological and hydrogeological information for the Aquaterra Cataract Site. Salient information derived from these reports and relating to water quantity assessment is summarized as follows.

Piezometric and Conductivity Survey on Crystal Springs Property and Surrounding Area. Caledon, Ontario (Geomines Ltd., June 1990)

A hydrogeological evaluation was conducted for the Aquaterra Cataract Site in May 1990; Crystal Springs Ltd. was the site owner at the time, and was extracting water from two wells, the Crystal Springs well (currently known as the Cataract Well) and the Canada Dry well, to supply water to its bottling plant in Mississauga. Several aggregate operations were located in the recharge area of the aquifer tapped by the two wells, raising concern with Crystal Springs Ltd. regarding potential groundwater contamination. The evaluation therefore also incorporated analysis of water quality and potential groundwater contamination risks.

A pumping test was performed on the production wells at two different flow rates for 54.5 hours: during the first 7 hours, the Crystal Springs well was pumped at a rate of 100 igpm (455 L/minute), and then both production wells were pumped together for a cumulative rate of 190 igpm (864 L/minute). Two piezometers, P3 (at 100 m radius) and P8 (at 30 m radius) were used as observation wells. A total of 12 piezometers (P1 to P12) were used to collect static groundwater elevations and determine natural groundwater flow gradient conditions.

The drawdown measured at P3 was not considered significant and P8 (0.285 m drawdown observed) was used to evaluate the aquifer parameters (computer based Theis curve matching method). The transmissivity was evaluated at 1.5 x 10^{-2} m^2/s with a storage coefficient of 0.15. The parameters were considered to correspond with an aquifer consisting of mixed sand and gravel. Assuming a mean porosity of 20% and an assessed local groundwater flow gradient between 0.01 and 0.015 towards the east a flow velocity of between 2 and 3 m/day was estimated. The pumping test results indicated that the aquifer capacity was greater than the demand, with the minimum recharge rate of the aquifer estimated to be in excess of 100,000 igpd (454,609 L/day). Geomines concluded that available demand is not foreseen as a problem but identified potential concerns for aquifer contamination from spills/activities on adjacent roadways and on the aggregate extraction properties.

The outflow of the springs located near the wells was also measured periodically during the test; a decrease in flows was observed over the course of the 54.5-hour test and the report admits that 'the water level during the low water level period is unknown'. The only related report recommendations were to prevent over pumping to avoid progressive groundwater mining, and to complete monthly water level monitoring for the piezometer network.

Hydrogeological Evaluation of an Increase in Discharge Rate at Crystal Springs' Property – Caledon, Ontario (Geomines Ltd., October 1996)

In 1996, a hydrogeological investigation was conducted to assess the feasibility of doubling the water taking from 227,305 L/day (50,000 igpd) to 454,609 L/day (100,000 igpd). The study included an inventory of neighbouring well water supplies within a 500 m radius. Five domestic wells were identified and Geomines concluded that most neighbouring wells were drawing from a different aquifer (bedrock aquifer or bedrock/overburden interface aquifer), though two wells, 1137 and 1177 Cataract Road tapping sandy deposits and the closest of these wells is 100 m from the Cataract Well.

The Cataract Well was pumped for 66.5 hours at a rate of 420 L/minute (equivalent to 133,037 igpd). Water levels were monitored in the Cataract Well, and six monitoring wells and the Canada Dry well were used as observation wells during the test.

At the end of pumping, the drawdown in the Cataract Well was measured at 0.44 m. Measured drawdowns at the observation wells were; 0.14 m at the Canada Dry well and MW-08, both located 40 m away, and; 0.07 m at MW-03 located 78 m away. The limited drawdown was noted as being typical of highly permeable aquifers. The aquifer reached equilibrium conditions within 63 hours of the start of the test, and it was estimated that the drawdown at a distance of 100 m from the well would be less than 0.08 m. The radius of influence was estimated at approximately 400 m by the end of the test, when water level in the pumping well and monitoring wells had mostly stabilized. This was noted as being typical of aquifers with very high transmissivities, where the drawdown resulting from pumping is limited, but the cone of depression covers a large area. Based on the pumping test data analysis, the transmissivity was evaluated as ranging from 1.6×10^{-2} m^2/s to 2.6×10^{-2} m^2/s and with a storage coefficient ranging from 0.07 to 0.18, similar to the Geomines, 2000 testing results. The well interference at 100 m from the pumping was determined by Geomines to be less than 0.10 m and is limited to the northeast by the regional break in topography. Geomines indicates 'the well can easily be pumped at the maximum authorized instantaneous pumping rate of 795 L/minute (175 igpm). An assessment of the rate of aquifer recovery following the 66.5 hour pumping test is not apparent in the study.

During the pumping test, streamflow monitoring was conducted at 2 stream locations on the hillside of the Credit River, Spring-1 and Spring-2. A measured decrease in streamflow was apparent for both locations during the test followed by a measured increase in flow within 2 hours after pumping.

Geomines conclusions are limited to indicating that the amount of water that the springs contribute to the Credit River is insignificant.

Geomines concludes that the aquifer tapped by the Cataract Well consists of thick sand and gravel deposits of glacial origin, with interbedded argillaceous layers. The aquifer is unconfined, is encountered by the well at depths between 8.3 and 12.0 m and is a different aquifer compared to most of the other wells in the area, many of which are drilled in the bedrock aquifer.

Flows from two springs near the production well were also monitored during and after the pumping test. During the first few hours of the test, flows at the two springs increased, indicating that the natural outflow of the springs is not constant. The flows subsequently decreased until the end of the test, after which they began to rise again.

Request for the increase of the discharge rate – Crystal Springs Well (Tecsult Inc., July 14, 1999)

The Tecsult Inc. (1999) document consists of a summary of technical information, submitted to the Ministry of the Environment (now the MECP), in support of a requested increase in daily taking from 227,305 L/day (50,000 igpd) to 454,609 L/day (100,000 igpd).

Based on pumping test results and studies that were performed on the Site in the previous 12 years, the aquifer tapped by the Cataract Well displayed a high transmissivity, in the range of 1.5 to 2.6 x 10^{-2} m^2/s, with a storage coefficient between 0.07 and 0.18, which Tecsult Inc. (1999) noted as being typical of an unconfined aquifer. A regional piezometric elevation contour map that was developed from a survey of about 20 monitoring wells in the area indicated that the horizontal hydraulic gradient in the vicinity of the Cataract Well is approximately 0.013 m/m.

Based on observations of flow in nearby tributaries, it was determined that the outflow from the sand and gravel aquifer is mainly flowing underground in the permeable sediment of the escarpment, and reaches the Credit River Valley as baseflow at the base of the escarpment. The two small springs at the top of the escarpment adjacent to the Aquaterra Cataract Site were also observed to dry out during the baseflow periods during the summer, as a result of natural seasonal water table fluctuations in the aquifer, which are on the order of 1 m.

Data Compilation for Crystal Springs, Inc. Property – Cataract, Ontario (Danone Waters of North America and Gartner Lee Limited, 2000)

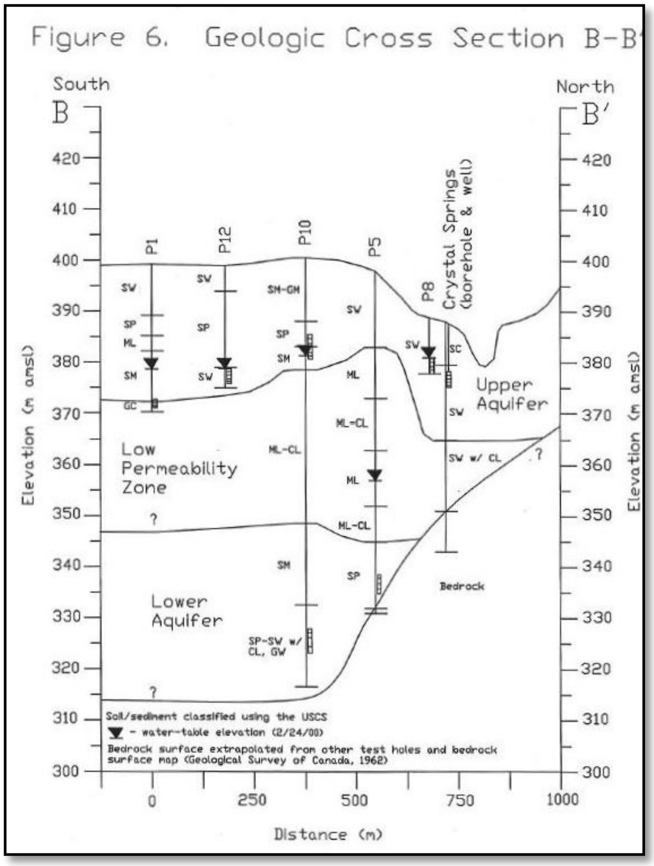
The above-titled data compilation report was prepared in support of the proposed daily increase in water taking, from 227,305 L/day (50,000 igpd) to 454,609 L/day (100,000 igpd). The report included a biological assessment to assess the potential for harmful alteration, disruption or destruction of fish habitat.

Groundwater levels had been manually measured within a piezometer network on the Aquaterra property since their installation in 1987. Continuous groundwater level measurement, through the use of downhole pressure transducers and data loggers, was ongoing at piezometers P6 and P8 since November 1998 (see also Figure 6-1 for their locations). Piezometers P6 and P8 provide a representation of conditions outside of, and within (respectively), the zone of influence of the Cataract Well. Based on water level measurements collected in the piezometer network, it was concluded that the aquifer's natural response to periods of high or low recharge is much greater than the impact of pumping from the Cataract Well.

The upper portion of the Upper Credit Aquifer, tapped by the Cataract Well, was estimated to have a total recharge area of 5 km^2, an average annual recharge of 0.4 m/year, and an average total recharge rate of 5,480,000 L/day.

It was noted that two of the springs adjacent to the Aquaterra Cataract Site emerge from the Niagara Escarpment at an elevation of approximately 382 m asl. Seepage from the springs both likely contribute flow to Tributary 4 from below ground and above ground during wet weather. The baseflow discharged into Tributary 4 contributes to cold water conditions and to flow in the lower reaches of the tributary and into the Credit River. However, the springs ceased flowing during all of 1999 and up to the middle of May 2000, as 1999 was a particularly dry year in southern Ontario. A south–north cross section showing the aquifers at the Site is reproduced below.

Text Figure 6-5: Aquaterra Cataract Site - Site Cross Section



Source: Figure 6 of Danone Waters of North America and Gartner Lee Limited, 2000

<u>Danone Waters of North America Inc./Crystal Springs. Permit to Take Water 96-P-3036 (DWNA & GLL, August 30, 2001)</u>

The above-titled document was prepared in order to provide the Ministry of the Environment (now the MECP) and the Department of Fisheries and Oceans (DFO) with requested monitoring data and to demonstrate their use in the development of early warning, action and threshold values.

Two continuous recording flow weirs were installed on the Aquaterra Cataract Site and had been recording every two hours for the year prior to the report. One flow weir was installed at Tributary 4 near the northern corner of the Site, at the culvert under the rail line, and one was installed on a spring at the eastern corner of the Aquaterra Cataract Site, just before it enters another tributary flowing into the Credit River.

At Tributary 4, a daily pattern in flows was observable at the weir; during the week days in the summer, there is a daily reduction in flow of about 1.5 to 2.5 L/s when pumping is occurring, which recovers during the weekend when no pumping occurs. A diurnal variation is still apparent even without pumping, between 0.5 and about 1 L/s, attributed to the evapotranspiration of the vegetation in the watershed and measurement fluctuation. DWNA and GLL (2001) suggested that the effect of pumping on Tributary 4 was between 1 and 2 L/s.

Based on the data collected to date (from 2000 to the summer of 2001), flows in Tributary 4 averaged between 9 – 13 L/s between July and December. Average spring flow was in the range of 20 – 24 L/s. Comparisons of flow against the daily total precipitation showed that flow in Tributary 4 is derived from groundwater, as it did not respond rapidly to increases in precipitation. Flows in Tributary 4 were observed to follow the same pattern as groundwater level fluctuations in piezometers P6 and P8, completed in the shallow aquifer and located outside and inside the zone of influence (respectively) of the Cataract Well. It was noted that flows in Tributary 4 appeared to be more dependent on groundwater elevation and significant snowmelt/recharge events than on precipitation events alone.

Based on flows measured at the spring at the eastern corner of the Site, the spring did not appear to be influenced by pumping at the Cataract Well, likely due to it being located outside of the estimated 400 m zone of pumping influence. Flows at the spring are very steady and of a small volume, averaging between 2.1 and 3.1 L/s between July 2000 and June 2001. Diurnal variation in the order of 0.3 L/s was evident, and was attributed to evapotranspiration and measurement fluctuation.

No pumping effects were evident at P6 (Upper Aquifer, 400 m from Cataract Well). Pumping effects at P8 (Upper Aquifer, 30 m from Cataract Well) resulted in fluctuations of less than 0.5 m in the summer months, and about 0.25 m during the fall and winter months.

Groundwater elevations at monitoring wells P11 (Upper Aquifer, 550 m from Cataract Well) and P5 (Lower Aquifer, ~200 m from Cataract Well) were assessed as representative of groundwater conditions in the upper and lower portions of the Upper Credit Aquifer (Site 'deep aquifer'), respectively. The only variability in water levels observed was attributed to changes in barometric pressure. That phenomenon is reportedly common in wells completed in confined, semi-confined or locally confined aquifers, which is the case in the lower portion of the aquifer, in which P5 is completed.

<u>Crystal Springs, Cataract Source – Resolution of Upwelling Issues (Gartner Lee Limited, September 26, 2001)</u>

In response to inquiries from the DFO, GLL prepared the above-titled document to explain the effects of pumping the Cataract Well on the local groundwater, as observed at a set of recently-installed mini-piezometers.

Three mini-piezometers (DWNA1, DWNA3 and DWNA4) were installed progressively downstream in the streambed along Tributary 4. Water levels in DWNA1 and DWNA3 indicated upward vertical gradients consistent with groundwater discharge. The strongest upward gradient was in DWNA1, closest to the Escarpment. Conversely, DWNA4 exhibited a consistent downward gradient; it was located the furthest downstream along Tributary 4, and was closer to the Credit River than it was to the Escarpment.

It was concluded that pumping does not affect the deep aquifer, as no evidence was observed of the pumping pattern in the deep water aquifer monitor P5 or in DWNA1. The lack of observable pumping effects in DWNA1 also indicated that pumping was not adversely affecting upwelling in the area of fish habitat in Tributary 4; the other monitors DWNA3 and DWNA4 also showed no effects from pumping. Rather, water levels in the monitors appeared to be mostly influenced by changes in water levels in the Credit River.

It was further noted that no pumping-induced pattern to upward gradients below Tributary 4 were observed, and the water chemistry below the tributary reflects that of the deeper aquifer, and not spring water. It was concluded that spring water emerging from the shallow aquifer does not re-infiltrate into the ground to later emerge as upwelling in Tributary 4.

Crystal Springs Caledon Operational Test Results and Assessment (Gartner Lee Limited, January 2003)

In November 2002, a temporary PTTW #02-P-3109PT was issued to Danone Waters of North America, to test the effects of taking 363,687 L/day (80,000 igpd) from the Cataract Well, in support of their application to raise the maximum daily withdrawal amount under their existing permit 96-P-3036. The test was conducted over a two-week period, during which monitoring was conducted in the mini-piezometer network and in Tributary 4.

During the test, there was little or no change in head observed at the mini-piezometers, indicating that that the increased withdrawal rate did not affect groundwater upwelling from the lower aquifer into Tributary 4. There was also little to no change in water levels in Tributary 4, indicating that pumping had little or no effect on stream depth.

Cataract Spring Source PTTW Amendment Supplementary Information (Gartner Lee Limited, 2007)

The above-titled report was prepared to present the supplementary information in support of a permit amendment application, which requested changes to the monitoring program required by PTTW 96-P-3036.

It was noted that since the start of monitoring in 2000, the water taking had no effect on the tributary extending away from the eastern corner of the Aquaterra Cataract Site. That tributary had historically been used as a background site located outside of the zone of influence of the pumping well. However, monitoring data indicated that the tributary did not exhibit seasonal and annual variabilities of flows and levels that are comparable to Tributary 4, nor did the two tributaries support the same type of fish population. As the tributary near the eastern corner of the Aquaterra Cataract Site did not provide a useful background condition, it was recommended that monitoring at that tributary be discontinued.

Hourly temperature monitoring for the previous six years have shown that stream water temperatures in Tributary 4 are dependent on the lower aquifer, and not the spring source. As the water temperatures showed no correlation to pumping at the Cataract Well, it was recommended that monitoring of water temperatures be discontinued.

It was also observed that the quantities, sizes, conditions, etc. of fish captured during fish surveys in Tributary 4 did not change significantly from year to year, including in the drier than normal 2003 year. Periods of lower than usual flows showed no significant impact on fish habitat.

Water levels in the upper aquifer, as measured in piezometer P8, were observed to have a close correlation with the measured spring flow in Tributary 4. GLL (2007) therefore proposed that P8 be used as a surrogate for monitoring stream flow in Tributary 4, and that trigger levels for reducing the maximum permitted withdrawal amount at the Cataract Well be based on groundwater levels in P8 (see also the PTTW history summary in Table 6-1).

Permit to Take Water (PTTW) 2012 – 2016 Report for the Canadian Springs Cataract Site (AECOM, 2016)
The 2012 – 2016 monitoring report by AECOM (2016) was completed per the requirements in PTTW 7541-72ZM8Z to report on water takings on a 5-year monitoring period. The monitoring program, first presented in GLL (2007), included continuous water level and temperature monitoring in piezometer P8, quarterly monitoring of water levels in wells P5, P6 and P11, monitoring of water levels in the mini-piezometers DWNA 1 – 5 in September and December, monitoring of flows in Tributary 4 in September and December, and annual monitoring of fish habitat and population in Tributary 4.

For the period 2012 – 2016, daily water takings were consistently below the maximum permitted threshold of 363,687 L/day (80,000 igpd). Water levels in piezometer P8 were consistently measured above trigger levels (below which the maximum daily water takings must be reduced to 227,305 L/day (50,000 igpd). Ever since the permit was issued in 2007, the trigger level was only reached once, in the late fall of 2007.

Monitoring results showed that surface water flows in Tributary 4 remained similar to those measured since 2007, indicating no changes or effects from the water taking. Groundwater levels and trends, and upwelling into Tributary 4 remained similar to historical trends. The fish survey results also continued to indicate a healthy fish community. It was concluded that overall, impacts to the groundwater and surface water system from the water taking continue to be acceptable.

6.4 DATA REVIEW AND STATE OF GROUNDWATER RESOURCES

The following section provides a review of Ontario water quantity management framework data relevant to the Aquaterra Cataract Site and available to MECP for consideration when making water management decisions.

6.4.1 Water Taking Reporting System

The Water Taking Reporting System (WTRS) is the ministry's repository for collection of water taking data for active Permits to Take Water (PTTW). As a requirement of each PTTW, the water taking data must be reported on an annual basis and daily water taking data must be entered into the system. The WTRS is not publicly available, but is available for use by ministry staff when assessing the status of a PTTW or addressing potential issues associated with a PTTW. The WTRS data was provided by the ministry for use in the WBSA assessment to be inclusive of all information available to MECP for making water management decisions.

Data on the volume of water taken per year and the number of water taking days per year for the Aquaterra well site was obtained from the MECP Water Taking Reporting System (WTRS), for review. Table 6-4 below includes annual water taking data for the period from 2007 to 2017.

Table 6-4: Aquaterra Cataract Site - Reported Water Takings

Permit Number	Year	Source Name	Annual amount permitted by the PTTW (Million L)	Permitted No. of Taking Days per Year	Reported No. of Days Taken per Year	Reported annual taking (Million L)	Reported annual taking (% of permitted amount)	Average volume taken per day (L/day)
7541-72ZM8Z	2007	Cataract Well	94.56	260	111	23.71	25%	213,621
7541-72ZM8Z	2008	Cataract Well	94.56	260	269	44.88	47%	166,844
7541-72ZM8Z	2009	Cataract Well	94.56	260	260	50.70	54%	194,988
7541-72ZM8Z	2010	Cataract Well	94.56	260	261	39.75	42%	152,300
7541-72ZM8Z	2011 [1]	Cataract Well	94.56	260	269	42.37	45%	157,505
7541-72ZM8Z	2012	Cataract Well	94.56	260	275	40.81	43%	148,381
7541-72ZM8Z	2013	Cataract Well	94.56	260	273	38.19	40%	139,877
7541-72ZM8Z	2014 [1]	Cataract Well	94.56	260	264	33.64	36%	127,426
7541-72ZM8Z	2015	Cataract Well	94.56	260	268	38.55	41%	143,844
7541-72ZM8Z	2016	Cataract Well	94.56	260	267	37.44	40%	140,213
7541-72ZM8Z	2017	Cataract Well	94.56	260	252	34.50	36%	136,885

[1] Data on water takings for the years 2011 and 2014 were not available in the WTRS. The values for these years were obtained from the Permit Holder's annual reporting.

As indicated in Table 6-4, annual water takings during the 2007 to 2017 period varied from 25% to 54% of the PTTW limit, but were generally between 40 to 50%. The maximum number of taking days per year was exceeded on several occasions, although the average volume taken per day was consistently far below the PTTW limit of 363,680 L/day.

The assessed study area for review of other active PTTW was set at a 5 km radius of the Aquaterra Cataract Well. The 5 km radius was considered appropriate for review based on the density of active PTTW in the area and as a conservative distance for any potential contribution from the Site on the cumulative impacts from multiple water takings.

As indicated on Figure 6-2, ten other active PTTWs are located within a 5 km radius of the Aquaterra Cataract Well. It should be noted that the Site is located adjacent to the Niagara Escarpment, along which groundwater from the shallow aquifer is discharged as seeps and springs. Consequently, as the Cataract Well draws water from the shallow aquifer, the groundwater takings to the east of (below) the Niagara Escarpment are not likely to be impacted by pumping activities at the Aquaterra Cataract Site. The 2016 and 2017 WTRS data for each neighbouring water taking is summarized in Table 6-5.

Table 6-5: Aquaterra Cataract Site - Neighbouring PTTWs

Permit Holder (Permit no.)*	Issue Date	End Date	Source	Purpose	Dist. from Cataract Well (Km)	PTTW Limits			2016 WTRS Data [1]		2017 WTRS Data [1]	
						Max. taken per day (Million L)	Taking Days per Year	Annual Taking (Million L)	Annual Reported Taking (Million L)	Annual Reported Taking (% of PTTW Limit)	Annual Reported Taking (Million L)	Annual Reported Taking (% of PTTW Limit)
1236-83DQ27 (Caledon Ski Club Limited)	Mar 15, 2010	Jun. 30, 2022	Src01 – Well #1	Communal water supply	1.6	0.11	365	41.61	5.19	12%	5.48	13%
			Src02 – Well #2	Communal water supply	1.3	0.086	365	31.55	2.82	9%	2.92	9%
			Src03 – West Pond Pumping Station	Commercial snow making	1.7	7.63	121	923.47	38.55	4%	35.53	4%
			Src04 – Main Pond Pumping Station	Commercial snow making	2.0	7.63	121	923.47	67.43	7%	62.76	7%
5458-9XXSA5 (The Regional Municipal. of Peel, Caledon Sanitary Landfill Site)	Sep. 16, 2015	Jun. 30, 2020	Src01 - PW1A-15	Remediat.	2.1	0.12	365	42.05	22.95	55%	27.19	65%
			Src02 - PW2-01	Remediat.	2.1	0.12	365	42.05	21.34	51%	22.48	53%
7403-86BRXJ (The Regional Municipal. of Peel, Caledon Waste Manage-ment Facility)	Jun. 15, 2010	Jun. 30, 2020	Src01 - PW1-99	Remediat.	2.1	0.12	365	42.05	-	-	-	-
			Src02 - PW2-01	Remediat.	2.1	0.12	365	42.05	-	-	-	-
8112-AGKLBS (Graham Bros. Aggregate Limited) *	Dec. 12, 2016	Dec. 12, 2021	Src01 – Pond 1	Aggregate washing	3.3	10.0	280	2,800	-	-	951.84	34%
			Src02 – Pond 2	Aggregate washing	3.3	4.0	280	1,120	-	-	174.62	16%
8562-96LMQL (Graham Bros. Aggregates Limited) *	May 2, 2013	Apr. 30, 2018	Src01 – Pond 1	Industrial	3.3	10.0	280	2,800	716.69	26%	-	-
			Src02 – Pond 2	Industrial	3.3	4.0	280	1,120	216.31	19%	-	-
5447-992KPZ (James Dick Construct. Limited)	Jun. 27, 2013	Aug. 31, 2023	Src01 – Pond 1	Aggregate washing	3.7	2.29	365	835.12	326.93	39%	325.12	39%
			Src02 – Pond 2	Aggregate washing	3.6	0.98	365	358.43	127.32	36%	117.84	33%

Permit Holder (Permit no.)*	Issue Date	End Date	Source	Purpose	Dist. from Cataract Well (Km)	PTTW Limits			2016 WTRS Data [1]		2017 WTRS Data [1]	
						Max. taken per day (Million L)	Taking Days per Year	Annual Taking (Million L)	Annual Reported Taking (Million L)	Annual Reported Taking (% of PTTW Limit)	Annual Reported Taking (Million L)	Annual Reported Taking (% of PTTW Limit)
2281-8TELTJ (Lafarge Canada Inc.)	Apr. 24, 2012	Dec. 31, 2021	Src01 - Petch Wash Pond	Aggregate washing	3.6	2.46	130	319.18	0.0075	0%	0.018	0%
			Src02 - Presswood Wash Pond	Aggregate washing	4.3	2.46	130	319.18	-	-	-	-
0578-95BS28 (2004295 Ontario Inc.) *	Mar. 15, 2013	Feb. 27, 2023	Src01 – Pond	Aggregate washing	4.2	26.19	200	5,237.11	2,151.69	41%	2,614.32	50%
1807-AC9P9J (Forgehill Equities Inc.)	Dec. 6, 2016	Dec. 31, 2026	Src01 – PW1	Water supply	4.1	0.43	365	155.31	-	-	0.83	1%
			Src02 – Pond 1	Golf Course Irrigation	4.0	6.55	210	1,374.68	-	-	34.81	3%
			Src03 – Pond 3 West	Golf Course Irrigation	4.2	8.51	210	1,787.08	-	-	102.15	6%
			Src04 - Credit River	Golf Course Irrigation	4.5	6.55	210	1,374.68	-	-	104.94	8%
0158-9DFMXH (The Regional Municipal. of Peel) *	Dec. 4, 2013	Dec. 31, 2018	Src01 - Caledon Village Well 3	Communal water supply	5.0	1.96	365	716.92	74.91	10%	65.74	9%
			Src02 - Caledon Village Well 3B	Communal water supply	5.0	1.31	365	477.77	56.10	12%	53.32	11%

[1] A hyphen (-) indicates that no taking was reported in the WTRS.

*** Permit Holders located below the Niagara Escarpment are marked with an asterisk.**

With the exception of PTTW 0158-9DFMXH, held by the Regional Municipality of Peel, the remaining active PTTWs are associated with industrial (aggregate washing) and commercial (golf club irrigation). PTTW 0158-9DFMXH is for two communal water supply wells of Caledon Village, located approximately 5 km northeast of the Cataract Well. For the years 2016 and 2017, the total reported annual takings at the Aquaterra Cataract Site were 37.44 and 34.50 million L, respectively, in comparison to the total reported annual takings from the Caledon Village water supply wells for 2016 and 2017, which were 140.65 and 109.42 million L, respectively. Based on their relative distances and locations within the Credit River watershed, the Aquaterra Cataract Site is not likely to be hydraulically upgradient of Caledon Village. The Aquaterra Cataract Site and Caledon Village are located on opposite sides of the Credit River, for which a large proportion of flow is attributed to groundwater discharge (see the discussion in Section 6.3.4.1). Based on regional groundwater flow in the Credit River watershed (CVSPA, 2015), groundwater flow from the Aquaterra Cataract Site and from Caledon Village are both inferred to be towards the Credit River. As such, a potential for water takings at the Aquaterra Cataract Site to cause unacceptable interference with the communal water supply is not apparent.

6.4.2 Provincial Groundwater Monitoring Network

The Provincial Groundwater Monitoring Network (PGMN) is a partnership program with all 36 CAs and 10 municipalities (in areas not covered by a conservation authority) to collect and manage ambient (baseline) groundwater level and quality information from key aquifers located across Ontario. During the spring and summer of 1999, low water conditions in many parts of southern Ontario prompted the formation of an inter-ministerial task force to assess drought conditions, determine trigger levels and develop a response strategy. The PGMN was approved in 2000 and there are currently more than 450 monitoring wells in the network.

The PGMN datasets report on ambient (baseline) groundwater level and chemistry conditions. The PGMN well locations are typically sited to be away from areas where there is a large density of permitted water takings. Consequently, the PGMN wells are typically far too distant from any permitted water taking to be used as an indicator of potential well interference impacts.

Water level data collected for the PGMN wells is of potential value in assessing regional groundwater level trends as an indicator of stress within the watershed/subwatershed. Data has been collected for the PGMN well network since 2001 though some wells were installed more recent than this. Also the data for some wells is not current to 2018. The Provincial Groundwater Monitoring Network database is made available by MECP on-line.

As a recent internal project the MECP has applied the Mann-Kendall (MK) and Seasonal Kendall (SK) tests to analyze the PGMN water level data for monotonic trends (i.e. consistently increases or decreases through time). The statistical analyses were performed using robust and defensible methodologies to look for longer-term trends in groundwater levels. An overall objective is to determine if there is enough data to support the presence of a widespread decrease in groundwater availability. Shorter trends within the PGMN data record (e.g. lasting for a few years) were not considered and the causes of any trends that were identified were not investigated. Both the data plots and preliminary findings for PGMN well locations nearest a WBSA were shared by the ministry and are presented and relied on herein. The data plots indicate data available for the well at the time of the assessment. Further, the MECP has indicated that the methodologies used require that certain values be dropped from the data set if the month/year in question does not have sufficient number of data points. The release of a final report that details the methodology and results from the PGMN data trends analysis is forthcoming from the ministry (MECP, 2018).

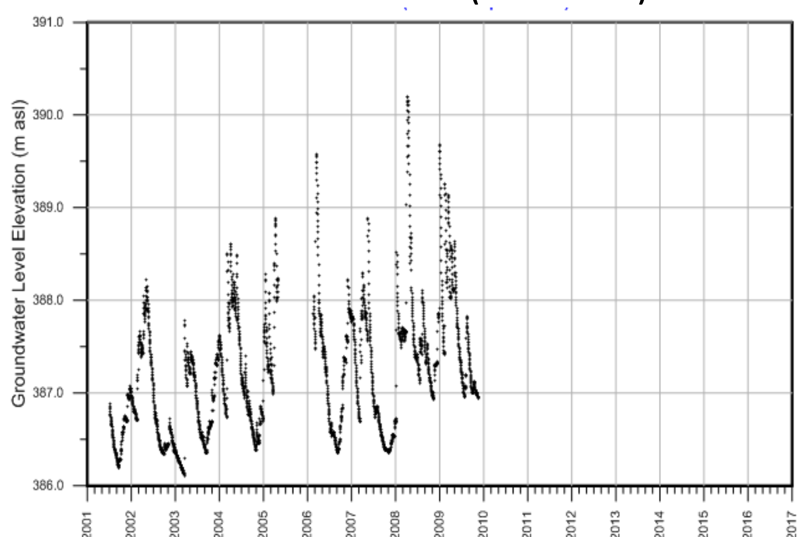
Five PGMN wells are located within 10 km of the Aquaterra Cataract Site, as shown on Figure 6-2. All five wells are located above the Niagara Escarpment. PGMN well information is summarized in Table 6-6.

Table 6-6: Aquaterra Cataract Site - PGMN Wells Summary

PGMN Well ID	Water Well Record ID	Distance from the Cataract Well (km)	Well Depth (m)	Ground Elevation (m asl)	Lithology of Aquifer
W0000026-1	6713771	5.2	35.96	392.96	Bedrock (limestone)
W0000163-2	4909396	5.5	8.14	426.84	Overburden (silty sand, sandy silt)
W0000163-3	4909396	5.5	23.16	426.84	Overburden (gravel)
W0000164-2	6714839	9.5	8.0	427.76	Overburden (silty sand, sandy silt, sand)
W0000164-3	6714839	9.5	13.26	427.76	Overburden (sand, gravel)

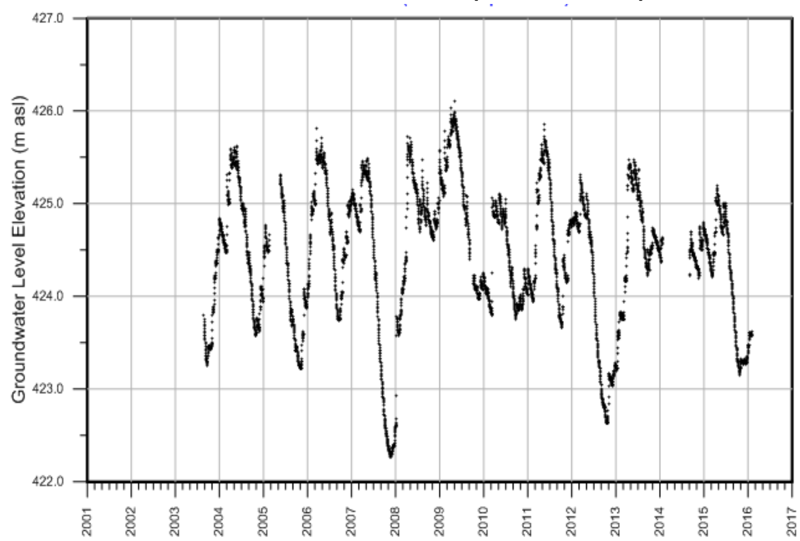
The data plot and trend analysis for the 5 PGMN well installations within 10 km of the Aquaterra Cataract Site are provided as follows.

Text Figure 6-6: Groundwater Level Elevations (2001 to 2010) for PGMN Well W0000026-1



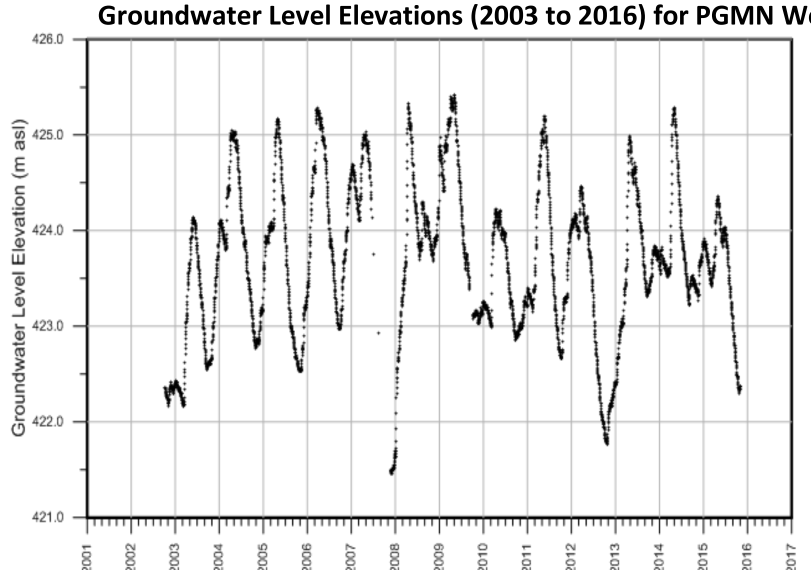
For PGMN well No. W0000026-1, the MK test (year over year) did not detect a significant trend. The SK test (season to season) detected an upward trend. A visual analysis of the data, which is only current to 2010, indicates a gradual increase in seasonal peak water levels between 2002 and 2008 while seasonal low water levels have remained consistent from year to year.

Text Figure 6-7: Groundwater Level Elevations (2003 to 2016) for PGMN Well W0000163-2



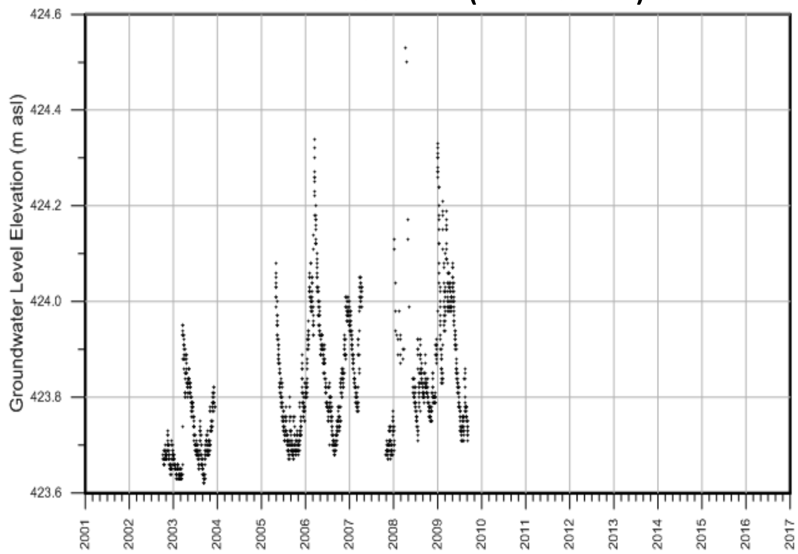
For PGMN well No. W0000163-2, the MK test (year over year) did not detect a significant trend. The SK test (season to season) also did not detect a significant trend. Visual analysis of the water level data indicates typical seasonal fluctuations of approximately 2.5 m the lowest water levels observed in the late fall of 2007 and late fall of 2012.

Text Figure 6-8: Groundwater Level Elevations (2003 to 2016) for PGMN Well W0000163-3



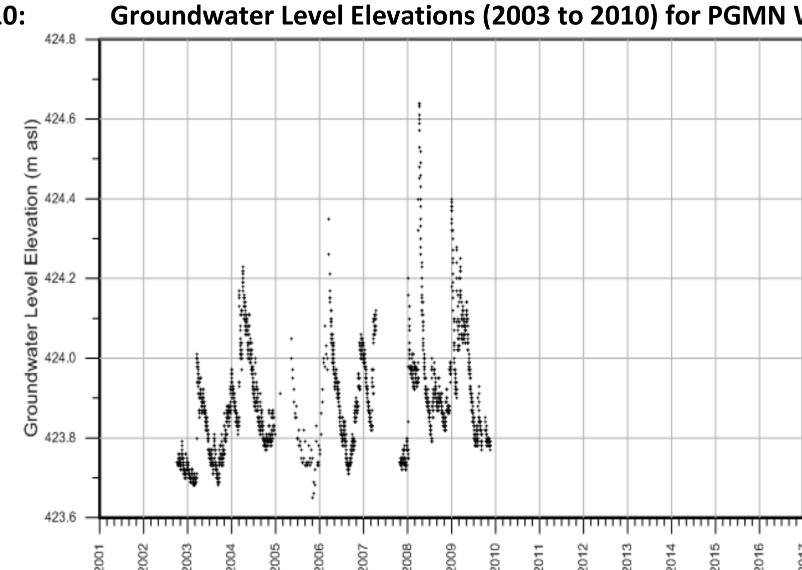
For PGMN well No. W0000163-3, the MK test (year over year) did not detect a significant trend. The SK test (season to season) also did not detect a significant trend. Visual analysis of the water level data indicates typical seasonal fluctuations of approximately 2.5 m the lowest water levels observed in the late fall of 2007 and late fall of 2012. (similar to W0000163-2).

Text Figure 6-9: Groundwater Level Elevations (2003 to 2010) for PGMN Well W0000164-2



For PGMN well No. W0000164-2, the MK test (year over year) did not detect a significant trend. The SK test (season to season) detected an upward trend. A visual analysis of the data, which is only current to 2010, indicates a gradual increase in seasonal peak water levels between 2003 and 2009 while seasonal low water levels have remained consistent from year to year (similar to W0000026-1).

Text Figure 6-10: Groundwater Level Elevations (2003 to 2010) for PGMN Well W0000164-3



For PGMN well No. W0000164-3, the MK test (year over year) did not detect a significant trend. The SK test (season to season) detected an upward trend. A visual analysis of the data, which is only current to 2010, indicates a gradual increase in seasonal peak water levels between 2003 and 2009 while seasonal low water levels have remained consistent from year to year (similar to W0000026-1 and W0000164-2).

No data trends that might be an indicator of reduced groundwater availability were identified from the PGMN groundwater level data review.

6.4.3 Ontario Low Water Response (OLWR) Program

The OLWR program was initiated in 2000 and is managed by the Ministry of Natural Resources and Forestry (MNRF). The program relies on the use of real time surface water monitoring data collected through the Surface Water Monitoring Centre and utilizing the Water Survey of Canada (WSC) stream gauge (HYDAT) station network to identify potential drought conditions based on set trigger levels. Presently, static groundwater level elevation data from the PGMN program is not a component of the OLWR program. Reportedly, this may be added to the program in future.

OLWR notifications are typically (i.e. not always) released in the last week of each month after a review of data for the previous weeks in the month. When trigger levels are identified for a monitoring station, the OLWR submits a notification to the respective CA or municipality. Based on its review of the OLWR data that accompanies the notification, combined with a review of local factors that include recent precipitation and reports of water shortfalls for surface water and well water supplies a Low Water Conditions Alert 'may' be posted by the CA/municipality. A CA or municipality may also choose to post an Alert without any OLWR notification. Decreases in water takings that are triggered by the declaration of Level 1, 2 and 3 Low Water Condition are as follows:

- Level 1 - A voluntary reduction of 10%
- Level 2 – A voluntary reduction of 10%, to achieve a 20% reduction;
- Level 3 – Reduce and manage water use demands to the maximum extent through regulatory measures, if required.

<u>Note</u>: Specific Permits to Take Water may have conditions requiring mandatory reductions of water takings during low water events. Upon renewal of their water bottling permit, the above decreases will be mandatory based on 3-month average actual flow as outlined in the guidance for bottled water renewals (MOECC, 2017).

The frequency of OLWR notifications over time can be a potential indicator of climate stress trends for surface water (and possibly shallow groundwater where directly connected to surface water), and an indicator of watershed/subwatersheds that are sensitive to seasonal drought conditions. However, the existing OLWR program database has not been prepared for this purpose, has inconsistencies that are attributed to different persons updating the database over the years, and the database does not provide notification Levels during the time period where a Low Water Alert has been declared by a CA/municipality. This is only indicated in the database as an 'Update'. Consequently, only a general review of the information in the OLWR database is provided herein for the geographic CA/municipality relevant to the Site.

A general review of the OLWR database indicates that a total of 11 Level 1 notifications and two Level 2 notifications were sent to the Credit Valley CA between 2000 and August 2018. Instances when more than one notification was issued in the same calendar year occurred in 2001 (two Level 1 notifications), 2012 (one level 1 and one Level 2 notification), and 2018 (two Level 1 notifications). No notifications were issued in 9 of 19 years. Most recently, no notifications were issued in 2013, 2014, and 2015. The Credit Valley CA posted Low Water Condition Alerts during two periods: a Level 1 Low Water Alert was posted from mid-May to mid-October 2012, and again from July 2016 to early February 2017 (this was raised to a Level 2 Low Water Alert between early August and mid-September 2016).

6.4.4 Water Budget Analyses

Extensive water budget work had already been completed in the Credit Valley Source Protection Area (CVSPA) prior to the development of the Source Water Protection program in Ontario, so the CVC was permitted to forego the requirement of undertaking conceptual and Tier 1 Water Budgets for the Assessment Report of the CVSPA (CVSPA, 2015). As moderate drinking water quantity stress had been identified in the early water budget work, CVSPA undertook a Tier 2 Water Budget.

In the "Melville to Forks of the Credit" subwatershed, in which the Aquaterra Cataract Site is located, it was determined through the Tier 2 water budget that the surface water and groundwater potential stress classifications were both low (CVSPA, 2015). As Tier 3 analyses are only conducted when a Tier 2 study identifies moderate or significant potential stress, a Tier 3 water budget was not recommended for the Melville to Forks of the Credit subwatershed.

Based on the findings of the Tier 2 water budget, the Aquaterra Cataract Site is not located in an area where hydrologic stress has been identified.

6.5 Impact Assessment

The following section provides a general assessment of potential water quantity interference with other groundwater uses and the environment.

6.5.1 Municipal Groundwater Use

In the Town of Caledon, a select number of villages and hamlets are serviced by municipal groundwater systems, operated by the Region of Peel: Caledon Village – Alton, Cheltenham, Inglewood, and Palgrave

– Caledon East (Region of Peel, 2017). Properties in the remainder of the town are serviced by private wells or surface water pumped from Lake Ontario. Of the municipal groundwater systems, the closest municipal groundwater supply wells are associated with Caledon Village; the wells are located approximately 5 km northeast of the Cataract Well (Aquaterra Cataract Site).

The Cataract Well and the Caledon Village wells are both above the Niagara Escarpment, but are located on opposite sides of the Credit River, which receives much of its flow from groundwater discharge. The Cataract Well is inferred to be located cross-gradient from the Caledon Village wells based on direction of groundwater flow in the upper Credit River watershed, as described and mapped in the Assessment Report for the CVSPA (CVSPA, 2015). In addition, the wellhead protection area for the Caledon Village wells extends to the north, away from the Cataract Well, indicating that groundwater flow in the vicinity of the village is in a general south direction.

Per the Town of Caledon's Official Plan (2018), the Rural Service Centres are designated as the primary growth areas to accommodate the projected increases in the town's population. The Rural Service Centres (Mayfield West, Bolton and Caledon East) are all located more than 10 km away from the Aquaterra Cataract Site. Based on the information reviewed, no 'planned' new municipal groundwater supply systems are apparent for the vicinity of the Site, where water servicing is from private individual well water supply.

In summary, the general assessment of potential water quantity interference with existing or planned municipal water supply systems did not identify any potential for unacceptable impact/interference.

6.5.2 Well Interference Potential

Based on the studies that have been completed, the Cataract Well takes water from a shallow sand and gravel aquifer forming the upper portion of the Upper Credit Aquifer and identified on Site as the Shallow Aquifer. The Geomines Ltd., October 1996 study included an inventory of neighbouring well water supplies. It was concluded that most neighbouring wells were drawing from a different aquifer (i.e. the bedrock aquifer or the bedrock/overburden interface aquifer). Only two wells, at 1137 and 1177 Cataract Road were identified as taking water from sandy deposits, the closest at 100 m from the Cataract Well.

An aquifer test was conducted in 1996 where the Cataract Well was pumped continuously for 66.5 hours at a rate of 420 L/minute (equivalent to 604,800 L/day). Six monitoring wells and the Canada Dry well were used as observation wells during the test. The aquifer reached equilibrium conditions within 63 hours of the start of the test, and it was estimated that the drawdown at a distance of 100 m from the well would be less than 0.08 m. The radius of influence was estimated at approximately 400 m by the end of the test, when the water level in the pumping well and monitoring wells had mostly stabilized. The current PTTW No. 7541-72ZM8Z water taking limit is 363,680 L/day (60% of the test rate in 1996) with a maximum number of hours of taking limited to 18 hours/day (i.e. a minimum of 6 hours per day must be provided for aquifer recovery).

Continuous groundwater level monitoring in the late 1990s at monitoring well P6 did not identify any observable effects from pumping at the Cataract Well at this well location 420 m southwest of the Cataract Well and at the Site boundary. P6 is currently monitored on a quarterly basis, and is used to provide a representation of water levels outside of the zone of influence of the well. Pumping at the Cataract Well has been determined to not affect the Deep Aquifer as no influence from pumping has been observed at P5, completed in the deep aquifer.

Based on the 2012 to 2016 monitoring report (AECOM, 2016), continued monitoring of well water levels at the existing groundwater monitors on the Aquaterra Cataract Site and the use of groundwater elevation trigger levels at piezometer P8, a potential for unacceptable well interference impacts to neighbouring groundwater supplies is not indicated. The need for additional quantitative prediction is also not apparent based on permitted/actual water taking rates for the Site.

No new, high water use activities are apparent near the Aquaterra Cataract Site, and growth in the Town of Caledon is planned to be focused in the Rural Service Centres, more than 10 km away. Any new neighbouring land development on private wells and/or any new PTTW of significant scale are expected to require a site specific hydrogeological study and well interference assessment in support of the proposed development/water taking.

6.5.3 Impact to Surface Water and Natural Functions of the Ecosystem

The outflow of the upper portion of the Upper Credit Aquifer, utilized by the Cataract Well, has been determined to mainly flow in the permeable sediment of the escarpment, and reaches the Credit River valley as baseflow at the base of the escarpment. Tributary 4, which extends in an eastern direction from the northern boundary of the Aquaterra Cataract Site, receives flow from seepage from two springs at the top of the escarpment adjacent to the Site, and from groundwater upwelling. The tributary flows into the Credit River at a point approximately 530 m east of the Cataract Well. Both the Credit River near the Aquaterra Cataract Site and Tributary 4 support cold water fish habitat; good quality fish habitat is restricted to the lower reaches of the tributary, below the steep slope of the Niagara Escarpment.

During a two-week pumping test in 2002, where the Cataract Well was pumped at a rate of 363,687 L/day (the current PTTW No. 7541-72ZM8Z water taking limit), little to no change in water levels were observed in Tributary 4, indicating that pumping had minimal effect on stream depth. Groundwater upwelling in Tributary 4 was determined to come from the lower aquifer, and not from the upper aquifer tapped by the Cataract Well, as evidenced by the water chemistry below the tributary compared to the water chemistry of the lower and upper aquifers. As noted in the Gartner Lee Limited, January 2003 report, pumping from the Cataract Well was not observed to produce any pumping-induced patterns to groundwater upwelling in Tributary 4.

Hourly water temperature monitoring was conducted in Tributary 4 for six years in the early to mid-2000s; the data indicated that water temperatures in the tributary are dependent on the lower aquifer, and not the springs emerging from the upper aquifer (tapped by the Cataract Well). In addition, periods of lower than usual flows in Tributary 4 showed no significant impacts on fish and fish habitat, as the quantities, sizes, and conditions of fish captured during fish surveys did not change significantly from year to year.

Another spring is present at the eastern corner of the Aquaterra Cataract Site, feeding into a tributary of the Credit River. As with Tributary 4, this tributary supports good, cold water fish habitat in its lower reaches. Flow measurements at the tributary have indicated that the spring is not influenced by pumping at the Cataract Well, likely due to it being outside of the estimated 400 m zone of influence.

Water levels in the upper aquifer, as measured at piezometer P8, were determined to have a close correlation with stream flow in Tributary 4. Therefore, hourly monitoring of water levels in P8 and the use of trigger levels for action (as outlined in PTTW 7541-72ZM8Z) appears to be an appropriate measure for protecting the aquatic environment in Tributary 4 and the Credit River.

Based on the findings from the information review, continued water takings at the permitted water taking rates are not expected to impact surface water and natural functions of the ecosystem. The existing monitoring programs as prescribed in PTTW No. 7541-72ZM8Z serve to identify any possible changes to these features.

6.6 SUSTAINABILITY OF WATER RESOURCES

Water resources are considered sustainable if the total amount of water entering, leaving, and being stored in the system meet existing needs without compromising the ability to meet the needs in the future. Typical indicators used to assess the sustainability of water quantity include Water Budgets completed at the watershed/subwatershed scale and/or for the specific water taking(s) and the evaluation of water level data for trends over time to ensure resources are remaining in a steady state.

The following provides a general assessment of the sustainability of regional water resources and of the potential impact from the Gott Enterprises Inc. Alnwick/Haldimand water taking on sustainability, now and in the future.

Regional Water Resources

The characterization of the regional study area indicates that the Aquaterra Cataract Site is located in the Melville to Forks of the Credit subwatershed where the Water Budget analyses was advanced immediately to a Tier 2 assessment (CVSPA, 2015). The Water Budget analyses included an estimate of future water demand. The Tier 2 Water Budget assessment also included two climate change scenarios that were developed and used as input for simulations. The scenarios represented warm and drier conditions and warmer and wetter conditions in annual average terms. Both groundwater stress potential and surface water stress potential were categorized as Low based on the completed Tier 2 Water Budget analyses. Consequently, stresses presented by existing and future demand are not an identified concern for the sustainability of water resources within the regional study area.

The OLWR Program uses real time surface water monitoring data collected from the WSC stream gauge (HYDAT) station network to identify potential drought conditions based on set trigger levels. BluMetric's review of the OLWR Program notification data (2000 to August 2018) for the Credit Valley CA did not identify any specific trends indicating the depletion in the availability of surface water (and possibly shallow groundwater where directly connected to surface water) resources. While Level 1 and Level 2 Low Water Condition Alerts have been necessary within the boundaries of the CVCA, the information indicates these have been in response to extended dry seasonal conditions.

BluMetric's review of PGMN groundwater level data for 5 wells located within 10 km of the Aquaterra Cataract water taking also did not identify any specific trends indicating a potential depletion in the availability of regional groundwater resources.

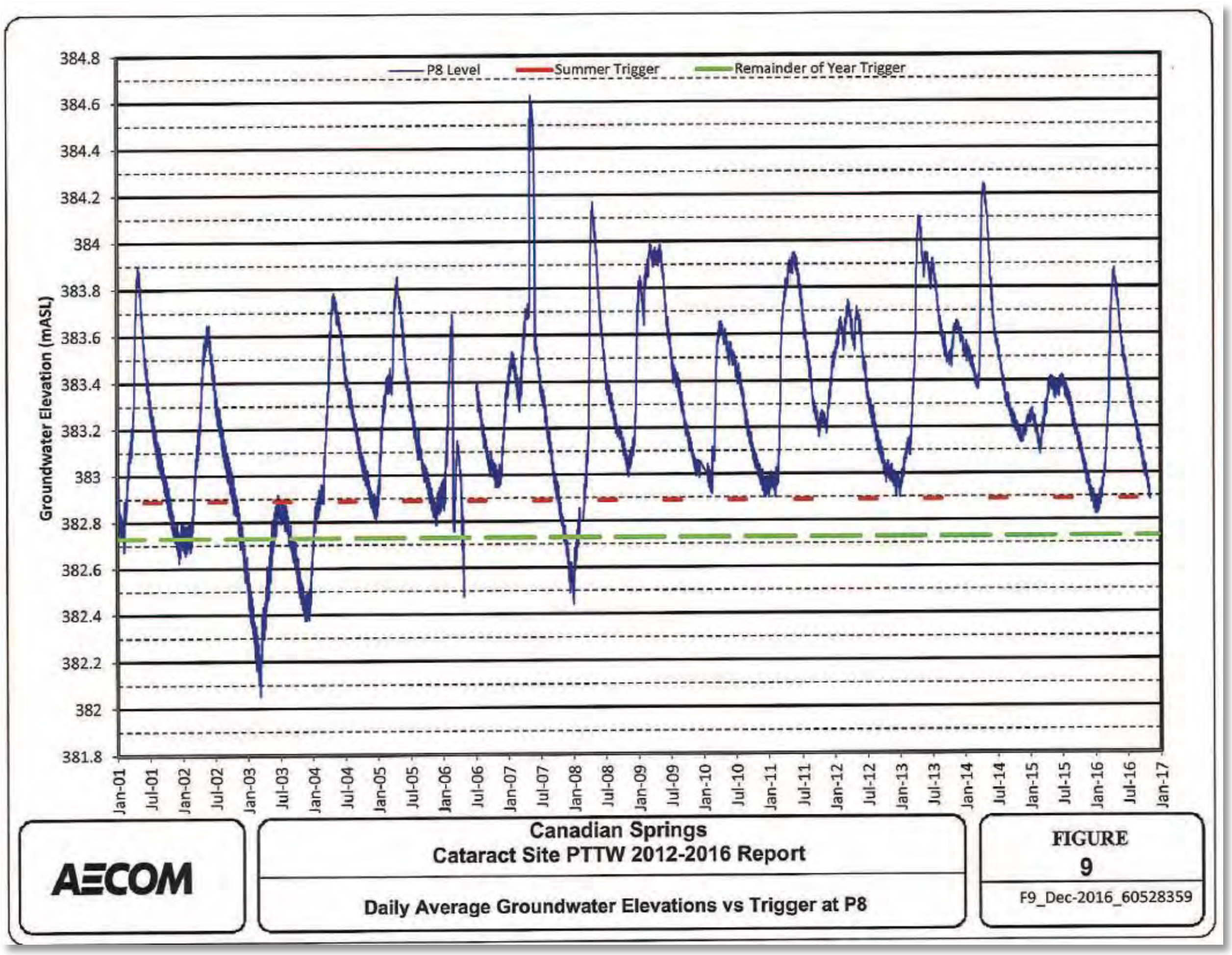
In summary, based on the information reviewed, no stress concerns were identified for the sustainability of regional water quantity resources.

Aquaterra Cataract Water Taking

Historical information relating to the Aquaterra Cataract Site indicates the groundwater resources have been used for commercial purposes for over a century, and water withdrawals for commercial water bottling have been permitted since at least the mid-1980s. The reported water taking amounts from 2007 to 2017 have consistently remained below 55% of the maximum permitted annual amount. Maximum withdrawal rates and maximum annual withdrawal amounts through the PTTW have remained unchanged since 2003. No documented well interference complaints/impacts from the water taking were identified in the files provided for review.

The last monitoring report, for 2012 to 2016, was received by the ministry in 2016. Monitoring of groundwater levels in the upper and lower overburden aquifers, as well as monitoring of stream flows/water levels/fish communities/habitat and groundwater upwelling in Tributary 4, have not provided any indications of unacceptable or increasing stress to groundwater or surface water due to the water taking. Piezometer P8 serves as a sentry well for the aquifer utilized by the Cataract well. The hydrograph for long term groundwater elevation data for P8 (January 2001 to January 2017) is reproduced below and does not indicate any decreasing trend in groundwater elevations.

Text Figure 6-11: Groundwater Level Elevations (2001 to Dec 2016) Piezometer P8



Source: Figure 9 of AECOM, 2016

A review of the WTRS database did not identify any other high volume water taking activities for the Ste. Anne's Aquifer Complex within the study area. The information review also did not identify any other planned water taking activities that might contribute to the overall cumulative effects/impacts on local groundwater resources.

Based on the information reviewed, there are no indicators of the Aquaterra Cataract Site water taking having an impact on the sustainability of existing and future water resources. Consequently, it is BluMetric's opinion that the water taking is being managed sustainably. The permit requirements/conditions as summarized in Section 6.1 are deemed adequate with a monitoring program in place to identify any potential changes to Site conditions. Since the annual water taking to date has been less than 55% of the PTTW limit and the future impact from climate change cannot be accurately predicted, the monitoring/reporting conditions under the PTTW also provides a measure of security to ensure the water resource remains sustainable.

6.7 Gaps and Recommendations

Based on the assessment of the Aquaterra Cataract Site, no gaps were identified in the science that has been used in the characterization of the Site. As such, potential enhancements to the existing monitoring program and PTTW requirements have not been identified.

6.8 Figures

Figures are provided in Appendix A-Main Figures.

7. GOLD MOUNTAIN SPRINGS INC. – ORO MEDONTE

7.1 BACKGROUND AND HISTORY

Gold Mountain Springs Inc. draws water from two screened overburden wells (Borehole/Well 1 and Borehole/Well 2) located at 2997 Line 9 North, Lot 3, Concession 10, Township of Oro-Medonte (former Oro Township). The 88 acre (approximate) property, herein referred to as the 'Site', is located in a rural setting approximately 1.5 km south of Horseshoe Valley Road East and 4.3 km west of Bass Lake. The Site falls within the jurisdictions of the MECP Barrie District Office –Central Region and the Nottawasaga Valley Conservation Authority. The Gold Mountain Springs water source well locations and Site boundaries are indicated on Figure 7-1.

Based on the records provided by MECP, the source has been permitted for the purposes of water bottling since 1994. No water bottling occurs on-site. All water withdrawn from the wells is hauled to local commercial establishments for water bottling and a small percentage of non-bottled water commercial purposes (i.e. pizza dough preparation, vinegar, carbonated water, etc.). An approximate timeline of events relevant to the PTTW history of the Site is provided in Table 7-1.

Table 7-1: Gold Mountain Springs - PTTW History Summary

YEAR	EVENT
1994	**PTTW 94-P-5056** was issued to Gold Mountain Springs Inc. on **November 21, 1994**, with an expiry date of March 31, 2005. The permit allowed water to be extracted from a single Well (Well #1) for commercial purposes (bottled water). The maximum withdrawal rate and withdrawal amount, for Well #1 was 909 L/minute for 16 hours in one day and a maximum daily taking of 872,640 L. Special Conditions of the Permit include measuring the quantity of water taken on a daily basis, recording a water level at the pumping well on a monthly basis (after a minimum 8 hours of zero water taking), and reporting the monitoring results to the Director on an annual basis.
1998	Borehole/Well #2 is constructed as a backup well. The report entitled, "Borehole Evaluation, Alternate Source, Gold Mountain Springs Inc. June 19, 1998 (Wilson, June 1998) is prepared. Note: It is understood the ministry did not amend the Permit to include this well until 2005.

YEAR	EVENT
2005	**PTTW 3448-6FARKC** was issued to Gold Mountain Springs Inc. on **November 14, 2005**, with an expiry date of December 31, 2007. The PTTW allowed for the taking of 909 L/minute for 16 hours in one day and a maximum daily taking of 872,640 L. The Permit includes both Well #1 and Well #2 (standby) with only one well permitted to operate at one time. The PTTW required: • A record of dates and times of water taking, the rates of pumping, and the daily taking volume. A separate record shall be maintained for each source; • Monitoring of water levels in all production wells using a pressure transducer or similar device; • Establish a new multilevel monitoring well or well nest on Site. The well(s) shall be screened in the three identified aquifers: shallow, intermediate and deep. Each monitor is to be equipped with a pressure transducer or similar device. The wells are to be installed and operating within 90 days of the issue date of the Permit; • Download and review the monitoring data on a monthly basis; • Install and maintain a rain gauge at the Site within 90 days of issue of the Permit; • Expand the off-site monitoring program in order to more fully assess any potential future impacts on the local aquifer and surface water resources. The monitoring program can utilize existing private wells or new dedicated wells. The Permit Holder shall have its consultant prepare a plan and submit it to the Director for review within 90 days of issue of the Permit; • Submit to the Director an annual monitoring report (by March 31 of each year) that presents and interprets the monitoring data. The report shall also address long term trends. A multi-level monitoring well is installed in late December 2005, approximately 75 m northwest of the two production wells.
2006	Letter submitted to ministry (Wilson, February 14, 2006) indicating compliance with Conditions under PTTW 3448-6FARKC, including: • Well 1 and the multi-level monitoring well are equipped with pressure transducers/dataloggers on January 30, 2006 (Well #2 was previously equipped in June 2003). • A rain gauge is installed at the Site in January 2006. • A proposal to expand the monitoring program to off-site wells is submitted to the ministry on February 14, 2006. Plan includes quarterly monitoring of water levels at the Pryde dug well (500 m northwest of the production wells) and the Buffalo Springs well/borehole (1 km northwest from the production wells. Note: this is inferred to be Well ID 5726429 which plots beyond the west boundary of Figure 7-1, see section 7.3.4.2) and the quarterly gauging of flow in the on-site stream to the north (drains to Bass Lake to the east).
2007	**PTTW 0628-78CJEN** was issued to Gold Mountain Springs Inc. on **November 2, 2007**, with an expiry date of October 31, 2017. The PTTW allowed for the taking of 909 L/minute for 16 hours in one day from Well #1 and Well #2 (only one well can operate at one time) with a maximum combined daily taking of 872,640 L from both wells. The maximum permitted water taking limits are consistent with the permit issued in 2005. Monitoring and reporting requirements are the same as the previous Permit 3448-6FARKC. The permit did not include a condition requiring the implementation of the off-site monitoring program submitted to the ministry on February 14, 2006.
2015	**PTTW 3122-9ZCQRS** was issued to Gold Mountain Springs Inc. on **October 15, 2015** as an amended Permit, with an expiry date of December 31, 2017. The PTTW allows for the taking of 909 L/minute for 16 hours in one day from Well #1 and Well #2 with a maximum combined daily taking of 872,640 L from both wells. The maximum permitted water taking limits are consistent with the permit issued in 2005. The amended Permit does not include a limitation for operating only one well at one time. The Permit also removes the groundwater level monitoring in the production wells and multi-level monitoring well, the monitoring and recording of rainfall events/volumes on the site, and annual monitoring data reporting conditions/requirements in previous permits.

YEAR	EVENT
2017	Gold Mountain Springs Inc. applies for a permit renewal more than 90 days before the expiry date (February 17, 2017). Per Section 34.1(6) of the *Ontario Water Resources Act*, the permit is deemed to continue to be in force until the date a decision is made on the permit renewal application while permit is under review. The report, "Hydrogeological Study, Renewal of Permit to Take Water 3122-9ZCQRS, Gold Mountain Springs Inc. 2997 Line 9 North, Lot 3, Concession 10, Township of Oro-Medonte (Oro). September 20, 2017. (Ian D. Wilson Associates Limited, 2017)", is submitted to comply with the MECP's *Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to Take Water Applications and Hydrogeological Study Requirements, April 2017.*

General information on the construction of the two Gold Mountain Springs Inc. production wells is summarized in Table 7-2.

Table 7-2: Gold Mountain Springs - Summary of Water Taking Sources

Source Name	Type/Date of Install	Well Record ID	Total Well Depth	Completion Unit	Screened Interval	PTTW No. 3122-9ZCQRS		
						Max. Taken Per Minute (L)	Max. Num. of Hours Take per Day	Max. Taken Per Day (m^3)
Well #1	Drilled Well/ Aug 20, 1994	5731146	97.5 m bgs (320 ft)	Gravel (some sand)	90.8 to 94.5 m bgs (298 to 310 ft)	909	16	872.64 (combined)
Well #2	Drilled Well/ May 20, 1998	5733504	94.5 m bgs (310 ft)	Sand/Gravel	90.8 to 94.5 m bgs (298 to 310 ft)	909	16	

As indicated in Table 7-2, both water taking sources are completed in gravel or sand/gravel and have identical screen intake intervals between 90.8 m and 94.5 m below ground surface (bgs) depth. The only structures reported to be located on the Site are the two well security enclosures, the on-site multilevel monitoring well and a small service building/loading dock. The on-site multilevel monitoring well was installed in 2005 and is located approximately 75 m northwest of Well #1 and Well #2. The multilevel well (MECP Well ID 5740500) is constructed with three monitoring levels with PVC screen intake intervals at 81.4 to 84.5 m bgs (Deep), 43.6 to 47.7 m bgs (Intermediate) and 14.3 to 17.4 m bgs (Shallow) depth.

7.2 PRIMARY INFORMATION SOURCES

The following records were on file with the MECP documenting the PTTW history:

- PTTW 94-P-5056, Gold Mountain Springs Inc., November 21, 1994.
- PTTW 3448-6FARKC, Gold Mountain Springs Inc., November 14, 2005.
- PTTW 0628-78CJEN, Gold Mountain Springs Inc., November 2, 2007.
- PTTW 3122-9ZCQRS, Gold Mountain Springs Inc., October 15, 2015.
- Gold Mountain Springs Inc. Application for a permit renewal, February 17, 2017.

The following key technical documents provided to the ministry by the proponent were identified and reviewed herein:

- Well Evaluation. Proposed Bottled Water Operation, Gold Springs Inc. Township of Oro-Medonte. Ian D. Wilson Associates Limited. August 2, 1994. (Wilson, 1994).
- Borehole Evaluation. Alternative Source, Gold Springs Inc. Township of Oro-Medonte. Ian D. Wilson Associates Limited. January 18, 1998. (Wilson, 1998).
- 2007 Status Report (Note: most recent report including expanded water level monitoring program), Gold Mountain Springs Inc. Permit to Take Water 344-6FARKC, Township of Oro-Medonte. Ian D. Wilson Associates Limited. March 31, 2015. (Wilson, 2008)
- 2014 Status Report (Note: most recent status report), Gold Mountain Springs Inc. Permit to Take Water 0628-78CJEN, Township of Oro-Medonte. Ian D. Wilson Associates Limited. March 27, 2015. (Wilson, 2015)
- Hydrogeological Study, Renewal of Permit to Take Water 3122-9ZCQRS, Gold Mountain Springs Inc. 2997 Line 9 North, Lot 3, Concession 10, Township of Oro-Medonte (Oro). Ian D. Wilson Associates Limited. September 20, 2017. (Wilson, 2017).

Other information sources used in this assessment included:

- The Hydrogeology of Southern Ontario. Second Edition. S.N. Singer, C.K. Cheng, and M.G. Scafe. Ontario Ministry of the Environment; Environmental Monitoring and Reporting Branch. 2003 (EMRB, 2003). Available at: http://www.ontla.on.ca/library/repository/mon/9000/246912.pdf
- Township of Amaranth Zoning By-Law 2-2009. Township Consolidation, December 2010. (TOM, 2010)
- Tier One Water Budget and Water Quantity Stress Assessment of the Severn Sound Watershed. Earthfx 2010. (Earthfx, 2010).
- Severn Sound Source Protection Area Assessment Report, 2010. (SSSPA AR, 2010).
- Approved South Georgian Bay Lake Simcoe Source Protection Plan. Approval Date January 26, 2015. (SGBLS, 2015).

- Township of Oro-Medonte Special Council Meeting February 15, 2017: Subdivision Agreement, Phases 1 B and 1 C, Braestone Development Corporation (formerly Buffalo Springs) Part of Lots 2 and 3, Concession 9, RP 51 R-21804, Part 1 (Oro,) Application: 43-T-91031. (TOM, February 2017).
- Township of Oro-Medonte Official Plan. Office Consolidation April 2017.(TOM, April 2017)
- Township of Oro-Medonte Municipal Residential Land Budget - Summary Results, 2017.
- Nottawasaga Valley Conservation Authority Interactive Map. Available at https://maps.simcoe.ca/NVCA/.
- Chapman, L.J. and Putnam, D.F. 2007. Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228. (Chapman and Putnam, 2007).
- Surficial Geology of Ontario; MNDM File - MRD128-REV. Ontario Geological Survey, 2010. (OGS, 2010).
- Bedrock Geology of Ontario; MNDM File - MRD126-REV1. Ontario Geological Survey, 2011. (OGS, 2011).
- MECP Water Taking Reporting System (WTRS), 2008-2017 Annual Totals by Source.
- MECP water well record database. Available at https://www.ontario.ca/environment-and-energy/map-well-records.
- MECP on-line Provincial Groundwater Monitoring Network database. Available at: https://www.ontario.ca/environment-and-energy/map-provincial-groundwater-monitoring-network.
- MECP on-line Permit to Take Water database. Available at: https://www.ontario.ca/environment-and-energy/map-permits-take-water.
- MECP on-line Source Protection Information Atlas. Available at: www.applications.ene.gov.on.ca/swp/en/index.php.
- MECP Water Taking Reporting System (WTRS) database (Confidential – Used with Permission from MECP).
- Ontario Low Water Response Program (LOWR) notifications and alert levels for Saugeen Valley Conservation Authority (2000 to 2018 data from MNRF).

7.3 CHARACTERIZATION OF STUDY AREA

This section provides a general characterization of the study area. Figure 7-2 presents the assessed regional study area which is an approximate 30 km by 30 km area centered over the Gold Mountain Springs Inc. water taking location (Figure 7-1). The regional study area boundaries were set based on an area that borders Orillia and Lake Simcoe to the east and the Coldwater municipal groundwater system to the north. The Gold Mountain Springs Inc. Site is situated within the administrative boundaries of the Nottawasaga Valley Conservation Authority, but is located within the jurisdiction of Severn Sound Environmental Association (SSEA) for the source protection program.

7.3.1 Land Use Setting

The Site is located in the Township of Oro-Medonte, which had a 2016 census total population of 21,689. The population is spread out over multiple communities with 13 separate water systems under municipal control and servicing 2,500 properties in the municipality (Source: https://www.oro-medonte.ca/water). The 'Township of Oro-Medonte Municipal Residential Land Budget - Summary Results, 2017' projects the total population to grow to 27,000 by 2031 (approximate 25% increase). The Township of Oro-Medonte Official Plan (TOM, April 2017) indicates it is the goal of the Plan to direct the majority of new residential growth to existing settlements and to prohibit the development of new residential subdivisions outside of the settlements.

The Gold Mountain Springs Inc. Site is located in the central portion of the Township of Oro-Medonte. Land use within an approximate 500 m radius of the Site (Figure 7-3), as per Schedule A17 of the Township of Oro-Medonte Official Plan (TOM, April 2017), is primarily rural/agricultural (to the north, south and east) and rural residential. Areas along the various creek tributaries that flow to the east toward Bass Lake are designated as Environmental Protection (EP). The EP areas fall under Ontario Regulation 172/06, which regulates development, interference with wetlands and alterations to shorelines and watercourses within the jurisdiction of the Nottawasaga Valley CA. The creek tributaries drain into a wetland area beyond the east boundary of Figure 7-3 and on the west side of Bass Lake. This wetland area has been classified as an area of natural and scientific interest (ANSI - Regional). Land cover within undeveloped areas in the study area is typically wetland, wooded wetland or woodland.

Braestone Development Corporation (Braestone) is in the process of constructing a residential development located on the west side of Line 9 North and immediately west of the Site as identified on Figure 7-3. The lands were approved for a 230 lot residential subdivision in 1994 by the Ontario Municipal Board. Braestone is developing the property in phases with Phase 1 currently under construction and consisting of a total of 118 lots. The development is serviced through a communal groundwater system and individual sewage systems on each lot. It is inferred that the communal wells were not considered at risk for water quality impacts from the on-Site sewage systems. The water system is constructed in the north end of the development within Phase 1 and utilizes two production wells located approximately 1050 m from the Site. The production wells are captured in PTTW No. 7845-94EKF9 (see Section 7.4.1). The water well IDs on the PTTW identified as 7104994 for PW1 and 7102599 for PW2. Well ID 7104994 appears in the WWIS database without any well construction information and it seems more likely that well ID 5726429 (97.5 m deep screened well constructed in 1990) is PW1. Well ID 7102599 appears in the WWIS database as a 92.5 m deep screened well that was constructed in December 2007. The Braestone communal water system will ultimately be transferred to the Township of Oro-Medonte for operation and maintenance by the municipality.

7.3.2 Physiographic Setting

The Site is located within the Simcoe Uplands physiographic region of southern Ontario, on the northern slope of the Oro Moraine. The physiographic landforms of the regional study area, as described by Chapman and Putnam, 2007, are provided in Figure 7-4. The area extending greater than 5 km to the south of the Site is mapped as kame moraines of the Oro Moraine. The Oro Moraine is recognized as an important groundwater recharge area and is characterized by glaciofluvial ice-contact stratified sediments of sand, gravelly sand and gravel. The area to the north of the Oro Moraine is mapped as drumlinized till plain consisting of silty sand to sand glacial till with clays and silts in lower lands. Sand plains dominate in the eastern end of the study area near Orillia with scattered drumlins and isolated beach deposits. Clay plains are located in the north end of the study area and east of Coldwater.

The regional topography and hydrology of the study area is provided in Figure 7-5. The Site is located within the western boundary of the North River subwatershed which is within the Severn Sound watershed. Drainage in the immediate vicinity of the Site is towards the northeast with various streams and tributaries draining into Bass Lake located 4.2 km east northeast of the Site. Bass Lake feeds into North River which flows to the north for approximately 12 km before changing its direction towards the west and ultimately discharging into Georgian Bay at Severn Sound. The divide between the North River subwatershed and the Coldwater River subwatershed is located less than 1 km west of the Site. Drainage within the Coldwater River subwatershed is directed to the north and northwest. The Coldwater River discharges into Georgian Bay at Severn Sound. The streams in the vicinity of the Site have been categorized as cool water with respect to fisheries habitat, indicating that groundwater is an important contributor to streamflow. Most of the streams within the North River subwatershed and north of Bass Lake are considered warm water habitat. Portions of the Coldwater River are considered cold water habitat (SGBLS, 2015).

The topography in the study area is characterized by relatively gentle slopes in the areas of the drumlinized till plains, and comparatively steeper slopes in the areas of the Kame Moraines. For the site itself the topography is at a high at the southeast corner of the property at an elevation of approximately 350 m above sea level (asl). The Site slopes steeply to the north toward the well field at approximately 280 m asl. The Site continues to slope gradually to the north towards a stream near the northeast corner of the property and at an elevation of approximately 250 m asl.

Two Water Survey of Canada (WSC) stream gauge (HYDAT) stations are located within 15 km of the Site. Both stations are located north of Bass Lake (Figure 7-2) and are within the North River subwatershed. Station 02ED030 and Station 02ED028 are located on Silver Creek, 12 km and 13 km northeast of the Gold Mountain Springs Inc. Site, respectively. Silver Creek drains towards the west into North River. A third WSC station is also located in the North river subwatershed; station 02ED024 is located on the

North River approximately 20 km north of the Site (i.e. beyond the north boundary of Figure 7-2) and is within 7 km of the North River outlet to Severn Sound.

As indicated in Section 7.1, a stream flow monitoring station was established at the north end of the Site as a previous PTTW condition (PTTW Number 3448-6FARKC). The stream is indicated to be approximately 400 m north of the production wells and flows to the northeast as a tributary of Bass Lake. A 'Stream Gauging Station' is indicated on-Site in Figure 2 of the '2007 Status Report' (Wilson, 2008) and is identified as a "Former Surface Water Station" on Figure 7-1. Stream flow monitoring for this location was initiated in 1999 and appears to have stopped in 2008 or 2009, as it is absent in the 2010 and subsequent 'Annual Status Reports'.

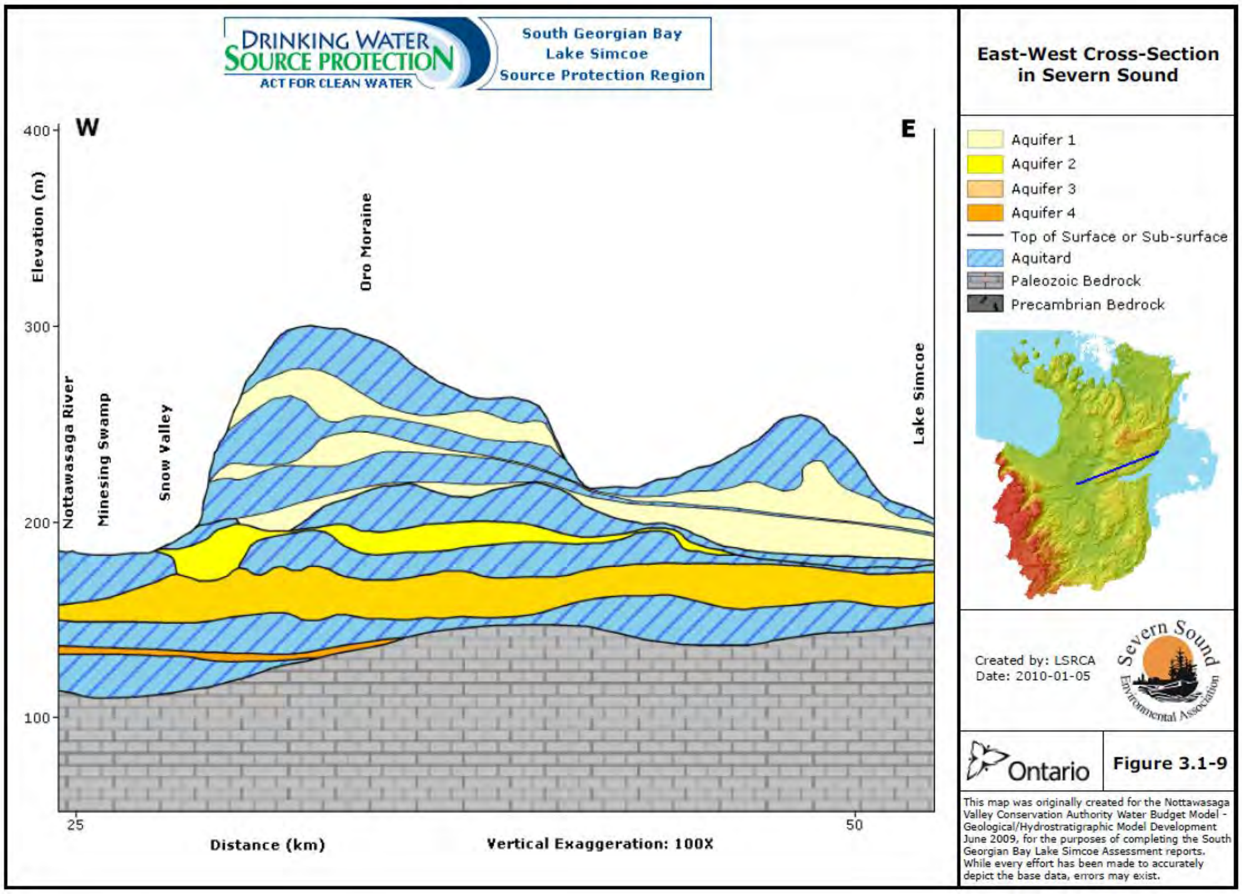
7.3.3 Geologic Setting

Information on surficial geology and bedrock geology was obtained from published maps and supplemented using information from the Severn Sound Source Protection Area 'Approved Assessment Report' (SGBLS, 2015). Surficial geology for the study area is mapped in Figure 7-6 and bedrock geology is mapped in Figure 7-7.

The mapped surficial geology of the regional study area is consistent with the physiographic setting. South of the Site and within the mapped area of the Oro Moraine the surficial geology consists of glaciofluvial ice-contact deposits consisting of sand and gravel, minor silt, clay and till. North of the Oro Moraine, surficial deposits are mapped predominantly as stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain. Areas of massive to well laminated fine-textured glaciolacustrine deposits of silt and clay, and minor sand and gravel are also mapped immediately north of the Site. A large area of organic deposits consisting of peat, muck and marl is mapped for an approximate 1000 acre area on the west side of Bass Lake and corresponds with the wetland area designated as an ANSI-Regional. Coarse-textured glaciolacustrine deposits (sand, gravel, minor silt and clay, foreshore and basinal deposits) are mapped for the area east of Bass Lake and containing Orillia.

The bedrock geology for the entire regional study area (Figure 7-7) with the exception of Coldwater is mapped as limestone, dolostone, shale, arkose, sandstone of the Ottawa Group; Simcoe Group; Shadow Lake Formation (now considered Upper Ordovician). The regional cross-section shown on Figure 3.1-9 of the Severn Sound Source Protection Area Assessment Report (SSSPA AR, 2010) suggests the depth to bedrock in the region ranges from a maximum of 175 m in the vicinity of the Oro Moraine to a minimum of 100 m in the adjacent low lying areas. This cross-section is reproduced below.

Text Figure 7-1: Gold Mountain Springs - East-West Cross Section in Severn Sound



Source: Severn Sound Source Protection Area Assessment Report (SSSPA AR, 2010)

7.3.4 Hydrogeologic Setting

7.3.4.1 Regional Hydrogeology

A description of the regional hydrogeology is provided herein as described in Chapter 3 of the Severn Sound Source Protection Area Assessment Report (SSSPA AR, 2010) which captures information from the 'North Simcoe Municipal Groundwater Study' (Golder Associates, 2004). The summarized information focuses on the regional overburden hydrostratigraphy as the bedrock aquifer is at significant depth and is not generally utilized.

A regional hydrostratigraphic framework was developed for the Severn Sound watershed by Golder Associates Ltd. through the use of local-scale hydrogeologic investigations completed by others. Four regional aquifer units (A1 to A4) and five aquitard units (C0 to C4) overlying bedrock were identified. The aquifer units (A1 to A4) as described by Golder Associates Ltd. is reproduced as follows.

A1- *The A1 aquifer is typically found at an elevation of 250 m asl; however, it has been mapped as low as 220 m asl in lowland areas, and as high as 350 m asl in some regions. This aquifer exists mainly as an unconfined surficial aquifer; however, it can be locally confined. It is composed of coarse-grained glacial and interglacial sediments. A1 has a unit thickness ranging from 10-50 m. Overall; this aquifer is considered to be a recharge unit. Within the study area this unit is thickest in the uplands of the Oro-Moraine, and thinnest is the Orillia-Coldwater area. In Tiny Township this aquifer is directly connected to the A2 aquifer.*

A2- *The A2 aquifer is typically found at elevations between 180-250 m asl; however, it has been mapped as low as 150 m asl in some lowland areas. This aquifer can be absent (Orillia-Coldwater area) or very thin in valleys, or very thick in upland areas (Horseshoe Valley- Hillsdale area). Within the study area the A2 aquifer is used as a municipal drinking water supply to the communities in Horseshoe Valley.*

A3- *The A3 aquifer is typically found at elevations between 130-210 m asl. It is composed of medium to coarse grained sediments, with some gravel and silt layers. It exists as a 70 m thick unit north of the Oro Moraine in Coldwater, it is found as a 35 m thick unit more often. This aquifer also supplies drinking water to the communities in Horseshoe Valley.*

A4- *The A4 aquifer is typically found at elevations below 150 m asl. It is composed of medium to coarse-grained sand and gravel. When defined as a regional unit the aquifer is composed of fine to medium grained sand with some minor gravel in areas. This aquifer is not continuous across the watershed, and ranges in thickness from 3-30 m. This aquifer is most prevalent in the Tiny Township area.*

The aerial extent of the described aquifers is shown in figures 3.1-16 to 3.1-19 of the SSSPA AR, 2010 report. In the vicinity of the Gold Mountain Springs Inc. Site the A1 Aquifer is indicated to be between 35 and 80 m in thickness, the A2 Aquifer is indicated to be <5 m in thickness, the A3 Aquifer is indicated to be between <1 and 10 m in thickness and the A4 Aquifer is indicated to be <1 m in thickness. Based on the reported aquifer elevation ranges and aquifer thickness it is inferred that the A2 or A3 Aquifer are being utilized by the Gold Mountain Springs Inc. wells.

Regarding regional groundwater flow the SSSPA AR, 2010 report indicates that groundwater divides in the study area coincide closely with the major basin topographic divides and local divides; groundwater flow is mainly towards the valleys of rivers and creeks and the valleys act as the main groundwater discharge zones within the watershed. According to Golder Associates (2004), groundwater gradients within the shallow groundwater regime typically range from 4 m/km to 6 m/km; however, gradients of up to 19 m/km have been measured on the flanks of the Oro Moraine. It is not uncommon to have groundwater divides that do not coincide with surface water divides resulting in inter-basin transfers of groundwater. Numerous cross-boundary groundwater fluxes occur across both subwatershed and primary watershed boundaries through the watershed region.

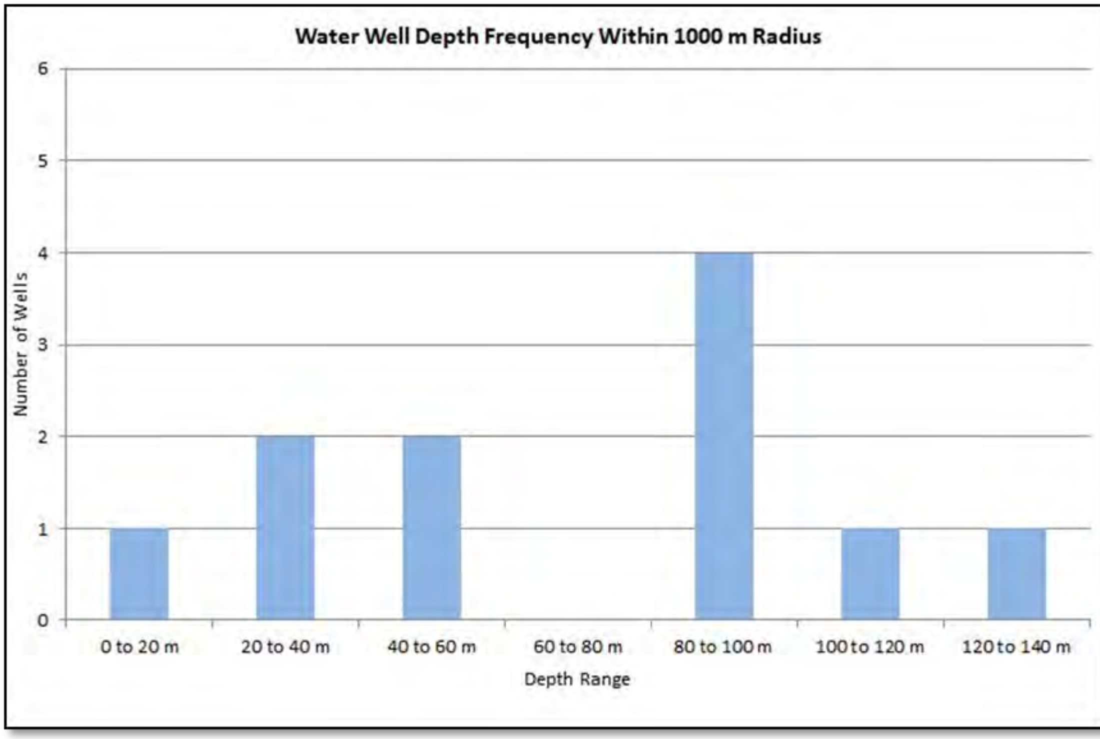
The water quality well head protection areas for the municipal well systems in the study area are reproduced in Figure 7-2. The WHPA mapping outlines time-of-travel (TOT) zones for groundwater captured by the municipal wells as indicators of the relative level of risk for water quality impact from land development activities within each zone. The mapped WHPA are a useful indicator of regional groundwater flow for the aquifer utilized by the municipal wells. All municipal groundwater supply systems in the study area make use of one or more overburden aquifers as a source. As indicated in Figure 7-2, the mapped WHPA extend to the south of the Horseshoe Valley and Sugarbush well fields indicating regional groundwater flow is towards the north in the Coldwater subwatershed. For the Warminster well field, the mapped WHPAs extend to the southwest indicating a regional groundwater flow direction to the northeast at this location within the North River subwatershed.

7.3.4.2 Local Hydrogeology

Rural properties in the Township of Oro-Medonte are serviced by individual private well water supply or by a communal/municipal well water supply system. As indicated previously herein, the Township of Oro-Medonte operates 13 separate water systems within the municipality. The MECP WWIS database was reviewed for water well records plotting within a 1,000 m radius of the Gold Mountain Springs Inc. production wells. A 1,000 m search radius was considered appropriate based on the observed density for water well records in this search area while ensuring records are representative of local hydrogeological conditions. Water well record locations as referenced in the WWIS are plotted on Figure 7-1. The location of a Braestone (former Buffalo Springs) residential subdivision production well (Well ID 7102599) was found to be slightly beyond the 1000 m search radius was, but included in the records review. A total of 11 well construction records for supply wells were identified (i.e. monitoring wells and well abandonment records were omitted) with reported well construction depths ranging from 9.8 to 121.9 m. The WWIS database suggests that one of the wells is completed in bedrock (Well ID 5725096). However, a review of the original water well record indicates this well is completed in gray clay with 'muck limestone' for the bottom 3 m of the well.

The frequency distribution in water well depths within the 1,000 m search radius is provided in the chart below, indicating the wide range in water well depths. Of these, 6 of the 11 wells were completed at greater than 80 m depth. Wells constructed to <60 m depth are inferred to be completed in the A1 Aquifer, while the deeper wells are inferred to be completed in the A2 or A3 Aquifer.

Text Figure 7-2: Gold Mountain Springs - Local Water Wells Depth Frequency



Overburden materials are commonly described in the well records as sand, silt, clay and gravel that appear to be present in random layers within the subsurface. Well ID 7102599 is plotted approximately 1,050 m northwest of the Gold Mountain Springs well field and corresponds with Well PW2 in Braestone's residential subdivision PTTW 7845-94EKF9. The water well record indicates the well is completed to a depth of 92.05 m and therefore, is completed to the same general depth as the Gold Mountain Springs wells. The well was constructed using a 6 m length of well screen installed from 85.96 to 92.05 m depth, within medium and coarse sand. Also similar to the Gold Mountain Springs wells, the water well record indicates it has a high yield and was pumped for 24-hours at 274 gallons per minute (1,037 L/minute). The well record indicates a static water level of 19.30 m bgs and a measured drawdown of approximately 8.9 m at the end of pumping, indicating approximately 60m of available drawdown at the end of pumping. Based on a review of the well record information it is concluded that this production well (Braestone PW2) is completed in the same aquifer (A2 or A3) as Gold Mountain Springs Inc. Well #1 and Well #2 (both completed to 94.5 m depth).

7.3.4.3 Site Hydrogeology

Four technical reports were identified in MECP files as providing key hydrological and hydrogeological information for the Gold Mountain Springs Inc. Site. Salient information derived from these reports is summarized as follows.

<u>Well Evaluation (Well 1) Proposed Bottled Water Operation, Gold Springs Inc. Township of Oro-Medonte (Wilson, 1994)</u>

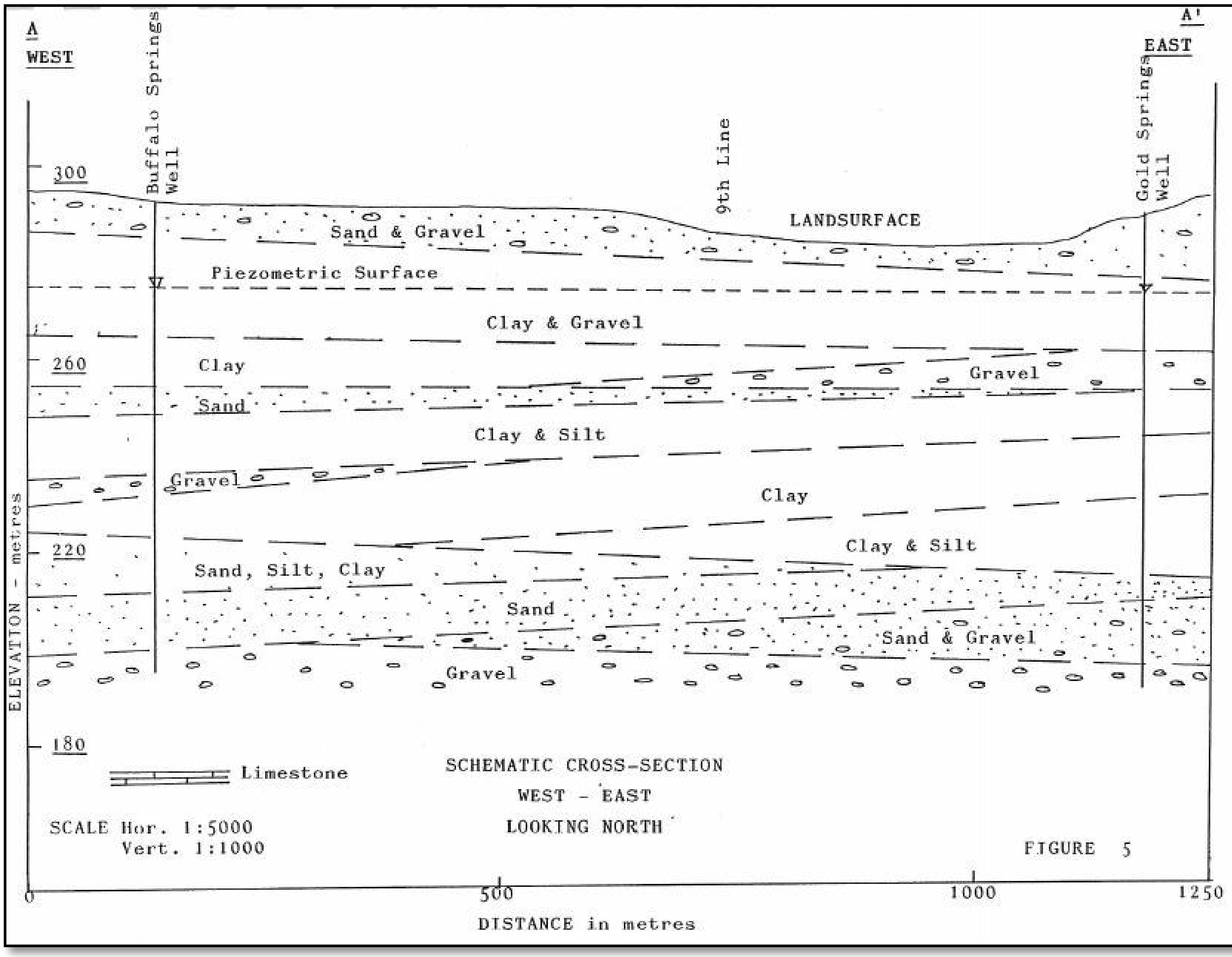
Well #1 was constructed in June 1994 as a potential source of bottled water for Gold Springs Inc. The Buffalo Springs (now Braestone) residential development on the west side of Line 9 North was in the planning stages at this time and had successfully tested a well (assumed to be Well ID 5726429, completed to 97.5 m depth) at 1,364 L/minute over a 61.5-hour period. Gold Springs Inc. Well #1 was installed using 3.66 m of 150 mm diameter well screen (Slot No. 16) set between 90.83 m and 94.5 m depth, within a gravel (with some sand) layer. In July 1994 a 72-hour continuous rate pumping test was completed on Well #1 at a rate of 946 L/minute. During testing, water levels were measured at the pumping well and at five off-site private wells, including:

- a dug well located 530 m to the northwest (Pryde: 7.55 m deep, no well record),
- a dug well located 430 m to the southeast (Ball: 15.85 m deep),
- the drilled test/communal well for the proposed Buffalo Springs development reported to be 97.54 m deep located 1050 m to the northwest (Note: this is inferred to be well ID 5726429 with 'an actual well location' near Braestone PW2 on Fig 7-1), and
- two observation monitoring wells; 89-01: 116.74 m deep; and 89-02: 121.92 m deep and indicated as being completed within shallow bedrock and located on the Buffalo Springs property and 1050 m to the northwest (Note: the locations of 89-01 and 89-02 are not indicated on any pf the report figures. The locations are indicated in the report as located near the 'Buffalo Springs Well'.

Well #1 had a static level of 16.66 m bgs and had 19.93 m of drawdown (27% of the available drawdown) over the course of the 72-hour test with a mostly stable water level over the final 3.5 hours of the test. No drawdown was observed at the two dug wells and observation well 89-01. A drawdown of 0.435 m was observed at both the Buffalo Springs test/communal well and observation well 89-02. The observed drawdown/interference at the Buffalo Springs well was considered acceptable by Wilson based on an available drawdown of 52.4 m for the aquifer. The recovery of Well #1 was rapid with the water level rising to 1.51 m of the static level within 90 minutes of pump shutoff.

The Wilson, 1994 report indicates that Buffalo Springs well and the Gold Springs Well are completed within the same aquifer. A west-east cross section showing the two wells is provided as Figure 5 in the Wilson, 1994 report and this is reproduced below.

Text Figure 7-3: Gold Mountain Springs - West-East Cross Section



Source: Figure 5 of Wilson, 1994

Based on the pumping test results for Well #1, a specific capacity of 47.5 L/minute/m of drawdown, a coefficient of transmissivity of 490 m^2/day, (Cooper and Jacob modified non-equilibrium method), a coefficient of storage of 2 x 10^{-4} and a safe perennial yield of 946 L/minute were determined. A zone of influence during pumping of approximately 1 km was determined for the deep aquifer (later referred to as Aquifer 3). A water balance assessment was completed by Wilson that indicated that for the 40.47 hectare Gold Springs Inc. property the onsite infiltration was adequate to offset any potential aquifer mining if the Well 1 was pumped at the planned rate of 909 L/minute. The aquifer source was deemed secure based on multiple sequences of low permeable clay and clay with silt that provide a cap over the aquifer.

<u>Borehole Evaluation (Well 2) Proposed Bottled Water Operation, Gold Springs Inc. Township of Oro-Medonte (Wilson, 1998)</u>

In May 1998, Well #2 was constructed 10.4 m northeast of Well #1 to serve as a standby or alternative source of water to Well #1. The report states 'it is not the current intention to take additional water from the Site'. Well #2 was installed using 3.66 m of 150 mm diameter well screen (Slot No. 16) set between 90.83 m and 94.5 m depth (identical to Well #1), within a 'cemented sand and gravel' layer. Well #2 was pumped at 573 L/minute for the first 150 minutes of a 23.4 hour test then at 773 L/minute for the balance of the test. During testing, water levels were measured at the pumping well (Well #2), Well #1 and at the same five off-site private wells monitored during the 1994 aquifer test program (Wilson, 1994). Well #2 had a static level of 15.37 m below grade and 12.75 m of total drawdown (17% of the available drawdown) was observed over the course of the 23.4-hour test. A stable well water level was observed over the final 5 hours of the test. No drawdown was observed at the two dug wells and observation well 89-01. A drawdown of 3.09 m was observed at Well #1 (10.4 m to southwest). A drawdown of 0.13 m was observed at the Buffalo Springs test well and 0.16 m of drawdown was observed at observation well 89-02. The observed drawdown/interference at the Buffalo Springs wells was considered acceptable based on an available drawdown in the deep overburden aquifer of ±74 m. The recovery of Well #2 was rapid with the water level rising to within 1.22 m of the static level (90% recovery) within 10 minutes of pump shutoff.

Based on the pumping test results for Well #2, a specific capacity of 61 L/minute/m of drawdown, a coefficient of transmissivity of 246 m^2/day (Cooper and Jacob modified non-equilibrium method), a coefficient of storage of 5×10^{-5} and a safe perennial yield of >773 L/minute were determined. Wilson concluded that Well #2 would provide 'a good standby or alternate borehole for the production borehole (Well #1)'.

<u>2014 Status Report, i.e. last annual status report (Wilson, April 2015)</u>

The '2014 Status Report' was the last annual monitoring report prepared as required under Condition 4.5 of PTTW No. 0628-78CJEN. Annual reports were no longer required with PTTW 3122-9ZCQRS, issued to Gold Mountain Springs Inc. on October 15, 2015.

Precipitation

Total precipitation in 2014 as reported by the Barrie-Oro weather station, located 11 km south of the Site, was 864.2 mm. The 30-year normal is 1043 mm/year for the Orillia area and 938.5 mm/year for the Barrie area. Total rain and minor melted snow/ice reported at the Gold Mountain Springs Inc. rain gauge for 2014 was 779.5 mm.

Automated Water Level Monitoring Data

Plots of water level data for the two pumping wells (since 2003) and the on-site monitoring well (since 2006) were provided. Collected data for the production wells indicated consistent and stable water levels ranging between 16 to 18 m below top of casing for both wells. Available drawdown in the two production wells is approximately 70 m to 75 m. The water level in the shallow onsite monitoring well was observed to fluctuate seasonally between 4.8 m to 5.8 m below top of casing, consistent with previous years. The water level in the intermediate aquifer monitor was observed to remain relatively stable, rising higher during precipitation events and ranging from 15 m to 16 m below top of casing. The water level in the deep aquifer monitor was observed to vary daily in response to the withdrawals from the Gold Mountain Springs production wells, typically in the range between 11 to 14 m below top of casing. Wilson, 2015 concluded that the 2014 water level monitoring data remained similar to levels observed when the production wells were constructed in 1994 and 1998.

A review of previous annual status reports indicates that quarterly off-site water level monitoring at the Pryde dug well and quarterly streamflow measurement for the onsite creek was discontinued in 2008 or 2009. As the water-level monitoring at the Pryde dug well and the onsite creek were not required as a condition of the permit, the Permit Holder did not require ministry approval for discontinuation of the monitoring.

Hydrogeological Study, Renewal of Permit to Take Water 3122-9ZCQRS (Wilson, 2017)

This study was submitted in September 2017 in support of the renewal application for the PTTW and as per the ministry's April 2017 'Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to take Water Applications and Hydrogeological Study Requirements'. The study provides a summary of previously-collected hydrogeological information for the Site (i.e. aquifer testing and groundwater monitoring results) and provides an expanded assessment of the Site hydrogeology in consideration of the regional hydrogeological conditions described in the Severn Sound Source Protection Area Assessment Report (SSSPA AR, 2010) and a review of water well records within a 500 m radius of the Gold Mountain Springs production wells. Wilson, 2017 identifies the Site hydrostratigraphy as intersecting 3 of the regional Aquifers, with Aquifer 4 (A4) not encountered for any wells at/near the Site. The Wilson, 2017 report interpretation of wells completed in specific aquifers is reproduced as follows.

Table 7-3: Gold Mountain Springs - Summary of Wells and Associated Aquifers

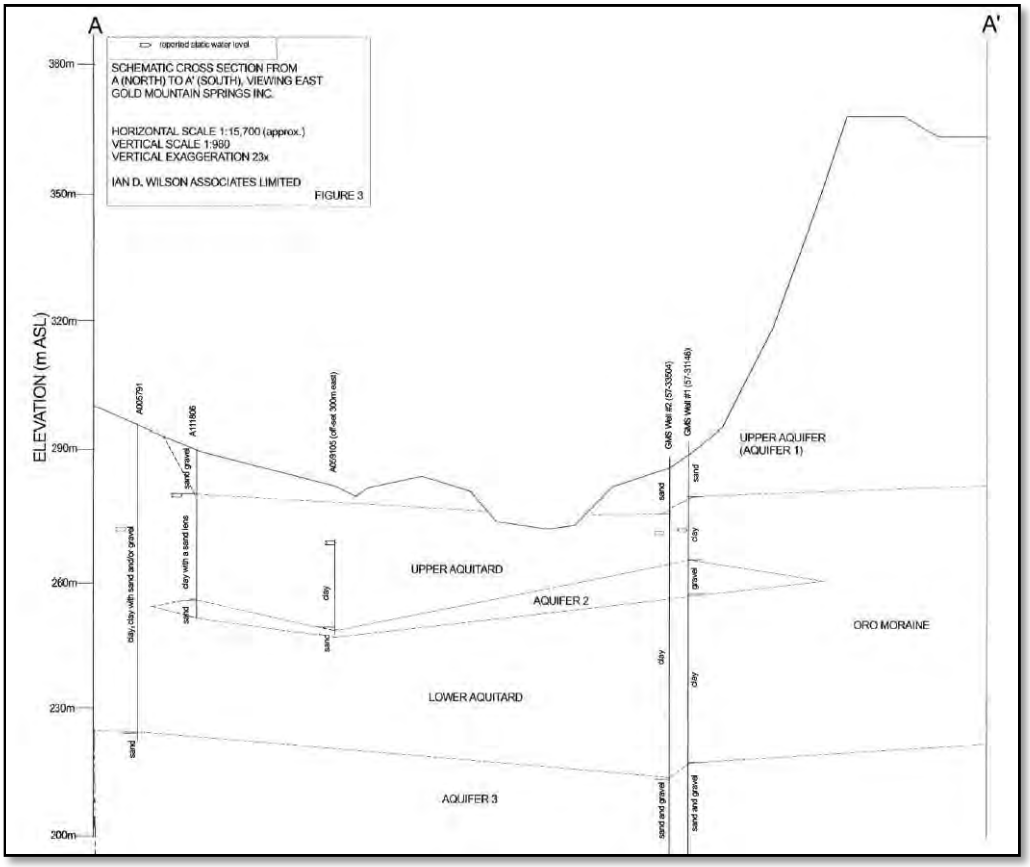
Elevation Range (m asl*)	Formation	Wells Completed within the Elevation Range
Above ±275	Upper Sands (Overburden **Aquifer 1**)	Ball dug well, Pryde dug well
±250 to ±275	Upper Aquitard	
±245 to ±250 (variable)	Intermediate Sands (Overburden **Aquifer 2**)	Braestone 89-01
±220 to ±245	Lower Aquitard	
±200 to ±220	Lower Sands (Overburden **Aquifer 3**)	Well #1, Well #2, Braestone Production Well(s), Braestone 89-02
±120 to ±220	Basal Aquitard	
Below ±120	Bedrock (Limestone, Simcoe Group)	

*m asl = metres above sea level

Source: Wilson, 2017

In the Wilson, 2017 assessment it is concluded that Aquifer 3 (Regional Aquifer A3) has no horizontal aquifer boundaries within the known zone of influence (±1 km radius). However, based on the available drawdown in Aquifer 3 (±75 m), there is no identified risk to the Braestone production wells and other supply wells completed in Aquifer 3. Further, all known off-site wells completed in Aquifer 3 are indicated to be more than 1 km from the Gold Mountain Springs Inc. production wells. The report also concludes that based on findings from past aquifer testing programs and past groundwater level monitoring programs at the Site, Aquifer 3 is not hydraulically connected to Aquifer 1 (Regional Aquifer A1) and Aquifer 2 (Regional Aquifer A2). Consequently, the pumping of the production wells poses no risk to local wells completed within these aquifers.

Text Figure 7-4: Gold Mountain Springs - North-South Cross Section



Source: Figure 3 of Wilson, 2017

In its impact analysis for surface water, Wilson indicates that the nearest surface water receives topographic discharge from Aquifer 1. Since past water level monitoring programs for wells completed in Aquifer 1 (off-site dug wells and on-site multilevel well) have shown no measurable impact from the withdrawal of water from the production wells, which are completed in Aquifer 3, there is no risk for impact to nearby surface water.

In its assessment of 'Drought and Cumulative Effects' the Wilson, 2017 report provides a summary table of the findings from the Tier 1 groundwater stress assessments for the North River and Coldwater River subwatersheds (SGBLS, 2015). The North River and Coldwater River subwatersheds are located within the Gold Mountain study area. The report states 'Groundwater resources in the North River and Coldwater River Subwatersheds are identified as being under low stress, for both existing and future uses, taking into account groundwater and surface water reserves. Accordingly, the proposed renewal of the Gold Mountain Springs PTTW is not considered to represent a risk to the function of groundwater resources in the watershed.'

Regarding 'Monitoring Program and Contingency' the Wilson, 2017 indicates that PTTW 3122-9ZCQRS discontinued the requirement for a comprehensive water level monitoring program based on the review of 2004 to 2014 data. However, monitoring of water levels in the on-site multilevel monitoring well has been continued by Gold Mountain Springs Inc. and water levels in all three overburden aquifers have been identified to remain stable through long-term water level monitoring. BluMetric's review of the hydrograph data for 2013 to 2017 (Figures 10 to 19 of Wilson, 2017) did not identify any indication of a downward trend for water levels in the year over year information.

It was recommended by Wilson that a future monitoring program consisting of the automated measurement of water levels in Aquifers 1, 2, and 3 in the on-site multilevel monitoring well be continued as a requirement of the PTTW renewal. This data along with local precipitation data and the daily withdrawal data would be summarized and presented in an annual report submitted to the ministry. This approach was recommended in lieu of preparing a comprehensive contingency plan (to address water well interference complaints) that is not considered necessary since there is no history of well interference complaints for the Site. The continuation of water level monitoring would provide both Gold Mountain Springs Inc. and the ministry the basis for determining whether any received water interference complaints are valid and would warrant further assessment by a Qualified Person.

7.4 DATA REVIEW AND STATE OF GROUNDWATER RESOURCES

The following section provides a review of Ontario Water Quantity Management Framework (WQMF) data relevant to the Gold Mountain Springs Inc. study area and available to MECP for consideration when making water management decisions.

7.4.1 Water Taking Reporting System

The Water Taking Reporting System (WTRS) is the ministry's repository for collection of water taking data for active Permits to Take Water (PTTW). As a requirement of each PTTW, the water taking data must be reported on an annual basis and daily water taking data must be entered into the system. The WTRS is not publicly available, but is available for use by ministry staff when assessing the status of a PTTW, addressing potential issues associated with a PTTW, and for evaluating the potential impact from multiple water takings within a given area. The WTRS data was provided by the ministry for use in the WBSA assessment to be inclusive of all information available to MECP for making water management decisions.

Reported water taking data for the Gold Mountain Springs Inc. Site was obtained from the WTRS for review. Table 7-4 below includes annual water taking data for the ten year period from 2008 to 2017.

Table 7-4: Gold Mountain Springs - Reported Water Takings

Permit Number	Year	Source Name	Annual Amount Permitted by the PTTW (Million L)	Reported No. of Days Taken per Year	Reported Annual Taking (Million L)	Reported annual taking (% of permitted amount)	Average Reported Volume Taken per Day (L/day)
0628-78CJEN	2008	Well #1	318.5136	179	26.91	8%	150,335
		Well #2		187	28.54	9%	152,620
					55.45	**17%**	
0628-78CJEN	2009	Well #1	318.5136	179	23.398	7%	130,715
		Well #2		186	25.893	8%	139,210
					49.291	**15%**	
0628-78CJEN	2010	Well #1	318.5136	177	23.554	7%	133,073
		Well #2		185	24.95	8%	134,865
					48.504	**15%**	
0628-78CJEN	2011	Well #1	318.5136	179	31.225	10%	174,441
		Well #2		186	36.181	11%	194,552
		Total			**67.406**	**21%**	
0628-78CJEN	2012	Well #1	318.5136	178	34.366	11%	192,899
		Well #2		187	36.935	12%	197,513
		Total			**71.271**	**22%**	
0628-78CJEN	2013	Well #1	318.5136	176	29.49	9%	167,557
		Well #2		183	32.816	10%	179,322
		Total			**62.306**	**20%**	
0628-78CJEN	2014	Well #1	318.5136	132	16.06	5%	121,667
		Well #2		134	15.768	5%	117,672
		Total			**31.828**	**10%**	
0628-78CJEN	2015	Well #1	318.5136	94	11.645	4%	123,883
		Well #2		102	12.001	4%	117,657
3122-9ZCQRS		Well #1		29	3.128	1%	107,862
		Well #2		27	3.411	1%	126,33
		Total			**30.185**	**9%**	
3122-9ZCQRS	2016	Well #1	318.5136	128	16.552	5%	129,313
		Well #2		136	16.964	5%	124,735
		Total			**33.516**	**11%**	
3122-9ZCQRS	2017	Well #1	318.5136	118	14.7435	5%	124,945
		Well #2		127	15.533	5%	122,307
		Total			**30.2765**	**10%**	

As indicated in Table 7-4, the reported annual water taking amounts for the Gold Mountain Springs Inc. Site reached a peak of 22% of the PTTW annual taking limit in 2012 and has ranged from 9% to 11% of the annual taking limit over the past four reporting years. In each of the past 10 years the reported water taking amounts from Well #1 and Well #2 have been similar in total volume with the reported water taking from Well #2 always marginally higher. As reported previously herein, water drawn from Well #1 is used only for bottled water while water drawn from Well #2 is used for both bottled water and other commercial water uses.

The assessed study area for review of other active PTTW was set at a 5 km radius of the Gold Mountain Springs Inc. well field (Figure 3-2). The 5 km radius was considered appropriate for review based on the density of active PTTW in the area and as a conservative distance for any potential contribution from the Site on the cumulative impacts from multiple water takings. Four other active PTTWs were identified. Three PTTWs are for communal well water supply systems and the fourth PTTW is for the Orillia Golf and Country Club, located 2.7 km to the northeast, to permit the seasonal taking of surface water for irrigation of the golf course. Assessment of the reported water takings from the three water supply systems was considered warranted since these takings are year round and potentially drawing from the same aquifer as Gold Mountain Springs Inc. The 2016 and 2017 WTRS data for the three communal groundwater systems is summarized in Table 7-5.

Table 7-5: Gold Mountain Springs - Neighbouring PTTWs

Permit Holder (Permit no.)	Issue Date	End Date	Source	Dist. from Site Wells (Km)	PTTW Limits			2016 WTRS Data		2017 WTRS Data	
					Max. taken per day (L)	Taking Days per Year	Annual Taking (Million L)	Annual Reported Taking (Million L)	Annual Reported Taking (% of PTTW Limit)	Annual Reported Taking (Million L)	Annual Reported Taking (% of PTTW Limit)
Braestone Residential Subd. (7845-94EKF9)	Feb. 22, 2013	Sept. 30, 2019	Well PW1	1.0	1,010,880	365	368.97	2.032	0.5%	5.701	1.5%
			Well PW2	1.0	1,010,880	365	368.97	1.196	0.3%	4.731	1.3%
Big Cedar Residents Association (2343-8SKST9)	Mar. 30, 2012	Mar. 27, 2022	Well 4	4.0	786,458	365	287.057	25.453	8.9%	25.771	9%
			Well 5	4.0	786,458	365	287.057	25.453	8.9%	25.771	9%
Sugarbush Residential Subd. (8546-92XM74)	Dec. 21, 2012	Dec. 31, 2022	Well 1	4.2	851,040	365	310.63	14.655	4.7%	11.412	3.7%
			Well 2	4.1	1,635,840	365	597.08	38.576	6.5%	35.817	6%
			Well 3	4.0	1,635,840	365	597.08	31.799	5.3%	33.3	5.6%

As mentioned previously herein, the Braestone residential subdivision is located on the west side of Line 9 North. Google air photo imagery suggests the residential development remains in the early stages of construction. The gradual build out of the development is reflected in the 2016 and 2017 reported water taking data with the 2017 reported annual water taking amount more than double the taking in 2016. Despite this, the 2017 reported annual water taking remains less than 2% of the permitted annual water taking amount of 737.94 million L/year for the water system. As discussed in Section 7.3.4.3, one of the Braestone production wells was used as an observation well in the 1994 testing program for Gold Mountain Springs Inc. Well #1 and in the 1998 testing program for Well #2. The Braestone production wells are completed to a similar depth and are screened within the same aquifer as the Gold Mountain Springs Inc. production wells (i.e. Aquifer 3). After pumping Well #1 for 72–hours at 946 L/minute, a drawdown of 0.435 m was measured at the Braestone production/test well which is located approximately 1050 m northwest of Well #1. The measured well interference with the Braestone production/test well was considered acceptable in relation to the available drawdown for wells completed in Aquifer 3 (±74 m). The permitted annual water taking amount of 737.94 million L/year for the Braestone water system is approximately 2.3 times the Gold Mountain Springs Inc. permitted water taking amount of 318.52 million L/year.

Big Cedar Estates (Big Cedar (Oro) Residents Association) is a 230 home retirement community on the south side of Bass Lake and approximately 4 km east of the Gold Mountain Springs Inc. production wells. The water system is privately owned but operated by the Township of Oro-Medonte. A review of the WWIS for well supplies in the development identified one production well completed as a 33.5 m deep screened well with a reported yield of 1491 L/minute (Note: Figure 3.1-16 of SSSPA AR, 2010 suggests this well is completed in the A1 regional Aquifer). The data provided in Table 7-4 indicates the reported annual water taking in 2016 and 2017 was approximately 9% of the permitted annual water taking amount in both years. The permitted annual water taking amount of 574.11 million L/year for the Big Cedar Estates water system is approximately 1.8 times the Gold Mountain Springs Inc. permitted water taking amount of 318.52 million L/year.

The Sugarbush residential subdivision is located on 6 Line North approximately 4 km west of the Gold Mountain Springs Inc. production wells. The water supply system consists of three wells: Well 1 is located on Huron Woods Drive, Well 2 is located on 6 Line North and Well 3 is located on Diamond Valley Drive and is the closest production well to the Gold Mountain Springs wells at 4.0 km. The water system serves an estimated population of 812 (296 lots as of 2001) and has been upgraded to service an additional 60 lots (SGBLS, 2015). Well 1 and Well 2 have been in operation since 2000 and 1973, respectively. Well 3 was connected to the system in 2008. According to PTTW # 8546-92XM74, the combined permitted water taking for the system is 4.123 million L/day. As indicated in Table 7-4, the 2016 and 2017 reported annual water taking was less than 10% of the permit limit for all 3 production wells. The Sugarbush wells are reported as being completed in a sand aquifer over the elevation range of 230 to 248 m asl (66 to 84 m below ground level) at Well 1 and approximately 10 m lower at Well 2. Well 3 is reported to be 90.2 m in depth and completed to a similar elevation as Well 2. The Sugarbush well depth elevations correlate with the A2 aquifer described in the SSSPA AR, 2010 report. The aquifers are believed to pinch out east of the wellfield and may be combined as a single unconfined aquifer to the north. The recharge area is believed to be located to the southeast. The permitted annual water taking amount of 1504.79 million L/year for the Sugarbush water system is approximately 4.7 times the Gold Mountain Springs Inc. permitted water taking amount of 318.52 million L/year.

7.4.2 Provincial Groundwater Monitoring Network

The Provincial Groundwater Monitoring Network (PGMN) is a partnership program with all 36 CAs and 10 municipalities (in areas not covered by a conservation authority) to collect and manage ambient (baseline) groundwater level and quality information from key aquifers located across Ontario. During the spring and summer of 1999, low water conditions in many parts of southern Ontario prompted the formation of an inter-ministerial task force to assess drought conditions, determine trigger levels and develop a response strategy. The PGMN was approved in 2000 and there are currently more than 450 monitoring wells in the network.

The PGMN datasets report on ambient (baseline) groundwater level and chemistry conditions. The PGMN well locations are typically sited to be away from areas where there is a large density of permitted water takings. Consequently, the PGMN wells are typically far too distant from any permitted water taking to be used as an indicator of potential well interference impacts.

Water level data collected for the PGMN wells is of potential value in assessing regional groundwater level trends as an indicator of stress within the watershed/subwatershed. Data has been collected for the PGMN well network since 2001 though some wells were installed more recent than this. Also the data for some wells is not current to 2018. The Provincial Groundwater Monitoring Network database is made available by MECP on-line.

As a recent internal project the MECP has applied the Mann-Kendall (MK) and Seasonal Kendall (SK) tests to analyze the PGMN water level data for monotonic trends (i.e. consistently increases or decreases through time). The statistical analyses were performed using robust and defensible methodologies to look for longer-term trends in groundwater levels. An overall objective is to determine if there is enough data to support the presence of a widespread decrease in groundwater availability. Shorter trends within the PGMN data record (e.g. lasting for a few years) were not considered and the causes of any trends that were identified were not investigated. Both the data plots and preliminary findings for PGMN well locations nearest a WBSA were shared by the ministry and are presented and relied on herein. The data plots indicate data available for the well at the time of the assessment. Further, the MECP has indicated that the methodologies used require that certain values be dropped from the data set if the month/year in question does not have sufficient number of data points. The release of a final report that details the methodology and results from the PGMN data trends analysis is forthcoming from the ministry (MECP, 2018).

Four PGMN wells were identified as located within 10 km of the Gold Mountain Springs Inc. Site (Figure 7-2). All four wells are completed in overburden aquifers to the west of the Site and are situated within the Coldwater River subwatershed as mapped in Figure 7-5. PGMN well W0000439-1 is the nearest PGMN well to the Site and is located approximately 2.9 km to the south-southwest within the Oro Moraine. PGMN well W0000293-3 is located in the same direction and is 5.9 km from the Site. PGMN wells W0000440-1 and W0000442-1 are located 6.1 km east and 9.8 km east of the Site, respectively. A summary of information for all four PGMN wells is provided in Table 7-6.

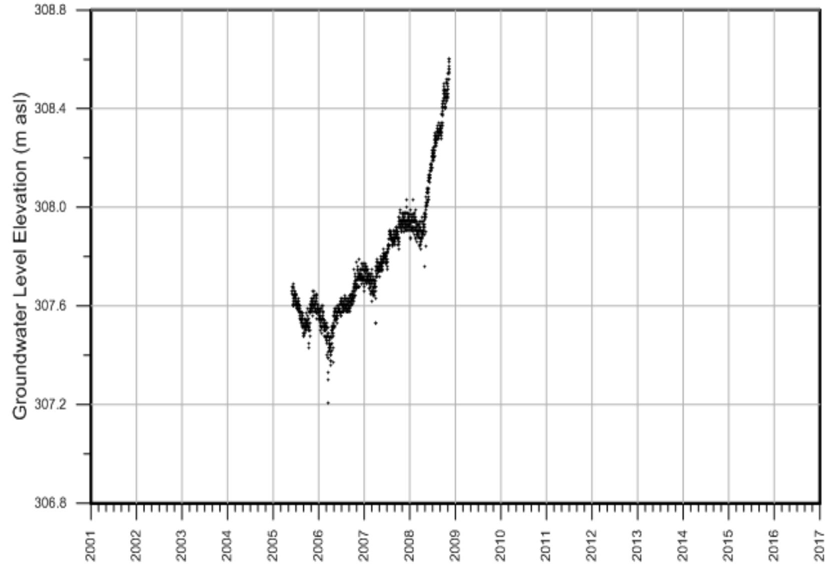
Table 7-6: Gold Mountain Springs - PGMN Wells Summary

PGMN Well ID	Water Well Record ID	Distance from Gold Mountain Springs Sources (Km)	Well Depth (m)	Ground Elevation m asl)	Lithology of Aquifer
W0000439-1	Not available	2.9	58.57	326.06	Overburden: Sand and Gravel (inferred to be A1 Aquifer based on elevation)
W0000293-3*	5737770	5.9	17.68	322.92	Overburden: Silt, Silty Sand (inferred to be A1 Aquifer based on elevation)
W0000440-1	Not available	6.1	66.41	238.26	Overburden: Sand and Gravel (inferred to be A2 Aquifer based on elevation and depth)
W0000442-1	1410428	9.8	19.83	256.72	Overburden (Sand, Silt, Stones) (Inferred to be A1 Aquifer based on depth)

Note: *Denotes the water level data was not reviewed due to MECP concerns with the reliability of the data.

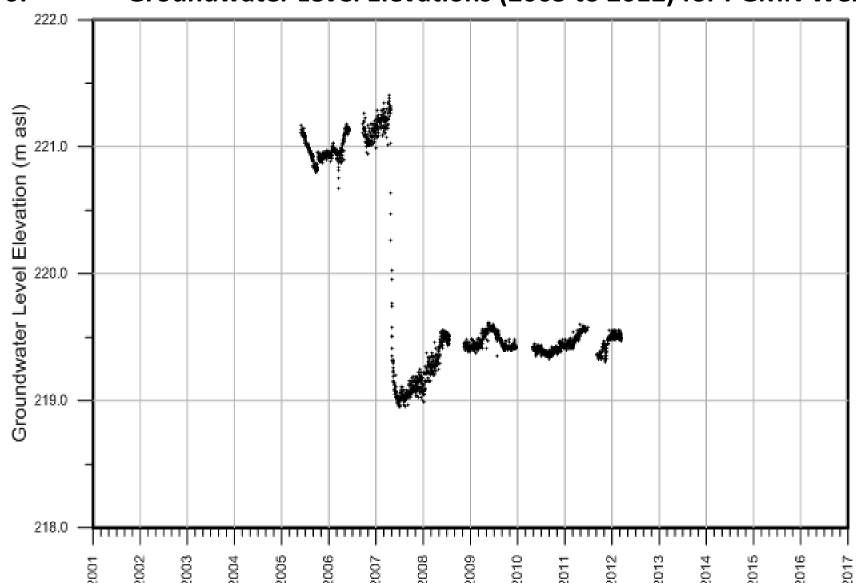
The data plot and trend analyses for the four overburden PGMN wells listed in Table 7-6 are provided as follows.

Text Figure 7-5: Groundwater Level Elevations (2005 to 2009) for PGMN Well W0000439-1



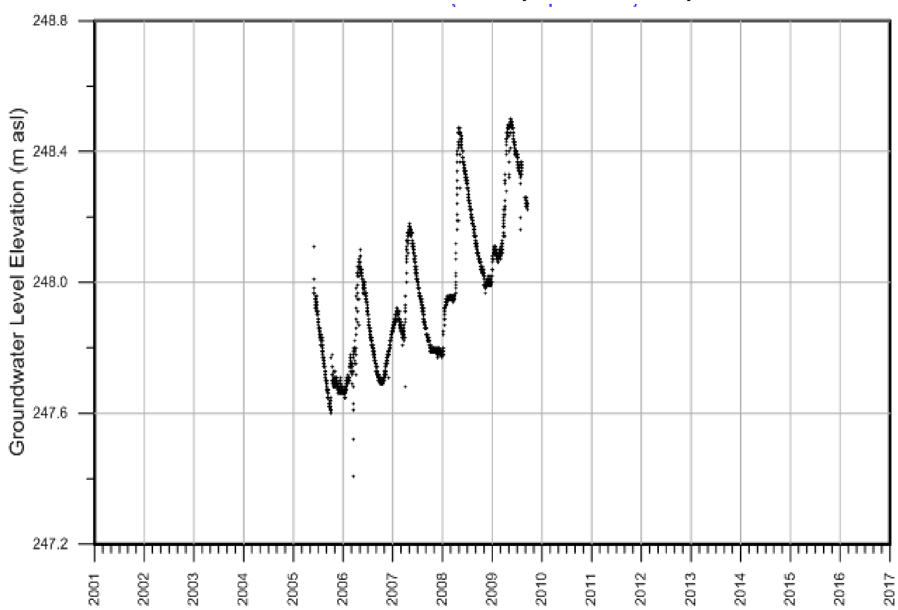
For PGMN well No. W0000439-1, the MK test (Year over year) did not detect a significant trend, using 4 years of data. The SK test (season over season) indicated an upward trend, based on 48 months of data. A visual analysis of the data, which is only current to end of 2008, indicates an approximate 1.0 m rise in groundwater level from mid-2006 to end of 2008.

Text Figure 7-6: Groundwater Level Elevations (2005 to 2012) for PGMN Well W0000439-1



For PGMN well No. W0000440-1, the MK test (year over year) did not detect a significant trend. The SK test (season to season) also did not detect a significant trend. A visual analysis of the data, which is only current to early 2012, indicates generally consistent groundwater levels from 2008 to 2012, with a seasonal fluctuation of <0.5 m.

Text Figure 7-7: Groundwater Level Elevations (2005 to 2010) for PGMN Well W0000442-1



For PGMN well No. W0000442-1, the MK test (year over year) detected an upward trend. The SK test (season to season) also indicated an upward trend. A visual analysis of the data, which is only current to late 2009, indicates an approximate 0.4 m rise in seasonal groundwater levels from 2005 to late 2009.

Based on the PGMN data trend analyses provided by MECP, and visual analysis of data plots, no downward data trends were identified for the 3 PGMN wells. Therefore, the water level data collected do not provide any indications of reduced availability of groundwater, though no data is provided beyond 2012.

7.4.3 Ontario Low Water Response (OLWR) Program

The OLWR program was initiated in 2000 and is managed by the Ministry of Natural Resources and Forestry (MNRF). The program relies on the use of real time surface water monitoring data collected through the Surface Water Monitoring Centre and utilizing the Water Survey of Canada (WSC) stream gauge (HYDAT) station network to identify potential drought conditions based on set trigger levels. Presently, static groundwater level elevation data from the PGMN program is not a component of the OLWR program. Reportedly, this may be added to the program in future.

OLWR notifications are typically (i.e. not always) released in the last week of each month after a review of data for the previous weeks in the month. When trigger levels are identified for a monitoring station, the OLWR submits a notification to the respective CA or municipality. Based on its review of the OLWR data that accompanies the notification, combined with a review of local factors that include recent precipitation and reports of water shortfalls for surface water and well water supplies a Low Water Conditions Alert 'may' be posted by the CA/municipality. A CA or municipality may also choose to post an Alert without any OLWR notification. Decreases in water takings that are triggered by the declaration of Level 1, 2 and 3 Low Water Condition are as follows:

- Level 1 - A voluntary reduction of 10%
- Level 2 – A voluntary reduction of 10%, to achieve a 20% reduction;
- Level 3 – Reduce and manage water use demands to the maximum extent through regulatory measures, if required.

Note: Specific Permits to Take Water may have conditions requiring mandatory reductions of water takings during low water events. Upon renewal of their water bottling permit, the above decreases will be mandatory based on 3-month average actual flow as outlined in the guidance for bottled water renewals (MOECC, 2017).

The frequency of OLWR notifications over time can be a potential indicator of climate stress trends for surface water (and possibly shallow groundwater where directly connected to surface water), and an indicator of watershed/subwatersheds that are sensitive to seasonal drought conditions. However, the existing OLWR program database has not been prepared for this purpose, has inconsistencies that are attributed to different persons updating the database over the years, and the database does not provide notification Levels during the time period where a Low Water Alert has been declared by a CA/municipality. This is only indicated in the database as an 'Update'. Consequently, only a general review of the information in the OLWR database is provided herein for the geographic CA/municipality relevant to the Site.

A review of the OLWR database indicates that a total of 23 Level 1 notifications and two Level 2 notifications were sent to the Nottawasaga Valley CA between 2000 and August 2018. Notifications were issued to the CA in 10 out of 19 years. Of note, Low Water Alerts were declared by the CA in 2005 and 2007 and there were no notification levels issued for these years (just 'Updates' during the Alerts). More than one notification was issued in the same calendar year: in 2002 (3 Level 1 notifications for September to November), 2003 (3 Level 1 notifications for June to August), 2006 (3 Level 1 notifications for June to August), 2010 (4 Level 1 notifications for January to April), 2012 (3 Level 1 notifications between March and June), 2015 (3 Level 1 notifications from March to May), and 2016 (3 notifications, including two Level 2 notifications from July to September). Between 2000 and August 2018, the Nottawasaga Valley CA posted a Level 1 Low Water Condition Alert for a cumulative total of approximately 25 months; Level 1 Alerts extending for more than 4 consecutive months occurred in 2001 (July to November), 2005 (August to December), 2007 (June to November) and 2016 (July to November). No Level 2 Low Water Condition Alerts have been declared by the CA. The OLWR notifications as presented in the reviewed database do not indicate any specific long term trends in the frequency of notifications issued to the CA. Both notifications and declared Alerts are most frequent in the late summer and fall months, though notifications were issued in the winter and spring months in 3 of 19 years.

7.4.4 Water Budget Analyses

A Tier 1 Water Budget and water quantity stress assessment of the Severn Sound watershed was completed by Earthfx, 2010. The Tier 1 water budget expands on the findings of a conceptual water budget by calculating water budgets at smaller spatial scales and by assigning water quantity stress levels to each subwatershed in the study area. The Tier 1 Water Budget estimates how much water exists in a subwatershed over a period of time, usually monthly and yearly. It accounts for water that is being added to a watershed, such as precipitation and removed (e.g. rivers flowing out) from a watershed. Stress levels for surface water and groundwater are calculated based on the net water balance and compared to threshold stress values set by the province.

The Severn Sound watershed was divided into 19 subwatersheds or hydrologic units for the purposes of the Tier 1 assessment. Separate assessments were completed for the two subwatersheds located within the WBSA, North River subwatershed and Coldwater River subwatershed. At the Tier 1 level two scenarios are evaluated for each subwatershed: 1) existing conditions; and 2) future demand. The goal of the existing conditions scenario is to identify subwatersheds that are under stress as a result of existing water takings. Whereas the goal of the future demand scenario is to identify additional subwatersheds that may become stressed as a result of increased municipal water supply demand requirements. Based on the results of the groundwater stress assessment under existing conditions and for future demand, both the North River subwatershed and the Coldwater River subwatershed had quantity stress assignments that were low. The surface water stress assessment indicated low stress for the Coldwater River subwatershed for all months and an elevated (moderate) stress value for the North River subwatershed during the month of June. The elevated value was attributed to 'low available supply values' used in the calculations, inferred to mean there was limited available data for the model. A Tier 2 assessment was not recommended for the North River subwatershed.

7.5 Impact Assessment

The following section provides a general assessment of potential water quantity interference with other groundwater uses and the environment.

7.5.1 Municipal Groundwater Use

As indicated previously herein, there are 13 separate water systems under municipal control within the Township of Oro-Medonte. The review of active PTTWs (Section 7.4.1) identified 3 municipal well water supply systems within a 5 km radius of the Gold Mountain Springs Inc. well field as indicated on Figure 7-2. At an approximate 1 km distance from the Gold Mountain Springs well field, the Braestone residential development production wells are considered the only system wells within the assessed zone of influence (±1 km radius) of the Gold Mountain Springs Inc. well field (Wilson, 1994). As discussed in Section 7.3.4.3, one of the Braestone production wells was used as an observation well in the 1994 testing program for Gold Mountain Springs Inc. Well #1 and in the 1998 testing program for Well 2. The Braestone production wells are completed to a similar depth and are screened within the same aquifer as the Gold Mountain Springs Inc. production wells (i.e. Aquifer 3). After pumping Well 1 for 72–hours at 946 L/minute, a drawdown of 0.435 m was measured at the Braestone production/test well which is located approximately 1050 m northwest of Well #1. The measured well interference with the Braestone production/test well was considered acceptable in relation to the available drawdown for wells completed in Aquifer 3 (±75 m). The two other municipal water supply systems within 5 km of the Site are too distant for cumulative impacts from multiple water takings to be considered significant.

In summary, the general assessment of potential water quantity interference with existing or planned municipal water supply systems did not identify any potential for unacceptable well interference and/or impediment to future expansion of existing municipal groundwater systems.

7.5.2 Well Interference Potential

The two nearest domestic wells to the Site are the Ball dug well (430 m to the southeast) and the Pryde dug well (530 m to the northwest). Both wells were monitored for potential well interference effects during the 1994 aquifer testing program for Well #1 (Wilson, 1994) and the 1998 aquifer testing program for Well #2 (Wilson, 1998). Both wells showed no measurable well interference impact during both aquifer testing programs. Quarterly off-site water level monitoring at the Pryde dug well was completed from approximately 1999 to 2008. The 2008 and 2009 annual monitoring reports were not provided in the files for review. It is inferred that Gold Mountain Springs Inc. discontinued monitoring as the operation of the production wells (drawing water from Aquifer 3) had no measurable impact on the Pryde dug well (completed in Aquifer 1).

The Wilson, 2017 report concludes that based on findings from past aquifer testing programs and past groundwater level monitoring programs at the Site, Aquifer 3 is not hydraulically connected to Aquifer 1 and Aquifer 2. Consequently, the pumping of the production wells poses no risk to local wells completed within these aquifers. Wilson, 2017 also indicates that all known off-site wells completed in Aquifer 3 are more than 1 km from the Gold Mountain Springs Inc. production wells. Wilson, 2017 recommends that a future monitoring program consisting of the automated measurement of water levels in Aquifers 1, 2, and 3 in the on-site multilevel monitoring well be continued as a requirement of the PTTW renewal. The continuation of water level monitoring would provide both Gold Mountain Springs Inc. and the ministry the basis for determining whether any received water interference complaints are valid and would warrant further assessment by a Qualified Person. BluMetric is in agreement with this approach as the continued water level monitoring provides a measure of security in assessing the cumulative impacts from all PTTW water takings in Aquifer 3 over time and ensuring the long term sustainability of the groundwater resource.

Based on the findings from the information review, Gold Mountain's continued water takings at the current permitted water taking rates are not expected to cause an unacceptable level of interference with neighbouring well water supplies.

7.5.3 Impact to Surface Water and Natural Functions of the Ecosystem

A surface water stream is reported to be present in the north end of the Site (approximately 400 m north of the production wells) and flows to the northeast as a tributary of Base Lake. Though an on-Site surface water station is indicated on Figure 2 of the Wilson, 2008 report, there are no photographs of the stream location. Also, no surface water feature is evident for this Site location based on current Google aerial photo imagery. Quarterly stream flow monitoring was completed from approximately 1999 to 2008. The last available data is provided in the Wilson, 2008 annual monitoring report for the 2007 monitoring year, indicating low stream flow rates that range from 59 to 359 L/minute.

Wilson, 2017 indicates that the nearest surface water to the Gold Mountain Springs Inc. production wells receives topographic discharge from Aquifer 1. Since past water level monitoring programs for wells completed in Aquifer 1 (off-site dug wells and on-site multilevel well) have shown no measurable impact from the withdrawal of water from the production wells, which are completed in Aquifer 3, there is no risk for impact to nearby surface water. It is apparent based on the ministry file review that that no ecosystem studies for the Bass Lake tributary have been requested from the Permit Holder by the ministry based on monitoring programs showing no evidence of any quantity or quality impacts to the creek.

Based on the findings from the information review, continued water takings at the current permitted water taking rates are not expected to impact surface water and natural functions of the ecosystem.

7.6 Sustainability of Water Resources

Water resources are considered sustainable if the total amount of water entering, leaving, and being stored in the system meet existing needs without compromising the ability to meet the needs in the future. Typical indicators used to assess the sustainability of water quantity include Water Budgets completed at the watershed/subwatershed scale and/or for the specific water taking(s) and the evaluation of water level data for trends over time to ensure resources are remaining in a steady state. The following provides a general assessment of the sustainability of regional water resources and of the potential impact from the Mountain Springs Inc. water taking, now and in the future.

Regional Water Resources

The characterization of the regional study area indicates that the Gold Mountain Springs Inc. Site is located in the North River subwatershed. Both the North River subwatershed and the Coldwater River subwatershed are located within the regional study area. The groundwater stress potential for both subwatersheds was categorized as Low based on the completed Tier 1 Water Budget analyses (Earthfx, 2010). The results of the groundwater stress assessment considered existing conditions and future demand. The surface water stress assessment indicated a low stress potential for the Coldwater River subwatershed for all months and an elevated (moderate) stress potential value for the North River subwatershed during the month of June, but this was attributed to the limited supply values available for the calculations and a Tier 2 assessment was not recommended. The population growth forecast for the Township of Oro-Medonte indicates a 25% increase in population by 2031. Population growth for the Township is to be focused on existing settlement areas where groundwater is identified as a primary source for water supply. The various existing municipal groundwater systems are generally far apart throughout the geographic area of the Township. Consequently, stresses presented by existing and future demand are not an identified concern for the sustainability of water resources within the regional study area.

The OLWR Program uses real time surface water monitoring data collected from the WSC stream gauge (HYDAT) station network to identify potential drought conditions based on set trigger levels. BluMetric's review of the OLWR Program notification data (2000 to August 2018) for the Nottawasaga Valley CA did not identify any specific trends indicating the depletion in the availability of surface water (and possibly shallow groundwater where directly connected to surface water) resources. The issuance of multiple Level 1 Low Water Condition Alerts by the CA and Level 1 and Level 2 Notifications under the OLWR program indicates the region is susceptible to seasonal low water conditions for surface water.

BluMetric's review of PGMN groundwater level data for 3 overburden wells located within 10 km of the Gold Mountain Springs Inc. water taking did not identify any trends indicating a potential reduction in the availability of regional groundwater resources.

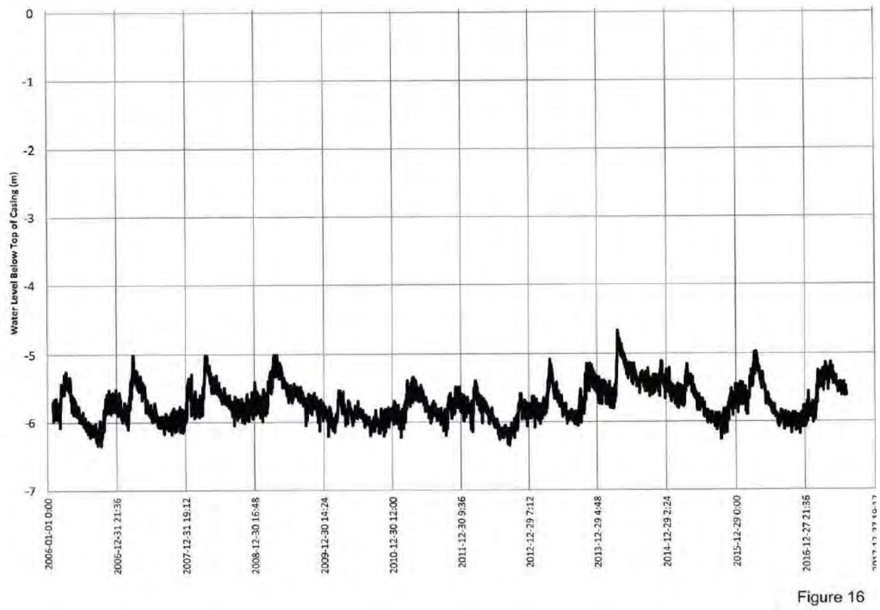
In summary, based on the information reviewed, no stress concerns were identified for the sustainability of regional groundwater quantity resources, though seasonal stress was identified as a potential concern for surface water quantity resources.

Gold Mountain Springs Inc. Water Taking

Historical information relating to the Gold Mountain Springs Inc. Site indicates it has been permitted for water bottling since 1994. The current PTTW maximum water taking limits from all sources, 872.64 m^3/day, has remained unchanged since 1994. Aquifer testing programs for the Gold Mountain Springs Inc. production wells indicate the presence of a high yield deep overburden aquifer source (Aquifer 3) which has ±75 m of available drawdown. The reported annual water taking amounts for the Gold Mountain Springs Inc. Site reached a peak of 22% of the PTTW annual taking limit in 2012 and has ranged from 9% to 11% of the annual taking limit over the past four reporting years.

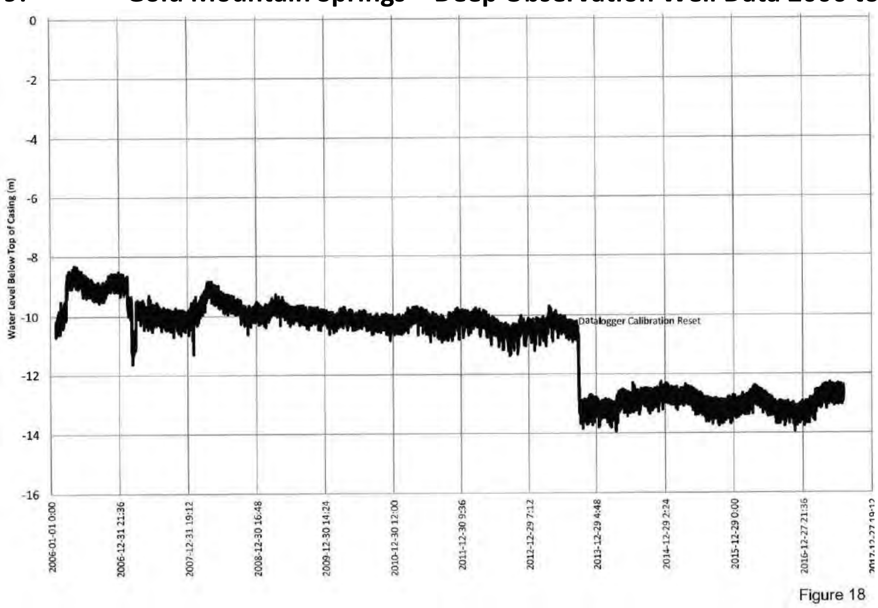
Comprehensive water level monitoring for the Gold Mountain Springs Inc. Site was undertaken as a condition of the Permit from 2004 to 2014. The 2014 annual monitoring report did not identify any adverse impact from the water taking. No downward trends for well water levels have been apparent for the three aquifer zones identified at the Site and no well interference complaints for neighbouring well water supplies have been documented. Hydrographs depicting the water level trends between 2006 and 2016 for the shallow (Aquifer 1) and deep (Aquifer 3) monitoring wells on the Site (from Wilson, 2017) indicate stable groundwater level conditions. These hydrographs are reproduced below.

Text Figure 7-8: Gold Mountain Springs – Shallow Observation Well Data 2006 to August 2017



Source: Figure 16 of Wilson, 2018

Text Figure 7-9: Gold Mountain Springs – Deep Observation Well Data 2006 to August 2017



Source: Figure 18 of Wilson, 2018

Though surface water stress has been indicated as a moderate concern for seasonal stress in the watershed (i.e., month of June), the monitoring completed for the Site indicates no hydraulic connection between the water taking aquifer (Aquifer 3) and nearby surface water.

A review of the WTRS database identified a high volume water taking for Aquifer 3 located approximately 1,050 m from the Gold Mountain Springs Inc. well field. However, based on the available drawdown in Aquifer 3 (±75 m), there is no identified risk to the sustainability of the groundwater resources from Aquifer 3.

The current Permit for the Gold Mountain Springs Inc. water taking (PTTW No. 3122-9ZCQRS) does not contain any groundwater monitoring requirements. Re-introduction of a monitoring program using the already automated measurement system for the on-site multilevel monitoring well was recommended by Wilson (2017) as a requirement of the PTTW renewal. This is also a recommended requirement in the MECP's "Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to Take Water Applications and Hydrogeological Study Requirements, April 2017". Since the reported annual water taking has not exceeded 22% of the PTTW limit and the future impact from climate change cannot be accurately predicted, it is BluMetric's opinion that the implementation of a groundwater monitoring requirement under the PTTW provides a measure of security in ensuring the water resource remains sustainable.

Based on the information reviewed, there are no indicators of the Gold Mountain Springs Inc. water taking having an impact on the sustainability of existing and future water resources. Consequently, it is BluMetric's opinion that the water taking is being managed sustainably. The implementation of a groundwater monitoring requirement under the PTTW is recommended by BluMetric as a measure of security in ensuring the groundwater resource utilized by the water taking remains sustainable in the future.

7.7 GAPS AND RECOMMENDATIONS

A summary of the gaps identified in the water quantity information for the Site and recommended action(s) to address each gap is provided as follows:

1. No gaps in the science that has been used in characterization of the Site was identified.
2. As recommended by Wilson, 2017, re-implementation of an on-site groundwater monitoring program for the three overburden aquifers located at the Site (using the multi-level monitoring well) and the two production wells is considered warranted. Continued water level monitoring will provide a measure of security in ensuring the long term sustainability of the groundwater resource.

7.8 FIGURES

Figures are provided in Appendix A-Main Figures

8. ROBINS HOLDINGS INC. – ALNWICK/HALDIMAND

8.1 BACKGROUND AND HISTORY

Robins Holdings Inc. is permitted for drawing water from three wells (MV-1, MV-3 and Restaurant Well) located at Lot 30, Concession 5, Haldimand Ward Alnwick/Haldimand, County of Northumberland, herein referred to as the 'Site'. The Site consists of three adjoined land parcels historically owned by various members of the Robins family. Wells MV-1, MV-2 (multilevel observation well) and MV-3 are located on the southernmost parcel (the largest parcel). The Restaurant Well is located on the neighbouring parcel to the northwest. Under the current Permit to Take Water (PTTW) (No. 2305-6TDH43), well MV-1 is indicated as the only source being used for bottled water. The Robins Holdings Inc. water source locations (MV-1, MV-3, and Restaurant Well) and observation well MV-2 are indicated on Figure 8-1. The Site is located within the jurisdictions of the Ontario Ministry of Environment, Conservation and Parks (MECP) Peterborough District Office (Kingston Regional Office) and the Ganaraska Region Conservation Authority.

Before 1998, the Restaurant Well and spring was used to supply a restaurant business and ice packaging business with a water taking quantity of below 50,000 L/day water (i.e. less than the permitting amount). In anticipation of growing the ice packaging business and entering into the bottled water market, wells MV-1, MV-2 and MV-3 were drilled and an application for a PTTW was submitted to the ministry in 1997. Based on the records provided by the ministry, the Site has been permitted for water taking for bottled water use since 1998. An approximate timeline of events relevant to the PTTW history of the Robins Holdings Inc. Site is provided as follows:

Table 8-1: Robins Holdings Inc. - PTTW History

YEAR	EVENT
1998	**PTTW No. 98-P-4044** is issued to Robin's Holdings Inc. on **April 29, 1998** and expires August 6, 2000. The Permit includes takings from three wells: - MV-1: 152 L/minute and 218,869 L/day (24 hour taking) - MV-3: 22.5 L/minute and 32,400 L/day (24 hour taking) - Restaurant well: 22.7 L/minute and 32,731 L/day (24 hour taking) Permit conditions/requirements include: • Record of daily water taking volumes for each source. • Monthly monitoring of Baltimore Creek tributary flow. • Static water levels of on-site wells and neighbouring wells within 500 m.
1999	**Renewal of PTTW No. 98-P-4044** is issued to Robins Holdings Inc. on **August 6, 1999** and expires on August 6, 2000. The Permit includes takings from three wells; MV-1, MV-3 and the Restaurant Well. Taking rates/volumes under the Permit are unchanged. The 'Condition' to install a flow meter and totalizer on the pumping systems of MV-1, MV-3 and the Restaurant Well has been added to the permit.

YEAR	EVENT
2002	**Renewal of PTTW No. 98-P-4044** is issued to Robins Holdings Inc. on **February 13, 2002** and expires February 11, 2004 for MV-1, MV-3 and the Restaurant Well. Taking rates/volumes under the Permit are unchanged. Installation of an automatic stage recorder at the Baltimore Creek tributary is required to monitor stream flow on a daily basis.
2004	**PTTW No. 1652-645RX7** was issued to Robins Holdings Inc. on **August 30, 2004** and expires on August 31, 2006. Taking rates/volumes under the Permit are unchanged. Sources MV-1 and MV-3 are indicated for use as 'Bottled Water'. Monitoring of static water levels and daily water takings of MV-3 and the Restaurant Well are no longer required. Monitoring of static water levels for all wells located within 300 m of MV-1 is required on a quarterly basis. Permit conditions/requirements include: At Taking Source MV-1: • Static water well level monitoring during operation on a monthly basis (Condition 4.1). • Recording of daily water taking volumes measured using a calibrated flow meter and flow totalizer (Condition 4.2). Groundwater Monitoring: • Quarterly static water level monitoring at private wells located within 300 m of well MV-1 with written permission. Monitoring required prior to the commencement of water taking and for a period of two years (Condition 4.3). Surface Water: • Daily monitoring of streamflow in the minor headwater tributary to Baltimore Creek using an automatic stage recorder at the stilling well location (Condition 4.4). Reporting: • Applications for renewal or amendment to the Permit require the submission of all data records collected under the Permit conditions with an analysis and interpretation done by a qualified hydrogeological consultant (Condition 4.5). Water Resources Management Measures (Triggers) • Complaints/Reported Impacts (Condition 5).
2006	The focus of the bottling plant is reported to have changed from 'high volume case-goods production to lower volume, value-added products'. • **PTTW No. 2305-6TDH43** is issued to Robins Holdings Inc. on **October 18, 2006** and expires on September 30, 2016. The specified taking purposes for the wells are as follows: MV-1 – bottled water, MV-3 – miscellaneous, Restaurant Well – commercial. Taking rates/volumes under the Permit are unchanged.
2016	Renewal of PTTW No. 2305-6TDH43 application submitted by Robins Holdings Inc. on September 22, 2016. Acknowledgement letter from the Ministry (April 6, 2017) states that pursuant to Section 34.1(6) of the Ontario Water Resources Act, the permit is deemed to continue to be in force until the date a decision is made on the permit renewal application while permit is under review.

File information indicates that Robins Holdings Inc. is presently drawing water from a single production well (MV-1) to produce bottled water while permitted wells MV-3 and the Restaurant Well are not used for bottled water. All three wells are drilled overburden wells constructed in 1986 (Restaurant Well), and 1997 (MV-1 and MV-3). Well construction information along with current permitted water taking limits (PTTW No. 2305-6TDH43) is provided in Table 8-2. The relative location of each well is shown on Figure 8-1.

Table 8-2: Robins Holdings Inc. - Summary of Water Taking Sources

Source Name	Type	Well Record ID	Total Well Depth	Completion Unit	Well Screen Interval	Taking Specific Purpose	PTTW No. 2305-6TDH43	
							Max. Taken Per Minute (L)	Max. Taken Per Day (m^3)
MV-1	Drilled Well (200 mm Diameter)	4511086	22.6 m (74 ft)	Sand / Gravel	18.9 m - 22.6 m (62 - 74 ft)	Bottled Water	152	218.869
MV-3	Drilled Well (300 mm Diameter)	4511259	5.2 m (17 ft)	Gravel	3.75 - 4.97m (12.3 - 16.3 ft)	Other-Miscell.	23	32.400
Rest. Well	Drilled Well (150 mm Diameter)	4506314	18.3 m (60 ft)	Sand with gravel	14.3 - 15.55 m (47 - 51 ft)	Restaurant / Business	23	32.731

As indicated in Table 8-2 the source wells range in depth from 5.2 to 22.6 m. The water well screens intersect gravel and/or sand and water-bearing zones are reported in the well records as ranging from 3.75 m to 22.6 m depth. Water is pumped from MV-1 using a submersible pump to the bottling plant located at the Site via underground pipes and is made into ice or packaged into containers ranging from 500 mL to 19 L in size. Reportedly, no bulk water takings were taken at the time of the PTTW renewal submission in September 2016. MV-3 is a demonstration well without a pump used for monitoring and sampling purposes and has never been utilized for production purposes. No water meter has been installed. The Restaurant Well supplies water to a small rural restaurant on the neighbouring property. Observation Well MV-2, used to provide water level data for the supply aquifer, is also located on Site (located 3.9 m from MV-1) and is constructed as a two-level nested piezometer completed to 8.1 m (MV-$2_{shallow}$) and 20.3 m (MV-2_{deep}) depth.

8.2 PRIMARY INFORMATION SOURCES

The following key technical documents were identified in the files provided by the ministry and are summarized and referenced herein:

- Hydrogeological Investigation, Permit to Take Water Application: Part of Lot 30, Con V Township of Haldimand Northumberland County, Oakridge Environmental Ltd., October 1997 (ORE, 1997).
- Application for Permit to Take Water - 98-P-4044 Robins Holding Ltd., Letter from the Ganaraska Region Conservation Authority to the Ministry of the Environment, December 11, 2000 (GRCA, 2000).
- Request for Renewal of Permit to Take Water and Compliance Monitoring Report, PTTW 98-P-4044, Oakridge Environmental Ltd., August 3, 2000 (ORE, 2000).
- Compliance Monitoring Program Results, Application to Renew, PTTW 98-P-4044, Oakridge Environmental Ltd., January 9, 2004 (ORE, 2004).

- Compliance Monitoring Program Results, Application to Renew, PTTW 1652-645RX7, Oakridge Environmental Ltd., August 8, 2006 (ORE, 2006).
- Application for Approval of Permit to Take Water, Commercial & Miscellaneous – MV-1, MV-3, Restaurant, 8104-AE3HTY, Oakridge Environmental Ltd., September 22, 2016. (ORE, 2016).
- MOECC Letter Re: Application for Approval of Permit to Take Water, Commercial & Miscellaneous – MV-1, MV-3, Restaurant, Township of Alnwick/Haldimand, County of Northumberland, Reference Number 8104-AE3TY, September 28, 2016. (MOECC, September 2016).

Other information sources used in this assessment included:

- Report - Township of Alnwick-Haldimand part of Municipal Groundwater Study for the Trent Conservation Coalition File No.: 210-021, Morrison Environmental Limited, April 2004 (MEL, 2004).
- Official Plan of the Township of Alnwick/Haldimand Schedule 'A-1' Oak Ridges Moraine Land Use Plan (Former Township of Haldimand), May 28, 2015 (TAH, 2015) Available at: https://www.alnwickhaldimand.ca/content/official-plan
- Oak Ridges Moraine Conservation Plan Land Use Designation Map, Map 10 – Townships of Alnwick-Haldimand & Cramahe, Municipality of Trent Hills. Ministry of Municipal Affairs, Ministry of Natural Resources and Forestry and the Ministry of Agriculture, Food and Rural Affairs, May 5, 2017 (MMA et al, 2017).
- Ganaraska Source Protection Plan. Trent Conservation Coalition Source Protection Committee, March 7, 2018 (GSPP, 2018).
- Trent Conservation Coalition Source Protection Committee. Approved Ganaraska Assessment Report, March 7, 2018 (TCCSPC, 2018).
- Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228. Chapman, L.J. and Putnam, D.F. 2007. (Chapman and Putnam, 2007).
    - Surficial Geology of Ontario; MNDM File - MRD128-REV. Ontario Geological Survey, 2010. (OGS, 2010).
- Bedrock Geology of Ontario; MNDM File - MRD126-REV1. Ontario Geological Survey, 2011. (OGS, 2011).
- Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to Take Water Applications and Hydrogeological Study Requirements. Ministry of Environment and Climate Change. April 2017. (MOECC, 2017).
- Groundwater Levels in Ontario: A Trends Analysis using the Provincial Groundwater Monitoring Network. Ministry of Environment, Conservation and Parks, Southwestern Region. 2018 pending. (MECP, 2018).
- Ministry of Natural Resources and Forestry Natural Heritage Areas online mapping tool. Available at https://www.ontario.ca/page/make-natural-heritage-area-map

- MECP Water Well Information System (WWIS). Available at: https://www.ontario.ca/environment-and-energy/map-well-records.
- MECP on-line Provincial Groundwater Monitoring Network database. Available at: https://www.ontario.ca/environment-and-energy/map-provincial-groundwater-monitoring-network.
- MECP on-line Permit to Take Water database. Available at https://www.ontario.ca/environment-and-energy/map-permits-take-water.
- MECP Water Taking Reporting System (WTRS) database (Confidential – Used with Permission from MECP).
- Ontario Low Water Response Program (OLWR) notifications and alert levels for Lower Trent Conservation Authority (2000 to 2018 data from MNRF).

Information sources referenced in other documentation but not provided in MECP files:

- Compliance Monitoring Program Results Report for the 2016 PTTW Application to Renew – Note: as reported by the MECP, the monitoring data that was to be provided with this application is not on file with the MECP. As a result of the Water Bottling Moratorium, this application has not been through the regulatory review process and monitoring data has not been requested.

8.3 CHARACTERIZATION OF STUDY AREA

This section provides a general characterization of the Robins Holdings Inc. Site and associated study area. Figure 8-2 presents the assessed regional study area which covers an approximate 30 km by 30 km area centred at the Robins Holdings Inc. source well location (Figure 8-1). The study area boundaries were set based on an area that captures the Oak Ridges Moraine Complex to the north and the nearest municipal groundwater supply systems located at Grafton to the southeast and the Hamilton Township communal well system located near Baltimore to the southwest. The majority of the study area falls within the boundaries of the Lower Trent Conservation Area (CA), though the Robins Holdings Inc. well field is located within the Ganaraska Region CA.

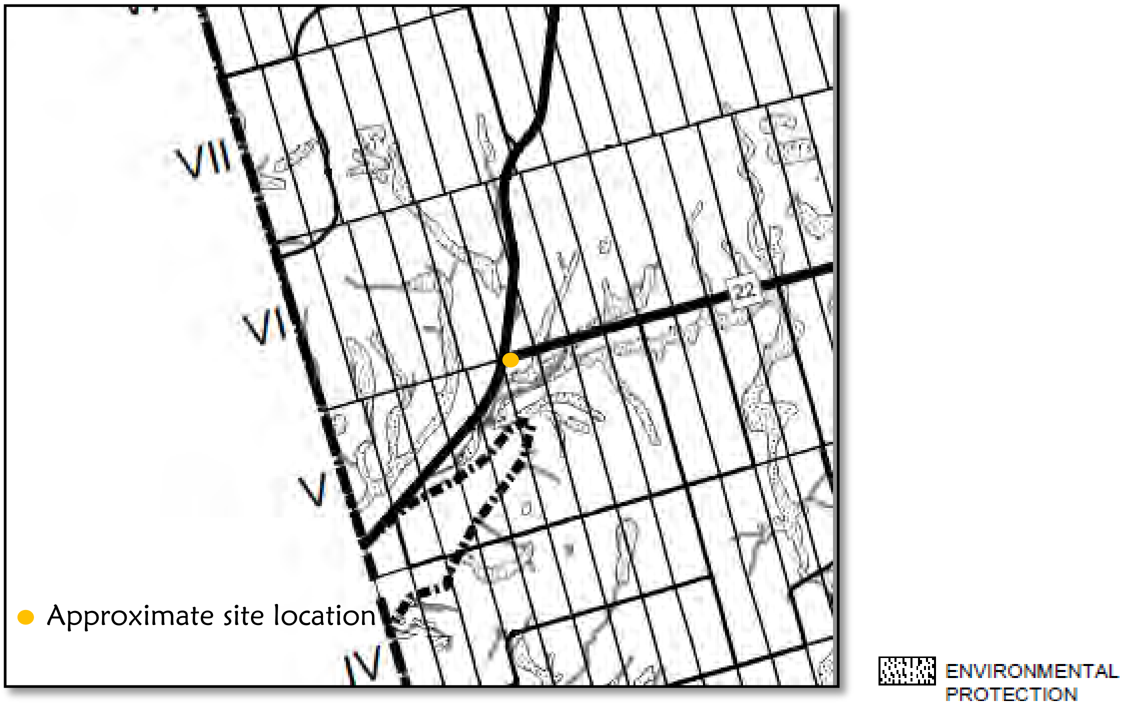
8.3.1 Land Use Setting

The Robins Holdings Inc. Site is located in the Township of Alnwick/Haldimand which had a 2011 census population of 6,617 (Statistics Canada, 2011 Census). The proposed population growth allocation for the Township for the years 2011 to 2034 is 887 persons (Official Plan of the Township of Alnwick/Haldimand, By-Law No. 50-2015 and dated May 28, 2015). The residential growth policies of the Official Plan focus on growth in Hamlet areas such as the community of Grafton.

The Oak Ridges Moraine Conservation Plan (ORMCP) established in 2001, sets development restrictions on properties located within the 'Moraine' under four land use designations: Natural Core Areas, Natural Linkage Areas, Countryside Areas and Settlement Areas. Since the Robins Holdings Inc. Site is located within a Natural Core Area of the Oak Ridges Moraine Boundary, development is limited to 'existing uses' and 'very restricted new resource management'. Development in these areas is not allowed to adversely affect the local natural heritage and hydrologically sensitive features. Neighbouring properties to the north and west are designated as Natural Core Areas and properties to the east and south are generally Countryside Areas – Agricultural with occasional Natural Linkage Areas (MMA et al, 2017). Land use within an approximate 4 km by 4 km area centred on the Robins Holding Ltd. Site as obtained from the Official Plan of the Township of Alnwick/Haldimand is indicated on Figure 8-3.

As indicated in the aerial photography included in Figure 8-1, local land use is generally agricultural while land cover in undeveloped areas is generally woodland or wetland. As shown in Schedule A-1 of the Alnwick/Haldimand Official Plan, areas designated as Environmental Protection extend on to the Site (TAH, 2015). The Ministry of Natural Resources and Forestry online mapping tool (MNRF, 2014) indicates a non-Provincially Significant Wetland complex located immediately to the east and south of the Site in the vicinity of the Baltimore Creek tributary. As stated in a letter from the Ganaraska Region CA to the Ministry of the Environment dated December 11, 2000, the Robins Holding production well MV-1 appears to be located outside of the environmental protection area while the observation well MV-3 appears to be located inside the wetland area without any development around it. The letter mentions that there are discrepancies in the actual defined wetland boundaries (GRCA, 2000). The local areas mapped as Environmental Protection as shown in Schedule A-1 of the Alnwick/Haldimand Official Plan (TAH, 2015) is reproduced below.

Text Figure 8-1: Robins Holdings Inc. - Environmental Protection Areas



Source: Alnwick/Haldimand Official Plan Schedule A-1 (TAH, 2015)

8.3.2 Physiographic Setting

The physiography of the regional study area as described by Chapman and Putnam, 2007 is provided in Figure 8-4. The entire area to the north of the Robins Holdings Inc. production well is mapped as kame moraines forming the Oak Ridges Moraine. The Dummer Moraine Physiographic Region consisting of drumlinized till plains is located to the south of the Robins Holdings Inc. production well. Drumlins are located to the southeast of the Site which is located near the boundary of the South Slope / Dummer Moraine physiographic region and the Oak Ridges Moraine (ORE, 1997).

The regional topography and hydrology of the regional study area is provided in Figure 8-5. The Robins Holdings Inc. Site is located in a low-lying area with the terrain rising to the north, east and west. In general, regional topography slopes to the southwest toward Lake Ontario. The bedrock elevation at the Oak Ridges Moraine lies at approximately 160 to 200 m asl and approximately 50 to 80 m asl at the shores of Lake Ontario (TCCSPR, 2018).

The Robins Holdings Inc. Site is located within the jurisdictional area of the Ganaraska Region Conservation Authority (CA). The Site itself is mapped within the Cobourg Creek watershed, which drains into Lake Ontario. The northern limit of the Cobourg Creek watershed is located approximately 3 km north of the Site. A tributary of Baltimore Creek is located on the east side of the Site (Figure 8-1), and flows in a southwest direction where it feeds into Baltimore Creek. Baltimore Creek is located on the west side of County Road 45, approximately 275 m west of production well MV-1. Baltimore Creek flows southwest until connecting with Cobourg Brook which drains into Lake Ontario, situated approximately 11 km to the south of the Robins Holdings Inc. production well. As indicated on Figure 8-5 the regional drainage for surface drainage features is towards the southwest.

There are four Water Survey of Canada (WSC) stream gauge (HYDAT) stations located within the Cobourg Creek watershed and their locations are shown on Figure 8-2. Station 02HD020 is located on Baltimore Creek approximately 6 km to the southwest of the Robins Holdings Inc. Site Stations 02HD022; 02HD019 and 02HD015 are located more than 12 km to the southwest of the Site. No identified WSC gauge is located upstream of the Site. A stilling well equipped with an automatic stage recorder is located in the minor headwater tributary of Baltimore Creek located to the east of the Site (Figure 8-1) to monitor the water levels of the tributary (Condition 4.3 of PTTW No. 2305-6TDH43). Stream water level monitoring data is recorded on a daily basis and is provided to the ministry with any permit renewal or amendment application.

8.3.3 Geologic Setting

Information on surficial geology and bedrock geology in the Cobourg Creek watershed was obtained from the following Ontario Geological Survey data: Surficial Geology of Ontario, MNDM File - MRD128-REV (OGS, 2010) and Bedrock Geology of Ontario, MNDM File - MRD126-REV1 (OGS, 2011). Surficial geology for the study area is mapped in Figure 8-6 and bedrock geology is mapped in Figure 8-7. The Township of Alnwick/Haldimand is covered by thick drift deposits overtop of Paleozoic bedrock which is inferred to be relatively flat-lying (MEL, 2004).

Surficial geology in the study area is dominated by a mixture of modern alluvial deposits, glaciofluvial deposits and foreshore-basinal deposits. These areas are bounded by stone-poor, carbonate-derived silty to sandy till to the west and southeast. The presence of this till near ground surface is generally associated with the higher elevation 'drumlinized' areas. To the north, these areas are bounded by ice-contact stratified deposits. Soil texture conditions are highly variable within the till with frequent thin layers of sand and/or gravel between low permeability layers consisting of clay and silty clay.

As indicated in Section 8.3.4.2, water well records show that overburden thickness over bedrock for the study area is greater than 79 m. As stated in the report, the overburden at the Site consists of silt and clay till over sands and gravels that are layered with fine clay seams followed by a dense clay horizon.

As indicated in Figure 8-7 the bedrock geology for the entire study area has been mapped as limestone, dolostone, shale, arkose, sandstone of the Ottawa Group / Simcoe Group; Shadow Lake Formation now considered as Upper Ordovician in age. With the significant depth to bedrock, the limestone is generally not utilized as an aggregate resource in the study area.

8.3.4 Hydrogeologic Setting

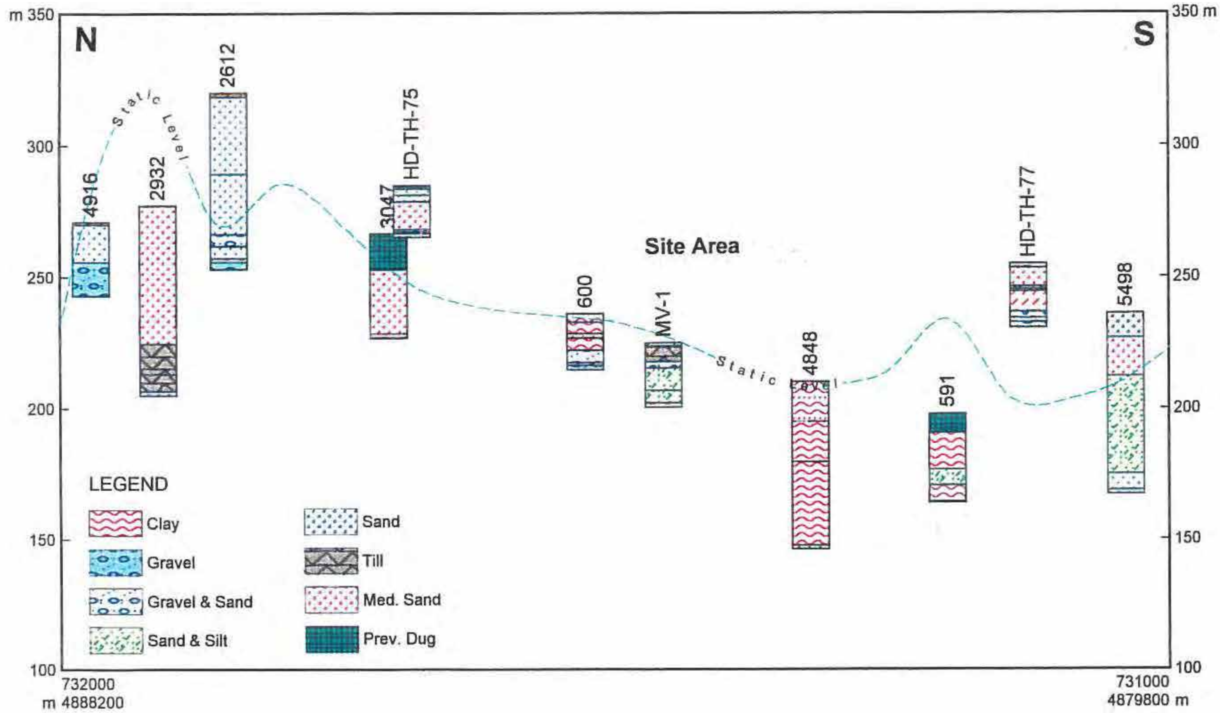
8.3.4.1 Regional Hydrogeology

The regional hydrogeology and aquifers are described in the 'Approved Ganaraska Assessment Report' (TCCSPR, 2018) which draws from the 2004 regional groundwater study completed by Morrison Environmental Ltd. (MEL, 2004).

Groundwater flow within the Cobourg Creek watershed originates from the Oak Ridges Moraine flowing south towards Lake Ontario. In some local areas, there is an inferred westerly component to the groundwater flow. The varying depths and types of unconsolidated glacier sediments greatly influence groundwater flow. The Quaternary overburden aquifer provides the greatest volume of groundwater storage (compared to the Paleozoic bedrock aquifers) in the watershed, since overburden deposits are typically able to store more water than fractured bedrock.

Primary recharge areas in the study area include the crests of moraines, drumlins, and other glacial deposits. The glacial and moraine deposits were estimated to have a recharge rate of 250 to 350 mm/year at the Oak Ridges Moraine while the South Slope till plains and the clays and silts were estimated to have a recharge rate of 100 mm/year (MEL, 2004). The variability in the overburden material is presented in the cross section presented in the hydrogeological report prepared by Oakridge Environmental Ltd. in October 1997. The cross section extends north and south, approximately 4 km in either direction, through the Robins Holdings Inc. Site and is based on a review of 49 well records in the vicinity of the line of section. In general, the water table is interpreted as following surface topography. The north-south cross section is reproduced as follows:

Text Figure 8-2: Robins Holdings Inc. - North-South Site Cross Section



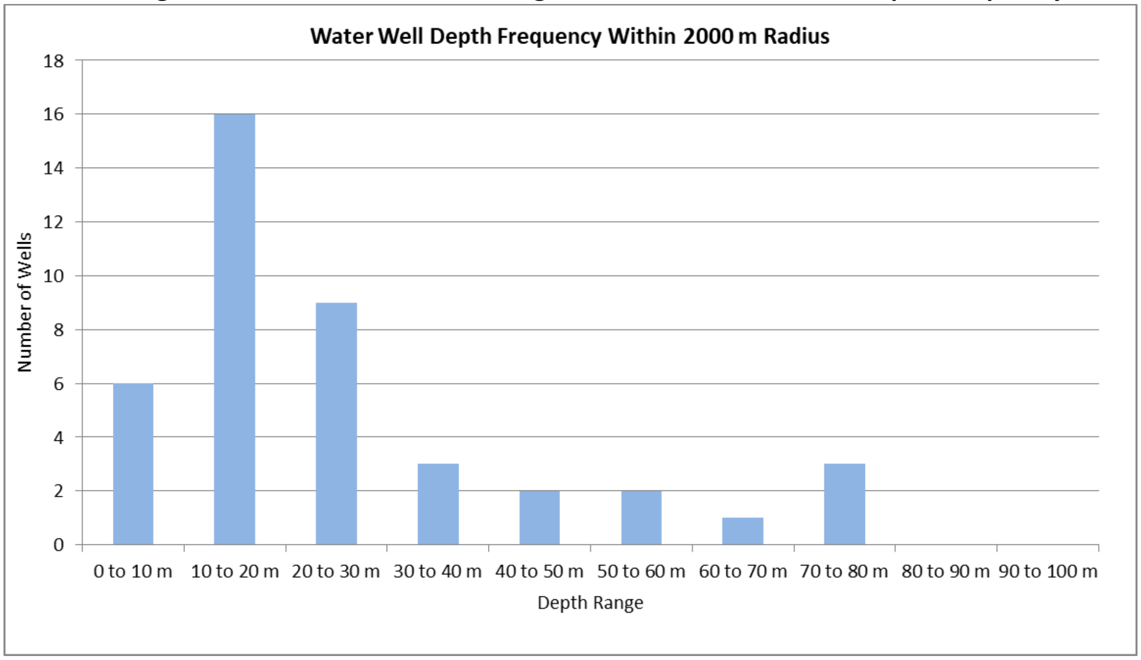
Source: Figure 5 from ORE, 1997

The well head protection areas (WHPA for water quality) for the Grafton municipal well system and Hamilton Township communal well system, located near Baltimore, are reproduced in Figure 8-2. The WHPA mapping outlines time-of-travel (TOT) zones for groundwater captured by the municipal wells as indicators of the relative level of risk for water quality impact from land development activities within each zone. The mapped WHPA areas on Figure 8-2 are useful indicators of regional groundwater flow conditions for the aquifers utilized by the municipal wells. Both the Hamilton Township WHPA and the Grafton WHPA extend to the north of the well fields indicating that regional groundwater flow is towards the south.

8.3.4.2 Local Hydrogeology

The MECP water well information system (WWIS) database was reviewed for well locations situated within 2,000 m of the Robins Holdings Inc. production well. A 2,000 m search radius was used based on a low density of water well records in the area and to be representative of conditions within and beyond the cone of influence of the Site water taking. Water well record locations as referenced in the WWIS are plotted on Figure 8-1. A total of 42 well construction records for supply and test wells were identified (i.e. well abandonment records were omitted) with reported well construction depths ranging from 5.2 to 79.2 m, all of which were completed in overburden. The frequency distribution in water well record depths within the 2,000 meter search radius is shown in the chart below, indicating 16 of the 42 wells are between 10 and 20 meters in depth.

Text Figure 8-3: Robins Holdings Inc. - Local Water Wells Depth Frequency



Overburden materials within the study area consist of a variety of materials including clay, sand, and gravel with occasional silt. This is generally consistent with the mapped surficial geology shown on Figure 8-6 (modern alluvial deposits, glaciofluvial deposits and foreshore-basinal deposits). Well construction information indicates wells are typically completed in sand, gravel or clay layers. Installed well screens are reported as ranging from 1.2 m (4 feet) to 3.7 m (12 feet) in length and with a wide range of slot sizes used. Reported well pumping rates range from 9 to 95 L/minute (2 to 25 gallons per minute). The water well records report static water levels ranging from 0 to 46.9 m bgs. As indicated in Table 8-2, the three permitted source wells (MV-1, MV-3 and the Restaurant Well) are completed in overburden at depths ranging from 5.2 to 22.6 m. The water-bearing zones are reported in the well records for these wells as ranging from 3.75 m to 22.6 m depth.

Hydrogeological studies, as described in the following section, indicate that there are artesian conditions in the vicinity of the site and that the Baltimore Creek tributary is fed from an intermediate aquifer. Active seeps or springs also occur in the area (see Figure 8.4).

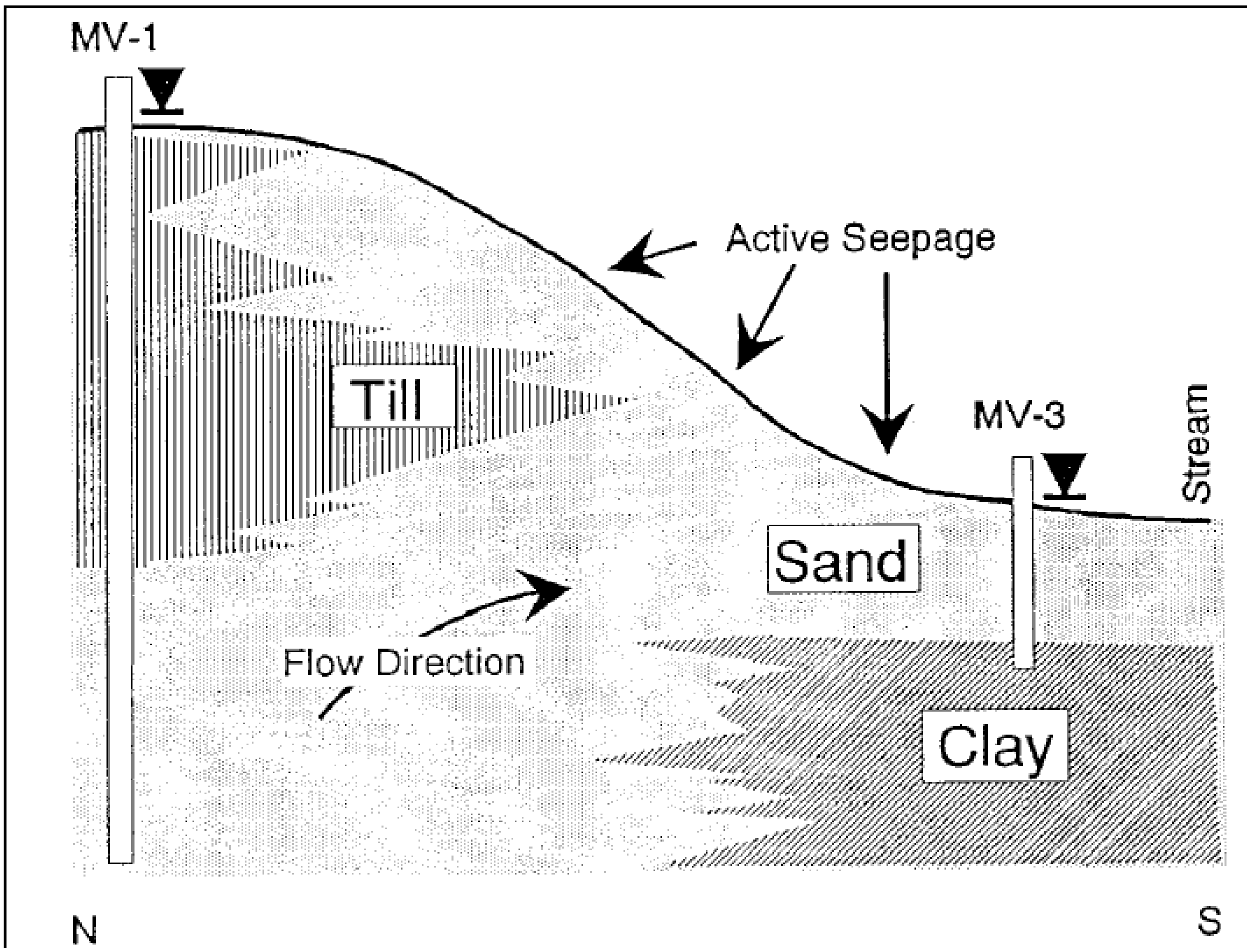
8.3.4.3 Site Hydrogeology

The following provides a summary of Site hydrogeological and hydrological information gleaned from studies available within the files provided by the ministry.

Hydrogeological Investigation (ORE, 1997)

This report is the main technical report assessing the hydrogeological conditions for the Site water taking. The investigation was prepared in October 1997 by Oakridge Environmental Ltd. (ORE) to support a PTTW application for the Site for the taking of water for the production of ice and for expansion into the bulk and bottled water operations. At the time of the report, water was being taking from the Restaurant Well and spring. This investigation included the installation of three new wells (MV-1, MV-2 and MV-3) and completion of a 24 hour pumping test. MV-2 was installed as a two-level nested piezometer located 3.9 m from MV-1. MV-3 is located approximately 33 m south of MV-1 between MV-1 and a neighbouring tributary of Baltimore Creek. MV-1 is reported to tap the bottom portions of the intermediate aquifer while MV-3 taps the top. ORE's interpretation of the Site hydrogeologic stratigraphy is provided as follows.

Text Figure 8-4: Robins Holdings Inc. – Active Seepage Areas



Source: ORE, 1997

The Site lies in the middle of the boundary between the Oak Ridges Moraine and the South Slope physiographic regions. The report indicates the presence of a shallow overburden, intermediate overburden and deep overburden aquifer systems. The **shallow overburden aquifer** discharges to the Baltimore Creek tributary located adjacent to the Site. Shallow dug or bored wells in the area are completed within the shallow overburden aquifer system. The **intermediate overburden aquifer** is described as a buried horizon of sand and gravel that extends from the 'Moraine' southward where it either pinches out or outcrops immediately south of the Site. The intermediate overburden aquifer is considered the principal aquifer at the Site and the water source for wells MV-1 and MV-3. At least 5 private well water supplies in the study area are identified as potentially being completed in the intermediate overburden aquifer. Only a few wells within the study area were noted to be installed within the **deep aquifer** as a result of the abundance of shallow water bearing zones. The depth of the deep aquifer is inferred to be in excess of 50 m based on the cross-section provided in Figure 5 of the ORE report (see Text Figure 8-2 herein). Vertical hydraulic connection between aquifers was considered limited due to the presence of clay and silty clay till material between the aquifer layers.

The Restaurant Well is reported as a flowing well which replaced a shallow dug well in 1986. Two other neighbouring residential dug wells located within the shallow aquifer (neither of which has been documented on a water well record) were included in the assessment. The Liberty well located approximately 170 m north of the production well MV-1, has reported dry periods in summer months. This Liberty well is reported to be 8.93 m deep and has a static water level of 2.7 m bgs. In comparison, the Robins dug well located approximately 100 m north of the production well MV-1 has a reported depth of 9.01 m and a static water level of 2.13 m bgs and is reported to provide adequate water year round.

A 24-hour (nominal) pumping test of Well MV-1 was conducted on March 10 and 11, 1997 at a maximum pumping rate of 175 L/minute. The report indicates that since well MV-3 has a comparatively low potential yield (22.7 L/minute) and only weak interference effects would be seen in MV-3 (by pumping MV-1 at the same time), better information would be obtained by pumping the 2 wells separately. During the pumping test for MW-1, water levels were monitored in the pumped well (MV-1), MV-2, the Restaurant Well, the Liberty dug well and the Robins dug well. A drawdown of 16.54 m had essentially stabilized at MV-1 near the end of pumping; a remaining available drawdown of 2.66 m for the well was observed. MV-1 recovered 90% in just over 2 hours after pump shutoff. A maximum drawdown of 3.07 m was observed at observation well MV-2 and a maximum drawdown of 0.2 m was observed at observation well MV-3. There were no observed influences from the pumping test on the water levels of the other observation wells (located onsite and offsite) or in the nearby tributary of Baltimore Creek. The estimated transmissivity (Hantush method) was reported as approximately 23.1 m^3/day; indicative of a semi-confined aquifer. ORE determined that a 20-year safe yield of 175 L/minute could be sustained by well MV-1.

A similar 24 hour test was completed on March 12 and 13, 1997 on MV-3 at a maximum pumping rate of 22.5 L/minute. The water level at MV-3 stabilized less than 1 hour into pumping and a maximum drawdown of 2.91 m was observed at the end of pumping. A pumping well recovery of approximately 90 % was observed 3 hours after pump shutoff. MV-3 is reported to have a theoretical specific capacity (24 hour) of approximately 20.4 L/minute/m (29.4 m^3/d/m) and a transmissivity of approximately 21 m^2/day. No interference was noted on the water levels of neighbouring wells during this pumping test, which was expected given the low pumping rate. ORE determined that a 20-year safe yield of 22.5 L/minute could be sustained by well MV-3 and that Wells MV-1 and MV-3 are capable of supporting the proposed combined pumping rate of 197.5 L/min (284,400 L/day).

Of note, the reported theoretical specific capacity for MV-3 is consistent with values reported in the Morrison Environmental Limited 2004 report (MEL, 2004) which included the specific capacity estimates for local wells. As reported, a well to the north of the Site has a specific capacity of 1 to 10 m^3/d/m. Wells further to the north and south of the Site have a reported specific capacity of 10 to 100 m^3/d/m.

The 1997 ORE study reported the theoretical area of influence was calculated to be 408 m based on a vertical recharge approach which excluded influences from the flow-through component and other physical attributes. The calculation assumed a continuous water taking rate of 197.5 L/minute. The drawdown cone of MV-1 interpreted as extending no more than 100 m from the well during sustained pumping.

The chemistry of the groundwater samples collected from the Baltimore Creek tributary is reported to be similar to the average water chemistry in samples collected from MV-1 and MV-3. This supports the assumption that the intermediate aquifer discharges to the neighbouring stream. Higher levels of several parameters also suggest that the intermediate aquifer waters mix with the deeper discharge waters.

Recommendations developed by ORE based on the study findings included:

- Although no impacts or interferences are expected based on the proposed pumping rates, it was recommended that the permit include a requirement for an initial 2-year periodic monitoring of nearby wells, specifically the following wells and times: MV-1, monthly water level measurements and recording of that month's pumpage; MV-3, monthly water level measurements and recording of that month's pumpage; Robins Drilled Well, monthly water level measurements; Liberty Dug Well, monthly water level measurements; and Robins Dug Well, monthly water level measurements.
- It was recommended that periodic measurements of stream flow in the neighbouring Baltimore Creek tributary be collected. It was recommended that for the initial 2-year period of the permit, streamflow monitoring be conducted on a monthly basis to establish a useful data base.

Compliance Monitoring Program Results (ORE, 2000)

This report was prepared in August 2000 by Oakridge Environmental Ltd. (ORE) to support the renewal of PTTW 98-P-4044. The report includes daily water taking records, water level measurement and stream flow measurements for the period from January 1997 to July 2000. The water takings for the production (MV-1) and Restaurant Well were reported as an average of 5,400 L/day and 904 L/day, respectively. No water takings occurred from MV-3. Water level monitoring results for residential wells located within a 500 m radius of the production well and for the Baltimore Creek Tributary was reported as not being influenced by the water taking.

Compliance Monitoring Program Results (ORE, January 2004)

This report was prepared in January 2004 by Oakridge Environmental Ltd. (ORE) to support the renewal of PTTW 98-P-4044. The report includes daily water taking records, water level measurement and stream flow measurements for the period from February 2002 to January 2004. Daily water takings at MV-1 were reported to vary seasonally and by production demand, ranging from less than 5,000 L/day to 37,500 L/day. The report indicates that the Restaurant well draws water from the same aquifer as production well MV-1. The maximum water taking at the Restaurant Well was reported to rarely exceed 1,250 L/day. Monthly static water levels were reported for wells within 500 m of MV-1, MV-3 and the Restaurant Well as required by the permit. As reported, the water takings of the production well did not show interference on neighbouring private wells and monitoring data showed no indication that the production well MV-1 has any impact on the Baltimore Creek tributary.

Compliance Monitoring Program Results (ORE, August 2006)

This report was prepared in August 2006 by Oakridge Environmental Ltd. (ORE) to support the renewal of PTTW 1652-645RX7. The report includes daily water taking records, water level measurement and stream flow measurements for the period from January 2004 to July 2006. Water takings at MV-1 are noted to vary seasonally with a minimum water taking of 5,000 L/day to a maximum taking of 90,700 L/day in the summer. MV-3 is reported to be an observation well that does not have a pump or water meter as it is only used to demonstrate compliance with the US Food and Drug Administration (FDA)'s "standard of identity" for natural spring water. Monitoring of the Restaurant Well was not included as a requirement of PTTW 1652-645RX7; however, previous to 2004, the reported maximum water taking was 1,250 L/day.

Water levels were taken quarterly at MV-1 and all wells within 300 m of MV-1. The Restaurant well and two neighbouring wells are reported to be flowing wells. MV-1 is reported to be a flowing well if it were not in use. MV-2$_{deep}$ is an observation well located approximately 3.9 m to the south of MV-1 and within the same aquifer as the production well. The maximum interference effect of MV-1 on MV-2$_{deep}$ was reported as being approximately 1.43 m. MV-2$_{shallow}$ is reported to be completed within the shallow overburden. Dug wells at neighbouring properties are located within the 300 m monitoring radius.

Hydrographs of January 2004 to May 2006 water level monitoring data are provided in the report. The report indicates that there is no evidence that the production well (MV-1) has any well interference on neighbouring wells.

Streamflow monitoring of the Baltimore Creek tributary included the continuous monitoring of water depth and temperature at the still well. ORE's interpretation of the collected data was that operation of the production well MV-1 has no noticeable impact on the creek. The report indicates that the temperature data shows that the creek receives a large component of its flow from discharging groundwater. Precipitation and runoff events are noted to have short term effects on flow rates of the stream.

Compliance Monitoring Program Results Post 2006

As reported by the MECP, the monitoring data that was to be provided with the 2016 PTTW renewal application for the site is not on file with the MECP. As a result of the Water Bottling Moratorium, this application has not been through the regulatory review process and monitoring data for the period of 2006 to present had not been requested. Monitoring and data collection continues to be a requirement as per the conditions of the 2006 PTTW (refer to section 8.1).

8.4 DATA REVIEW AND STATE OF GROUNDWATER RESOURCES

The following section provides a review of the Ontario Water Quantity Management Framework data for the Robins Holdings Inc. Site that is presently available to the MECP for making water management decisions.

8.4.1 Water Taking Reporting System

The Water Taking Reporting System (WTRS) is the ministry's repository for collection of water taking data for active Permits to Take Water (PTTW). As a requirement of each PTTW the water taking data must be reported on an annual basis and daily water taking data must be entered into the system. The WTRS is not publicly available, but is available for use by ministry staff when assessing the status of a PTTW or addressing potential issues associated with a PTTW. The WTRS data was provided by the ministry for use in this assessment to be inclusive of all information available to the MECP for making water management decisions.

Data on the volume of water taken per year and the number of water taking days per year for the Robins Holdings site was obtained from the MECP Water Taking Reporting System (WTRS), for review. Table 8-3 below includes annual water taking data for the period from 2010 to 2017 for MV-1. The water takings for this period were reported as zero for both MV-3 and the Restaurant Well.

Table 8-3: Robins Holdings Inc. - Reported Water Takings

PTTW No.	Year	Source	Annual amount permitted by the PTTW (Million L)	Reported No. of Days Taken per Year	Reported annual taking (Million L)	Reported annual taking (% of permitted amount)	Average volume taken per day (L/day)
1652-645RX7	2005	MV-1	79.89	152	5.33	7%	35,076
2305-6TDH43	2006	MV-1	79.89	61	1.23	2%	20,202
2305-6TDH43	2007	MV-1	79.89	282	5.11	6%	18,126
2305-6TDH43	2008	MV-1	79.89	255	4.59	6%	17,981
2305-6TDH43	2009	MV-1	79.89	261	4.11	5%	15,764
2305-6TDH43	2010	MV-1	79.89	249	4.37	5%	17,542
2305-6TDH43	2011	MV-1	79.89	272	8.47	11%	31,158
2305-6TDH43	2012	MV-1	79.89	216	7.27	9%	33,669
2305-6TDH43	2013	MV-1	79.89	181	4.37	5%	24,160
2305-6TDH43	2014	MV-1	79.89	233	3.97	5%	17,046
2305-6TDH43	2015	MV-1	79.89	243	4.17	5%	17,158
2305-6TDH43	2016	MV-1	79.89	188	3.49	4%	18,561
2305-6TDH43	2017	MV-1	79.89	193	0.03	0.04%	170

As indicated in Table 8-3, the annual water taking amounts for the 2010 to 2017 period are relatively consistent from year to year and show a maximum reported annual taking of 11 % of the PTTW limit. Of further note, the average daily water taking volumes are less than the minimum PTTW volume requirement of 50,000 L/day. Based on water taking data available in the MECP file (i.e. pre-2007) exceedances of the PTTW volume requirement occurred in 2005 and 2006. The minimum PTW volume for these years appears to occur on several occasions throughout the year, except for a short period in the late spring.

The assessed study area for review of other active PTTW was set at a 5 km radius of the Robin Holdings Ltd. Production well as a conservative distance for any potential contribution from the Site on the cumulative impacts from multiple water takings. However, no other active PTTWs within a 5 km radius were identified. The nearest active PTTW located within the Ganaraska Region SPA is located approximately 6.7 km to the southwest of the Robins Holdings production well. The Corporation of the Township of Hamilton (PTTW No. 7265-8W9HLX) is permitted to take groundwater from three water supply wells. The 2016-2017 annual taking amounts for this active PTTW are summarized in Table 8-4 below.

Table 8-4: Robins Holdings Inc. - Neighbouring PTTW

Permit Holder	Issue Date	End Date	Source	Dist. From Robin's Holdings Wells (Km)	PTTW Limits			2016 WTRS Data		2017 WTRS Data	
					Max. Taken per Day (Million L)	Taking Days per Year	Annual Taking (Million L)	Annual Reported Taking (Million L)	Annual Reported Taking (% of PTTW Limit)	Annual Reported Taking (Million L)	Annual Reported Taking (% of PTTW Limit)
Corp. of the Township of Hamilton	Aug. 31, 2012	July 31, 2022	Ground water	6.7	2.448	365	893.52	129.67	14.5%	128.13	14.3%

As indicated in Table 8-4 the reported taking amount for the Corporation of the Township of Hamilton for 2016 and 2017 is less than 15% of the PTTW limit. The annual taking limit of 893.52 million L/year is more than ten times the permitted taking amount for Robin's Holdings Ltd. Based on the significant distance between water takings and the comparatively small water taking amount for Robin's Holdings Ltd., a potential for unacceptable interference with the municipal supply is not evident.

8.4.2 Provincial Groundwater Monitoring Network

The Provincial Groundwater Monitoring Network (PGMN) is a partnership program with all 36 CAs and 10 municipalities (in areas not covered by a conservation authority) to collect and manage ambient (baseline) groundwater level and quality information from key aquifers located across Ontario. During the spring and summer of 1999, low water conditions in many parts of southern Ontario prompted the formation of an inter-ministerial task force to assess drought conditions, determine trigger levels and develop a response strategy. The PGMN was approved in 2000 and there are currently more than 450 monitoring wells in the network.

The PGMN datasets report on ambient (baseline) groundwater level and chemistry conditions. The PGMN well locations are typically sited to be away from areas where there is a large density of permitted water takings. Consequently, the PGMN wells are typically far too distant from any permitted water taking to be used as an indicator of potential well interference impacts.

Water level data collected for the PGMN wells is of potential value in assessing regional groundwater level trends as an indicator of stress within the watershed/subwatershed. Data has been collected for the PGMN well network since 2001 though some wells were installed more recent than this. Also the data for some wells is not current to 2018. The Provincial Groundwater Monitoring Network database is made available by MECP on-line.

As a recent internal project the MECP has applied the Mann-Kendall (MK) and Seasonal Kendall (SK) tests to analyze the PGMN water level data for monotonic trends (i.e. consistently increases or decreases through time). The statistical analyses were performed using robust and defensible methodologies to look for longer-term trends in groundwater levels. An overall objective is to determine if there is enough data to support the presence of a widespread decrease in groundwater availability. Shorter trends within the PGMN data record (e.g. lasting for a few years) were not considered and the causes of any trends that were identified were not investigated. Both the data plots and preliminary findings for PGMN well locations nearest a WBSA were shared by the ministry and are presented and relied on herein. The data plots indicate data available for the well at the time of the assessment. Further, the MECP has indicated that the methodologies used require that certain values be dropped from the data set if the month/year in question does not have sufficient number of data points. The release of a final report that details the methodology and results from the PGMN data trends analysis is forthcoming from the ministry (MECP, 2018).

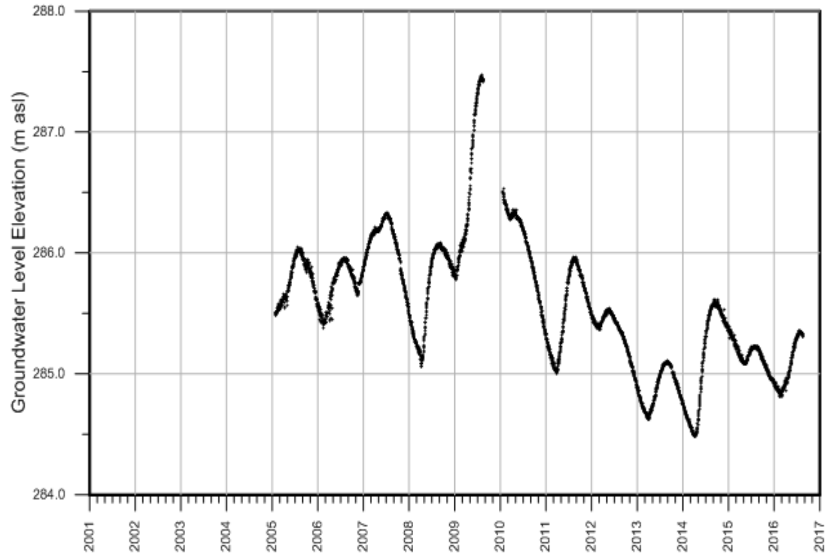
Five PGMN wells are located within 10 kilometers of the Robins Holdings site as shown on Figure 8-2. Three wells W0000412-1, W0000411-2 and W0000411-3) are indicated at one location 5 km to the north with the deepest monitor (W0000411-3) completed at the bedrock/overburden interface. Overburden PGMN well W0000393-1 is located 6 km to the southwest and overburden PGMN Well W0000348-1 is located 9.6 km to the west. The PGMN well info is summarized below in Table 8-5.

Table 8-5: Robins Holdings Inc. - PGMN Wells Summary

PGMN Well ID	Water Well Record ID	Distance from Robin's Holdings Ltd. Source Wells (km)	Well Depth (m)	Ground Elevation (m asl)	Lithology of Aquifer
W0000412-1	4514022	5.0	16.98	299.36	Overburden (Sandy silt to silt)
W0000411-2	4514022	5.0	47.4	299.36	Overburden (sand and silt)
W0000411-3	4514022	5.0	179.8	299.36	Interface (Silt, Sand/Limestone)
W0000393-1	4513604	6.0	21.52	152.83	Overburden (Grey Sand with Gravel)
W0000348-1	4513608	9.6	16.8	253.28	Overburden (Grey gravel)

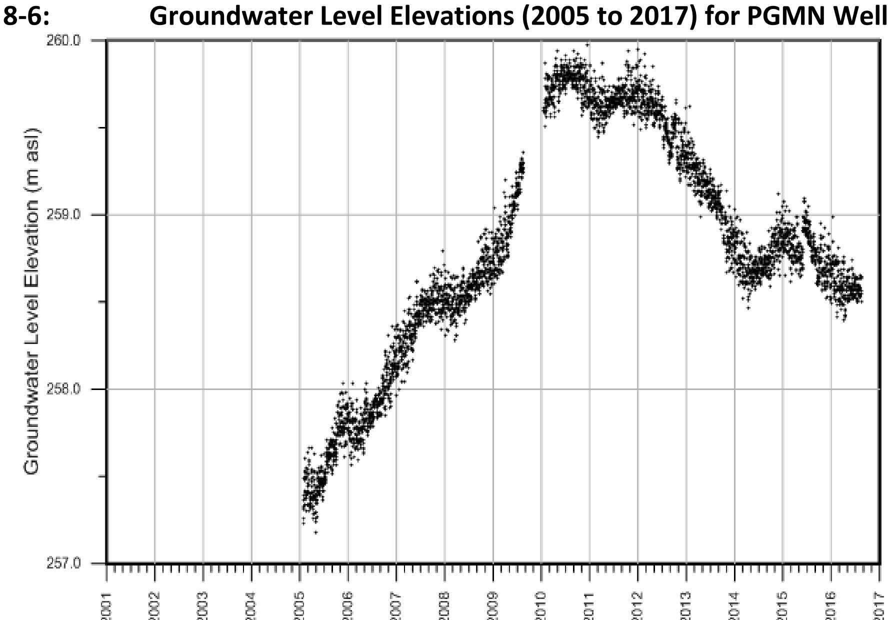
The data plots and trends analysis for the 5 PGMN well installations within 10 km of the Robins Holdings Inc. Site are provided as follows.

Text Figure 8-5: Groundwater Level Elevations (2005 to 2017) for PGMN Well W0000412-1



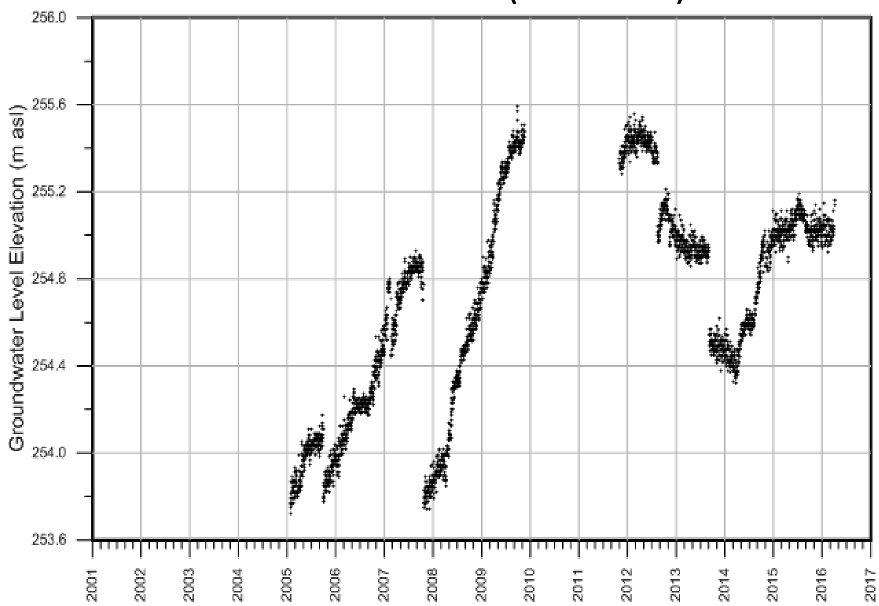
For PGMN Well No. W0000412-1 (shallow overburden well), the MK test (year over year) detected a downward trend. The SK test (season to season) also detected a downward trend. A visual analysis of the data indicates peak water level elevations in mid-2009 followed by a general decline until 2014 followed by a modest recovery between 2014 and 2017.

Text Figure 8-6: Groundwater Level Elevations (2005 to 2017) for PGMN Well W0000411-2



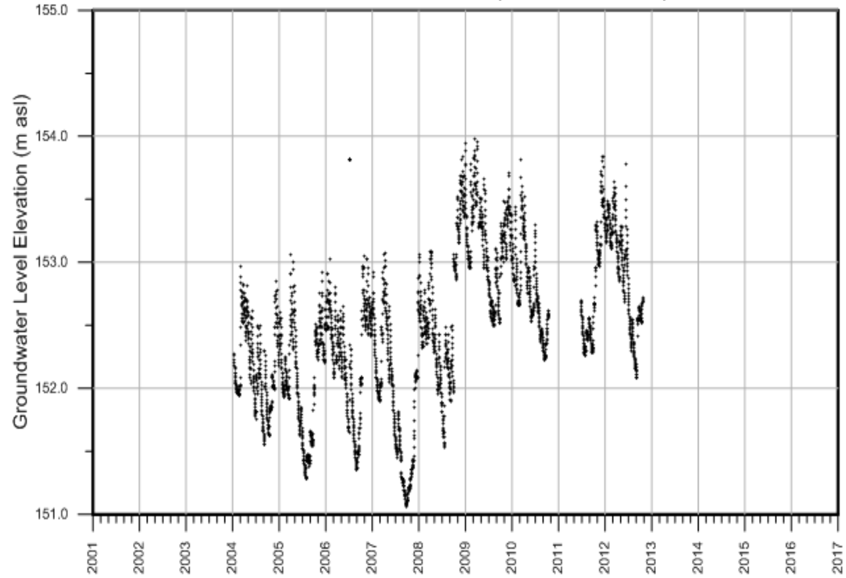
For PGMN Well No. W0000411-2 (deep overburden well), the MK test did not detect a significant trend while the SK test identified an upward seasonal trend. Based on a visual analysis of the data an upward trend is indicated from 2005 to 2010 followed by a downward trend from 2012 to 2014.

Text Figure 8-7: Groundwater Level Elevations (2005 to 2017) for PGMN Well W0000411-3



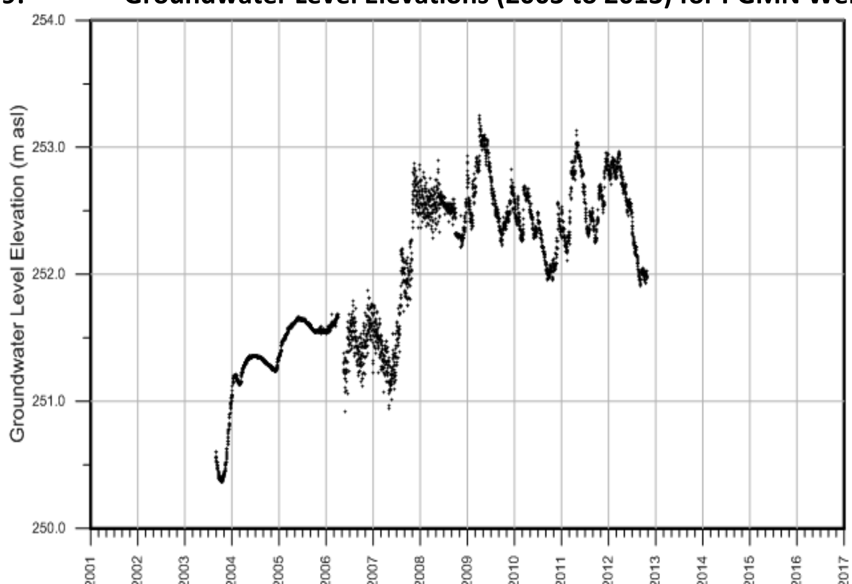
For PGMN Well No. W0000411-3 (overburden/bedrock interface), the MK test (year over year) did not detect a significant trend while the SK test (season to season) identified an upward seasonal trend. Visual analysis of the data plot does not identify much seasonal fluctuation in water levels with a steady 1.0 m rise in water level from 2005 to late 2007, followed by rapid 1.0 m drop in water level and then a steady 1.7 m rise from end of 2007 to end of 2009. The most recent groundwater level data for the 2015 year appears relatively stable throughout this year.

Text Figure 8-8: Groundwater Level Elevations (2004 to 2013) for PGMN Well W0000393-1



For PGMN Well No. W0000393-1 (shallow overburden well), the MK test (year over year) did not detect a significant trend. The SK test (season to season) detected an upward trend. A visual analysis of the groundwater level data which is only current to 2012 indicates a sudden rise in the elevation range of seasonal water levels after 2008. Before and after 2008, seasonal fluctuations are approximately 1.6 m each year.

Text Figure 8-9: Groundwater Level Elevations (2003 to 2013) for PGMN Well W0000348-1



For PGMN Well No. W0000348-1 (shallow overburden well), the MK test (year over year) detected an upward trend. The SK test also detected an upward trend. A visual analysis of the data plot which is only current to 2012 indicates a sudden rise in the elevation range of water levels in 2007 followed by a general seasonal fluctuation of 1.0 m for 2008 to 2012.

Based on the PGMN data trend analyses provided by MECP, PGMN well No. W0000412-1, a shallow overburden well completed to 16.98 m depth was the only location indicating a downward water level trend. At the same location the deep overburden well completed to 47.4 m depth (411-2), and the overburden/bedrock interface well completed to 179.8 m depth (411-3) indicated an upward seasonal trend. In general, the assessed PGMN well data does not provide any indication of a potential decreasing trend in the availability of groundwater.

8.4.3 Ontario Low Water Response (OLWR) Program

The OLWR program was initiated in 2000 and is managed by the Ministry of Natural Resources and Forestry (MNRF). The program relies on the use of real time surface water monitoring data collected through the Surface Water Monitoring Centre and utilizing the Water Survey of Canada (WSC) stream gauge (HYDAT) station network to identify potential drought conditions based on set trigger levels. Presently, static groundwater level elevation data from the PGMN program is not a component of the OLWR program. Reportedly, this may be added to the program in future.

OLWR notifications are typically (i.e. not always) released in the last week of each month after a review of data for the previous weeks in the month. When trigger levels are identified for a monitoring station, the OLWR submits a notification to the respective CA or municipality. Based on its review of the OLWR data that accompanies the notification, combined with a review of local factors that include recent precipitation and reports of water shortfalls for surface water and well water supplies a Low Water Conditions Alert 'may' be posted by the CA/municipality. A CA or municipality may also choose to post an Alert without any OLWR notification. Decreases in water takings that are triggered by the declaration of Level 1, 2 and 3 Low Water Condition are as follows:

- Level 1 - A voluntary reduction of 10%
- Level 2 – A voluntary reduction of 10%, to achieve a 20% reduction;
- Level 3 – Reduce and manage water use demands to the maximum extent through regulatory measures, if required.

<u>Note</u>: Specific Permits to Take Water may have conditions requiring mandatory reductions of water takings during low water events. Upon renewal of their water bottling permit, the above decreases will be mandatory based on 3-month average actual flow as outlined in the guidance for bottled water renewals (MOECC, 2017).

The frequency of OLWR notifications over time can be a potential indicator of climate stress trends for surface water (and possibly shallow groundwater where directly connected to surface water), and an indicator of watershed/subwatersheds that are sensitive to seasonal drought conditions. However, the existing OLWR program database has not been prepared for this purpose, has inconsistencies that are attributed to different persons updating the database over the years, and the database does not provide notification Levels during the time period where a Low Water Alert has been declared by a CA/municipality. This is only indicated in the database as an 'Update'. Consequently, only a general review of the information in the OLWR database is provided herein for the geographic CA/municipality relevant to the Site.

A review of the OLWR database indicates that a total of 8 Level 1 notifications and 2 Level 2 notifications were sent to the Ganaraska CA between 2000 and August 2018. Of the Level 1 notifications, the Ganaraska CA posted 5 Level 1 Alerts (July 2005, August 2007, May 2010, May 2012, and August 2016). The Level 1 Alerts generally lasted from 1.5 to 6 months in length. Of the 2 Level 2 notifications, only 1 was issued as a Level 2 alert (August 2016) which lasted for a period of 1.5 months before it was downgraded to a Level 1 alert that continued until mid-February 2017.

Based on a general review of the frequency of OLWR notifications, no specific trends that might be attributed to changing climate conditions within the boundaries of the CA are apparent. However, the Level 1 Low Water Condition Alerts that have been necessary for the summer and fall months in approximately 30 % of the years where the OLWR program has been in place indicate that seasonal stresses on water resources do occur for the region.

8.4.4 Water Budget Analyses

Tier 1 water budget and water quantity stress assessments of the Cobourg Creek watershed (where the Robins Holding Ltd. Site is located) were included in the 2018 Approved Ganaraska Assessment Report (TCCSPC, 2018). The Tier 1 water budget expands on the findings of the conceptual water budget by calculating water budgets at smaller spatial scales and by assigning water quantity stress levels to each subwatershed in the study area. The Tier 1 water budget estimates how much water exists in a subwatershed over a period of time, usually monthly and yearly. It accounts for water that is being added to a watershed, such as precipitation and removed (e.g. rivers flowing out) from a watershed. Stress levels for surface water and groundwater are calculated based on the net water balance and compared to threshold stress values set by the province.

The Tier 1 water budget analyses completed for the Cobourg Creek watershed indicated both a low potential for surface water and groundwater stress. A Tier 2 assessment was not deemed as warranted. Based on the findings from available local Water Budget analyses, the Robins Holdings Inc. Site is not located in an area where hydrologic stress has been identified.

8.5 IMPACT ASSESSMENT

The following section provides a general assessment of potential water quantity interference with other groundwater uses and the environment.

8.5.1 Municipal Groundwater Use

The Township of Alnwick/Haldimand provides municipal drinking water in some of its Hamlets. In Alnwick/Haldimand, approximately 8 % of the water use is for municipal supplies, 78 % for individual domestic use, 10 % for agriculture and 2 % for industrial/commercial use (MEL, 2004). The nearest Hamlet within Alnwick/Haldimand to the Site that has a municipal groundwater supply system is Grafton, located approximately 9 km to the southeast of the Site and within the Lower Trent Watershed/Barnhamhouse Creek subwatershed. The Hamilton Township communal well system is located near Baltimore approximately 6.7 km south west of the Site and within the same watershed as the Site (Cobourg Creek). The ORE, 1997 hydrogeological investigation reported a calculated theoretical area of influence for the water taking as a 408 m radius of well MV-1. The drawdown cone produced by MV-1 was interpreted as extending no more than 100 m from the well during sustained pumping. The calculation/assessment was based on an assumed continuous water taking rate of 197.5 L/minute (Note: current permit rate for MV-1 is 152 L/minute). Consequently, both existing municipal groundwater systems are considered too distant from the Robins Holdings Inc. water taking to be a concern for unacceptable well interference. No 'planned' new municipal groundwater supply systems are apparent for the vicinity of the Site which is a rural land use setting where water servicing is from private individual well water supply.

In summary, the general assessment of potential water quantity interference with existing or planned municipal water supply systems did not identify any potential for unacceptable impact/interference.

8.5.2 Well Interference Potential

The ORE, 1997 hydrogeological investigation identified that local well water supplies were utilizing either a shallow overburden source/aquifer (dug wells and bored hole supplies), an intermediate overburden aquifer (utilized by the Robins Holding Ltd. production well MV-1) or a deep overburden aquifer. Vertical hydraulic connection between aquifers was considered limited due to the presence of clay and silty clay between the aquifer layers. Consequently, wells completed in the intermediate overburden aquifer were considered most susceptible to the proposed water taking at the Site. As indicated in Section 8.3.4.3, a 24 hour pumping test was completed for the Robins Holdings Inc. production well MV-1 at a continuous rate of 175 L/min (i.e. 252,000 L/day). After 24 hours of pumping, no observed influences on the water level of neighbouring off-site wells were observed. The calculated aquifer transmissivity from the pumping test was 23.1 m^2/day (semi-confined aquifer). The current PTTW (No. 2305-6TDH43) allows water to be taken at a maximum rate of 152 L/min (lower than the ORE, 1997 test rate) and at a maximum taking amount per day of 218,869 L (87 % of the 1997 test rate). The theoretical area of influence of MV-1 was determined by ORE, 1997 to be 408 m and the drawdown cone was reported to not likely expand more than 100 m from the well. A water level monitoring program for neighbouring wells was recommended to verify that interference impacts were acceptable.

Following the issuance of the original (1998) PTTW for the Site, the well interference potential continued to be assessed regularly through static water level monitoring at private wells located within a defined distance of well MV-1. As stated in the 2000, 2004 and 2006 ORE PTTW compliance reports, no unacceptable impacts to neighbouring wells were identified based on the results of the monitoring programs since issuance of the original PTTW. Based on the file information provided by MECP, no well interference issues/complaints have been documented for the Site.

In summary, based on the 1997 aquifer testing results for MV-1, the current PTTW taking limits (lower than rates used in the 1997 assessment), the continued monitoring of neighbouring well water levels, and no well interference issues/complaints received to date, a potential for unacceptable well interference impacts to neighbouring groundwater supplies is not indicated.

Regarding well interference potential with future growth/development near the Site, no new high water use activities are apparent and a low growth rate for the municipality is indicated from available information. Any new neighbouring land development on private wells and of significant scale is expected to require a site specific hydrogeological study and well interference assessment in support of the proposed development.

8.5.3 Impact to Surface Water and Natural Functions of the Ecosystem

The ORE, August 2006 compliance report indicated that the continuous monitoring of water depth and temperature at the sampling location within the Baltimore Creek tributary located to the east of the Site showed that there was no indication that the production well had any noticeable impact on the creek. The report also indicated that the data showed that the creek receives a large component of its flow from discharging groundwater. Precipitation and runoff events are noted to have short term effects on flow rates of the stream.

PTTWs for the Site prior to 2004 included a Condition for stream water quality monitoring. As stated in the ORE, 2004 compliance monitoring program report, monthly water samples were collected and analyzed for major ion analyses and quarterly samples for phenols and metals. As stated in the report, the stream flow originates as groundwater discharge and the chemistry of the stream appears similar to that of MV-1. The report indicates that the data suggests there was no indication of impact on stream quality as a result of the water taking. Within this report, ORE recommended that monitoring of the quality of the stream be removed as a condition of the PTTW as continued monitoring would not provide additional information under normal conditions. Subsequent PTTWs have not included the condition for stream quality analysis. It is apparent based on the ministry file review that no ecosystem studies for the Baltimore Creek tributary have been requested from the Permit Holder based on monitoring programs showing no evidence of any quantity or quality impacts to the creek.

The Robins Holdings Inc. Site is located within a Natural Core Area of the Oak Ridges Moraine Boundary where development is limited to 'existing uses' and 'very restricted new resource management'. Development in these areas is not allowed to adversely affect hydrologically sensitive features. Neighbouring properties to the north and west of the Site are also designated as Natural Core Areas. These restrictions on land development on/near the Site serve to be protective of the Oak Ridges Moraine groundwater recharge area. The development controls will also curb potential cumulative effects from new water takings near the Robins Holdings Inc. Site.

Based on the findings from the information review, no impact to surface water and natural functions of the ecosystem has been identified for the Robins Holdings Inc. water taking.

8.6 SUSTAINABILITY OF WATER RESOURCES

Water resources are considered sustainable if the total amount of water entering, leaving, and being stored in the system meet existing needs without compromising the ability to meet the needs in the future. Typical indicators used to assess the sustainability of water quantity include Water Budgets completed at the watershed/subwatershed scale and/or for the specific water taking(s) and the evaluation of water level data for trends over time to ensure resources are remaining in a steady state. The following provides a general assessment of the sustainability of regional water resources and of the potential impact from the Robins Holdings Inc. water taking on sustainability, now and in the future.

<u>Regional Water Resources</u>
The characterization of the regional study area indicates that the Robins Holdings Inc. Alnwick/Haldimand Site is located in the Cobourg Creek watershed where both groundwater stress and surface water stress was categorized as Low based on a Tier 1 Water Budget analyses (XCG, March 2010). The Water Budget analyses considered existing water demand and projected future water

demand. A modest population growth rate is indicated for the region with new growth to be focused on the existing hamlets within the municipality. Consequently, existing and future demand are not an identified concern for stress on the sustainability of water resources within the regional study area.

The 'Approved Ganaraska Assessment Report' (TCCSPR, 2018) includes a discussion on the implications of climate change on the report finding, including the XCG, March 2010 Water Budget results. The discussion indicates that climate change (e.g., a decrease in surplus water due to an increase in evapotranspiration) has the potential for increased stress levels for groundwater and surface water in the Great Lakes Basin. The TCCSPR, 2018 Report recommends continual improvement in climate change modeling to capture potential variability between models and their results. The report also recommends further consideration be given to the effects of climate change on the quantity and quality of drinking water sources at a local level.

The OLWR Program uses real time surface water monitoring data collected from the WSC stream gauge (HYDAT) station network to identify potential drought conditions based on set trigger levels. BluMetric's review of the OLWR Program notification data (2000 to August 2018) for the Ganaraska CA did not identify any specific trends indicating the depletion in the availability of surface water (and possibly shallow groundwater where directly connected to surface water) resources. While Level 1 and Level 2 Low Water Condition Alerts have been necessary within the boundaries of the CA, the information indicates these have been in response to extended dry seasonal conditions and no annual trends that suggest the depletion in surface water resources were identified.

BluMetric's review of PGMN groundwater level data for 5 monitoring network wells located within 10 km of the Robins Holdings Inc. water taking did not identify any specific trends indicating a potential depletion in the availability of regional groundwater resources.

In summary, based on the information reviewed, no stress concerns were identified for the sustainability of regional water quantity resources.

<u>Robins Holdings Inc. Alnwick/Haldimand Water Taking</u>
Historical information relating to the Robins Holdings Inc. Site indicates it has been permitted for water bottling since 1998. The PTTW water taking limits have remained unchanged since 1998. The 2005 to 2017 reported annual water taking amounts for the Site range from 1 % to 11 % of the permitted amount. The calculated average reported daily taking in each year is less than 50,000 L/day based on the reported number of days of taking for each year.

Monitoring requirements for groundwater and surface water have been in place for the Site since 1998 with a gradual decrease in the monitoring program for off-site well water supplies and surface water based on assessment of monitoring data and with ministry approval. The last monitoring report received by the ministry was in 2006. The report provides hydrographs for groundwater level monitoring data collected from January 2004 to May 2006. The hydrograph data as provided does not indicate any unacceptable impact or downward trends for the neighbouring wells or the on-site monitoring wells MV-2S/D. No documented well interference complaints/impacts were identified in the ministry files/reports provided for review. Assessment of the sustainability of the water taking over the long term is not considered possible based on the limited available data. However, based on the reported WTRS data from 2005 to 2017 (Table 8-3), indicating a daily taking of less than 50,000 L/day, an impact on the sustainability of the local groundwater resource is considered unlikely. Groundwater level data collection and streamflow monitoring is required as per the conditions of PTTW No. 2305-6TDH431 (refer to section 8.1) and the presentation and analysis of all data since 2006 will need to be provided by Robins Holdings Inc. in support of a Permit renewal.

Based on the information reviewed, there are no indicators of the Robin Holdings Inc. water taking having an impact on the sustainability of existing and future water resources, though no monitoring data is available for the water taking since May 2006. Current Permit requirements/conditions in place through PTTW No. 2305-6TDH431 appear to be suitable in identifying potential issues should climate change and growth pressures become a larger factor in the sustainability of local water resources.

8.7 Gaps and Recommendations

Based on the assessment of the Robins Holdings Inc. Site, no gaps were identified in the science that has been used in the characterization of the Site. However, no monitoring data is available for the water taking since May 2006 will need to be provided by Robins Holdings Inc. in support of a Permit renewal. As such, potential enhancements to the existing monitoring program and PTTW requirements have not been identified.

8.8 Figures

Figures are provided in Appendix A-Main Figures.

9. SAVARIN SPRINGS INC. – SOUTH BRUCE

9.1 BACKGROUND AND HISTORY

Savarin Springs Inc. draws water from an artesian bedrock well located at 1189 Bruce Road 12 within Formosa, Ontario, herein referred to as the 'Site'. The Site is located within the Municipality of South Bruce, County of Bruce and falls within the jurisdictions of the MECP Owen Sound District Office - Southwestern Region and the Saugeen Valley Conservation Authority. The Savarin Springs Inc. water source location and Site boundaries are indicated on Figure 9-1.

Based on the records provided by MECP, the water taking has been permitted for bottling water since 1989. Water taken at the Site is hauled to the Savarin Springs Inc. bottling plant in Kitchener, Ontario. An approximate timeline of events relevant to the PTTW history of the Savarin Springs Inc. site is provided in Table 9-1.

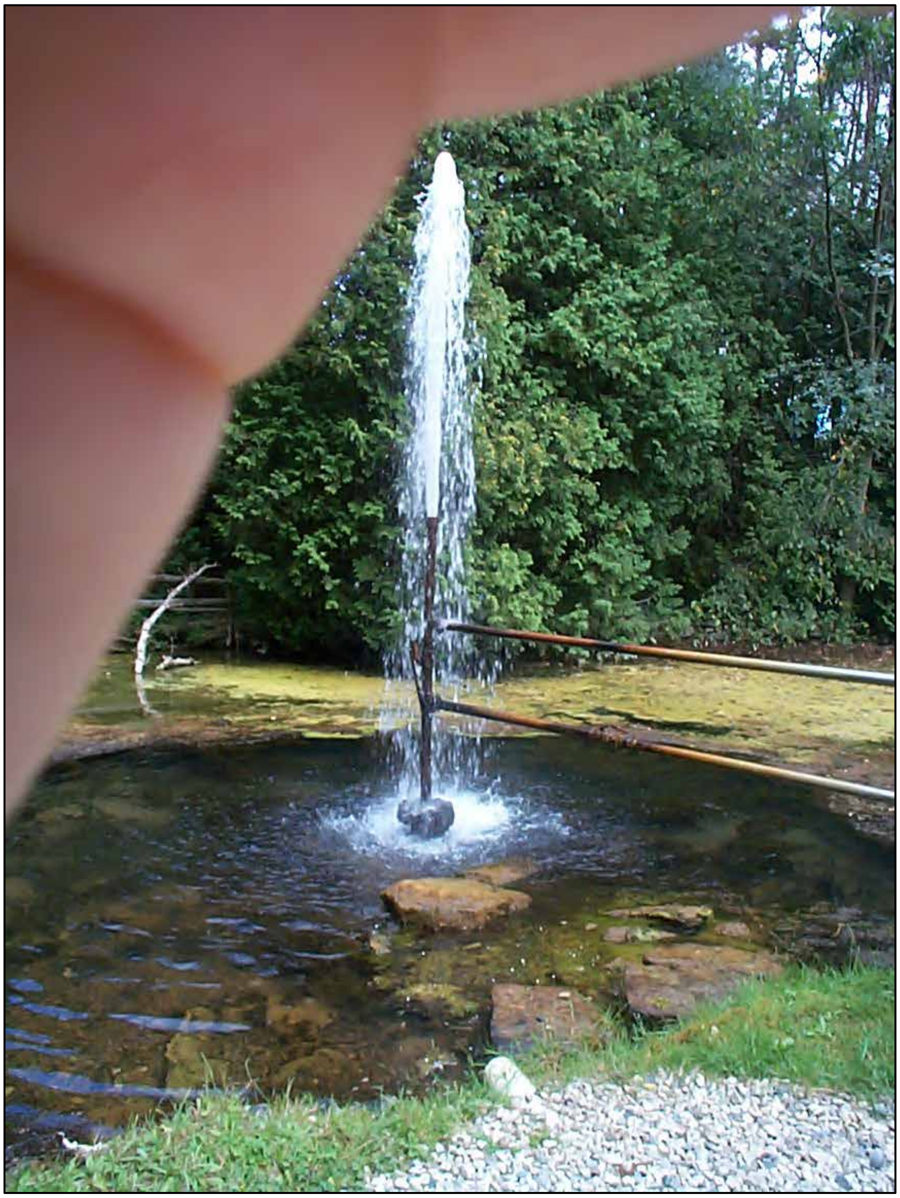
Table 9-1: Savarin Springs Inc. - PTTW History

YEAR	EVENT
1901	Reportedly, 'Artesian Well 1' is installed to a depth of 289.6 m (950 feet). The well was possibly installed as an oil exploration well and no water well construction record for the well is available.
1989	Reportedly, PTTW issued to Savarin Springs Inc. on **November 10, 1989** (permit not available) allowing water to be taken from Artesian Well 1 at a maximum rate of 2,273 L/minute (500 imperial gallons per minute) for a maximum of 2 hours per day.
1992	PTTW No. **92-P-0005** issued on **February 17, 1992** to Clearly Canadian Beverage Corporation, allowing water to be taken at a maximum rate of 2,273 L/minute (500 imperial gallons per minute) for a maximum of 20 hours per day and conditional on the water taking rate not exceeding the artesian flow rate from the well. Public concerns arise that the artesian well is an important water source for Formosa Creek. A well flow rate (artesian flow rate) and stream flow rate determination is completed by Paragon Engineering Ltd. (PEL, August 1992). In November 1992, Schedule 'A' of PTTW No. 92-P-0005 is amended, reducing the maximum taking rate to 750 L/minute (equivalent to 165 imperial gallons per minute) and requiring that artesian flow to the creek be maintained. The PTTW is also amended with an expiry date of March 31, 2002.
1993	A hydrogeologic assessment is completed by Paragon Engineering Ltd. (PEL, July 1993) that includes geophysical logging of Artesian Well 1 and an 86 hour constant rate aquifer test at 12.9 L/s (774 L/minute). A measured well depth of 199 m (654 feet) is reported for the Source well at this time.
1994	Clearly Canadian Beverage Corporation requests an administrative amendment assigning PTTW No. **92-P-0005** to Clearly Canadian Beverage Corporation. The amendment is approved by the Director on **November 30, 1994** (Note: Notice of Amendment for name change dated December 6, 1999).
2002	In its review of the PTTW renewal application, the ministry identifies the well as part of the natural ecosystem and the artesian flow's importance in maintaining a brook trout population in Formosa Creek. The need to maintain 10% of the base flow from the outflow pond to Formosa Creek during water tanker filling is identified. PTTW No. **92-P-0005** is issued for the taking in the name of Clearly Canadian Beverage Corporation on **November 7, 2002** for two years. The renewed PTTW allows water to be taken at a maximum rate of 485 L/minute and a maximum amount per day of 582,000 L from Artesian Well 1. Conditions 14, 15 and 16 of the renewed permit 92-P-0005 requires the Permit Holder to develop a flow monitoring and taking system that ensures flows that exit the holding pond to Formosa Creek do not drop below 10% of the instantaneous base flow condition.

YEAR	EVENT
2003	To address the PTTW Conditions 14, 15, and 16 the artesian flow rate from the overflow pond is reassessed by Pryde Schopp McComb Inc. (Letter dated November 18, 2003). It is concluded that a pumping flow rate of approximately 273 L/minute (60 imperial gallons per minute) is required to meet the PTTW requirement that flow exiting the holding pond to Formosa Creek does not drop below 10% of the instantaneous base flow condition.
2004	PTTW No. **92-P-0005** is renewed by Clearly Canadian Beverage Corporation on **November 10, 2004** for two years. The renewed PTTW (PTTW 3714-66KK3R) allows water to be taken at a maximum rate of 485 litres per minute and a maximum amount per day of 582,000 L from Artesian Well 1. In correspondence the Ministry of Environment (MOE) indicates the proponent has installed the necessary equipment and is compliant with Conditions 14, 15, and 16 of the 2002 permit.
2007	PTTW **8731-6Y7QQR** is issued on **February 28, 2007** to Clearly Canadian Beverage Corporation for 10 years. The PTTW allows water to be taken at a maximum rate of 273 L/ minute and a maximum amount per day of 327,600 L. The maximum per minute rate was reduced to more accurately reflect the actual taking of approximately 273 L/minute. Condition 3.3 of the Permit limits the taking of water from Artesian Well 1 for up to 10 percent of the instantaneous streamflow from the Well Pond (man-made) to Formosa Creek present on the day or days of taking. Condition 4.2 of the PTTW indicates "The Permit Holder shall maintain a v-notch weir at the well pond outlet to correlate pond outflow with takings. The staff gauge shall be calibrated annually to maintain accurate flow volumes. Flow volumes from the pond shall be monitored during pumping to maintain 90% of outflow."
2010	PTTW No. **0282-836LBB** replaces PTTW No. 8731-6Y7QQR. The permit was amended to reflect the sale of Clearly Canadian Beverage Corporation to Savarin Springs Inc., but contains no other changes. Permit conditions/requirements include: At Taking Source: • The Permit limits the taking of water up to 10 percent of the instantaneous stream flow from the Well Pond to Formosa Creek present on the day or days of taking. (Condition 3.3). • Recording of daily water taking volumes measured using a calibrated flow meter and flow totalizer (Condition 4.1). Surface Water: • A V-Notch weir must be maintained at the Well Pond Outlet to correlate pond outflow with takings. The staff gauge should be calibrated annually to maintain accurate flow rate volumes. Flow volumes from the pond to be monitored and recorded during pumping to maintain 90 percent of outflow (Condition 4.4). Reporting: • Permit Holder shall submit annual records of water taking and staff gauge calibration to the MECP Owen Sound Area Office by December 31st of each year (Condition 4.3). Water Resources Management Measures (Triggers) • Complaints/Reported Impacts (Condition 5).
2016	Savarin Springs Inc. applies for a permit renewal more than 90 days before the expiry date (February 28, 2017). Per Section 34.1(6) of the *Ontario Water Resources Act*, the permit is deemed to continue to be in force until the date a decision is made on the permit renewal application while permit is under review.

In Savarin Springs Inc.'s November 2016 PTTW renewal application it is reported that water from the artesian well flows continuously up out of the well and into a small, man-made pond that is approximately 0.40 m deep at the pond outlet V-notch weir. Artesian flow from the top of the well casing is restricted through a 50.8 mm diameter vertical pipe. The water discharge from the vertical pipe is continuous as a water fountain over the well. Two horizontal pipes connected to the vertical pipe run to a nearby pump house containing two centrifugal pumps used for the filling of water tankers. Excess water derived from the artesian well flows out of the pond through the V-notch weir and into a small stream connecting to Formosa Creek. A staff gauge is used to monitor water levels in the pond before, during and after pumping. Water tanker loading time is reported to be approximately 1.5 hours. It is indicated that water is drawn from the well 3 to 6 times per week, depending on needs. The water is collected in a 26,500 L tanker truck, and is transported to Kitchener, Ontario, for bottling. Water metering and the use of a water flow restrictor ensure that no more than 260 L/minute is drawn from the well. A photograph of the water taking location is provided below.

Text Figure 9-1: Savarin Springs Inc. – Photo of Well Location



Source: Ministry File Photo Dated September 3, 2002.

9.2 Primary Information Sources

The following records were on file with the MECP documenting the PTTW history:

- PTTW No. 92-P-0005, Savarin Springs Inc., February 17, 1992. Notice of amendment dated November 18, 1992.
- PTTW No. 8731-6Y7QQR, Clearly Canadian Beverage Corporation, February 28, 2007. PTTW Application Reference No. 5226-7ZURMU, Savarin Springs Inc., January 19, 2010.
- PTTW No. 0282-836LBB, Savarin Springs Inc., March 17, 2010.
- PTTW Application Reference No. 6007-AFJS6N, Savarin Springs Inc., November 18, 2016.

The following key technical documents provided to the ministry by the proponent / Permit Holder were identified and reviewed herein:

- Clearly Canadian Formosa Operation, Palace Gardens, Formosa, Ontario. Well and Stream Flow Determination. Paragon Engineering Limited August, 1992 (PEL, August 1992).
- Palace Gardens Formosa Water Taking Operation, Hamlet of Formosa. Hydrogeologic Assessment. Paragon Engineering Limited July, 1993 (PEL, July 1993).
- Flow Monitoring Program, Formosa Site. Pryde Schopp McComb Inc. Letter dated November 18, 2003 (PSM, November 2003).

Other information sources used in this assessment included:

- Grey and Bruce Counties Groundwater Study. Final Report. Waterloo Hydrogeologic, Inc., July 2003 (Waterloo Hydrogeologic, 2003).
- The Official Plan for the Formosa, Mildmay and Teeswater Settlement Areas - The Urban Communities of the Municipality of South Bruce. Adopted September 21, 2004.
- Approved Assessment Report for the Saugeen Valley Source Protection Area (SPA). Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2015 (SGSNBPSPR, 2015).
- Vulnerable Areas Mapping Tool. Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2018 (SGSNBPSPR, 2018) at http://home.waterprotection.ca/interactive-map-viewer/.
- Bruce County Maps. Bruce County on-line mapping tool at https://brucecounty.on.ca/maps
- Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228. Chapman, L.J. and Putnam, D.F. 2007. (Chapman and Putnam, 2007).
- Surficial Geology of Ontario; MNDM File - MRD128-REV. Ontario Geological Survey, 2010. (OGS, 2010).
- Bedrock Geology of Ontario; MNDM File - MRD126-REV1. Ontario Geological Survey, 2011. (OGS, 2011).

- Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to Take Water Applications and Hydrogeological Study Requirements. Ministry of Environment and Climate Change. April 2017. (MOECC, 2017).
- Groundwater Levels in Ontario: A Trends Analysis using the Provincial Groundwater Monitoring Network. Ministry of Environment, Conservation and Parks, Southwestern Region. 2018 pending. (MECP, 2018).
- MECP Water Well Information System (WWIS). Available at: https://www.ontario.ca/environment-and-energy/map-well-records.
- MECP on-line Provincial Groundwater Monitoring Network database. Available at: https://www.ontario.ca/environment-and-energy/map-provincial-groundwater-monitoring-network.
- MECP on-line Permit to Take Water database. Available at https://www.ontario.ca/environment-and-energy/map-permits-take-water.
- MECP Water Taking Reporting System (WTRS) database (Confidential – Used with Permission from MECP).
- Ontario Low Water Response Program (OLWR) notifications and alert levels for Saugeen Valley Conservation Authority (2000 to 2018 data from MNRF).

Noted data and reports not available:

- No flow data collected for the V-notch weir or water level data for the staff gauge at the artesian pond is provided in information received from MECP. No records of staff gauge calibration as required under Section 4.3 of the permit were identified.

9.3 Characterization of Study Area

This section provides a general characterization of the Site and associated study area. Figure 9-2 presents the assessed regional study area which is an approximate 30 km by 30 km area centred over the Savarin Springs Inc. water taking location. The regional study area boundaries were set based on an area that captures the nearest municipal well water supply systems that include Walkerton to the north, Mildmay to the east southeast and Teeswater to the southwest. The Savarin Springs Inc. water taking location and the three municipal groundwater supply systems are all located within the Saugeen Valley Source Protection Area (SPA).

9.3.1 Land Use Setting

The Savarins Springs Inc. Site is located in the Municipality of South Bruce which has a 2016 census population of 5,639. The greatest portion of the population is located in Teeswater and Mildmay. The "Official Plan for the Formosa, Mildmay and Teeswater Settlement Areas, 2005 and amendments" indicates a 2006 population of 435 for Formosa and a projected population of 513 in 2021. The

'Municipality of South Bruce Corporate Strategic Plan 2014 – 2019, June 9, 2014' indicates that South Bruce has experienced limited growth with a decline in population between 2001 and 2011 and a demographic structure that indicates an aging population. Reportedly, the Bruce Nuclear Generating Station near Tiverton is the largest employer in Bruce County.

The Savarins Springs Inc. Site is located in the north end of Formosa which is comprised of several rural residential neighbourhoods and a number of main street commercial businesses, churches and schools that are located along the core of Bruce Road 12. Formosa Brewery is a large local employer and is located in the south end of Formosa. All properties in Formosa are serviced by individual private well water supply, but are on municipal wastewater servicing. A sewage pumping station is located in the south end of Formosa and pumps wastewater to the Teeswater wastewater treatment plant at Teeswater.

Land use within an approximate 1 km by 1km area centred over the Savarins Springs Inc. Site (Figure 9-3) was assessed to identify any existing or planned land uses that might be incompatible with the water taking. Land use based on 'Schedule A of the Official Plan for the Formosa, Mildmay and Teeswater Settlement Areas' is primarily rural residential with the Formosa Community Park and Hall located immediately northwest of the Site. Several small commercial businesses are located along Bruce Road 12. Agricultural lands are located approximately 200 m east and west of the Site. As indicated on Figure 9-3, the nearest areas designated for future development are located to the east and to the west of the Savarins Springs Inc. Site. These areas are adjacent to existing residential areas and future land development that is compatible with residential land use on private well water servicing is inferred. It is understood that the development of these areas is not currently planned or approved.

The Bruce County Maps on-line mapping tool indicates that a portion of the Savarin Springs Inc. property is located within the Ontario Regulation 169/06 screening area which regulates development, interference with wetlands and alterations to shorelines and watercourses within the Saugeen Valley Conservation Authority jurisdiction. This screening area correlates with the 'Hazard' area as delineated on Figure 9-3. Consequently, the location of Savarin Springs Inc.'s artesian well and outflow pond and nearly half of the 1189 Bruce Road 12 property are located within the 'Hazard' area, and are subject to controls on future land development.

9.3.2 Physiographic Setting

The physiography of the regional study area as described by Chapman and Putnam, 2007 is provided in Figure 9-4. In the immediate vicinity of Formosa the geomorphology is described as drumlinized till plains and spillways. The till plains are described as a stone-poor, carbonate-derived, silty to sandy deposit. The spillways are described as glacial meltwater drainage channels that may be floored wholly or in part by gravel beds. Small drumlins fields are located to the north of Formosa near Walkerton, to the west near Salem and to the southeast near Mildmay. Sand plains are indicated 10 km northwest of Formosa.

The topography and hydrology of the regional study area is provided in Figure 9-5. Topography ranges from flat-lying in the area of the sand plains to the northwest of the Site to heavily rolling in the areas of drumlinized till plain which dominate much of the regional study area. As indicated on Figure 9-5 the water course flow directions are primarily towards the west and north with the Greenock Swamp and Wetland Complex (15 km northwest of Formosa) being a primary receiving area for surface water flow within the Saugeen Valley watershed. The Greenock Swamp and Wetland Complex is recognized as Southern Ontario's largest forested wetland at approximately 8,094 hectares (SGSNBPSPR, 2015).

Formosa Creek is a cold water stream (SGSNBPSPR, 2015) that is located approximately 35 m south of the Savarin Springs Inc. artesian well and receives storage pond outflow derived from the artesian well. During a September 2002 ministry inspection of the Savarin Springs Inc. Site, two pools close to 1 m deep and each containing approximately 50 brook trout were observed on Formosa Creek. One pool was located at the outlet of the channel from the storage pond and the second pool was located 3 m downstream of the outlet. The ministry determined at this time that the channel from the storage pond has likely become brook trout habitat and a requirement that flow in the channel should not be reduced by more than 10% during pumping of the Springs Inc. well was added as a condition in the 2002 renewal of PTTW No. 92-P-0005. Based on communications with the Saugeen Valley CA and Ministry of Natural Resources and Forestry (MNRF) Owen Sound Area / Midhurst District Office, no recent fish habitat / ecosystem assessment studies for Formosa Creek are available. Although MNRF indicated that data from the early 1990s and 1980’s is available in hard copy in the Owen Sound Office files.

Formosa Creek is located within the Greenock Swamp/Teeswater River watershed and flows in a general west direction until it joins the Teeswater River approximately 9.5 km west of the Savarin Springs site. The Teeswater River flows to the north and ultimately joins the main Saugeen River at the Village of Paisley, approximately 27 km north of the Savarin Springs site. The Saugeen River drains in a general northwest direction into Lake Huron. SGSNBPSPR, 2015 reports that most rivers in the Saugeen Valley watershed show strong flows in the fall and spring due to rainfall and snow melt, respectively. During the remainder of the year, the rivers and small creeks are fed predominantly by groundwater base flow.

Two Water Survey of Canada (WSC) stream gauge (HYDAT) stations are located in the study area and their locations are shown on Figure 9-2. Station 02FC002 (Saugeen River near Walkerton) is located 10 km to the northeast of the Site. Station 02FC002 is located upstream of the confluence between the Teeswater River and the Saugeen River and is within the Lower Saugeen River subwatershed. Station 02FC020 (Teeswater River at Teeswater) is located 9 km to the southwest of the Savarin Springs Inc. Site and is within the Teeswater River subwatershed, but is not an upstream location for the Savarin Springs Inc. Site. No WSC stream gauges are located on Formosa Creek and there is no identified WSC gauge located upstream of the Savarin Springs Site. The closest WSC gauge downstream of the Site is located beyond the study area (Station 02FC015, Teeswater River near Paisley) and more than 45 km downstream.

9.3.3 Geologic Setting

Information on surficial geology and bedrock geology in the Saugeen River watershed was obtained from published Ontario Geological Survey (OGS) mapping and supplemented using information from the "Approved Assessment Report" for the Saugeen Valley SPA (SGSNBPSPR, 2015). Surficial geology for the study area is mapped in Figure 9-6 and bedrock geology is mapped in Figure 9-7.

Surficial geology in the study area is dominated by a mixture of glaciofluvial deposits and a stone-poor, carbonate-derived silty clay to sandy till known as the Elma Till. As indicated on Figure 9-6 the glaciofluvial deposits include localized sand and sand/gravel deposits with mapped areas extending within the 500 m radius area of the Savarin Springs source well. The glaciofluvial outwash deposits host numerous small, shallow aquifers, which are considered the source for a large portion of the base flow in the Saugeen River (SGSNBPSPR, 2015). The Elma Till typically has a low hydraulic conductivity due to its fine-textured character.

The bedrock geology for the study area (see Figure 9-7) is mapped as limestone, dolostone, shale of the Middle Devonian – Detroit River Group for Formosa and the Savarin Springs source well location. Towards the east from Formosa the mapped bedrock geology progresses through increasingly older formations, namely the Lower Devonian – Bois Blanc Formation, followed by Upper Silurian – Bass Islands Formation and then Upper Silurian – Salina Formation. Bedrock for all formations consists primarily of carbonate (limestone and dolostone) rocks, with some shale interbeds for the Detroit River Group Onondaga Formation and the Salina Formation. The presence of bedrock at surface is infrequent for the study area, though Figure 9-6 indicates that Paleozoic bedrock is near ground surface for much of the south portion of Formosa.

9.3.4 Hydrogeologic Setting

9.3.4.1 Regional Hydrogeology

The "Grey and Bruce Counties Groundwater Study" (Waterloo Hydrogeologic, 2003) reports that the Grey and Bruce Counties can be conceptualized as a three-layered hydrogeologic model with, from top to bottom, a fine-grained overburden aquitard layer, a thin weathered bedrock aquifer layer, and a thick unweathered bedrock aquifer. The majority of wells in Bruce County obtain groundwater from bedrock aquifers. However, there are some overburden aquifers in the sands and gravels of kames, spillways, sand plains and beach ridges, with well yields ranging from 0.2 to 3.8 L/s. The limestone and dolostone of the Detroit River Group is reported as moderately to highly permeable, having solution cavities, such as joints and caverns that are well developed in places, resulting in average well yields of 0.8 to 3.8 L/s. The limestone and dolostone of the Bois Blanc and Bass Island formations are moderately permeable, with well yields of 0.8 to 1.9 L/s. As per the Waterloo Hydrogeologic, 2003, shallow groundwater flows generally in a northwest direction across the majority of Grey and Bruce Counties, toward Lake Huron. The Municipality of South Bruce is identified as being an area within Bruce County where upward groundwater flow gradients within the bedrock are common as evidenced by the large number of artesian wells in the area.

Formosa and the Savarin Springs Inc. Site are situated near the centre of a triangle formed by Walkerton located 8 km to the north, Mildmay located 7.6 km to the southeast and Teeswater located 8.7 km to the southwest. All three municipal areas are serviced by communal well water supply systems and are captured within the Approved Assessment Report for the SVSPA (SGSNBPSPR, 2015). The Walkerton communal system utilizes two drilled bedrock wells referred to as Well 7 and 9 and are 76.2 m and 79.3 m deep, respectively. Well 7 is artesian. The primary aquifers utilized are inferred to be within the Bass Island Formation and Salina Formation. The PTTW taking limit (combined) is 7136 m^3/day. The Teeswater municipal water system utilizes one drilled bedrock well referred to as Teeswater 3, is 85.3 m deep and is artesian. The aquifer utilized is inferred to be within the Detroit River Group. The PTTW taking limit is 1600 m^3/day. The Mildmay municipal water system utilizes two drilled bedrock wells referred to as Mildmay 1 and Mildmay 2 and are 34.9 m and 34.4 m deep, respectively. The primary aquifer utilized is inferred to be within the Bass Island Formation. The PTTW taking limit (combined) is 1637 m^3/day.

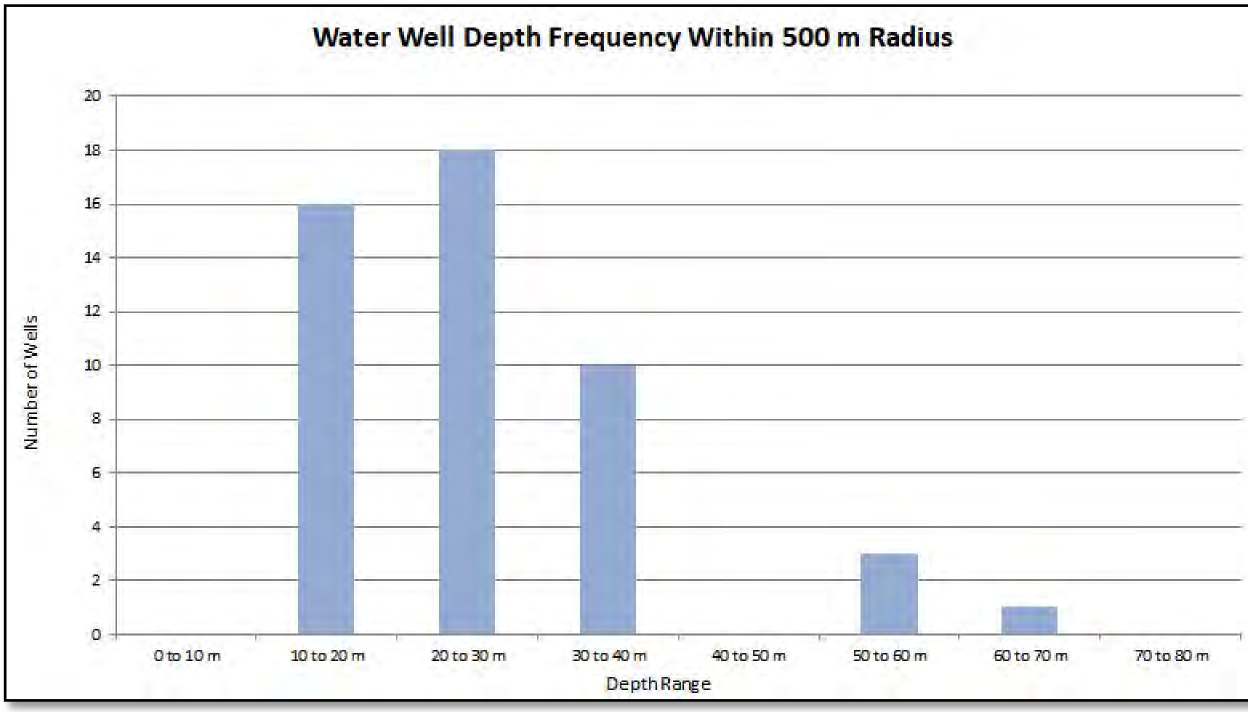
The well head protection areas (WHPA for water quality) for the three communal well systems are reproduced in Figure 9-2. The WHPA mapping outlines time-of-travel (TOT) zones for groundwater captured by the municipal wells as indicators of the relative level of risk for water quality impact from land development activities within each zone. The mapped WHPA areas on Figure 9-2 are useful indicators of regional groundwater flow conditions for the bedrock aquifers utilized by the municipal wells. The Walkerton WHPA extends directly to the south of the municipal wellfield indicating that regional groundwater flow is towards the north. A similar regional flow direction to the north is indicated by the mapped WHPA for Teeswater and Mildmay.

As described by SGSNBPSPR (2015), with existing limited data, it is difficult to delineate groundwater recharge areas in the Saugeen Valley Source Protection Area, and little is known about discharges from the bedrock aquifer. In the southern portion of the watershed, where the Savarin Springs Site is located, the bedrock aquifer is generally not exposed at the surface, so any recharge is believed to be transient through the overburden deposits. Based on numerous reports of artesian well conditions for the bedrock aquifer (including municipal wells at Walkerton and Teeswater), the bedrock is believed to discharge into the overlying overburden aquifers in the area, though the extent of such an interaction is unknown. It is also assumed that the bedrock aquifers in the lower reaches of the major rivers are discharging directly into these rivers and into Lake Huron.

9.3.4.2 Local Hydrogeology

Properties in Formosa are serviced by individual private well water supply. The MECP WWIS database was reviewed for well locations situated within 500 m of the Savarin Springs Inc. well. A 500 m search radius was considered appropriate based on the observed density for water well records in this search area and with land development primarily along the core of Bruce Road 12. Water well record locations as referenced in the WWIS are plotted on Figure 9-1. A total of 48 well construction records for supply wells were identified (i.e. monitoring wells and well abandonment records were omitted) with reported well construction depths ranging from 11.0 to 63.4 m. All but 3 wells are reported as completed in bedrock. Of note, water well record 1406161 plots on the Savarin Springs Inc. Property, and is shown at the same location in the PEL, July 1993 study, but its actual presence on the Site is not indicated in the reviewed files. Also, the original water well record for 1407070 was reviewed at the MECP 'Map: Well records' website and indicates Palace Gardens in the well location diagram, suggesting this 18.3 m deep bedrock well may have also been on the Savarin Springs Inc. Site. The frequency distribution in water well depths within the 500 m search radius is shown in the chart below, indicating 44 of the 48 wells are between 10 and 40 m in depth.

Text Figure 9-2: Savarin Springs Inc. - Local Water Wells Depth Frequency



The depth to bedrock reported in the assessed water well records range from 0 to 38.7 m. Overburden materials are most commonly described in the well records as hardpan; a general term used to describe a compact glacial till that typically has low hydraulic conductivity and is not a significant source of water. Two of the 3 overburden wells indicated on Figure 9-1 are located approximately 500 m north-northeast of the Savarin Springs Inc. well and are situated on a topographic rise that is 20 to 30 m higher in elevation than the Savarin Springs Inc. well location. A sand and gravel aquifer at approximately 15 m depth is indicated by these well records for this location. Water well record 1404927 is plotted near the south property line of the Savarin Springs Inc. The original water well record was reviewed at the MECP 'Map: Well records' website and the plotted location is considered likely to be incorrect. Bedrock material in most water well records in the 500 m radius is described as brown or white limestone, consistent with the Middle Devonian – Detroit Group Formation mapped for the area. Nine water well records report static water levels of 0 m bgs or less (i.e. -0.3 m is reported for one well) suggesting that artesian flow conditions, similar to the Savarin Springs Inc. well, exist for other supply wells in the area. The water well record plotting nearest to the Savarin Springs Inc. source well (Well ID 7048161) indicates a 24.4 m deep well constructed for the Formosa Hall at 13 Community Drive. The well is reported as completed in limestone with bedrock encountered at a depth of 2.7 m. Water bearing zones are reported at 13.1 m, 15.5 m and 22.6 m depth. A static water level of 0 m bgs is reported indicating a static level at/near ground surface. The well was pumped for 1 hour at 227 L/minute (60 gpm) and 3.2 m of drawdown was observed. The water well record indicates a recommended pumping rate of 189 L/minute (50 GPM) and a reported water use for 'cooling, air conditioning and heating'.

9.3.4.3 Site Hydrogeology

Three technical reports were identified in MECP files providing hydrological and hydrogeological information for the Savarin Springs Inc. Site. A well flow rate (artesian flow rate) and stream flow rate determination was completed by Paragon Engineering Ltd. in 1992 (PEL, August 1992) after the public expressed concerns that the artesian flow from the Savarin Springs Inc. well was a primary source of flow for Formosa Creek and must be maintained. A hydrogeologic assessment was then completed by Paragon Engineering Ltd. in 1993 (PEL, July 1993) that included characterization of the local hydrogeology, geophysical logging of the Savarin Springs Inc. well, step rate flow testing and an 86 hour constant rate aquifer test at 12.9 L/s (774 L/minute) for the well. In 2003, the artesian flow rate from the overflow pond was reassessed by Pryde Schopp McComb Inc. (PSM, November 2003) to determine an optimal pumping rate for tanker filling that would ensure that base flow leaving the outflow pond did not decrease by more than 10%. A summary of the findings from these assessments is provided as follows.

<u>Well and Stream Flow Determination (PEL, August 1992)</u>

This study was undertaken in response to concerns whether the withdrawal of water from the Savarin Springs Inc. well for bottling could affect the base flow of Formosa Creek. An assessment was completed on July 21, 1992 to determine the artesian flow rate from the well during full artesian flow as well as the artesian flow rate during filling of tanker trucks to assess the impact during water taking to flows in Formosa Creek. In addition, flow measurements in Formosa Creek were conducted upstream and downstream of the channel discharge from the well storage pond to determine the relative contribution of flows from the well.

Various methods were used to measure the artesian flow from the well, including use of an artesian plate, measuring the height of the free flowing jet above the discharge pipe and direct measurement by capturing the flow in a container. PEL determined the direct measurement method as the most accurate method. The artesian discharge flow rate during full flow conditions was determined to be 12.6 L/s (756 L/minute). Under pumping conditions to load the tanker trucks the flow from the well was estimated at 8.8 L/s (528 L/min).

The overflow storage pond outlet is a concrete chute that discharges to the channel to Formosa Creek. The pond level can be controlled by baffles in the chute. The discharge flow rates from the overflow/storage pond to the channel were measured using a sharp crested weir plate that was installed on the upstream side of the baffles. Discharge from the overflow pond to the channel ranged from 240 L/minute (4.0 L/s) during well pumping conditions to 348 L/minute (5.8 L/s) under free flow conditions. Flow rate changes were not discernible during the duration of well pumping with water levels over the sharp crested weir remaining constant. A culvert located downstream of the concrete chute was also used to assess flow rates in the channel. Flow rates through the culvert were estimated between 294 L/minute (4.9 L/s) and 396 L/minute (6.6 L/s), comparable to the free flow weir discharge estimate. PEL surmised that the lower flow rate leaving the overflow pond compared to the artesian flow rate from the well could be due to seepage and/or unknown outlets from the pond and potential inaccuracy in the weir flow measurement method.

Flow measurements along Formosa Creek were obtained by profiling the cross-section of the creek and measuring the stream flow rate with a meter. Flow in Formosa Creek was measured at 3,534 L/minute (58.9 L/s) upstream of the well pond discharge point and 3,834 L/minute (63.9 L/s) downstream of the pond discharge point during full artesian flow from the well. PEL noted that the flow difference was similar to the measured flow leaving the overflow/storage pond. PEL concluded that the overflow pond was contributing 9% of the flow in Formosa Creek during full flow conditions and this was reduced by less than 3% during tanker truck filling. PEL notes in the report that weather conditions had been wet for some time prior to the testing and it was not possible to indicate whether the Formosa Creek flow conditions were representative of extreme low flow conditions. Based on its review of the study results the ministry amended PTTW No. 92-P-0005 and reduced the maximum allowable taking rate from the source well from 2,273 L/minute to 750 L/minute.

<u>Hydrogeologic Assessment (PEL, July 1993)</u>

A hydrogeologic assessment was completed by Savarin Springs Inc. in 1993 to address a number of concerns about the impacts from the water taking that were brought forward by the Bruce County Planning Advisory Committee. To gain a better understanding of the source well construction and water bearing zones a downhole camera and geophysical profile (included resistivity, gamma ray, and caliper logs) was completed for the well. Based on the downhole camera inspection the well casing was determined to extend to a depth of 5.5 m (18 ft). Based on the geophysical profiling an actual total well depth of 199 m (654 ft) was indicated. The PEL, July 1993 report surmises that the original well may have been on the order of 289.6 meters but then plugged back to this depth at some point in time. Based on the geophysical logging results the following geological profile was produced by PEL for the well.

Table 9-2: Savarin Springs Inc. - Source (Artesian Well) Profile

Formation	Geologic Age	Top of Formation Depth in m (feet)	Top of Formation Elevation (m asl)
Detroit River Group	Middle Devonian	0	302
Bois Blanc	Lower Devonian	35 (115)	267
Bass Islands	Upper Silurian	66 (216)	236
Salina	Upper Silurian		
F-Unit		93 (305)	209
G-Unit		105 (344)	197
E-Unit		147 (482)	155
C-Unit		176 (577)	126
Total Well Depth		199 (654)	103

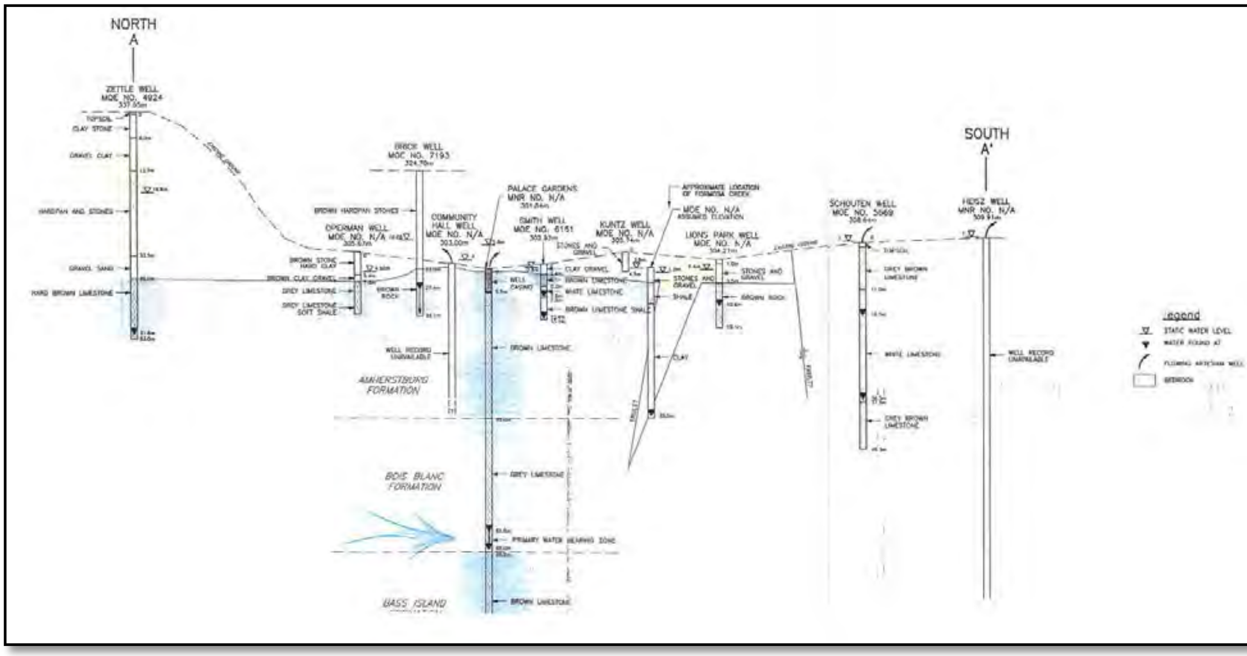
m asl – meters above sea level

Source: PEL, July 1993

Based on downhole camera work completed while the well was free flowing it was determined that water was entering the well from as high up as 5.5 m depth down to 65 m depth and from possibly as deep as 93 m. PEL identified the primary water bearing Formation for the well as the Bois Blanc Formation, with most water entering the well between 61 m and 65 m depth. PEL indicates in its assessment that the Recharge area for the well extends from Formosa to just east of Walkerton. Of note, this is in the opposite direction to the capture zone delineated as part of the water quality WHPA modelled for the Walkerton/Teeswater and Mildmay municipal wells and the recharge area for the Savarin Springs Inc. source more likely extends to the south of the well.

In its assessment of local water well records PEL produced a cross section that extends approximately 700 m north and 700 m south of the Savarin Springs source well. A portion of the PEL cross section is reproduced as follows.

Text Figure 9-3: Savarin Springs Inc. – North-South Cross Section



Source: Taken from Section 1 – Geologic Cross Section of PEL, July 1993
Note: Palace Gardens (Savarin Springs Inc.) Well is cut off at bottom of Figure.

PEL concluded in its assessment that the overburden thickness varies significantly in the study area while the elevation of the bedrock surface is relatively consistent. Virtually no overburden in the vicinity of the Savarin Springs source well is reported. PEL also indicates that most local wells draw water from the Detroit River Group - Lower Amherstburg Formation while the Savarin Springs source well is drawing from the underlying Bois Blanc Formation.

Incremental step rate testing was completed for the Savarin Springs Inc. well with the maximum step rate of 774 L/minute (12.9 L/s) determined to be suitable for a long term constant rate test. The constant rate test was carried out from May 31 to June 5, 1993 with 86 hours of continuous pumping. Dataloggers were installed in 3 neighbouring domestic wells to collect continuous observation well data through the duration of the testing. Five additional domestic wells, some with artesian flow, were monitored randomly throughout the test to provide additional indications of potential interference. Observation well distances ranged from 125 m to 980 m from the pumping well. The wells with dataloggers were located 275 m northwest, 685 m north-northeast, and 718 m south-southeast of the pumping well. The southernmost well was located approximately 200 m from the main building of the brewery. After the 86 hours of pumping PEL observed a maximum drawdown of 0.2 m at the observation wells and recovery of the observation wells was observed immediately after pump shutoff. Due to the artesian nature of the pumping well and a static head of approximately 4 m above ground surface, water levels for the pumping well during testing were based on the water fountain height above the top of a pipe reference point. A drawdown of approximately 2.0 m was observed for the pumping well 45 minutes into the test and a steady state condition was observed for the remainder of the 86 hour test. Aquifer testing data analysis by PEL determined a transmissivity of 561 m^2/day and storativity value of 0.0033 for the aquifer. Theoretical drawdown calculations determined that at a continuous pumping rate of 12.9 L/s (774 L/minute) the drawdown in the Savarin Springs Inc. well would be 0.3 m after one year of pumping and 0.55 m after 100 years of continuous pumping. Also, a pumping rate of 16 L/s (960 L/minute) would be needed to reduce the artesian flow from the well to zero.

PEL concluded that since the water taking would not be continuous (i.e. regular period of recovery are allowed) the impact from the water taking would be minimal. Based on the aquifer testing results and the requirement to maintain flow to Formosa Creek, PEL concluded that the safe pumping rate for the Savarin Springs Inc. source well was 12.9 L/s (774 L/minute).

<u>Flow Monitoring Program, Formosa Site (PSM, November 2003)</u>
Conditions of the renewed permit 92-P-0005 (dated November 7, 2002) introduced the requirement that the Permit Holder develop a flow monitoring and taking system that ensures flows that exit the holding pond to Formosa Creek do not drop below 10% of the instantaneous base flow condition. To address the conditions, various flow rate tests were completed by PSM, on behalf of Clearly Canadian Beverage Corporation, to evaluate the effect of the pumping rate from the well on the flow rate exiting the pond and to determine an optimal pumping rate to satisfy the permit condition. Testing was conducted at well pumping rates of 505 L/minute (111 IGPM), 386 L/minute (85 IGPM), and 295 L/minute (65 IGPM). Discharge from the outflow pond was measured with a V-notch weir and leakage around the weir was accounted for in the assessment. It was concluded by PSM that a maximum pumping flow rate of 273 L/minute (60 imperial gallons per minute) is required to meet the PTTW requirement that flow exiting the holding pond to Formosa Creek does not drop below 10% of the instantaneous base flow condition. The PSM report provided a log sheet and conversion chart allowing truck drivers to convert the measured water height flowing over the weir to a flow rate. The letter indicates that the temporary weir and staff gauge system were subject to frequent vandalism and a more permanent weir would be installed.

9.4 DATA REVIEW AND STATE OF GROUNDWATER RESOURCES

The following section provides a review of the Ontario WQMF data for the Savarin Springs Inc. Site that is presently available to the MECP for making water management decisions.

9.4.1 Water Taking Reporting System

The Water Taking Reporting System (WTRS) is the ministry's repository for collection of water taking data for active Permits to Take Water (PTTW). As a requirement of each PTTW the water taking data must be reported on an annual basis and daily water taking data must be entered into the system. The WTRS is not publicly available, but is available for use by ministry staff when assessing the status of a PTTW or addressing potential issues associated with a PTTW. The WTRS data was provided by the ministry for use in the WBSA assessment to be inclusive of all information available to MECP for making water management decisions.

Data on the volume of water taken per year and the number of water taking days per year for the Savarin Springs Inc. Site was obtained from the MECP Water Taking Reporting System (WTRS), for review. Table 9-3 below includes annual water taking data for the period from 2010 to 2017.

Table 9-3: Savarin Springs Inc. - Reported Water Takings

PTTW No.	Year	Annual Amount Permitted by the PTTW (Million L)	Reported No. of Days Taken per Year	Reported Annual Taking (Million L)	Reported Annual Taking (% of Permitted Amount)	Average Reported Volume Taken per day (L/day)
0282-836LBB	2010	117.94	94	2.13	2%	22,710
0282-836LBB	2011	117.94	127	3.46	3%	27,276
0282-836LBB	2012	117.94	149	4.05	3%	27,167
0282-836LBB	2013	117.94	180	5.04	4%	27,979
0282-836LBB	2014	117.94	203	5.56	5%	27,406
0282-836LBB	2015	117.94	86	2.4	2%	27,879
0282-836LBB	2016	117.94	200	5.57	5%	27,836
0282-836LBB	2017	117.94	192	5.48	4.6%	28,565

As indicated in Table 9-3, no annual water taking during the 2010 to 2017 period exceeded more than 5% of the PTTW annual taking limit of 117.94 million L. Also the reported number of days of taking for each year ranged from 86 to 203 days. Further to the annual data review the 2017 daily water taking data was evaluated and reports that of the 192 days in 2017 where water was taken, 183 days had a taking of 26,367 L (i.e. 1 tanker truck), 2 days had a taking of 52,735 L (i.e. 2 tanker trucks) and 7 days had a taking of 79,102 L (i.e. 3 tanker trucks).

The assessed study area for review of other active PTTW was set at a 5 km radius of the Savarin Springs Inc. well (Figure 9-2). The 5 km radius was considered appropriate for review based on the low density of active PTTW in the area and as a conservative distance for any potential contribution from the Site on the cumulative impacts from multiple water takings. As indicated on Figure 9-2, one other active PTTW is located within a 5 km radius of the Site. Formosa Springs Brewery Inc. is permitted to take groundwater from 2 wells at its location approximately 800 meters to the south. A review of water well records in the MECP WWIS identified one well record (ID 1405304) inferred to be a primary supply well for the brewery. The 46 m (151 ft) deep limestone bedrock well was constructed in 1980 and the well record indicates it was tested at 250 imperial gallons per minute for 24 hours. The MECP online PTTW database identifies the permit number for Formosa Brewery as 2473-ARLJE5, whereas the records from the Water Taking Reporting System identify the permit number to be 6432-8DML3E. This is attributed to the reported change in ownership for the site in 2017. The 2016-2017 annual taking amounts for this active PTTW are summarized in Table 9-4 below.

Table 9-4: Savarin Springs Inc. - Neighbouring PTTWs

Permit Holder	Issue Date	End Date	Source	Dist. from Savarin Springs Well (Km)	PTTW Limits			2016 WTRS Data		2017 WTRS Data	
					Max. taken per day (L)	Taking Days per Year	Annual Taking (Million L)	Annual Reported Taking (Million L)	Annual Reported Taking (% of PTTW Limit)	Annual Reported Taking (Million L)	Annual Reported Taking (% of PTTW Limit)
Formosa Springs	Feb. 28, 2011	Jan. 31, 2021	Well 1	0.8	218,880	365	79.9	2.17	2.71%	1.45	1.82%
			Well 2	0.8	435,840	365	159.1	10.88	6.84%	5.10	3.21%

As indicated in Table 9-4 the reported taking amount for the Formosa Springs Brewery for 2016 and 2017 is less than 10% of the PTTW limit. Reportedly, the brewery was in a temporary shutdown during this time prior during the change in ownership. In comparison, the Savarins Springs Inc. PTTW taking limit (i.e., 327,600 litres per day) is less than 50% of the permitted taking limit for Formosa Springs Brewery. The 2016 and 2017 annual water taking amounts for Savarins Springs Inc. were 43% and 84% of the Formosa Springs Brewery taking amounts, respectively.

9.4.2 Provincial Groundwater Monitoring Network

The Provincial Groundwater Monitoring Network (PGMN) is a partnership program with all 36 CAs and 10 municipalities (in areas not covered by a conservation authority) to collect and manage ambient (baseline) groundwater level and quality information from key aquifers located across Ontario. During the spring and summer of 1999, low water conditions in many parts of southern Ontario prompted the formation of an inter-ministerial task force to assess drought conditions, determine trigger levels and develop a response strategy. The PGMN was approved in 2000 and there are currently more than 450 monitoring wells in the network.

The PGMN datasets report on ambient (baseline) groundwater level and chemistry conditions. The PGMN well locations are typically sited to be away from areas where there is a large density of permitted water takings. Consequently, the PGMN wells are typically far too distant from any permitted water taking to be used as an indicator of potential well interference impacts.

Water level data collected for the PGMN wells is of potential value in assessing regional groundwater level trends as an indicator of stress within the watershed/subwatershed. Data has been collected for the PGMN well network since 2001 though some wells were installed more recent than this. Also the data for some wells is not current to 2018. The Provincial Groundwater Monitoring Network database is made available by MECP on-line.

As a recent internal project the MECP has applied the Mann-Kendall (MK) and Seasonal Kendall (SK) tests to analyze the PGMN water level data for monotonic trends (i.e. consistently increases or decreases through time). The statistical analyses were performed using robust and defensible methodologies to look for longer-term trends in groundwater levels. An overall objective is to determine if there is enough data to support the presence of a widespread decrease in groundwater availability. Shorter trends within the PGMN data record (e.g. lasting for a few years) were not considered and the causes of any trends that were identified were not investigated. Both the data plots and preliminary findings for PGMN well locations nearest a WBSA were shared by the ministry and are presented and relied on herein. The data plots indicate data available for the well at the time of the assessment. Further, the MECP has indicated that the methodologies used require that certain values be dropped from the data set if the month/year in question does not have sufficient number of data points. The release of a final report that details the methodology and results from the PGMN data trends analysis is forthcoming from the ministry (MECP, 2018).

Three PGMN wells are located within 10 kilometers of the Savarin Springs Inc. site. All well locations are situated to the north and are within 4 kilometers of the Walkerton municipal well field. Overburden PGMN well W0000304-1 is situated immediately beside Bedrock PGMN well W0000188-2. The PGMN well info is summarized below.

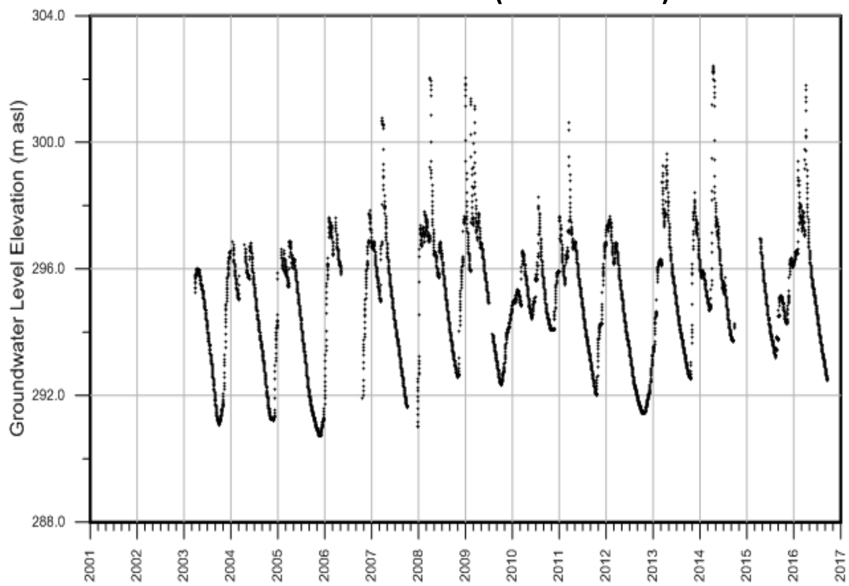
Table 9-5: Savarin Springs Inc. - PGMN Wells Summary

PGMN Well ID	Water Well Record ID	Distance from Savarin Springs Source (Km)	Well Depth (m)	Ground Elevation (m asl)	Lithology of Aquifer
W0000304-1	1410428	6.7	17.68	305.44	Overburden (Sand, Silt, Stones)
W0000188-2	1410311	6.7	19.81	305.21	Bedrock (Limestone)
W0000221-1	1405166	6.8	28.04	288	Bedrock (Limestone, Shale)

m asl – meters above sea level

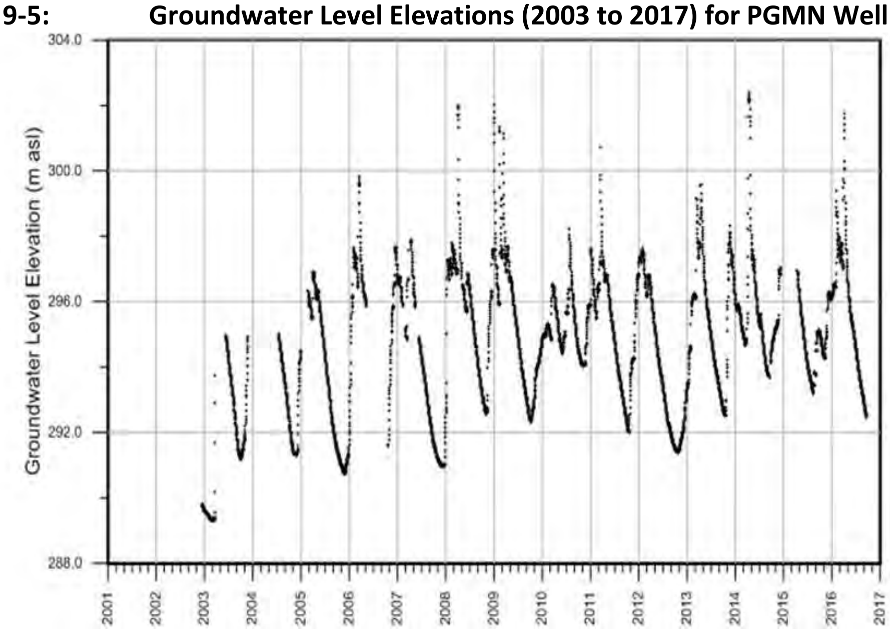
The data plot and trend analysis for the two bedrock wells and one overburden well listed in Table 9-5 are provided as follows.

Text Figure 9-4: Groundwater Level Elevations (2003 to 2017) for PGMN Well W0000304-1



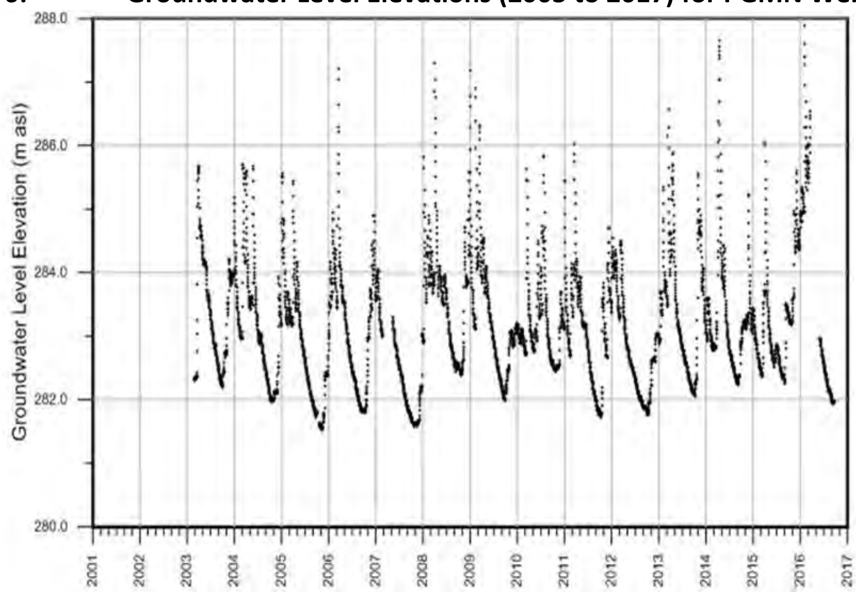
For PGMN well No. W0000304-1 (overburden well located adjacent to W0000188-2), no trend with the MK test (year over year) was identified, but an upward trend with the SK test (season to season) was identified. Seasonal fluctuations in water levels of >8.0 m is indicated by the 2007 to 2016 data.

Text Figure 9-5: Groundwater Level Elevations (2003 to 2017) for PGMN Well W0000188-2



For PGMN well No. W0000188-2, the MK test (year over year) did not detect a significant trend. The SK test (season over season) did detect a significant upward trend. Visual analysis of the data suggests similar seasonal fluctuations between 2008 and 2017 (sometimes >8.0 m), with fall having the lowest seasonal water levels during that time period.

Text Figure 9-6: Groundwater Level Elevations (2003 to 2017) for PGMN Well W0000221-1



For PGMN well No. W0000221-1, the MK test (year over year) did not detect a significant trend and the SK test (season to season) also did not detect a significant trend. Seasonal fluctuations in water levels often >4.0 m is indicated by the 2006 to 2017 data.

In summary, the Mann Kendall analysis, which looks at the year over year water levels, determined that all three wells had no trends. The Seasonal Mann Kendall analysis, which determines the trend from season to season (i.e., Spring 2010 to Spring 2011) and then adds the sum of each seasonal analysis together, established that two of three wells had an upward water level trend, and one well (W0000221-1) had no seasonal trend. In summary, the assessed PGMN well data does not provide any indication of a potential decreasing trend in the availability of groundwater.

9.4.3 Ontario Low Water Response (OLWR) Program

The OLWR program was initiated in 2000 and is managed by the Ministry of Natural Resources and Forestry (MNRF). The program relies on the use of real time surface water monitoring data collected through the Surface Water Monitoring Centre and utilizing the Water Survey of Canada (WSC) stream gauge (HYDAT) station network to identify potential drought conditions based on set trigger levels. Presently, static groundwater level elevation data from the PGMN program is not a component of the OLWR program. Reportedly, this may be added to the program in future.

OLWR notifications are typically (i.e. not always) released in the last week of each month after a review of data for the previous weeks in the month. When trigger levels are identified for a monitoring station, the OLWR submits a notification to the respective CA or municipality. Based on its review of the OLWR data that accompanies the notification, combined with a review of local factors that include recent precipitation and reports of water shortfalls for surface water and well water supplies a Low Water Conditions Alert 'may' be posted by the CA/municipality. A CA or municipality may also choose to post an Alert without any OLWR notification. Decreases in water takings that are triggered by the declaration of Level 1, 2 and 3 Low Water Condition are as follows:

- Level 1 - A voluntary reduction of 10%
- Level 2 – A voluntary reduction of 10%, to achieve a 20% reduction;
- Level 3 – Reduce and manage water use demands to the maximum extent through regulatory measures, if required.

Note: Specific Permits to Take Water may have conditions requiring mandatory reductions of water takings during low water events. Upon renewal of their water bottling permit, the above decreases will be mandatory based on 3-month average actual flow as outlined in the guidance for bottled water renewals (MOECC, 2017).

The frequency of OLWR notifications over time can be a potential indicator of climate stress trends for surface water (and possibly shallow groundwater where directly connected to surface water) and an indicator of watershed/subwatersheds that are sensitive to seasonal drought conditions. However, the existing OLWR program database has not been prepared for this purpose, has inconsistencies that are attributed to different persons updating the database over the years, and the database does not provide notification Levels during the time period where a Low Water Alert has been declared by a CA/municipality. This is only indicated in the database as an 'Update'. Consequently, only a general review of the information in the OLWR database is provided herein for the geographic CA/municipality relevant to the Site.

A review of the OLWR dataset indicates that no alerts have been posted by the Saugeen Valley CA since 2007. As reported by Jo-Anne Harbinson, Manager, Water Resources and Stewardship Services at Saugeen Valley CA, where notifications have been received during this time period, recent precipitation data and other factors have indicated that the posting of an Alert is not required. Given no history of Low Water Condition Alerts within the boundaries of the CA, the watershed would not appear to have a history of water scarcity.

9.4.4 Water Budget Analyses

The "Grey and Bruce Counties Groundwater Study" (Waterloo Hydrogeologic, 2003) included a desktop level water budget analysis using information on Canadian Climate Normals (1961-1990) from Agriculture and Agri-Food Canada. The assessment concluded that on a regional-scale there appears to be adequate groundwater available to meet current and future needs. However, the analysis did not consider the effects that concentrated water taking may have on the groundwater system or overall ecosystem health. Additional analysis at a watershed or sub-watershed scale was recommended to provide more information about safe groundwater yield and impacts that future development activities may have.

Since 2003, Tier 1 Water Budget assessments have been completed for the subwatersheds for all three municipal well water supply systems in the study area. The Tier 1 Water Budget estimates how much water exists in a subwatershed over a period of time, usually monthly and yearly. It accounts for water that is being added to a watershed, such as precipitation and removed (e.g. rivers flowing out) from a watershed. Stress levels for surface water and groundwater are calculated based on the net water balance and compared to threshold stress values set by the province. For the Greenock Swamp/Teeswater subwatershed where the Savarin Springs Inc. Site is located a low potential for surface water stress and a low potential for groundwater stress (for both average (annual) water demand and monthly (maximum) demand) has been determined (SGSNBPSPR, 2015). For the Saugeen River/Walkerton subwatershed located immediately to the east, similar potential stress conditions were determined with the exception that the percent water demand calculations under maximum demand conditions were near the threshold stress values set by the province. The Saugeen River/Walkerton subwatershed was advanced to a Tier 2 Water Budget assessment which used more refined water demand estimates and a more advanced water budget model. The Tier 2 assessment for the subwatershed determined that the potential for groundwater stress on the subwatershed was low and a more detailed assessment (Tier 3) was not warranted.

Based on the findings from local Water Budget analyses the Savarin Springs Inc. Site is not located in an area where hydrologic stress poses a concern for the water taking. This aligns with the findings from the OLWR program assessment.

9.5 IMPACT ASSESSMENT

The following section provides a general assessment of potential water quantity interference with other groundwater uses and the environment.

9.5.1 Municipal Groundwater Use

The Official Plan for the Formosa, Mildmay and Teeswater Settlement Areas, 2005 and amendments indicates "it is the long term objective of the plan to have full services in all three settlement areas and to initiate the necessary environmental studies to obtain this goal". However, as indicated in Section 9.3.1, the population growth rate for Formosa has been low with a projected population of 513 in 2021. Given this, the Municipality of South Bruce Public Works was contacted for information on the current status of any studies in support of development of a municipal groundwater supply for Formosa. As indicated by Gary Pipe, Operations Manager, South Bruce Public Works, no studies have been completed to date and Formosa is at least 10 years away, possibly 20 years away from developing a municipal groundwater supply source.

As indicated in Section 9.3.4.1, Formosa and the Savarin Springs Inc. Site are situated near the center of a triangle formed by Walkerton located 8 km to the north, Mildmay located 7.6 kilometers to the southeast and Teeswater located 8.7 km to the southwest. All three municipal areas are presently serviced by communal well water supply systems that are captured within the Approved Assessment Report for the SVSPA (SGSNBPSPR, 2015). As indicated by the assessment herein the Savarin Springs Inc. well is 199 m in depth, intersects multiple bedrock formations/aquifers in the study area and is likely drawing water from the same bedrock aquifers utilized by one or more of the municipal well systems. However, given the large separation distance (in excess of 5 km) from the municipal groundwater takings, the aquifer testing results from 1993 (PEL, July 1993) indicating minimal interference from the Savarin Springs Inc. well on nearby domestic wells, and a current PTTW water taking limit that has been reduced from 750 L/minute to 273 L/minute since 1993 (i.e. a 65% reduction), a potential for unacceptable well interference and/or impediment to future expansion of these existing municipal groundwater systems is not indicated.

9.5.2 Well Interference Potential

As indicated in Section 9.3.4.3, an 86 hour pumping test was completed for the Savarin Springs Inc. well (PEL, July 1993) at a continuous rate of 774 L/min (i.e. 1,114,560 L/day). A drawdown of approximately 2.0 m was observed for the pumping well 45 minutes into the test and a steady state condition with continued artesian flow was observed for the remainder of the 86 hour test. After 86 hours of pumping a maximum drawdown of 0.2 m was observed at the observation wells which were located at distances ranging from 125 m to 980 m from the pumping well. Aquifer recovery was near immediate upon pump shutoff, indicating that mining of the aquifer had not occurred. The current PTTW (No. 0282-836LBB) allows water to be taken at a maximum rate of 273 L/min (35 % of the 1993 test rate) and at a maximum taking amount per day of 327,600 L (30 % of the 1993 test rate). The current PTTW limits the water taking to a maximum of 20 hours/day allowing 4 hours/day for aquifer recovery. Based on the 1993 aquifer testing results and the current PTTW taking limits a potential for unacceptable well interference impacts to neighbouring groundwater supplies is not indicated. Further to this, no well interference complaints were identified in ministry files over the history of the water taking. In summary, the potential for unacceptable well interference with domestic wells is considered low and the need for additional quantitative prediction is not apparent.

Regarding well interference potential with future growth/development, no planned high water use activities were identified for Formosa and a low growth rate for the municipality in recent years is indicated from available information. Potential new land development(s) on private wells to the east and west of the Savarin Springs Inc. Site are expected to require site specific hydrogeologic assessment studies and well interference assessments in support of the development(s).

9.5.3 Impact to Surface Water and Natural Functions of the Ecosystem

Excess artesian water flow from the Savarin Springs Inc. well has, reportedly, been discharging to Formosa Creek for more than 100 years and is established as part of the local ecosystem. As indicated in Sections 9.3.2 and 9.3.4.3, the maintenance of water flow from the Savarin Springs Inc. well pond to Formosa Creek is considered important in maintaining the current ecosystem (i.e. for the established brook trout population). This requirement has been expressed as a public concern and has been acknowledged by the ministry. The PEL, August 1992 "Well and Stream Flow Determination" study was undertaken in response to concerns whether the withdrawal of water from the Savarin Springs Inc. well could affect the base flow of Formosa Creek. The assessment determined that the free flow from the artesian well was approximately 750 L/minute and the well pond was contributing 9% (300 to 400 L/minute) of the downstream flow in Formosa Creek during full flow conditions. The ministry reduced the maximum allowable taking rate from the source well at this time from 2,273 L/minute to 750 L/minute. The maintenance of excess artesian flow to Formosa Creek was re-assessed by the ministry in 2002 while evaluating the PTTW renewal application. A water taking condition was added to the renewed Permit at this time that limits the quantity of the water taking to 10% of the instantaneous stream flow from the Well Pond to Formosa Creek present on the day or days of taking (as also indicated in Section 3.1, Section 3.3 and Section 4.2 of the most recent PTTW No. 0282-836LBB). To meet this condition it was determined by PSM, November 2003 that a maximum pumping flow rate of 273 L/minute (60 imperial gallons per minute) is required to ensure the flow exiting the holding pond to Formosa Creek does not drop below 10% of the instantaneous base flow condition. A maximum taking rate of 273 L/minute has been specified since 2007 (PTTW No. 8731-6Y7QQR) and is currently specified under PTTW No. 0282-836LBB. While no recent or on-going ecosystem studies have been conducted for Formosa Creek, an acceptable level of impact from the current water taking is indicated based on the absence of any reported complaints in the ministry files. Completion of an ecosystem assessment is considered necessary in support of any proposed increase to the Permit water taking limits.

Based on the language used in the current PTTW the onus is on the Permit Holder to comply with the water taking conditions. It was noted that annual records of water taking and staff gauge calibration were not present in the files. As per Condition 4.3 of the permit, this information is to be submitted by the Permit Holder to the MECP Owen Sound Area Office by December 31st of each year. It is recommended that the ministry's Owen Sound District Office follow up on this information gap and/or decide whether this Permit condition is of any value since water taking data is reported to the WTRS and the provision of staff gauge calibration information provides little added protection for the environment if it is not reviewed.

9.6 SUSTAINABILITY OF WATER RESOURCES

Water resources are considered sustainable if the total amount of water entering, leaving, and being stored in the system meet existing needs without compromising the ability to meet the needs in the future. Typical indicators used to assess the sustainability of water quantity include Water Budgets completed at the watershed/subwatershed scale and/or for the specific water taking(s) and the evaluation water level data for trends over time to ensure resources are remaining in a steady state. The following provides a general assessment of the sustainability of regional water resources and of the potential impact from the Savarin Springs Inc. water taking on sustainability, now and in the future.

Regional Water Resources

The characterization of the regional study area indicates that the Savarin Springs Inc. Site is located in the Greenock Swamp/Teeswater subwatershed where both groundwater stress and surface water stress was categorized as Low based on Tier 1 Water Budget analyses (SGSNBPSPR, 2015). The Water Budget analyses considered existing water demand and projected future water demand. A low population growth rate is indicated for the Municipality of South Bruce with new growth focused on the existing communities within the municipality. Consequently, stresses presented by existing and future demand are not an identified concern for the sustainability of water resources within the regional study area.

The OLWR Program uses real time surface water monitoring data collected from the WSC stream gauge (HYDAT) station network to identify potential drought conditions based on set trigger levels. BluMetric's review of the OLWR Program notification data (2000 to August 2018) for the Grey Sauble CA did not identify any specific trends indicating the depletion in the availability of surface water (and possibly shallow groundwater where directly connected to surface water) resources. BluMetric's review of PGMN groundwater level data for 1 overburden well and 2 bedrock wells located within 10 km of the Savarin Springs Inc. water taking also did not identify any specific trends indicating a potential depletion in the availability of regional groundwater resources.

The 'Approved Assessment Report for the Saugeen Valley Source Protection Area' (SGSNBPSPR, 2015) includes a chapter on climate change and the potential impacts in the future. The report discussion indicates that climate change has the potential for increased stress levels for groundwater and surface water in the Great Lakes Basin. The amount and availability of municipal drinking water in the Saugeen Valley SPA is not expected to be significantly impacted by changes in climate in the next few decades. The SGSNBPSPR, 2015 report indicates the largest impact is expected for private overburden wells and Karstic systems; however, very little research is available to estimate the magnitude of these potential impacts.

In summary, based on the information reviewed, no stress concerns were identified for the sustainability of regional water quantity resources.

Savarin Springs Inc. Water Taking

Historical information relating to the Savarin Springs Inc. water source indicates that the well is in excess of one hundred years old, has likely produced a continuous artesian flow since the date of its construction, and the artesian flow is now established as part of the local ecosystem.

Aquifer testing of the Savarin Springs Inc. well indicates the presence of a high transmissivity bedrock aquifer source. Artesian flow exists for the source well with a static head elevation several meters above ground level. Artesian flow has also been identified/reported for many neighbouring well water supplies located within 500 m. Minimal drawdown (maximum of 0.2 m) was observed for observation wells located from 125 m to 980 m from the pumping well during the 86-hour continuous rate pumping test. Aquifer testing was conducted at 774 L/minute, nearly 3 times the current permit limit of 273 L/minute. Aquifer recovery was near immediate at the end of the pumping test, indicating that mining of the aquifer had not occurred during the duration of the test.

Despite regular pumping of the well for bottled water use since 1989, the artesian flow of the well has continued. The current PTTW water taking limit of 273 L/minute is reduced by 65% from the permit limit of 750 L/minute in 1992. The reduction of the permit water taking limit was necessary to ensure sufficient excess water flow into Formosa Creek is maintained and not due to groundwater resource quantity concerns or well interference complaints. Though groundwater level monitoring has not been possible for the water taking, the continued artesian water flow for the well indicates that the groundwater resource has remained sustainable. Since the water taking source is contributing to local surface water resources, rather than taking from this resource, no impact on the sustainability of surface water resources are indicated.

The WTRS database did not identify any other high volume water taking activities of potential concern for sustainability of the local bedrock aquifer. The information review also did not identify any other planned water taking activities that might contribute to the overall cumulative effects/impacts on local groundwater resources.

Based on the information reviewed, there are no indicators of the Savarin Springs Inc. water taking having an impact on the sustainability of existing and future water resources. Consequently, it is BluMetric's opinion that the water taking is being managed sustainably. The permit requirements/conditions as summarized in Section 9.1 are deemed adequate with the primary water resource management control designed to ensure that adequate flow to Formosa Creek is maintained.

9.7 GAPS AND RECOMMENDATIONS

A summary of information gaps and potential enhancements identified from the assessment of the Savarin Springs Inc. WBSA is provided as follows:

1. No baseline or on-going ecosystem studies have been conducted for Formosa Creek, but an acceptable level of impact from the current water taking is indicated based on the absence of any reported complaints in the ministry files. Completion of an ecosystem assessment is considered necessary in support of any proposed increase to the Permit water taking limits, or if any complaints or concerns are raised about ecosystem impacts.

9.8 FIGURES

Figures are provided in Appendix A-Main Figures.

10. SUMMARY OF GAPS AND RECOMMENDATIONS

A summary of the findings from the information review completed for the 7 WBSAs is provided as Appendix B - Table 10-1. A summary of the gaps and recommendations developed from the assessment of the seven WBSA Sites is provided as follows.

10.1 WBSA Specific Gaps and Recommendations

The gaps identified in the water quantity information for each WBSA, if any, and the recommended action(s) to address each gap are included on Table 10-1 and in the WBSA specific chapters of this report. No information gaps or potential enhancements were identified for one WBSA:

- Aquaterra Corp. Ltd. Cataract Site Caledon

Information gaps and/or potential enhancements identified for the remaining six WBSA are summarized as follows:

- Gott Enterprises Inc. Grey Highlands

The most recent monitoring report provided for review (for 2015) was received by the ministry in 2016. The long term water level monitoring hydrographs presented in the report do not provide data beyond 2011. The long term water level monitoring data hydrographs need to be updated for the annual reports as they are the key indicator in confirming steady state conditions for the water resources and confirming the water taking is sustainable.

- Gott Enterprises Inc. Alnwick/ Haldimand

For Gott Enterprises Inc. Alnwick/ Haldimand it was noted that the property boundaries indicated in the AECOM, February 2018 report did not appear in previous documentation for the Site. The property boundaries are not consistent with the property boundaries indicated in the ORE, March 1997 report and do not appear to match the legal description provided in PTTW No. 8404-7YBLB2. If the property boundaries have changed for the Site, this will need to be indicated for a Permit Renewal.

Also, for the Gott Enterprises Inc. Alnwick/ Haldimand Site it was noted that the monitoring program requirements as approved by the ministry over the time period since 1997 have changed from the requirements indicated in PTTW No. 8404-7YBLB2. The monitoring program conditions should be updated in a Permit renewal and include specific requirements/locations for monitoring to ensure the assessment of potential impacts from the water taking are adequately scoped and that the monitoring program is clearly understood.

- Gott Enterprises Inc. Amaranth

For Gott Enterprises Inc. Amaranth no Site cross sections identifying geology and hydrostratigraphic units were identified in the documentation reviewed. It is BluMetric's opinion that provision of cross sections is necessary in support of the conceptual hydrogeological model for the Site.

- Gold Mountain Springs Inc. Oro-Medonte

Presently, the Gold Mountain Springs Inc. PTTW has no groundwater level monitoring requirements. Re-implementation of an on-site groundwater monitoring program for the three overburden aquifers located at the Site (using the multi-level monitoring well) and the two production wells was recommended in the Wilson, 2017 report. It is BluMetric's opinion that a groundwater level monitoring program should be implemented as a PTTW condition for the Site. The groundwater level monitoring program provides a measure of security in ensuring the groundwater resource utilized by the water taking remains sustainable in the future with potential changing climate conditions and potential increasing growth pressures.

- Robins Holdings Ltd. Alnwick/ Haldimand

No monitoring data is available for the Robin Holdings Inc. water taking since May 2006. Consequently, only limited data was available for assessment of the water taking impact on local water resources. Data collected since May 2006 will need to be provided by Robins Holdings Inc. in support of a Permit renewal.

- Savarin Springs Inc. South Bruce

For Savarin Springs Inc. it was noted that annual records of water taking and staff gauge calibration were not present in the ministry files. As per Condition 4.3 of the permit, this information is to be submitted by the Permit Holder to the MECP Owen Sound Area Office by December 31st of each year. It is recommended that the ministry's Owen Sound District Office follow up on the information gap with the Water Bottler. This Permit condition as currently administered does not appear to be of any value for protection of the environment and the ministry should re-evaluate this condition for a Permit renewal.

Also for Savarin Springs Inc., no baseline or on-going ecosystem studies were identified for Formosa Creek which receives excess water overflow from the Savarin Springs Inc. well and baseflow from the Site. While no recent or on-going ecosystem studies have been conducted for Formosa Creek, an acceptable level of impact from the current water taking is indicated based on the absence of any reported complaints in the ministry files. Completion of an ecosystem assessment is considered necessary in support of any proposed increase to the Permit water taking limits, or if any complaints or concerns are raised about ecosystem impacts.

10.2 Gaps and Recommendations for All Sites to Enhance the Water Quantity Management Frame ² ork

The gaps and recommendations relating to all WBSA are included in Table 10-1 and discussed further below.

Data Availability to Assess Sustainability - As indicated herein, typical indicators used to assess the sustainability of water quantity include Water Budgets completed at the watershed/subwatershed scale and/or for the specific water taking(s) and the evaluation of long term water level monitoring data for trends over time to ensure resources are remaining in a steady state.

For all 7 WBSA reviewed, Tier 1 and/or Tier 2 Water Budget analyses for the associated watershed/subwatershed were available for assessment of potential stress levels on regional water quantity resources. All water budget analyses considered existing and projected future demand. The incorporation of climate change scenarios were only apparent where a Tier 2 Water Budget analyses had been done.

PGMN wells were identified within 10 km of all WBSA water takings with ambient (baseline) groundwater level data available for assessment. However, as indicated for the Gott Enterprises Inc. (Amaranth) water taking, the only PGMN well within 10 km was an overburden well and the water taking source is a bedrock aquifer. Also, as discussed in further detail below, the water level data for many PGMN wells has not been updated in many years and, therefore recent data is often not available for consideration.

Groundwater and/or surface water level monitoring programs were identified as PTTW requirements for all WBSA with the exception of Gold Mountain Springs Inc. The presentation of hydrographs with long term water level data (e.g. groundwater level and surface water level data collected over many years) was identified as the best available science in assessing whether steady state conditions exist and for addressing sustainability of the water taking. On-going monitoring also provides a measure for identifying potential issues should climate change and growth pressures become a larger factor in the sustainability of water resources. Consequently, on-going monitoring and the presentation of long term monitoring data as hydrographs is recommended for all WBSAs to establish that the water taking is sustainable now and in the future. Implementation of an appropriate monitoring program is also a recommended requirement in the MECP's "Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to Take Water Applications and Hydrogeological Study Requirements, April 2017".

<u>OLWR Program Database</u> – The OLWR Program uses real time surface water monitoring data collected from the WSC stream gauge (HYDAT) station network to identify potential drought conditions based on set trigger levels. The current database was not designed to assess potential climate change trends and contains some data entry inconsistencies that are attributed to different persons updating the database over the years. The database also does not indicate notification Levels during the time period where a Low Water Alert has been declared by a CA/municipality. It is recommended that the OLWR Program database be reviewed to identify improvements that will enhance the use of OLWR 'Notifications' as a tool for assessing trends in the availability of surface water, and possibly shallow groundwater resources. Integration of PGMN groundwater level data into the OLWR Program would provide a further enhancement by providing a monthly status of groundwater levels within the watershed. Timely release of the integrated data would allow for timely response to Alert conditions.

<u>PGMN Database</u> – For the PGMN database it was noted that data for many PGMN wells has not been updated in many years (some wells not since 2010). It is understood that the current method of data management requires multiple tiers of data review before data is released. It is also understood that the smaller CA's generally do not have the resources to maintain the PGMN network stations and complete a timely review of the PGMN data. The current system of data management for the PGMN network should be reviewed to create a system that will ensure the timely release of date.

File Management – The ministry file management system remains reliant on the storage and management of hard copy files. For the WBSA file review it was apparent that most documentation for the WBSAs is in hard copy only. Hard copy documentation storage and file management is considered inefficient for timely access to information and poses a number of challenges and risks. Challenges are associated with access to files that get moved from desk to desk. Risks are associated with the potential misplacement of files and the potential loss of hard copy documents to fire or other forms of damage. Transitioning file management to an e-based system is recommended.

Respectfully submitted,
BluMetric Environmental Inc.

Robert Hillier, B.Sc., P.Geo.
Senior Hydrogeologist

Tiffany Svensson, M.Sc., P.Geo.
Project Manager/ Senior Hydrogeologist

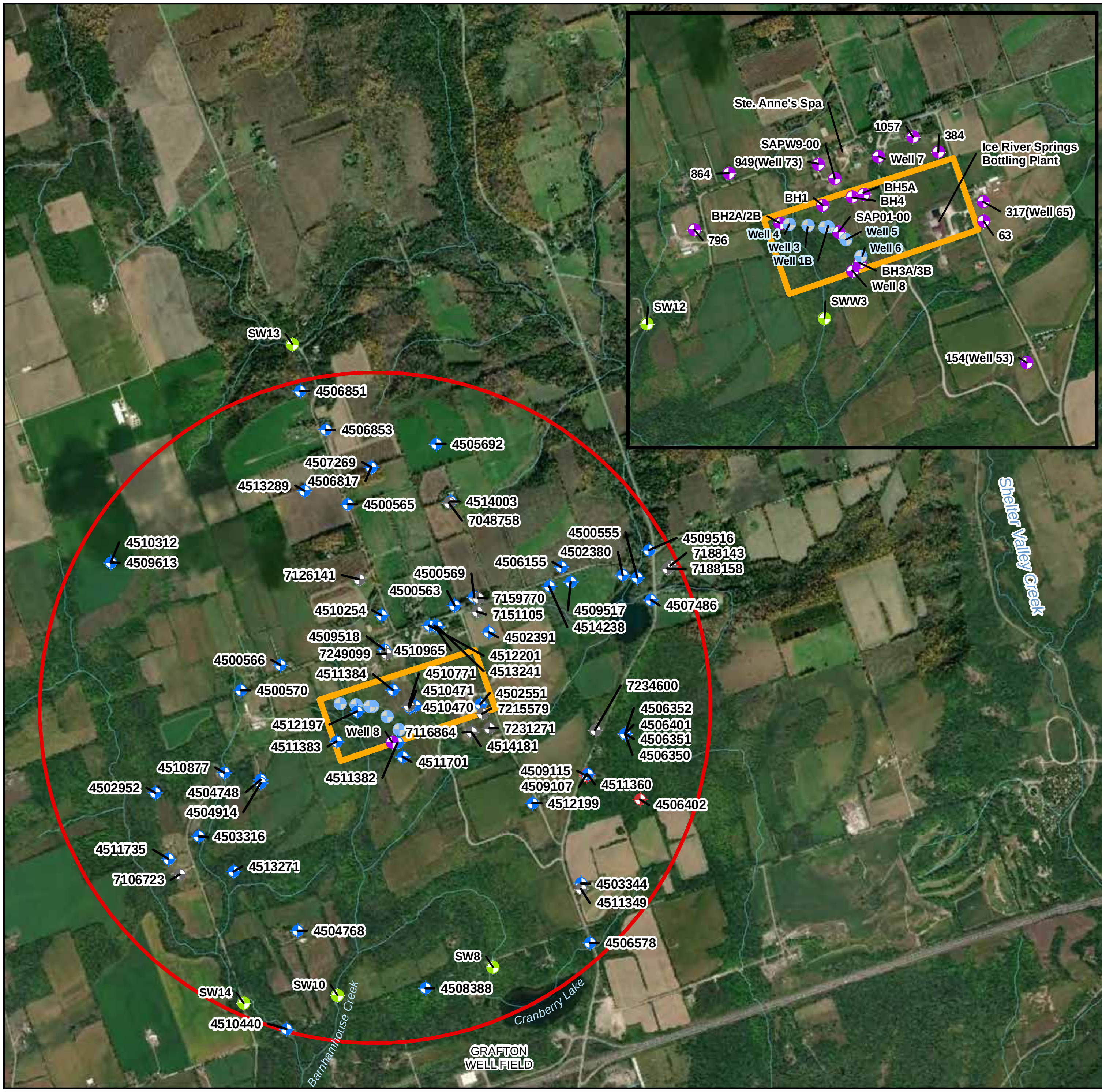
Muriel Kim-Brisson, M.Sc.
Environmental Scientist

11. REFERENCES

A list of references is provided in the 'Primary Information Sources' section of each chapter.

APPENDIX A

Main Figures



LEGEND

- Observation/Residential Well
- Surface Water Monitor
- Bedrock Well
- Overburden Well
- Unknown Well Type
- Source Well Locations
- Gott Enterprises Haldimand 2000 m Radius
- Gott Enterprises Inc. Haldimand Property Boundary

NOTE:
MECP well records sourced from MECP, 2018.
Source Wells, Observation/Residential Well, Surface Water Monitoring stations sourced from AECOM Ste. Anne's Well Field Gott Enterprises Inc. Annual Monitoring Report, April 2014 and Site Plan, January 2018.

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
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REFERENCES

N W E S

0 500 1,000 Meters

CLIENT

MECP

PROJECT

Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Alnwick-Haldimand Source Location and Site Plan

BluMetric Environmental
171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
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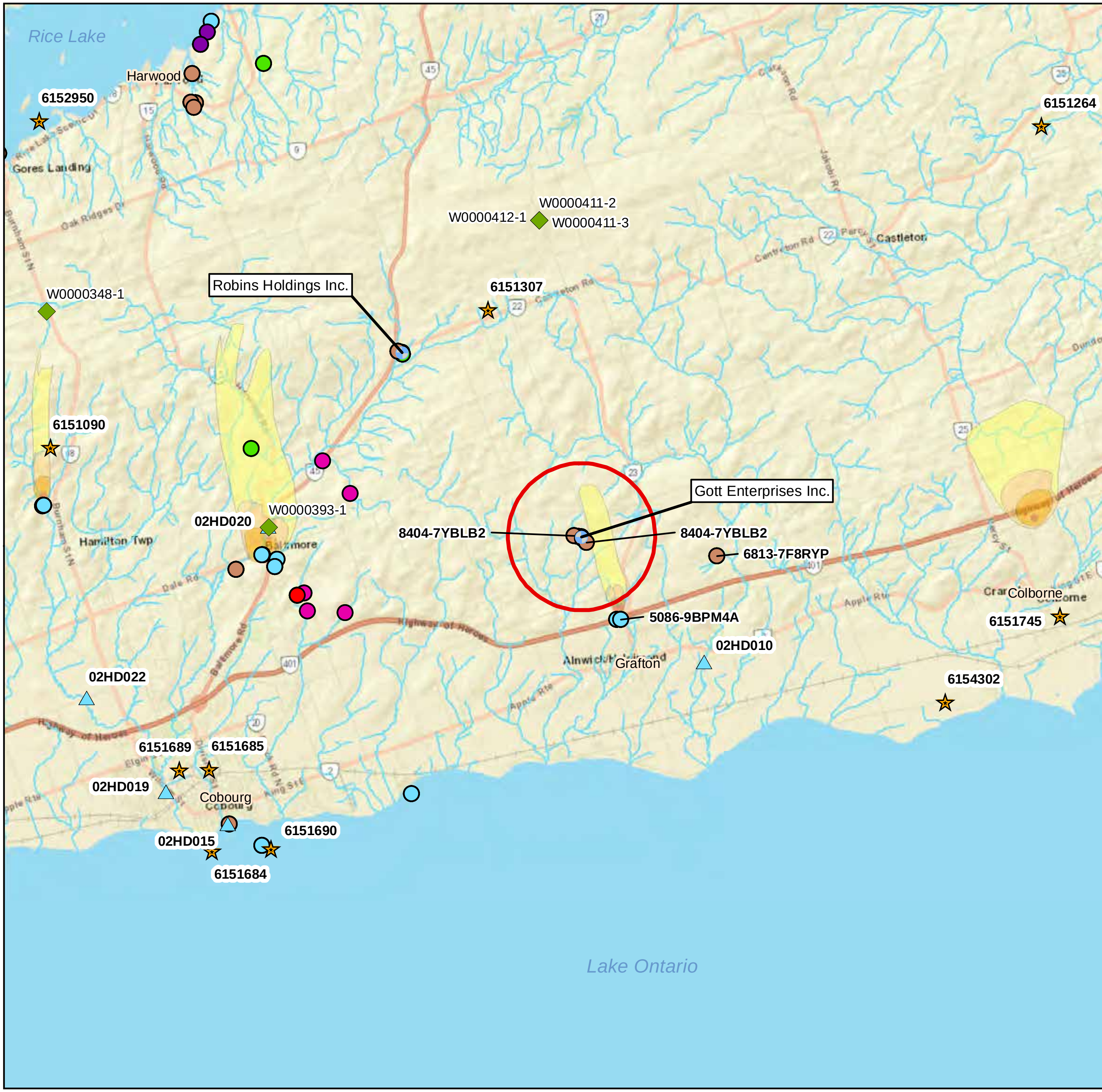

LEGEND

- Source Well Location
- Provincial Groundwater Monitoring Network Wells and ID

WTRS (Active PTTW) and Use

- Agricultural
- Commercial
- Industrial
- Institutional
- Miscellaneous
- Recreational
- Remediation
- Water Supply

- Weather Stations and ID
- HYDAT Stations and ID
- Source Well 2000 m Radius

Municipal Well Head Protection Areas - Quality

- A - 100 m Radius
- B - 2 Year Time of Travel
- C - 5 Year Time of Travel
- D - 25 Year Time of Travel

NOTE:
Base Map: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan
Municipal Wellhead Protection Areas: MECP, http://www.applications.ene.gov.on.ca/swp/en/index.php
Active PTTWs: MECP, 2018. https://www.ontario.ca/environment-and-energy/map-permits-take-water
Provincial Groundwater Monitoring Network: MECP, https://www.ontario.ca/environment-and-energy/map-provincial-groundwater-monitoring-network
Weather Stations: Government of Canada, http://climate.weather.gc.ca/
HYDAT stations: Government of Canada, https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey/data-products-services/national-archive-hydat.html

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REFERENCES

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Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Alnwick-Haldimand Regional Study Area

BluMetric Environmental
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TEL: (519) 742-6685
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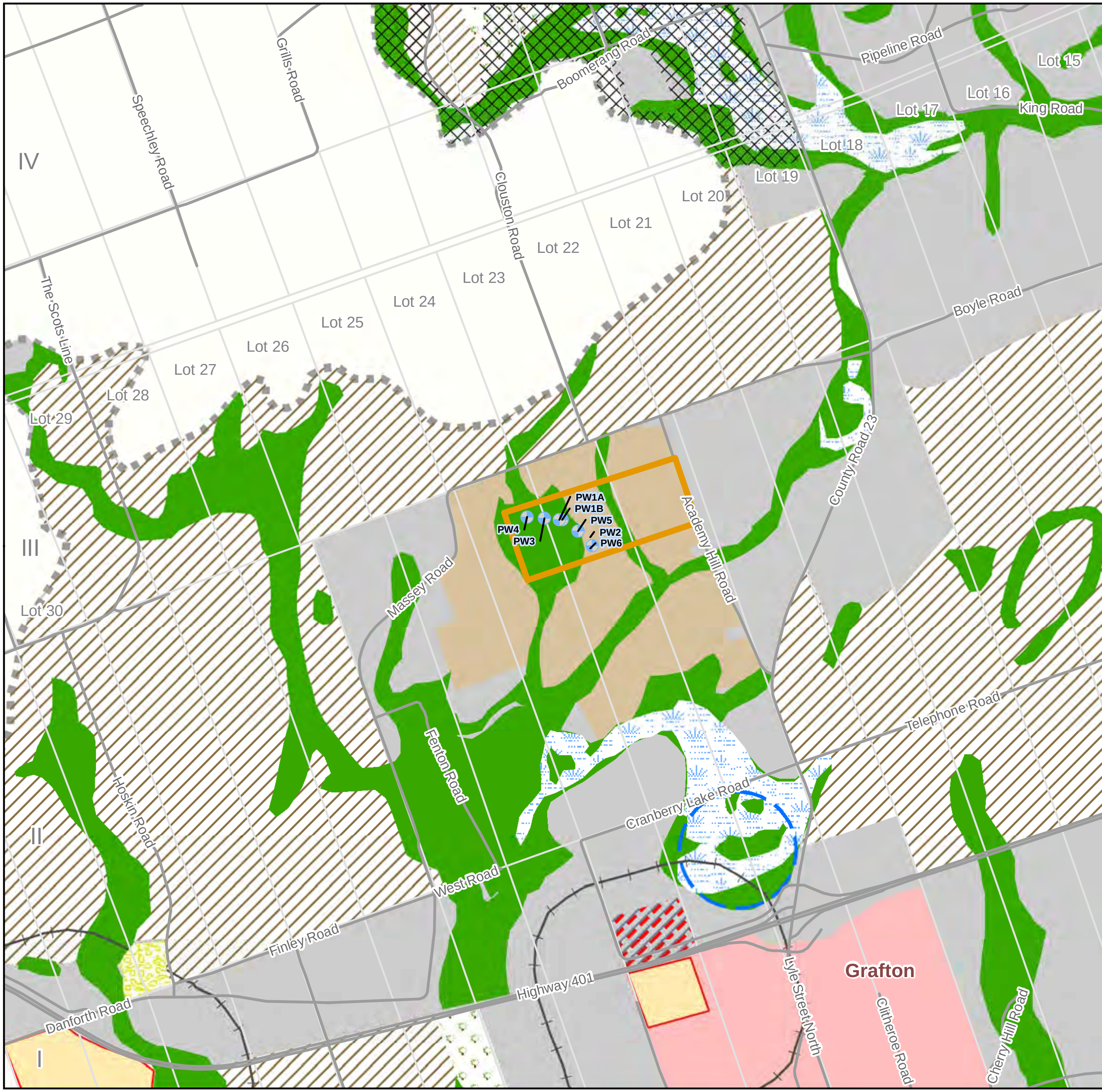

LEGEND

- Source Well Locations
- Gott Enterprises Inc. Haldimand Property Boundary
- Parcels

Land Use Classification

- Municipal Wellhead & Policy Area
- Provincially Significant ANSI
- Aggregate Resource
- Environmental Protection / PSW
- Waste Disposal Assessment Area
- Environmental Protection
- Agricultural
- Industrial
- Oak Ridges Moraine Boundary
- Waste Disposal C-Closed
- Hamlet
- Recreational / Conservation
- Resort
- Agricultural
- Rural

NOTE:
Land use information sourced from the Official Plan of the Township of Alnwick/Haldimand, Schedule "A" Land Use Plan, March 9, 2016.

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REFERENCES

N W E S

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PROJECT

Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Alnwick-Haldimand
Land Use Setting

BluMetric™ Environmental
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180107-07	December 03, 2018		
DRAWN	CHECKED	FIG NO.	REV
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LEGEND

Source Well Location

Source Well 2000 m Radius

Physiography

- 2: Till Moraines
- 3: Spillways
- 4: Kame Moraines
- 6: Till Plains (Drumlinized)
- 7: Drumlins
- 9: Limestone Plains
- 11: Sand Plains
- 12: Clay Plains
- 13: Eskers
- 14: Beaches
- 17: Peat And Muck

NOTE:
Physiography data sourced from Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228. Chapman, L.J. and Putnam, D.F. 2007. (Chapman and Putnam, 2007).

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Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Alnwick-Haldimand Physiography

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171 Victoria St. N.,
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PROJECT #	DATE
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LEGEND

- Source Well Location
- Source Well 2000 m Radius
- Waterbody
- Conservation Authority
- Quaternary Watershed Boundaries
- Watercourse

Elevation Contours

- 20 m
- 100 m

NOTE:
Conservation authority and watershed boundaries sourced from MECP, 2018.
All topographic features including waterbody, watercourse, and elevation contours sourced from CanVec, 2017.

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REFERENCES

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Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Alnwick-Haldimand Regional Topography and Watersheds

BluMetric™ Environmental

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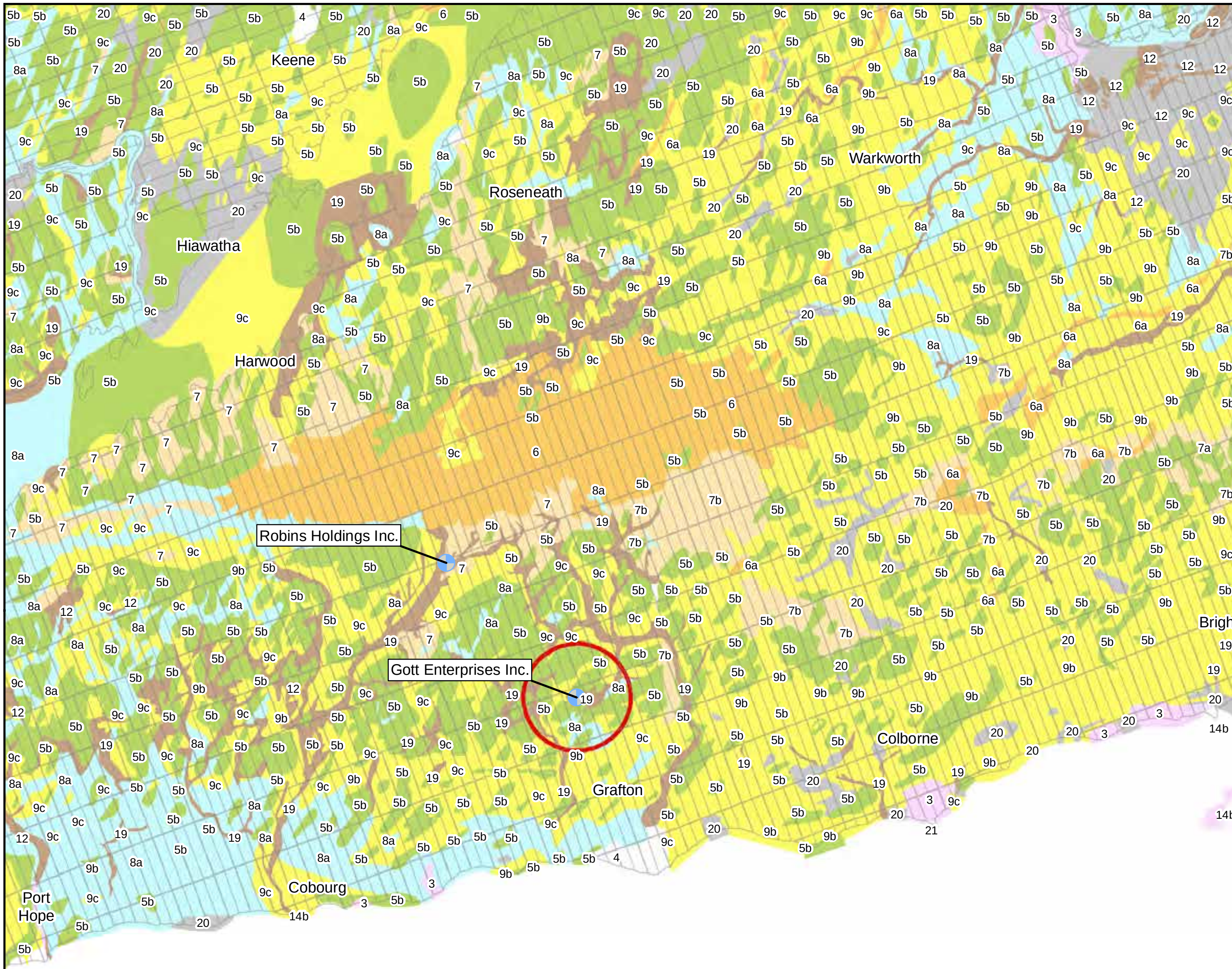

LEGEND

Source Well Location

Source Well 2000 m Radius

Surficial Geology (MNDM File - MRD128-REV)

3: Paleozoic bedrock

5b: Stone-poor, carbonate-derived silty to sandy till

6: Ice-contact stratified deposits

6a: In moraines, eskers, kames and crevasse fills

7: Glaciofluvial deposits

7a: Sandy deposits

7b: Gravelly deposits

8a: Massive-well laminated

9b: Littoral deposits

9c: Foreshore-basinal deposits

12: Older alluvial deposits

19: Modern alluvial deposits

20: Organic deposits

NOTE:
Surficial geology features sourced from Surficial Geology of Ontario; MNDM File - MRD128-REV. Ontario Geological Survey, 2010. (OGS, 2010).

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Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Alnwick-Haldimand Surficial Geology

BluMetric™ Environmental

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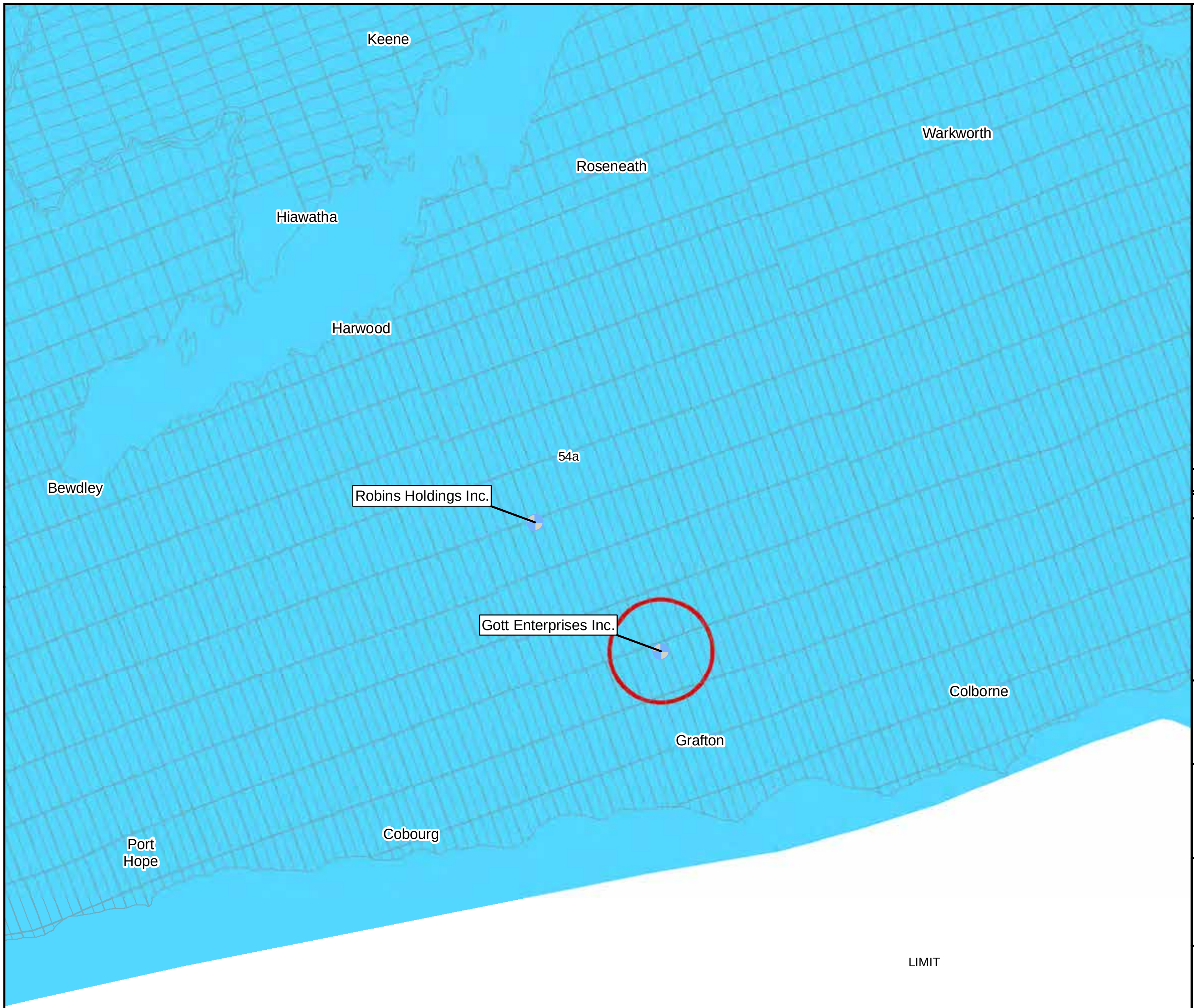

LEGEND

Source Well Location

Source Well 2000 m Radius

Middle Ordovician - limestone, dolostone, shale, arkose, sandstone

54a - Ottawa Group; Simcoe Group; Shadow Lake Formation (now considered Upper Ordovician)

NOTE:
Bedrock geology features sourced from Bedrock Geology of Ontario; MNDM File - MRD126-REV1. Ontario Geological Survey, 2011. (OGS, 2011).

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REFERENCES

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0 5 10 Kilometers

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MECP

PROJECT

Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Alnwick-Haldimand
Bedrock Geology

BluMetric Environmental

171 Victoria St. N.,
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180107-07	December 03, 2018

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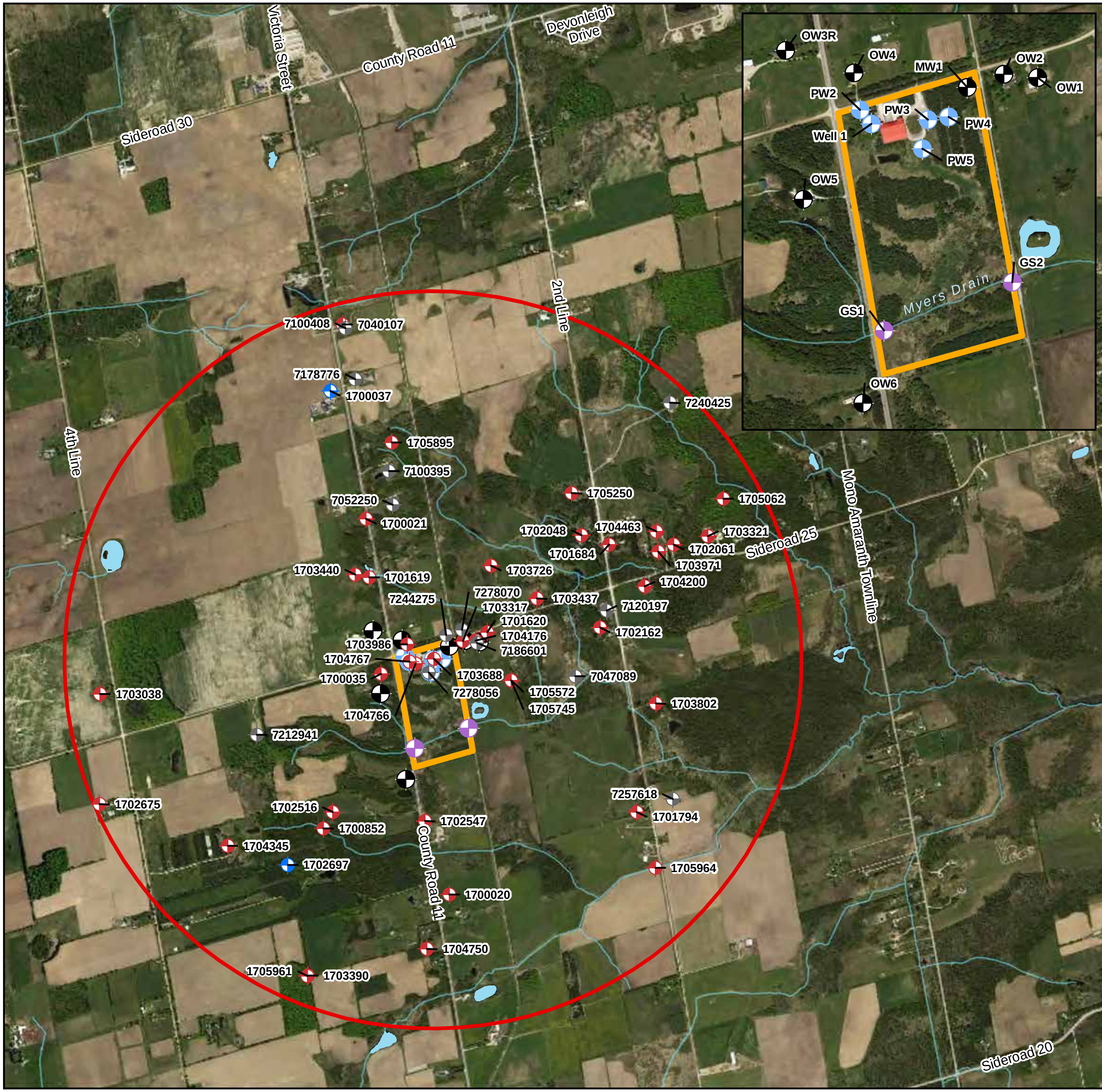

LEGEND

- Bedrock Well
- Overburden Well
- Unknown Well Type

Amaranth Well Locations

- Myers Drain Monitoring Station
- Groundwater Monitoring Location
- Source Well
- Gott Enterprises Amaranth 2000m Radius
- Gott Enterprises Inc Amaranth Property Boundary

NOTE:
MECP well records sourced from MECP, 2018.

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REFERENCES

N W E S

0 500 1,000 Meters

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Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Amaranth Source Location and Site Plan

BluMetric™ Environmental

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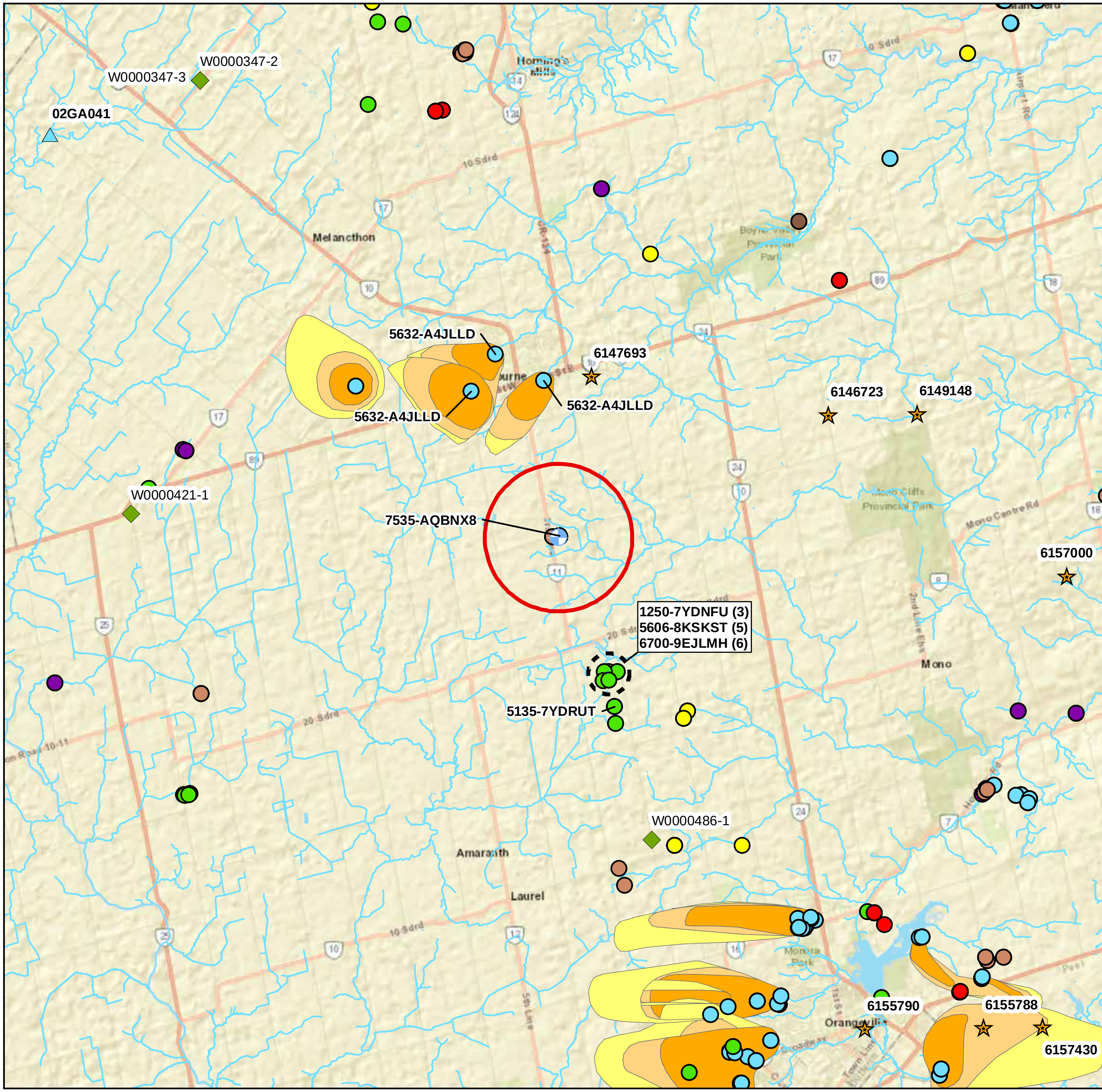

LEGEND

Source Well

Provincial Groundwater Monitoring Network Wells and ID

WTRS (Active PTTW) and Use

- Agricultural
- Commercial
- Industrial
- Institutional
- Miscellaneous
- Recreational
- Remediation
- Water Supply

Weather Stations and ID

HYDAT Stations and ID

Gott Enterprises Amaranth 2000m Radius

Quality

- A - 100 m Radius
- B - 2 Year Time of Travel
- C - 5 Year Time of Travel
- D - 25 Year Time of Travel

NOTE:
Base Map: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan
Municipal Wellhead Protection Areas: MECP, http://www.applications.ene.gov.on.ca/swp/en/index.php
Active PTTWs: MECP, 2018. https://www.ontario.ca/environment-and-energy/map-permits-take-water
Provincial Groundwater Monitoring Network: MECP, https://www.ontario.ca/environment-and-energy/map-provincial-groundwater-monitoring-network
Weather Stations: Government of Canada, http://climate.weather.gc.ca/
HYDAT stations: Government of Canada, https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey/data-products-services/national-archive-hydat.html

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0 2 4 Kilometers

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CLIENT

MECP

PROJECT

Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Amaranth Regional Study Area

BluMetric™ Environmental

171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	January 02, 2019

DRAWN	CHECKED	FIG NO.	REV
KH	RH	4-2	0

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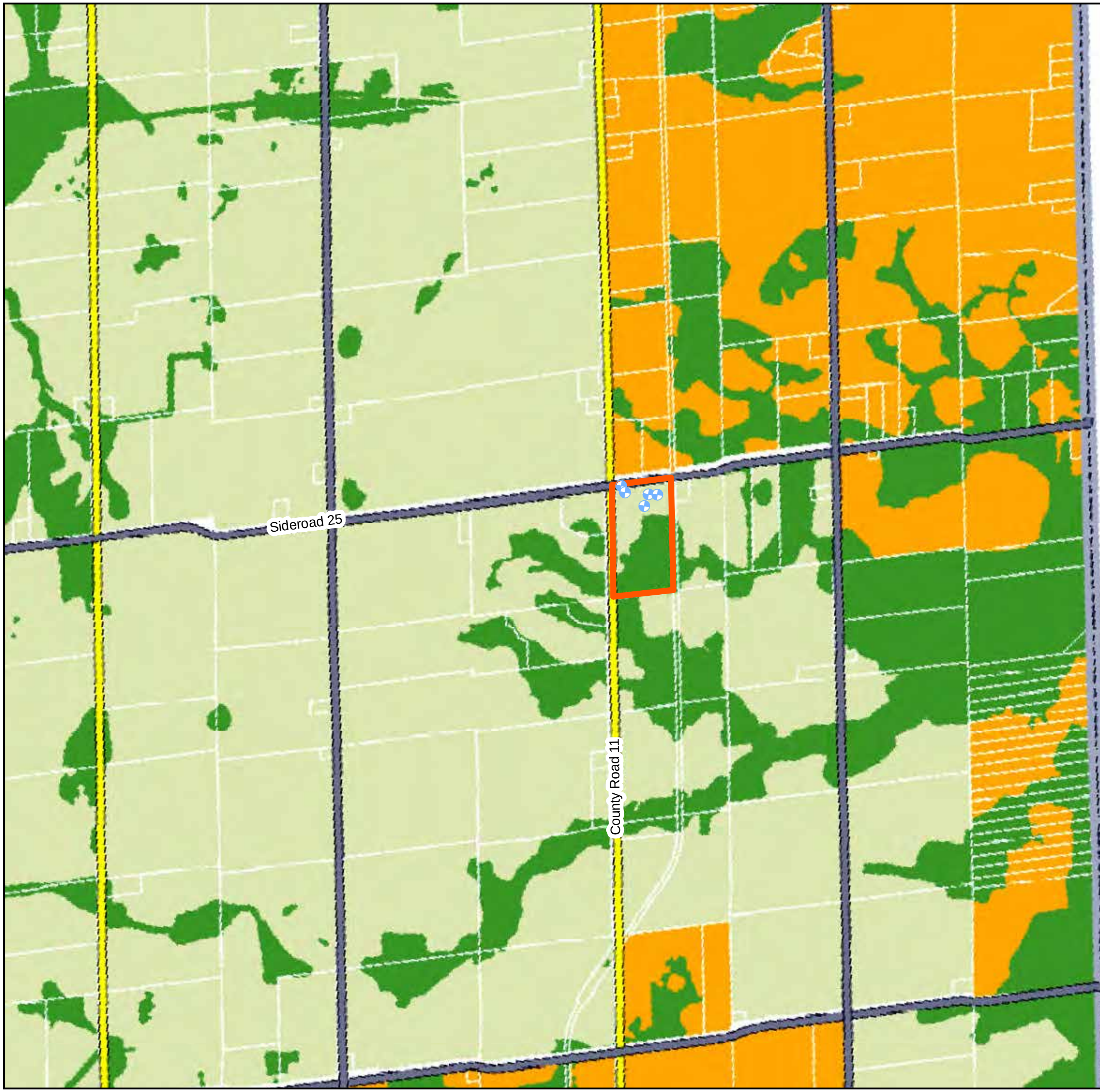

LEGEND

Source Wells

Gott Enterprises Inc. Amaranth Property Boundary

Land Use Classification

Agricultural

Environmental Protection

Rural

NOTE:
Land Use Information is sourced from the Township of Amaranth Official Plan Schedule "A" - Land Use & Transportation, July 19, 2011

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

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0 500 1,000 Meters

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MECP

PROJECT

Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Amaranth Land Use Setting

BluMetric™ Environmental

171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
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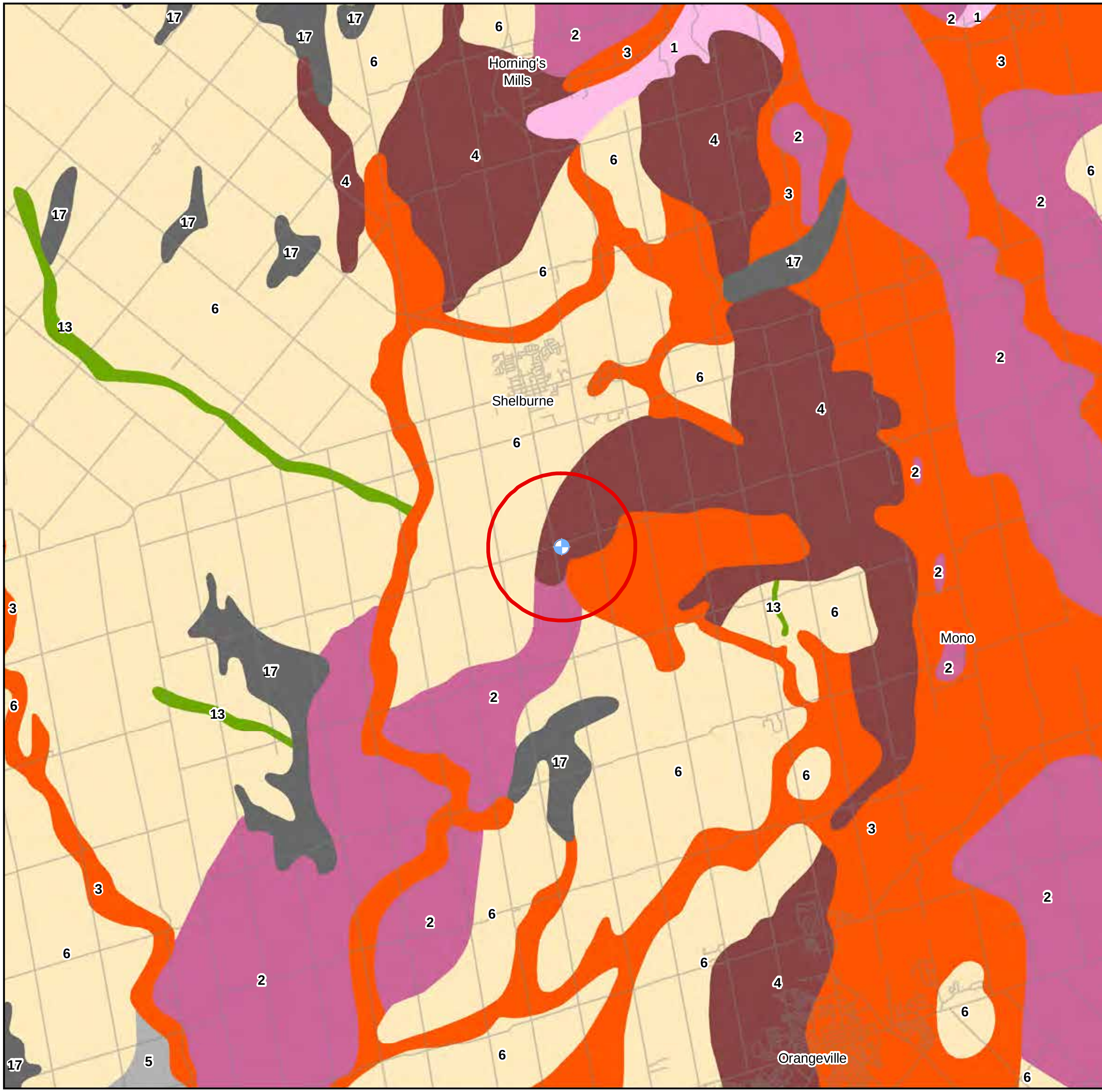
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	4-3	0

K:\Projects\MOECC\07 - WBSA\Gott Enterprises\Amaranth\MXD\2018-12-03 TitleChange\180107-07-GottEnt-Amaranth-Fig4-3-LandUse.mxd



LEGEND

Source Well

Gott Enterprises Amaranth 2000m Radius

Physiography

- 13. Eskers
- 1. Escarpments
- 2: Till Moraines
- 3: Spillways
- 4: Kame Moraines
- 5: Till Plains (Undrumlinized)
- 6: Till Plains (Drumlinized)
- 17: Peat And Muck

NOTE:
Physiography data sourced from Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228. Chapman, L.J. and Putnam, D.F. 2007. (Chapman and Putnam, 2007).

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

0 2 4 Kilometers

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PROJECT
Water Bottling Study Areas Report

TITLE
Gott Enterprises Inc. Amaranth Physiography

BluMetric™ Environmental
171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
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FAX: (519) 742-9810
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PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	4-4	0

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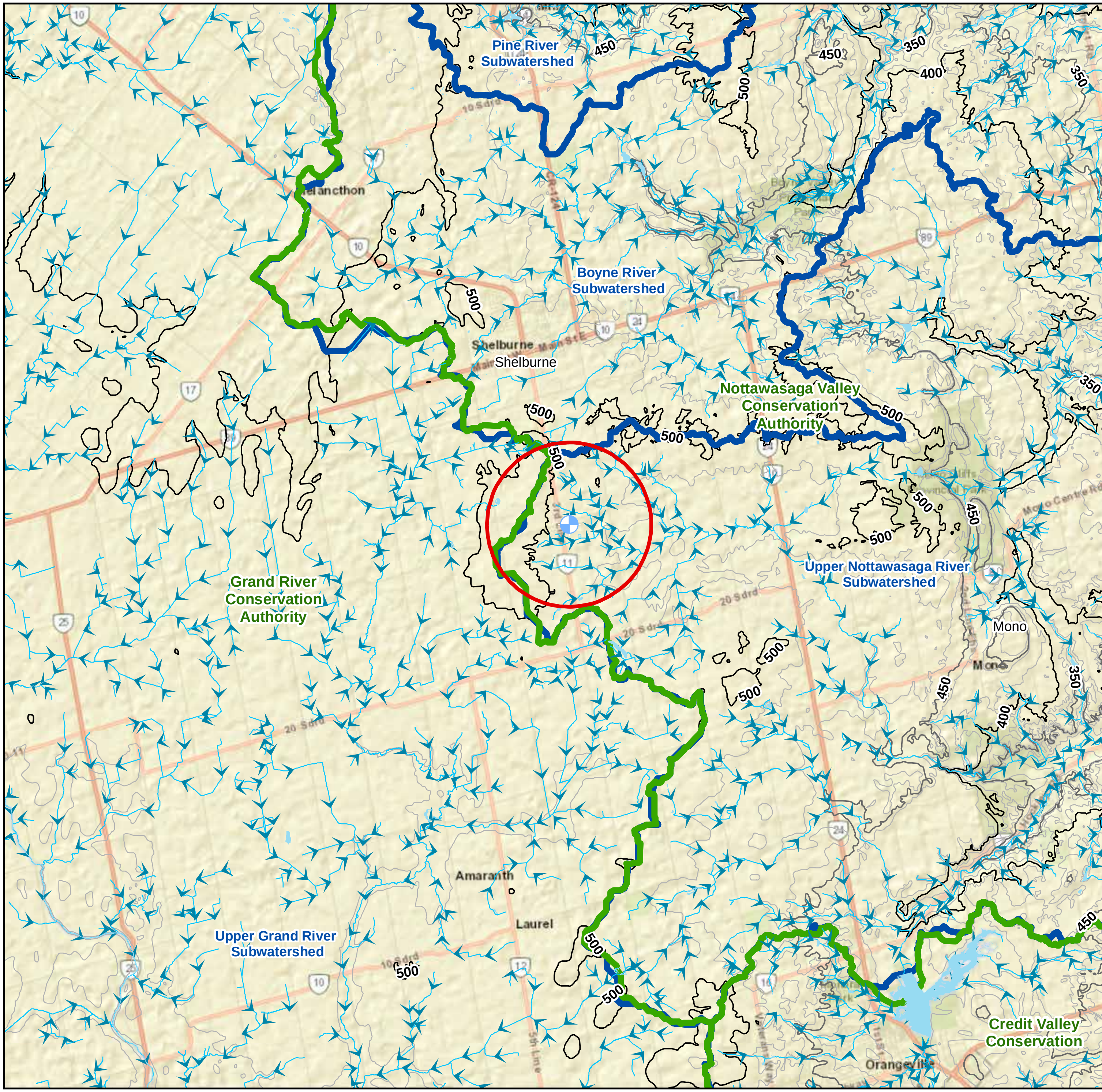

LEGEND

- Source Well
- Gott Enterprises Amaranth 2000m Radius
- Watercourse
- Conservation Authority
- Quaternary Watershed Boundaries

elevation

- 20 m
- 50 m
- 100 m

NOTE:
Conservation authority and watershed boundaries sourced from MECP, 2018.
All topographic features including waterbody, watercourse, and elevation contours sourced from CanVec, 2017.

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

0 2 4 Kilometers

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PROJECT

Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Amaranth
Regional Topography and Watersheds

BluMetric Environmental
171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
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PROJECT #		DATE	
180107-07		December 03, 2018	
DRAWN	CHECKED	FIG NO.	REV
KH	RH	4-5	0

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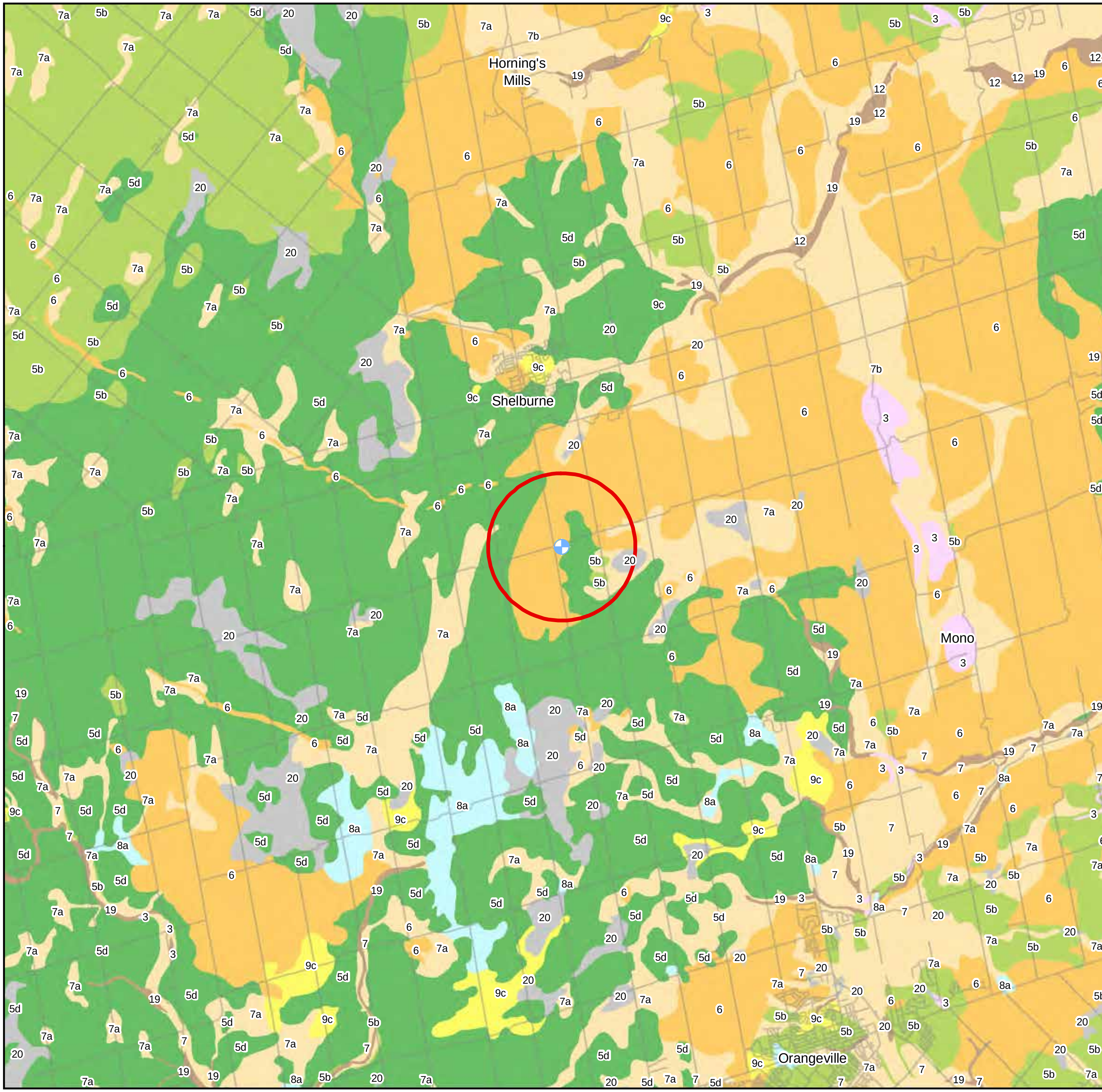

LEGEND

Source Well

Gott Enterprises Amaranth 2000m Radius

Surficial Geology (MNDM File - MRD128-REV)

- 3: Paleozoic bedrock
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 5d: Glaciolacustrine-derived silty to clayey till
- 6: Ice-contact stratified deposits
- 7: Glaciofluvial deposits
- 7a: Sandy deposits
- 7b: Gravelly deposits
- 8a: Massive-well laminated
- 9c: Foreshore-basinal deposits
- 12: Older alluvial deposits
- 19: Modern alluvial deposits
- 20: Organic deposits

NOTE:
Surficial geology features sourced from Surficial Geology of Ontario; MNDM File - MRD128-REV. Ontario Geological Survey, 2010. (OGS, 2010).

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

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PROJECT

Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Amaranth
Surficial Geology

BluMetric™ Environmental

171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
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PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	4-6	0

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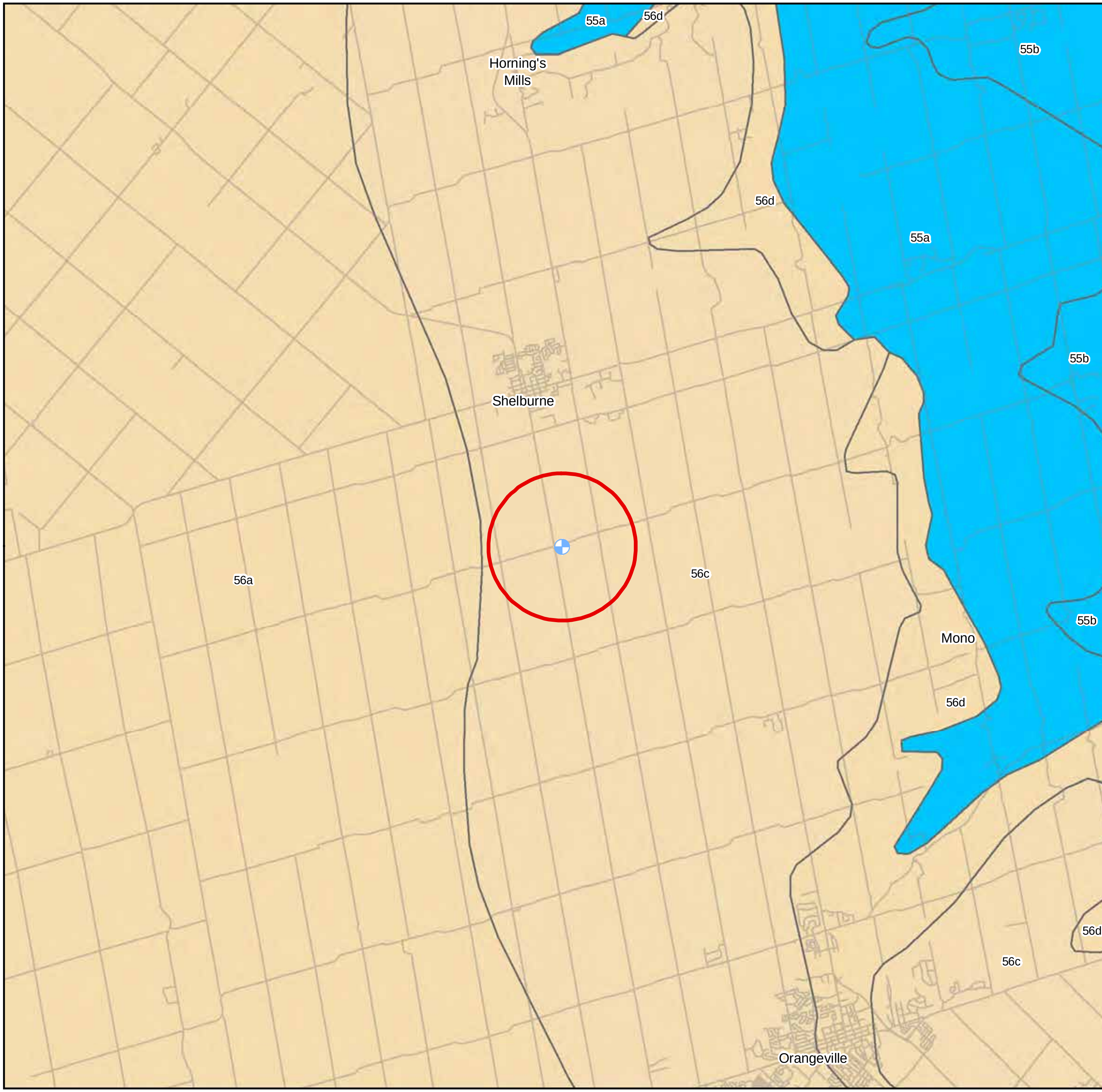


LEGEND

Source Well

Gott Enterprises Amaranth 2000m Radius

Lower Silurian - sandstone, shale, dolostone, siltstone

56a - Guelph Formation (also present in the Upper Silurian)

56c - Lockport Formation

56d - Amabel Formation

Upper Ordovician - shale, limestone, dolostone, siltstone

55a - Queenston Formation

55b - Georgian Bay Formation; Blue Mountain Formation; Billings Formation; Collingwood Mb.; Eastview Mb.

Middle Ordovician - limestone, dolostone, shale, arkose, sandstone

54a - Ottawa Group; Simcoe Group; Shadow Lake Formation (now considered Upper Ordovician)

NOTE:
Bedrock geology features sourced from Bedrock Geology of Ontario; MNDM File - MRD126-REV1. Ontario Geological Survey, 2011. (OGS, 2011).

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

0 2 4 Kilometers

CLIENT
MECP

PROJECT
Water Bottling Study Areas Report

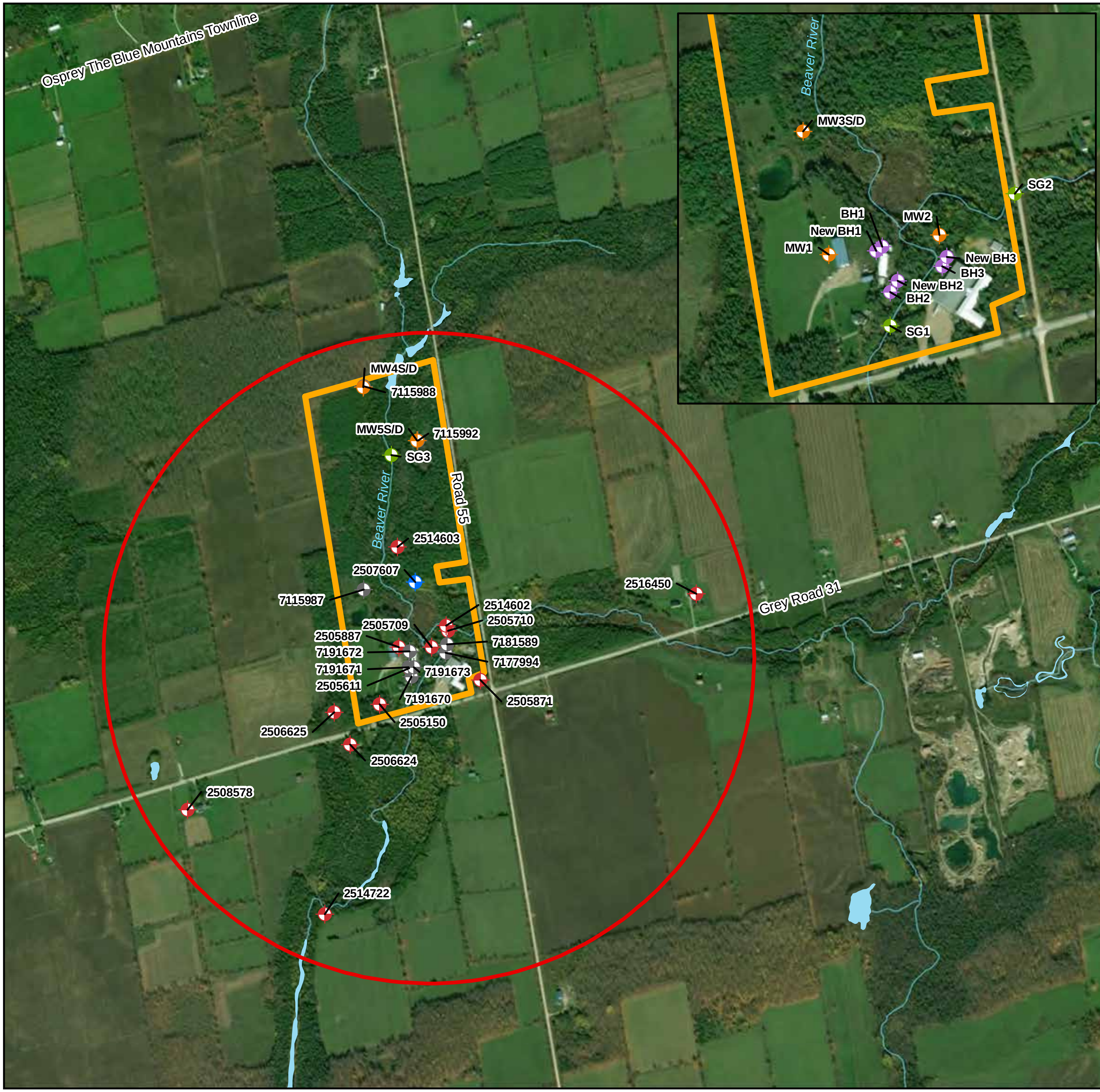
TITLE
Gott Enterprises Inc. Amaranth
Bedrock Geology

BluMetric Environmental
171 Victoria St. N., Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	4-7	0

K:\Projects\MOECC\07 - WBSA\Gott Enterprises\Amaranth\MXD\2018-12-03 TitleChange\180107-07-GottEnt-Amaranth-Fig4-7-BedrockGeology.mxd



LEGEND

- Monitoring Well
- Production Borehole
- Stream Level Station
- Bedrock Well
- Overburden Well
- Unknown Well Type
- Gott Enterprises Inc. Property Boundary
- Gott Enterprises Grey-Highlands 1000 m Radius

NOTE:
MECP well records sourced from MECP, 2018.
Source Wells, Monitoring Wells, Surface Water Monitoring station sourced from Ian D. Wilson Associates Limited 2015 Annual Report and Monitoring Program Summary Gott Enterprises Inc., April 2016.

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

0 200 400 Meters

CLIENT

MECP

PROJECT

Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Grey Highlands
Source Location and Site Plan

BluMetric™ Environmental

171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
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PROJECT #	DATE		
180107-07	December 03, 2018		
DRAWN	CHECKED	FIG NO.	REV
KH	RH, JP	5-1	0

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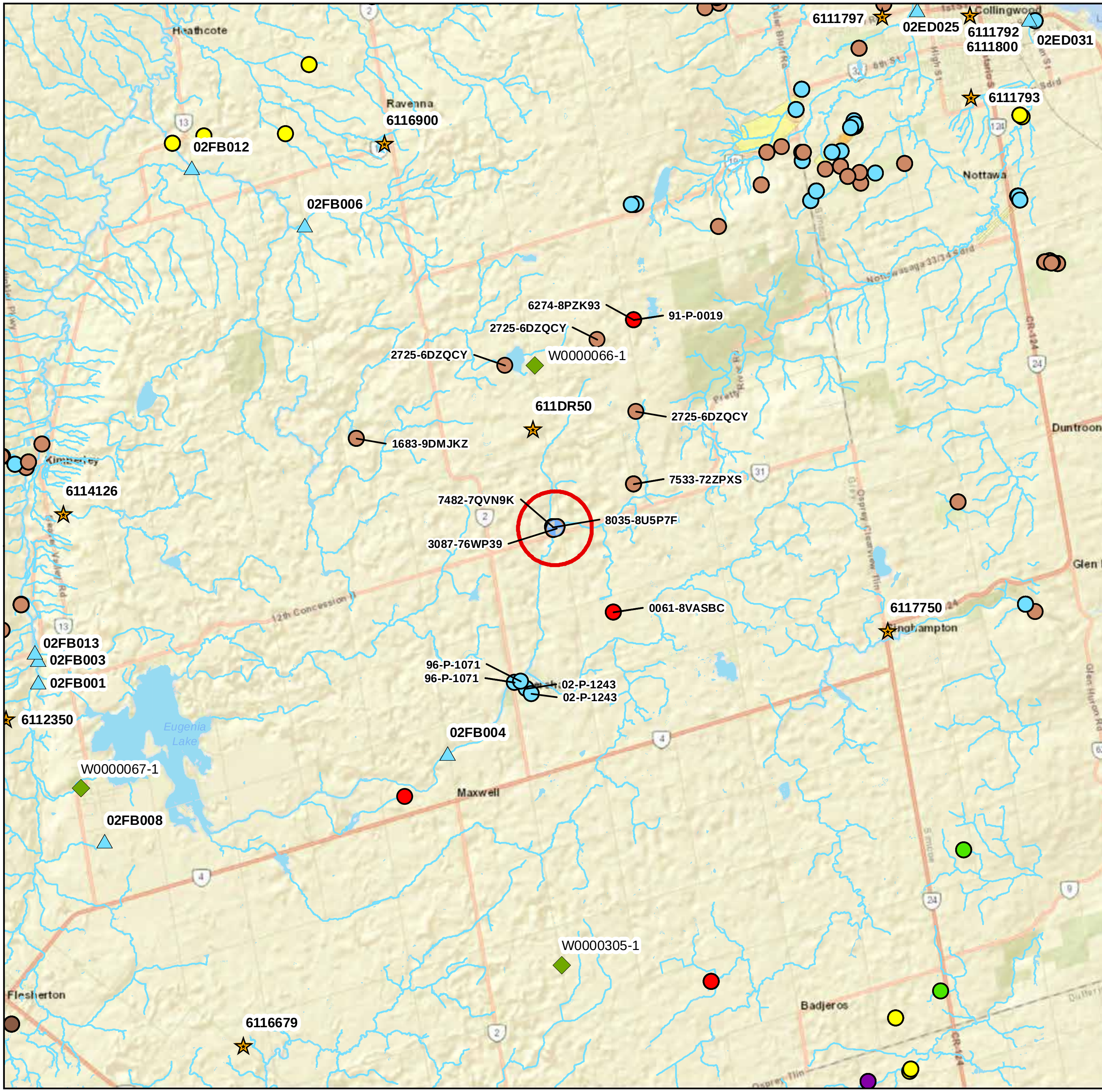

LEGEND

- Source Well Locations
- Provincial Groundwater Monitoring Network Wells and ID
- Weather Stations and ID
- HYDAT Stations and ID
- Gott Enterprises Grey-Highlands 1000 m Radius

WTRS (Active PTTW) and Use

- Agricultural
- Commercial
- Industrial
- Institutional
- Miscellaneous
- Recreational
- Remediation
- Water Supply

Quality

- A - 100 m Radius
- B - 2 Year Time of Travel
- C - 5 Year Time of Travel
- D - 25 Year Time of Travel

NOTE:
Base Map: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan
Municipal Wellhead Protection Areas: MECP, http://www.applications.ene.gov.on.ca/swp/en/index.php
Active PTTWs: MECP, 2018. https://www.ontario.ca/environment-and-energy/map-permits-take-water
Provincial Groundwater Monitoring Network: MECP, https://www.ontario.ca/environment-and-energy/map-provincial-groundwater-monitoring-network
Weather Stations: Government of Canada, http://climate.weather.gc.ca/
HYDAT stations: Government of Canada, https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey/data-products-services/national-archive-hydat.html

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

0 2 4 Kilometers

N W E S

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MECP

PROJECT

Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Grey Highlands Regional Study Area

BluMetric™ Environmental
171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	January 02, 2019

DRAWN	CHECKED	FIG NO.	REV
KH	RH, JP	5-2	0

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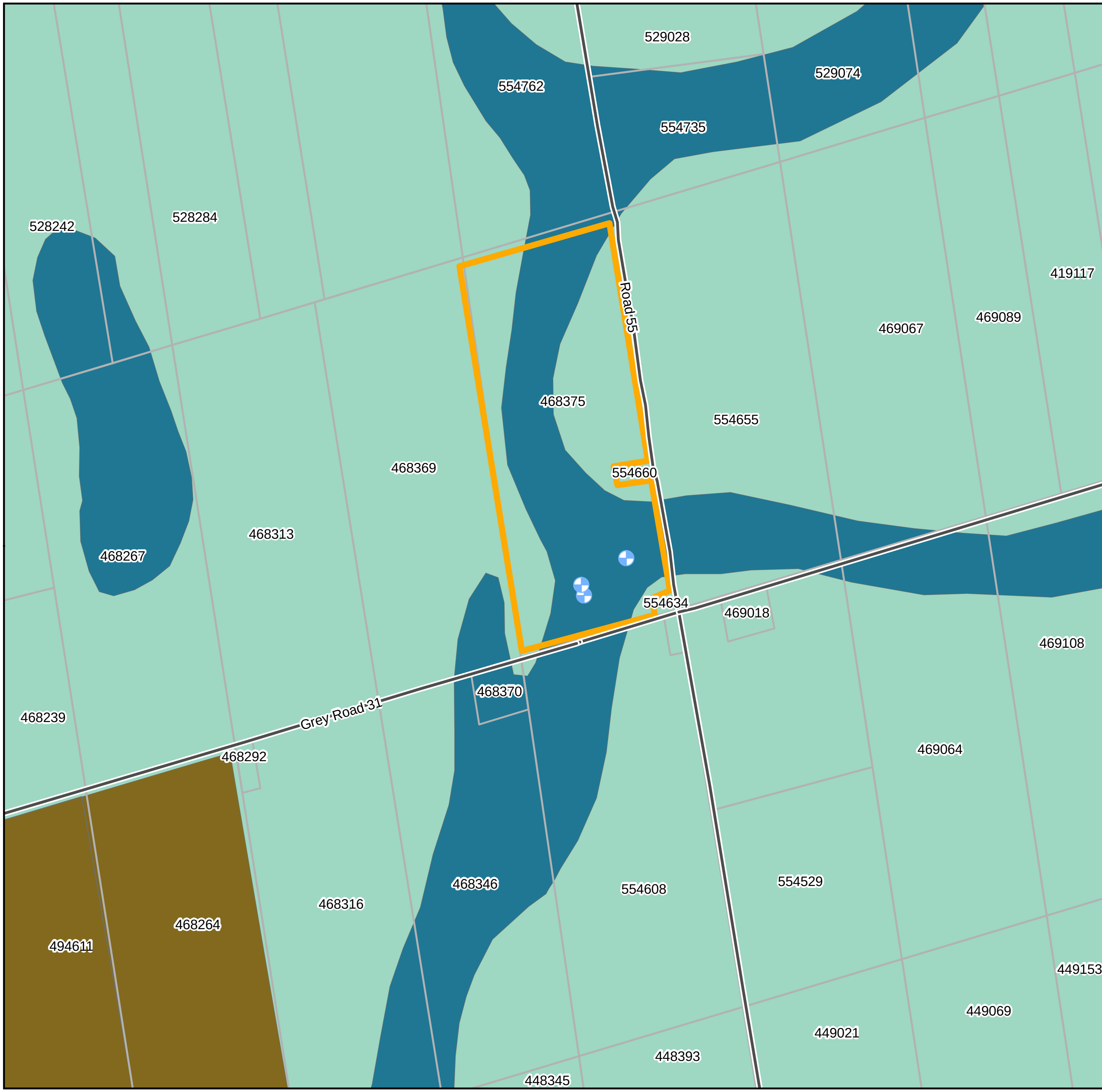

LEGEND

- Source Well Locations
- Gott Enterprises Inc. Grey-Highlands Property Boundary
- Parcels

Land Use Classification

- Agricultural
- Hazard Lands
- Rural

NOTE:
Land Use Information is sourced from Grey County webmapping applications.
https://geo.grey.ca/Html5Viewer/Index.html?configBase=https://geo.grey.ca/Geocortex/Essentials/REST/sites/Public__Planning__Development/viewers/H5/virtualdirectory/Resources/Config/Default

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

0 200 400 Meters

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PROJECT

Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Grey Highlands
Land Use Setting

BluMetric™ Environmental
171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
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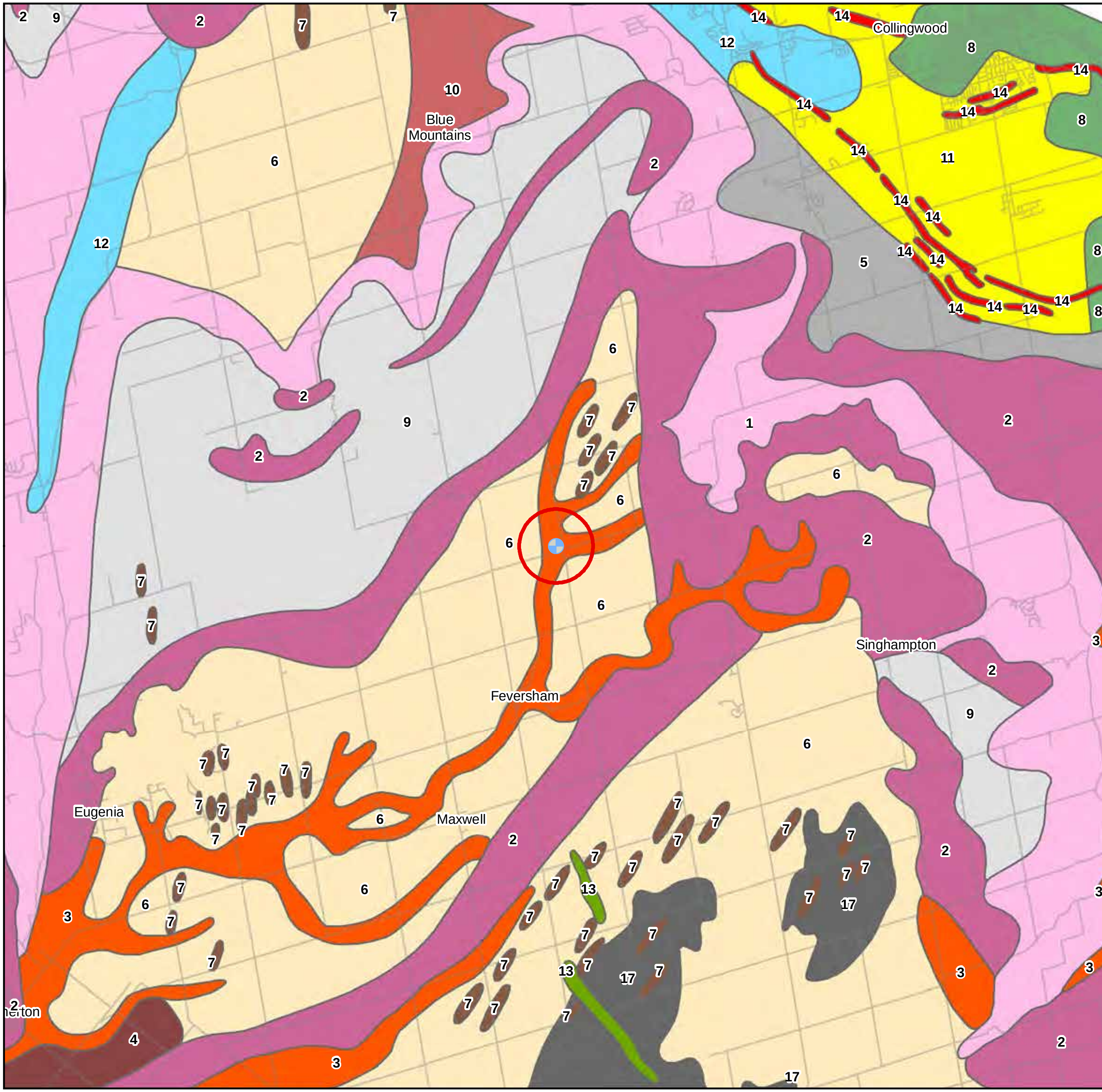
PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH, JP	5-3	0



LEGEND

- Source Well Locations
- Gott Enterprises Grey-Highlands 1000 m Radius

Physiography

- 13. Eskers
- 1. Escarpments
- 2: Till Moraines
- 3: Spillways
- 4: Kame Moraines
- 5: Till Plains (Undrumlinized)
- 6: Till Plains (Drumlinized)
- 7: Drumlins
- 8. Bevelled Till Plains
- 9. Limestone Plains
- 10. Shale Plains
- 11: Sand Plains
- 12: Clay Plains
- 17: Peat And Muck
- 14. Beaches

NOTE:
Physiography data sourced from Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228. Chapman, L.J. and Putnam, D.F. 2007. (Chapman and Putnam, 2007).

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

0 2 4 Kilometers

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PROJECT

Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Grey Highlands Physiography

BluMetric™ Environmental

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PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	5-4	0

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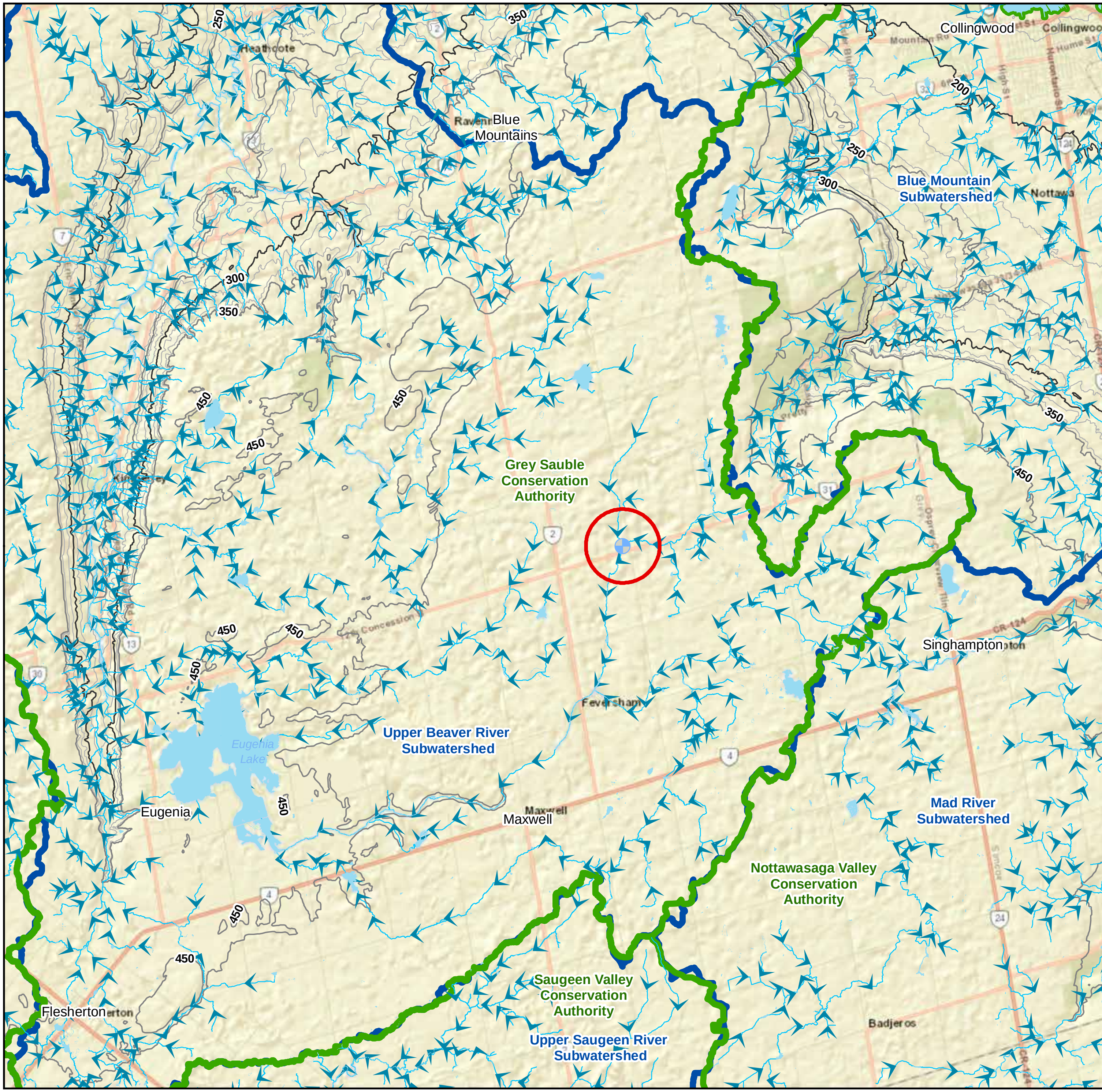

LEGEND

- Source Well Locations
- Gott Enterprises Grey-Highlands 1000 m Radius
- Conservation Authority
- Quaternary Watershed Boundaries

Elevation Contours

- 20 m
- 50 m
- 100 m
- Watercourse

NOTE:
Conservation authority and watershed boundaries sourced from MECP, 2018.
All topographic features including waterbody, watercourse, and elevation contours sourced from CanVec, 2017.

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

0 2 4 Kilometers

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PROJECT

Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Grey Highlands Regional Topography and Watersheds

BluMetric™ Environmental
171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH, JP	5-5	0

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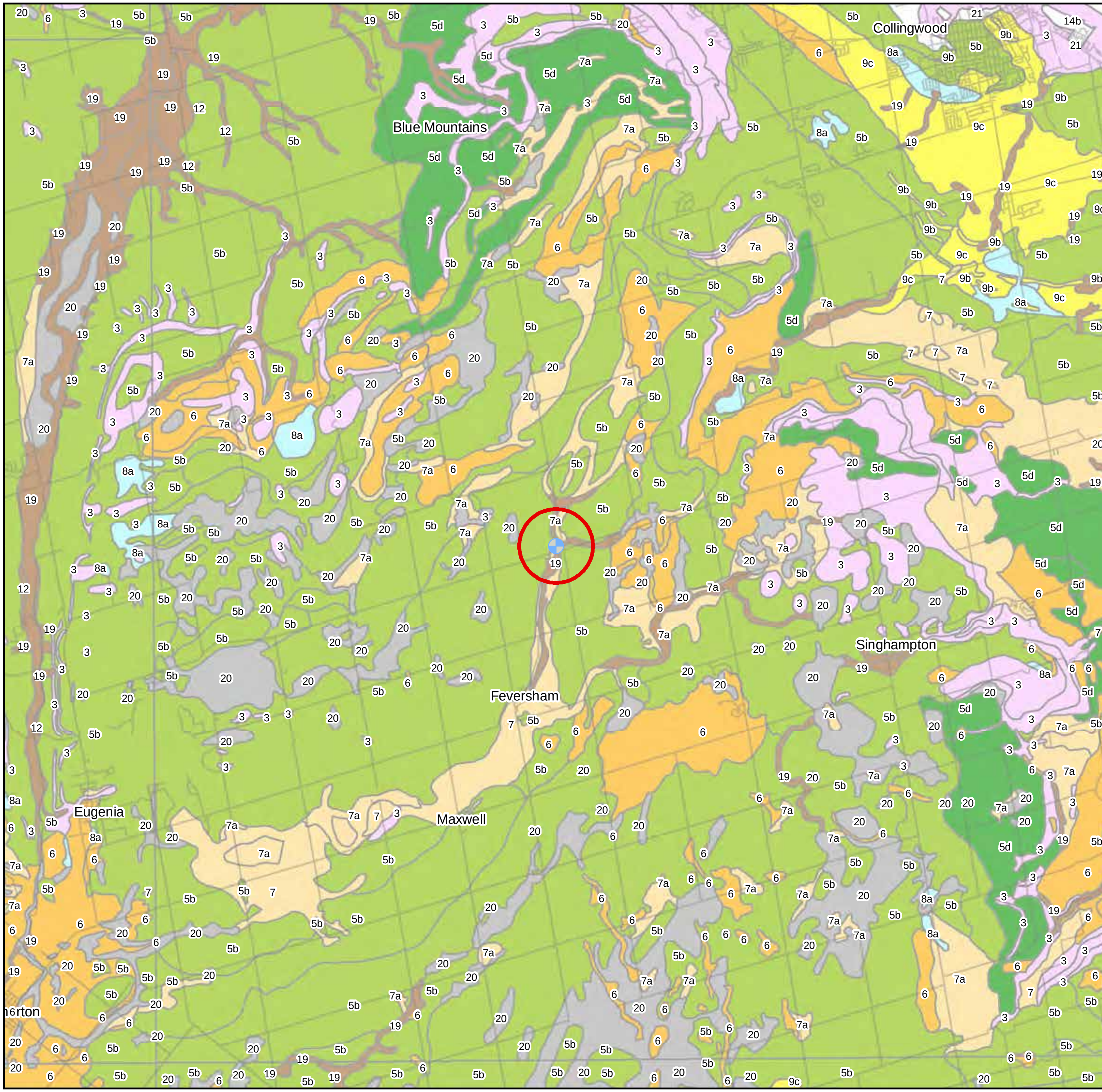

LEGEND

Source Well Locations

Gott Enterprises Grey-Highlands 1000 m Radius

Surficial Geology (MNDM File - MRD128-REV)

- 3: Paleozoic bedrock
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 5d: Glaciolacustrine-derived silty to clayey till
- 6: Ice-contact stratified deposits
- 7: Glaciofluvial deposits
- 7a: Sandy deposits
- 8a: Massive-well laminated
- 9b: Littoral deposits
- 9c: Foreshore-basinal deposits
- 12: Older alluvial deposits
- 19: Modern alluvial deposits
- 20: Organic deposits

NOTE:
Surficial geology features sourced from Surficial Geology of Ontario; MNDM File - MRD128-REV. Ontario Geological Survey, 2010. (OGS, 2010).

1				
REV.	DESCRIPTION	YY/MM/DD	BY	CHK

REFERENCES

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N W E S

0 2 4 Kilometers

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MECP

PROJECT

Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Grey Highlands Surficial Geology

BluMetric™ Environmental
171 Victoria St. N., Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH, JP	5-6	0

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LEGEND

Source Well Locations

Gott Enterprises Grey-Highlands 1000 m Radius

Lower Silurian - sandstone, shale, dolostone, siltstone

56a - Guelph Formation (also present in the Upper Silurian)

56c - Lockport Formation

56d - Amabel Formation

Upper Ordovician - shale, limestone, dolostone, siltstone

55a - Queenston Formation

55b - Georgian Bay Formation; Blue Mountain Formation; Billings Formation; Collingwood Mb.; Eastview Mb.

Middle Ordovician - limestone, dolostone, shale, arkose, sandstone

54a - Ottawa Group; Simcoe Group; Shadow Lake Formation (now considered Upper Ordovician)

NOTE:
Bedrock geology features sourced from Bedrock Geology of Ontario; MNDM File - MRD126-REV1. Ontario Geological Survey, 2011. (OGS, 2011).

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

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PROJECT

Water Bottling Study Areas Report

TITLE

Gott Enterprises Inc. Grey Highlands Bedrock Geology

BluMetric™ Environmental

171 Victoria St. N., Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
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PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH, JP	5-7	0

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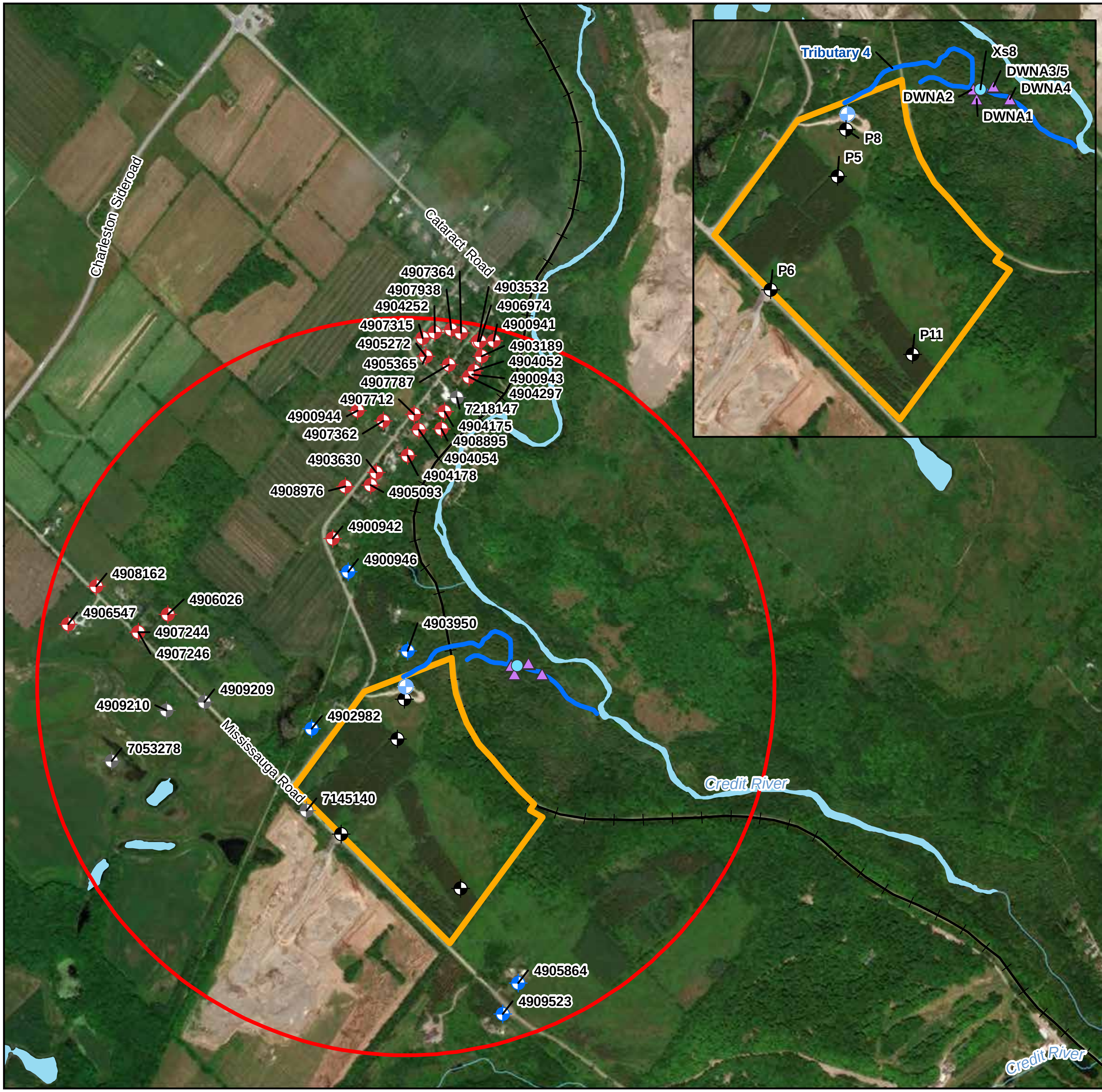

LEGEND

- Source Well Location

MOE Wells

- Bedrock Well
- Overburden Well
- Unknown Well Type
- Groundwater Monitoring Location
- Flow Monitoring Location
- Mini-Piezometer
- Tributary
- Railway
- Aquaterra Cataract 1000m Radius
- Aquaterra Corp. Cataract Property Boundary

Note:
MECP well records sourced from MECP, 2018.
Groundwater and flow monitoring locations, mini-piezometer, and tributary sourced from AECOM, 2016.

1				
REV.	DESCRIPTION	YY/MM/DD	BY	CHK

REFERENCES

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N W E S

0 250 500 Meters

CLIENT

MECP

PROJECT

Water Bottling Study Areas Report

TITLE

Aquaterra Corp. Ltd. Cataract Site
Source Location and Site Plan

BluMetric™ Environmental

171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	6-1	0

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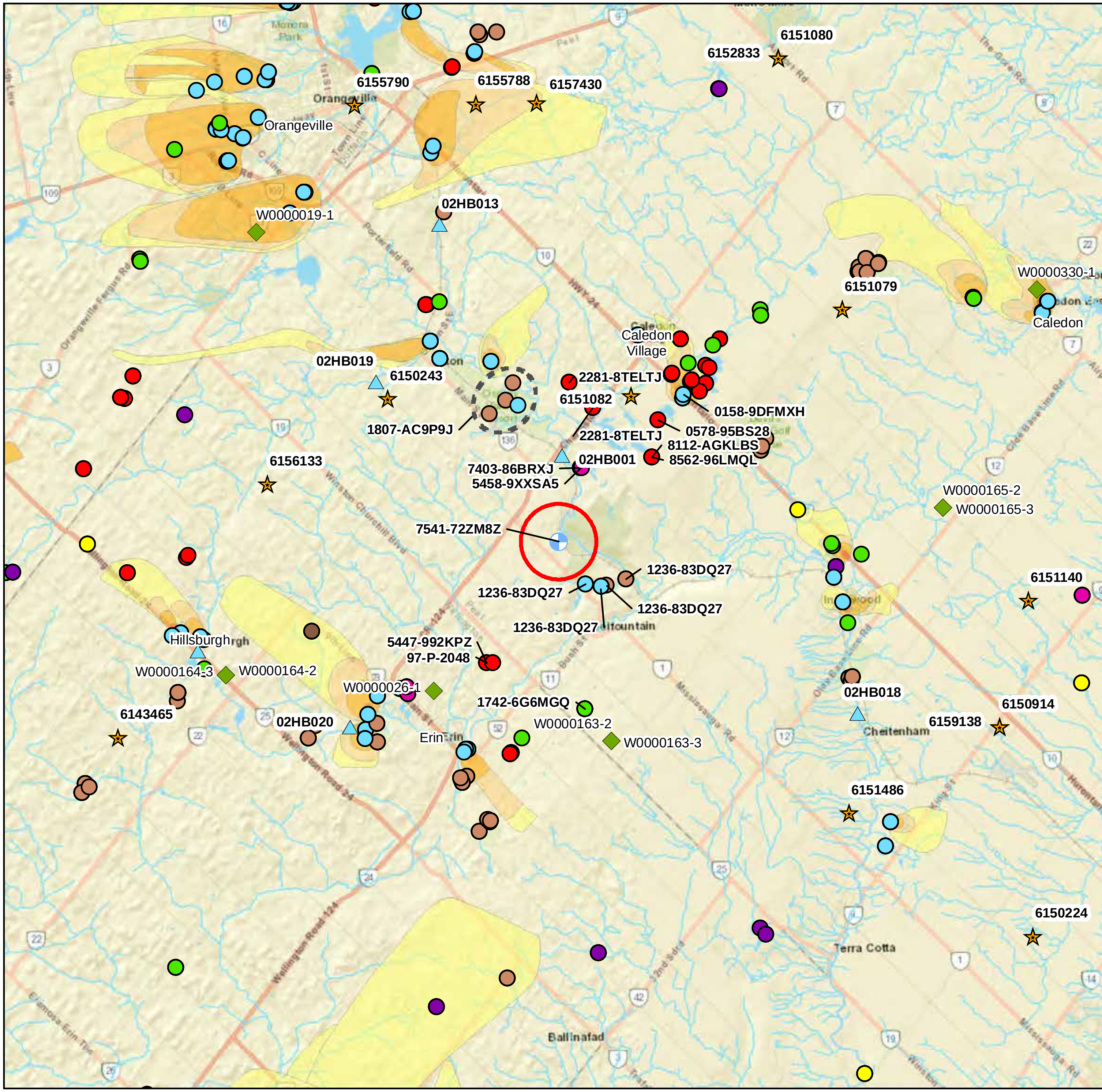

LEGEND

- Source Well Location
- Provincial Groundwater Monitoring Network Wells and ID
- Weather Stations and ID
- HYDAT Stations and ID
- Aquaterra Cataract 1000m Radius

WTRS (Active PTTW) and Use

- Agricultural
- Commercial
- Industrial
- Institutional
- Miscellaneous
- Recreational
- Remediation
- Water Supply

Municipal Well Head Protection Areas - Quality

- A - 100 m Radius
- B - 2 Year Time of Travel
- C - 5 Year Time of Travel
- D - 25 Year Time of Travel

NOTE:
Base Map: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan
Municipal Wellhead Protection Areas: MECP, http://www.applications.ene.gov.on.ca/swp/en/index.php
Active PTTWs: MECP, 2018. https://www.ontario.ca/environment-and-energy/map-permits-take-water
Provincial Groundwater Monitoring Network: MECP, https://www.ontario.ca/environment-and-energy/map-provincial-groundwater-monitoring-network
Weather Stations: Government of Canada, http://climate.weather.gc.ca/
HYDAT stations: Government of Canada, https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey/data-products-services/national-archive-hydat.html

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

0 2.5 5 Kilometers

CLIENT
MECP

PROJECT
Water Bottling Study Areas Report

TITLE
Aquaterra Corp. Ltd. Cataract Site Regional Study Area

BluMetric Environmental
171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE		
180107-07	January 02, 2019		
DRAWN	CHECKED	FIG NO.	REV
KH	RH	6-2	0

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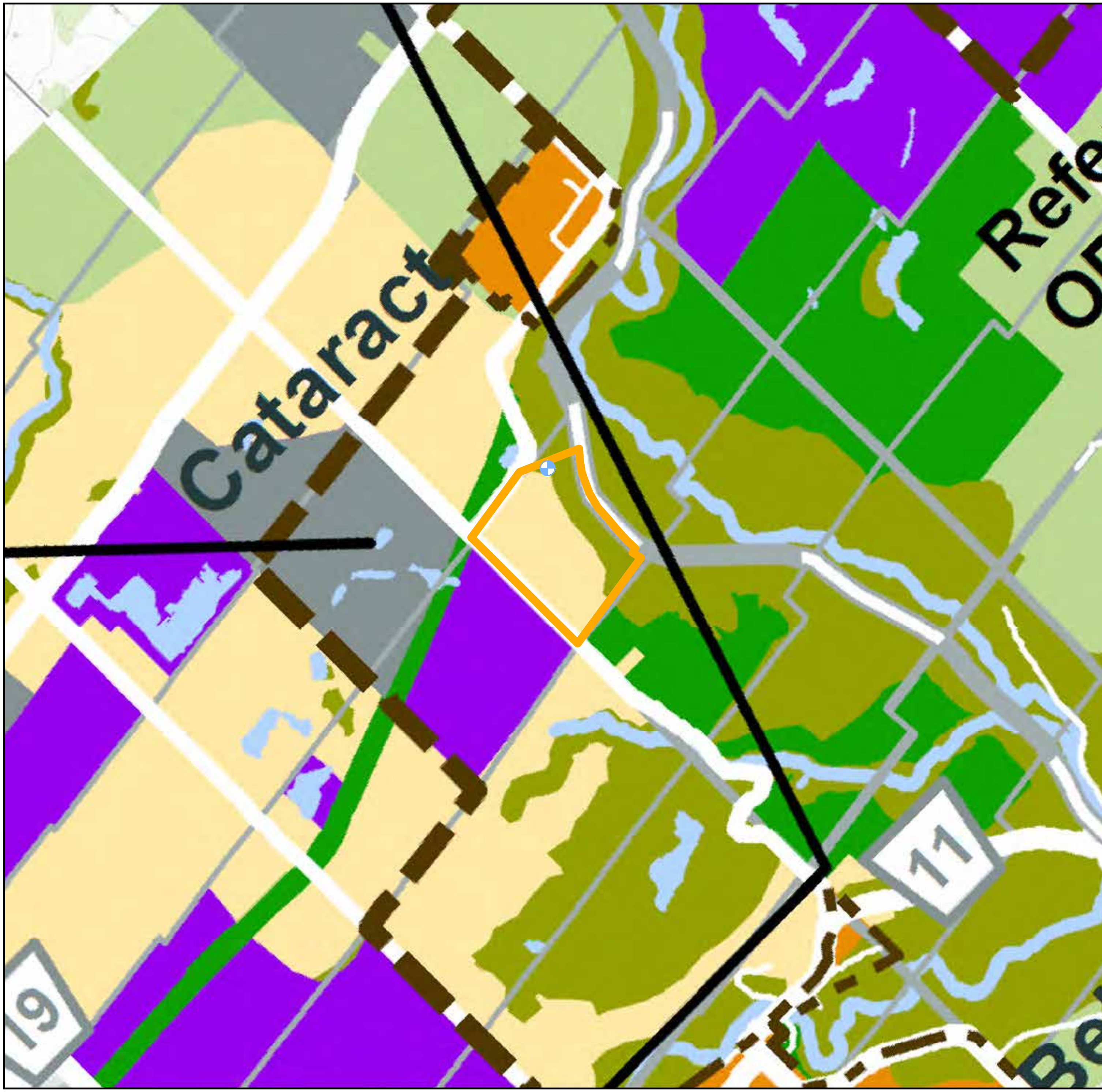

LEGEND

Source Well Location

Aquaterra Corp. Cataract Property Boundary

Land Use Classification

- General Agricultural Area
- Prime Agricultural Area
- Rural Lands
- Extractive Industrial Area
- Open Space Policy Area
- Environmental Policy Area
- Settlement Area
- Niagara Escarpment Plan Area

Note:
Land Use information sourced from Town of Caledon Official Plan. Consolidated in April 2018. Schedule A: Land Use Plan.

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

PROPRIETARY INFORMATION MAY NOT BE REPRODUCED OR DIVULGED WITHOUT PRIOR WRITTEN CONSENT OF BLUMETRIC ENVIRONMENTAL INC.
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N S E W

0 250 500 Meters

CLIENT

MECP

PROJECT

Water Bottling Study Areas Report

TITLE Aquaterra Corp. Ltd. Cataract Site Land Use Setting

BluMetric™ Environmental
171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	7-3	0

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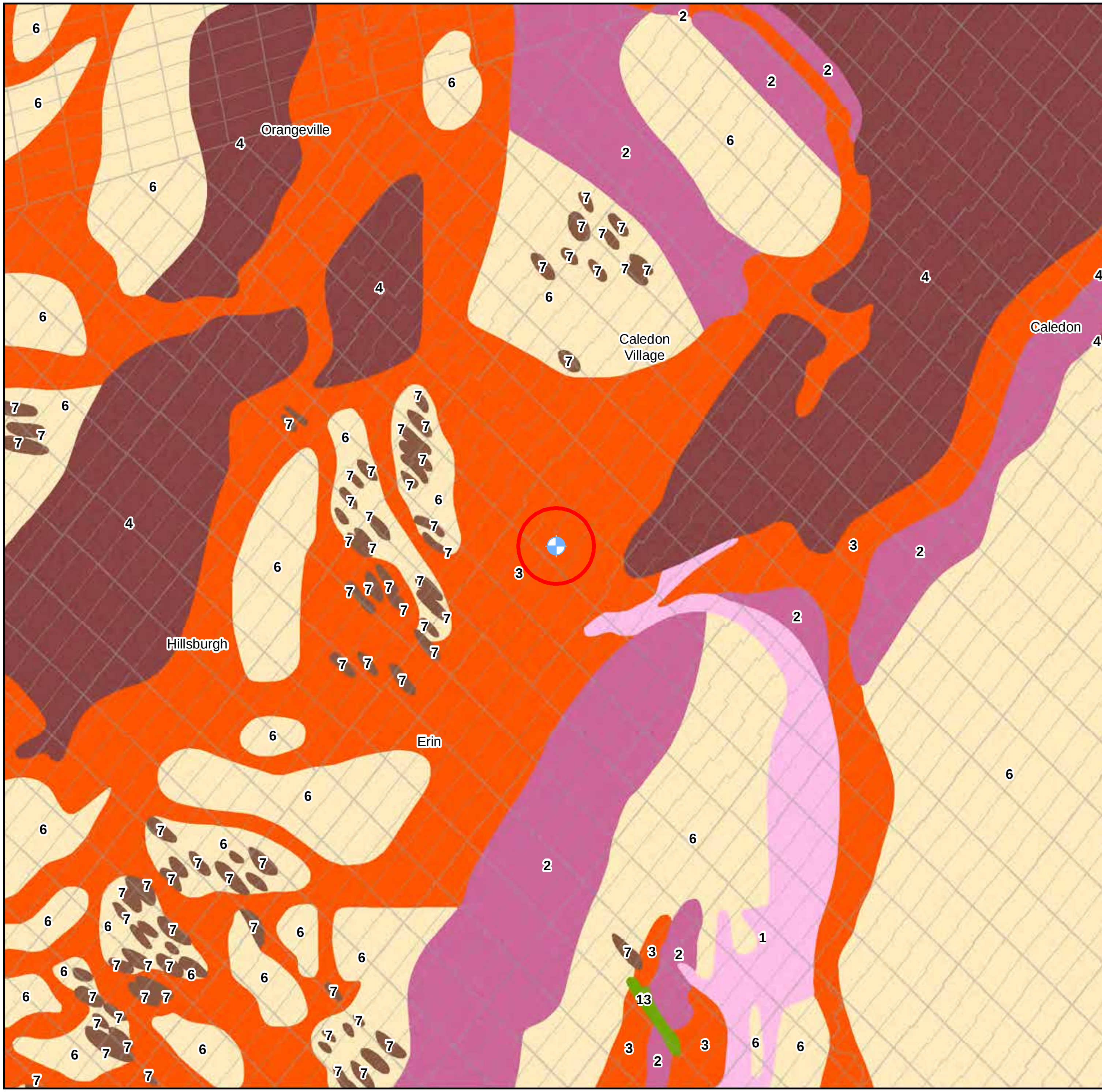

Note:
Physiography data sourced from Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228. Chapman, L.J. and Putnam, D.F. 2007. (Chapman and Putnam, 2007).

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

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PROJECT
Water Bottling Study Areas Report

TITLE
Aquaterra Corp. Ltd. Cataract Site Physiography

BluMetric™ Environmental
171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	6-4	0

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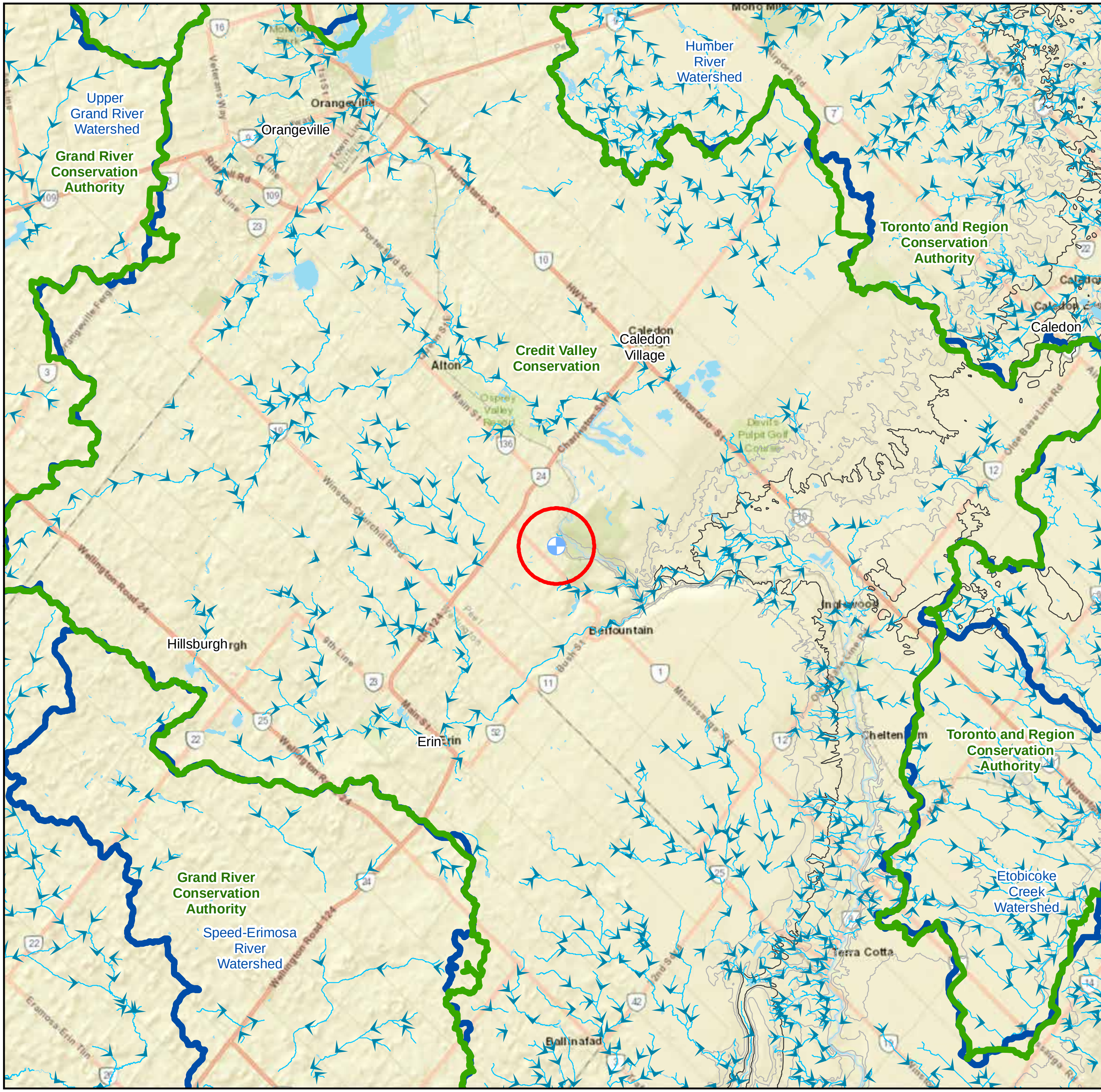

LEGEND

- Source Well Location
- Aquaterra Cataract 1000m Radius
- Conservation Authority
- Watershed Boundaries
- Waterbody
- Watercourse

Elevation Contours

- 20 m
- 100 m

Note:
Conservation authority and watershed boundaries sourced from MECP, 2018.
All topographic features including waterbody, watercourse, and elevation contours sourced from CanVec, 2017.

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

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N W E S

0 2.5 5 Kilometers

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PROJECT

Water Bottling Study Areas Report

TITLE

Aquaterra Corp. Ltd. Cataract Site
Regional Topography and Watersheds

BluMetric™ Environmental

171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	6-5	0

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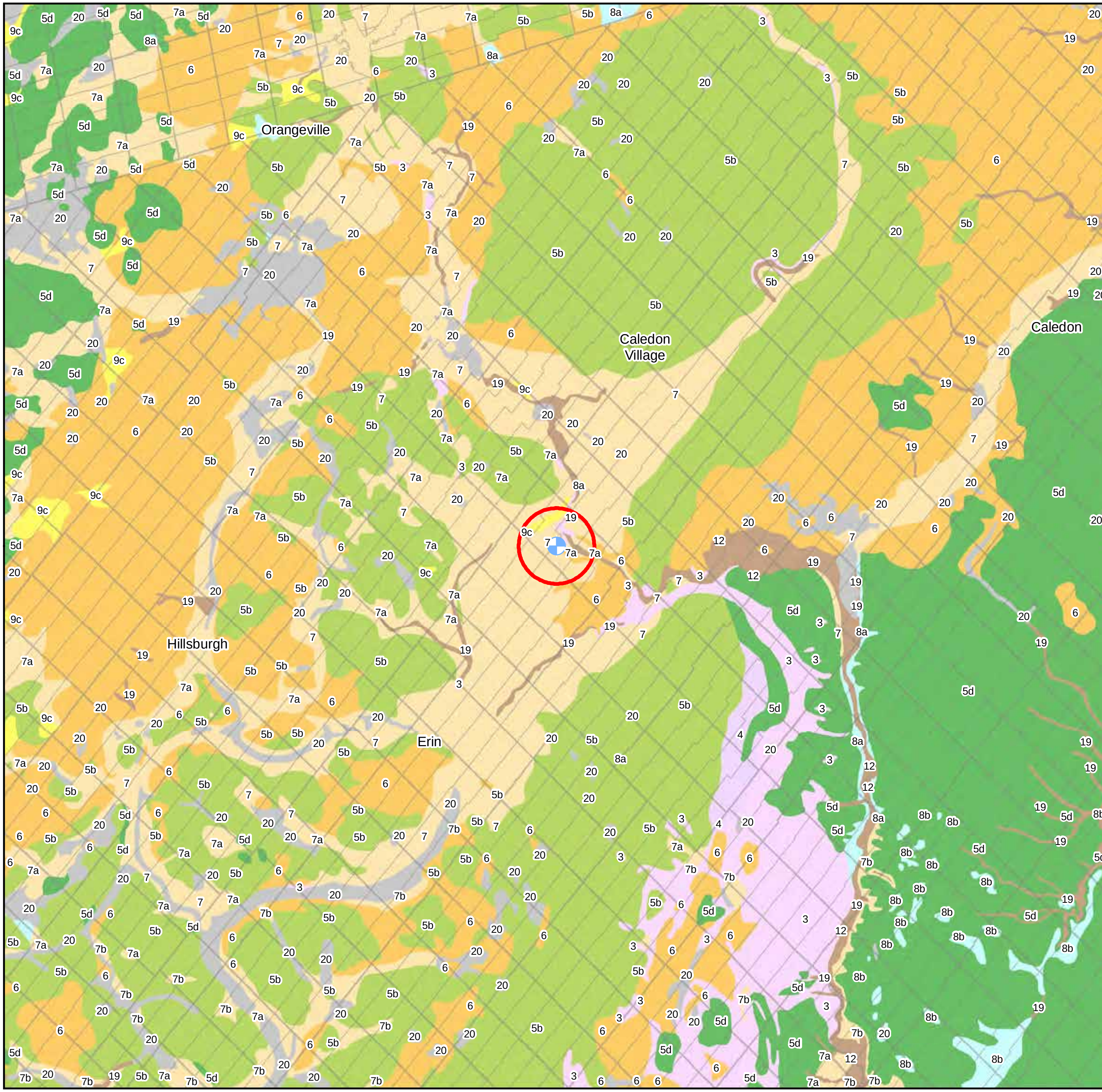

LEGEND

Source Well Location

Aquaterra Cataract 1000m Radius

Surficial Geology (MNDM File - MRD128-REV)

- 3: Paleozoic bedrock
- 4: Bedrock-drift complex in Paleozoic terrain
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 5d: Glaciolacustrine-derived silty to clayey till
- 6: Ice-contact stratified deposits
- 7: Glaciofluvial deposits
- 7a: Sandy deposits
- 7b: Gravelly deposits
- 8a: Massive-well laminated
- 8b: Interbedded silt and clay and gritty, pebbly flow till and rainout deposits
- 9c: Foreshore-basinal deposits
- 12: Older alluvial deposits
- 19: Modern alluvial deposits
- 20: Organic deposits

Note:
Surficial geology features sourced from Surficial Geology of Ontario; MNDM File - MRD128-REV. Ontario Geological Survey, 2010. (OGS, 2010).

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

0 2.5 5 Kilometers

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PROJECT

Water Bottling Study Areas Report

TITLE

Aquaterra Corp. Ltd. Cataract Site
Surficial Geology

BluMetric™ Environmental
171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	6-6	0

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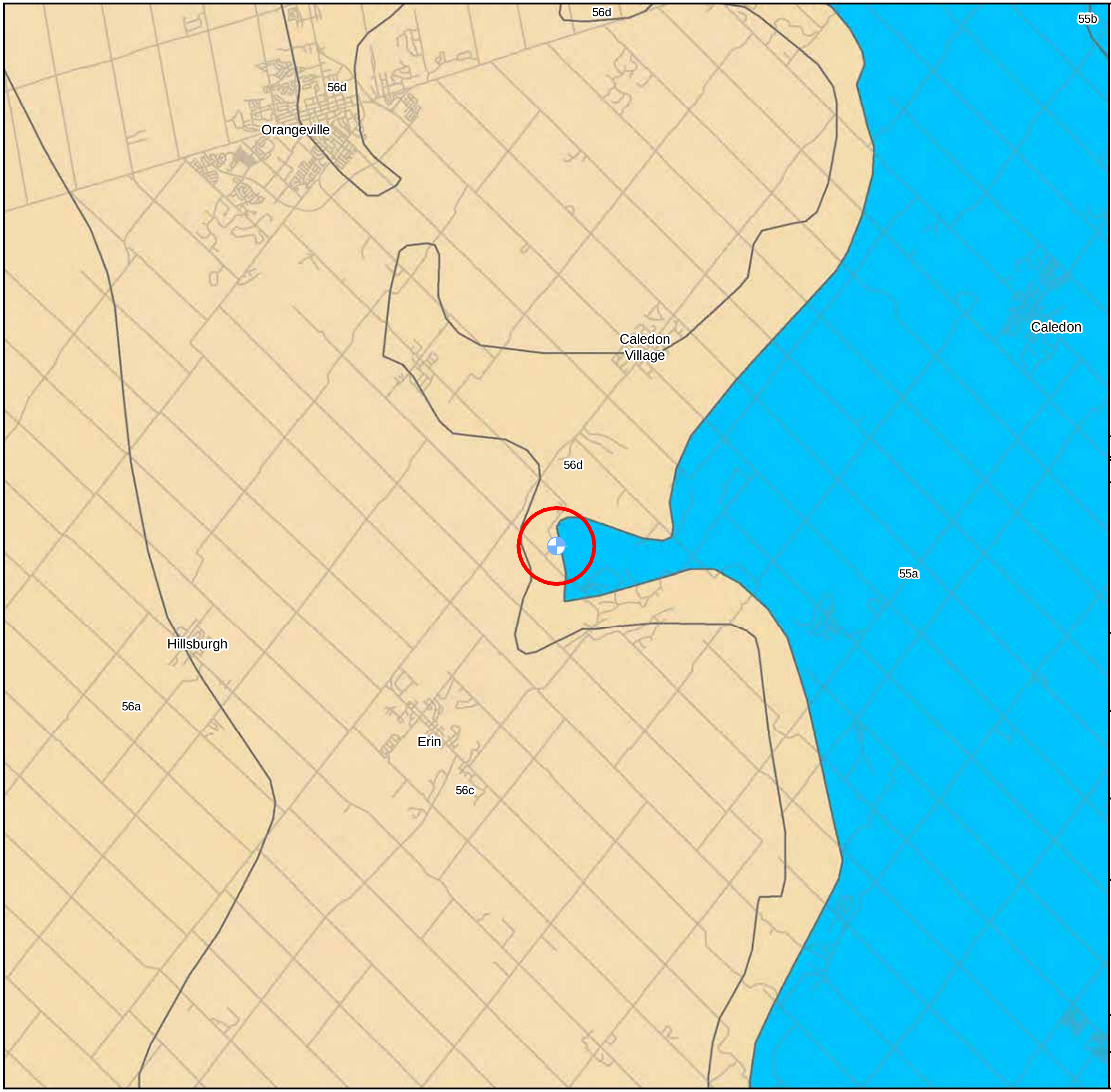

LEGEND

Source Well Location

Aquaterra Cataract 1000m Radius

Lower Silurian - sandstone, shale, dolostone, siltstone

56a - Guelph Formation (also present in the Upper Silurian)

56c - Lockport Formation

56d - Amabel Formation

Upper Ordivician - shale, limestone, dolostone, siltstone

55a - Queenston Formation

55b - Georgian Bay Formation; Blue Mountain Formation; Billings Formation; Collingwood Mb.; Eastview Mb.

Note:
Bedrock geology features sourced from Bedrock Geology of Ontario; MNDM File - MRD126-REV1. Ontario Geological Survey, 2011. (OGS, 2011).

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

0 2 4 Kilometers

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PROJECT

Water Bottling Study Areas Report

TITLE

Aquaterra Corp. Ltd. Cataract Site
Bedrock Geology

BluMetric™ Environmental
171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	6-7	0

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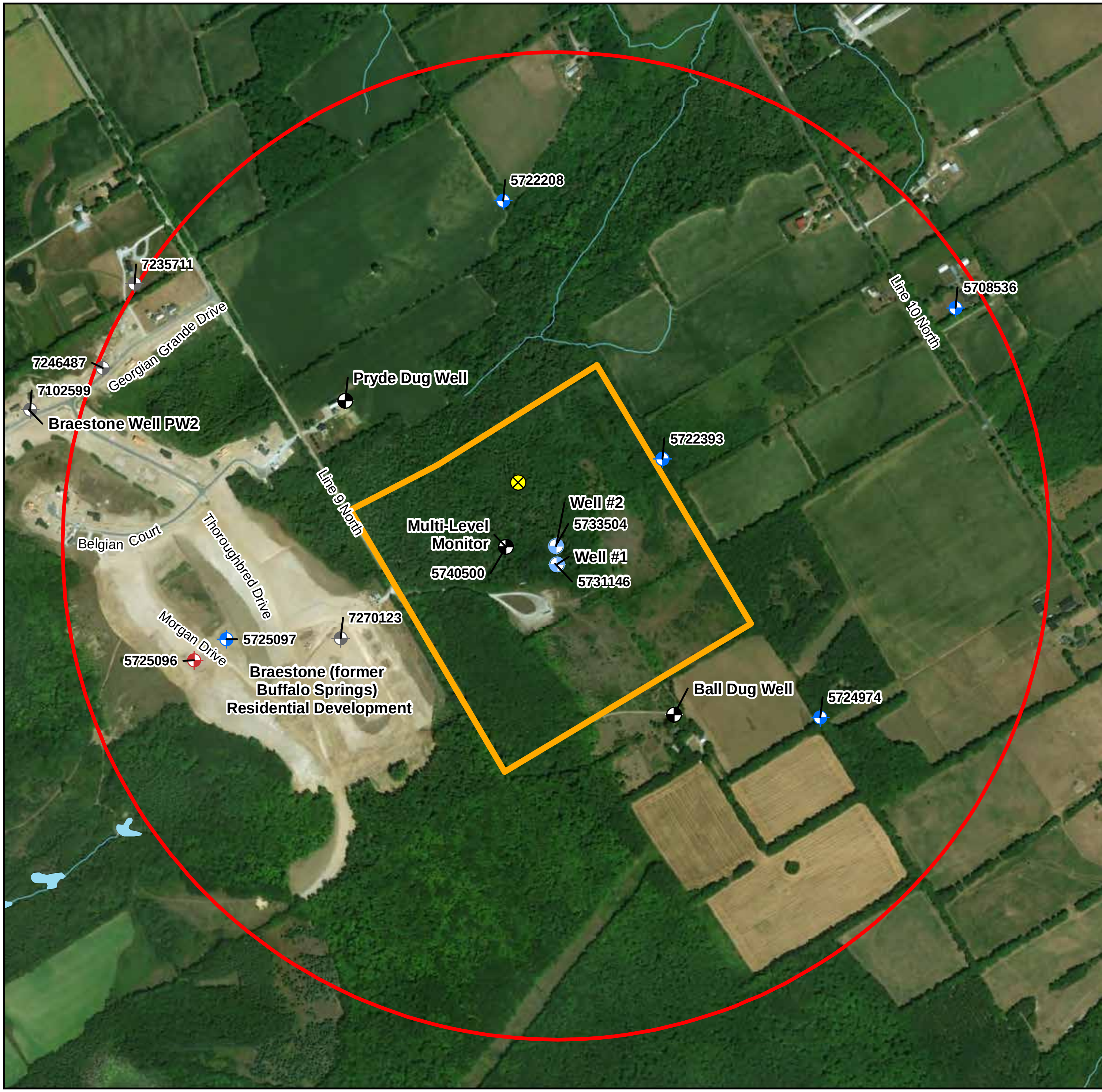

LEGEND

- Source Well Location
- Monitoring Program Well
- Former Surface Water Station
- Bedrock Well
- Overburden Well
- Unknown Well Type
- Gold Mountain Springs 1000mRadius
- Gold Mountain Springs Inc. Property Boundary

NOTE:
MECP well records sourced from MECP, 2018.
Hydrogeological Study, Renewal of Permit to Take Water 3122-9ZCQRS, Gold Mountain Springs Inc. (Wilson 2017).
'Stream Gauging Station' location obtained from: 2007 Status Report, Gold Mountain Springs Inc. Permit to Take Water 344-6FARKC (Wilson, 2008).

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

0 250 500 Meters

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PROJECT
Water Bottling Study Areas Report

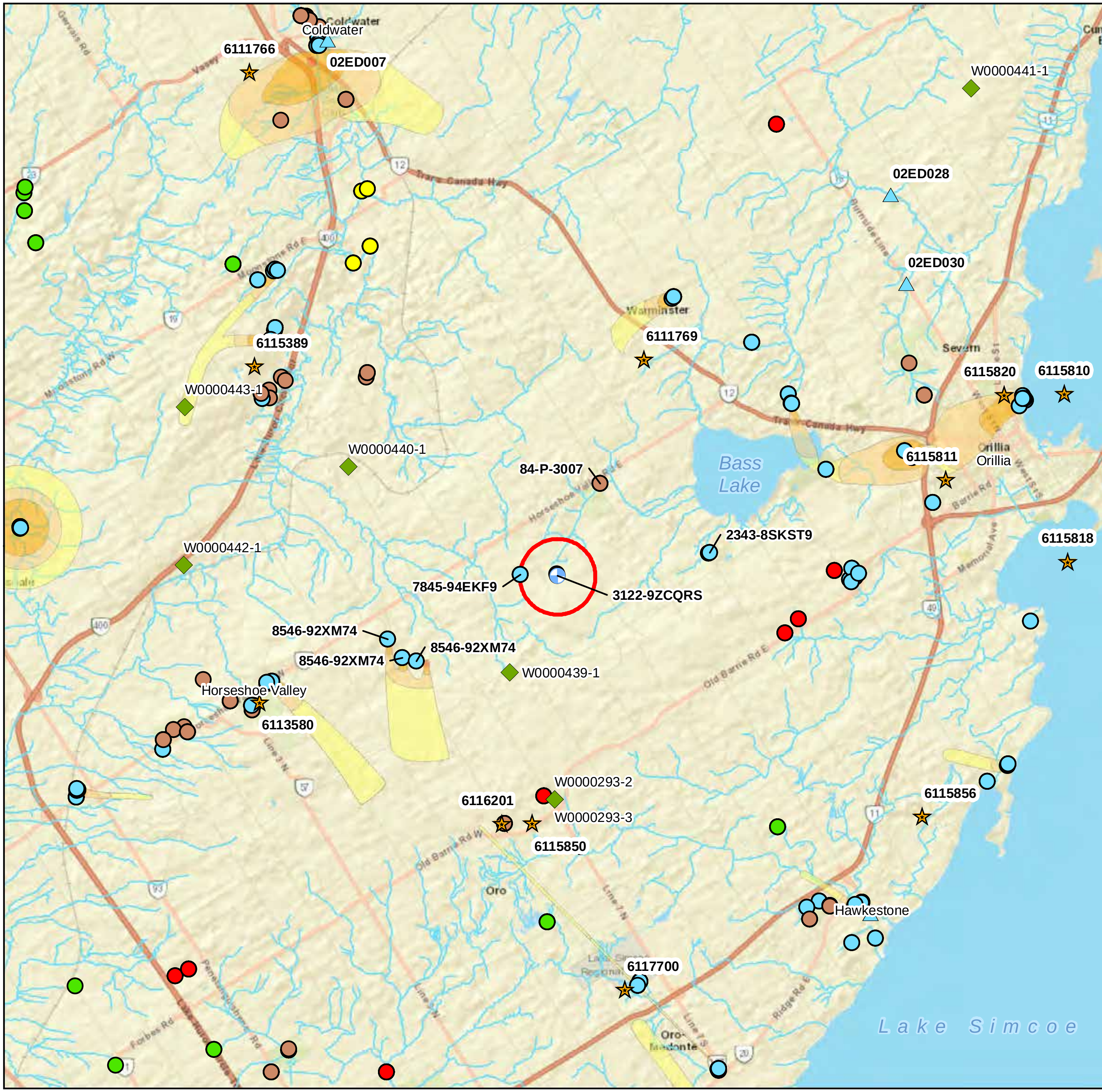
TITLE
Gold Mountain Springs Inc. Source Location and Site Plan

BluMetric™ Environmental

171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	7-1	0



LEGEND

- Source Well Location
- Provincial Groundwater Monitoring Network Wells and ID
- Weather Stations and ID
- HYDAT Stations and ID
- Gold Mountain Springs 1000m Radius

WTRS (Active PTTW) and Use

- Agricultural
- Commercial
- Industrial
- Institutional
- Miscellaneous
- Recreational
- Remediation
- Water Supply

Municipal Well Head Protection Areas - Quality

- A - 100 m Radius
- B - 2 Year Time of Travel
- C - 5 Year Time of Travel
- D - 25 Year Time of Travel

NOTE:
Base Map: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan
Municipal Wellhead Protection Areas: MECP, http://www.applications.ene.gov.on.ca/swp/en/index.php
Active PTTWs: MECP, 2018. https://www.ontario.ca/environment-and-energy/map-permits-take-water
Provincial Groundwater Monitoring Network: MECP, https://www.ontario.ca/environment-and-energy/map-provincial-groundwater-monitoring-network
Weather Stations: Government of Canada, http://climate.weather.gc.ca/
HYDAT stations: Government of Canada, https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey/data-products-services/national-archive-hydat.html

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

0 2.5 5 Kilometers

CLIENT

MECP

PROJECT

Water Bottling Study Areas Report

TITLE

Gold Mountain Springs Inc. Regional
Regional Study Area

BluMetric Environmental
171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
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Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	January 02, 2019

DRAWN	CHECKED	FIG NO.	REV
KH	RH	7-2	0

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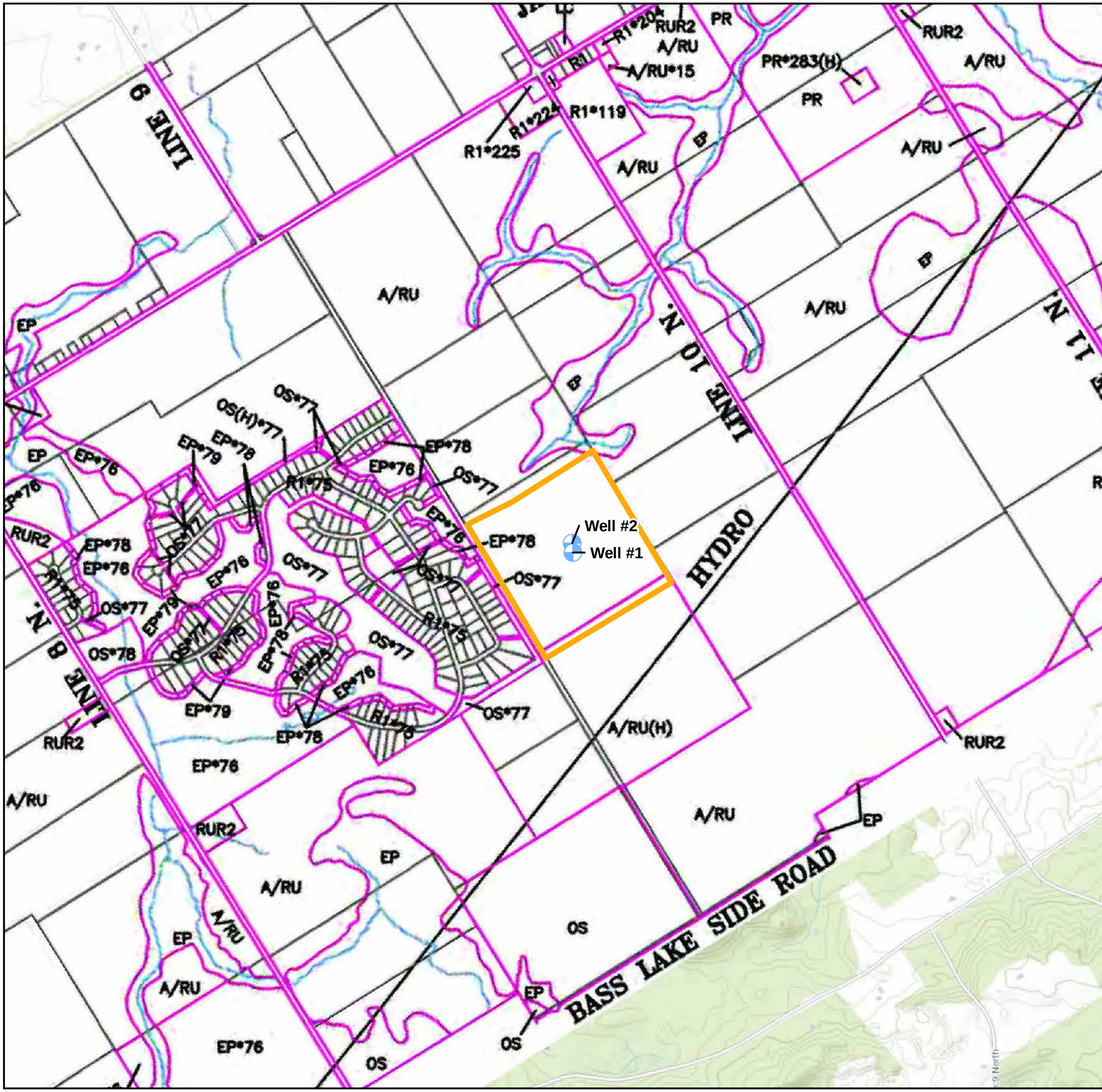

LEGEND

Source Well Locations

Gold Mountain Springs Inc. Property Boundary

Zoning Classification

- R1 - Residential One
- RUR2 - Rural Residential Two
- A/RU - Agricultural/Rural
- EP - Environmental Protection
- OS - Open Space
- PR - Private Recreational
- Parcel

NOTE:
Land Use information is sourced from the Township of Oro-Medonte Zoning By-law 97-95 Schedule A17, Revised May 2018.

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

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0 250 500 Meters

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Water Bottling Study Areas Report

TITLE

Gold Mountain Springs Inc.
Land
Use Setting

BluMetric Environmental
171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 03, 2018

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KH	RH	7-3	0

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LEGEND

Gold Mountain Springs 1000m Radius

Source Well Location

Physiography

- 4: Kame Moraines
- 6: Till Plains (Drumlinized)
- 7: Drumlins
- 9: Limestone Plains
- 11: Sand Plains
- 12: Clay Plains
- 14: Beaches
- 15: Shallow Till And Rock Ridges
- 17: Peat And Muck

NOTE:
Physiography data sourced from Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228. Chapman, L.J. and Putnam, D.F. 2007. (Chapman and Putnam, 2007).

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

0 2.5 5 Kilometers

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Water Bottling Study Areas Report

TITLE

Gold Mountain Springs Inc.
Physiography

BluMetric Environmental
171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	7-4	0

LEGEND

Source Well Location

Gold Mountain Springs 1000m Radius

Conservation Authority

Subwatershed Boundaries

Waterbody

Watercourse

Elevation Contours

20 m

100 m

NOTE:
Conservation authority and watershed boundaries sourced from MECP, 2018.
All topographic features including waterbody, watercourse, and elevation contours sourced from CanVec, 2017.

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

0 2.5 5 Kilometers

CLIENT

MECP

PROJECT

Water Bottling Study Areas Report

TITLE

Gold Mountain Springs Inc. Regional Topography and Watersheds

BluMetric™ Environmental
171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	7-5	0

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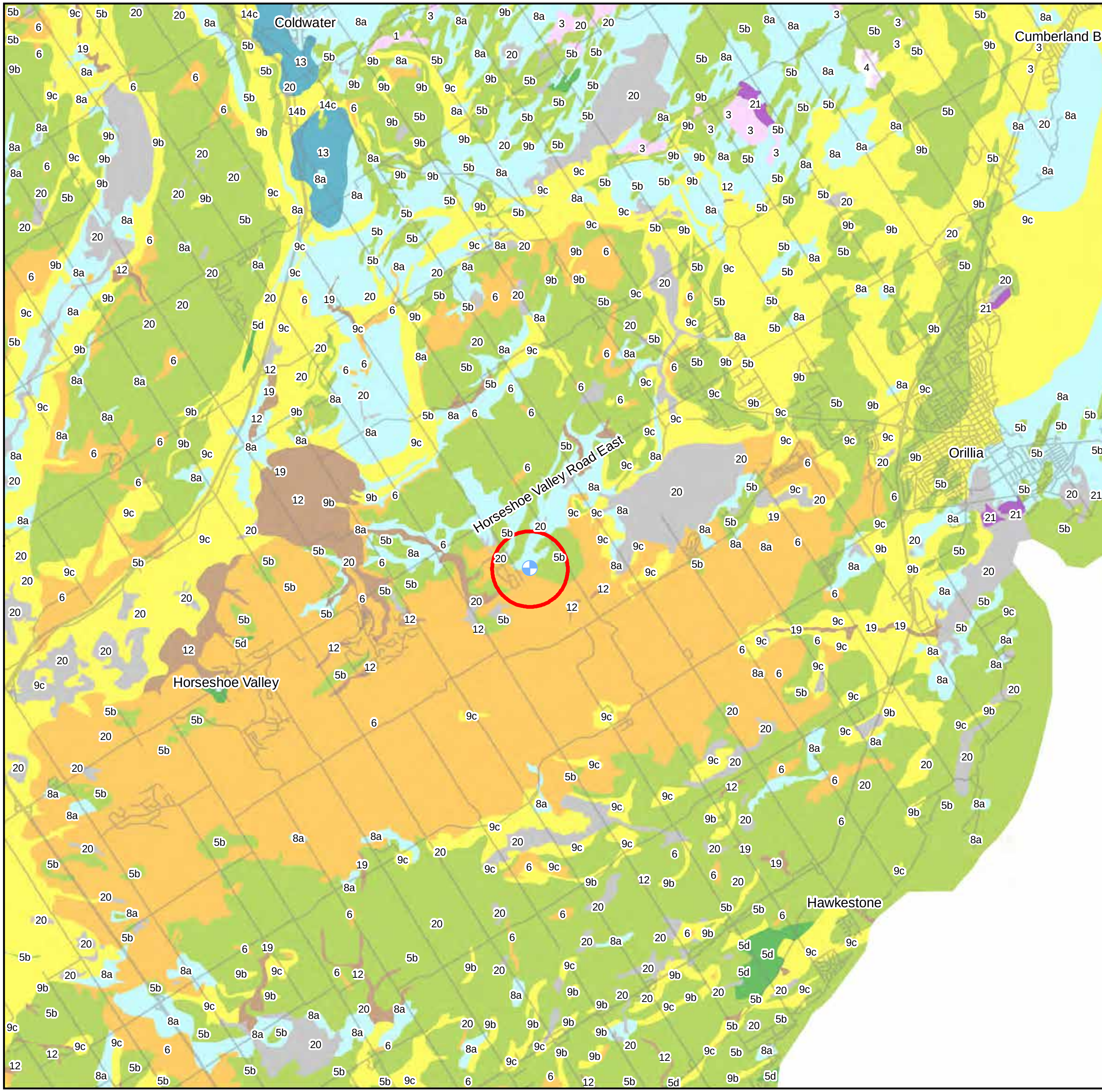

LEGEND

- Source Well Location
- Gold Mountain Springs 1000m Radius

Surficial Geology (MNDM File - MRD128-REV)

- 3: Paleozoic bedrock
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 5d: Glaciolacustrine-derived silty to clayey till
- 6: Ice-contact stratified deposits
- 8a: Massive-well laminated
- 9b: Littoral deposits
- 9c: Foreshore-basinal deposits
- 12: Older alluvial deposits
- 13: Fine-textured lacustrine deposits - silt and clay, minor sand and gravel
- 14b: Coarse-textured lacustrine deposits - Littoral deposits
- 14c: Coarse-textured lacustrine deposits - Foreshore and basinal deposits
- 19: Modern alluvial deposits
- 20: Organic deposits
- 21: Man-made deposits - fill sewage lagoon, landfill, urban development

NOTE:
Surficial geology features sourced from Surficial Geology of Ontario; MNDM File - MRD128-REV. Ontario Geological Survey, 2010. (OGS, 2010).

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

0 2.5 5 Kilometers

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PROJECT

Water Bottling Study Areas Report

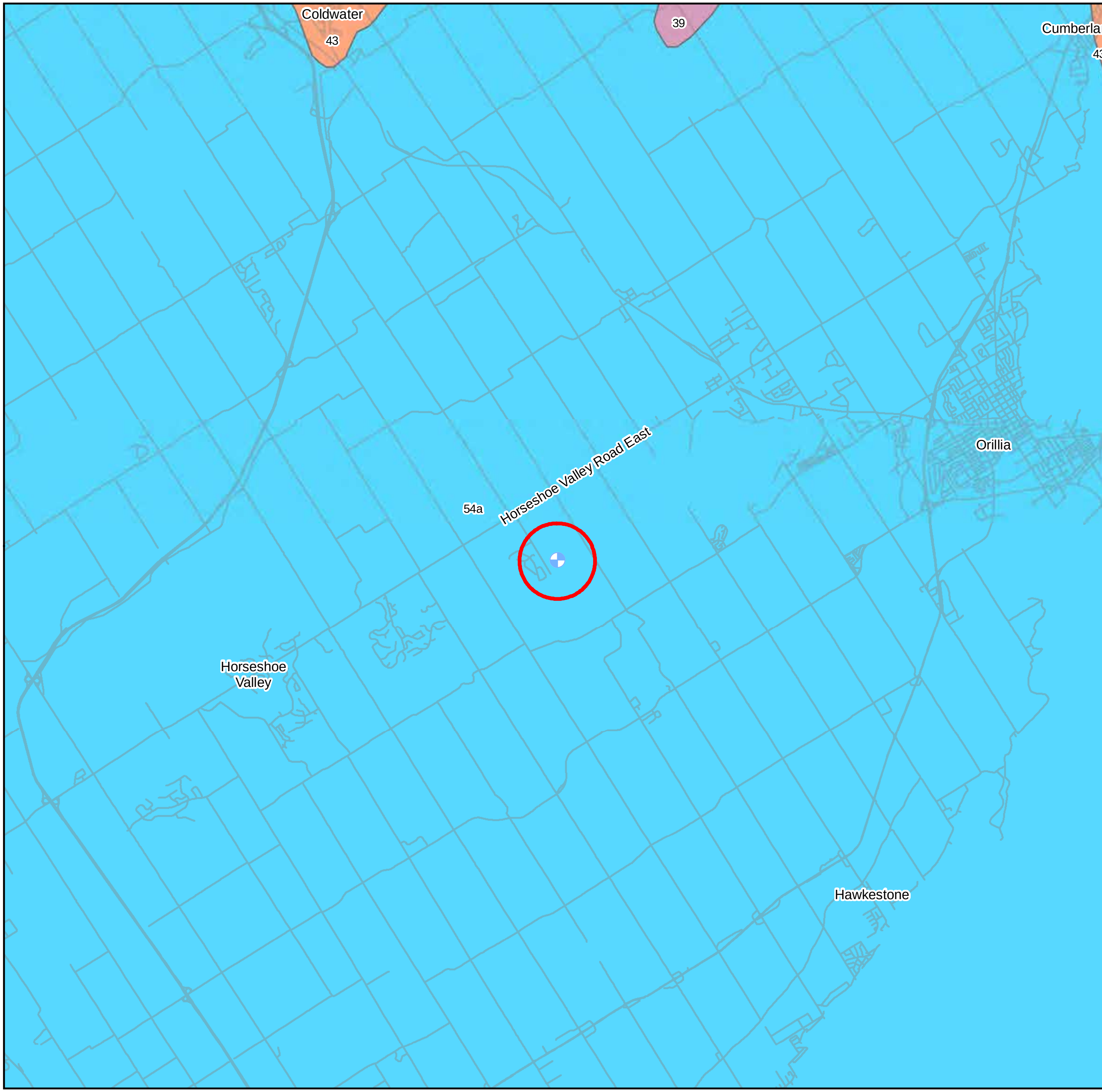
TITLE

Gold Mountain Springs Inc. Surficial Geology

BluMetric™ Environmental
171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	7-6	0



LEGEND

Source Well Location

Gold Mountain Springs 1000m Radius

39 - quartzofelspathic gneisses, pelitic to semi-pelitic gneisses, calc-silicate gneisses, minor quartzite, minor marble and marble breccia

43 - tonalite, granodiorite, monzonite, granite, syenite; derived gneisses

Middle Ordovician - limestone, dolostone, shale, arkose, sandstone

54a - Ottawa Group; Simcoe Group; Shadow Lake Formation (now considered Upper Ordovician)

NOTE:
Bedrock geology features sourced from Bedrock Geology of Ontario; MNDM File - MRD126-REV1. Ontario Geological Survey, 2011. (OGS, 2011).

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

0 2 4 Kilometers

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MECP

PROJECT

Water Bottling Study Areas Report

TITLE

Gold Mountain Springs Inc. Bedrock Geology

BluMetric™ Environmental

171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	7-7	0

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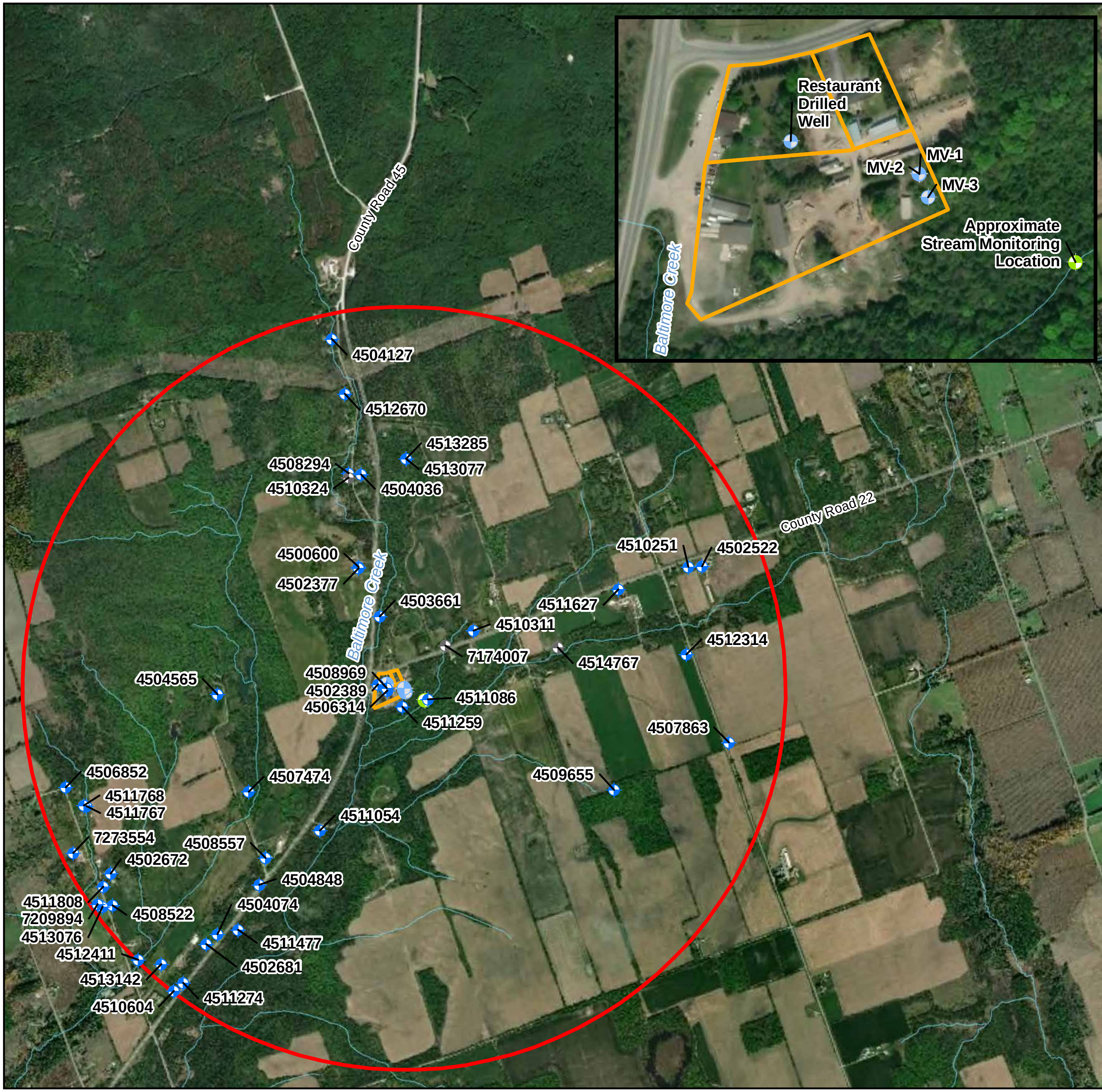

LEGEND

- Bedrock Well
- Overburden Well
- Unknown Well Type

Robins Holdings Wells

- Approximate Stream Monitoring Location
- Source Well
- Robins Holdings 2000m Radius
- Robins Holdings Inc. Property Boundary

NOTE:
MECP well records sourced from MECP, 2018.
Stream Monitoring Locations and Source Wells sourced from AECOM Canadian Springs Site Location and Monitoring Map, December 2016.

1				
REV.	DESCRIPTION	YY/MM/DD	BY	CHK

REFERENCES

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N W E S

0 500 1,000 Meters

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PROJECT

Water Bottling Study Areas Report

TITLE

Robins Holdings Inc. Source Location and Site Plan

BluMetric™ Environmental

171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #		DATE	
180107-07		December 04, 2018	
DRAWN	CHECKED	FIG NO.	REV
KH	RH	8-1	0

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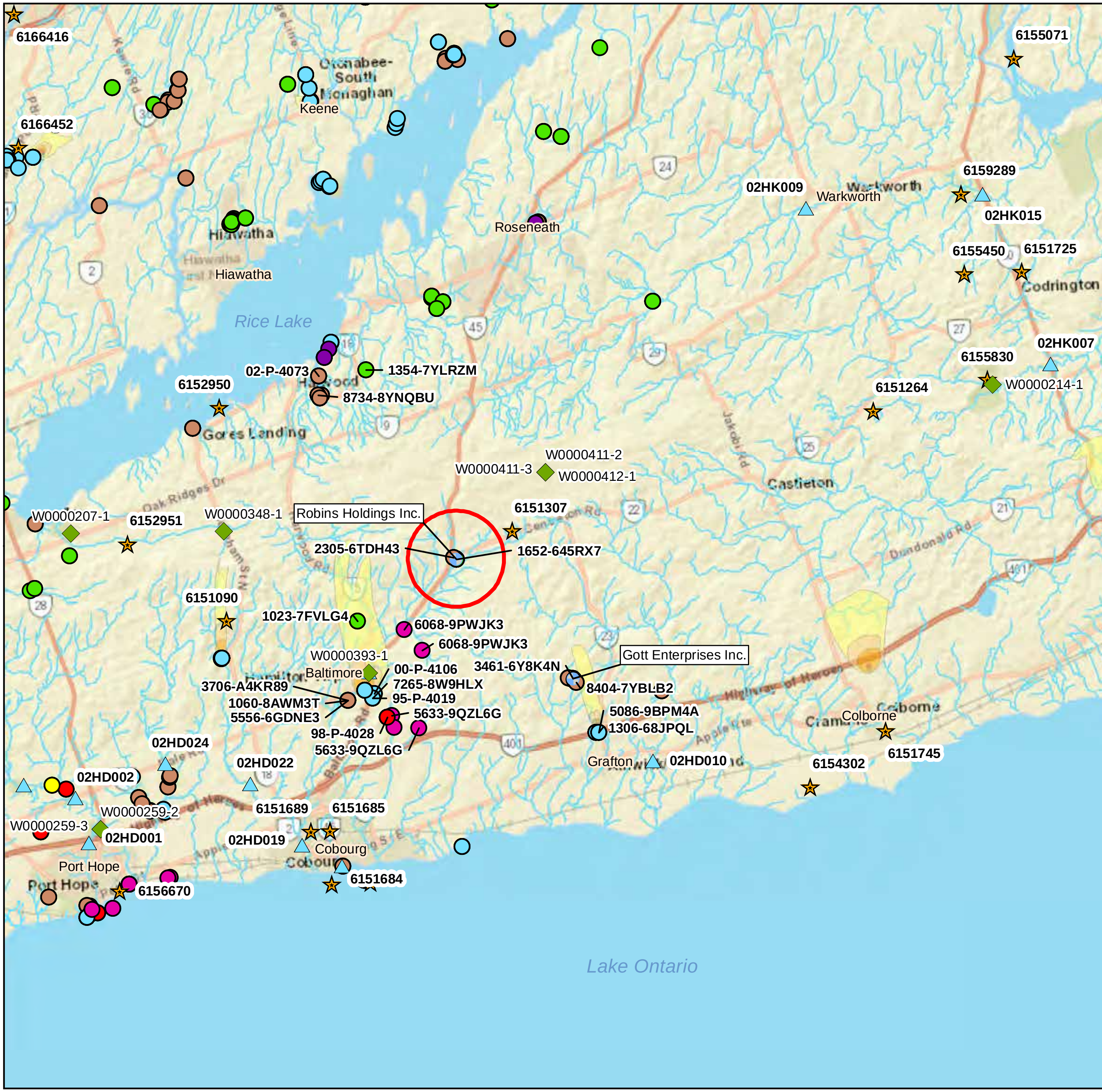

LEGEND

- Source Well Location
- Provincial Groundwater Monitoring Network Wells and ID
- Weather Stations and ID
- HYDAT Stations and ID
- Robins Holdings 2000m Radius

WTRS (Active PTTW) and Use

- Agricultural
- Commercial
- Industrial
- Institutional
- Miscellaneous
- Recreational
- Remediation
- Water Supply

Municipal Well Head Protection Areas - Quality

- A - 100 m Radius
- B - 2 Year Time of Travel
- C - 5 Year Time of Travel
- D - 25 Year Time of Travel

NOTE:
Base Map: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan
Municipal Wellhead Protection Areas: MECP, http://www.applications.ene.gov.on.ca/swp/en/index.php
Active PTTWs: MECP, 2018. https://www.ontario.ca/environment-and-energy/map-permits-take-water
Provincial Groundwater Monitoring Network: MECP, https://www.ontario.ca/environment-and-energy/map-provincial-groundwater-monitoring-network
Weather Stations: Government of Canada, http://climate.weather.gc.ca/
HYDAT stations: Government of Canada, https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey/data-products-services/national-archive-hydat.html

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N E S W

0 5 10 Kilometers

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PROJECT

Water Bottling Study Areas Report

TITLE

Robins Holdings Inc. Regional Study Area

BluMetric™ Environmental

171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	January 02, 2019

DRAWN	CHECKED	FIG NO.	REV
KH	RH	8-2	0

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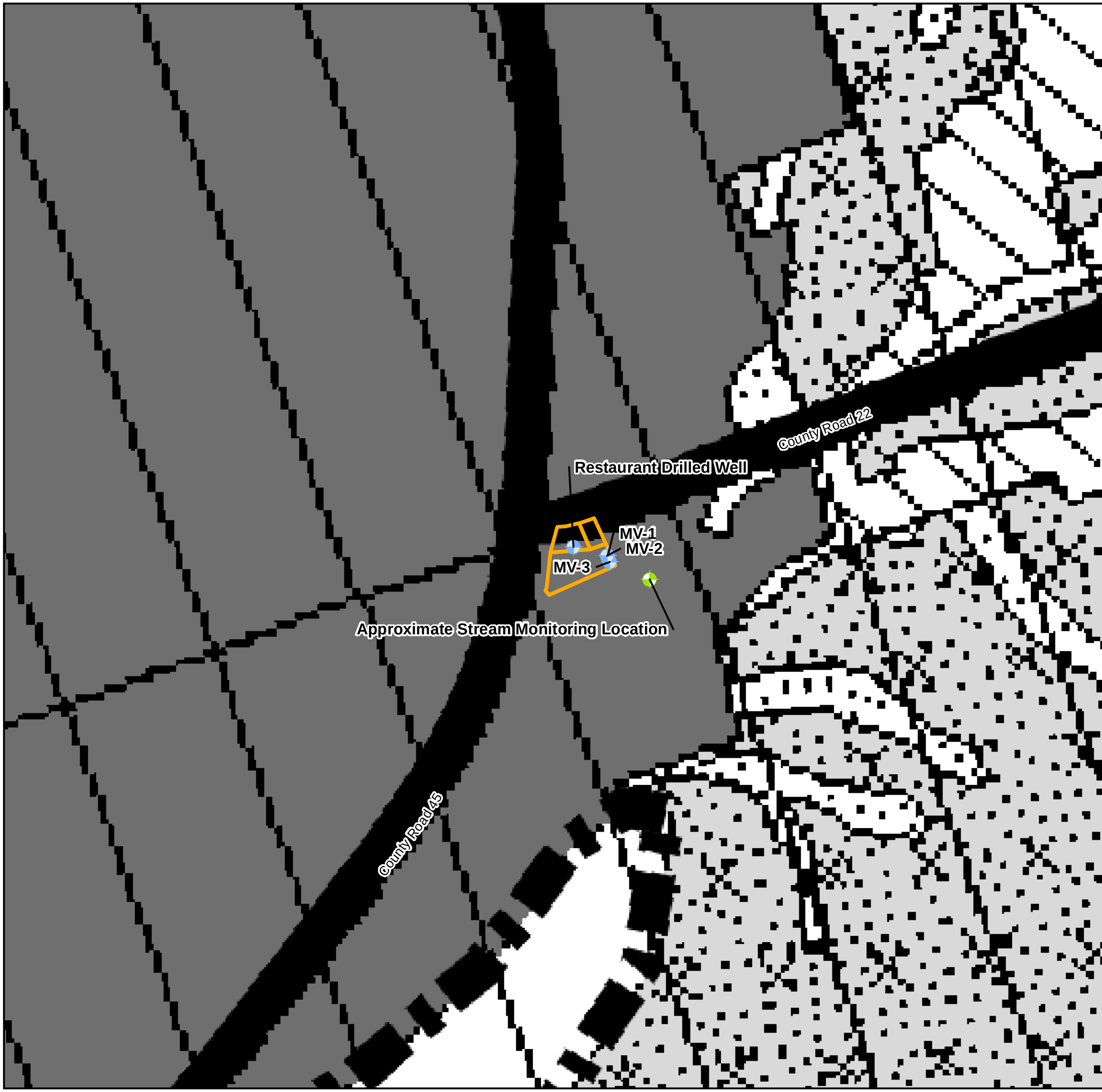

LEGEND

Robins Holdings Wells

Approximate Stream Monitoring Location

Source Well

Robins Holdings Property Boundary

COUNTRYSIDE - AGRICULTURAL

NATURAL LINKAGE

NATURAL CORE

COUNTRYSIDE - RURAL

OAK RIDGES MORAINE BOUNDARY

Note:
Land Use information is sourced from the Official Plan of the Township of Alnwick/Haldimand Schedule 'C-5' Oak Ridges Moraine Land Use Designations, November 4, 2015

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

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0 250 500 Meters

N E S W

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Water Bottling Study Areas Report

TITLE

Robins Holdings Inc. Land Use Setting

BluMetric™ Environmental
171 Victoria St. N.,
Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 04, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	8-3	0

LEGEND

Robins Holdings 2000m Radius

Source Well Location

Physiography

- 2: Till Moraines
- 3: Spillways
- 4: Kame Moraines (Oak Ridges Moraine)
- 6: Till Plains (Drumlinized) (South Slope/Dummer Moraine)
- 7: Drumlins
- 9: Limestone Plains
- 11: Sand Plains (Iroquois Plain)
- 12: Clay Plains
- 13: Eskers
- 14: Beaches
- 17: Peat And Muck

NOTE:
Physiography data sourced from Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228. Chapman, L.J. and Putnam, D.F. 2007. (Chapman and Putnam, 2007).

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

DO NOT SCALE DRAWING.
THIS DRAWING MAY HAVE BEEN REDUCED. ALL SCALE NOTATIONS INDICATED ARE BASED ON 8.5"x11" FORMAT DRAWINGS.

N S E W

0 5 10 Kilometers

CLIENT

MECP

PROJECT

Water Bottling Study Areas Report

TITLE

Robins Holdings Inc. Physiography

BluMetric Environmental
171 Victoria St. N.,
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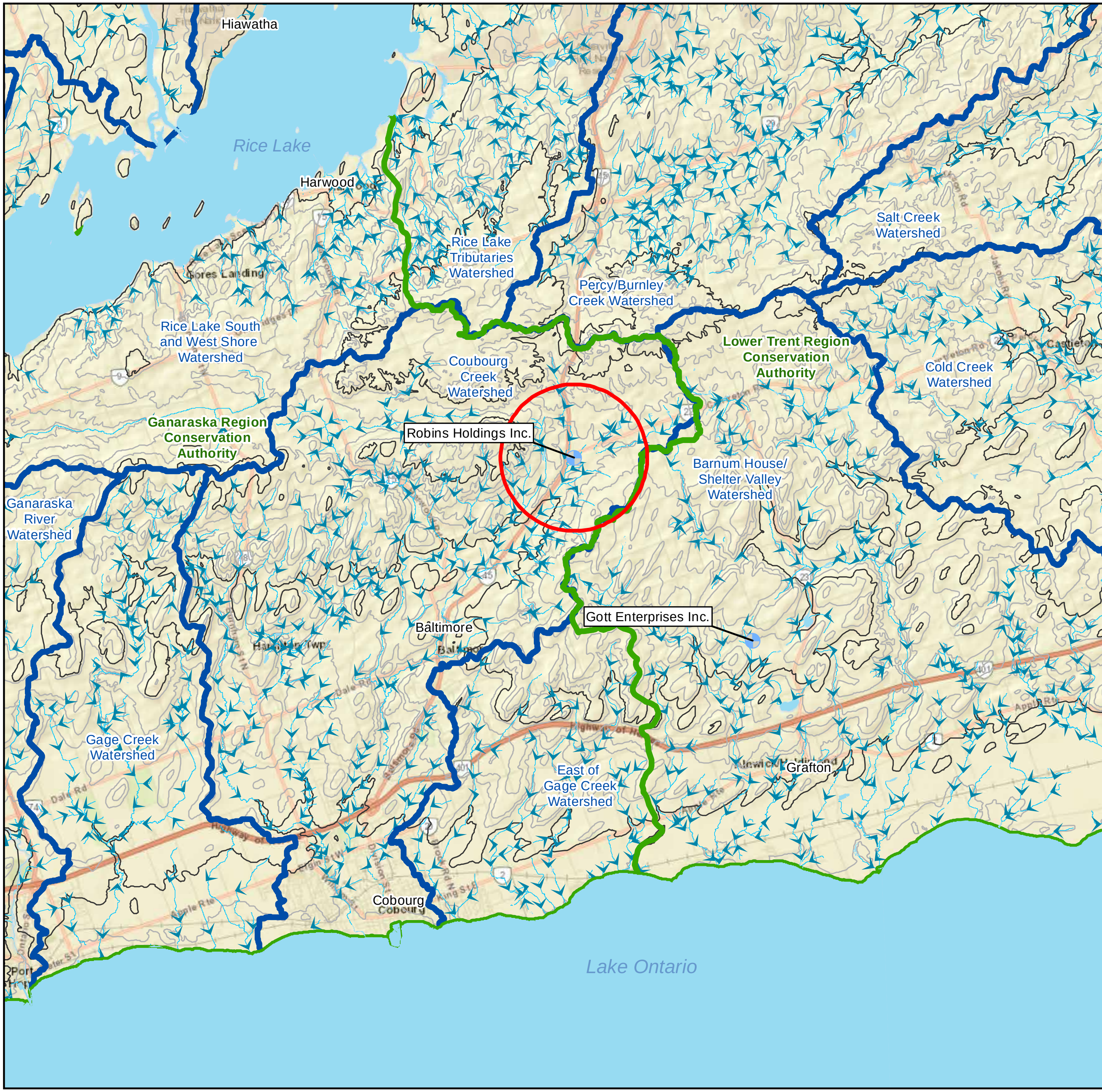
PROJECT #	DATE
180107-07	December 04, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	8-4	0

K:\Projects\MOECC\07 - WBSA\Robins Holdings\MXD\2018-12-03\180107-07-RobinsHoldings-Fig8-4-Physiography.mxd



LEGEND

- Source Well Location
- Robins Holdings 2000m Radius
- Waterbody
- Conservation Authority
- Watershed Boundaries
- Watercourse

Elevation Contours

- 20 m
- 100 m

NOTE:
Conservation authority and watershed boundaries sourced from MECP, 2018.
All topographic features including waterbody, watercourse, and elevation contours sourced from CanVec, 2017.

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N E S W

0 2.5 5 Kilometers

CLIENT

MECP

PROJECT

Water Bottling Study Areas Report

TITLE

Robins Holdings Inc. Regional Topography and Watersheds

BluMetric™ Environmental
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Kitchener, Ontario, N2H 5C5
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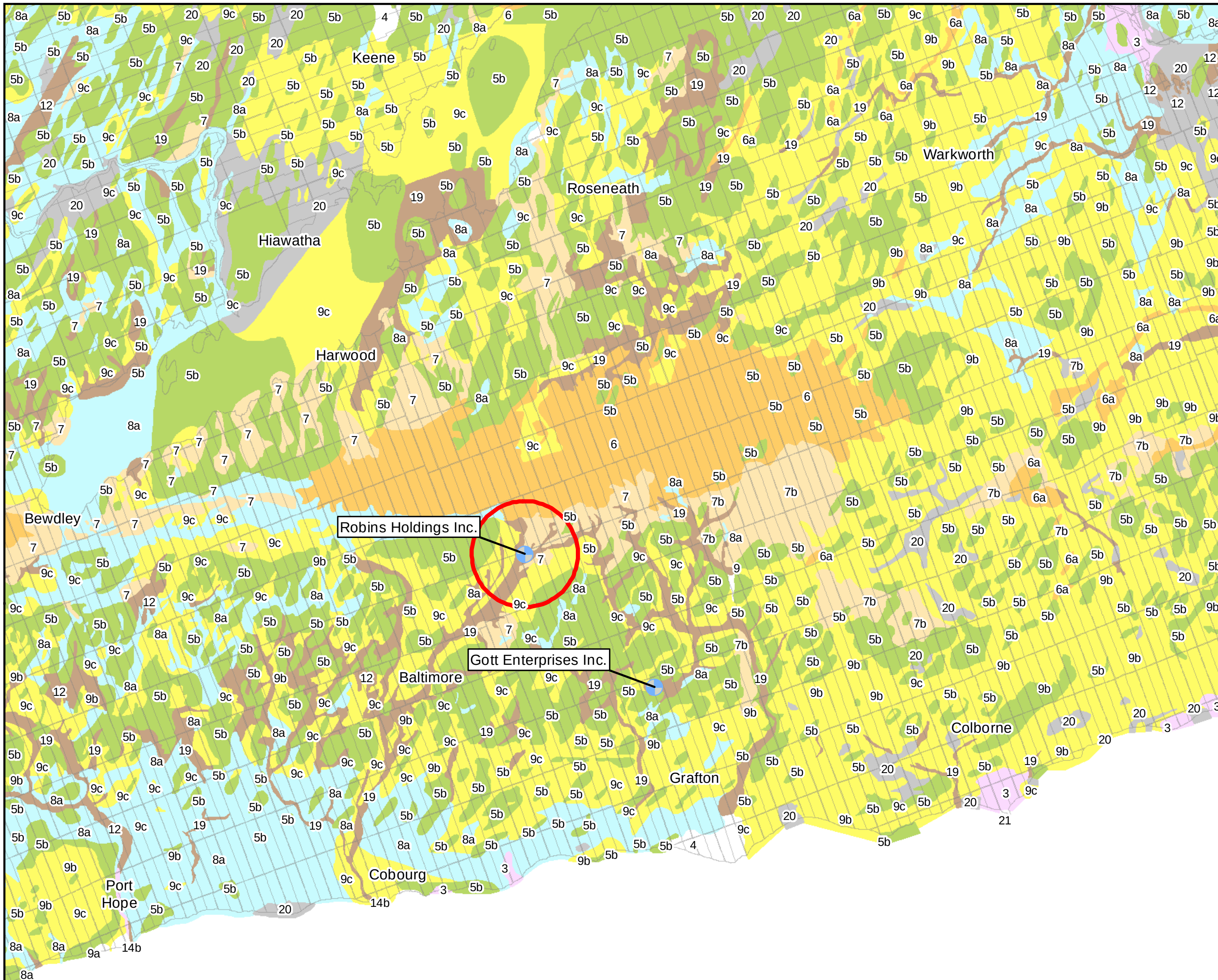
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 04, 2018

DRAWN	CHECKED	FIG NO.	REV
KH	RH	8-5	0



LEGEND

- Source Well Location
- Robins Holdings 2000m Radius

Surficial Geology (MNDM File - MRD128-REV)

- 3: Paleozoic bedrock
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 6: Ice-contact stratified deposits
- 6a: In moraines, eskers, kames and crevasse fills
- 7: Glaciofluvial deposits
- 7a: Sandy deposits
- 7b: Gravelly deposits
- 8a: Massive-well laminated
- 9b: Littoral deposits
- 9c: Foreshore-basinal deposits
- 12: Older alluvial deposits
- 19: Modern alluvial deposits
- 20: Organic deposits

NOTE:
Surficial geology features sourced from Surficial Geology of Ontario; MNDM File - MRD128-REV. Ontario Geological Survey, 2010. (OGS, 2010).

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N S E W

0 5 10 Kilometers

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PROJECT
Water Bottling Study Areas Report

TITLE
Robins Holdings Inc. Surficial Geology

BluMetric Environmental
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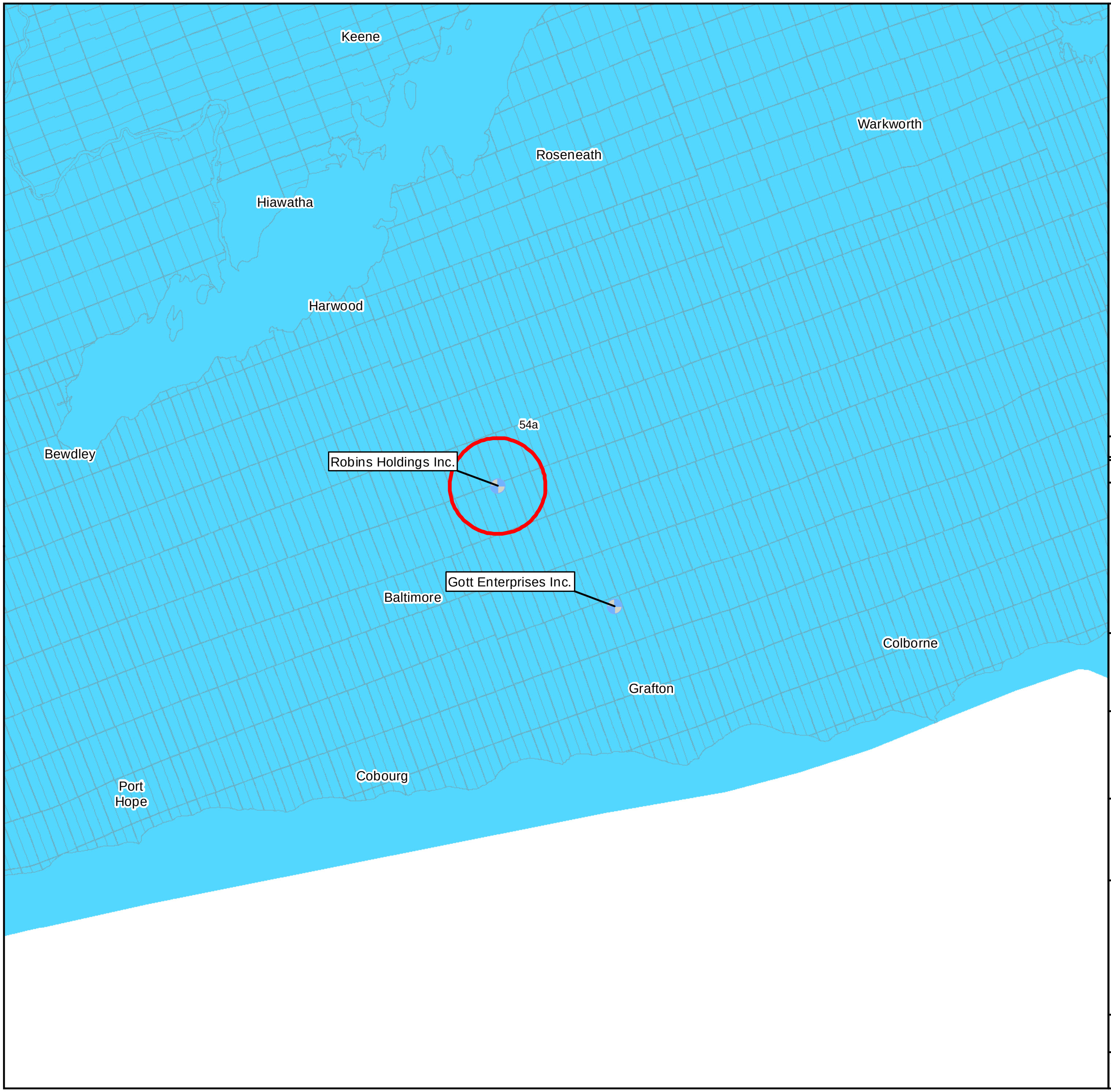
PROJECT #	DATE		
180107-07	December 04, 2018		
DRAWN	CHECKED	FIG NO.	REV
KH	RH	8-6	0



LEGEND

Source Well Location

Robins Holdings 2000m Radius

Middle Ordovician - limestone, dolostone, shale, arkose, sandstone

54a - Ottawa Group; Simcoe Group; Shadow Lake Formation (now considered Upper Ordovician)

NOTE:
Bedrock geology features sourced from Bedrock Geology of Ontario; MNDM File - MRD126-REV1. Ontario Geological Survey, 2011. (OGS, 2011).

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

0 5 10 Kilometers

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PROJECT
Water Bottling Study Areas Report

TITLE
Robins Holdings Inc. Bedrock Geology

BluMetric™ Environmental
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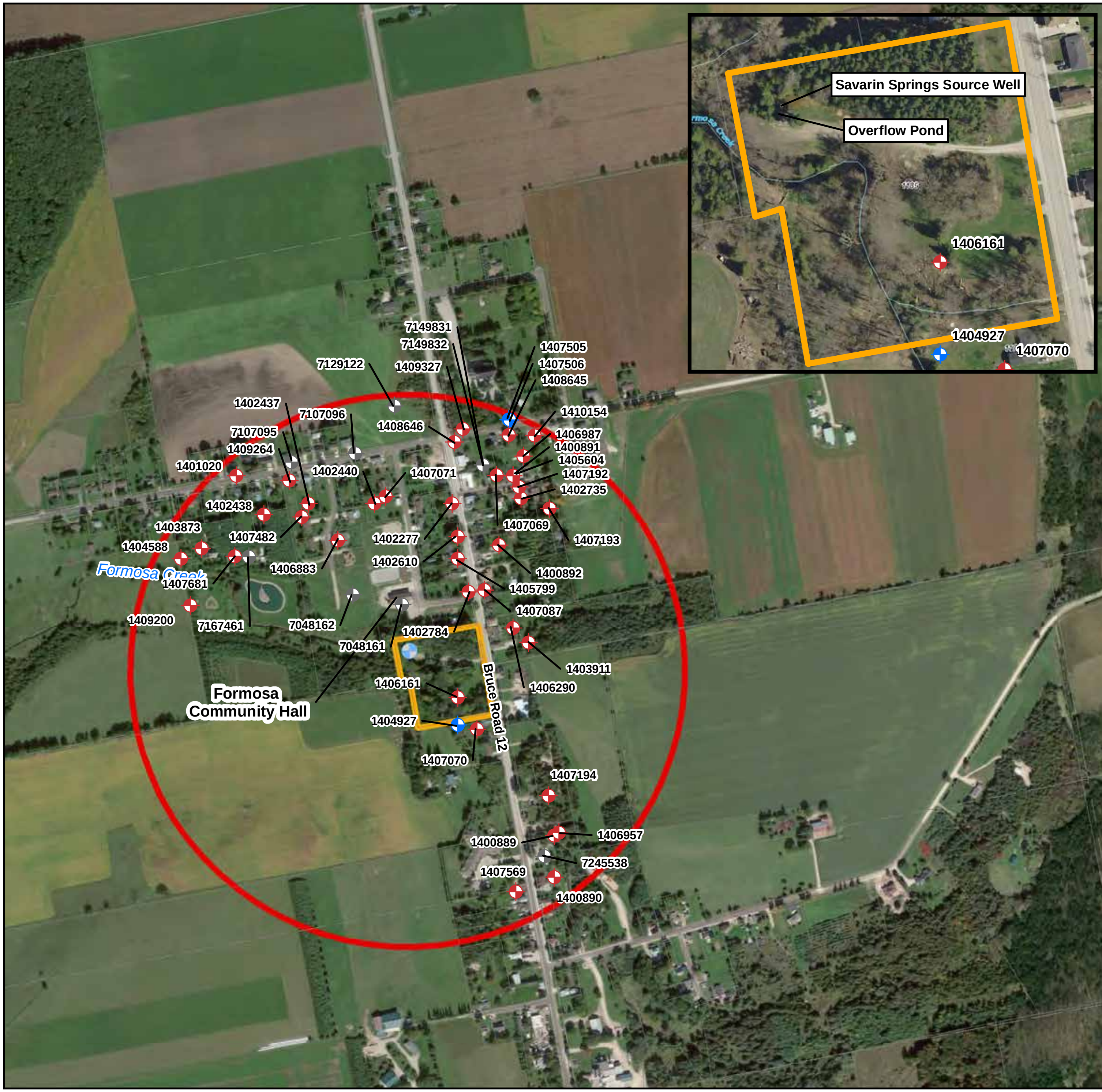
PROJECT #	DATE		
180107-07	December 04, 2018		
DRAWN	CHECKED	FIG NO.	REV
KH	RH	8-7	0



LEGEND

- Bedrock Well
- Overburden Well
- Unknown Well Type
- Source Well Location
- Savarin Spring Inc. Property Boundary
- Savarin Springs 500 m Radius

NOTE:
MECP well records sourced from MECP, 2018.

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

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N W E S

0 200 400 Meters

CLIENT
MECP

PROJECT
Water Bottling Study Areas Report

TITLE
Savarin Springs Inc. Source Location and Site Plan

BluMetric™ Environmental
171 Victoria St. N.,
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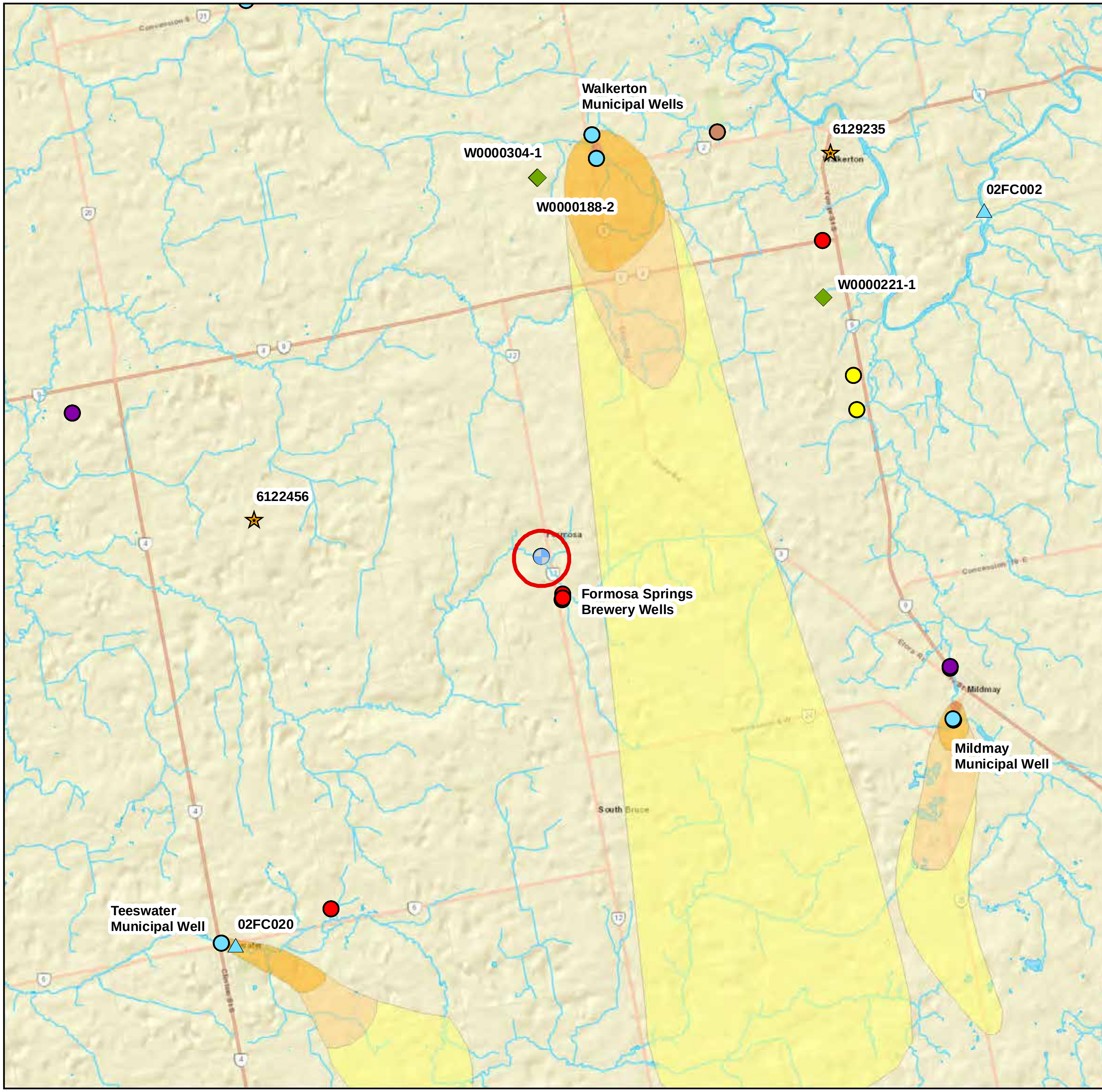
PROJECT #	DATE		
180107-07	December 03, 2018		
DRAWN	CHECKED	FIG NO.	REV
GM	RH	9-1	0



LEGEND

- Source Well Location
- Provincial Groundwater Monitoring Network Wells and ID

WTRS (Active PTTW) and Use

- Agricultural
- Commercial
- Industrial
- Institutional
- Miscellaneous
- Recreational
- Remediation
- Water Supply

- Weather Stations and ID
- HYDAT Stations and ID
- Savarin Springs 500 m Radius

Municipal Well Head Protection Areas - Quality

- A - 100 m Radius
- B - 2 Year Time of Travel
- C - 5 Year Time of Travel
- D - 25 Year Time of Travel

NOTE:
Base Map: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan
Municipal Wellhead Protection Areas: MECP, http://www.applications.ene.gov.on.ca/swp/en/index.php
Active PTTWs: MECP, 2018. https://www.ontario.ca/environment-and-energy/map-permits-take-water
Provincial Groundwater Monitoring Network: MECP, https://www.ontario.ca/environment-and-energy/map-provincial-groundwater-monitoring-network
Weather Stations: Government of Canada, http://climate.weather.gc.ca/
HYDAT stations: Government of Canada, https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey/data-products-services/national-archive-hydat.html

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

0 2 4 Kilometers

N W E S

CLIENT

MECP

PROJECT

Water Bottling Study Areas Report

TITLE

Savarin Springs Inc. Regional Study Area

BluMetric™ Environmental

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Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
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Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	January 02, 2019

DRAWN	CHECKED	FIG NO.	REV
GM	RH	9-2	0

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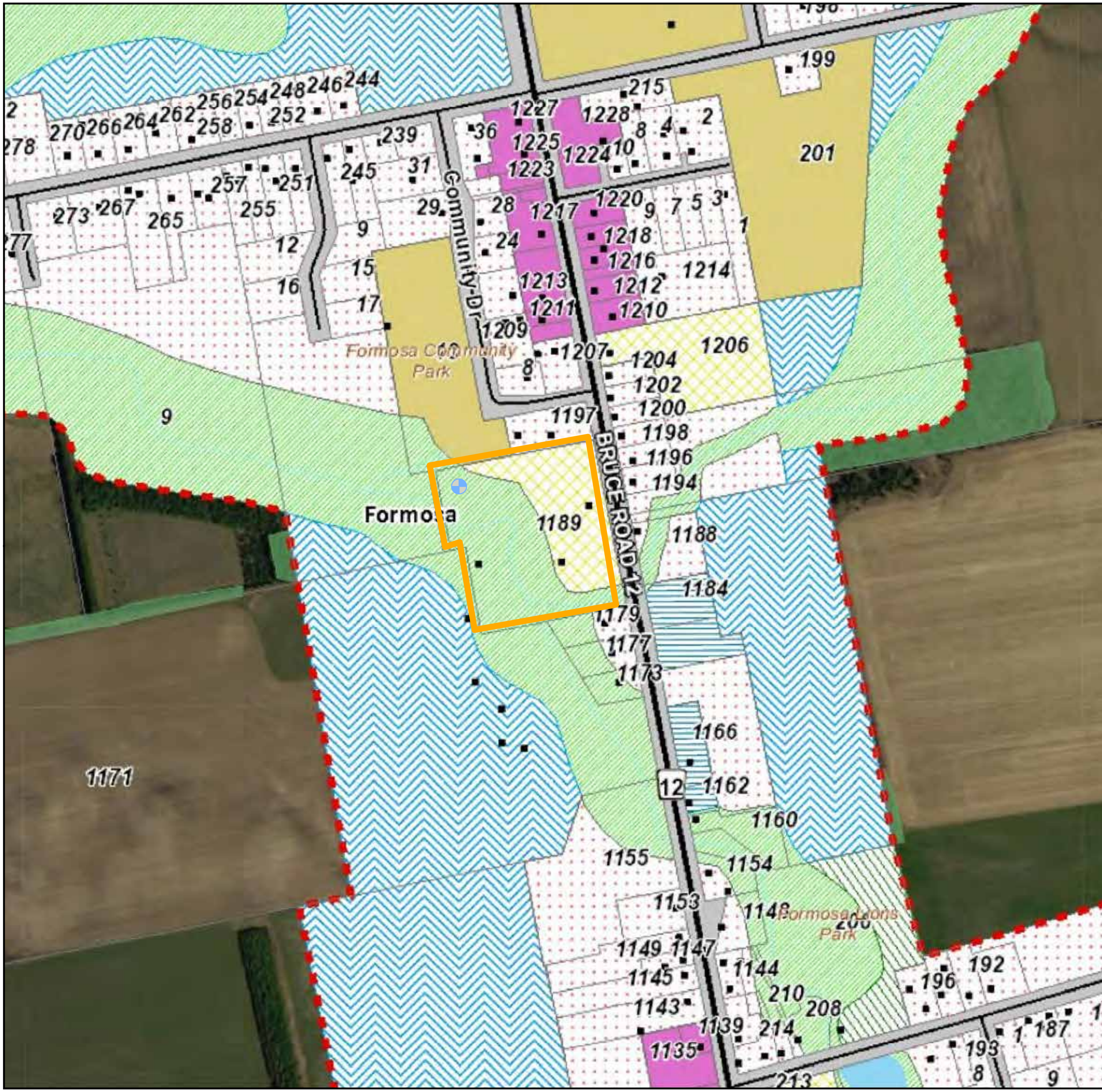

LEGEND

Source Well Location

Savarin Spring Inc. Property Boundary

Environmental Hazard

Future Development

General Commercial

Hazard

Highway Commercial

Industrial

Institutional

Open Space

Residential

Note:
Land Use information is sourced from the Bruce County webmapping applications
https://maps.brucecounty.on.ca/GVH/index.html?viewer=BruceGVH

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

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0 100 200 Meters

N W E S

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PROJECT

Water Bottling Study Areas Report

TITLE

Savarin Springs Inc. Land Use Setting

BluMetric Environmental

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PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
GM	RH	9-3	0

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LEGEND

Source Well Location

Savarin Springs 500 m Radius

Physiography

2: Till Moraines
3: Spillways
4: Kame Moraines
5: Till Plains (Undrumlinized)
6: Till Plains (Drumlinized)
7: Drumlins
11: Sand Plains
17: Peat And Muck

NOTE:
Physiography data sourced from Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228. Chapman, L.J. and Putnam, D.F. 2007. (Chapman and Putnam, 2007).

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

0 2 4 Kilometers

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PROJECT
Water Bottling Study Areas Report

TITLE
Savarin Springs Inc.
Physiography

BluMetric™ Environmental

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PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
GM	RH	9-4	0

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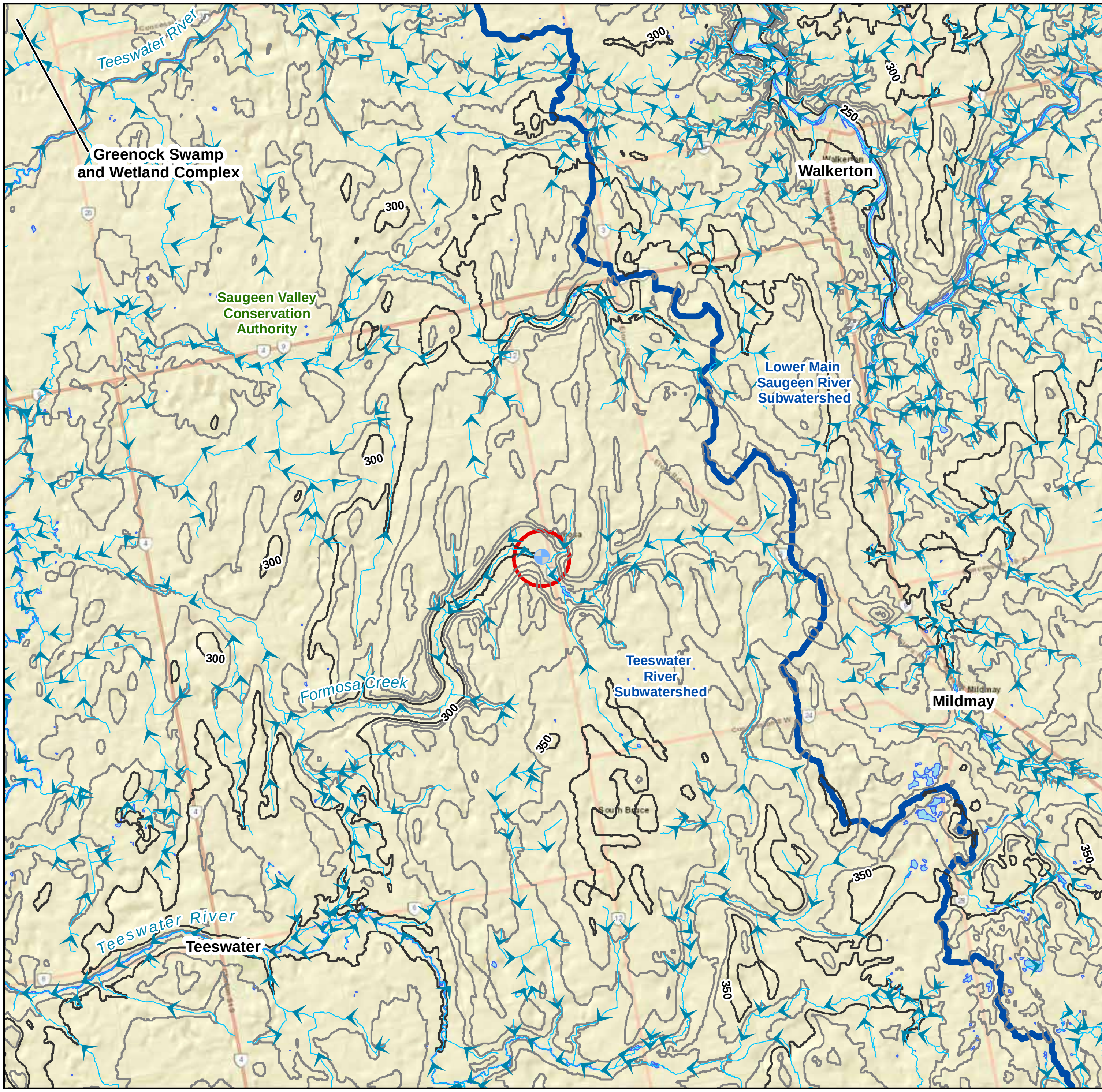

LEGEND

Source Well Location

Watercourse and Flow Direction

Elevation Contours

10 m

50 m

Waterbody

Watershed Boundaries

Savarin Springs 500 m Radius

NOTE:
Watershed boundaries sourced from MECP, 2018.
All topographic features including waterbody, watercourse, and elevation contours sourced from CanVec, 2017.

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

0 2 4 Kilometers

CLIENT

MECP

PROJECT

Water Bottling Study Areas Report

TITLE

Savarin Springs Inc. Regional Topography and Watersheds

BluMetric™ Environmental
171 Victoria St. N., Kitchener, Ontario, N2H 5C5
TEL: (519) 742-6685
FAX: (519) 742-9810
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
GM	RH	9-5	0

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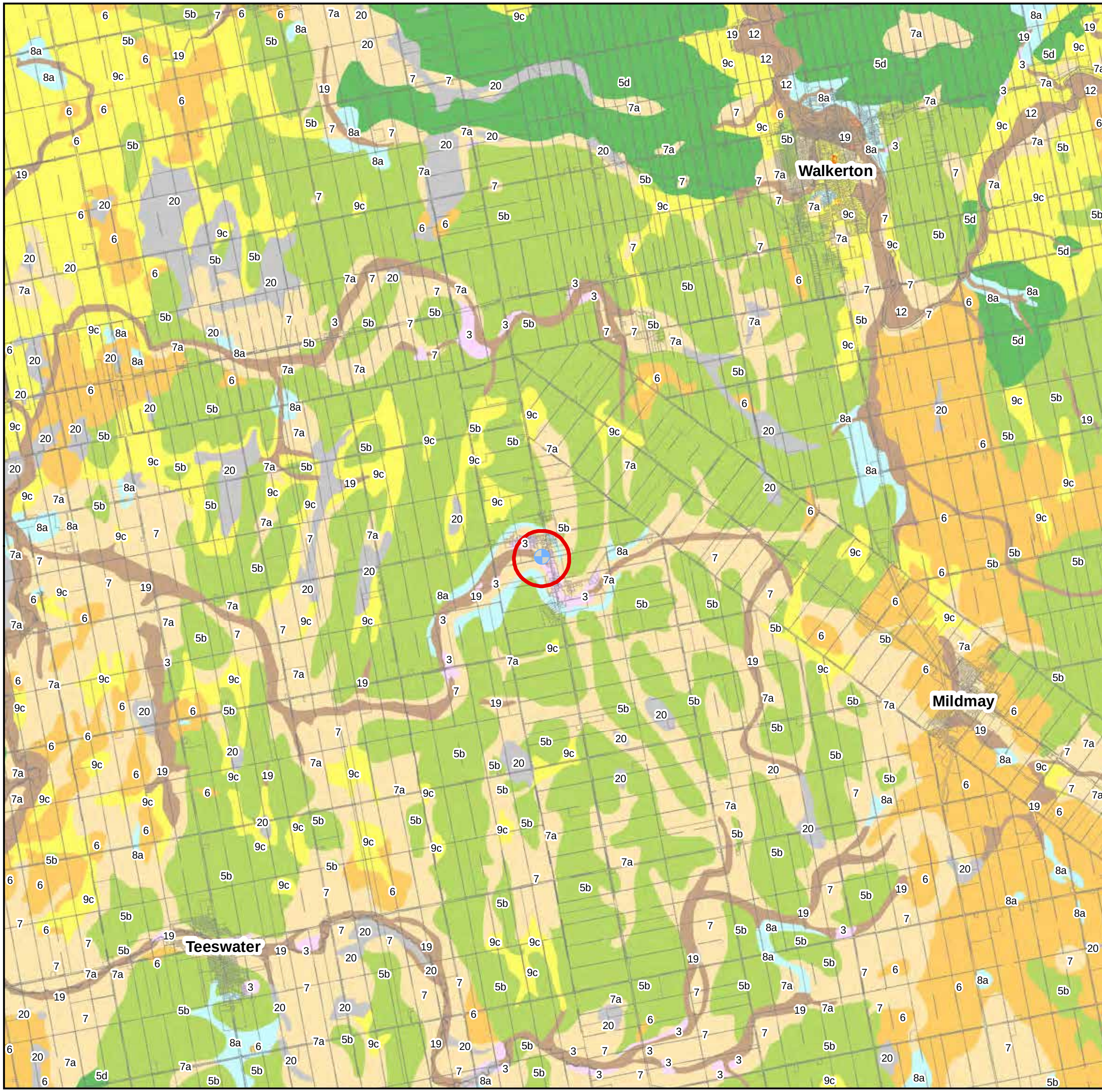

LEGEND

- Source Well Location
- Savarin Springs 500 m Radius

Surficial Geology (MNDM File - MRD128-REV)

- 3: Paleozoic bedrock
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 5d: Glaciolacustrine-derived silty to clayey till
- 6: Ice-contact stratified deposits
- 7: Glaciofluvial deposits
- 7a: Sandy deposits
- 8a: Massive-well laminated
- 9c: Foreshore-basinal deposits
- 12: Older alluvial deposits
- 19: Modern alluvial deposits
- 20: Organic deposits

NOTE:
Surficial geology features sourced from Surficial Geology of Ontario; MNDM File - MRD128-REV. Ontario Geological Survey, 2010. (OGS, 2010).

1				
REV.	DESCRIPTION	YY/MM/DD	BY	CHK

REFERENCES

N W E S

0 2 4 Kilometers

CLIENT

MECP

PROJECT

Water Bottling Study Areas Report

TITLE

Savarin Springs Inc.
Surficial Geology

BluMetric™ Environmental

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PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
GM	RH	9-6	0

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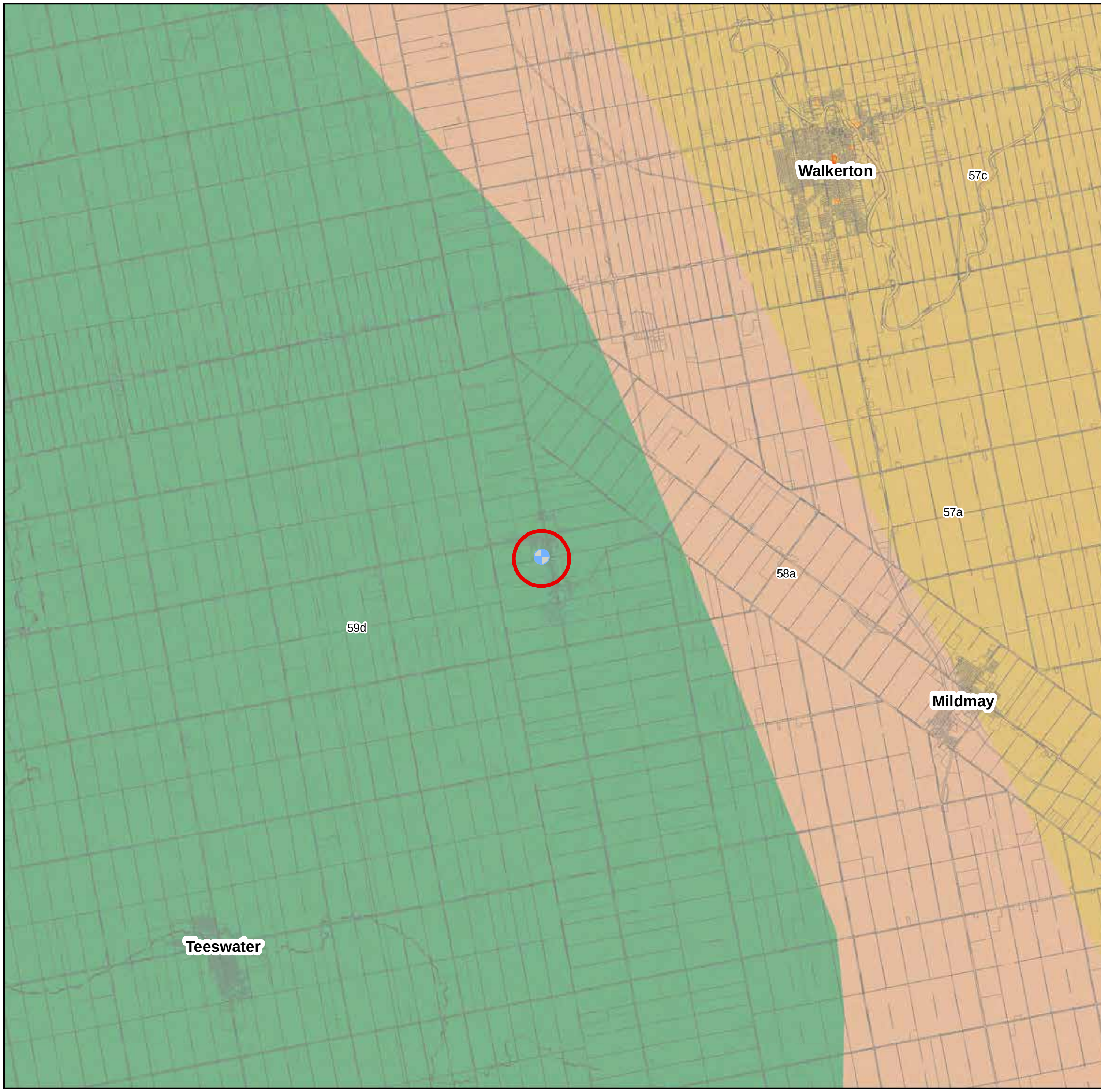

LEGEND

Source Well Location

Savarin Springs 500 m Radius

Upper Silurian - limestone, dolostone, shale, sandstone, gypsum, salt

57a - Bass Islands Formation

57c - Salina Formation

Lower Devonian - sandstone, dolostone, limestone

58a - Bois Blanc Formation; Oriskany Formation

Middle Devonian - limestone, dolostone, shale

59d - Detroit River Group; Onondaga Formation

NOTE:
Bedrock geology features sourced from Bedrock Geology of Ontario; MNDM File - MRD126-REV1. Ontario Geological Survey, 2011. (OGS, 2011).

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

0 2 4 Kilometers

CLIENT

MECP

PROJECT

Water Bottling Study Areas Report

TITLE

Savarin Springs Inc.
Bedrock Geology

BluMetric™ Environmental

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PROJECT #	DATE
180107-07	December 03, 2018

DRAWN	CHECKED	FIG NO.	REV
GM	RH	9-7	0

APPENDIX B

Table 10-1

Table 10-1: Water Bottling Study Areas Report - Summary of Findings, Information Gaps and Recommendations

FINAL: January 11-2019

		Gott Enterprises (Alnwick/ Haldimand)	Gott Enterprises (Amaranth)	Gott Enterprises (Grey Highlands)	Aquaterra Corp. Ltd. Cataract Site	Gold Mountain Springs Inc.	Robins Holdings Ltd.	Savarin Springs Inc.
PTTW INFORMATION SUMMARY								
Municipality		Alnwick/Haldimand	Amaranth	Grey Highlands	Caledon	Oro-Medonte	Alnwick/Haldimand	South Bruce
Conservation Authority		Lower Trent Region CA	Nottawasaga Valley CA	Grey Sauble CA	Credit Valley CA	Nottawasaga Valley CA	Ganaraska Region CA	Saugeen Valley CA
MECP District Office / Regional Office		Peterborough / Kingston (Eastern)	Guelph / Hamilton (West Central)	Owen Sound / London (Southwest)	Halton-Peel / Toronto (Central)	Barrie / Toronto (Central)	Peterborough / Kingston (Eastern)	Owen Sound / London (Southwest)
PTTW Number		8404-7YBLB2	7535-AQBNX8	8035-8U5P7F	7541-72ZM8Z	3122-9ZCQRS	2305-6TDH43[1]	0282-836LBB
PTTW Issue Date (month/day/ year)		12/03/2009	02/23/2018	05/14/2012	07/20/2007	10/15/2015	10/18/2006	03/17/2010
PTTW Expiry Date (month/ day/ year)		05/01/2017	07/31/2021	05/12/2022	03/31/2017	10/31/2017	09/30/2016	02/28/2017
Source Description		5 screened **overburden wells** (11.6 to 20.7 m deep; screened to depths of 10.5 to 16.9 m)	3 limestone **bedrock wells** (41.5 to 43 m deep)	3 limestone **bedrock wells** (25.9 to 30.5 m deep)	1 **overburden well** (12.8 m deep; screened to depth of 12.5 m)	2 screened **overburden wells** (97.5 and 94.5 m deep; both screened to depth of 94.5 m)	3 screened **overburden wells** (5.2 to 22.6 m deep; screened to depths of 4.97 to 22.6 m), only well MV-1 is used for water bottling	1 artesian **bedrock well** (reported depth of 199 m)
Annual Amount Permitted by the PTTW (Million Litres)		272.29	238.72	1195.69	94.56	318.51	79.89	117.94
Max. Taken per Day (Litres)		746,000	327,000 (combined total)	3,275,863	363,680	1,745,280	218,877	327,600
WTRS Amount Taken in 2017 (% of PTTW)		45%	72%	40%	36%	10%	0.03%	4.6%
How Long Have Current Water Taking Limits Been in Effect?		Since 1997	Since 2003	Since 2000	Since 2002	Since 1994	Since 1998	Since 2007 (reduced since 1989)
How Long Has there Been a Water Taking at the Site?		Since 1992	Since 1989	Since 1977 (fish hatchery), since 1993 for water bottling	Since 1984 for bottled water (Canada Dry well water taking pre-dates bottled water taking)	Since 1994	Since 1998	Since 1989 (artesian flow pre-dates taking for water bottling)
PTTW Monitoring Requirements	**At Taking Sources:**	Daily: date, time, total daily taking volume Annual: WTRS	Daily: date, time, total daily taking volume Continuous WL @ each taking well (transducer) Annual: WTRS	Daily: date, time, total daily taking volume Continuous WL @ each taking well (transducer) Annual: WTRS	Daily: date, time, total daily taking volume Annual: WTRS	Daily: date, time, total daily taking volume Annual: WTRS	MV-1 Only Daily: date, time, total daily taking volume Annual: WTRS	Daily: date, time, total daily taking volume Annual: WTRS
	Groundwater:	Monthly WL @ 7 off-site water supply wells (Note: no off-Site wells are currently monitored due to denial of access) Annual water quality sampling @ 6 off-site water supply wells	Monthly WL @ 1 on-site MW Monthly WL @ 6 off-site MW	Continuous WL @ 5 MWs (transducer)	Hourly WL and Temp @ trigger well (P8) Quarterly WL @ 3 MWs Sept, Dec WL @ 5 piezometers	None	Quarterly WL @ all private wells within 300 m of MV-1	None
	Surface Water:	Monthly WL @ 5 locations	Monthly WL @ 2 piezometers installed in drain Monthly flow @ two locations	Continuous WL @ 3 monitoring stations	Sept, Dec Flow in Tributary 4	None	Daily streamflow monitoring @ 1 location (minor headwater tributary of Baltimore Creek)	Continuous flow rate monitoring at Well Pond outlet during active taking
	Ecosystem Monitoring:	None	None	None	Annual assessment of fish and habitat conditions in Tributary 4	None	None	None
	Other:	None	None	None	If the daily average water level in piezometer P8 falls below 382.89 m asl (from June 1 to August 31) or 382.73 m asl (during the rest of the year), no more than 227,300 L/day can be taken.	None	None	Flow exiting the holding pond to Formosa Creek must not drop below 10% of the instantaneous base flow condition. Maximum pumping rate (273 L/minute) was determined (PSM, November 2003) to comply with this Condition.
	Reporting of Monitoring Data:	Annual Monitoring Reports available on request by MECP	Annually - Name & Location of facilities where >20L delivered Size of containers Total volume transported to facilities	Monitoring Report submitted annually and at Permit Renewal	Monitoring Report submitted every 5 years and at Permit Renewal	None	Annual (Provided at Ministry Request) and at PTTW Renewal	Annual provision of pond staff gauge calibration records and daily flow data to Owen Sound Distrct office

		Gott Enterprises (Alnwick/ Haldimand)	Gott Enterprises (Amaranth)	Gott Enterprises (Grey Highlands)	Aquaterra Corp. Ltd. Cataract Site	Gold Mountain Springs Inc.	Robins Holdings Ltd.	Savarin Springs Inc.
ASSESSMENT FINDINGS								
Completeness of Site Characterization	**Are construction records available for all source wells and monitoring wells?**	Borehole instrumentation logs could not be located for the borehole wells BH1, BH2-A, BH2-B, BH3-A, BH3-B, BH4, BH5-A, and observation well SAP01-00.	Yes	Yes	Yes (However, for ease of reference, monitoring well depths and monitoring location distances from the production well should be provided in reports as a summary table)	Yes	Yes	Yes (Note: no water well record exists for the source well)
	Are Site boundaries well defined?	New property boundaries identified in AECOM, February 2018 report. Boundaries do not match legal description provided in PTTW No. 8404-7YBLB2.	Yes	Yes	Yes	Yes	Yes	Yes
	Are all monitoring locations indicated on Site Drawings and Tables?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Have cross sections been prepared for the Site?	Yes	No Site cross sections identified in reviewed files	Yes	Yes	Yes	Yes	Yes
	Have the main hydrostratigraphical units been characterized for the Site?	Yes	Yes (but not on cross sections)	Yes	Yes	Yes	Yes	Yes
	Is there aquifer testing data and analysis for all sources?	Yes (Note: Well #1B not tested, opinion provided that well properties are the same as the well that it replaced, Well #1)	Yes (Note: Well PW5 not tested, opinion provided that well properties are the same as the well that it replaced, Well PW2)	Yes	Yes	Yes	Yes	Yes
	Has the Zone of Influence been determined?	Yes - Radius of influence of the well field was estimated to be approx. 1 km based on MODFLOW computer simulations (ORE, 1997). AECOM, February 2018 repeated the simulation using the current PTTW limit and predicted 0.7 m of drawdown at 500 m from the wells. AECOM, February 2018 indicates actual water level influences are limited to 100 m from the production wells based on monitoring data.	Yes - Limit of influence identified as 1.1 km radius (Wilson, September 1994)	Radius of influence of the production wells was determined to be 430 m from the center of the three production wells (MEH, July 1999)	The radius of influence was estimated at approximately 400 m (Geomines Ltd., October 1996)	Yes - approximately 1 km (Wilson, 1994)	Yes - area of influence was calculated to be 408 m. Cone of influence was interpreted to be 100 m (Ore, 1997)	Source is artesian, as are many nearby well supplies.
	Overall, is there adequate information to assess the sustainability of the water taking?	Yes	Yes	Yes - However, the long term water level monitoring hydrographs provided in the most recent annual report (for 2015) do not show data beyond 2011. These hydrographs need to be updated for the annual report as the key indicator that the water taking is sustainable.	Yes	Yes	Yes - However, the most recent available data is May 2006. Subsequent monitoring data along with long term monitoring data hydrographs need to be provided in support of a Permit renewal.	Yes

Table 10-1: Water Bottling Study Areas Report - Summary of Findings, Information Gaps and Recommendations

FINAL: January 11-2019

		Gott Enterprises (Alnwick/ Haldimand)	Gott Enterprises (Amaranth)	Gott Enterprises (Grey Highlands)	Aquaterra Corp. Ltd. Cataract Site	Gold Mountain Springs Inc.	Robins Holdings Ltd.	Savarin Springs Inc.
Stress Review	**Has A Water Budget Been Completed for the Watershed/ Subwatershed?**	Yes - Barhamhouse Creek/Shelter Valley Creek subwatershed	Yes - Upper Nottawasaga River subwatershed	Yes - Beaver River watershed	Yes - Melville to Forks of the Credit subwatershed	Yes - North River Subwatershed	Yes - Cobourg Creek watershed	Yes : Greenock Swamp/Teeswater subwatershed
	Tier 1 Groundwater	Low Stress Potential	Low Stress Potential	Low Stress Potential	Not Done	Low Stress Potential	Low Stress Potential	Low Stress Potential
	Tier 1 Surface Water	Low Stress Potential	Significant in July to August	Low Stress Potential	Not Done	Moderate Stress Potential [2]	Low Stress Potential	Low Stress Potential
	Tier 2 Groundwater	Not Recommended after Tier 1	Not Recommended after Tier 1	Not Recommended after Tier 1	Low Stress Potential (Tier 3 Not Recm.)	Not Recommended after Tier 1	Not Recommended after Tier 1	Not Recommended after Tier 1
	Tier 2 Surface Water	Not Recommended after Tier 1	Not Recommended after Tier 1	Not Recommended after Tier 1	Low Stress Potential (Tier 3 Not Recm.)	Not Recommended after Tier 1	Not Recommended after Tier 1	Not Recommended after Tier 1
	Are there Population Growth Pressures?	No	The Official Plan for the Township of Amaranth (June 2018) indicates that the communities of Laurel, Waldemar and Farmington, all located more than 9 km south and southwest of the Site, are intended to be the focus for residential and employment growth in the Township, which has seen increased growth pressure as the Greater Toronto Area continues to grow. The population for the Township is forecast to rise to about 4,680 by the year 2031.	No	The Town of Caledon is described in its Official Plan (April 2018) as exhibiting the characteristics of a distinct rural area under increasing pressure from expanding urban areas from Toronto, located to the southeast of the Town. The primary growth areas are designated to occur in Rural Service Centres: Mayfield West, Bolton and Caledon East, located 13.5 km northeast, 22.9 km east-northeast, and 17.9 km southeast of the Aquaterra Cataract Site, respectively.	The population growth forecast for the Township of Oro-Medonte indicates a 25% increase in population by 2031. Population growth for the Township is to be focused on existing settlement areas where groundwater is identified as a primary source for water supply.	No	No
	PGMN Wells (Distance) Type	W0000393-1 (5.8 km) Overburden W0000412-1 (4.9 km) Overburden W0000411-2 (4.9 km) Overburden W0000411-3 (4.9 km) Interface	W0000486-1 (8.6 km) Overburden	W0000066-1 (4.4 km) Limestone Bedrock	W0000026-1 (5.2 km) Bedrock W0000163-2 (5.5 km) Overburden W0000163-3 (5.5 km) Overburden W0000164-2 (9.5 km) Overburden W0000164-3 (9.5 km) Overburden	W0000439-1 (2.9 km) Overburden W0000293-3 (5.9 km) Overburden W0000440-1 (6.1 km) Overburden W0000442-1 (9.8 km) Overburden	W0000412-1 (5.0 km) Overburden W0000411-2 (5.0 km) Overburden W0000411-3 (5.0 km) Bedrock Contact W0000393-1 (6.0 km) Overburden W0000348-1 (9.6 km) Overburden	W0000304-1 (6.7 km) Overburden W0000188-2 (6.7 km) Bedrock W0000221-1 (6.8 km) Bedrock
	Were Decreasing Water Level Trends Detected for PGMN Wells?	1 shallow overburden well showed downward year to year and seasonal trends: 2 deeper overburden wells at the same location showed upward seasonal trends	No	No	No	No	1 shallow overburden well showed downward year to year and seasonal trends: 2 deeper overburden wells at the same location showed upward seasonal trends	No
	OLWR: What trends were identified for 'Notifications' and 'Declared Alerts'?	None	None	Level 1 Low Water Condition Alerts have been necessary for the late summer and fall months in approximately 1/3 of the years where the OLWR program has been in place.	None	None	None	None
	Have Level 2 or Level 3 Low Water Conditions Alerts been Declared for Watershed and when?	Yes - Level 2 Alert in 2012 and 2016	No	No	Yes - Level 2 Alert between early August and mid-September 2016	No	Yes - Level 2 (August 2016)	No - Last Level 1 in 2007
	Overall Findings of Stress Review	Based on the information reviewed, no stress concerns were identified for the sustainability of regional water quantity resources.	Based on the information reviewed, no stress concerns were identified for the sustainability of regional groundwater quantity resources, though seasonal stress was identified for surface water quantity resources.	Based on the information reviewed, no stress concerns were identified for the sustainability of regional water quantity resources.	Based on the information reviewed, no stress concerns were identified for the sustainability of regional water quantity resources.	Based on the information reviewed, no stress concerns were identified for the sustainability of regional water quantity resources.	Based on the information reviewed, no stress concerns were identified for the sustainability of regional water quantity resources.	Based on the information reviewed, no stress concerns were identified for the sustainability of regional water quantity resources.

Table 10-1: Water Bottling Study Areas Report - Summary of Findings, Information Gaps and Recommendations FINAL: January 11-2019

		Gott Enterprises (Alnwick/ Haldimand)	Gott Enterprises (Amaranth)	Gott Enterprises (Grey Highlands)	Aquaterra Corp. Ltd. Cataract Site	Gold Mountain Springs Inc.	Robins Holdings Ltd.	Savarin Springs Inc.
Cumulative Effects/Impacts	**Have there been documented well interference impacts?**	No	No	No	No	No	No	No
	Has there been a documented decline in groundwater Levels for the Site?	No	No	No	No	No	No	No
	Other Large Water Takings of Potential Interest	PTTW No. 5086-9BPM4A (Grafton Municipal Wells) @ 2.0 km	PTTW No. 1353-AZHJCQ (Shelburne Municipal wells) @ 4.2 to 5.2 km	None within 5 km	PTTW No. 0158-9DFMXH (Caledon Village Municipal wells) @ 5.0 km	PTTW No. 7845-94EKF9 Braestone Subdivision (Communal supply) @ 1.05 km	None within 5 km	PTTW No. 6432-8DML3E Formosa Springs (commercial) @ 0.8 km
	Has a potential for unacceptable well interference been identified?	The general assessment of potential water quantity interference with existing or planned municipal water supply systems did not identify any potential for unacceptable well interference and/or impediment to future expansion of existing municipal groundwater systems.	The general assessment of potential water quantity interference with existing or planned municipal water supply systems did not identify any potential for unacceptable well interference and/or impediment to future expansion of existing municipal groundwater systems. The future expansion of the Township of Amaranth system will be based on the outcome of the Municipal Class EA, not available for consideration in this assessment.	The general assessment of potential water quantity interference with existing or planned municipal water supply systems did not identify any potential for unacceptable well interference and/or impediment to future expansion of existing municipal groundwater systems.	The general assessment of potential water quantity interference with existing or planned municipal water supply systems did not identify any potential for unacceptable well interference and/or impediment to future expansion of existing municipal groundwater systems.	The general assessment of potential water quantity interference with existing or planned municipal water supply systems did not identify any potential for unacceptable well interference and/or impediment to future expansion of existing municipal groundwater systems. The various existing municipal groundwater systems are generally far apart throughout the geographic area of the Township. The Braestone Subdivision communal wells draw from the same aquifer as the water bottler (Aquifer 3), a high aquifer yield and the significant available aquifer drawdown indicates a low potential for unacceptable well interference impacts. Consequently, cumulative impacts from these water takings are not a likely concern for the sustainability of groundwater in the area.	The general assessment of potential water quantity interference with existing or planned municipal water supply systems did not identify any potential for unacceptable well interference and/or impediment to future expansion of existing municipal groundwater systems.	The Site is located near the centre of a triangle formed by the communities of Walkerton, Mildmay and Tesswater (all located within 9 km of the Site). The source well is likely to be drawing water from the same bedrock aquifers utilized by one or more of the municipal well systems. However, given the large separation distance, and based on aquifer testing results from 1993 (PEL, July 1993) indicating minimal interference from the source well on nearby domestic wells, and the significantly reduced PTTW limits (65% reduction since 1993), a potential for unacceptable well interference and/or impediment to future expansion of these existing municipal groundwater systems is not indicated.
Ecosystem and Environmental Flow Needs Assessment	**Is there Groundwater/Surface Water Interaction at the Site?**	Yes (Note: Hydraulic connection not indicated for on-Site. Aquifer discharge to surface water 800 m south of the well field has been reported)	No confirmed vertical hydraulic connection with surface water at the Myers Drain and adjacent wetland. Monthly water level and stream flow monitoring for 2 locations at the Myers Drain is a PTTW Condition.	Yes	Yes	No	Yes - The shallow overburden aquifer discharges to the Baltimore Creek tributary located adjacent to the Site (ORE, 1997). An aquitard is situated above the intermediate overburden aquifer utilized by the production wells.	Yes - Excess artesian flow considered essential for healthy ecosystem of Formosa Creek
	Has an Ecosystem Study been done?	No	No	Yes - No impact identified (Golder, June 2006)	Yes	No	No	No
	Is there On-going Ecosystem Monitoring?	No	No	No	Yes - Annual assessment of fish and habitat conditions in Tributary 4	No	No	No
	Are Ecosystem and/or Environmental Flow Needs (EFN) Assessments Warranted?	Based on the information reviewed, the need for ecosystem/EFN assessments was not identified. Potential impact to surface water appears to be adequately addressed through the current water level monitoring program which has shown no indications of an impact.	Based on the information reviewed, the need for ecosystem/EFN assessments was not identified. Continued water takings at the permitted water taking limits are not expected to impact surface water and natural functions of the ecosystem. The existing monitoring program in place serves to identify any possible changes to these features.	Based on the information reviewed, the need for ecosystem/EFN assessments was not identified. Continued water takings at the permitted water taking levels are not expected to impact surface water and natural functions of the ecosystem. The existing monitoring program in place serves to identify any possible changes to these features.	Ecosystem/EFN assessments have been undertaken for the Site. Continued water takings at the permitted water taking levels are not expected to impact surface water and natural functions of the ecosystem. The existing monitoring program in place serves to identify any possible changes to these features.	No; no groundwater-surface water interaction was identified at the Site.	Based on the information reviewed, the need for ecosystem/EFN assessments was not identified. No impact to surface water and natural functions of the ecosystem has been identified for the Robins Holdings Inc. water taking.	Current water taking limit was determined based on maintaining a minimum flow into Formosa Creek. The current limit appears to be adequately protective of ecosystem and EFN. Completion of an ecosystem assessment is considered necessary in support of any proposed increase to the Permit water taking limits, or if any complaints or concerns are raised about ecosystem impacts.

Table 10-1: Water Bottling Study Areas Report - Summary of Findings, Information Gaps and Recommendations **FINAL: January 11-2019**

		Gott Enterprises (Alnwick/ Haldimand)	Gott Enterprises (Amaranth)	Gott Enterprises (Grey Highlands)	Aquaterra Corp. Ltd. Cataract Site	Gold Mountain Springs Inc.	Robins Holdings Ltd.	Savarin Springs Inc.
Sustainability	**Are Regional Water Resources Sustainable?**	Based on the information reviewed, no stress concerns were identified for the sustainability of regional water quantity resources.	Based on the information reviewed, no stress concerns were identified for the sustainability of regional groundwater quantity resources. A seasonal moderate stress potential was identified for the sustainability of regional surface water quantity resources.	Based on the information reviewed, no stress concerns were identified for the sustainability of regional water quantity resources.	Based on the information reviewed, no stress concerns were identified for the sustainability of regional water quantity resources.	Based on the information reviewed, no stress concerns were identified for the sustainability of regional water quantity resources.	Based on the information reviewed, no stress concerns were identified for the sustainability of regional water quantity resources.	Based on the information reviewed, no stress concerns were identified for the sustainability of regional water quantity resources.
	Are the PTTW Water Taking Limits Sustainable?	Based on the information reviewed, there are no indicators that the water taking is having an impact on the sustainability of existing and future water resources. Consequently, it is BluMetric's opinion that the water taking is sustainable.	Based on the information reviewed, there are no indicators that the water taking is having an impact on the sustainability of existing and future water resources. Since the water taking is for groundwater and not surface water, it is BluMetric's opinion that the water taking is sustainable.	Based on the information reviewed, there are no indicators that the water taking is having an impact on the sustainability of existing and future water resources. Consequently, it is BluMetric's opinion that the water taking is sustainable.	Based on the information reviewed, there are no indicators that the water taking is having an impact on the sustainability of existing and future water resources. Consequently, it is BluMetric's opinion that the water taking is sustainable.	Based on the information reviewed, there are no indicators that the water taking is having an impact on the sustainability of existing and future water resources. Consequently, it is BluMetric's opinion that the water taking is sustainable.	Based on the limited information reviewed, there are no indicators that the water taking is having an impact on the sustainability of existing and future water resources. It is BluMetric's opinion that the water taking is likely sustainable based on the low water taking volumes. As noted below: the most recent available data for review is from May 2006.	Based on the information reviewed, there are no indicators that the water taking is having an impact on the sustainability of existing and future water resources. Consequently, it is BluMetric's opinion that the water taking is sustainable.
	Are PTTW Monitoring Conditions Adequate to Ensure Sustainability?	Monitoring/reporting conditions under the PTTW are considered adequate. The monitoring program provides a measure of security in ensuring the water taking remains sustainable in future.	Monitoring/reporting conditions under the PTTW are considered adequate. The monitoring program provides a measure of security in ensuring the water taking remains sustainable in future.	Monitoring/reporting conditions under the PTTW are considered adequate. The monitoring program provides a measure of security in ensuring the water taking remains sustainable in future.	Monitoring/reporting conditions under the PTTW are considered adequate. The monitoring program provides a measure of security in ensuring the water taking remains sustainable in future.	No monitoring/reporting conditions exist under the current PTTW. A Groundwater level monitoring program is recommended as a measure of security in ensuring the water taking remains sustainable in future.	Monitoring/reporting conditions under the PTTW are considered adequate. The monitoring program provides a measure of security in ensuring the water taking remains sustainable in future.	Monitoring/reporting conditions under the PTTW are considered adequate. It is understood that groundwater level monitoring is not feasible/required due to the high static head for the aquifer and artesian water taking source. The PTTW conditions ensure that adequate flow to Formosa Creek is maintained.
GAPS & RECOMMENDATIONS								
Site Specific Information Gaps and Recommendations for the Water Quantity Management Framework		For a permit renewal it is recommended that the monitoring program conditions be updated to reflect current monitoring requirements which are changed from the requirements indicated in PTTW No. 8404-7YBLB2. The conditions should indicate specific requirements/ locations for monitoring to ensure the assessment of potential impacts from the water taking are adequately scoped and understood.	No Site cross sections identifying geology and hydrostratigraphic units were identified in the documentation reviewed. Cross sections should be included with the Permit Renewal Application Report.	The long term water level monitoring hydrographs provided in the most recent annual report (for 2015) do not show data beyond 2011. Hydrographs showing long term monitoring data need to be updated for the annual report as the key indicator of steady state conditions and confirming the water taking is sustainable.	No gaps or potential enhancements identified.	As recommended by Wilson, 2017, re-implementation of an on-site groundwater monitoring program for the three overburden aquifers located at the Site (using the multi-level monitoring well) and the two production wells is considered warranted. Continued water level monitoring will provide a measure of security in ensuring the long term sustainability of the groundwater resource.	No monitoring data is available for the Robin Holdings Inc. water taking since May 2006. Consequently, only limited data was available for assessment of the water taking impact on local water resources. Data collected since May 2006 will need to be provided by Robins Holdings Inc. in support of a Permit renewal.	It was noted that annual records of water taking and staff gauge calibration were not present in the ministry files. As per Condition 4.3 of the permit, this information is to be submitted by the Permit Holder to the MECP Owen Sound Area Office by December 31st of each year. It is recommended that the ministry's Owen Sound District Office follow up on the information gap with the Water Bottler and/or decide whether this Permit condition as currently administered provides any value for protection of the environment.
		New property boundaries identified in AECOM, February 2018 report. Boundaries do not match legal description provided in PTTW No. 8404-7YBLB2.						No baseline or on-going ecosystem studies have been conducted for Formosa Creek. As a minimum, completion of a baseline ecosystem study is considered necessary in support of any proposed increases to the Permit Holder water taking limits.
Gaps / Recommendations for All Sites to Enhance the Water Quantity Management Framework		Data Availability to Assess Sustainability - The presentation of hydrographs with long term water level data (e.g. groundwater level and surface water level data collected over many years) was identified as the best available science in assessing whether steady state conditions exist and for addressing sustainability of the water taking. Consequently, on-going monitoring and the presentation of long term monitoring data as hydrographs is recommended for all water bottler water takings to establish that the water taking is sustainable.						
		OLWR Program Database - It is recommended that the OLWR Program database be reviewed to identify improvements that will enhance the use of OLWR 'Notifications' (that are based on surface water trigger levels) as a tool for assessing trends in the availability of surface water, and possibly shallow groundwater resources. Integration of PGMN groundwater level data into the OLWR Program would provide a further enhancement by providing a monthly status of groundwater levels within the watershed. Timely release of the integrated data would allow for timely response.						
		PGMN Database - It was noted that data for many PGMN wells has not been updated in many years (some wells not since 2010). The current system of data management for the PGMN network should be revised to ensure the timely release of date.						
		File Management - During the completion of the file review it was apparent that most documentation for the WBSAs remain in hard copy only. Hard copy documentation storage and file management poses a number of challenges and risks. Challenges are associated with access to files that get moved from desk to desk. Risks are associated with the potential misplacement of files and the potential loss of hard copy documents to fire or other forms of damage. Consequently, transitioning file management to an e-based system is recommended.						

Table 10-1: Water Bottling Study Areas Report - Summary of Findings, Information Gaps and Recommendations

FINAL: January 11-2019

	Gott Enterprises (Alnwick/ Haldimand)	Gott Enterprises (Amaranth)	Gott Enterprises (Grey Highlands)	Aquaterra Corp. Ltd. Cataract Site	Gold Mountain Springs Inc.	Robins Holdings Ltd.	Savarin Springs Inc.
LIMITATIONS ON REVIEW							
Information, data, records, etc. missing from the documents provided by MECP for review:	Instrumentation logs could not be located for the borehole wells and one observation well (BH1, BH2-A, BH2-B, BH3-A, BH3-B, BH4, BH5-A, and SAP01-00) utilized in the Gott Enterprises Inc. water level monitoring program.	None	Information sources referenced in other documentation but not provided in MECP files: • Electrical Resistivity Imaging Survey to Profile Depth to Bedrock, Aquafarms 93 Property. Golder Associates Limited, June 2008. (GAL, June 2008). • Assessment of Groundwater Monitoring Data, 2002 to 2007, Aquafarms 93, Dillon Consulting Limited. July 8, 2008 (Dillon, July 2008). • Groundwater Monitoring Report 2009, Aquafarms 93, April 9, 2009. Dillon Consulting Limited. (Dillon April 2009).	Information sources referenced in other documentation but not provided in MECP files: • Hydrogeological Investigation, Caledon, Ontario. January 1987. Geomines Ltd. • Follow-up Hydrogeological Study After Completion of an Observation Well Network Construction Program at Crystal Springs Property, Caledon, Ontario. February 1988. Geomines Ltd. • Notice Presenting the Protection Area Required in the Recharge Area of the Cataract Source by Crystal Springs. January 1994. Geomines Ltd.	Documentation indicating the ministry's acceptance of the removal of off-Site groundwater monitoring and on-Site surface water monitoring from the Permit monitoring program (in 2008 or 2009) was not identified in the files provided for review. It is recommended that this information be located to provide a complete Permit history for the file.	Compliance Monitoring Program Results Report for the 2016 PTTW Application to Renew – Note: as reported by the MECP, the monitoring data that was to be provided with this application is not on file with the MECP. As a result of the Water Bottling Moratorium, this application has not been through the regulatory review process and monitoring data has not been requested.	No flow data collected for the V-notch weir or water level data for the staff gauge at the artesian pond is provided in information received from MECP. No records of staff gauge calibration as required under Section 4.3 of the permit were identified.

Notes:
1 PTTW includes Restaurant Well
2 The elevated stress value was attributed to low available supply values used in the calculations and a Tier 2 assessment was not recommended
GW Groundwater
MW Monitoring Well
WL Water Level
Denotes identified information Gap to be addressed by Water Bottler