



**REPORT**

**Blue Triton Brands Aberfoyle Site**  
*2021 Annual Monitoring Report*

Submitted to:

**Blue Triton Brands**

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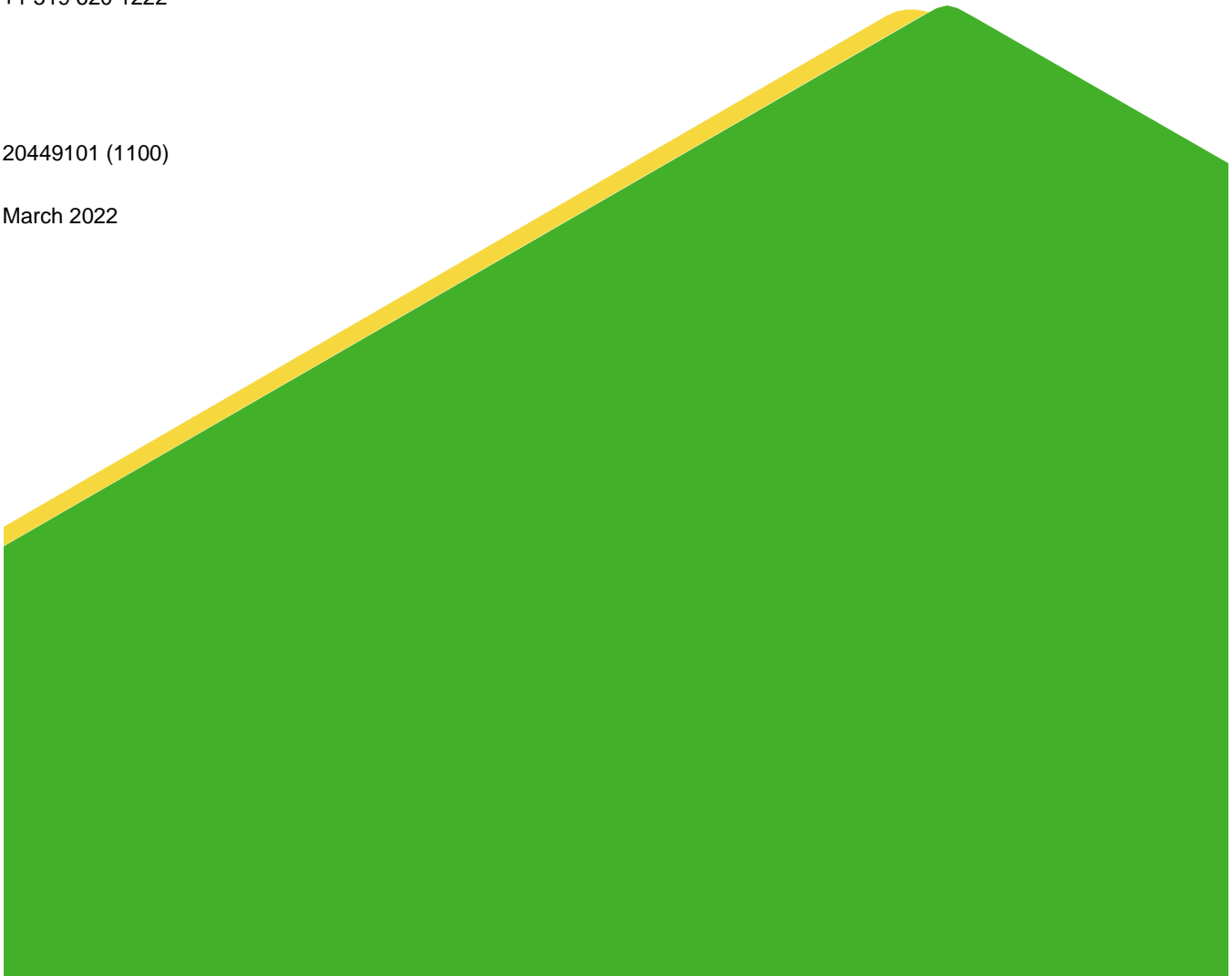
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## Key Facts for 2021 Operations at Aberfoyle

Key facts for the 2021 operations at Aberfoyle are summarized below.

- 1) Between January 1, 2021 and November 15, 2021, Blue Triton Brands (Blue Triton) operated under the terms of Permit to Take Water (PTTW) 1381-95ATPY for wells TW3-80 and TW2-11. Since November 15, 2021, Blue Triton operates under PTTW 3133-C5BUH9 for well TW3-80.
- 2) Blue Triton has complied with all the conditions in both permits for the Aberfoyle well TW3-80 in 2021.
- 3) Comprehensive annual monitoring reports are prepared for the Aberfoyle well (TW3-80) under the conditions of the PTTW.
- 4) No complaints arising from the taking of water authorized under the PTTWs were received in 2021.
- 5) The Grand River Low Water Response Team declared a Level 1 Low Water Condition for the entire Grand River Watershed, including Mill Creek, on June 4, 2021. The Level 1 Low Water Condition was removed on September 29, 2021. Blue Triton complied with the request by the Grand River Conservation Authority for all water-users in the Grand River watershed to voluntarily limit water takings to 90% of their monthly maximum permitted volume during the Level 1 Condition.
- 6) TW3-80 pumps water from the Lower Bedrock Aquifer which is overlain by a Middle Bedrock Aquitard, an Upper Bedrock Aquifer and an overburden aquifer/aquitard.
- 7) The total volume of water taken in 2021 from TW3-80 was 597,402,783 L, approximately 45% of the permitted annual volume assuming continuous well operation. No water was taken from TW2-11 in 2021.
- 8) The daily water takings at TW3-80 ranged from 0 L to 2,530,551 L. The average daily water taking was 1,636,720 L. The maximum daily taking corresponded to less than 71% of the permitted maximum daily taking and on most days was substantially less than the maximum permitted daily taking.
- 9) The variations in water levels in TW3-80 are due mainly to short-term changes in the pumping rate and during 2021 were within the historical range of observed water levels. Ongoing pumping from TW3-80 has not led to a long-term water level decline in the well.
- 10) Water levels in the Lower Bedrock Aquifer around the property over both the short-term and long-term, are influenced mainly by pumping of TW3-80. The effects of long-term variability in pumping are observed more in the wells closer to TW3-80 where mean annual water levels correlate with total annual water takings (i.e., increased water takings result in lower water levels). The influence of pumping decreases with distance from the pumping well. Water levels recover when pumping rates are reduced, indicating that the water taking is sustainable. There is also some influence on the water levels from recharge and external influences, to varying degrees. Water levels measured within the Lower Bedrock Aquifer in 2021 were generally similar to the water levels in 2019 and 2020 including the summer low water levels.
- 11) Water levels in the Upper Bedrock Aquifer around the property are partly influenced by pumping from TW3-80 (i.e., there is hydraulic connection between the Upper Bedrock and Lower Bedrock Aquifers); however, the connection is limited (i.e., there is less response than in the Lower Bedrock Aquifer). The magnitude of

influence varies based on distance from TW3-80 and existing hydrogeologic conditions, reflecting complexity in the subsurface and differences in permeability. While there is an influence on water levels in the Upper Bedrock Aquifer from pumping TW3-80, there are also seasonal and long-term trends in the Upper Bedrock water levels that are reflective of recharge trends (i.e., lower water levels during years of below-average precipitation and higher water levels during years of above-average precipitation). Water levels measured in the Upper Bedrock Aquifer in 2021 are lower than those measured over the past five years due to the below average precipitation during the first half of the year.

- 12) Water levels in the overburden are affected both by natural factors (recharge) and to a much lesser degree from pumping at TW3-80. The response to pumping in the overburden is muted compared to the responses in the Upper and Lower Bedrock Aquifers and only observed in the immediate vicinity of the pumping well. Water levels measured within the overburden in 2021 were within the historical measured ranges.
- 13) The water levels in the mini-piezometers generally increase in the spring, decline through the summer, and then increase in the fall. In addition to the seasonal trend, short-term changes (“spikes”) in water level in the shallow groundwater are influenced by individual precipitation events. Overall, the water levels are influenced primarily by precipitation events, which overwhelm any changes due to pumping from TW3-80. Some of the lowest water levels over the past five years were measured in the mini-piezometers in the summer of 2021, reflecting a period of sustained below average precipitation.
- 14) Surface water levels in Aberfoyle Creek and Mill Creek fluctuate in response to natural processes (i.e., precipitation, snow melt and evapotranspiration) with no measurable effects from changes in pumping from TW3-80. In general, surface water levels are higher in the winter/spring and lower in the summer and then increase slightly into the fall. “Spikes” in the water levels are related to precipitation events or spring melt. Summer surface water levels at SW1 and SW2 were the lowest observed over the past five years, reflecting a period of sustained below average precipitation.
- 15) Stream flows are higher in the spring, following precipitation and melt events, and then decline through the summer with less variability in flow. Summer surface water flows at SW1 and SW2 were the lowest observed over the past five years, reflecting a period of sustained below average precipitation. The effects of pumping TW3-80 could not be detected in the surface water flows observed at SW1 and SW2 in 2021.

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Permit To Take Water Number 3133-C5BUH9

### **APPENDIX B**

TW3-80 Borehole Log

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TW3-80 Water Taking

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Technical Memoranda: Estimation of Infiltration and TW3-80 Drawdown Analysis

## 1.0 INTRODUCTION

Blue Triton Brands (Blue Triton), formerly Nestlé Waters Canada (Nestlé), has retained Golder Associates Ltd. (Golder) to conduct the annual monitoring program and report preparation for the Blue Triton Aberfoyle Site as required by Permit To Take Water (PTTW) Number 3133-C5BUH9 issued by the Ministry of the Environment, Conservation and Parks (MECP). The PTTW is provided in Appendix A. The PTTW was issued on November 15, 2021 and replaces the previous PTTW 1381-95ATPY.

The location of the Aberfoyle Spring/Plant (Site) is shown on Figure 1.1. The PTTW authorizes water taking from one on-Site bedrock well located on Lot 23, Concession 7, Geographic Township of Puslinch, Wellington County, Ontario. Water from TW3-80 is taken for the purpose of bottling water. Under PTTW 1381-95ATPY, water from TW2-11 was permitted for taking for miscellaneous purposes such as providing water to the on-Site pond for firefighting purposes, although it was not used. Well TW2-11 is no longer included in PTTW 3133-C5BUH9.

The Aberfoyle bottling facility is located on a 46.75 hectare parcel owned by Blue Triton, approximately 5 km southeast of Guelph and 12 km northeast of Cambridge (Figure 1.1). The Aberfoyle facility consists of a bottling plant, warehouse, paved parking and access drives, ponds, and open fields, and is bordered by wooded areas, wetlands and aggregate operations.

A summary of the PTTW Conditions and where the information can be found in this report are outlined in Table 1:

**Table 1: Permit To Take Water Conditions**

Condition Number	Condition Description	Report Section
3.2	Identifies use, rates, time and total takings allowed.	3.1.1, 4.1, Appendix C
3.3	Low Water Response Plan	4.1
4.1	Maintain a daily record of all water takings including date, volume of water taken and rate at which it was taken.	Appendix C
4.2, 4.3, 4.5	Establish the specified groundwater and surface water monitoring programs including monitoring requirements and monitoring timing.	3.1.2, 3.1.3
4.4	Undertake wetland monitoring and redd surveys and submit results to Director.	Appendix H
4.6	Notify the Director of monitoring locations that become inaccessible or abandoned and provide a recommendation for replacement.	3.1.2.1, 3.1.3.1, 3.1.4
4.7	Prepare and submit an annual monitoring report to the Director, which presents and interprets the data collected under the conditions of the PTTW.	This report
4.8	Submit details of the bottling operations to the Director.	4.1



Condition Number	Condition Description	Report Section
4.9.1, 4.9.2, 4.9.3	Establish a publicly accessible website and have select technical data available for download.	Completed outside of report
4.10	Host an annual stakeholder meeting.	Completed outside of report
5.1	Notify the local District Office of any complaint arising from the taking of water and proposed action to rectify the complaint.	4.1
5.2	Supply water to anyone with a water supply (in effect prior to this taking) that has been negatively impacted.	Not applicable

Golder began monitoring at the Site in May 2014 on behalf of Nestlé and continues to monitor the site on behalf of its new owner Blue Triton. Prior to 2014, monitoring was performed by Conestoga Rovers and Associates (CRA) and Nestlé. The MECP has requested that the reporting follow the same outline and format as previous reports. The reporting of the geologic characterization has been updated to be consistent with the updated interpretation developed by the Ontario Geological Survey (Brunton, 2008, 2009; Brunton and Brintnell, 2011) rather than the previous geologic nomenclature. At some well locations there were insufficient data (i.e., core log, geophysical logs, detailed stratigraphic logging) to update to the new nomenclature. The bedrock has been divided into three units based on both the old and new nomenclature: Upper Bedrock Aquifer, Middle Bedrock Aquitard and Lower Bedrock Aquifer (as described in detail below).

The report is structured as follows:

- **Section 1.0:** Introduction including site location, history, and construction details for supply well TW3-80;
- **Section 2.0:** Regional setting including a description of topography, drainage, ecology, physiography, geology and hydrogeology;
- **Section 3.0:** Summary of 2021 field program including a description of field activities conducted in 2021;
- **Section 4.0:** Monitoring program results including a summary and analysis of the data collected in 2021;
- **Section 5.0:** Conclusions from the 2021 monitoring program; and
- **Section 6.0:** Recommendations from the 2021 monitoring program.

## 1.1 Historical Summary

TW3-80 was constructed in April 1980 for an aquaculture (fish farming) operation. In December 2000, the Perrier Group of America, a Nestlé Company, purchased the property. Nestlé has now been purchased by Blue Triton. Including the recently issued PTTW, seven consecutive PTTWs have been issued for TW3-80 since Nestlé acquired the property, allowing for water takings for bottling water purposes. Additional investigations have been conducted over the years to determine if there have been any negative impacts on the natural environment and ensure that the water taking by Nestlé (now Blue Triton) is sustainable. These additional investigations have

been requirements of previous permits and have been completed to the satisfaction of the MECP. Other than the on-going conditions of the PTTW, no additional studies were required in 2021.

## 1.2 Construction Details for Supply Well TW3-80

The borehole log for TW3-80 is provided in Appendix B. The glacial overburden at the well is 14.6 m thick and consists of a silt till to a depth of 12.2 m below grade, and 2.4 m of fine-to-medium sand overlying bedrock. Any coarse-grain sediments at surface may have been removed in the past.

The well was originally completed to a depth of 42.4 m below grade, 27.8 m into the bedrock. Conestoga Rovers and Associates (CRA, 2014) interpreted the bedrock through which TW3-80 was drilled as consisting of the Guelph Formation dolostone (14.6 to 16.8 m) and the Amabel Formation (Eramosa Member and Unsubdivided Member) (16.8 to 42.4 m). Changes to the bedrock nomenclature have been made by the Ontario Geological Survey (OGS) (i.e., Brunton, 2008, 2009; Brunton and Brintnell, 2011). Based on the revised nomenclature, TW3-80 is interpreted to have been drilled through the Guelph, Eramosa, and Goat Island Formations and possibly into the Gasport Formation. The stratigraphy at TW3-80 is consistent with that of other wells in the area.

When TW3-80 was initially constructed in 1980; a 305 mm diameter steel casing was installed through the overburden and approximately 0.6 m into the top of rock, to a depth of 15.2 m, and cemented in place (CRA, 2014). The remainder of the well was completed as a 305 mm diameter open hole.

In 1999, the bottom 11.3 m of TW3-80 was sealed with gravel, bentonite grout, and a cement cap so that the well would pump water with more favourable natural water quality from within the Guelph to Goat Island/Gasport Formations. The revised finished depth is 31.1 m below grade.

To comply with Nestlé (now Blue Triton) water well construction standards, a liner was installed in the well in 2002. A 250 mm diameter stainless steel liner was installed inside the 305 mm steel casing and grouted in place, to a depth of 28.4 m. The revised open interval of TW3-80 is now 28.4 m to 31.1 m below grade and only allows pumping from the Goat Island/Gasport Formations. A schematic of the well construction is included on Figure 1.2.

## 2.0 REGIONAL SETTING

The following sections provide a summary of the regional and local topography, drainage, physiography, and overburden and bedrock geology/hydrogeology for the Site.

### 2.1 Topography and Drainage

Regional topography is characterized by northeast-southwest trending bands of hummocky terrain (Chapman and Putnam, 1984). Locally, the Blue Triton property is located in a relatively flat area between the Paris and Galt Moraines. Surface topography is shown on Figure 2.1. Within a 1 km radius of the Blue Triton property, ground surface elevations typically range from 310 to 330 masl (metres above sea level) with the lows occurring along Aberfoyle Creek and Mill Creek. The streambed elevation of the portion of Aberfoyle Creek that traverses Blue Triton's property is approximately 310.5 masl (+/- 1 m).

The Site is located within the Mill Creek Subwatershed (Figure 2.1) which forms part of the larger Grand River Watershed. Part of Mill Creek is located north of the Blue Triton property and generally flows in a southwesterly direction within the study area. A tributary of Mill Creek, referred to as Aberfoyle Creek, flows through the Site,

also in a southwesterly direction, and converges with Mill Creek west of the Blue Triton property. Aberfoyle Creek is located approximately 150 m to the northwest of TW3-80 at its nearest point. Mill Creek and Aberfoyle Creek are shown on Figure 2.1 along with other surface water and wetland features, which are described below.

As shown on Figure 2.1 several ponds exist, both natural and man-made, within a 1 km radius of the Blue Triton property. One such pond, referred to as the Aberfoyle Mill Pond, located east of and upstream from the Site, is created by a dam across Aberfoyle Creek. Most of the other ponds in the area appear to be man-made and are off-line ponds (i.e., not connected to streams). Some of the ponds are the result of aggregate extraction below the water table. Some small on-Site ponds exist on the Blue Triton property.

In addition to the ponds, several wetland areas are also present within a 1 km radius of the Blue Triton property (Figure 2.1). Most of these wetlands are part of the Mill Creek Puslinch Wetland Complex and are considered provincially significant. Wetlands are present within the northwest part of the Blue Triton property.

## 2.2 Ecological Setting

The northwestern half of the Blue Triton property is in a natural condition and supports a diversity of forest and wetland habitats as well as a watercourse and fish habitat. Most of these habitats are relatively undisturbed and support a diverse range of flora and fauna, including some that are locally significant.

The wetland habitats along Aberfoyle Creek form part of the provincially significant Mill Creek Puslinch Wetland Complex.

Collectively, these natural features comprise part of an extensive natural heritage system of the headwaters of the Mill Creek watershed. This natural heritage system is recognized for its provincial, regional and local significance.

Aberfoyle Creek is a branch of Mill Creek that traverses the Blue Triton property. Its confluence with Mill Creek is immediately downstream from the Blue Triton property. Upstream of the Blue Triton property, Aberfoyle Creek flows through a 10 hectare pond, created by a dam constructed in the 1860's to power a grist mill. Outflows from the pond are controlled by a series of weirs. Upstream of mill pond, Aberfoyle Creek is a cold-water stream that contains both Brook Trout (*Salvelinus fontinalis*) and Brown Trout (*Salmo trutta*). However, during the summer the water is warmed in the Mill Pond so that downstream from the pond, through the Blue Triton property, the water temperature frequently exceeds the lethal temperature for these trout species. The most abundant fish species through the Blue Triton property are common cool-water species for which the water temperatures are suitable. Like the upper reaches of Aberfoyle Creek, Mill Creek is a cold-water stream that supports Brook Trout and Brown Trout.

## 2.3 Physiography

Chapman and Putnam (1984) define the physiographic region within which the Blue Triton property lies as the eastern limb of the Horseshoe Moraines. The existing landforms and most of the surficial soils in the area were created/deposited during the most recent glacial period, specifically the recession of the Lake Ontario ice lobe. During the recession of the Lake Ontario ice lobe, three distinct end moraines were formed in the area: the Paris Moraine, the Galt Moraine, and the Moffat Moraine (Karrow, 1987). The Paris Moraine is situated to the north of the property and the Galt Moraine is situated to the south of the property. These moraines are primarily composed of silty to sandy till and form the major drainage divides for the Mill Creek subwatershed. The Blue Triton property is situated mainly within an outwash gravel plain situated between the two moraines (Figure 2.2). The outwash gravel plain was likely formed by glacial meltwater associated with a halt in the ice retreat during the formation of the Galt Moraine.

## 2.4 Geology and Hydrogeology

The following sections provide a summary of the regional and local geology and hydrogeology. The regional interpretation is based on published mapping and information contained in the Mill Creek Subwatershed Study (CH2M Gore & Storrie, 1996). Detailed geologic information has also been obtained from logging of the stratigraphy by CRA at locations where monitoring wells were installed as part of previous field investigations. The bedrock interpretation has been updated to follow the revised nomenclature of the OGS (Brunton, 2008 and 2009, Brunton and Brintnell, 2011).

### 2.4.1 Overburden Geology

The overburden ranges in thickness from 15 m in low-lying areas of the subwatershed near Mill Creek and Aberfoyle Creek to 35 m along the crests of the Paris and Galt Moraines (Drift Thickness Map P.535, M.A., Vos, 1968; CH2M Gore & Storrie, 1996).

The surficial overburden geology, as mapped by the OGS is shown on Figure 2.2. The surficial overburden of the area is characterized by the following units:

- Outwash gravel;
- Ice-contact gravel: kames and eskers; and
- Stoney, sandy silt till (Wentworth Till).

Regionally, the Paris and Galt Moraines, located north and south of the property, respectively, consist of Wentworth Till. Karrow (1987) describes the till as a buff-coloured, stony, sandy silt till. Located between the moraines are younger outwash gravel deposits and ice-contact gravel deposits. Deposits along parts of Aberfoyle Creek and Mill Creek are mapped as peat and muck (organic deposits). There are no bedrock outcrops within the study area.

The coarse-grained deposits between the moraines generally overlie the Wentworth Till. In some areas, particularly the central part of the Mill Creek subwatershed, the till is not present, and the coarse-grained deposits are continuous to bedrock. The surficial coarse-grained deposits are thinner and separated from the bedrock by the underlying till in the upper and lower reaches of the Mill Creek subwatershed. The site is located within the upper half of the watershed. Occasional coarse-grained deposits exist at various depths as lenses or discontinuous layers within or between till units (CH2M Gore & Storrie, 1996). A gravel layer is also present immediately above the bedrock in some locations, including at TW3-80.

Locally, within a 1 km radius of the property, the overburden is typically 10 m to 30 m thick and consists mainly of outwash gravel or ice-contact gravel deposits. As previously discussed, these coarse-grained deposits are situated between the moraines and are elongated in a southwest to northeast direction. The Wentworth Till is mapped as the surficial deposit along the moraines to the southeast (approximately 500 m) and northwest (approximately 2 to 2.5 km) of TW3-80.

### 2.4.2 Bedrock Geology

The bedrock surface is somewhat irregular, but generally dips to the southwest. The bedrock elevation in the vicinity of the Blue Triton property declines from approximately 306 masl northeast of the property (MW10-09) to 293 masl south of the property (MW16-12).

The regional bedrock geology is shown on Figure 2.3. As noted above, the bedrock nomenclature shown on Figure 2.3 has since been revised based on work by the OGS (Brunton, 2008 and 2009, Brunton and Brintnell, 2011). In summary, the previous Guelph Formation is now divided into the Guelph Formation and the Eramosa Formation (Stone Road Member and Reformatory Quarry Member); the previous Eramosa Member of the Amabel Formation is now the Vinemount Member of the Eramosa Formation; and the previous Unsubdivided Member of the Amabel Formation is now divided into the Goat Island, Gasport and Irondequoit Formations. The bedrock hydrogeologic units underlying the property, which are relevant to the Blue Triton water taking, are composed of limestone, dolostone and shale sequences and are described as follows (from oldest to youngest).

- **Cabot Head Formation:** The Cabot Head Formation, readily distinguished by its grey-green colour, is a non-calcareous shale with thin interbeds of sandstone and limestone. Due to its low hydraulic conductivity, the top of the Cabot Head Formation is interpreted to be the base of the active groundwater flow system.
- **Merritton Formation:** The Merritton Formation consists of a pinkish-brown, finely crystalline dolostone unit with dark shaley partings. This unit is relatively thin where present in the area.
- **Rockway Formation:** The Rockway Formation is a greenish-grey fine crystalline argillaceous dolostone with shaley partings (Brunton, 2008). The thickness of the Formation is fairly consistent and typically less than 2 m.
- **Irondequoit Formation:** This Formation is a thickly to medium-bedded crinoidal grainstone (Brunton, 2008). The unit has a fairly consistent thickness of approximately 3 m throughout the area.
- **Gasport Formation:** The Gasport Formation is a cross-bedded crinoidal grainstone-packstone with sequences of reef mound and coquina (shell bed) lithofacies. This unit has commonly been referred to as the Amabel Formation (Unsubdivided Member) in previous studies in the area (Turner, 1978). Wells in the vicinity of the Blue Triton property are generally not drilled through the entire sequence. In and around the City of Guelph, the Formation varies in thickness from about 25 to over 70 m, and the upper sections of the reef mounds, the crinoidal grainstones and the coquina shell beds make this formation highly transmissive, where they are present (Golder, 2011).
- **Goat Island Formation:** The Goat Island Formation consists of two members; the lower Niagara Falls Member and the upper Ancaster Member. Based on the boreholes completed in the area, the Goat Island Formation is estimated to range in thickness from approximately 2 m to 15 m.
  - **Goat Island Formation – Niagara Falls Member:** The Niagara Falls Member is a finely crystalline and cross laminated crinoidal grainstone with small reef mounds; and
  - **Goat Island Formation – Ancaster Member:** The Ancaster Member is a chert-rich, finely crystalline dolostone that is medium to ash grey in colour.
- **Eramosa Formation:** The Eramosa Formation consists of three members including, from oldest to youngest, the Vinemount Member, the Reformatory Quarry Member and the Stone Road Member.
  - **Eramosa Formation – Vinemount Member:** The Vinemount Member consists of thinly bedded, fine crystalline dolostone with shaley beds that give off a distinctive petroliferous odour when broken (Brunton, 2008). This dark grey to black dolostone unit was commonly identified in water well records as 'black shale' and mapped in previous studies in the City of Guelph as the Eramosa Member of the Amabel Formation. The shaley beds of this Formation significantly reduce the vertical permeability

across this unit relative to the other Formations. The Vinemount Member ranges in thickness from approximately 4 m to 12 m in the area of the property;

- **Eramosa Formation** – Reformatory Quarry Member: The Reformatory Quarry Member, is described by Brunton (2008) as light brown to cream coloured, pseudonodular, thickly bedded and coarsely crystalline dolostone. This unit is susceptible to karstification due to its uniform fine dolomite crystallinity (Brunton, 2008). This unit also often contains mud-rich and microbial mat-bearing lithofacies that may act as aquitard materials, reducing the vertical permeability across this unit; and
- **Eramosa Formation** – Stone Road Member: This cream coloured coarsely crystalline Upper Eramosa unit is not present in most of the area and can be difficult to distinguish from the Guelph Formation.
- **Guelph Formation:** The Guelph Formation is the upper bedrock unit in the study area and consists of medium to thickly bedded crinoidal grainstones and wackestones and reefal complexes (Brunton, 2008). The Guelph Formation is cream coloured and fossiliferous. The upper 0.3 m to 0.6 m is noted to be highly fractured and weathered. Based on data from borehole drilling, the Guelph Formation is typically less than 5 m thick in the vicinity of the property, which is thin relative to the regional scale thickness.

### 2.4.3 Hydrogeology

The interpretation and nomenclature for the bedrock formations has been revised (as indicated above); however, the interpretation of the hydrostratigraphy at the property and surrounding area has remained consistent. The hydrostratigraphy consists of the following from surface down:

- Overburden Aquifer/Aquitard;
- Upper Bedrock Aquifer (Guelph Formation, Reformatory Quarry Member of the Eramosa Formation);
- Middle Bedrock Aquitard (Vinemount Member of the Eramosa Formation and sometimes parts of the Reformatory Quarry Member of the Eramosa Formation and the Goat Island Formation); and
- Lower Bedrock Aquifer (Goat Island Formation and Gasport Formation).

The designations of aquifers and aquitards is a simplification of the hydrostratigraphy for conceptual purposes. In reality, the hydraulic properties of the bedrock are variable and at some locations of the hydraulic conductivity may be sufficiently small that locally a bedrock stratum act as an aquitard.

Two hydrostratigraphic cross-sections (A-A' and B-B') through the property are included on Figures 2.4 and 2.5 with the locations shown on Figure 2.2. Cross-section A-A' is oriented southwest to northeast roughly along Aberfoyle Creek and cross-section B-B' is oriented north to south through the property, crossing Aberfoyle Creek and including supply well TW3-80.

Based on the hydrostratigraphic interpretation around the property, the thickness of the hydrostratigraphic units is as follows: Overburden Aquifer/Aquitard – 7 to 35 m; Upper Bedrock Aquifer – 2 to 14 m; Middle Bedrock Aquitard – 4 to 12 m; and Lower Bedrock Aquifer – 46 to 58 m. As shown in cross-section A-A', TW3-80 is completed in the upper part of the Lower Bedrock Aquifer.

### 2.4.4 Groundwater Flow Under Non-Pumping Conditions

Non-pumping conditions have been observed prior to the start of pumping tests. In addition to the pumping tests, there are sometimes brief shutdowns during which water levels in the aquifers evolve towards non-pumping

conditions. One such shutdown occurred in October 2010 for 3.4 days. CRA (2014) provided an interpretation of the non-pumping conditions in the overburden and bedrock groundwater levels measured on October 12, 2010, as discussed below and also compared to shutdowns that occurred in October 2004 and November 2006.

- The overburden water table interpretation is presented on Figure 2.6, which indicates that the direction of groundwater flow in the overburden is generally to the southwest, with local components of flow to the west and south toward Aberfoyle Creek. CRA (2014) indicates that this flow configuration was similar to the pattern observed for October 2004 and November 2006 shutdowns;
- The Upper Bedrock Aquifer interpretation is shown on Figure 2.7 with the groundwater flow direction identified in a southwest, south, and southeast direction, which is reported to be similar to the pattern observed for October 2004 and November 2006 shutdowns; and
- The Lower Bedrock Aquifer interpretation is shown on Figure 2.8 with the groundwater flow direction to the southwest in the vicinity of supply well TW3-80, which is reported to be similar to the pattern observed for October 2004 and November 2006 shutdowns.

Groundwater in the Lower Bedrock Aquifer flows generally south in the direction of TW3-80. The Aberfoyle aquifer is interpreted to be recharged primarily within the northern portion of the Mill Creek subwatershed and the capture zone for TW3-80 is inferred to extend to the north-northeast of the well. The Lower Bedrock Aquifer extends beyond Aberfoyle to the southwest, and groundwater is inferred to discharge to the Grand River in the vicinity of Cambridge.

## 2.5 Source Water Protection

Since the passing of the Clean Water Act (2006), municipalities in Ontario have been required to develop source protection plans to protect their municipal sources of drinking water. These plans identify both water quality and water quantity risks to local drinking water sources and develop strategies to reduce or eliminate these risks. Potential and existing risks for a municipal source are identified within wellhead protection areas (WHPA). A WHPA is an area projected to ground surface that delineates the zone in an aquifer where groundwater is flowing to a municipal drinking water source (pumping well). These areas are defined to protect water quality. The Blue Triton Aberfoyle property and well TW3-80 are located more than 2.6 km from the closest WHPAs, which include the City of Guelph WHPA to the northwest and the Freelon WHPA to the southeast and east in the Lake Ontario Basin. The closest City of Guelph wells are the Burke Well, which is located approximately 7 km away from TW3-80, and the Downey Well, which is more than 8 km away from TW3-80. The Freelon Wells are more than 10 km from TW3-80.

In addition to protecting water quality, water quantity is also a concern and is considered under Water Quantity Protection Plans. A Water Quantity Risk Assessment is completed to ensure that future water needs of a community can be met. It identifies existing and potential water quantity threats and future activities that may limit municipal water supplies. This is important because when more water is taken from an area than can be naturally replenished, water supplies are threatened, and water shortages are possible. The Aberfoyle property falls within a Water Quantity Protection Zone (WHPA-Q) for the City of Guelph municipal wells. The WHPA-Q zone for the City of Guelph has been assigned a significant risk level (Matrix Solutions, 2017). The Tier 3 Assessment scenarios predicted that the City's municipal wells can meet current needs. However, the assessment predicted that the City's Queensdale municipal well would be unable to meet projected increased future demands under normal climate conditions and during prolonged drought (Matrix Solutions, 2017). The Queensdale municipal well is located approximately 12 km northwest of TW3-80. The Tier 3 Assessment also assigned a high level of uncertainty to the results of the analyses for the City's Arkell Well 1, which is located approximately 10 km north of

TW3-80. It is for these reasons that the City's WHPA-Q has been assigned a significant risk level with respect to water quantity. The Source Protection Committee reviewed all existing water takings within the WHPA-Q to evaluate their contribution to water quantity stress in the area. The study showed that municipal wells have the greatest impact on themselves (i.e., pumping at a municipal well influences the water levels in other municipal wells). TW3-80 was not found to interfere with the municipal wells' ability to supply water (Matrix Solutions, 2018). TW3-80 is estimated to be responsible for 1% of the drawdown at the closest municipal well (Burke Well located approximately 7 km north-northeast of TW3-80) (Matrix Solutions, 2018). With a drawdown in the order of approximately 10.8 m at the Burke Well, pumping from TW3-80 is estimated to be responsible for approximately 0.1 m of the drawdown observed at the Burke Well.

An assessment of the potential cumulative impacts that could be caused by the bottled water takings at the Blue Triton facilities at Aberfoyle was also conducted as part to the Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to Take Water Applications and Hydrogeological Study Requirements (Ontario Ministry of the Environment and Climate Change Operations Division, April 2017). Matrix Solutions (2019) ran modelling scenarios to estimate the potential additional drawdown caused by an increase in the TW3-80 pumping from the current average to the maximum permitted rate. The additional drawdown at the City of Guelph Burke Well was predicted to be less than 0.02 m, well below the 2 m threshold to account for the natural seasonal variability beyond the effects of municipal pumping. As such, the groundwater withdrawal from TW3-80 has been assessed to not significantly interfere with existing municipal uses in the City of Guelph.

Matrix Solutions (2019) also analyzed how water levels change if Nestlé (now Blue Triton) increased its pumping and there was a reoccurrence of the period of sustained below-average precipitation that was observed in the early to mid-1960s. The analysis showed that the effects of the increased pumping are predicted to be negligible.

## 3.0 SUMMARY OF 2021 FIELD PROGRAM

This section describes the field activities performed in 2021 associated with PTTW 3133-C5BUH9 (and previous PTTW 1381-95ATPY) for TW3-80.

### 3.1 Groundwater and Surface Water Monitoring Program

Groundwater and surface water monitoring was initiated in 2000 and has evolved over the years with the objectives to 1) characterize the existing hydrogeologic setting, and 2) document potential long-term changes to the groundwater and surface water resources in the area. The monitoring program includes measurement and record-keeping of water takings, groundwater levels, mini-piezometer levels, surface water levels, surface water flows and surface water temperatures. The monitoring program for PTTW 3133-C5BUH9 includes the following instrumentation, with the locations shown on Figures 3.1 through 3.3:

- Groundwater levels and pumping volumes in 1 production well;
- Groundwater levels in 43 monitoring wells at 18 sites (17 consisting of multiple monitoring intervals) with monitors in the Lower Bedrock Aquifer, Upper Bedrock Aquifer, and overburden;
- Groundwater levels in 2 private wells;
- Shallow groundwater levels in 8 mini-piezometers with a total of 16 monitors;
- Surface water levels at 5 stations;



- Stream flow at 2 locations; and
- Stream temperature at 6 locations.

Differences in the monitoring requirements with respect to PTTW 1381-95ATPY, which prevailed until November 2021 are discussed below.

### 3.1.1 Water Taking

Water taking from TW3-80 in 2021 was measured using a Krohne magnetic flow meter wired to an Allen Bradley industrial Programmable Logic Controller. The instantaneous flow and cumulative volume pumped are recorded every minute. The flow meter was calibrated on December 1, 2021 by Endress+Hauser.

The daily volumes taken from supply well TW3-80 in 2021 are provided in Appendix C. No water was taken from TW2-11 in 2021.

### 3.1.2 Groundwater Monitoring Program

Groundwater levels have been measured at various locations for varying periods of time on-Site and off-Site since December 1980. Following the purchase of the Site by the Perrier Group of America, a monitoring program was initiated in December 2000. Modifications to the monitoring program have been made over time as a result of PTTW requirements, well abandonments, physical inaccessibility to wells, and changes in property ownership. In 2018, a homeowner requested that monitoring be discontinued at their well and a surface water station was destroyed (see Section 3.1.4). In 2020 and 2021, private well “I” could not be accessed due to pandemic restrictions. During the 2021 monitoring period, none of the wells required as part of the monitoring program became inaccessible. Previous wells that have been decommissioned or are no longer part of the monitoring program are shown on Figure 3.4. All the existing monitoring locations and the decommissioned or unused wells are shown on Figure 3.5.

The monitoring locations for the 2021 groundwater monitoring program are shown on Figures 3.1 and 3.2 and are summarized below. Wells underlined have been removed from the current PTTW and bolded wells have been added to the current PTTW.

#### Overburden Monitors

- MW2D-07, MW2E-07, MW4C-07, MW10A-09, TW1-93, TW1-99, MW-S, PCC-S, PCC-I.

#### Bedrock Monitors

##### Upper Bedrock Aquifer Monitors

- MW2C-07, MW4B-07, MW6B-08, MW7B-08, MW8B-08, MW10B-09, MW14B-11, MW14C-11, MW15B-12, MW16B-12, MW17B-12, MW18B-12, **MW19-18-7**, **MW20-19-7**, **MW21-18-4**, MW-D, MW-I, PCC-D, 8 MLL (67-08317), 2 Brock Road North, 58 Brock Road South, 7404 Road 34 (67-07589), Private Well “Y”.

##### Middle Bedrock Aquitard Monitors

- I (67-07389).

##### Lower Bedrock Aquifer Monitors

- TW3-80 (Production Well), TW2-11, MW2A-07, MW2B-07, MW4A-07, MW6A-08, MW7A-08, MW8A-08, MW10C-09, MW10D-09, MW14A-11, MW15A-12, MW16A-12, MW17A-12, MW18A-12, **MW19-18-4**, **MW20-19-5**, **MW21-18-3**, Fireflow, B (67-07383), M1 (67-13755), PW5, 67-08740, W2.

Some private wells are open across multiple bedrock units (for example private wells with a finished depth in the Lower Bedrock Aquifer are typically open across the Upper and Lower Bedrock Aquifers). Wells constructed in this manner have been grouped with the lowermost unit in which they are installed. It should be noted that water levels measured in wells open to multiple aquifer units represent average water levels that are not representative of the levels in any of the individual aquifer units. In addition, these wells may represent a potential pathway for contaminants in the shallow groundwater system to move into the deeper strata. Monitoring of these private wells is no longer required under PTTW3133-C5BUH9. None of the wells that Blue Triton owns are open across multiple aquifer units.

Water levels were measured at all locations during the third week of each month under PTTW 1381-95ATPY and are now measured quarterly under PTTW 3133-C5BUH9. Where required by the PTTW, dataloggers are used to record water levels at 60-minute intervals and downloaded quarterly (monthly in 2021). The groundwater levels measured in 2021 are presented in Appendix D.

### 3.1.2.1 Missing Data

The following table provides a list and description of missing data from the 2021 groundwater monitoring. In some wells (e.g., PCC), the water level is close to surface and can become frozen in the winter. Other issues include frozen lids, restricted access and health and safety restrictions due to COVID. With the exception of the COVID restrictions, the other issues were temporary and have been resolved.

**Table 2: Missing Groundwater Data from the 2021 Monitoring**

Monitoring Location	Missing Data	Comment
MW8A-08	Manual water level in January and February (transducer downloaded)	Frozen
M1	Manual water level in February	Lid frozen. M1 has been removed from the monitoring program.
PCC-D	Manual water level in February (transducer downloaded)	Frozen
B Well	Manual water level in February and December	Lid frozen in February and fence constructed in December - no access. B Well has been removed from the monitoring program.
Private Well "I"	Manual water level in January through December	Well is in house and could not enter house due to health and safety restrictions (COVID). Well "I" has been removed from the monitoring program.

### 3.1.3 Surface Water Monitoring Program

The monitoring locations for the 2021 surface water monitoring program are shown on Figure 3.3 and are summarized below. Wells underlined have been removed from the current PTTW and bolded wells have been added to the current PTTW.

#### Surface Water Levels

Measurement of surface water levels was initiated in December 2001 as part of Nestlé's (now Blue Triton) monthly monitoring program. In 2021, surface water levels were measured at the following locations:

- Aberfoyle Creek:
  - SW1 - located within the upstream part of the Blue Triton property;
  - SW2 - located within the downstream part of the Blue Triton property; and
  - SW3 - located at Gilmour Road, upstream of the Nestlé property.
- Mill Creek:
  - SW4 - located on Mill Creek at Maple Leaf Lane, upstream of the confluence with Aberfoyle Creek; and
  - SW5 - located on Mill Creek at McLean Road, downstream of the Blue Triton property.
- Ponds:
  - SW9 - located in the Dufferin Aggregates owned pond located southeast of the Blue Triton property (destroyed in 2018); and
  - SW10 - located in the Dufferin Aggregates owned pond at the entrance to the Blue Triton property.

Water levels are measured at all locations during the third week of each month using a water level meter. At SW1 and SW2, dataloggers are used to record water levels at 60-minute intervals, which are also downloaded once a month. The surface water levels for 2021 are presented in Appendix E.

#### Stream Flow

Measurement of stream flow was initiated in December 2001 as part of Nestlé's (now Blue Triton) monthly monitoring program. Stream flow is measured at SW1 (upstream part of Blue Triton property) and SW2 (downstream part of Blue Triton property) in Aberfoyle Creek during the third week of each month. Stream flows are measured at SW1 and SW2 to monitor for changes that could be attributed to pumping at TW3-80. In 2021, stream flow velocities were measured using a Hach electromagnetic flow meter and the stream flows were calculated using the cross-sectional area-velocity method. The stream flow calculations for 2021 are presented in Appendix F.

In addition, the monthly surface water elevations ("stage") and stream flow measurements ("discharge") collected in 2021 were used to update and/or re-establish the stage-discharge relationships (rating curves) at SW1 and SW2. The rating curves were used to infer continuous records of stream flow from the continuous water level measurements at SW1 and SW2.

### **Mini-Piezometers**

Mini-piezometers were initially installed in 2004 with additional mini-piezometers being installed since that time. In 2021, water levels were measured in mini-piezometers at ten locations, each containing a shallow and a deep monitor (see locations on Figure 3.3). The mini-piezometer nests are located along Aberfoyle Creek upstream of the Blue Triton property to Mill Creek downstream of the confluence of the two creeks as follows.

- MP11S-08/D-04;
- **MP1-16S/D;**
- MP16S/D-08;
- MP6S-08/D-04;
- MP12S/D-04;
- MP14S/D-07;
- MP8S/D-04;
- MP19S/D-12;
- MP17S/D-11; and
- MP18S/D-11.

Water levels were measured at all locations during the third week of each month under PTTW 1381-95ATPY and are now measured quarterly under PTTW 3133-C5BUH9. Where required by the PTTW, dataloggers are used to record water levels at 60-minute intervals and downloaded quarterly (monthly in 2021). The water levels measured in 2021 are presented in Appendix E.

### **Temperature**

Measurement of surface water temperature began in 2005. In 2021, surface water temperature was measured at six locations along Aberfoyle Creek. The most upstream location is situated at Brock Road with the remainder of the sites located on the Blue Triton property downstream of Brock Road. Beginning upstream and moving downstream, the stream temperature sites are as follows (see locations on Figure 3.3).

- ST6-08;
- ST1-05;
- ST2-05;
- ST3-05;
- ST4-05; and
- ST5-05.

The dataloggers are located at the sediment-water interface with temperature data measured and logged at 30-minute intervals using Stowaway Tidbit® dataloggers or HOBO Tidbit MX dataloggers. Two dataloggers are installed at each site. Air temperature is also measured in a shaded area at ST1-05 at 30-minute intervals.

C. Portt and Associates Ltd. (2011) conducted a review of the appropriateness of the methodology for the temperature monitoring program. The report was approved by the MECP in October 2011 and recommendations from the report were implemented by CRA at that time and continued by Golder since May 2014. The temperature data are analyzed by C. Portt and Associates using ThermoStat software. A report on the surface water temperature is included as Appendix G.

### 3.1.3.1 Missing Data

The following table provides a list and description of missing data from the 2021 surface water monitoring. Some of the missing data are technically not missing but rather were affected by winter conditions. The water levels in the mini-piezometers are close to surface and can become frozen in the winter. Slow moving water in the creeks can also become frozen in the winter. The water level is not necessarily representative of the actual water level under these frozen winter conditions. Other issues included unsafe access. The issues were temporary and have been resolved.

**Table 3: Missing Surface Water Data from the 2021 Monitoring**

Monitoring Location	Missing Data	Comment
MP1-16D	Frozen	Frozen in January, February, March and December
MP6S-08/D-04	Frozen	Frozen in January, February and December
MP8S/D-04	Frozen	Frozen in January and February
MP11D-04	Frozen	Frozen in January
MP12S/D-04	Frozen	Frozen in January and February (D only)
MP14S/D-07	Frozen	Frozen in January and February
MP16D-08	Frozen	Frozen in January
MP17S/D-11	Frozen	Frozen in February
MP18S/D-11	Frozen	Frozen in February
SW1	Frozen	Frozen in February
SW2	Frozen	Frozen in February
SW4	Frozen and manual measurement	Frozen in February and not accessible in December
SW10	Frozen	Frozen in January and February

### 3.1.4 Notification Regarding Locations Which Become Inaccessible

A list of the wells that have become inaccessible and removed from the monitoring program, along with replacements that were recommended, are provided in the following table.

**Table 4: Inaccessible Monitors**

Monitoring Location	Reason for Inaccessibility	Action recommended by Nestlé	Documented in Letter to MECP (Appendix J)
SW9	In April 2018 the station was destroyed when part of the aggregate wash pond was filled in	No additional station to be established since the pond levels vary due to aggregate operations and nearby SW10 can be used for monitoring in the same area	April 30, 2018
W2	In August 2018 the landowner notified Nestlé that they would no longer like their well monitored	Install a monitoring well on a neighbouring property	August 9, 2018

### 3.2 Biological Monitoring

Biological monitoring undertaken on the Blue Triton Aberfoyle property in 2021 was completed in accordance with the requirements of the PTTW for the site and under the guidance of recommendations provided in the 2020 Biological Monitoring Report (Beacon Environmental, 2021). Monitoring of terrestrial resources (vegetation and wildlife) was completed by Beacon Environmental and monitoring of aquatic resources (salmonid redd survey reaches of Aberfoyle Creek) was completed by C. Portt and Associates. The findings of the 2021 Biological Monitoring Program are presented in the 2021 Biological Monitoring Program Report (Beacon Environmental, 2022) which is included in Appendix H.

### 3.3 Surveying

No surveying needed to be conducted in 2021.

### 3.4 Precipitation

Prior to 2021, precipitation data were obtained from Environment Canada from the Kitchener/Waterloo (KW) Station or the Waterloo Wellington Station (not recorded since April 2017), both of which reported total daily precipitation over the entire year. Based on reviews of the data it has been concluded that the KW Station may have underestimated the total precipitation since 2017. Environment Canada has been notified of this discrepancy and the data is under review. As such precipitation data were obtained from the Grand River Conservation Authority for the Shades Mill Station and are used in this report. The same data were used for the analysis of the potential recharge presented in Appendix I.

The following table provides a summary of the annual precipitation. The annual 20-year average (2001-2020) precipitation from the Shades Mill Station is 943.7 mm. For comparison, the annual 30-year average (1981-2010) precipitation from the Waterloo Wellington Station 916.5 mm. The total precipitation measured in 2021 was 1022.8 mm, which is approximately 8% above the average. The above average precipitation in 2021 follows a year of below average precipitation in 2020 which followed three years of above average precipitation. Annual precipitation is also shown graphically on Figure 3.6 along with the 20-year average.

To assess the variability in precipitation locally, the total precipitation at the Shades Mill Station has been compared to the total precipitation recorded at the University of Waterloo. Annual precipitation at the University of Waterloo in 2021 totalled 1021.5 mm (email from weather@uwaterloo.ca) which is similar to the total recorded at the Shades Mill Station.

**Table 5: Annual Precipitation**

Year	Precipitation (mm)	% Difference from Average
2001	829.5	-12.1
2002	727.3	-22.9
2003	911.9	-3.4
2004	840.5	-10.9
2005	854.8	-9.4
2006	1180.5	25.1
2007	726.3	-23.0
2008	1200.8	27.2
2009	1011.0	7.1
2010	921.5	-2.4
2011	1023.9	8.5
2012	807.1	-14.5
2013	1108.1	17.4
2014	898.7	-4.8
2015	839.4	-11.1
2016	937.8	-0.6
2017	1091.8	15.7
2018	1048.6	11.1
2019	1058.9	12.2
2020	856.45	-9.2
2021	1022.8	8.4

Year	Precipitation (mm)	% Difference from Average
Average (2001-2020)	943.7	

The monthly precipitation for 2021 is included in Table 6. Below average precipitation was recorded during the first five months of the year and the last two months of the year. While the annual precipitation was above the average, most of the precipitation occurred during June, September and October.

**Table 6: Monthly Precipitation in 2021**

Month	Precipitation (mm)	Average from 2001-2020 (mm)	% Difference from Average
January	32.6	71.4	-54.3
February	52.6	63.3	-16.9
March	55.0	64.6	-14.9
April	64.3	81.0	-20.6
May	33.6	81.4	-58.7
June	132.2	82.2	60.7
July	94.7	95.3	-0.6
August	84.1	77.4	8.6
September	222.7	81.6	173.0
October	130.3	93.2	39.9
November	47.3	75.8	-37.6
December	73.4	76.5	-4.1

It is noted that in 2017, Nestlé (now Blue Triton) benefited from an exchange with the consulting hydrogeologist for Puslinch Township regarding the assessment of precipitation data from stations in the general area of the Aberfoyle facilities (memorandum prepared by Harden Environmental Services Inc. for Puslinch Township, May 12, 2017). It is recognized that there are differences between the amounts of precipitation recorded at the different stations. It is impossible to obtain a perfectly representative estimate of the annual precipitation over the full extent of the area of contribution for the Blue Triton Aberfoyle well. What is most important is that adopting a consistent approach from year to year allows an assessment of the differences with respect to long-term average conditions (30-year climate normals). An analysis of precipitation trends was conducted to see if there is a correlation with water level trends. We note that the actual influence on water levels (groundwater) would be due to recharge and not total precipitation, and that recharge is controlled by more than just precipitation. However, in



the absence of detailed recharge data in the area, the use of precipitation totals allows for some comparison of long-term trends in water levels, particularly in the shallow monitors (overburden and mini-piezometers).

For the 2018 Annual Report, an independent soil water balance analysis was conducted to estimate annual average rates of potential recharge over the region surrounding TW3-80. The SWB code of the United States Geological Survey was applied (Westenbroek et al., 2010) with the records of precipitation data compiled for the Annual Monitoring Report for 2008-2018. The results of the analysis suggested that the annual average potential recharge is about 17% of the annual precipitation. The analysis was updated in the following years and again in 2021. The estimated annual potential recharge is consistent with the trends inferred from the previous analyses. The estimated annual potential recharge for 2021 is 148 mm with an annual precipitation of 1022.8 mm. The updated analyses are documented in a technical memorandum included in Appendix I.

## 4.0 MONITORING PROGRAM RESULTS

### 4.1 Water Taking for TW3-80 and TW2-11

Water taking at the Blue Triton Aberfoyle Site in 2021 continues to be governed by PTTW 3133-C5BUH9 (formerly PTTW 1381-95ATPY), which permits water to be taken from one well as outlined in Table 7.

**Table 7: Permitted Water Takings at Aberfoyle**

Source	Maximum Rate	Maximum Number of Hours of Water Taking per Day	Maximum Daily Water Taking	Maximum Number of Days of Water Taking per Year
TW3-80	2,500 L/min	24	3,600,000 L	365

The daily water takings for 2021 are tabulated in Table C1 in Appendix C. The daily water taking at TW3-80 ranged from 0 L to 2,530,551 L; the latter is 70% of the permitted taking. The average daily taking was 1,636,720 L. During 2021, the instantaneous flow rates and the daily takings were always below the limits of the PTTW (i.e., less than 2,500 L/min and 3,600,000 L, respectively).

The total volume of water taken each year from 2001 to 2021 is presented on Figure 4.1. The total volume of water taken in 2021 from TW3-80 was 597,402,783 L. In 2021, the total volume taken was approximately 45% of the permitted volume. The total pumping from TW3-80 in 2021 was similar to the total annual water taking in 2019 and 2020. Since 2002, the groundwater taking has ranged from approximately 43% to 67% of the permitted taking.

The monthly water takings for the past 5 years are presented on Figure 4.2. The monthly water takings in 2021 from TW3-80 ranged from 36,349,108 L in February to 62,013,047 L in August. In 2021, the monthly water takings generally increased during the first half of the year (with the exception of the high water takings in January), with the peak water taking in August, and then decreased during the remainder of the year. In general, the monthly water taking amounts and trends over the year were similar over the past three years.

The Grand River Low Water Response Team declared a Level 1 Low Water Condition for the entire Grand River Watershed, including Mill Creek, on June 4, 2021. The Level 1 Low Water Condition was removed on September 29, 2021. Blue Triton complied with the request by the Grand River Conservation Authority for all water-users in

the Grand River watershed to voluntarily limit water takings to 90% of their monthly maximum permitted volume during the Level 1 Condition. Blue Triton's water takings were below 71% of the permitted daily amount during the low-water condition.

No water was taken from TW2-11 in 2021.

Condition 4.8 of the PTTW requires details of the bottling operations such as location and name of facilities where water is delivered in bulk containers, if bulk water is containerized at the receiving location, the size of the containers into which the water is transferred, and total volume of water transported in bulk to each remote facility. Blue Triton has indicated that no water was shipped in bulk (container greater than 20 litres) in 2021.

As per Condition 5.1, Blue Triton has indicated that no complaints arising from the taking of water authorized under this PTTW were received in 2021.

## 4.2 Groundwater Monitoring Program

The groundwater levels measured manually in 2021 at the monitoring wells are tabulated in Table D1 in Appendix D. Hydrographs with the manual or transducer water level data are also included in Appendix D. In addition to the water levels, the hydrographs include the daily pumping volumes at TW3-80 and daily precipitation as recorded at the Shades Mill meteorological station.

### 4.2.1 TW3-80

Water levels and average daily pumping rates for TW3-80, along with daily precipitation, from 2017 through 2021 are shown on Figure D1a (Appendix D).

Water levels measured in 2021 at TW3-80 range from approximately 298.8 to 312.3 masl (or approximately 17.6 to 4.1 m below ground surface) under pumping and non-pumping conditions, respectively. These variations in water levels are mainly due to changes in the pumping rate and are within the historical range of water levels observed at TW3-80. An analysis of monthly-average water levels at TW3-80 versus average pumping at TW3-80 was undertaken to assess how pumping water levels are related to pumping rates. A linear regression of the data indicates that pumping rate accounts for approximately 90% of the variation in water levels in TW3-80. A technical memorandum on the analysis is included in Appendix I.

Operation records of TW3-80 indicate that the well is seldom shut-down for significant periods of time and, consequently, there are few fully recovered non-pumping water levels available. Based on previous shutdowns, CRA (2014) indicates that the non-pumping water levels are approximately 311 to 313 masl or 5.4 to 3.4 m below ground surface. The estimated non-pumping water levels (partially recovered conditions following shutdown of the pump) observed in 2021 range from approximately 307 to 312 masl. The water levels are similar to the non-pumping water levels observed since September 2018 and higher than the previous three years (2016 through 2018) when the water takings were higher. It should be noted that non-pumping water levels do not represent "true" conditions that would be observed if there was no pumping at TW3-80 for an extended period. Instead, they represent partially recovered conditions, with the amount of recovery dependent on the average pumping rate before the pumping stopped, how much time has elapsed before pumping resumes and whether there is a background (seasonal) trend in the water levels. The results of the analysis presented in Appendix I suggest that the fully recovered non-pumping level in TW3-80 is about 313 m.

The pumping water levels in 2021 range from approximately 300 to 307 masl. Based on a static water level of 313 masl, the estimated drawdown at the well in 2021 ranged from approximately 6 to 13 m. The total available

drawdown to the top of the pump intake is about 20.7 m (based on a static water elevation of 313 masl and a top of pump intake elevation of 292.3 masl). Referring to Figure 1.2, the top of the Lower Bedrock Aquifer is at an elevation of approximately 292.3 masl. The pumping levels in 2021 ranged from about 8 to 15 m above the top of the aquifer; confirming that the aquifer remained under confined conditions throughout 2021.

The records of average monthly water levels, monthly withdrawals and monthly precipitation between 2006 and 2021 are shown on the hydrograph for TW3-80 (Figure D1b). The hydrograph extends back to 2006 to include the period of increased pumping up to 2008. The data provide important insights into the performance of the well and the long-term sustainability of pumping. The water levels and pumping volumes can be categorized into four periods with a year of transition between each period as follows: 2006 through 2007 when pumping rates were higher and water levels were lower; 2009 through 2013 when pumping rates were lower and water levels were higher; 2015 through 2017, when pumping rates were higher and water levels were lower; and 2019 to present, when pumping rates have been lower and water levels higher. In general, the water level changes in TW3-80 correspond to the changes in the overall water taking from the well (i.e., lower water levels during periods of higher water takings (e.g., 2007) and higher water levels during periods of lower water takings (e.g., 2011)). Overall, the water levels respond to pumping as expected and the on-going groundwater taking at TW3-80 has not led to a long-term declining trend in the TW3-80 water levels. The capacity of the well has not changed through time.

#### 4.2.2 Lower Bedrock Aquifer

The regional groundwater potentiometric surface in the Lower Bedrock Aquifer is shown on Figure 4.3. The potentiometric surface was prepared based on the water levels measured during the July 23, 2021 monthly monitoring event. This represents a time when the highest pumping volumes were recorded at TW3-80 and monthly precipitation was close to its long-term average for the month of July. A review of the potentiometric surface on July 23, 2021, indicates groundwater flow toward TW3-80 from the northeast, north and northwest. The greater hydraulic connection with the area toward MW7-08 is evident in the potentiometric surface under pumping conditions. It is estimated that the water elevation contours return to the regional mean southerly flow pattern approximately 1.5 km south of the Site.

Hydrographs for wells completed in the Lower Bedrock Aquifer are included on Figures D2 through D17 in Appendix D. It should be noted that private wells installed in the Lower Bedrock Aquifer are constructed as open-hole installations and are therefore also open through the Upper Bedrock Aquifer and the Middle Bedrock Aquitard. The water levels in these wells do not provide a reliable measure of water levels specific for any of the individual aquifer units across which the well is open.

The findings from a review of the hydrographs of wells completed in the Lower Bedrock Aquifer, specifically with continuous water level data from dataloggers, are summarized below.

- Water levels measured within this aquifer in 2021 are generally similar to the water levels measured in 2020 with the summer low water levels similar to those measured in 2018 and 2020. These low water levels are also similar to water levels in previous years when the pumping at TW3-80 was higher. The water levels in 2021 are within the range measured over the past years with the exception of MW15A-12 (1,300 m west of TW3-80) and MW16A-12 (1,600 m south of TW3-80). Water levels in these wells may be influenced by other operations in those areas or the below-average precipitation during the first half of the year and do not appear to be related to the water taking at TW3-80 since it has not changed in the past three years;

- Water levels in portions of the Lower Bedrock Aquifer near TW3-80 are influenced by short-term fluctuations in TW3-80 pumping. The short-term pumping effects are evident with the water levels fluctuating in response to daily changes in pumping rates and are observed in monitoring wells closest to TW3-80 (e.g., MW2A-07 and MW4A-07). In comparison, wells located further away (upgradient – MW6A-08, MW8A-08, MW10C-09 and MW10D-09; downgradient – MW15A-12, MW16A-12 and MW17A-12) show only minor differences between the daily high and low water levels;
- Water levels in the Lower Bedrock Aquifer are also influenced by longer term trends in the TW3-80 pumping. The long-term pumping effects are evident in the wells closer to TW3-80 where water level changes from year to year correlate with overall annual water takings (i.e., increased annual water takings result in lower average water levels). During periods of reduced pumping, the water levels recover with no long-term increasing or decreasing trends. These effects of variations in total annual pumping decrease with distance from TW3-80, as can be seen by comparing the hydrographs for MW2A-07 against hydrographs for wells further from TW3-80 (e.g., MW8A-08, MW15A-12 and MW16A-12). This is evident with the observed rise in water levels since September 2018 at MW2A-07, which correlates with an overall decrease in pumping at TW3-80. The long-term water level trend in the monitoring wells further away from TW3-80 indicate that there is no increasing or decreasing trend over the last five years;
- An exception to these trends is at MW7A-08 (located approximately 1,050 m north of TW3-80) where there appears to be a stronger hydraulic connection with TW3-80 compared to the connection between TW3-80 and MW14A-11 (located approximately 750 m northwest of TW3-80) and TW3-80 and MW18A-12 (located approximately 750 m southwest of TW3-80). The response at MW7A-08 suggests that the zone of influence extends further upgradient toward MW7-08, as opposed to downgradient toward MW18-12. This interpreted hydraulic connection is consistent with previous years;
- Another exception to these trends is at MW10C/D-09 (located approximately 1,230 m north east of TW3-80) and at MW16A-12 (located approximately 1,650 m south of TW3-80), where less seasonal change is evident. This is consistent with previous years. These wells are located further away from TW3-80 and may be influenced by external sources; and
- Water levels in the Lower Bedrock Aquifer show some correlation with conditions in the shallower subsurface. During the spring, shallow groundwater levels are highest and the water levels in some wells (MW6A-08, MW10C/D-09) are on increasing trends while pumping is increasing.

In summary, the water levels in the onsite monitoring wells in the Lower Bedrock Aquifer are influenced primarily by pumping at TW3-80. The effects of pumping at TW3-80 diminish with distance from the well, and beyond about a kilometre water levels are predominantly affected by other influences. In addition, water levels recover when pumping rates are reduced, as has been observed since September 2018. No long-term trends in the water levels have been observed over the last five years.

### 4.2.3 Middle Bedrock Aquitard

Hydrographs for wells completed in the Middle Bedrock Aquitard are included on Figure D18 in Appendix D. Two wells are monitored within this unit, including one monitoring well (MW2B-07) that is sealed within the Middle Bedrock Aquitard but close to the top of the Lower Bedrock Aquifer, and one private well (“I”), that like other private wells is constructed as an open hole that is also open to the Upper Bedrock Aquifer. Since private well “I” is completed partially within the upper aquifer, it is not considered a true Middle Bedrock Aquitard monitoring well and its data are not representative of Middle Bedrock Aquitard conditions. Previously, monitoring well MW14B-11

was also considered to be situated within the Eramosa Aquitard; however, with the recent re-interpretation of aquifer/aquitard units, MW14B-11, which is located in the Reformatory Quarry Member of the Eramosa Formation and is now considered to be located within the Upper Bedrock Aquifer.

The results of a review of the hydrographs of wells completed in the Middle Bedrock Aquitard are summarized below.

- Water levels measured within this aquitard in 2021 are similar to the water levels measured in 2019 and 2020 and higher than water levels observed during the previous three years (2016 through 2018). The water levels are within the historical range measured at the wells;
- The water levels in MW2B-07 follow a similar trend as the water levels in the Lower Bedrock Aquifer from year to year and respond to pumping at TW3-80. The water levels show a response to pumping. However, the response to pumping is less compared to the response in the lower bedrock aquifer. This is consistent with the interpretation that the bottom of the screen is only 2 m above the contact between the Middle Bedrock Aquitard and the Lower Bedrock Aquifer; and
- Water levels at "I" have not been measured since February 2020 due to restrictions during the pandemic.

#### 4.2.4 Upper Bedrock Aquifer

The regional groundwater potentiometric surface in the Upper Bedrock Aquifer is shown on Figure 4.4. The potentiometric surface was prepared based on the water levels measured during the July 23, 2021 monthly monitoring event. This represents a time in 2021 when the highest pumping volumes were recorded at TW3-80 and monthly precipitation was close to its long-term average for the month of July. A review of the potentiometric surface on July 23, 2021, indicates groundwater flow toward TW3-80 from the northeast, north and northwest. The greater hydraulic connection with the area toward MW7-08 is evident in the potentiometric surface under pumping conditions.

Hydrographs for wells completed in the Upper Bedrock Aquifer are included on Figures D19 through D29 in Appendix D.

The findings from a review of the hydrographs of wells completed in the Upper Bedrock Aquifer, specifically with continuous water level data from dataloggers, are summarized below.

- Water levels measured in the Upper Bedrock Aquifer in 2021 are lower than those measured over the past five years due to the below-average precipitation during the first half of the year. Water levels were generally stable through the winter, decline into the summer, and then rise and become stable through the fall;
- Water levels in the Upper Bedrock Aquifer around the Site show some effects of pumping at TW3-80 (i.e., there is hydraulic connection between the Lower Bedrock and Upper Bedrock Aquifers); however, the connection is limited (i.e., less response than in the Lower Bedrock Aquifer). The extent of influence varies based on distance from TW3-80 and existing hydrogeologic conditions (i.e., complexity in the subsurface geologic structure and properties);
- The relationship between the long-term average pumping rates and water levels (i.e., higher water levels during periods of decreased pumping since September 2018) is only observed in the monitoring wells on the property (e.g., MW2C-07 and MWI/D) and MW7B-08 (upgradient);

- Typically, wells further away from TW3-80 show less effect from pumping, although this is not always the case. The greatest influence from pumping is observed at MW2C-07 and MW7B-08. There appears to be a stronger hydraulic connection between TW3-80 and MW7B-08 (located approximately 1,050 m north of TW3-80) compared to the connection between TW3-80 and MW4B-07 (located approximately 330 m northwest of TW3-80). This is also consistent with previous years and points to complexity in the subsurface;
- While there is an influence on water levels in the Upper Bedrock Aquifer from pumping TW3-80, there are also long-term water level fluctuations that are reflective of variations in recharge (i.e., lower water levels during years of below-average precipitation and higher water levels during years of above-average precipitation); and
- There are also seasonal influences observed in the water levels in the Upper Bedrock Aquifer. For example, melt events and significant precipitation events influence the water levels in the Upper Bedrock Aquifer. Recharge to the aquifer has more of an effect than pumping during these events (i.e., the changes in water level are more reflective of the wet spring/dry summer and fall compared to the total pumping).

In summary, the water levels in the onsite monitoring wells in the Upper Bedrock Aquifer are influenced by pumping at TW3-80 but to a lesser degree than water levels in the Lower Bedrock Aquifer due to a lower permeability bedrock layer that exists between the two aquifers. There is also an influence on water levels reflective of trends in recharge. The long-term monitoring data, which show that water levels recover when pumping rates are reduced, are consistent with the interpretation that the water taking is sustainable.

#### 4.2.5 Overburden

The potentiometric surface of the overburden plotted in Figure 4.5 is also based on water levels measured on July 23, 2021, during the month of highest pumping. A review of the potentiometric surface on July 23, 2021, indicates that groundwater flow is generally in a southerly direction with potentially some flow towards Aberfoyle Creek. We note that there is both lateral and vertical flow in the overburden. An interpretation of the lateral flow in the overburden is shown in Figure 4.5, while vertical gradients in the shallow overburden along the creek are discussed below. Shallow groundwater flow directions are more variable locally than the deeper bedrock flow systems as they are more influenced by topography and interactions with surface features.

Hydrographs for wells completed in the overburden are included on Figures D30 through D34 in Appendix D. The intermediate and deep overburden wells are installed in the till, in sand and gravel within or below the till, or deep within the surficial sand and gravel aquifer. Shallow overburden wells are typically installed in the upper portion of the surficial sand gravel.

Findings from a review of the hydrographs of wells completed in the overburden are summarized below.

- Water levels measured within the overburden did not increase as much during the spring melt compared to previous years which resulted in lower water levels during the summer. This was due to the below-average precipitation recorded over the first half of the year. Water levels have partially recovered and stabilized into the fall. The water levels are within the historical measured ranges. There is no significant overall increasing or decreasing trend;
- Water levels varied during the year (increases due to spring melt and precipitation events) with an overall general decline until September when water levels increased and then stabilized through the fall; and

- Water levels in the overburden are affected by natural factors (recharge), and to a lesser degree by pumping at TW3-80. The response to pumping in the overburden is muted compared to the response in Upper and Lower Bedrock Aquifers but for monitoring wells immediately adjacent to TW3-80 there is a correlation with long-term variations in pumping.

In summary, the water levels in the overburden are influenced by weather events and to a lesser degree, pumping at TW3-80. The influence of pumping on water levels in the overburden is less than the influence of pumping on water levels in both the Upper and Lower Bedrock Aquifers. There are no long-term declining trends in the overburden water levels. The fact that water levels recover when pumping rates are reduced and there are no long-term declining trends is a line of evidence that the water taking is sustainable.

#### 4.2.6 Vertical Gradients

Vertical gradients between the Lower Bedrock Aquifer and the Upper Bedrock Aquifer are plotted on Figures D35 through D45 in Appendix D; the gradients are inferred from multi-level monitoring wells completed in both units.

Note that a positive gradient is calculated when the water level in the upper aquifer exceeds the level in the lower aquifer. Under these conditions, the mean direction of vertical groundwater flow is downwards.

In general, based on a review of the graphs for the multi-level monitoring well locations, a dampened response in the Upper Bedrock Aquifer relative to the response in the Lower Bedrock Aquifer is evident. At locations where the positive gradient increases when pumping increases, this is due to the fact that water levels in the Lower Bedrock Aquifer respond more to pumping than do the water levels in the Upper Bedrock Aquifer.

A description of the gradients at the Site is as follows:

- MW2A/C-07 – positive gradient (potential downward flow) that increases with increased pumping. There are brief periods in 2021 and other years when the gradient is reversed, coinciding with reduced pumping. The positive gradient has decreased since September 2018 which corresponds with the decrease in pumping over the same time period. The long-term gradient trend correlates with the long-term pumping trend (i.e., increased pumping results in an increasing positive gradient). Seasonal changes in vertical gradient are also evident and correspond to the seasonal changes in pumping (i.e., higher pumping during the summer months). Daily changes in the vertical gradient are greater than at wells further away from TW3-80;
- MW4A/C-07 – positive gradient (potential downward flow) that increases with increased pumping. The positive gradient has decreased since September 2018 which corresponds with the decrease in pumping over the same time period. The long-term gradient trends and seasonal changes in vertical gradient are also evident and similar to those observed at MW2-07. The daily changes in the vertical gradient are less than at MW2-07;
- MW6A/B-08 – positive gradient (potential downward flow) that has been relatively consistent over the past five years with a slight decrease since September 2018 correlating to the decrease in pumping over the same time period. There has also been a slight increase since mid 2020 due to slightly lower water levels in the Lower Bedrock Aquifer which are not related to pumping at TW3-80 where pumping has remained consistent over the past three years;
- MW7A/B-08 – positive gradient (potential downward flow) that increases with increased pumping. There is a daily fluctuation in the positive gradient that relates to the daily pumping at TW3-80. There is some correlation between the long-term change in the gradient and the long-term changes in pumping of TW3-80

(i.e., the decreased pumping since September 2018 has resulted in a decrease in the positive gradient), however, not as much compared to MW2-07;

- MW8A/B-08 – negative gradient (potential upward flow) that occasionally reverses to a positive gradient (potential downward flow) mainly during the summer. Since September 2018 the gradient has been negative with the exception of some positive gradients during the summer of 2020 and 2021 when pumping from TW3-80 was higher. Similar to MW6-08 there has also been a slight increase in the gradient since mid 2020 due to slightly lower water levels in the Lower Bedrock Aquifer which are not related to pumping at TW3-80 where pumping has remained consistent over the past three years;
- MW10B/C-09 – positive gradient (potential downward flow) that does not change with seasonal pumping fluctuations. The gradient has been consistent over the past five years and the change in total pumping in 2018 was not observed in the gradient;
- MW14A/C-11 – positive gradient (potential downward flow) that increases with increased pumping and correlates with the long-term pumping trend. Seasonal changes in vertical gradient are also evident and correspond to the seasonal changes in pumping. The positive gradient has decreased since September 2018 when pumping was less;
- MW15A/B-12 – negative gradient (potential upward flow) that does not change with increased pumping. There was a slight decrease in the vertical gradient during the second half of 2021;
- MW16A/B-12 – positive gradient (potential downward flow) with minor changes related to seasonal changes in pumping;
- MW17A/B-12 – positive gradient (potential downward flow) that reverses to a negative gradient (potential upward flow) during times of decreased pumping. Seasonal changes in vertical gradient are also evident and correspond to the seasonal changes in pumping; and
- MW18A/B-12 – negative gradient (potential upward flow) that reverses to a positive gradient (potential downward flow) during times of increased pumping. In the last three years the gradient was mainly negative corresponding to the decrease in pumping since 2018. Seasonal changes in vertical gradient are also evident and correspond to the seasonal changes in pumping.

Most of the area around TW3-80 is characterized by positive gradients (downward flow) in the bedrock. A negative gradient (upward flow) is present at wells further away from TW3-80 (i.e., at MW15-12 to the west and MW8-08 to the north). Over the past five years, a negative gradient (upward flow) is also present at MW2-07 (close to TW3-80), and MW17-12 and MW18-12 (to the south) when pumping at TW3-80 has been lower.

### 4.3 Surface Water Monitoring Program

The surface water monitoring program includes measurement of mini-piezometer and surface water levels, surface water flows and surface water temperatures. The surface water levels measured in 2021 are presented in Appendix E along with hydrographs of the water levels. Surface water flows are tabulated and graphed in Appendix F. The hydrographs also include the daily pumping volumes at TW3-80 and daily precipitation as recorded at the Shades Mill meteorological stations. Surface water temperatures are discussed in Section 4.3.4 and Appendix G.



### 4.3.1 Mini-Piezometer Water Levels

Hydrographs for the mini-piezometer locations are presented on Figures E1 through E10 in Appendix E with the “a” figures including data for the last 5 years (2017 through 2021) and the “b” figures including data for 2021 only.

The findings from a review of the hydrographs for the mini-piezometers are summarized below.

- A new mini-piezometer nest (MP1-16) was installed in Aberfoyle Creek at the Blue Triton Gilmour Road property in April 2016 to monitor background conditions upstream of the Site. The location of MP1-16 is more representative of shallow groundwater conditions near the creek than the MP11 nest which was used previously. In 2018, the casing at MP1-16 was extended so that the mini-piezometer doesn't flow (when not frozen). For the 2021 analysis, MP1-16 is considered to represent background conditions;
- The variation in water levels at MP1-16 over 2021 was approximately 0.7 m in the deep piezometer and 0.6 m in the shallow piezometer with spikes related to precipitation and/or snowmelt events. In 2021 the water levels were generally stable to March, increased in March, decreased into summer, increased in September and then were stable through the fall. These changes in water level are influenced by natural seasonal patterns. Lower water levels were observed during the summer months due to the below average precipitation recorded through the first half of the year. The potential for vertical flow at the MP1-16 nest is consistently upwards in 2021, similar to previous years (i.e., as shown in Figure E1a/b, water levels in MP1-16D exceed those in MP1-16S);
- There are six mini-piezometer nests situated on the Blue Triton Aberfoyle property (MP16, MP6, MP12, MP14, MP8, MP19) and two located downstream of the confluence of Aberfoyle Creek and Mill Creek (MP17, MP18). These mini-piezometer nests, located upgradient and downgradient of TW3-80, showed fluctuations of approximately 0.4 m to 0.6 m during 2021. The trends in water levels at the mini-piezometers were similar to those observed at MP1-16. The similarity in water level fluctuations indicates that changes in water levels correspond more with natural events rather than changes in pumping in TW3-80 and are mainly due to precipitation, snow melt and evaporation;
- Some of the lowest water levels were measured in the mini-piezometers in the summer of 2021 compared to the past five years, however, with the exception of MP17-11 and MP18-11 these water levels are within the historical ranges. The summer water levels at MP17-11 and MP18-11 were similar to those observed in the summer of 2018. The low water levels are attributed to the below average precipitation recorded during the first half of the year;
- The water levels have generally increased in the spring, declined through the summer, and then increased in the fall; and
- In addition to the seasonal trends, short-term changes (“spikes”) in water level in the shallow groundwater reflect the influence of precipitation.

Shallow gradients observed in the mini-piezometers are shown on Figures E11a, c and e for the last 5 years (2017 through 2021) and Figures E11b, d and f for 2021. Beginning upstream and moving downstream, the vertical gradients are as follows:

- **MP1-16** – strong negative gradient (potential upward flow) in 2021 and over the past five years. There are several short-term decreases in the negative gradient caused by rapidly rising surface water elevations

following precipitation events. A decrease in the vertical gradient was recorded in March which is related to change from freezing conditions to spring melt;

- **MP11** – strong negative gradient (potential upward flow) that changes seasonally with decreased gradient in the summer;
- **MP16** – no gradient observed in 2021. Over the past five years, the gradient has varied from a weak negative gradient (potential upward flow) to a weak positive gradient (potential downward flow) that has remained close to no gradient. There is less “noise” in the data following the spring of 2019;
- **MP6** – weak negative gradient (potential upward flow) that reversed to a weak positive gradient (potential downward flow) in the summer and back to a negative gradient (potential upward flow) in the fall. This is similar to the trend over the past five years;
- **MP12** – weak negative gradient (potential upward flow) during the entire year with the exception of a few events with a reversal to a weak positive gradient (potential downward flow) in 2021. Similar trends have been observed over the past five years;
- **MP14** – strong negative gradient (potential upward flow) in 2021. Historically the gradient is reduced during the summer but generally remains negative;
- **MP8** – weak negative gradient (potential upward flow) during the entire year except in October when the gradient is reversed to a weak positive gradient (potential downward flow). There was also an increase in the negative gradient (potential upward flow) in August and September. Historically there has been a weak negative gradient (potential upward flow) at this location. There is less “noise” in the data following the spring of 2019;
- **MP19** – weak negative gradient (potential upward flow) in 2021. Over the past five years there has been a weak negative gradient (potential upward flow) that has occasionally reversed to a weak positive gradient (potential downward flow) during the summer; and
- **MP17 and MP18** – weak positive gradient (potential downward flow) that occasionally reversed to a weak negative gradient (potential upward flow) in 2021. Over the past five years there has generally been a weak negative gradient (potential upward flow) during the first half of the year and then a weak positive gradient (potential downward flow) during the second half of the year. The change in 2021 is due to the below average precipitation during the first half of the year. The stream rehabilitation work conducted in the summer of 2019 has not changed the water level trends at MP17-11 and MP18-11.

The water levels in the mini-piezometers on July 23, 2021 are plotted on Figure 4.6 which is during the month of highest pumping. Review of the water levels on July 23, 2021 indicates that there is a strong negative gradient (potential upward flow) at MP1-16 located upstream of Aberfoyle Mill Pond. There is essentially no gradient at the two piezometers (MP16, MP6) upgradient of TW3-80 and then a weak negative gradient at MP12 and a strong negative gradient at MP14 near the middle of the property. Further downstream the gradient changes back to a weak negative gradient at MP8 and MP19. Weak positive gradients are observed at MP17 and MP18 located downgradient of the confluence of Aberfoyle Creek and Mill Creek. These gradients are similar to those observed in the past.

### 4.3.2 Surface Water Levels

Hydrographs for the surface water level monitoring locations are included on Figures E12 through E18 in Appendix E with the “a” figures including data for the last 5 years (2017 through 2021) and the “b” figures including data only for 2021.

A review of the hydrographs for the surface water level monitoring locations indicates the following:

- In general, surface water levels have been higher in the winter/spring and lower in the summer and then have increased slightly into the fall;
- Surface water levels in the creeks fluctuate in response to precipitation, snow melt and evapotranspiration with no measurable effects from pumping at the current rates;
- In general, surface water levels at the off-Site stations (SW3, SW4 and SW5) were similar throughout the year, with higher water levels observed in February or March followed by lower water levels in the summer and higher water levels again in the fall. Higher water levels were observed at all three stations in September which corresponded to a major precipitation event. Similar to other water level observations on the site, the summer water levels were some of the lowest observed over the past five years;
- Surface water levels at the on-Site stations (SW1 and SW2) generally follow similar trends, with higher water levels in the spring followed by lower water levels in the summer and higher water levels again in the fall. Over the past five years the water levels in the spring have generally been higher than the water levels in the fall; however, in 2021 with the below-average precipitation during the first half of the year, the water levels in the spring and fall were similar. This also influenced the summer water levels, which were the lowest over the past five years. In addition to these changes being attributed to precipitation, the lower water levels are also attributed to changes to the channel geometry that occurred in July/August 2019. “Spikes” in the water levels are related to precipitation events or spring melt. The changes in water levels at SW1 and SW2 are due to natural processes (i.e., precipitation, snow melt and evaporation) which is confirmed by the fact that water levels at SW2 are lower while overall pumping from TW3-80 has also been lower over the past three years;
- Water levels are no longer measured at SW9 since it was destroyed in April 2018 when part of the pond was filled in. Monitoring at SW9 is no longer required under the current PTTW; and
- Water levels at SW10 are measured in a pond on the neighbouring property. This pond may represent water table conditions. In 2021, the water levels generally declined through the first three months of the year and then generally rose through the remainder of the year. It is our understanding that operations at the aggregate pit commenced in 2016 and aggregate washing of the sand and gravel may be occurring. The changes in water levels likely have some seasonal changes, however, it appears that the water levels are influenced by aggregate operations.

The water levels at the surface water stations on July 23, 2021 are included on Figure 4.6, during the month of highest pumping. Review of the water levels on July 23, 2021 indicates that surface water features varied in elevation from approximately 317.35 masl at SW3 to 307.22 masl at SW5 with surface water levels across the Site ranging from 311.40 masl (SW1) to 310.22 masl (SW2).

It is important to note that the stream flow provides a more reliable data set for investigating the potential impacts of pumping compared to an analysis of stream water levels, which can be affected by channel geometry. An analysis of stream flow is presented in the following section.

### 4.3.3 Surface Water Flow

The monthly stream flow data collected in 2021 are summarized in Appendix F. Stream flow has been measured at SW1 and SW2 since December 2001. SW1 is located along Aberfoyle Creek near the upstream part of the property while SW2 is located along Aberfoyle Creek near the downstream part of the property.

Stage-discharge curves were developed for SW1 and SW2 which show the relationship between surface water elevation (stage) and stream flow (discharge). The stage-discharge relationships at surface water stations SW1 and SW2 were updated and reassessed to account for the 2021 measured water levels and flow rates. Due to changing stream conditions, individual stage-discharge curves sometimes need to be created for individual years or a series of years. This is done because a review of the discrete flow and water level measurement results indicates that the hydraulic controls at the gauging stations have changed subtly. The stream geometry appears to have changed in the winter resulting in the need for new stage-discharge curves for SW1 and SW2. New stage-discharge curves were developed to represent continuous flows in 2021 at SW1 and SW2 to provide a better fit to the data. Stage-discharge curves were developed by estimating the level at which zero flow would occur (i.e.,  $y_0$ ) at each station. This was estimated using the available low-flow measurements collected over the monitoring period. Historical data were included for comparison and to include measured data over a larger range of stream discharge conditions. Power functions were used to develop a best fit curve for the measured data at each station. Data outliers were evaluated with a lower confidence due to suspected winter conditions or measurement error. The updated stage-discharge curves for SW1 and SW2 are presented on Figures F1 and F2, respectively. Flow data from previous years were estimated using historic stage-discharge curves that best fit the historic monitoring data (as presented in previous reports). There was a distinct change in the rating curve for SW2 after the summer of 2019 (as shown on Figure F2) due to changes from the rehabilitation conducted by the Mill Creek Rangers.

Graphs of estimated stream flow at SW1 and SW2, along with pumping rates and precipitation, are presented on Figure F3 in Appendix F with the “a” figure including data for the last 5 years (2017 through 2021) and the “b” figure including data for 2021. The updated stage-discharge relationship was used to estimate stream flow from the continuous water level elevation data in 2021. It should be noted that historically there are a few occasions when flow was estimated at SW1 and SW2 for stream elevations outside of the observed stage-discharge curve relationship (typically flows exceeding approximately 1,200 L/s), however, none were observed in 2021.

Review of the flow data indicates the following:

- In 2021, stream flow measured in the field (during monthly monitoring) at SW1 ranged from 37.6 L/s (June) to 975.4 L/s (September) and at SW2 stream flow ranged from 46.9 L/s (August) to 1,086.6 L/s (September);
- The trends in surface water flow at SW1 and SW2 over the year are similar. This is consistent with previous years;
- In 2021, stream flow was higher in the spring following precipitation and melt events and then declined through the summer with less variability in flow. The stream flow rose in September and then was relatively constant to the end of the year;

- The 2021 stream flows at SW1 and SW2 were within the historical range over the past five years including the low flows during the summer;
- The calculated flows, using the rating curves, indicate that flow at SW2 is typically greater than the flow at SW1 with the exception of brief periods in January and March. These observations are likely caused by backwater from ice in January and blockage (debris) following the significant flow event in March. The single rating curve for the whole year is not as accurate under iced conditions; and
- A review of the manual flow measurements indicates that flow at SW2 was higher than flow at SW1 with the exception of January and August. The flows in August are essentially the same. The difference in flow in January may be due to errors in the measurements during frozen conditions.

It was noted in CRA (2014) that pumping tests conducted in 2004, 2007, and 2010 indicated that surface water flow at SW1 and SW2 was not measurably affected by pumping. The on-going monitoring confirms this conclusion and shows that the stream flows are influenced primarily by precipitation events and fluctuate seasonally.

#### 4.3.4 Surface Water Temperature

Surface water temperature was monitored at six stations across the Blue Triton property.

The average daily water and air temperature data for 2017 through 2021 are shown on Figure G1a and for 2021 on Figure G1b. Review of the data indicates the following:

- The seasonal trend in stream temperature levels in 2021 is similar to previous years;
- Average daily ambient air temperature ranged from -15.4°C to 24.5°C in 2021;
- Average daily surface water temperature ranged from 0.4°C to 27.1°C at the upstream end of the property (ST6-08) and from -0.1°C to 25.2°C at the downstream end of the property (ST5-05). Surface water temperatures generally decrease, across the Site, moving downstream; and
- Air temperature significantly influences stream temperature as seen by the strong correlation between the two. The correlation is not evident during the winter months when air temperature typically drops below 0°C and surface water temperature remains relatively constant around 0°C.

The surface water temperature data were provided to C. Portt and Associates, and the results were incorporated in their report, which is also included in Appendix G.

The mill pond on Aberfoyle Creek has a major influence on the temperature of the creek and its fish community. During the summer, the water in the mill pond, upstream from Brock Road, becomes warm and, as a consequence, the creek is warm through the Blue Triton property. In the C. Portt and Associates report it is concluded that:

*In 2021, mean summer (June – August) air temperature was the second highest in the period 2007 – 2021. The overall pattern of water temperature suitability's for the fish species found in the Aberfoyle Branch of Mill Creek from Brock Road downstream through the Blue Triton property in 2021 are consistent with previous years. Water temperatures during the June 1 – August 31 period are usually too warm for coldwater species such as brook trout and brown trout and too cold for warmwater species such as largemouth bass. The water temperatures during this period are most*

*favourable for species such as common shiner that have intermediate thermal requirements. During the summer, the water in the mill pond upstream from Brock Road becomes warm and, although the creek temperature decreases with distance downstream, it frequently exceeds the ultimate upper incipient lethal temperature for brook trout and brown trout at the furthest downstream temperature monitoring site.*

*The relationships between air temperature and water temperature were consistent with those observed in previous years.*

## 4.4 Biological Monitoring Program

In the 2021 Biological Monitoring Report (Beacon Environmental, 2022) it is concluded that:

*In summary, the findings suggest that there have not been any significant changes to the various terrestrial and aquatic parameters being monitored on the Aberfoyle property. Species richness, abundance, and distribution are generally within the range expected and attributable to natural variation and succession. The subject property continues to support high quality terrestrial and wetland habitats that support a diverse range of native wildlife. The aquatic environment is strongly influenced by the thermal loading from the Aberfoyle Mill Pond.*

The report also includes recommendations for continued biological monitoring in 2022. Details are included in the report which can be found in Appendix H.

## 5.0 CONCLUSIONS

The following conclusions are provided based on the results of the 2021 monitoring program.

- 1) Between January 1, 2021 and November 15, 2021, Blue Triton complied with the conditions in the existing permit for the Aberfoyle well TW3-80, PTTW 1381-95ATPY. Since November 15, 2021 Blue Triton has complied with the conditions in the new permit PTTW 3133-C5BUH9.
- 2) TW3-80 has been operated in accordance with the pumping limits outlined in the PTTWs listed above. The daily water taking at TW3-80 in 2021 ranged from 0 L to 2,530,551 L. The average daily taking in 2021 was 1,636,720 L. The total volume of water taken in 2021 from TW3-80 was 597,402,783 L or 45% of the permitted volume. No water was taken from TW2-11 in 2021.
- 3) The interpreted non-pumping water levels in TW3-80, which obtains water from the Lower Bedrock Aquifer, ranged from approximately 307 to 312 masl in 2021 and the interpreted water levels under variable pumping conditions ranged from approximately 300 to 307 masl. The drawdown at the well ranged from approximately 13 m to 6 m in 2021. At all times the water level in TW3-80 remained above the top of the Lower Bedrock Aquifer. Historical and current records indicate that long-term water levels generally correlate with the monthly pumping volumes (i.e., higher water levels during months of lower pumping and lower water levels during months of higher pumping). When pumping stopped briefly in 2021 water levels in TW3-80 approached fully recovered non-pumping levels.
- 4) The trends of water level variations within the Lower Bedrock Aquifer are stable with nearby monitoring wells in the Lower Bedrock Aquifer fluctuating in response to variations in pumping at TW3-80. The groundwater taking from TW3-80 has not led to a long-term declining trend in the aquifer water levels. Average water

levels in the aquifer in 2021 that are influenced by the pumping at TW3-80 have increased due to the overall decrease in pumping since September 2018. Summer lower water levels have been similar over the past three years.

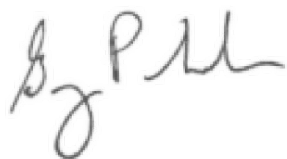
- 5) The muted responses at monitoring wells in the Upper Bedrock Aquifer relative to the Lower Bedrock Aquifer confirm that the Middle Bedrock Aquitard limits the effect of pumping on overlying units. Unacceptable impacts (i.e., long-term declining trends) to the Upper Bedrock Aquifer and overburden aquifer have not been observed. The water levels in the Upper Bedrock Aquifer and overburden aquifer show seasonal trends that are reflective of spring melt and precipitation.
- 6) Surface water levels fluctuate in response to precipitation, snow melt and evapotranspiration.
- 7) The water taking does not hinder the ability of the water resource to support existing natural functions of the ecosystem. The withdrawal does not result in physical and ecological impacts to the adjacent Mill Creek and Aberfoyle wetlands.
- 8) The water taking does not prevent other water users from continuing their established pattern of use. The groundwater withdrawal from TW3-80 does not interfere with existing municipal uses or private uses. There have been no well interference complaints at Aberfoyle due to the water taking from TW3-80.
- 9) No irreversible impacts have been observed due to pumping of the aquifer or deterioration of groundwater quantity or quality on neighbouring properties.
- 10) Based on the monitoring data collected, the 2021 water takings from TW3-80 are sustainable.

## 6.0 RECOMMENDATIONS

No changes to the existing monitoring program are recommended.

## Signature Page

### Golder Associates Ltd.



Greg Padusenko, M.Sc., P.Eng., P.Geo.  
*Hydrogeologist*



Craig DeVito, P.Eng.  
*Water Resources Engineer*



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

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[https://golderassociates.sharepoint.com/sites/139500/project files/6 deliverables/aberfoyle/2021 annual report/final/20449101 fnl rpt 2022mar15 2021 aberfoyle report.docx](https://golderassociates.sharepoint.com/sites/139500/project%20files/6%20deliverables/aberfoyle/2021%20annual%20report/final/20449101%20fnl%20rpt%202022mar15%202021%20aberfoyle%20report.docx)



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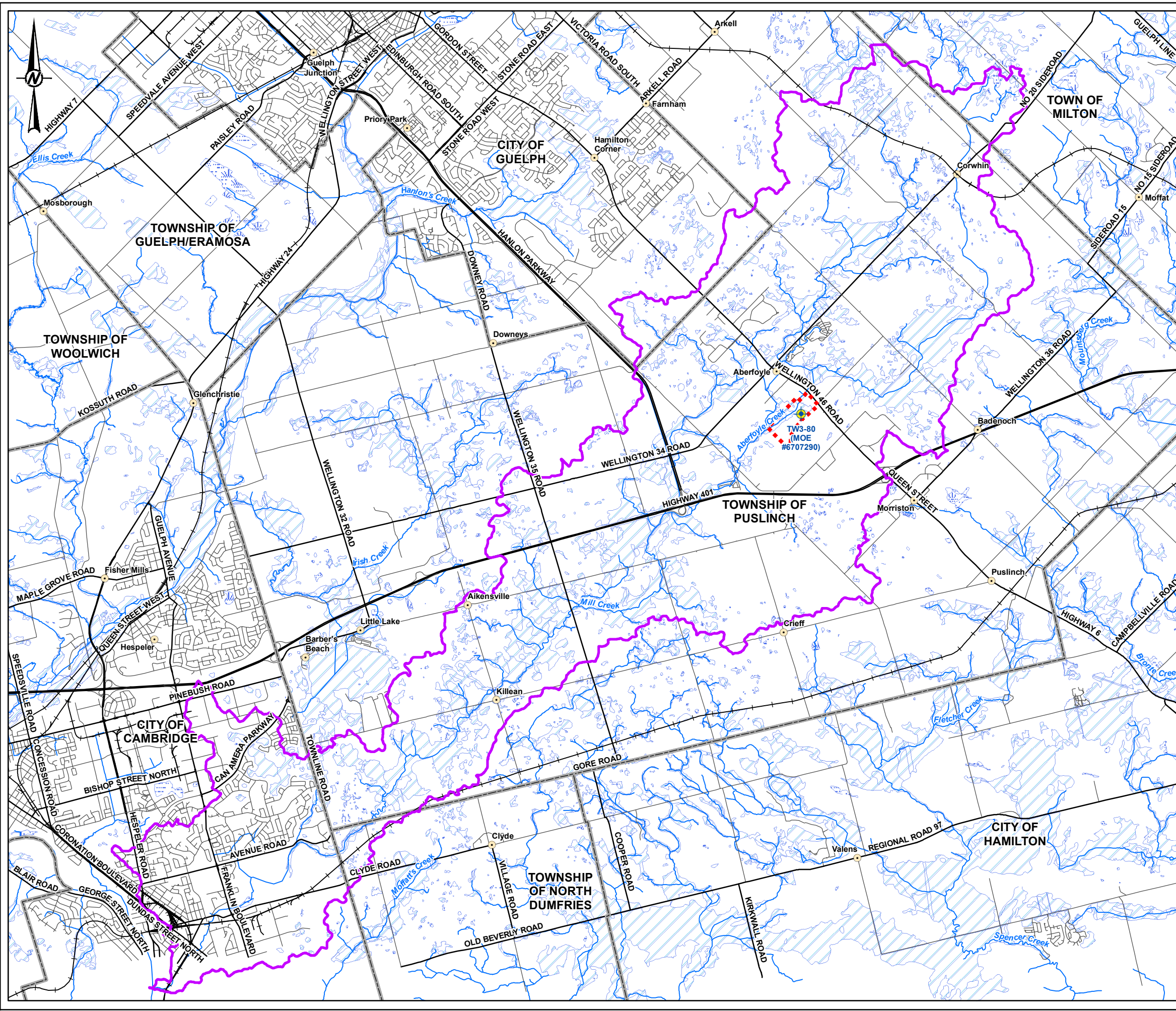
Turner, M.E., 1978. Major Aquifers in Ontario: Guelph-Amabel Aquifer, Hamilton to Orangeville, Ontario Ministry of the Environment, Hydrogeologic Map 78-3.

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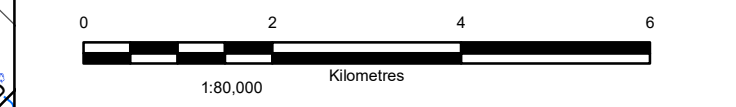
**FIGURES**

**Figures 1.1 to 4.6**



**LEGEND**

- Production Well
- City / Town
- Main Road /Highway
- Local Road
- Railway
- Watercourse
- Waterbody
- Wetland
- Provincially Significant Wetland
- Municipal Boundary
- Property Boundary
- Mill Creek Sub-Watershed



**REFERENCE(S)**  
 BASE DATA - MNR LIO, OBTAINED 2013  
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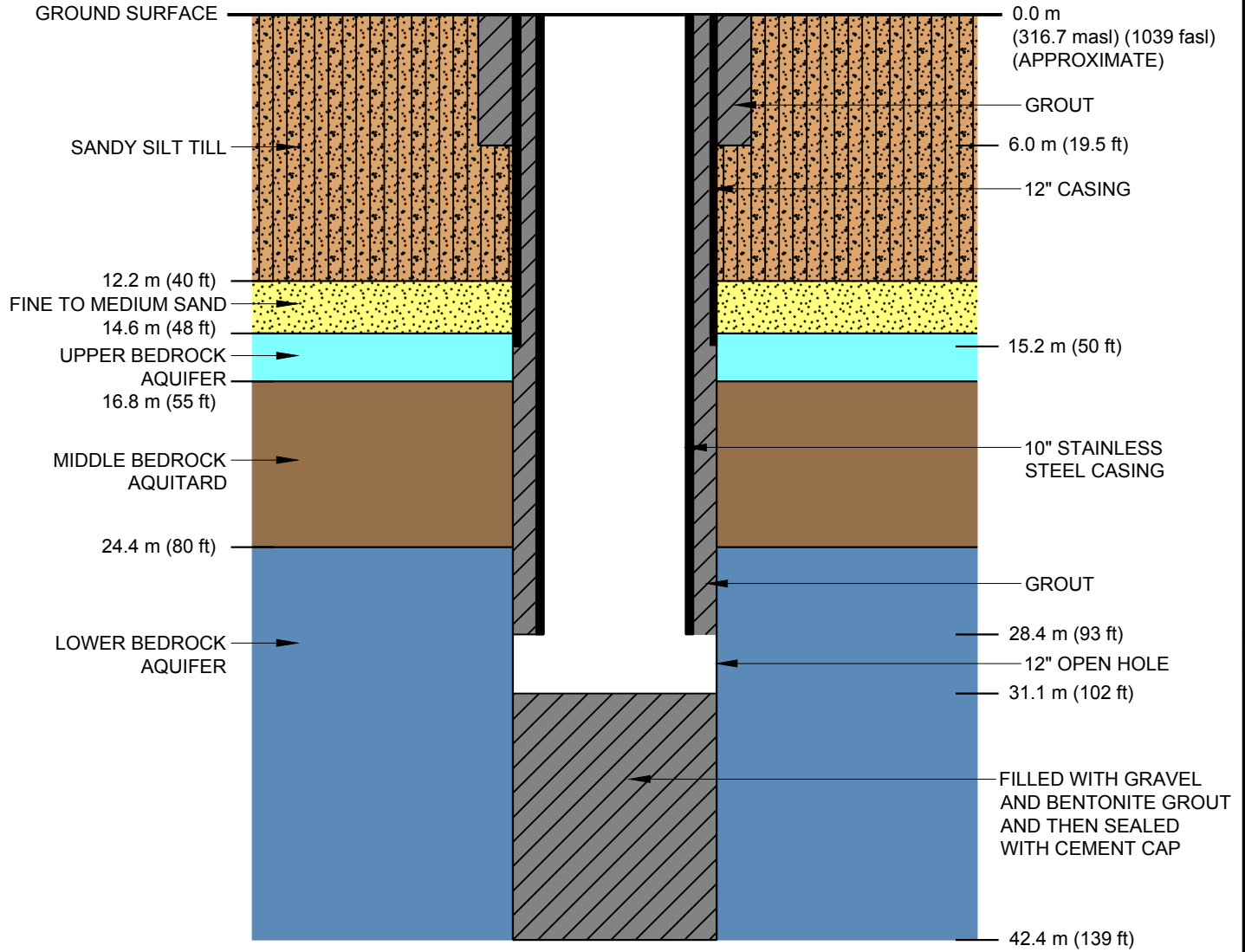
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 2021 ANNUAL REPORT

**TITLE**  
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CONSULTANT	DATE	REVISION
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PREPARED	ST	
REVIEWED	GP	
APPROVED	JP	

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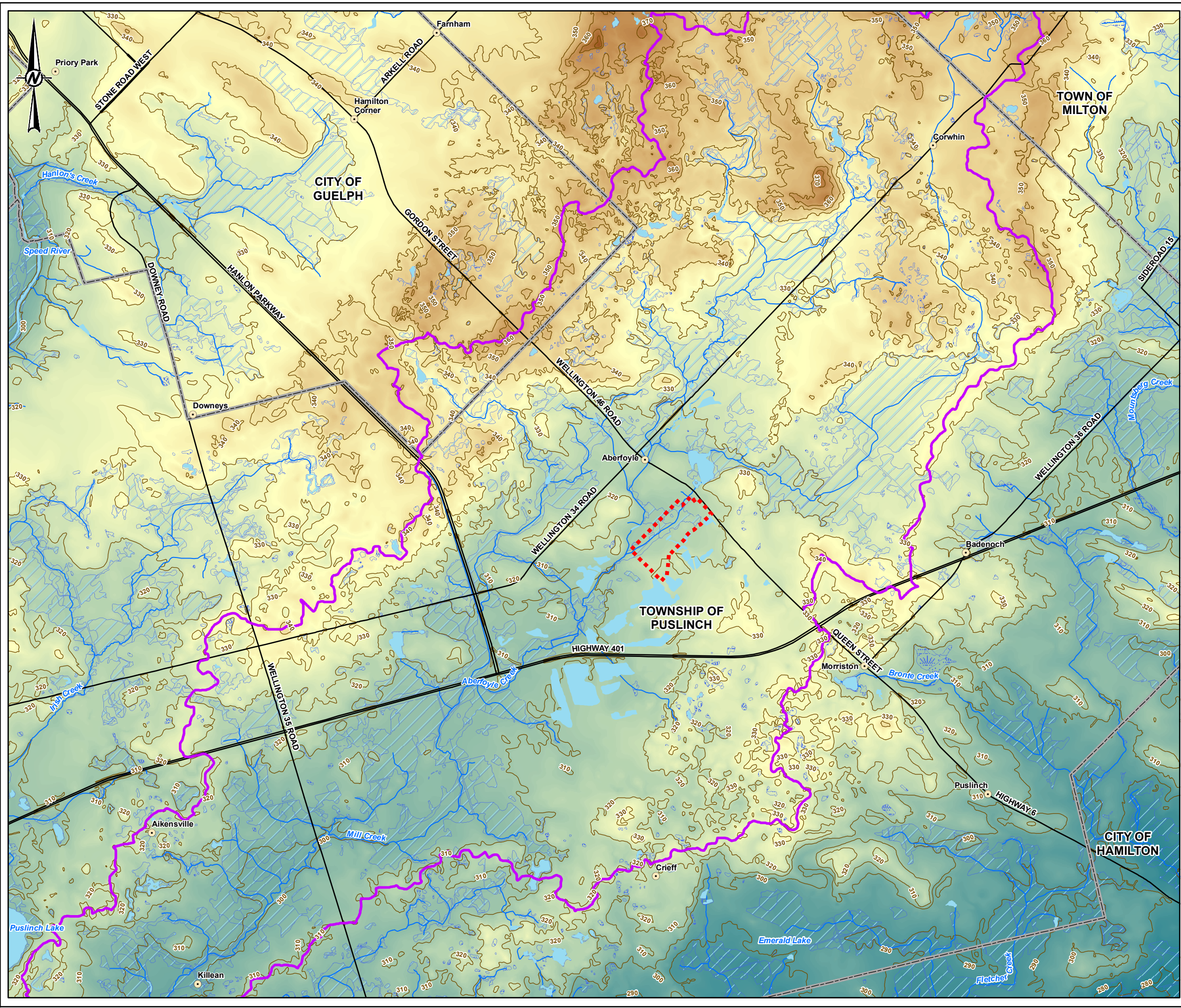
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PROJECT  
**2021 ANNUAL REPORT**

CONSULTANT	YYYY-MM-DD	2022-01-26
	PREPARED	DD
	DESIGN	
	REVIEW	GP
	APPROVED	GP

TITLE	PROJECT No.	PHASE	Rev.	FIGURE
<b>ABERFOYLE TW3-80 SCHEMATIC</b>	20449101	(1100)	A	<b>1.2</b>



**LEGEND**

- City / Town
- Topographic Elevation Contour (masl)
- Main Road /Highway
- Watercourse
- Waterbody
- Wetland
- Provincially Significant Wetland
- Mill Creek Sub-Watershed
- Municipal Boundary
- Property Boundary

**Value**

High : 385.707

Low : 278.55



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**PROJECT**  
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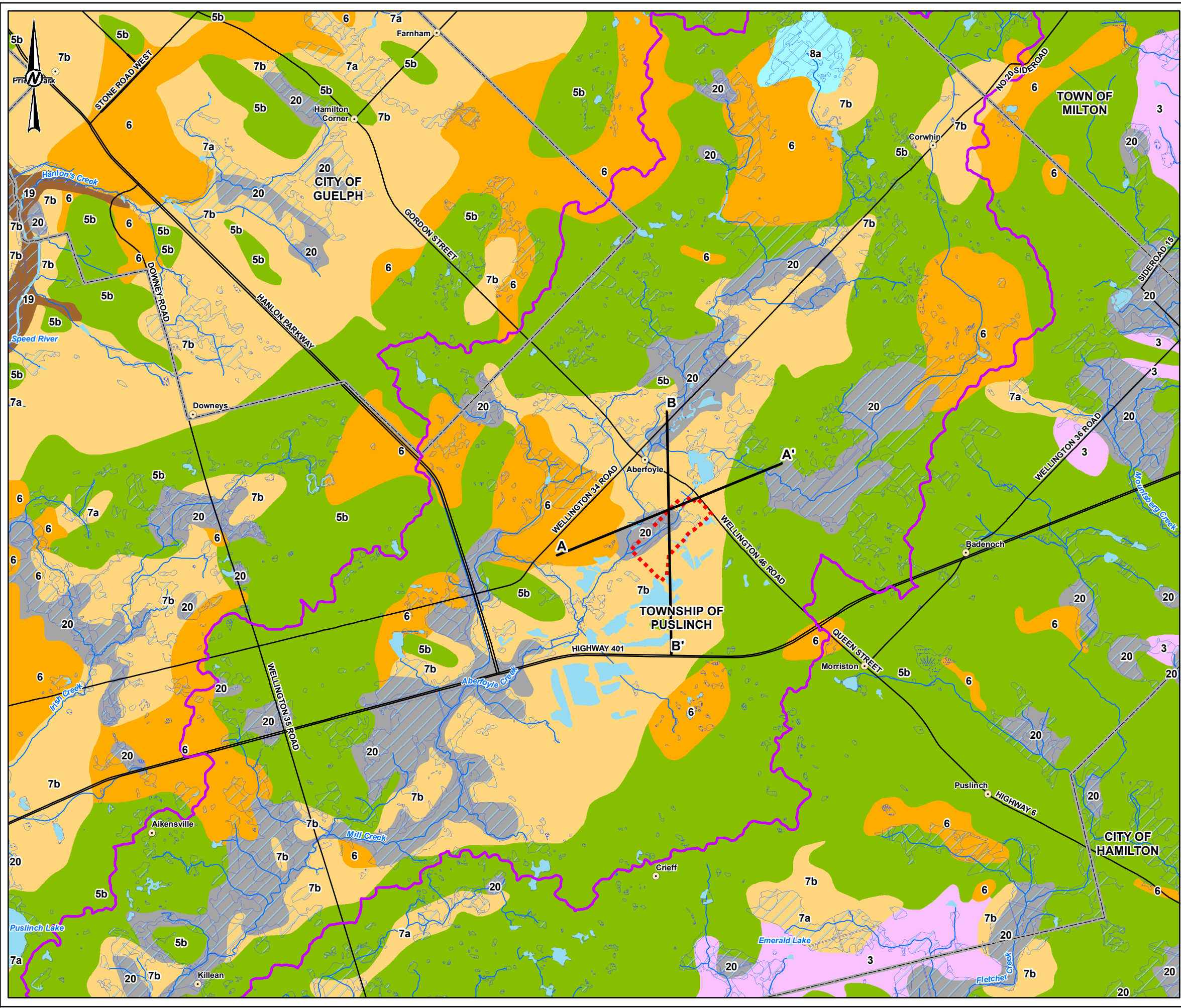
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 TOPOGRAPHY AND DRAINAGE

CONSULTANT	DATE	BY
YYYY-MM-DD	2021-02-14	
DESIGNED		ST
PREPARED		ST
REVIEWED		GP
APPROVED		JP

PROJECT NO. 20449101 CONTROL 0019 REV. 1.0 FIGURE 2.1

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- LEGEND**
- City / Town
  - Cross-Section Location
  - Main Road /Highway
  - Watercourse
  - Waterbody
  - Wetland
  - Provincially Significant Wetland
  - Mill Creek Sub-Watershed
  - Municipal Boundary
  - Property Boundary
  - 3: Paleozoic bedrock
  - 5b: Stone-poor, carbonate-derived silty to sandy till
  - 6: Ice-contact stratified deposits
  - 7a: Sandy deposits
  - 7b: Gravelly deposits
  - 8a: Massive-well laminated
  - 19: Modern alluvial deposits
  - 20: Organic deposits



**REFERENCE(S)**  
 BASE DATA - MNR LIO, OBTAINED 2013  
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PROJECT  
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TITLE  
**REGIONAL QUATERNARY GEOLOGY**

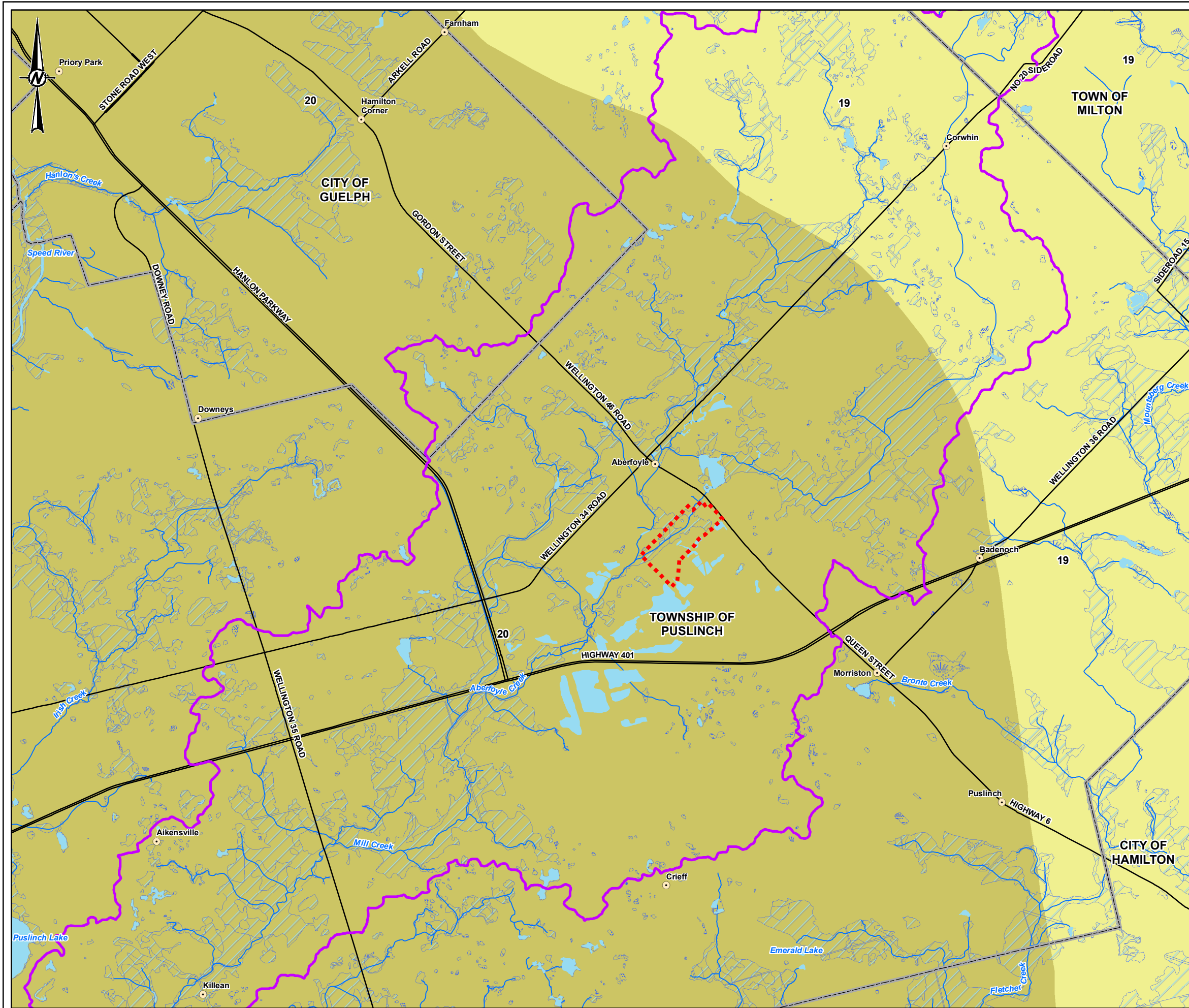
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YYYY-MM-DD	2021-01-25
DESIGNED	ST
PREPARED	ST
REVIEWED	GP
APPROVED	JP



PROJECT NO. 20449101 CONTROL 0019 REV. 1.0 **FIGURE 2.2**

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 26mm



- LEGEND**
- City / Town
  - Main Road /Highway
  - Watercourse
  - Waterbody
  - Wetland
  - Provincially Significant Wetland
  - Mill Creek Sub-Watershed
  - Municipal Boundary
  - Property Boundary
  - 20: Guelph - dolostone; thick-bedded, crinoidal, locally biohermal; locally bituminous (Eramosa Mb)
  - 19: Amabel - dolostone, limestone, argillaceous dolostone; locally cherty; locally bituminous (Eramosa Mb)



**REFERENCE(S)**  
 BASE DATA - MNR LIO, OBTAINED 2013  
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CLIENT  
**BLUE TRITON BRANDS**

PROJECT  
**2021 ANNUAL REPORT**

TITLE  
**REGIONAL BEDROCK GEOLOGY**

CONSULTANT	YYYY-MM-DD	2021-02-14
<b>GOLDER</b> MEMBER OF WSP	DESIGNED	ST
	PREPARED	ST
	REVIEWED	GP
	APPROVED	JP

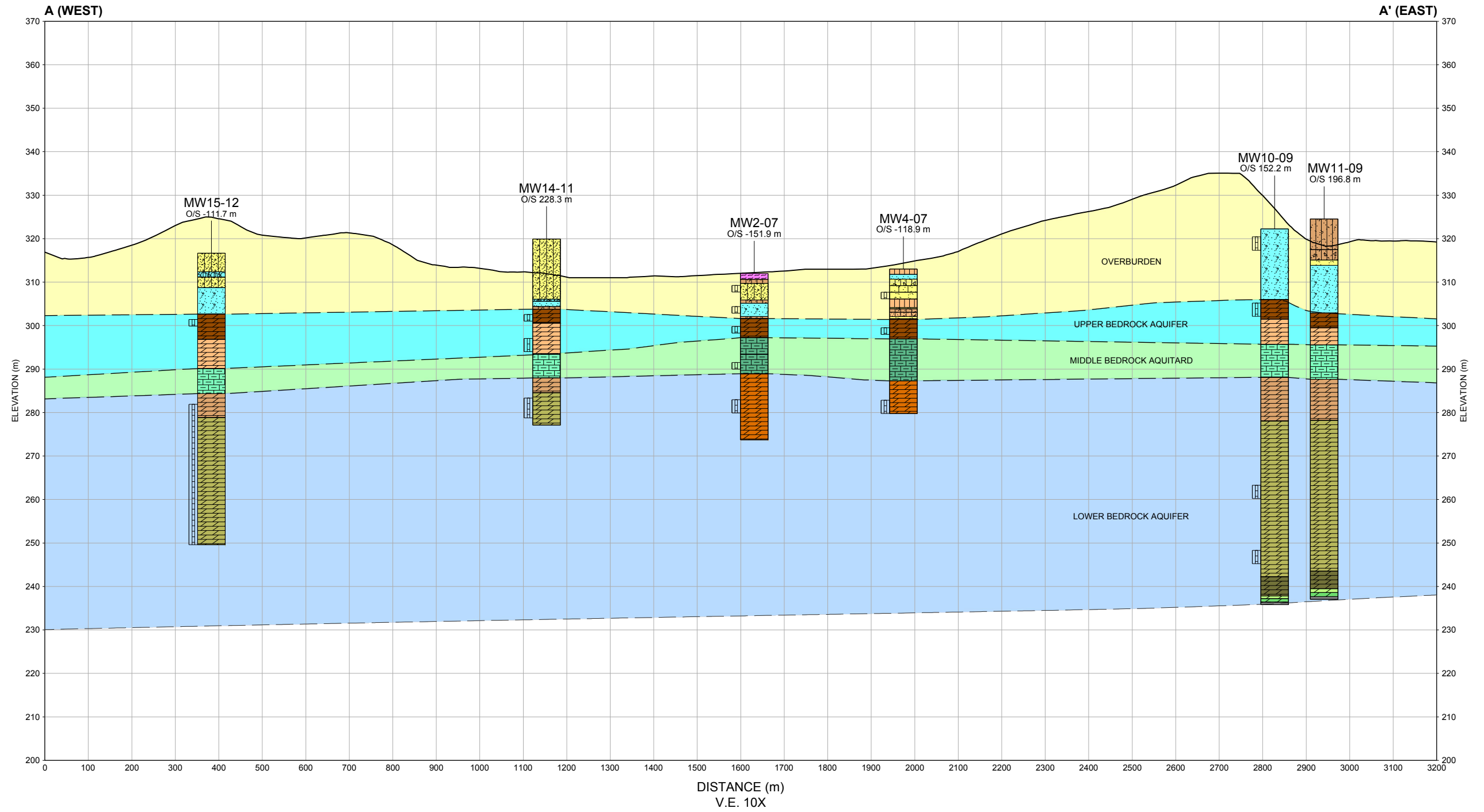
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**LEGEND**

**OVERBURDEN**

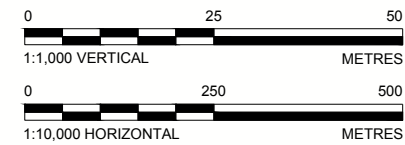
- SAND
- SILTY SAND
- SILTY SAND TILL
- SANDY SILT
- SANDY SILT TILL
- SILT
- SILT TILL
- TOPSOIL
- SAND AND GRAVEL
- GRAVEL AND SILT

**BEDROCK (OLD)**

- GUELPH
- ERAMOSIA
- AMABEL
- BEDROCK

**BEDROCK (NEW)**

- GUELPH
- REFORMATORY QUARRY
- VINEMOUNT
- GOAT ISLAND
- GASPORT
- IRONDEQUOIT
- ROCKWAY
- MERRITTON
- CABOT HEAD



CLIENT  
 BLUE TRITON BRANDS

PROJECT  
 2021 ANNUAL REPORT

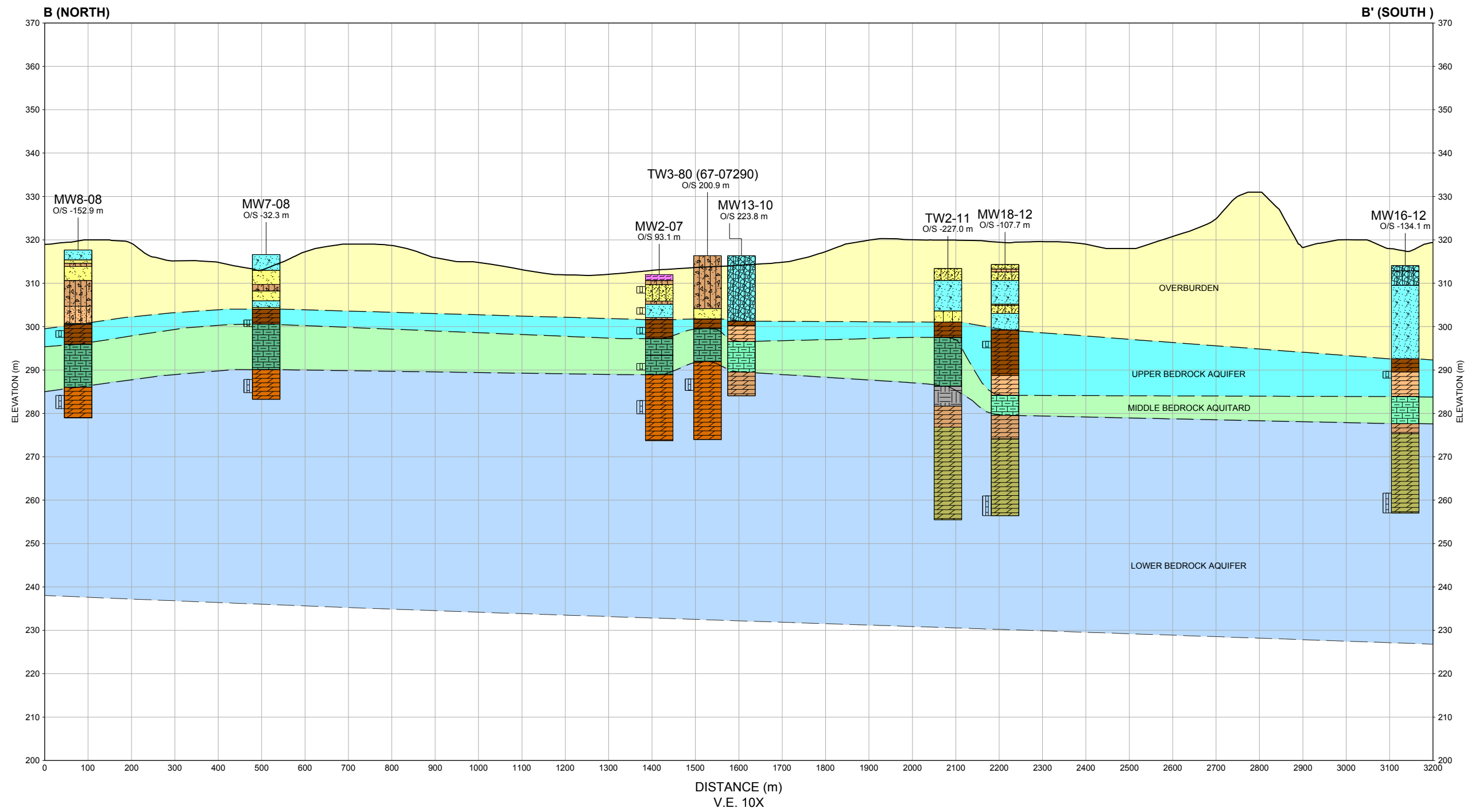
TITLE  
 CROSS SECTION A-A'

CONSULTANT	YYYY-MM-DD	2022-01-26
DESIGNED		
PREPARED	DD	
REVIEWED	GP	
APPROVED	GP	

PROJECT NO. 20449101      PHASE (1100)      REV. A      FIGURE 2.4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSIB 28 mm

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**LEGEND**

**OVERBURDEN**

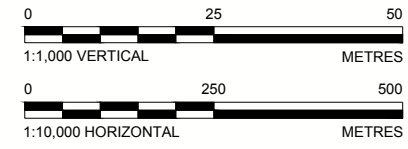
- SAND
- SILTY SAND
- SILTY SAND TILL
- SANDY SILT
- SANDY SILT TILL
- SILT
- SILT TILL
- TOPSOIL
- SAND AND GRAVEL
- GRAVEL AND SILT

**BEDROCK (OLD)**

- GUELPH
- ERAMOSIA
- AMABEL
- BEDROCK

**BEDROCK (NEW)**

- GUELPH
- REFORMATORY QUARRY
- VINEMOUNT
- GOAT ISLAND
- GASPORT
- IRONDEQUOIT
- ROCKWAY
- MERRITTON
- CABOT HEAD



CLIENT  
BLUE TRITON BRANDS

PROJECT  
2021 ANNUAL REPORT

TITLE  
CROSS SECTION B - B'

CONSULTANT	YYYY-MM-DD	2022-01-26
DESIGNED		
PREPARED	DD	
REVIEWED	GP	
APPROVED	GP	

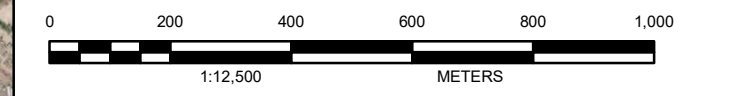
PROJECT NO. 20449101      PHASE (1100)      REV. A      FIGURE 2.5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A3S1B 25 mm



**LEGEND**

- Production Well
- Monitoring Well (Bedrock)
- Monitoring Well (Overburden)
- Private Well (Bedrock)
- Piezometer
- Surface Water Station
- Surface Water Temperature Station
- Water Level Elevation Contour (Oct. 12, 2010)
- Watercourse
- Property Boundary



**REFERENCE(S)**  
 BASE DATA - MNR LIO, OBTAINED 2013  
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**PROJECT**  
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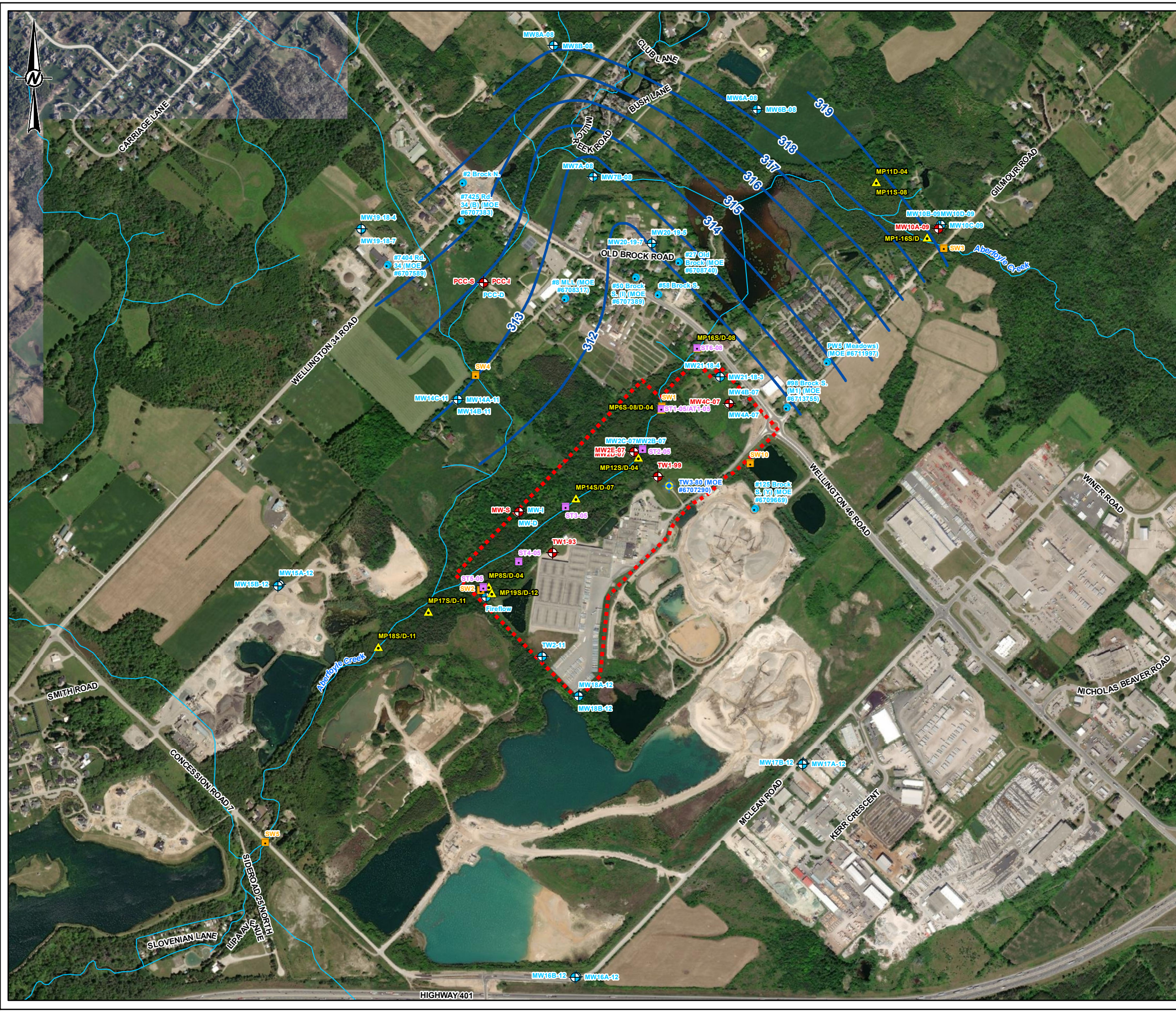
**TITLE**  
 OVERBURDEN AND SURFACE WATER ELEVATIONS  
 (NON-PUMPING CONDITION OCTOBER 2010)

CONSULTANT	DATE	REVISION
	YYYY-MM-DD	2021-01-25
	DESIGNED	ST
	PREPARED	ST/PR
	REVIEWED	GP
	APPROVED	JP

PROJECT NO. 20449101 CONTROL 0019 REV. 1.0 FIGURE 2.6

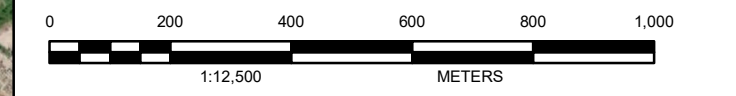
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 26mm



**LEGEND**

- Monitoring Well (Bedrock)
- Monitoring Well (Overburden)
- Production Well
- Private Well (Bedrock)
- Piezometer
- Surface Water Station
- Surface Water Temperature Station
- Water Level Elevation Contour (Oct. 12, 2010)
- Watercourse
- Property Boundary



**REFERENCE(S)**  
 BASE DATA - MNR LIO, OBTAINED 2013  
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**CLIENT**  
 BLUE TRITON BRANDS

**PROJECT**  
 2021 ANNUAL REPORT

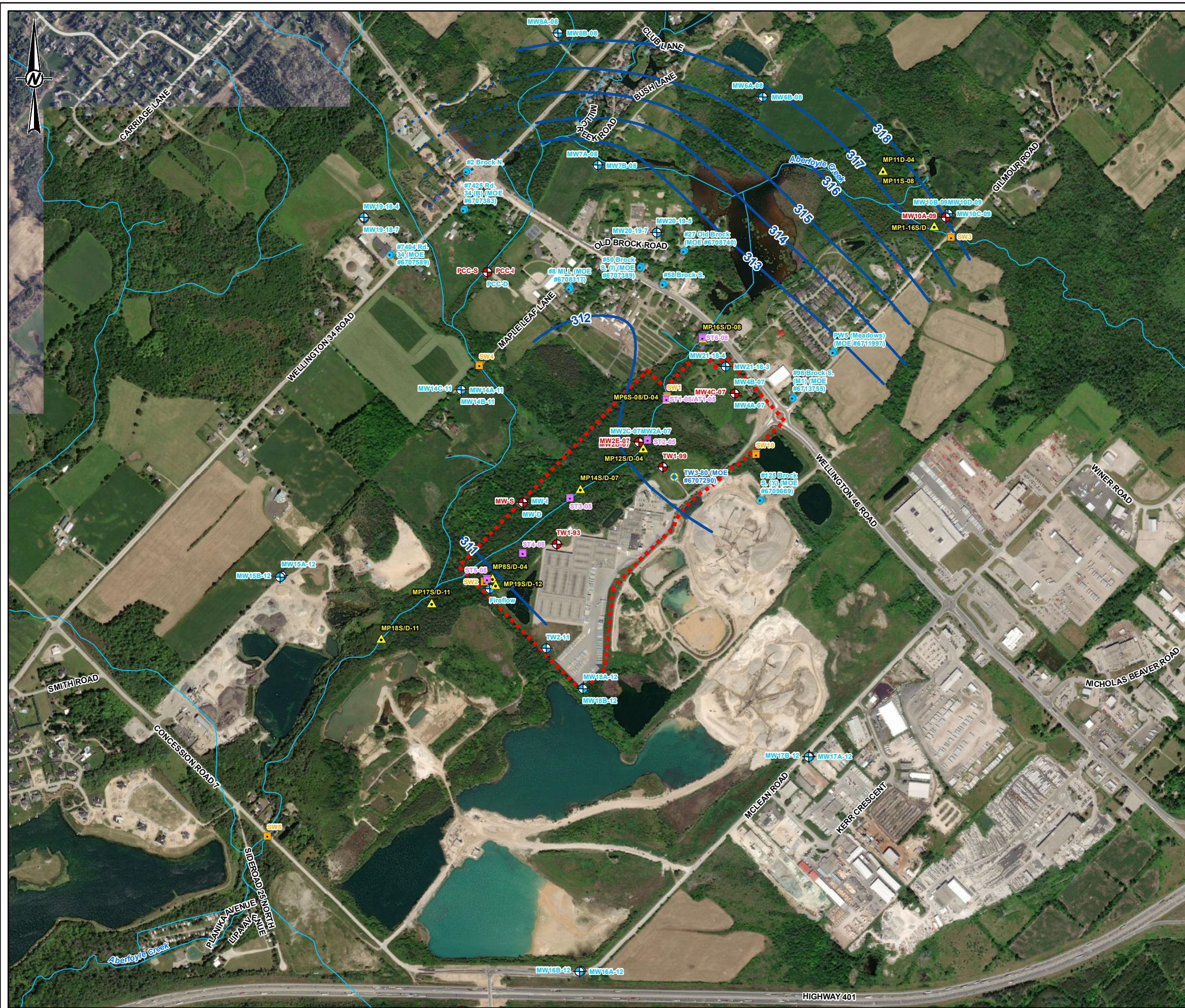
**TITLE**  
 POTENTIOMETRIC SURFACE OF UPPER BEDROCK AQUIFER (NON-PUMPING CONDITION OCTOBER 2010)

CONSULTANT	YYYY-MM-DD	2021-01-25
	DESIGNED	ST
	PREPARED	ST/PR
	REVIEWED	GP
	APPROVED	JP

PROJECT NO. 20449101 CONTROL 0019 REV. 1.0 FIGURE 2.7

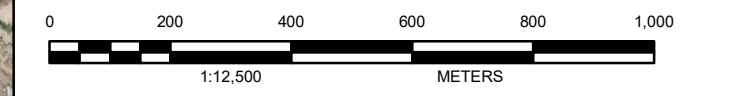
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**LEGEND**

- Production Well
- Monitoring Well (Bedrock)
- Monitoring Well (Overburden)
- Private Well (Bedrock)
- Piezometer
- Surface Water Station
- Surface Water Temperature Station
- Water Level Elevation Contour (Oct. 12, 2010)
- Watercourse
- Property Boundary



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 PROJECTION: UTM NAD83 ZONE 17  
 WATERCOURSES PRODUCED USING INFORMATION UNDER LICENSE WITH THE GRAND RIVER CONSERVATION AUTHORITY © GRAND RIVER CONSERVATION AUTHORITY, 2014  
 PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

**CLIENT**  
 BLUE TRITON BRANDS

**PROJECT**  
 2021 ANNUAL REPORT

**TITLE**  
 POTENTIOMETRIC SURFACE OF LOWER BEDROCK AQUIFER (NON-PUMPING CONDITION OCTOBER 2010)

CONSULTANT	YYYY-MM-DD	2019-01-18
DESIGNED	ST	
PREPARED	ST/PR	
REVIEWED	GP	
APPROVED	JP	

PROJECT NO. 20449101 CONTROL 0019 REV. 1.0 FIGURE 2.8

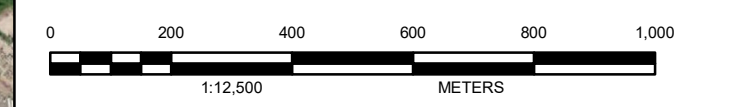
S:\Client\NorthAbercree\999\_PROD\1311520250\_Reporting\40\_PROD\0119\_2018\_Annual\_Report\1311522250-0019-Ch-02.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 26mm



**LEGEND**

- Production Well
- Monitoring Well (Bedrock)
- Private Well (Bedrock)
- Private Well (not monitored)
- Watercourse
- Property Boundary



**REFERENCE(S)**  
 BASE DATA - MNR LIO, OBTAINED 2013  
 PRODUCED BY GOLDR ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013  
 PROJECTION: UTM NAD83 ZONE 17  
 WATERCOURSES PRODUCED USING INFORMATION UNDER LICENSE WITH THE GRAND RIVER CONSERVATION AUTHORITY © GRAND RIVER CONSERVATION AUTHORITY, 2014  
 PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

**CLIENT**  
 BLUE TRITON BRANDS

**PROJECT**  
 2021 ANNUAL REPORT

**TITLE**  
 2021 BEDROCK MONITORING LOCATIONS

CONSULTANT	YYYY-MM-DD	2021-01-25
DESIGNED	ST	
PREPARED	ST	
REVIEWED	GP	
APPROVED	JP	

PROJECT NO. 20449101 CONTROL 0019 REV. 1.0 FIGURE 3.1

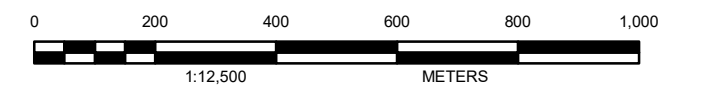
S:\Client\Abercrombie\Abercrombie\_2021\_Annual\_Report\1311522020\_Reporting\0\_PROD\0019\_2021\_Annual\_Report\1311522020\_0019-Ch4-0011.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 28mm



**LEGEND**

- Production Well
- Monitoring Well (Overburden)
- Watercourse
- Property Boundary



**REFERENCE(S)**  
 BASE DATA - MNR LIO, OBTAINED 2013  
 PRODUCED BY GOLDR ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013  
 PROJECTION: UTM NAD83 ZONE 17  
 WATERCOURSES PRODUCED USING INFORMATION UNDER LICENSE WITH THE GRAND RIVER CONSERVATION AUTHORITY © GRAND RIVER CONSERVATION AUTHORITY, 2014  
 PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

**CLIENT**  
 BLUE TRITON BRANDS

**PROJECT**  
 2021 ANNUAL REPORT

**TITLE**  
 2021 OVERBURDEN MONITORING LOCATIONS

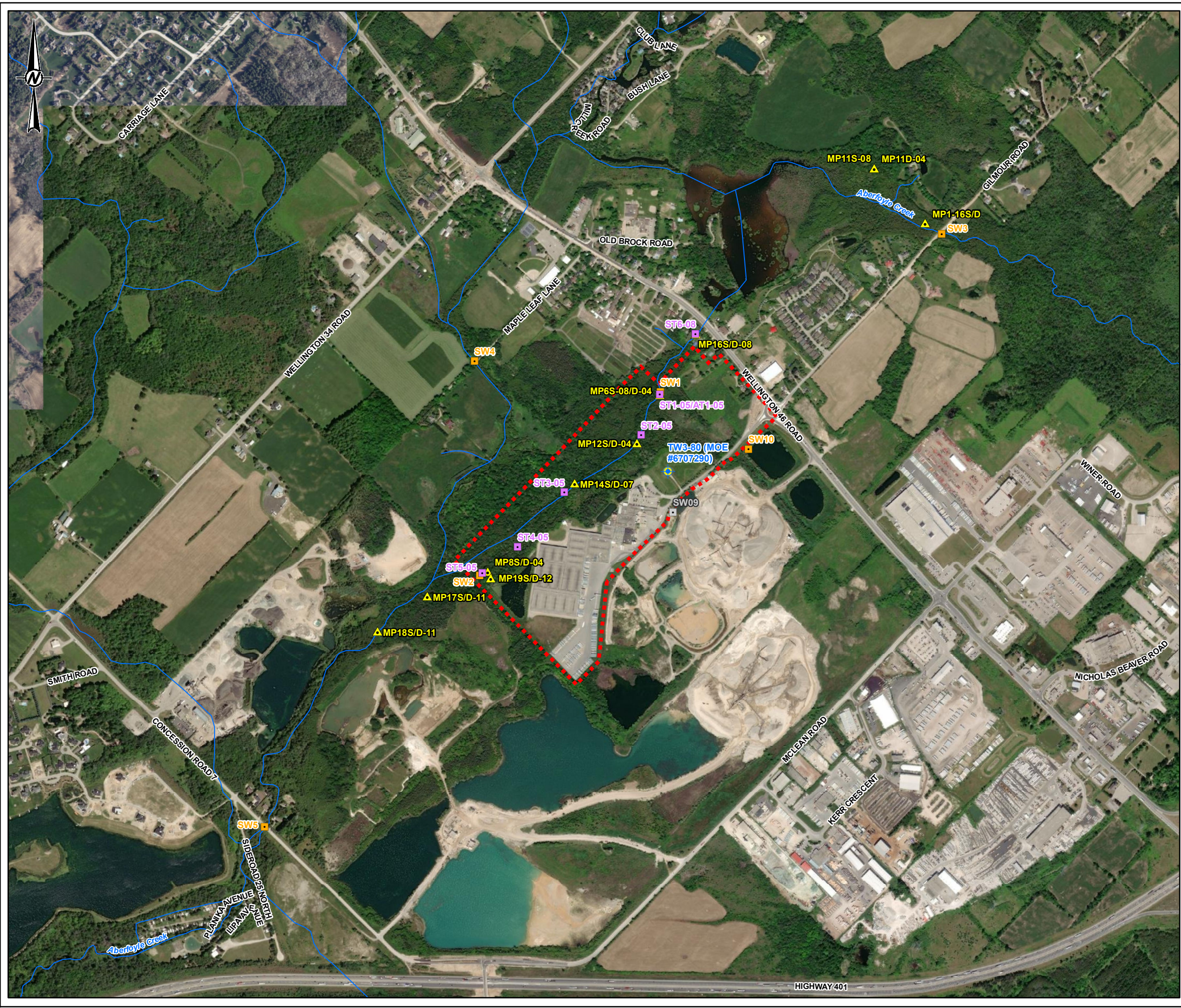
CONSULTANT	YYYY-MM-DD	2021-01-25
GOLDER MEMBER OF WSP	DESIGNED	ST
	PREPARED	ST/PR
	REVIEWED	GP
	APPROVED	JP

PROJECT NO. 20449101      CONTROL 0019      REV. 1.0      FIGURE 3.2

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

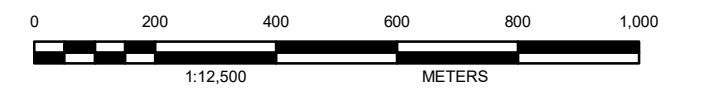
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 28mm



**LEGEND**

- Production Well
- Piezometer
- Surface Water Station
- Surface Water Temperature Station
- Surface Water Station (Destroyed)
- Watercourse
- Property Boundary



**REFERENCE(S)**  
 BASE DATA - MNR LIO, OBTAINED 2013  
 PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013  
 PROJECTION: UTM NAD83 ZONE 17  
 WATERCOURSES PRODUCED USING INFORMATION UNDER LICENSE WITH THE GRAND RIVER CONSERVATION AUTHORITY © GRAND RIVER CONSERVATION AUTHORITY, 2014  
 PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT  
**BLUE TRITON BRANDS**

PROJECT  
**2021 ANNUAL REPORT**

TITLE  
**2021 SURFACE WATER MONITORING LOCATIONS**

CONSULTANT	YYYY-MM-DD	2021-01-25
DESIGNED	ST	
PREPARED	ST	
REVIEWED	GP	
APPROVED	JP	

PROJECT NO. 20449101	CONTROL 0019	REV. 1.0	FIGURE <b>3.3</b>
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S:\Client\Kerr\Abercrombie\k989\_PRCO1311520250\_Monitoring\0\_PRCO1311520250\_2015\_Annual\_Report\1311520250-0019-Ch4-013.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 28mm





**LEGEND**

- Production Well
- Decommissioned
- Watercourse
- Property Boundary

**Well Status as of December 2021**



**REFERENCE(S)**  
 BASE DATA - MNR LIO, OBTAINED 2013  
 PRODUCED BY GOLDR ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013  
 PROJECTION: UTM NAD83 ZONE 17  
 WATERCOURSES PRODUCED USING INFORMATION UNDER LICENSE WITH THE GRAND RIVER CONSERVATION AUTHORITY © GRAND RIVER CONSERVATION AUTHORITY, 2014  
 PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

**CLIENT**  
 BLUE TRITON BRANDS

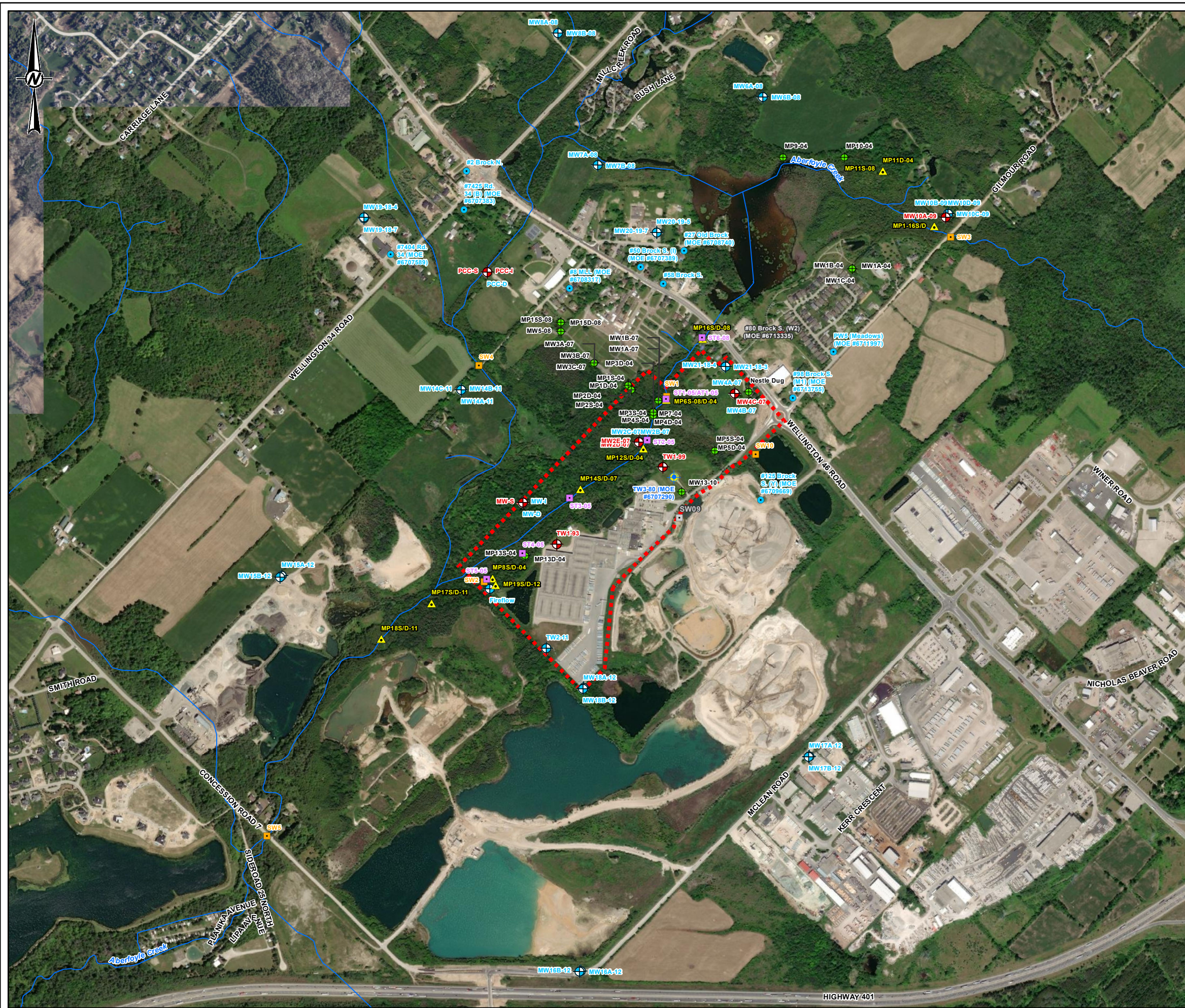
**PROJECT**  
 2021 ANNUAL REPORT

**TITLE**  
 UNUSED OR DECOMMISSIONED WELLS

CONSULTANT	YYYY-MM-DD	2021-01-25
GOLDER MEMBER OF WSP	DESIGNED	ST
	PREPARED	ST
	REVIEWED	GP
	APPROVED	JP

S:\Client\North\Abercrombie\999\_PROD\1311520250\_Reporting\00\_PROD\0019\_2021\_Annual\_Report\1311520250\_0019-Ch-03-04.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 26mm



**LEGEND**

- Production Well
- Monitoring Well (Bedrock)
- Monitoring Well (Overburden)
- Private Well (Bedrock)
- Piezometer
- Surface Water Station
- Surface Water Temperature Station
- Surface Water Station (Destroyed)

**Well Status as of December 2021**

- Decommissioned
- Watercourse
- Property Boundary



**REFERENCE(S)**  
 BASE DATA - MNR LIO, OBTAINED 2013  
 PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013  
 PROJECTION: UTM NAD83 ZONE 17  
 WATERCOURSES PRODUCED USING INFORMATION UNDER LICENSE WITH THE GRAND RIVER CONSERVATION AUTHORITY © GRAND RIVER CONSERVATION AUTHORITY, 2014  
 PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT  
**BLUE TRITON BRANDS**

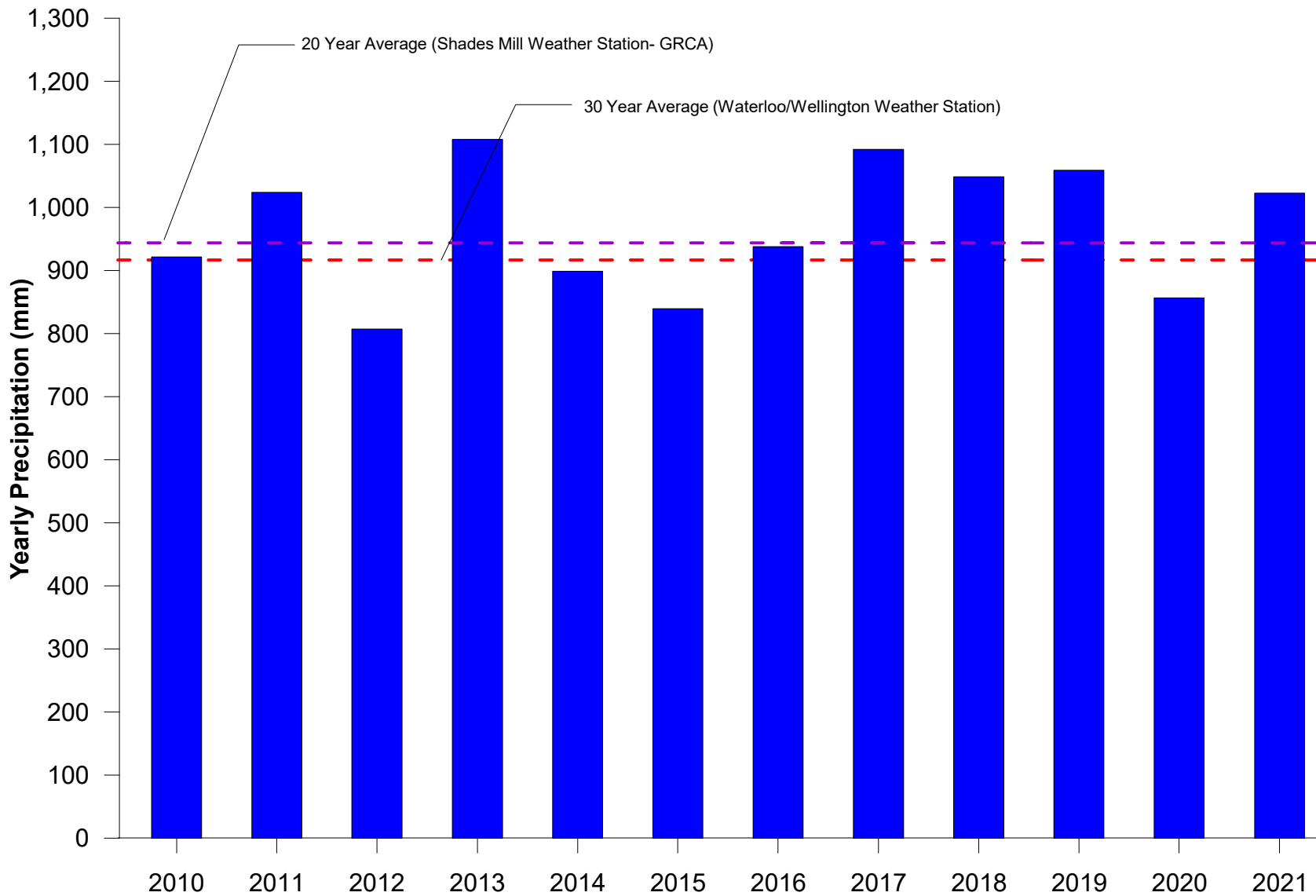
PROJECT  
**2021 ANNUAL REPORT**

TITLE  
**WELL LOCATIONS**

CONSULTANT	YYYY-MM-DD	2021-01-25
<b>GOLDER</b> MEMBER OF WSP	DESIGNED	ST
	PREPARED	ST
	REVIEWED	GP
	APPROVED	JP

S:\Client\NorthAbercayle\999\_PROD\1311520250\_HomeBoring\00\_PROD\0013\_2017\_Annual\_Report\_Emit\1311520250-0013-CH-0016.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 26mm



PROJECT **BLUE TRITON BRANDS**  
Guelph, Ontario

TITLE **HISTORICAL YEARLY PRECIPITATION (2010 TO 2021)**  
**2021 ANNUAL MONITORING REPORT**

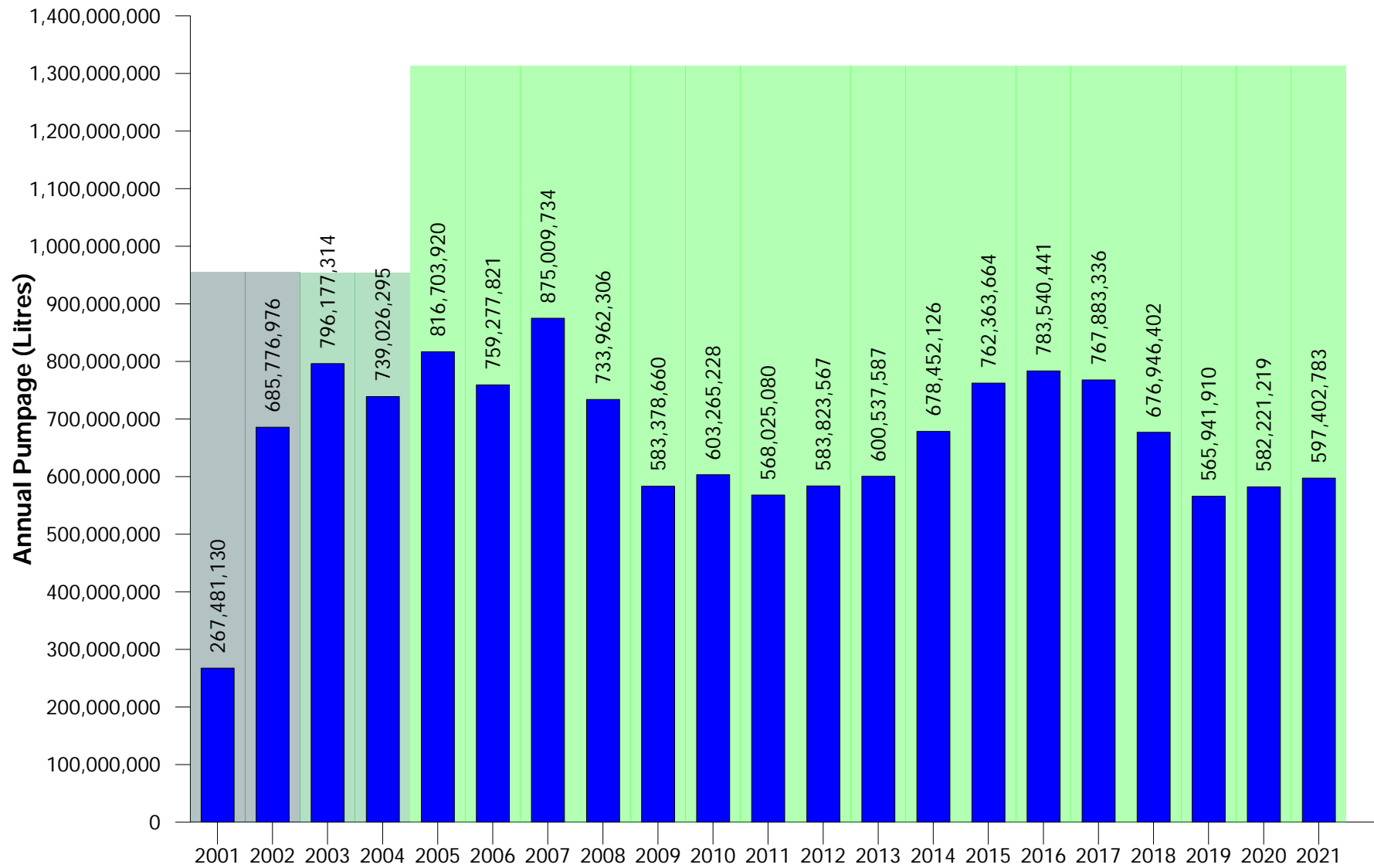
PROJECT NO. 20449101 (1000)

REV A

FIGURE 3.6



DATE DECEMBER 2021  
DESIGN SK  
REVIEW GP  
APPROVED GP



DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

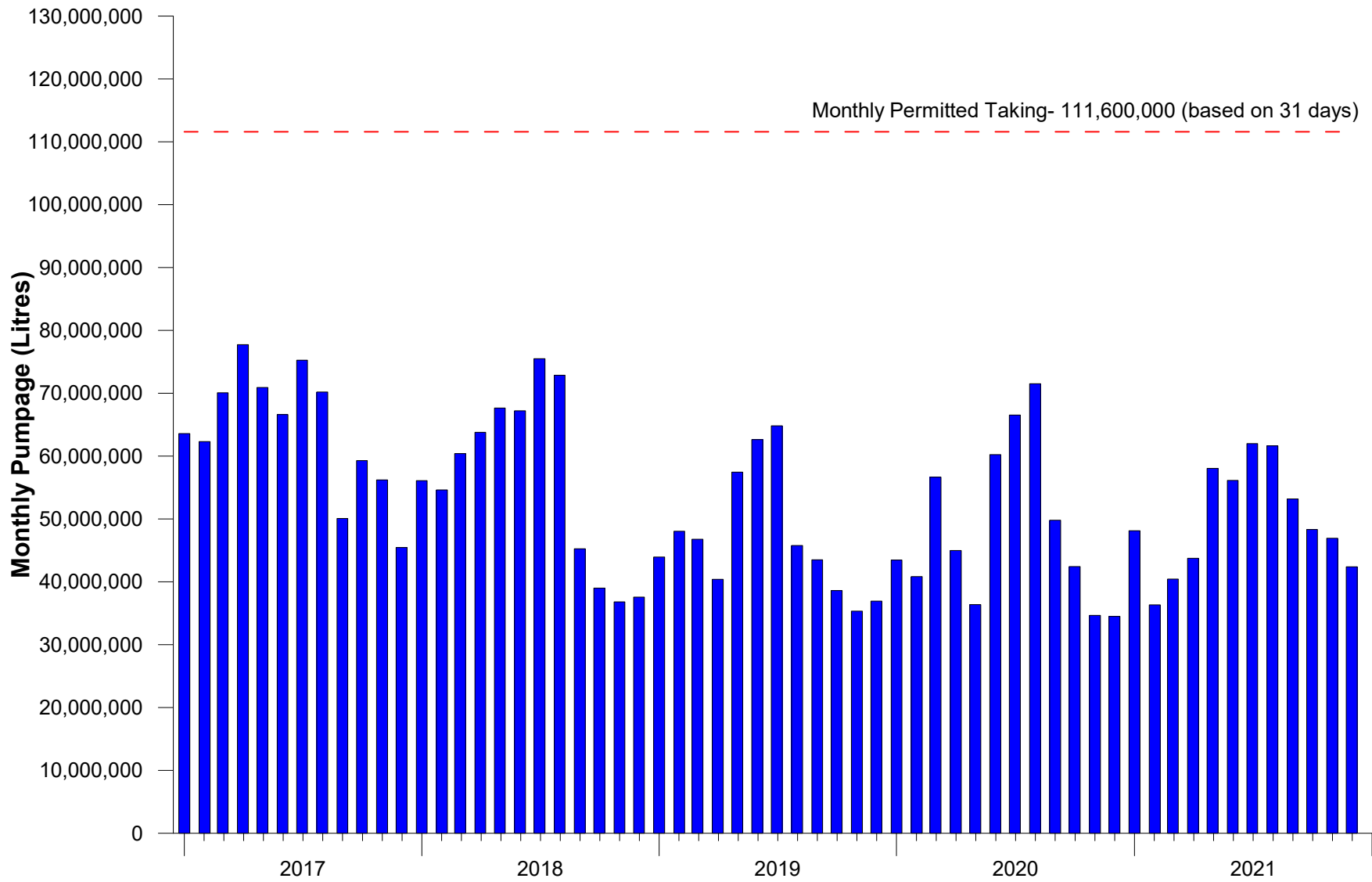
**PROJECT**  
**BLUE TRITON BRANDS**  
 Guelph, Ontario

**TITLE**  
**TW3-80 ANNUAL WATER TAKING (2001 TO 2021)**  
**2021 ANNUAL MONITORING REPORT**

**PROJECT NO.**  
 20449101 (1100)

**REV**  
 A

**FIGURE**  
 4.1



PROJECT

**BLUE TRITON BRANDS**  
Guelph, Ontario

TITLE

**TW3-80 MONTHLY WATER TAKING (2017 TO 2021)**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO.

20449101 (1100)

REV

A

FIGURE

4.2



DATE DECEMBER 2021

DESIGN KS

REVIEW GP

APPROVED GP



**LEGEND**

- Production Well
- Monitoring Well (Bedrock)
- Private Well (Bedrock)
- Watercourse
- 311.5 Water Level Elevation (July 23, 2021)
- Water Elevation Contour (masl)
- Inferred Water Elevation Contour
- Property Boundary



**REFERENCE(S)**  
 BASE DATA - MNR LIO, OBTAINED 2013  
 PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013  
 PROJECTION: UTM NAD83 ZONE 17  
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 PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT  
**BLUE TRITON BRANDS**

PROJECT  
**2021 ANNUAL REPORT**

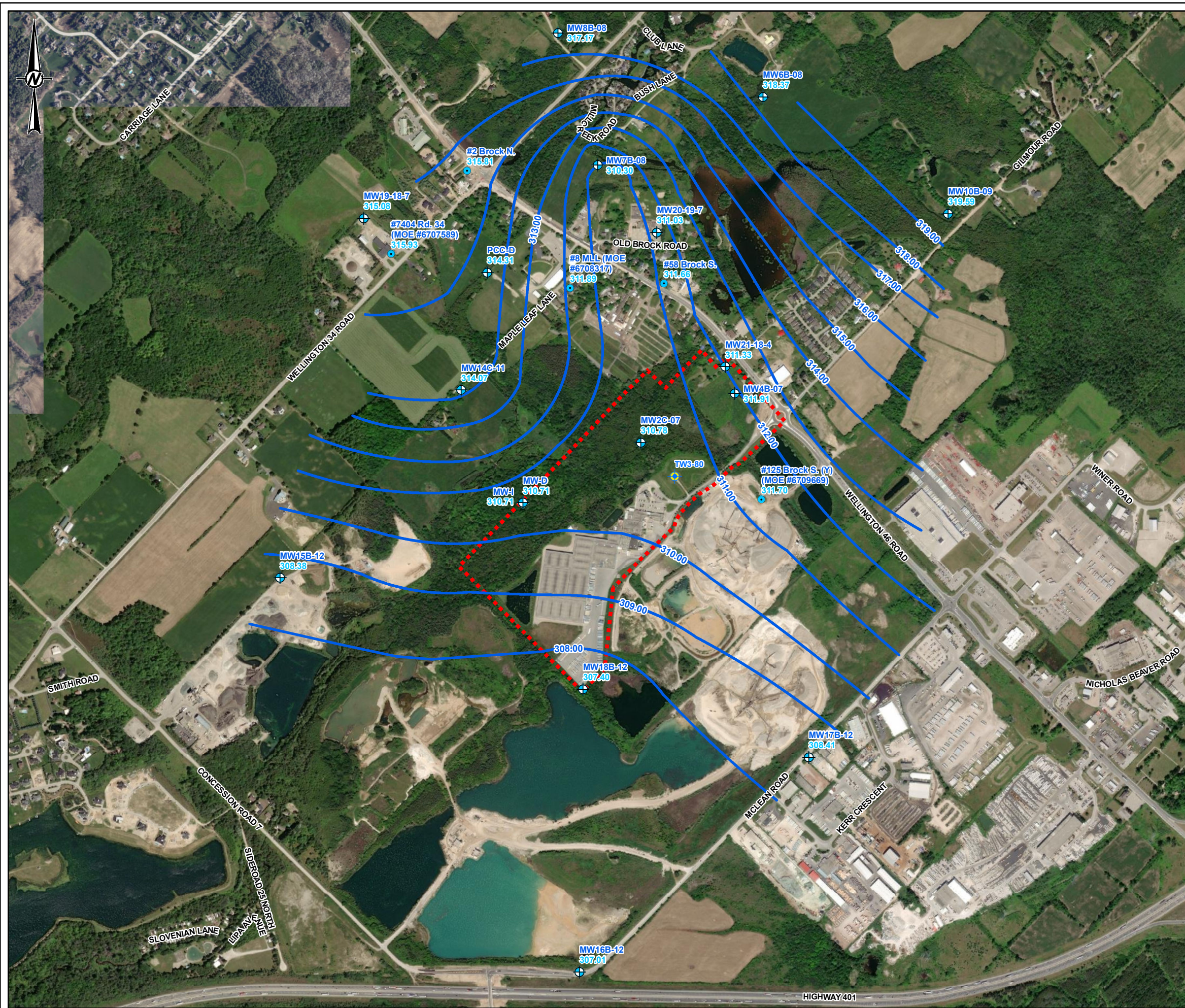
TITLE  
**POTENTIOMETRIC SURFACE OF LOWER BEDROCK AQUIFER (JULY 2021)**

CONSULTANT	YYYY-MM-DD	2021-01-25
<b>GOLDER</b> MEMBER OF WSP	DESIGNED	ST
	PREPARED	ST
	REVIEWED	GP
	APPROVED	JP

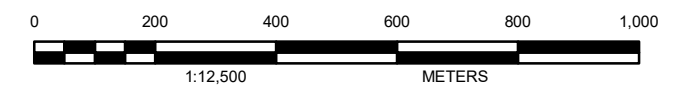
PROJECT NO. 20449101      CONTROL 0019      REV. 1.0      FIGURE 4.3

S:\Clients\News\Aberfoyle\99 PROJ\1311520250 Momboring\4 PROJ\1311520250-0019-2019 Annual Report\1311520250-0019-Ch4-016.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 28mm



- LEGEND**
- Production Well
  - Monitoring Well (Bedrock)
  - Private Well (Bedrock)
  - Watercourse
  - Water Elevation Contour (masl)
  - 311.5 Water Level Elevation (July 23, 2021)
  - Property Boundary



**REFERENCE(S)**  
 BASE DATA - MNR LIO, OBTAINED 2013  
 PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013  
 PROJECTION: UTM NAD83 ZONE 17  
 WATERCOURSES PRODUCED USING INFORMATION UNDER LICENSE WITH THE GRAND RIVER CONSERVATION AUTHORITY © GRAND RIVER CONSERVATION AUTHORITY, 2014  
 PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT  
**BLUE TRITON BRANDS**

PROJECT  
**2021 ANNUAL REPORT**

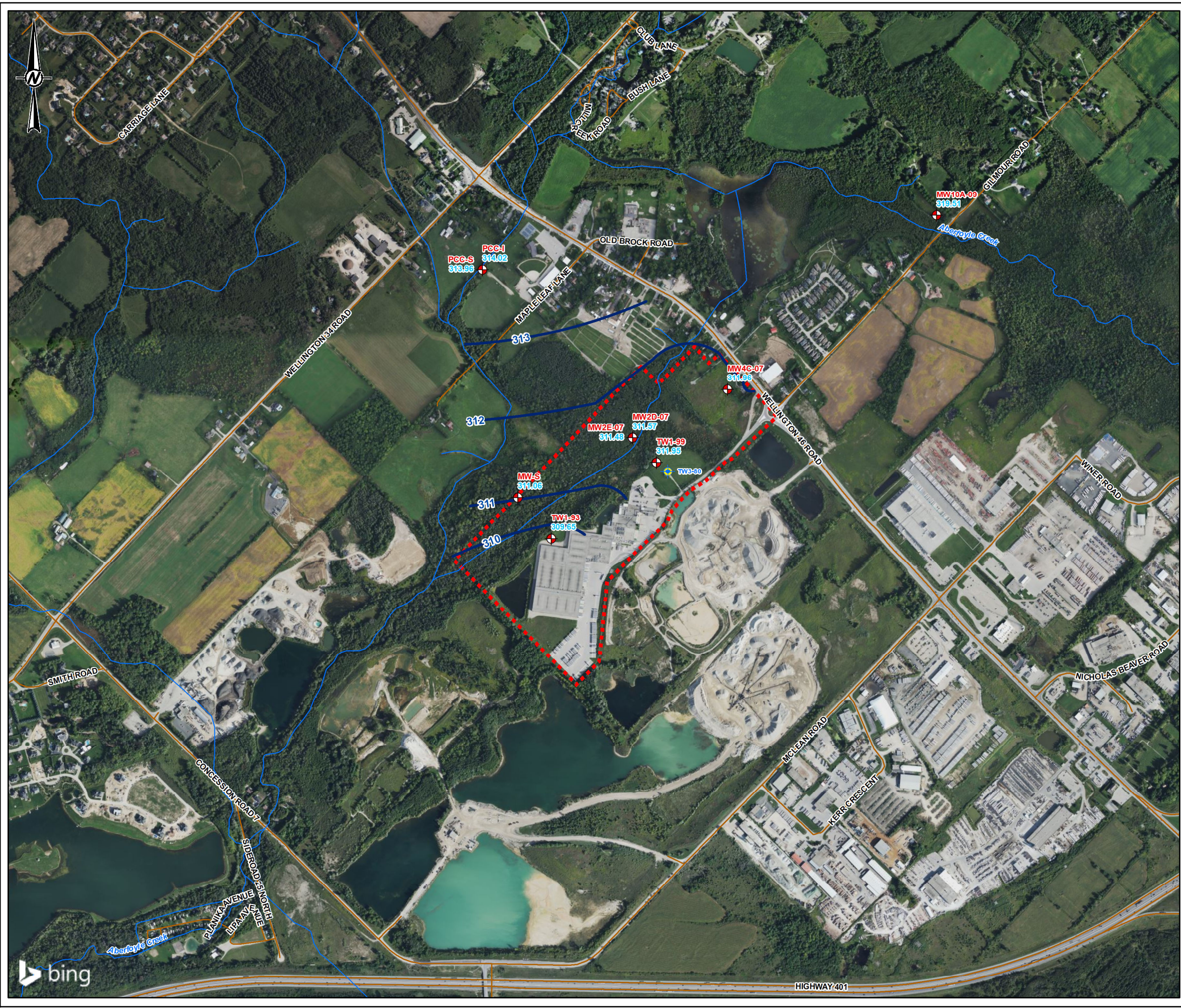
TITLE  
**POTENTIOMETRIC SURFACE OF UPPER BEDROCK AQUIFER (JULY 2021)**

CONSULTANT	YYYY-MM-DD	2021-01-05
DESIGNED	ST	
PREPARED	ST	
REVIEWED	GP	
APPROVED	JP	

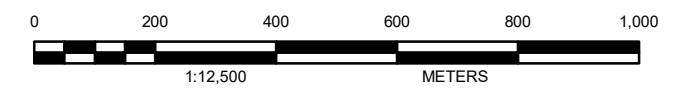
PROJECT NO. 20449101	CONTROL 0019	REV. 1.0	FIGURE <b>4.4</b>
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S:\Client\triton\blue\triton\2021\Annual\_Report\_Fina\Final\112525250\_2021\_Annual\_Report\_Fina\Final\112525250\_0013.CH-0018.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 28mm



- LEGEND**
- Production Well
  - Monitoring Well (Overburden)
  - Watercourse
  - Water Elevation Contour (masl)
  - 311.4 Water Level Elevation (July 23, 2021)
  - Property Boundary



**REFERENCE(S)**  
 BASE DATA - MNR LIO, OBTAINED 2013  
 PRODUCED BY GOLDR ASSOCIATES LTD UNDER LICENCE FROM  
 ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013  
 PROJECTION: UTM NAD83 ZONE 17  
 WATERCOURSES PRODUCED USING INFORMATION UNDER LICENSE WITH THE GRAND RIVER  
 CONSERVATION AUTHORITY © GRAND RIVER CONSERVATION AUTHORITY, 2014  
 PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT  
**BLUE TRITON BRANDS**

PROJECT  
**2021 ANNUAL REPORT**

TITLE  
**POTENTIOMETRIC SURFACE OF OVERBURDEN (JULY 2021)**

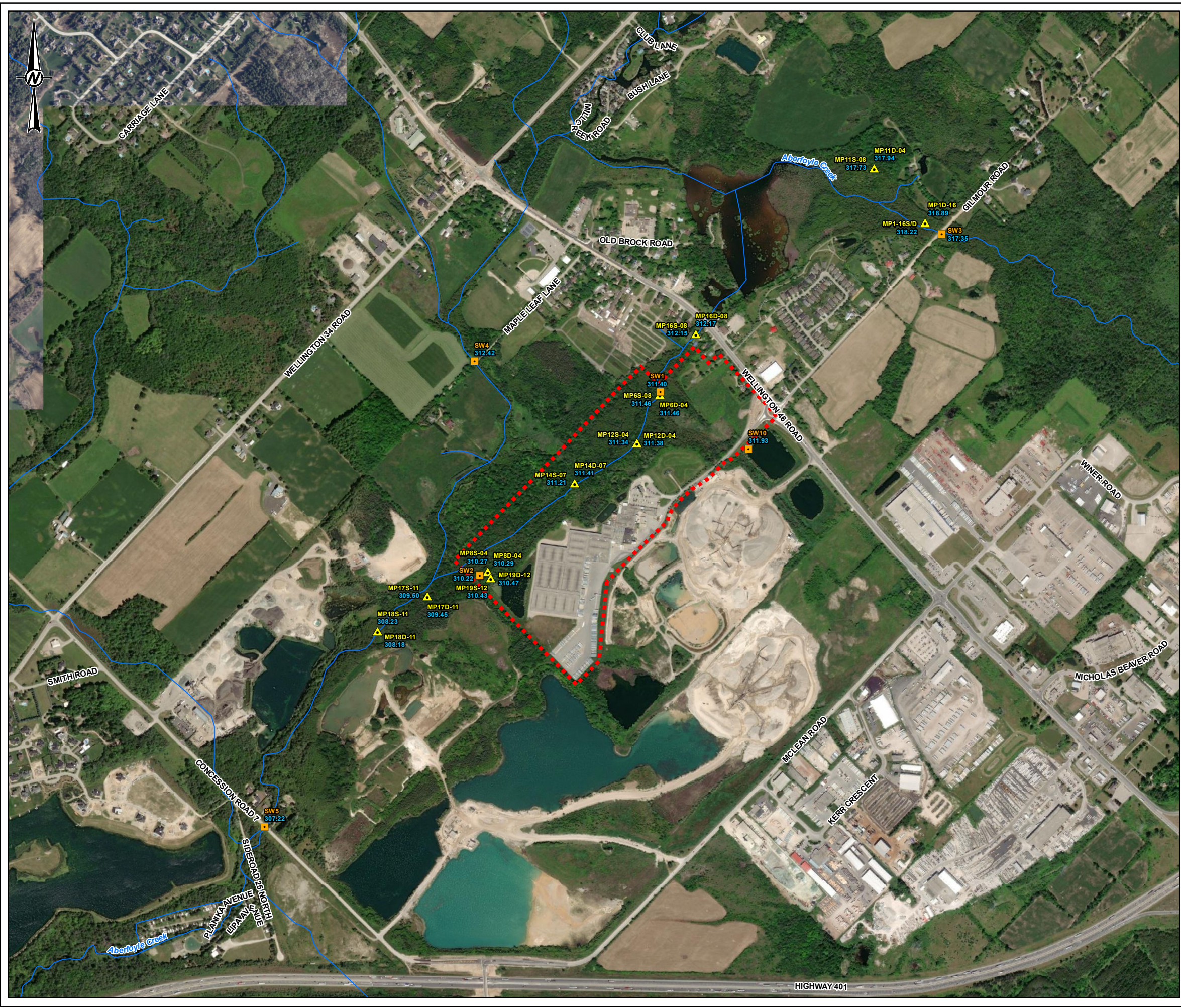
CONSULTANT	YYYY-MM-DD	2021-01-25
	DESIGNED	JMC
	PREPARED	ST
	REVIEWED	GP
	APPROVED	JP

PROJECT NO. 20449101 CONTROL 0019 REV. 1.0 FIGURE 4.5

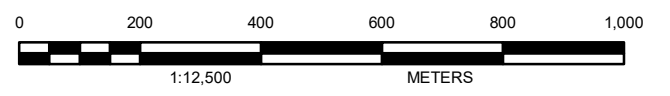
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 28mm





- LEGEND**
- Piezometer
  - Surface Water Station
  - Watercourse
  - 311.5 Water Level Elevation (July 23, 2021)
  - Property Boundary



**REFERENCE(S)**  
 BASE DATA - MNR LIO, OBTAINED 2013  
 PRODUCED BY GOLDR ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013  
 PROJECTION: UTM NAD83 ZONE 17  
 WATERCOURSES PRODUCED USING INFORMATION UNDER LICENSE WITH THE GRAND RIVER CONSERVATION AUTHORITY © GRAND RIVER CONSERVATION AUTHORITY, 2014  
 PROPERTY BOUNDARY OBTAINED FROM CRA, NOVEMBER 2014.

CLIENT  
**BLUE TRITON BRANDS**

PROJECT  
**2021 ANNUAL REPORT**

TITLE  
**SURFACE WATER ELEVATIONS (JULY 2021)**

CONSULTANT	DATE	REVISION
	YYYY-MM-DD	2021-01-25
	DESIGNED	JMC
	PREPARED	ST
	REVIEWED	GP
	APPROVED	JP

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 28mm

**APPENDIX A**

**Permit To Take Water Number  
3133-C5BUH9**

**Ministry of the Environment,  
Conservation and Parks**

Environmental Assessment and  
Permissions Division  
Brownfields and Permit to Take Water  
Permit To Take Water Unit  
Floor 1, 135 St Clair Ave W  
Toronto, ON  
M4V 1P5  
Tel: (289) 830-5867

**Ministère de l'Environnement, de la  
Protection de la nature et des  
Parcs**

Division des évaluations et des  
permissions environnementales  
Réaménagement des friches  
contaminées et réglementation des  
prélèvements d'eau  
Unité de la réglementation des  
prélèvements d'eau  
1er étage, 135 av. St. Clair O  
Toronto, ON  
M4V 1P5  
Tél:(289) 830-5867



November 15, 2021

Triton Water Canada Holdings, Inc.  
101 Brock Rd S  
Puslinch, Ontario, N0B 2J0  
Canada

Dear Andreeanne Simard:

**RE:** Permit To Take Water No. 3133-C5BUH9  
101 Brock Rd S, Puslinch, County of Wellington  
Reference Number 3572-A8XGCE

Please find attached a Permit to Take Water which authorizes the withdrawal of water in accordance with the application for this Permit to Take Water, dated April 1, 2016 and signed by Andreeanne Simard.

**This Permit expires on November 15, 2026.** Authorized rates and amounts are indicated on Table A. This Permit cancels and replaces Permit Number 1381-95ATPY, issued on December 19, 2013

Section 9(3) of Ontario Regulation 387/04 (Water Taking and Transfer) requires all holders of a permit to report daily water taking amounts annually, in a manner and form approved by the Director (<https://www.lrcsde.lrc.gov.on.ca/wtrs/>). For the purpose of s. 9(3), such reports shall be submitted electronically to the Water Taking Reporting System (WTRS) electronic database or via hard copy, as described in the Technical Bulletin entitled "Permit to Take Water Program Monitoring and Reporting of Water Takings", dated November 2010, PIBs 6003e (<https://archive.org/details/std01079790.ome/mode/2up>).

If you have questions about reporting requirements, please call the WTRS Help Desk at 416-235-6322 (toll free: 1-877-344-2011) or by email, [WTRSHelpdesk@ontario.ca](mailto:WTRSHelpdesk@ontario.ca). It is preferred that you submit your data directly and electronically to the WTRS. Where this is impracticable, please contact the WTRS Help Desk to arrange for written submission of your data.

Condition 1.4 specifically indicates that this Permit is not transferable to another party. Any queries regarding a change in owner/operator should be made to the Permit to Take Water Evaluator at the above address.

Take notice that in issuing this Permit, terms and conditions pertaining to the taking of water and to the results of the taking have been imposed. The terms and conditions have been designed to allow for the development of water resources, while providing reasonable protection to existing water uses and users.

Yours truly,

A handwritten signature in blue ink, appearing to read 'G. Meek', written over a horizontal line.

---

Gregory Meek  
Supervisor (Acting), Permit To Take Water  
Director, Section 34.1, Ontario Water Resources Act, R.S.O. 1990  
Environmental Permissions Branch

File Storage Number: -

**PERMIT TO TAKE WATER**  
Ground Water  
NUMBER 3133-C5BUH9

*Pursuant to Section 34.1 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To Take Water is hereby issued to:*

Triton Water Canada Holdings, Inc.  
101 Brock Rd S  
Puslinch, Ontario  
N0B 2J0

*For the water taking from:* One Drilled Well (TW3-80)

*Located at:* 101 Brock Rd S  
Puslinch, County of Wellington

*For the purposes of this Permit, and the terms and conditions specified below, the following definitions apply:*

**DEFINITIONS**

- (a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34.1, OWRA.
- (b) "Provincial Officer" means any person designated in writing by the Minister as a Provincial Officer pursuant to section 5 of the OWRA.
- (c) "Ministry" means Ontario Ministry of the Environment, Conservation and Parks.
- (d) "District Office" means the Guelph District Office.
- (e) "Permit" means this Permit to Take Water No. 3133-C5BUH9 including its Schedules, if any, issued in accordance with Section 34.1 of the OWRA.
- (f) "Permit Holder" means Triton Water Canada Holdings, Inc..
- (g) "OWRA " means the *Ontario Water Resources Act*, R.S.O. 1990, c. O. 40, as amended.

*You are hereby notified that this Permit is issued subject to the terms and conditions outlined below:*

## **TERMS AND CONDITIONS**

### **1. Compliance with Permit**

- 1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated April 1, 2016 and signed by Andreanne Simard, and all Schedules included in this Permit.
- 1.2 The Permit Holder shall ensure that any person authorized by the Permit Holder to take water under this Permit is provided with a copy of this Permit and shall take all reasonable measures to ensure that any such person complies with the conditions of this Permit.
- 1.3 Any person authorized by the Permit Holder to take water under this Permit shall comply with the conditions of this Permit.
- 1.4 This Permit is not transferable to another person.
- 1.5 This Permit provides the Permit Holder with permission to take water in accordance with the conditions of this Permit, up to the date of the expiry of this Permit. This Permit does not constitute a legal right, vested or otherwise, to a water allocation, and the issuance of this Permit does not guarantee that, upon its expiry, it will be renewed.
- 1.6 The Permit Holder shall keep this Permit available at all times at or near the site of the taking, and shall produce this Permit immediately for inspection by a Provincial Officer upon his or her request.
- 1.7 The Permit Holder shall report any changes of address to the Director within thirty days of any such change. The Permit Holder shall report any change of ownership of the property for which this Permit is issued within thirty days of any such change. A change in ownership in the property shall cause this Permit to be cancelled.

### **2. General Conditions and Interpretation**

- 2.1 Inspections  
The Permit Holder must forthwith, upon presentation of credentials, permit a Provincial Officer to carry out any and all inspections authorized by the OWRA, the *Environmental Protection Act*, R.S.O. 1990, the *Pesticides Act*, R.S.O. 1990, or the *Safe Drinking Water Act*, S. O. 2002.
- 2.2 Other Approvals  
The issuance of, and compliance with this Permit, does not:
  - (a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the *Ontario Water Resources Act*, and

the *Environmental Protection Act* , and any regulations made thereunder; or

(b) limit in any way any authority of the Ministry, a Director, or a Provincial Officer, including the authority to require certain steps be taken or to require the Permit Holder to furnish any further information related to this Permit.

### 2.3 Information

The receipt of any information by the Ministry, the failure of the Ministry to take any action or require any person to take any action in relation to the information, or the failure of a Provincial Officer to prosecute any person in relation to the information, shall not be construed as:

(a) an approval, waiver or justification by the Ministry of any act or omission of any person that contravenes this Permit or other legal requirement; or

(b) acceptance by the Ministry of the information's completeness or accuracy.

### 2.4 Rights of Action

The issuance of, and compliance with this Permit shall not be construed as precluding or limiting any legal claims or rights of action that any person, including the Crown in right of Ontario or any agency thereof, has or may have against the Permit Holder, its officers, employees, agents, and contractors.

### 2.5 Severability

The requirements of this Permit are severable. If any requirements of this Permit, or the application of any requirements of this Permit to any circumstance, is held invalid or unenforceable, the application of such requirements to other circumstances and the remainder of this Permit shall not be affected thereby.

### 2.6 Conflicts

Where there is a conflict between a provision of any submitted document referred to in this Permit, including its Schedules, and the conditions of this Permit, the conditions in this Permit shall take precedence.

## 3. **Water Takings Authorized by This Permit**

### 3.1 **Expiry**

This Permit expires on **November 15, 2026**. No water shall be taken under authority of this Permit after the expiry date.

### 3.2 Amounts of Taking Permitted

The Permit Holder shall only take water from the source, during the periods and at the rates and amounts of taking specified in Table A. Water takings are authorized only for the purposes specified in Table A.

**Table A**

	Source Name / Description:	Source: Type:	Taking Specific Purpose:	Taking Major Category:	Max. Taken per Minute (litres):	Max. Num. of Hrs Taken per Day:	Max. Taken per Day (litres):	Max. Num. of Days Taken per Year:	Zone/ Easting/ Northing:
1	TW3-80	Well Drilled	Bottled Water	Commercial	2,500	24	3,600,000	365	17 569053 4812797
						<b>Total Taking:</b>	3,600,000		

3.3 It is the responsibility of the Permit Holder to keep advised of any Low Water Advisory within the jurisdiction of the Grand River Conservation Authority. For the purpose of this condition, Low Water Advisory means a Level 1, Level 2, or Level 3 low water condition as defined by the Ministry of Northern Development, Mines, Natural Resources and Forestry (MNDMNRF) in their Low Water Response Program, as may be amended from time to time by the MNDMNRF.

When a Low Water Advisory exists within the Grand River Conservation Authority watershed, the Permit Holder shall undertake measures outlined in the Low Water Response Plan, as described in **Item 6 of Schedule A**.

**4. Monitoring**

4.1 Under section 9 of O. Reg. 387/04, and as authorized by subsection 34(6) of the *Ontario Water Resources Act*, the Permit Holder shall, on each day water is taken under the authorization of this Permit, record the date, the volume of water taken on that date and the rate at which it was taken. The daily volume of water taken shall be measured by a flow meter or calculated in accordance with the method described in the application for this Permit, or as otherwise accepted by the Director. The Permit Holder shall keep all records required by this condition current 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. The Permit Holder, unless otherwise required by the Director, shall submit, on or before March 31<sup>st</sup> in every year, the records required by this condition to the ministry's Water Taking Reporting System.

4.2 The Permit Holder shall establish the following groundwater monitoring program for the duration of the Permit:

**Bedrock Wells**

(i) Continuous monitoring of groundwater levels in the following bedrock and overburden monitoring wells:

Upper Bedrock

- MW2C-07
- MW4B-07



- MW-D
- PCC-D
- MW6B-08
- MW7B-08
- MW8B-08
- MW10B-09
- MW14B-11
- MW14C-11
- MW15B-12
- MW16B-12
- MW17B-12
- MW18B-12
- MW19-18-7
- MW20-19-7
- MW21-18-4
- Private well "Y" MOE WWR #67-09669 (continuous monitoring is subject to owner's concurrence)
- MW-I

Lower bedrock

- TW3-80 (67-07290)
- TW2-11
- MW2A-07
- MW2B-07
- MW4A-07
- MW6A-07
- MW7A-08
- MW8A-08
- MW10C-09
- MW-10D-09
- MW14A-11
- MW15A-12
- MW16A-12
- MW17A-12
- MW18A-12
- MW19-18-4
- MW20-19-5
- MW21-18-3
- PW5 (continuous monitoring is subject to owner's concurrence)

Overburden Wells

- TW1-93
- MW-S
- PCC-S
- PCC-I

- MW2D-07
- MW2E-07
- MW4C-07
- MW10A-09

4.3 The Permit Holder shall establish the following surface water monitoring program for the duration of the Permit:

**Surface Water Levels**

(i) Continuous monitoring of water levels at the following locations:

- SW1
- SW2

(ii) Monthly monitoring of water levels at the following locations:

- SW3
- SW4
- SW5

**Stream Flow**

(iii) Monthly monitoring of flow, encompassing a range of flow conditions, and the development of a stage-discharge curve at the following surface water locations:

- SW1
- SW2

**Multi-level Piezometers**

(iv) Continuous monitoring of multi-level piezometers at the following locations:

- MP16S/D-08
- MP6S-08/D -04
- MP12S/D-04
- MP14S/D-07
- MP8S/D-04
- MP1-16S/D
- MP17S/D-11
- MP18S/D-11

**Temperature**

(v) Continuous monitoring of temperature at the sediment-water interface at the following locations:

- ST6-08
- ST1-05/AT-01
- ST2-05
- ST3-05
- ST4-05
- ST5-05

- 4.4 The Permit Holder shall undertake wetland monitoring and redd surveys as recommended in "2010 Biological Monitoring Program Final Report" by C. Portt and Associates dated January 28, 2011. Results from the wetland and redd surveys shall be submitted to the Director as a part of the annual monitoring report required under Condition 4.7.
- 4.5 Continuous monitoring shall be datalogged at 60 minute intervals and downloaded quarterly, however, the daily minimum water levels can be used to evaluate the water level variation with respect to pumping to improve the data handling and presentation.

Where monthly monitoring data is datalogged, this data shall also be downloaded on a quarterly basis.

- 4.6 The Permit Holder shall identify to the Director in writing, within 15 days of any monthly monitoring event, any monitoring locations identified in Conditions 4.2 and 4.3 which become permanently inaccessible and/or abandoned along with a recommendation for replacement monitoring locations. This shall exclude wells that become temporarily inaccessible, i.e., due to frozen conditions. Upon approval of the Director the monitoring program shall be appropriately modified.
- 4.7 The Permit Holder shall submit to the Director, an annual monitoring report which present and interprets the monitoring data to be collected under the Terms and Conditions of this Permit. This report shall be prepared, signed and stamped by a licensed professional geoscientist or a licensed professional engineer specializing in hydrogeology who shall take responsibility for its accuracy. Surface water impact assessment shall be conducted by a qualified surface water scientist who shall co-sign the report as responsibility for the accuracy of the surface water portion. The report shall be submitted to the Director by March 31 of each calendar year and include monitoring data for the 12 month period ending December 31 of the previous year.
- 4.8 The Permit Holder shall submit to the Director as part of the annual monitoring report, details of the bottling operations involved with water taking under this Permit to Take Water to indicate compliance with OWRA Section 34.3. These details shall include:
- Location and name of the facilities to which water is delivered in bulk containers greater than 20 L from this source,
  - If the bulk water is containerized at the receiving location,
  - The size of container(s) into which the water is transferred at the receiving location, and
  - Total volume of the water transported in bulk in each calendar year to each remote facility.
- 4.9.1 Prior to December 31, 2021, the Permit Holder shall establish a publicly accessible internet Website, with no user, access or registration fees, and shall maintain the website for the duration of this permit. Following the establishment of the Website, the Permit Holder shall notify the Director in writing, of the Website URL address.
- 4.9.2 By December 31, 2021, the Permit Holder shall upload and make available for download the following information:

- all technical documentation submitted to support the Permit To Take Water application, items listed in Schedule A of this Permit;
- a plain language executive summary of the water taking activity; and,
- the well interference protocol.

4.9.3 By March 31 of each calendar year (until March 31, 2027) the Permit Holder shall upload and make available for download the following information to the Website:

- the monitoring report required by Condition 4.7 for the 12-month period ending December 31 of the previous year.
- The daily water taking records collected as required by Condition 4.1, uploaded in a suitable electronic format (e.g. Microsoft Excel) for the 12-month period ending December 31 of the previous year.

4.10 By September 30 of each calendar year (until September 30, 2027), the Permit Holder shall host an annual stakeholder meeting. The meeting will provide an opportunity for the Permit Holder to inform stakeholders of the Permit and the results of the annual monitoring report (for the 12-month period ending December 31 of the previous year), to receive submissions from stakeholders and the public, and to answer questions concerning the water taking.

The Permit Holder shall also directly notify the following stakeholders:

- The Director
- The City of Guelph
- The Grand River Conservation Authority
- Credit Valley Conservation Authority
- The Township of Puslinch
- The Six Nations of the Grand River
- The Mississaugas of the New Credit First Nation
- The Haudenosaunee Confederacy Chiefs Council (via the Haudenosaunee Development Institute)
- The Wellington Water Watchers
- Council of Canadians

The meeting may be held virtually and/or at suitable accessible and public venue within the County of Wellington.

A copy of the meeting invitations, agenda and minutes shall be submitted to the Director within 30 days of the meeting.

## **5. Impacts of the Water Taking**

### **5.1 Notification**

The Permit Holder shall immediately notify the local District Office of any complaint arising from the taking of water authorized under this Permit and shall report any action which has been taken or is proposed with regard to such complaint. The Permit Holder shall immediately notify the local District Office if the taking of water is observed to have any significant impact on the surrounding waters. After hours, calls shall be directed to the Ministry's Spills Action Centre at 1-800-268-6060.

### **5.2 For Groundwater Takings**

If the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of so doing, or shall reduce the rate and amount of taking to prevent or alleviate the observed negative impact. Pending permanent restoration of the affected supplies, the Permit Holder shall provide, to those affected, temporary water supplies adequate to meet their normal requirements, or shall compensate such persons for their reasonable costs of doing so.

If permanent interference is caused by the water taking, the Permit Holder shall restore the water supplies of those permanently affected.

## **6. Director May Amend Permit**

The Director may amend this Permit by letter requiring the Permit Holder to suspend or reduce the taking to an amount or threshold specified by the Director in the letter. The suspension or reduction in taking shall be effective immediately and may be revoked at any time upon notification by the Director. This condition does not affect your right to appeal the suspension or reduction in taking to the Environmental Review Tribunal under the *Ontario Water Resources Act*, Section 100 (4).

### **6.1 Subsection 4 (4) in the Water Taking and Transfer Regulation (Ontario Regulation 387/04) (“Regulation”) sets out priorities of water use that the Director will take into account as a last resort to avoid or resolve conflict among water users in the event of a shortage of water resources in an area. The four priority of use categories set out in subsection 4 (2) of the regulation, are as follows:**

- Priority 1 – Environment, drinking water, and Farm animal production;
- Priority 2 – Agricultural;
- Priority 3 – Industrial and commercial and other (including water bottling); and
- Priority 4 – Aesthetic

In the event of an urgent shortage of water resources in the Puslinch area, the Director may amend this Permit prioritize water takings in Priority categories 1 and 2.

The Director may also require the Permit Holder to investigate and resolve interferences that occur between existing water takings, working with the affected water users to identify potential solutions.

*The reasons for the imposition of these terms and conditions are as follows:*

1. Condition 1 is included to ensure that the conditions in this Permit are complied with and can be enforced.
2. Condition 2 is included to clarify the legal interpretation of aspects of this Permit.
3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.

*In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written notice served upon me, the Environmental Review Tribunal and the Minister of the Environment, Conservation and Parks, within 15 days after receipt of this Notice, require a hearing by the Tribunal. The Minister of the Environment, Conservation and Parks will place notice of your appeal on the Environmental Registry. Section 101 of the Ontario Water Resources Act, as amended provides that the Notice requiring a hearing shall state:*

1. The portions of the Permit or each term or condition in the Permit in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

*In addition to these legal requirements, the Notice should also include:*

- a. The name of the appellant;
- b. The address of the appellant;
- c. The Permit to Take Water number;
- d. The date of the Permit to Take Water;
- e. The name of the Director;
- f. The municipality within which the works are located;

*This notice must be served upon:*

*The Secretary  
Environmental Review Tribunal  
655 Bay Street, 15th Floor  
Toronto ON  
M5G 1E5  
Fax: (416) 326-5370  
Email:  
ERTTribunalsecretary@ontario.ca*

*AND*

*The Minister of the Environment,  
Conservation and Parks  
777 Bay Street, 5th Floor  
Toronto, Ontario  
M7J 2J3*

*AND*

*The Director, Section 34.1,  
Ministry of the Environment,  
Conservation and Parks  
Floor 1, 135 St Clair Ave W  
Toronto, ON  
M4V 1P5*

***Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal:***

by Telephone at

(416) 212-6349

Toll Free 1(866) 448-2248

by Fax at

(416) 326-5370

Toll Free 1(844) 213-3474

by e-mail at

www.ert.gov.on.ca

*This instrument is subject to Section 38 of the **Environmental Bill of Rights** that allows residents of Ontario to seek leave to appeal the decision on this instrument. Residents of Ontario may seek to appeal for 15 days from the date this decision is placed on the Environmental Registry. By accessing the Environmental Registry, you can determine when the leave to appeal period ends.*

This Permit cancels and replaces Permit Number 1381-95ATPY, issued on 2013/12/19.

Dated at Toronto this 15th day of November, 2021.

A handwritten signature in blue ink, appearing to read 'G. Meek', written in a cursive style.

Gregory Meek  
Director, Section 34.1  
*Ontario Water Resources Act* , R.S.O. 1990



## Schedule A

This Schedule "A" forms part of Permit To Take Water 3133-C5BUH9, dated November 15, 2021.

1. Report titled "Nestle Waters Canada – Aberfoyle, Technical Study for Permit to Take Water Renewal Application", signed by Greg Padusenko, M.Sc., P.Eng., P.Geo. and John Piesol, M.Sc., P.Eng. of Golder Associates Ltd., Christopher J. Neville, M.Sc., P.Eng. of S.S. Papadopulos & Associates, Inc. and Ken Ursic, M.Sc. of Beacon Environmental, dated June 2019.
2. Report titled "Nestle Waters of Canada Aberfoyle Site, 2020 Annual Monitoring Report", signed by Greg Padusenko, M.Sc. P.Eng., P.Geo, and Kevin MacKenzie, P.Eng. and John Piersol, M.Sc. P.Geo. of Golder Associates Limited, dated March 2021.
3. Memo titled "Nestle Waters Canada Aberfoyle 2016 Annual Monitoring Report", prepared by Sarah Day, Surface Water Specialist, Technical Support Section, West Central Region, Ministry of the Environment and Climate Change, dated September 18, 2017.
4. Report titled "Examination of the Temperature Suitability of Aberfoyle Creek for Resident Fish: 2006 to 2020:", signed by Cam Portt and Jim Reid of C. Portt & Associates, dated February 2021.
5. Report titled "2020 Biological Monitoring Program, Nestle Waters Canada, Aberfoyle Property", signed by Anna Cunningham, B. Sc, and Ken Ursic, M. Sc. of Beacon Environmental Limited, dated February 2021. Project No. 216114.
6. Technical Memorandum "Low Water Response Plan For Aberfoyle TW3-80" prepared by Greg Padusenko and John Piersol of Golder Associates Ltd., dated October 19, 2021, Project No. 20449101 (1000).

**APPENDIX B**

**TW3-80 Borehole Log**

Attachment 2

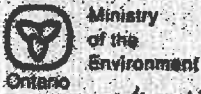
Project Name: ABERFOYLE FISHERIES  
 Job No. 979-653  
 Client: CUSTOM AGGREGATE  
 Borehole Type: 12" Ø Cable Tool  
 Location: Pit No. 1, Aberfoyle

Borehole No. TW3-80  
 Date Completed April 14/80  
 Geologist/Engineer A.V.N.  
 Elevation 1040.90, top of casing

Depth (Elev.)	Stratigraphy	Profile		Penetration Test Blows/Foot	Piezometer or Standpipe Installation
		Description & Remarks	Sample Number Type Blows/Foot		
				20 40 60 80	
0		(316.7 m amsl)			
(1039)		Brown clayey-silt till containing some sand and small gravel			12" Ø steel casing to rock grouted to 20' from surface
40		(304.5 m amsl)			
45		fine - medium sand (303.0 m amsl)			
48		fine sand matrix w/sand and gravel (302.1 m amsl)			
80		Eramosa member of the Guelph formation * Black dolomite slightly crystalline solid			12" Ø Drive shoe seated into rock
(959)		(292.3 m amsl)			
		Saw Warton formation of the Amabel Group light - medium grey dolomite slightly crystalline fractured water bearing zone			12" Ø Open hole in rock
139		(274.3 m amsl)			
(900)		N.B. Static level, 11.42 ft. below top of casing on April 15/80 ELEV. = 1029.48			

FIGURE 2.3

\* Based on driller's log, Guelph Fm. interpreted to occur from El. 302.1 to 299.9 m amsl.  
 Eramosa from 299.9 to 292.3 m amsl.



*TW #5/18*

The Ontario Water Resources Act  
**WATER WELL RECORD**

*NOE # 67-07290*

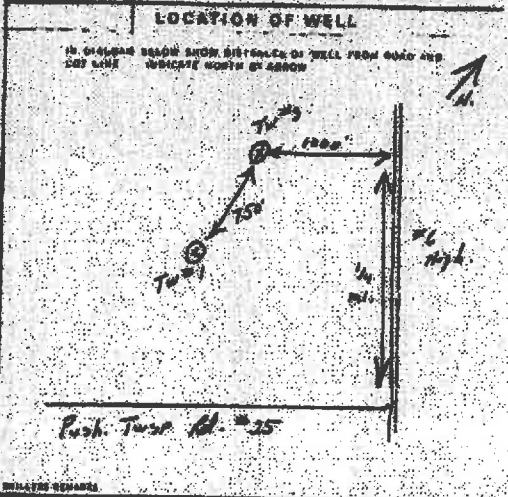
City or Town: <b>Wellington</b>	County: <b>Fuelton</b>	Well Name: <b>Con 7</b>	Lot: <b>31.2</b>
Owner: <b>Lillett, Mr. John</b>	Address: <b>R.R. #3, Guelph, Ontario</b>	Drill Date: <b>11</b>	Drill Month: <b>Apr</b>

LOG OF OVERBURDEN AND BEDROCK MATERIALS - SEE INSTRUCTIONS					
GENERAL COLOUR	SOFT	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH FEET	
				FROM	TO
Brown	Clay	Stones		0	20
Brown	sand	Gravels		20	47
M. Br.		Rock		47	55
D. Br.		Rock		55	75
Black		Rock		75	85
M. Br.		Rock		85	95
Gray & Br.		Rock		95	135
D. Gray		Rock		135	139
<b>Total Depth</b>					<b>139</b>

**12" shoe**

<b>WATER RECORD</b> Depth of water: 55 93 130	<b>CASING &amp; OPEN HOLE RECORD</b> 12" casing 12" open hole 48 - 139	<b>PLUGGING &amp; SEALING RECORD</b> 102 118 139
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<b>FINAL STATUS OF WELL</b> <input type="checkbox"/> open well <input type="checkbox"/> abandoned well <input type="checkbox"/> plugged well	<b>WATER USE</b> <input type="checkbox"/> domestic <input type="checkbox"/> irrigation <input type="checkbox"/> industrial <input type="checkbox"/> other	<b>METHOD OF DRILLING</b> <input type="checkbox"/> auger <input type="checkbox"/> rotary <input type="checkbox"/> other
---	---	--



<b>CONTRACTOR'S COPY</b> Contractor: <b>Graham Well Drilling Ltd.</b> Address: <b>Guelph, Ont.</b> Name: <b>J. Hawkins 22w</b> Date: <b>30 Apr 00</b>	<b>OFFICE USE ONLY</b>
---	------------------------

**CONTRACTOR'S COPY**

**APPENDIX C**

**TW3-80 Water Taking**

**TABLE C1**  
**TW3-80 DAILY WATER TAKING**  
**BLUE TRITON BRANDS**  
**ABERFOYLE, ONTARIO**

<b>Date</b>	<b>Volume</b> (US gpd)	<b>Average Flow</b> <b>Rate Over</b> <b>Time Taken</b> (US gpm)	<b>Volume</b> (L/day)	<b>Average Flow</b> <b>Rate Over</b> <b>Time Taken</b> (L/min)
01-Jan-21	57,178.00	41	216,442	155.2
02-Jan-21	319,118.00	223	1,207,993	844.1
03-Jan-21	359,342.00	249	1,360,257	942.6
04-Jan-21	388,845.00	271	1,471,938	1025.8
05-Jan-21	594,920.00	415	2,252,016	1570.9
06-Jan-21	539,820.00	375	2,043,440	1419.5
07-Jan-21	601,292.00	417	2,276,137	1578.5
08-Jan-21	534,686.00	373	2,024,006	1412.0
09-Jan-21	480,099.00	332	1,817,372	1256.8
10-Jan-21	370,917.00	258	1,404,073	976.6
11-Jan-21	337,192.00	233	1,276,410	882.0
12-Jan-21	305,877.00	214	1,157,870	810.1
13-Jan-21	452,764.28	315	1,713,898	1192.8
14-Jan-21	436,220.00	302	1,651,272	1143.0
15-Jan-21	514,052.38	355	1,945,899	1345.2
16-Jan-21	485,795.94	337	1,838,937	1275.0
17-Jan-21	314,040.88	217	1,188,774	822.9
18-Jan-21	267,250.22	186	1,011,652	702.2
19-Jan-21	336,394.38	233	1,273,391	882.6
20-Jan-21	362,584.44	253	1,372,531	956.0
21-Jan-21	478,476.78	332	1,811,231	1257.3
22-Jan-21	569,490.19	395	2,155,754	1494.7
23-Jan-21	576,079.63	400	2,180,698	1514.8
24-Jan-21	554,915.75	381	2,100,584	1443.1
25-Jan-21	306,023.56	212	1,158,425	802.8
26-Jan-21	337,536.78	235	1,277,715	890.6
27-Jan-21	299,612.91	208	1,134,158	787.3
28-Jan-21	348,339.59	243	1,318,608	919.4
29-Jan-21	343,909.78	239	1,301,840	904.1
30-Jan-21	433,104.22	299	1,639,477	1131.9
31-Jan-21	406,896.38	281	1,540,270	1065.4

**TABLE C1**  
**TW3-80 DAILY WATER TAKING**  
**BLUE TRITON BRANDS**  
**ABERFOYLE, ONTARIO**

<b>Date</b>	<b>Volume</b> (US gpd)	<b>Average Flow</b> <b>Rate Over</b> <b>Time Taken</b> (US gpm)	<b>Volume</b> (L/day)	<b>Average Flow</b> <b>Rate Over</b> <b>Time Taken</b> (L/min)
01-Feb-21	410,585.56	280	1,554,235	1058.7
02-Feb-21	342,177.31	237	1,295,281	897.0
03-Feb-21	350,656.50	243	1,327,379	921.7
04-Feb-21	487,180.28	336	1,844,177	1271.9
05-Feb-21	408,190.91	282	1,545,170	1066.2
06-Feb-21	295,290.31	204	1,117,795	773.7
07-Feb-21	332,637.81	230	1,259,171	872.3
08-Feb-21	438,729.16	302	1,660,770	1144.9
09-Feb-21	344,199	239	1,302,936	903.6
10-Feb-21	406,485	275	1,538,714	1039.3
11-Feb-21	409,571	285	1,550,395	1079.7
12-Feb-21	389,297	269	1,473,649	1017.3
13-Feb-21	384,329	259	1,454,842	979.8
14-Feb-21	29,616	22	112,109	82.4
15-Feb-21	55,354	37	209,539	140.8
16-Feb-21	419,696	291	1,588,720	1100.0
17-Feb-21	440,971	305	1,669,257	1154.8
18-Feb-21	257,406	178	974,389	674.2
19-Feb-21	295,525	204	1,118,683	773.1
20-Feb-21	353,894	246	1,339,635	931.7
21-Feb-21	292,831	201	1,108,487	760.0
22-Feb-21	242,074	167	916,351	634.0
23-Feb-21	289,013	201	1,094,033	759.0
24-Feb-21	289,957	201	1,097,604	761.3
25-Feb-21	381,947	265	1,445,826	1005.0
26-Feb-21	406,353	280	1,538,214	1059.1
27-Feb-21	437,488	303	1,656,072	1145.2
28-Feb-21	410,966	283	1,555,676	1071.7

**TABLE C1  
TW3-80 DAILY WATER TAKING  
BLUE TRITON BRANDS  
ABERFOYLE, ONTARIO**

<b>Date</b>	<b>Volume (US gpd)</b>	<b>Average Flow Rate Over Time Taken (US gpm)</b>	<b>Volume (L/day)</b>	<b>Average Flow Rate Over Time Taken (L/min)</b>
01-Mar-21	241,244	167	913,207	632.3
02-Mar-21	360,011	249	1,362,789	944.3
03-Mar-21	333,668	231	1,263,069	875.9
04-Mar-21	385,535	262	1,459,407	990.9
05-Mar-21	413,699	287	1,566,019	1087.1
06-Mar-21	383,221	259	1,450,648	980.2
07-Mar-21	444,370	307	1,682,122	1163.8
08-Mar-21	400,290	274	1,515,261	1037.2
09-Mar-21	294,974	203	1,116,597	769.0
10-Mar-21	345,498	239	1,307,851	903.7
11-Mar-21	412,958	283	1,563,216	1071.6
12-Mar-21	419,623	289	1,588,445	1094.6
13-Mar-21	278,823	200	1,055,459	757.0
14-Mar-21	160,154	112	606,248	423.7
15-Mar-21	224,986	152	851,663	577.0
16-Mar-21	249,264	172	943,566	650.7
17-Mar-21	282,885	193	1,070,837	729.2
18-Mar-21	412,151	285	1,560,161	1079.7
19-Mar-21	464,921	312	1,759,918	1179.7
20-Mar-21	445,988	310	1,688,247	1172.3
21-Mar-21	454,497	301	1,720,458	1141.1
22-Mar-21	364,635	254	1,380,293	960.3
23-Mar-21	338,412	231	1,281,026	876.3
24-Mar-21	68,527	48	259,404	182.4
25-Mar-21	48,929	35	185,215	133.3
26-Mar-21	445,467	309	1,686,276	1170.5
27-Mar-21	468,951	325	1,775,173	1231.3
28-Mar-21	484,863	337	1,835,404	1274.6
29-Mar-21	468,816	324	1,774,661	1226.9
30-Mar-21	310,391	214	1,174,955	810.5
31-Mar-21	274,823	190	1,040,317	721.0



**TABLE C1  
TW3-80 DAILY WATER TAKING  
BLUE TRITON BRANDS  
ABERFOYLE, ONTARIO**

<b>Date</b>	<b>Volume (US gpd)</b>	<b>Average Flow Rate Over Time Taken (US gpm)</b>	<b>Volume (L/day)</b>	<b>Average Flow Rate Over Time Taken (L/min)</b>
01-Apr-21	339,719	236	1,285,976	893.1
02-Apr-21	66,416	47	251,412	176.8
03-Apr-21	384,009	266	1,453,632	1006.8
04-Apr-21	391,822	270	1,483,208	1020.8
05-Apr-21	455,651	316	1,724,825	1196.4
06-Apr-21	406,761	279	1,539,757	1055.4
07-Apr-21	279,694	194	1,058,757	734.9
08-Apr-21	271,024	183	1,025,936	693.0
09-Apr-21	264,395	184	1,000,844	695.4
10-Apr-21	278,356	190	1,053,690	718.2
11-Apr-21	292,111	203	1,105,760	769.0
12-Apr-21	336,564	232	1,274,032	877.6
13-Apr-21	409,816	284	1,551,323	1075.1
14-Apr-21	405,367	278	1,534,480	1052.2
15-Apr-21	389,364	266	1,473,903	1007.3
16-Apr-21	315,861	218	1,195,664	824.5
17-Apr-21	354,627	244	1,342,409	922.9
18-Apr-21	451,006	312	1,707,244	1179.8
19-Apr-21	472,236	329	1,787,605	1244.4
20-Apr-21	516,833	357	1,956,426	1349.6
21-Apr-21	564,847	382	2,138,177	1447.6
22-Apr-21	542,368	376	2,053,086	1423.7
23-Apr-21	384,797	266	1,456,613	1008.6
24-Apr-21	355,435	246	1,345,469	930.7
25-Apr-21	397,320	276	1,504,019	1044.4
26-Apr-21	308,159	209	1,166,508	792.3
27-Apr-21	450,469	304	1,705,208	1152.1
28-Apr-21	546,263	379	2,067,828	1433.6
29-Apr-21	439,803	305	1,664,835	1156.2
30-Apr-21	484,717	336	1,834,852	1272.5

**TABLE C1  
TW3-80 DAILY WATER TAKING  
BLUE TRITON BRANDS  
ABERFOYLE, ONTARIO**

<b>Date</b>	<b>Volume (US gpd)</b>	<b>Average Flow Rate Over Time Taken (US gpm)</b>	<b>Volume (L/day)</b>	<b>Average Flow Rate Over Time Taken (L/min)</b>
01-May-21	537,326	369	2,033,997	1397.6
02-May-21	556,829	384	2,107,825	1452.8
03-May-21	519,475	361	1,966,427	1364.7
04-May-21	450,426	314	1,705,049	1188.0
05-May-21	597,092	415	2,260,236	1569.1
06-May-21	615,304	426	2,329,180	1612.2
07-May-21	522,954	363	1,979,595	1374.2
08-May-21	571,018	397	2,161,539	1503.2
09-May-21	519,895	360	1,968,017	1363.1
10-May-21	406,225	278	1,537,729	1052.8
11-May-21	452,016	288	1,711,067	1091.5
12-May-21	441,147	306	1,669,923	1159.1
13-May-21	473,416	329	1,792,072	1245.2
14-May-21	561,268	388	2,124,628	1469.5
15-May-21	604,087	420	2,286,719	1590.6
16-May-21	582,567	403	2,205,255	1526.1
17-May-21	420,906	291	1,593,303	1102.0
18-May-21	317,740	219	1,202,775	829.3
19-May-21	403,045	280	1,525,691	1059.9
20-May-21	447,856	311	1,695,320	1177.5
21-May-21	557,490	388	2,110,330	1468.8
22-May-21	624,459	433	2,363,834	1638.9
23-May-21	600,414	417	2,272,813	1579.6
24-May-21	90,804	65	343,729	244.9
25-May-21	418,947	292	1,585,886	1105.3
26-May-21	475,328	330	1,799,312	1250.2
27-May-21	388,221	270	1,469,577	1022.0
28-May-21	455,300	316	1,723,497	1194.7
29-May-21	537,921	374	2,036,251	1415.3
30-May-21	640,856	444	2,425,902	1681.7
31-May-21	543,112	377	2,055,900	1426.8

**TABLE C1  
TW3-80 DAILY WATER TAKING  
BLUE TRITON BRANDS  
ABERFOYLE, ONTARIO**

<b>Date</b>	<b>Volume (US gpd)</b>	<b>Average Flow Rate Over Time Taken (US gpm)</b>	<b>Volume (L/day)</b>	<b>Average Flow Rate Over Time Taken (L/min)</b>
01-Jun-21	547,567	380	2,072,765	1440.3
02-Jun-21	438,709	305	1,660,692	1153.1
03-Jun-21	367,625	255	1,391,612	965.8
04-Jun-21	275,832	192	1,044,136	726.3
05-Jun-21	389,027	270	1,472,625	1022.3
06-Jun-21	529,833	368	2,005,636	1393.7
07-Jun-21	576,913	396	2,183,852	1497.6
08-Jun-21	538,987	374	2,040,287	1415.6
09-Jun-21	518,240	360	1,961,751	1363.9
10-Jun-21	427,879	296	1,619,698	1121.4
11-Jun-21	412,705	288	1,562,257	1088.8
12-Jun-21	463,876	323	1,755,960	1221.0
13-Jun-21	459,408	319	1,739,048	1208.1
14-Jun-21	551,627	384	2,088,133	1454.3
15-Jun-21	546,291	380	2,067,935	1437.6
16-Jun-21	606,696	422	2,296,592	1597.5
17-Jun-21	575,490	399	2,178,466	1511.1
18-Jun-21	474,200	320	1,795,042	1212.5
19-Jun-21	548,921	381	2,077,890	1444.0
20-Jun-21	540,954	376	2,047,734	1422.3
21-Jun-21	477,582	332	1,807,845	1256.1
22-Jun-21	579,959	402	2,195,382	1522.1
23-Jun-21	668,501	461	2,530,551	1744.9
24-Jun-21	600,208	418	2,272,035	1583.5
25-Jun-21	577,416	401	2,185,755	1517.9
26-Jun-21	478,576	332	1,811,605	1258.5
27-Jun-21	530,254	369	2,007,229	1397.6
28-Jun-21	462,623	322	1,751,216	1218.5
29-Jun-21	250,422	175	947,950	662.7
30-Jun-21	419,867	292	1,589,370	1105.4

**TABLE C1  
TW3-80 DAILY WATER TAKING  
BLUE TRITON BRANDS  
ABERFOYLE, ONTARIO**

<b>Date</b>	<b>Volume (US gpd)</b>	<b>Average Flow Rate Over Time Taken (US gpm)</b>	<b>Volume (L/day)</b>	<b>Average Flow Rate Over Time Taken (L/min)</b>
01-Jul-21	505,760	352	1,914,510	1332.7
02-Jul-21	614,541	425	2,326,289	1610.3
03-Jul-21	576,957	400	2,184,017	1513.9
04-Jul-21	561,861	391	2,126,873	1481.5
05-Jul-21	427,773	297	1,619,297	1124.7
06-Jul-21	341,674	239	1,293,376	903.9
07-Jul-21	439,547	306	1,663,867	1159.1
08-Jul-21	353,159	246	1,336,853	929.7
09-Jul-21	503,091	350	1,904,406	1323.4
10-Jul-21	592,906	412	2,244,394	1560.0
11-Jul-21	539,750	374	2,043,177	1414.2
12-Jul-21	453,513	315	1,716,733	1192.4
13-Jul-21	504,860	351	1,911,101	1327.0
14-Jul-21	498,776	347	1,888,073	1314.3
15-Jul-21	544,657	377	2,061,749	1426.0
16-Jul-21	550,987	383	2,085,712	1449.8
17-Jul-21	597,365	415	2,261,270	1571.4
18-Jul-21	587,907	409	2,225,470	1547.3
19-Jul-21	543,328	378	2,056,718	1430.1
20-Jul-21	486,355	339	1,841,053	1282.4
21-Jul-21	496,917	346	1,881,034	1308.1
22-Jul-21	602,098	419	2,279,187	1584.5
23-Jul-21	522,892	363	1,979,361	1375.0
24-Jul-21	605,169	421	2,290,814	1594.8
25-Jul-21	602,986	419	2,282,547	1584.3
26-Jul-21	594,867	244	2,251,815	924.3
27-Jul-21	580,004	403	2,195,552	1525.7
28-Jul-21	511,760	356	1,937,220	1347.5
29-Jul-21	501,824	349	1,899,609	1321.0
30-Jul-21	557,783	388	2,111,436	1468.0
31-Jul-21	581,056	403	2,199,535	1527.2

**TABLE C1**  
**TW3-80 DAILY WATER TAKING**  
**BLUE TRITON BRANDS**  
**ABERFOYLE, ONTARIO**

<b>Date</b>	<b>Volume</b> (US gpd)	<b>Average Flow</b> <b>Rate Over</b> <b>Time Taken</b> (US gpm)	<b>Volume</b> (L/day)	<b>Average Flow</b> <b>Rate Over</b> <b>Time Taken</b> (L/min)
01-Aug-21	550,455	382	2,083,696	1444.6
02-Aug-21	503,554	350	1,906,158	1326.7
03-Aug-21	512,990	357	1,941,876	1351.4
04-Aug-21	538,710	373	2,039,238	1411.6
05-Aug-21	504,631	351	1,910,234	1329.3
06-Aug-21	532,133	369	2,014,341	1398.2
07-Aug-21	520,908	363	1,971,851	1374.4
08-Aug-21	535,621	372	2,027,544	1408.7
09-Aug-21	437,478	304	1,656,034	1151.5
10-Aug-21	561,894	391	2,126,999	1479.6
11-Aug-21	523,395	364	1,981,264	1377.6
12-Aug-21	514,788	358	1,948,684	1355.7
13-Aug-21	531,258	369	2,011,031	1395.9
14-Aug-21	580,199	403	2,196,291	1525.5
15-Aug-21	540,717	376	2,046,835	1422.3
16-Aug-21	521,666	362	1,974,719	1370.5
17-Aug-21	576,853	401	2,183,624	1517.0
18-Aug-21	559,866	389	2,119,323	1472.6
19-Aug-21	473,934	327	1,794,034	1237.3
20-Aug-21	569,636	396	2,156,305	1499.5
21-Aug-21	570,858	398	2,160,932	1505.6
22-Aug-21	568,210	396	2,150,908	1497.2
23-Aug-21	533,757	372	2,020,490	1406.5
24-Aug-21	480,528	333	1,818,994	1261.6
25-Aug-21	535,093	373	2,025,546	1411.0
26-Aug-21	547,267	380	2,071,630	1436.9
27-Aug-21	557,723	388	2,111,209	1467.4
28-Aug-21	506,659	352	1,917,912	1333.6
29-Aug-21	504,413	350	1,909,411	1326.1
30-Aug-21	543,259	377	2,056,459	1427.2
31-Aug-21	351,994	243	1,332,443	918.7

**TABLE C1  
TW3-80 DAILY WATER TAKING  
BLUE TRITON BRANDS  
ABERFOYLE, ONTARIO**

<b>Date</b>	<b>Volume (US gpd)</b>	<b>Average Flow Rate Over Time Taken (US gpm)</b>	<b>Volume (L/day)</b>	<b>Average Flow Rate Over Time Taken (L/min)</b>
01-Sep-21	424,585	296	1,607,228	1120.2
02-Sep-21	463,255	323	1,753,608	1221.3
03-Sep-21	487,397	339	1,844,997	1282.6
04-Sep-21	504,665	350	1,910,366	1325.8
05-Sep-21	493,932	342	1,869,737	1296.0
06-Sep-21	493,911	343	1,869,656	1297.5
07-Sep-21	509,890	354	1,930,143	1338.2
08-Sep-21	504,948	351	1,911,436	1329.1
09-Sep-21	487,974	338	1,847,181	1279.2
10-Sep-21	402,702	280	1,524,393	1060.2
11-Sep-21	397,529	271	1,504,811	1026.0
12-Sep-21	376,589	261	1,425,543	987.7
13-Sep-21	524,411	364	1,985,112	1379.1
14-Sep-21	398,295	276	1,507,709	1045.2
15-Sep-21	560,067	389	2,120,082	1473.3
16-Sep-21	448,499	311	1,697,752	1175.6
17-Sep-21	519,504	360	1,966,536	1363.4
18-Sep-21	524,331	363	1,984,807	1372.8
19-Sep-21	511,662	356	1,936,849	1348.2
20-Sep-21	423,006	294	1,601,251	1114.5
21-Sep-21	455,105	316	1,722,758	1197.5
22-Sep-21	472,383	328	1,788,162	1240.8
23-Sep-21	404,002	279	1,529,313	1055.0
24-Sep-21	453,261	316	1,715,780	1195.3
25-Sep-21	426,092	296	1,612,932	1121.9
26-Sep-21	508,111	355	1,923,409	1342.4
27-Sep-21	463,798	321	1,755,665	1216.7
28-Sep-21	494,755	344	1,872,849	1301.0
29-Sep-21	473,333	330	1,791,761	1248.0
30-Sep-21	444,901	309	1,684,132	1169.3

**TABLE C1**  
**TW3-80 DAILY WATER TAKING**  
**BLUE TRITON BRANDS**  
**ABERFOYLE, ONTARIO**

<b>Date</b>	<b>Volume</b> (US gpd)	<b>Average Flow</b> <b>Rate Over</b> <b>Time Taken</b> (US gpm)	<b>Volume</b> (L/day)	<b>Average Flow</b> <b>Rate Over</b> <b>Time Taken</b> (L/min)
01-Oct-21	453,282	316	1,715,859	1194.5
02-Oct-21	408,598	279	1,546,713	1055.3
03-Oct-21	155,895	109	590,125	412.8
04-Oct-21	426,579	296	1,614,777	1121.6
05-Oct-21	429,289	290	1,625,036	1096.8
06-Oct-21	423,113	293	1,601,656	1109.5
07-Oct-21	458,259	316	1,734,698	1196.0
08-Oct-21	451,873	314	1,710,523	1189.9
09-Oct-21	386,827	269	1,464,297	1017.8
10-Oct-21	404,572	280	1,531,469	1061.8
11-Oct-21	22,245	16	84,208	61.2
12-Oct-21	380,988	265	1,442,197	1004.3
13-Oct-21	424,728	295	1,607,769	1115.1
14-Oct-21	413,362	288	1,564,743	1088.9
15-Oct-21	412,656	287	1,562,072	1084.8
16-Oct-21	486,325	338	1,840,940	1279.8
17-Oct-21	430,531	299	1,629,735	1131.6
18-Oct-21	383,927	266	1,453,320	1006.3
19-Oct-21	345,942	240	1,309,532	908.6
20-Oct-21	432,519	301	1,637,263	1140.8
21-Oct-21	588,123	411	2,226,285	1555.5
22-Oct-21	450,206	313	1,704,214	1184.0
23-Oct-21	455,769	317	1,725,274	1199.3
24-Oct-21	433,472	301	1,640,867	1137.6
25-Oct-21	499,999	347	1,892,700	1312.8
26-Oct-21	470,558	326	1,781,253	1233.6
27-Oct-21	538,280	376	2,037,611	1422.2
28-Oct-21	473,561	327	1,792,621	1237.9
29-Oct-21	351,055	244	1,328,888	923.1
30-Oct-21	357,620	248	1,353,738	940.0
31-Oct-21	420,534	292	1,591,894	1104.5

**TABLE C1**  
**TW3-80 DAILY WATER TAKING**  
**BLUE TRITON BRANDS**  
**ABERFOYLE, ONTARIO**

<b>Date</b>	<b>Volume</b> (US gpd)	<b>Average Flow</b> <b>Rate Over</b> <b>Time Taken</b> (US gpm)	<b>Volume</b> (L/day)	<b>Average Flow</b> <b>Rate Over</b> <b>Time Taken</b> (L/min)
01-Nov-21	506,337	352	1,916,694	1332.5
02-Nov-21	445,560	309	1,686,626	1169.6
03-Nov-21	530,314	369	2,007,455	1397.3
04-Nov-21	490,998	341	1,858,627	1289.6
05-Nov-21	642,038	445	2,430,376	1684.5
06-Nov-21	585,179	394	2,215,142	1491.8
07-Nov-21	598,387	411	2,265,139	1554.9
08-Nov-21	511,152	353	1,934,918	1337.0
09-Nov-21	423,273	294	1,602,261	1114.3
10-Nov-21	435,778	302	1,649,598	1142.5
11-Nov-21	452,213	313	1,711,813	1183.3
12-Nov-21	531,992	370	2,013,809	1401.9
13-Nov-21	522,460	361	1,977,725	1367.8
14-Nov-21	577,965	401	2,187,833	1519.6
15-Nov-21	32,073	22	121,410	84.7
16-Nov-21	0	1	0	3.7
17-Nov-21	69,556	49	263,298	183.7
18-Nov-21	267,939	188	1,014,258	710.0
19-Nov-21	357,867	247	1,354,673	935.3
20-Nov-21	392,241	273	1,484,795	1033.0
21-Nov-21	382,286	267	1,447,108	1010.1
22-Nov-21	395,304	276	1,496,386	1043.2
23-Nov-21	410,296	285	1,553,140	1079.9
24-Nov-21	414,503	288	1,569,062	1091.2
25-Nov-21	391,558	271	1,482,207	1025.2
26-Nov-21	482,452	336	1,826,280	1271.4
27-Nov-21	323,093	225	1,223,038	852.2
28-Nov-21	332,924	231	1,260,253	873.5
29-Nov-21	381,120	265	1,442,697	1002.6
30-Nov-21	513,727	357	1,944,667	1350.1



**TABLE C1**  
**TW3-80 DAILY WATER TAKING**  
**BLUE TRITON BRANDS**  
**ABERFOYLE, ONTARIO**

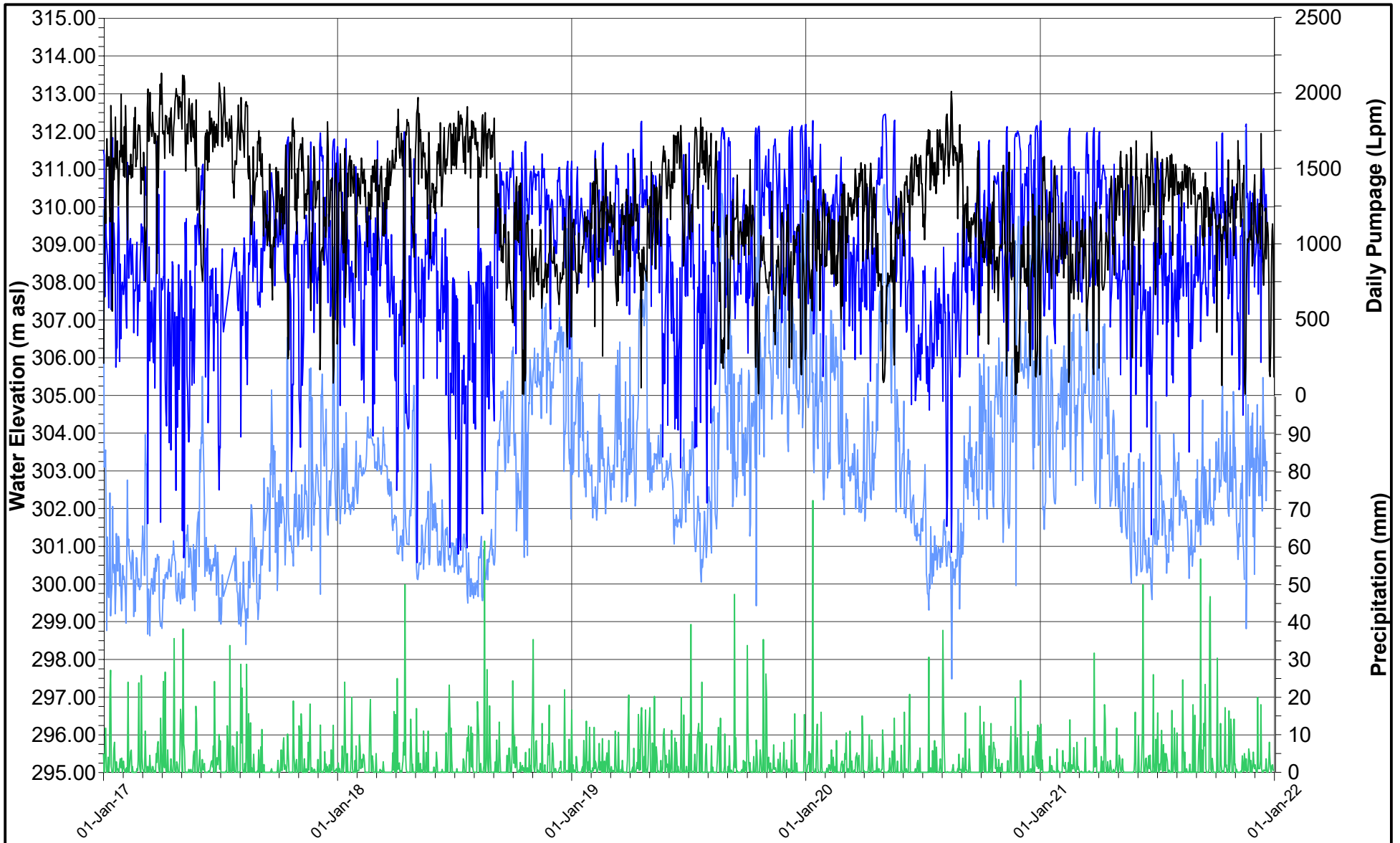
<b>Date</b>	<b>Volume</b> (US gpd)	<b>Average Flow</b> <b>Rate Over</b> <b>Time Taken</b> (US gpm)	<b>Volume</b> (L/day)	<b>Average Flow</b> <b>Rate Over</b> <b>Time Taken</b> (L/min)
01-Dec-21	554,920	385	2,100,600	1457.4
02-Dec-21	437,557	304	1,656,331	1149.9
03-Dec-21	406,775	283	1,539,812	1072.0
04-Dec-21	402,160	280	1,522,342	1060.6
05-Dec-21	396,524	275	1,501,006	1042.9
06-Dec-21	380,756	265	1,441,318	1003.7
07-Dec-21	419,353	291	1,587,422	1101.4
08-Dec-21	482,144	335	1,825,112	1267.2
09-Dec-21	412,847	286	1,562,797	1084.5
10-Dec-21	367,506	255	1,391,159	967.1
11-Dec-21	527,828	457	1,998,045	1731.6
12-Dec-21	485,108	329	1,836,333	1245.5
13-Dec-21	477,058	332	1,805,859	1256.1
14-Dec-21	314,751	219	1,191,463	828.4
15-Dec-21	275,579	192	1,043,181	725.1
16-Dec-21	346,080	241	1,310,055	912.7
17-Dec-21	382,165	266	1,446,652	1007.4
18-Dec-21	469,750	327	1,778,197	1236.6
19-Dec-21	341,062	238	1,291,059	899.2
20-Dec-21	405,064	280	1,533,332	1059.9
21-Dec-21	432,141	302	1,635,831	1142.0
22-Dec-21	400,395	278	1,515,658	1053.5
23-Dec-21	280,922	196	1,063,403	740.4
24-Dec-21	58,639	42	221,971	157.6
25-Dec-21	44,226	32	167,414	120.6
26-Dec-21	126,605	89	479,250	335.4
27-Dec-21	317,195	220	1,200,715	832.3
28-Dec-21	411,540	287	1,557,848	1086.3
29-Dec-21	431,712	299	1,634,207	1132.9
30-Dec-21	365,664	254	1,384,190	961.0
31-Dec-21	43,236	31	163,665	117.3

Notes:

1. All volumes measured with a flow meter and recorded on a datalogger.

**APPENDIX D**

# Groundwater Level Monitoring



- Precipitation (mm)
- Daily Pumpage (Lpm)
- TW3-80 Daily Max
- TW3-80 Daily Min

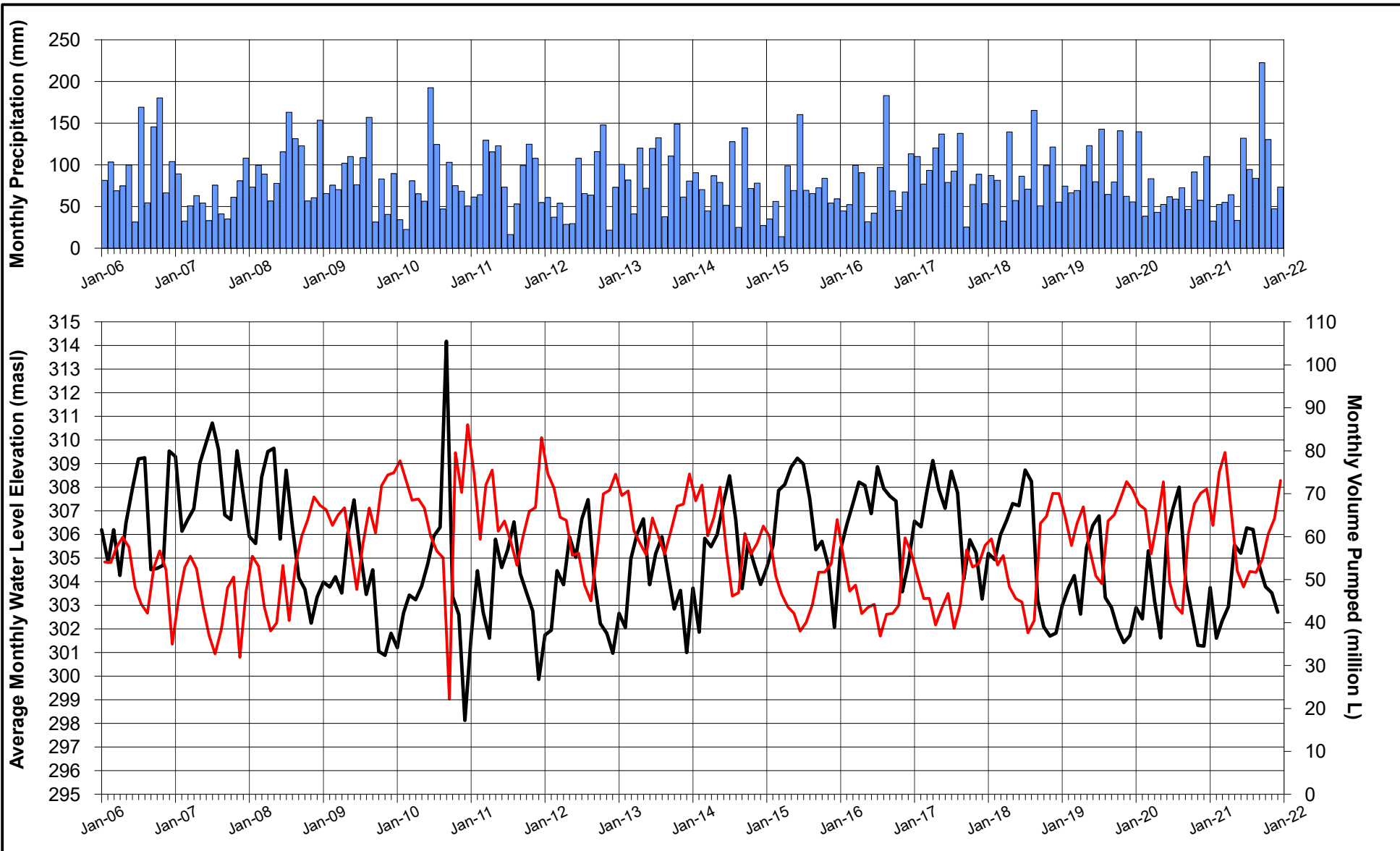


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**HYDROGRAPH FOR TW3-80**  
**2021 ANNUAL MONITORING REPORT**

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> D1a
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— Volume Pumped (L)  
 — TW3-80

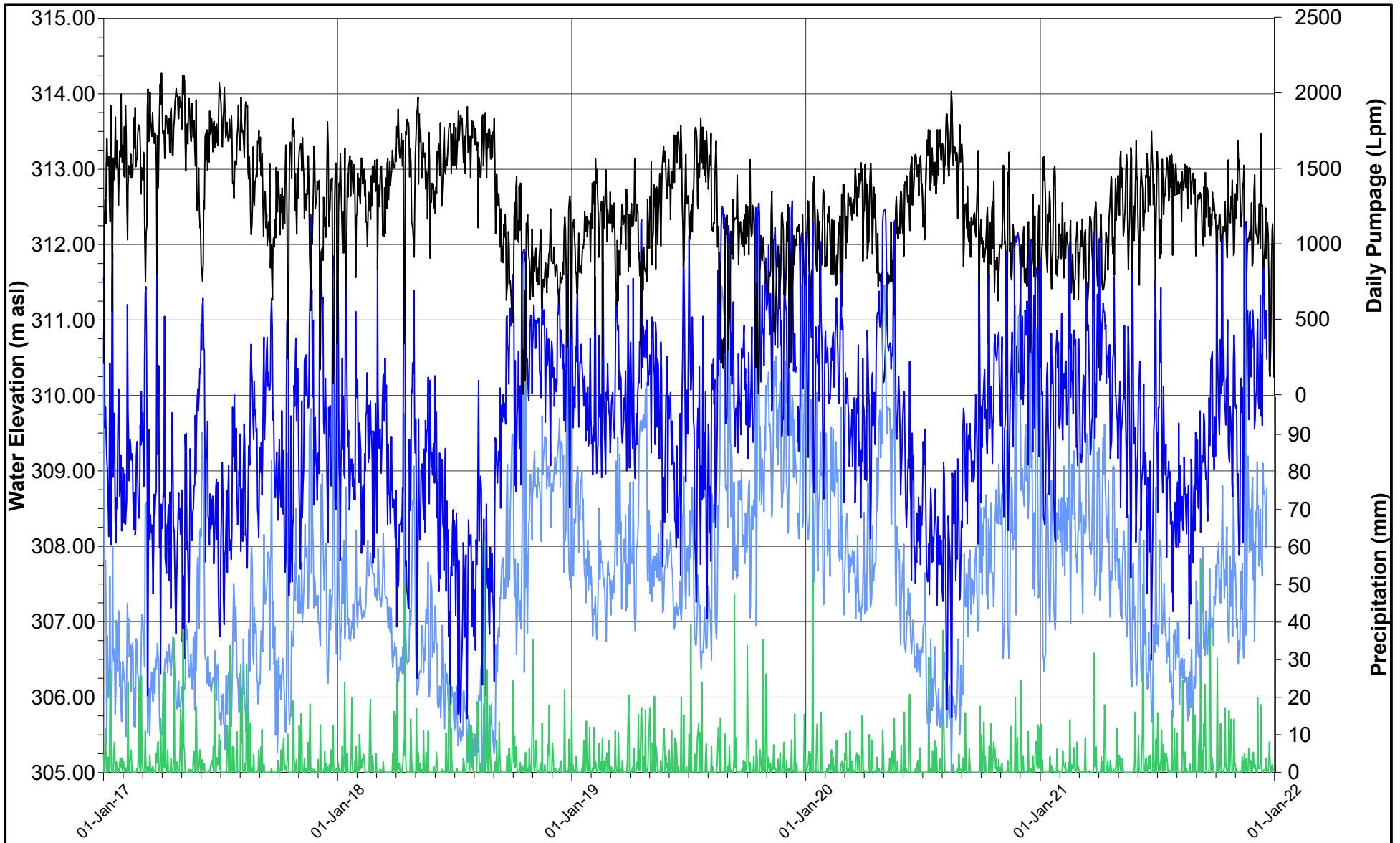
PROJECT  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE  
**AVERAGE MONTHLY WATER LEVELS TW3-80**  
**2021 ANNUAL MONITORING REPORT**



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 REVIEW GP  
 APPROVED GP

PROJECT NO. 20449101 (1100)      REV A      FIGURE D1b



— Precipitation (mm)  
— Daily Pumpage (Lpm)  
— MW2A-07 Daily Min  
— MW2A-07 Daily Max

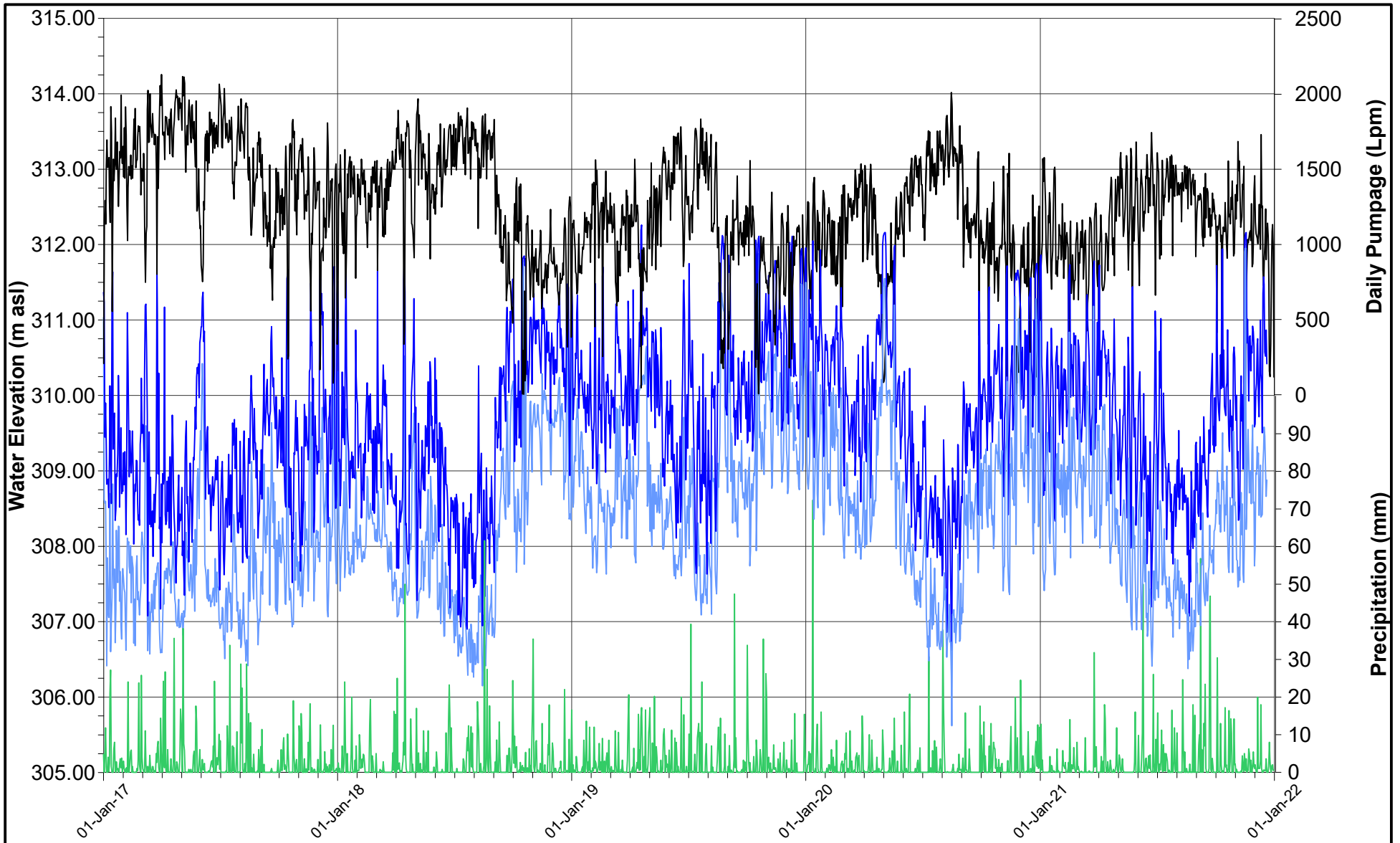


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **LOWER BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D2



- Precipitation (mm)
- Daily Pumpage (Lpm)
- MW4A-07 Daily Max
- MW4A-07 Daily Min

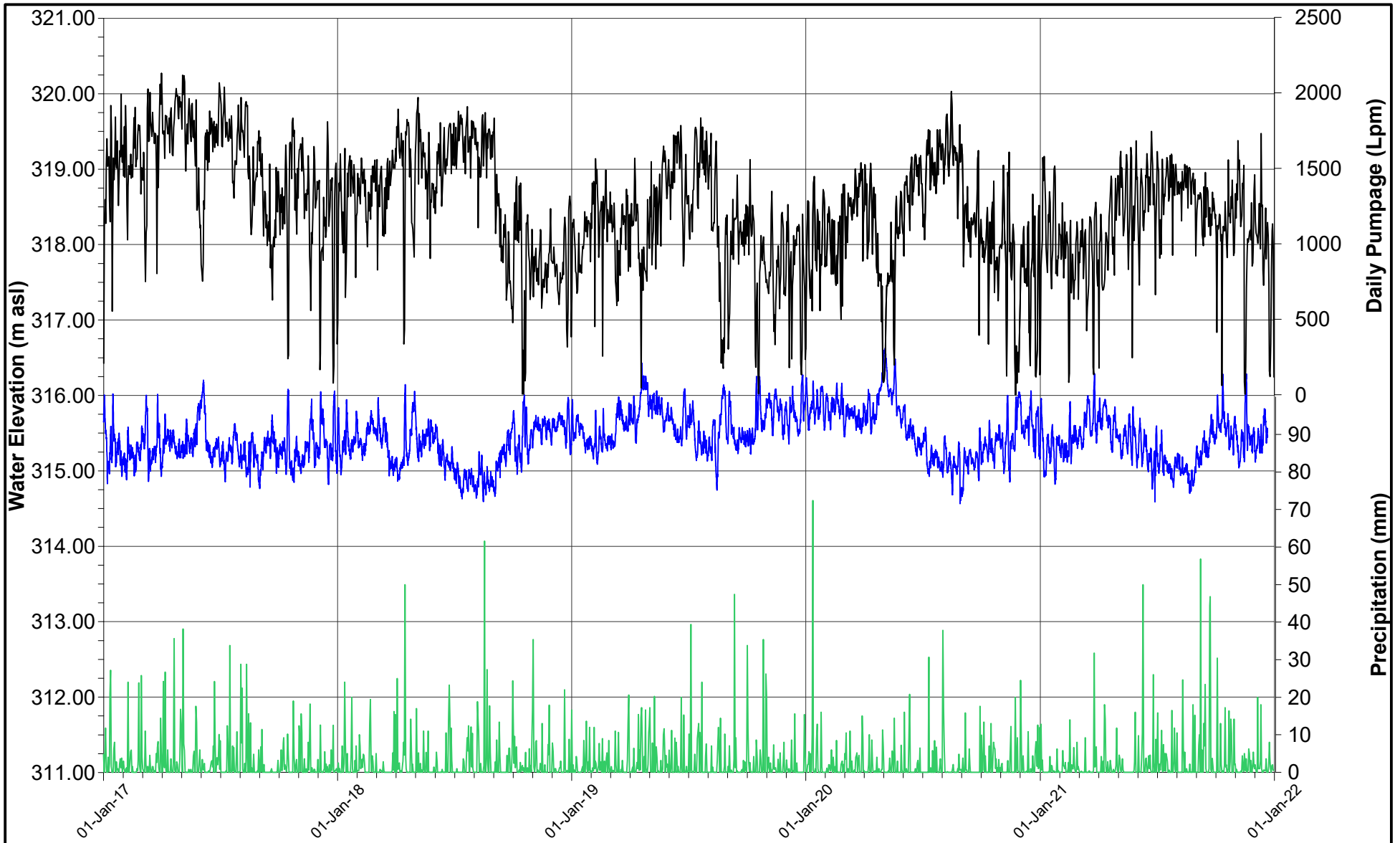


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**LOWER BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> D3
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— Precipitation (mm)  
— Daily Pumpage (Lpm)  
— MW6A-08

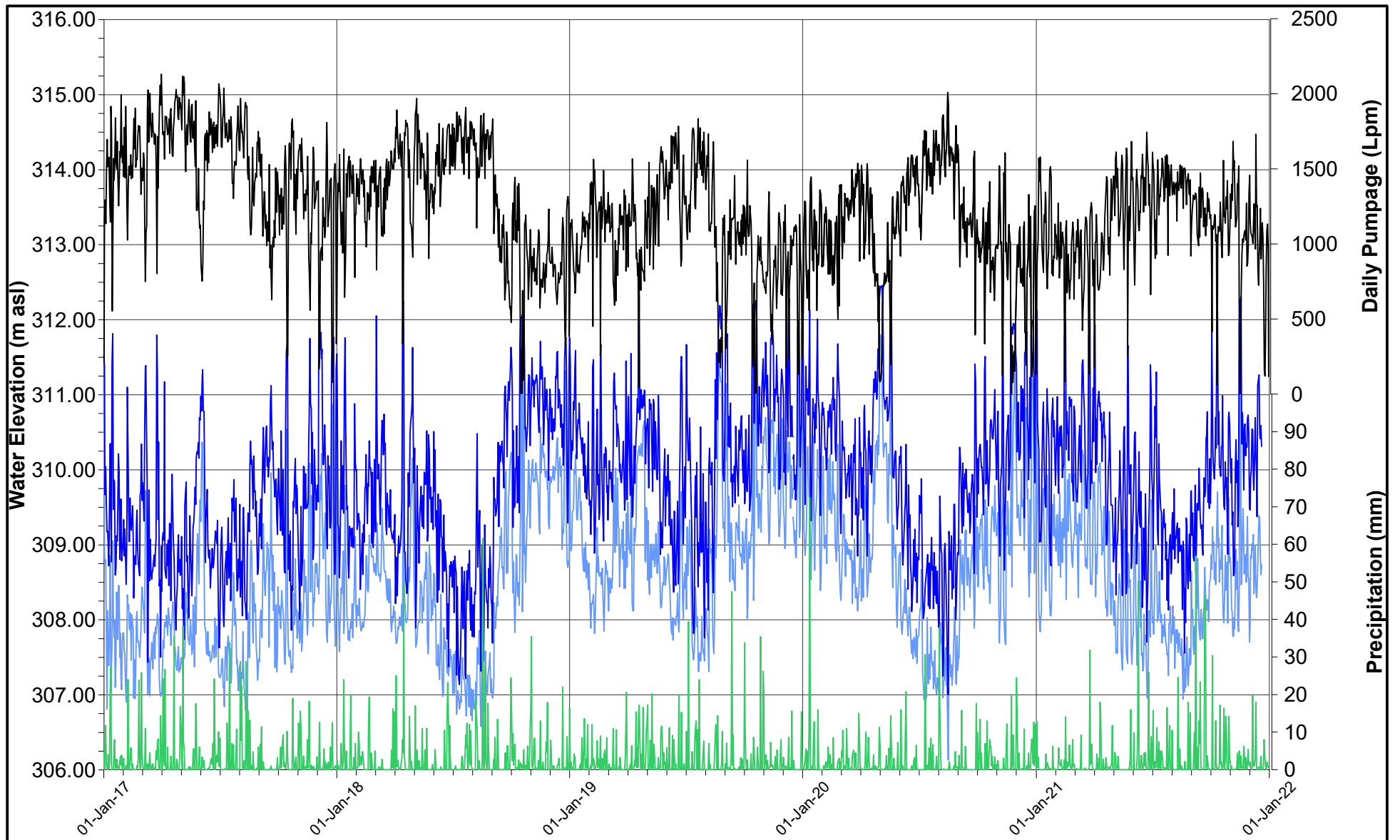


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **LOWER BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D4



- Precipitation (mm)
- Daily Pumpage (Lpm)
- MW7A-08 Daily Max
- MW7A-08 Daily Min



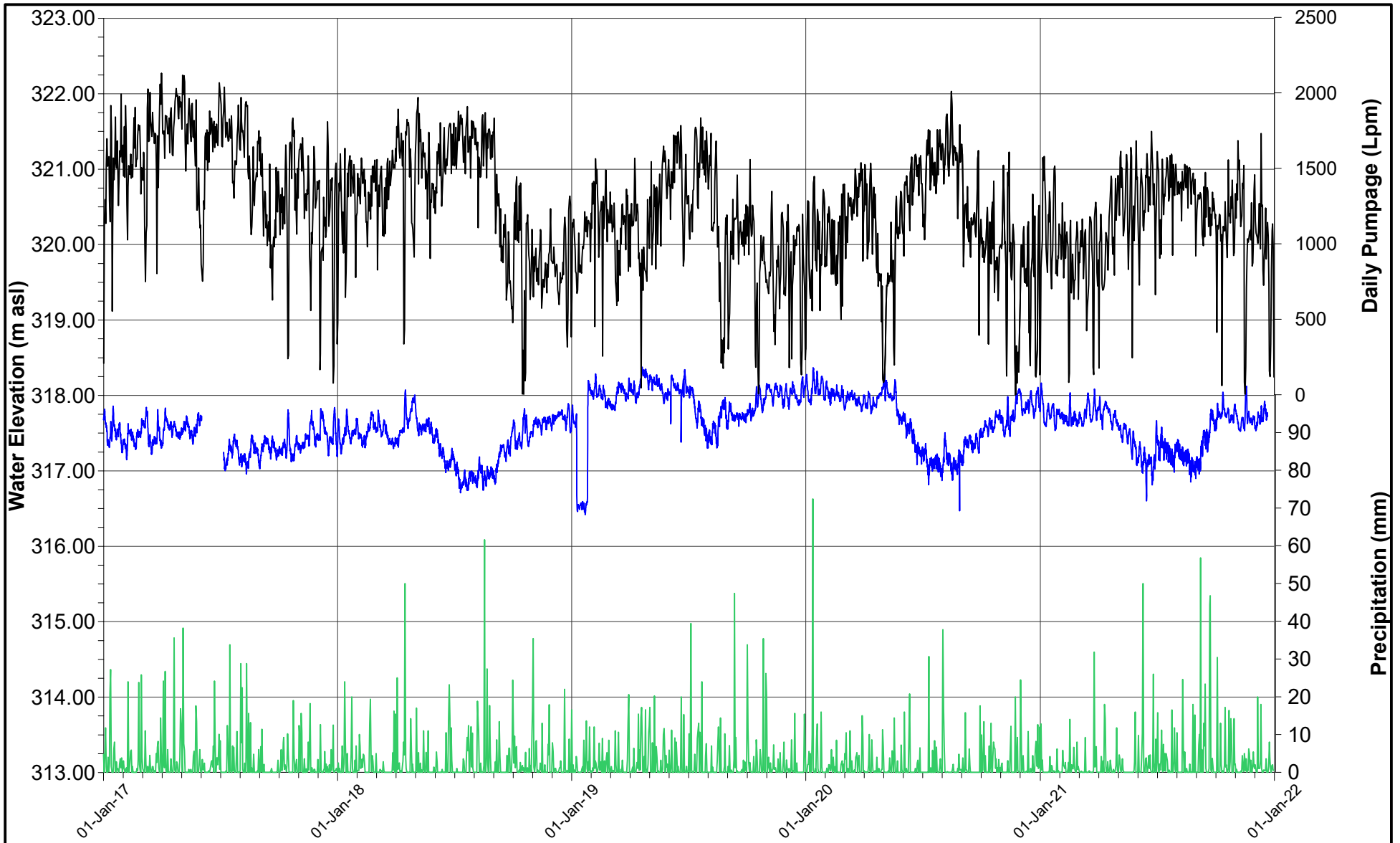
DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**LOWER BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> D5
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— Precipitation (mm)  
— Daily Pumpage (Lpm)  
— MW8A-08

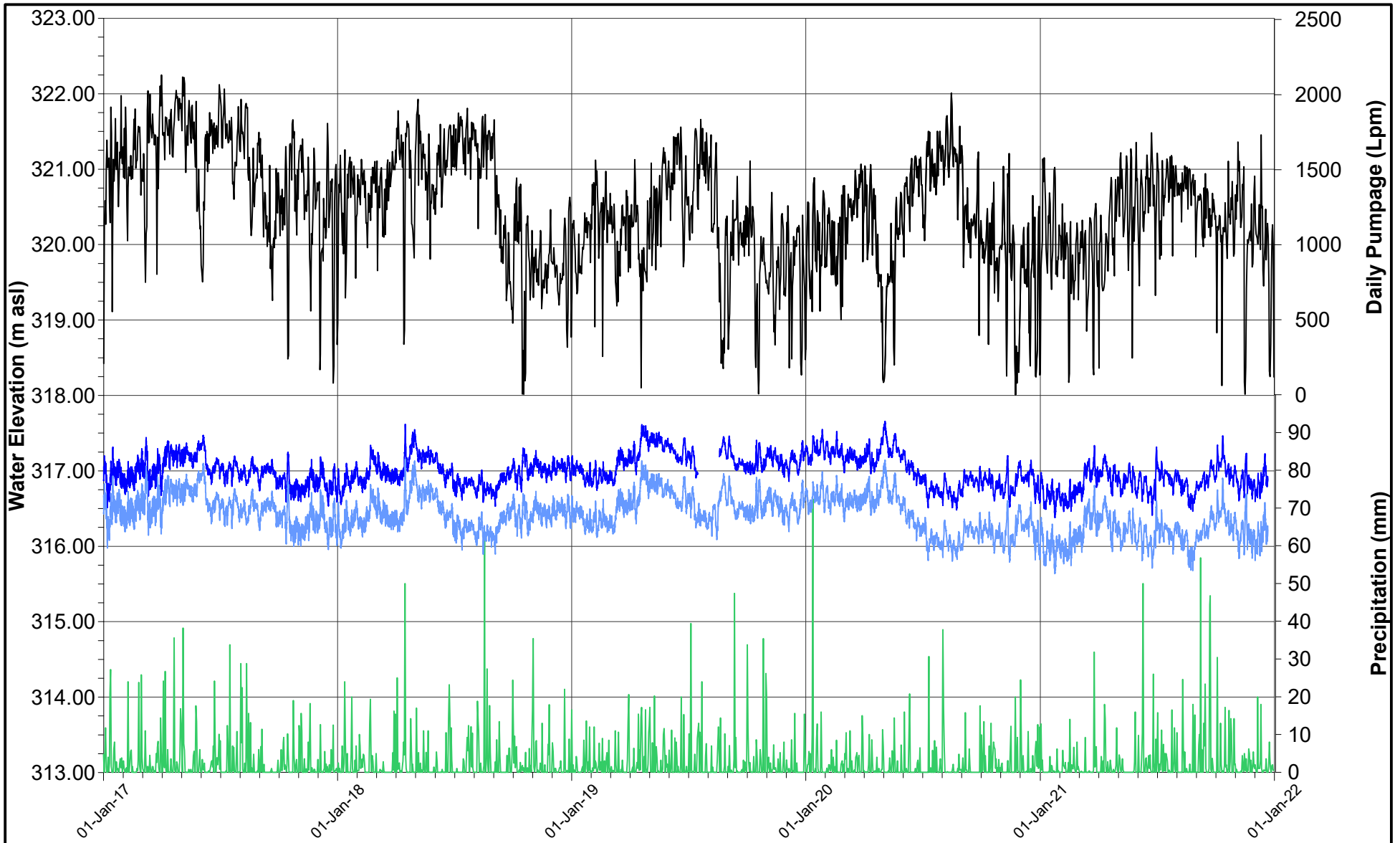


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **LOWER BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D6



- Precipitation (mm)
- Daily Pumpage (Lpm)
- MW10D-09
- MW10C-09

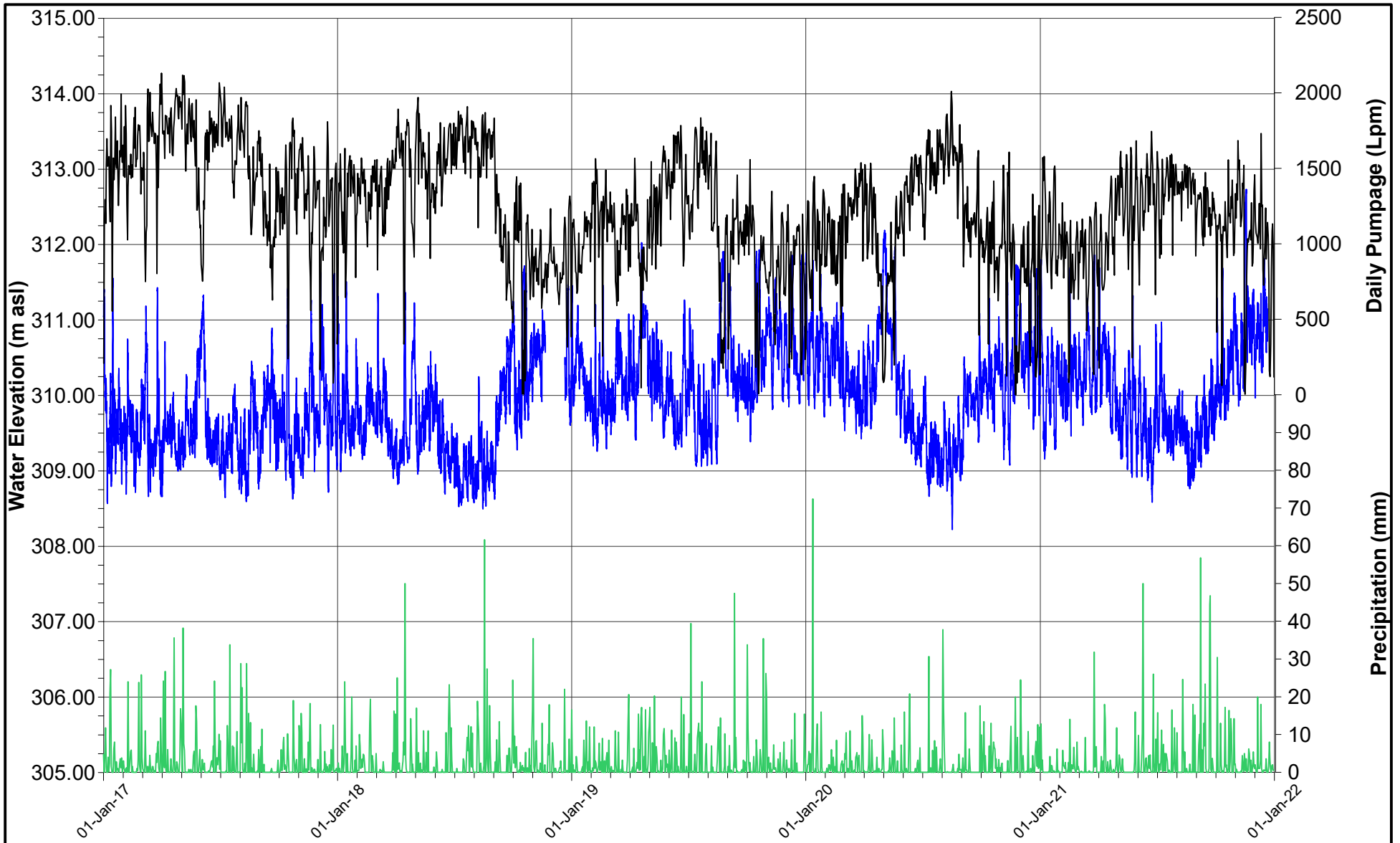


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
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**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**LOWER BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> D7
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— Precipitation (mm)  
— Daily Pumpage (Lpm)  
— MW14A-11

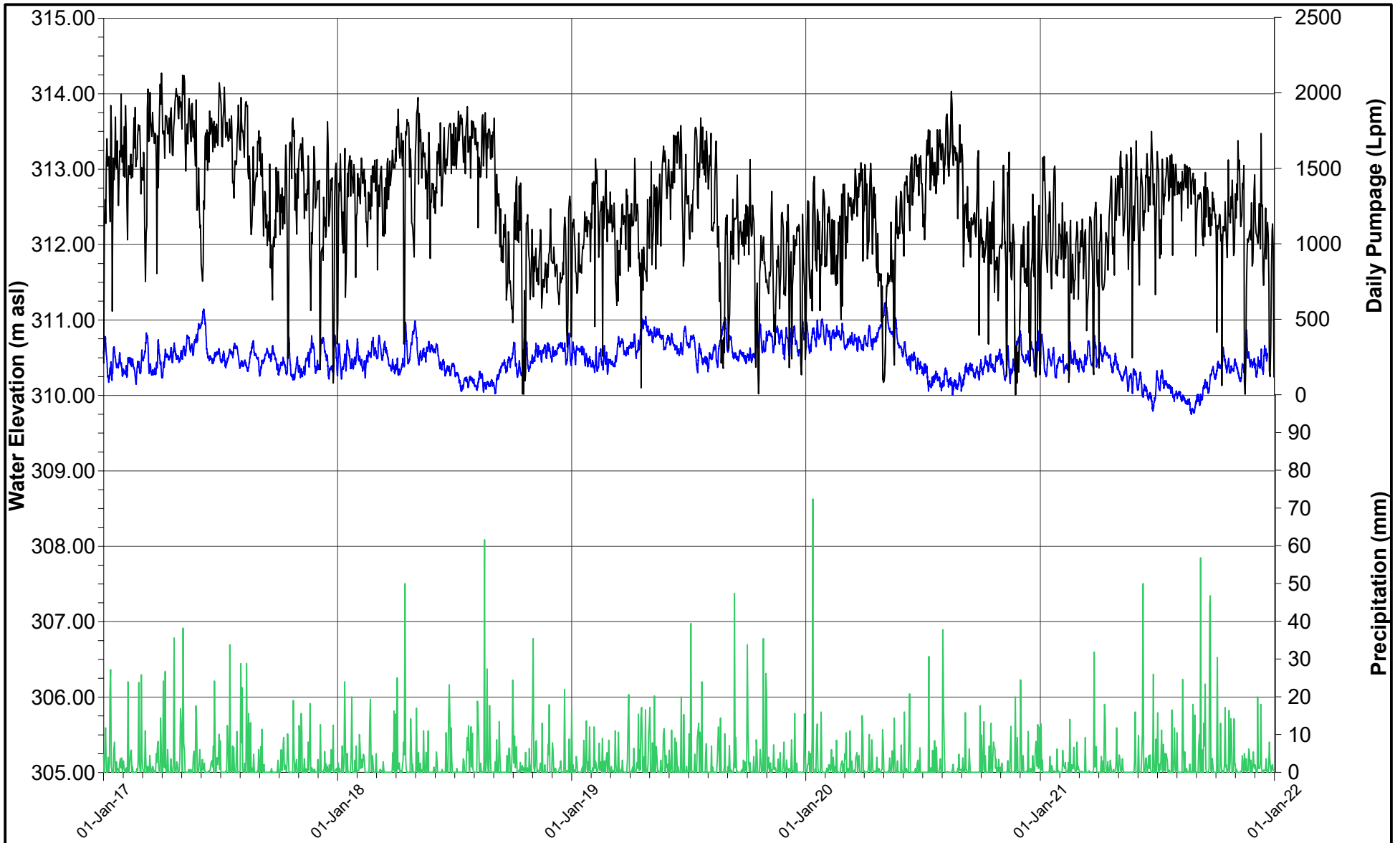


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT **BLUE TRITON BRANDS**  
Town of Aberfoyle, Ontario

TITLE **LOWER BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D8



— Precipitation (mm)  
— Daily Pumpage (Lpm)  
— MW15A-12

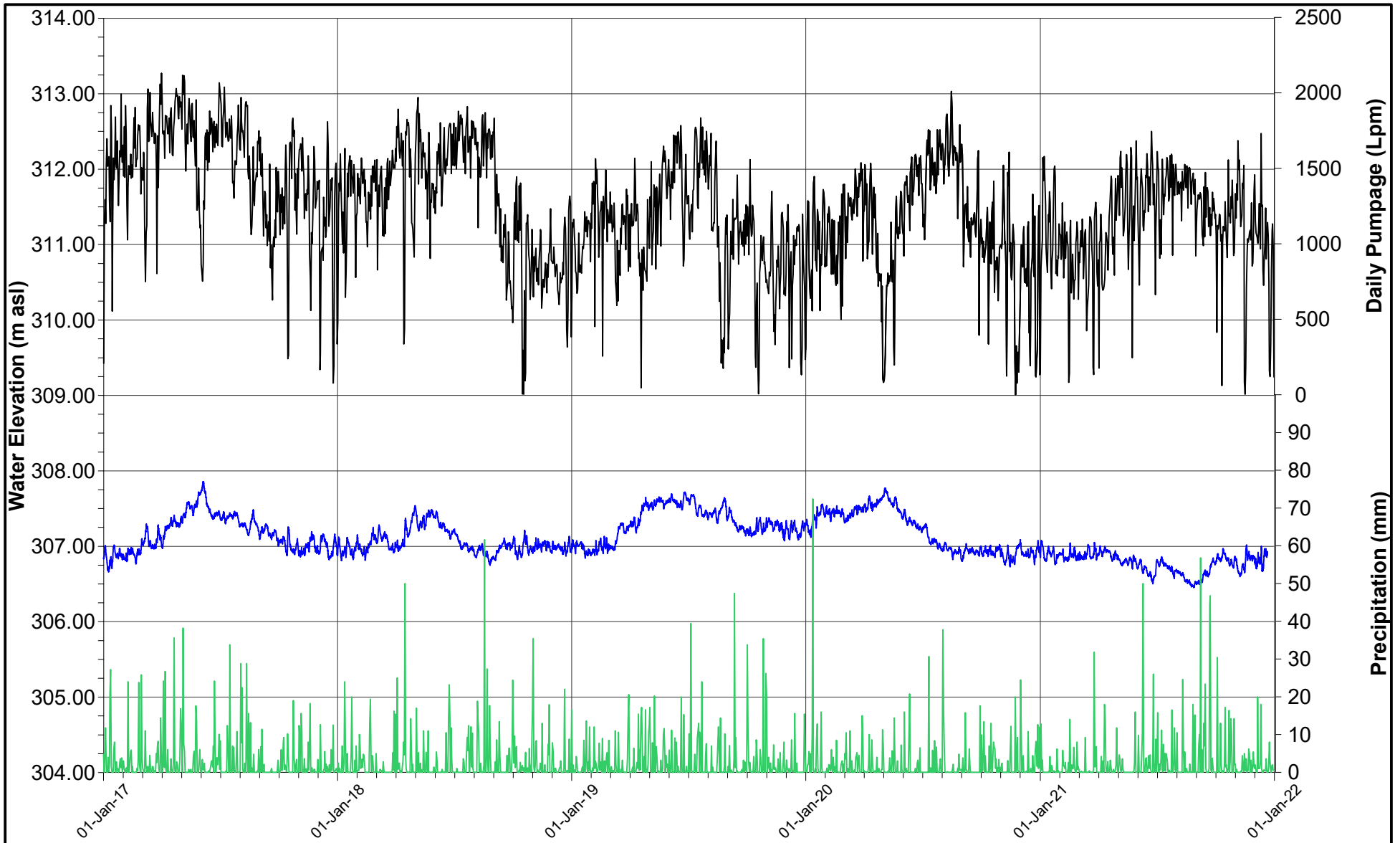


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **LOWER BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D9



— Precipitation (mm)  
— Daily Pumpage (Lpm)  
— MW16A-12

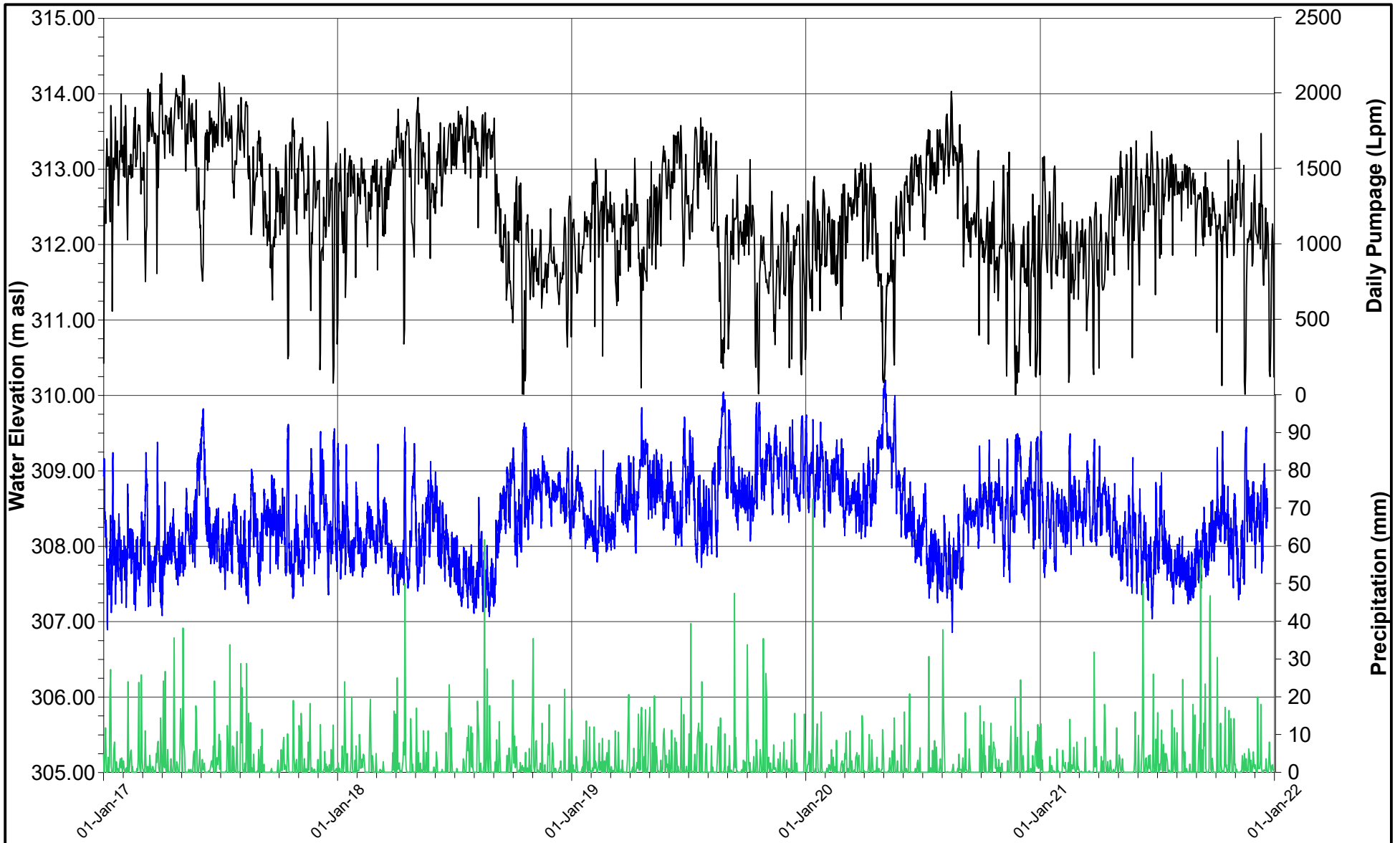


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **LOWER BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D10



— Precipitation (mm)  
— Daily Pumpage (Lpm)  
— MW17A-12

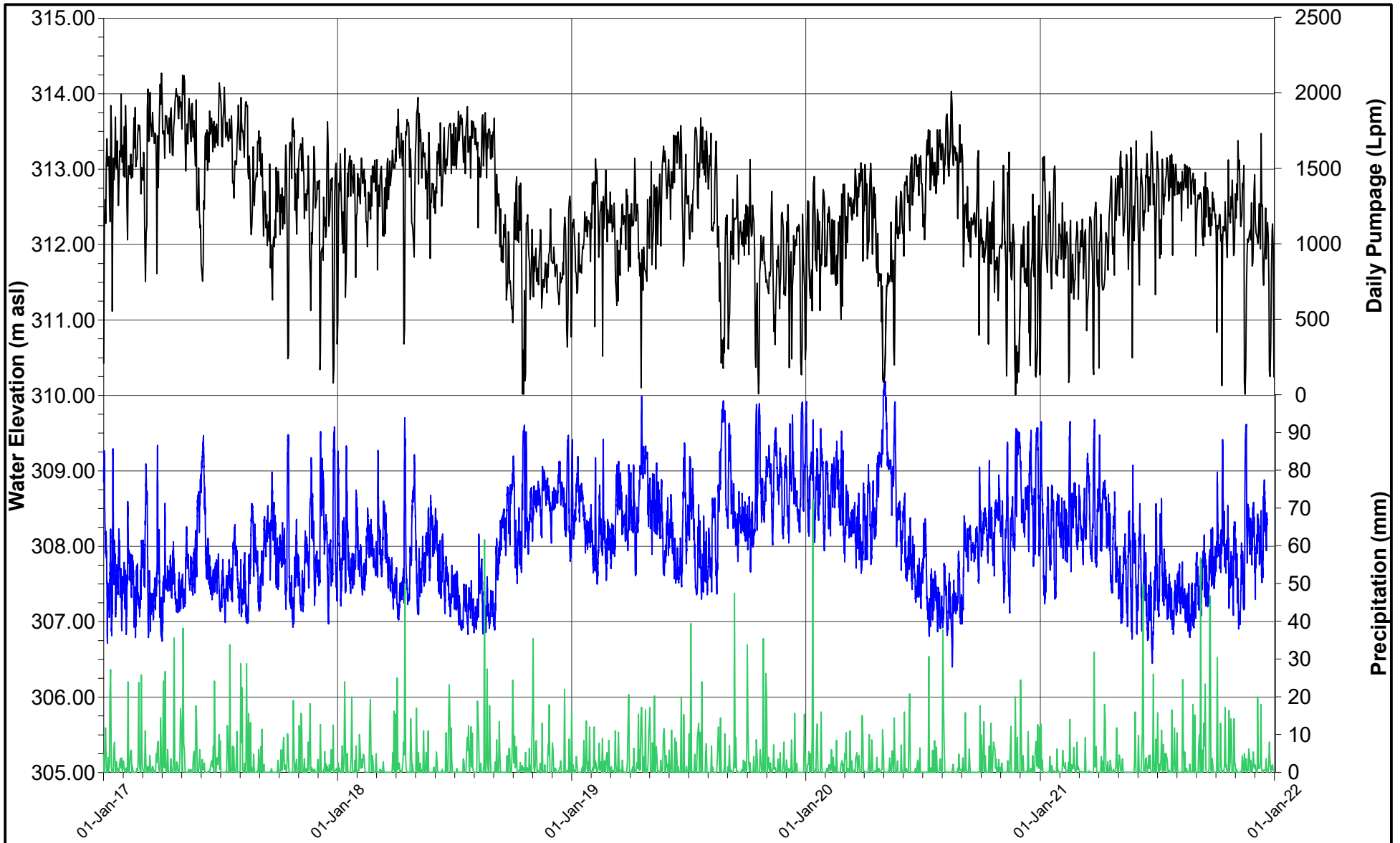
PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **LOWER BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**



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PROJECT NO. 20449101 (1100)      REV A      FIGURE D11



— Precipitation (mm)  
— Daily Pumpage (Lpm)  
— MW18A-12

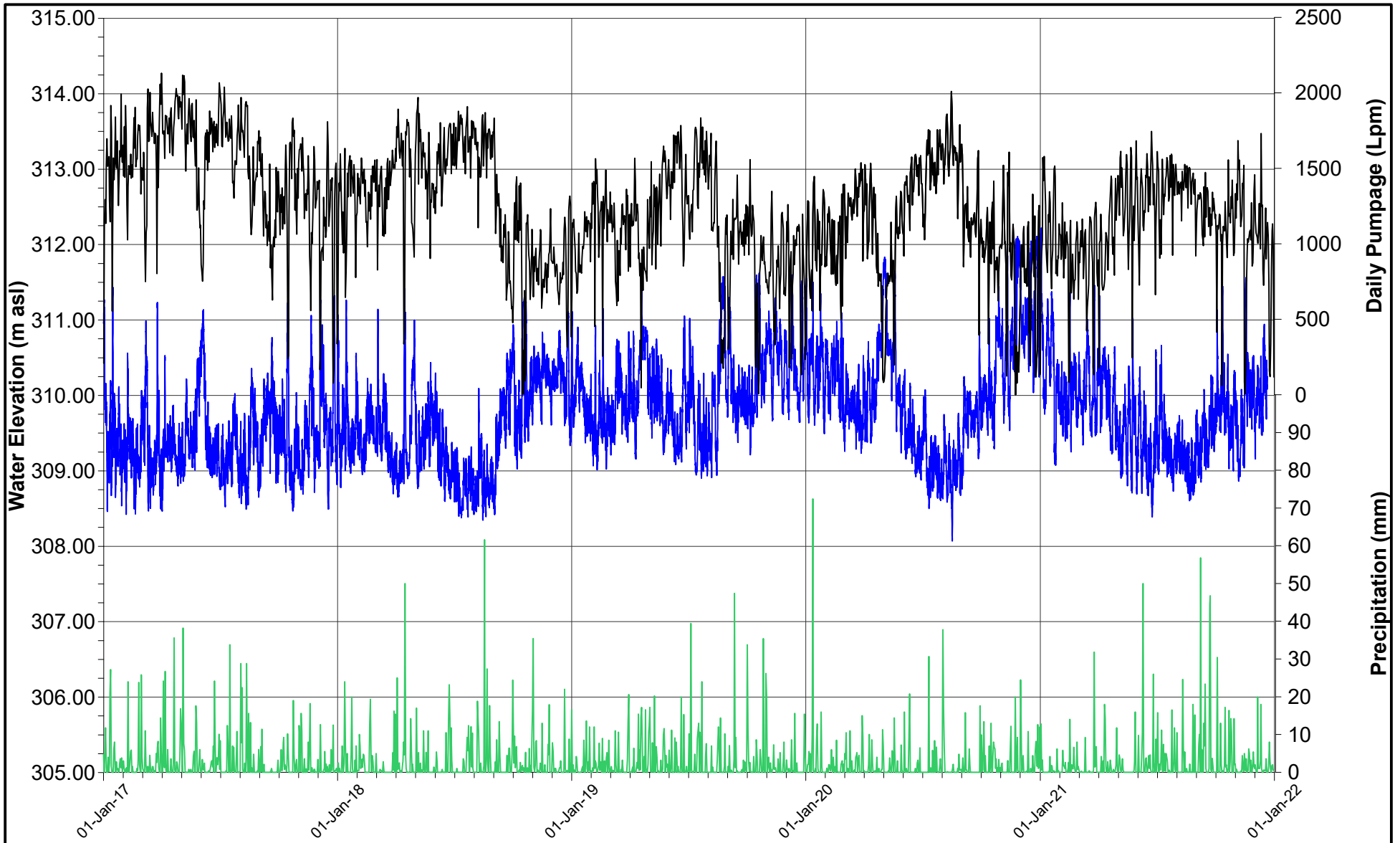
PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **LOWER BEDROCK HYDROGRAPHS**  
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PROJECT NO. 20449101 (1100)      REV A      FIGURE D12



— Precipitation (mm)  
— Daily Pumpage (Lpm)  
— TW2-11

PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

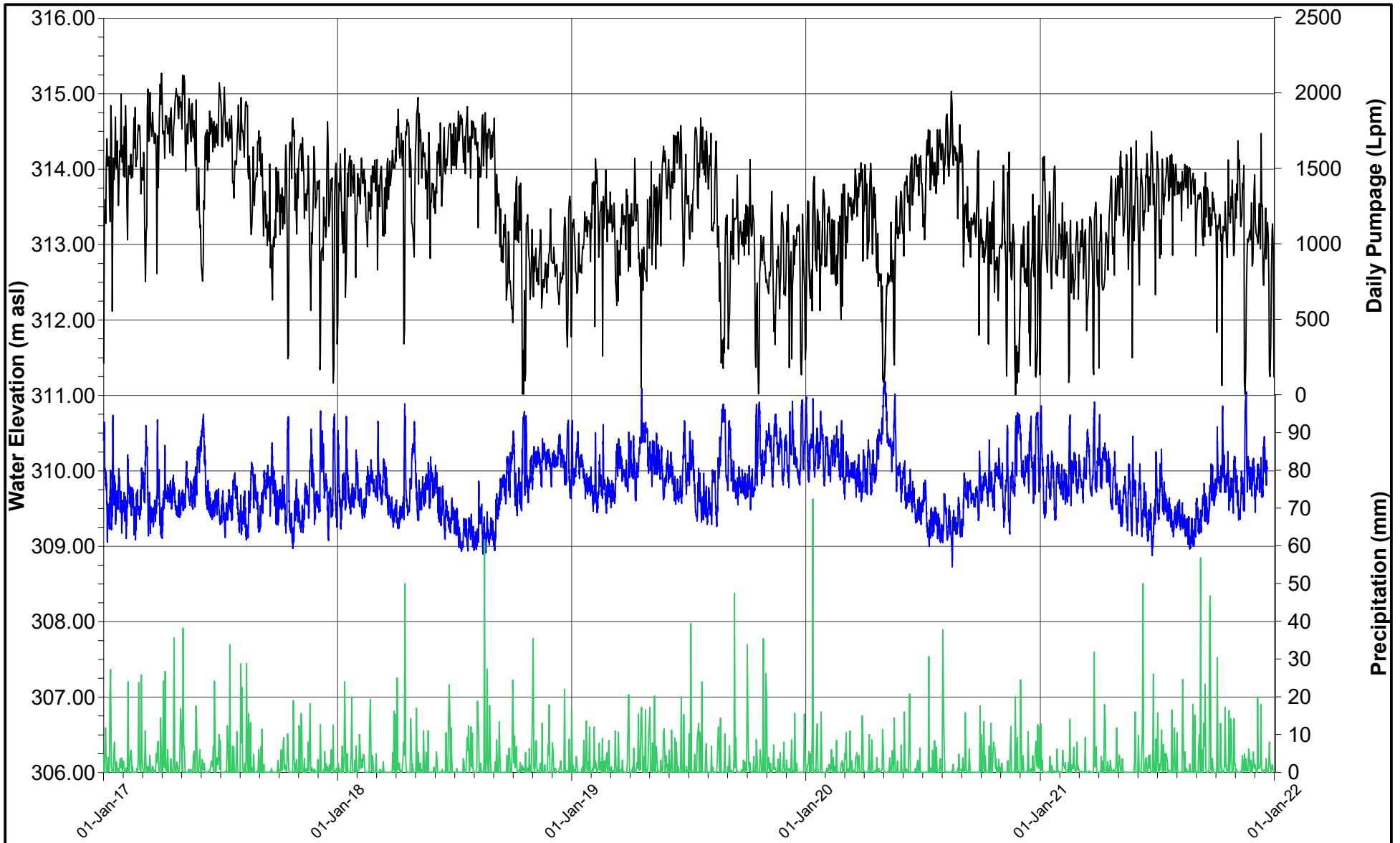
TITLE **LOWER BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**



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APPROVED	GP

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D13





— Precipitation (mm)  
— Daily Pumpage (Lpm)  
— Fireflow Well

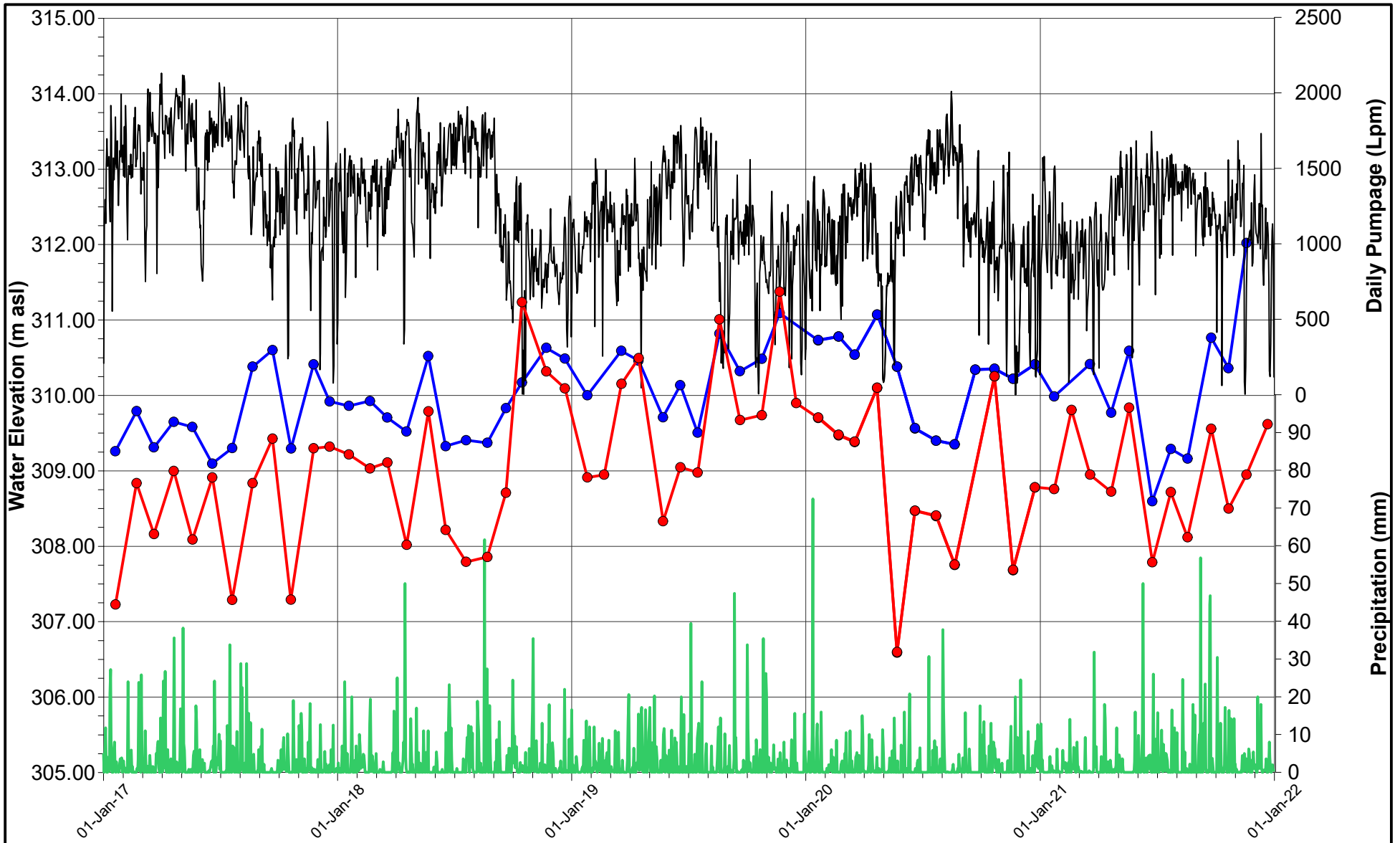
PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **LOWER BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**



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PROJECT NO. 20449101 (1100)      REV A      FIGURE D14



- Precipitation (mm)
- Daily Pumpage (Lpm)
- 27 Old Brock Rd (67-08740)
- 7425 County Rd 34 (B Well)

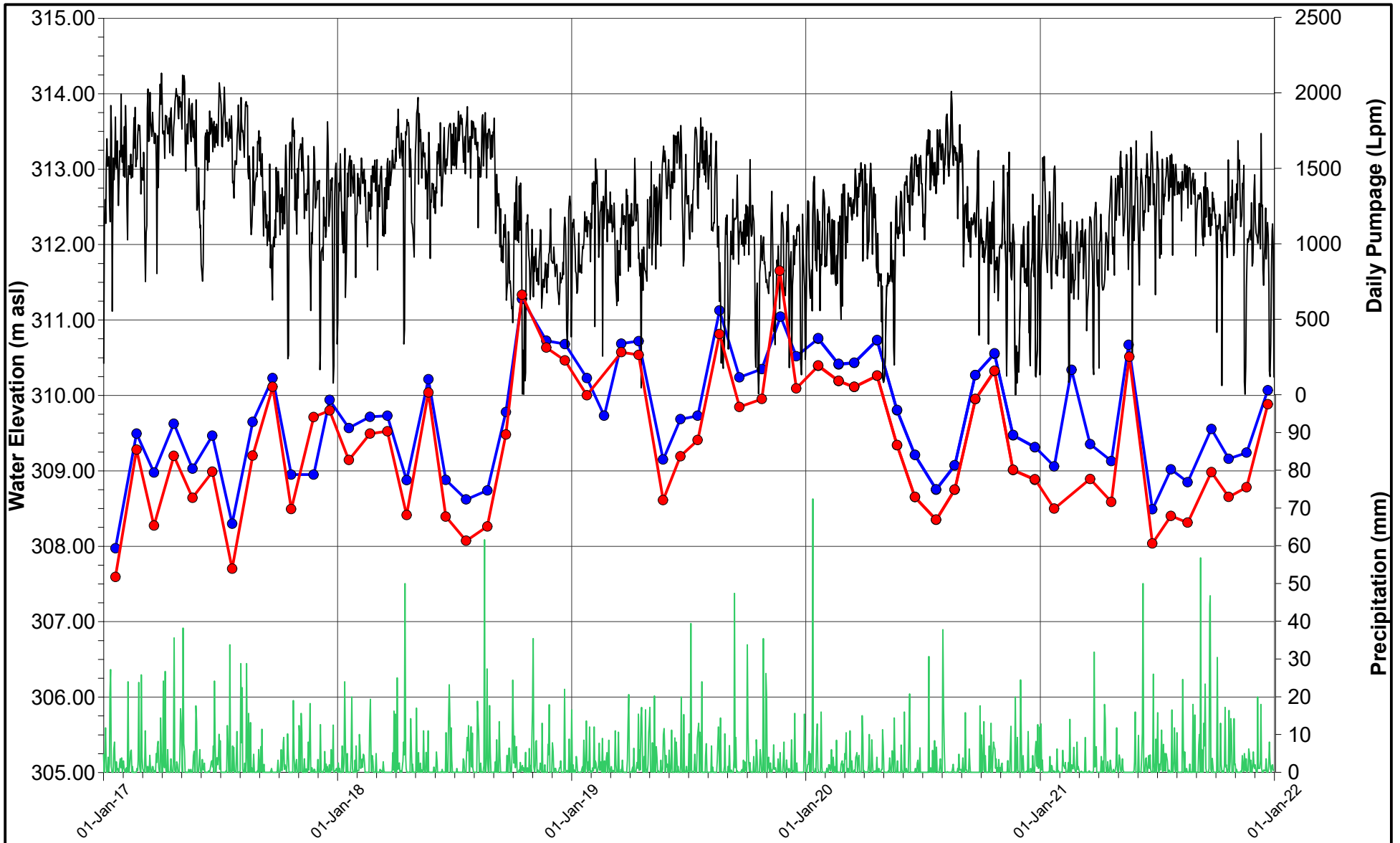


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PROJECT **BLUE TRITON BRANDS**  
Town of Aberfoyle, Ontario

TITLE **LOWER BEDROCK HYDROGRAPHS**  
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PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D15



- Precipitation (mm)
- Daily Pumpage (Lpm)
- 98 Brock Rd S. (M1)
- PW5 (Meadows of Aberfoyle)

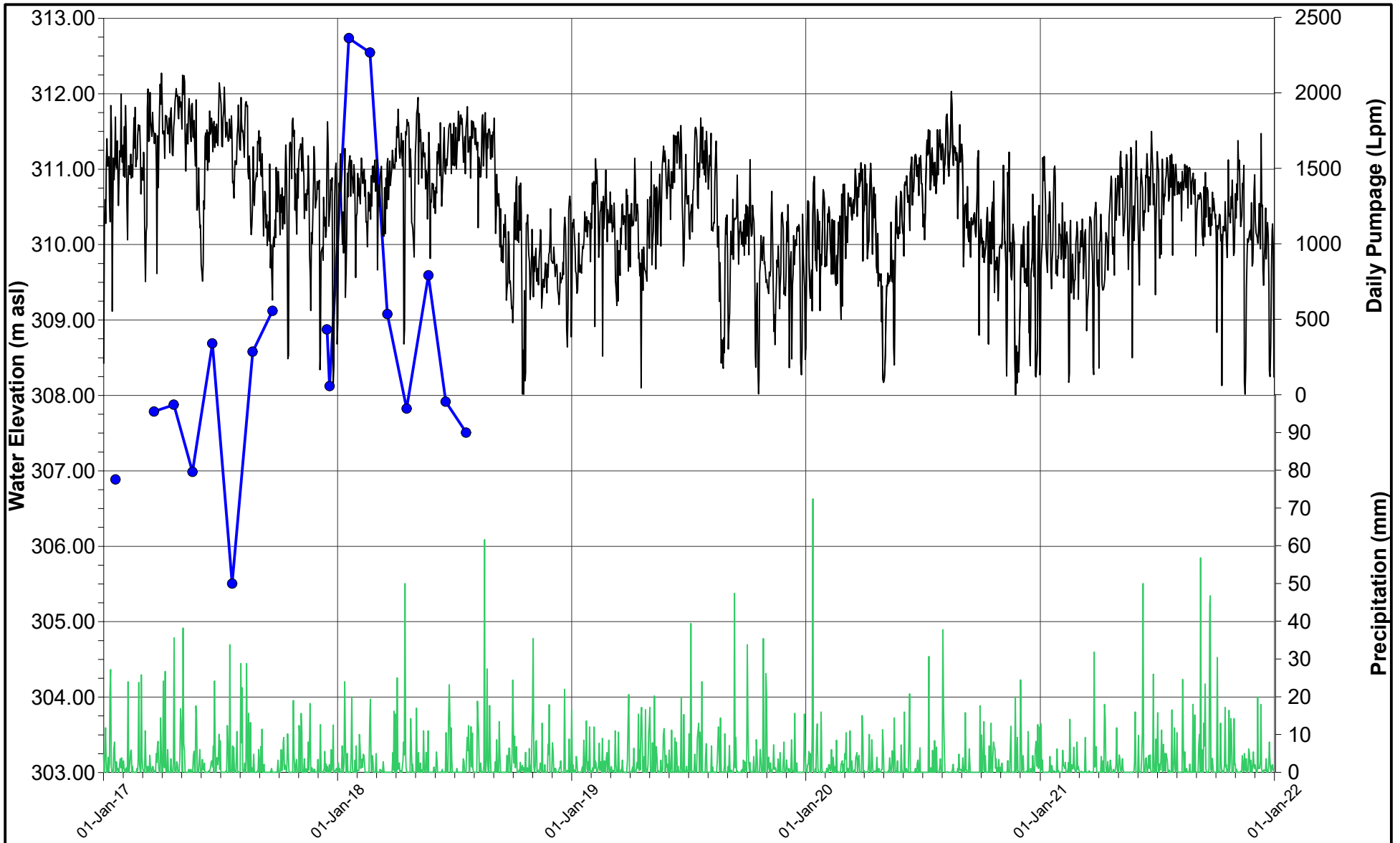


DATE	DECEMBER 2021
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REVIEW	GP
APPROVED	GP

PROJECT **BLUE TRITON BRANDS**  
Town of Aberfoyle, Ontario

TITLE **LOWER BEDROCK HYDROGRAPHS**  
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PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D16



- Precipitation (mm)
- Daily Pumpage (Lpm)
- 80 Brock Rd S. (W2)

Note: Beginning August 2018, the property owner no longer wanted their well included in the Blue Triton long term monitoring.

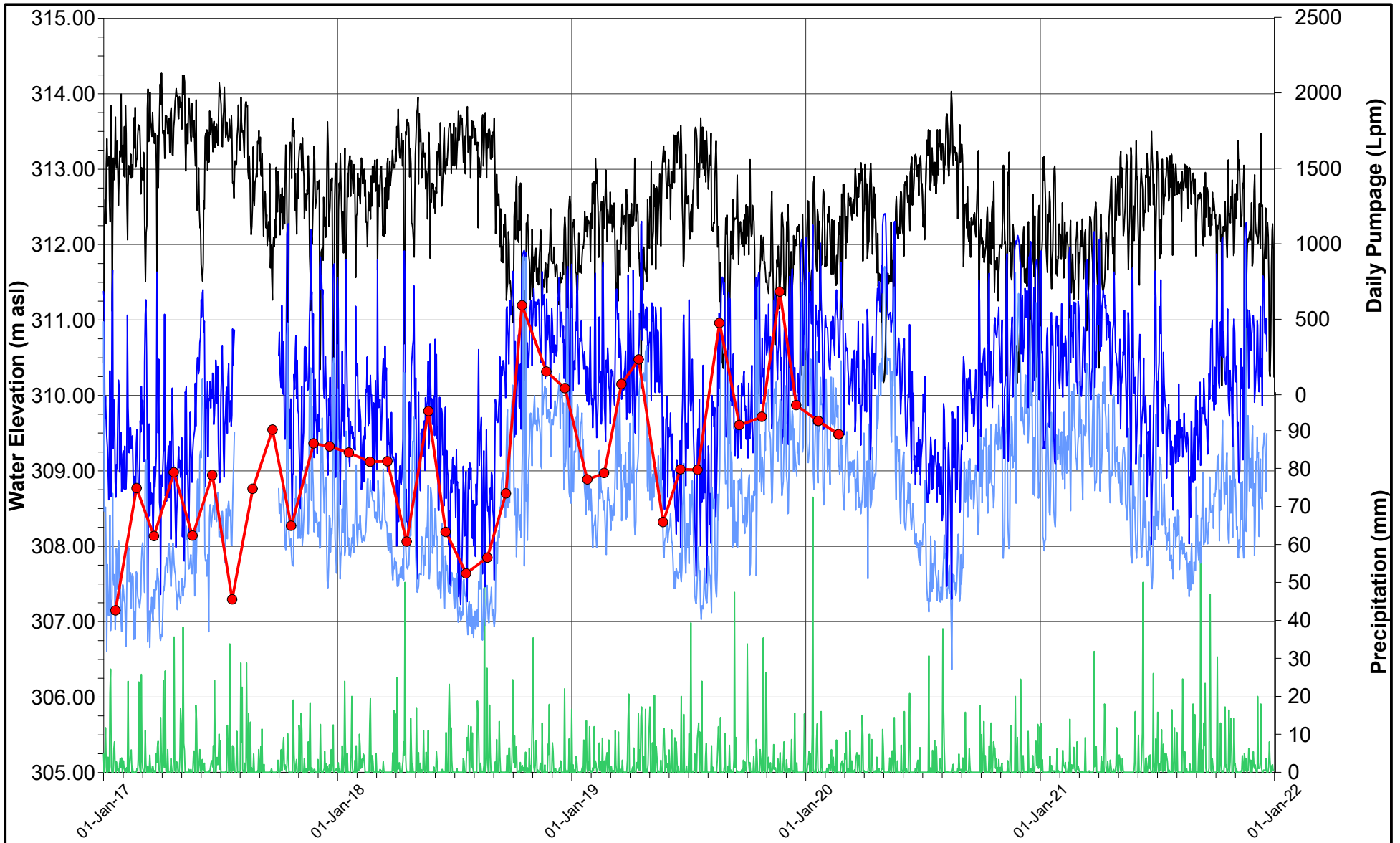
PROJECT **BLUE TRITON BRANDS**  
Town of Aberfoyle, Ontario

TITLE **LOWER BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**



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PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D17



- Precipitation (mm)
- Daily Pumpage (Lpm)
- 50 Brock Rd S. (I Well)
- MW2B-07 Daily Max
- MW2B-07 Daily Min

Note: Manual water level measurements not taken at I Well after February 2020 due to pandemic restrictions.

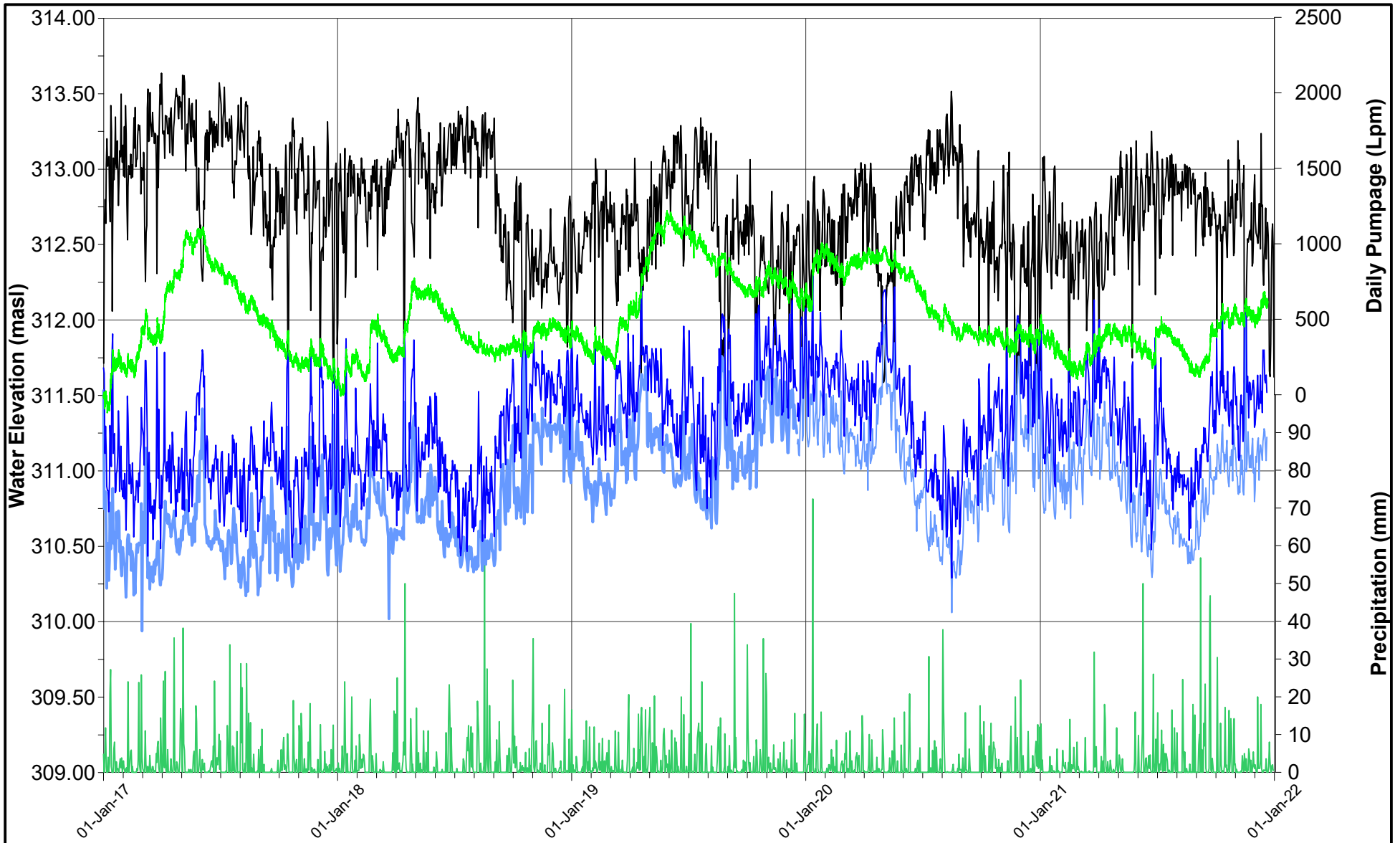


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**MIDDLE BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> D18
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- Precipitation (mm)
- Daily Pumpage (Lpm)
- MW4B-07
- MW2C-07 Daily Min
- MW2C-07 Daily Max

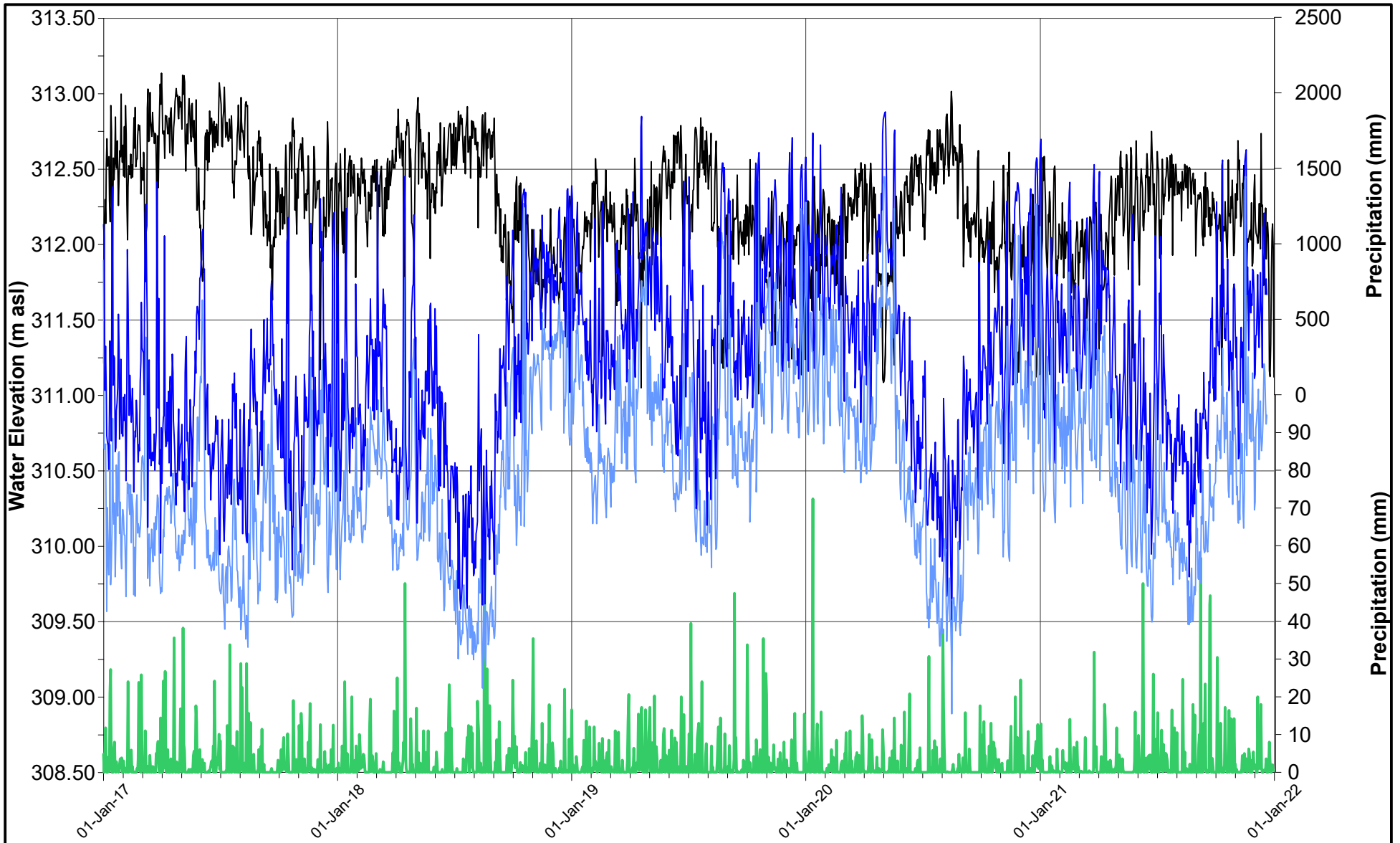


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**UPPER BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> D19
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- Precipitation (mm)
- Daily Pumpage (Lpm)
- MW7B-08 Daily Max
- MW7B-08 Daily Min

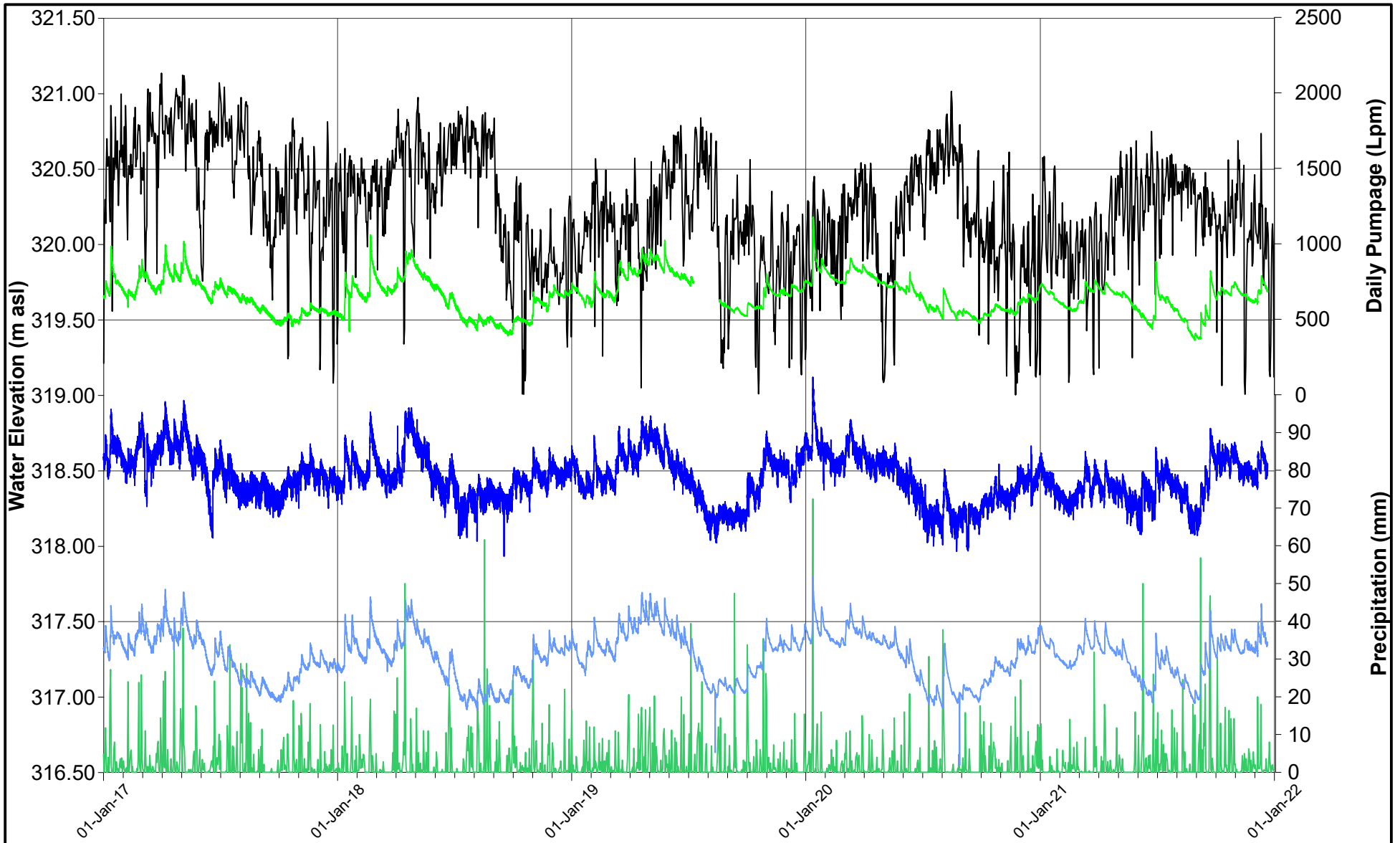


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**UPPER BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> D20
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- Precipitation (mm)
- Daily Pumpage (Lpm)
- MW6B-08
- MW8B-08
- MW10B-09



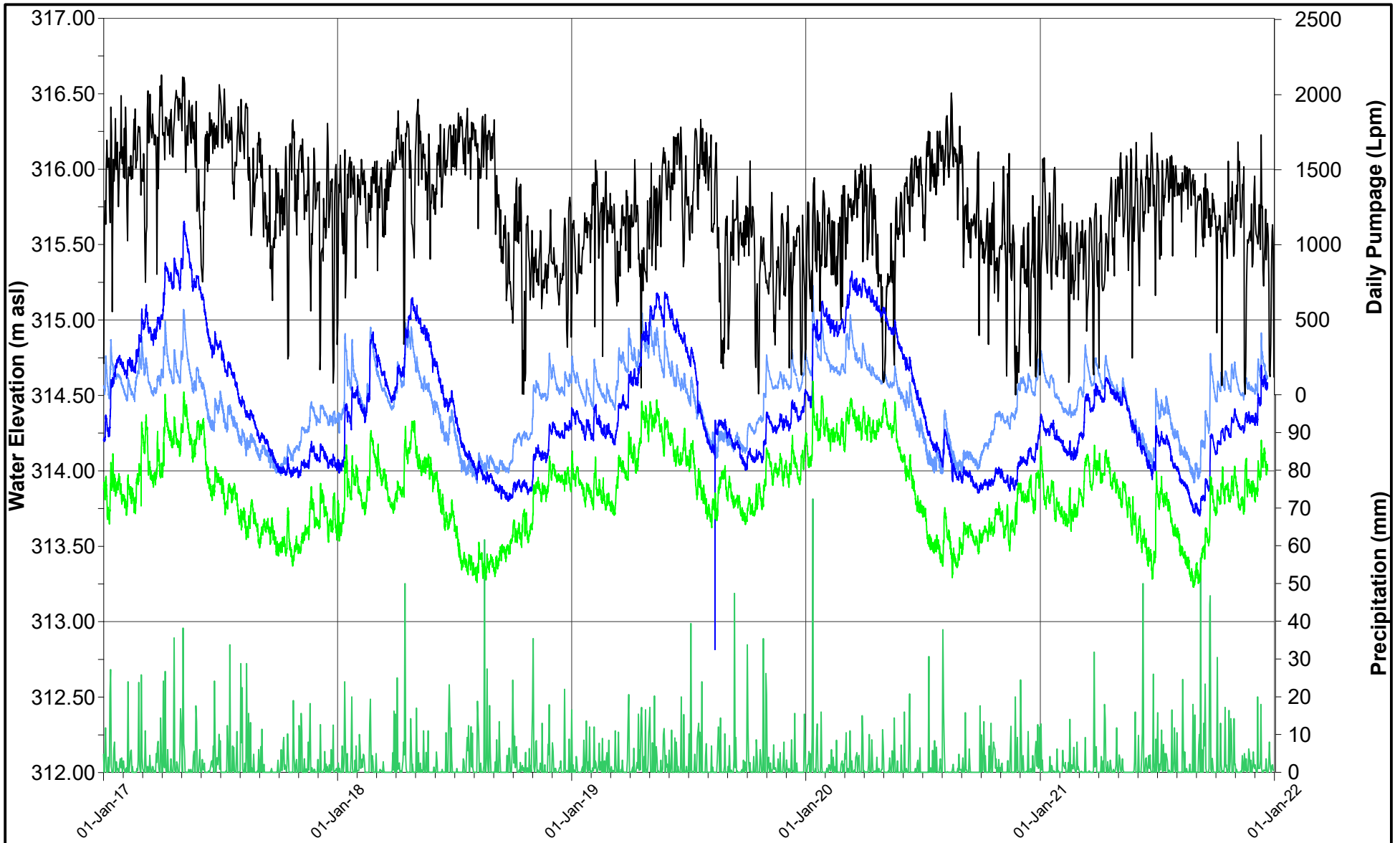
DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
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**TITLE**  
**UPPER BEDROCK HYDROGRAPHS**  
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<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> D21
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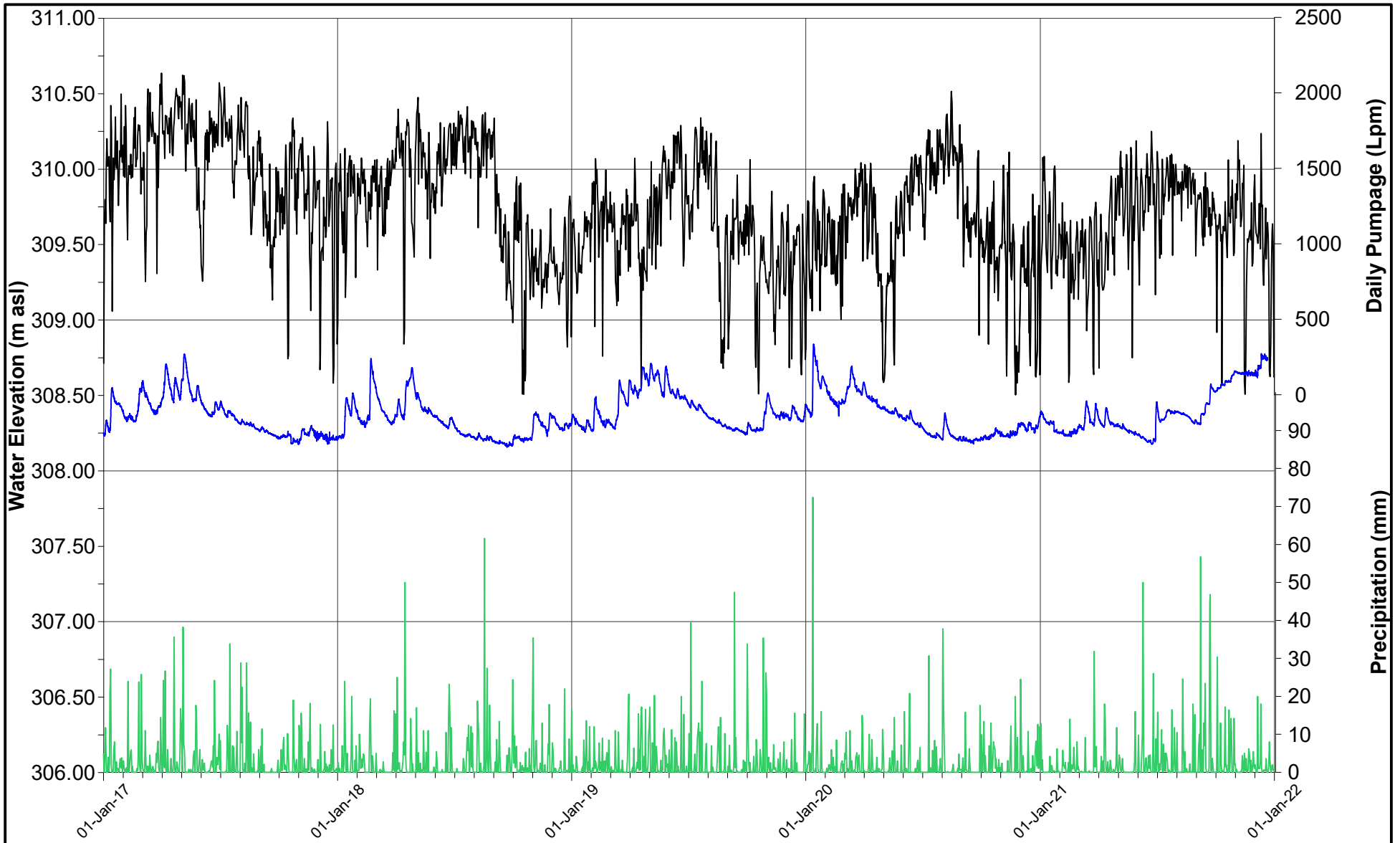


- Precipitation (mm)
- Daily Pumpage (Lpm)
- PCC-D
- MW14C-11
- MW14B-11



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PROJECT	<b>BLUE TRITON BRANDS</b> Town of Aberfoyle, Ontario		
TITLE	<b>UPPER BEDROCK HYDROGRAPHS</b> <b>2021 ANNUAL MONITORING REPORT</b>		
PROJECT NO.	20449101 (1100)	REV	A
		FIGURE	D22



— Precipitation (mm)  
— Daily Pumpage (Lpm)  
— MW15B-12

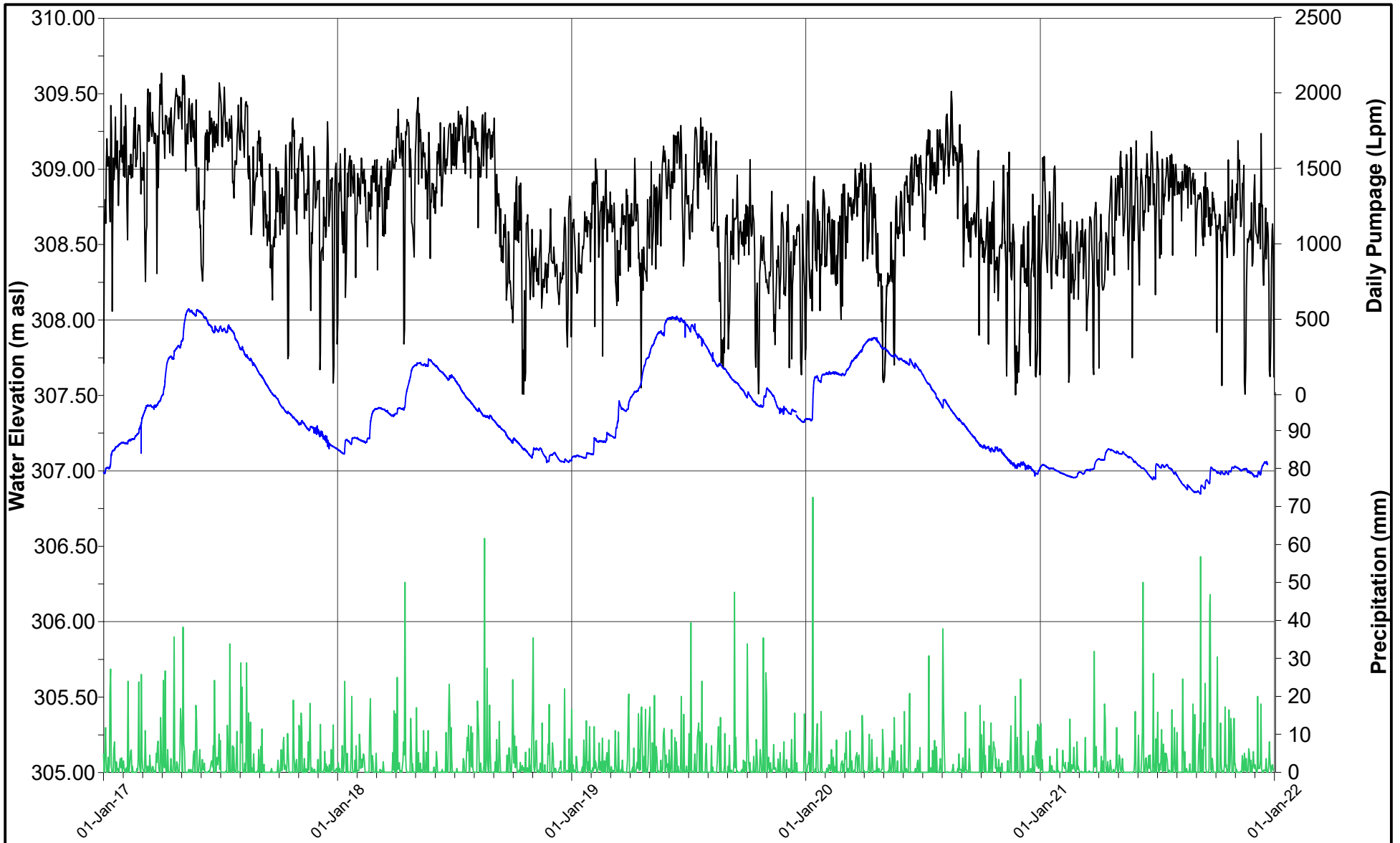


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **UPPER BEDROCK HYDROGRAPHS**  
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PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D23



— Precipitation (mm)  
— Daily Pumpage (Lpm)  
— MW16B-12

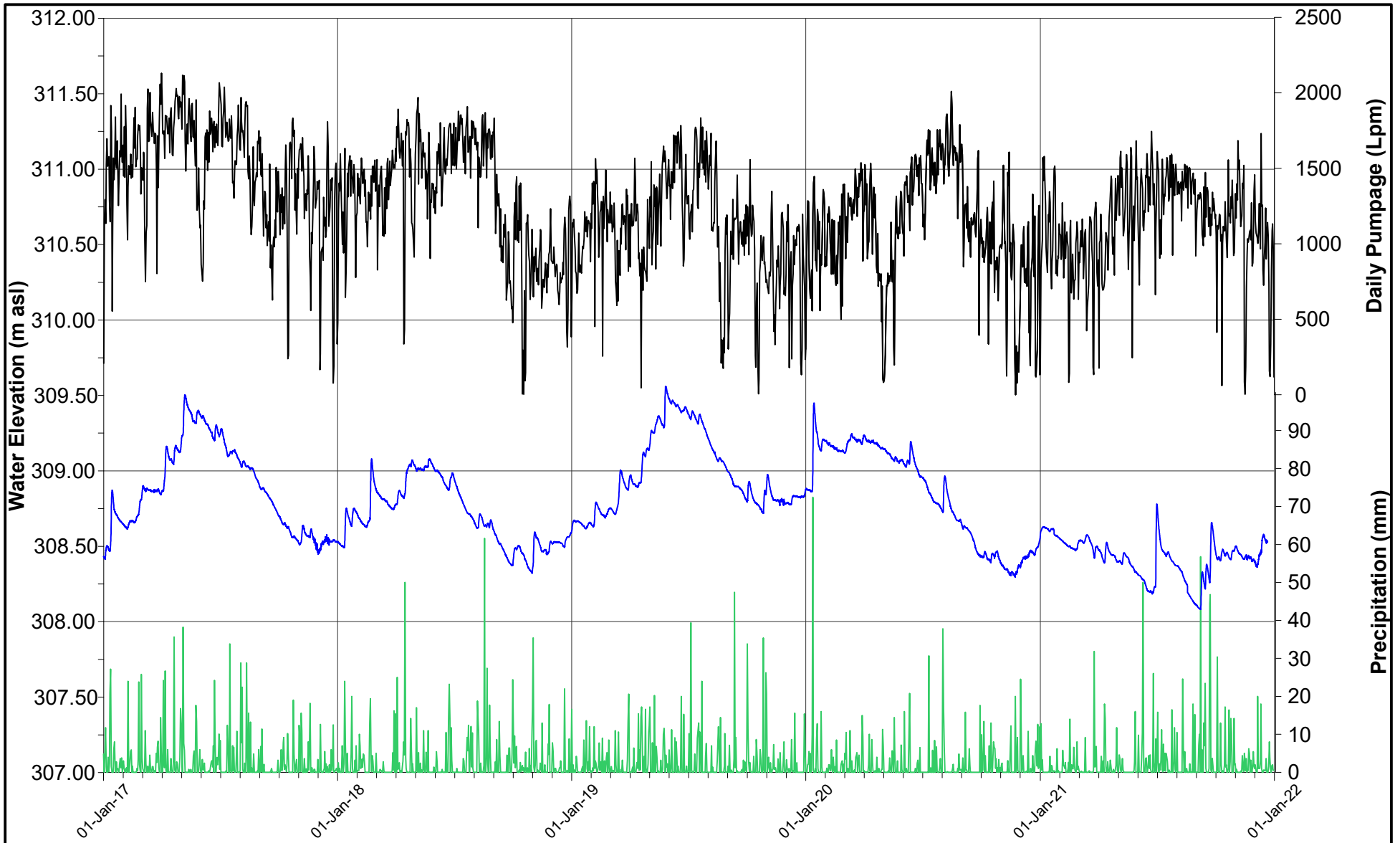
PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **UPPER BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**



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PROJECT NO. 20449101 (1100)      REV A      FIGURE D24



— Precipitation (mm)  
— Daily Pumpage (Lpm)  
— MW17B-12

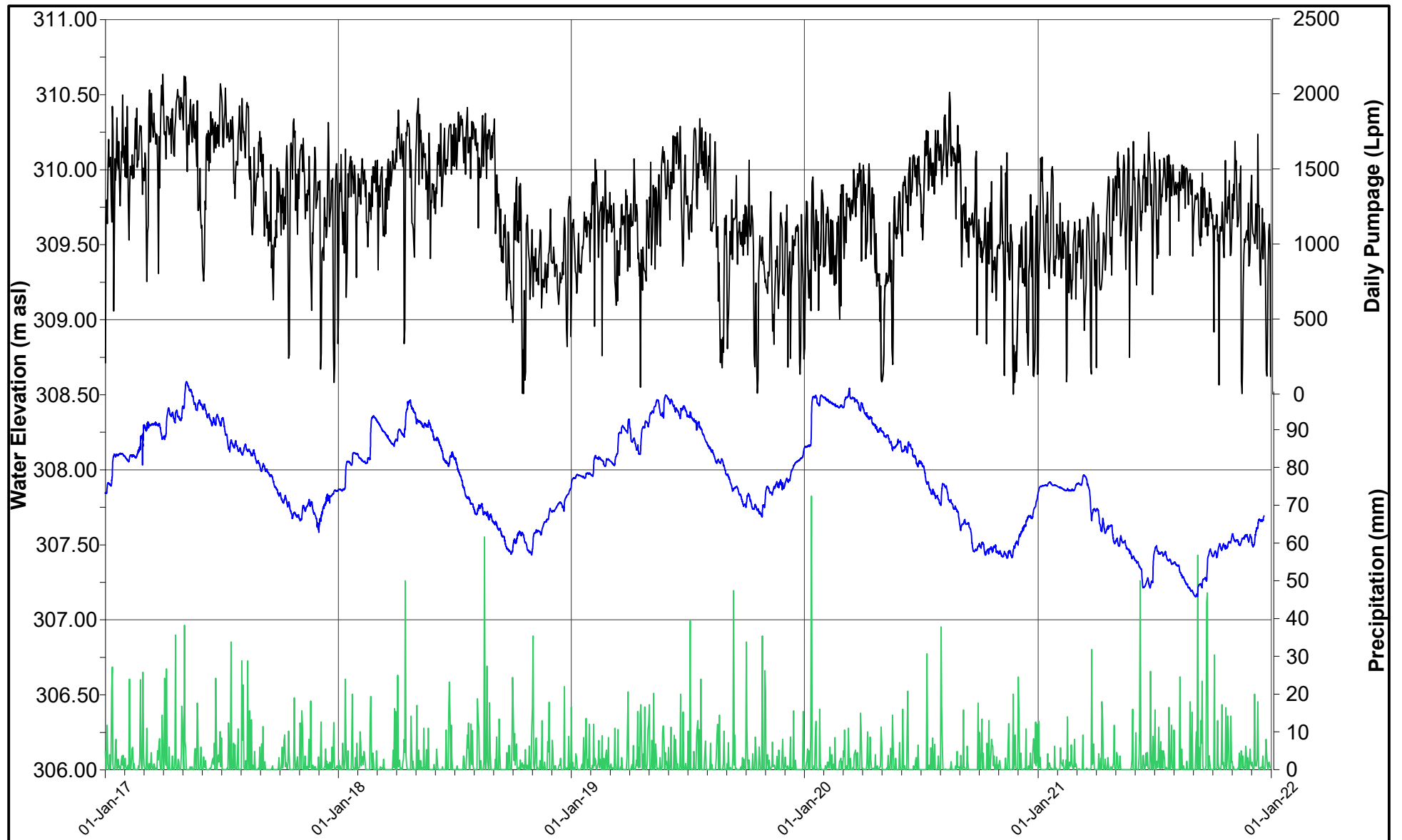
**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**UPPER BEDROCK HYDROGRAPHS**  
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**PROJECT NO.** 20449101 (1100)      **REV** A      **FIGURE** D25



- Precipitation (mm)
- Daily Pumpage (Lpm)
- MW18B-12

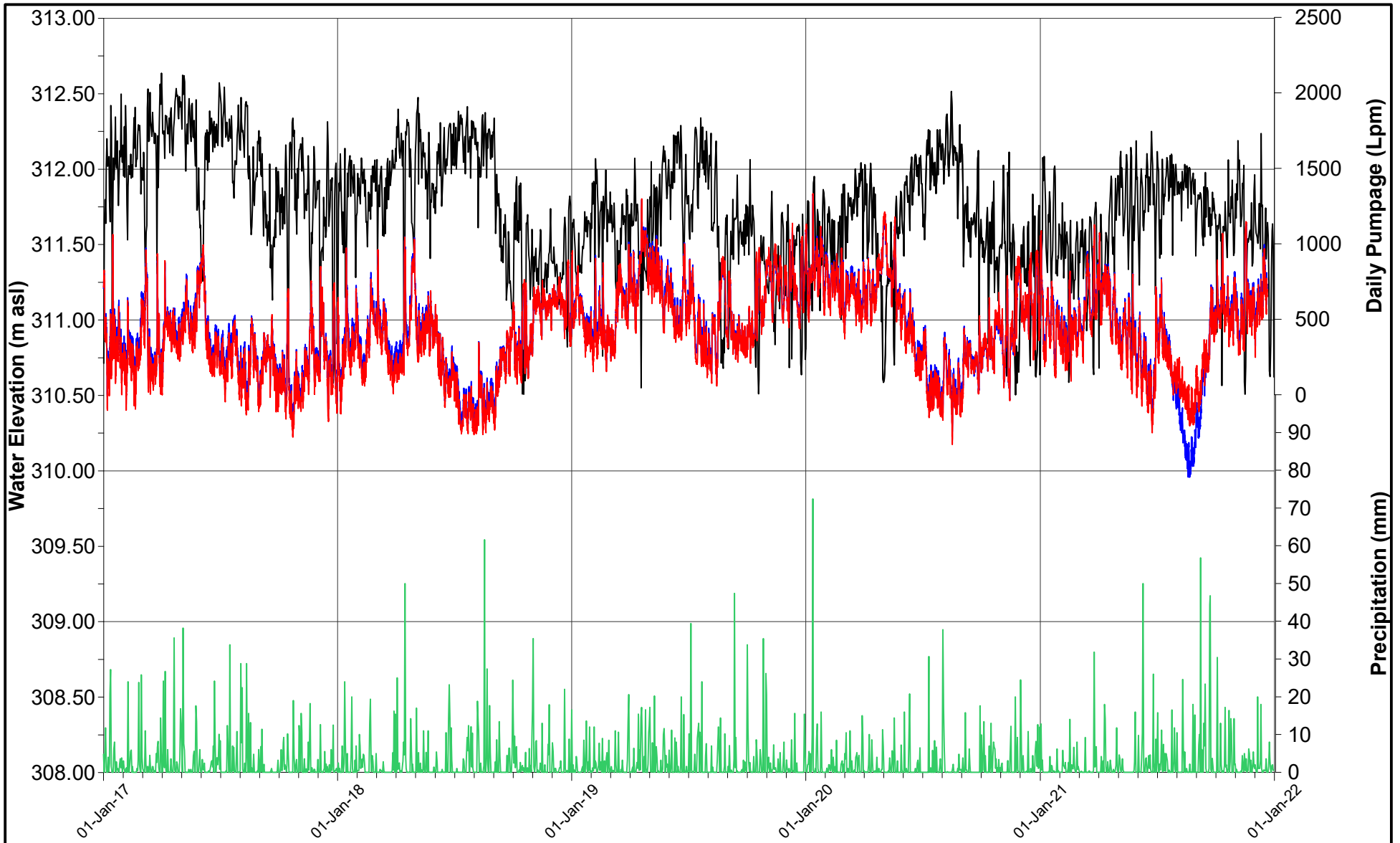


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REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**UPPER BEDROCK HYDROGRAPHS**  
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<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> D26
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- Precipitation (mm)
- Daily Pumpage (Lpm)
- MW-D
- MW-I

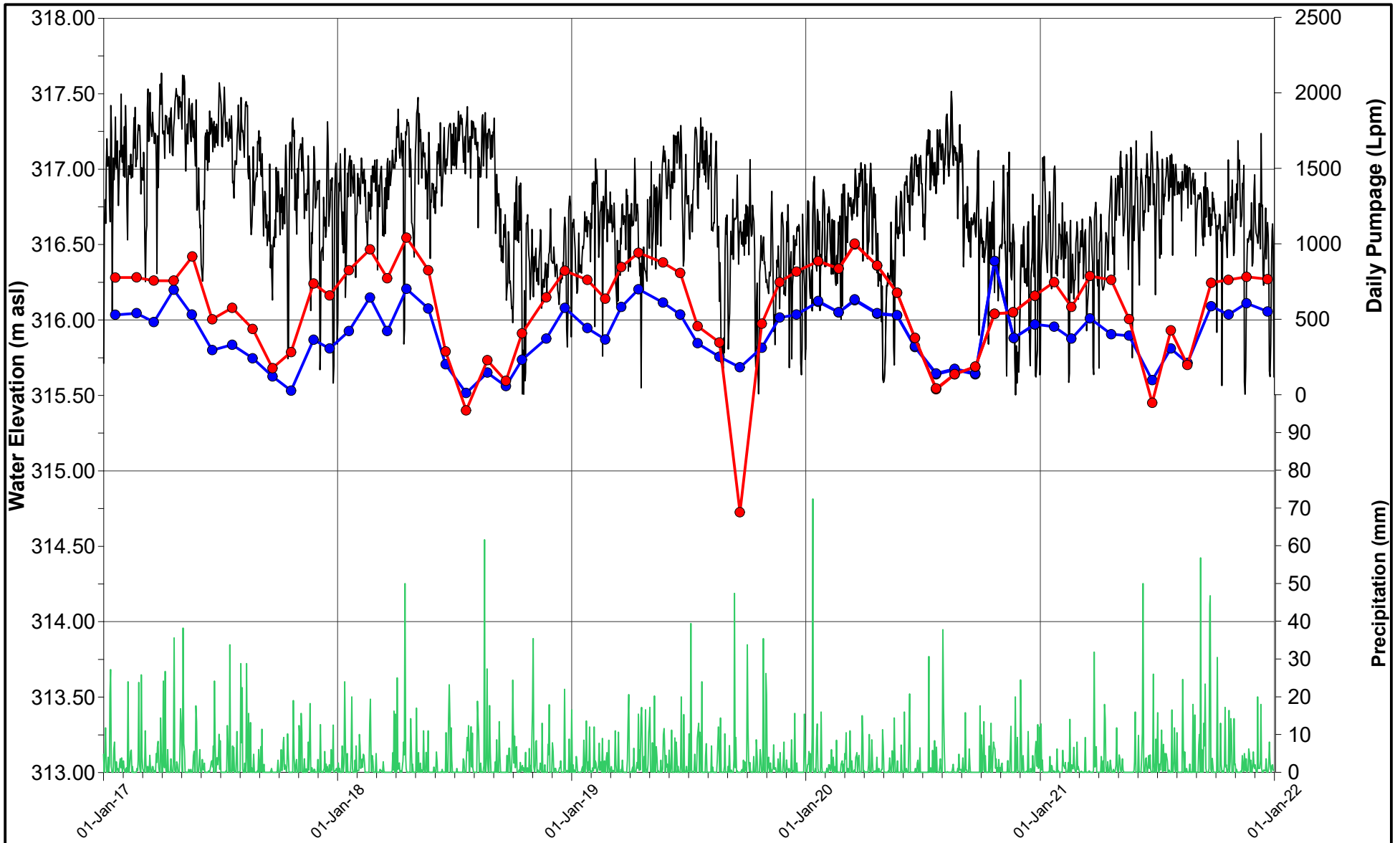


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DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**UPPER BEDROCK HYDROGRAPHS**  
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<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> D27
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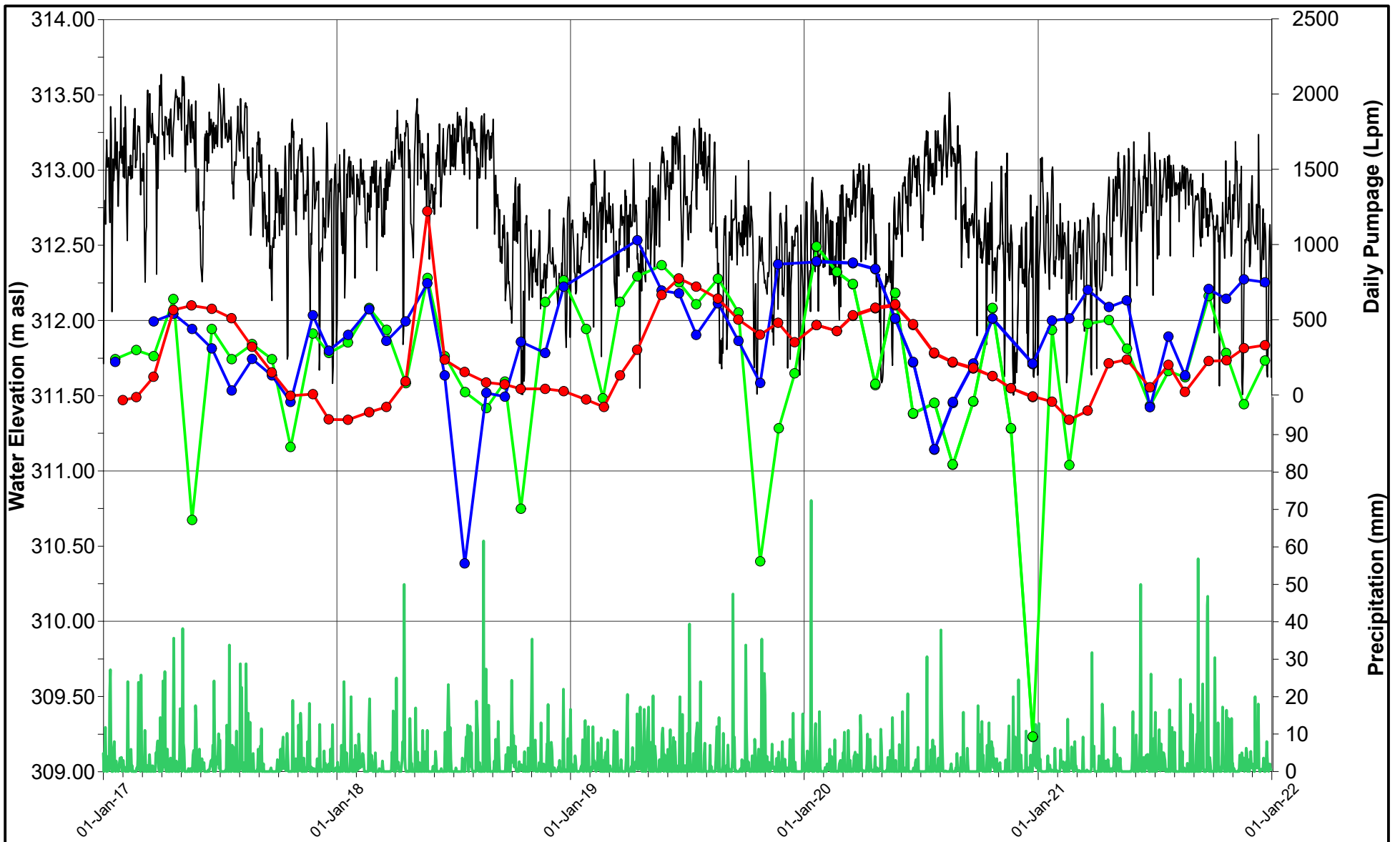


- Precipitation (mm)
- Daily Pumpage (Lpm)
- 2 Brock Rd N
- 7404 County Rd 34 (67-07589)
- Precipitation



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PROJECT	<b>BLUE TRITON BRANDS</b> Town of Aberfoyle, Ontario		
TITLE	<b>UPPER BEDROCK HYDROGRAPHS</b> <b>2021 ANNUAL MONITORING REPORT</b>		
PROJECT NO.	20449101 (1100)	REV	A
		FIGURE	D28



- Precipitation (mm)
- Daily Pumpage (Lpm)
- 58 Brock Rd S
- 8 Mapleleaf Lane
- Dufferin Pit (Y Well)

Note: Well at 58 Brock Rd S was pumping during the December 2020 measurement



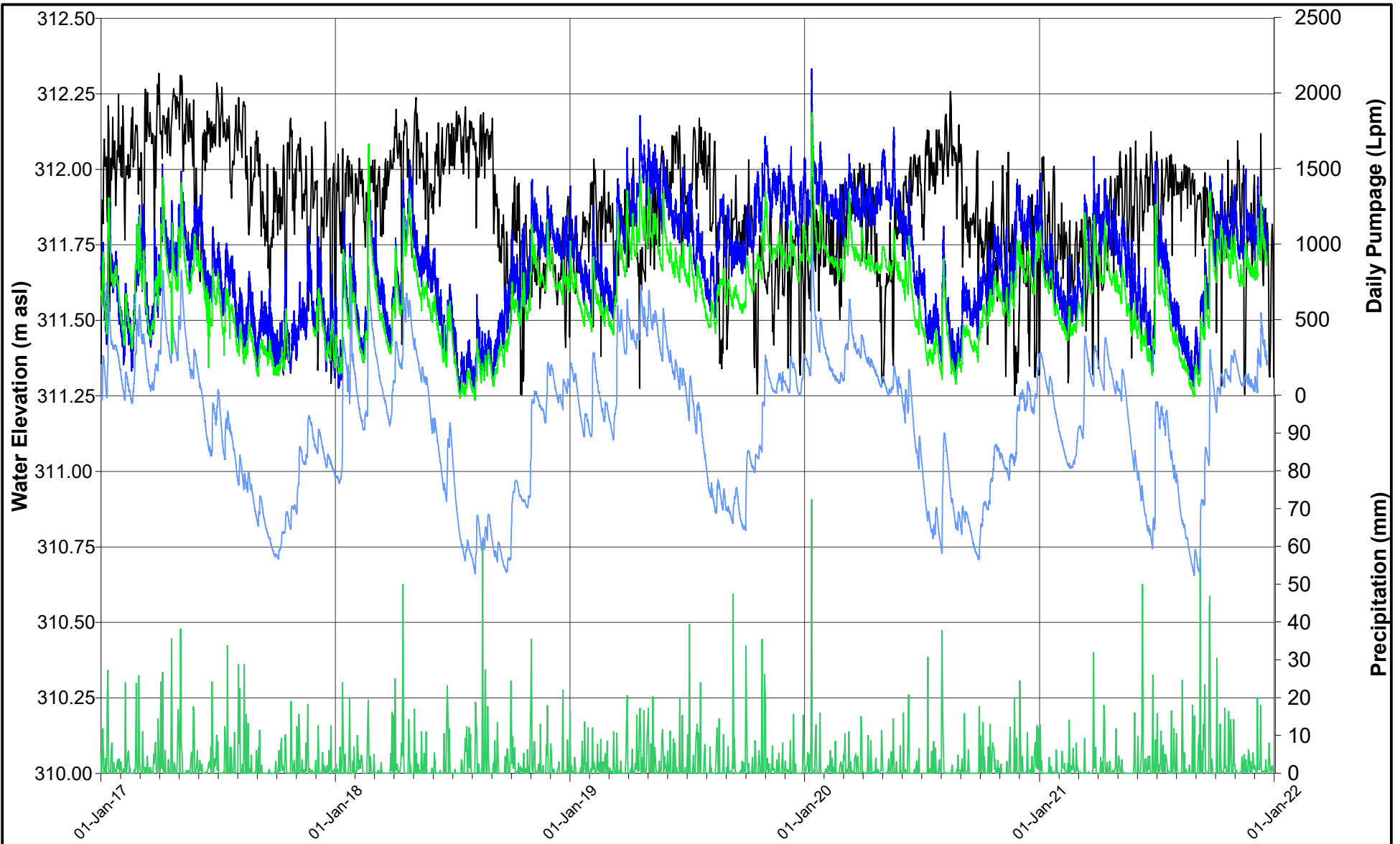
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DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**UPPER BEDROCK HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO. 20449101 (1100)	REV A	FIGURE D29
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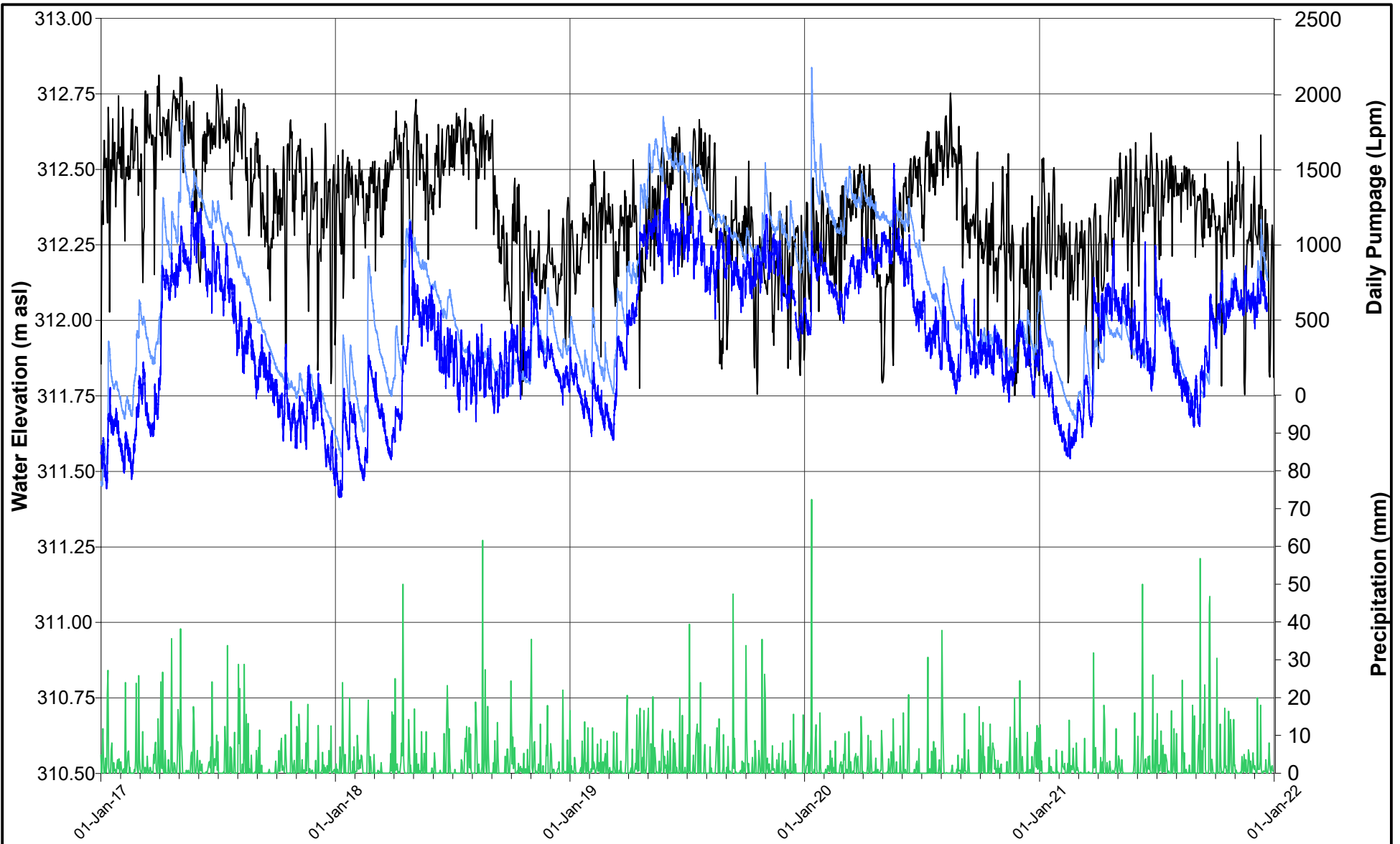


- Precipitation (mm)
- Daily Pumpage (Lpm)
- MW2D-07
- MW-S
- MW2E-07



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<b>PROJECT</b>		<b>BLUE TRITON BRANDS</b> Town of Aberfoyle, Ontario	
<b>TITLE</b>		<b>OVERBURDEN HYDROGRAPHS</b> <b>2021 ANNUAL MONITORING REPORT</b>	
<b>PROJECT NO.</b>	<b>REV</b>	<b>FIGURE</b>	
20449101 (1100)	A	D30	



- Precipitation (mm)
- Daily Pumpage (Lpm)
- TW1-99
- MW4C-07

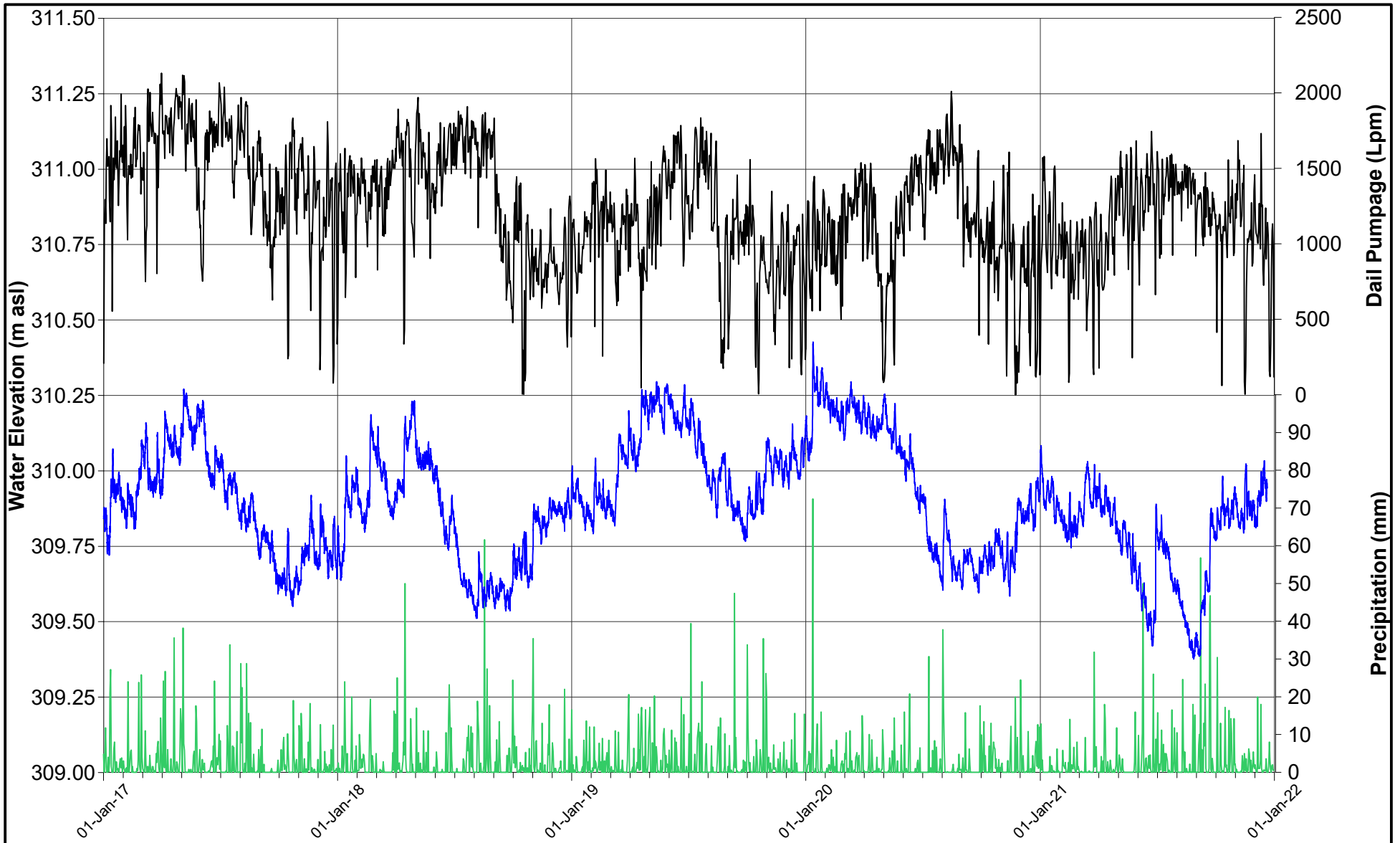


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DESIGN	KS
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APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**OVERBURDEN HYDROGRAPHS**  
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<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> D31
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— Precipitation (mm)  
— Daily Pumpage (Lpm)  
— TW1-93

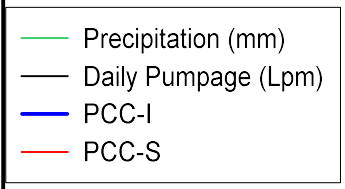
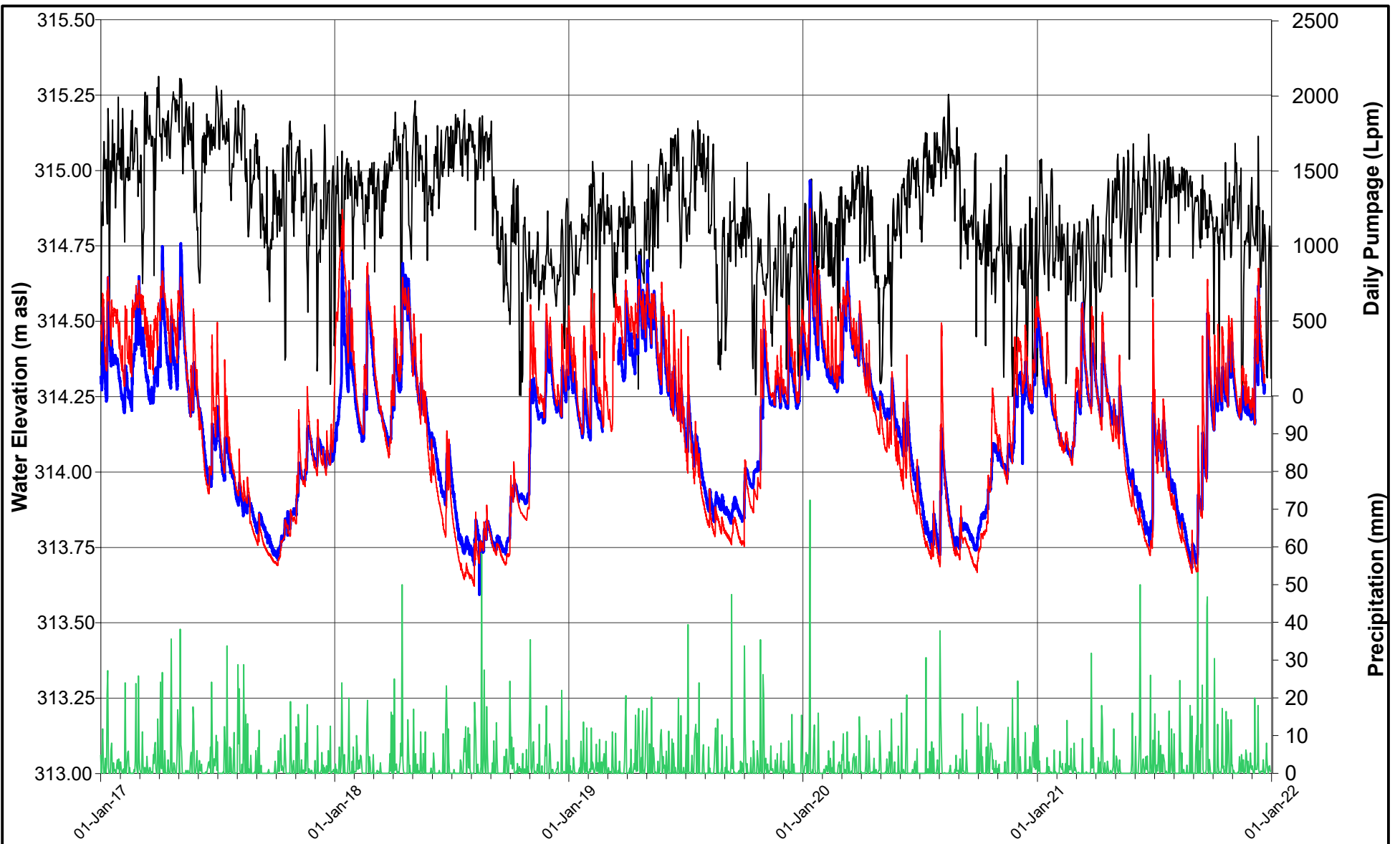
PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **OVERBURDEN HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**



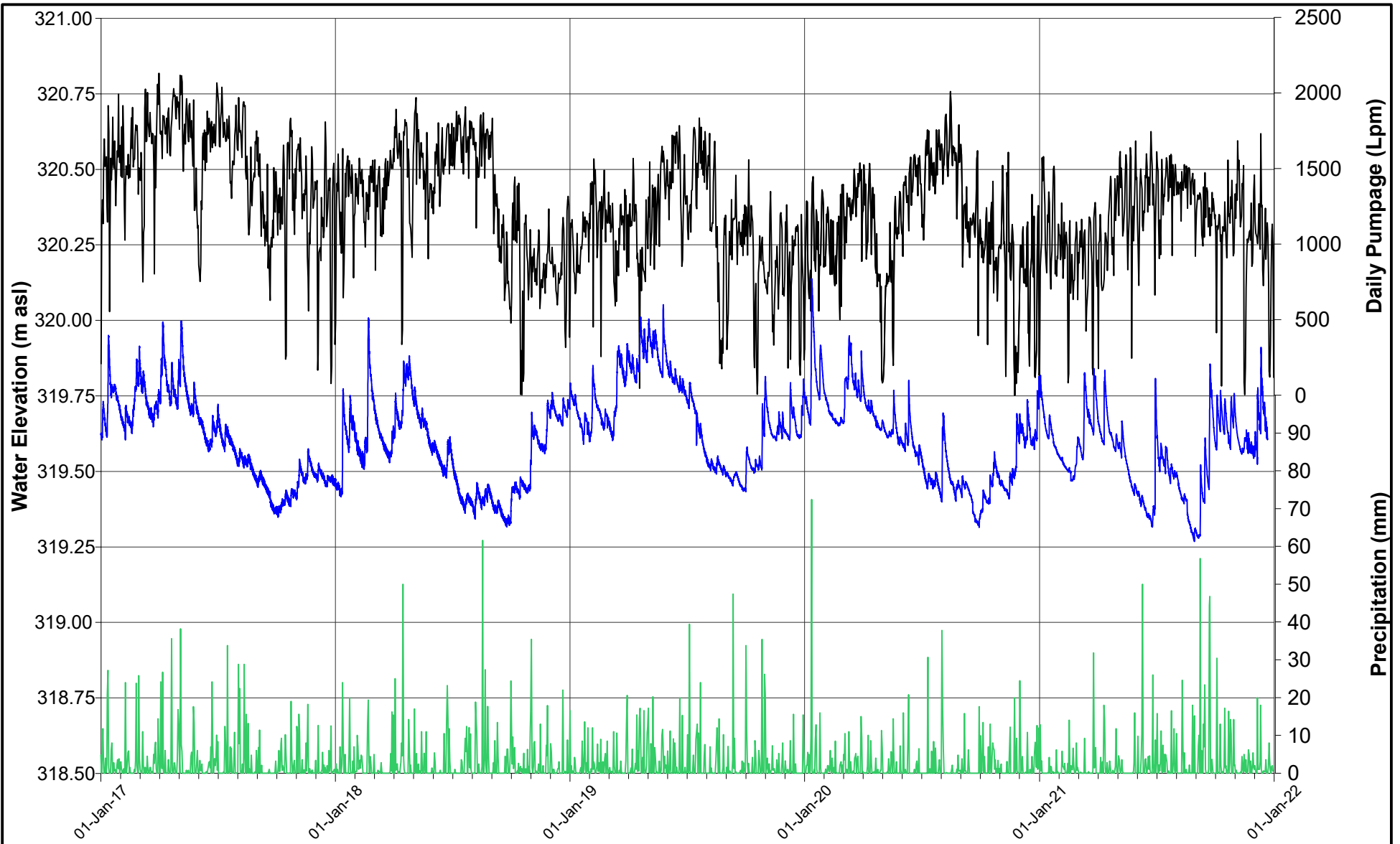
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 APPROVED GP

PROJECT NO. 20449101 (1100)      REV A      FIGURE D32



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PROJECT	<b>BLUE TRITON BRANDS</b> Town of Aberfoyle, Ontario		
TITLE	<b>OVERBURDEN HYDROGRAPHS</b> <b>2021 ANNUAL MONITORING REPORT</b>		
PROJECT NO.	20449101 (1100)	REV	A
		FIGURE	D33



— Precipitation (mm)  
— Daily Pumpage (Lpm)  
— MW10A-09

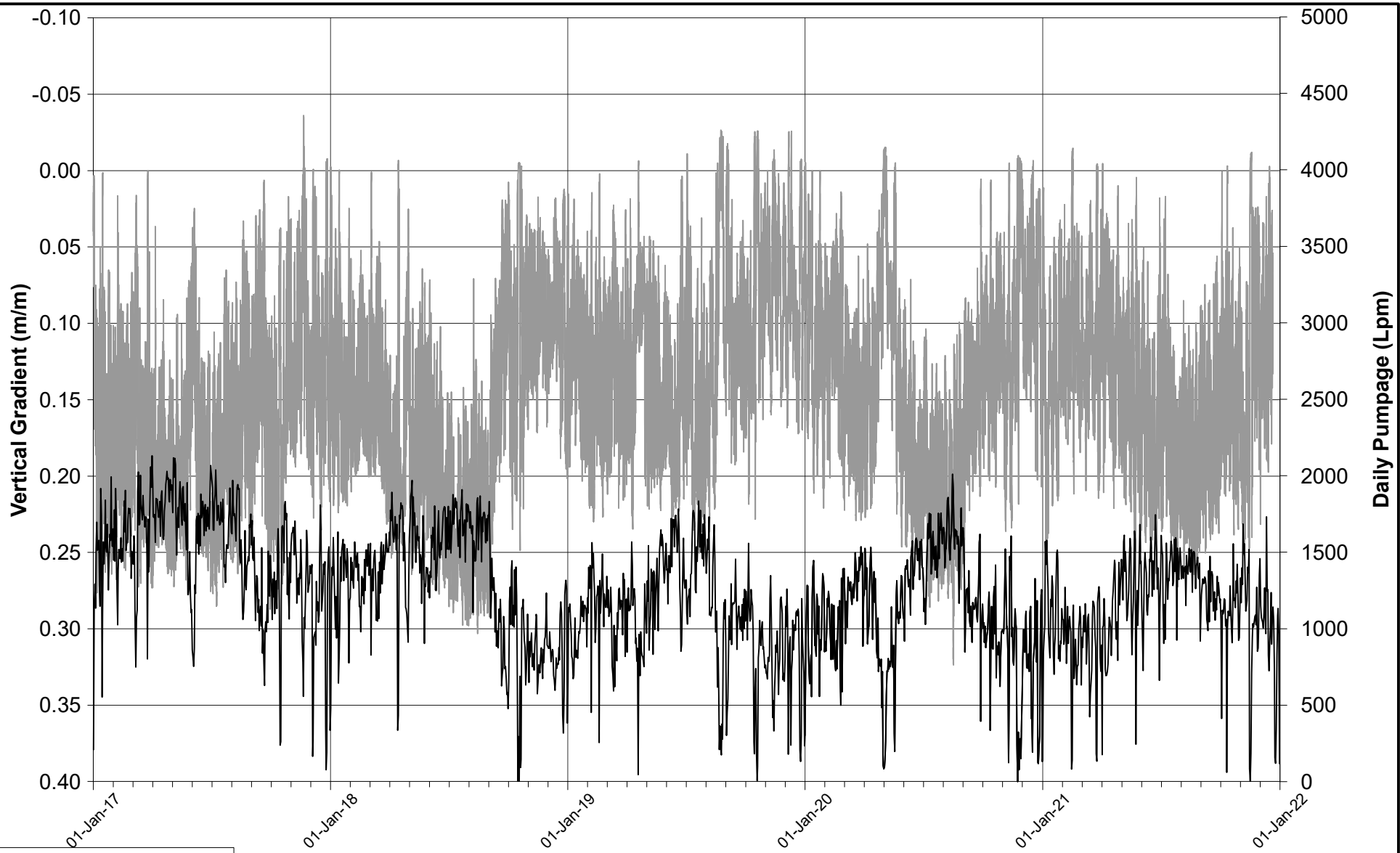


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PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **OVERBURDEN HYDROGRAPHS**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D34



— Vertical Gradient (m/m)  
 — Daily Pumpage (Lpm)

Note: Vertical gradient between MW2C-07 and MW2A-07

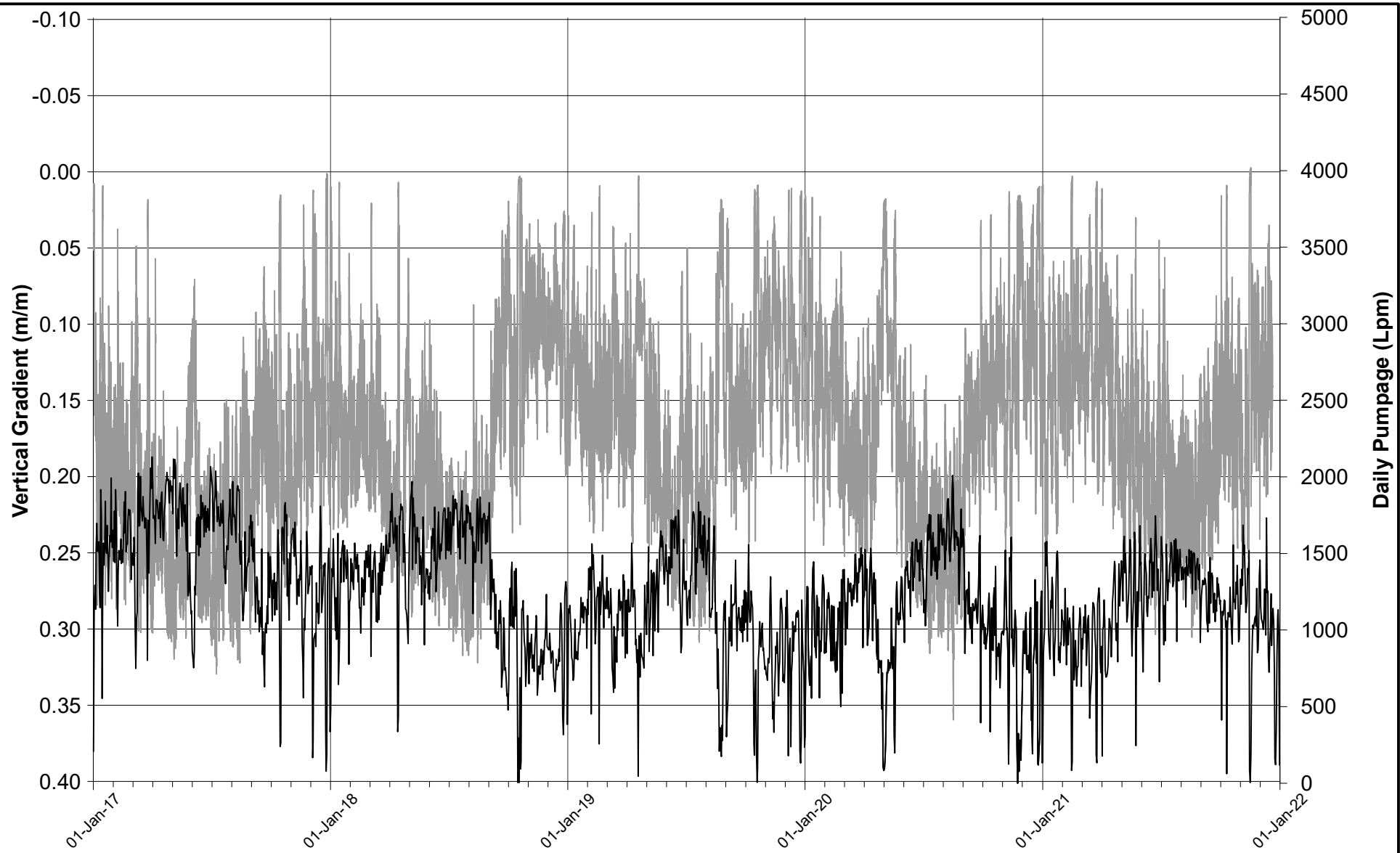
PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **MW2-07 VERTICAL GRADIENT**  
**2021 ANNUAL MONITORING REPORT**



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PROJECT NO. 20449101 (1100)      REV A      FIGURE D35



— Vertical Gradient (m/m)  
 — Daily Pumpage (Lpm)

Note: Vertical gradient between MW4B-07 and MW4A-07

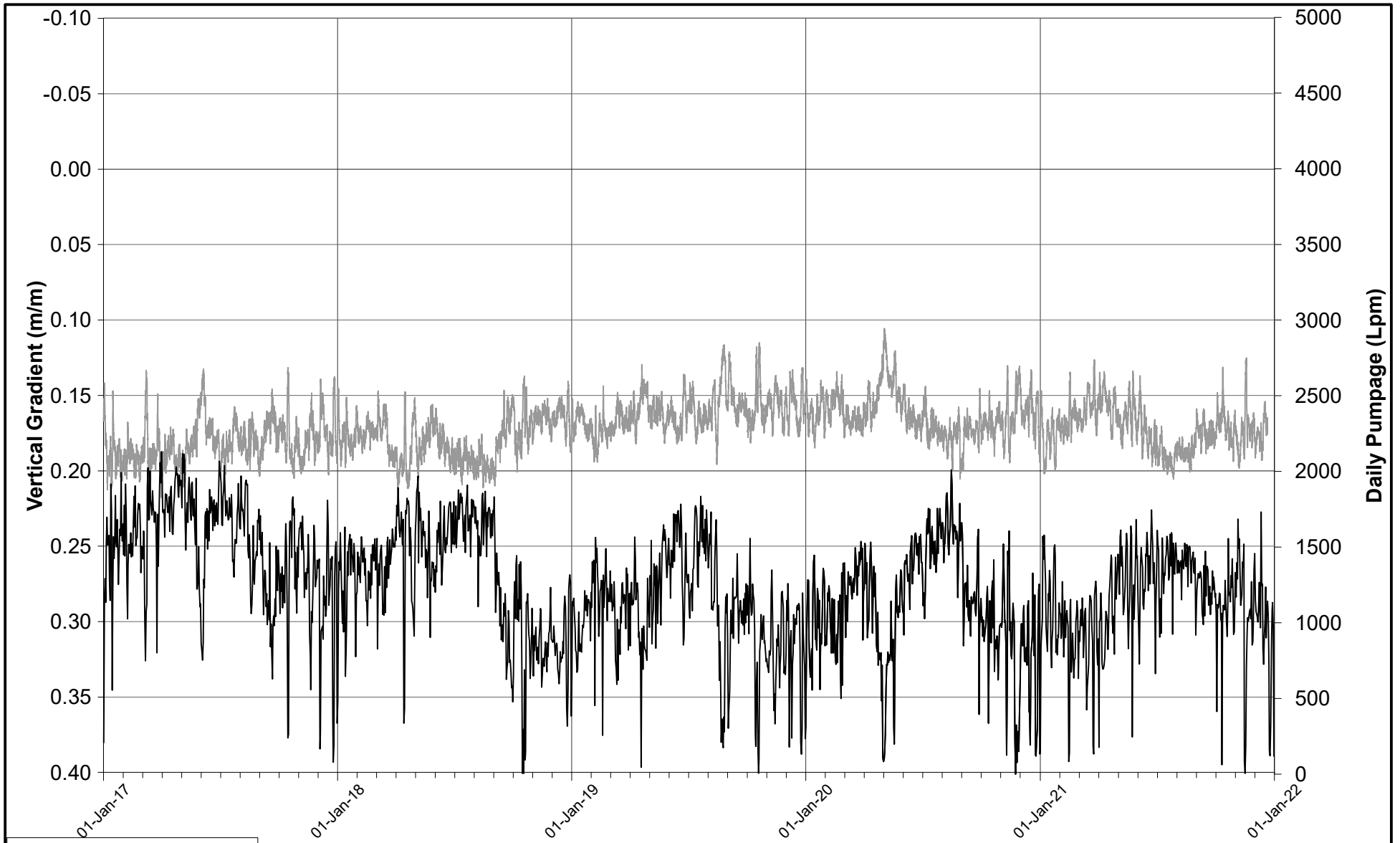
PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **MW4-07 VERTICAL GRADIENT**  
**2021 ANNUAL MONITORING REPORT**



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PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D36



— Vertical Gradient (m/m)  
 — Daily Pumpage (Lpm)

PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

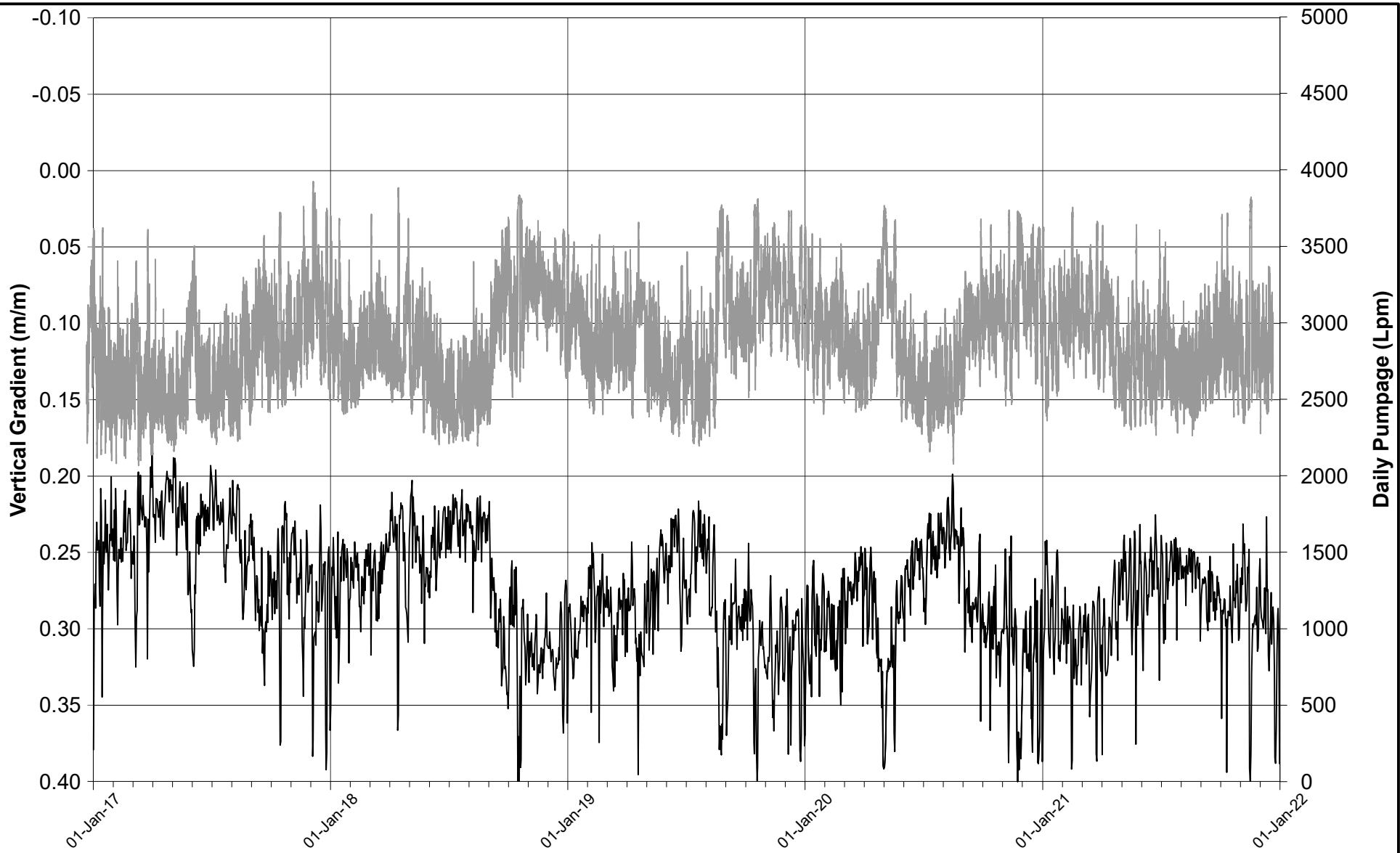
TITLE **MW6-08 VERTICAL GRADIENT**  
**2021 ANNUAL MONITORING REPORT**



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PROJECT NO. 20449101 (1100)      REV A      FIGURE D37





— Vertical Gradient (m/m)  
 — Daily Pumpage (Lpm)

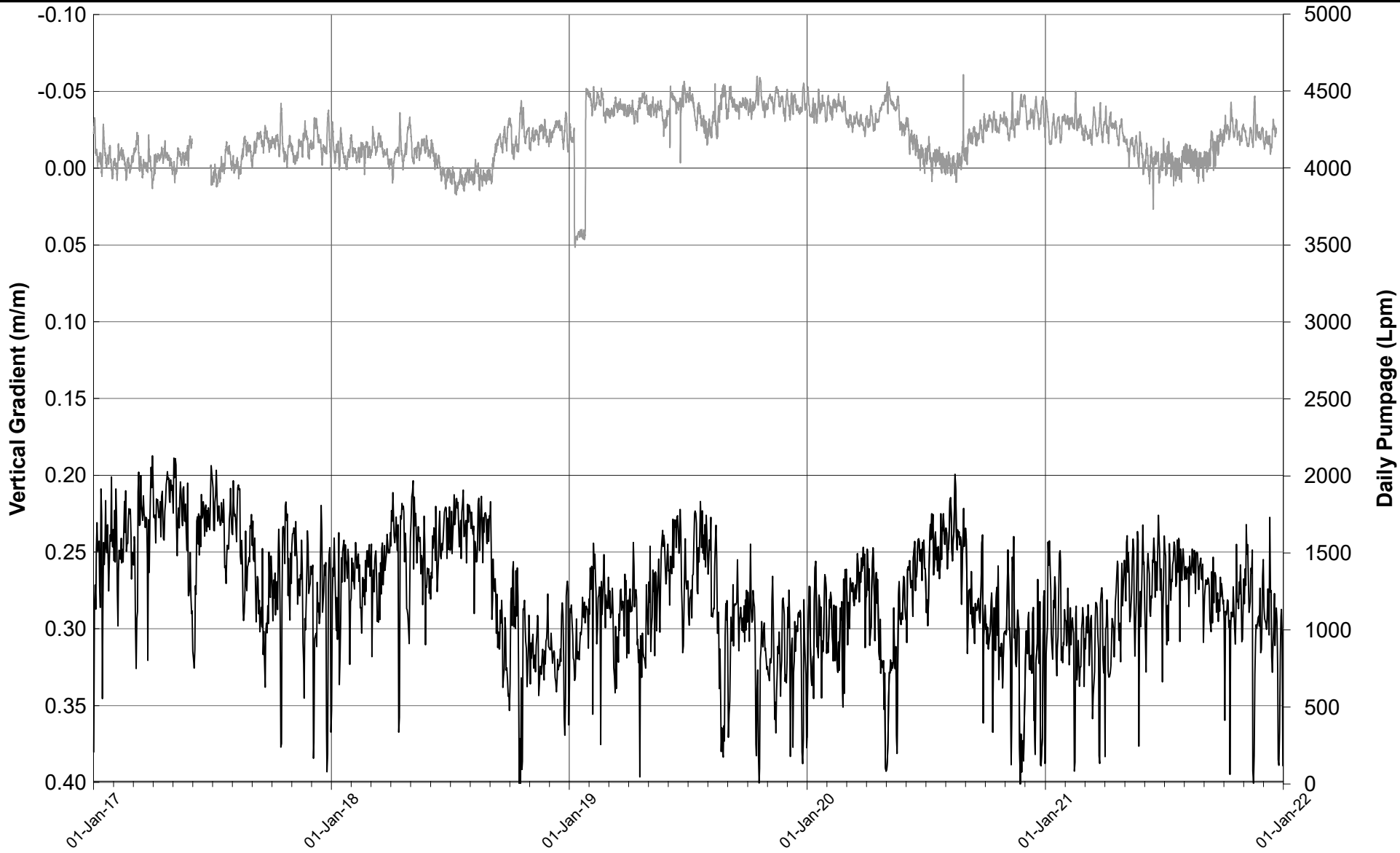
PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **MW7-08 VERTICAL GRADIENT**  
**2021 ANNUAL MONITORING REPORT**



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 DESIGN KS  
 REVIEW GP  
 APPROVED GP

PROJECT NO. 20449101 (1100)      REV A      FIGURE D38



— Vertical Gradient (m/m)  
 — Daily Pumpage (Lpm)

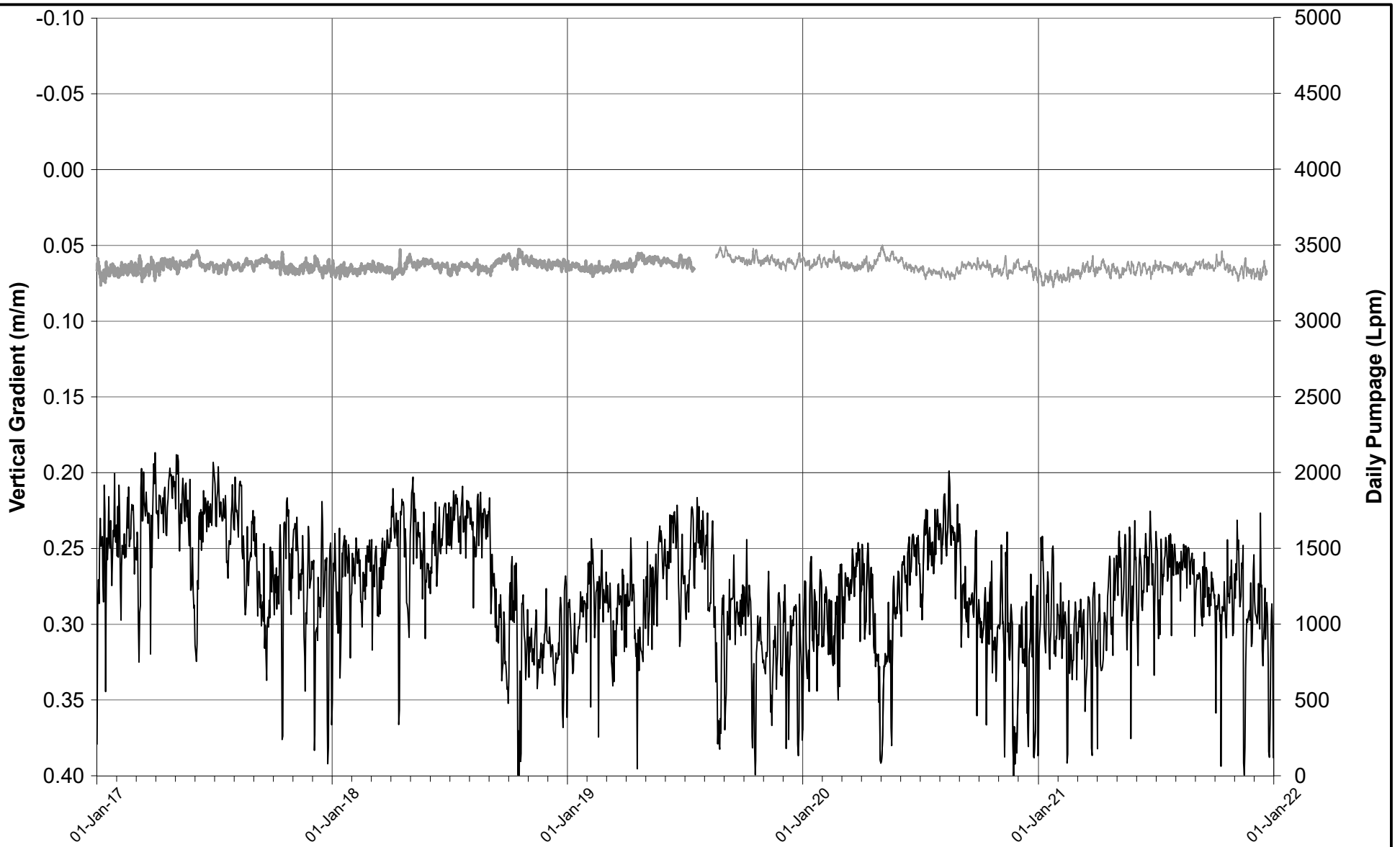
PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **MW8-08 VERTICAL GRADIENT**  
**2021 ANNUAL MONITORING REPORT**



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 DESIGN KS  
 REVIEW GP  
 APPROVED GP

PROJECT NO. 20449101 (1100)      REV A      FIGURE D39



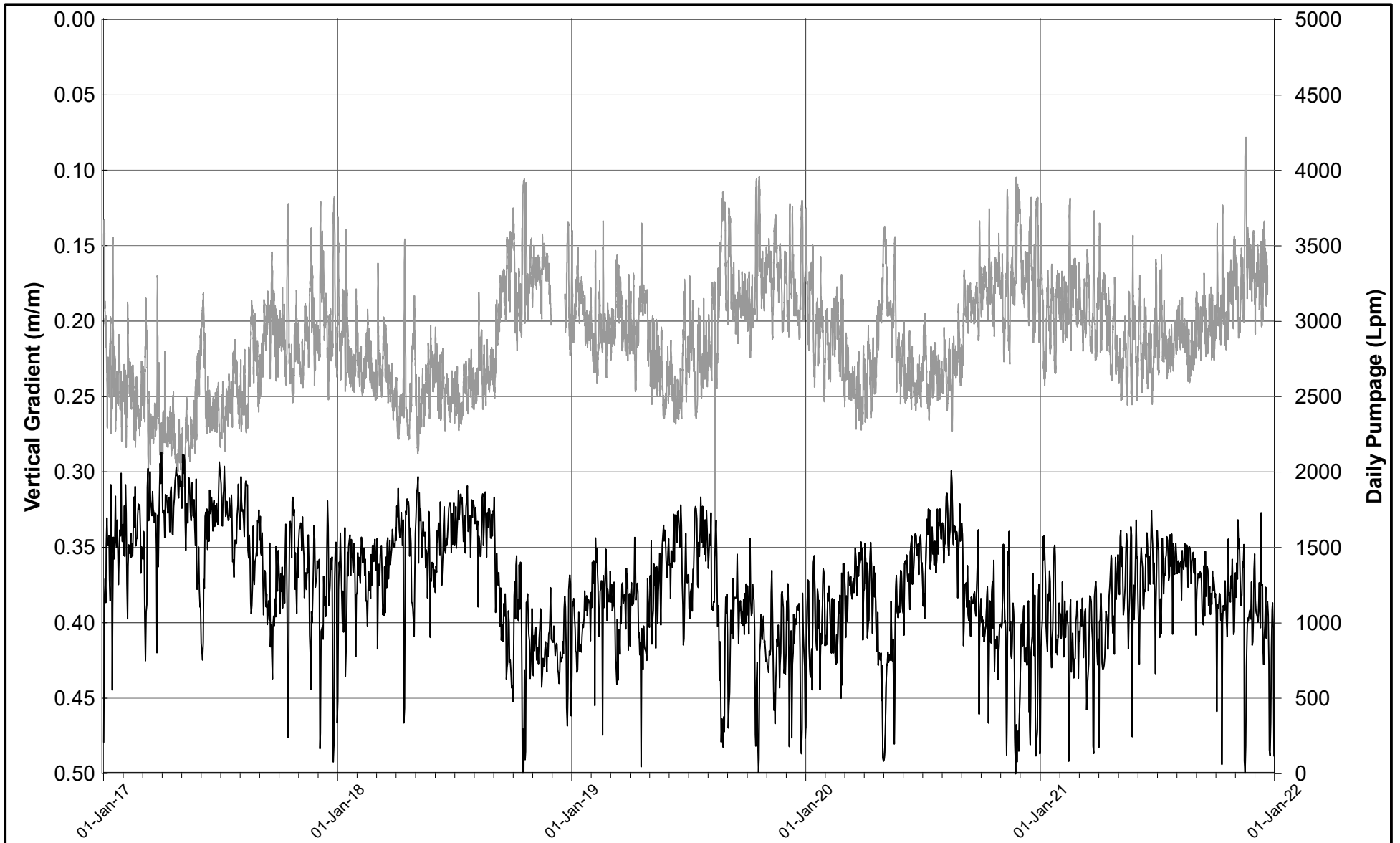
— Vertical Gradient (m/m)  
 — Daily Pumpage (Lpm)

Note: Vertical gradient between MW10B-09 and MW10C-09



DATE	DECEMBER 2021
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PROJECT	<b>BLUE TRITON BRANDS</b> Town of Aberfoyle, Ontario		
TITLE	<b>MW10-09 VERTICAL GRADIENT</b> <b>2021 ANNUAL MONITORING REPORT</b>		
PROJECT NO.	20449101 (1100)	REV	A
		FIGURE	D40



— Vertical Gradient (m/m)  
 — Daily Pumpage (Lpm)

Note: Vertical gradient between MW14C-11 and MW14A-11

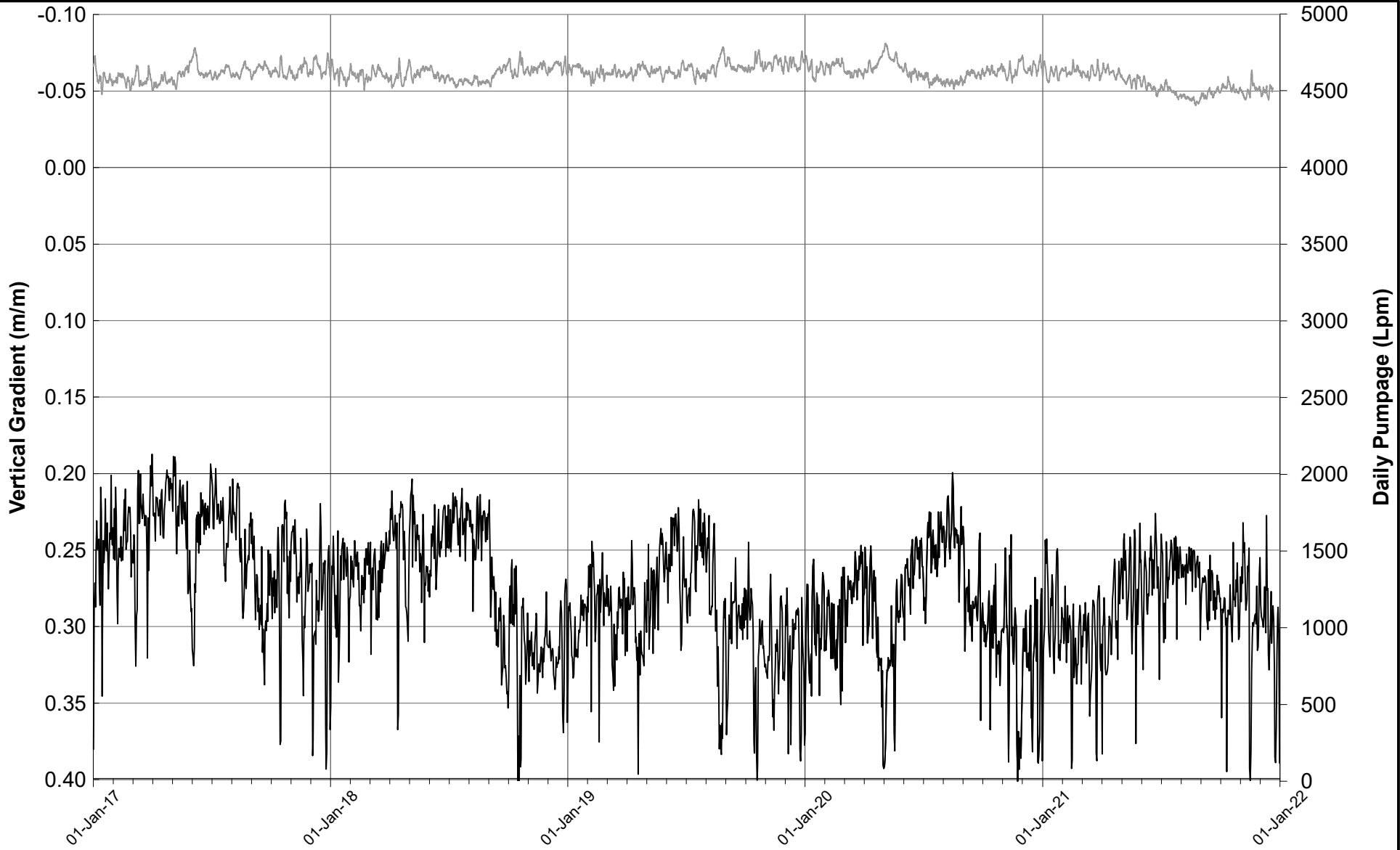


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PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **MW14-11 VERTICAL GRADIENT**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	D41



— Daily Pumpage (Lpm)  
 — Vertical gradient (m/m)

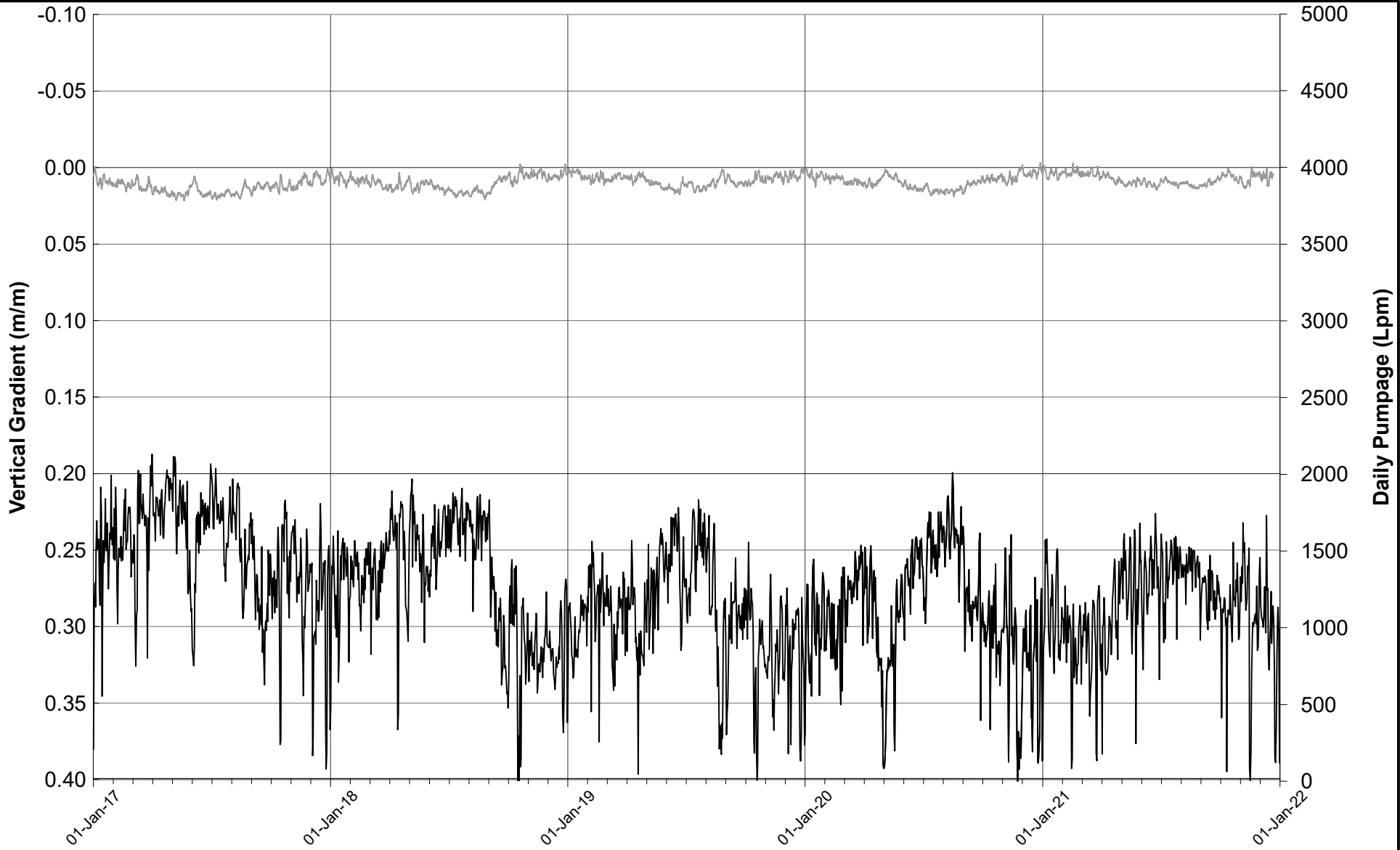
PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **MW15-12 VERTICAL GRADIENT**  
**2021 ANNUAL MONITORING REPORT**



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 DESIGN KS  
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PROJECT NO. 20449101 (1100)      REV A      FIGURE D42



— Daily Pumpage (Lpm)  
 — Vertical Gradient (m/m)

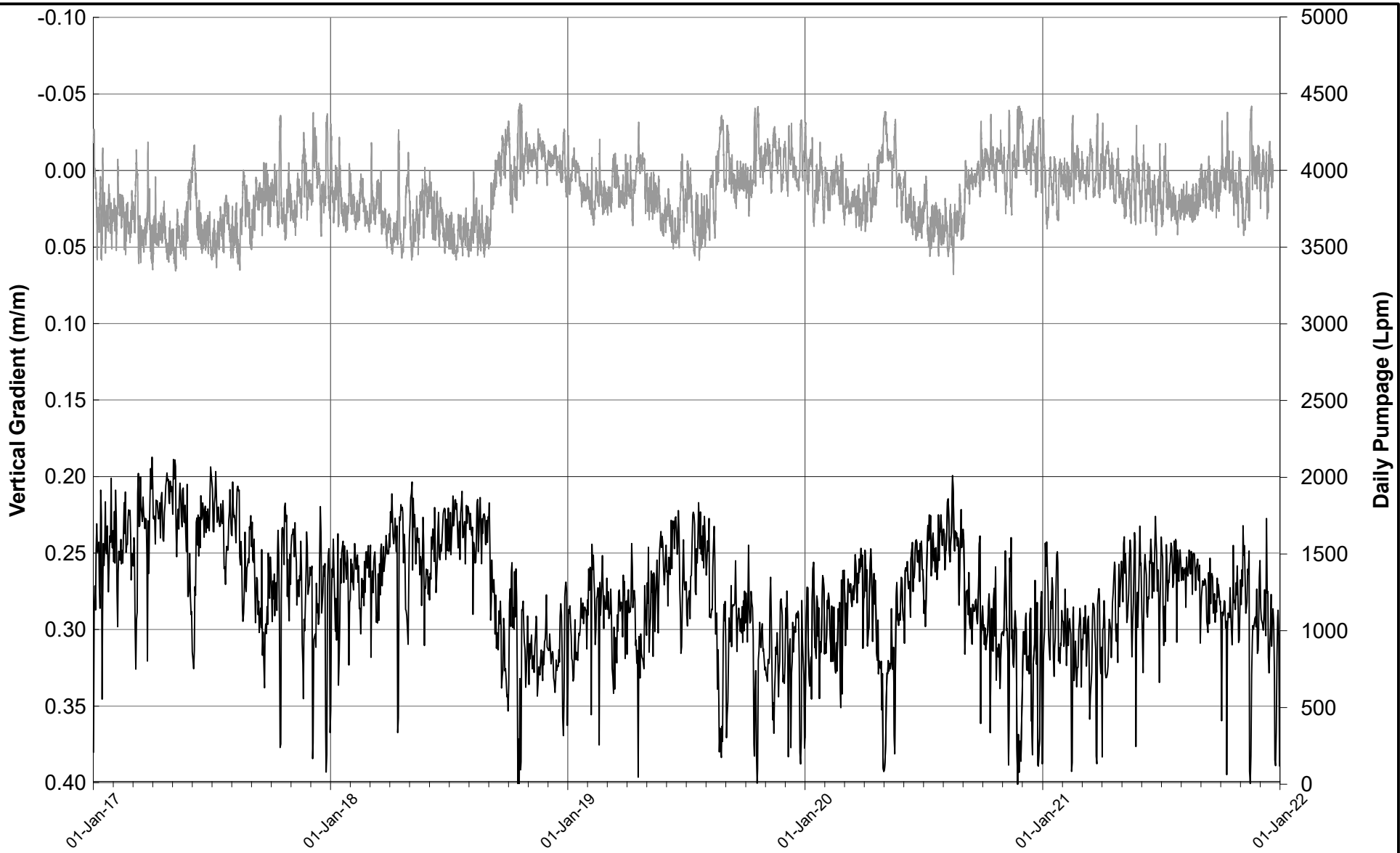
PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **MW16-12 VERTICAL GRADIENT**  
**2021 ANNUAL MONITORING REPORT**



DATE DECEMBER 2021  
 DESIGN KS  
 REVIEW GP  
 APPROVED GP

PROJECT NO. 20449101 (1100)      REV A      FIGURE D43



— Daily Pumpage (Lpm)  
 — Vertical Gradient (m/m)

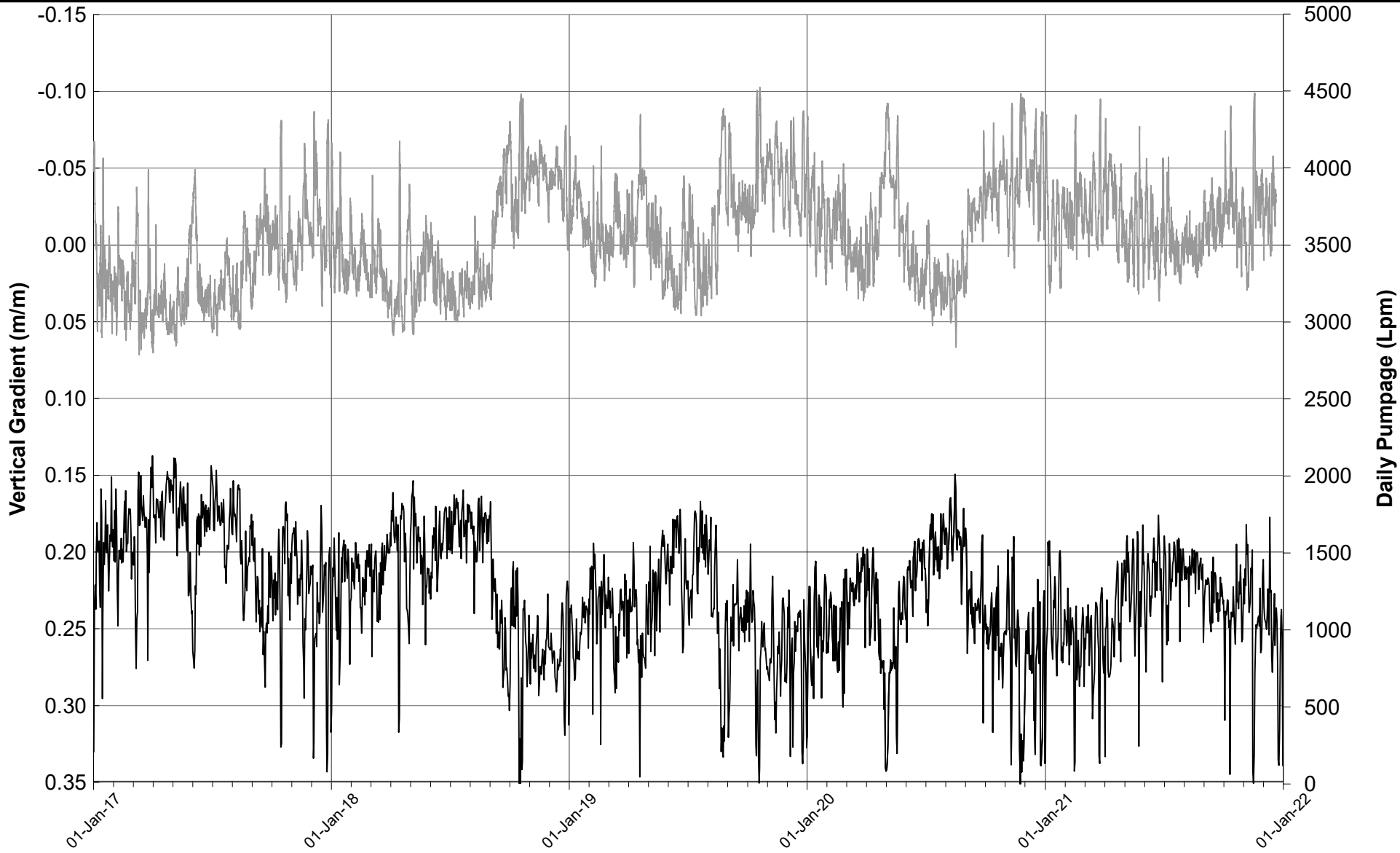
PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **MW17-12 VERTICAL GRADIENT**  
**2021 ANNUAL MONITORING REPORT**



DATE DECEMBER 2021  
 DESIGN KS  
 REVIEW GP  
 APPROVED GP

PROJECT NO. 20449101 (1100)      REV A      FIGURE D44



— Daily Pumpage (Lpm)  
 — Vertical Gradient (m/m)

PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **MW18-12 VERTICAL GRADIENT**  
**2021 ANNUAL MONITORING REPORT**



DATE DECEMBER 2021  
 DESIGN KS  
 REVIEW GP  
 APPROVED GP

PROJECT NO. 20449101 (1100)      REV A      FIGURE D45



**TABLE D1**  
**Manual Groundwater Elevations**  
**2021 Annual Report**

Date	Water Level (masl)							
	TW3-80	MW2A-07	MW2B-07	MW2C-07	MW2D-07	MW2E-07	MW4A-07	MW4B-07
20/22-Jan-2021	308.38	309.17	310.02	311.29	311.71	311.62	308.35	311.82
17/18-Feb-2021	303.50	307.58	308.72	310.73	311.48	311.46	309.67	311.65
18/19-Mar-2021	307.70	308.98	309.94	311.23	311.74	311.68	308.65	311.74
20/21-Apr-2021	306.81	308.93	309.72	311.19	311.78	311.64	308.29	311.90
18/19-May-2021	310.59	310.30	310.64	311.35	311.74	311.55	309.84	311.93
24/25-Jun-2021	300.08	306.71	308.22	310.53	311.40	311.33	307.65	311.74
21/23-Jul-2021	304.01	307.59	308.65	310.84	311.63	311.53	307.90	311.91
18/19-Aug-2021	303.74	307.05	308.36	310.64	311.40	311.33	307.89	311.75
23/24-Sep-2021	306.73	307.75	309.03	311.18	311.92	311.89	308.98	311.94
21/22-Oct-2021	303.32	307.91	308.95	311.12	311.77	311.72	308.21	312.01
18/19-Nov-2021	306.90	308.25	309.10	311.17	311.79	311.68	308.23	312.04
20/21-Dec-2021	308.25	310.33	310.47	311.49	311.87	311.70	309.66	312.12

**TABLE D1**  
**Manual Groundwater Elevations**  
**2021 Annual Report**

Date	Water Level (masl)							
	MW4C-07	MW6A-08	MW6B-08	MW7A-08	MW7B-08	MW8A-08	MW8B-08	MW10A-09
20/22-Jan-2021	311.88	315.18	318.35	308.63	310.57	FROZEN	317.30	319.60
17/18-Feb-2021	311.70	315.19	318.27	310.03	311.19	FROZEN	317.20	319.50
18/19-Mar-2021	311.81	315.63	318.37	309.13	310.86	317.73	317.34	319.66
20/21-Apr-2021	311.96	315.37	318.37	308.92	310.80	317.65	317.32	319.63
18/19-May-2021	311.94	315.72	318.24	309.80	311.19	317.50	317.22	319.50
24/25-Jun-2021	311.83	314.80	318.21	307.18	309.59	316.87	316.97	319.32
21/23-Jul-2021	311.96	314.91	318.33	308.74	310.49	317.18	317.16	319.50
18/19-Aug-2021	311.80	314.95	318.31	308.05	310.04	317.22	317.09	319.40
23/24-Sep-2021	312.07	315.73	318.66	309.82	311.23	317.81	317.47	319.76
21/22-Oct-2021	312.06	315.65	318.57	308.58	310.76	317.81	317.33	319.63
18/19-Nov-2021	312.07	316.27	318.50	308.49	311.32	318.11	317.37	319.60
20/21-Dec-2021	312.14	315.47	318.48	309.73	311.39	317.72	317.35	319.61

**TABLE D1**  
**Manual Groundwater Elevations**  
**2021 Annual Report**

Date	Water Level (masl)							
	MW10B-09	MW10C-09	MW10D-09	MW14A-11	MW14B-11	MW14C-11	MW15A-12	MW15B-12
20/22-Jan-2021	319.66	316.57	315.87	309.72	313.79	314.26	310.51	308.26
17/18-Feb-2021	319.57	316.53	315.86	310.26	313.67	314.10	310.45	308.24
18/19-Mar-2021	319.69	316.86	316.23	310.05	313.93	314.42	310.55	308.35
20/21-Apr-2021	319.70	316.88	316.25	309.65	313.90	314.53	310.39	308.31
18/19-May-2021	319.64	317.08	316.43	310.43	313.81	314.40	310.22	308.26
24/25-Jun-2021	319.44	316.43	315.73	308.60	313.29	313.95	309.85	308.18
21/23-Jul-2021	319.60	316.83	316.10	309.29	313.66	314.11	310.10	308.42
18/19-Aug-2021	319.49	316.82	316.10	309.08	313.37	313.90	309.88	308.36
23/24-Sep-2021	319.75	317.14	316.52	310.46	313.95	314.22	310.28	308.57
21/22-Oct-2021	319.67	317.05	316.40	309.92	313.85	314.26	310.47	308.59
18/19-Nov-2021	319.63	317.12	316.52	312.21	314.02	314.36	310.84	308.65
20/21-Dec-2021	319.69	316.93	316.27	310.32	314.01	314.56	310.53	308.78

**TABLE D1**  
**Manual Groundwater Elevations**  
**2021 Annual Report**

Date	Water Level (masl)							
	MW16A-12	MW16B-12	MW17A-12	MW17B-12	MW18A-12	MW18B-12	MW-D	MW-I
20/22-Jan-2021	306.89	307.01	308.09	308.58	308.35	307.89	311.06	311.03
17/18-Feb-2021	306.86	306.96	308.47	308.49	307.80	307.86	310.70	310.66
18/19-Mar-2021	306.89	307.03	308.39	308.52	308.70	307.94	310.82	311.24
20/21-Apr-2021	306.87	307.14	307.97	308.44	307.59	307.60	310.99	310.95
18/19-May-2021	306.81	307.09	308.51	308.41	308.20	307.49	311.06	311.03
24/25-Jun-2021	306.53	306.95	308.70	308.18	306.64	307.22	310.48	310.41
21/23-Jul-2021	306.68	307.03	307.56	308.42	307.53	307.41	310.86	310.82
18/19-Aug-2021	306.51	306.88	307.40	308.16	307.12	307.26	310.06	310.45
23/24-Sep-2021	306.75	307.03	308.60	308.62	307.72	307.41	311.08	311.03
21/22-Oct-2021	306.84	306.98	308.35	308.44	307.74	307.47	311.01	310.98
18/19-Nov-2021	307.01	307.02	309.52	308.44	308.45	307.54	310.97	310.91
20/21-Dec-2021	307.50	307.05	308.50	308.53	308.32	307.69	311.22	311.17

**TABLE D1**  
**Manual Groundwater Elevations**  
**2021 Annual Report**

Date	Water Level (masl)							
	MW-S	PCC-D	PCC-I	PCC-S	TW1-93	TW1-99	TW2-11	PW5 Meadows of Aberfoyle
20/22-Jan-2021	311.26	314.54	314.23	314.26	309.93	311.76	309.37	309.06
17/18-Feb-2021	311.00	FROZEN	314.06	314.07	309.76	311.54	310.06	310.34
18/19-Mar-2021	311.36	314.60	314.28	314.29	309.80	311.74	309.63	309.36
20/21-Apr-2021	311.34	314.57	314.23	314.25	309.82	307.03	309.36	309.13
18/19-May-2021	311.19	314.41	314.07	313.99	309.76	312.09	310.05	310.67
24/25-Jun-2021	310.75	314.04	313.77	313.73	309.43	311.81	308.68	308.49
21/23-Jul-2021	311.10	314.32	314.01	313.96	309.71	312.03	309.42	309.02
18/19-Aug-2021	310.77	314.10	313.82	313.77	309.48	311.78	309.08	308.85
23/24-Sep-2021	311.40	314.68	314.41	314.51	309.85	312.04	309.60	309.56
21/22-Oct-2021	311.31	314.57	314.24	314.27	309.85	312.04	309.46	309.16
18/19-Nov-2021	311.30	314.60	314.26	314.33	309.92	312.04	309.92	309.24
20/21-Dec-2021	311.37	314.61	314.27	314.30	309.96	312.05	310.14	310.07

**TABLE D1**  
**Manual Groundwater Elevations**  
**2021 Annual Report**

Date	Water Level (masl)							
	#125 Brock S. (Y Well)	#2 Brock N.	#27 Old Brock	#50 Brock S. (I Well)	#58 Brock S.	#7404 Rd. 34	#7425 Rd. 34 (B Well)	#8 Maple Leaf Lane
20/22-Jan-2021	311.46	315.96	308.76	NO ACCESS	311.94	316.25	309.99	312.00
17/18-Feb-2021	311.34	315.88	309.81	NO ACCESS	311.04	316.09	NO ACCESS	312.01
18/19-Mar-2021	311.40	316.01	308.95	NO ACCESS	311.98	316.29	310.42	312.20
20/21-Apr-2021	311.72	315.91	308.72	NO ACCESS	312.00	316.27	309.77	312.09
18/19-May-2021	311.74	315.90	309.84	NO ACCESS	311.81	316.01	310.59	312.13
24/25-Jun-2021	311.56	315.60	307.79	NO ACCESS	311.43	315.45	308.60	311.42
21/23-Jul-2021	311.71	315.81	308.72	NO ACCESS	311.66	315.93	309.29	311.89
18/19-Aug-2021	311.53	315.72	308.12	NO ACCESS	311.62	315.70	309.16	311.63
23/24-Sep-2021	311.73	316.09	309.56	NO ACCESS	312.16	316.25	310.77	312.21
21/22-Oct-2021	311.74	316.04	308.50	NO ACCESS	311.78	316.27	310.36	312.14
18/19-Nov-2021	311.82	316.11	308.95	NO ACCESS	311.44	316.29	312.02	312.27
20/21-Dec-2021	311.84	316.06	309.62	NO ACCESS	311.73	316.27	NO ACCESS	312.25

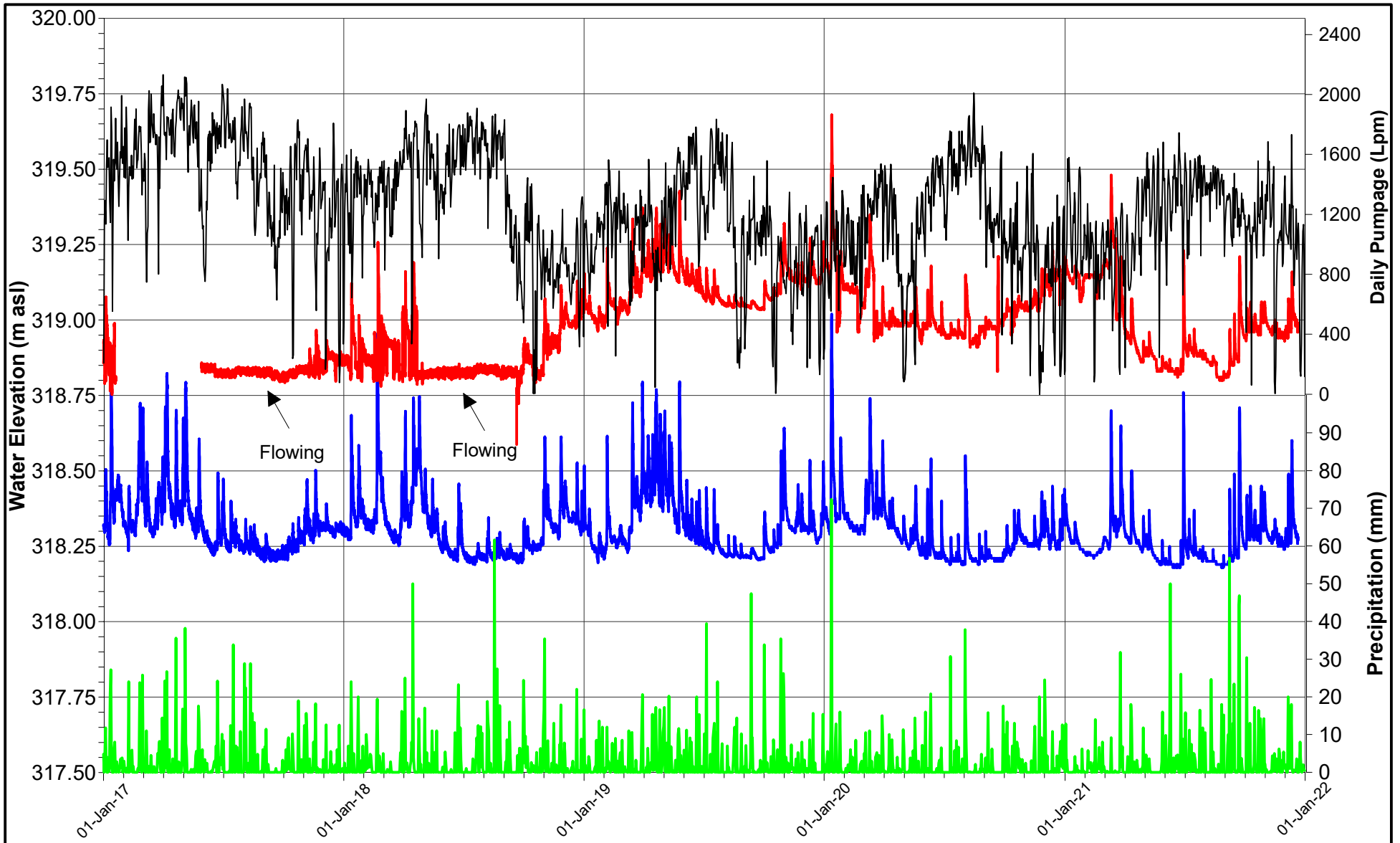
**TABLE D1**  
**Manual Groundwater Elevations**  
**2021 Annual Report**

Date	Water Level (masl)							
	#98 Brock S. (M1 Well)	Fireflow	MW19-18-4	MW19-18-7	MW20-19-5	MW20-19-7	MW21-18-3	MW21-18-4
20/22-Jan-2021	308.50	310.01	312.935	-	-	-	-	-
17/18-Feb-2021	NO ACCESS	309.63	312.840	315.24	309.34	311.30	308.15	311.07
18/19-Mar-2021	308.89	310.24	313.160	315.42	308.62	311.41	310.08	311.24
20/21-Apr-2021	308.59	309.65	312.740	315.40	308.24	311.21	307.96	311.35
18/19-May-2021	310.51	309.83	312.915	315.18	309.40	311.53	309.98	311.44
24/25-Jun-2021	308.04	309.07	311.645	314.74	307.50	310.71	308.21	311.13
21/23-Jul-2021	308.40	309.56	312.235	315.08	308.19	311.21	307.63	311.33
18/19-Aug-2021	308.31	309.04	312.155	314.86	307.65	310.87	307.64	311.16
23/24-Sep-2021	308.98	309.72	312.980	315.44	309.05	311.45	308.80	311.43
21/22-Oct-2021	308.65	309.67	313.080	315.43	308.06	311.43	307.97	311.46
18/19-Nov-2021	308.78	309.81	314.005	315.49	308.27	311.49	308.31	311.43
20/21-Dec-2021	309.88	310.02	313.040	315.43	309.13	311.76	309.08	311.57

**APPENDIX E**

# Surface Water Level Monitoring





- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP1-16 D
- MP1-16 S

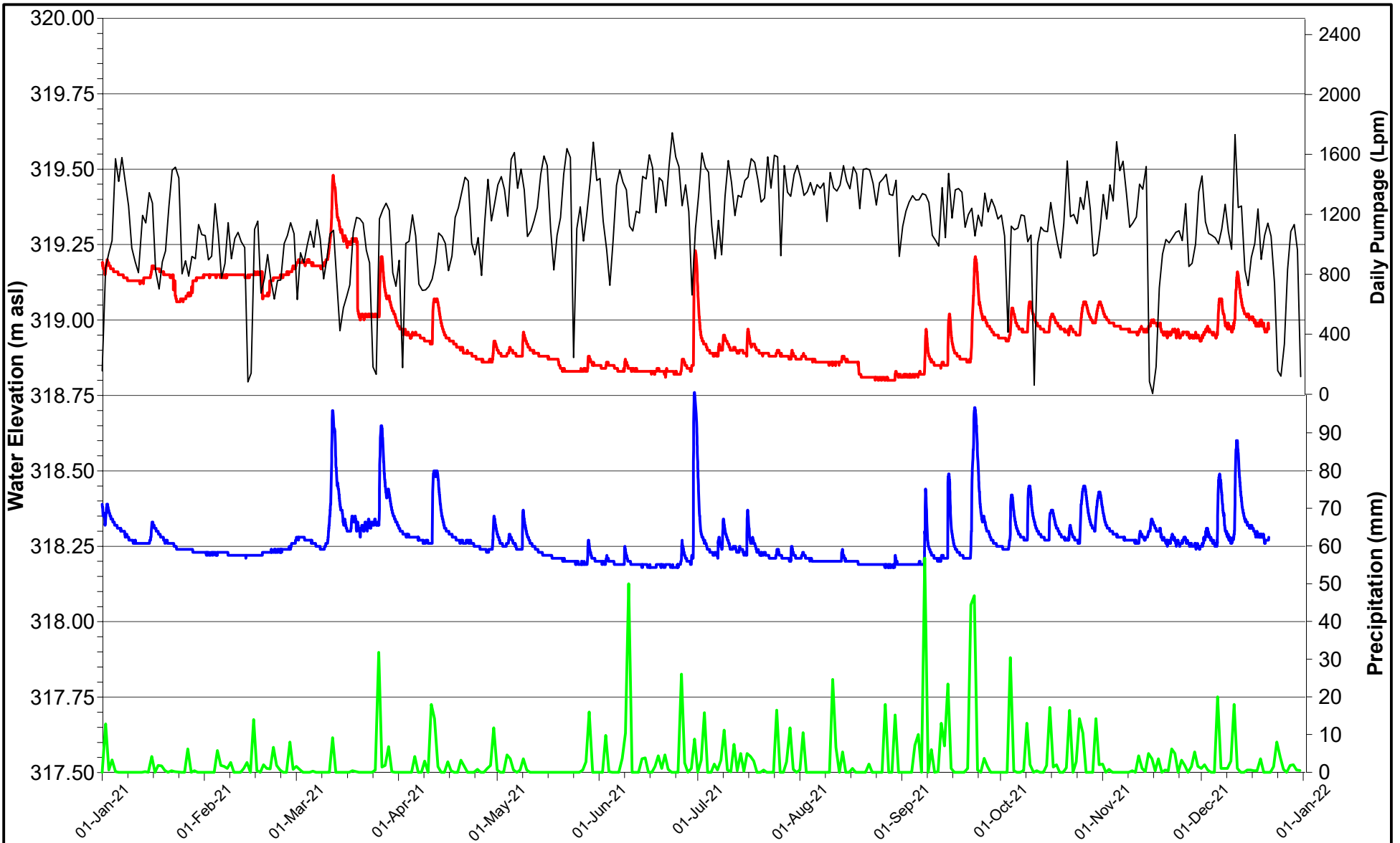
Note: MP1-16S and MP1-16D Reference elevations are taken from a topographic map.

Note: MP1-16D casing was extended September 20, 2018.



DATE	December 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

<b>PROJECT</b>		
<b>BLUE TRITON BRANDS</b> Town of Aberfoyle, Ontario		
<b>TITLE</b>		
<b>MP1-16 NEST HYDROGRAPH</b> <b>2021 ANNUAL MONITORING REPORT</b>		
<b>PROJECT NO.</b>	<b>REV</b>	<b>FIGURE</b>
20449101 (1100)	A	E1a



- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP1-16 D
- MP1-16 S

Note: MP1-16S and MP1-16D Reference elevations are taken from a topographic map.

**PROJECT**

**BLUE TRITON BRANDS**  
Town of Aberfoyle, Ontario

**TITLE**

**MP1-16 NEST HYDROGRAPH (2021)**  
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**PROJECT NO.**

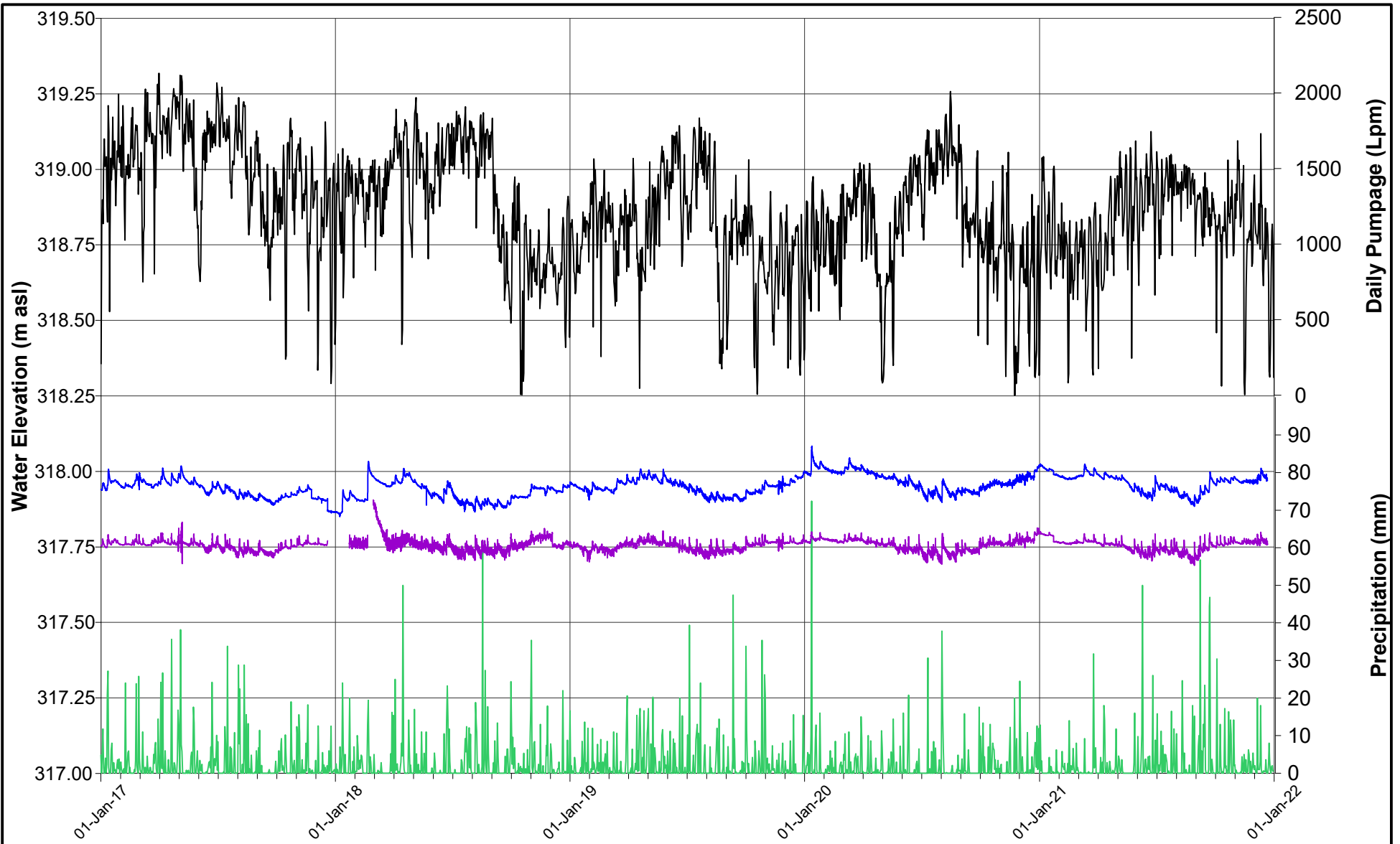
20449101 (1100)

**REV**

A

**FIGURE**

E1b



- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP11D-04
- MP11S-08

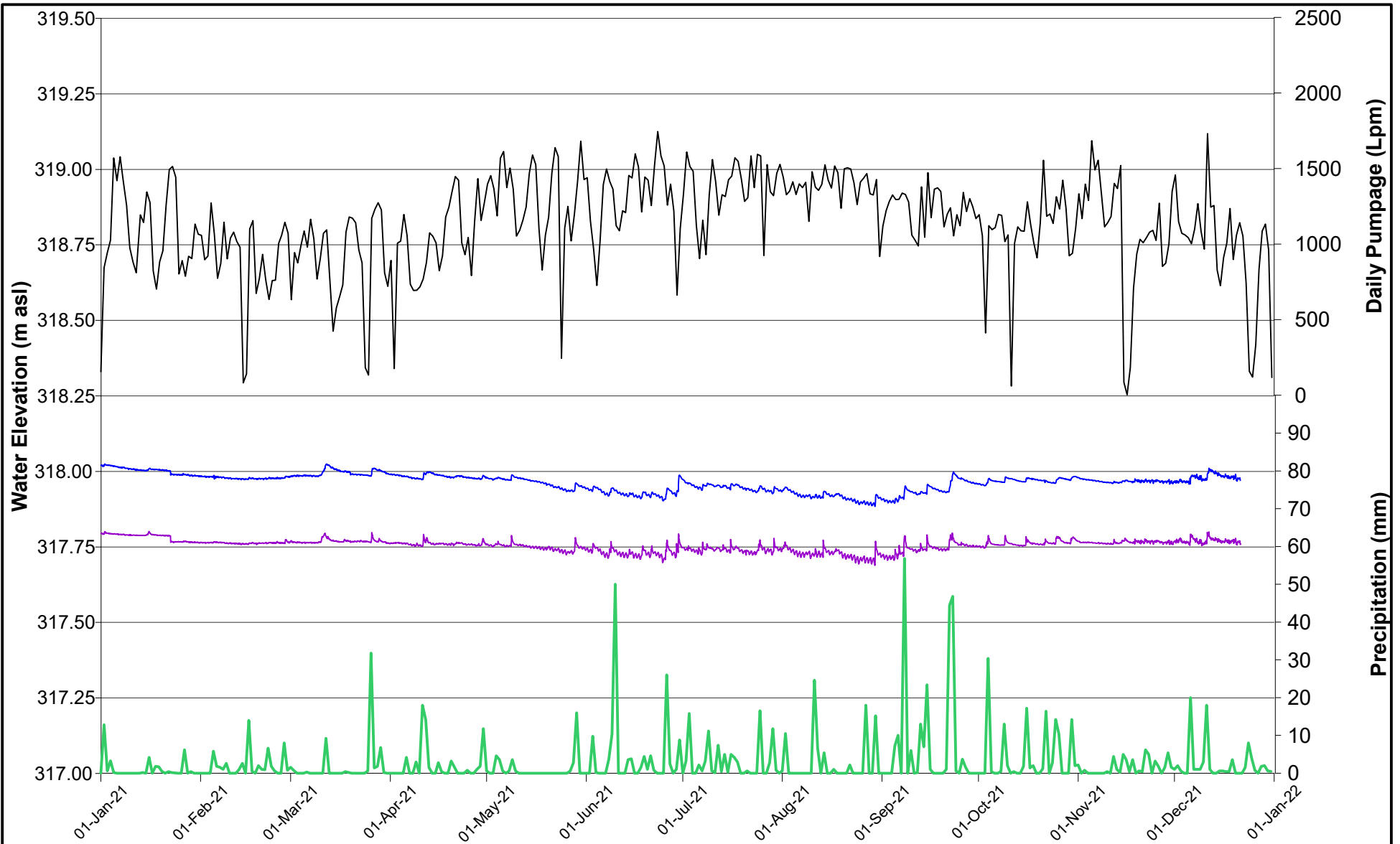


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**MP11 NEST HYDROGRAPH**  
**2021 ANNUAL MONITORING REPORT**

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> E2a
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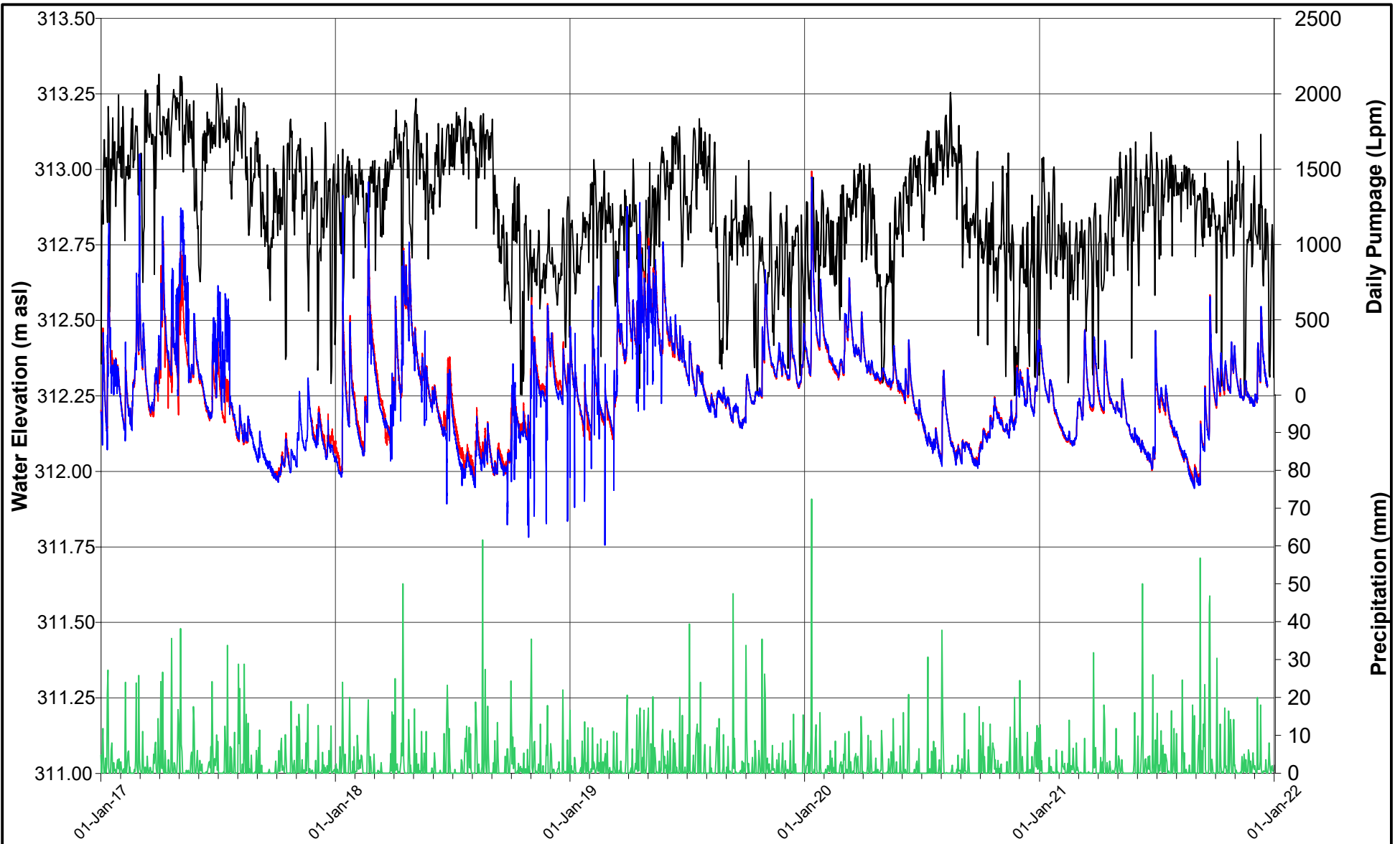


- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP11D-04
- MP11S-08



DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

<b>PROJECT</b>		<b>BLUE TRITON BRANDS</b> Town of Aberfoyle, Ontario	
<b>TITLE</b>		<b>MP11 NEST HYDROGRAPH (2021)</b> <b>2021 ANNUAL MONITORING REPORT</b>	
<b>PROJECT NO.</b>	20449101 (1100)	<b>REV</b>	A
		<b>FIGURE</b>	E2b



- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP16D-08
- MP16S-08

Note: Roundabout constructed on Brock Road starting on May 21, 2019



DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

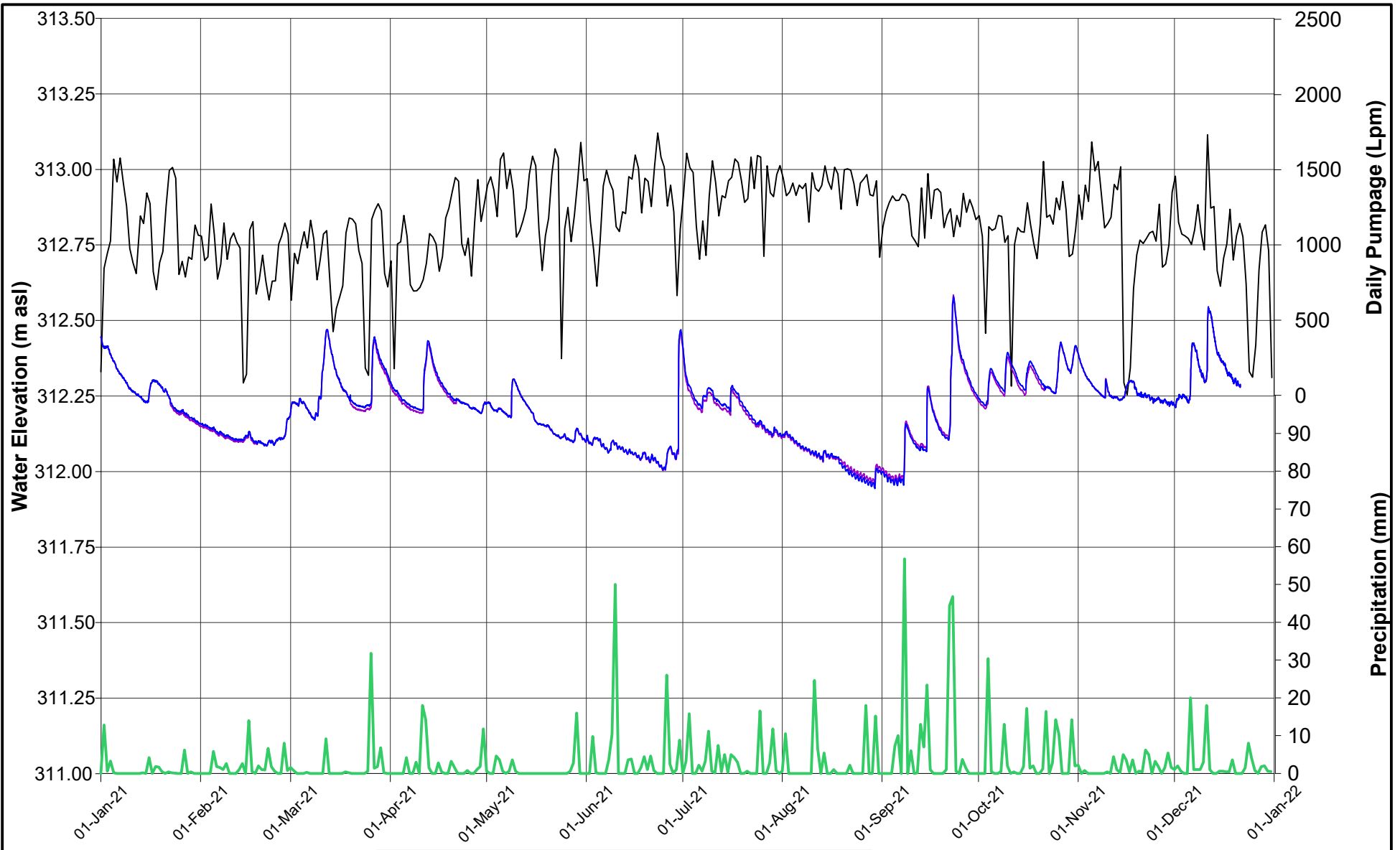
**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**MP16 NEST HYDROGRAPH**  
**2021 ANNUAL MONITORING REPORT**

**PROJECT NO.**  
 20449101 (1100)

**REV**  
 A

**FIGURE**  
 E3a



Note: Roundabout constructed on Brock Road starting on May 21, 2019

- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP16D-08
- MP16S-08



DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

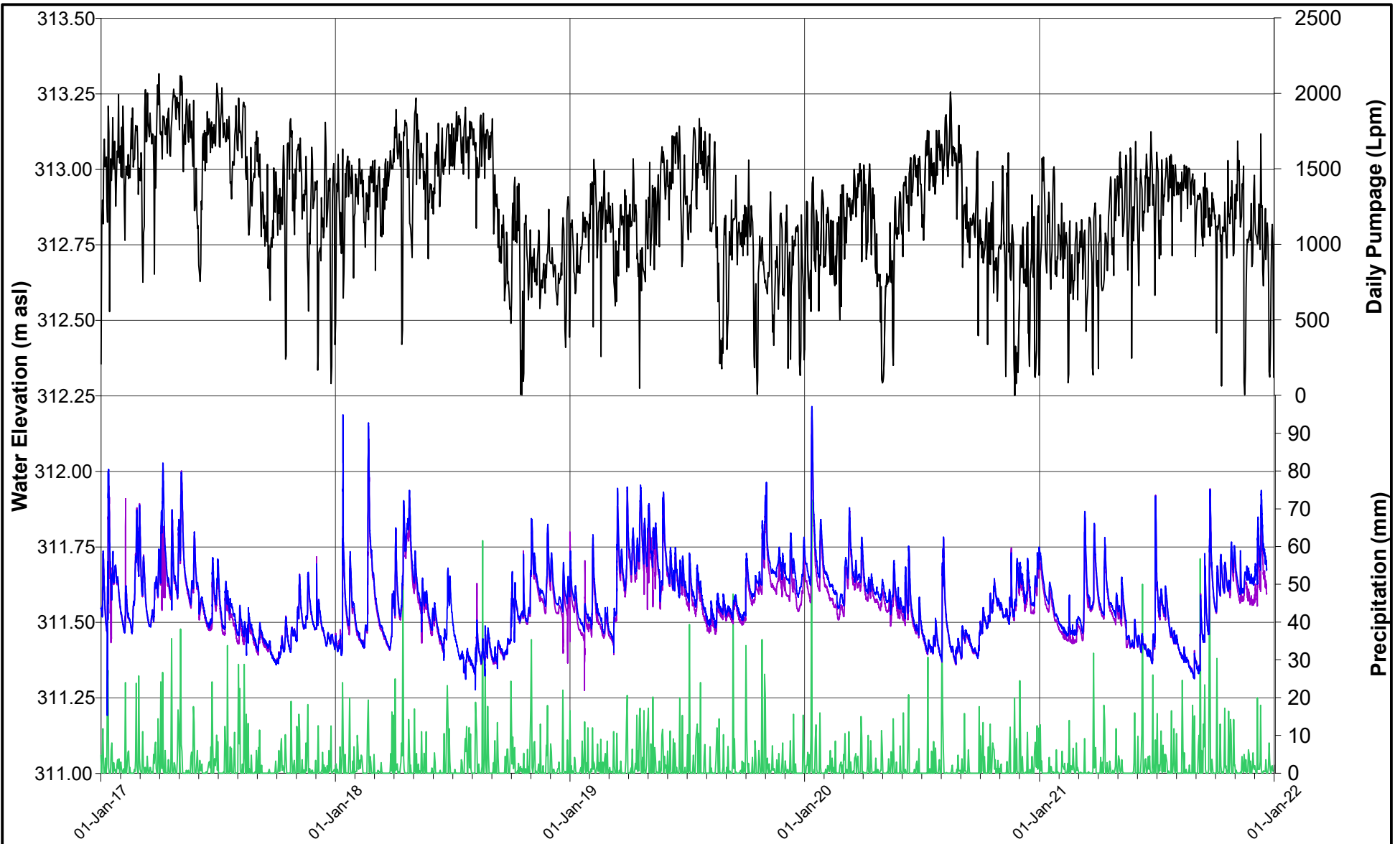
**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**MP16 NEST HYDROGRAPH (2021)**  
**2021 ANNUAL MONITORING REPORT**

**PROJECT NO.**  
 20449101 (1100)

**REV**  
 A

**FIGURE**  
 E3b



- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP6D-04
- MP6S-08

Note: Roundabout constructed on Brock Road starting on May 21, 2019

PROJECT

**BLUE TRITON BRANDS**  
Town of Aberfoyle, Ontario

TITLE

**MP6 NEST HYDROGRAPH**  
**2021 ANNUAL MONITORING REPORT**

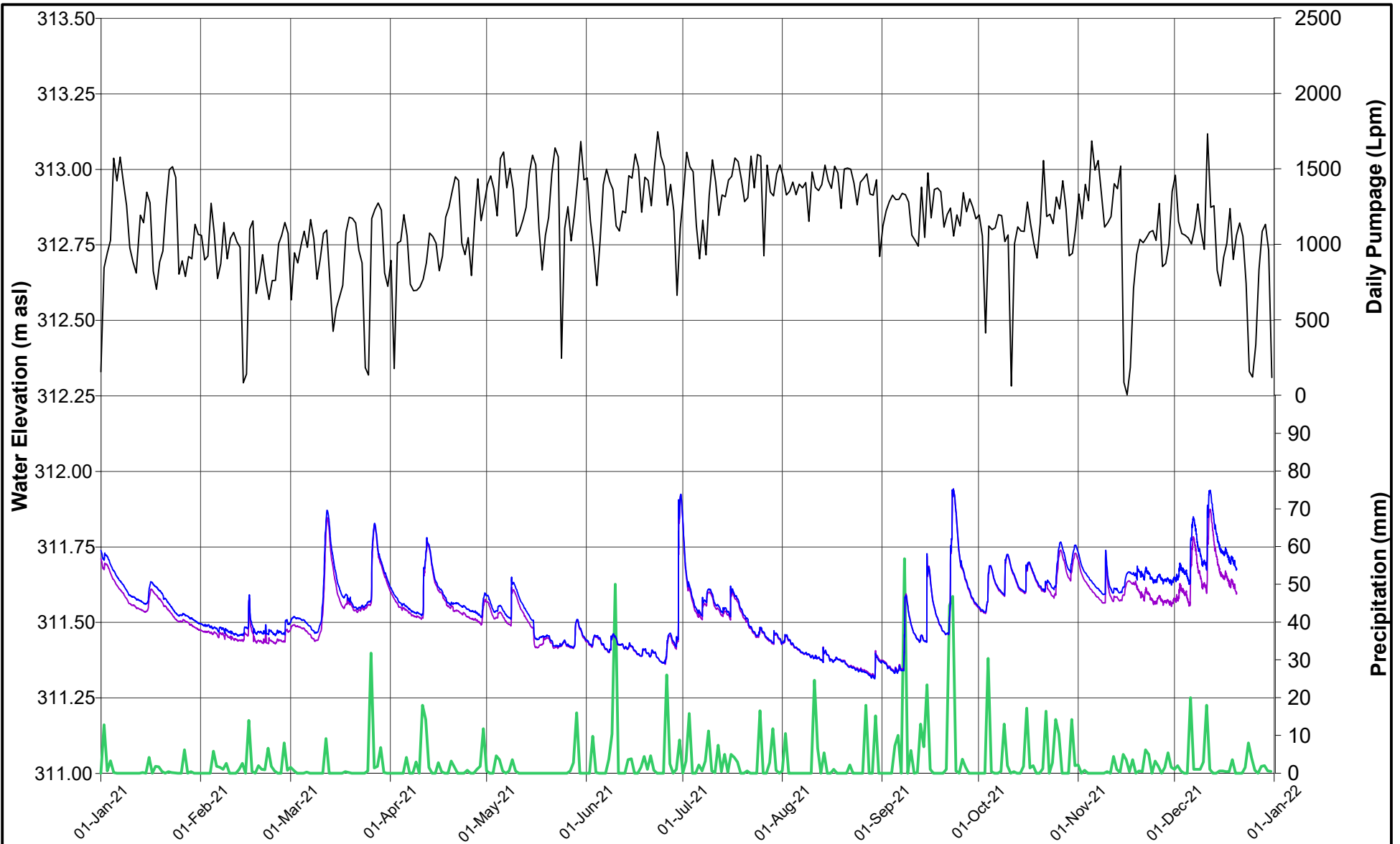


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT NO.  
20449101 (1100)

REV  
A

FIGURE  
E4a



- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP6D-04
- MP6S-08

PROJECT **BLUE TRITON BRANDS**  
Town of Aberfoyle, Ontario

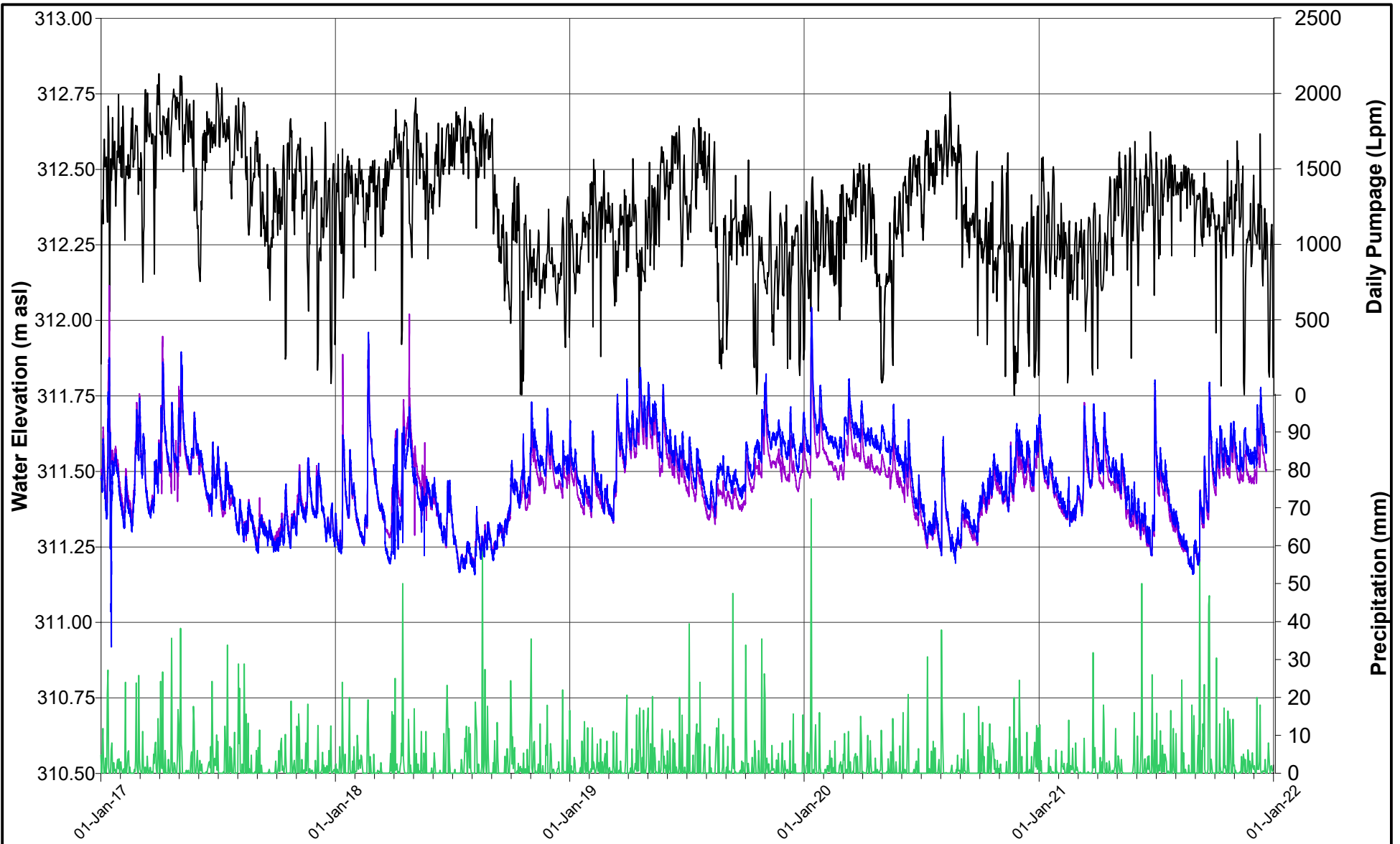
TITLE **MP6 NEST HYDROGRAPH (2021)**  
**2021 ANNUAL MONITORING REPORT**



DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E4b





- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP12D-04
- MP12S-04

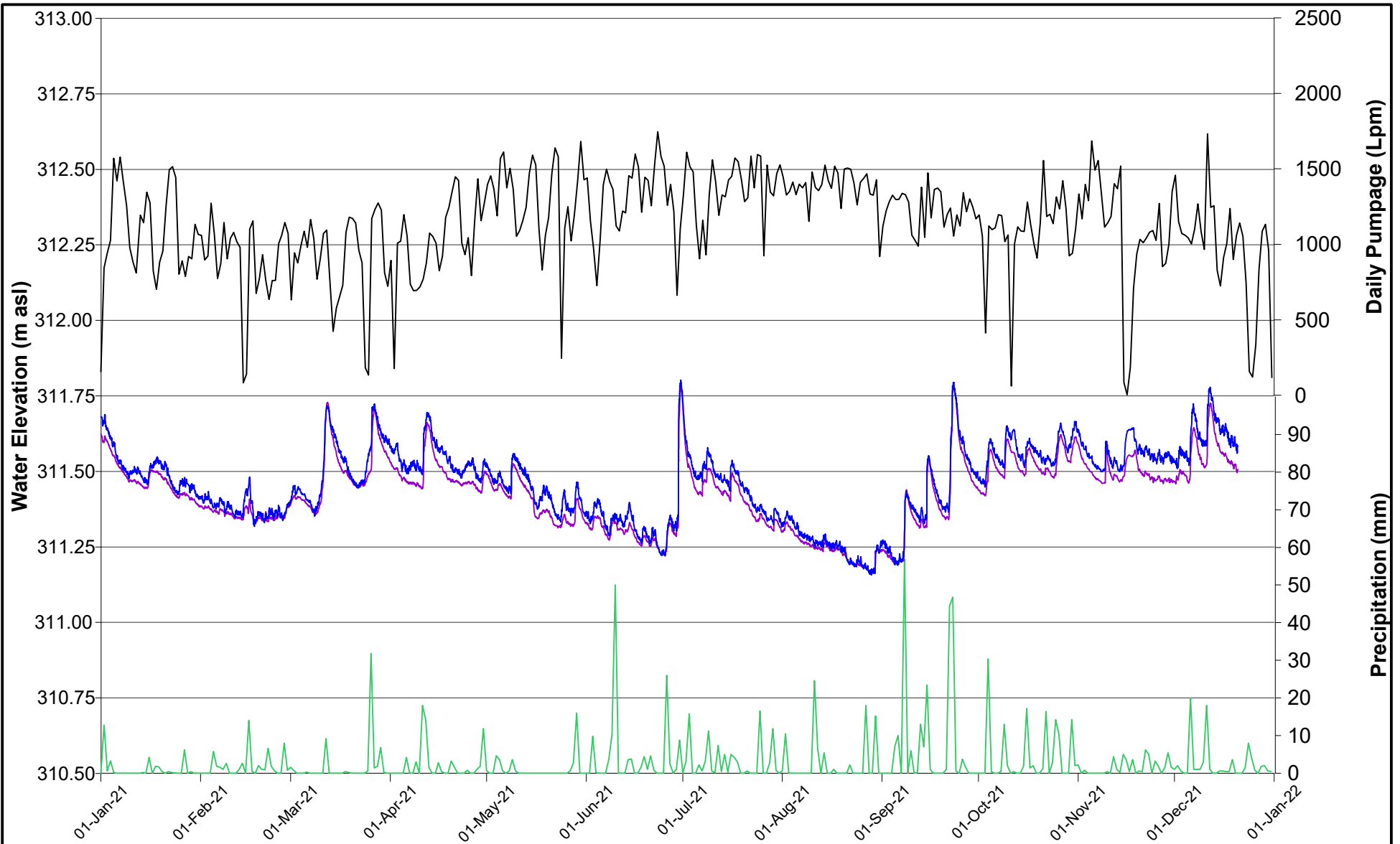


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**MP12 NEST HYDROGRAPH**  
**2021 ANNUAL MONITORING REPORT**

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> E5a
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- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP12D-04
- MP12S-04

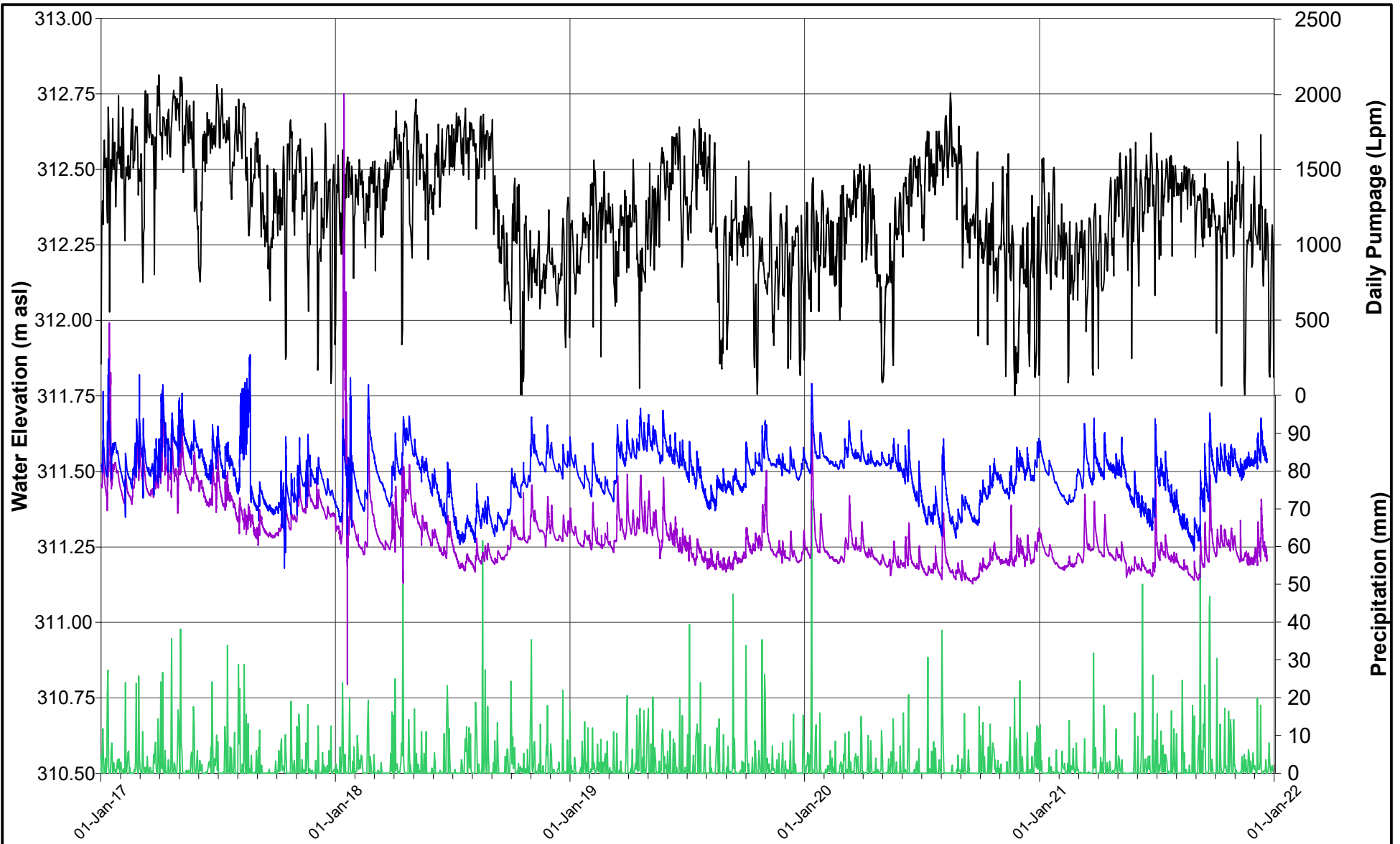


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**MP12 NEST HYDROGRAPH (2021)**  
**2021 ANNUAL MONITORING REPORT**

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> E5b
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- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP14D-07
- MP14S-07

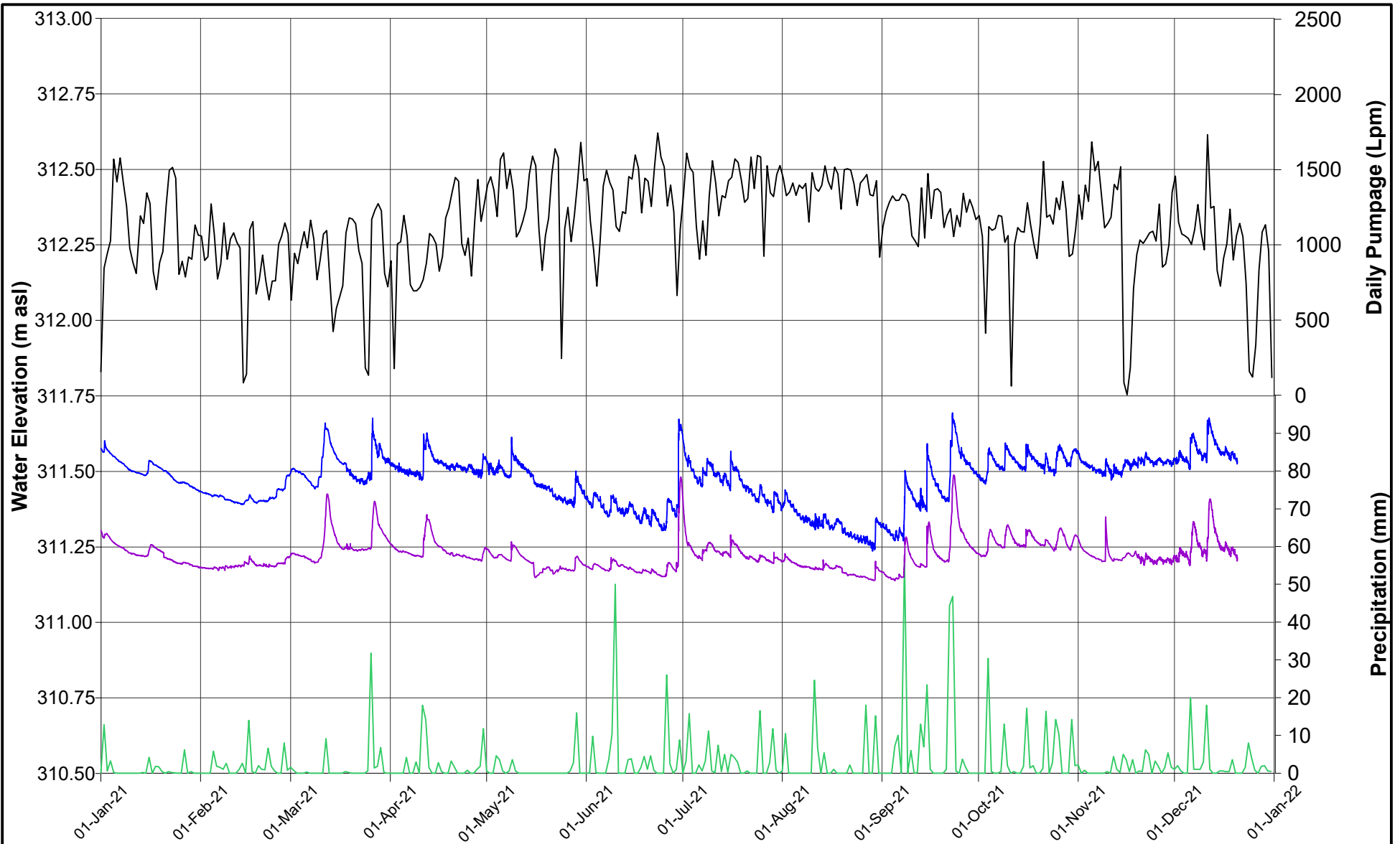


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**MP14 NEST HYDROGRAPH**  
**2021 ANNUAL MONITORING REPORT**

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> E6a
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- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP14D-07
- MP14S-07

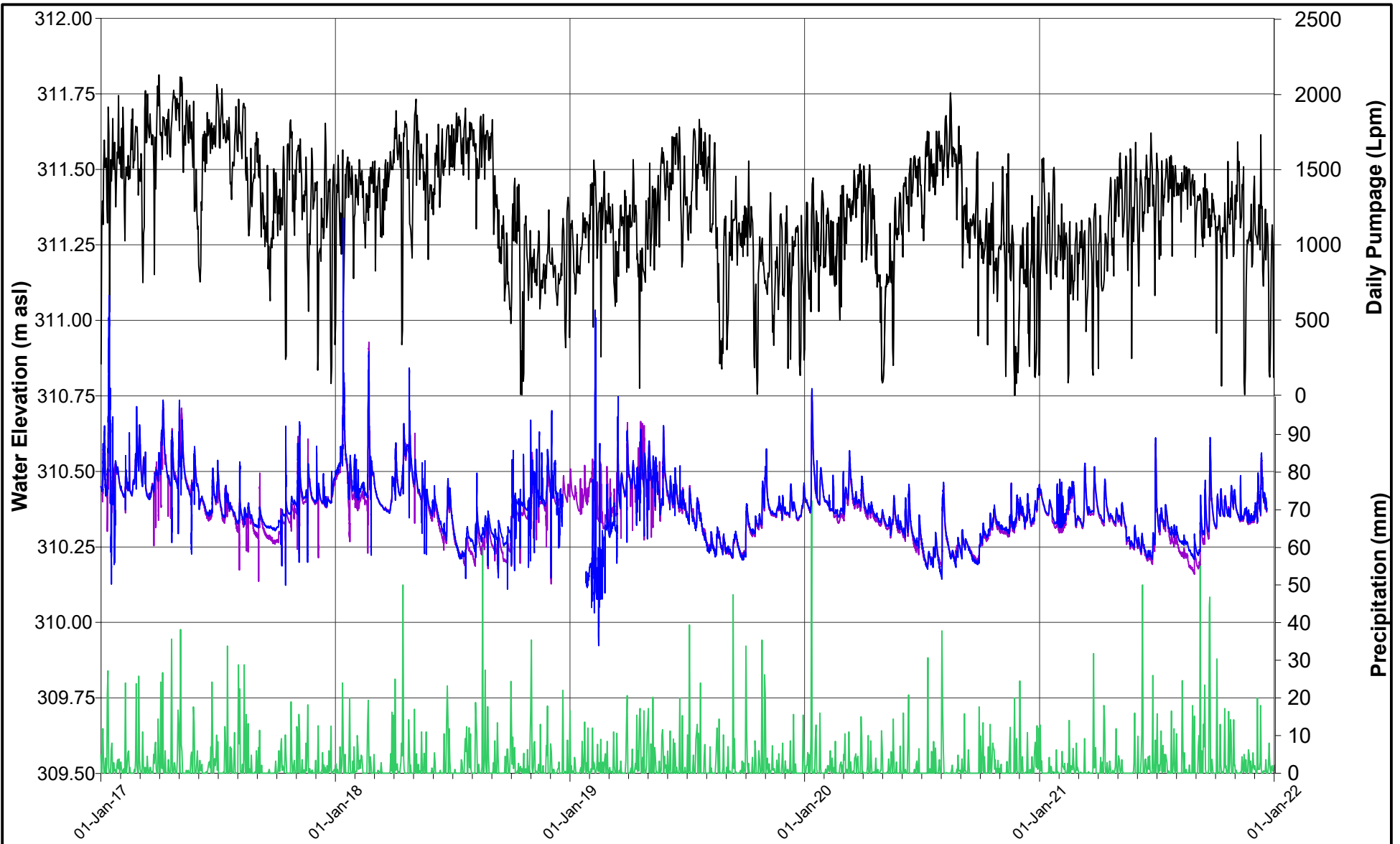


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT **BLUE TRITON BRANDS**  
Town of Aberfoyle, Ontario

TITLE **MP14 NEST HYDROGRAPH (2021)**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO. 20449101 (1100)	REV A	FIGURE E6b
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- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP8D-04
- MP8S-04

Note: Stream rehabilitation from July 22, 2019 to August 21, 2019



DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

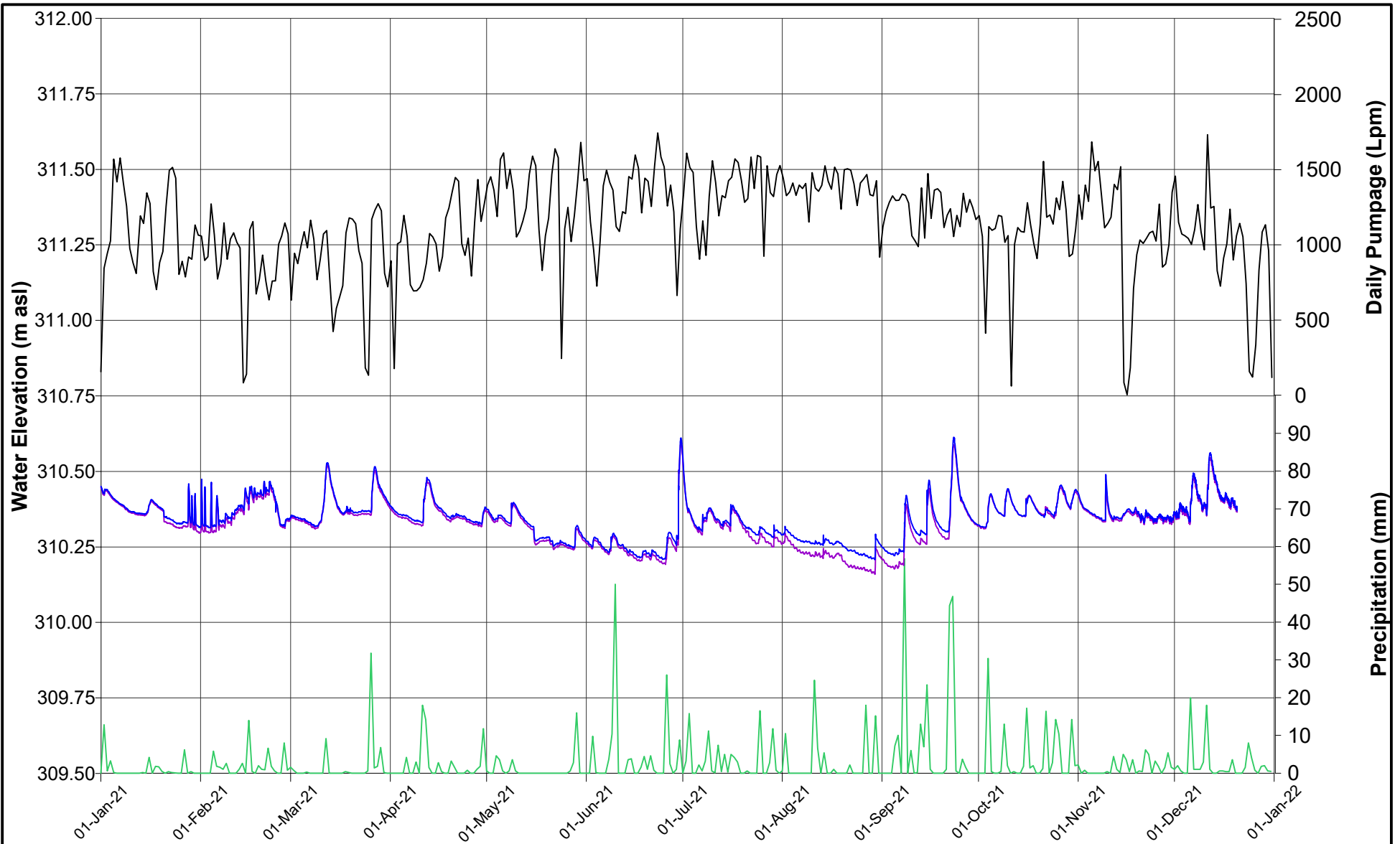
**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**MP8 NEST HYDROGRAPH**  
**2021 ANNUAL MONITORING REPORT**

**PROJECT NO.**  
 20449101 (1100)

**REV**  
 A

**FIGURE**  
 E7a



- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP8D-04
- MP8S-04

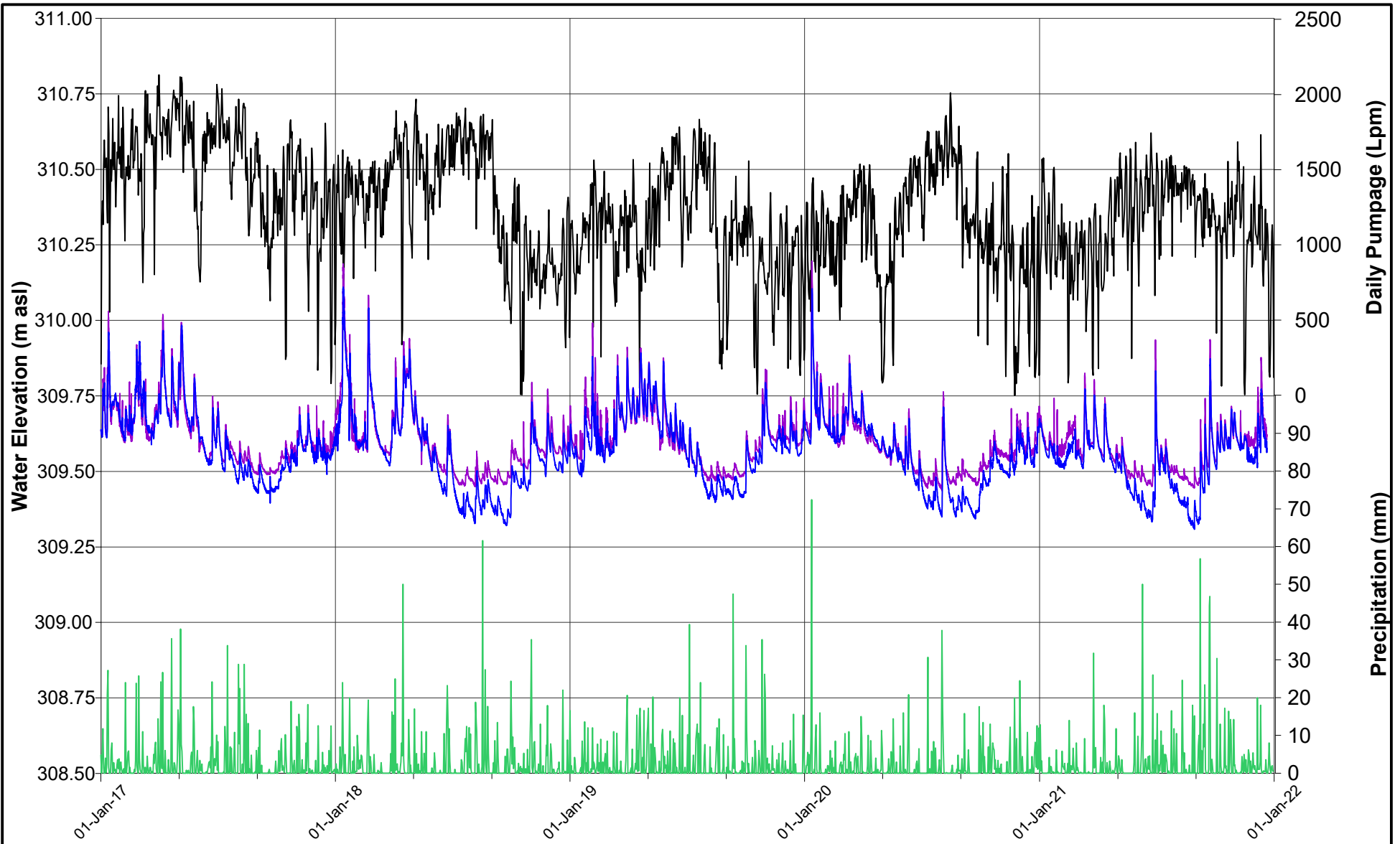


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**MP8 NEST HYDROGRAPH (2021)**  
**2021 ANNUAL MONITORING REPORT**

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> E7b
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- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP17D-11
- MP17S-11

Note: Stream rehabilitation from July 22, 2019 to August 21, 2019

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**MP17 NEST HYDROGRAPH**  
**2021 ANNUAL MONITORING REPORT**

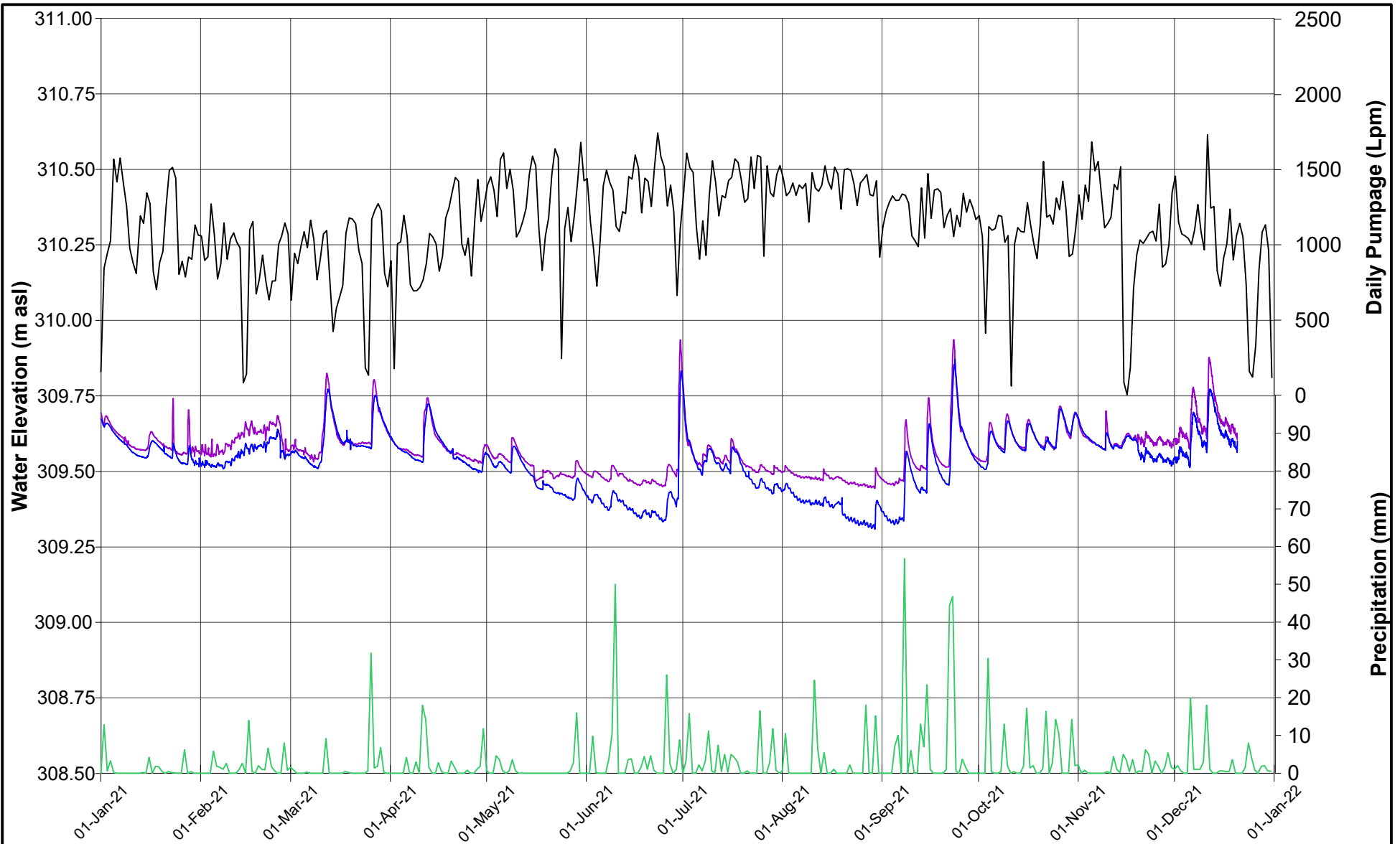


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT NO.**  
 20449101 (1100)

**REV**  
 A

**FIGURE**  
 E8a



- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP17D-11
- MP17S-11



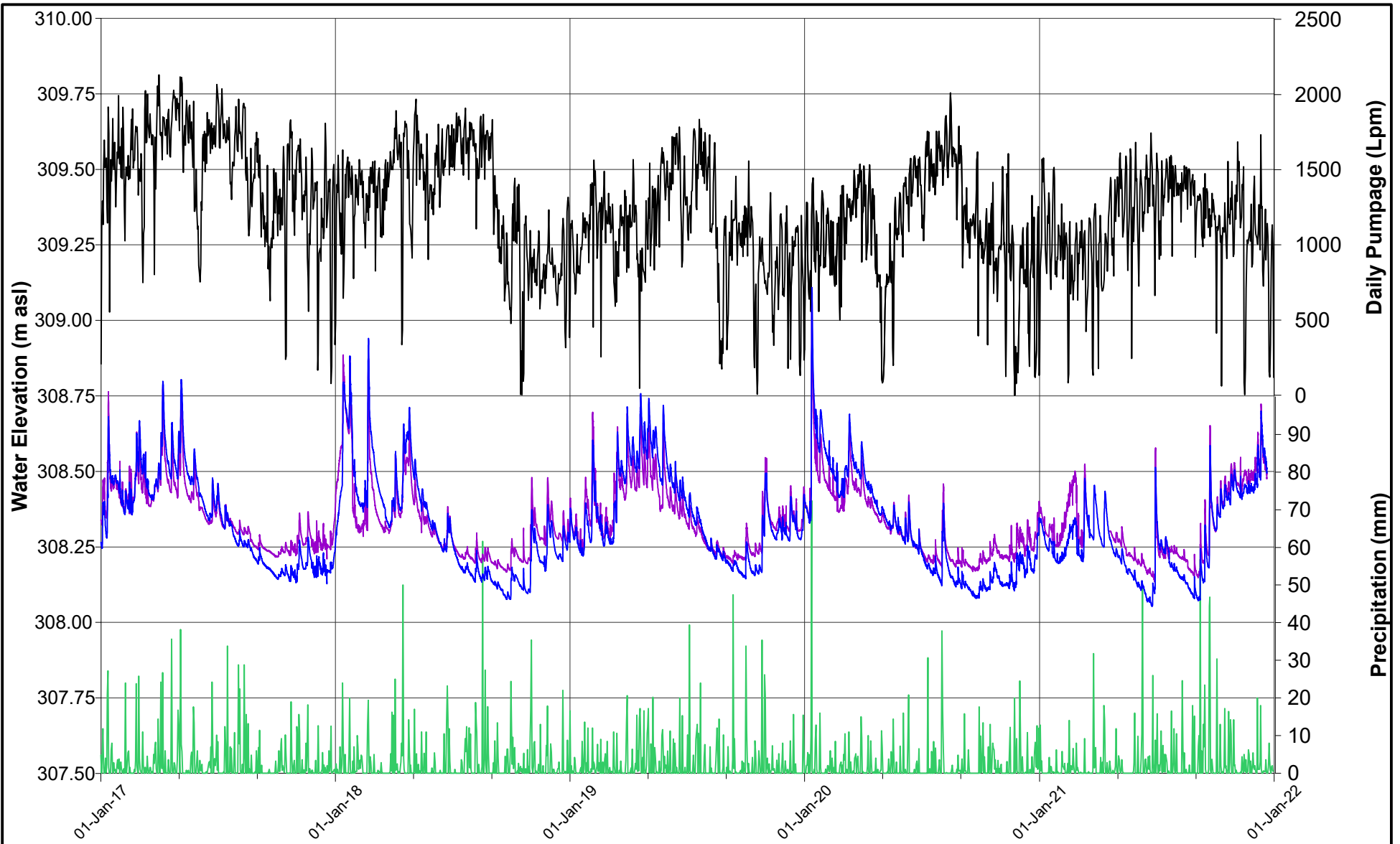
DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**MP17 NEST HYDROGRAPH (2021)**  
**2021 ANNUAL MONITORING REPORT**

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> E8b
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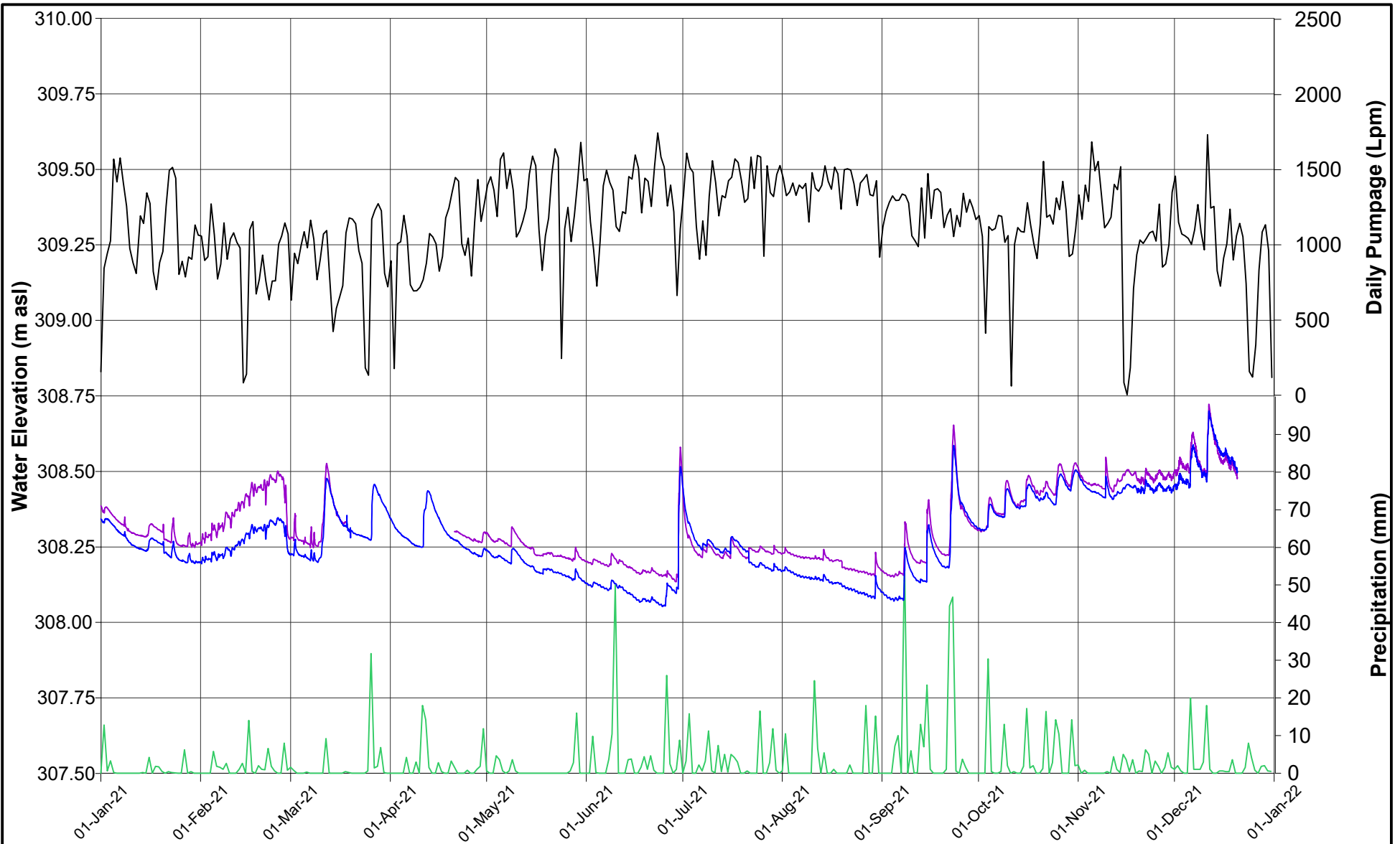


— Precipitation (mm)  
 — Daily Pumpage (Lpm)  
 — MP18D-11  
 — MP18S-11



DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT	<b>BLUE TRITON BRANDS</b> Town of Aberfoyle, Ontario		
TITLE	<b>MP18 NEST HYDROGRAPH</b> <b>2021 ANNUAL MONITORING REPORT</b>		
PROJECT NO.	20449101 (1100)	REV	A
		FIGURE	E9a



- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP18D-11
- MP18S-11

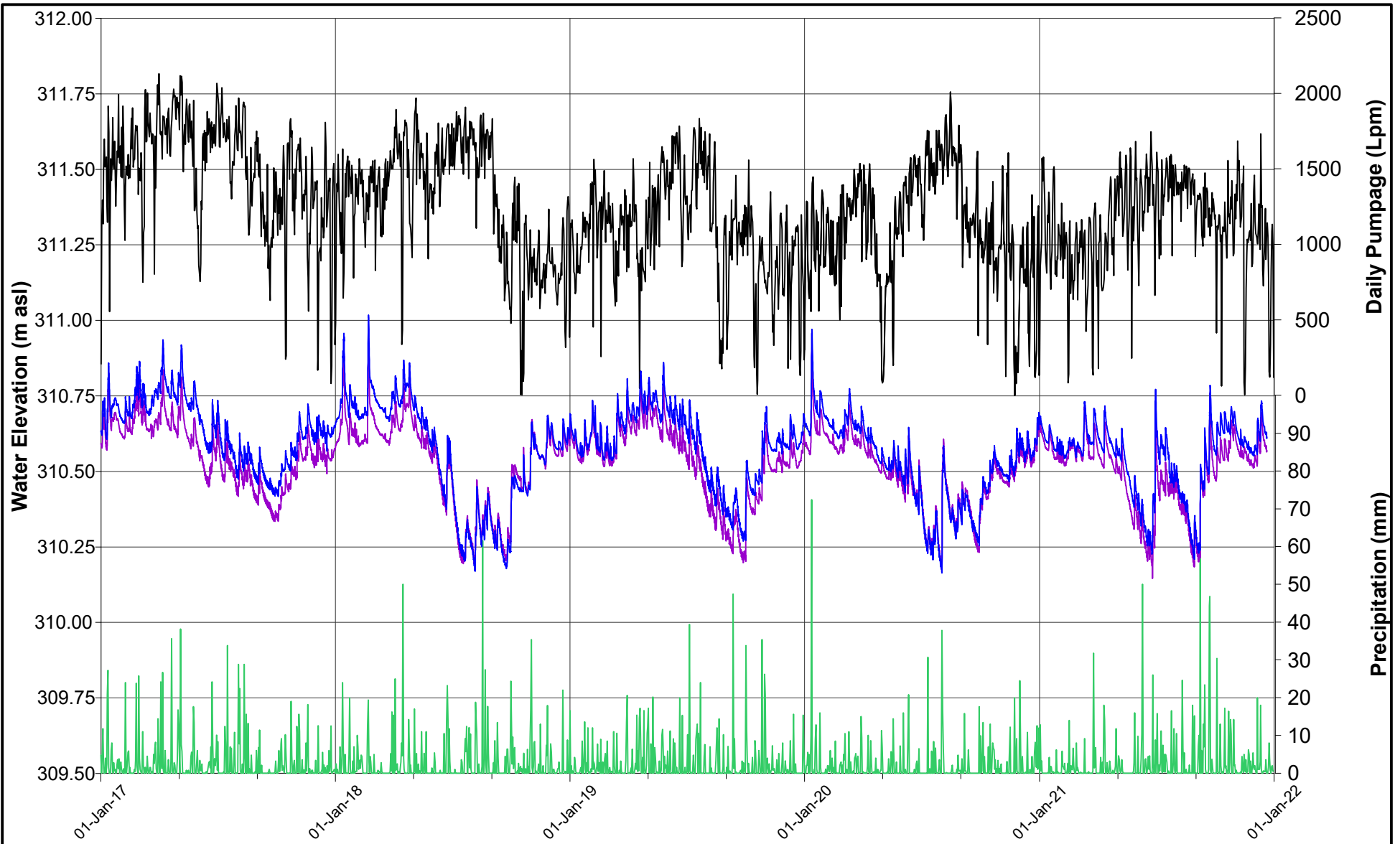


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**MP18 NEST HYDROGRAPH (2021)**  
**2021 ANNUAL MONITORING REPORT**

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> E9b
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- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP19D-12
- MP19S-12

Note: Stream rehabilitation from July 22, 2019 to August 21, 2019

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**MP19 NEST HYDROGRAPH**  
**2021 ANNUAL MONITORING REPORT**

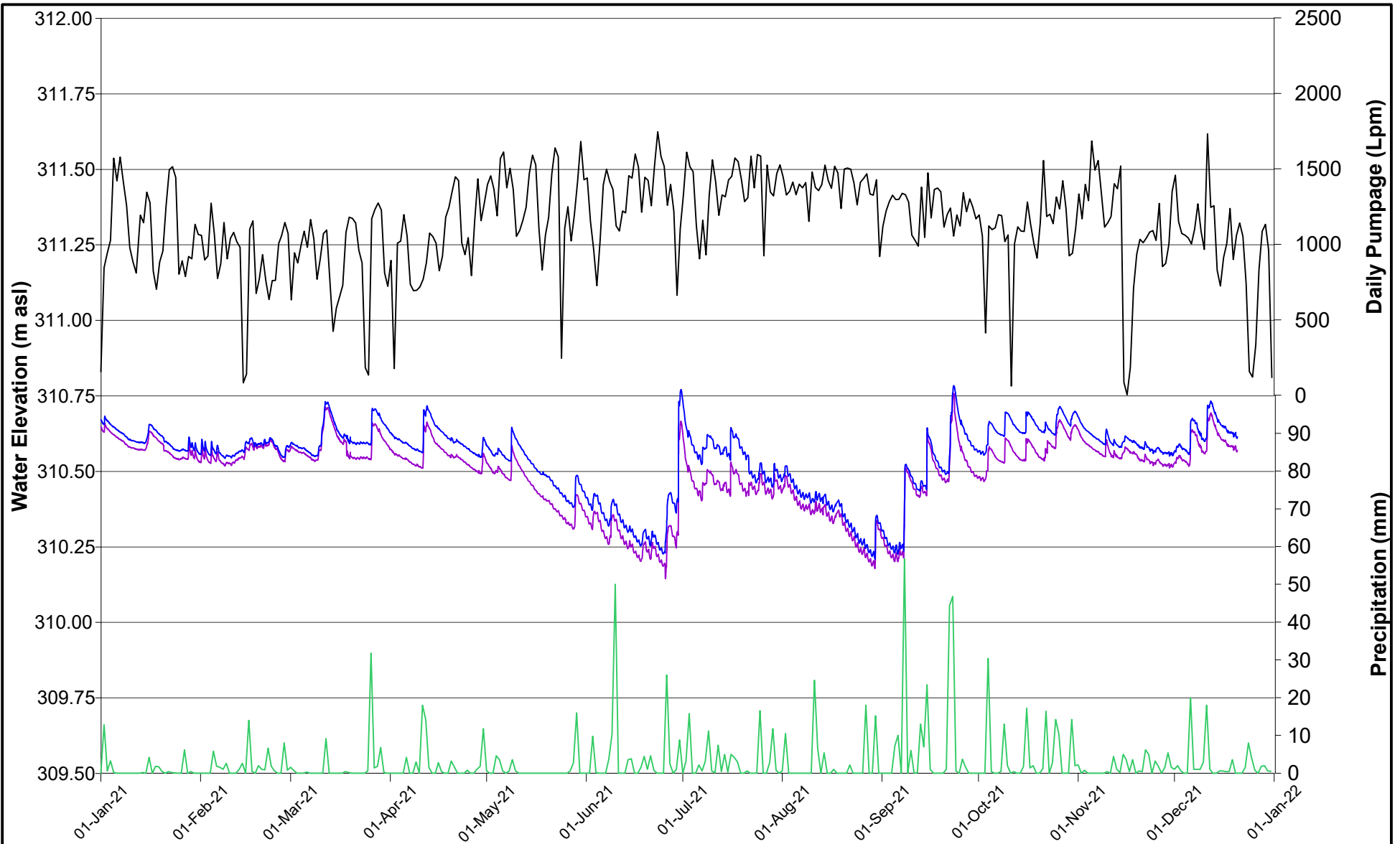


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT NO.**  
 20449101 (1100)

**REV**  
 A

**FIGURE**  
 E10a



- Precipitation (mm)
- Daily Pumpage (Lpm)
- MP19D-12
- MP19S-12

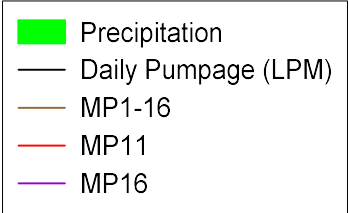
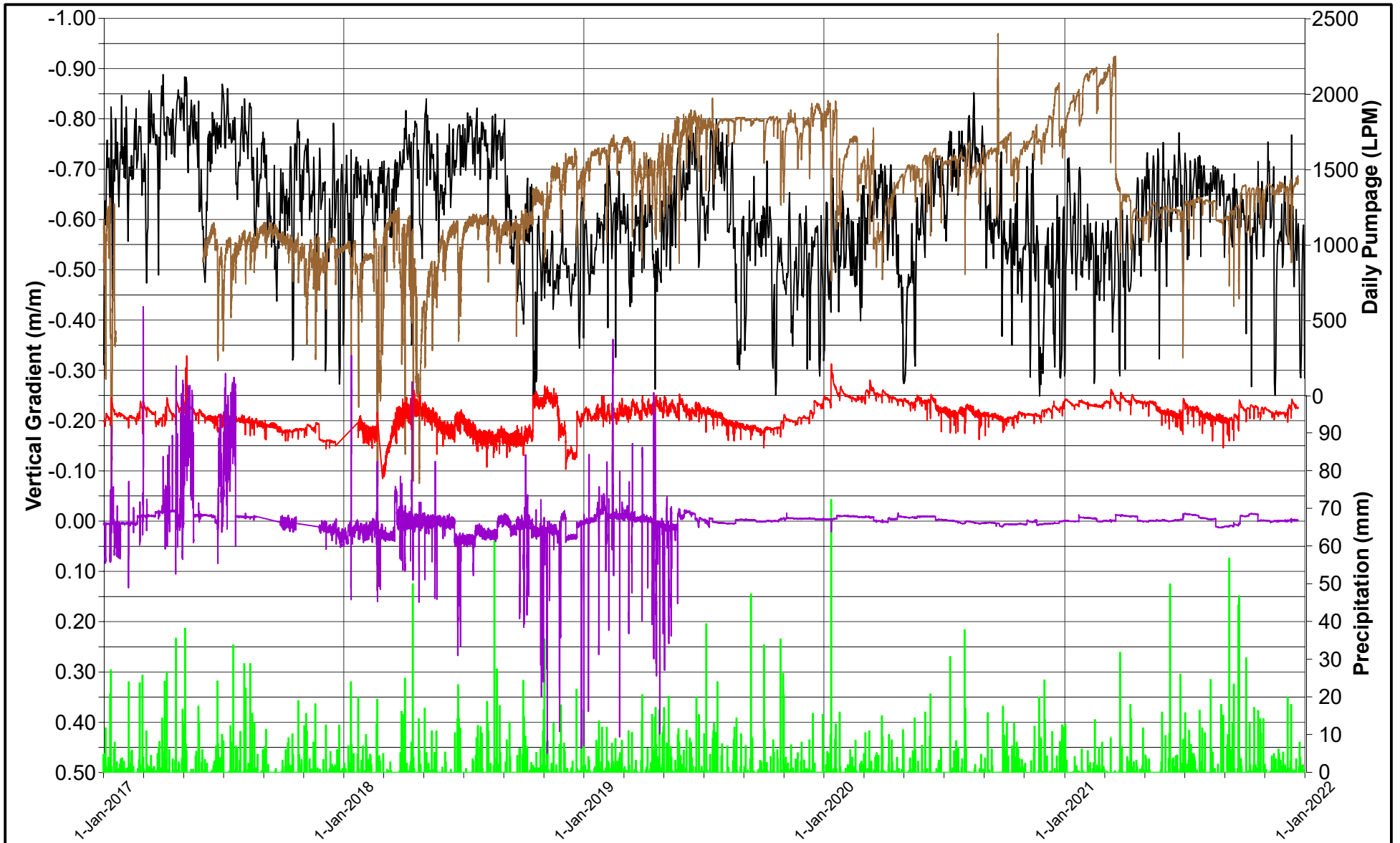


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

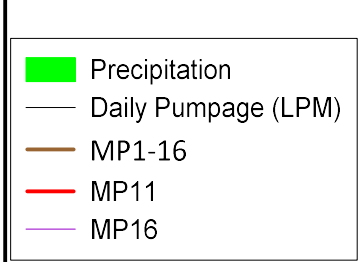
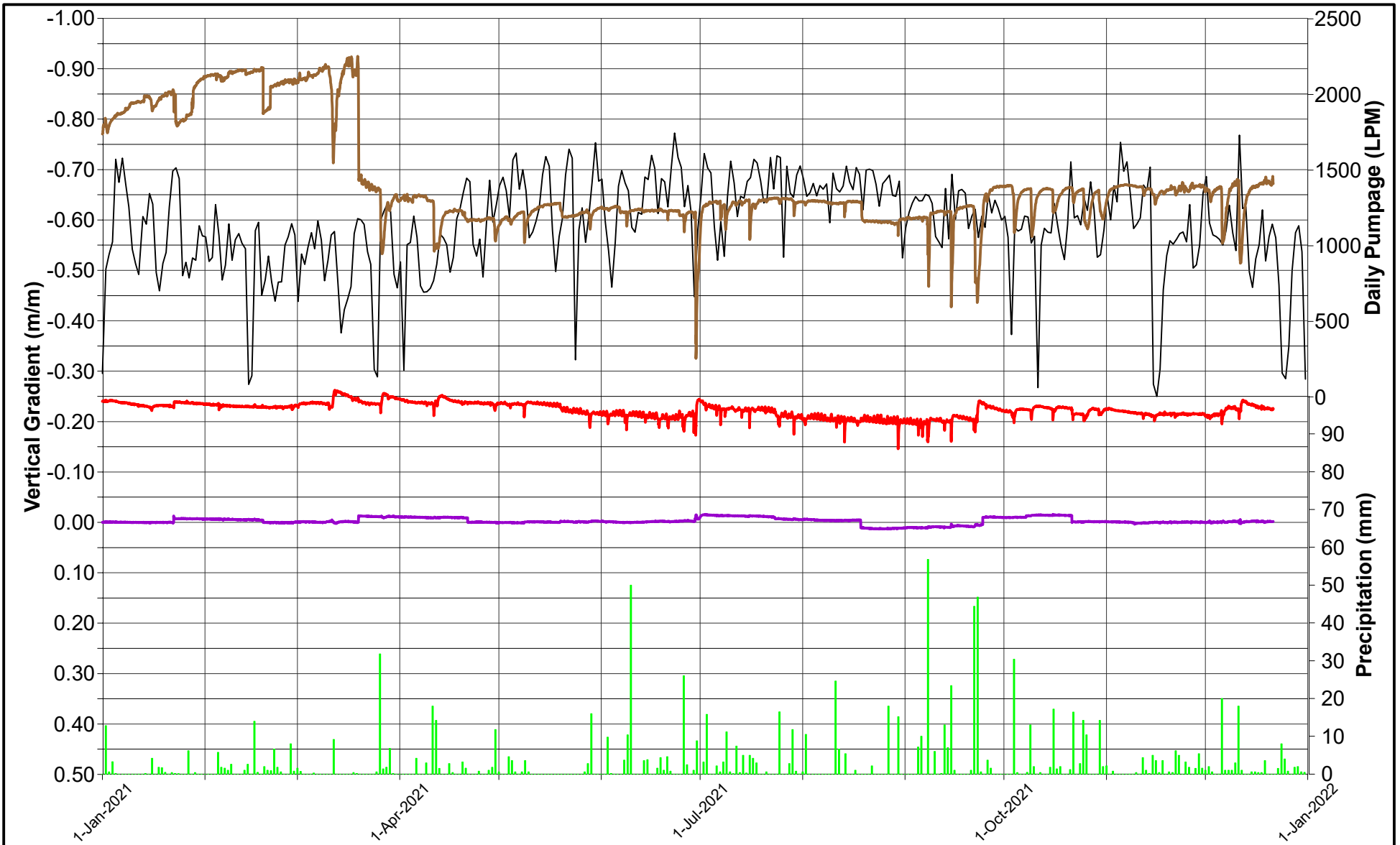
**TITLE**  
**MP19 NEST HYDROGRAPH (2021)**  
**2021 ANNUAL MONITORING REPORT**

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> E10b
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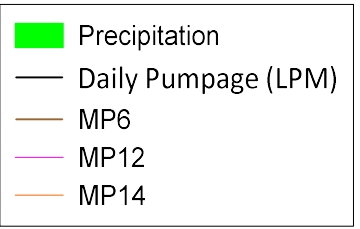
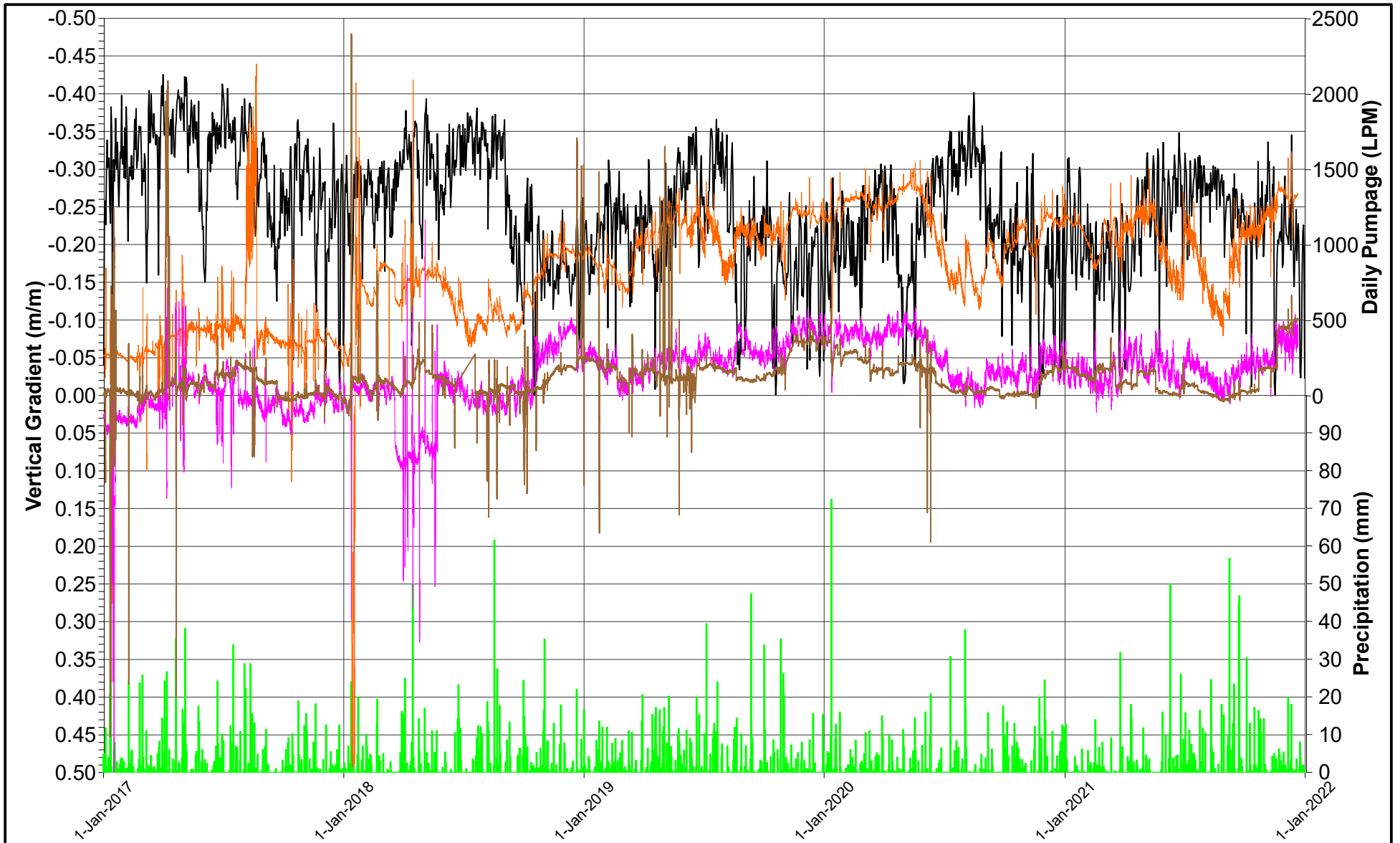
DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT	<b>BLUE TRITON BRANDS</b> Town of Aberfoyle, Ontario	
TITLE	<b>VERTICAL GRADIENT VERSUS TIME</b> <b>MINI-PIEZOMETER NESTS (UPGRADIENT)</b> <b>2021 ANNUAL MONITORING REPORT</b>	
PROJECT NO.	20449101 (1100)	REV A
		FIGURE E11a



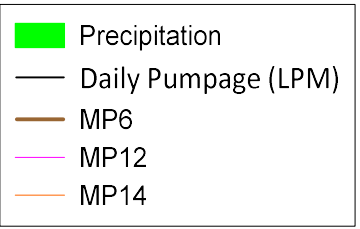
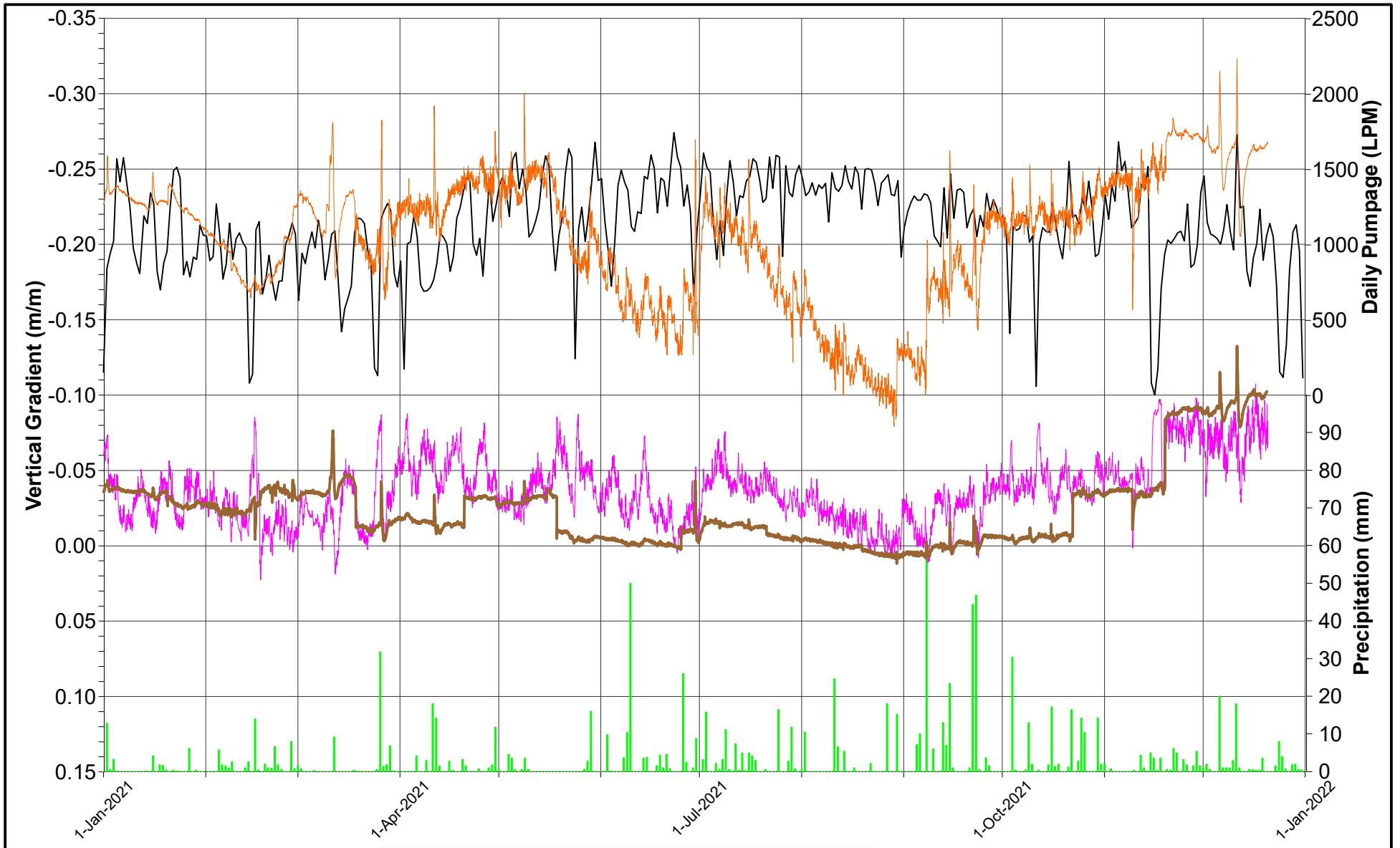
DATE	DECEMBER 2021
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT	<b>BLUE TRITON BRANDS</b> Town of Aberfoyle, Ontario	
TITLE	<b>VERTICAL GRADIENT VERSUS TIME</b> <b>MINI-PIEZOMETER NESTS FOR 2021 (UPGRADIENT)</b> <b>2021 ANNUAL MONITORING REPORT</b>	
PROJECT NO.	20449101 (1100)	REV A
		FIGURE E11b



DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

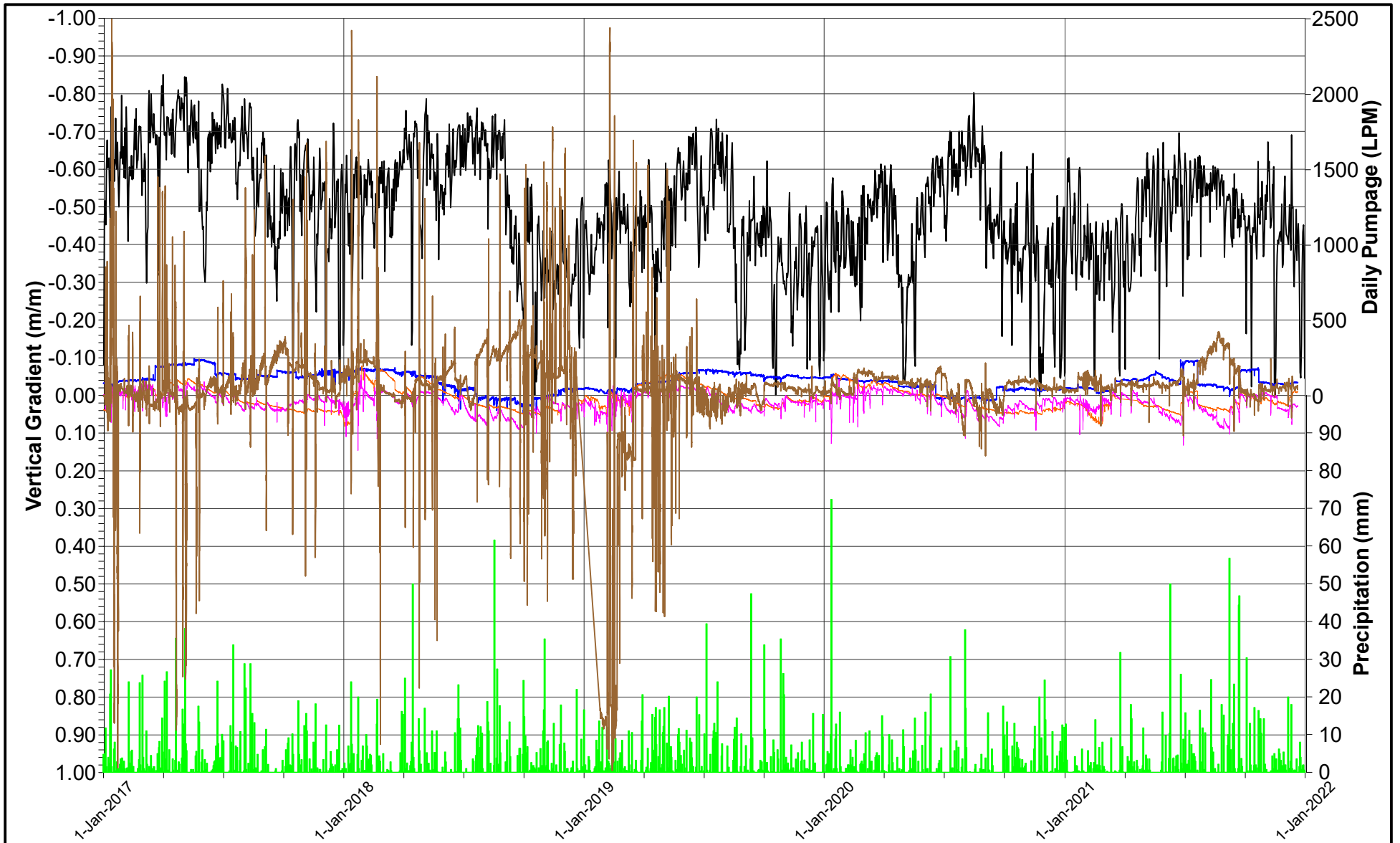
PROJECT	<b>BLUE TRITON BRANDS</b> Town of Aberfoyle, Ontario		
TITLE	<b>VERTICAL GRADIENT VERSUS TIME MINI-PIEZOMETER NESTS (ONSITE) 2021 ANNUAL MONITORING REPORT</b>		
PROJECT NO.	20449101 (1100)	REV	A
		FIGURE	E11c



DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT	<b>BLUE TRITON BRANDS</b> Town of Aberfoyle, Ontario	
TITLE	<b>VERTICAL GRADIENT VERSUS TIME MINI-PIEZOMETER NESTS FOR 2021 (ONSITE) 2021 ANNUAL MONITORING REPORT</b>	
PROJECT NO.	20449101 (1100)	REV A
		FIGURE E11d



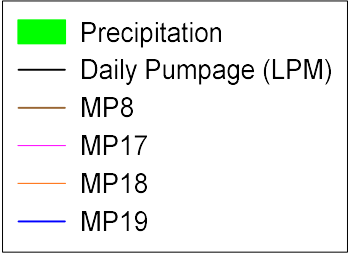
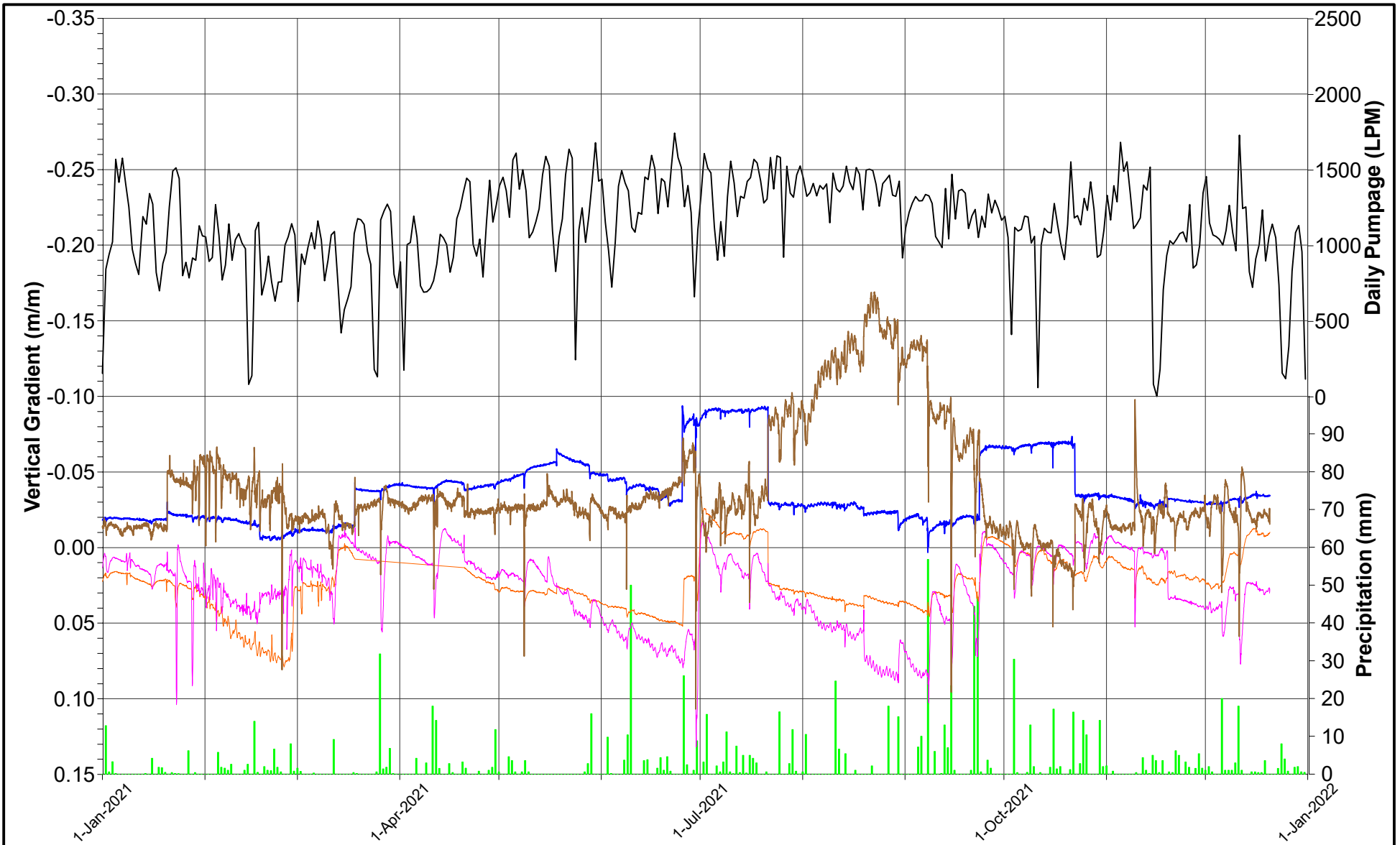


- █ Precipitation
- Daily Pumpage LPM)
- MP8
- MP17
- MP18
- MP19



DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT	<b>BLUE TRITON BRANDS</b> Town of Aberfoyle, Ontario	
TITLE	<b>VERTICAL GRADIENT VERSUS TIME</b> <b>MINI-PIEZOMETER NESTS (DOWNGRADIENT)</b> <b>2021 ANNUAL MONITORING REPORT</b>	
PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E11e



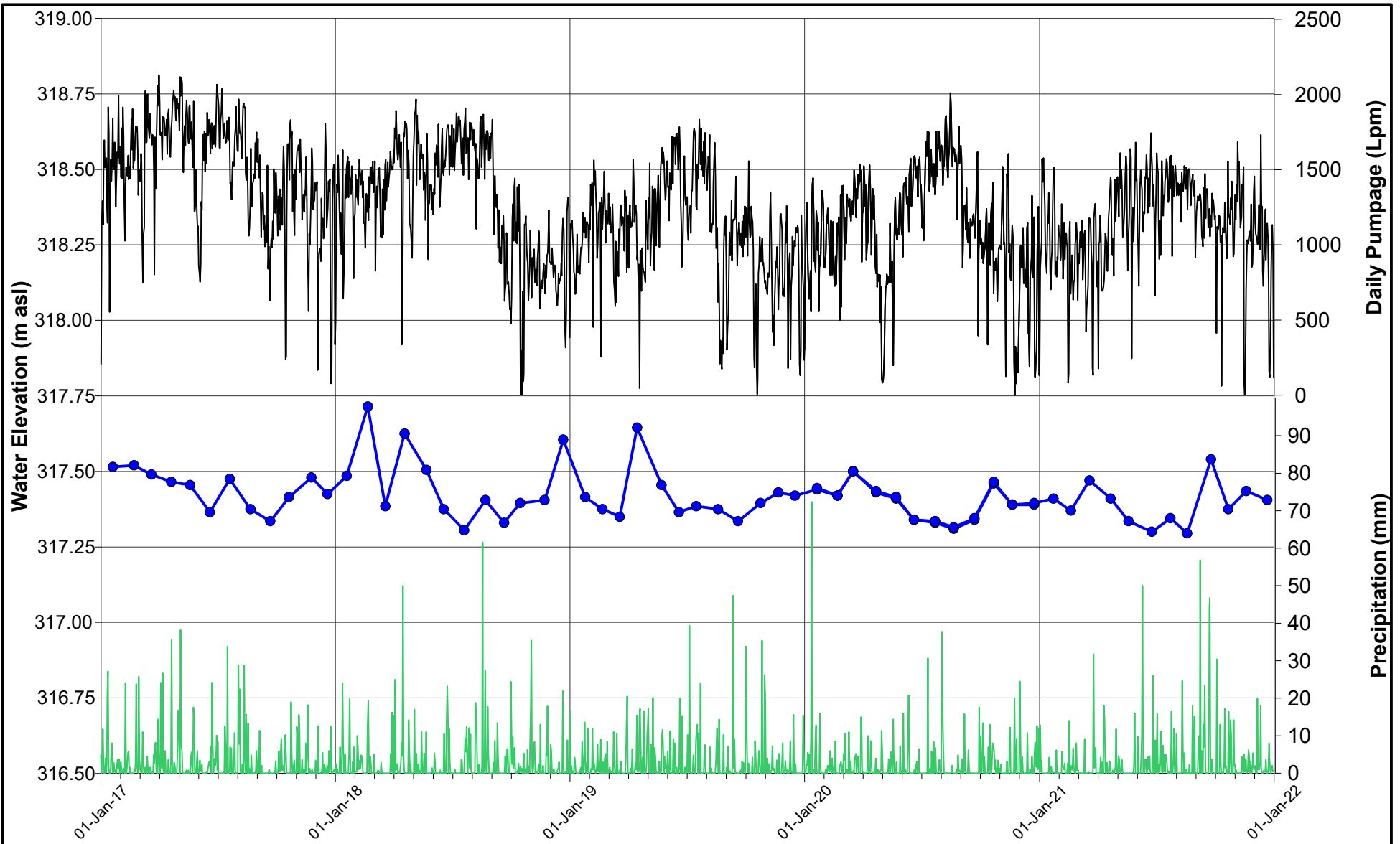
PROJECT **BLUE TRITON BRANDS**  
Town of Aberfoyle, Ontario

TITLE **VERTICAL GRADIENT VERSUS TIME**  
**MINI-PIEZOMETER NESTS FOR 2021 (DOWNGRADIENT)**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO. 20449101 (1100)      REV A      FIGURE E11f



DATE DECEMBER 2021  
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— Precipitation (mm)  
— Daily Pumpage (Lpm)  
—●— SW3

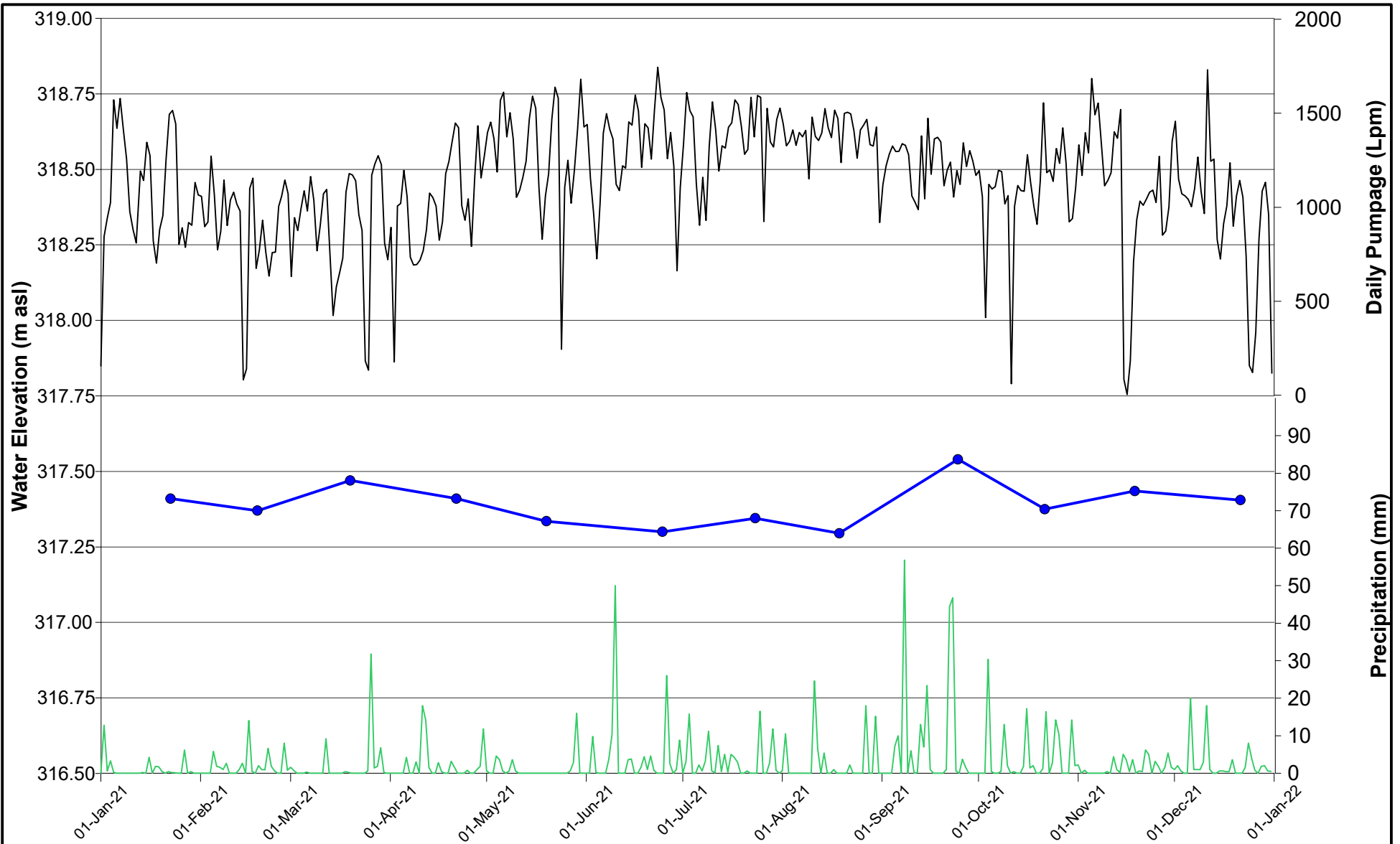
PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **SW3 HYDROGRAPH**  
**2021 ANNUAL MONITORING REPORT**



DATE DECEMBER 2021  
 DESIGN KS  
 REVIEW GP  
 APPROVED GP

PROJECT NO. 20449101 (1100)      REV A      FIGURE E12a



— Precipitation (mm)  
— Daily Pumpage (Lpm)  
—●— SW3

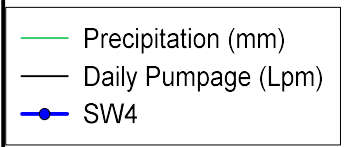
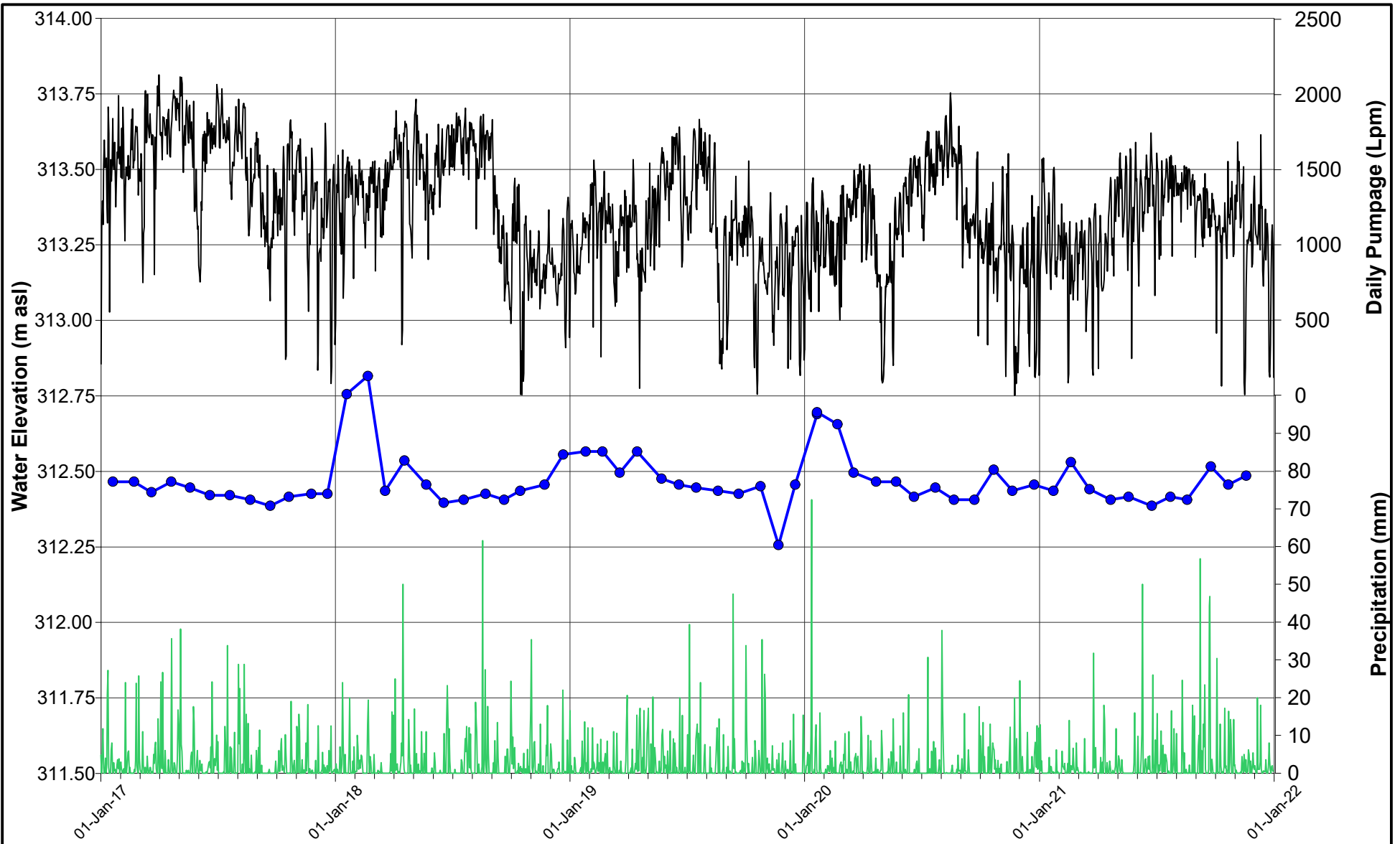


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **SW3 HYDROGRAPH (2021)**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO.	20449101 (1100)	REV	A	FIGURE	E12b
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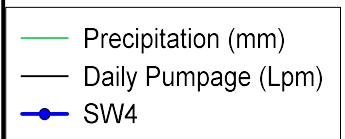
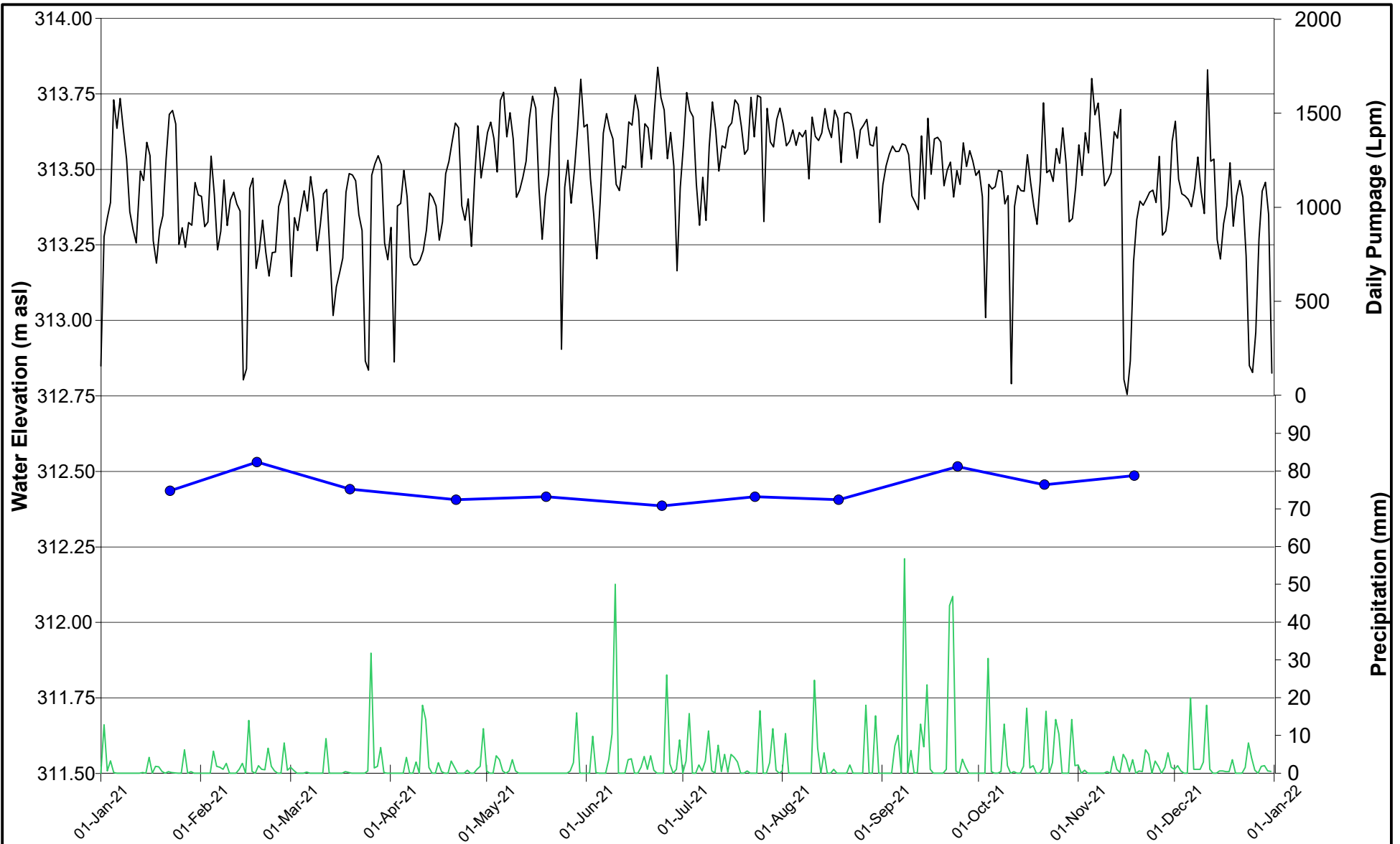
PROJECT **BLUE TRITON BRANDS**  
Town of Aberfoyle, Ontario

TITLE **SW4 HYDROGRAPH**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO. 20449101 (1100)      REV A      FIGURE E13a



DATE DECEMBER 2021  
DESIGN KS  
REVIEW GP  
APPROVED GP



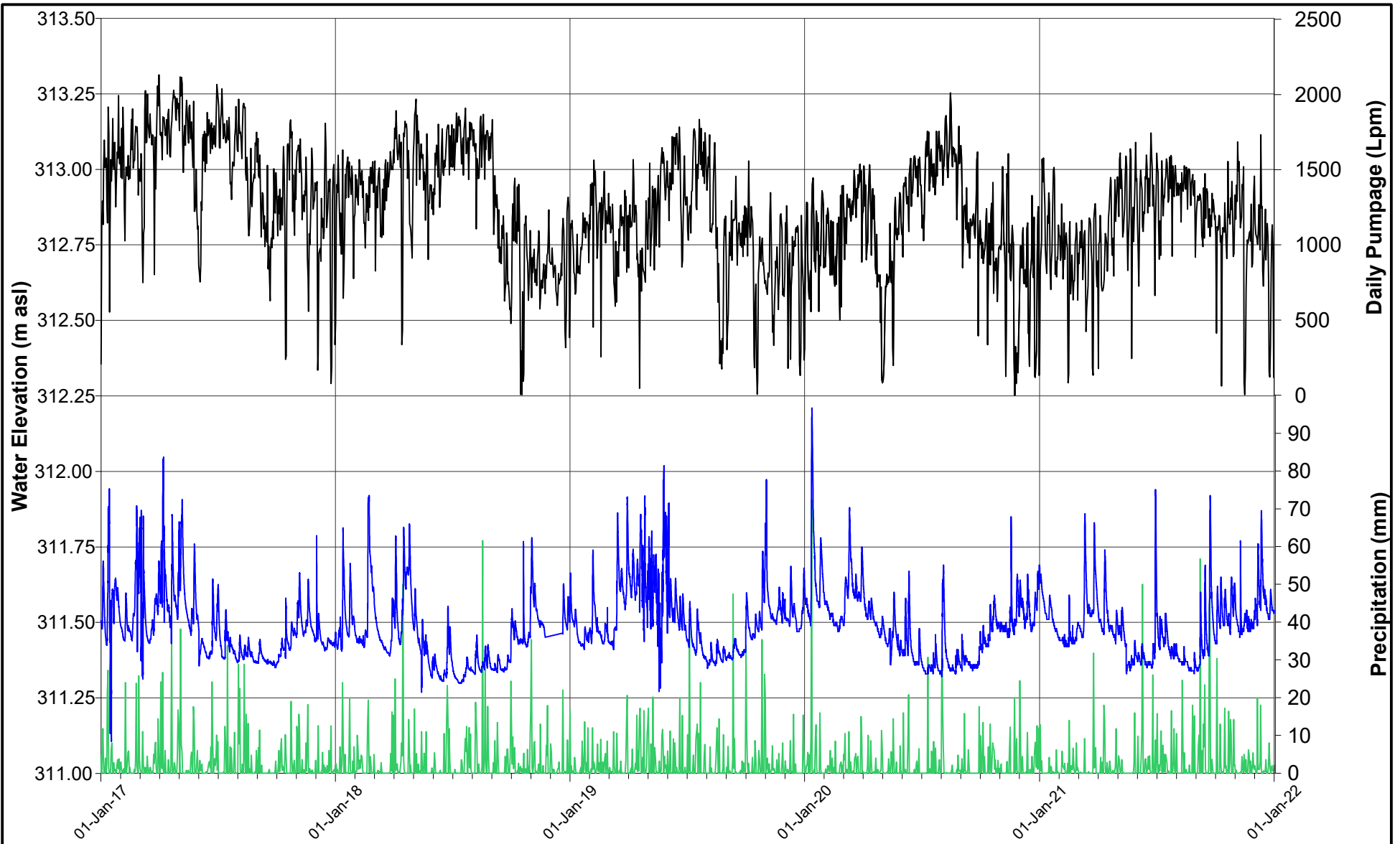
PROJECT **BLUE TRITON BRANDS**  
Town of Aberfoyle, Ontario

TITLE **SW4 HYDROGRAPH (2021)**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO. 20449101 (1100)      REV A      FIGURE E13b



DATE DECEMBER 2021  
DESIGN KS  
REVIEW GP  
APPROVED GP



— Precipitation (mm)  
— Daily Pumpage (Lpm)  
— SW1

Note: Roundabout constructed on Brock Road starting on May 21, 2019

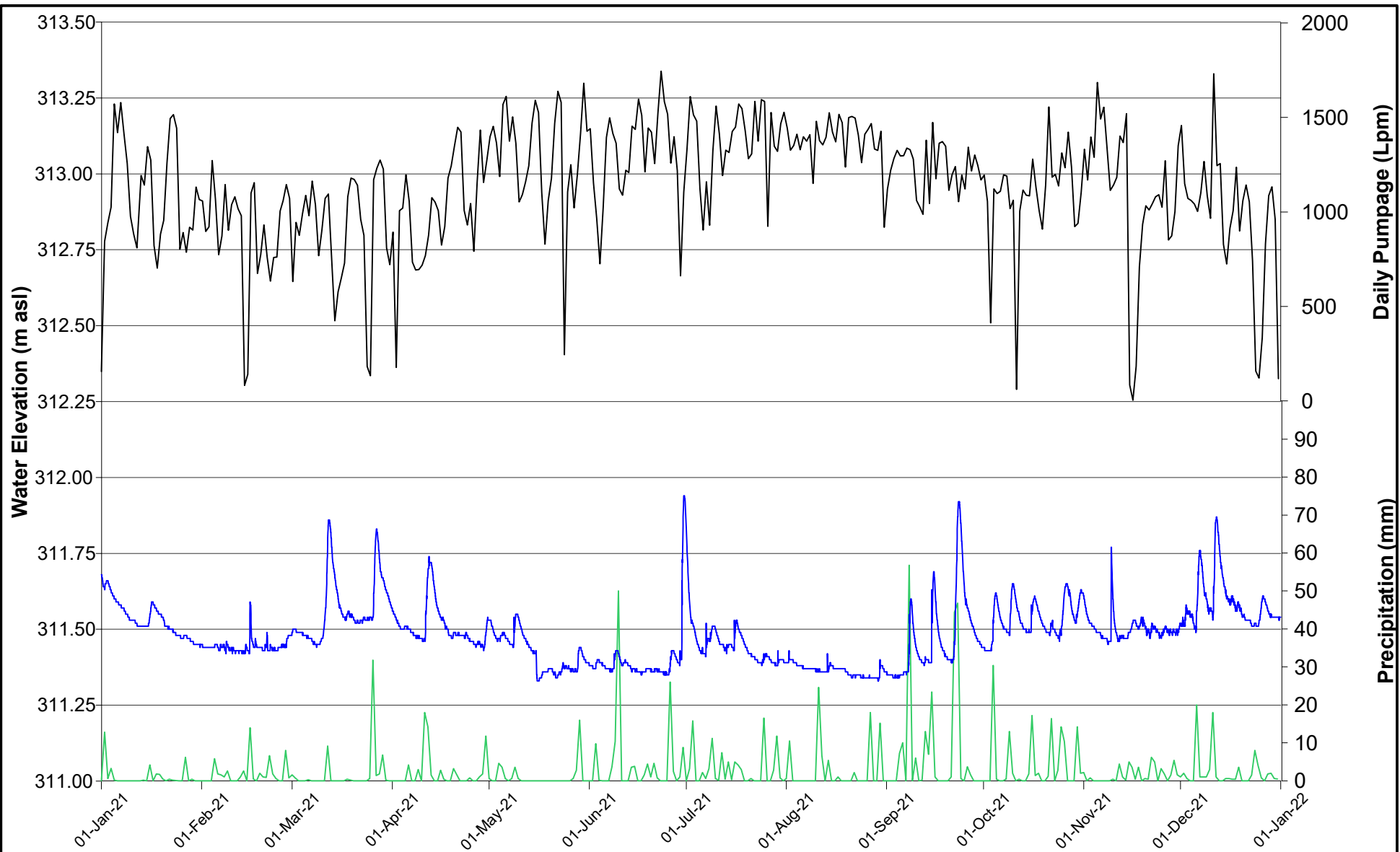
**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**SW1 HYDROGRAPH**  
**2021 ANNUAL MONITORING REPORT**



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DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E14a



- Precipitation (mm)
- Daily Pumpage (Lpm)
- SW1

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

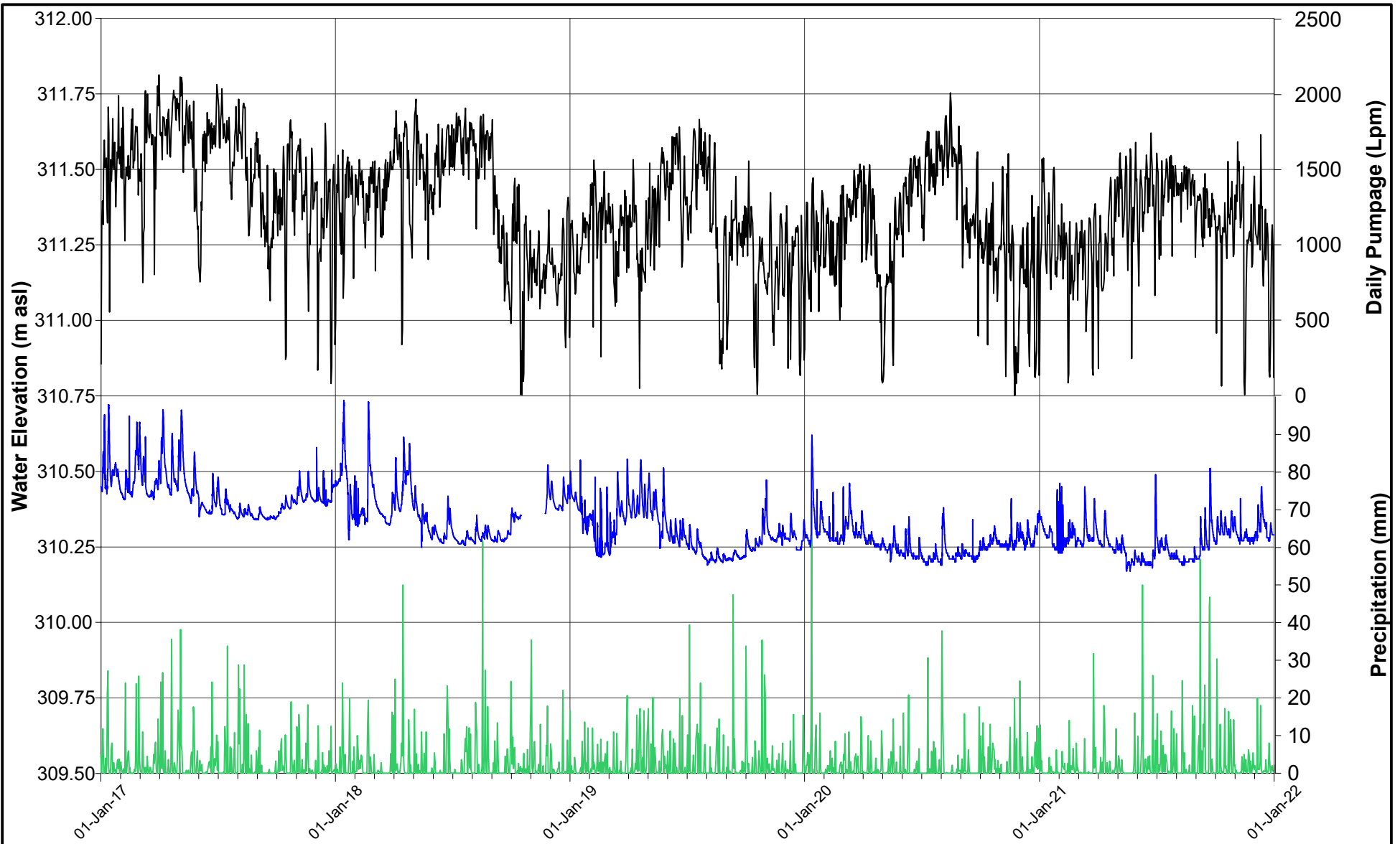
**TITLE**  
**SW1 HYDROGRAPH (2021)**  
**2021 ANNUAL MONITORING REPORT**



DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> E14b
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— Precipitation (mm)  
— Daily Pumpage (Lpm)  
— SW2

Note: Stream rehabilitation from July 22, 2019 to August 21, 2019

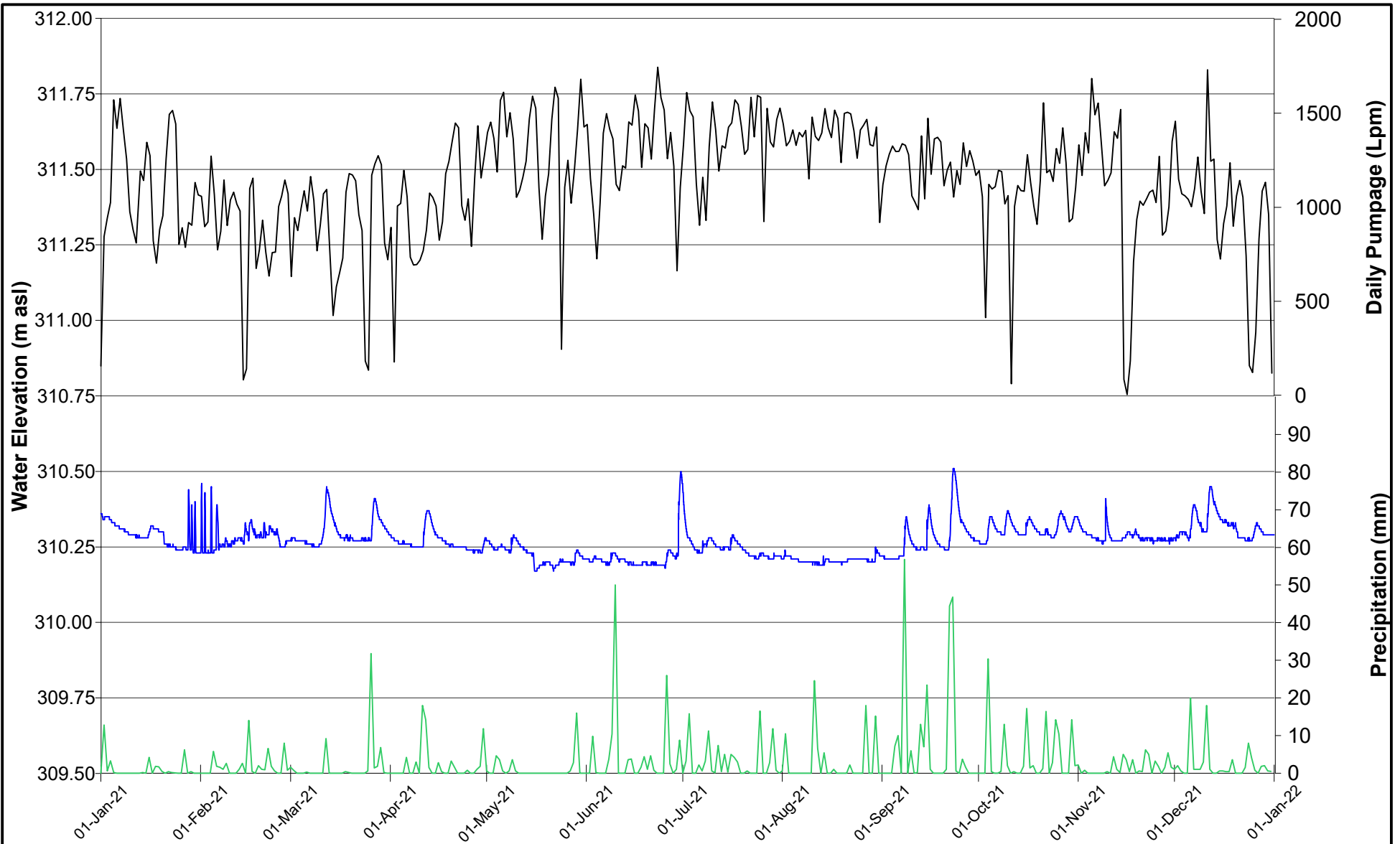
**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**SW2 HYDROGRAPH**  
**2021 ANNUAL MONITORING REPORT**



DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	E15a



- Precipitation (mm)
- Daily Pumpage (Lpm)
- SW2

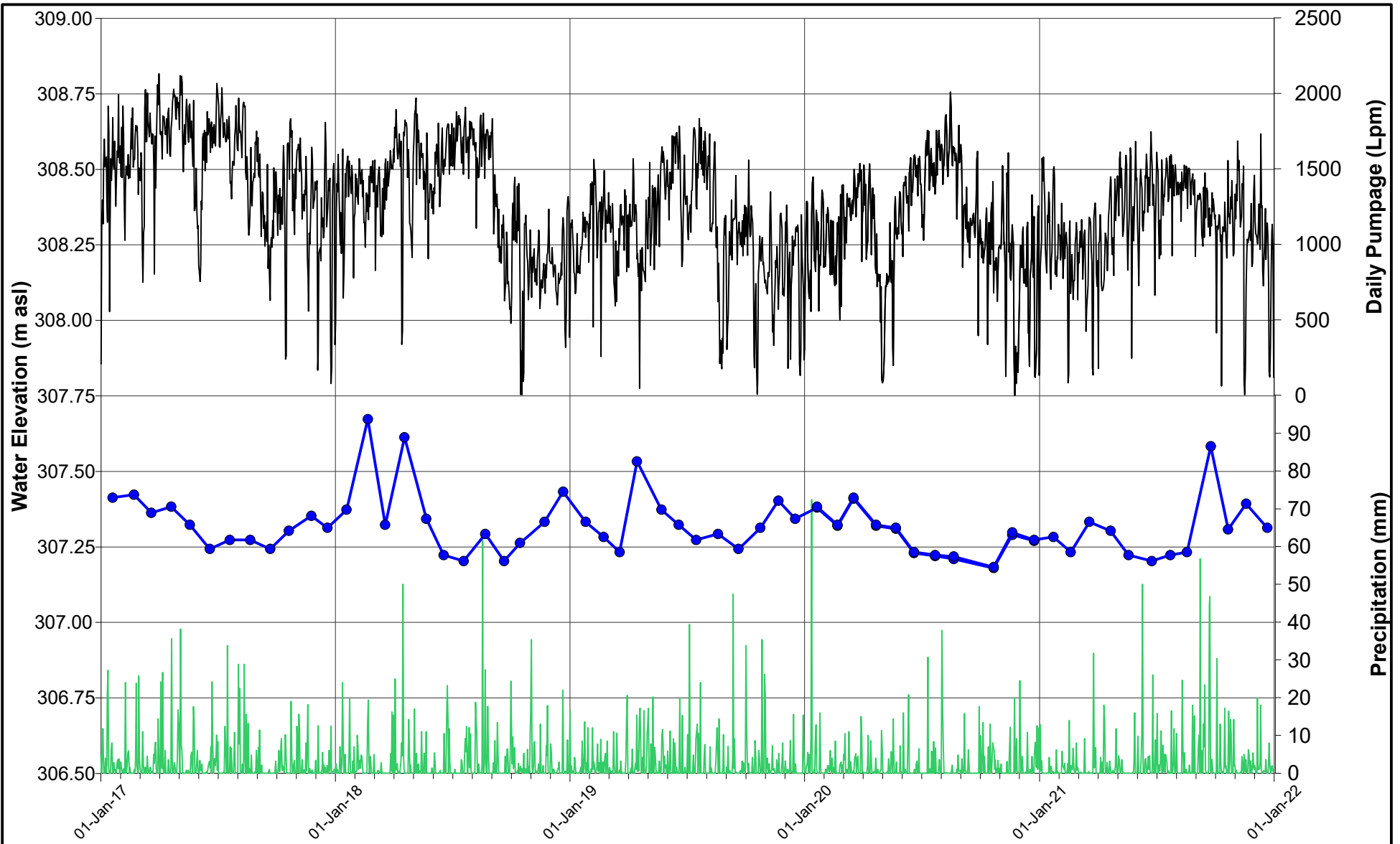
**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**SW2 HYDROGRAPH (2021)**  
**2021 ANNUAL MONITORING REPORT**



DATE	DECEMBER 2021
DESIGN	KS
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APPROVED	GP

PROJECT NO. 20449101 (1100)	REV A	FIGURE E15b
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— Precipitation (mm)  
— Daily Pumpage (Lpm)  
—●— SW5

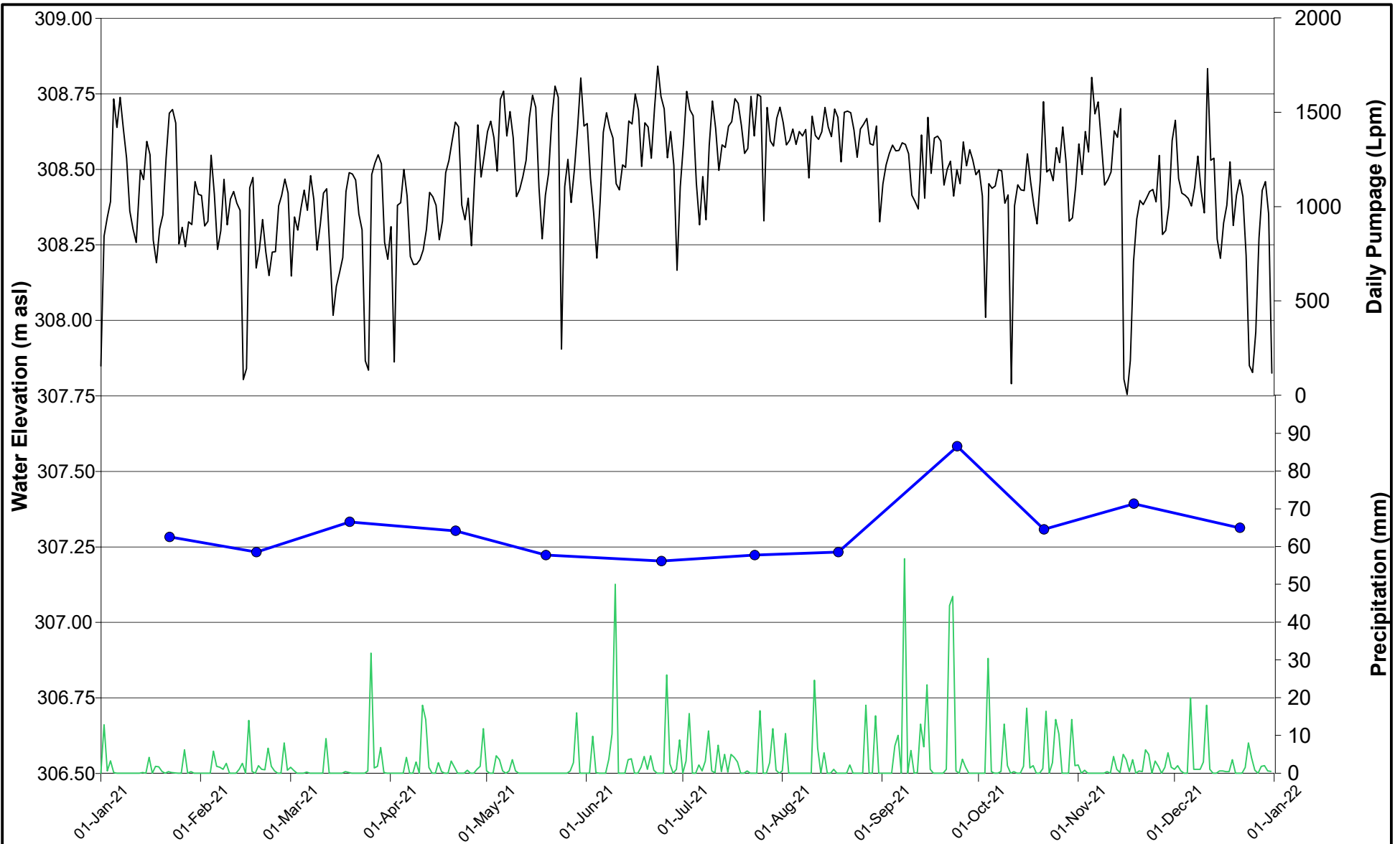
PROJECT **BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

TITLE **SW5 HYDROGRAPH**  
**2021 ANNUAL MONITORING REPORT**



DATE DECEMBER 2021  
 DESIGN KS  
 REVIEW GP  
 APPROVED GP

PROJECT NO. 20449101 (1100)      REV A      FIGURE E16a

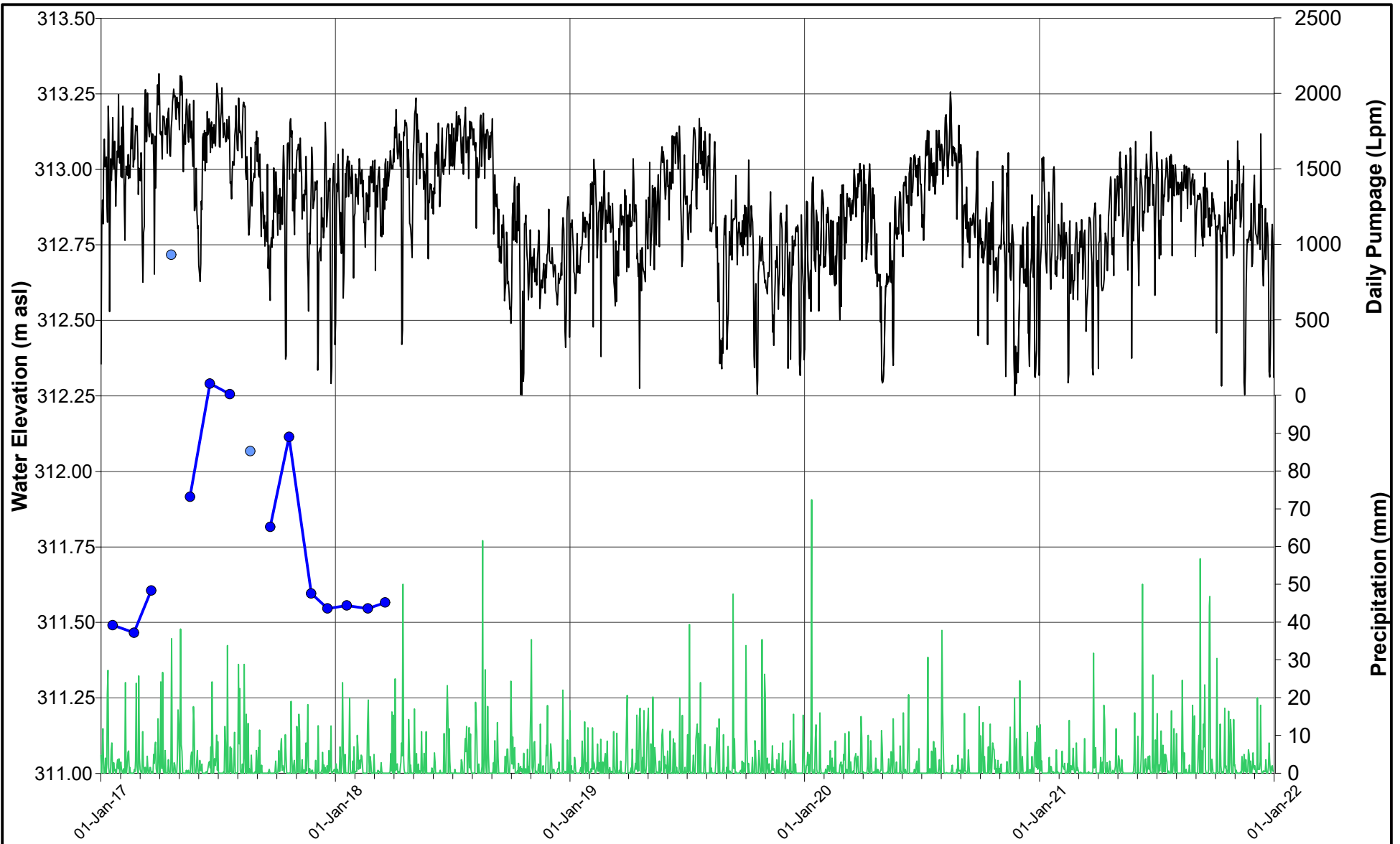


— Precipitation (mm)  
— Daily Pumpage (Lpm)  
—●— SW5



DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT		<b>BLUE TRITON BRANDS</b> Town of Aberfoyle, Ontario	
TITLE		<b>SW5 HYDROGRAPH (2021)</b> <b>2021 ANNUAL MONITORING REPORT</b>	
PROJECT NO.	20449101 (1100)	REV	A
		FIGURE	E16b



- Precipitation (mm)
- Daily Pumpage (Lpm)
- SW9C
- SW9D

Note: Surface water station was destroyed April 2018

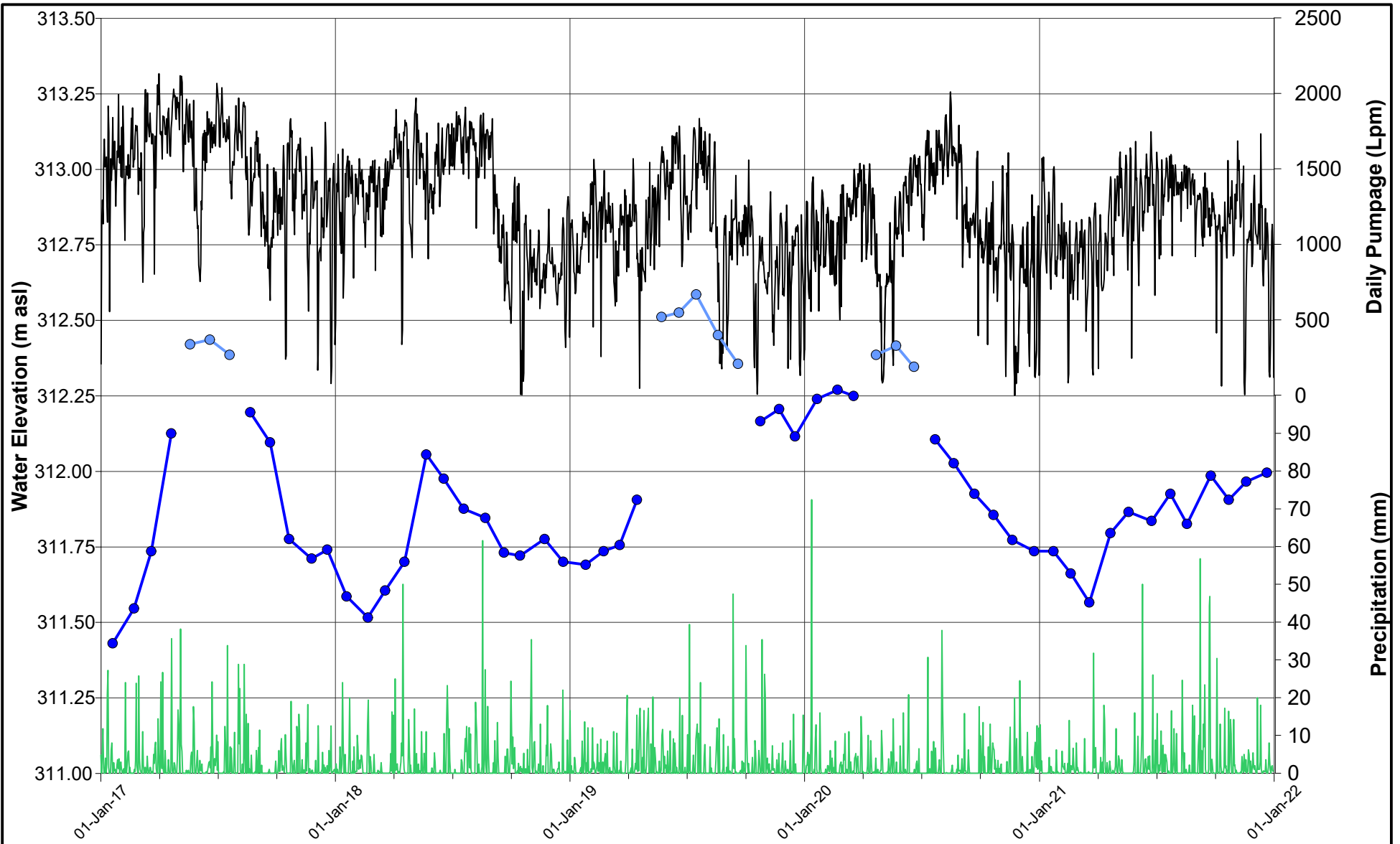


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT **BLUE TRITON BRANDS**  
Town of Aberfoyle, Ontario

TITLE **SW9 HYDROGRAPH**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO. 20449101 (1100)      REV A      FIGURE E17



- Precipitation (mm)
- Daily Pumpage (Lpm)
- SW10A
- SW10B



DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**SW10 HYDROGRAPH**  
**2021 ANNUAL MONITORING REPORT**

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> E18
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**TABLE E1**  
**Manual Surface Water Elevations (Mini Piezometers)**  
**2021 Annual Report**

Date	Water Level (masl)							
	MP1D-16	MP1S-16	MP11D-04	MP11S-08	MP16D-08	MP16S-08	MP6D-04	MP6S-08
20/22-Jan-2021	FROZEN	318.26	FROZEN	317.77	FROZEN	312.22	FROZEN	FROZEN
17/18-Feb-2021	FROZEN	318.24	317.98	317.76	312.10	312.09	FROZEN	FROZEN
18/19-Mar-2021	FROZEN	318.34	317.98	317.76	312.24	312.24	311.59	311.56
20/21-Apr-2021	318.91	318.28	317.98	317.76	312.24	312.23	311.56	311.55
18/19-May-2021	318.87	318.22	317.96	317.74	312.15	312.15	311.46	311.43
24/25-Jun-2021	318.83	318.20	317.91	317.71	312.01	312.01	311.38	311.37
21/23-Jul-2021	318.89	318.23	317.94	317.73	312.17	312.16	311.51	311.50
18/19-Aug-2021	318.87	318.21	317.93	317.74	312.05	312.04	311.37	311.37
23/24-Sep-2021	319.06	318.43	317.98	317.76	312.45	312.45	311.94	311.94
21/22-Oct-2021	318.97	318.28	317.97	317.76	312.29	312.27	311.63	311.63
18/19-Nov-2021	318.99	318.31	317.97	317.76	312.29	312.29	311.64	311.61
20/21-Dec-2021	FROZEN	318.28	317.97	317.76	312.15	312.21	FROZEN	FROZEN

**TABLE E1**  
**Manual Surface Water Elevations (Mini Piezometers)**  
**2021 Annual Report**

Date	Water Level (masl)							
	MP12D-04	MP12S-04	MP14D-07	MP14S-07	MP8D-04	MP8S-04	MP17D-11	MP17S-11
20/22-Jan-2021	FROZEN	FROZEN	FROZEN	FROZEN	FROZEN	FROZEN	309.57	309.59
17/18-Feb-2021	FROZEN	311.35	FROZEN	FROZEN	FROZEN	FROZEN	FROZEN	FROZEN
18/19-Mar-2021	311.52	311.50	311.19	311.25	310.38	310.37	309.60	309.60
20/21-Apr-2021	311.52	311.47	311.52	311.23	310.36	310.34	309.56	309.57
18/19-May-2021	311.43	311.37	311.45	311.17	310.28	310.27	309.44	309.48
24/25-Jun-2021	311.24	311.24	311.32	311.16	310.21	310.20	309.34	309.46
21/23-Jul-2021	311.42	311.38	311.43	311.21	310.31	310.30	309.48	309.52
18/19-Aug-2021	311.25	311.23	311.32	311.18	310.26	310.22	309.39	309.48
23/24-Sep-2021	311.77	311.76	311.65	311.48	310.61	310.59	309.85	309.90
21/22-Oct-2021	311.55	311.51	311.53	311.27	310.38	310.38	309.60	309.61
18/19-Nov-2021	311.56	311.52	311.52	311.22	310.36	310.35	309.59	309.60
20/21-Dec-2021	311.59	311.44	311.54	310.63	310.37	310.37	309.60	309.61



**TABLE E1**  
**Manual Surface Water Elevations (Mini Piezometers)**  
**2021 Annual Report**

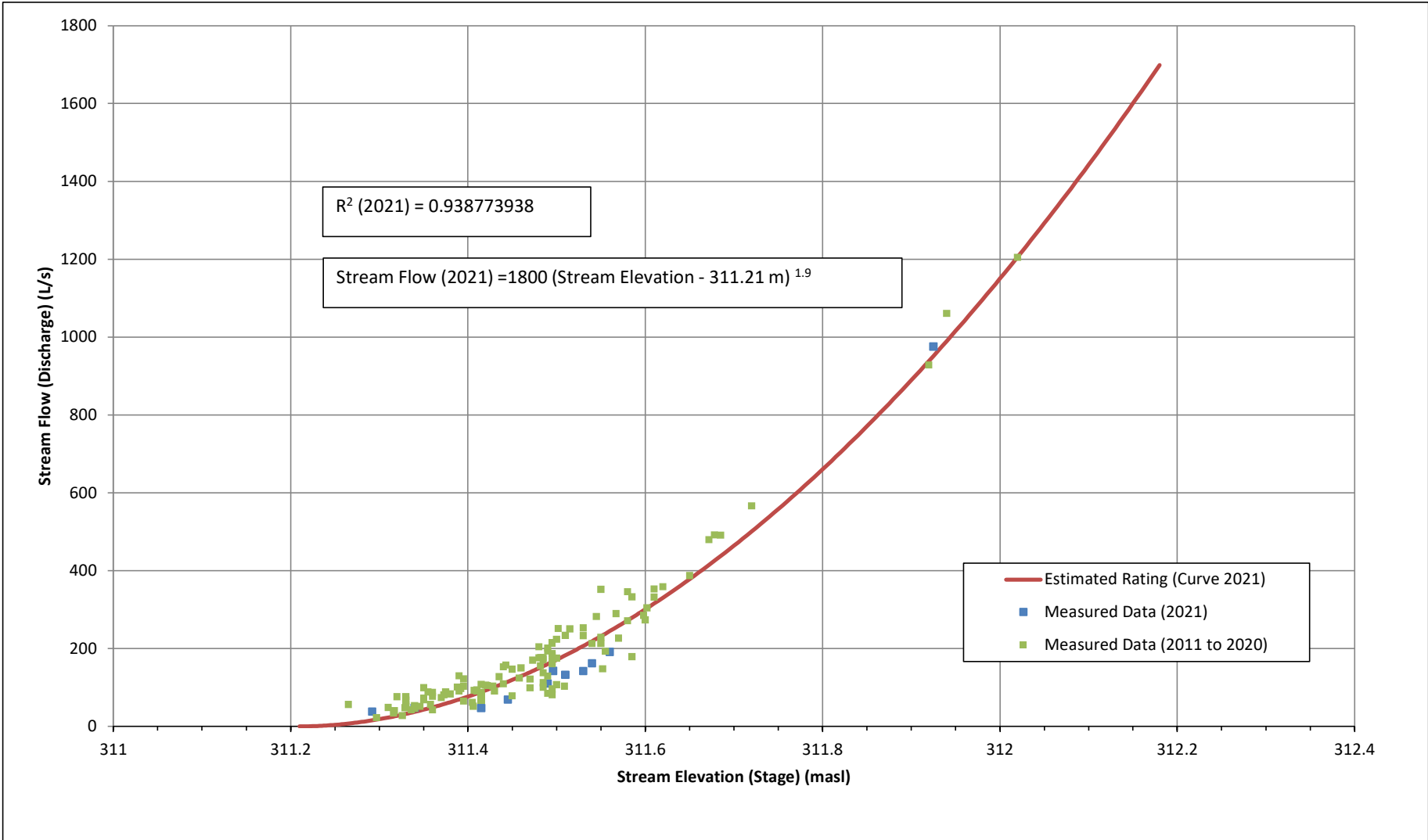
Date	Water Level (masl)			
	MP18D-11	MP18S-11	MP19D-12	MP19S-12
20/22-Jan-2021	308.23	308.28	310.59	310.55
17/18-Feb-2021	FROZEN	FROZEN	310.59	310.57
18/19-Mar-2021	308.32	308.33	310.62	310.57
20/21-Apr-2021	308.28	308.30	310.61	310.55
18/19-May-2021	308.16	308.22	310.49	310.42
24/25-Jun-2021	308.06	308.16	310.23	310.19
21/23-Jul-2021	308.23	308.21	310.54	310.42
18/19-Aug-2021	308.13	308.20	310.39	310.36
23/24-Sep-2021	308.57	308.61	310.78	310.76
21/22-Oct-2021	308.43	308.46	310.65	310.56
18/19-Nov-2021	308.43	308.47	310.59	310.55
20/21-Dec-2021	308.50	308.48	310.62	310.57

**TABLE E2**  
**Manual Surface Water Elevations (Surface Water Stations)**  
**2021 Annual Report**

Date	Water Level (masl)					
	SW1	SW2	SW3	SW4	SW5	SW10
20/22-Jan-2021	311.50	310.27	317.41	312.44	307.28	FROZEN
17/18-Feb-2021	FROZEN	FROZEN	317.37	FROZEN	307.23	FROZEN
18/19-Mar-2021	311.56	310.29	317.47	312.44	307.33	311.57
20/21-Apr-2021	311.49	310.26	317.41	312.41	307.30	311.80
18/19-May-2021	311.42	310.20	317.34	312.42	307.22	311.87
24/25-Jun-2021	311.35	310.20	317.30	312.39	307.20	311.84
21/23-Jul-2021	311.45	310.24	317.35	312.42	307.22	311.93
18/19-Aug-2021	311.34	310.20	317.30	312.41	307.23	311.83
23/24-Sep-2021	311.93	310.51	317.54	312.52	307.58	311.99
21/22-Oct-2021	311.53	310.35	317.38	312.46	307.31	311.91
18/19-Nov-2021	311.51	310.29	317.44	312.49	307.39	311.97
20/21-Dec-2021	311.54	310.27	317.41	NA	307.31	312.00

**APPENDIX F**

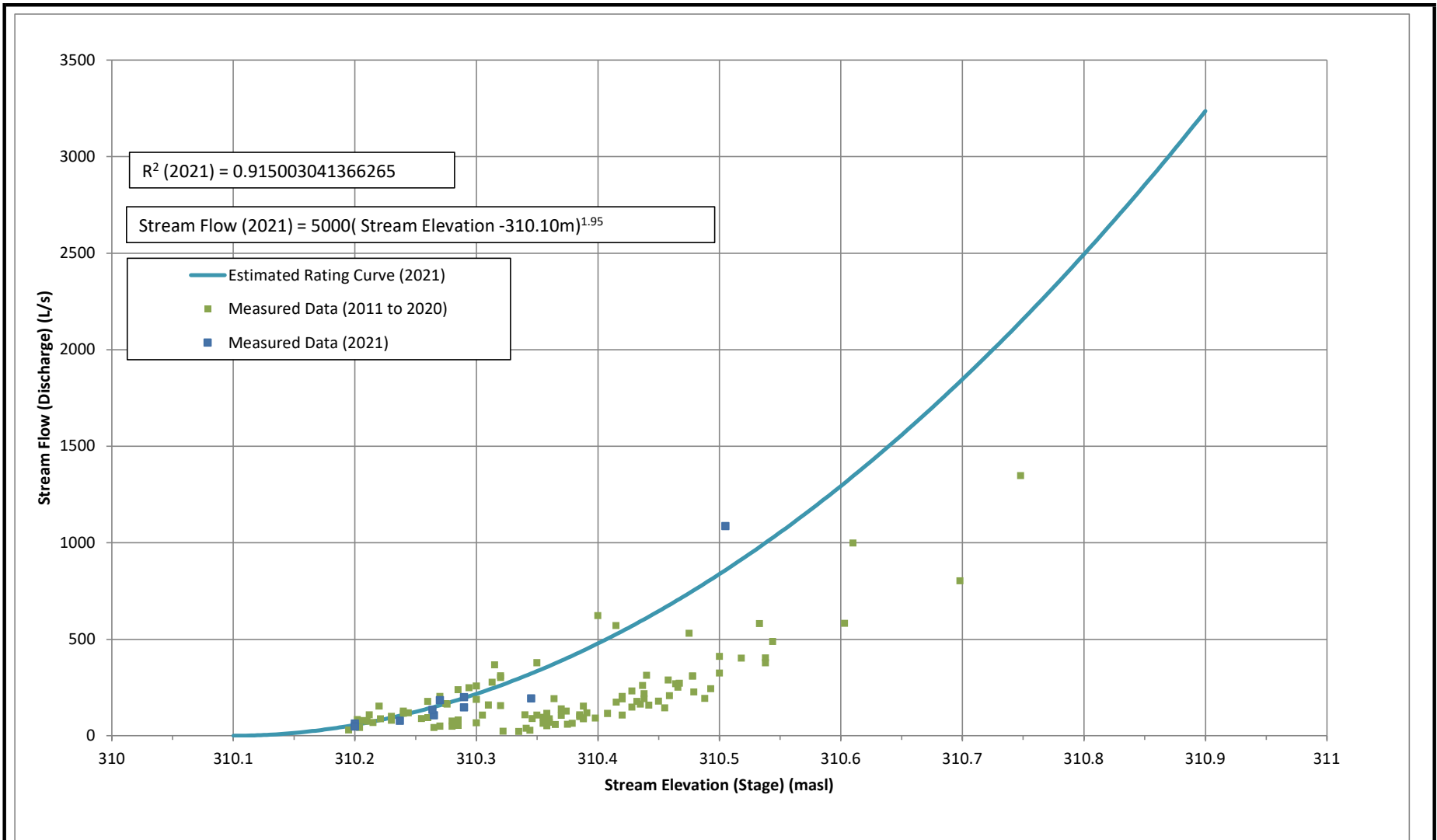
# Surface Water Flow Monitoring



2021 Data Notes:  
 In 2021, the range of water levels recorded during manual flow measurements (and used to determine the stage-discharge relationship) = ~311.33 to 311.93 masl. The full range of water levels recorded in 2021 = ~311.33 to 311.95 masl.

Figure. F1  
 STAGE-DISCHARGE MEASUREMENTS FOR SW1 (2021)  
 2021 ANNUAL MONITORING REPORT  
 BLUE TRITON BRANDS  
 Aberfoyle, Ontario

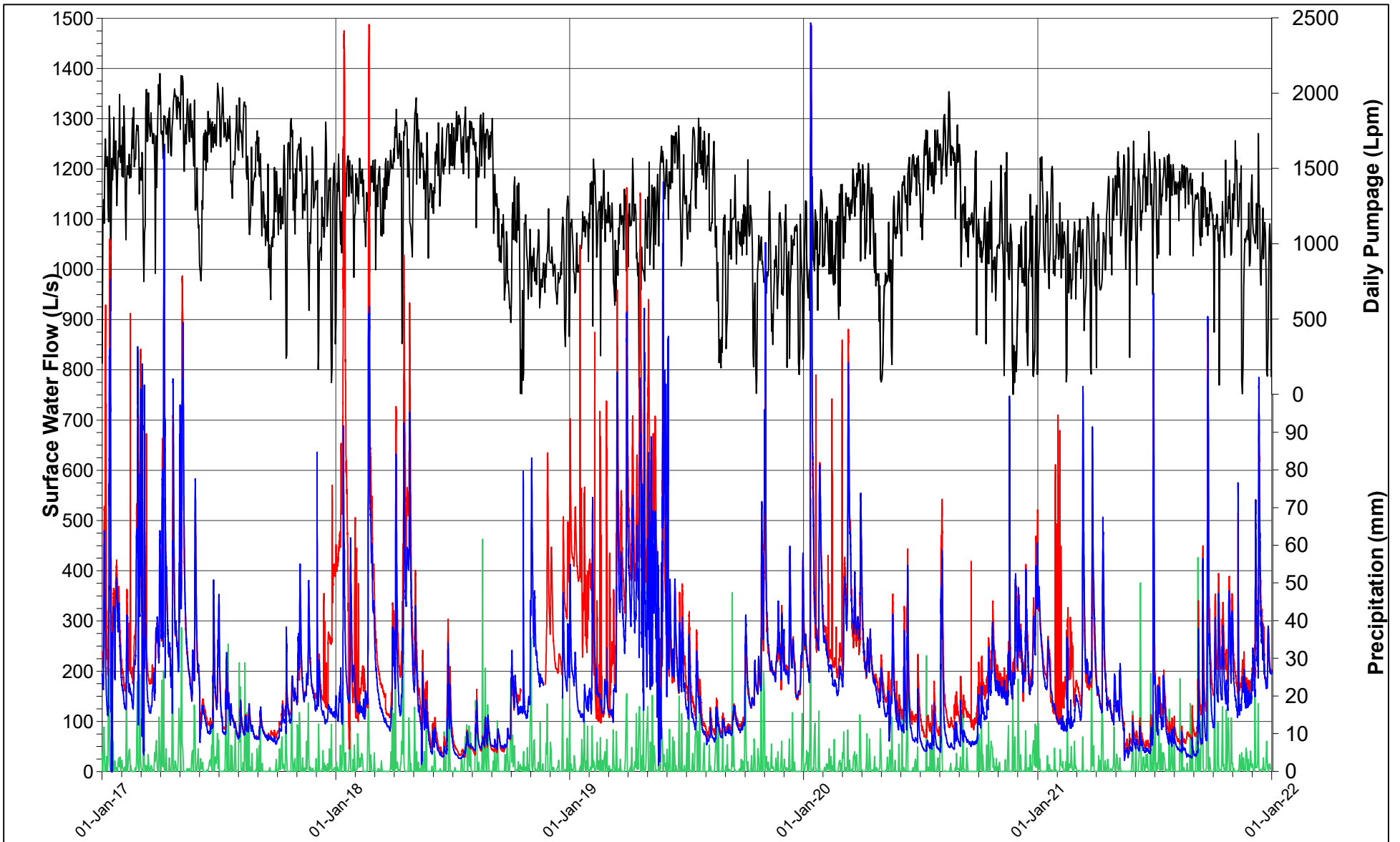




2021 Data Notes:  
 In 2021, the range of water levels recorded during manual flow measurements = 310.20 to 310.51 masl. The full range of water levels recorded in 2021 = ~310.17 to 310.54 masl.



Figure. F2  
 STAGE-DISCHARGE MEASUREMENTS FOR SW2 (2021)  
 2021 ANNUAL MONITORING REPORT  
 BLUE TRITON BRANDS  
 Aberfoyle, Ontario



- Precipitation (mm)
- Daily Pumpage (Lpm)
- SW1
- SW2



DATE	DECEMBER 2021
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APPROVED	GP

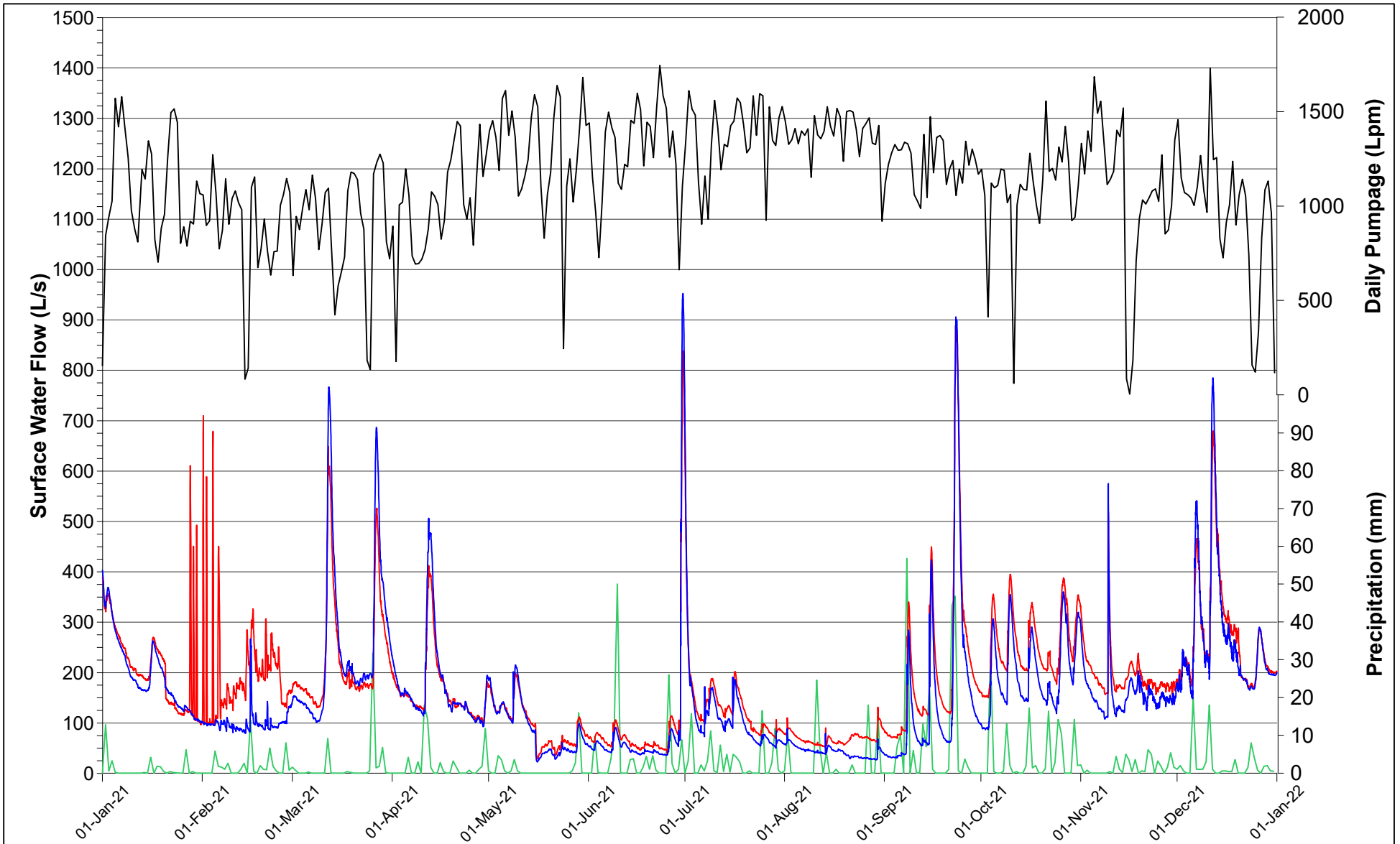
PROJECT **BLUE TRITON BRANDS**  
Town of Aberfoyle, Ontario

TITLE **SURFACE WATER FLOW VS. TIME**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO.  
20449101 (1100)

REV  
A

FIGURE  
F3a



- Precipitation (mm)
- Daily Pumpage (Lpm)
- SW1
- SW2



DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

**PROJECT**  
**BLUE TRITON BRANDS**  
 Town of Aberfoyle, Ontario

**TITLE**  
**SURFACE WATER FLOW VS. TIME (2021)**  
**2021 ANNUAL MONITORING REPORT**

<b>PROJECT NO.</b> 20449101 (1100)	<b>REV</b> A	<b>FIGURE</b> F3b
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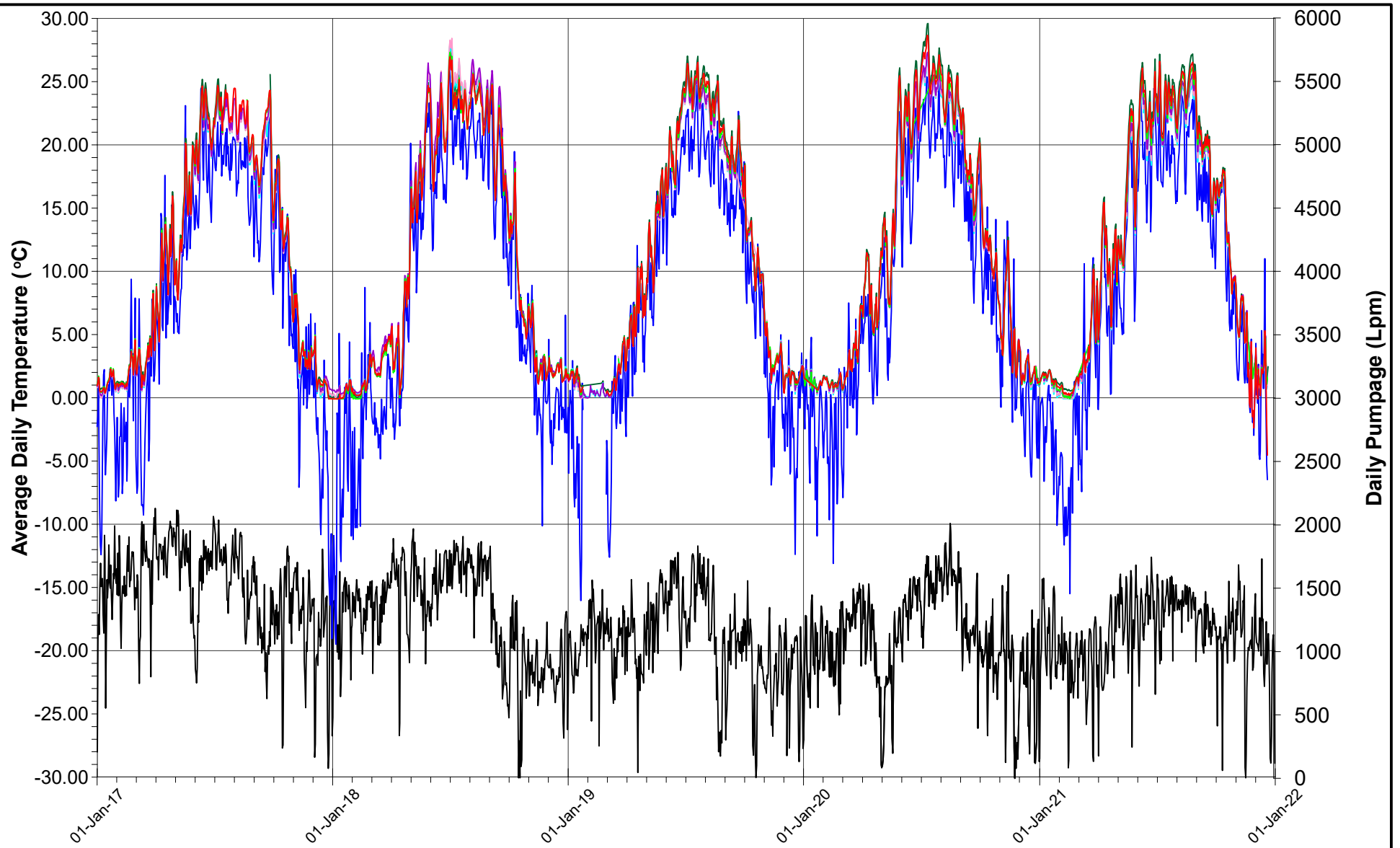
**TABLE F1**  
**Surface Water Flow**  
**2021 Annual Report**

<b>DATE</b>	<b>SW-1 Flow (L/sec)</b>	<b>SW-2 Flow (L/sec)</b>
20-Jan-21	142.2	105.7
17-Feb-21	FROZEN	FROZEN
18-Mar-21	190.9	199.5
20-Apr-21	109.6	133.3
18-May-21	46.7	48.5
25-Jun-21	37.6	62.7
21-Jul-21	68.7	77.0
18-Aug-21	47.2	46.9
23-Sep-21	975.4	1086.6
23-Oct-21	141.7	192.9
19-Nov-21	132.2	146.5
20-Dec-21	161.6	183.9



**APPENDIX G**

# Stream Temperature Monitoring



— Daily Pumpage (Lpm)	— ST3-05
— AT1-05 (Air)	— ST4-05
— ST1-05	— ST5-05
— ST2-05	— ST6-08

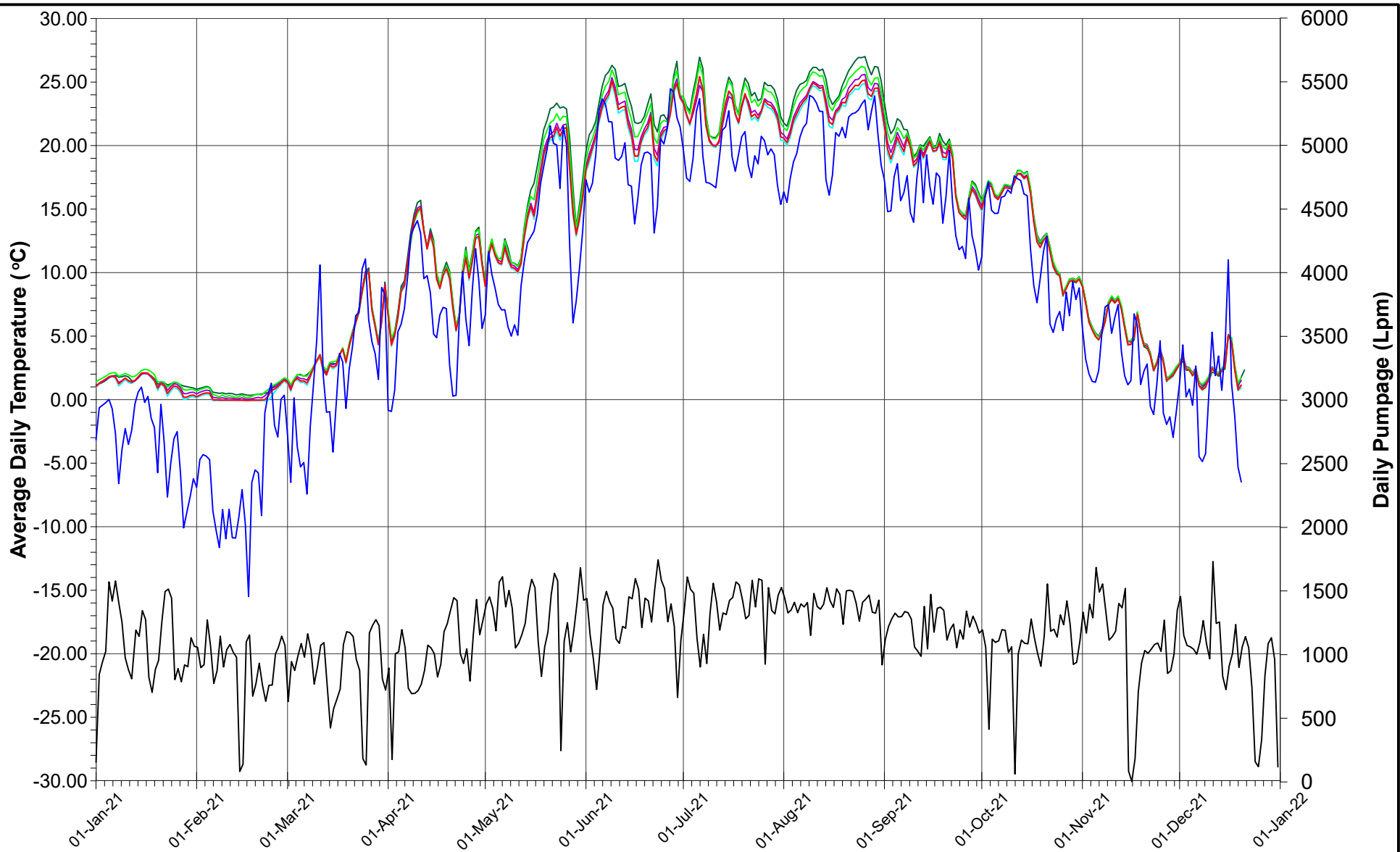


DATE	DECEMBER 2021
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT **BLUE TRITON BRANDS**  
Town of Aberfoyle, Ontario

TITLE **AVERAGE DAILY SURFACE WATER TEMPERATURE VS. TIME**  
**2021 ANNUAL MONITORING REPORT**

PROJECT NO.	REV	FIGURE
20449101 (1100)	A	G1a



— Daily Pumpage (Lpm)	— ST3-05
— AT1-05 (Air)	— ST4-05
— ST1-05	— ST5-05
— ST2-05	— ST6-08

PROJECT **BLUE TRITON BRANDS**  
Town of Aberfoyle, Ontario

TITLE **AVERAGE DAILY SURFACE WATER TEMPERATURE VS. TIME  
2021 ANNUAL MONITORING REPORT**



DATE DECEMBER 2021  
DESIGN KS  
REVIEW GP  
APPROVED GP

PROJECT NO. 20449101 (1100)      REV A      FIGURE G1b

# Examination of the Temperature Suitability of Aberfoyle Creek for Resident Fishes: 2006-2021

Prepared for Blue Triton Brands



Prepared by Cam Portt and Jim Reid

C. Portt and Associates

February 2022

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## Introduction

Condition 4.4 of the Permit to Take Water (PTTW Number 1763-8FXR29) issued to Nestlé Waters Canada (Nestlé), now Blue Triton Brands (Blue Triton), by the Ontario Ministry of Environment (MOE, now Ministry of Environment, Conservation and Parks) on April 29, 2011, required that Nestlé review the appropriateness of the methodology of their water temperature monitoring program in Aberfoyle Creek (the Nestlé program). C. Portt and Associates conducted that review for Nestlé and made a number of recommendations (Portt, 2011). The recommendations of the review were accepted by the MOE and were to be incorporated commencing in the 2012 field season (letter from Carl Slater, MOE, to Don DeMarco, Nestlé, October 26, 2011). One of those recommendations was that historical and future temperature data be analyzed using ThermoStat software that has been developed to evaluate the thermal suitability of Ontario streams for thermal guilds for individual species of fishes in order to provide insight into the ecological implications of the current temperature regime. The monitoring is now required under Condition 4.4 of PTTW 3133-C5BUH9. Subsequently, the results of these analyses have been reported annually (Portt and Reid, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021). This report presents the results of the analyses of the 2021 data, together with the data from previous years.

## Methods

Water temperature is monitored at the sediment-water interface at six locations in Aberfoyle Creek (Figure 1) using Tidbit© V2 and MX2203 temperature loggers manufactured by Onset Computer Corporation. ([http://www.onsetcomp.com/products/data-loggers/utbi-001\\_or\\_mx2203](http://www.onsetcomp.com/products/data-loggers/utbi-001_or_mx2203)). The loggers have an accuracy of  $\pm 0.2^{\circ}\text{C}$  between  $0^{\circ}\text{C}$  and  $50^{\circ}\text{C}$  and drift is  $0.1^{\circ}\text{C}$  per year. Monitoring at Stations 1 – 5 began in 2005; monitoring at Station 6, which is the station furthest upstream, began in 2008. The data are logged at half-hour intervals.

The data were analyzed using ThermoStat Version 3.1 temperature analysis software (Jones and Schmidt, <http://people.trentu.ca/nicholasjones/thermostat.htm>). ThermoStat calculates the thermal suitability for individual fish species based on laboratory determined optimal and lethal temperatures, compiled by Hasnain et al. (2010), and the water temperature record.

Hasnain et al. (2010) provide the following definitions for the temperature criteria:

**Optimum growth temperature (OGT):** *The optimum growth temperature is that which supports the highest growth rate in an experiment where separate groups of fish are exposed to one of a set of constant temperatures under ad libitum feeding conditions. The range of these constant temperatures is chosen so that reduced growth is observed at both extremes (McCauley and Casselman 1980 cited in Wismer and Christie 1987, Jobling 1981).*

**Final temperature preferendum (FTP):** *Final temperature preferendum is that towards which fish gravitate when exposed to an 'infinite' temperature range (Giattina and Garton 1982 cited in Wismer and Christie 1987). Two methods are used to determine FTP: the gravitation method and the acclimation method (Jobling 1981). The gravitation method involves exposing fish to a temperature gradient until they*

gravitate towards a specific temperature. The acclimation method extends the gravitation method by carrying out repeated ‘gravitation trials’ with fish acclimated to progressively higher temperatures. The preferred temperature exhibited in each trial is then plotted against the acclimation temperature and the FTP is the temperature at which the best fit line for these data crosses the line of equality (Jobling 1981). An informal survey of a subset of the original sources indicated that most estimates were determined via the gravitation method. FTP estimates obtained using both methods were compiled in the database.

**Upper incipient lethal temperature (UILT):** The upper incipient lethal temperature is that at which 50% of the fish in an experimental trial survive for an extended period (Spotila et al. 1979, Jobling 1981, Wismer and Christie 1987). Testing for UILT involves placing groups of fish in separate baths, each held at a different constant temperature, using a sufficiently wide range of constant temperatures that rapid mortality is observed in some baths whereas slow incomplete mortality occurs in others (Spotila et al. 1979).

**Critical thermal maximum (CTMax):** The critical thermal maximum is an indicator of ‘thermal resistance’ and is defined as the temperature at which a fish loses its ability to maintain a ‘normal’ upright posture in the water (loss of equilibrium; Jobling 1981). It is determined by exposing fish in a tank to steadily increasing water temperatures (typically at a rate of 1 °C min<sup>-1</sup>) and noting the temperature at which the fish exhibit spasms and loss of equilibrium (Jobling 1981, Wismer and Christie 1987). Remaining at, or above, CTMax results in mortality (Jobling 1981, Wismer and Christie 1987).

Thermal indices that reflect suitability are calculated based on the temperature record for a location and the laboratory derived criteria (Table 1). The proportion of the June through August temperature measurements that are within ±2 °C of the optimal or preferred temperature and the proportion of the June through August temperature measurements that equal or exceed the lethal threshold temperatures are expressed as a percentage of the total number of temperature measurements during this period. Because the temperature measurements occurred at fixed intervals, this percentage of measurements is equivalent to the percentage of the time from June 1st through August 31st that the temperature conditions are met.

**Table 1. Indices used to evaluate the thermal suitability for individual fish species.**

<b>Optimal Range Indices</b>	
%OGT	Percent of temperature measurements within ±2°C of the optimal growth temperature. Higher values indicate better conditions, to a theoretical maximum of 100%.
%FTP	Percent of temperature measurements within ±2°C of the final temperature preferendum. Higher values indicate better conditions, to a theoretical maximum of 100%.
<b>Lethal Threshold Indices</b>	
%>UILT	Percent of temperature measurements that equal or exceed the upper incipient lethal temperature. Lower values indicate better conditions. 0% is optimum.
%>CTmax	Percent of temperature measurements that equal or exceed the critical thermal maximum. Lower values indicate better conditions. 0% is optimum.

Not all the temperature criteria are available from the scientific literature (Hasnain et al, 2010) and, therefore, some of the thermal suitability indices cannot be calculated for some species. The temperature criteria that were available and used by ThermoStat for the fish species that were captured in Aberfoyle Creek during electrofishing conducted in 2008 are presented in (Table 2), together with the number of individuals of each species that was captured on each of the two sampling dates.

**Table 2. Number of individuals of each species that were captured by electrofishing Aberfoyle Creek on January 31 and September 24, 2008 and the temperature criteria that are available from the scientific literature, from Hasnain et al (2010), and are used by ThermoStat to calculate thermal indices.**

Common name	Scientific name	Number of individuals captured Sampling date		Temperature criteria available from the scientific literature			
		01/31/2008	09/24/2008	OGT	FTP	UILT	CTmax
blacknose dace	<i>Rhinichthys atratulus</i>	25	29	na <sup>1</sup>	19.6	28.6	30.2
bluntnose minnow	<i>Pimephales notatus</i>	3	2	26.2	24.1	31.5	29.9
brook trout	<i>Salvelinus fontinalis</i>	1	0	14.2	14.8	24.9	29.3
brown trout	<i>Salmo trutta</i>	4	3	12.6	15.7	25.0	28.3
common shiner	<i>Luxilus cornutus</i>	96	36	22.0	21.9	30.4	31.2
common white sucker	<i>Catostomus commersonii</i>	49	76	25.5	23.4	27.8	31.6
creek chub	<i>Semotilus atromaculatus</i>	154	353	na	24.9	29.1	33.0
johnny darter	<i>Etheostoma nigrum</i>	59	52	na	na	na	na
largemouth bass	<i>Micropterus salmoides</i>	0	3	26.6	28.6	31.9	38.4
pumpkinseed	<i>Lepomis gibbosus</i>	2	10	25.0	27.7	31.7	37.6
rainbow darter	<i>Etheostoma caeruleum</i>	3	28	na	19.9	na	32.1
rock bass	<i>Ambloplites rupestris</i>	9	37	28.4	24.9	33.9	36.0

1. na indicates that the temperature metric was not available.

The water temperature data were analyzed for each year at each monitoring location, excluding cases for which a significant portion of the potential temperature measurements was missing for the June through August period. Temperature logging at Sites 1 through 5 began on July 1, 2005; consequently, 2006 is the first year for which thermal suitability indices were calculated. Temperature logging at Site 6 began on May 15, 2008, so there are no thermal suitability indices for that site prior to 2008. There are significant gaps in the summer temperature data for Site 4 in 2010, so the thermal suitability indices were not calculated. Approximately 3.5 days of data were missing for Sites 2 and 3, at the end of August in 2010, and 9.5 hours of data for June 1 were missing for Site 1 in 2010; it was assumed that these amounts of missing data would not materially alter the calculated thermal suitabilities. There are no gaps in the summer temperature data series after 2010.

The mean air temperature at the Guelph Turfgrass weather station, which is the closest Environment Canada weather station to the site, was calculated for the period June 1 through August 31 for the years 2007- 2009 and 2011-2021. The weather station began operating during the summer of 2006, and there are missing data during June of 2010, so the June – August mean could not be calculated for those years. The relationship between mean June – August air temperature and mean June – August water temperature was explored graphically and using regression analyses.



## Results

Graphs of the thermal suitability indices are presented in Figure 2 (%>UILT), Figure 3 (%>CTmax), Figure 4 (%FTP) and Figure 5 (%OTG). The indices values are presented in Appendix A. Summer water temperatures are highest at the most upstream location, which is closest to the Aberfoyle Mill pond, and decrease with distance downstream. This is reflected in the thermal indices, which improve from upstream to downstream for species that require cold temperatures and improve from downstream to upstream for species that require warm temperatures. Mean June – August air temperature was 19.63 °C in 2021, which is second highest for the period 2007 – 2021 (Figure 6). This is also evident in the thermal suitability indices.

Lethal temperatures are arguably the most critical thermal factor in determining fish distributions. If lethality occurs, other factors such as growth are immaterial. It is clear from Figure 2 that brook trout and brown trout are the species whose upper incipient lethal temperature is equaled or exceeded most frequently from June 1st to August 31st; in the warmest years, at the warmest site (Site 6), the %>UILT exceeds 40% for those species. The upper incipient lethal temperature is also exceeded, but infrequently, for blacknose dace, common shiner, creek chub and white sucker. In 2021, the upper incipient lethal temperature for brook trout and brown trout was exceeded 41% and 40% of the time, respectively, at the farthest upstream station and 8% of the time for brook trout and 7% of the time for brown trout at the station farthest downstream. In 2021, the *CTMax* was exceeded only for brown trout and only at the two most upstream stations (Figure 3).

The percentage of the time, from June 1st to August 31st, that water temperature is within 2°C of the final temperature preferendum (%FTP) is lowest for brown trout and brook trout, which have the lowest preferred temperatures, at all sites in all years (Figure 4; Table 2). The next lowest %FTP values, in most years, are for pumpkinseed and largemouth bass (Figure 4), which have the highest preferred temperatures (Table 2). In 2021, as in past years, the %FTP was highest for species with intermediate temperature requirements.

The percentage of the time, from June 1st to August 31st, that water temperature was within 2°C of the optimal temperature for growth (%OGT) is presented in Figure 5. The lowest %OGT values are for brown trout and brook trout, which have the lowest optimum temperature for growth among the species that occur in this portion of Aberfoyle Creek (Table 2). In 2021, %OGT was zero for both species at all sites except for brook trout at Site 5, where it was 0.1. The next lowest value is for rock bass, which is the species with the highest optimum temperature for growth (Table 2). As in previous years, the highest mean %OGT in 2021 was for species with intermediate optimum temperatures for growth.

The mean June – August water temperature at each monitoring location is plotted versus mean June – August air temperature at the Guelph Turfgrass Institute in Figure 6. Mean June – August water temperature decreases in a downstream direction through the Blue Triton property (Figure 6). This is also evident in the plots of the temperature indices (Figures 2 – 5). For example, the percent of temperature measurements that exceed the ultimate upper incipient lethal temperature (%>UILT) for brook trout decreases with distance downstream (Figure 2). As Figure 6 illustrates, the mean June – August water temperature is highly correlated with the mean June – August air temperature. The best fit regressions

are two-stage polynomials. At five of the six sites mean June – August air temperature accounts for more than 90% of the variation in mean June – August water temperature. The rate of increase in water temperature with air temperature tends to decrease in a downstream direction, as does the proportion of the variation accounted for (the  $r^2$ ). The relationship between mean air temperature and mean water temperature was consistent with previous years and the  $r^2$  of the relationship changed by less than 0.01 at all sites with the addition of the 2021 data.

## Discussion

The 2021 results were consistent with those from previous years. In the reach of Aberfoyle Creek that flows through the Blue Triton property, some species (i.e. largemouth bass, rock bass) are limited by low temperatures and the individuals that occur there probably originate from the mill pond that is just upstream. Brook trout and brown trout, on the other hand, are limited by high temperatures that exceed their upper incipient lethal temperature frequently during the summer (Figure 2) and often exceed their preferred temperature and their optimum temperature for growth (Figure 5), even in cool summers. The 2021 results continue to support the previously expressed opinion that water temperature is the principal factor limiting trout abundance in the Blue Triton reach of Aberfoyle Creek, which was based on an analysis by C. Portt using the thermal suitability model of Wehrly et al. (2007) and presented in the Response to Technical Stakeholders' Comments on the TW3-80 Permit Renewal Application (Distributed: March 4, 2011).

The data continue to demonstrate the strong correlation between mean June – August air temperature and mean water temperature for the same period in Aberfoyle Creek. The correlation coefficient changed only slightly at each of the sites with the addition of the 2021 data. It remains clear that any study that attempts to link changes in water temperature over time to causative factors must take year-to-year differences in air temperature into account.

## Conclusions

In 2021, mean summer (June – August) air temperature was the second highest in the period 2007 – 2021. The overall pattern of water temperature suitabilities for the fish species found in the Aberfoyle Branch of Mill Creek from Brock Road downstream through the Blue Triton property in 2021 are consistent with previous years. Water temperatures during the June 1 – August 31 period are usually too warm for coldwater species such as brook trout and brown trout and too cold for warmwater species such as largemouth bass. The water temperatures during this period are most favourable for species such as common shiner that have intermediate thermal requirements. During the summer, the water in the mill pond upstream from Brock Road becomes warm and, although the creek temperature decreases with distance downstream, it frequently exceeds the ultimate upper incipient lethal temperature for brook trout and brown trout at the furthest downstream temperature monitoring site.

The relationships between air temperature and water temperature were consistent with those observed in previous years.

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Figure 1. Temperature logging locations used in the Blue Triton monitoring program in Aberfoyle Creek.

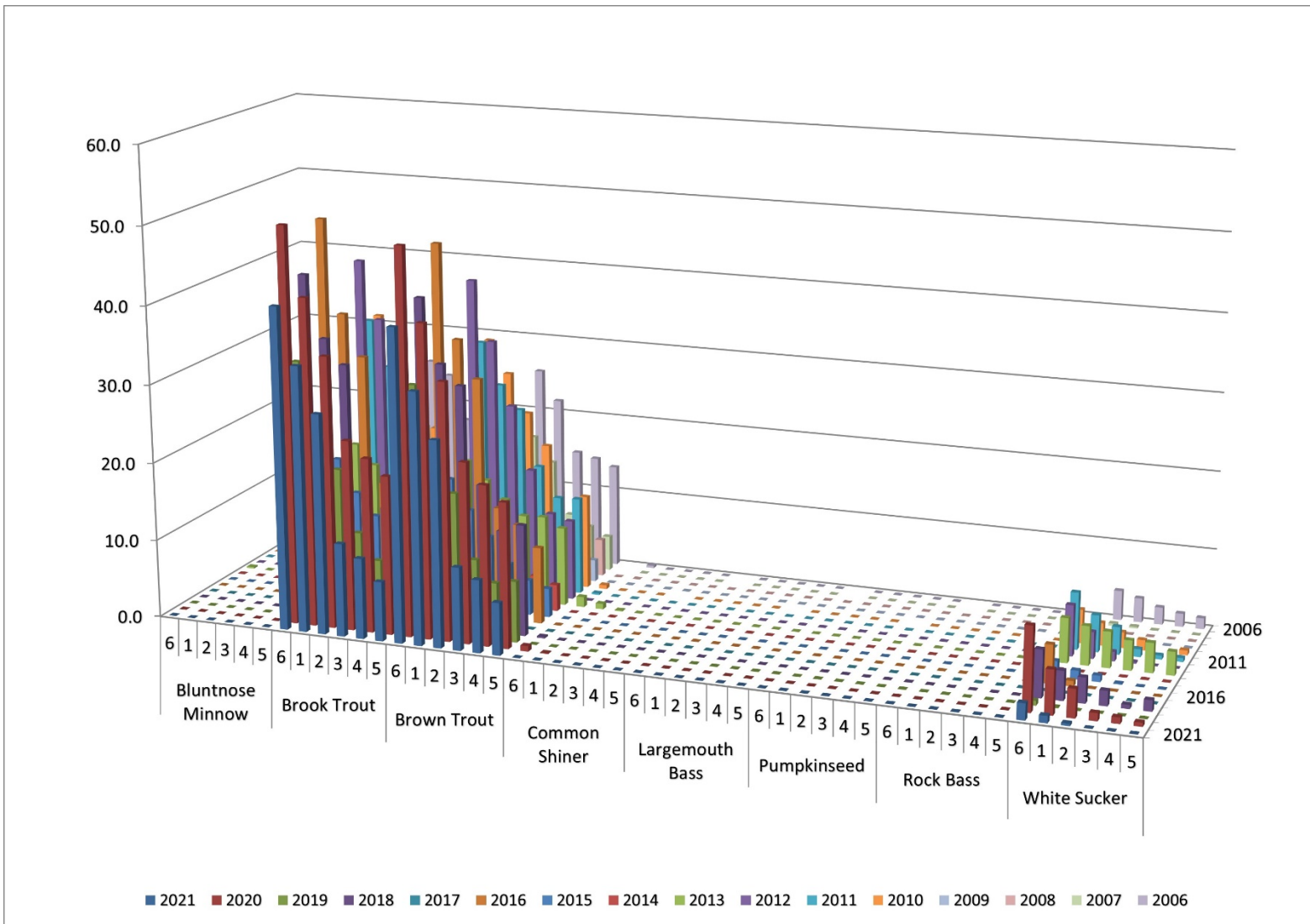


Figure 2. Percent of temperature measurements that exceed the ultimate upper incipient lethal temperature (>UILT) during the period June 1 to August 31, by species, station, and year.

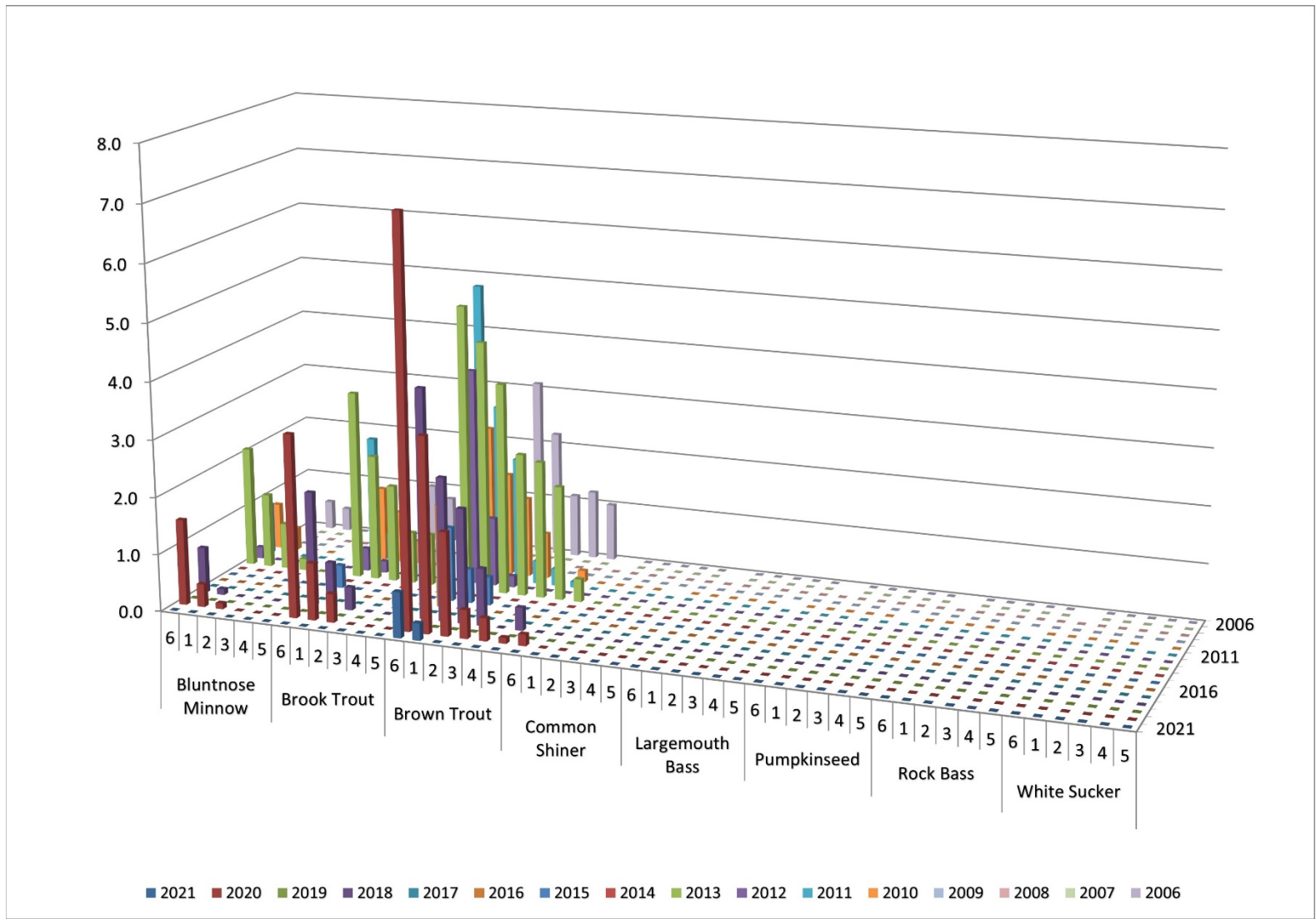


Figure 3. Percent of temperature measurements that exceed the critical thermal maximum temperature (>CTmax) during the period June 1 to August 31, by species, station, and year.

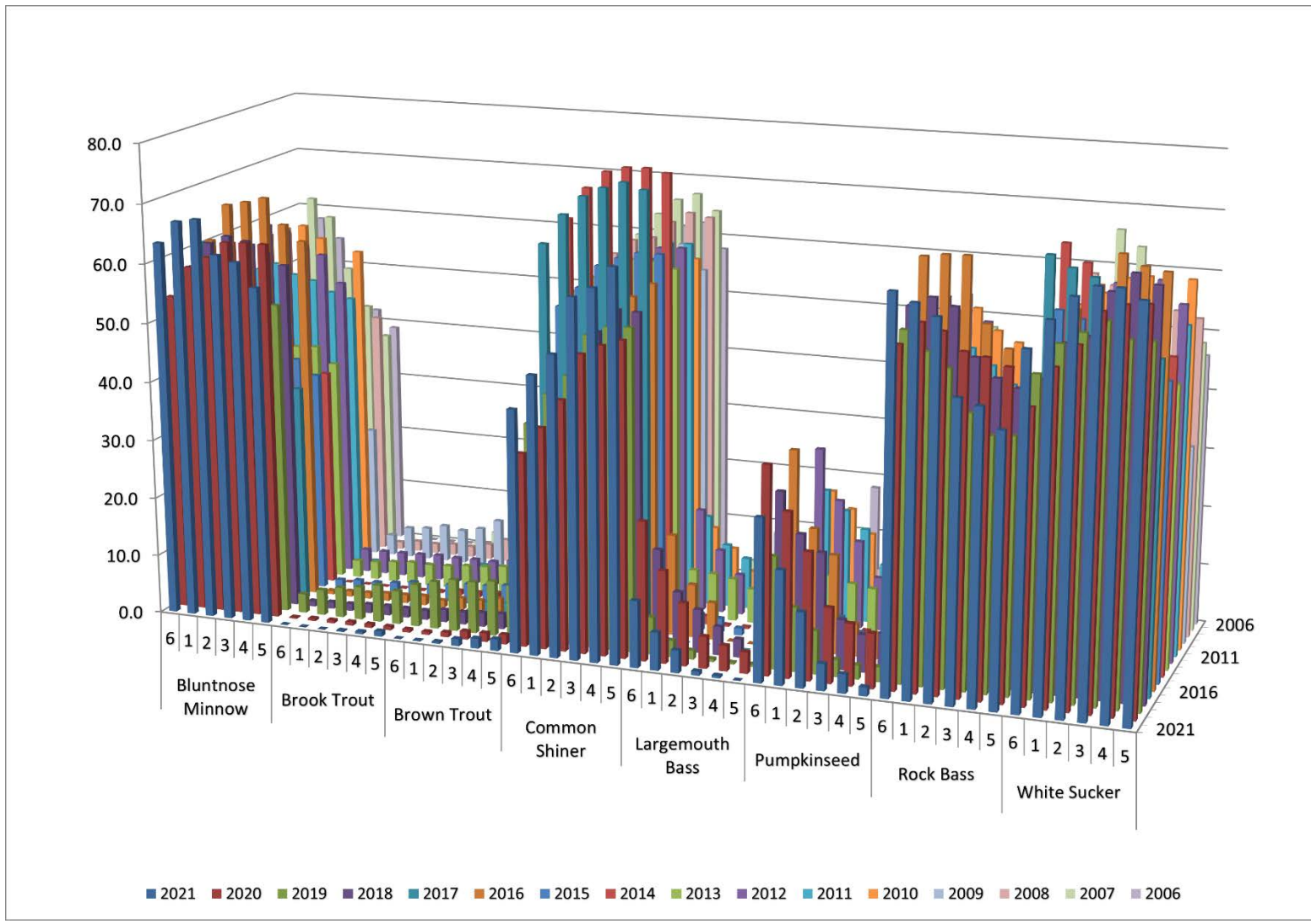


Figure 4. Percent of temperature measurements within  $\pm 2^\circ\text{C}$  of the final temperature preferendum (%FTP) during the period June 1 to August 31, by species, station, and year.



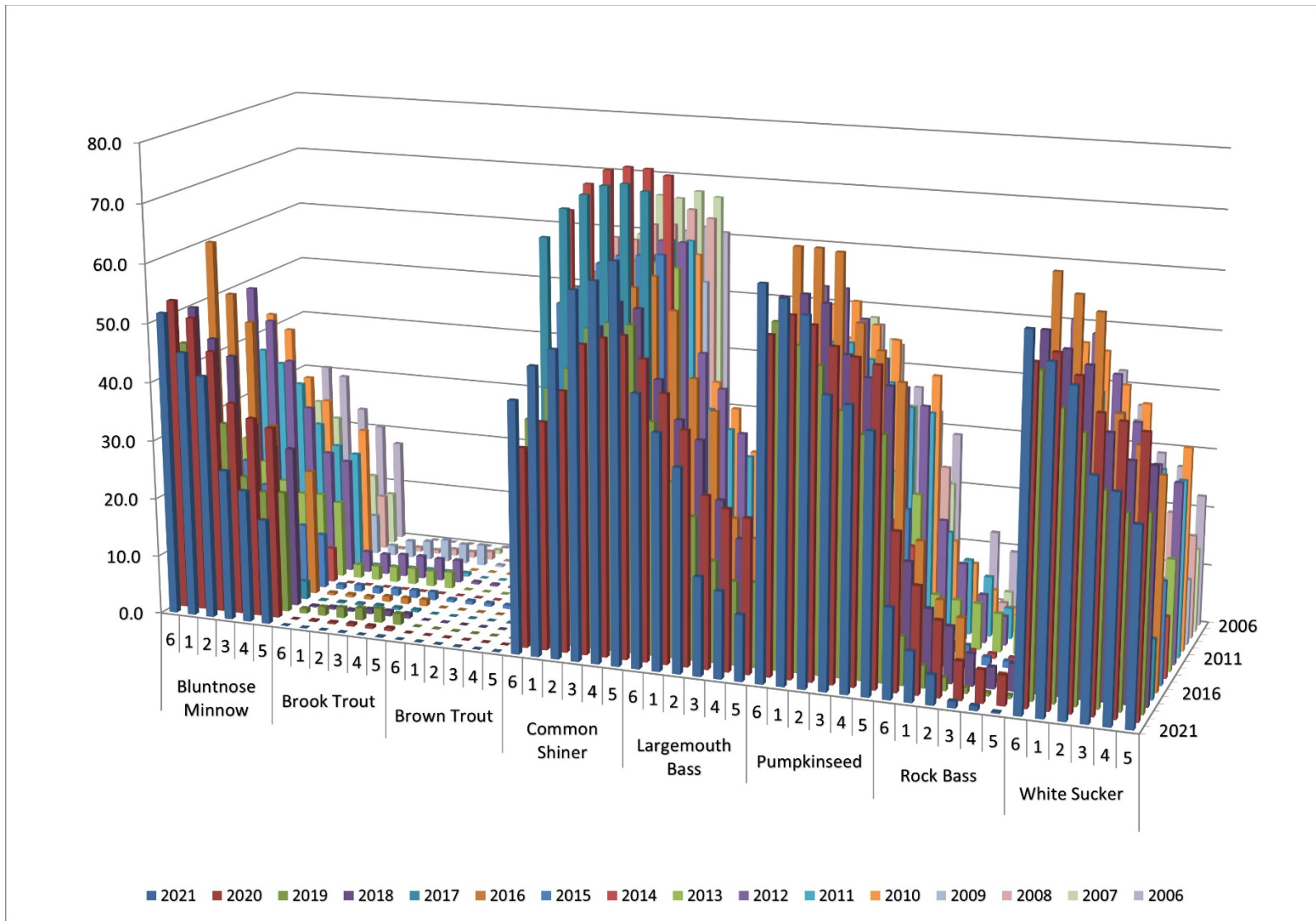


Figure 5. Percent of temperature measurements within  $\pm 2^\circ\text{C}$  of the optimal temperature for growth (%OTG) during the period June 1 to August 31, by species, station, and year.

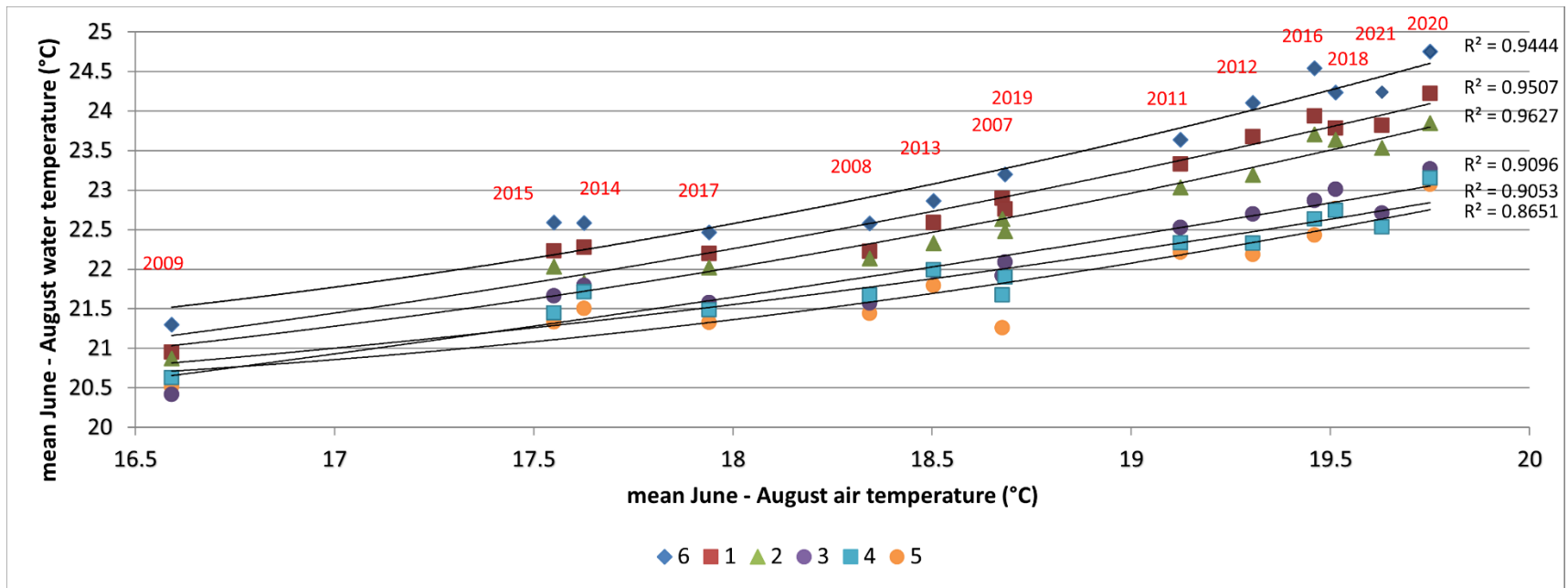


Figure 6. Plot of the mean June 1 - August 31 water temperature at each site versus mean June – August air temperature at the Guelph Turfgrass Institute weather station, by year. The lines and R<sup>2</sup> values are for second order polynomial regressions.

## **APPENDIX A**

### Thermal suitability indices









	Mean	25.8	20.6	27.9	22.9	44.9	20.8	43.6	46.2	39.4	24.2	34.7	29.8	59.7	40.6	40.8	40.6	43.6
Rock Bass	6	64.9	55.9	57.4	60.4	44.9	66.8	43.9	42.1	40.5	57.4	47.9	53.6	23.3	45.2			35.1
	1	63.4	59.6	54.3	62.0	38.1	67.3	39.4	34.8	37.7	58.0	48.4	54.3	18.1	38.3	48.8	45.0	50.3
	2	61.5	58.5	51.9	60.8	34.3	67.4	37.1	25.3	33.9	53.8	45.8	50.8	19.2	38.0	44.9	43.0	48.0
	3	49.3	55.6	45.2	53.1	25.7	56.8	30.9	24.9	29.4	47.8	42.9	49.1	13.7	29.0	34.1	36.5	45.4
	4	48.3	55.0	41.9	50.1	23.1	53.1	27.8	23.3	30.0	43.5	38.6		16.2	32.1	30.1	34.1	39.0
	5	44.9	53.8	42.2	48.8	20.5	48.4	25.9	18.9	26.9	40.4	38.4	43.9	14.9	26.7	21.2	28.9	36.5
	Mean	55.4	56.4	48.8	55.9	31.1	60.0	34.2	28.2	33.1	50.2	43.7	50.3	17.6	34.9	35.8	37.5	34.0
White Sucker	6	57.7	47.9	52.2	50.5	69.2	51.1	59.1	69.0	57.1	52.3	54.7	56.2	43.5	59.9			42.1
	1	62.4	54.4	57.2	56.5	67.4	60.2	57.9	66.1	55.5	57.5	56.1	58.4	38.1	58.2	66.7	60.3	55.7
	2	66.2	58.1	59.2	57.8	66.2	64.3	56.9	58.3	52.8	61.7	55.4	61.1	35.8	57.6	64.1	59.3	58.3
	3	68.0	63.5	61.3	65.0	59.3	69.4	53.9	58.3	49.7	62.7	56.1	61.6	32.2	55.3	58.5	54.7	58.4
	4	68.0	64.8	58.7	68.1	57.4	67.7	51.3	57.2	50.0	62.7	57.0		33.6	54.8	54.0	49.7	58.1
	5	66.4	65.1	58.7	66.5	54.4	67.1	49.3	52.3	47.1	59.1	55.0	61.6	33.4	53.8	49.0	46.1	57.0
	Mean	0.9	59.0	57.9	60.7	62.3	63.3	54.7	60.2	52.0	59.3	55.7	59.8	36.1	56.6	58.5	54.0	55.3







	Mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
White Sucker	6	2.1	10.6	0.6	6.0	0.0	4.9	2.0	0.0	5.7	6.5	7.3	4.3	0.0	0.4			3.6
	1	0.9	5.6	0.1	3.7	0.0	0.7	1.1	0.0	5.0	3.4	4.7	2.9	0.0	0.0	0.3	3.8	2.0
	2	0.3	3.6	0.0	3.2	0.0	0.0	0.8	0.0	4.6	1.2	3.5	2.0	0.0	0.0	0.2	3.1	1.4
	3	0.0	1.0	0.0	1.9	0.0	0.0	0.1	0.0	3.8	0.2	1.0	1.3	0.0	0.0	0.0	2.2	0.7
	4	0.0	0.8	0.0	0.5	0.0	0.0	0.0	0.0	3.8	0.0	0.5		0.0	0.0	0.0	1.7	0.5
	5	0.0	0.5	0.0	1.4	0.0	0.0	0.0	0.0	3.0	0.0	0.5	0.6	0.0	0.0	0.0	1.4	0.5
	Mean	0.6	3.7	0.1	2.8	0.0	0.9	0.7	0.0	4.3	1.9	2.9	2.2	0.0	0.1	0.1	2.4	1.4





	Mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rock Bass	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
White Sucker	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

**APPENDIX H**

**Biological Monitoring**



GUIDING SOLUTIONS IN THE  
NATURAL ENVIRONMENT

# 2021 Biological Monitoring Program Blue Triton Brands Aberfoyle Property

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*Prepared For:*

**Blue Triton Brands**

*Prepared By:*

**Beacon Environmental Limited**

*Date:*      *Project:*

**February 2022      216114**



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Appendix B. Flora Checklist
Appendix C. Breeding Bird Checklist (2021)

# 1. Introduction

Beacon Environmental Limited (Beacon) and C. Portt and Associates were retained by Blue Triton Brands to undertake terrestrial and aquatic monitoring at the company's Aberfoyle property located at 101 Brock Road South in the Township of Puslinch (**Figure 1**). A Site Context Map is included as **Figure 2**. The biological monitoring program for the property was initiated in 2007 as a condition of a Ministry of Environment, Conservation and Parks (MECP) Permit to Take Water (PTTW) (#7043-74BL3K) for the onsite wells that service their bottling operations. Biological monitoring remains a condition of the current PTTW (#3133-C5BUH9).

Condition 4.4 of the PTTW states:

*The Permit Holder shall undertake wetland monitoring and redd surveys as recommended in "2010 Biological Monitoring Program Final Report" by C. Portt and Associates\* dated January 28, 2011. Results from the wetland and redd surveys shall be submitted to the Director as a part of the annual monitoring report...*

*\*Note: Authorship of the 2010 report should be attributed to Dougan & Associates and C. Portt and Associates.*

The objectives of the biological monitoring program are to:

1. Characterize existing aquatic, wetland and terrestrial resources; and
2. Document potential long-term changes to the site's biological resources.

Existing or baseline biological conditions on the Aberfoyle property were established through surveys and inventories completed between 2007 and 2009 which fulfilled the first objective. To achieve the second objective, there has been ongoing biological monitoring with annual reports submitted to the MECP as per the PTTW conditions. The type and frequency of biological monitoring is variable and based on the recommendations provided in each year's annual monitoring report.

Between 2007 and 2021, biological monitoring has included the following:

- Electrofishing surveys of Aberfoyle Creek; [C. Portt & Associates]
- Salmonid spawning (redd) surveys of Aberfoyle Creek; [C. Portt & Associates]
- Ecological Land Classification (ELC);
- Vascular plant surveys;
- Permanent vegetation monitoring plot surveys;
- Amphibian call surveys;
- Breeding bird surveys;
- Odonate (dragonfly/damselfly) surveys;
- Owl surveys;
- Turtle surveys;
- Marsh surveys (assessment of surface hydrology); and
- Invasive species mapping - Common Reed.

Biological monitoring completed on the property between 2007 and 2021 is summarized in **Table 1**.

**Table 1. Summary of Biological Monitoring Program (2007-2021)**

Year	Aquatic			Vegetation				Wildlife				
	Electrofishing	Habitat characterization	Spawning (i.e. Redd) surveys	Ecological Land Classification (ELC) mapping	Vegetation plot sampling	Marsh surveys	Invasive species mapping	Nocturnal amphibian call monitoring	Breeding bird surveys	Owl surveys	Basking Turtle surveys	Odonate surveys
2007			X	X								
2008	X		X	X	X			X	X			
2009		X	X	X		X	X	X	X			
2010			X		X	X	X	X	X	X	X	X
2011			X			X	X	X	X	X	X	X
2012			X								X	X
2013			X		X	X	X					
2014			X		X							
2015			X					X	X		X	
2016			X		X		X	X	X		X	
2017			X				X	X	X		X	
2018			X					X	X		X	
2019			X	X	X			X	X		X	
2020			X					X	X		X	
2021			X					X	X		X	

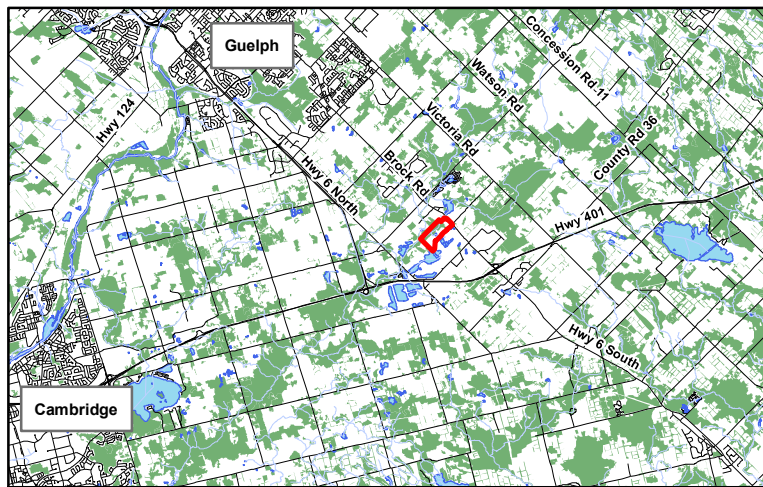
The 2020 Aberfoyle Biological Monitoring Program Report (Beacon 2021) recommended that core wildlife monitoring (amphibian, reptiles and birds) be completed in 2021. Additionally, it recommended salmonid spawning surveys in Aberfoyle Creek will be conducted as required in 2021 by C. Portt and Associates. The recommended biological monitoring was completed in 2021. Beacon completed core wildlife monitoring and C. Portt and Associates completed salmonid spawning (redd) surveys of Aberfoyle Creek.



This annual report includes a comprehensive summary of the biological monitoring program and data collected between 2007 and 2021. The report describes the methods and findings of the various monitoring activities and compares data from prior years to identify potential changes or trends in selected monitoring parameter or indicators over the long term.



**Legend**

Subject Property

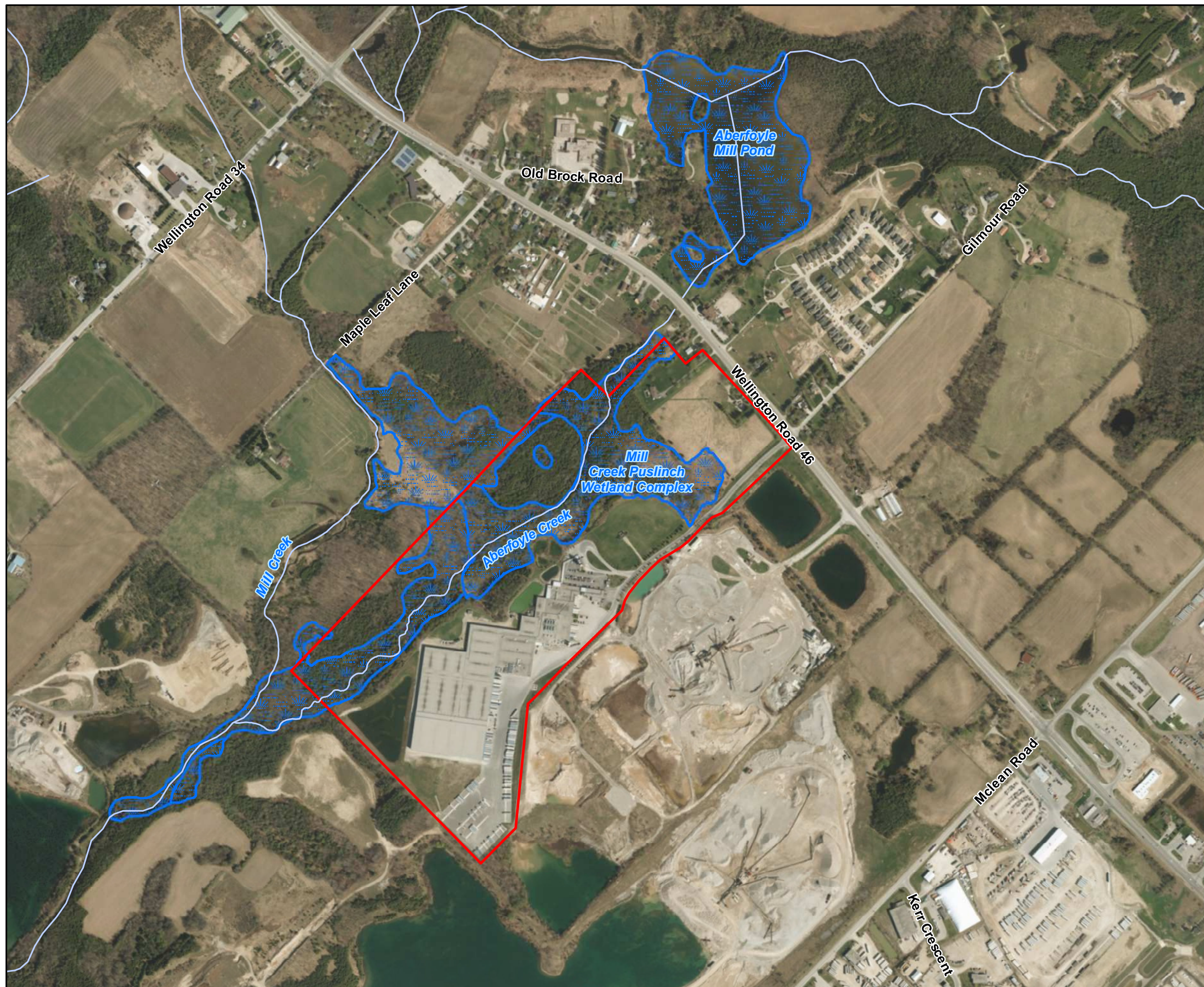


<b>Site Location</b>		<b>Figure 1</b>
Aberfoyle 2021 Biological Monitoring Program		
		Project: 216114 Last Revised: January 2022
Client: Blue Triton Brands		Prepared by: DU Checked by: KU
	1:40,000	Inset Map: 1:250,000
<small>Contains information licensed under the Open Government License— Ontario Orthoimagery Baselayer: FBS Wellington 2010</small>		

Aberfoyle 2021 Biological Monitoring Program

Legend

- Subject Property
- Wetlands
- Watercourse



Project: 216114

Last Revised: January 2022

Client: Blue Triton Brands

Prepared by: DU  
Checked by: KU



1:8,000

0 150 300 m

## 2. Methods

### 2.1 Aquatic Survey

C. Portt and Associates has surveyed Aberfoyle Creek for evidence of Brown Trout (*Salmo trutta*) or Brook Trout (*Salvelinus fontinalis*) spawning, from its confluence with Mill Creek upstream to the limit of the Blue Triton Brands property (**Figure 2**) annually, beginning in 2007. In 2021, the surveys were conducted on October 27 and November 12. On these dates, this entire reach of the creek was walked and searched for spawning fish or areas of disturbed substrate that could be indicative of salmonid spawning.

### 2.2 Vegetation Surveys

#### 2.2.1 Ecological Land Classification

Ecological communities associated with the subject property were classified in accordance with the Ecological Land Classification System for Southern Ontario (ELC) (Lee *et al.* 1998). ELC is the provincial standard for classifying ecological communities. Ecological communities are classified based on their biophysical parameters such as vegetation composition and structure as well as physical site conditions such as topography, slope, soil, moisture and drainage. Information on these parameters is collected from each polygon to confirm the appropriate classification using the ELC community catalogue.

Ecological communities were initially described and mapped by Dougan & Associates in the fall 2007. As the mapping was more than ten years old, Beacon reviewed the boundaries of the various ecological communities on July 23, 2019 to confirm their classifications, adjust boundaries and update the mapping where necessary.

ELC classification and mapping is generally conducted only once a decade as the rate of vegetation change is relatively slow and was therefore not repeated in 2021.

#### 2.2.2 Floristic Surveys

A floristic survey of the property was initially completed by Dougan & Associates in the fall of 2007 to establish baseline conditions and develop a checklist of vascular plants for the subject property. The checklist has been variably amended over the years based on data collected from the vegetation plots and incidental observations. To update this checklist, Beacon completed a floristic survey of the subject property on July 23, 2019.

Floristic surveys are generally completed every five to ten years as the rate of vegetation change is relatively slow and were therefore not repeated in 2021.

### 2.2.3 Vegetation Plot Sampling

To monitor changes to vegetation resources on the property over time, six permanent vegetation sampling plots were established in 2007 in representative wetland communities. The UTM coordinates for each plot in NAD83 are provided in **Table 2** and mapped on **Figure 3**.

**Table 2. Locations of Permanent Vegetation Monitoring Plots**

Plot No.	UTM Zone	UTM Easting	UTM Northing
1	17T	569227	4812889
2	17T	569075	4812948
3	17T	568804	4812731
4	17T	568500	4812482
5	17T	568500	4812482
6	17T	568892	4812956

The vegetation plots are circular and 100 m<sup>2</sup> in area. The centre of each plot is marked with a steel T-bar. The plots were sampled in the summers of 2008, 2010, 2013, 2014, 2017 and 2019. No plot sampling occurred in 2021. A handheld GPS is used to locate the plots. The outer boundaries of each sample plot were delineated by attaching a 5.64 m length of rope to the T-bar centre post and temporarily marking the plot perimeter with flagging tape. Within each sampling plot, information is collected on the composition and structure of the vegetation, by estimating the cover abundance at various height classes.

Vegetation data collection methods follow the standardized vegetation sampling protocols of the Ecological Land Classification System (ELC) for Southern Ontario (Lee *et al.* 1998). Within each plot, all observed species are documented, and the percent cover estimated by assigning a cover value of 1-4 (1) <10%; 2) 10-25%; 3) 25-60%; and 4) >60%) to each species for each vegetation layer it occurs in. Vegetation layers corresponded with the following height classes 1) <0.5 m; 2) 0.5-2 m; 3) 2-10 m, and 4) >10 m).

As in previous sampling years, vegetation plot data was subjected to a Floristic Quality Assessment (FQA) and provides a metric for monitoring change over time (Oldham *et al.*, 1995). The FQA is determined from total number of species (species richness) in a given area (e.g. sampling plot) and summing their conservatism values. Species conservatism is considered a measure of “*the degree of faithfulness a plant displays to a specific habitat or set of environmental conditions*” (Oldham *et al.*, 1995). More conservative species display a higher degree of fidelity to particular habitats or ecological conditions and are relatively intolerant of disturbance. Less conservative species tend to be habitat generalists and more tolerant of disturbance. In Ontario, plant species have been assigned a coefficient of conservatism value (CC) value ranging from 0-10. A description of how these values were assigned is provided below:

- 0-3: Species found in a wide variety of habitats including disturbed sites;
- 4-6: Species found in specific habitats, but tolerate moderate disturbance;
- 7-8: Species found in advanced successional communities with minor disturbance; or
- 9-10: Species found in high quality natural areas and/or limited to a narrow range of environmental conditions.



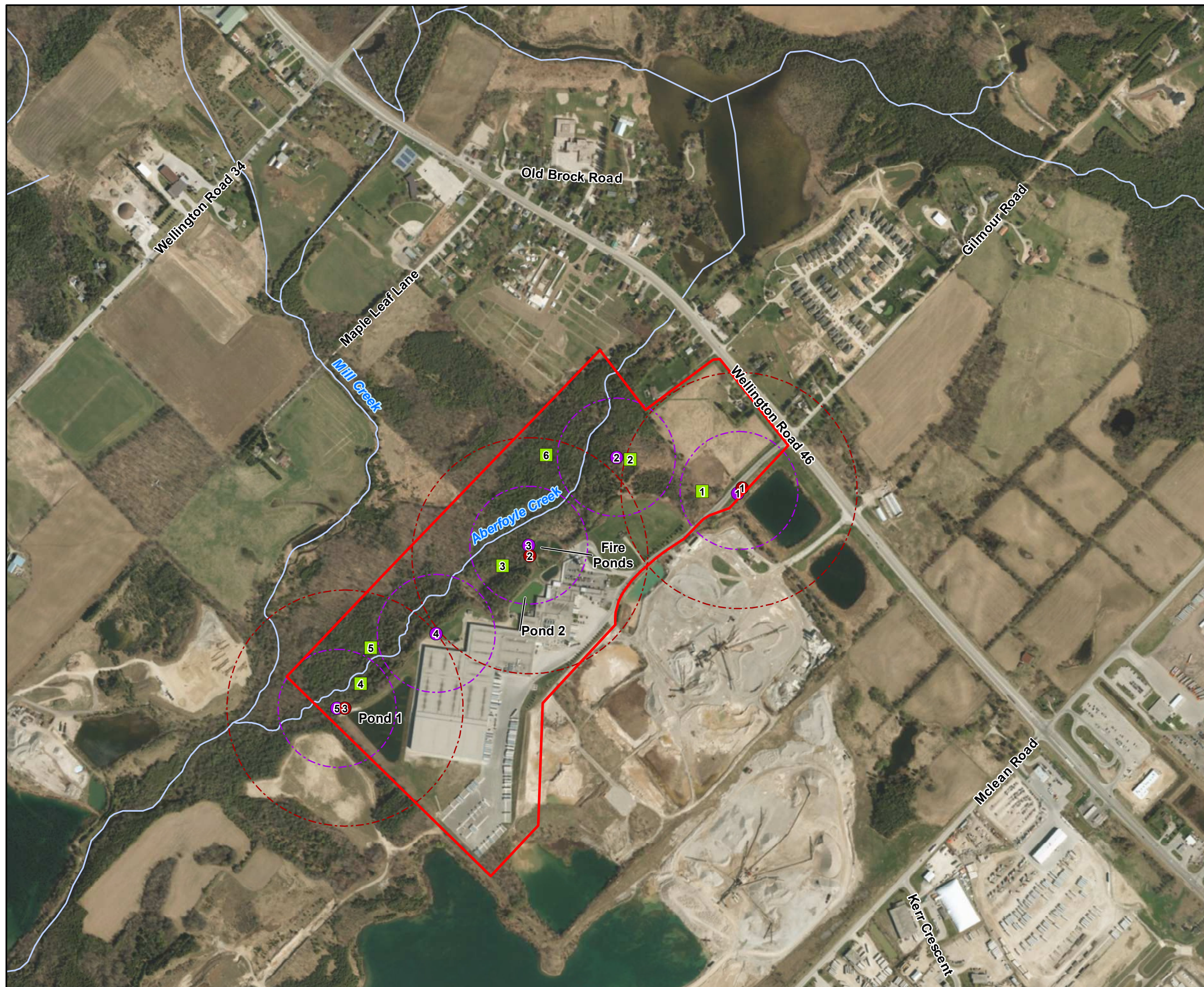
**Monitoring Stations and Survey Locations**

**Figure 3**

Aberfoyle 2021 Biological Monitoring Program

**Legend**

- Subject Property
- Watercourse
- Vegetation Monitoring Station
- Amphibian Call Monitoring Station (with 250 m radius)
- Breeding Bird Monitoring Station (with 125 m radius)



Note: Basking Turtle Surveys were conducted at Pond 1, Pond 2 and the Fire Ponds



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The FQA is used to establish a Floristic Quality Index (FQI) value. Generally speaking, higher FQI values are indicative of higher floristic quality and lower levels of disturbance, whereas lower FQI values indicate poorer quality and higher disturbance. FQI values were determined for each of the six monitoring plots by calculating the mean CC for each plot and multiplying it by the square root of the total number of species. FQI values were calculated using both the total number of species per plot and for native species only. The FQI values were then used to compare changes over time both within and among vegetation plots.

In addition to the FQI, a Wetness Index was also calculated for each plot and the site as a whole. Each plant species in Ontario has been assigned a Coefficient of Wetness (CW) based on their probability of occurring in wetlands. CW values range from -5 to 5. Species with negative CW values favour wetter conditions and typically occur in wetlands; species with positive CW values prefer drier conditions and tend to occur in uplands. The Wetness Index is calculated by averaging the CW values of each species observed in the plot. A Wetness Index for the site was obtained by averaging the CW of each plot. The wetness index could potentially be used as an indicator of hydrological changes.

The 2020 monitoring report recommended vegetation plot sampling resume in 2022, however as the rate of observed vegetation change is relatively slow, it is recommended that this sampling occur in 2024.

#### **2.2.4 Marsh Surveys**

Marsh surveys were undertaken by Dougan & Associates in 2009, 2010, 2011 and 2013. The purpose of these surveys was to check moisture levels and to confirm these classifications of ELC communities. This was done by determining the approximate depth of standing water (if present) versus the presence of saturated soil, moist soil or dry soil. This level of detail is sufficient to differentiate a Shallow Marsh and a Meadow Marsh within the ELC system (Lee *et al.* 1998). A key difference between the two communities is the presence of standing water for much or all of the growing season within a Shallow Marsh compared to the seasonally flooded meadow marsh. However, this level of detail is not sufficient for correlating long term trends with any degree of certainty, as moisture levels in wetlands vary seasonally and annually depending on factors such as precipitation, average temperature, etc. For these reasons, the marsh surveys have not been repeated.

#### **2.2.5 Invasive Species Mapping**

There are several colonies of Common Reed (*Phragmites australis*) present on the subject property. Common Reed is a highly invasive non-native plant species that is known to displace native wetland vegetation. Since 2007, the colonies on the property have been observed to be expanding. Colonies of Common Reed were originally mapped in several locations on the property in 2009, 2010, 2011, and 2013 by Dougan & Associates to track changes in the size of the colonies. The edges of the colonies were mapped using a high-resolution GPS. The Common Reed colonies were re-surveyed and mapped again by Beacon in 2016 and 2017 using an RTK (Real-Time-Kinematic) GPS to facilitate comparison with prior years. The Common Reed colonies were not surveyed in 2021.

Common Reed is ubiquitous in the adjacent landscape. It is prevalent in roadside ditches next to the property and is also present on neighbouring properties. The species is very difficult to control. The most effective control method is chemical treatment using herbicide. While such treatments are considered safe and pose minimal risk to the environment when appropriately applied, Blue Triton

Brands has elected not to implement a treatment program due to the proximity of the colonies to the production well (TW3-80). Common Reed will continue to be monitored and alternative management approaches researched to inform potential future management actions.

## 2.3 Wildlife Surveys

### 2.3.1 Amphibian Surveys

Amphibian call surveys were undertaken to document species richness and abundance of frog and toad populations associated with the subject property. Because there is variation in the breeding periods during which different frog and toad species frogs are calling and detectable, surveys were completed at three different periods between April and June to ensure coverage of the full range of early to late breeding species. These surveys were conducted by Dougan and Associates in 2008, 2009, 2010 and 2011, and then by Beacon annually between 2015 and 2021.

In 2021, Beacon conducted surveys on April 5, May 17, and June 9 using the survey protocols developed for the Marsh Monitoring Program (MMP) (Bird Studies Canada, 2009). On each occasion the subject property was visited at least 0.5 hours after sunset during suitable weather conditions to listen for calling frogs and toads using three permanent monitoring stations that were established in 2008. The locations of these amphibian monitoring stations are illustrated in **Figure 3**. Amphibians observed or heard calling in other locations on the property during these and other surveys were also recorded as incidental observations.

Surveys were conducted using the point count method whereby the surveyor stands at a set point or station for a specific period of time and records all species that can be heard calling within the sample area. A minimum of three minutes was spent listening at each station. The approximate locations of calling amphibians were noted on a standard MMP data sheet and chorus activity for each species was assigned a call code as follows:

- 0 - No calls;
- 1 - Individuals of one species can be counted, calls not simultaneous;
- 2 - Calls of one species simultaneous, numbers can be reliably estimated; or
- 3 - Full chorus, calls continuous and overlapping, individuals indistinguishable.

In addition to recording species and call levels, weather conditions (i.e., air temperature, precipitation, wind speed, and cloud cover) at the time of survey were also recorded. Weather conditions for the 2021 surveys are summarized in **Table 3**.

**Table 3. Amphibian Survey Details**

	Survey 1	Survey 2	Survey 3
<b>Date:</b>	April 5, 2021	May 17, 2021	June 9, 2021
<b>Start time:</b>	8:00 pm	9:10 pm	9:30 pm
<b>Temperature:</b>	7°C	19°C	21°C
<b>Wind speed:</b>	1 – 6 km/h	1 – 6 km/h	0 km/h
<b>Cloud cover:</b>	95%	10%	90%
<b>Precipitation:</b>	None	None	None

### 2.3.2 Breeding Bird Surveys

Breeding bird surveys were undertaken in 2021 by Beacon to document the diversity and abundance of avian populations associated with the subject property. Previous surveys were completed in 2008, 2009, 2010 and 2011 by Dougan & Associates. Beacon completed surveys annually between 2015 and 2021.

There are five permanent point count stations that were established in 2008 that provide coverage for the majority of the property. Each point count station is positioned so the observer can detect calling birds up to a distance of 125 m. The locations of the point count stations are illustrated in **Figure 3**. A handheld GPS was used to locate the plots.

A modified point count methodology, based on protocols established for the Ontario Breeding Bird Atlas for point counts (Cadman *et al.* 2007), Forest Bird Monitoring Program (CWS, 2006) and a standard method recommended for monitoring songbird populations in the Great Lakes Region (Howe *et al.* 1997), was utilized to complete breeding bird surveys. The following is a detailed description of the modified approach utilized to complete these surveys:

- Surveys should be conducted a minimum of one week apart (CWS 2006);
- Point count stations will be at least 250 m apart (Howe *et al.* 1997 & CWS 2006);
- Since the Blue Triton Brands property in Aberfoyle is relatively small, a randomized site selection approach will not be required. The majority of natural features on the site are covered by the five- point count station survey areas;
- Survey duration for each point count is 10 minutes, consistent with the Forest Bird Monitoring Program (CWS 2006) and Howe *et al.* (1997) and is not restricted to forested habitats;
- The location of each individual adult bird is recorded on a field sheet as per the layout and symbols used by the Forest Bird Mapping Protocol (CWS 2006) or Howe *et al.* (1997). Bird flying overhead (i.e., not directly associating with the survey area) or otherwise not showing any breeding evidence will be distinguished from the other breeding birds;
- Observations recorded on the field maps are transferred into a summary table. All birds observed or heard within suitable habitat are assumed to be breeding; and
- Breeding evidence is documented according to the Ontario Breeding Bird Atlas protocols (Cadman *et al.* 2007).

Birds observed between the point count surveys are noted separately on a field map to help ensure that no bird species present on the property are missed as the point count circles do not cover the entire property.

Weather conditions (i.e., air temperature, precipitation, wind speed, and cloud cover) at the time of survey were recorded (see **Table 4**).

**Table 4. Breeding Bird Survey Details**

	Survey 1	Survey 2
<b>Date:</b>	June 1, 2021	June 29, 2021
<b>Start time:</b>	6:30 am	6:00 am
<b>End Time:</b>	8:45 am	8:00 am
<b>Temp:</b>	12°C	21°C
<b>Wind:</b>	0 km/h	1 – 6 km/h
<b>Cloud cover:</b>	70-100%	50%
<b>Precipitation:</b>	None	None

### 2.3.3 Owl Surveys

Barred Owl (*Strix varia*) was reported from the northeast portion of the subject property in August 2009 by Dougan & Associates. To confirm this record, two surveys were completed in 2010 and an additional survey was completed in 2011. The survey consisted of broadcasting Barred Owl calls using a portable compact disc (CD) player. In 2011, Northern Saw-whet Owl (*Aegolius acadicus*) calls were also broadcast prior to the Barred Owl calls. A period of silence was included following each series of calls to allow the surveyor to listen for a response. The surveys were completed from two stations in forested habitats in the vicinity of the original observation. No additional owl surveys have been undertaken since 2011.

### 2.3.4 Basking Turtle Survey

The ponds on the subject property are known to support populations of Midland Painted Turtle (*Chrysemys picta marginata*) and Snapping Turtle (*Chelydra serpentina*). Snapping Turtle was assigned “Special Concern” status in Canada in 2008 and Ontario in 2009. Snapping Turtle was originally observed in the large pond near the western property boundary in 2008, which is labelled as Pond 1 on **Figure 3**.

To monitor these populations, basking surveys were completed by Dougan & Associates annually between 2010 and 2012, and by Beacon annually between 2015 and 2021.

In 2021, basking turtle surveys on the property were primarily focused on Pond 1; brief surveys of the other ponds were also completed. The surveys consist of slowly walking along the outer edge of the ponds using binoculars to scan the perimeter and other potential basking sites within the pond. Surveys were completed in mid-May and mid-September between 8:00 am and 5:00 pm during sunny periods when the air temperature was greater than water temperature and after inclement weather. Details of these surveys, including weather conditions, are included in **Table 5**.

**Table 5. Basking Turtle Survey Details**

	<b>Survey 1</b>	<b>Survey 2</b>	<b>Survey 3</b>
<b>Date:</b>	May 12, 2021	May 18, 2021	September 16, 2021
<b>Start time:</b>	12:00 pm	12:40 pm	10:30 am
<b>End time:</b>	1:15 pm	2:00 pm	11:30 am
<b>Temp:</b>	13°C	25°C	19 °C
<b>Wind Speed:</b>	1-11 km/h	1 – 6 km/h	1-11 km/h
<b>Cloud cover:</b>	5%	5%	10%
<b>Precipitation:</b>	None	None	None

### 2.3.5 Odonate Surveys

While not included in the original monitoring program, it was felt that baseline surveys for dragonflies and damselfly surveys could be used to supplement the baseline biological data available for the site. In 2010, 2011 and 2012, Dougan & Associates conducted odonate surveys for select habitats on the subject property, while in 2009 they were recorded incidentally. Surveys were informally conducted during ideal weather conditions simultaneously to turtle basking surveys using a net. Any individuals caught were immediately examined with a 10x (power) hands lens and then released following identification. No individuals were collected, and no microscopic analysis was conducted. When needed, identifications were confirmed using Jones (2008) and Lam (2004). The surveys were brief, and the findings were not considered a comprehensive list of species potentially present. No additional odonate surveys have been undertaken since 2012.

### 2.3.6 Other Wildlife Observations

Other wildlife species observations and habitat encountered over the course of the 2021 field season were recorded as incidental observations. When encountered, the species and locations of the wildlife were noted.

## 3. Results

### 3.1 Aquatic Survey

No evidence of salmonid spawning was observed along Aberfoyle Creek on the subject property in 2021. This is consistent with the findings of previous surveys completed annually from 2007 through 2020.

### 3.2 Vegetation Surveys

No vegetation surveys were conducted in 2021. The discussion presented below provides a summary of previous surveys. It is expected that vegetation plot sampling surveys will be conducted again in 2024 and floristic and ELC surveys will be conducted in 2028.

### 3.2.1 Ecological Land Classification Mapping

No significant changes to any of the ecological communities were observed during the 2019 review, however minor adjustments were made to the boundaries of several communities. The changes are as follows:

- ELC unit 22 changed from Cultural Woodland (CUW1) to Fresh-Moist White Cedar Coniferous Forest (FOC 4-1) due to increased size and dominance of Eastern White Cedar; and
- ELC Unit 11 changed from Mineral Meadow Marsh (MAM2) to Cattail Mineral Shallow Marsh/Reed Canary Grass Mineral Meadow Marsh (MAS2-1/MAM2-2) due to a shift in dominance of cattails and reed canary grass.

The revised ELC mapping is presented in **Figure 4** and a table summarizing the various ecological communities is presented in **Appendix A**.

### 3.2.2 Flora

Floristic surveys completed between 2007 and 2019 have documented a total of 255 vascular plant species. Of these, 242 have been determined to the species level and 13 could only be determined to genus for various reasons. An updated checklist is provided in **Appendix B**. Of the species identified, 56 are considered non-native to Ontario and represents 23% of the total site flora. Native species are ranked S4 or S5 by the NHIC, indicating that they are generally common and secure in Ontario.

Two regionally rare and six regionally uncommon species have been documented on the subject property, which are summarized in **Table 6**.

**Table 6. Regionally Rare and Uncommon Plants Species**

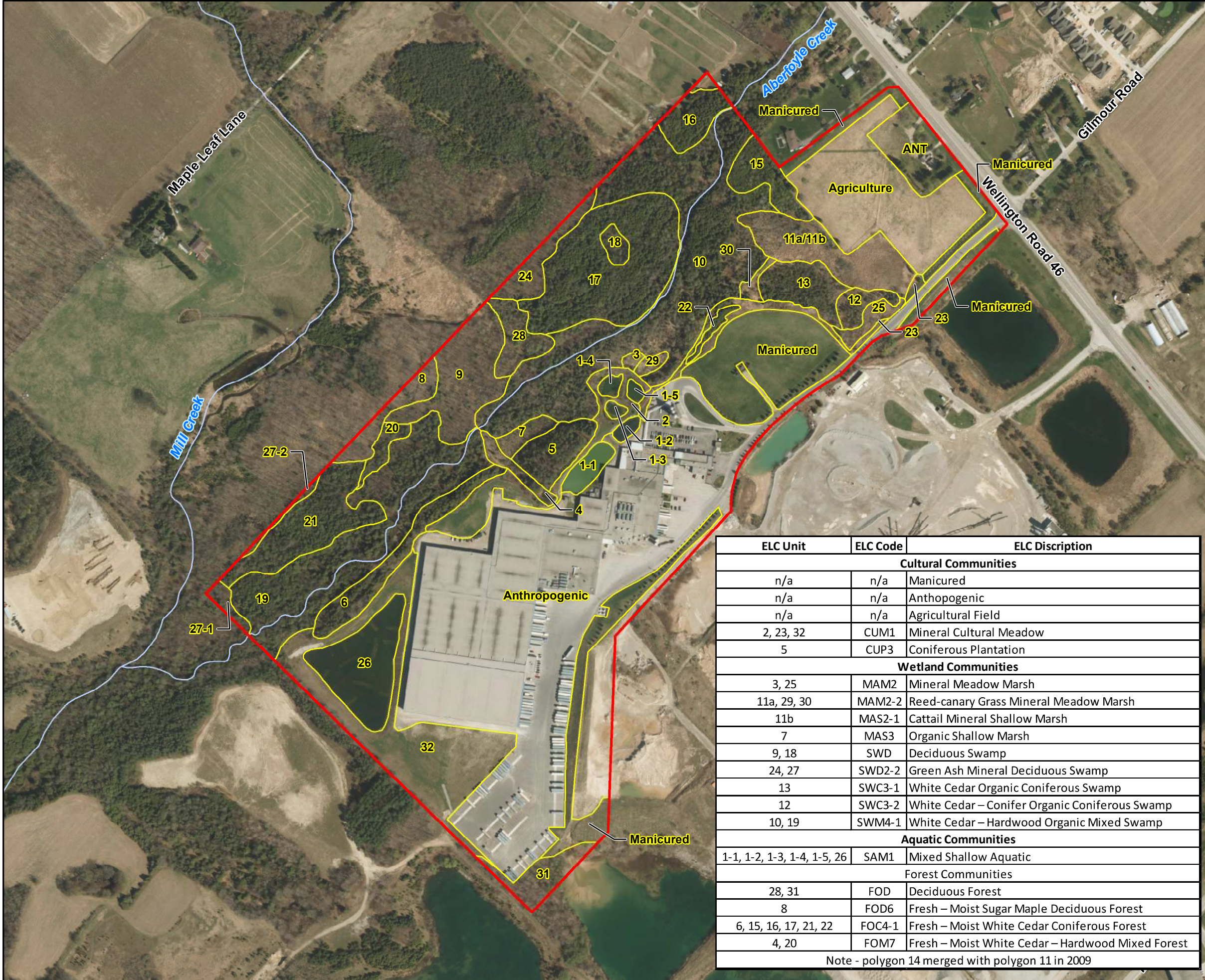
Scientific Name	Common Name	Region Status <sup>1</sup>
<i>Asplenium platyneuron</i>	Ebony Spleenwort	Rare
<i>Brachyelytrum erectum</i>	Long-awned Wood Grass	Rare
<i>Symphyotrichum urophyllum</i>	Arrow-leaved Aster	Uncommon
<i>Cardamine pensylvanica</i>	Pennsylvania Bitter-cress	Uncommon
<i>Equisetum sylvaticum</i>	Woodland Horsetail	Uncommon
<i>Cinna latifolia</i>	Slender Wood Reedgrass	Uncommon
<i>Ranunculus pensylvanicus</i>	Bristly Crowfoot	Uncommon
<i>Symphyotrichum pilosum</i>	Frost Aster	Uncommon

<sup>1</sup>Draft Wellington Country Vascular Plant List (Cecile 2017)

Aberfoyle 2021 Biological Monitoring Program

**Legend**

- Subject Property
- ELC Communities
- Watercourse



ELC Unit	ELC Code	ELC Discription
<b>Cultural Communities</b>		
n/a	n/a	Manicured
n/a	n/a	Anthopogenic
n/a	n/a	Agricultural Field
2, 23, 32	CUM1	Mineral Cultural Meadow
5	CUP3	Coniferous Plantation
<b>Wetland Communities</b>		
3, 25	MAM2	Mineral Meadow Marsh
11a, 29, 30	MAM2-2	Reed-canary Grass Mineral Meadow Marsh
11b	MAS2-1	Cattail Mineral Shallow Marsh
7	MAS3	Organic Shallow Marsh
9, 18	SWD	Deciduous Swamp
24, 27	SWD2-2	Green Ash Mineral Deciduous Swamp
13	SWC3-1	White Cedar Organic Coniferous Swamp
12	SWC3-2	White Cedar – Conifer Organic Coniferous Swamp
10, 19	SWM4-1	White Cedar – Hardwood Organic Mixed Swamp
<b>Aquatic Communities</b>		
1-1, 1-2, 1-3, 1-4, 1-5, 26	SAM1	Mixed Shallow Aquatic
<b>Forest Communities</b>		
28, 31	FOD	Deciduous Forest
8	FOD6	Fresh – Moist Sugar Maple Deciduous Forest
6, 15, 16, 17, 21, 22	FOC4-1	Fresh – Moist White Cedar Coniferous Forest
4, 20	FOM7	Fresh – Moist White Cedar – Hardwood Mixed Forest

Note - polygon 14 merged with polygon 11 in 2009

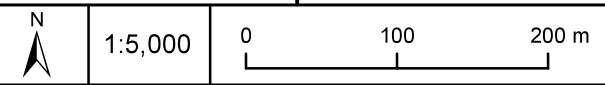


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### 3.2.3 Vegetation Plot Sampling

A total of 115 plants were recorded from the six vegetation plots in 2019, including five that were identified to genus. Of the 110 species identified, 85 (85%) are native, and 16 (15%) are considered non-native in Ontario. The proportion of native/non-native is similar to previous years with 88% native in 2008, 87% in 2010, 85% in 2013, 87% in 2014, and 92% in 2016. **Photograph 1** shows a portion of Plot 5 that was surveyed in 2019.

Data for individual vegetation plots has not included in this report but is on file with Beacon.



**Photograph 1. Representative Photograph of Plot 5 on August 12, 2019**

#### 3.2.3.1 Floristic Quality Assessment

FQA values for each plot between 2008 and 2019 is summarized in **Table 7**. A comparison of FQA values averaged across all plots is provided in **Table 8**. Species richness is noticeably lower in 2008 compared to the following five monitoring years. The data show a spike in species richness and a corresponding increase in FQI between 2008 and 2010. After 2010, the numbers decrease somewhat and generally level off between 2013 and 2019.

**Table 7. FQA Summary by Plot for 2008-2019**

Plot	Variable/ Parameter	2008	2010	2013	2014	2016	2019
1	Total Species	22	52	41	44	39	35
	Native Species	19	43	31	36	31	30
	Introduced Species	3	9	10	8	8	5

Plot	Variable/ Parameter	2008	2010	2013	2014	2016	2019
	Wetness Index	-2.18	-2.33	-1.24	-1.93	-1.49	-2.26
	Mean Total CC	3.32	2.98	2.20	2.65	2.59	3.17
	Mean Native CC	3.84	3.60	2.90	3.51	3.26	3.60
	Total FQI	15.56	21.49	13.86	17.55	16.17	18.76
	Native FQI	16.75	23.64	16.16	21.09	18.15	19.72
2	Total Species	30	53	40	41	41	41
	Native Species	27	48	34	38	34	35
	Introduced Species	3	5	6	5	7	6
	Wetness Index	-1.93	-2.52	-1.73	-1.93	-1.61	-1.78
	Mean Total CC	3.23	3.88	3.08	3.32	3.1	3.12
	Mean Native CC	3.59	3.51	3.62	3.78	3.74	3.66
	Total FQI	17.71	25.55	18.14	21.24	19.85	19.99
	Native FQI	18.67	26.85	21.09	22.67	21.81	21.64
3	Total Species	23	62	47	50	48	47
	Native Species	20	55	39	45	42	41
	Introduced Species	3	7	8	6	7	6
	Wetness Index	-1.09	-1.86	-1.26	-2.18	-2.10	-1.89
	Mean Total CC	3.26	3.60	3.21	3.62	3.42	3.57
	Mean Native CC	3.75	4.05	3.97	4.11	3.90	4.10
	Total FQI	15.64	28.45	20.36	25.60	23.7	24.5
	Native FQI	16.77	30.33	24.18	27.29	27.27	26.24
4	Total Species	17	30	28	31	37	39
	Native Species	15	27	25	29	32	34
	Introduced Species	2	3	3	3	5	4
	Wetness Index	-0.29	-1.63	-1.61	-1.42	-1.27	-1.33
	Mean Total CC	4.00	4.17	3.82	4.10	3.97	3.92
	Mean Native CC	4.53	4.63	4.28	4.54	4.59	4.50
	Total FQI	16.49	22.82	18.92	22.81	24.13	24.5
	Native FQI	17.56	24.06	21.4	24.00	25.98	26.24
5	Total Species	21	46	37	36	41	47
	Native Species	19	39	33	34	36	42
	Introduced Species	2	7	4	3	5	5
	Wetness Index	-1.19	-0.48	-0.95	-0.75	-1.15	-1.26
	Mean Total CC	4.05	3.85	3.78	3.88	3.71	3.77
	Mean Native CC	4.47	4.54	4.24	4.33	4.27	4.21
	Total FQI	18.55	26.10	21.6	23.27	23.74	25.82
	Native FQI	19.50	28.34	24.37	24.89	25.32	27.31
6	Total Species	16	29	26	28	24	24
	Native Species	14	21	20	22	19	20
	Introduced Species	2	8	6	6	5	4
	Wetness Index	-1.00	0.21	-0.46	-0.32	-0.1	-0.63
	Mean Total CC	3.06	2.45	2.62	2.86	2.92	2.71
	Mean Native CC	3.50	3.38	3.40	3.64	3.68	3.25
	Total FQI	12.25	13.18	12.85	15.12	14.31	13.27
	Native FQI	13.10	15.49	15.21	17.06	16.04	14.53

**Table 8. Comparison of Floristic Quality Assessment scores averaged across all plots, 2008-2019**

Parameter	2008	2010	2013	2014	2016	2019
Average Total Species Richness	21.50	45.33	36.50	38.33	38.33	38.83
Average Native Species richness	19.00	38.83	30.33	34.00	32.33	33.67
Average Non-native Species Richness	2.50	6.50	6.17	5.17	6	5.16
Average Wetness Index	-1.28	-1.44	-1.21	-1.42	-1.29	-1.52
Average Native CC	3.95	3.95	3.74	3.99	3.90	3.89
Average Total CC	3.49	3.49	3.12	3.41	3.28	3.38
Average Native FQI	17.06	24.79	20.40	22.83	22.1	22.61
Average Total FQI	16.03	23.04	17.62	20.93	20.31	21.14

The fluctuations in the floristic parameters could be attributed to various environmental factors such as precipitation, herbivory, competition from dominant species, and natural dieback, which can vary on a seasonal and annual basis. Based on the monitoring data available, it is not possible to directly attribute the observed changes to specific environmental factors or variables. Some of the variability observed is likely attributable to observer bias, especially in plots where certain species occur in low numbers and can be easily overlooked or are not reliably detected.

Overall, there have been some minor shifts in species composition and abundance from year-to-year, which is to be expected within a dynamic natural environment. The general composition and structure of the vegetation within the plots have not changed substantially and the observed changes are within the expected range of natural variation for the wetland community types present.

### 3.2.4 Marsh Surveys

As part of the ELC confirmation work completed by Dougan & Associates in 2009, marshes on the subject property were assessed and recorded, and some ELC was updated from 2008 to 2009. These surveys were again conducted by Dougan & Associates in 2010, 2011 and 2013 (not in 2012). The resulting predominant vegetation species and the biophysical characteristics of each marsh surveyed have been included in Dougan and Associates' annual monitoring reports.

In 2010, the overall conditions that had been recorded in 2009 had not changed substantially. However, ELC Unit 7 (**Figure 4**) appeared drier due to lack of deep standing water and a new moisture gradient was observed in ELC Unit 29. No changes or re-classifications to ELC communities were made in 2010.

Again, the hydrologic conditions and vegetation composition observed in 2011 were not significantly different from 2010. Common Reed had spread, but the abundance of hydrophilic species (which would be indicative of changing wetland conditions) did not significantly change. No changes or re-classifications to ELC communities were made in 2010.

The conditions of the marshes observed in 2013 were slightly drier in comparison to what was noted in 2010 and 2011. Dougan & Associates attributed these changes to the much lower than average level

of precipitation in 2012 and the slightly lower than average precipitation in 2013. No changes or re-classifications to ELC communities were made in 2013.

Dougan & Associates note that ELC Units 3, 29, 5 and 6 are impacted by discharge of water from the complex of small ponds west of the parking lot. The water level in these ponds are being artificially regulated, which could explain fluctuations. Dougan & Associates also noted that the variation in vegetation in marshes could also be a result of plant responses to variations in weather patterns and environmental conditions rather than permanent trends.

### 3.2.5 Invasive Species Mapping

Since monitoring was initiated on the property, colonies of Common Reed have been slowly expanding (**Figure 5**). Patch sizes were recorded in 2013, 2016 and 2017 (**Table 9**).

**Table 9. Comparison of Common Reed Patch Size between 2013, 2016 and 2017**

Colony	Size (m <sup>2</sup> )			Difference (m <sup>2</sup> )	Difference (%)
	2013	2016	2017		
A	172.28	254.43	255.04	0.61	0.24%
B	1,698.69	1,813.99	1,964.49	150.50	8.30%
C	1,920.17	1,401.47	2,886.44	266.24	10.16%
D	1,511.74	1,218.73	-	-	-
E	3,095.25	1,913.31	2,439.94	526.63	27.52%
F	1,061.60	202.67	123.36	-79.31	-39.13%
G	101.73	84.08	118.58	34.50	41.03%
H	-	127.31	162.44	35.13	27.59%
I	-	4.92	7.55	2.63	53.46%
J	-	25.05	18.73	-6.32	-25.23%
K	-	1,655.91	1,456.14	199.77	-12.06%
L	-	182.24	210.49	28.25	15.50%
M	-	-	16.77	-	-
N	-	-	70.55	-	-
O	-	-	132.15	-	-
P	-	-	62.52	-	-
Q	-	-	6.23	-	-
<b>Total</b>	<b>9,561.46</b>	<b>8,884.11</b>	<b>9,931.42</b>	<b>1,047.31</b>	<b>11.79%</b>

Aberfoyle 2021 Biological Monitoring Program

Legend

- Subject Property
- Common Reed Colonies (December 2017)
- Common Reed Colonies (December 2017)
- Common Reed Colonies (2016)
- Common Reed Colonies (December 2017)

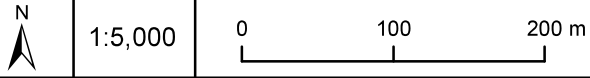


Project: 216114

Last Revised: January 2022

Client: Blue Triton Brands

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Monitoring of the Common Reed colonies in 2016 revealed a decrease in the rate of expansion of these colonies, but an increase in the colony size was observed in 2017. Between these two years, the following changes in Common Reed on the property were documented:

- Notable increases in colonies B, C (which has now joined with colony D), E and K;
- Small increases in colonies A, G, H, I and L;
- Small decreases in colonies F and J;
- Five new colonies, M through Q, were identified; and
- 32 additional points that were too small to map as polygons were identified.

The change in cover of Common Reed on the subject property increased by 1,047.31 m<sup>2</sup>, or 11.79% between 2016 and 2017. The Common Reed cover in 2017 was similar to that of the patch size recorded in 2013. It is anticipated that Common Reed will continue to spread throughout suitable open habitat on the property. An area being invaded by Common Reed is shown in **Photograph 2**.



Photograph 2. Common Reed within Colony E on December 18, 2017

### 3.3 Wildlife Surveys

#### 3.3.1 Breeding Amphibians

Four frog species and one toad species were recorded from three stations on the subject property during the 2021 nocturnal amphibian call surveys. Species include American Toad (*Anaxyrus americanus*), Green Frog (*Rana clamitans*), Gray Tree Frog (*Hyla versicolor*), Spring Peeper (*Pseudacris crucifer*) and Wood Frog (*Lithobates sylvaticus*). The findings of these amphibian breeding surveys are summarized in **Table 10**.

The primary amphibian breeding area on the property is the group of three small ponds/shallow aquatic features (“fire ponds”) located just west of the parking lot.

Amphibians observed incidentally during other field surveys included: Green Frog, Gray Tree Frog and Bull Frog (*Lithobates catesbeianus*).

**Table 10. Breeding Amphibian Survey Results (2021)**

Location (Figure 3)	Round 1 (April 5, 2021)	Round 2 (May 17, 2021)	Round 3 (June 9, 2021)
1	SPPE – 2(2) SPPE*	AMTO – 2(3) SPPE*	GRTR – 1(2)
2	SPPE – 3 WOFR – 2(1)	GRTR – 2(5) SPPE – 2(10)	GRTR – 1(1)
3	SPPE – 1(1)	AMTO – 2(2) GRTR*	GRFR – 1(2)

\* = Call recorded from outside of station area

AMTO = American Toad, GRFR = Green Frog, GRTR = Gray Tree Frog, SPPE = Spring Peeper, WOFR = Wood Frog  
Code 0 - No calling

Code 1 - Individuals can be counted; calls not simultaneous. Estimated number of individuals indicated in brackets

Code 2 - Calls distinguishable; some simultaneous calling. Estimated number of individuals indicated in brackets

Code 3 - Full chorus; calls continuous and overlapping.

The 2021 amphibian breeding surveys are generally comparable to those of previous years (2008-2011 and 2015-2020) as shown in **Table 11**. Spring Peeper, Gray Tree Frog, and Green Frog have been observed each year monitoring has been completed. Wood Frog, previously heard only in 2008, was detected again from 2015 to 2017 and from 2019 to 2021. Northern Leopard Frog was not noted on the subject property in 2021, but it was observed incidentally on the property in 2010, 2016, 2018 and 2019, and was documented calling during the nocturnal amphibian surveys at Pond 1 in 2017 and 2019. American Bullfrog was only observed incidentally near Pond 1 during the second breeding bird survey in 2021. Previously, this species had been heard calling during the third breeding survey in 2017 and 2019 within the pond just east of the property, and incidental observations were recorded in 2015, 2018, and 2020.

**Table 11. Breeding Amphibian Monitoring Results (2008-2021)**

Year	SPPE	GRTR	GRFR	CHFR	WOFR	AMTO	NLFR	BUFR
2008	X	X	X	X	X	-	-	-
2009	X	X	X	-	-	-	-	-
2010	X	X	X	-	-	-	X	-
2011	X	X	X	X	X	X	-	-
2015	X	X	X	-	X	-	X*	X*
2016	X	X	X	-	X	X	X*	-
2017	X	X	X	-	X	X	X	X
2018	X	X	X	-	-	X	-	-
2019	X	X	X	-	X*	X	X	X
2020	X	X	X	-	X	X	-	X*
2021	X	X	X	-	X	X	-	X*

SPPE = Spring Peeper, GRTR = Gray Treefrog, GRFR = Green Frog, CHFR = Western Chorus Frog, WOFR = Wood Frog, AMTO = American Toad, NLFR = Northern Leopard Frog, BUFR = American Bullfrog

\* Indicates species observed incidentally and not recorded during amphibian monitoring surveys (from 2015 onward)

Overall the results of these surveys have been relatively consistent with minor variations from year to year which are to be expected based on the types of habitat present on the property and daily and annual species variations as some adult amphibian species are very mobile and often travel over upland areas to other suitable habitats.

### 3.3.2 Breeding Birds

A total of 44 species of birds (**Appendix C**) was documented on and directly adjacent to the subject property in 2021. Of the 44 species documented, 32 exhibited evidence of breeding and are considered to be breeding on the subject property.

During the field surveys in 2021, species that were observed flying or foraging over the property, or observed during migration and not considered to be breeding on the property, included: Great Blue Heron (*Ardea herodias*), Mallard (*Anas platyrhynchos*), Turkey Vulture (*Cathartes aura*), Red-tailed Hawk (*Buteo jamaicensis*), American Woodcock (*Scolopax minor*), Ring-billed Gull (*Larus delawarensis*), Caspian Tern (*Sterna caspia*), Belted Kingfisher (*Ceryle alcyon*), Northern Rough-winged Swallow (*Stelgidopteryx serripennis*), Barn Swallow (*Hirundo rustica*), Connecticut Warbler (*Oporornis agilis*) and Swamp Sparrow (*Melospiza georgiana*). These species were either observed flying overhead or were using the property to forage (e.g., swallow species) or for some species there is no suitable breeding habitat present (e.g., Caspian Tern).

Of the 32 species that exhibited breeding evidence, none are species designated as Special Concern, Threatened or Endangered. All species have a conservation rank of S5 (Secure) or S4 (Apparently Secure) (NHIC 2021). Eastern Wood-Pewee (*Contopus virens*), which is designated as Special Concern under the federal *Species at Risk Act* (2002) and provincial *Endangered Species Act* (2007), has been noted on the property, but it was not recorded during the 2020 or 2021 breeding bird surveys.

One of the 32 bird species that displayed some level of breeding evidence on the property is considered to be a “priority landbird species” in Bird Conservation Region (BCR) 13, the Lower Great Lakes – St.



Lawrence Plain. Priority species are those that meet Partners in Flight criteria for Species of Continental or Regional Importance, because of high conservation concern / vulnerability and/or high stewardship responsibility scores (OPIF 2008). The single priority species is Baltimore Oriole (*Icterus galbula*) which was recorded at breeding bird monitoring stations 1 and 5.

Two of the 32 breeding bird species are considered significant in Wellington County (Dougan & Associates 2009). These species include:

1. American Redstart (*Setophaga ruticilla*); and
2. Baltimore Oriole.

American Redstart was documented at breeding bird monitoring stations 1, 2, 3 and 4 and Baltimore Oriole (*Icterus galbula*) was documented at breeding bird monitoring stations 1 and 5.

Two of the 32 breeding bird species observed in 2021 are considered area-sensitive. Area-sensitive species require larger areas of suitable habitat in order to sustain their populations (OMNR 2000) and are therefore considered more sensitive to habitat loss and fragmentation. These species include:

1. White-breasted Nuthatch (*Sitta carolinensis*); and
2. American Redstart.

Both species are associated with the forested habitats on the site.

The number of breeding and total birds recorded each year through the monitoring surveys is shown in **Table 12**.

**Table 12. Breeding Bird Monitoring Results (2008-2021)**

Monitoring Year	Number of Total Bird Species	Number of Breeding Bird Species
2008	40	34
2009	45	39
2010	48	36
2011	50	38
2015	39	33
2016	48	40
2017	51	37
2018	39	32
2019	44	34
2020	47	35
2021	44	32

Breeding bird species that were not recorded this year were primarily woodland species that breed in the forested habitat north of the plant. Birds in this area can be difficult to hear from the point count stations if wind levels are towards the higher end of what is permitted for breeding bird surveys.

However, the overall results of the breeding bird surveys in 2021 are similar to the results of breeding bird surveys that were completed in previous years at the site. Differences in the results of these surveys can be attributed to daily and annual species variations.

### 3.3.3 Owl Surveys

During the two Barred Owl surveys conducted in 2010, Barred Owl was not recorded. However, during the second owl survey in 2010 on July 27, a Northern Saw-whet Owl was recorded calling continuously for 5 minutes in the northeast corner. The Ontario Breeding Bird Atlas states that this species breeds in a variety of forest types but is most abundant in coniferous forests (Cadman *et al.* 2007). Therefore, the Blue Triton Brands Aberfoyle property provides suitable habitat for this owl species. Northern Saw-whet Owl is considered locally rare in Wellington County (Dougan and Associates 2009) and ranked as “apparently secure” (S4) by NHIC (2021).

As a result of this record, the 2011 field surveys included broadcasting calls for Northern Saw-whet Owls, as discussed in **Section 2.3.3**. However, in 2011, no owls were heard during the survey, and no formal owl surveys or incidental observations of owls have occurred since.

### 3.3.4 Basking Turtle Survey

The results of the basking turtle surveys are shown below in **Table 13**. Pond locations are shown on **Figure 3**.

**Table 13. Basking Turtle Survey Results (2021)**

	Survey 1 (May 12, 2021)			Survey 2 (May 18, 2021)			Survey 3 (September 16, 2021)		
	Pond 1	Pond 2	Fire Ponds	Pond 1	Pond 2	Fire Ponds	Pond 1	Pond 2	Fire Ponds
Midland Painted Turtle ( <i>Chrysemys picta marginata</i> )	21	0	0	13	0	0	8	0	0
Snapping Turtle ( <i>Chelydra serpentina</i> )	2	0	0	1	0	0	0	0	0

The majority of the turtles that were observed on the subject property were Midland Painted Turtles, all of which were observed in Pond 1 (**Figure 3**). This species is not considered significant at the local (Dougan & Associates 2009), regional (Plourde *et al.* 1989), or provincial (NHIC 2021) level. In April 2018, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) updated this species’ status to Special Concern due to loss of wetlands in Ontario; the *Species at Risk Act* (2002) has not created a schedule yet for Midland Painted Turtle.

The number of Midland Painted Turtles seen in 2018-2021 is lower than what has previously been recorded (refer to **Table 14**). This is likely due to the establishment of Common Reed and willows around the edge of Pond 1, which is reducing basking opportunities.

Two Snapping Turtles were observed basking along the edges of Pond 1 during the first turtle basking survey. This basking behaviour is typical for Snapping Turtles, which typically only leave the water to

migrate between suitable habitats or to lay their eggs. Additionally, as has been noted in previous years, Snapping Turtle nests were observed adjacent to Pond 1 and Pond 2. In 2019, Blue Triton Brands staff indicated that Snapping Turtle are frequently observed nesting in the gravel around the ponds.

A summary of the basking turtle survey results from the Blue Triton Brands monitoring program on the Aberfoyle property are shown below in **Table 14**.

**Table 14. Basing Turtle Monitoring Results (2008-2021)**

Year	Snapping Turtle*	Midland Painted Turtle*
2008	1	0
2010	0	8 (5)
2011	1	38 (23)
2015	2 (1)	80 (36)
2016	5 (4)	42 (23)
2017	5	44 (25)
2018	1	30 (13)
2019	4 (2)	34 (22)
2020	6	34 (17)
2021	3 (2)	34 (21)

\* Maximum number observed per survey event are noted in parentheses.

### 3.3.5 Odonate Surveys

Baseline odonate surveys were completed by Dougan & Associates in 2010 and 2011 in the vicinity of Pond 1. The following taxa were observed:

- Common Green Darner - *Anax junius*;
- Northern/Vernal Bluet - *Enallagma annexum*/*E. vernale*;
- Rainbow Bluet - *Enallagma antennatum*;
- Boreal Bluet - *Enallagma boreale*;
- Marsh Bluet - *Enallagma eribium*;
- Unidentified Bluet species - *Enallagma sp.*;
- Eastern Pondhawk - *Erythemis simplicicollis*;
- Eastern Forktail - *Ischnura verticalis*;
- Dot-tailed Whiteface - *Leucorrhinia intacta*; and
- Unidentified Spreadwing species - *Sympetrum sp.*

Additionally, Canada Darner and Eastern Pondhawk were noted incidentally in 2009.

Dougan & Associates note that this list is likely quite conservative since the survey was focussed in the Pond 1 area, and there are likely many other taxa present on the subject property. Common Green Darner, Boreal Bluet, Marsh Bluet, Eastern Pondhawk, Eastern Forktail and Dot-tailed Whiteface are ranked as “secure” (S5) while Rainbow Bluet, Northern Bluet and Vernal Bluet are ranked as “apparently secure” (S4) (NHIC 2021). Both Northern and Vernal Bluets are also considered Significant in Wellington County (Dougan & Associates 2009).

No additional odonate surveys are proposed in the near future.

### 3.3.6 Other Wildlife Species Observations

Other wildlife that were recorded on the subject property during the 2021 field season included:

- Groundhog (*Marmota monax*);
- Eastern Gartersnake (*Thamnophis sirtalis sirtalis*);
- Smallmouth Bass (*Micropterus dolomieu*); and
- Sunfish (*Crapet* sp.).

These incidental wildlife observations are similar to those noted in previous years.

## 4. Conclusion and Recommendations

This annual monitoring report describes the methods and findings of the 2021 biological monitoring field programs for the Blue Triton Brands Aberfoyle property. Aquatic and terrestrial monitoring completed in 2021 included:

- Salmonid spawning (redd) surveys in Aberfoyle Creek;
- Stream temperature monitoring;
- Amphibian breeding surveys;
- Breeding bird surveys; and
- Turtle basking surveys.

Consistent with the required aquatic monitoring program, salmonid spawning surveys were completed along Aberfoyle Creek in 2021 by C. Portt and Associates. No evidence of spawning was observed. These findings are consistent with those of previous years (2007-2020).

Amphibian breeding surveys completed in 2021 documented five species and one additional species documented incidentally. These findings are consistent with previous survey years and there are no significant changes to the resident breeding populations.

Breeding bird surveys were completed in 2021. Thirty-two (32) species were noted to be breeding on the property, which is consistent with numbers observed in 2015 and 2018. These numbers are average in comparison to other years and are consistent with normal year to year variation.

Turtle basking surveys of the pond habitats on site were completed in 2021 and confirmed that Painted Turtle and Snapping Turtle are actively using the site for basking, breeding and over-wintering. While the survey methodologies employed have been standardized, year to year variation in numbers observed remains relatively high.

Floristic surveys of the property were completed in 2019 to update the overall plant species checklist which was last updated in 2011. A total of 255 species were documented. Over 77% of the species present are considered native to Ontario and is reflects the quality of the ecological communities present.

In 2019, ecological communities on the subject property were verified and ELC mapping updated. The last update was in 2009. No significant changes were observed to warrant re-classification; however the boundaries of several communities were adjusted slightly.

Monitoring of vegetation in the six permanent sampling plots located in select wetland communities was completed in 2019. The data indicate that while there have been minor shifts in species composition and abundance from year-to-year, that most of this variation is attributable to sampling biases and does not reflect changes related to altered hydrology or disturbance; although there is some evidence to suggest compositional changes in some plots are related to expansion of Common Reed colonies.

No vegetation surveys were conducted in 2021. It is expected that vegetation plot surveys will be conducted again in 2024 and ELC and floristic surveys will resume in 2028.

In summary, the findings suggest that there have not been any significant changes to the various terrestrial and aquatic parameters being monitored on the Aberfoyle property. Species richness, abundance, and distribution are generally within the range expected and attributable to natural variation and succession. The subject property continues to support high quality terrestrial and wetland habitats that support a diverse range of native wildlife. The aquatic environment is strongly influenced by the thermal loading from the Aberfoyle Mill Pond.

Based on findings of the 2021 biological monitoring program, we recommend that Core wildlife monitoring (amphibian, reptiles and birds) be completed in 2022. Additionally, Salmonid spawning surveys in Aberfoyle Creek should be conducted as required in 2022 by C. Portt and Associates.

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# Appendix A

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## Key Biophysical Attributes of the Vegetation Communities in the Study Area

# Appendix A

## Key Biophysical Attributes of the Vegetation Communities in the Study Area<sup>1</sup>

Unit. ELC Code	1 SAM1	2 CUM1	3 MAM2	4 FOM7	5 CUP3
<b>Vegetation Type</b>	Mixed Shallow Aquatic Ecosite	Mineral Cultural Meadow Ecosite	Mineral Shallow Marsh Ecosite	Fresh-Moist White Cedar - Hardwood Mixed Forest Ecosite	Coniferous Plantation Ecosite
<b>Overstorey Composition</b>	<i>Salix sp</i>	<i>Thuja occidentalis, Populus tremuloides, Populus deltoides ssp. deltoides,</i>	<i>Alnus incana spp. rugosa, Thuja occidentalis, Sambucus nigra ssp. Canadensis, Fraxinus pennsylvanica, Fraxinus nigra</i>	<i>Acer rubrum, Acer negundo, Fraxinus pennsylvanica, Thuja occidentalis, Populus tremuloides, Salix amygdaloides</i>	<i>Pinus strobes, Pinus sylvestris, Thuja occidentalis, Betula papyrifera, Prunus serotina, Acer saccharum var. saccharum, Carya cordiformis, Fraxinus americana, Rhamnus cathartica, Lonicera tatarica</i>
<b>Understorey Composition</b>	<i>Polygonum hydropiper, Rumex crispus, Schoenoplectus tabernaemontani, Typha angustifolia, Verbena hastata</i>	<i>Salix eriocephala, Rhamnus cathartica, Lonicera tatarica, Salix purpurea, Cornus sericea ssp. sericea, Vitis riparia, Rubus idaeus ssp. idaeus, Salix exigua</i>	<i>Ribes triste Cornus sericea ssp. sericea</i>	<i>Cornus sericea ssp. sericea, Salix sp, Rubus idaeus ssp. idaeus</i>	<i>Rubus idaeus ssp. idaeus, Prunus virginiana var. virginiana</i>
<b>Groundcover Composition</b>	<i>Lemna minor</i>	<i>Solidago Canadensis, Daucus carota, Aster sp, Symphyotrichum novae-angliae, Asclepias syriaca, Echium vulgare, Achillea millefolium var. millefolium, Oenothera biennis, Tussilago farfara, Verbascum Thapsus, Fragaria virginiana ssp. Virginiana, Anemone sp, Trifolium sp</i>	<i>Typha latifolia, Carex stricta, Solanum dulcamara, Phalaris arundinacea, Thalictrum dioicum, Laportea canadensis, Mentha sp, Solidago rugosa ssp. Rugosa, Onoclea sensibilis, Carex intumescens, Eupatorium maculatum var. maculatum, Eupatorium perfoliatum, Symphyotrichum puniceum var. puniceum, Impatiens capensis, Lysimachia thyrsiflora, Ranunculus hispidus var. hispidus, Glyceria striata, Leersia oryzoides, Carex sp</i>	<i>Equisetum arvense, Tussilago farfara, Phalaris arundinacea</i>	<i>Asarum canadense Solidago flexicaulis Maianthemum canadense Tussilago farfara Eurybia macrophylla Carex granularis Sanguinaria canadensis</i>
<b>Diameter Range</b>	N/A	N/A	1	1– 2	2– 3
<b>Structural Diversity</b>	1	1	2	2	2
<b>Canopy Closure</b>	N/A	1	1	2(3)	3
<b>Relative Age</b>	2	1	2	2	2
<b>Soil Texture</b>	L	L	Om 15/ L	L – rip/rap	LfS
<b>Drainage Class</b>	3	1	3	1	1
<b>Slope Class</b>	1	1	1	2	2– 3
<b>Topographic Class</b>	1	1	2	1	1
<b>Botanical Quality</b>	1	1	2	1	1

<sup>1</sup> Appendix A is based off the 2011 Biological Monitoring Program - Final Report (Dougan & Associates 2012) with minor updates from work done by Beacon in 2019.

Unit. ELC Code	6 FOC4-1	7 MAS3	8 FOD6	9 SWD	10 SWM4-1
<b>Vegetation Type</b>	Fresh-Moist White Cedar Coniferous Forest	Organic Shallow Marsh Ecosite	Fresh-Moist Sugar Maple Deciduous Forest Ecosite	Deciduous Swamp	White Cedar - Hardwood Organic Mixed Swamp
<b>Overstorey Composition</b>	<i>Thuja occidentalis</i> <i>Fraxinus pennsylvanica</i> <i>Acer saccharum</i> var. <i>saccharum</i>	<i>Thuja occidentalis</i> , <i>Betula papyrifera</i> , <i>Ulmus americana</i> , <i>Fraxinus nigra</i> , <i>Betula alleghaniensis</i> , <i>Acer saccharum</i> var. <i>saccharum</i> <i>Fraxinus pennsylvanica</i> , <i>Acer rubrum</i> , <i>Prunus serotina</i> , <i>Carpinus caroliniana</i> ssp. <i>virginiana</i> , <i>Tilia americana</i> ,	<i>Acer saccharum</i> var. <i>saccharum</i> , <i>Ostrya virginiana</i> , <i>Tilia americana</i> , <i>Thuja occidentalis</i> , <i>Betula alleghaniensis</i> , <i>Betula papyrifera</i> , <i>Tsuga canadensis</i> , <i>Fagus grandifolia</i> , <i>Fraxinus pennsylvanica</i> , <i>Fraxinus americana</i>	<i>Fraxinus nigra</i> <i>Populus tremuloides</i> <i>Betula alleghaniensis</i> <i>Acer rubrum</i> <i>Tilia americana</i> <i>Thuja occidentalis</i> <i>Fraxinus pennsylvanica</i> <i>Fagus grandifolia</i>	<i>Thuja occidentalis</i> , <i>Populus tremuloides</i> , <i>Fraxinus pennsylvanica</i> , <i>Ulmus americana</i> , <i>Fraxinus nigra</i> , <i>Betula papyrifera</i> , <i>Betula alleghaniensis</i> , <i>Acer rubrum</i> ,
<b>Understorey Composition</b>	<i>Sambucus racemosa</i> var. <i>racemosa</i> <i>Cornus alternifolia</i> <i>Ribes</i> sp	<i>Cornus sericea</i> ssp. <i>sericea</i> , <i>Rubus pubescens</i> , <i>Parthenocissus vitacea</i> , <i>Sambucus nigra</i> ssp. <i>canadensis</i>	-	<i>Sambucus nigra</i> ssp. <i>canadensis</i> , <i>Cornus sericea</i> ssp. <i>sericea</i>	<i>Rhamnus cathartica</i> , <i>Rubus idaeus</i> ssp. <i>idaeus</i> , <i>Salix petiolaris</i> , <i>Amelanchier alnifolia</i> , <i>Hamamelis virginiana</i> , <i>Cornus sericea</i> ssp. <i>sericea</i> , <i>Sambucus nigra</i> ssp. <i>canadensis</i> , <i>Parthenocissus vitacea</i> , <i>Lonicera dioica</i> , <i>Prunus virginiana</i> var. <i>virginiana</i> , <i>Cornus alternifolia</i> , <i>Alnus incana</i> spp. <i>rugosa</i> , <i>Frangula alnus</i> , <i>Cornus racemosa</i> , <i>Rubus pubescens</i> , <i>Prunus serotina</i> ,
<b>Groundcover Composition</b>	<i>Cystopteris bulbifera</i> <i>Tussilago farfara</i> <i>Carex communis</i> <i>Asarum canadense</i> <i>Onoclea sensibilis</i>	<i>Phragmites australis</i> , <i>Thelypteris palustris</i> var. <i>pubescens</i> , <i>Carex hystericina</i> , <i>Solanum dulcamara</i> , <i>Scirpus atrovirens</i> , <i>Epilobium hirsutum</i> , <i>Onoclea sensibilis</i> , <i>Cicuta maculata</i> , <i>Bidens frondosa</i> , <i>Typha latifolia</i> , <i>Sium suave</i> , <i>Rorippa nasturtium-aquaticum</i> , <i>Lycopus americanus</i> , <i>Agrostis stolonifera</i>	<i>Carex pennsylvanica</i> , <i>Onoclea sensibilis</i> , <i>Solidago flexicaulis</i> , <i>Tussilago farfara</i> , <i>Polystichum acrostichoides</i> , <i>Caulophyllum thalictroides</i> , <i>Asarum canadense</i> , <i>Anemone acutiloba</i> , <i>Carex pedunculata</i>	<i>Phalaris arundinacea</i> <i>Carex</i> sp <i>Solidago rugosa</i> ssp. <i>rugosa</i> <i>Onoclea sensibilis</i> , <i>Boehmeria cylindrica</i> <i>Carex lupulina</i> <i>Euonymus obovata</i>	<i>Solanum dulcamara</i> , <i>Agrimonia gryposepala</i> , <i>Thalictrum dioicum</i> , <i>Onoclea sensibilis</i> , <i>Oxalis stricta</i> , <i>Carex eburnea</i> , <i>Cystopteris bulbifera</i> , <i>Pilea pumila</i> , <i>Viola sororia</i> , <i>Clematis virginiana</i> , <i>Echinocystis lobata</i> , <i>Lysimachia thyrsoiflora</i> , <i>Circaea lutetiana</i> ssp. <i>canadensis</i> , <i>Phalaris arundinacea</i> , <i>Aster puniceus</i> var. <i>puniceus</i> , <i>Anemone virginiana</i> var. <i>cylindroidea</i> , <i>Dryopteris carthusiana</i> , <i>Echinocystis lobata</i>
<b>Diameter Range</b>	3	1	2– 3	2– 3	2– 3
<b>Structural Diversity</b>	2	2	2	2	2
<b>Canopy Closure</b>	3	1	3	3	3
<b>Relative Age</b>	2	2	2	2	2
<b>Soil Texture</b>	LfS	Om/SiL	L	L	O/L
<b>Drainage Class</b>	2	3	2	3	3
<b>Slope Class</b>	2(3)	1	1– 2	1	1
<b>Topographic Class</b>	2	2	1	2	2
<b>Botanical Quality</b>	2	2	2	2	3

Unit.	11	12	13	14-merged with Polygon 11 in 2009	15
ELC Code	MAS2-1/MAM2-2	SWC3-2	SWC3-1	SWT2	FOC4-1
<b>Vegetation Type</b>	Cattail Mineral Shallow Marsh/Reed Canary Grass Mineral Meadow Marsh	White Cedar - Conifer Organic Coniferous Swamp	White Cedar Organic Coniferous Swamp	Mineral Thicket Swamp Ecosite	Fresh-Moist White Cedar Coniferous Forest
<b>Overstorey Composition</b>	<i>Populus tremuloides</i> , <i>Thuja occidentalis</i>	<i>Thuja occidentalis</i> <i>Larix laricina</i>	<i>Thuja occidentalis</i> , <i>Populus balsamifera</i> ssp. <i>balsamifera</i> <i>Larix laricina</i> , <i>Betula papyrifera</i>	<i>Thuja occidentalis</i>	<i>Thuja occidentalis</i>
<b>Understorey Composition</b>	<i>Rhamnus cathartica</i> <i>Salix</i> sp <i>Salix petiolaris</i> <i>Ribes</i> sp <i>Cornus sericea</i> ssp. <i>sericea</i>	<i>Lonicera tatarica</i>	<i>Parthenocissus vitacea</i> <i>Lonicera tatarica</i>	<i>Salix</i> sp <i>Parthenocissus vitacea</i>	-
<b>Groundcover Composition</b>	<i>Typha latifolia</i> , <i>Phalaris arundinacea</i> , <i>Solidago canadensis</i> var. <i>scabra</i> <i>Tussilago farfara</i> , <i>Lysimachia thyrsiflora</i> , <i>Solanum dulcamara</i> , <i>Equisetum arvense</i> , <i>Carex hystericina</i> , <i>Carex stipata</i> <i>Aster puniceus</i> var. <i>puniceus</i> , <i>Eupatorium maculatum</i> var. <i>maculatum</i> , <i>Caltha palustris</i> , <i>Onoclea sensibilis</i> , <i>Impatiens capensis</i> , <i>Poa</i> sp, <i>Schoenoplectus tabernaemontani</i> , <i>Cicuta maculate</i> , <i>Carex stricta</i>	<i>Carex stricta</i> , <i>Carex pellita</i> <i>Dryopteris carthusiana</i> <i>Thelypteris palustris</i> var. <i>pubescens</i> , <i>Osmunda cinnamomea</i> , <i>Galium aparine</i> , <i>Equisetum arvense</i> , <i>Aster</i> sp, <i>Typha latifolia</i> , <i>Tussilago farfara</i> , <i>Fragaria virginiana</i> ssp. <i>virginiana</i> , <i>Caltha palustris</i> , <i>Solidago canadensis var. scabra</i> , <i>Thalictrum pubescens</i> , <i>Cypripedium parviflorum</i> , <i>Phragmites australis</i> , <i>Onoclea sensibilis</i>	<i>Equisetum arvense</i> , <i>Tussilago farfara</i> , <i>Onoclea sensibilis</i> <i>Galium aparine</i> , <i>Solanum dulcamara</i> , <i>Carex stipata</i> , <i>Phalaris arundinacea</i> , <i>Aster puniceus var. puniceus</i> <i>Thalictrum pubescens</i> <i>Dryopteris carthusiana</i> , <i>Caltha palustris</i> , <i>Eupatorium perfoliatum</i> , <i>Impatiens capensis</i> , <i>Eupatorium maculatum</i> var. <i>maculatum</i> , <i>Carex rosea</i> , <i>Cypripedium parviflorum</i> , <i>Taraxacum officinale</i>	<i>Typha latifolia</i> <i>Aster puniceus</i> var. <i>puniceus</i> <i>Phalaris arundinacea</i> <i>Solanum dulcamara</i> <i>Carex stipata</i> <i>Cicuta maculata</i> <i>Impatiens capensis</i> <i>Lysimachia thyrsiflora</i> <i>Onoclea sensibilis</i> <i>Thalictrum pubescens</i> <i>Asclepias syriaca</i> <i>Typha angustifolia</i>	-
<b>Diameter Range</b>	N/A	1– 2	2– 3	1	3
<b>Structural Diversity</b>	2	2	2	2	2
<b>Canopy Closure</b>	N/A	2– 3	3	1	3
<b>Relative Age</b>	2	2	2	2	2
<b>Soil Texture</b>	L	Om	Om	L	LfS
<b>Drainage Class</b>	3	3	3	3	2
<b>Slope Class</b>	1	1	1	1	1
<b>Topographic Class</b>	2	2	2	2	2
<b>Botanical Quality</b>	2	2	2	2	2

Unit. ELC Code	16 FOC4-1	17 FOC4-1	18 SWD	19 SWM4-1	20 FOM7
<b>Vegetation Type</b>	Fresh-Moist White Cedar Coniferous Forest	Fresh-Moist White Cedar Coniferous Forest	Deciduous Swamp	White Cedar - Hardwood Organic Mixed Swamp	Fresh-Moist White Cedar - Hardwood Mixed Forest Ecosite
<b>Overstorey Composition</b>	<i>Thuja occidentalis</i>	<i>Thuja occidentalis, Pinus strobus Populus tremuloides, Betula papyrifera, Prunus serotina Picea abies, Abies balsamea</i>	<i>Fraxinus nigra Rubus idaeus ssp. idaeus Rubus pubescens Parthenocissus vitacea Rhamnus cathartica Thuja occidentalis Vitis riparia Frangula alnus Populus tremuloides</i>	<i>Species composition similar to unit 10</i>	<i>Thuja occidentalis, tilia americana, Acer saccharum ssp saccharum, Ostrya virginiana, Tsuga canadensis</i>
<b>Understorey Composition</b>	-	<i>Prunus virginiana var. virginiana Rhamnus cathartica</i>	-	-	<i>Acer saccharum ssp saccharum</i>
<b>Groundcover Composition</b>	-	<i>Carex flacca, Danthonia spicata, Solidago nemoralis</i>	<i>Anemone canadensis Solanum dulcamara Geum sp Thalictrum pubescens Circaea lutetiana ssp. canadensis Arisaema triphyllum ssp. triphyllum Galium sp Solidago rugosa ssp. rugosa</i>	-	<i>Carex pensylvanica, Dryopteris carthusiana, Asarum canadense</i>
<b>Diameter Range</b>	2- 3	2- 3	1- 2	2- 3	2- 3
<b>Structural Diversity</b>	1	1	2	2	2
<b>Canopy Closure</b>	3	3	2	3	3
<b>Relative Age</b>	2	2	1	2	2
<b>Soil Texture</b>	L	L	L	O/L	L
<b>Drainage Class</b>	1	1	3	3	2
<b>Slope Class</b>	1	1	1	1	1- 2
<b>Topographic Class</b>	2	2	2	2	2
<b>Botanical Quality</b>	2	2	2	3	2

Unit. ELC Code	21 FOC4-1	22 FOC4-1	23 CUM1	24 SWD2-2	25 MAM2
<b>Vegetation Type</b>	Fresh-Moist White Cedar Coniferous Forest	Fresh-Moist White Cedar Coniferous Forest	Mineral Cultural Meadow Ecosite	Red Ash Mineral Deciduous Swamp	Common Reed Mineral Meadow Marsh
<b>Overstorey Composition</b>	<i>Populus tremuloides</i> <i>Thuja occidentalis</i> <i>Fraxinus pennsylvanica</i> <i>Fraxinus americana</i> <i>Acer saccharum</i> var. <i>saccharum</i> <i>Betula alleghaniensis</i>	<i>Thuja occidentalis</i> , <i>Betula papyrifera</i> <i>Salix fragilis</i> , <i>Populus balsamifera</i> ssp. <i>balsamifera</i> , <i>Populus tremuloides</i> ,	<i>Acer negundo</i>	-	<i>Populus balsamifera</i> ssp. <i>balsamifera</i> <i>Acer negundo</i>
<b>Understorey Composition</b>	-	<i>Salix purpurea</i> , <i>Cornus sericea</i> ssp. <i>sericea</i> , <i>Lonicera tatarica</i>	<i>Rhamnus cathartica</i> , <i>Rubus idaeus</i> ssp. <i>idaeus</i> , <i>Vitis riparia</i>	-	<i>Vitis riparia</i> , <i>Parthenocissus vitacea</i>
<b>Groundcover Composition</b>	<i>Solidago canadensis</i>	<i>Equisetum arvense</i> , <i>Solidago canadensis</i> , <i>Tussilago farfara</i> , <i>Taraxacum officinale</i>	<i>Solidago canadensis</i> var. <i>scabra</i> , <i>Echium vulgare</i> , <i>Linaria vulgaris</i> , <i>Thlaspi arvense</i> , <i>Equisetum arvense</i> , <i>Symphyotrichum novae-angliae</i> , <i>Bromus inermis</i> ssp. <i>pumpellianus</i> , <i>Leucanthemum vulgare</i> , <i>Solidago canadensis</i> , <i>Arctium minus</i> , <i>Lotus corniculatus</i> , <i>Daucus carota</i> , <i>Cirsium arvense</i> , <i>Rumex crispus</i> , <i>Tussilago farfara</i> , <i>Anemone canadensis</i> , <i>Asclepias syriaca</i> , <i>Trifolium repens</i>	-	<i>Phalaris arundinacea</i> <i>Rumex crispus</i> <i>Anemone canadensis</i> , <i>Ranunculus acris</i> , <i>Phragmites australis</i>
<b>Diameter Range</b>	2– 3	2– 3	N/A	2– 3	N/A
<b>Structural Diversity</b>	1	2	1	2	1
<b>Canopy Closure</b>	3	3	N/A	3	N/A
<b>Relative Age</b>	2	2	1	2	1
<b>Soil Texture</b>	L	L	L	L	L
<b>Drainage Class</b>	1	1	1	3	2
<b>Slope Class</b>	1	2	1– 2	1	1
<b>Topographic Class</b>	2	2	1	2	1
<b>Botanical Quality</b>	2	2	1	2	1

Unit. ELC Code	26 SAM1	27 SWD2-2	28 FOD	29 MAM2-2	30 MAM2-2
<b>Vegetation Type</b>	Mixed Shallow Aquatic Ecosite	Green Ash Mineral Deciduous Swamp	Deciduous Forest	Reed Canary-grass Mineral Meadow Marsh	Reed Canary-grass Mineral Meadow Marsh
<b>Overstorey Composition</b>	<i>Salix exigua</i>	<i>Fraxinus pennsylvanica, Fraxinus nigra, Ulmus americana, Betula allegheniensis, Tilia Americana, Populus tremuloides</i>	<i>Fraxinus pennsylvanica, Populus tremuloides, Thuja occidentalis, Pinus strobus</i>	<i>Thuja occidentalis, Fraxinus nigra</i>	-
<b>Understorey Composition</b>	-	<i>Rubus idaeus ssp melanolasius, Rhamnus cathartica, Sambucus canadensis, Thuja occidentalis, Viburnum trilobum (R)</i>	<i>Thuja occidentalis, Cornus sericea ssp sericea, Rhamnus frangula, abies balsamea</i>	<i>Cornus sericea ssp sericea, Rubus idaeus ssp strigosus, Thuja occidentalis</i>	-
<b>Groundcover Composition</b>	<i>Coronilla varia, Poa sp Achillea millefolium var. millefolium, Typha latifolia, Juncus effusus ssp. solutes, Silene vulgaris, Melilotus officinalis Rumex crispus, Schoenoplectus tabernaemontani, Ranunculus sceleratus var. sceleratus</i>	<i>Onoclea sensibilis, Solidago rugosa, Clematis virginiana, Cystopteris bulbifera</i>	<i>Carex pennsylvanica, Solidago canadensis var. scabra, Pteridium aquilinum, solidago rugosa, Solanum dulcamara, Solidago rugosa</i>	<i>Phalaris arundinacea -D, Symphyotrichum lateriflorum var. angustifolium, Eupatorium maculatum, Aster puniceus, Carex sp.,</i>	<i>Phalaris arundinacea -D, Aster puniceus-A, Typha angustifolia, Typha latifolia, Symphyotrichum lanceolatum var. lanceolatum, Cyperipedium parviflorum var. makasin</i>
<b>Diameter Range</b>	N/A	2	1,2 (3)	1	1
<b>Structural Diversity</b>	1	2	2	1	1
<b>Canopy Closure</b>	N/A	3	3	1	1
<b>Relative Age</b>	1	2	1- 2	1	1
<b>Soil Texture</b>	L	L	L	L	L
<b>Drainage Class</b>	3	2- 3	1	2- 3	2- 3
<b>Slope Class</b>	1	1	1	1	1
<b>Topographic Class</b>	1	1	1	1	1
<b>Botanical Quality</b>	2	2	2	2	2

Unit. ELC Code	31 FOD	32 CUM1
<b>Vegetation Type</b>	Deciduous Forest Remnant	Cultural Meadow
<b>Overstorey Composition</b>	<i>Acer saccharum ssp saccharum, Tilia americana</i>	-
<b>Understorey Composition</b>	-	-
<b>Groundcover Composition</b>	-	Some areas manicured turf, some areas seeded; <i>Medicago sativa, Melilotus sp, Daucus carota</i>
<b>Diameter Range</b>	2	1
<b>Structural Diversity</b>	1	1
<b>Canopy Closure</b>	3	1
<b>Relative Age</b>	2	1
<b>Soil Texture</b>	L	L
<b>Drainage Class</b>	1	1
<b>Slope Class</b>	1	1
<b>Topographic Class</b>	1	1
<b>Botanical Quality</b>	2	1

**LEGEND**

Diameter Range (1 = <15 cm dbh.; 2 = 15 – 30 cm dbh.; 3 = >30 cm dbh.)

Structural Diversity (1 = strata 1 & 2; 2 = >2 strata; 3 = > 3 strata, old growth)

Canopy Closure (1 = <25%; 2 = 25– 50%; 3 = >50%)

Relative Age (1 = immature; 2 = mature; 3 = old growth)

Soil Texture (sand/silt/clay/org)

Drainage Class (1 = well-drained; 2 = imperfectly drained (1 – 3 mottles); 3 = poorly drained (>3 mottles)

Slope Class (1 = <10%; 2 = 10– 25%; 3 = >25%)

Topographic Class (1 = uniform; 2 = uneven; 3 = high variability (hummocky)

Botanical Quality (1 = disturbed, exotics; 2 = low diversity; 3 = high diversity (sig spp. present)

Edge Abbreviations: ( ) represent localized condition; D = Dominant (51– 100%); A = Abundant (21– 50%); F = Frequent (11– 20%); O = Occasional (5– 10%); S = Scarce (<5%)



# **Appendix B**

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## **Flora Checklist**

# Appendix B

## Flora Checklist

Family Name	Scientific Name	Common Name (FOIBIS)	Coefficient of Conservatism	Wetness Index	S-Rank	Wellington
Alismataceae	<i>Alisma triviale</i>	Northern Water-plantain	1	-5	S5	-
Alismataceae	<i>Sagittaria latifolia</i>	Broadleaf Arrowhead	4	-5	S5	-
Anacardiaceae	<i>Toxicodendron rydbergii</i>	Western Poison Ivy	0	0	S5	-
Apiaceae	<i>Cicuta bulbifera</i>	Bulb-bearing Water-hemlock	5	-5	S5	-
Apiaceae	<i>Cicuta maculata</i>	Spotted Water-hemlock	6	-5	S5	-
Apiaceae	<i>Daucus carota</i>	Queen Anne's Lace	0	5	SNA	-
Apiaceae	<i>Hydrocotyle americana</i>	American Water-pennywort	7	-5	S5	-
Apiaceae	<i>Sium suave</i>	Hemlock Water-parsnip	4	-5	S5	-
Apocynaceae	<i>Apocynum androsaemifolium</i> ssp. <i>androsaemifolium</i>	Spreading Dogbane	3	5	S5	-
Araceae	<i>Arisaema triphyllum</i> ssp. <i>triphyllum</i>	Jack-in-the-pulpit	5	-2	S5	-
Araliaceae	<i>Aralia nudicaulis</i>	Wild Sarsaparilla	4	3	S5	-
Aristolochiaceae	<i>Asarum canadense</i>	Wild Ginger	6	5	S5	-
Asclepiadaceae	<i>Asclepias incarnata</i> ssp. <i>incarnata</i>	Swamp Milkweed	6	-5	S5	-
Asclepiadaceae	<i>Asclepias syriaca</i>	Common Milkweed	0	5	S5	-
Aspleniaceae	<i>Asplenium platyneuron</i>	Ebony Spleenwort	6	3	S4	R
Asteraceae	<i>Achillea millefolium</i> var. <i>occidentalis</i>	Woolly Yarrow	0	3	S5	-
Asteraceae	<i>Ambrosia trifida</i>	Great Ragweed	0	-1	S5	-
Asteraceae	<i>Bidens frondosa</i>	Devil's Beggar's Ticks	3	-3	S5	-
Asteraceae	<i>Cichorium intybus</i>	Chicory	0	5	SNA	-
Asteraceae	<i>Cirsium vulgare</i>	Bull Thistle	0	4	SNA	-
Asteraceae	<i>Erigeron philadelphicus</i> var. <i>philadelphicus</i>	Philadelphia Fleabane	1	-3	S5	-
Asteraceae	<i>Eupatorium perfoliatum</i>	Common Boneset	2	-4	S5	-
Asteraceae	<i>Euthamia graminifolia</i>	Grass-leaved Goldenrod	2	-2	S5	-
Asteraceae	<i>Eutrochium maculatum</i> var. <i>maculatum</i>	Spotted Joe-pye Weed	3	-5	S5	-
Asteraceae	<i>Hieracium</i> sp.	Hawkweed Species	0	0	-	-
Asteraceae	<i>Lactuca biennis</i>	Tall Blue Lettuce	6	0	S5	-
Asteraceae	<i>Lactuca</i> sp.	Lettuce Species	0	0	-	-
Asteraceae	<i>Leucanthemum vulgare</i>	Oxeye Daisy	0	5	SNA	-
Asteraceae	<i>Solidago altissima</i> var. <i>altissima</i>	Tall Goldenrod	1	3	S5	-
Asteraceae	<i>Solidago canadensis</i>	Canada Goldenrod	1	3	S5	-
Asteraceae	<i>Solidago flexicaulis</i>	Broad-leaved Goldenrod	6	3	S5	-
Asteraceae	<i>Solidago gigantea</i>	Smooth Goldenrod	4	-3	S5	-
Asteraceae	<i>Solidago nemoralis</i> var. <i>nemoralis</i>	Field Goldenrod	2	5	S5	-
Asteraceae	<i>Solidago rugosa</i> ssp. <i>rugosa</i>	Rough Goldenrod	4	-1	S5	-
Asteraceae	<i>Sonchus arvensis</i> ssp. <i>arvensis</i>	Field Sowthistle	0	1	SNA	-

Family Name	Scientific Name	Common Name (FOIBIS)	Coefficient of Conservatism	Wetness Index	S-Rank	Wellington
Asteraceae	<i>Sonchus asper</i> ssp. <i>asper</i>	Spiny-leaf Sowthistle	0	0	SNA	-
Asteraceae	<i>Symphotrichum lanceolatum</i> ssp. <i>lanceolatum</i>	Panicled Aster	3	-3	S5	-
Asteraceae	<i>Symphotrichum lateriflorum</i> var. <i>lateriflorum</i>	Calico Aster	3	-2	S5	-
Asteraceae	<i>Symphotrichum novae-angliae</i>	New England Aster	2	-3	S5	-
Asteraceae	<i>Symphotrichum pilosum</i> var. <i>pilosum</i>	Hairy Aster	4	2	S5	U
Asteraceae	<i>Symphotrichum puniceum</i> var. <i>puniceum</i>	Purple-stemmed Aster	6	-5	S5	-
Asteraceae	<i>Symphotrichum urophyllum</i>	Arrow-leaved Aster	6	5	S4	U
Asteraceae	<i>Taraxacum officinale</i>	Common Dandelion	0	3	SNA	-
Asteraceae	<i>Tussilago farfara</i>	Colt's Foot	0	3	SNA	-
Balsaminaceae	<i>Impatiens capensis</i>	Spotted Jewel-weed	4	-3	S5	-
Berberidaceae	<i>Caulophyllum giganteum</i>	Blue Cohosh	-	-	S5	-
Berberidaceae	<i>Caulophyllum thalictroides</i>	Blue Cohosh	6	5	S5	-
Betulaceae	<i>Alnus incana</i> ssp. <i>rugosa</i>	Speckled Alder	6	-5	S5	-
Betulaceae	<i>Betula alleghaniensis</i>	Yellow Birch	6	0	S5	-
Betulaceae	<i>Betula papyrifera</i>	Paper Birch	2	2	S5	-
Betulaceae	<i>Carpinus caroliniana</i> ssp. <i>virginiana</i>	American Hornbeam	6	0	S5	-
Boraginaceae	<i>Echium vulgare</i>	Common Viper's-bugloss	0	5	SNA	-
Boraginaceae	<i>Hackelia virginiana</i>	Virginia Stickseed	5	1	S5	-
Boraginaceae	<i>Myosotis laxa</i>	Small Forget-me-not	6	-5	S5	-
Boraginaceae	<i>Myosotis scorpioides</i>	True Forget-me-not	0	-5	SNA	-
Boraginaceae	<i>Symphytum officinale</i> ssp. <i>officinale</i>	Common Comfrey	0	5	SNA	-
Brassicaceae	<i>Cardamine diphylla</i>	Broad-leaved Toothwort	7	5	S5	-
Brassicaceae	<i>Cardamine pensylvanica</i>	Pennsylvania Bitter-cress	6	-4	S5	U
Brassicaceae	<i>Rorippa nasturtium-aquaticum</i>	True Watercress	0	-5	SNA	-
Brassicaceae	<i>Thlaspi arvense</i>	Field Penny-cress	0	5	SNA	-
Campanulaceae	<i>Lobelia siphilitica</i>	Great Blue Lobelia	6	-4	S5	-
Caprifoliaceae	<i>Lonicera tatarica</i>	Tartarian Honeysuckle	0	3	SNA	-
Caprifoliaceae	<i>Sambucus canadensis</i>	Common Elderberry	5	-2	S5	-
Caprifoliaceae	<i>Sambucus nigra</i>	Europeean Elderberry	-	-	SNA	-
Caprifoliaceae	<i>Viburnum opulus</i>	Guelder-rose Viburnum	0	0	SNA	-
Caryophyllaceae	<i>Silene vulgaris</i>	Maiden's Tears	0	5	SNA	-
Celastraceae	<i>Euonymus obovatus</i>	Running Strawberry-bush	6	5	S5	-
Clusiaceae	<i>Hypericum perforatum</i>	St. John's-wort	0	5	SNA	-
Convolvulaceae	<i>Convolvulus arvensis</i>	Field Bindweed	0	5	SNA	-
Cornaceae	<i>Cornus alternifolia</i>	Alternate-leaf Dogwood	6	5	S5	-
Cornaceae	<i>Cornus racemosa</i>	Gray Dogwood	2	-2	S5	-
Cornaceae	<i>Cornus sericea</i> ssp. <i>sericea</i>	Red-osier Dogwood	2	-3	S5	-
Cucurbitaceae	<i>Echinocystis lobata</i>	Wild Mock-cucumber	3	-2	S5	-
Cupressaceae	<i>Thuja occidentalis</i>	Northern White Cedar	4	-3	S5	-
Cyperaceae	<i>Carex bebbii</i>	Bebb's Sedge	3	-5	S5	-

Family Name	Scientific Name	Common Name (FOIBIS)	Coefficient of Conservatism	Wetness Index	S-Rank	Wellington
Cyperaceae	<i>Carex bromoides</i>	Brome-like Sedge	7	-4	S5	-
Cyperaceae	<i>Carex communis</i>	Fibrous-root Sedge	6	5	S5	-
Cyperaceae	<i>Carex flacca</i>	Heath Sedge	0	0	SNA	-
Cyperaceae	<i>Carex flava</i>	Yellow Sedge	5	-5	S5	-
Cyperaceae	<i>Carex gracillima</i>	Graceful Sedge	4	3	S5	-
Cyperaceae	<i>Carex granularis</i>	Meadow Sedge	3	-4	S5	-
Cyperaceae	<i>Carex hystericina</i>	Porcupine Sedge	5	-5	S5	-
Cyperaceae	<i>Carex intumescens</i>	Bladder Sedge	6	-4	S5	-
Cyperaceae	<i>Carex lupulina</i>	Hop Sedge	6	-5	S5	-
Cyperaceae	<i>Carex pedunculata</i>	Longstalk Sedge	5	5	S5	-
Cyperaceae	<i>Carex pellita</i>	Woolly Sedge	4	-5	S5	-
Cyperaceae	<i>Carex pensylvanica</i>	Pennsylvania Sedge	5	5	S5	-
Cyperaceae	<i>Carex radiata</i>	Stellate Sedge	4	5	S5	-
Cyperaceae	<i>Carex sp.</i>	Sedge Species	0	0	-	-
Cyperaceae	<i>Carex stipata</i>	Stalk-grain Sedge	3	-5	S5	-
Cyperaceae	<i>Carex stricta</i>	Tussock Sedge	4	-5	S5	-
Cyperaceae	<i>Carex vulpinoidea</i>	Fox Sedge	3	-5	S5	-
Cyperaceae	<i>Schoenoplectus tabernaemontani</i>	Soft-stemmed Bulrush	5	-5	S5	-
Cyperaceae	<i>Scirpus atrovirens</i>	Woolgrass Bulrush	3	-5	S5	-
Dennstaedtiaceae	<i>Pteridium aquilinum</i> var. <i>latiusculum</i>	Bracken Fern	2	3	S5	-
Dryopteridaceae	<i>Athyrium filix-femina</i> var. <i>angustum</i>	Lady-fern	4	0	S5	-
Dryopteridaceae	<i>Cystopteris bulbifera</i>	Bulblet Fern	5	-2	S5	-
Dryopteridaceae	<i>Dryopteris carthusiana</i>	Spinulose Wood Fern	5	-2	S5	-
Dryopteridaceae	<i>Dryopteris cristata</i>	Crested Wood Fern	7	-5	S5	-
Dryopteridaceae	<i>Dryopteris intermedia</i>	Evergreen Wood Fern	5	0	S5	-
Dryopteridaceae	<i>Dryopteris marginalis</i>	Marginal Wood Fern	5	3	S5	-
Dryopteridaceae	<i>Matteuccia struthiopteris</i> var. <i>pensylvanica</i>	Ostrich Fern	5	-3	S5	-
Dryopteridaceae	<i>Onoclea sensibilis</i>	Sensitive Fern	4	-3	S5	-
Dryopteridaceae	<i>Polystichum acrostichoides</i>	Christmas Fern	5	5	S5	-
Equisetaceae	<i>Equisetum arvense</i>	Field Horsetail	0	0	S5	-
Equisetaceae	<i>Equisetum sylvaticum</i>	Woodland Horsetail	7	-3	S5	U
Fabaceae	<i>Coronilla varia</i>	Crown-vetch	0	5	SNA	-
Fabaceae	<i>Lotus corniculatus</i>	Bird's-foot Trefoil	0	1	SNA	-
Fabaceae	<i>Medicago lupulina</i>	Black Medic	0	1	SNA	-
Fabaceae	<i>Trifolium repens</i>	White Clover	0	2	SNA	-
Fabaceae	<i>Trifolium sp.</i>	Clover Species	0	0	-	-
Fagaceae	<i>Fagus grandifolia</i>	American Beech	6	3	S5	-
Geraniaceae	<i>Geranium maculatum</i>	Wild Geranium	6	3	S5	-
Geraniaceae	<i>Geranium robertianum</i>	Herb-robert	0	5	S5	-
Grossulariaceae	<i>Ribes cynosbati</i>	Prickly Gooseberry	4	5	S5	-

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Grossulariaceae	<i>Ribes triste</i>	Swamp Red Currant	6	-5	S5	-
Iridaceae	<i>Iris versicolor</i>	Blueflag	5	-5	S5	-
Juglandaceae	<i>Carya cordiformis</i>	Bitternut Hickory	6	0	S5	-
Juglandaceae	<i>Juglans nigra</i>	Black Walnut	5	3	S4?	-
Juncaceae	<i>Juncus effusus</i> ssp. <i>solutus</i>	Soft Rush	4	-5	S5	-
Lamiaceae	<i>Galeopsis tetrahit</i>	Brittle-stem Hempnettle	0	5	SNA	-
Lamiaceae	<i>Lycopus americanus</i>	American Bugleweed	4	-5	S5	-
Lamiaceae	<i>Lycopus uniflorus</i>	Northern Bugleweed	5	-5	S5	-
Lamiaceae	<i>Mentha arvensis</i>	Corn Mint	3	-3	S5	-
Lamiaceae	<i>Nepeta cataria</i>	Catnip	0	1	SNA	-
Lamiaceae	<i>Prunella vulgaris</i> ssp. <i>lanceolata</i>	Self-heal	5	5	S5	-
Lamiaceae	<i>Prunella vulgaris</i> ssp. <i>vulgaris</i>	Common Heal-all	0	0	SNA	-
Lamiaceae	<i>Scutellaria galericulata</i>	Hooded Skullcap	6	-5	S5	-
Lamiaceae	<i>Scutellaria lateriflora</i>	Mad Dog Skullcap	5	-5	S5	-
Lamiaceae	<i>Scutellaria</i> sp.	Skullcap Species	0	0	-	-
Lemnaceae	<i>Lemna minor</i>	Lesser Duckweed	2	-5	S5	-
Liliaceae	<i>Allium tricoccum</i>	Wild Leek	7	2	S5	-
Liliaceae	<i>Maianthemum canadense</i>	Wild-lily-of-the-valley	5	0	S5	-
Liliaceae	<i>Maianthemum stellatum</i>	Starflower False Solomon's Seal	6	1	S5	-
Liliaceae	<i>Polygonatum pubescens</i>	Downy Solomon's Seal	5	5	S5	-
Liliaceae	<i>Trillium grandiflorum</i>	White Trillium	5	5	S5	-
Liliaceae	<i>Trillium</i> sp.	Trillium Species	0	0	-	-
Lythraceae	<i>Lythrum salicaria</i>	Slender-spike Loosestrife	0	-5	SNA	-
Oleaceae	<i>Fraxinus nigra</i>	Black Ash	7	-4	S5	-
Oleaceae	<i>Fraxinus pennsylvanica</i>	Green Ash	3	-3	S5	-
Onagraceae	<i>Circaea lutetiana</i> ssp. <i>canadensis</i>	Enchanter's Nightshade	3	3	S5	-
Onagraceae	<i>Epilobium hirsutum</i>	Great-hairy Willow-herb	0	-4	SNA	-
Onagraceae	<i>Epilobium parviflorum</i>	Small-flower Willow-herb	0	3	SNA	-
Onagraceae	<i>Epilobium</i> sp.	Willow-herb Species	0	0	-	-
Orchidaceae	<i>Cypripedium parviflorum</i>	Small Yellow Lady's-slipper	7	-1	S5	-
Orchidaceae	<i>Epipactis helleborine</i>	Eastern Helleborine	0	5	SNA	-
Osmundaceae	<i>Osmunda cinnamomea</i>	Cinnamon Fern	7	-3	S5	-
Oxalidaceae	<i>Oxalis stricta</i>	Upright Yellow Wood Sorrel	0	3	S5	-
Papaveraceae	<i>Sanguinaria canadensis</i>	Bloodroot	5	4	S5	-
Pinaceae	<i>Abies balsamea</i>	Balsam Fir	5	-3	S5	-
Pinaceae	<i>Larix laricina</i>	American Larch	7	-3	S5	-
Pinaceae	<i>Pinus nigra</i>	Black Pine	0	-5	SNA	-
Pinaceae	<i>Pinus strobus</i>	Eastern White Pine	4	3	S5	-
Pinaceae	<i>Tsuga canadensis</i>	Eastern Hemlock	7	3	S5	-
Plantaginaceae	<i>Plantago lanceolata</i>	English Plantain	0	0	SNA	-

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Plantaginaceae	<i>Plantago major</i>	Nipple-seed Plantain	0	-1	SNA	-
Poaceae	<i>Agrostis gigantea</i>	Redtop	0	0	SNA	-
Poaceae	<i>Brachyelytrum erectum</i>	Long-awned Wood Grass	7	5	S4S5	R
Poaceae	<i>Bromus ciliatus</i>	Fringed Brome	6	-3	S5	-
Poaceae	<i>Bromus inermis</i> ssp. <i>inermis</i>	Smooth Brome	0	5	SNA	-
Poaceae	<i>Cinna latifolia</i>	Slender Wood Reedgrass	7	-4	S5	U
Poaceae	<i>Danthonia spicata</i>	Poverty Oat-grass	5	5	S5	-
Poaceae	<i>Echinochloa crusgalli</i>	Barnyard Grass	0	-3	SNA	-
Poaceae	<i>Elymus hystrix</i>	Bottle-brush Grass	5	5	S5	-
Poaceae	<i>Elymus repens</i>	Quack Grass	0	3	SNA	-
Poaceae	<i>Elymus virginicus</i> var. <i>virginicus</i>	Virginia Wild-rye	5	-2	S5	-
Poaceae	<i>Glyceria grandis</i>	American Manna Grass	5	-5	S4S5	-
Poaceae	<i>Glyceria striata</i>	Fowl Manna Grass	3	-5	S5	-
Poaceae	<i>Leersia oryzoides</i>	Rice Cutgrass	3	-5	S5	-
Poaceae	<i>Phalaris arundinacea</i>	Reed Canary Grass	0	-4	S5	-
Poaceae	<i>Phleum pratense</i>	Timothy	0	3	SNA	-
Poaceae	<i>Phragmites australis</i> ssp. <i>australis</i>	European Common Reed	0	-4	SNA	-
Poaceae	<i>Poa palustris</i>	Fowl Bluegrass	5	-4	S5	-
Poaceae	<i>Poa pratensis</i> ssp. <i>pratensis</i>	Kentucky Bluegrass	0	1	SNA	-
Poaceae	<i>Schizachne purpurascens</i> ssp. <i>purpurascens</i>	Purple Oat	6	2	S5	-
Polygonaceae	<i>Polygonum hydropiper</i>	Water-pepper	4	-5	SNA	-
Polygonaceae	<i>Rumex crispus</i>	Curly Dock	0	-1	SNA	-
Polygonaceae	<i>Rumex orbiculatus</i>	Water Dock	6	-5	S4S5	-
Primulaceae	<i>Lysimachia ciliata</i>	Fringed Loosestrife	4	-3	S5	-
Primulaceae	<i>Lysimachia thyrsoiflora</i>	Water Loosestrife	7	-5	S5	-
Primulaceae	<i>Trientalis borealis</i> ssp. <i>borealis</i>	Northern Starflower	6	-1	S5	-
Pteridaceae	<i>Adiantum pedatum</i>	Northern Maidenhair-fern	7	1	S5	-
Ranunculaceae	<i>Actaea pachypoda</i>	White Baneberry	6	5	S5	-
Ranunculaceae	<i>Anemone acutiloba</i>	Sharp-lobed Hepatica	6	5	S5	-
Ranunculaceae	<i>Anemone canadensis</i>	Canada Anemone	3	-3	S5	-
Ranunculaceae	<i>Anemone virginiana</i> var. <i>virginiana</i>	Virginia Anemone	4	5	S5	-
Ranunculaceae	<i>Aquilegia canadensis</i>	Wild Columbine	5	1	S5	-
Ranunculaceae	<i>Caltha palustris</i>	Marsh Marigold	5	-5	S5	-
Ranunculaceae	<i>Clematis virginiana</i>	Virginia Virgin-bower	3	0	S5	-
Ranunculaceae	<i>Ranunculus abortivus</i>	Kidney-leaved Buttercup	2	-2	S5	-
Ranunculaceae	<i>Ranunculus acris</i>	Tall Buttercup	0	-2	SNA	-
Ranunculaceae	<i>Ranunculus hispidus</i> var. <i>caricetorum</i>	Swamp Buttercup	5	-5	S5	-
Ranunculaceae	<i>Ranunculus pensylvanicus</i>	Bristly Crowfoot	3	-5	S5	U
Ranunculaceae	<i>Ranunculus recurvatus</i> var. <i>recurvatus</i>	Hooked Crowfoot	4	-3	S5	-
Ranunculaceae	<i>Ranunculus</i> sp.	Buttercup Species	0	0	-	-

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Ranunculaceae	<i>Thalictrum dioicum</i>	Early Meadowrue	5	2	S5	-
Ranunculaceae	<i>Thalictrum pubescens</i>	Tall Meadowrue	5	-2	S5	-
Rhamnaceae	<i>Frangula alnus</i>	Glossy Buckthorn	0	-1	SNA	-
Rhamnaceae	<i>Rhamnus cathartica</i>	Buckthorn	0	0	SNA	-
Rosaceae	<i>Agrimonia gryposepala</i>	Tall Hairy Agrimony	2	2	S5	-
Rosaceae	<i>Fragaria virginiana</i>	Wild Strawberry	2	1	S5	-
Rosaceae	<i>Geum canadense</i>	White Avens	3	0	S5	-
Rosaceae	<i>Geum laciniatum</i>	Rough Avens	4	-3	S4	-
Rosaceae	<i>Geum</i> sp.	Avens Species	0	0	-	-
Rosaceae	<i>Geum urbanum</i>	Clover-root	0	5	SNA	-
Rosaceae	<i>Malus</i> sp.	Apple Species	0	0	-	-
Rosaceae	<i>Prunus serotina</i>	Wild Black Cherry	3	3	S5	-
Rosaceae	<i>Rubus idaeus</i> ssp. <i>strigosus</i>	Wild Red Raspberry	0	-2	S5	-
Rosaceae	<i>Rubus pubescens</i>	Dwarf Raspberry	4	-4	S5	-
Rosaceae	<i>Spiraea alba</i>	Narrow-leaved Meadow-sweet	3	-4	S5	-
Rubiaceae	<i>Galium aparine</i>	Cleavers	4	3	S5	-
Rubiaceae	<i>Galium asprellum</i>	Rough Bedstraw	6	-5	S5	-
Rubiaceae	<i>Galium palustre</i>	Marsh Bedstraw	5	-5	S5	-
Rubiaceae	<i>Galium</i> sp.	Bedstraw Species	0	0	-	-
Salicaceae	<i>Populus balsamifera</i> ssp. <i>balsamifera</i>	Balsam Poplar	4	-3	S5	-
Salicaceae	<i>Populus deltoides</i> ssp. <i>deltoides</i>	Eastern Cottonwood	-	-	S5	-
Salicaceae	<i>Populus tremuloides</i>	Quaking Aspen	2	0	S5	-
Salicaceae	<i>Salix alba</i>	White Willow	0	-3	SNA	-
Salicaceae	<i>Salix bebbiana</i>	Bebb's Willow	4	-4	S5	-
Salicaceae	<i>Salix discolor</i>	Pussy Willow	3	-3	S5	-
Salicaceae	<i>Salix eriocephala</i>	Heart-leaved Willow	4	-3	S5	-
Salicaceae	<i>Salix exigua</i>	Sandbar Willow	3	-5	S5	-
Salicaceae	<i>Salix fragilis</i>	Crack Willow	0	-1	SNA	-
Salicaceae	<i>Salix petiolaris</i>	Meadow Willow	3	-4	S5	-
Salicaceae	<i>Salix purpurea</i>	Basket Willow	0	-3	SNA	-
Salicaceae	<i>Salix</i> sp.	Willow Species	0	0	-	-
Sapindaceae	<i>Acer negundo</i>	Manitoba Maple	0	-2	S5	-
Sapindaceae	<i>Acer platanoides</i>	Norway Maple	0	5	SNA	-
Sapindaceae	<i>Acer rubrum</i>	Red Maple	4	0	S5	-
Sapindaceae	<i>Acer saccharinum</i>	Silver Maple	5	-3	S5	-
Sapindaceae	<i>Acer saccharum</i> var. <i>saccharum</i>	Sugar Maple	4	3	S5	-
Sapindaceae	<i>Acer x freemanii</i>	Freeman's Maple	-	0	S5	-
Saxifragaceae	<i>Mitella nuda</i>	Naked Bishop's-cap	6	-3	S5	-
Saxifragaceae	<i>Tiarella cordifolia</i>	Heart-leaved Foam-flower	6	1	S5	-
Scrophulariaceae	<i>Chelone glabra</i>	Turtlehead	7	-5	S5	-

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Scrophulariaceae	<i>Verbascum thapsus</i>	Common Mullein	0	5	SNA	-
Scrophulariaceae	<i>Veronica anagallis-aquatica</i>	Brook-pimpernell	0	-5	SNA	-
Scrophulariaceae	<i>Veronica officinalis</i>	Common Speedwell	0	5	SNA	-
Smilacaceae	<i>Smilax herbacea</i>	Smooth Herbaceous Greenbrier	5	0	S4	-
Solanaceae	<i>Solanum dulcamara</i>	Climbing Nightshade	0	0	SNA	-
Thelypteridaceae	<i>Thelypteris palustris</i> var. <i>pubescens</i>	Marsh Fern	5	-4	S5	-
Tiliaceae	<i>Tilia americana</i>	American Basswood	4	3	S5	-
Typhaceae	<i>Typha angustifolia</i>	Narrow-leaved Cattail	3	-5	S5	-
Typhaceae	<i>Typha latifolia</i>	Broad-leaf Cattail	3	-5	S5	-
Ulmaceae	<i>Ulmus americana</i>	American Elm	3	-2	S5	-
Ulmaceae	<i>Ulmus pumila</i>	Siberian Elm	0	5	SNA	-
Urticaceae	<i>Boehmeria cylindrica</i>	False Nettle	4	-5	S5	-
Urticaceae	<i>Laportea canadensis</i>	Wood Nettle	6	-3	S5	-
Urticaceae	<i>Pilea pumila</i>	Canada Clearweed	5	-3	S5	-
Urticaceae	<i>Urtica dioica</i> ssp. <i>gracilis</i>	Slender Stinging Nettle	2	-1	S5	-
Verbenaceae	<i>Verbena hastata</i>	Blue Vervain	4	-4	S5	-
Violaceae	<i>Viola sororia</i>	Woolly Blue Violet	4	1	S5	-
Violaceae	<i>Viola</i> sp.	Violet Species	0	0	-	-
Vitaceae	<i>Parthenocissus vitacea</i>	Thicket Creeper	3	3	S5	-
Vitaceae	<i>Vitis riparia</i>	Riverbank Grape	0	-2	S5	-

a - COSEWIC = Committee on the Status of Endangered Wildlife in Canada: END = Endangered, THR = Threatened, SC = Special Concern

b - Species at Risk in Ontario List (as applies to ESA) as designated by COSSARO (Committee on the Status of Species at Risk in Ontario): END = Endangered, THR = Threatened, SC = Special Concern

c - SRANK (from Natural Heritage Information Centre) for breeding status if: S1 (Critically Imperiled), S2 (Imperiled), S3 (Vulnerable), S4 (Apparently Secure), S5 (Secure) SNA (Not applicable... 'because the species is not a suitable target for conservation activities'; includes non-native species)

d - Draft Wellington County Vascular Plant List (Cecile 2017). Status only shown if: R = Rare, U = Uncommon



# Appendix C

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## Breeding Bird Checklist (2021)



Common Name	Scientific Name	Status					2021-04-05 Incidentals	2021-05-12 Incidentals	2021-05-17 Incidentals	2021-05-18 Incidentals	June 1, 2021						June 29, 2021					
		National Species at Risk COSEWIC <sup>a</sup>	Species at Risk in Ontario Listing <sup>b</sup>	Provincial breeding season SRANK <sup>c</sup>	Wellington Regional Status <sup>d</sup>	Area- sensitive (OMNR) <sup>e</sup>					PCS #1	PCS #2	PCS #3	PCS #4	PCS #5	Incidentals	PCS #1	PCS #2	PCS #3	PCS #4	PCS #5	Incidentals
Brown-headed Cowbird	<i>Molothrus ater</i>			S4			X		X								1					
Baltimore Oriole	<i>Icterus galbula</i>			S4	S								1				1					
American Goldfinch	<i>Spinus tristis</i>			S5			X		X		1		1				2	1	1	1	1	

**KEY**

a - COSEWIC = Committee on the Status of Endangered Wildlife in Canada: END = Endangered, THR = Threatened, SC = Special Concern

b - Species at Risk in Ontario List (as applies to ESA) as designated by COSSARO (Committee on the Status of Species at Risk in Ontario): END = Endangered, THR = Threatened, SC = Special Concern

c - SRANK (from Natural Heritage Information Centre) for breeding status if: S1 (Critically Imperiled), S2 (Imperiled), S3 (Vulnerable), S4 (Apparently Secure), S5 (Secure) SNA (Not applicable... 'because the species is not a suitable target for conservation activities'; includes non-native species)

d - Significant Wildlife List for Wellington County from the City of Guelph Natural Heritage Strategy, Volume 2 (Dougan & Associates with Snell and Cecile 2009), last updated by the City of Guelph 2012. Status only shown if: S = Significant, R = Rare

Note that the following designations were excluded from this list:

\*\* = Only habitats that support or have recently supported active nests should be considered significant;

† = Bank Swallow: Significant only when found nesting in colonies equal to or greater than 100. However, recent OBBA data for Wellington County should be reviewed to see if this is appropriate.

‡ = Cliff Swallow: Significant only when found nesting in colonies equal to or greater than 8. However, recent OBBA data for Wellington County should be reviewed to see if this is appropriate.

‡ = Being small and secretive, these species are often overlooked. When more information is collected, it is possible that they may not merit significant species status in the future.

o = Habitat protection should be considered only when larval habitat is present at or in close proximity to where adults were documented.

Δ = Considered significant at present, but may prove to be too common to be so regarded in the future.

e - Ontario Ministry of Natural Resources (OMNR). 2000. Significant Wildlife Habitat Technical Guide (Appendix G). 151 p plus appendices.

Beacon Breeding Status classifications:

# - breeding pair

F- foraging/flyover

x- Species observed not breeding

**APPENDIX I**

**Technical Memoranda:  
Estimation of Infiltration and  
TW3-80 Drawdown Analysis**



## Memorandum

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Date: February 10, 2022  
From: Xiaomin Wang and Christopher Neville  
To: File  
Project: SSP-994-33: Nestle Ontario - Aberfoyle  
Subject: **Analysis of potential recharge at Aberfoyle with the SWB model: 2021 analysis**

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### Overview

S.S. Papadopoulos & Associates, Inc. (SSP&A) has applied the SWB model of the United States Geological Survey to estimate potential recharge in the Aberfoyle area during 2021. The analysis has been conducted to support the assessment of the likely variability in potential recharge and its distribution across the area around the NWC production well TW3-80 at the Aberfoyle facility.

The results of the SWB analysis for 2018, 2019 and 2020 have been reported in the corresponding Aberfoyle Annual Monitoring Reports (Golder Associates, March 2019; March 2020 and March 2021). This memorandum documents the development of the analysis with 2021 climate data. An important change with respect to previous years is the use of climate data from the Shade's Mills climate station in Cambridge, provided by the Grand River Conservation Authority.

In 2021 the total reported precipitation was 1022 mm. The annual potential recharge estimated with the SWB model is about 150 mm (148 mm). The results of the updated analysis are consistent with the general trends inferred from the analyses for 2008-2020.



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## **1. Introduction**

In March 2019, S.S. Papadopoulos & Associates, Inc. (SSP&A) applied the SWB model to estimate potential recharge to the water table over the area surrounding the Nestlé Waters Canada (NWC) Aberfoyle facility. The SWB is a simplified Soil-Water Balance code developed by the United States Geological Survey (Westenbroek et al., 2010). The results of the analyses with 2008-2018 precipitation data were presented in the 2018 Aberfoyle Annual Monitoring Report (Golder Associates, March 2019). The SWB analyses were subsequently updated with precipitation data from 2019 and 2020, with results presented in the corresponding Aberfoyle Annual Monitoring Reports (Golder Associates, March 2020 and March 2021). This memorandum documents the results of the SWB analyses applied with 2021 daily precipitation and temperature data. The 2021 daily precipitation and temperature data are derived from the Shade's Mills climate station. The Grand River Conservation Authority has provided these data. Analyses for previous years used climate data from the Kitchener-Waterloo climate station. The data from the Shade's Mills are considered to be more representative (H. Whiteley, written communication December 7, 2021).

The SWB model refers consistently to “recharge”. Following the guidance of Dr. Hugh Whiteley, the quantity that is reported as “recharge” should be interpreted as “potential recharge” (H. Whiteley, written communication December 7, 2021). Potential recharge is that portion of the precipitation that has moved downward across the earth surface plane (i.e., infiltration) and that has the potential to eventually recharge the water table (H. Whiteley, written communication December 7, 2021). The interval between the bottom of the root zone and the top of the water table is not considered in the SWB analysis. For cases in which the water table is close to the bottom of the root zone, the results of the SWB model should approximate the annual recharge. For cases in which there is a significant travel time between the bottom of the root zone and the water table, the SWB results may not match actual groundwater recharge rates in time or in space.

This memorandum consists of six main sections:

1. Introduction [this section];
2. SWB conceptual model;
3. SWB model input;
4. Sources of input data for the Aberfoyle area;
5. Potential recharge calculated for 2021; and
6. References.



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## **2. SWB conceptual model**

The SWB model implements a modified Thornthwaite-Mather soil-water balance analysis (Westenbroek et al., 2010). The SWB model estimates each component of the soil-water balance for daily timesteps. Model outputs may be daily, monthly, or annual values of infiltration, along with estimates of interception, snow cover, runoff, potential and actual evapotranspiration. The spatial distributions of these quantities are calculated over time using a gridded data structure.

As indicated in the introduction, the documentation of the SWB model refers to infiltration. This nomenclature will be retained here, recognizing that “infiltration” is more correctly interpreted as “potential recharge”. The SWB model calculates infiltration with a modified Thornthwaite-Mather soil-water accounting method (Thornthwaite and Mather, 1957). Infiltration is calculated as the difference between the change in soil moisture and sources and sinks:

$$\textit{infiltration} = (\textit{precip} + \textit{snowmelt} + \textit{inflow}) - (\textit{interception} + \textit{outflow} + \textit{ET}) \\ - \Delta \textit{soil moisture}$$

The descriptions of the terms in the water balance are presented below, following the terminology of the documentation of the SWB model:

*Precip* – daily values of precipitation using ASCII or Surfer grid formats;

*Snowmelt* – daily values of snowmelt calculated based on air temperature of daily mean, maximum and minimum;

*Inflow* – daily values of water inflow into a cell calculated over a flow-direction grid derived from a digital elevation model;

*Interception* – daily values of rainfall trapped and used by vegetation, calculated by use of a “bucket” approach assuming a user-specified amount which varies from different land-use types and seasons;

*Outflow* – daily values of water outflow from a cell calculated based on curve number rainfall-runoff relation (Cronshey and others, 1986), soil type and runoff conditions;



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*ET* – daily values of evapotranspiration. There are five methods included in the SWB code. The simplest method is Thornthwaite and Mather (1957) requiring only daily maximum and minimum air temperature. The Thornthwaite-Mather method contains functions considering daylight length, radiation, sunset angle for the estimation of potential evapotranspiration; and

*Δ soil moisture* – daily values of the amount of water held in soil storage for a given cell calculated based on the Thornthwaite and Mather (1957) procedure.





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### 3. SWB model input

The datasets required for the application of the SWB model are listed below.

<b>Gridded (ESRI ASCII or Surfer)</b>
Land-use classification
Hydrologic soil group
Flow direction
Available soil-water capacity
<b>Tabular</b>
Climate data (e.g. precipitation and temperature)
Soil and land use property lookup table
Soil-water retention table (Thorntwaite and Mather, 1957)

A text model control file must be prepared for running the SWB code and the following additional information is required:

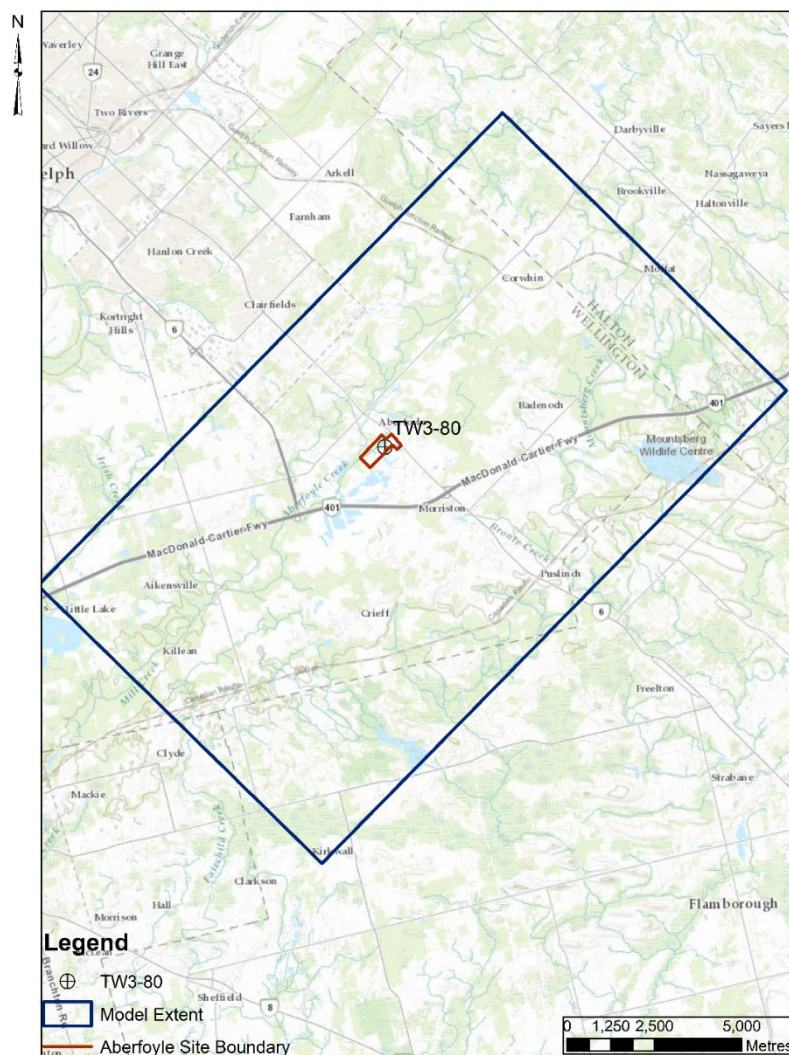
- Model domain, grid size;
- Growing season start and end;
- Initial soil moisture;
- Initial snow cover;
- Runoff calculation and routing method;
- Evapotranspiration method; and
- Output options.

Optional inputs for *ET* methods other than Thorntwaite and Mather (1957) and Hargreaves and Samani (1985) include daily average wind speed in m/s, average relative humidity in percent, maximum relative humidity in percent and percentage of possible sunshine.

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#### 4. Sources of input data for the Aberfoyle area

The limits of the area considered in the analysis are shown in Figure 1. The area has been selected to extend northeast beyond the expected limits of the capture zone of the NWC TW3-80 production well, and southwest to the Sideroad 10 stream gauge on Mill Creek.



**Figure 1. Model limits**



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### **Climate data**

Two types of climate data are required: daily precipitation and temperature (minimum, maximum and average). Both sets of data are obtained from the climate station at Shade's Mills, monitored by the Grand River Conservation Authority. When data are missing from the station, gaps are filled using the daily precipitation data from the Kitchener/Waterloo (KW) Station.

### **Land cover data**

Land cover data are obtained from the Southern Ontario Land Resource Information System (SOLRIS v2) mapping compiled by OMNRF (2015).

<https://www.javacoeapp.lrc.gov.on.ca/geonetwork/srv/en/main.home>

### **Flow direction data**

Flow direction data are obtained from the Ontario Integrated Hydrology Data (OMNRF, 2012).

<https://www.javacoeapp.lrc.gov.on.ca/geonetwork/srv/en/main.home>

### **Hydrologic soil type data**

Hydrologic soil groups are used to estimate runoff from precipitation. The classification of soils within the study area has been obtained using the Ontario Data - Soil Survey Complex created by Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA, 2012).

<https://www.javacoeapp.lrc.gov.on.ca/geonetwork/srv/en/main.home>



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**Soil-water capacity data**

The soil-water capacity data are specified based on the textures of the surficial soils. The description of the soil textures, 'A' horizon, are provided in the field named “ATEXTURE1” of the Soil Survey Complex Data obtained from the OMAFRA website. A lookup table relating soil-water capacity and soil texture is reproduced below (Earthfx, 2016; Table 8.11).

Table 8.11: Soils mapping based parameters lookup table.

"A" Horizon Texture	Description	Proportion	PRMS Soil Type	Wilting Point (wp)	Field Capacity (Fc)	Porosity (n)	Plant Available Water (PAW)	Sat Hydraulic Conductivity (mm/hr)
SIL	Silt Loam	27%	Loam	0.14	0.32	0.48	0.18	12.2
L	Loam	22%	Loam	0.13	0.27	0.46	0.14	18.6
SL	Sandy Loam	15%	Sand	0.08	0.18	0.45	0.10	50.3
CL	Clay Loam	11%	Clay	0.21	0.35	0.47	0.14	16.7
Unclassified	Unclassified	8.7%	Loam	0.13	0.26	0.40	0.13	9.3
LS	Loamy Sand	5.9%	Loam	0.06	0.12	0.46	0.06	91.3
FSL	Fine Sandy Loam	3.5%	Loam	0.09	0.21	0.45	0.12	42.0
ORG	Organic	3.3%	Clay	0.16	0.34	0.65	0.18	2.1
GL	Gravelly Loam	1.9%	Sand	0.05	0.11	0.42	0.05	12.4
SICL	Silty Clay Loam	0.51%	Loam	0.21	0.38	0.51	0.17	5.9
FS	Fine Sand	0.14%	Sand	0.03	0.08	0.46	0.05	110.0
LFS	Loamy Fine Sand	0.12%	Loam	0.07	0.14	0.45	0.07	72.5
GS	Gravelly Sand	0.11%	Sand	0.02	0.05	0.41	0.03	76.0
VFSL	Very Fine Sandy Loam	0.08%	Loam	0.13	0.25	0.45	0.12	19.5
GSL	Gravelly Sandy Loam	0.01%	Sand	0.00	0.00	0.43	0.00	33.5

**Soil and land use property lookup table**

The soil and land use property lookup table is developed with the following procedure:

- Obtain the land use description provided by SOLRIS v2, e.g., Forest – tree cover > 60%;
- Download the Land Use Code (LU) “LU\_lookup\_WISCLAND\_w\_forested\_hillslope.txt” from the USGS website;
- Based on the land description, obtain the SCS number, maximum infiltration rates, interception storage values and depth of root zone from the USGS table; and
- Integrate all the information into a new lookup table for the Aberfoyle analysis.



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## 5. SWB results for the Aberfoyle area for 2021

The calculated distribution of annual potential recharge for 2021 is shown in Figure 2. The distribution of estimated daily potential recharge values over the study area are shown in Figure 3.

The annual total precipitation and the annual total potential recharge values estimated with the SWB model from previous analyses are tabulated below. Over the 14-year period of the analyses, the estimated annual potential recharge has varied over a relatively wide range, from about 90 mm to 240 mm. Values of estimated potential annual recharge are plotted against the total annual precipitation in Figure 4. As shown in the figure, the estimated annual potential recharge for 2021 follows the general trend of the results for previous years.

<b>Year</b>	<b>Annual total precipitation (mm)</b>	<b>Annual potential recharge (mm)</b>
<b>2008</b>	1304.7	242.6
<b>2009</b>	964.9	160
<b>2010</b>	833.1	113.7
<b>2011</b>	1081	217.9
<b>2012</b>	770.6	113.7
<b>2013</b>	1088.6	175.5
<b>2014</b>	973.8	201.1
<b>2015</b>	795.8	97.2
<b>2016</b>	931.9	161.9
<b>2017</b>	949.4	195.6
<b>2018</b>	807.1	126.9
<b>2019</b>	740.0	122.6
<b>2020</b>	692.0	87.7
<b>2021</b>	1021.7	147.8
<b>Mean</b>	925.3	154.6
<b>Median</b>	940.7	153.9



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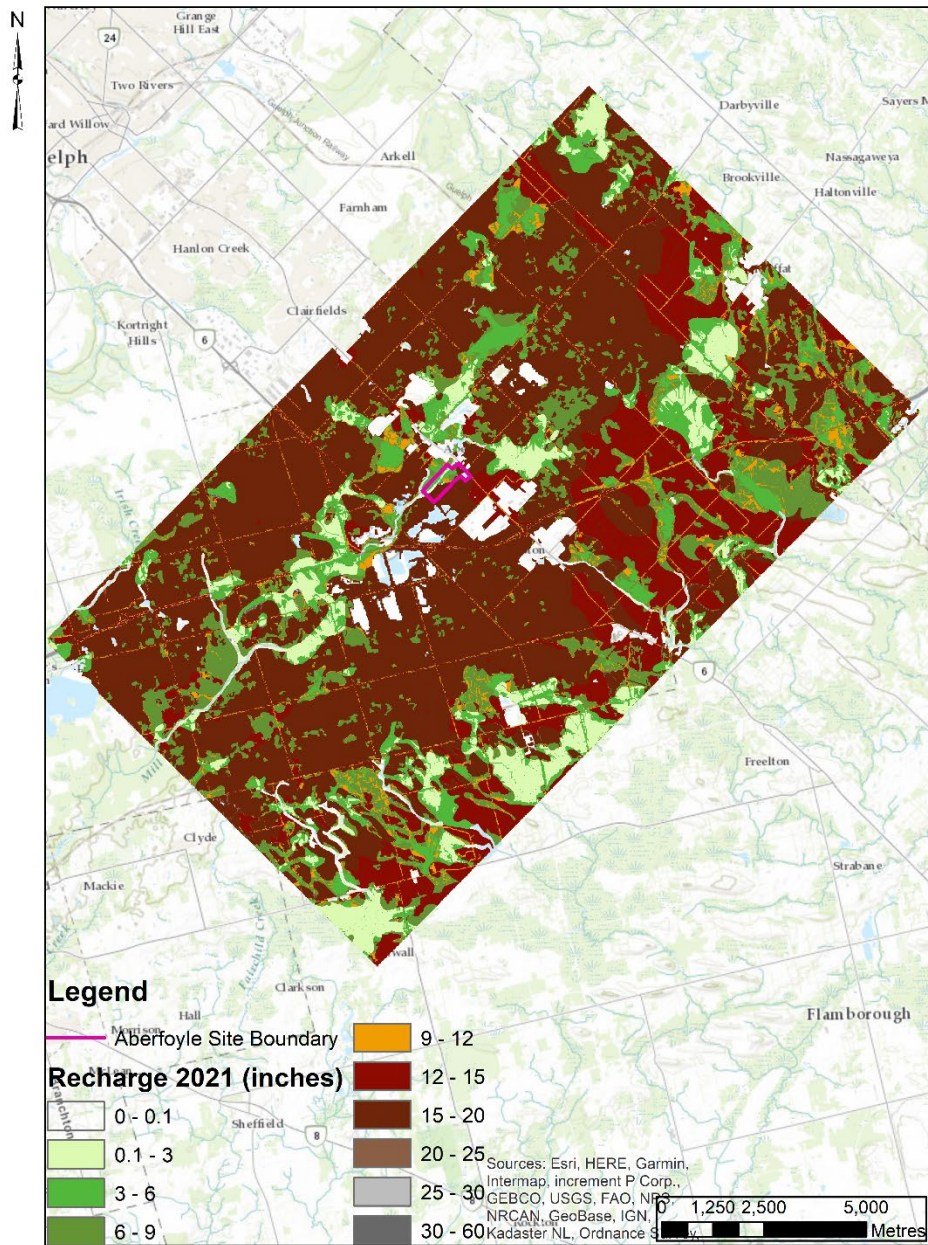
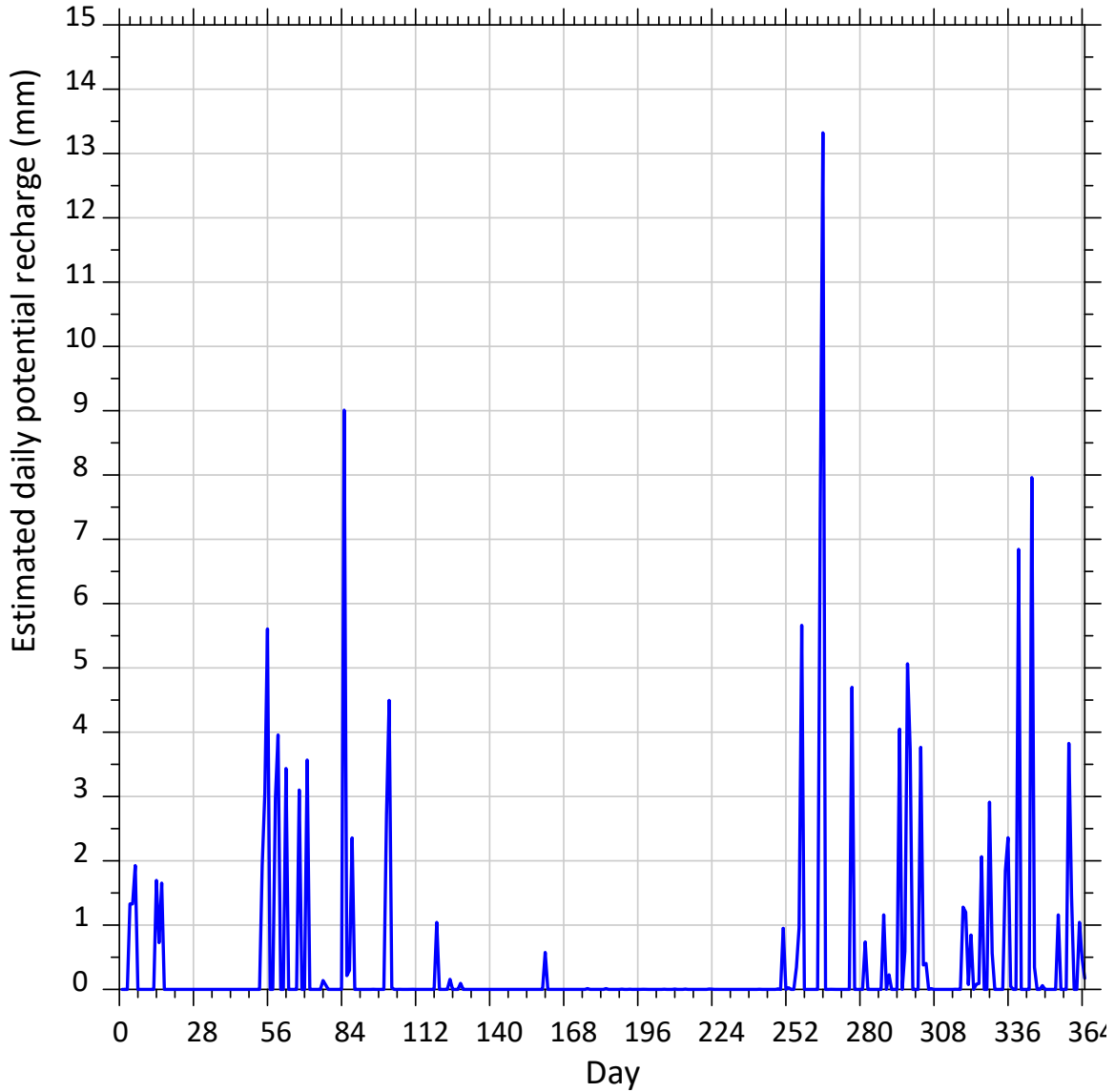


Figure 2. Calculated distribution of annual potential recharge for 2021



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**Figure 3. Estimated daily potential recharge over the study area**

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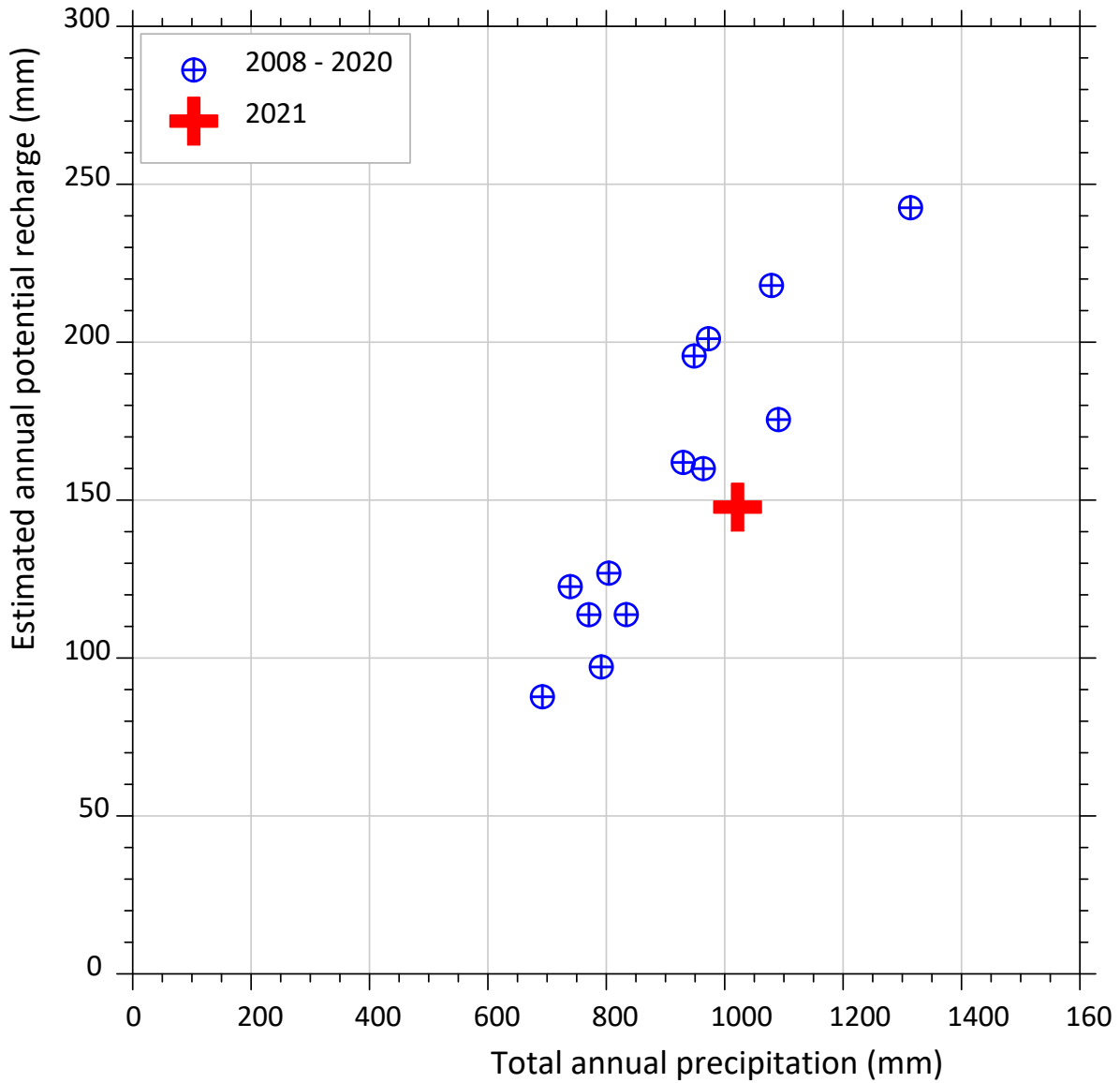


Figure 4. Relationship between estimated potential recharge and precipitation





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## **6. References**

- Cronshey, R., R. McCuen, N. Miller, W. Rawls, S. Robbins, and D. Woodward, 1986: Urban hydrology for small watersheds – TR-55 (2<sup>nd</sup> ed.), Washington, D.C., U.S. Dept. of Agriculture, Soil Conservation Service, Engineering Division, Technical Release 55, 164p.
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- Thornthwaite, C.W. and Mather, J.R., 1957: Instructions and tables for computing potential evapotranspiration and the water balance, Centerton, N.J., Laboratory of Climatology, *Publications in Climatology*, vol. 10, no. 3, pp. 185-311.
- Westenbroek, S.M., V.A. Kelson, W.R. Dripps, R.J. Hunt, and K.R. Bradbury, 2010: SWB—A Modified Thornthwaite-Mather Soil-Water-Balance code for estimating groundwater recharge, U.S. Geological Survey Techniques and Methods 6–A31, 60 p.

## TECHNICAL MEMORANDUM

**DATE** February 23, 2022 **Project No.** 20449101 (1100)

**TO** Andreeanne Simard, Ph.D., Natural Resource Manager  
Blue Triton Brands

**CC** John Piersol, Chris Neville

**FROM** Joel Henry, Greg Padusenko **EMAIL** gpadusenko@golder.com

### TW3-80 DRAWDOWN ANALYSIS

Withdrawals from well TW3-80 by Blue Triton Brands (Blue Triton) are authorized by Permit to Take Water (PTTW) number 3133-C5BUH9. Water levels have consistently been presented as hydrographs that simultaneously present up to five years of daily pumping data from TW3-80, daily precipitation, and daily water level data (Figure D1a in Annual Report). Because water levels at TW3-80 can vary up to 15 m each day, the TW3-80 hydrograph illustrates both the daily maximum and daily minimum levels rather than each hourly measurement. The hydrographs are effective for enabling a rapid, qualitative assessment of multiple years of data, graphically illustrating the degrees of daily, seasonal, and annual variability. Furthermore, long-term trends in aquifer capacity can be noted in the multi-year hydrographs, and the absence of clear declining trends in water levels is a significant line of evidence that the aquifer is being sustainably managed.

However, a qualitative review of the hydrographs is limited in its ability to support the interpretation of long-term trends, and to distinguish between potential causes of water level changes. The pumping rate of TW3-80 is the primary influence on the water level in TW3-80. Other factors such as aquifer recharge and nearby competing withdrawals also influence water levels, but the degrees to which they contribute to water level changes cannot be distinguished by visual inspection. The following analysis has been completed to quantitatively determine the degree to which TW3-80 pumping rates affect water levels at TW3-80.

### TW3-80 Annual Withdrawal Volumes

Annual water withdrawals from well TW3-80 increased each year from 2011 through 2016, before decreasing in 2017 through 2019. The water takings over the past three years are similar but have increased slightly over the three years. The water takings over the last three years (2019 through 2021) were similar to those between 2011 and 2013. The volumes of groundwater withdrawn from TW3-80 in each of the last eleven years are listed in Table 1.

**Table 1: Annual TW3-80 Withdrawal Volumes**

Year	Annual Volumes (litres)
2011	568,025,081
2012	583,823,567

Year	Annual Volumes (litres)
2013	600,537,587
2014	678,452,126
2015	762,363,664
2016	783,540,441
2017	767,883,336
2018	676,946,402
2019	565,941,910
2020	582,221,219
2021	597,402,783

To quantitatively demonstrate the degree to which the water levels are directly related to pumping rates, the following analysis evaluates the relationship between monthly pumping rates with monthly average water levels in TW3-80.

### Analysis

The TW3-80 transducer dataset extends from September 2005 through December 2021. Hourly water level measurements for the entire dataset were averaged each day and then assembled in monthly averages. Months in which fewer than 20 days of water levels were recorded, due to periodic data gaps related to transducer failure, are excluded from the analysis. Daily groundwater withdrawal data from TW3-80 are aggregated as monthly totals. The monthly averaged water levels are plotted against cumulative monthly pumping on Figure 1.

Figure 1 illustrates the inverse linear relationship between the monthly TW3-80 pumping rate, and the average monthly water levels in TW3-80. Based on a regression of 195 months of data, every 100 L/min increase in pumping results in a 0.62 m decline in water level. Most individual data points do not fall directly on the regressed line, meaning that variables other than the pumping rate influence the TW3-80 water level; however, 183 of the 195 data points (94%) are within 1 m of the expected water level, defined by the regression.

The regression goodness of fit ( $r^2$  statistic) may be used to assess the ability of the regression relation to explain the relationship between the pumping level and the pumping rate. The  $r^2$  value of 0.90 means that the monthly average pumping rate accounts for 90% of the variation in the monthly average TW3-80 water level. The 10% balance is understood to be caused by the other external variables, such as variations in vertical flow into the deep bedrock and other nearby groundwater withdrawals.

### Effect of Precipitation

It is very challenging to quantitatively describe the relationship between precipitation and aquifer water levels, as precipitation is not the same as recharge which in turn is not the same as flow into the Lower Bedrock Aquifer. The relationship between precipitation and aquifer recharge is seasonally variable, with most recharge occurring

in late winter and early spring, after the ground surface thaws and before plant transpiration becomes significant. The relationship between precipitation and aquifer recharge is not linear either, as unusually intense precipitation is likely to increase runoff, and not enhance recharge. Additionally, aquifer recharge (or the lack thereof during a drought) to the deep aquifer is not instantaneous, such that relating precipitation in a discrete month is unlikely to have a good correlation to the average water level in that same month.

However, the data illustrated on Figure 1 suggest that variations in aquifer recharge (and by extension, precipitation) have no greater than about +/-1 m effect on aquifer water levels. As stated, 183 of 195 data points in this regression are within +/-1 m of the regressed line. This means that even under drought conditions and significant precipitation deficits, the deep aquifer is affected by no greater than 1 m beyond what is predicted based only on the monthly pumping.

## Conclusions

Changes in groundwater withdrawals from TW3-80 account for 90% of the influence on changes in water levels measured at TW3-80. For each 100 L/min change in the monthly average pumping rate, water levels are predicted to change by 0.62 m. The effects of precipitation deficits that have been observed, affecting recharge volumes to the Lower Bedrock Aquifer, have been inferred to have no greater impact than about 1 m of additional decline on TW3-80 water levels.

**Golder Associates Ltd.**

JH/GRP/

Attachments: Figure 1

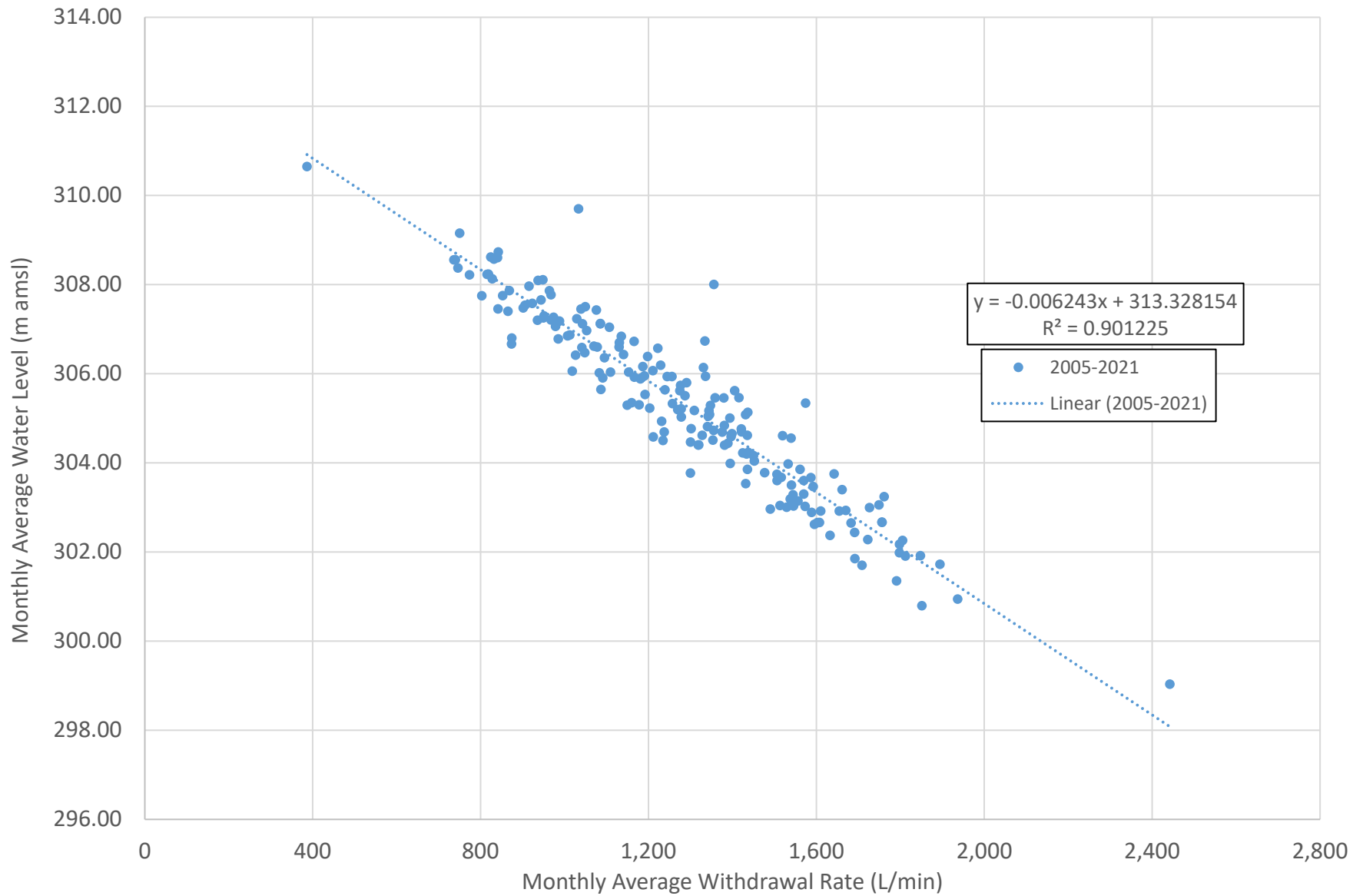
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**APPENDIX A**

**Figure 1**

Figure 1

Relationship between TW3-80 Withdrawal Rate and Water Level





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