REPORT

Nestlé Waters Canada Aberfoyle Site

2018 Annual Monitoring Report

Submitted to:

Nestlé Waters Canada
101 Brock Road South
Puslinch, Ontario
N0B 2J0

Submitted by:

Golder Associates Ltd.
210 Sheldon Drive, Cambridge, Ontario, N1T 1A8, Canada
+1 519 620 1222

13-1152-0250 (1000)

March 2019

Distribution List

2 Copies - Nestlé Waters Canada

1 e-copy - MECP

1 e-copy - Puslinch Township

1 e-copy - Golder Associates Ltd.

Key Facts for 2018 Operations at Aberfoyle

Key facts for the 2018 operations at Aberfoyle include:

1) Well TW3-80 continued to operate under the terms of Permit to Take Water 1381-95ATPY. Nestlé submitted an application for renewal of the permit to the Ministry of the Environment, Conservation and Parks (MECP), formerly the Ministry of the Environment and Climate Change (MOECC), in April 2016, prior to the expiration of the permit on July 31, 2016. In accordance with the Ontario Water Resources Act, Section 34.1 (6), Nestlé has continued to legally operate under the existing permit until a decision is made regarding the renewal of the permit.

2) No water was shipped in containers greater than 20 litres in 2018; therefore, per Condition 4.9 of the PTTW, Nestlé was not required to provide information on containerization and bulk shipping.

3) No complaints arising from the taking of water authorized under this PTTW were received in 2018.

4) The total precipitation in 2018 was about 12% below normal and approximately 15% lower than in 2017.

5) The total pumping from TW3-80 in 2018 amounted to approximately 52% of the permitted taking and was 12% lower than the total for 2017. No water was taken from TW2-11 in 2018.

6) The monthly water takings in 2018 from TW3-80 ranged from 36,833,502 L to 75,519,527 L, or from 34% to 68% of the permitted takings. The monthly takings never exceeded 83,700,000 L; therefore, per Condition 4.5 of the PTTW, no data from multi-level piezometers MP6, MP12, MP11 and MW2 were required to be submitted to the MECP during the year.

7) The variations in water levels in TW3-80 were due mainly to short-term changes in the pumping rate and were within the historical range of observed water levels. A rise in water levels at the end of the year corresponded with a decrease in the water taking over the same period. Consistent with data from previous years, in general, the water level trend in TW3-80 corresponds to the overall water taking from the well. Ongoing pumping from TW3-80 has not led to a long-term decline in water levels in the well.

8) Water levels measured within the Lower Bedrock Aquifer in 2018 were within the range measured over the past five years. The water levels in the wells closer to TW3-80 showed a similar trend to the water levels in TW3-80 (i.e., a response to pumping) with no long-term increasing or decreasing trend, while the water levels in the wells further away also have not shown an increasing or decreasing trend over the last five years.

9) Water levels measured in the Upper Bedrock Aquifer in 2018 were within the range measured over the past five years with no long-term increasing or decreasing trends. The spring water levels in 2018 were consistent with the higher water levels observed in the spring of 2014, 2016 and 2017. Water levels in the spring of 2015 did not peak as high as the other years.

10) Water levels measured in overburden monitoring wells in 2018 were within the range measured over the past five years, with no overall increasing or decreasing trend.

11) Water levels measured in the mini-piezometers in 2018 were within the range measured over the past five years with the exception of a few wells, where low water levels were observed during the summer months when dry conditions occurred.

12) Surface water levels in the creeks fluctuate in response to precipitation, snow melt and evapotranspiration with no measurable effects from pumping. The lowest water levels were observed in the creek at the downgradient end of the property (SW2) in 2018 when dry conditions occurred during the summer.

Table of Contents

1.0 INTRODUCTION 1

1.1 Historical Summary 2

1.2 Construction Details for Supply Well TW3-80 3

2.0 REGIONAL SETTING 3

2.1 Topography and Drainage 3

2.2 Physiography 4

2.3 Geology and Hydrogeology 4

2.3.1 Overburden Geology 4

2.3.2 Bedrock Geology 5

2.3.3 Hydrogeology 6

2.3.4 Groundwater Flow Under Non-Pumping Conditions 7

2.4 Source Water Protection 7

3.0 SUMMARY OF 2018 FIELD PROGRAM 8

3.1 Groundwater and Surface Water Monitoring Program 8

3.1.1 Water Taking 9

3.1.2 Groundwater Monitoring Program 9

3.1.2.1 Missing Data 10

3.1.3 Surface Water Monitoring Program 10

3.1.3.1 Missing Data 12

3.1.4 Notification Regarding Locations Which Become Inaccessible 14

3.2 Biological Monitoring 14

3.3 Surveying 14

3.4 Precipitation 14

4.0 MONITORING PROGRAM RESULTS 17

4.1 Water Taking for TW3-80 and TW2-11 17

4.2 Groundwater Monitoring Program 18

4.2.1 TW3-80 18

4.2.2 Lower Bedrock Aquifer....19
4.2.3 Middle Bedrock Aquitard....20
4.2.4 Upper Bedrock Aquifer....21
4.2.5 Overburden....22
4.2.6 Vertical Gradients....23
4.3 Surface Water Monitoring Program....24
4.3.1 Mini-Piezometer Water Levels....25
4.3.2 Surface Water Levels....27
4.3.3 Surface Water Flow....28
4.3.4 Surface Water Temperature....29
4.4 Biological Monitoring Program....30
5.0 CONCLUSIONS....30
6.0 RECOMMENDATIONS....31

TABLES

Table 1: Permit To Take Water Conditions....1
Table 2: Missing Groundwater Data from the 2018 Monitoring....10
Table 3: Missing Surface Water Data from the 2018 Monitoring....13
Table 4: Inaccessible Monitors....14
Table 5: Annual Precipitation....15
Table 6: Monthly Precipitation in 2018....16
Table 7: Permitted Water Takings at Aberfoyle....17

FIGURES

Figure 1.1: Site Location
Figure 1.2: Aberfoyle TW3-80 Schematic
Figure 2.1: Topography and Drainage
Figure 2.2: Regional Quaternary Geology
Figure 2.3: Regional Bedrock Geology
Figure 2.4: Hydrogeologic Cross-Section A-A'
Figure 2.5: Hydrogeologic Cross-Section B-B'
Figure 2.6: Overburden and Surface Water Elevations (Non-Pumping Condition)

Figure 2.7: Potentiometric Surface of Upper Bedrock Aquifer (Non-Pumping Condition)
Figure 2.8: Potentiometric Surface of Lower Bedrock Aquifer (Non-Pumping Condition)
Figure 3.1: 2018 Bedrock Monitoring Locations
Figure 3.2: 2018 Overburden Monitoring Locations
Figure 3.3: 2018 Surface Water Monitoring Locations
Figure 3.4: Unused or Decommissioned Wells
Figure 3.5: Well Locations
Figure 3.6: Historical Yearly Precipitation (2009 to 2018)
Figure 4.1: TW3-80 Annual Water Taking (2001 to 2018)
Figure 4.2: TW3-80 Monthly Water Taking (2014 to 2018)
Figure 4.3: Potentiometric Surface of Lower Bedrock Aquifer (July 2018)
Figure 4.4: Potentiometric Surface of Upper Bedrock Aquifer (July 2018)
Figure 4.5: Potentiometric Surface of Overburden (July 2018)
Figure 4.6: Surface Water Elevations

APPENDICES

APPENDIX A
Permit To Take Water Number 1381-95ATPY

APPENDIX B
TW3-80 Borehole Log

APPENDIX C
TW3-80 Water Taking

APPENDIX D
Groundwater Level Monitoring

APPENDIX E
Surface Water Level Monitoring

APPENDIX F
Surface Water Flow Monitoring

APPENDIX G
Stream Temperature Monitoring

APPENDIX H
Biological Monitoring

APPENDIX I
Technical Memorandum: Estimation of Infiltration and TW3-80 Drawdown Analysis

APPENDIX J
Letters to MECP

1.0 INTRODUCTION

Nestlé Waters Canada (Nestlé) has retained Golder Associates Ltd. (Golder) to conduct the annual monitoring program and report preparation for the Nestlé Aberfoyle Site as required by Amended Permit To Take Water (PTTW) Number 1381-95ATPY issued by the Ministry of the Environment, Conservation and Parks (MECP), formerly the Ministry of the Environment and Climate Change (MOECC). The PTTW is included in Appendix A. The current PTTW was issued on December 19, 2013. The PTTW renewal application was submitted to the MECP in April 2016. The current PTTW expired on July 31, 2016, but in accordance with the Ontario Water Resources Act Section 34.1 (6), Nestlé can continue to legally operate TW3-80 under the terms of the existing PTTW until a decision is made regarding the renewal.

The location of the Aberfoyle Spring/Plant (Site) is shown on Figure 1.1. The PTTW authorizes water taking from two on-Site bedrock wells 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. Although it has not been used, water from TW2-11 is permitted for taking for miscellaneous purposes such as providing water to the on-Site pond for firefighting purposes.

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, 3.3, 3.4	Identifies use, rates, time and total takings allowed.	3.1.1, 4.1, Appendix C
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, 4.6	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
4.5	If monthly water takings exceed 83,700,000 L, then multi-level piezometer data for selected wells must be submitted to the Director within 30 days of the end of the calendar month.	4.1
4.7	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
4.8	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
4.9	Submit details of the bottling operations to the Director.	4.1

Condition Number	Condition Description	Report Section
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. Prior to that, monitoring was performed by Conestoga Rovers and Associates (CRA) and Nestlé. The MECP has requested that the reporting follow the same outline and presentation 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 was insufficient data to update to the new nomenclature. As such, the bedrock has been divided into three units based on both the old and new nomenclature including Upper Bedrock Aquifer, Middle Bedrock Aquitard and Lower Bedrock Aquifer (as described in detail below). Additional reporting is also being prepared separately to satisfy the new hydrogeological study requirements (MECP, 2017) issued since the submission of the application for renewal of the PTTW.

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, physiography, geology and hydrogeology.
- Section 3.0: Summary of 2018 field program including a description of field activities conducted in 2018.
- Section 4.0: Monitoring program results including a summary and analysis of the data collected in 2018.
- Section 5.0: Conclusions from the 2018 monitoring program.
- Section 6.0: Recommendations from the 2018 monitoring program.

1.1 Historical Summary

TW3-80 was constructed in April 1980 for a proposed fish farming operation. In December 2000, the Perrier Group of America, a Nestlé Company, purchased the property. Six consecutive PTTWs have been issued for TW3-80 since that time, allowing for water taking for bottling water purposes. Additional investigations have occurred over the years to determine if there have been any negative impacts on the natural environment and ensure that the water taking by Nestlé is sustainable. These additional investigations have been requirements of previous permits and have been completed to the satisfaction of the MECP. No additional studies were required in 2018.

Most recently, PTTW Number 1381-95ATPY was issued in December 2013, which also allows for water taking from TW2-11 for miscellaneous purposes (such as providing water to the on-Site pond for firefighting purposes) but not bottling water. The combined water taking from TW3-80 and TW2-11 is restricted to 3,600,000 L per day.

The Aberfoyle bottling facility is located on a 46.75 hectare parcel owned by Nestlé 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.

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 clayey silt till to a depth of 12.2 m below ground surface, and 2.4 m of fine-to-medium sand overlying the bedrock. The well was originally drilled an additional 27.8 m into the bedrock, completed at a depth of 42.4 m below ground surface.

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 below ground surface) and the Amabel Formation (Eramosa Member and Unsubdivided Member) (16.8 to 42.4 m below ground surface). 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 below ground surface 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 and Goat Island/Gasport Formations. The revised finished depth is now 31.1 m below ground surface.

To comply with Nestlé 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 below ground surface. The revised open interval of TW3-80 is now 28.4 m to 31.1 m below ground surface 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 Nestlé 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 Nestlé property, ground surface elevations typically range from 310 to 330 metres above sea level (masl) with the lows occurring along Aberfoyle Creek and Mill Creek. The streambed elevation of the portion of Aberfoyle Creek that traverses Nestlé’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 Nestlé 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 Nestlé 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 Nestlé property. One such pond, referred to as the Aberfoyle Mill Pond, is located east of the Site and discharges water to Aberfoyle Creek. Some small on-Site ponds exist on the Nestlé property. Most of the other ponds in the area appear to be man-made and are off-stream ponds (i.e., not connected to streams). Some of the ponds are the result of aggregate extraction below the water table.

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

2.2 Physiography

Chapman and Putnam (1984) define this physiographic region 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 Nestlé 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.

2.3 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).

2.3.1 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

- 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. Occasional subsurface 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.

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.

2.3.2 Bedrock Geology

The bedrock surface is somewhat irregular, but generally dips to the southwest. The bedrock elevation in the vicinity of the Nestlé 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 over recent years (Brunton, 2008 and 2009, Brunton and Brintnell, 2011). In general, the previously named Guelph Formation is now split into the Guelph Formation and the Eramosa Formation (Stone Road Member and Reformatory Quarry Member); the previously named Amabel Formation (Eramosa Member) is now the Eramosa Formation (Vinemount Member); and the previously named Amabel Formation (Unsubdivided Member) is split into the Goat Island, Gasport and Irondequoit Formations. The bedrock hydrogeologic units underlying the property, which are relevant to the Nestlé water taking, are composed of limestone, dolostone and shale sequences and are summarized 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. Where test data are available in southern Ontario, the hydraulic conductivity of the Cabot Head Formation has been shown to be low. 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 in previous studies in the area (Turner, 1978). Wells in the vicinity of the Nestlé property are generally not drilled through the entire sequence. In and around the City of Guelph, the Formation generally 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.

  - **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 Eramosa Formation above the Vinemount 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.

  - **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.

2.3.3 Hydrogeology

The interpretation and nomenclature for the bedrock formations has recently changed (as indicated above); however, the interpretation of the hydrostratigraphy at the property and surrounding area is relatively unchanged.

This is a simplification of the hydrostratigraphy for conceptual purposes. In reality, portions of the bedrock aquifers can act as aquitards. 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
- Lower Bedrock Aquifer (Goat Island Formation and Gasport Formation).

Two 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. Hydrogeologic 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.

2.3.4 Groundwater Flow Under Non-Pumping Conditions

In addition to the pumping tests, there are sometimes brief shutdowns when water levels in the aquifers recover. One such shutdown occurred in October 2010 for 3.4 days. Based on data from this shutdown, CRA (2014) provided an interpretation of the non-pumping conditions in the overburden and bedrock groundwater levels, as discussed below:

- 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 is similar to the pattern previously presented for the 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 previously presented for the October 2004 and November 2006 shutdowns.
- 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 previously presented for the October 2004 and November 2006 shutdowns.

The overburden 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. Groundwater flows generally south in the direction of TW3-80. The bedrock aquifer extends beyond Aberfoyle to the southwest, and is inferred to discharge to the Grand River in the vicinity of Cambridge.

2.4 Source Water Protection

With the passing of the Clean Water Act (2006), municipalities in Ontario are required to develop source protection plans to protect their municipal sources of drinking water. These plans identify 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 reflects the zone in an aquifer where groundwater is flowing to a municipal drinking water source (pumping well). The WHPAs that are nearest the Nestlé Aberfoyle property and well TW3-80 are associated with the City of Guelph wells to the northwest (AquaResource Inc., 2010; Lake Erie Source Protection Committee, 2015) and the Freelton well, southeast and east in the Lake Ontario Basin (Halton-Hamilton Source Protection Region, 2015). The Aberfoyle property and well TW3-80 are located more than 2.6 km from the closest WHPAs.

In addition to protecting water quality, water quantity is also a concern and is considered under Water Quantity Protection Plans. The Water Quantity assessment is completed to ensure that future water needs of a community can be met. It identifies existing water quantity threats and future activities that may limit the supplies for municipal water supplies. Based on the results of modeling conducted for the Tier Three Water Budget Study, the Aberfoyle property has been identified as lying 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 future needs under normal climate conditions and during prolonged drought (Matrix Solutions, 2017) which triggers a significant risk level. There is also a high level of uncertainty with the results for the City's Arkell Well 1, which also triggers a significant risk level. It is for these reasons that the City's WHPA-Q is assigned a significant risk level. 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, to any significant degree, with the municipal wells (Matrix, 2018). TW3-80 is estimated to be responsible for 1% of the drawdown at the closest municipal well (Burke Well). With a drawdown in the order of approximately 10.8 m at the Burke Well, pumping from TW3-80 would be responsible for approximately 0.1 m of the drawdown observed at the Burke Well. The Water Quantity assessment was completed using the Guelph Tier 3 Model. Recent work completed as part of the Technical Study in support of the PTTW renewal indicates that a decline of 0.02 m in the average water level at the Burke Well is predicted when pumping at the Nestlé well is increased to the current permitted maximum.

3.0 SUMMARY OF 2018 FIELD PROGRAM

This section describes the field activities performed in 2018 associated with PTTW Number 1381-95ATPY (for TW3-80 and TW2-11).

3.1 Groundwater and Surface Water Monitoring Program

The field activities included completion of a monitoring program including maintaining a record of water taking and measurement of groundwater levels, mini-piezometer levels, surface water levels, flows and temperatures. Monitoring events were conducted during the third week of each month by Golder. The monitoring program includes the following instrumentation:

- Groundwater levels and pumping volumes in 2 production wells;
- Groundwater levels in 38 monitoring wells at 16 sites (11 consisting of multiple monitoring intervals) with monitors in deep bedrock, shallow bedrock, and overburden;
- Groundwater levels in 11 private wells;

- Shallow groundwater levels in 9 mini-piezometers with a total of 18 monitors;
- Surface water levels at 7 stations;
- Stream flows at 2 locations; and
- Stream temperature at 6 locations.

The monitoring locations are shown on Figures 3.1 through 3.3.

3.1.1 Water Taking

Water taking from TW3-80 in 2018 was measured using a Krohne magnetic flow meter that is wired to an Allen Bradley industrial Programmable Logic Controller. The instantaneous flow (USgpm) and cumulative volume pumped (US gallons) were recorded. The flow meter was calibrated on November 5, 2018 by Endress+Hauser.

The daily volumes taken from supply well TW3-80 in 2018 are provided in Appendix C. No water was taken from TW2-11 in 2018.

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, one owner requested that monitoring be discontinued at their well and a surface water station was destroyed (see Section 3.1.4). Previous wells that have been decommissioned or are no longer part of the monitoring program are shown on Figure 3.4. All of the existing monitoring locations and the decommissioned or unused wells are shown on Figure 3.5.

The monitoring locations for the 2018 groundwater monitoring program are shown on Figures 3.1 and 3.2 and are summarized as follows:

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, MW14C-11, MW15B-12, MW16B-12, MW17B-12, MW18B-12, MW-D, MW-I, PCC-D, 8 MLL (67-08317), 2 Brock Road North, 58 Brock Road South, 7404 Road 34 (67-07589), Y well

Middle Bedrock Aquitard Monitors

- MW2B-07, MW14B-11, I (67-07389)

Lower Bedrock Aquifer Monitors

- TW3-80 (Production Well), TW2-11, MW2A-07, MW4A-07, MW6A-08, MW7A-08, MW8A-08, MW10C-09, MW10D-09, MW14A-11, MW15A-12, MW16A-12, MW17A-12, MW18A-12, Fireflow, B (67-07383), M1 (67-13755), PW5 Meadows of Aberfoyle (67-1197), 67-08740, W2 (67-13335)

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. It should be noted that none of the wells that Nestlé owns are open across multiple aquifer units.

Water levels were measured and dataloggers downloaded at all locations during the third week of each month. Where required by the PTTW, dataloggers are used to record water levels at 60-minute intervals. The groundwater levels measured in 2018 are presented in Appendix D.

3.1.2.1 Missing Data

The following table provides a list and description of missing data from the 2018 groundwater monitoring. Transducer dataloggers occasionally stop working and need to be replaced. When a transducer stops working, it is replaced with a new transducer. Transducer data can be missing for up to one month depending on when the failure occurs between monitoring events. In some wells (e.g., PCC), the water level is close to surface and can become frozen in the winter. The issues were temporary and have been resolved.

Table 2: Missing Groundwater Data from the 2018 Monitoring

Monitoring Location	Missing Data	Comment
MW14A-11	Transducer water levels between the November and December monitoring events	Transducer issue (failure)
PCC-S	Manual water level in January and February	Frozen
PCC-D	Manual water level in January, February and March	Frozen

3.1.3 Surface Water Monitoring Program

The surface water monitoring program includes the following components:

- Surface water levels;
- Stream flow;
- Water levels in nested mini-piezometers; and
- Temperature at the sediment-water interface.

The 2018 surface water monitoring locations are shown on Figure 3.3 and summarized below.

Surface Water Levels

Measurement of surface water levels was initiated in December 2001 as part of Nestlé's monthly monitoring program. In 2018, surface water levels were measured at the following locations:

- Aberfoyle Creek:
  - SW1 - located within the upstream part of the Nestlé property;
  - SW2 - located within the downstream part of the Nestlé 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 Nestlé property.
- Ponds:
  - SW9 - located in the Dufferin Aggregates owned pond located southeast of the Nestlé property; and
  - SW10 - located in the Dufferin Aggregates owned pond at the entrance to the Nestlé property.

Water levels were 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 2018 are presented in Appendix E.

Stream Flow

Measurement of surface water flow was initiated in December 2001 as part of Nestlé's monthly monitoring program. Surface water flow was measured at SW1 (upstream part of Nestlé property) and SW2 (downstream part of Nestlé property) in Aberfoyle Creek during the third week of each month in 2018. Stream flows are measured at SW1 and SW2 to confirm that pumping from TW3-80 does not cause local effect on streams. Stream flow velocities were measured using a Valeport electromagnetic flow meter and the surface water flows were calculated using the cross-sectional area-velocity method. The surface water flow calculations for 2018 are presented in Appendix F.

In addition, the monthly surface water elevations ("stage") and stream flow measurements ("discharge") collected in 2018 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 2018, water levels were measured in mini-piezometers at ten locations, each containing a shallow and a deep monitor (see locations on Figure 3.3). For background purposes, one mini-piezometer nest (MP11S-08/D-04) has been installed in the bank, adjacent to a tributary of Aberfoyle Creek upstream of the Nestlé property. Due to concerns with the location of MP11 (see Section 4.3.1), a new mini-piezometer nest (MP1-16) was installed in April 2016 in the main branch of Aberfoyle Creek near SW3 at Gilmour Road. The mini-piezometer nests are listed below. Mini-piezometer nests MP16S/D-08 to MP19S/D-12 are located along Aberfoyle Creek on the Nestlé property. Mini-piezometer nests MP17S/D-11 and MP18S/D-11 are located along Mill Creek downstream of its confluence with Aberfoyle Creek.

- MP11S-08/D-04

- MP16S/D-08
- MP6S-08/D-04
- MP12S/D-04
- MP14S/D-07
- MP8S/D-04
- MP19S/D-12
- MP17S/D-11
- MP18S/D-11

Water levels were measured and dataloggers downloaded at all locations during the third week of each month. Dataloggers are used to record water levels at 60-minute intervals. The water levels measured in 2018 are presented in Appendix E.

Temperature

Measurement of surface water temperature began in 2005. In 2018, 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 Nestlé 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
- 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 with a Stowaway Tidbit® datalogger.

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 MOECC 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 is 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 2018 surface water monitoring. Some of the missing data is due to winter conditions. The water levels in the mini-piezometers are close to surface and can become frozen in the winter. Slow moving water can also become frozen in the winter. Transducer dataloggers occasionally stop working and need to be replaced. When a transducer stops working, it is replaced with a new transducer. Transducer data can be missing for up to one month depending on when the failure occurs between monitoring events. The issues were temporary and have been resolved.

Table 3: Missing Surface Water Data from the 2018 Monitoring

Monitoring Location	Missing Data	Comment
MP1S/D-16 (not part of PTTW)	Not missing but frozen	Frozen in January, February (D only), March (D only), April (D only) and November
MP6S-08/D-04	Not missing but frozen	Frozen in January and November (D only)
MP6S-08	Transducer water levels between the June and July monitoring events	Transducer issue (failure)
MP8S/D-04	Not missing but frozen	Frozen in January
MP11S-08/D-04	Not missing but frozen	Frozen in January, March (D only) and November (D only)
MP11S-08	Transducer water levels in March were erroneous	Transducer issue
MP12S/D-04	Not missing but frozen	Frozen in January, March (D only) and November (D only)
MP14S/D-07	Not missing but frozen	Frozen in January, February (D only), March and November (D only)
MP16S/D-08	Not missing but frozen	Frozen in January and November
MP17S/D-11	Not missing but frozen	Frozen in January
MP18S/D-11	Not missing but frozen	Frozen in January and February (D only)
MP19S/D-12	Not missing but frozen	Frozen in January and March
SW1	Not missing but frozen	Frozen in January
SW1	Transducer water levels between the November and December monitoring events	Transducer issue (failure)
SW2	Not missing but frozen	Frozen in January and March
SW2	Transducer water levels between the October and November monitoring events	Transducer issue (failure)

Monitoring Location	Missing Data	Comment
SW4	Not missing but frozen	Frozen in January
SW9	Not missing but frozen	Frozen in January
SW10	Not missing but frozen	Frozen in January, March and November

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	Recommendation	Documented in Letter to MECP (Appendix J)
SW9	Destroyed in April 2018 when part of pond was filled in	No additional surface water stations to be monitored in place of SW9	April 30, 2018
W2	In August 2018, the owner 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 Nestlé Waters Canada Aberfoyle property in 2018 was completed in accordance with the requirements of the PTTW for the site and under the guidance of recommendations provided in the 2017 Biological Monitoring Report (Beacon Environmental and C. Portt and Associates, 2018). Monitoring of terrestrial resources (vegetation and wildlife) was completed by Beacon Environmental and monitoring of aquatic resources (salmonid spawning along reaches of Aberfoyle Creek) was completed by C. Portt and Associates. The findings of the 2018 Biological Monitoring Program are presented in the 2018 Biological Monitoring Program Report (Beacon Environmental and C. Portt and Associates, 2019) which is included in Appendix H.

3.3 Surveying

No surveying needed to be conducted in 2018.

3.4 Precipitation

In 2017, Nestlé 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 Nestlé 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). An independent soil water balance analysis has been conducted to estimate the annual average infiltration over the region surrounding TW3-80. The SWB code of the United States Geological Survey has been applied (Westenbroek et al., 2010) with the 11-year record of precipitation data compiled for the Annual Monitoring Report. The results of the analysis suggest that the annual average infiltration is about 20% of the annual precipitation. The findings are summarized in a technical memorandum included in Appendix I.

In 2018, precipitation data were obtained from Environment Canada from the Kitchener/Waterloo (KW) Station. Environment Canada indicates that the KW station is an automated Nav Canada station that reports total daily precipitation over the entire year. When data are missing from the station, the gap is filled in using data from the Roseville or Elora RCS meteorological stations. Precipitation records were also previously obtained from the Waterloo Wellington Station; however, precipitation has not been recorded at the station since April 2017. Environment Canada does not calculate 30-year climate normal for the Kitchener Waterloo Station and as such the 30-year climate normal from the Waterloo Wellington Station continue to be used for comparison.

The following table provides a summary of the annual precipitation. The annual 30-year average (1981-2010) precipitation from the Waterloo Wellington Station (closest station to the KW station with 30-year average data) is 916.5 mm. The total precipitation measured in 2018 was 807.1 mm, which is 11.9% below the average. Declines of more than 10% below average precipitation were observed in 2012, 2015 and 2018. Increases of more than 10% above average precipitation were observed in 2008, 2011 and 2013. Following a couple years of near-normal precipitation, the total precipitation in 2018 was about 12% below average (the total precipitation in 2018 was about 15% lower than in 2017). Annual precipitation is also shown graphically on Figure 3.6 along with the 30-year average.

Table 5: Annual Precipitation

Year	Precipitation (mm)	% Difference from Average
2008	1304.7	42.3
2009	964.9	5.3
2010	833.1	-9.1
2011	1081	17.9
2012	770.6	-15.9
2013	1088.6	18.8

Year	Precipitation (mm)	% Difference from Average
2014	973.8	6.3
2015	795.8	-13.2
2016	931.9	1.7
2017	949.4	3.6
2018	807.1	-11.9
Average (1981-2010)	916.5	

The monthly precipitation for 2018 is included in Table 6. Below-average precipitation was recorded in 9 of the 12 months in 2018.

Table 6: Monthly Precipitation in 2018

Month	Precipitation (mm)	Average (mm)	% Difference from Average
January	59.8	65.2	-8.3
February	78.7	54.9	43.4
March	29.3	61.0	-52.0
April	96.9	74.5	30.1
May	72.3	82.3	-12.2
June	59.4	82.4	-27.9
July	72.0	98.6	-27.0
August	92.3	83.9	10.0
September	61.1	87.8	-30.4
October	54.4	67.4	-19.3
November	71.7	87.1	-17.7
December	59.2	71.2	-16.9

4.0 MONITORING PROGRAM RESULTS

4.1 Water Taking for TW3-80 and TW2-11

Water taking at the Nestlé Aberfoyle Site in 2018 continues to be governed by PTTW 1381-95ATPY, which permits water to be taken from two wells 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/day	365
TW2-11	475 L/min	24	684,000 L/day	365
Total			3,600,000 L/day	

The daily water taking at TW3-80 ranged from 0 L to 2,808,648 L. The maximum daily taking of 2,808,648 L corresponds to 78% of the maximum permitted taking. The average daily taking was 1,854,648 L/day. The daily water takings for 2018 are tabulated in Table C1 in Appendix C.

The total volume of water taken in 2018 from TW3-80 was 676,946,402 L. The total volume of water taken each year from 2001 to 2018 is presented on Figure 4.1. In 2018, the total volume taken was approximately 52% of the permitted volume. Since 2002, the groundwater taking has ranged from approximately 43% to 67% of the permitted taking. The total pumping from TW3-80 in 2018, was 12% lower than the total reported for 2017 (767,883,336 L).

The monthly water takings in 2018 from TW3-80 ranged from 36,833,502 L or 34% of permitted taking in November to 75,519,527 L or 68% of the permitted taking in July. The monthly water takings for the past 5 years are presented on Figure 4.2. In 2018, the monthly water takings generally increased during the first half of the year, with the peak water taking in July, and then decreased during the remainder of the year. Water takings during the last four months of the year were less than the water takings during the first eight months of the year and some of the lowest over the past five years.

During 2018, the daily takings and instantaneous flow rates were below the limits of the PTTW (i.e., less than 3,600,000 L/day and 2,500 L/min).

The Grand River Low Water Response Team declared a Level 1 Low Water Condition for the entire Grand River Watershed, including Mill Creek, on July 12, 2018. The Level 1 Low Water Condition was removed on September 13, 2018. Nestlé Waters Canada 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. Nestlé's water takings were below 80% of the permitted daily amount during the low water condition.

Condition 4.5 of the PTTW indicates that if the monthly amount of water taken exceeds 83,700,000 L, then multi-level piezometer (MP6, MP12, MP11 and MW2) data shall be submitted to the MECP. The monthly threshold of 83,700,000 L represents 75% of the permitted monthly water taking, based on a 31-day month. As shown on Figure

4.2, the monthly water takings in 2018 were less than the 83,700,000 L threshold, and therefore no multi-level piezometer data were submitted to the MECP during the year.

No water was taken from TW2-11 in 2018.

Condition 4.9 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. Nestlé has indicated that no water was shipped in bulk (container greater than 20 litres) in 2018.

As per Condition 5.1, Nestlé has indicated that no complaints arising from the taking of water authorized under this PTTW were received in 2018.

4.2 Groundwater Monitoring Program

The groundwater levels measured manually in 2018 at the monitoring wells are tabulated in Table D1 in Appendix D. Hydrographs prepared using both manual measurements and transducer data are also provided in Appendix D. The hydrographs include the daily pumping volumes at TW3-80 and daily precipitation as recorded at the Waterloo Wellington or Kitchener Waterloo meteorological stations prior to April 2017 and from the Kitchener Waterloo station after April 2017 (as described in Section 3.4, with missing data filled in from other nearby stations).

4.2.1 TW3-80

Water levels and average daily pumping rates for TW3-80, along with daily precipitation, from 2014 through 2018 are shown on Figure D1a (Appendix D).

Water levels measured in 2018 at TW3-80 range from approximately 299.5 to 312.0 masl (or approximately 16.9 to 4.4 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 average water levels at TW3-80 versus average pumping at TW3-80 was undertaken to assess how pumping 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. 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 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 2018 range from approximately 308 to 312 masl. The water levels are similar to the non-pumping water levels observed over the past three years (2015 through 2017). 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. 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 pumping levels in 2018 range from approximately 299.5 to 305.5 masl. Based on a static water level of 313 masl, the estimated drawdown at the well in 2018 range from approximately 7.5 to 13.5 m. CRA (2014) indicates that 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 approximately 292.3 masl). The drawdown in TW3-80 decreased from September onward when daily pumping was reduced (with some of the highest pumping levels observed over the past five years).

The water taking from TW3-80 in 2018 was slightly lower than the water takings from the previous three years (2015 – 2017) but similar to the water taking in 2014. The water levels in the pumping well follow similar trends over the same period (Figure D1a) with water levels at the end of 2018 similar to those observed at the beginning of 2014. The lower water levels from 2015 through 2017 are due to an increase in pumping over the same time. In general, the water level trend in TW3-80 corresponds to 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)). This relationship is shown on Figure D1b, which shows average monthly water levels, monthly pumping volumes and monthly precipitation. 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 levels (i.e., the on-going water taking is sustainable).

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 20, 2018 monthly monitoring event. This represents a time when the highest pumping volumes were recorded at TW3-80 and monthly precipitation had been below normal for approximately three months. A review of the potentiometric surface on July 20, 2018, 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 resume back to the regional southerly flow pattern approximately 1.5 km south of the Site. It should be noted that a regional scale interpretation of groundwater elevations is being developed as part of the on-going modelling for the technical study report in support of the PTTW renewal application.

Hydrographs for wells completed in the Lower Bedrock Aquifer are included on Figures D2 through D18 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 represent an "average" water level and do not provide a reliable measure of water levels specific for any of the individual aquifer units across which the well is open.

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

General Summary

- Water levels measured within this aquifer in 2018 are within the range measured over the past five years.
- There are two general long-term trends in the water levels based on distance away from the pumping well. The long-term water level trend in the monitoring wells closer to TW3-80 show higher water levels at the beginning of 2014 and the end of 2018, with lower water levels in the period between. This is consistent with the annual pumping trend over the same five-year period, which recorded lower pumping volumes in 2014 and 2018. The second trend is observed in the monitoring wells further away TW3-80; there is no increasing or decreasing trend over the last five years.
- The lowest water levels typically occur through the summer months when pumping volumes are higher. The summer water levels observed in 2018 are similar to those observed in 2016.

- Water levels in the Lower Bedrock Aquifer are influenced by pumping of TW3-80 over the short-term and long-term. The short-term pumping effects are evident with the water levels fluctuating in response to daily changes in pumping rates. The long-term pumping effects are observed more in the wells closer to TW3-80 where water level changes from year to year correlate with overall annual water taking (i.e., increased water takings result in lower water levels). During lower pumping periods, the water levels recover with no long-term increasing or decreasing trends.
- There may also be some correlation with recharge. During the spring, the water levels in some wells (MW6A-08, MW8A-08, MW10C/D 09, MW15A-12 and MW16A-12) are on a stable trend while pumping is increasing.

Detailed Summary

- The monitoring well closest to TW3-80 in the same aquifer is MW2A-07, located approximately 150 m northwest of TW3-80 by Aberfoyle Creek. In 2018, the difference between the daily high and low water levels at MW2A-07 ranged from 0.1 m to 5.6 m (short-term) with an average difference of 2.0 m, similar to previous years. There was approximately 3 m of fluctuation in the daily high-water levels over the year. For comparison, wells located further away (upgradient - MW6A-08, MW8A-08, MW10C-09 and MW10D-09; downgradient - MW15A-12, MW16A-12 and MW17A-12 (see Figure 3.1 for locations)) showed only minor differences between high and low water levels and approximately 0.5 to 1.2 m of fluctuation over the year. Some of the fluctuation over the year at MW2A-07 is due to pumping variations at TW3-80.
- There appears to be a stronger hydraulic connection between TW3-80 and MW7A-08 (located approximately 1,050 m north of 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). This may also indicate 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.

4.2.3 Middle Bedrock Aquitard

Hydrographs for wells completed in the Middle Bedrock Aquitard are included on Figure D19 in Appendix D. This unit is generally considered an aquitard in area. Three wells are monitored within this unit, including one private well (“I”). The two monitoring wells (MW2B-07 and MW14B-11) are sealed within the Middle Bedrock Aquitard but, like other private wells, “I” 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 is not representative of Middle Bedrock Aquitard conditions.

The results of a review of the hydrographs of wells completed in the Middle Bedrock Aquitard, specifically with continuous water level data from dataloggers, are summarized below:

General Summary

- Water levels measured within this aquitard in 2018 are similar and within the range of water levels measured over the past five years with the exception of some high-water levels at the “I” well in September and October.
- 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 and non-

pumping. 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.

- The water levels in MW14B-11 follow a similar trend to the water levels in the Upper Bedrock Aquifer from year to year and show some response to pumping at TW3-80. Furthermore, the fluctuations have a different frequency than those of MW14A-11, suggesting that the water level fluctuations are caused by variations in barometric pressure and not changes in the TW3-80 pumping rate. The well was previously considered to be within the Eramosa Aquitard, but is actually within the Reformatory Quarry Member of the Eramosa Formation which is included as part of the Upper Bedrock Aquifer. [In future annual reports, this well should be considered within the Upper Bedrock Aquifer].
- There is also some correlation with recharge during the spring melt, specifically at MW14B-11. During the spring, the water levels are on a rising trend while pumping is also increasing, indicating that recharge has more of an effect than pumping during this period of time.
- Continuous water level data are not available for "I", so it is not obvious that the responses to pumping are similar but the absolute water levels suggest that the well may respond as a Lower Bedrock Aquifer monitoring well.

Detailed Summary

- A review of water levels in the closest monitoring well (MW2B-07) to TW3-80, indicates that the difference between the daily high and low water levels at MW2B-07 ranged from 0 m to 4.2 m (short-term) with an average difference of 1.5 m. There was less than 3 m of fluctuation in the daily high-water levels over the year. This is somewhat dampened relative to water levels in the Lower Bedrock Aquifer at this location (MW2A-07) where high to low water levels vary by an average of 2 m and fluctuate over the year by 3 m. For comparison, MW14B-11 (located approximately 750 m northwest of TW3-80) showed only minor difference between high and low water levels and approximately 1 m of fluctuation over the year in 2018. Most of the fluctuation over the year at MW2B-07 is due to pumping variations.

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 20, 2018 monthly monitoring event. This represents a time when the highest pumping volumes were recorded at TW3-80 (i.e., during the month of July) and monthly precipitation was below normal. A review of the potentiometric surface on July 20, 2018, 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 D20 through D30 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.

General Summary

- Water levels measured in the Upper Bedrock Aquifer in 2018 are within the ranges measured over the past five years with high water levels observed in the spring. The high-water levels occurring in the spring are similar to those in the spring of 2014, 2016 and 2017. Water levels generally rose during the first half of the year and then there are two different trends during the second half of the year. The water levels in the monitoring wells upgradient of TW3-80 increased during this time period, which coincides with the decrease in pumping volume. The water levels in the wells downgradient of TW3-80 generally decreased and then stabilized during the during the second half of the year.

- 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 amount of influence varies based on distance from TW3-80 and existing hydrogeologic conditions (i.e., complexity in the subsurface and changes in permeability). 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.
- While there is an influence on water levels in the Upper Bedrock Aquifer from pumping TW3-80, there is also a long-term water level trend that is reflective of recharge (i.e., lower water levels during years of below normal precipitation and higher water levels during years of above normal precipitation).
- There are also seasonal influences observed in the water levels in the Upper Bedrock Aquifer. For example, there is a rise in water levels measured in the wells within the Upper Bedrock Aquifer in the spring that is not due to changes in pumping at TW3-80 but due to spring recharge. This indicates that recharge to the aquifer has more of an effect than pumping during this period of time (i.e., the changes in water level are more reflective of the wet spring/dry summer and fall compared to the total pumping). There are also short-term fluctuations in water levels that reflect changes in barometric pressure.

Detailed Summary

- In 2018, the water levels in well MW2C-07 (closest well to TW3-80 in the Upper Bedrock Aquifer) had a difference of 0 m to 1.2 m (short-term) between the daily high and low water levels at and an average difference of 0.4 m, which is less than previous years. This may be due to the difference in well operation (i.e., the wells are now operated on a more continuous basis). There was less than 1 m of fluctuation in the daily high-water levels over the year. This is somewhat dampened relative to water levels in the Lower Bedrock Aquifer at this location (MW2A-07) where the daily high to low water levels vary by an average of 2 m and fluctuate over the year by 3 m.
- Wells located further away from TW3-80 (upgradient – MW6B-08, MW8B-08 and MW10B-09; downgradient – MW15B-12, MW16B-12 and MW17B-12 (see Figure 3.1 for locations)) showed only a minor difference between high and low water levels and less than 1 m of fluctuation over the year, similar to previous years.
- 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 a complexity in the subsurface.

4.2.5 Overburden

The potentiometric surface of the overburden is also plotted (Figure 4.5) based on water levels measured on July 20, 2018, during the month of highest pumping. A review of the potentiometric surface on July 20, 2018, indicates that groundwater flow is generally in a south to southwest 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 topographic changes and interactions with surface features.

Hydrographs for wells completed in the overburden are included on Figures D31 through D35 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.

General Summary

- Water levels measured within the overburden in 2018 are within the ranges measured over the past five years, with no significant overall increasing or decreasing trend. Overall the water levels are slightly higher in 2017 and 2018 following 2016 when a Level 2 Low Water Condition was in effect over the entire Grand River watershed. The water levels in some of the wells are more influenced by total precipitation.
- Water levels in the overburden fluctuated by 0.7 to 1.3 m in 2018. A rise in water levels during the winter was observed. Water levels declined into the summer and then increased again in the fall.
- Water levels in the overburden are affected both by natural events (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 Lower Bedrock Aquifer and appears to be less than 0.2 m under daily pumping changes and less than 1 m over the year in nearby monitoring wells (i.e., MW2D/E-07 approximately 150 m northwest of TW3-80).

4.2.6 Vertical Gradients

Vertical gradients between the Lower Bedrock Aquifer and the Upper Bedrock Aquifer are plotted on Figures D36 through D46 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, a dampened response in the Upper Bedrock Aquifer relative to the response in the Lower Bedrock Aquifer is evident based on a review of the graphs for the multi-level monitoring well locations. 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. In October, there is a brief period when the gradient is reversed coinciding with reduced pumping. The positive gradient has been similar over the past four years with a slight increase since 2014;
- MW4A/C-07 – positive gradient (potential downward flow) that increases with increased pumping. Gradients have been similar over the past four years with a slight increase since 2014 due to increased pumping. The gradients at the end of 2018 are similar to those at the beginning of 2014;
- MW6A/B-08 – positive gradient (potential downward flow) that has been relatively consistent since 2015 when annual water takings were similar. Changes in pumping during each year are not evident in the

gradient (i.e., increased pumping during the summer does not result in an increased positive gradient). Note that the increased gradient since the second half of 2016 is due to a temporary drop in the water level at MW6A-08 following purging of the well for sampling;

- MW7A/B-08 – positive gradient (potential downward flow) that increases with increased pumping. The positive gradient increased slightly in 2017 but is similar in 2014, 2015, 2016 and 2018. In the past (2015) there was a reversal of gradient not related to the pumping at TW3-80 (potentially in response to reduced pumping at another source). This other source may also be partially related to the increased gradient observed at MW7-08 in 2017;
- MW8A/B-08 – negative gradient (potential upward flow) that occasionally reverses to a positive gradient (potential downward flow) mainly during the summer. The gradient is similar over the past five 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 four years after a small increase from 2014, which may be related to other water takings in the area;
- MW14A/C-11 – positive gradient (potential downward flow) that increases with increased pumping. The positive gradient is similar over the past five years and decreased slightly during the second half of 2018 when pumping was less;
- MW15A/B-12 – negative gradient (potential upward flow) that does not change with increased pumping;
- MW16A/B-12 – positive gradient (potential downward flow) with minor changes with increased pumping;
- MW17A/B-12 – positive gradient (potential downward flow) that increases with increased pumping. During times of lower pumping the gradient reverses (potential upward flow). During the later part of 2018 when the pumping was reduced, the gradient was mainly negative (potential upward flow); and
- MW18A/B-12 – positive gradient (potential downward flow) that increases with increased pumping. During times of lower pumping the gradient reverses (potential upward flow). During the later part of 2018 when the pumping was reduced, the gradient was consistently negative (potential upward flow);

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., MW15-12 to the west and MW8-08 to the north). A negative gradient (upward flow) is also present at MW17-12 and MW18-12 when pumping at TW3-80 is lower.

4.3 Surface Water Monitoring Program

The surface water monitoring program includes measurement of mini-piezometer and surface water levels, surface water flow and surface water temperature. The surface water levels measured in 2018 are presented in Appendix E along with hydrographs of the water levels and the 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 Waterloo Wellington or Kitchener Waterloo meteorological stations (with missing data filled in from other nearby stations).

4.3.1 Mini-Piezometer Water Levels

Hydrographs for the mini-piezometer locations are presented on Figures E1 through E10 in Appendix E with "a" figures including data for the last 5 years (2014 through 2018) and "b" figures including data for the current year (2018).

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

General Summary

- Water levels measured in the mini-piezometers in 2017 are within the ranges measured over the past five years with the exception of MP14S, MP8D, MP17D and MP18S, where low water levels were observed during the summer months. The low water levels in the other mini-piezometers during the summer of 2018 were either at or higher than the low water levels observed during the summer of 2016 when the Level 2 Low Water condition was in effect. In 2018, dry conditions were observed during the summer months.
- The water levels generally increase in the spring, decline through the summer, and then increase in the fall. There were two periods in the spring when the water levels in the mini-piezometers declined which correlate with periods of below normal precipitation. In addition to the seasonal trend, short-term changes ("spikes") in water level in the shallow groundwater are influenced by precipitation.
- The MP11 mini-piezometer nest located at the Nestlé Gilmour Road property is considered to represent background conditions (i.e., conditions along Aberfoyle Creek that are beyond any influence of pumping TW3-80). However, the water level changes at this location are more subtle or muted than at other locations. This may be due to the fact that the nest is constructed in organic material on the bank beside the stream (as opposed to in the stream similar to the other mini-piezometer nests) and the nest is located on a tributary of Aberfoyle Creek (as opposed to the main branch of Aberfoyle Creek). A new mini-piezometer nest (MP1-16) was installed in Aberfoyle Creek in April 2016, in the general vicinity of the MP11 nest 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. In 2018, the casing at MP1-16 was extended so that the mini-piezometer doesn't flow (when not frozen).

Detailed Summary

- The variation in water levels at MP11 over 2018 was less than 0.2 m. The water levels were relatively stable in 2018 with a slight increase at the end of February followed by a slight decrease through the summer and a slight increase into the fall. These changes in water level are influenced by natural seasonal patterns. The potential for vertical flow at the MP11 nest is consistently upward in 2018, similar to previous years (i.e., as shown in Figure E2a/b, water levels in MP11D-04 exceed those in MP11S-08). For comparison, and based on the data available, the water levels at MP1-16S fluctuated over 0.7 m in 2018. The fluctuation is similar to that observed in the downgradient mini-piezometers. The data collected at MP1-16 indicates that the response at MP11 is more subtle or muted. This is due to the locations of the mini-piezometers (i.e., in main creek versus a tributary) and how they are constructed (i.e., in stream bed versus outside of the stream). Despite the qualitative differences in the responses at MP11 and MP1-16, as shown in Figure E1a/b, the vertical gradient inferred from the data from the MP1-16 nest is consistent with the gradient inferred at MP11.
- There are six mini-piezometer nests situated on the Nestlé property (MP16, MP6, MP12, MP14, MP8, MP19) and two located downstream of the confluence of Aberfoyle Creek and Mill Creek (MP17, MP18). The mini-piezometer nests located upgradient and downgradient of TW3-80 showed fluctuations of approximately 0.5

m to 1.0 m during 2018. Changes in water levels correspond more with natural events rather than changes in pumping in TW3-80 and as such are mainly due to precipitation, snow melt and evaporation. There is some correlation between the increasing water levels at the end of the year and the decreased pumping. However, there is no change in water levels during the significant decrease in pumping in mid-October.

Shallow gradients observed in the mini-piezometers are shown on Figures E11a, b, c, and d. Beginning upstream and moving downstream, the vertical gradients are as follows:

- MP1-16 – strong negative gradient (potential upward flow). There are several short-term decreases in the negative gradient caused by rapidly rising surface water elevations following precipitation events;
- MP11 – strong negative gradient (potential upward flow) with a small decrease in March, from June to October and in December. There are several short-term decreases in the negative gradient caused by rapidly rising surface water elevations following precipitation events;
- MP16 – no gradient to weak positive gradient (potential downward flow) and relatively constant;
- MP6 – weak negative gradient (potential upward flow) to no gradient that occasionally changes to a weak positive gradient (potential downward flow) throughout the year;
- MP12 – no gradient that changes to a weak positive gradient (potential downward flow) from mid-March to mid-May and then to a weak negative gradient (potential upward flow) from mid-October to the end of the year;
- MP14 – strong negative gradient (potential upward flow) during the entire year that decreased slightly through the summer;
- MP8 – weak negative gradient (potential upward flow) with occasional weak positive gradient (potential downward flow) with a strong negative gradient occurring from mid-March to mid-October;
- MP19 – weak negative gradient (potential upward flow) until mid-July and then weak positive gradient (potential downward flow) until mid-November when the gradient changes back to a weak negative gradient to the end of the year;
- MP17 – no gradient that changes to a weak positive gradient (potential downward flow) from June to the end of the year;
- MP18 – weak negative gradient (potential upward flow) during the first half of the year that reverses to a weak positive gradient (potential downward flow) during the second half of the year; and
- The changes in vertical gradients appear to be somewhat similar to the background trend in MP1-16 and MP11.

The water levels in the mini-piezometers on July 20, 2018 are plotted on Figure 4.6 which is during the month of highest pumping. Review of the water levels on July 20, 2018 indicates that there is a strong upward flow at the new station (MP1-16) located upstream of Aberfoyle Mill Pond. There is essentially no gradient at the three piezometers (MP16, MP6, MP12) upgradient of TW3-80 and then a strong negative gradient at MP14 near the middle of the property. There is a weak negative gradient at the downstream end of the property (MP8). Weak positive gradients are observed at the two piezometers (MP17, MP18) located downgradient of the confluence of Aberfoyle Creek and Mill Creek. These gradients are similar to those observed in the past with no measurable influence with well pumping. No long-term changes or trends in the mini-piezometer gradients have been noted during the last five years.

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 "a" figures including data for the last 5 years (2014 through 2018) and "b" figures including data for the current year (2018).

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

- 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 higher in the winter/spring and lower in the summer and then increased slightly into the fall. There was a decline in water levels at all three stations in March following a period of below normal precipitation. The low water levels observed in the summer of 2018 at SW3 were higher than the low water levels observed in the summer of 2016 (during the Level 2 Low Water Condition) and the low water levels at SW4 and SW5 in 2018 were similar to the low water levels in 2016;
- Surface water levels at the on-Site stations (SW1 and SW2) generally follow a similar trend with higher water levels in the spring followed by lower water levels in the summer and higher water levels again in the fall (although generally lower than those in the spring). The low water levels in the summer of 2018 are similar to the low water levels in the summer of 2016 and higher than those observed in 2014. The low water levels in the summer of 2018 at SW2 are the lowest observed over the past 10 years and are likely related to the below normal precipitation over the same period. "Spikes" in the water levels are related to precipitation events or spring melt. The changes in water levels at SW1 and SW2 are mainly due to natural events (i.e., precipitation, snow melt and evaporation); and
- Water levels at SW9 and SW10 are measured in ponds on the neighbouring property. These ponds may represent water table conditions. SW9 was destroyed in April 2018 when part of the pond was filled in. In general, the water levels in these ponds were declining in 2014 and 2015 followed by a rise in water levels in the spring of 2016 and then a decline into summer. In 2017, the water levels rose in the spring and early summer to the highest levels observed over the current five-year period (2014 through 2018). In 2018, the water levels rose to May and then declined to September and have been relatively stable to the end 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 is likely due to a combination of seasonal changes and potentially to aggregate operations.

The water levels at the surface water stations on July 20, 2018 are included on Figure 4.6, during the month of highest pumping. Review of the water levels on July 20, 2018 indicates that surface water features varied in elevation from approximately 317.3 masl at SW3 to 307.2 masl at SW5 with surface water levels across the Site ranging from 311.3 masl (SW1) to 310.3 masl (SW2).

4.3.3 Surface Water Flow

The monthly stream flow data collected in 2018 are summarized in Appendix F. Stream flow has been measured at these locations 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 2018 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 measurement results indicates that they have changed subtly. A new stage-discharge curve was developed to represent continuous flows in 2018 at SW1 and SW2 to provide a better fit of the data. Stage-discharge curves were developed by estimating the level at which zero flow would occur (i.e., y0) 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.

Graphs of stream flow measured 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 (2014 through 2018) and the “b” figure including data for the current year (2018). The stage-discharge relationship was used to estimate stream flow from the continuous water level elevation data. 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).

Review of the flow data indicates the following:

- In 2018, stream flow measured (during monthly monitoring) at SW1 ranged from 50.1 L/s (July) to 1,060.6 L/s (February) and at SW2 stream flow ranged from 41.5 L/s (July) to 998.1 L/s (February);
- The trends in surface water flow at SW1 and SW2 over the year are similar. This is consistent with previous years;
- There was variability in the flows at SW2 in late January and early February. The variability in the logger data is most likely caused by ice conditions at the water level logger at the station;
- In 2018, 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 from October to the end of the year;
- The 2018 measured stream flow at SW1 and SW2 were generally lower during the summer months. Although, the measurements at SW1 and SW2 were similar to each other during this period, the flows at SW2 were slightly below the historic range for this station;
- The calculated flows from the rating curves indicates that flow in the creek was higher at SW2 compared to SW1 at the beginning and end of the year (estimated based on available data). Flow calculated at the stations based on the water levels and rating curve indicates that flow was similar at SW1 and SW2 from mid-July to the beginning of October; and

- A review of the manual measurements indicates that flow at SW2 was slightly less than flow at SW1 in February, June, July and September. Flow measurement error is +/- 15%. Taking into consideration the potential error in measurement, it is possible that the flow in these months may have been lower at SW1 compared to SW2.

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 by precipitation events and fluctuate seasonally.

4.3.4 Surface Water Temperature

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

The average daily water and air temperature data for 2014 through 2018 are shown on Figure G1a and for 2018 on Figure G1b. Review of the data indicates the following:

- The seasonal trend in stream temperature levels in 2018 is similar to previous years and relatively stable;
- Average daily ambient air temperature ranged from -19.7ºC to 26.2ºC in 2018;
- Average daily surface water temperature ranged from 0.2ºC to 29.1ºC at the upstream end of the property and from -0.1ºC to 27.3ºC at the downstream end of the property. Surface water temperatures generally decrease, across the Site, moving downstream; and
- Ambient 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 0ºC and surface water temperature remains relatively constant around 0ºC. It is noted that the air temperature is generally cooler than the water temperature. This is due to location of the air temperature sensor being located in a box in shaded area.

The surface water temperature monitoring results 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 is 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 Nestlé property. The C. Portt and Associates report concluded that:

> *In 2018, mean summer (June – August) air temperature and water temperatures were high relative to most other years in the period 2007 – 2017. 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 Nestle property in 2018 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

The 2018 Biological Monitoring Report (Beacon Environmental and C. Portt and Associates) makes the following conclusions:

In summary, the results of the biological monitoring at the Aberfoyle property to date indicate that there have not been any significant changes to the terrestrial and aquatic monitoring parameters that would suggest altered hydrology. The 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 report also includes recommendations for continued biological monitoring in 2019. 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 2018 monitoring program.

1) TW3-80 and TW2-11 operated in accordance with the limits outlined in the PTTW. The total volume of water taken in 2018 from TW3-80 was 676,946,402 L or 52% of the permitted volume. No water was taken from TW2-11 in 2018.

2) The daily water taking at TW3-80 ranged from 0 L/day to 2,808,648 L/day. The average daily taking in 2018 was 1,854,648 L/day.

3) The estimated non-pumping water levels in TW3-80, which obtains water from the Lower Bedrock Aquifer, ranged from approximately 308 to 312 masl in 2018 and the lower water levels, or estimated pumping levels, ranged from approximately 299.5 to 305.5 masl. The drawdown at the well ranged from approximately 13.5 m to 7.5 m in 2018. Historical and current records indicate that long-term water levels generally correlate with the annual pumping volumes (i.e., higher water levels during years of lower pumping and lower water levels during years of higher pumping).

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 during the end of 2018 were similar to those observed during 2014, years during which the total volumes pumped by TW3-80 were almost identical.

5) The Middle Bedrock Aquitard limits the effect of pumping on overlying units (indicating semi-confined conditions). Unacceptable impacts (i.e., long-term declining trends) to the Upper Bedrock Aquifer and overburden aquifer have not been identified. In addition, no private well interference complaints were received in 2018. The water levels in the Upper Bedrock Aquifer and overburden aquifer show seasonal trends that are reflective of spring melt and precipitation. In 2018, the below normal precipitation during the summer is evident in the water level trends in the Upper Bedrock and Overburden Aquifers.

6) Surface water levels fluctuate in response to precipitation, snow melt and evapotranspiration.

7) The 2018 water taking from TW3-80 is sustainable.

6.0 RECOMMENDATIONS

The following recommendations are provided based on the results of the 2018 monitoring program:

1) The data from mini-piezometer MP11 suggest that this location does not serve the purpose of monitoring background conditions (i.e., conditions along Aberfoyle Creek that are beyond any influence of pumping TW3-80). The MP11 nest is constructed in organic material on the bank beside the stream and not in the stream, and is located on a tributary of Aberfoyle Creek rather than in the main branch of the creek. It is recommended that monitoring at MP11 be discontinued. MP1-16 is an appropriate alternative monitoring location.

2) Monitoring of the private wells (as outlined below) should be replaced with monitoring at dedicated monitoring wells. The monitoring program has been on-going since 2000 with more detailed monitoring occurring since 2008 and no impacts to private wells or the surrounding aquifer have been noted. In addition, the monitoring data from these private wells are often influenced by pumping at the private well itself. Nestlé is in the process of installing monitoring wells on various properties to replace the private wells used for monitoring. The following changes to the monitoring program should be discussed with the MECP during the permit renewal process:

    a. Discontinue monitoring at M1 and W2, which are wells completed in the Lower Bedrock Aquifer. Note that the owner of W2 has requested that the well not be included in the Nestlé monitoring program. Monitoring of the Lower Bedrock Aquifer should be completed at the proposed new well to be constructed at the northeast corner of the Nestlé property to replace the private wells.

    b. Discontinue monitoring at 8 Maple Leaf Lane, Private Well "I" (50 Brock Road), 58 Brock Road and MOE WWR #67-08740. Monitoring of the Upper and Lower Bedrock Aquifers should be completed at the proposed multi-level monitoring well to be constructed by the Aberfoyle School to replace the private wells.

    c. Discontinue monitoring at MOE WWR #67-07589, Private Well "B" and 2 Brock Road. Monitoring of the Upper and Lower Bedrock Aquifers should be completed at the proposed multi-level monitoring well to be constructed behind the Township Office to replace the private wells.

3) SW9 should be removed from the monitoring program since it has been destroyed when part of the pond was filled in and SW10 provides suitable coverage for monitoring surface water in the area.

4) Nestlé would like to decommission the Fireflow well. Upon approval by the MECP, the Fireflow well would be decommissioned following regulated abandonment procedures, so that the well could not act as a potential pathway to the aquifer. A surface water pond on the Nestlé property is used for fire suppression. A review of the monitoring network and data indicates that TW2-11 provides similar water level response to the Fireflow well and is close enough that it could replace the Fireflow well for monitoring purposes. TW2-11 is an appropriate monitoring location as Nestlé has indicated that they will no longer require a water taking from

TW2-11. The Fireflow well should then be removed from the PTTW (provided TW2-11 is removed from the PTTW as a source well and kept on as a monitoring point).

5) The remaining groundwater and surface water monitoring program should continue as is.

6) The PTTW should be updated with the following administrative changes when the PTTW is renewed:

   a. MW1A-04 should be removed from continuous monitoring of groundwater levels at bedrock wells as it has been decommissioned and replaced with MW10B-09, which is in the permit.

   b. Private well “J” should be removed from monthly monitoring of groundwater levels in bedrock and replaced with Private well “I” as previously indicated by CRA or both should be removed if dedicated monitoring wells are to replace the private wells.

   c. MP17S/D-12 and MP18S/D-12 should be renamed MP17S/D-11 and MP18S/D-11.

   d. MW-I should be removed from the list of continuous monitoring overburden wells and added to the list of continuous monitoring bedrock wells.

Signature Page

Golder Associates Ltd.

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

Kevin MacKenzie, M.Sc., P.Eng.
Senior Hydrologist, Principal

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

GRP/JAP/KM/ll

\\golder.gds\gal\mississauga\active\2013\1152\13-1152-0250 nestle waters ws s. ontario\aberfoyle\reports\2018 annual report\final report\13-1152-0250 rpt 2019mar18 2018 aberfoyle report.docx

REFERENCES

AquaResource Inc., 2010. City of Guelph Source Protection Project, Final Groundwater and Surface Water Vulnerability Report, March 2010.

Brunton, F.R., 2008. Preliminary revisions to the Early Silurian stratigraphy of Niagara Escarpment: integration of sequence stratigraphy, sedimentology and hydrogeology to delineate hydrogeologic units; in Summary of Field Work and Other Activities, 2008, Ontario Geological Survey, Open File Report 6226, p.31-1 to 31 18.

Brunton, F.R., 2009. Update of revisions to the Early Silurian stratigraphy of the Niagara Escarpment: integration of sequence stratigraphy, sedimentology and hydrogeology to delineate hydrogeologic units; in Summary of Field Work and Other Activities, 2009, Ontario Geological Survey, Open File Report 6240 p.25-1 to 25 20.

Brunton, F.R. and C. Brintnell, 2011. Final Update of the Early Silurian Stratigraphy of the Niagara Escarpment and Correlation with Subsurface Units Across Southwestern Ontario and the Great Lakes Basin; in Summary of Field Work and Other Activities, 2011, Ontario Geological Survey, Open File Report 6270, p.30-1 to 30-11.

CH2M Gore & Storrie Limited, et al., 1996. Mill Creek Subwatershed Plan, prepared for the Grand River Conservation Authority, June 1996.

Chapman, L.J., and D.F. Putnam, 1984. The Physiography of Southern Ontario. Geological Survey, Special Volume 2.

CRA, 2014. 2013 Annual Monitoring Report, Nestlé Waters Canada, Guelph, Ontario.

Freeze, R.A. and J.A. Cherry, 1979. Groundwater.

Golder Associates Ltd., 2011. City of Guelph Tier Three Water Budget and Local Area Risk Assessment Appendix A: Characterization Final Report.

Halton-Hamilton Source Protection Region, 2015. Assessment Report for the Halton Region Source Protection Area, Version 3.3, July 24, 2015. (http://www.protectingwater.ca/uploads/Planning/Halton%20Region%20WHPAs.jpg)

Karrow, P.F., 1987. Quaternary Geology of the Cambridge, Area, Southern Ontario. Ontario Geologic Survey, Map 2508, scale 1:50,000.

Lake Erie Region Source Protection Committee, 2015. Grand River Source Protection Area Approved Assessment Report, Chapter 8, November 25, 2015. (https://www.sourcewater.ca/en/source-protection-areas/Grand-River-Assessment-Report.aspx)

Matrix Solutions Inc., 2018. Guelph-Guelph/Eramosa Water Quantity Policy Development Study: Threats Management Strategy. Prepared for the Lake Erie Source Protection Region.

Matrix Solutions Inc., 2017. City of Guelph and Township of Guelph/Eramosa Tier 3 Water Budget and Local Area Risk Assessment. Prepared for the Lake Erie Source Protection Region.

Miller, R.F., Farrell, Lorraine and Karrow, P.F., 1979. Bedrock Topography of the Cambridge Area, Southern Ontario. Ontario Geological Survey Preliminary Map P. 1985, Bedrock Topography Series, scale 1:50,000, Geology 1978.

Ministry of the Environment and Climate Change, 2017. Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to Take Water Applications and Hydrogeological Study Requirements, April 2017.

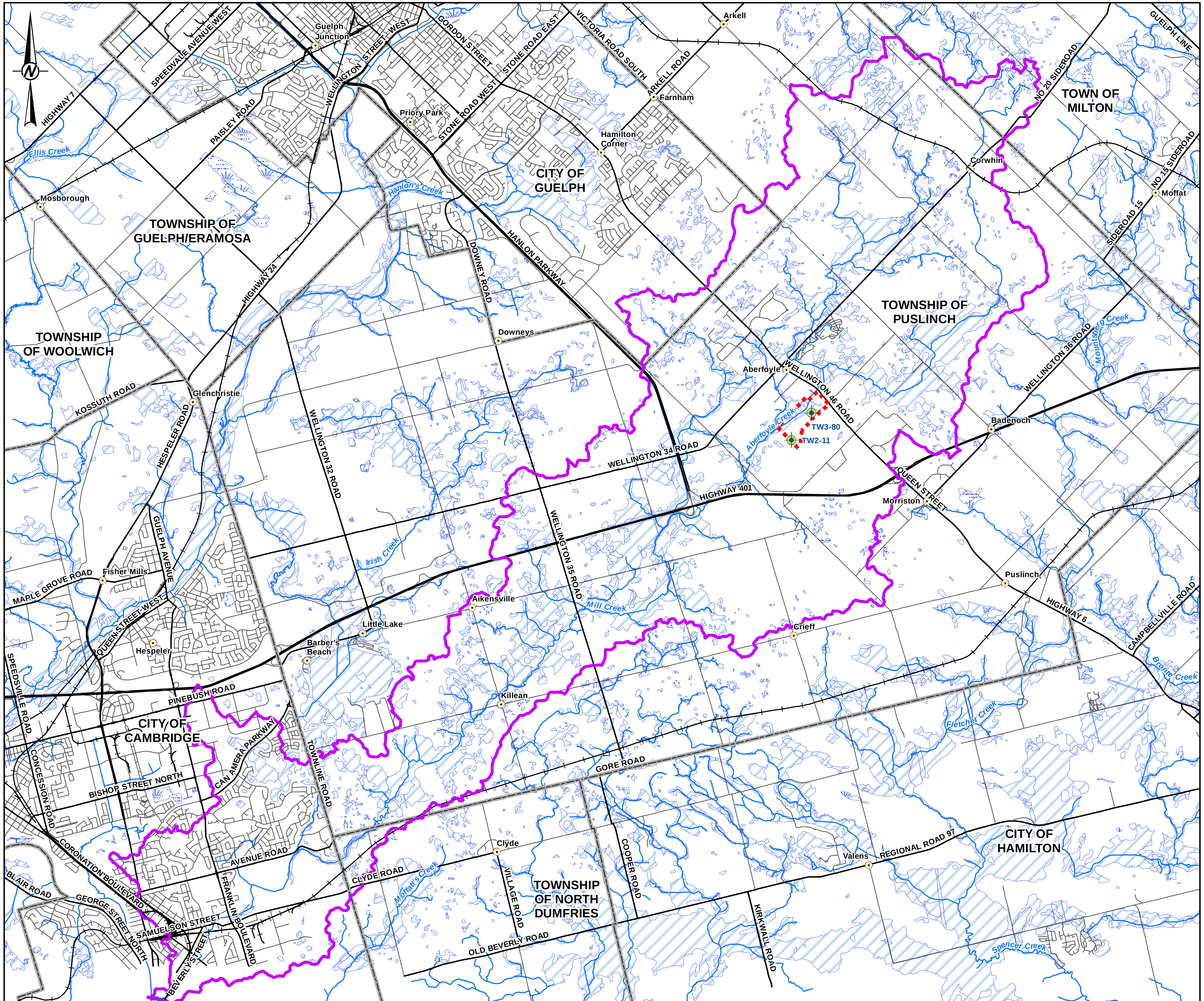
Telford, P.G., 1979. Paleozoic Geology of the Cambridge Area, Southern Ontario. Ontario Geologic Survey, Preliminary Map P.1983.

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

Vos, M.A., 1968. Drift Thickness Map P.535.

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.

FIGURES



LEGEND

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

0 2 4 6

Kilometres

1:80,000

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
NESTLE WATERS CANADA

PROJECT
2018 ANNUAL REPORT

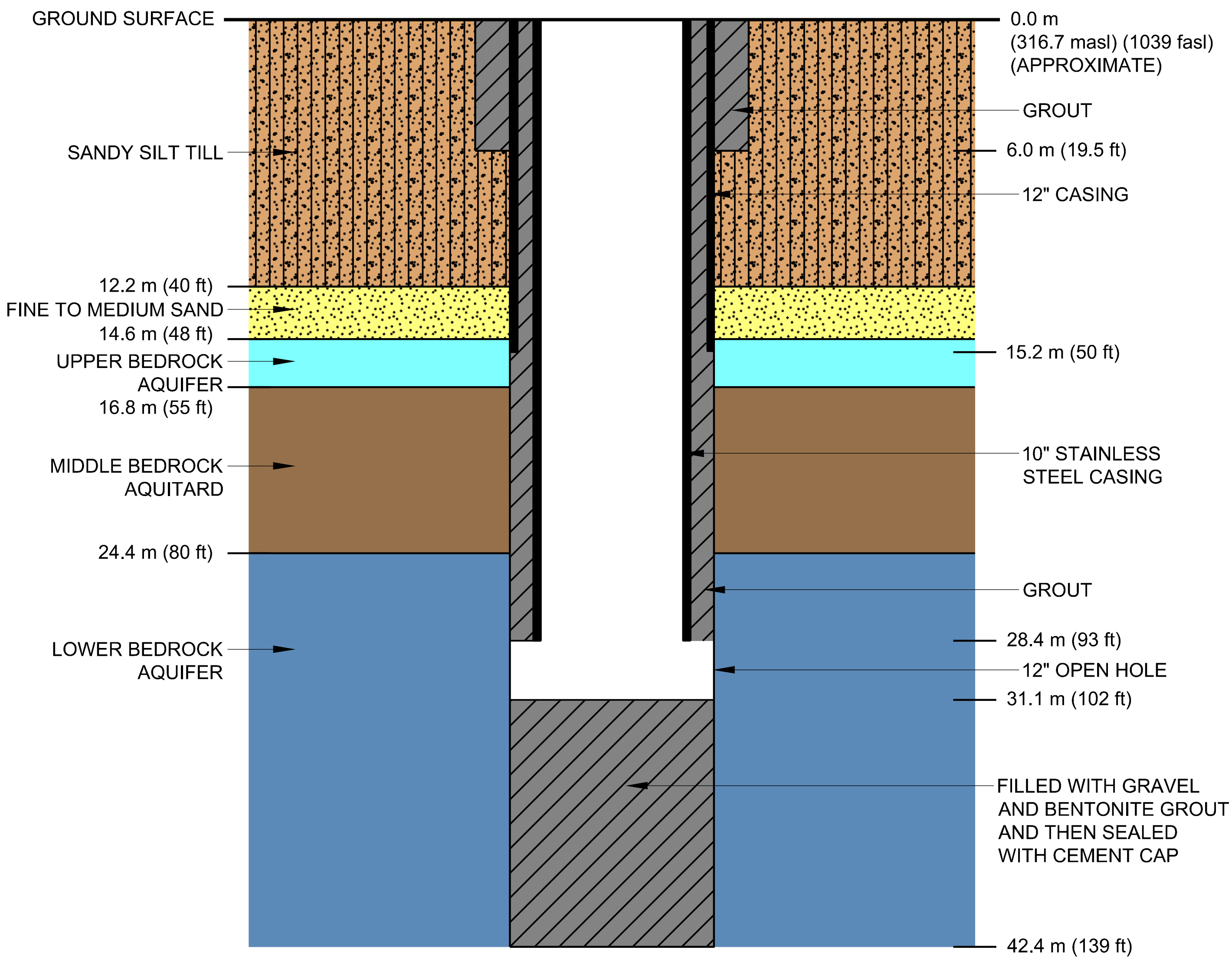
TITLE
SITE LOCATION

CONSULTANT

GOLDER

YYYY-MM-DD	2019-01-21
DESIGNED	JMC
PREPARED	JMC/PR
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	1.1



CLIENT
NESTLE WATERS CANADA

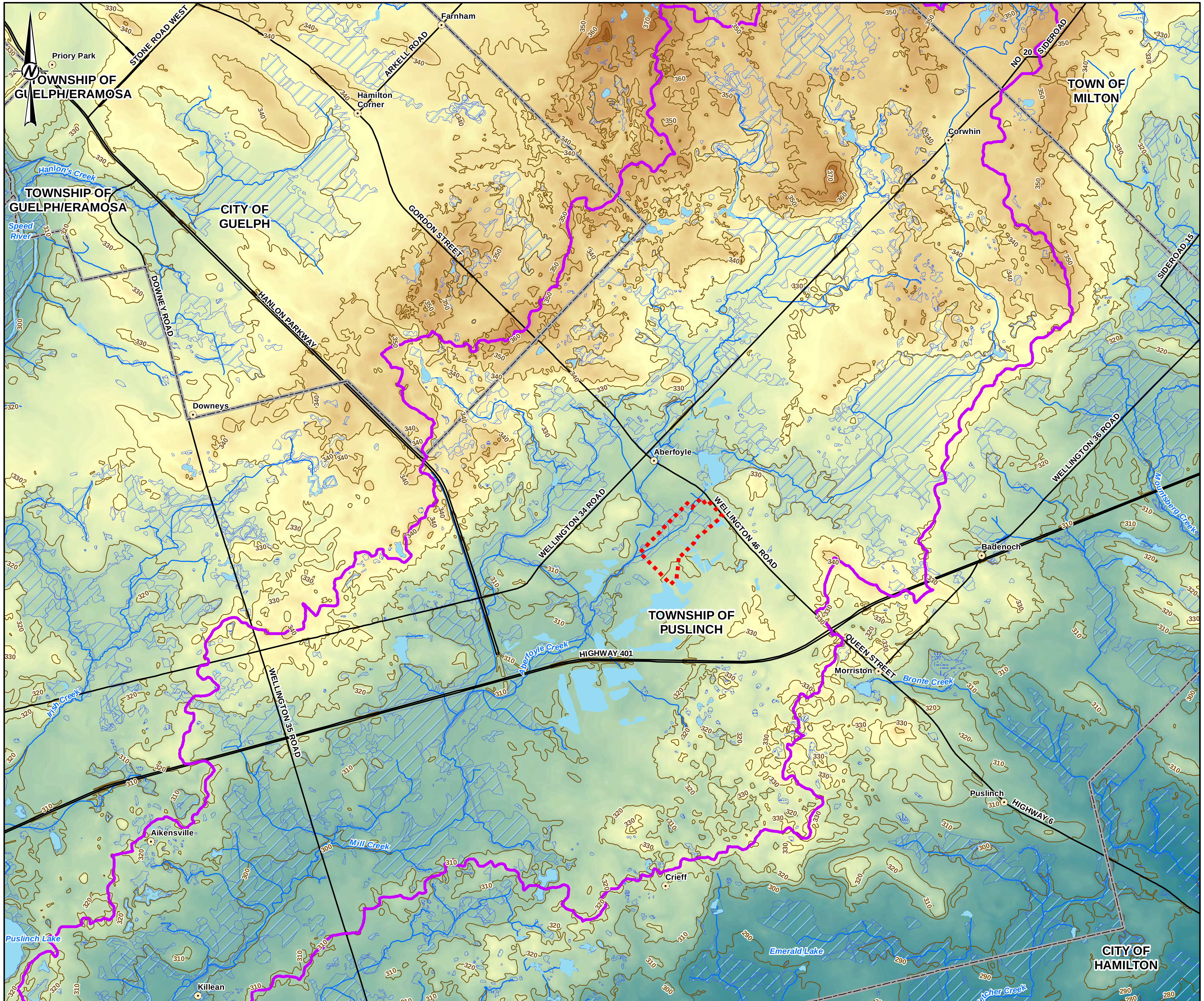
PROJECT
2018 ANNUAL REPORT

CONSULTANT
GOLDER

YYYY-MM-DD	2019-01-22
PREPARED	SW
DESIGN	MR
REVIEW	GP
APPROVED	GP

TITLE
ABERFOYLE TW3-80 SCHEMATIC

PROJECT No.	PHASE	Rev.	FIGURE
13-1152-0250		A	1.2



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

0 1 2 3 4

Kilometres

1:50,000

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
NESTLE WATERS CANADA

PROJECT
2018 ANNUAL REPORT

TITLE
TOPOGRAPHY AND DRAINAGE

CONSULTANT

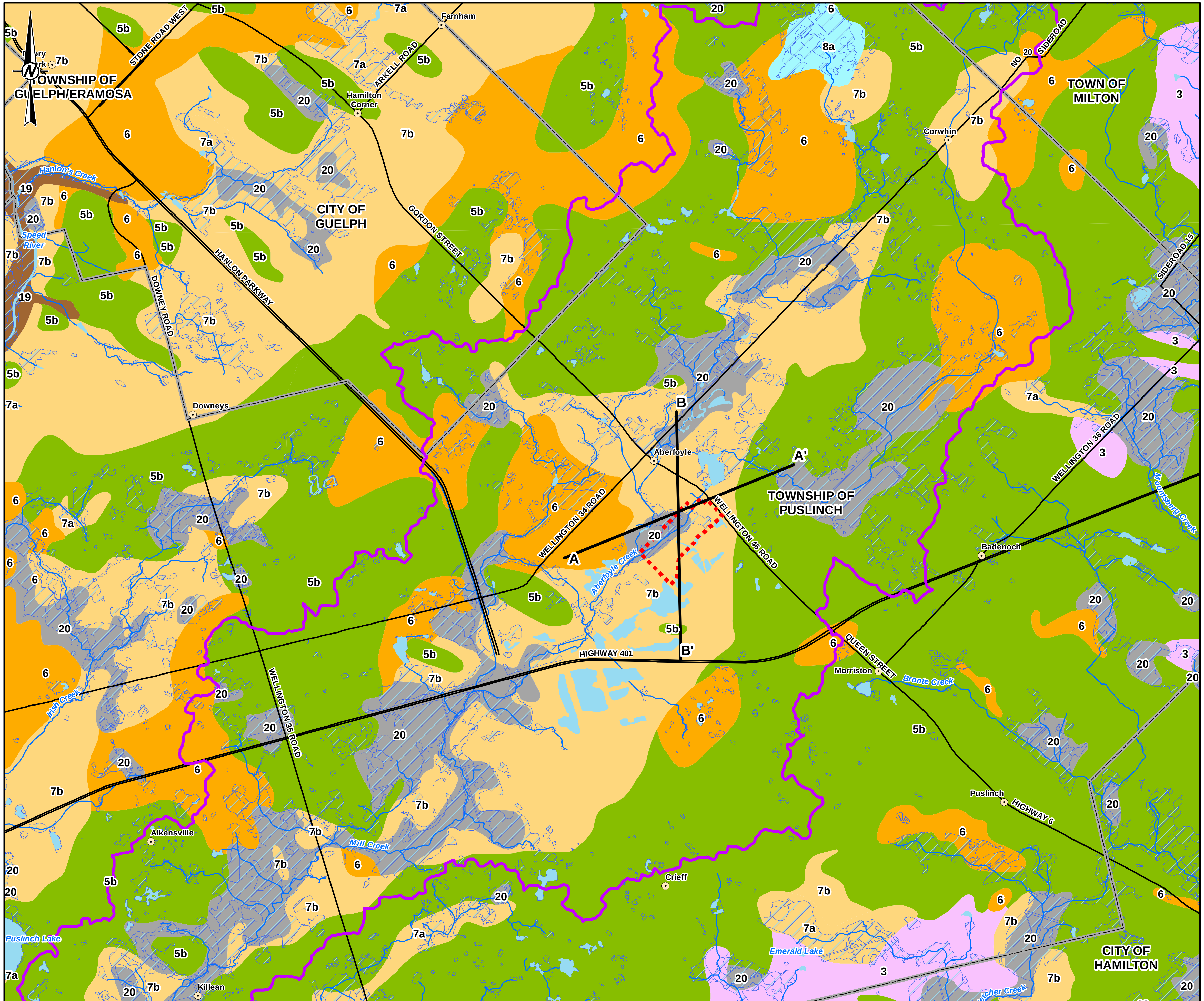
GOLDER

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

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	2.1

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

S:\Clients\Nestle\Aberfoyle\99_PROJ\1311520250_Monitoring\40_PROD\0019_2018_Annual_Report\1311520250-0019-CH-0003.mxd



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

0 1 2 3 4
Kilometres
1:50,000

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
NESTLE WATERS CANADA

PROJECT
2018 ANNUAL REPORT

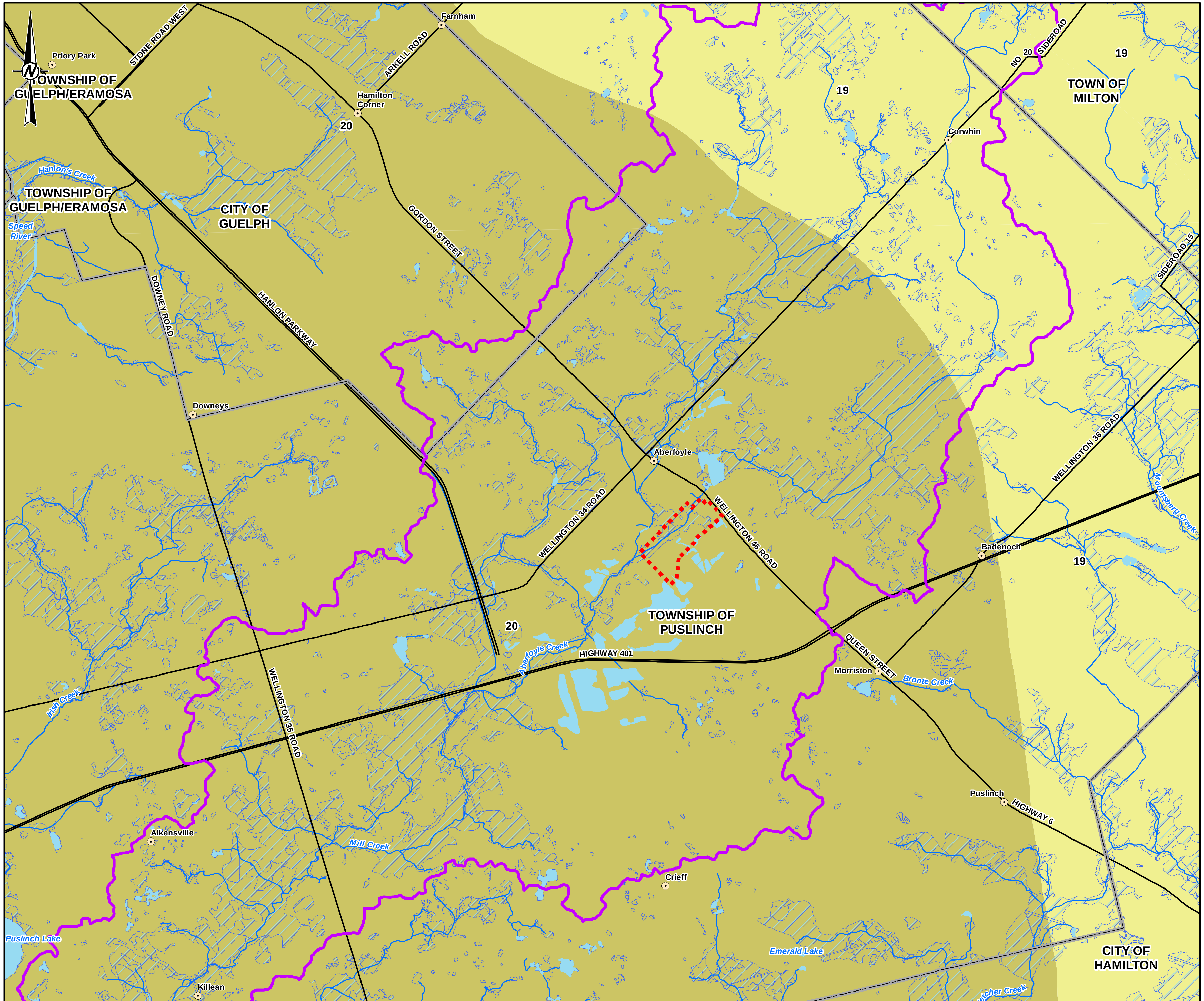
TITLE
REGIONAL QUATERNARY GEOLOGY

CONSULTANT
GOLDER

YYYY-MM-DD	2019-01-18
DESIGNED	JMC
PREPARED	JMC
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	2.2

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



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
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
NESTLE WATERS CANADA

PROJECT
2018 ANNUAL REPORT

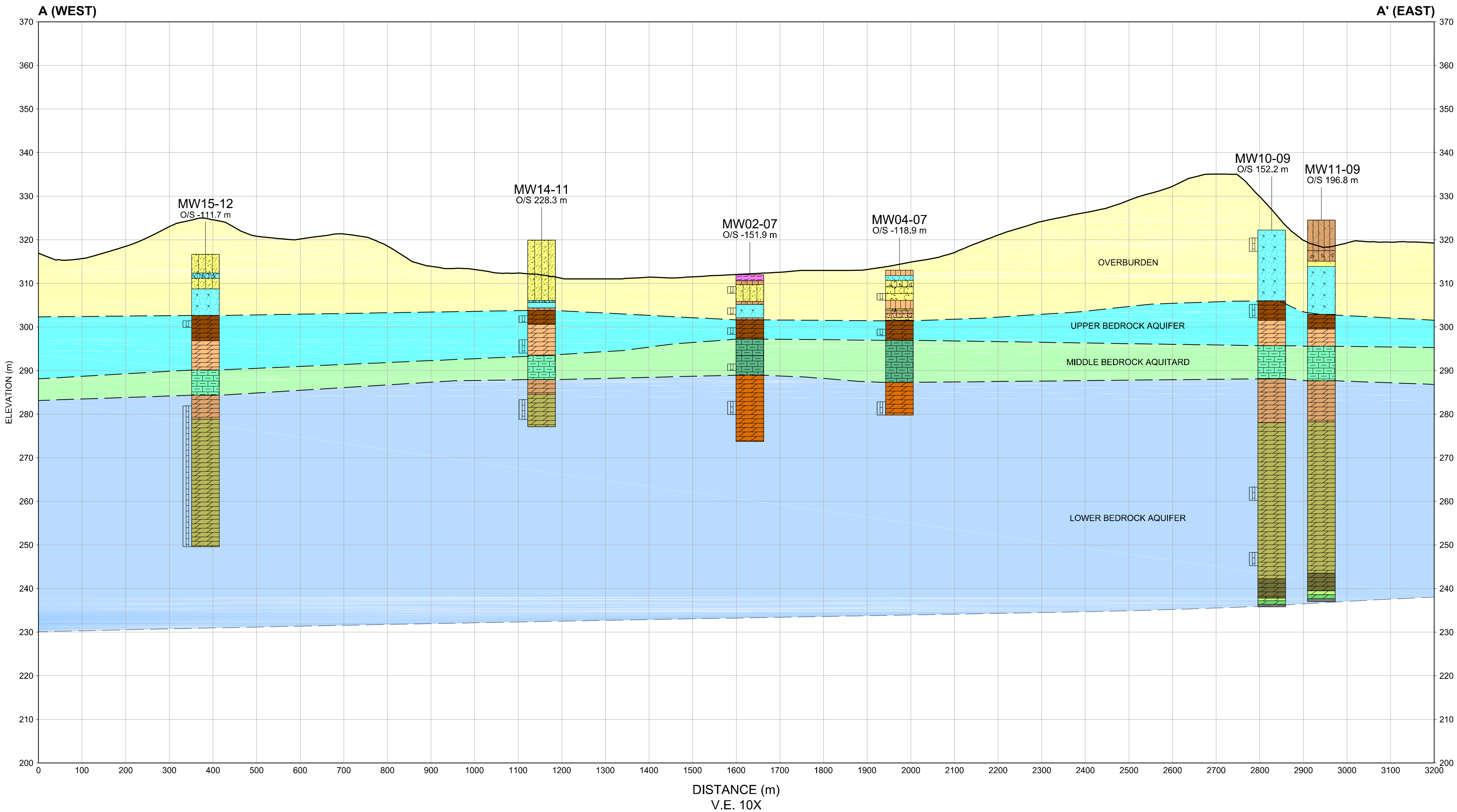
TITLE
REGIONAL BEDROCK GEOLOGY

CONSULTANT
GOLDER

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

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	2.3

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



LEGEND

OVERBURDEN	BEDROCK (OLD)	BEDROCK (NEW)
SAND	GUELPH	GUELPH
SILTY SAND	ERAMOSA	REFORMATORY QUARRY
SILTY SAND TILL	AMABEL	VINEMOUNT
SANDY SILT	BEDROCK	GOAT ISLAND
SANDY SILT TILL		GASPORT
SILT		IRONDEQUOIT
SILT TILL		ROCKWAY
TOPSOIL		MERRITTON
SAND AND GRAVEL		CABOT HEAD
GRAVEL AND SILT		

0 25 50
1:1,000 VERTICAL METRES

0 250 500
1:10,000 HORIZONTAL METRES

CLIENT
NESTLE WATERS CANADA

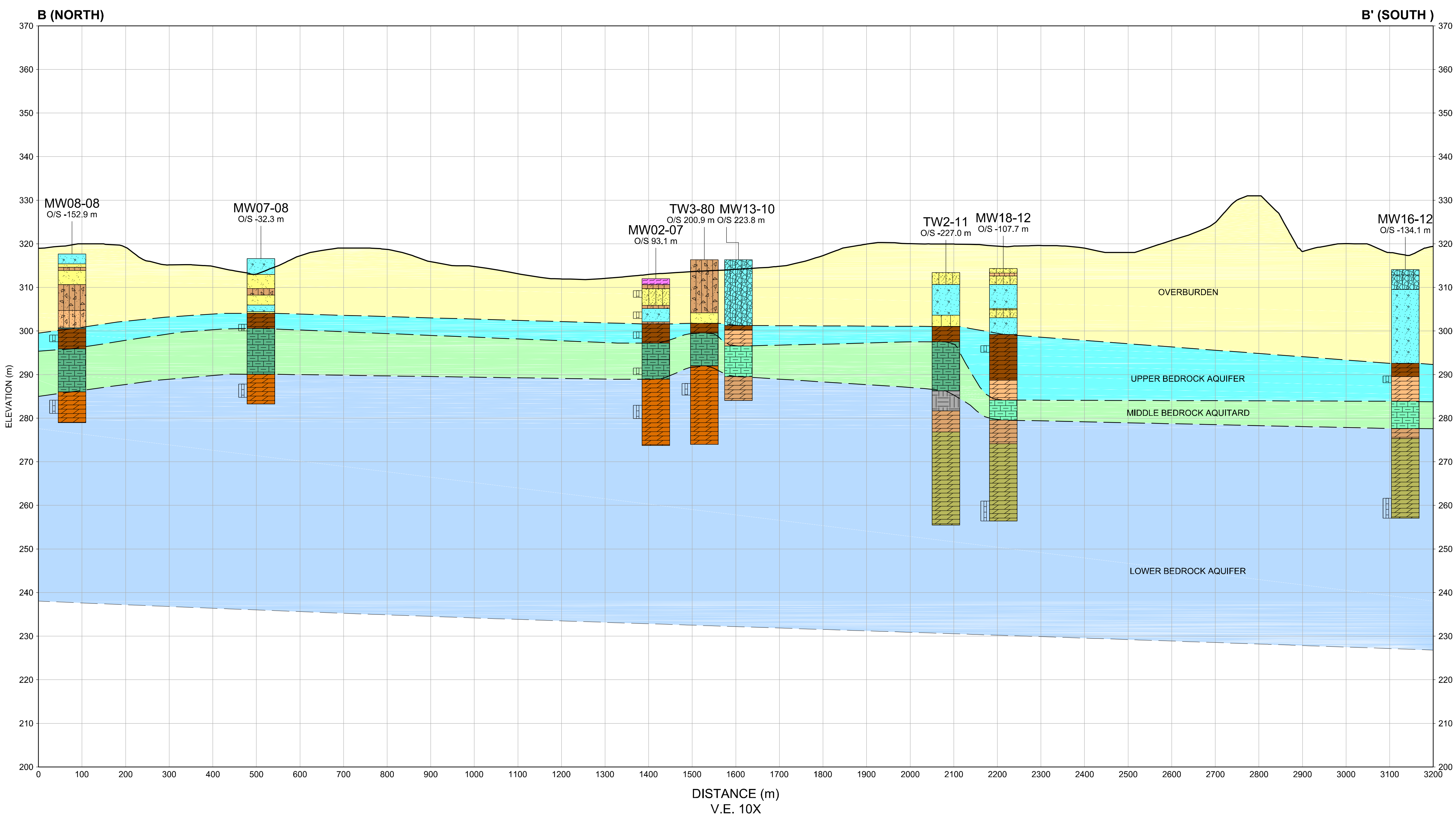
PROJECT
2018 ANNUAL REPORT

TITLE
CROSS SECTION A - A'

CONSULTANT
GOLDER

YYYY-MM-DD	2019-01-23
DESIGNED	
PREPARED	SW
REVIEWED	GP
APPROVED	

PROJECT NO.	PHASE	REV.	FIGURE
13-1152-0250	1000	A	2.4



LEGEND

OVERBURDEN	BEDROCK (OLD)	BEDROCK (NEW)
SAND	GUELPH	GUELPH
SILTY SAND	ERAMOSA	REFORMATORY QUARRY
SILTY SAND TILL	AMABEL	VINEMOUNT
SANDY SILT	BEDROCK	GOAT ISLAND
SANDY SILT TILL		GASPORT
SILT		IRONDEQUOIT
SILT TILL		ROCKWAY
TOPSOIL		MERRITTON
SAND AND GRAVEL		CABOT HEAD
GRAVEL AND SILT		

0 25 50
1:1,000 VERTICAL METRES

0 250 500
1:10,000 HORIZONTAL METRES

CLIENT
NESTLE WATERS CANADA

PROJECT
2018 ANNUAL REPORT

TITLE
CROSS SECTION B-B'

CONSULTANT

GOLDER

YYYY-MM-DD	2019-01-23
DESIGNED	
PREPARED	SW
REVIEWED	GP
APPROVED	

PROJECT NO.	PHASE	REV.	FIGURE
13-1152-0250	1000	A	2.5

25 mm

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

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

0 200 400 600 800 1,000

1:12,500 METERS

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
NESTLE WATERS CANADA

PROJECT
2018 ANNUAL REPORT

TITLE
OVERBURDEN AND SURFACE WATER ELEVATIONS (NON-PUMPING CONDITION OCTOBER 2010)

CONSULTANT
GOLDER

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

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	**2.6**

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

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

0 200 400 600 800 1,000

1:12,500 METERS

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
NESTLE WATERS CANADA

PROJECT
2018 ANNUAL REPORT

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

CONSULTANT

GOLDER

YYYY-MM-DD	2019-01-21
DESIGNED	JMC
PREPARED	JMC/PR
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	**2.7**

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

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

0 200 400 600 800 1,000

1:12,500 METERS

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
NESTLE WATERS CANADA

PROJECT
2018 ANNUAL REPORT

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

CONSULTANT

GOLDER

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

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	2.8

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

LEGEND

- Production Well
- Monitoring Well (Bedrock)
- Private Well (Bedrock)
- Watercourse
- Property Boundary

0 200 400 600 800 1,000

1:12,500 METERS

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
NESTLE WATERS CANADA

PROJECT
2018 ANNUAL REPORT

TITLE
2018 BEDROCK MONITORING LOCATIONS

CONSULTANT

GOLDER

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

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	3.1

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

S:\Clients\Nestle\Aberfoyle\99_PROJ\1311520250_Monitoring\40_PROD\0019_2018_Annual_Report\1311520250-0019-CH-0011.mxd

LEGEND

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

0 200 400 600 800 1,000

1:12,500 METERS

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
NESTLE WATERS CANADA

PROJECT
2018 ANNUAL REPORT

TITLE
2018 OVERBURDEN MONITORING LOCATIONS

CONSULTANT

GOLDER

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

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	**3.2**

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

LEGEND

- Production Well
- Piezometer
- Surface Water Station
- Surface Water Temperature Station
- Watercourse
- Property Boundary

0 200 400 600 800 1,000

1:12,500 METERS

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
NESTLE WATERS CANADA

PROJECT
2018 ANNUAL REPORT

TITLE
2018 SURFACE WATER MONITORING LOCATIONS

CONSULTANT

GOLDER

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

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	3.3

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

S:\Clients\Nestle\Aberfoyle\99_PROJ\1311520250_Monitoring\40_PROD\0019_2018_Annual_Report\1311520250-0019-CH-0013.mxd

LEGEND

Production Well

Well Status as of December 2018

Decommissioned

Watercourse

Property Boundary

0 100 200 300 400 500

1:12,500 METERS

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
NESTLE WATERS CANADA

PROJECT
2018 ANNUAL REPORT

TITLE
UNUSED OR DECOMMISSIONED WELLS

CONSULTANT

GOLDER

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

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	3.4

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

25mm

LEGEND

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

Well Status as of December 2018

- Decommissioned
- Watercourse
- Property Boundary

0 200 400 600 800

1:12,500 METERS

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
NESTLE WATERS CANADA

PROJECT
2018 ANNUAL REPORT

TITLE
WELL LOCATIONS

CONSULTANT
GOLDER

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

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	3.5

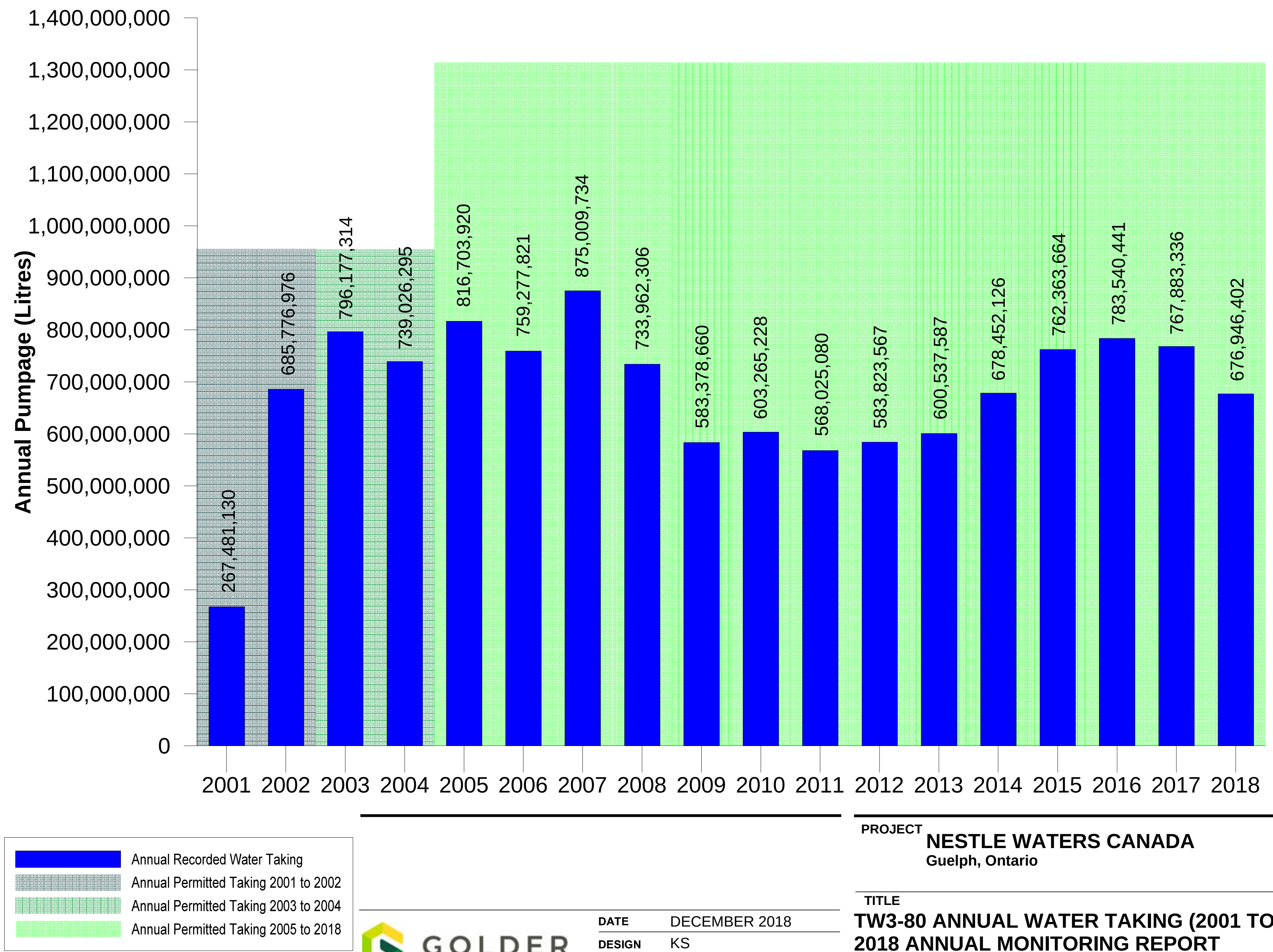
GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT
NESTLE WATERS CANADA
Guelph, Ontario

TITLE
HISTORICAL YEARLY PRECIPITATION (2009 TO 2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	3.6



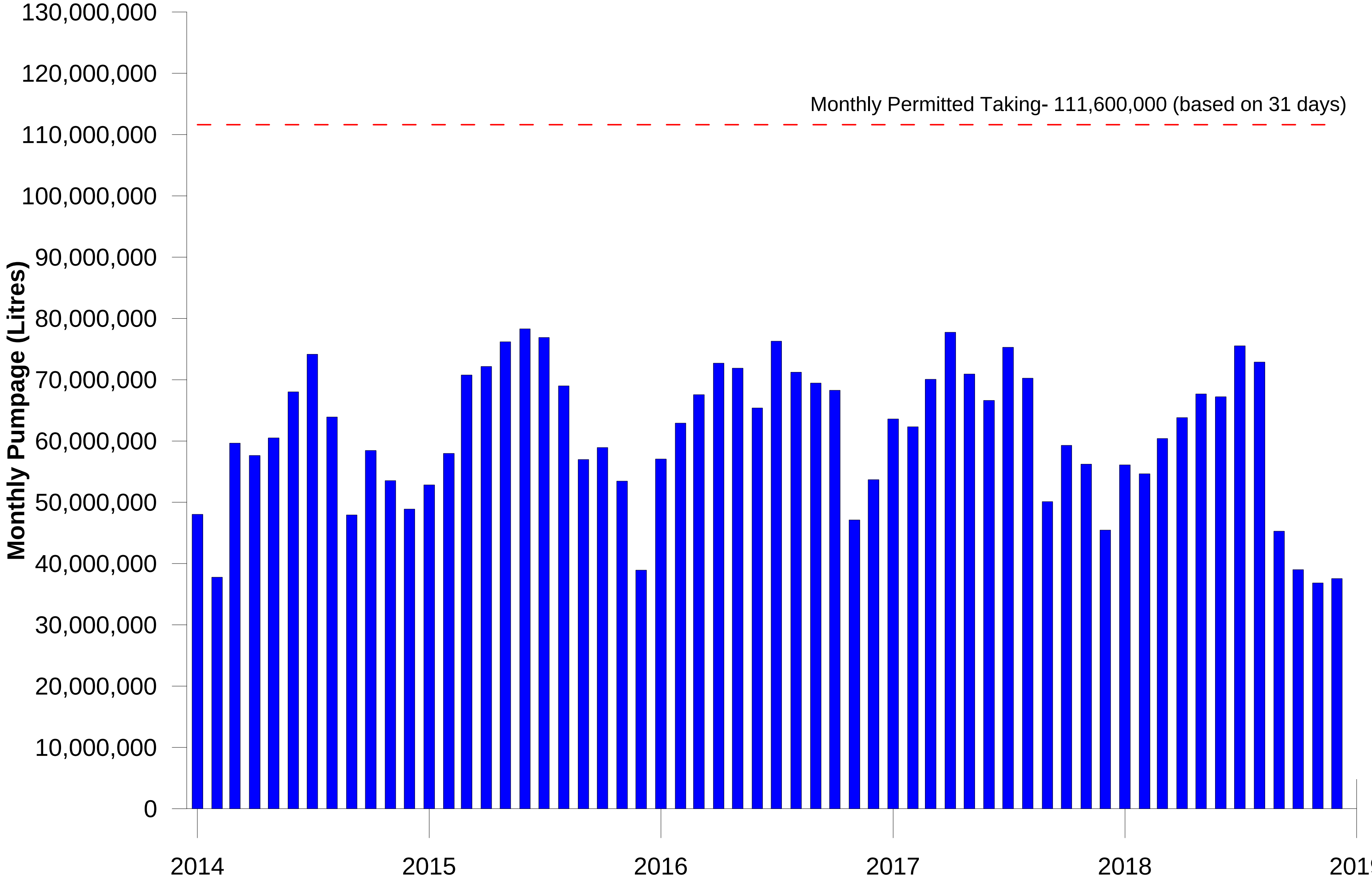
GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT
NESTLE WATERS CANADA
Guelph, Ontario

TITLE
TW3-80 ANNUAL WATER TAKING (2001 TO 2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	4.1



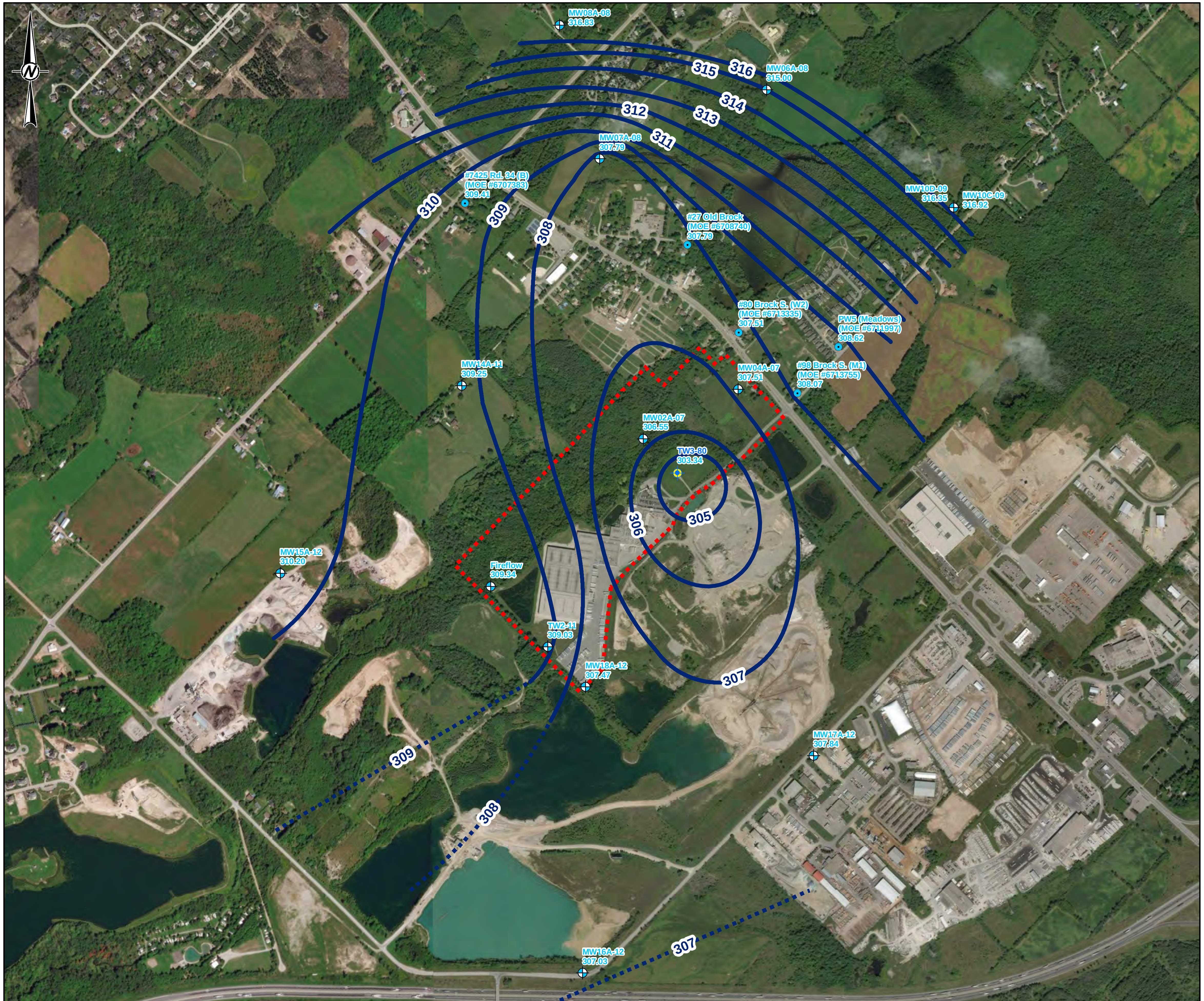
GOLDER

DATE	DECEMBER 2018
DESIGN	KS
REVIEW	GP
APPROVED	GP

PROJECT
NESTLE WATERS CANADA
Guelph, Ontario

TITLE
TW3-80 MONTHLY WATER TAKING (2014 TO 2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	4.2



LEGEND

- Production Well
- Monitoring Well (Bedrock)
- Private Well (Bedrock)
- Watercourse
- 311.5 Water Level Elevation (July 20, 2018)
- Water Elevation Contour (masl)
- Property Boundary

0 200 400 600 800 1,000

1:12,500 METERS

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
NESTLE WATERS CANADA

PROJECT
2018 ANNUAL REPORT

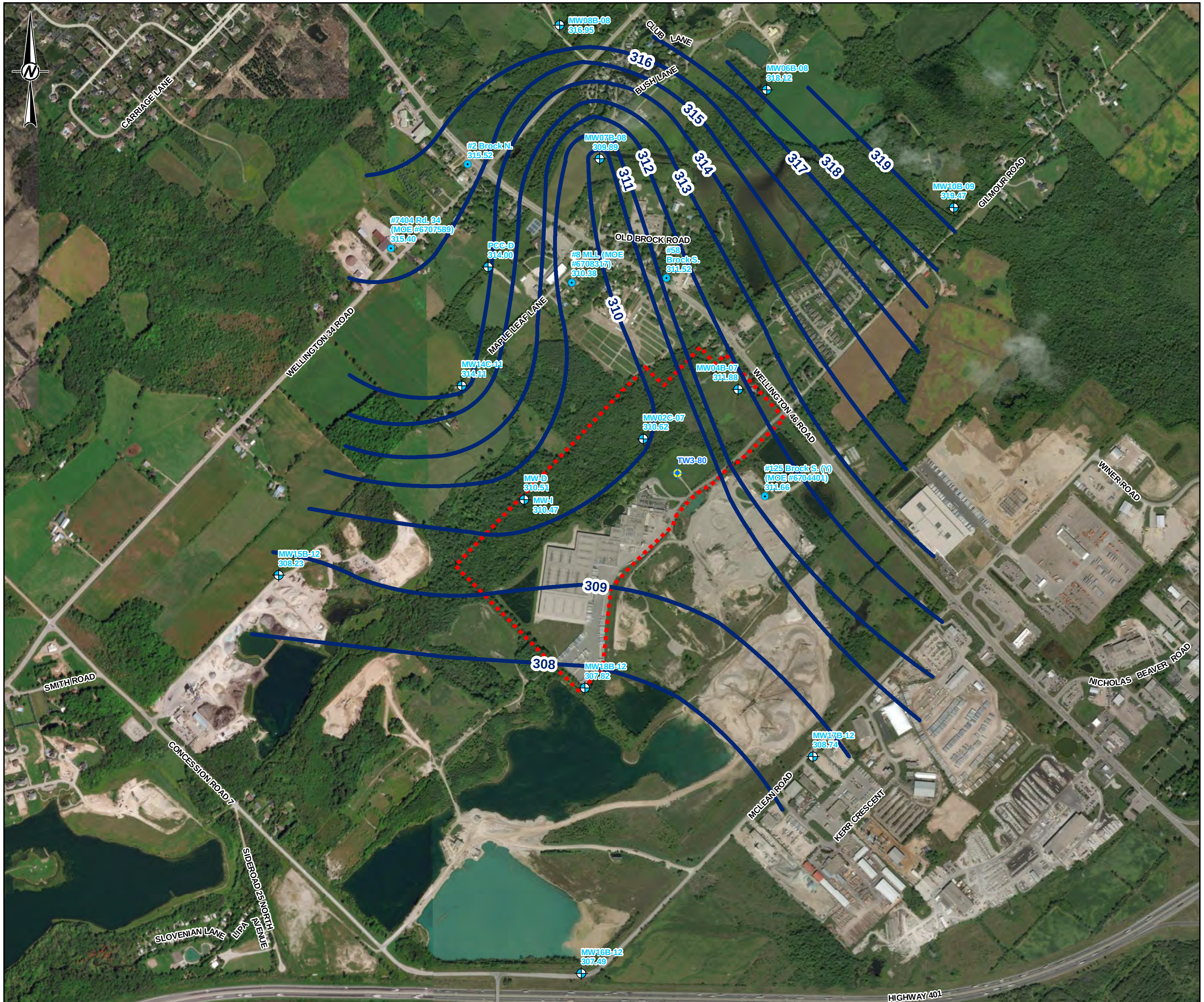
TITLE
POTENTIOMETRIC SURFACE OF LOWER BEDROCK AQUIFER (JULY 2018)

CONSULTANT

GOLDER

YYYY-MM-DD	2019-01-29
DESIGNED	JMC
PREPARED	PR
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	4.3



LEGEND

- Production Well
- Monitoring Well (Bedrock)
- Private Well (Bedrock)
- Watercourse
- 311.5 Water Level Elevation (July 20, 2018)
- Water Elevation Contour (masl)
- Property Boundary

0 200 400 600 800 1,000

1:12,500 METERS

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
NESTLE WATERS CANADA

PROJECT
2018 ANNUAL REPORT

TITLE
POTENTIOMETRIC SURFACE OF UPPER BEDROCK AQUIFER (JULY 2018)

CONSULTANT
GOLDER

YYYY-MM-DD	2019-01-18
DESIGNED	JMC
PREPARED	PR
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	4.4

LEGEND

- Production Well
- Monitoring Well (Overburden)
- Watercourse
- 311.4 Water Level Elevation (July 20, 2018)
- Water Elevation Contour (masl)
- Property Boundary

0 200 400 600 800 1,000

1:12,500 METERS

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
NESTLE WATERS CANADA

PROJECT
2018 ANNUAL REPORT

TITLE
POTENTIOMETRIC SURFACE OF OVERBURDEN (JULY 2018)

CONSULTANT
GOLDER

YYYY-MM-DD	2019-01-29
DESIGNED	JMC
PREPARED	PR
REVIEWED	GP
APPROVED	JP

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	4.5

LEGEND

- Production Well
- Piezometer
- Surface Water Station
- Watercourse
- 311.5 Water Level Elevation (July 20, 2018)
- Property Boundary

0 200 400 600 800 1,000

1:12,500 METERS

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
NESTLE WATERS CANADA

PROJECT
2018 ANNUAL REPORT

TITLE
SURFACE WATER ELEVATIONS

CONSULTANT

GOLDER

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

PROJECT NO.	CONTROL	REV.	FIGURE
13-1152-0250	0019	1.0	4.6

APPENDIX A

Permit To Take Water Number 1381-95ATPY

Ministry of the Environment
West-Central Region
Technical Support Section
12th Floor
119 King St W
Hamilton ON L8P 4Y7
Fax: (905)521-7820
Tel: (905) 521-7640

Ministère de l'Environnement
Direction régionale du Centre-Ouest
Secteur du Soutien Technique
12e étage
119 rue King W
Hamilton ON L8P 4Y7
Télécopieur: (905)521-7820
Tél:(905) 521-7640

December 19, 2013

Nestle Canada Inc.
101 Brock Road S.
Puslinch, Ontario
N1H 6H9

Dear Sir/Madam:

RE: Lot 23, Concession 7
Geographic Township of Puslinch
City of Guelph
Wellington County
Permit Number 1381-95ATPY

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 December 3, 2012 and signed by Don DeMarco.

This Permit expires on July 31, 2016. Authorized rates and amounts are indicated on Table A. This Permit cancels and replaces Permit Number 1763-8FXR29, issued on April 29, 2011.

Ontario Regulation 387/04 (Water Taking) requires all water takers to report daily water taking amounts to the Water Taking Reporting System (WTRS) electronic database: http://www.ene.gov.on.ca/envision/water/pttw.htm . Daily water taking must be reported on a calendar year basis. If no water is taken, then a "no taking" report must be entered. Please consult the Regulation and Section 4 of this Permit for monitoring requirements.

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 . It is preferred that you submit your data directly and electronically to the WTRS. Where this is impracticable, please use the Water Taking Submission Form *(included as Appendix C of the Technical Bulletin: Permit To Take Water (PTTW)-Monitoring and Reporting of Water Takings),* which can be downloaded from the above website, and fax your completed forms to 416-235-6549 or mail them to: Water User Reporting Section, 125 Resources Rd. Toronto, ON M9P 3V6.

Please also note 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,

Carl Slater

Carl Slater
Director, Section 34, Ontario Water Resources Act
West Central Region

File Storage Number: AP28 PUNE

Ministry of the Environment
Ministère de l’Environnement

AMENDED PERMIT TO TAKE WATER
Ground Water
NUMBER 1381-95ATPY

Pursuant to Section 34 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To Take Water is hereby issued to:

Nestle Canada Inc.
101 Brock Road S.
Puslinch, Ontario N1H 6H9

For the water taking from: Two bedrock wells (TW3-80 and TW2-11)

Located at: Lot 23, Concession 7, Geographic Township of Puslinch
Guelph, 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, 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.

(d) "District Office" means the Guelph District Office.

(e) "Permit" means this Permit to Take Water No. 1381-95ATPY including its Schedules, if any, issued in accordance with Section 34 of the OWRA.

(f) "Permit Holder" means Nestle Canada 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:

<u>TERMS AND CONDITIONS</u>

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 December 3, 2012 and signed by Don DeMarco, 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 **July 31, 2016**. 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	Well TW3-80	Well Drilled	Bottled Water	Commercial	2,500	24	3,600,000	365	17 569053 4812797
2	Well TW2-11	Well Drilled	Other - Miscellaneous	Miscellaneous	475	24	684,000	365	17 568638 4812238
						Total Taking:	3,600,000		

3.3 For greater certainty, Source Name Well TW2-11 in Table A shall not be used for bottled water and shall be used for miscellaneous purposes such as providing water to the on site pond for fire fighting purposes.

3.4 For greater certainty, the total amount of water taken for the combination of sources in Table A shall not exceed 3,600,000 litres per day.

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. A separate record shall be maintained for each source. 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 31st 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 wells:
- TW3-80 (67-07290)
- MW2A/B/C-07
- MW4A/B-07
- Fireflow (67-14195)
- MW-D (67-11936)
- MW1A-04
- PCC-D (67-11650)
- MW10B/C/D-09
- MW6A/B-08

- MW7A/B-08
- MW8A/B-08
- TW2-11
- MW14A/B/C-11
- MW15A/B-12
- MW16A/B-12
- MW17A/B-12
- MW18A/B-12

(ii) Monthly monitoring of groundwater levels at the following private wells (if the owner permits):

- Private well MOE WWR #67-08740
- Private well at 2 Brock Road
- Private well MOE WWR #67-07589
- Private well MOE WWR #67-08317 also known as 8 Maple Lane Well
- Private well at 58 Brock Road
- Private well "B"
- Private well "M1"
- Private well "Y" MOE WWR #67-09669
- Private well "J"
- Meadows of Aberfoyle well #PW5 (67-1197)
- Private Well "W2" (67-13335)

Overburden Wells

(iii) Continuous monitoring of groundwater levels in the following wells:

- TW1-93 (67-11283)
- TW1-99 (67-12929)
- MW-S/I
- PCC S/I
- MW2D/E-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
- SW9
- SW10

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
- MP11S-08/D-04
- MP17S/D-12
- MP18S/D-12
- MP19S/D-12

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 4.8.

4.5 The Permit Holder shall determine the total amount of water taken for each calendar month. If the monthly amount exceeds 83,700,000 L, the Permit Holder shall submit multi-level piezometer data in a letter report to the Director within 30 days of the end of the calendar month for the following monitoring locations:

- MP6S-08/D-04
- MP12S/D-04
- MP11S-08/D-04
- MW2-D/E

4.6 Continuous monitoring shall be datalogged at 60 minute intervals and downloaded monthly, 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. Monthly groundwater monitoring shall be conducted in the same week each calendar month.

4.7 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 inaccessible and/or abandoned along with a recommendation for replacement monitoring locations. Upon approval of the Director the monitoring program shall be appropriately modified.

4.8 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.

4.9 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.

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).

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 Environmental Commissioner, ***Environmental Bill of Rights****, R.S.O. 1993, Chapter 28, within 15 days after receipt of this Notice, require a hearing by the Tribunal. The Environmental Commissioner 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:

3. The name of the appellant;
4. The address of the appellant;
5. The Permit to Take Water number;
6. The date of the Permit to Take Water;
7. The name of the Director;
8. 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) 314-4506
Email:
ERTTribunalsecretary@ontario.ca

AND

The Environmental Commissioner
1075 Bay Street
6th Floor, Suite 605
Toronto, Ontario M5S 2W5

AND

The Director, Section 34
Ministry of the Environment
12th Floor
119 King St W
Hamilton ON L8P 4Y7
Fax: (905)521-7820

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

by telephone at (416) 314-4600 ***by fax at (416) 314-4506*** ***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 1763-8FXR29, issued on 2011/04/29.

Dated at Hamilton this 19th day of December, 2013.

Carl Slater

Carl Slater
Director, Section 34
Ontario Water Resources Act , R.S.O. 1990

Schedule A

This Schedule “A” forms part of Permit To Take Water 1381-95ATPY, dated December 19, 2013.

Ministry of the Environment and Climate Change
West Central Region

119 King Street West
12th Floor
Hamilton, Ontario L8P 4Y7
Tel.: 905 521-7640
Fax: 905 521-7820

Ministère de l'Environnement et de l'Action en matière de changement climatique
Direction régionale du Centre-Ouest

119 rue King Ouest
12e étage
Hamilton (Ontario) L8P 4Y7
Tél. : 905 521-7640
Téléc. : 905 521-7820

Ontario

February 5, 2015

Nestle Canada Inc.
101 Brock Road S.
Puslinch, Ontario
N1H 6H9

Attention: Ms. Andreanne Simard

Dear Ms. Simard:

RE: Request for short term pumping rate change for well sanitization
Permit to Take Water 1381-95ATPY

NOTICE

Pursuant to s. 100, Ontario Water Resources Act, R.S.O. 1990, c. O.40 as amended, I am issuing notice that, as Director of Section 34 of the Ontario Water Resources Act, I am exercising my discretion to amend Permit to Take Water 1381-95ATPY condition 3.5. All other terms and conditions of Permit to Take Water 1381-95ATPY shall continue in force.

In an email dated November 27, 2014, Ms. Simard, requested the sanitation Notice issued on December 20, 2013 be applicable for all years remaining on the permit.

This Notice supersedes the Notice issued December 20, 2013. Condition 3.5 is hereby revoked and replaced as follows:

3.5 Notwithstanding Table A, the maximum pumping of water extracted from Source TW3-80 may be increased to 2575 litres per minute (680 U.S. gallons per minute) annually, or as needed, for the sole purpose of sanitization of the well. The maximum amount of water taken shall not exceed 3,600,000 litres/day.

This Notice now forms part of the current permit and must be attached to the original Permit to Take Water, if available. If the original is no longer available, this letter must be kept attached to a certified copy of the Permit to Take Water.

Any change in circumstances related to this permit should be reported promptly to a Director.

It is your responsibility to ensure that any person taking water under the authority of this permit is familiar with and complies with the terms and conditions.

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 Environmental Commissioner, ***Environmental Bill of Rights****, R.S.O. 1993, Chapter 28, within 15 days after receipt of this Notice, require a hearing by the Tribunal. The Environmental Commissioner 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:

3. The name of the appellant;
4. The address of the appellant;
5. The Permit to Take Water number;
6. The date of the Permit to Take Water;
7. The name of the Director;
8. The municipality within which the works are located;

This notice must be served upon:

The Secretary Environmental Review Tribunal 2300 Yonge Street, Suite 1700 Toronto, Ontario M4P 1E4	*AND*	*The Director, Section 34 Ministry of the Environment 12th Floor 119 King St W Hamilton ON L8P 4Y7 Fax: (905)521-7820*

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

by telephone at (416) 314-4600   by fax at (416) 314-4506   by e-mail at www.ert.gov.on.ca

Yours truly,

Dan Dobrin

Director, Section 34, Ontario Water Resources Act
West Central Region

File Storage Number: AP28 PUNE

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	Description & Remarks	Sample: Number	Type	Blows/Foot	Penetration Test Blows/Foot (20 40 60 80)	Piezometer or Standpipe Installation
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)					
		Eramosa member of the Guelph formation * Black dolomite slightly crystalline solid					12" Ø Drive shoe seated into rock
80		(292.3 m amsl)					
(959)		Saw Wiarton 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.

Conestoga - Rovers & Associates

Ministry of the Environment
Ontario

TW #3/80

The Ontario Water Resources Act

WATER WELL RECORD

MOE # 67-07290

County or District	Township, Borough, City, Town, Village	Con., Block, Tract, Survey, etc.	Lot
Wellington	Puslinch	Con 7	23, 2

Owner (Surname First)	Address	Date Completed
Elliott, Mr. John	R.R. #3, Guelph, Ontario.	14 Apr. 8

LOG OF OVERBURDEN AND BEDROCK MATERIALS

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth 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
Grey & Br.		Rock		95	135
D. Grey		Rock		135	139
	TW #3/80	Total Depth			139

12" shoe

WATER RECORD

Water Found at Feet	Kind of Water
55	Fresh
93	Fresh
130	Fresh

CASING & OPEN HOLE RECORD

Inside Diam. Inches	Material	Wall Thickness Inches	Depth From	Depth To
12"	Steel	.250	0	48
12	Open Hole		48	139

PLUGGING & SEALING RECORD

Depth Set At – From	To	Material and Type
102	118	Cement
118	120	Bentonite Grout
120	139	Limestone Gravel

PUMPING TEST

Pumping Test Method: Pump. Pumping Rate: 1200 GPM. Duration of Pumping: 24 Hrs.

Static Level: 11' 6". Water Level End of Pumping: 50 ft. Water Levels During: 11' 6".

Recommended pump type: Deep. Recommended pumping rate: 1200 GPM. Recommended pump setting: 100 feet.

FINAL STATUS OF WELL

Water Supply

WATER USE

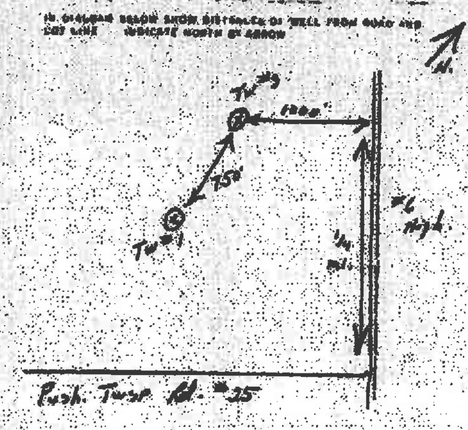
Commercial

METHOD OF DRILLING

Cable Tool

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.



Push. Twsp. Rd. #35

CONTRACTOR

Name of Well Contractor: Graham Well Drilling Ltd. Licence Number: 2936

Address: Guelph, Ont.

Name of Well Technician: J. Hawkins 22w

Submission Date: 30 Apr. 80

CONTRACTOR'S COPY

APPENDIX C

TW3-80 Water Taking

TABLE C1
TW3-80 DAILY WATER TAKING
NESTLE WATERS CANADA
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
1-Jan-18	181,993	127	688,918	481
2-Jan-18	459,074	322	1,737,782	1,218
3-Jan-18	523,126	371	1,980,246	1,403
4-Jan-18	513,205	356	1,942,689	1,349
5-Jan-18	611,752	422	2,315,733	1,596
6-Jan-18	533,505	366	2,019,536	1,387
7-Jan-18	450,242	313	1,704,352	1,185
8-Jan-18	387,960	263	1,468,586	996
9-Jan-18	462,373	320	1,750,273	1,211
10-Jan-18	354,393	248	1,341,521	939
11-Jan-18	437,120	305	1,654,680	1,155
12-Jan-18	620,456	431	2,348,680	1,632
13-Jan-18	246,997	170	934,984	645
14-Jan-18	305,035	213	1,154,683	807
15-Jan-18	405,353	282	1,534,426	1,068
16-Jan-18	558,438	388	2,113,917	1,468
17-Jan-18	490,459	346	1,856,588	1,311
18-Jan-18	569,223	399	2,154,743	1,509
19-Jan-18	589,986	409	2,233,338	1,548
20-Jan-18	601,456	418	2,276,756	1,584
21-Jan-18	497,213	347	1,882,154	1,314
22-Jan-18	591,387	410	2,238,643	1,553
23-Jan-18	553,172	385	2,093,984	1,457
24-Jan-18	543,717	377	2,058,193	1,425
25-Jan-18	503,412	353	1,905,619	1,336
26-Jan-18	578,977	403	2,191,665	1,524
27-Jan-18	551,358	386	2,087,117	1,461
28-Jan-18	504,099	333	1,908,223	1,261
29-Jan-18	293,923	205	1,112,621	776
30-Jan-18	448,028	312	1,695,970	1,183
31-Jan-18	456,245	318	1,727,075	1,205

TABLE C1
TW3-80 DAILY WATER TAKING
NESTLE WATERS CANADA
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
1-Feb-18	555,507	387	2,102,823	1,466
2-Feb-18	495,442	348	1,875,451	1,317
3-Feb-18	542,749	379	2,054,529	1,434
4-Feb-18	497,336	347	1,882,621	1,314
5-Feb-18	478,677	334	1,811,990	1,265
6-Feb-18	556,196	389	2,105,428	1,472
7-Feb-18	592,883	414	2,244,305	1,568
8-Feb-18	563,413	393	2,132,750	1,488
9-Feb-18	529,592	370	2,004,722	1,400
10-Feb-18	555,562	388	2,103,030	1,469
11-Feb-18	565,332	395	2,140,014	1,495
12-Feb-18	497,591	347	1,883,585	1,315
13-Feb-18	538,183	376	2,037,245	1,422
14-Feb-18	432,670	302	1,637,833	1,143
15-Feb-18	433,992	303	1,642,838	1,146
16-Feb-18	369,996	259	1,400,586	980
17-Feb-18	431,765	301	1,634,408	1,138
18-Feb-18	514,014	354	1,945,752	1,341
19-Feb-18	468,077	322	1,771,864	1,217
20-Feb-18	502,420	350	1,901,865	1,327
21-Feb-18	440,651	307	1,668,046	1,162
22-Feb-18	551,779	384	2,088,711	1,452
23-Feb-18	472,988	330	1,790,455	1,250
24-Feb-18	576,721	400	2,183,124	1,514
25-Feb-18	576,814	400	2,183,477	1,514
26-Feb-18	533,527	372	2,019,619	1,407
27-Feb-18	573,610	398	2,171,349	1,507
28-Feb-18	588,014	411	2,225,873	1,554

TABLE C1
TW3-80 DAILY WATER TAKING
NESTLE WATERS CANADA
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
1-Mar-18	510,561	356	1,932,682	1,348
2-Mar-18	539,576	377	2,042,518	1,425
3-Mar-18	587,906	412	2,225,466	1,558
4-Mar-18	206,512	218	781,732	827
5-Mar-18	475,825	332	1,801,191	1,258
6-Mar-18	525,390	367	1,988,817	1,389
7-Mar-18	470,751	329	1,781,985	1,247
8-Mar-18	547,311	382	2,071,797	1,447
9-Mar-18	561,956	392	2,127,233	1,485
10-Mar-18	547,833	400	2,073,771	1,513
11-Mar-18	501,081	350	1,896,798	1,326
12-Mar-18	400,581	279	1,516,364	1,055
13-Mar-18	421,371	295	1,595,061	1,115
14-Mar-18	395,880	277	1,498,567	1,050
15-Mar-18	518,957	362	1,964,464	1,372
16-Mar-18	403,871	282	1,528,818	1,067
17-Mar-18	543,581	379	2,057,675	1,436
18-Mar-18	466,183	326	1,764,694	1,233
19-Mar-18	578,254	404	2,188,930	1,529
20-Mar-18	594,726	414	2,251,281	1,566
21-Mar-18	487,722	341	1,846,229	1,292
22-Mar-18	533,970	373	2,021,297	1,413
23-Mar-18	587,526	409	2,224,028	1,549
24-Mar-18	523,374	366	1,981,184	1,386
25-Mar-18	544,640	381	2,061,687	1,441
26-Mar-18	563,389	394	2,132,657	1,490
27-Mar-18	611,295	428	2,314,001	1,621
28-Mar-18	591,719	411	2,239,898	1,556
29-Mar-18	570,546	396	2,159,751	1,500
30-Mar-18	578,304	402	2,189,118	1,522
31-Mar-18	567,807	396	2,149,384	1,500

TABLE C1
TW3-80 DAILY WATER TAKING
NESTLE WATERS CANADA
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
1-Apr-18	617,792	431	2,338,594	1,632
2-Apr-18	576,415	408	2,181,966	1,545
3-Apr-18	670,363	469	2,537,600	1,776
4-Apr-18	648,302	451	2,454,089	1,706
5-Apr-18	722,332	500	2,734,322	1,893
6-Apr-18	659,384	458	2,496,039	1,733
7-Apr-18	613,942	427	2,324,021	1,615
8-Apr-18	590,459	414	2,235,128	1,566
9-Apr-18	616,153	429	2,332,393	1,624
10-Apr-18	659,287	458	2,495,671	1,733
11-Apr-18	605,489	420	2,292,025	1,588
12-Apr-18	571,703	400	2,164,129	1,515
13-Apr-18	639,172	445	2,419,526	1,684
14-Apr-18	129,152	89	488,893	336
15-Apr-18	161,955	114	613,068	433
16-Apr-18	568,302	398	2,151,257	1,505
17-Apr-18	664,616	460	2,515,845	1,742
18-Apr-18	656,025	454	2,483,323	1,720
19-Apr-18	694,914	482	2,630,533	1,823
20-Apr-18	680,180	472	2,574,759	1,786
21-Apr-18	686,390	477	2,598,268	1,804
22-Apr-18	671,214	466	2,540,820	1,765
23-Apr-18	547,572	381	2,072,785	1,442
24-Apr-18	620,475	430	2,348,753	1,629
25-Apr-18	583,594	403	2,209,142	1,527
26-Apr-18	422,478	301	1,599,251	1,139
27-Apr-18	430,097	299	1,628,094	1,132
28-Apr-18	416,419	290	1,576,316	1,098
29-Apr-18	385,762	267	1,460,268	1,009
30-Apr-18	342,419	241	1,296,196	912

TABLE C1
TW3-80 DAILY WATER TAKING
NESTLE WATERS CANADA
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
1-May-18	512,748	358	1,940,960	1,356
2-May-18	600,016	421	2,271,308	1,592
3-May-18	648,039	450	2,453,093	1,705
4-May-18	701,657	493	2,656,060	1,866
5-May-18	712,860	501	2,698,468	1,895
6-May-18	741,967	520	2,808,648	1,969
7-May-18	526,931	369	1,994,650	1,396
8-May-18	701,125	492	2,654,045	1,863
9-May-18	632,923	443	2,395,872	1,677
10-May-18	661,832	464	2,505,306	1,757
11-May-18	621,695	435	2,353,371	1,646
12-May-18	543,097	379	2,055,846	1,434
13-May-18	592,969	415	2,244,630	1,569
14-May-18	630,166	442	2,385,437	1,672
15-May-18	599,089	419	2,267,798	1,585
16-May-18	594,763	416	2,251,422	1,574
17-May-18	607,422	423	2,299,342	1,601
18-May-18	517,815	360	1,960,144	1,364
19-May-18	558,003	392	2,112,272	1,484
20-May-18	548,194	383	2,075,139	1,451
21-May-18	441,093	308	1,669,719	1,165
22-May-18	545,637	380	2,065,458	1,439
23-May-18	652,378	459	2,469,519	1,739
24-May-18	588,902	410	2,229,235	1,554
25-May-18	367,651	239	1,391,709	903
26-May-18	488,621	340	1,849,631	1,289
27-May-18	486,098	337	1,840,079	1,276
28-May-18	526,945	370	1,994,703	1,401
29-May-18	530,227	361	2,007,125	1,368
30-May-18	529,128	369	2,002,965	1,397
31-May-18	469,385	327	1,776,815	1,239

TABLE C1
TW3-80 DAILY WATER TAKING
NESTLE WATERS CANADA
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
1-Jun-18	515,466	357	1,951,251	1,351
2-Jun-18	454,259	317	1,719,557	1,201
3-Jun-18	518,913	363	1,964,299	1,375
4-Jun-18	507,165	353	1,919,828	1,336
5-Jun-18	610,471	425	2,310,882	1,610
6-Jun-18	581,071	404	2,199,592	1,531
7-Jun-18	630,855	439	2,388,046	1,663
8-Jun-18	625,414	436	2,367,447	1,649
9-Jun-18	550,469	383	2,083,752	1,452
10-Jun-18	687,461	476	2,602,323	1,803
11-Jun-18	580,712	404	2,198,231	1,530
12-Jun-18	476,636	330	1,804,261	1,249
13-Jun-18	516,541	359	1,955,320	1,360
14-Jun-18	562,283	391	2,128,470	1,482
15-Jun-18	627,832	435	2,376,602	1,648
16-Jun-18	672,196	468	2,544,537	1,771
17-Jun-18	561,456	391	2,125,341	1,482
18-Jun-18	555,252	386	2,101,858	1,462
19-Jun-18	593,987	413	2,248,484	1,562
20-Jun-18	576,759	401	2,183,270	1,516
21-Jun-18	596,669	415	2,258,638	1,569
22-Jun-18	633,825	440	2,399,288	1,665
23-Jun-18	672,780	466	2,546,748	1,764
24-Jun-18	681,534	473	2,579,886	1,789
25-Jun-18	683,366	475	2,586,821	1,798
26-Jun-18	683,936	474	2,588,980	1,793
27-Jun-18	558,674	387	2,114,810	1,464
28-Jun-18	659,265	456	2,495,589	1,726
29-Jun-18	577,232	402	2,185,059	1,520
30-Jun-18	605,410	421	2,291,724	1,594

TABLE C1
TW3-80 DAILY WATER TAKING
NESTLE WATERS CANADA
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
1-Jul-18	686,078	475	2,597,088	1,800
2-Jul-18	578,318	401	2,189,170	1,517
3-Jul-18	593,961	416	2,248,387	1,575
4-Jul-18	673,355	468	2,548,924	1,772
5-Jul-18	566,756	395	2,145,402	1,495
6-Jul-18	615,184	427	2,328,724	1,615
7-Jul-18	651,274	452	2,465,338	1,712
8-Jul-18	719,574	496	2,723,881	1,878
9-Jul-18	640,503	445	2,424,567	1,683
10-Jul-18	659,409	455	2,496,133	1,723
11-Jul-18	699,722	489	2,648,736	1,851
12-Jul-18	699,897	490	2,649,395	1,854
13-Jul-18	680,807	473	2,577,132	1,791
14-Jul-18	686,244	483	2,597,715	1,829
15-Jul-18	642,204	446	2,431,006	1,687
16-Jul-18	581,534	406	2,201,343	1,539
17-Jul-18	630,218	433	2,385,632	1,640
18-Jul-18	646,254	452	2,446,337	1,711
19-Jul-18	552,809	387	2,092,610	1,464
20-Jul-18	666,393	467	2,522,572	1,767
21-Jul-18	687,982	481	2,604,295	1,819
22-Jul-18	719,330	504	2,722,958	1,909
23-Jul-18	605,999	424	2,293,953	1,606
24-Jul-18	609,099	425	2,305,689	1,610
25-Jul-18	630,204	443	2,385,581	1,675
26-Jul-18	646,551	452	2,447,462	1,712
27-Jul-18	541,994	379	2,051,668	1,435
28-Jul-18	630,832	442	2,387,956	1,674
29-Jul-18	684,209	480	2,590,012	1,816
30-Jul-18	643,566	449	2,436,160	1,699
31-Jul-18	679,900	478	2,573,701	1,810

TABLE C1
TW3-80 DAILY WATER TAKING
NESTLE WATERS CANADA
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
1-Aug-18	673,041	471	2,547,738	1,784
2-Aug-18	659,776	463	2,497,524	1,751
3-Aug-18	626,129	438	2,370,154	1,658
4-Aug-18	666,419	466	2,522,668	1,765
5-Aug-18	622,834	438	2,357,681	1,657
6-Aug-18	616,148	428	2,332,374	1,621
7-Aug-18	629,109	442	2,381,436	1,674
8-Aug-18	419,491	292	1,587,944	1,106
9-Aug-18	595,496	416	2,254,198	1,575
10-Aug-18	584,640	407	2,213,104	1,542
11-Aug-18	547,250	381	2,071,564	1,441
12-Aug-18	549,722	382	2,080,923	1,447
13-Aug-18	583,067	408	2,207,146	1,545
14-Aug-18	687,945	482	2,604,155	1,823
15-Aug-18	698,559	490	2,644,331	1,856
16-Aug-18	572,643	400	2,167,689	1,516
17-Aug-18	624,092	433	2,362,442	1,641
18-Aug-18	678,342	470	2,567,802	1,780
19-Aug-18	713,271	494	2,700,024	1,868
20-Aug-18	625,914	437	2,369,340	1,656
21-Aug-18	543,795	379	2,058,487	1,436
22-Aug-18	652,684	457	2,470,675	1,730
23-Aug-18	616,326	432	2,333,047	1,634
24-Aug-18	661,879	463	2,505,483	1,754
25-Aug-18	664,050	465	2,513,701	1,762
26-Aug-18	657,088	460	2,487,347	1,742
27-Aug-18	592,126	413	2,241,438	1,564
28-Aug-18	589,237	412	2,230,504	1,561
29-Aug-18	649,386	454	2,458,192	1,720
30-Aug-18	593,286	416	2,245,830	1,575
31-Aug-18	656,668	460	2,485,757	1,742

TABLE C1
TW3-80 DAILY WATER TAKING
NESTLE WATERS CANADA
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
1-Sep-18	656,282	459	2,484,296	1,736
2-Sep-18	690,211	484	2,612,733	1,832
3-Sep-18	580,638	407	2,197,952	1,541
4-Sep-18	407,779	282	1,543,612	1,069
5-Sep-18	451,068	315	1,707,477	1,193
6-Sep-18	552,364	386	2,090,922	1,461
7-Sep-18	488,431	341	1,848,910	1,291
8-Sep-18	478,729	330	1,812,185	1,250
9-Sep-18	501,557	352	1,898,599	1,333
10-Sep-18	454,132	317	1,719,074	1,199
11-Sep-18	372,286	258	1,409,253	978
12-Sep-18	471,396	326	1,784,427	1,232
13-Sep-18	334,204	234	1,265,097	886
14-Sep-18	376,096	261	1,423,678	987
15-Sep-18	332,089	231	1,257,092	876
16-Sep-18	328,620	231	1,243,961	876
17-Sep-18	427,992	298	1,620,125	1,129
18-Sep-18	397,195	276	1,503,547	1,044
19-Sep-18	446,008	315	1,688,324	1,192
20-Sep-18	386,892	270	1,464,546	1,022
21-Sep-18	239,321	165	905,929	626
22-Sep-18	265,837	186	1,006,300	702
23-Sep-18	278,989	197	1,056,086	744
24-Sep-18	411,165	285	1,556,429	1,081
25-Sep-18	374,804	262	1,418,787	993
26-Sep-18	280,447	195	1,061,605	738
27-Sep-18	285,680	199	1,081,414	753
28-Sep-18	252,749	179	956,760	676
29-Sep-18	217,734	150	824,213	569
30-Sep-18	219,882	154	832,343	581

TABLE C1
TW3-80 DAILY WATER TAKING
NESTLE WATERS CANADA
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
1-Oct-18	179,673	126	680,137	477
2-Oct-18	245,602	171	929,704	649
3-Oct-18	443,437	311	1,678,590	1,179
4-Oct-18	484,612	336	1,834,456	1,273
5-Oct-18	387,129	271	1,465,443	1,027
6-Oct-18	525,344	366	1,988,641	1,384
7-Oct-18	544,726	382	2,062,011	1,444
8-Oct-18	389,173	269	1,473,179	1,020
9-Oct-18	433,724	304	1,641,824	1,151
10-Oct-18	385,746	267	1,460,207	1,009
11-Oct-18	522,161	366	1,976,594	1,385
12-Oct-18	413,906	288	1,566,804	1,090
13-Oct-18	532,211	371	2,014,636	1,403
14-Oct-18	462,279	321	1,749,915	1,215
15-Oct-18	243,486	168	921,695	636
16-Oct-18	117	1	444	4
17-Oct-18	105,048	78	397,650	295
18-Oct-18	0	1	0	4
19-Oct-18	258,462	182	978,384	689
20-Oct-18	34,082	25	129,012	93
21-Oct-18	54,160	39	205,018	146
22-Oct-18	431,329	300	1,632,756	1,137
23-Oct-18	425,930	299	1,612,320	1,133
24-Oct-18	454,816	315	1,721,665	1,193
25-Oct-18	383,673	267	1,452,360	1,009
26-Oct-18	351,707	244	1,331,356	925
27-Oct-18	331,230	232	1,253,842	878
28-Oct-18	239,498	167	906,598	631
29-Oct-18	280,936	195	1,063,456	739
30-Oct-18	345,747	241	1,308,793	911
31-Oct-18	418,424	289	1,583,907	1,095

TABLE C1
TW3-80 DAILY WATER TAKING
NESTLE WATERS CANADA
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
1-Nov-18	340,636	236	1,289,447	893
2-Nov-18	244,637	171	926,050	649
3-Nov-18	348,750	242	1,320,161	915
4-Nov-18	326,722	215	1,236,779	815
5-Nov-18	347,213	241	1,314,343	911
6-Nov-18	371,119	257	1,404,836	972
7-Nov-18	283,582	199	1,073,473	752
8-Nov-18	314,724	217	1,191,358	820
9-Nov-18	314,658	221	1,191,108	837
10-Nov-18	275,927	192	1,044,496	729
11-Nov-18	340,969	237	1,290,706	895
12-Nov-18	370,345	256	1,401,908	968
13-Nov-18	413,539	289	1,565,416	1,094
14-Nov-18	407,825	284	1,543,784	1,075
15-Nov-18	220,307	152	833,954	574
16-Nov-18	245,424	172	929,031	652
17-Nov-18	290,705	202	1,100,437	765
18-Nov-18	283,213	196	1,072,078	742
19-Nov-18	269,627	188	1,020,649	711
20-Nov-18	308,865	215	1,169,181	813
21-Nov-18	332,611	231	1,259,068	874
22-Nov-18	292,610	203	1,107,651	768
23-Nov-18	257,434	178	974,493	675
24-Nov-18	327,502	228	1,239,731	865
25-Nov-18	295,804	205	1,119,740	778
26-Nov-18	352,518	245	1,334,424	928
27-Nov-18	360,378	250	1,364,177	946
28-Nov-18	389,427	271	1,474,140	1,025
29-Nov-18	464,246	326	1,757,363	1,233
30-Nov-18	339,071	236	1,283,521	892

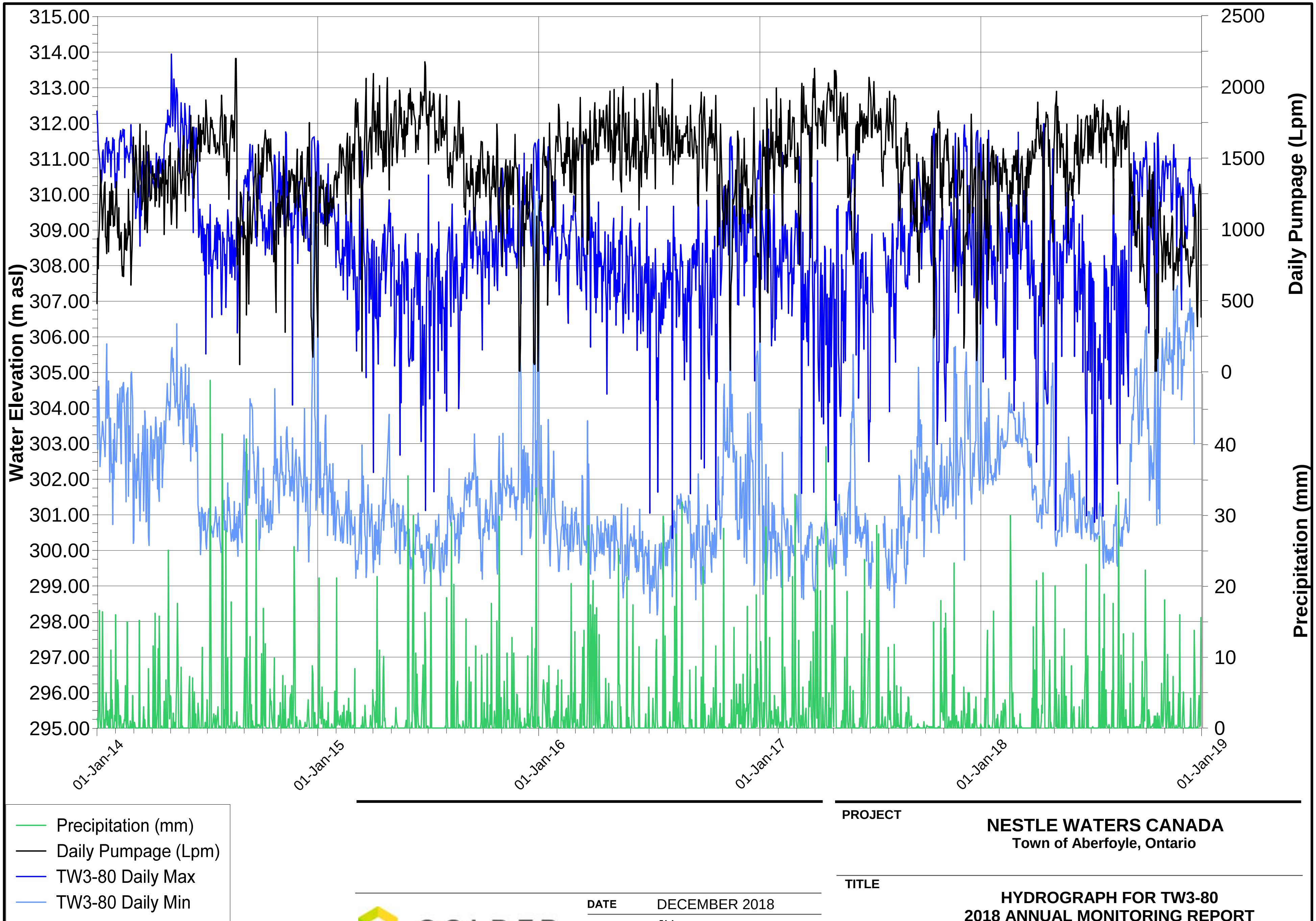
TABLE C1
TW3-80 DAILY WATER TAKING
NESTLE WATERS CANADA
ABERFOYLE, ONTARIO

Date	Volume (US gpd)	Average Flow Rate Over Time Taken (US gpm)	Volume (L/day)	Average Flow Rate Over Time Taken (L/min)
1-Dec-18	336,578	233	1,274,085	884
2-Dec-18	331,381	230	1,254,412	871
3-Dec-18	329,094	230	1,245,756	872
4-Dec-18	358,449	259	1,356,876	979
5-Dec-18	346,297	235	1,310,876	889
6-Dec-18	298,009	207	1,128,088	783
7-Dec-18	318,980	222	1,207,471	839
8-Dec-18	329,071	228	1,245,667	864
9-Dec-18	328,178	226	1,242,288	855
10-Dec-18	261,353	183	989,328	693
11-Dec-18	252,623	175	956,282	664
12-Dec-18	227,262	158	860,278	597
13-Dec-18	259,264	181	981,421	684
14-Dec-18	310,053	214	1,173,679	809
15-Dec-18	279,616	196	1,058,461	741
16-Dec-18	294,816	204	1,116,000	773
17-Dec-18	291,613	203	1,103,875	767
18-Dec-18	334,156	232	1,264,916	877
19-Dec-18	302,351	210	1,144,522	795
20-Dec-18	416,022	289	1,574,814	1,094
21-Dec-18	410,933	311	1,555,551	1,176
22-Dec-18	418,577	291	1,584,484	1,102
23-Dec-18	311,917	216	1,180,734	819
24-Dec-18	165,648	115	627,044	434
25-Dec-18	119,162	84	451,078	317
26-Dec-18	210,125	147	795,408	558
27-Dec-18	463,777	322	1,755,585	1,220
28-Dec-18	491,782	342	1,861,596	1,293
29-Dec-18	500,257	348	1,893,680	1,317
30-Dec-18	478,548	332	1,811,499	1,258
31-Dec-18	147,418	101	558,039	383

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

APPENDIX D

Groundwater Level Monitoring



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

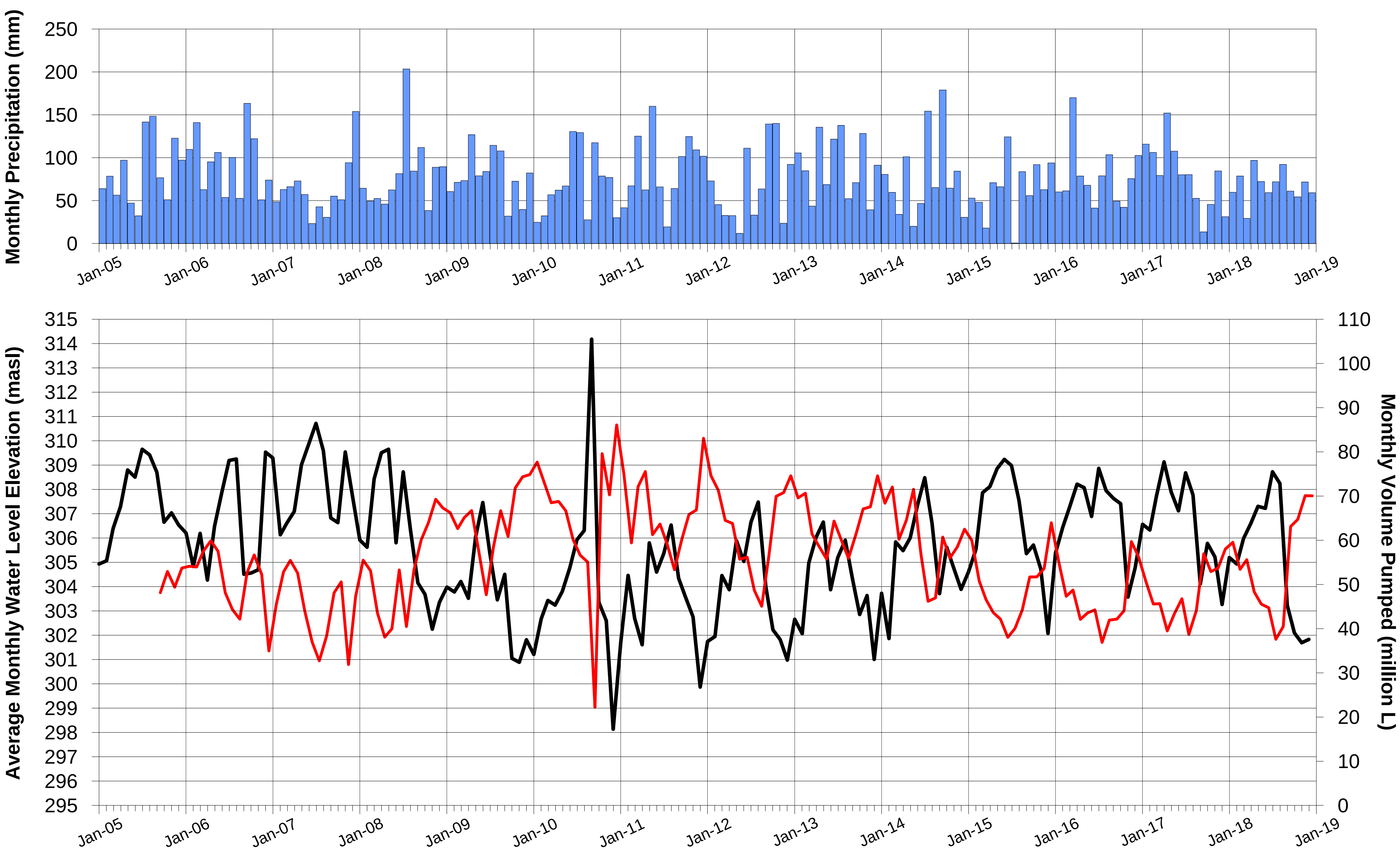
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

HYDROGRAPH FOR TW3-80
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D1a



Volume Pumped (L)
TW3-80

GOLDER

DATE	December 2018
DESIGN	KJ
REVIEW	GP
APPROVED	GP

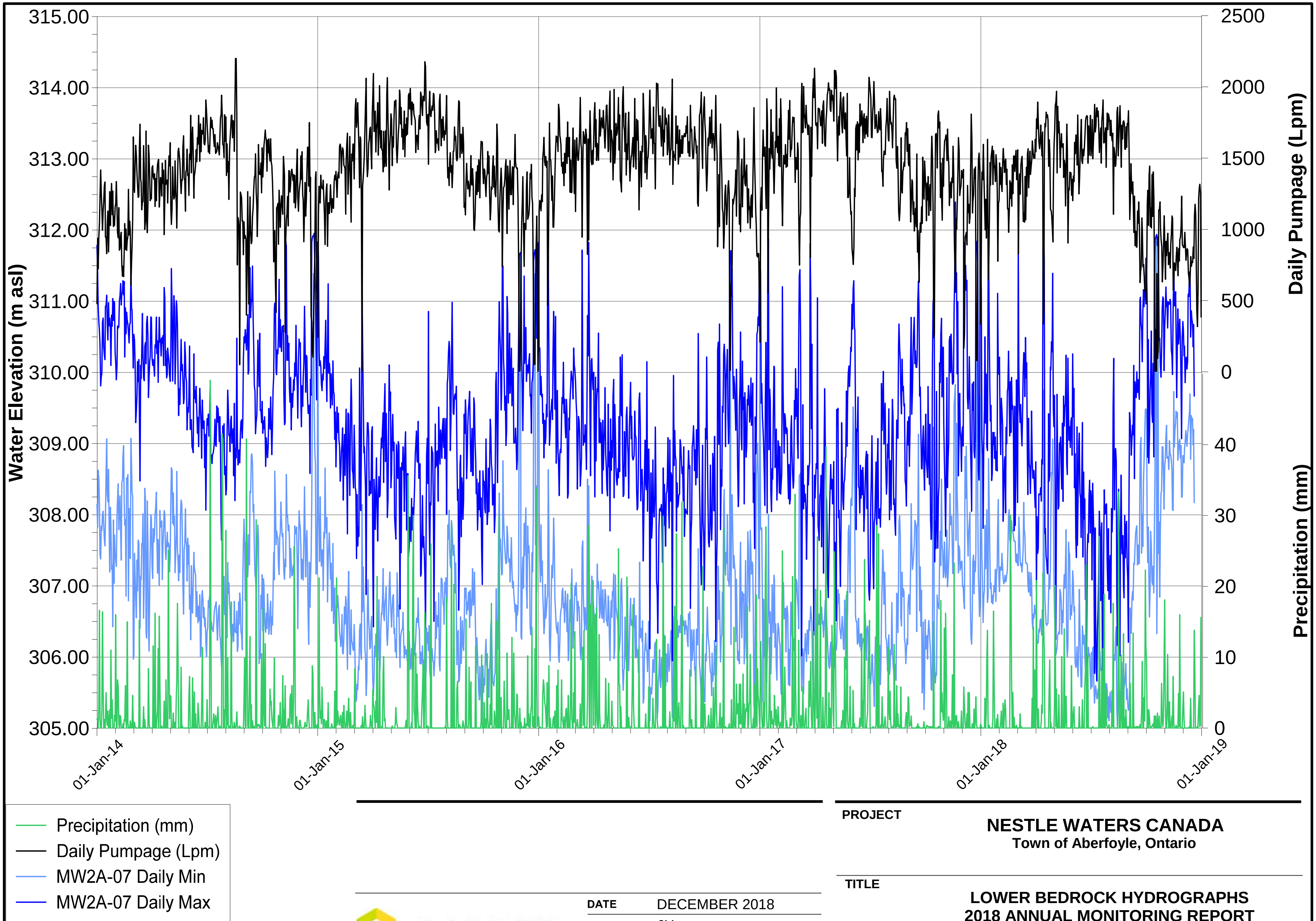
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

AVERAGE MONTHLY WATER LEVELS TW3-80
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D1b



DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

GOLDER

PROJECT

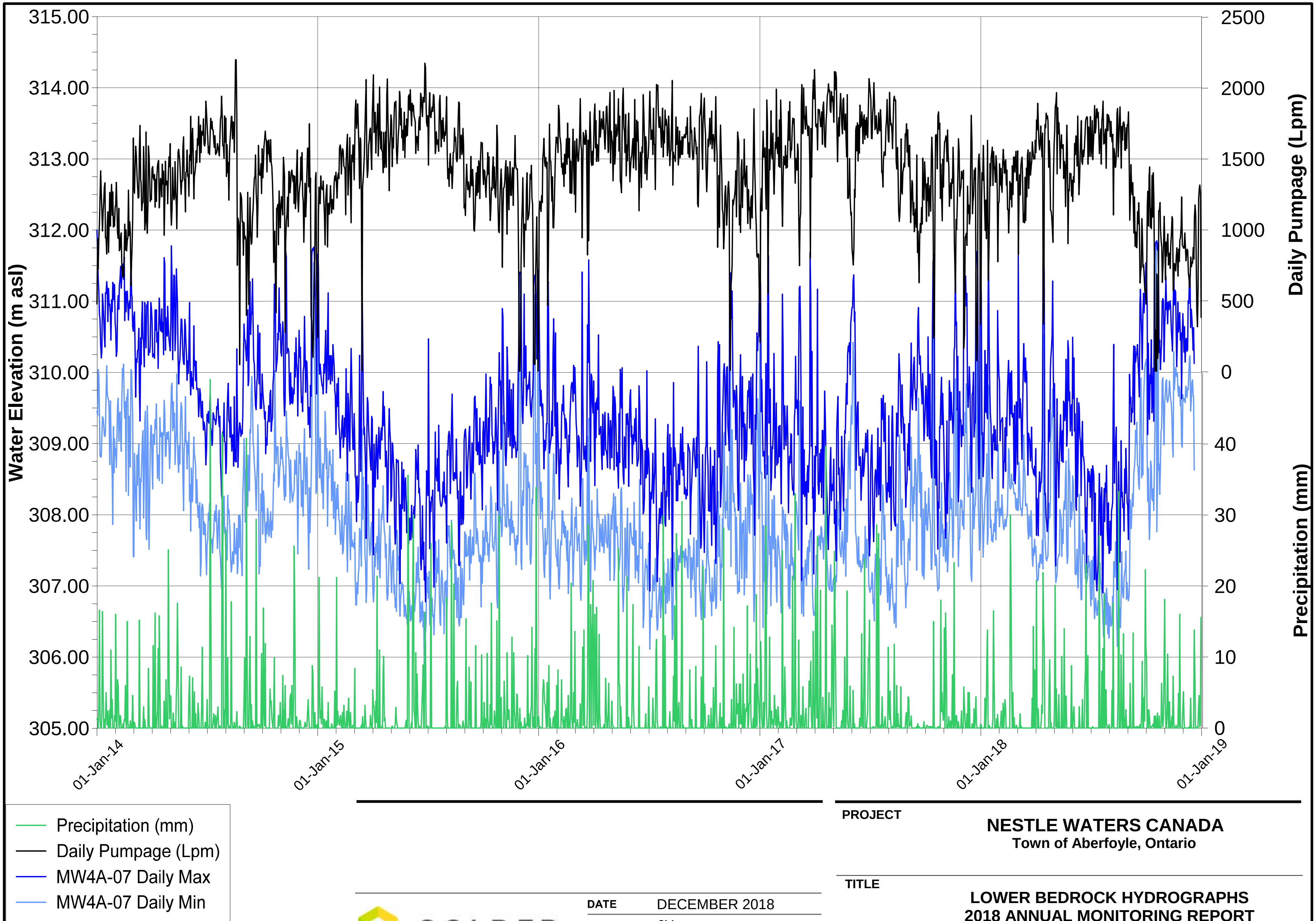
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D2



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

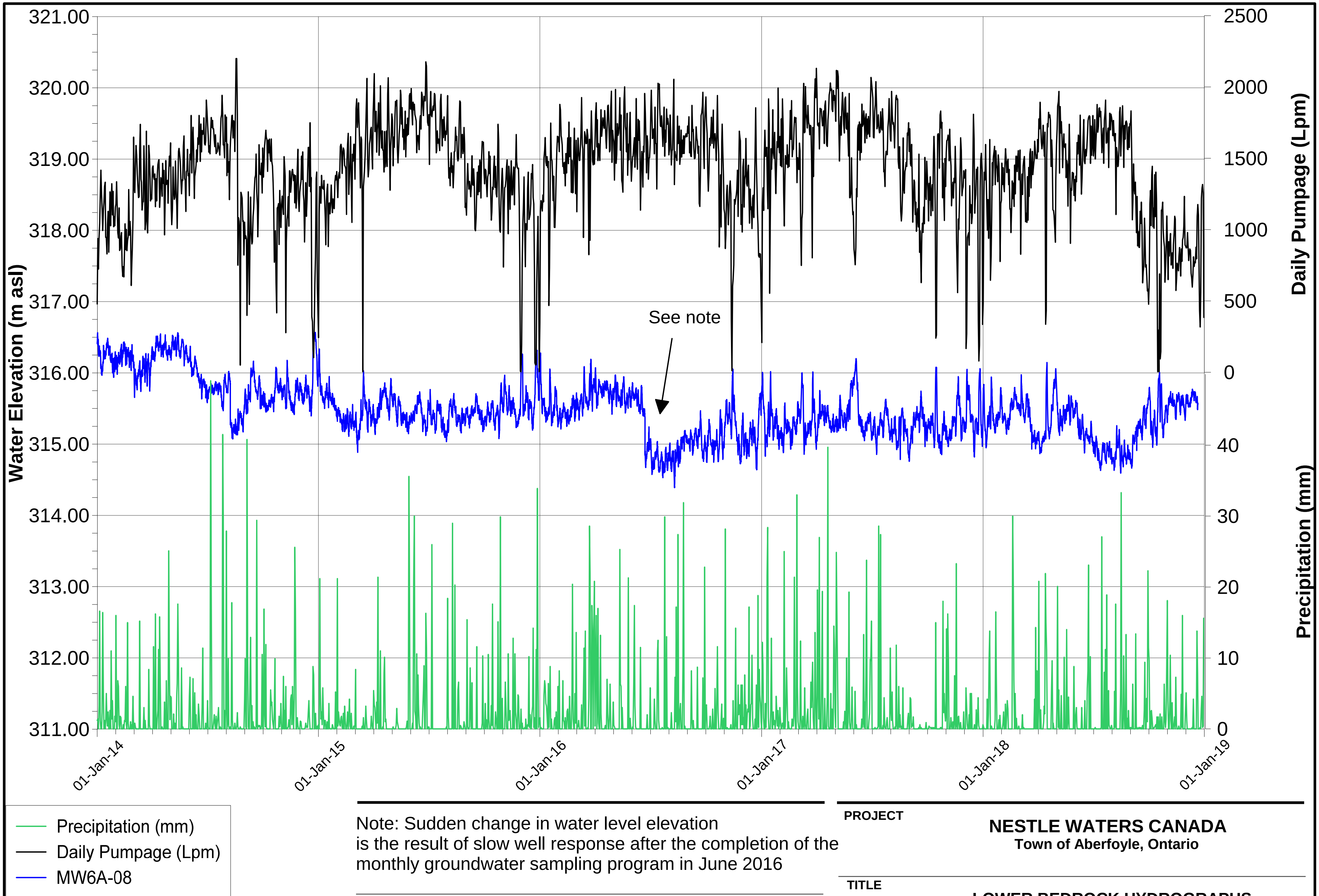
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D3



Note: Sudden change in water level elevation is the result of slow well response after the completion of the monthly groundwater sampling program in June 2016

GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

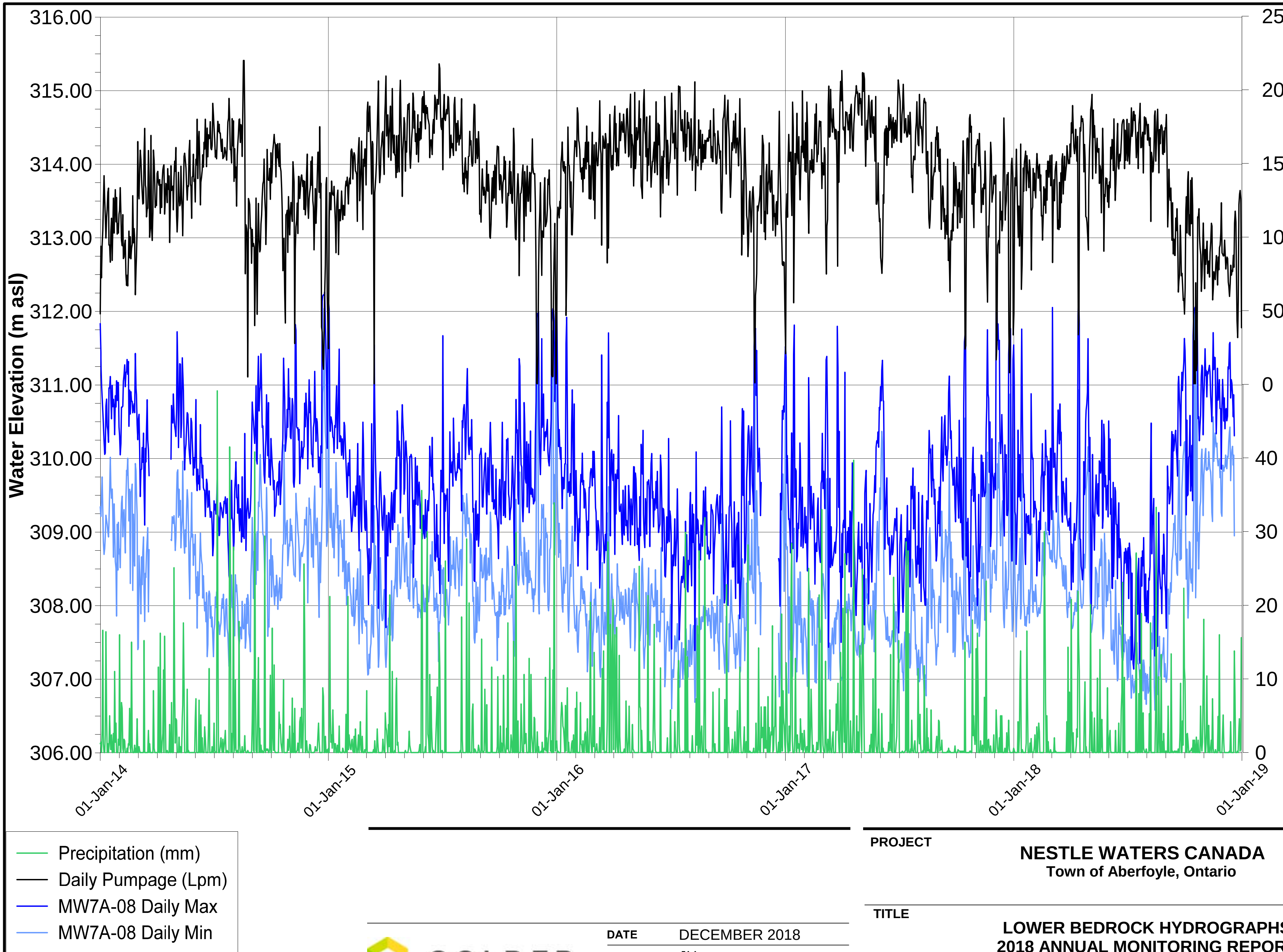
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D4



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

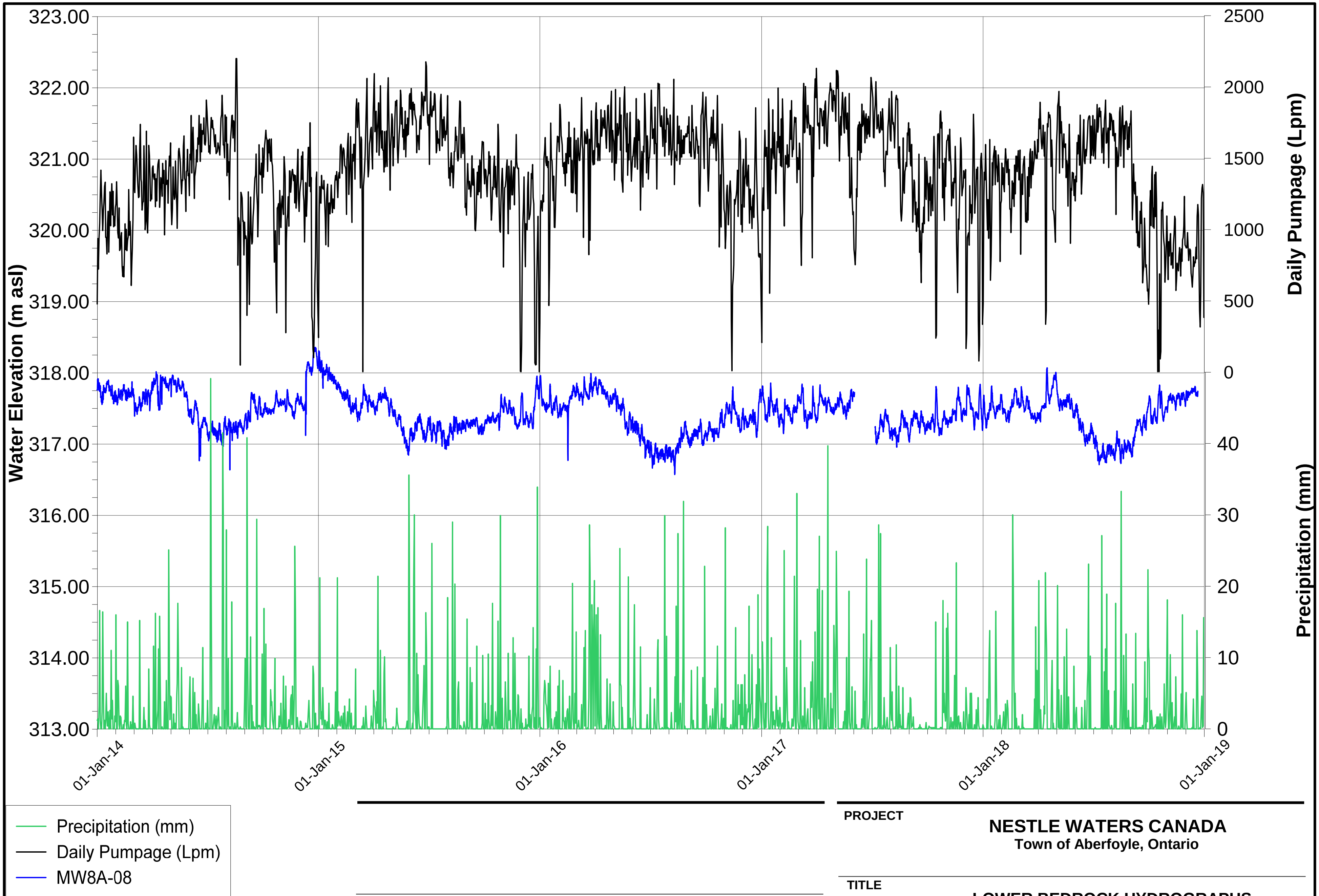
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D5



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

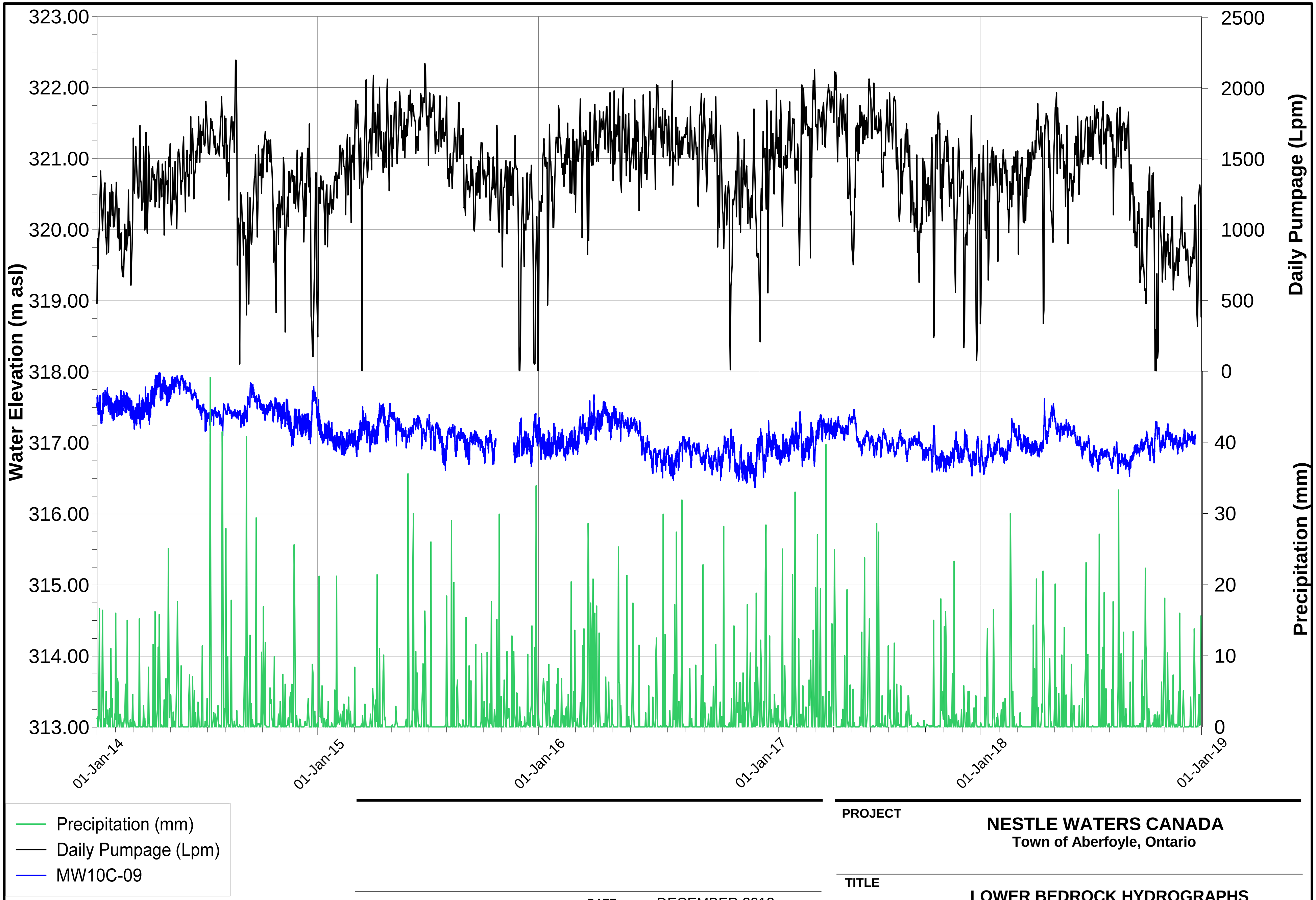
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D6



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

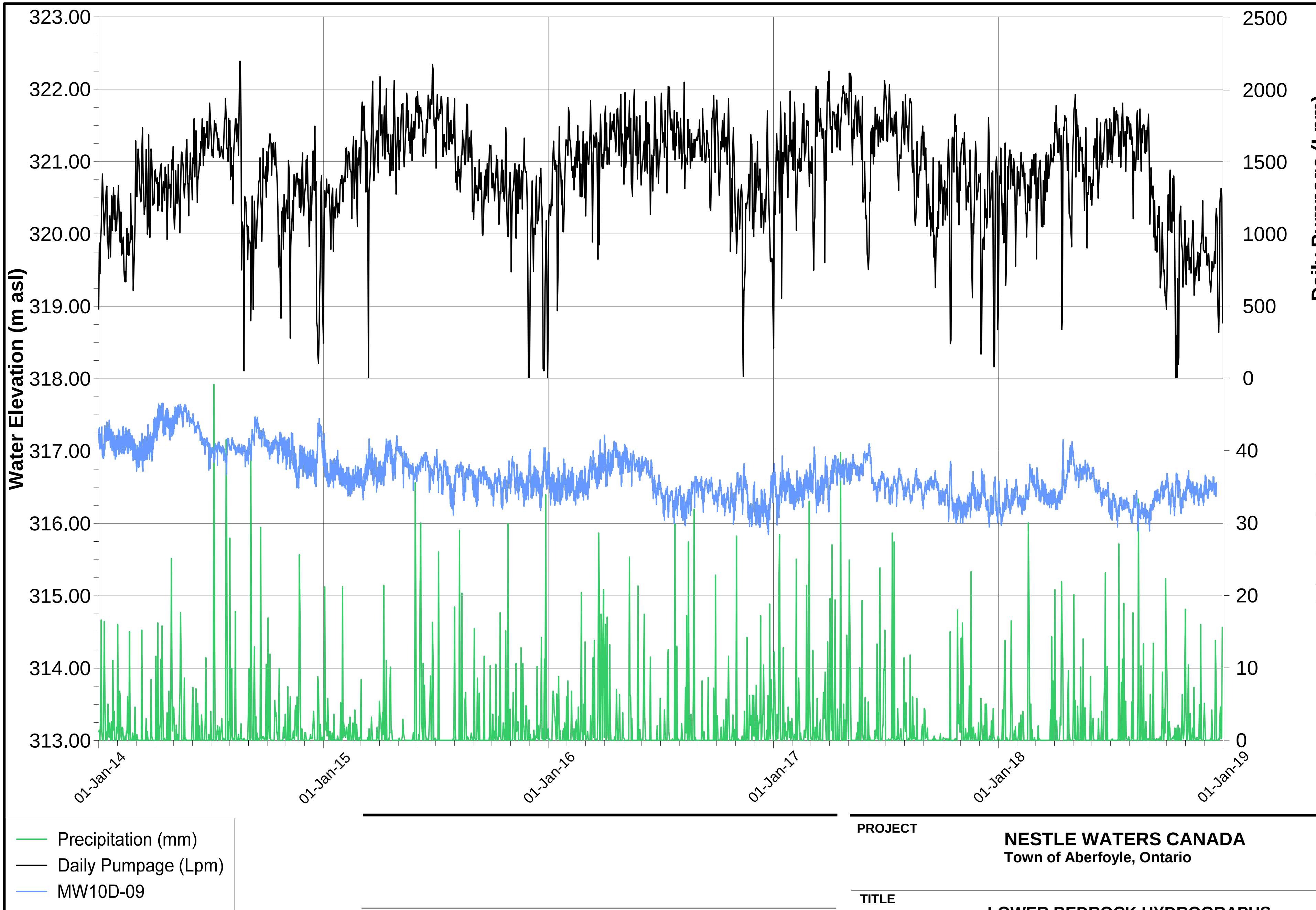
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D7



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

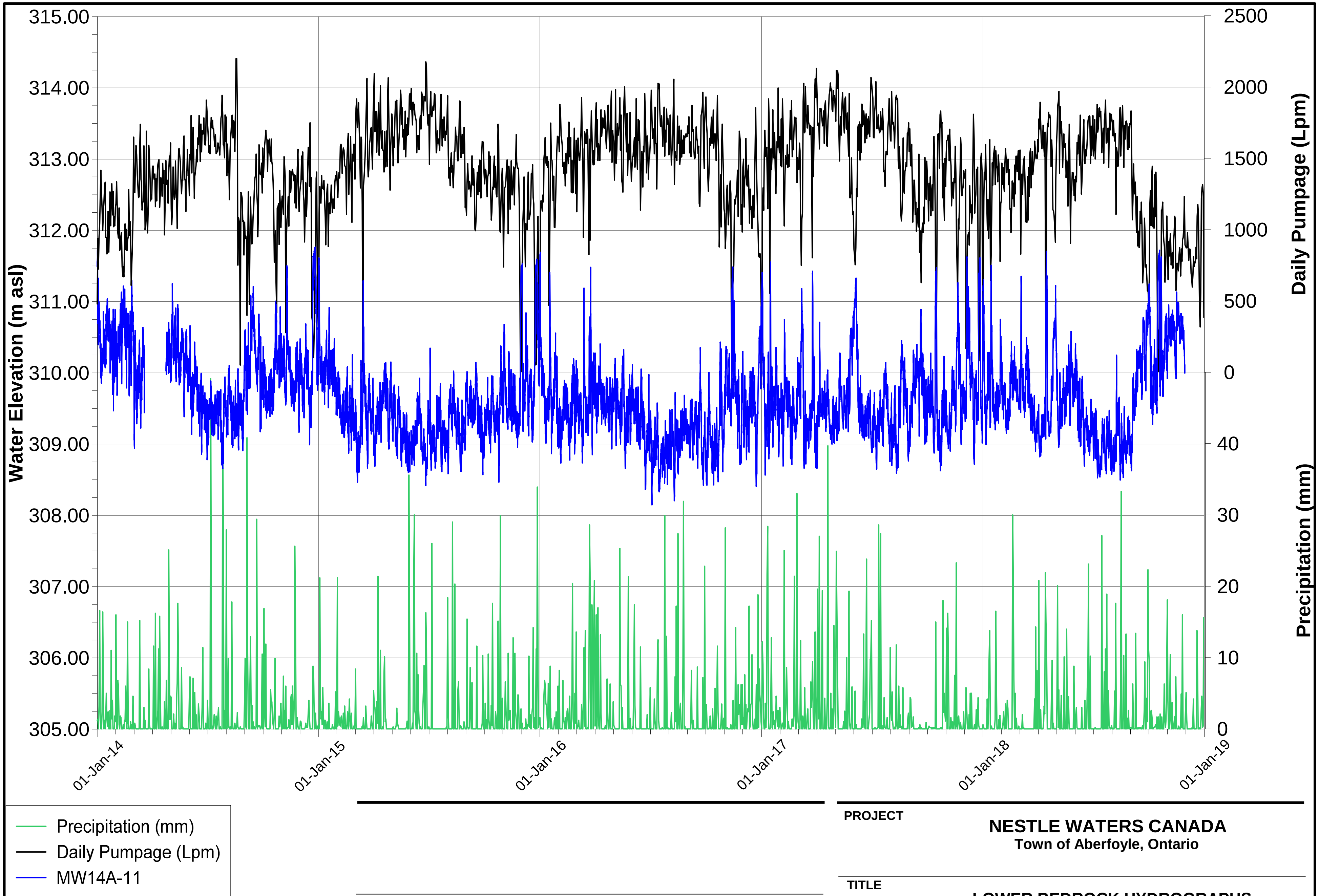
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D8



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

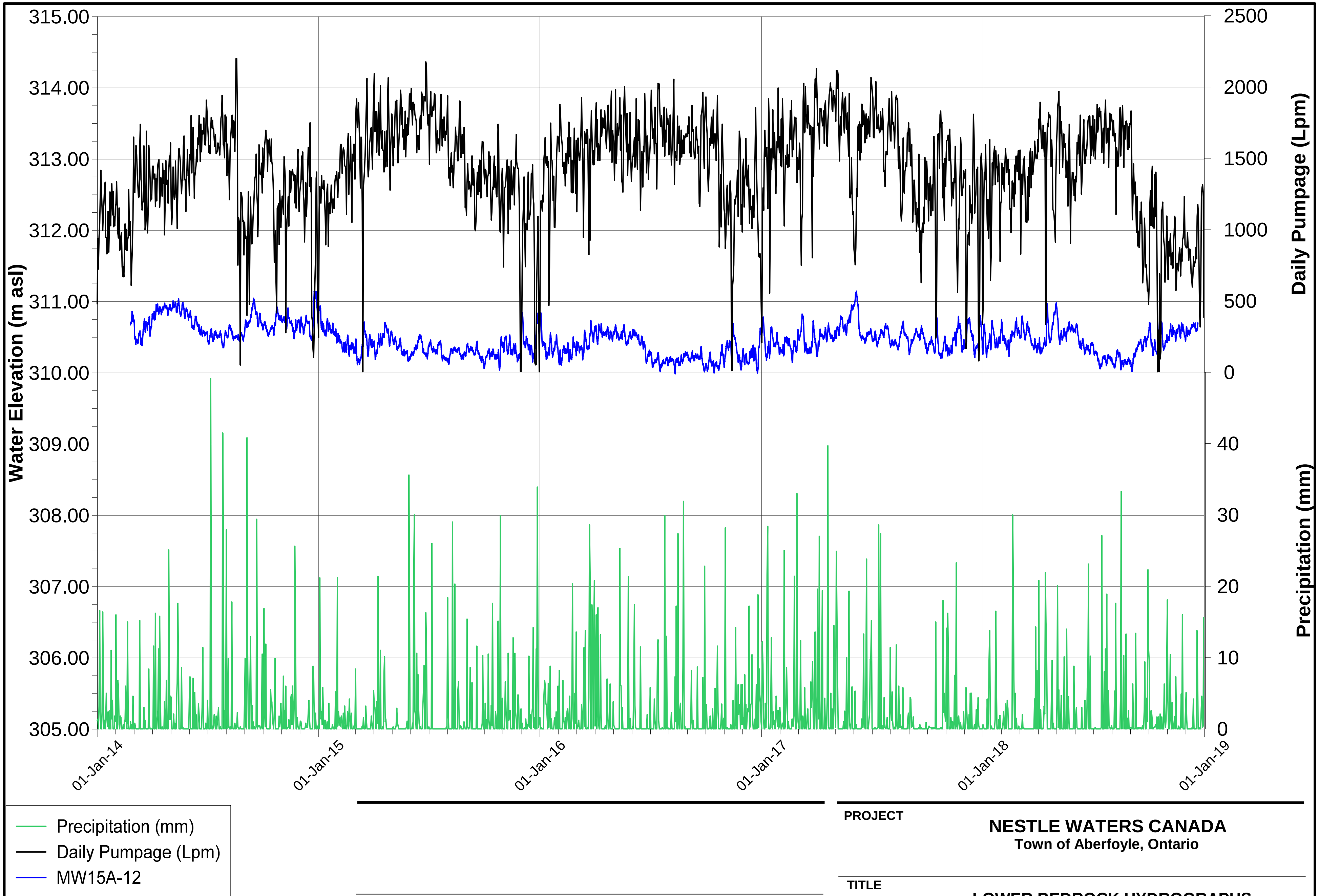
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D9



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

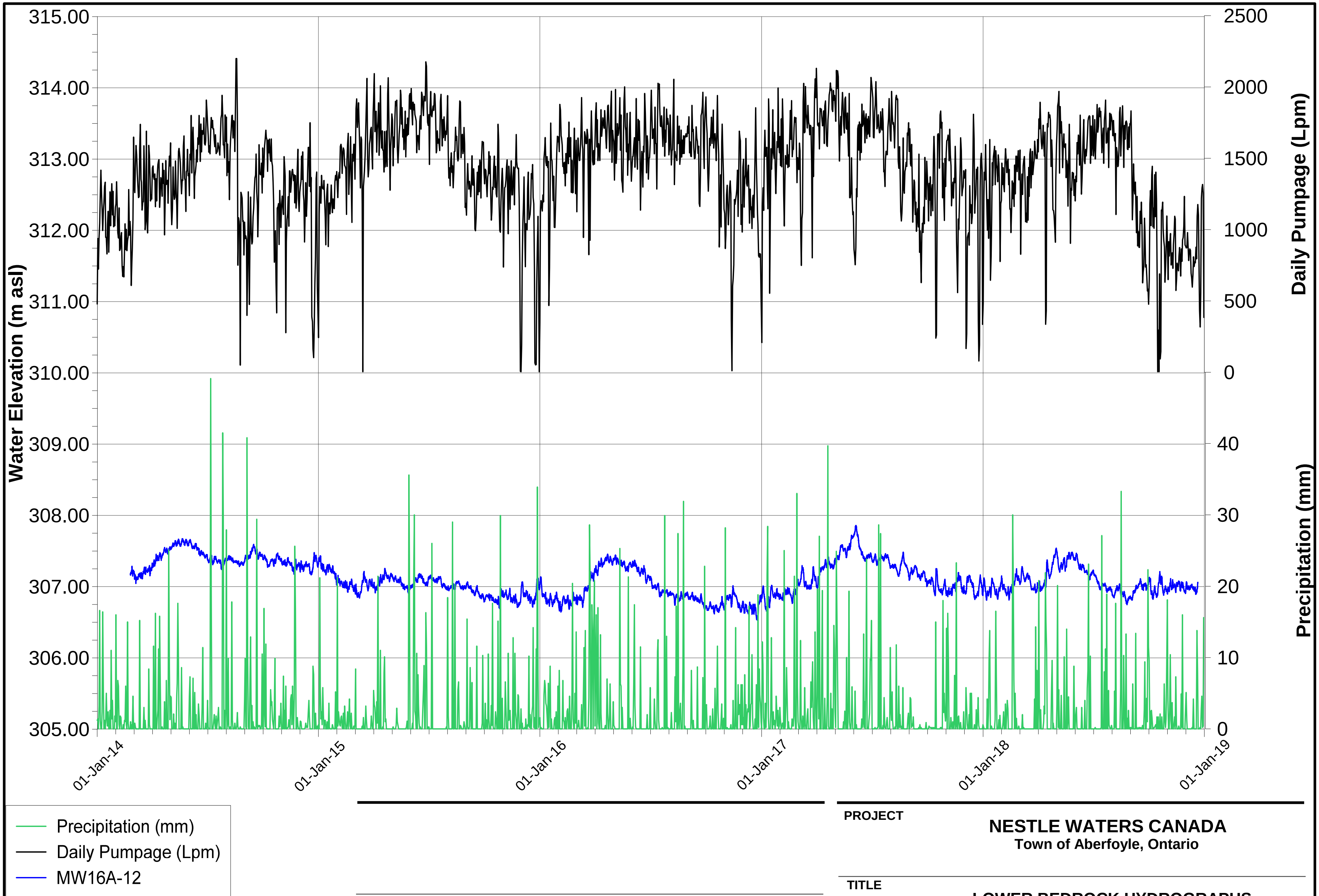
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D10



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

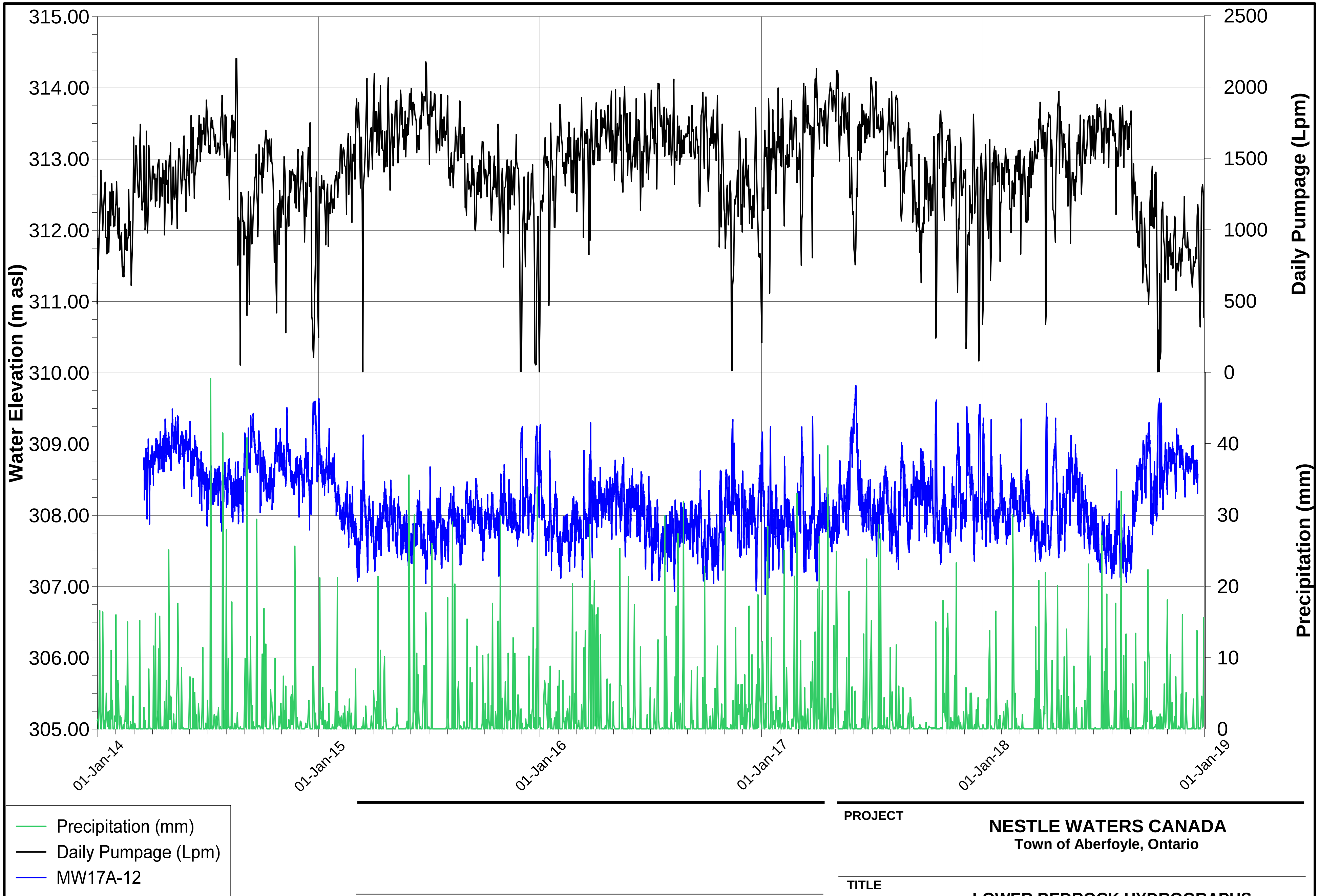
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D11



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

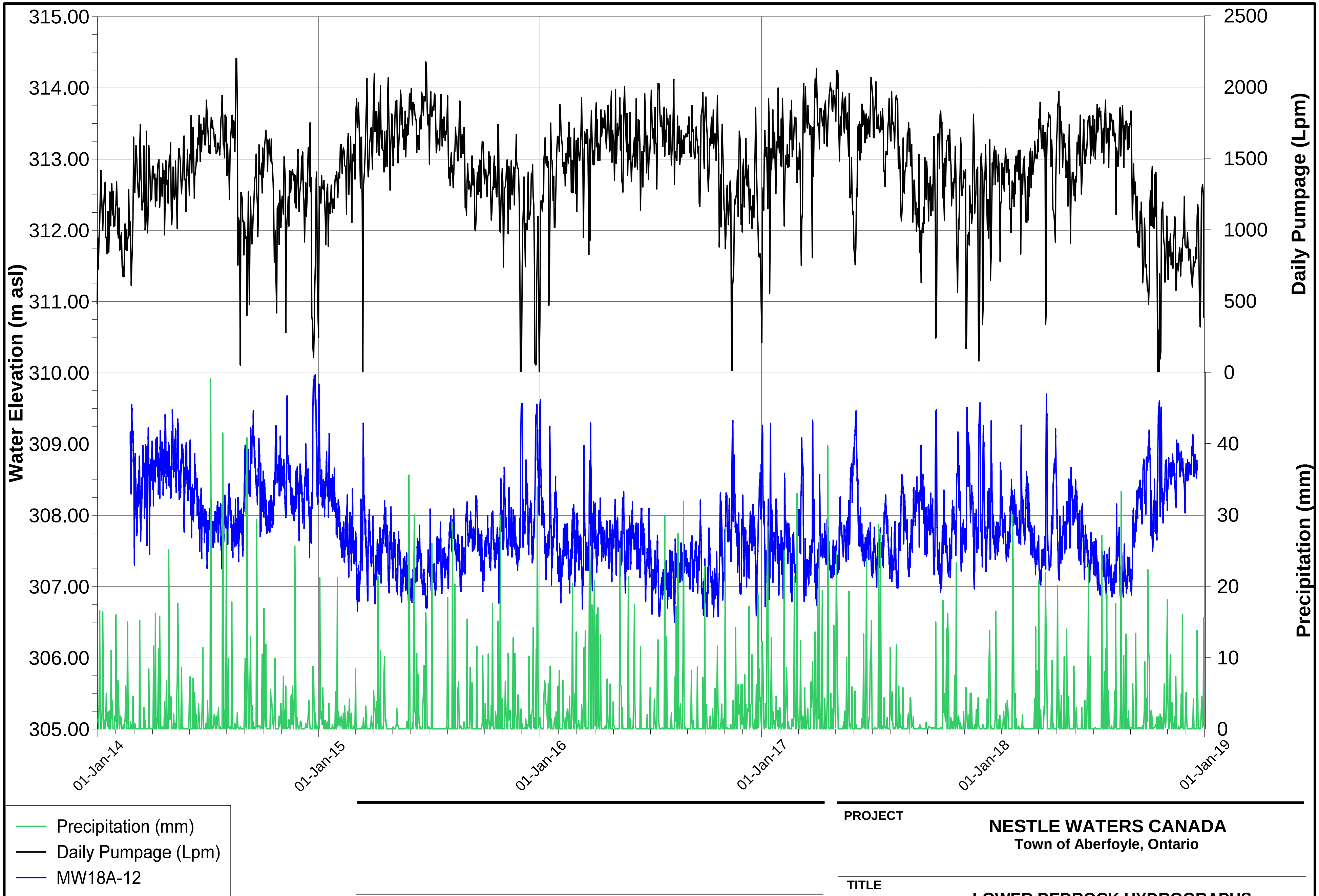
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D12



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

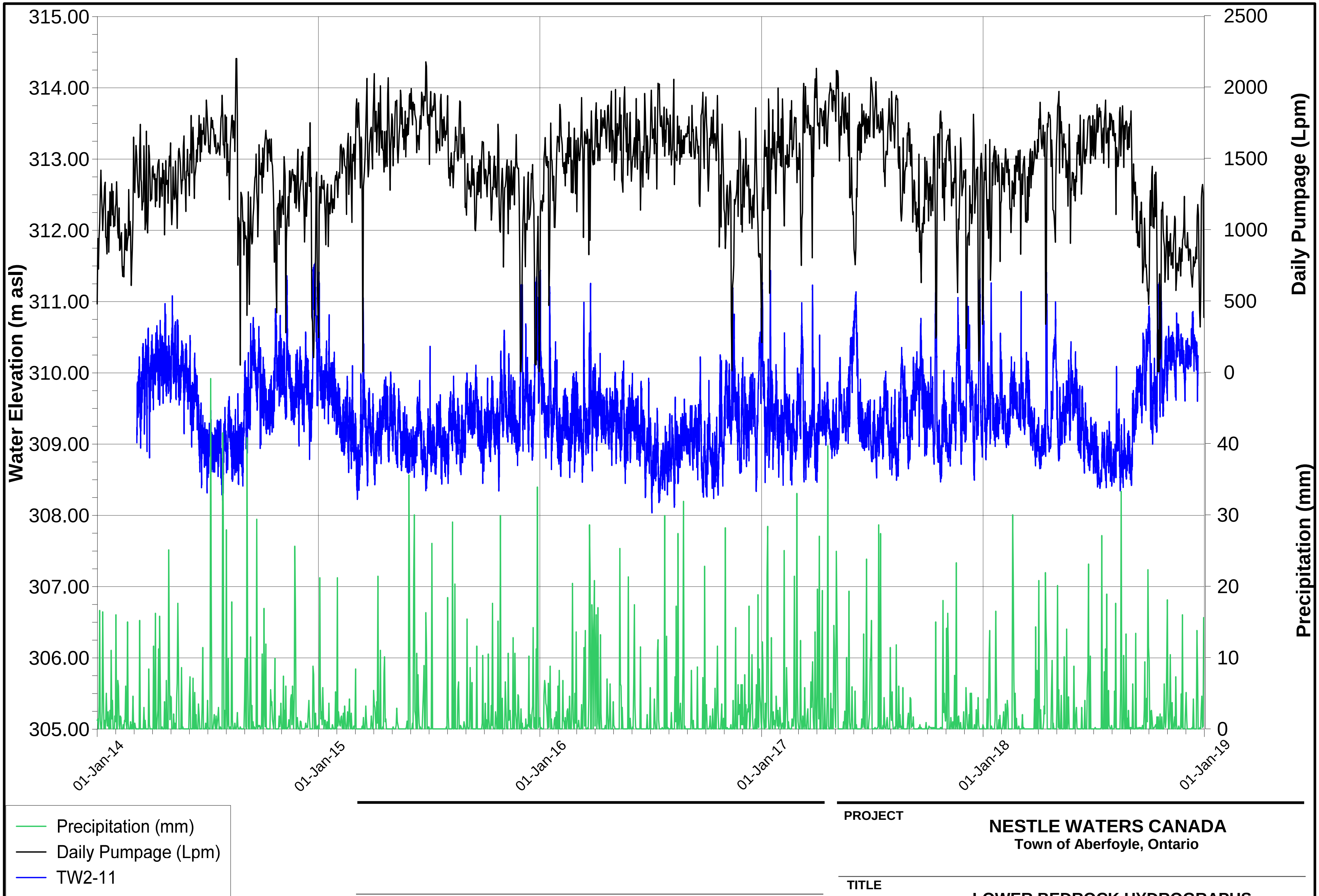
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D13



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

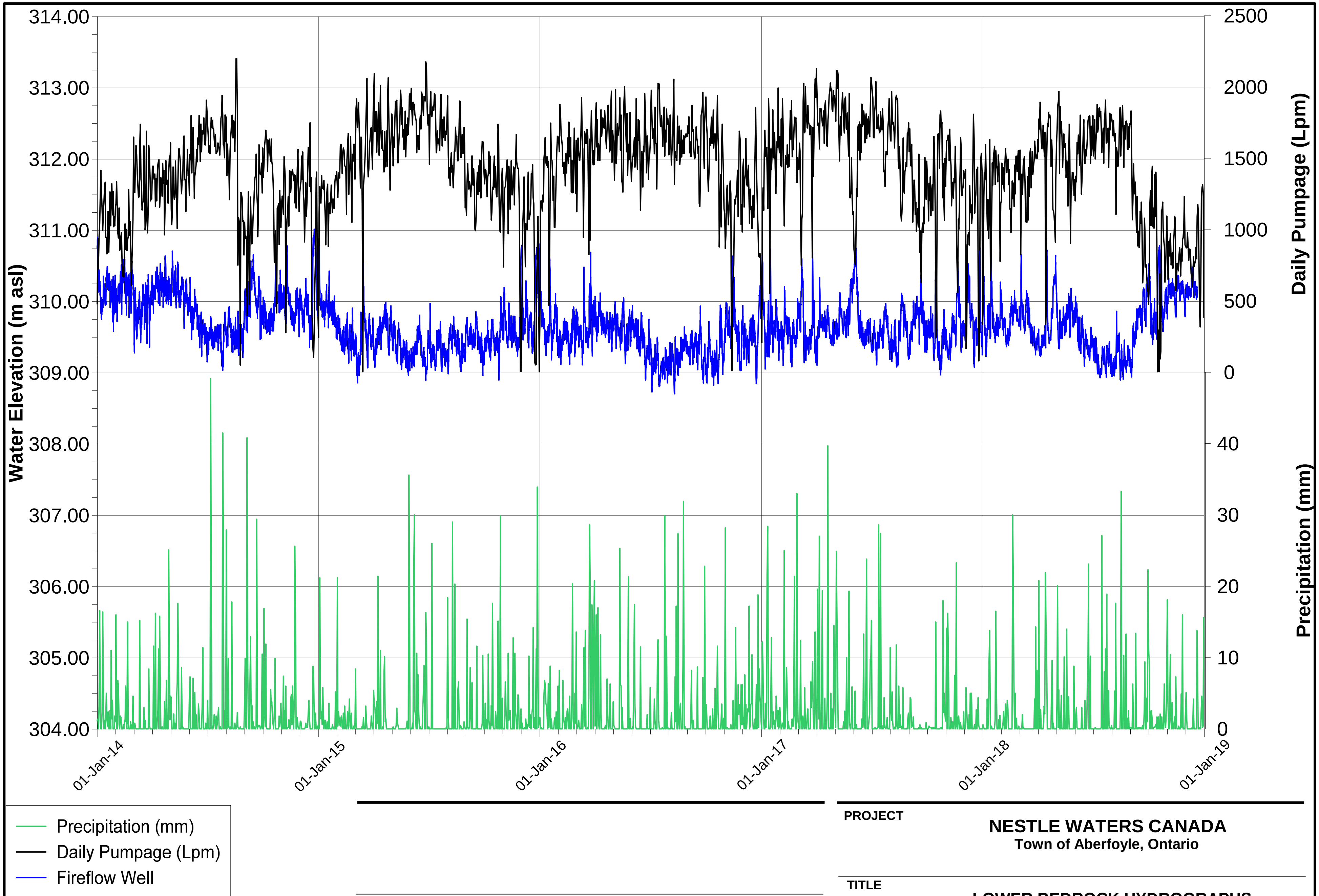
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D14



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

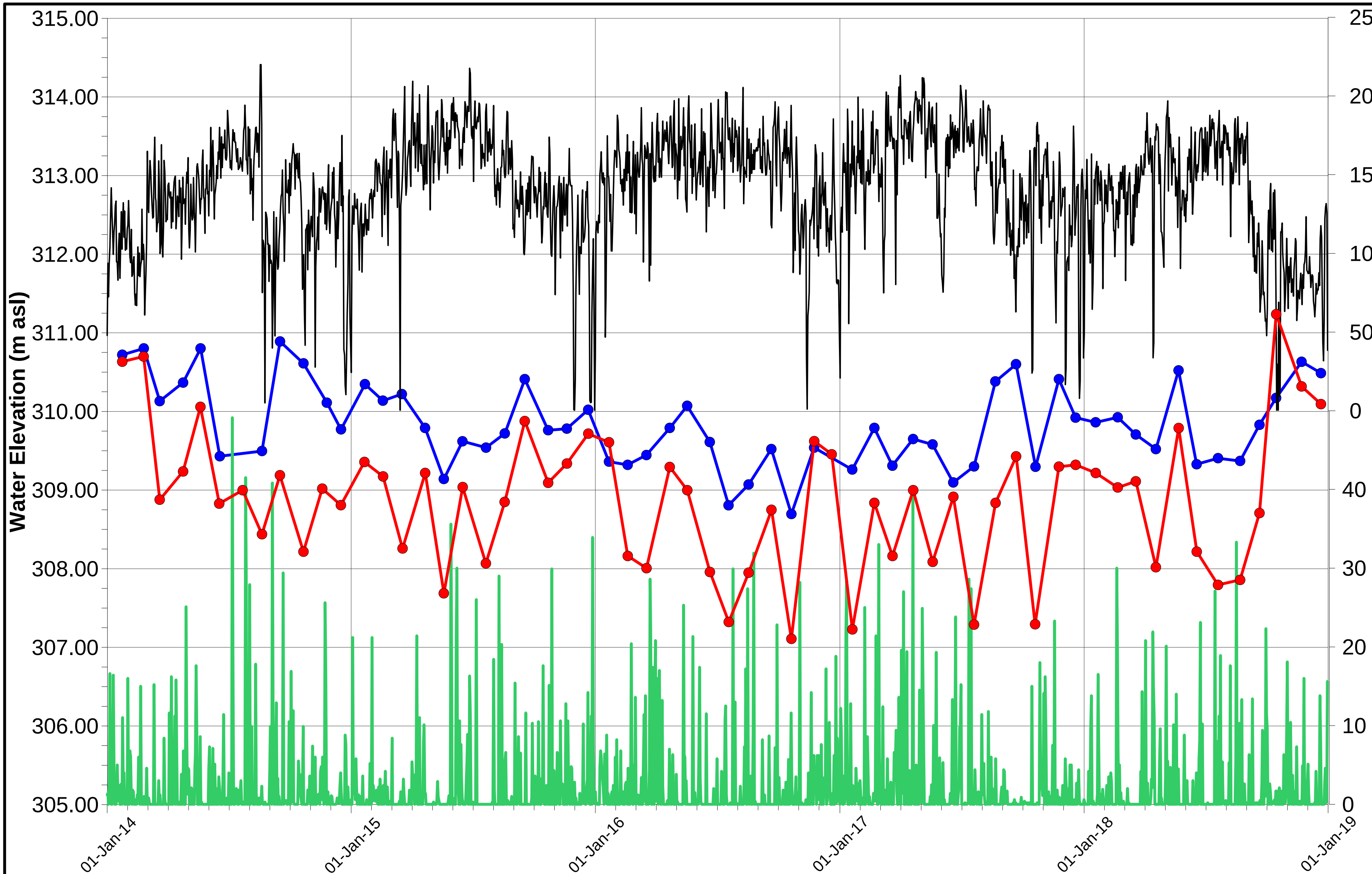
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D15



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

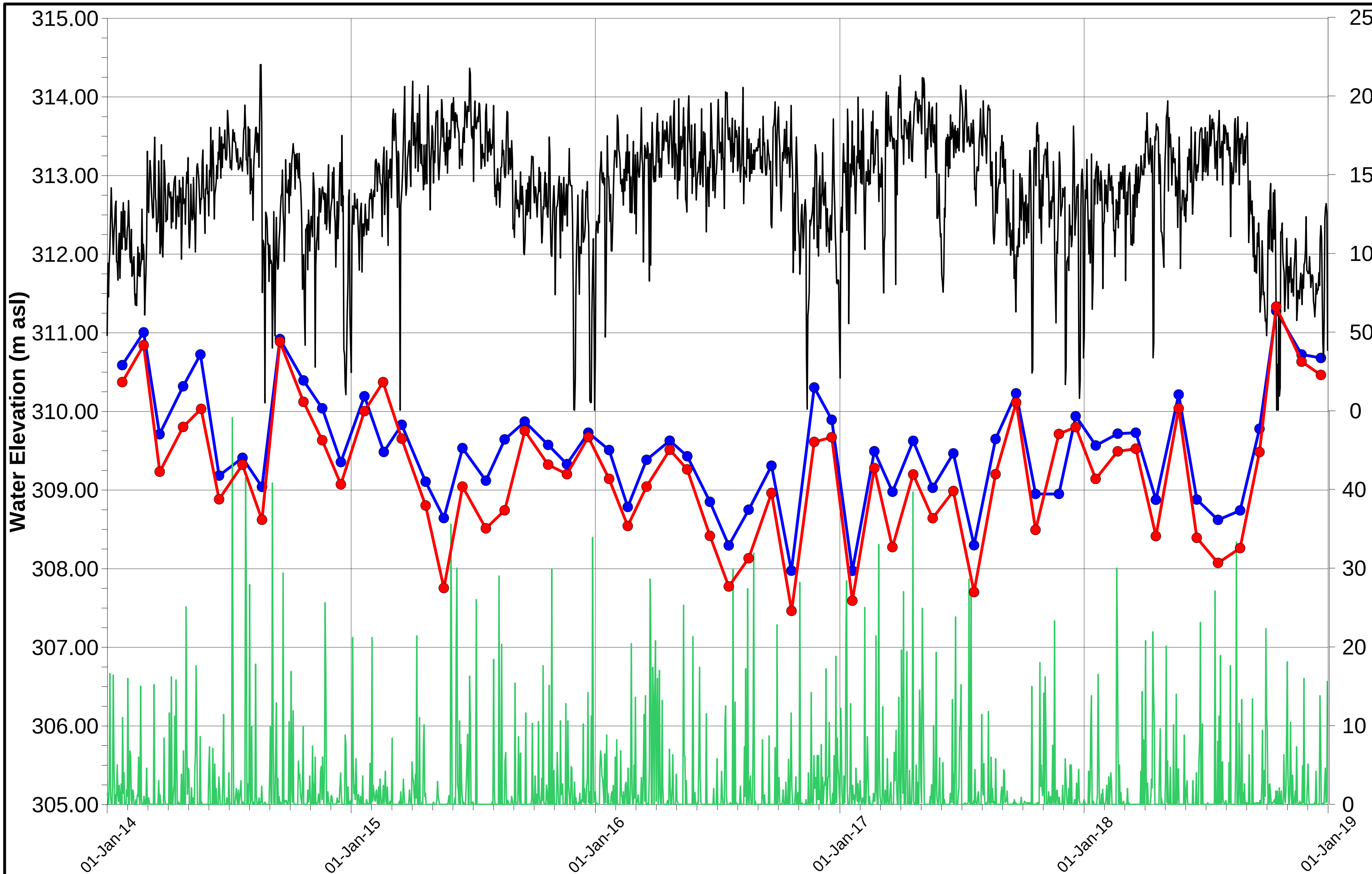
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D16



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

GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

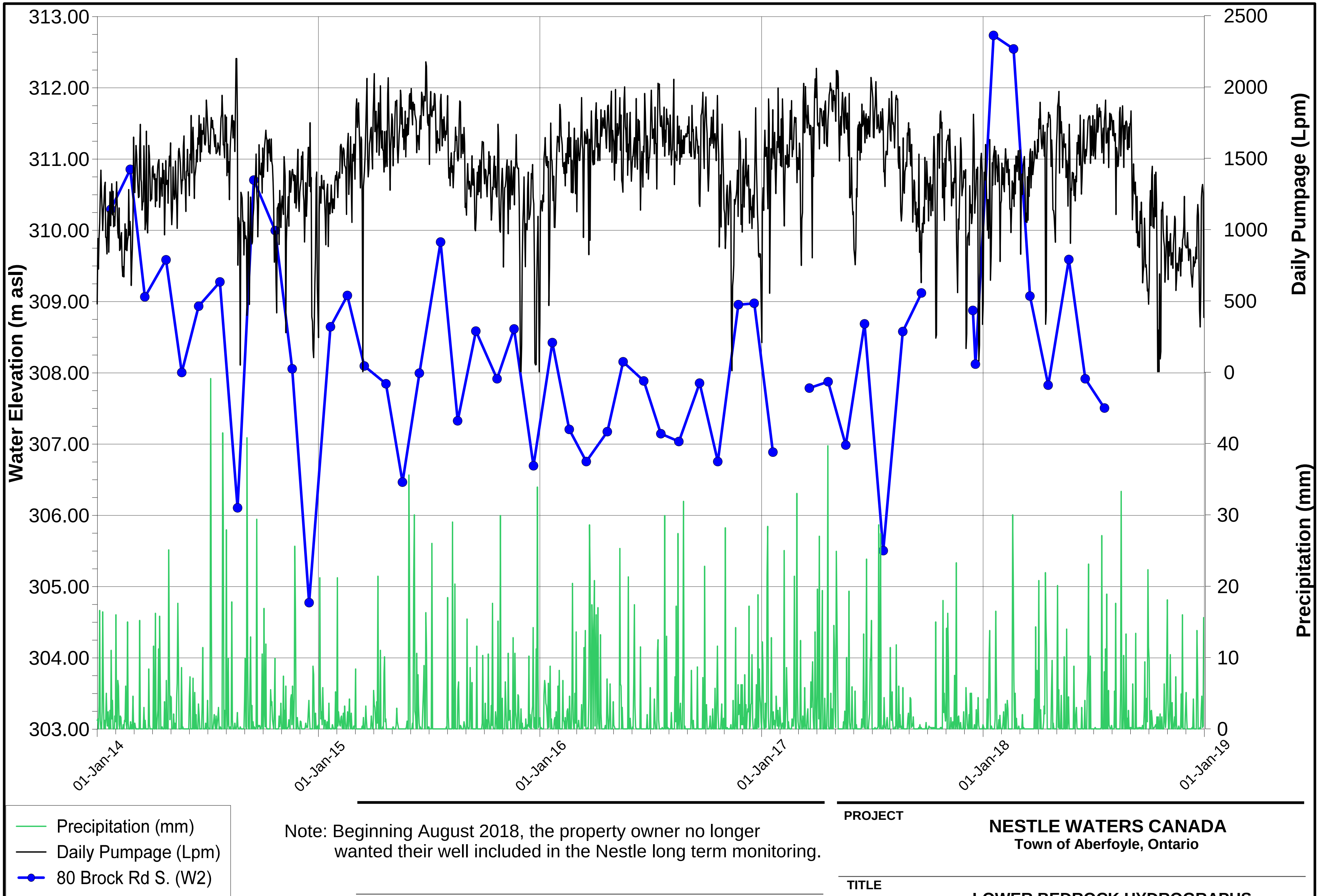
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D17



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

GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

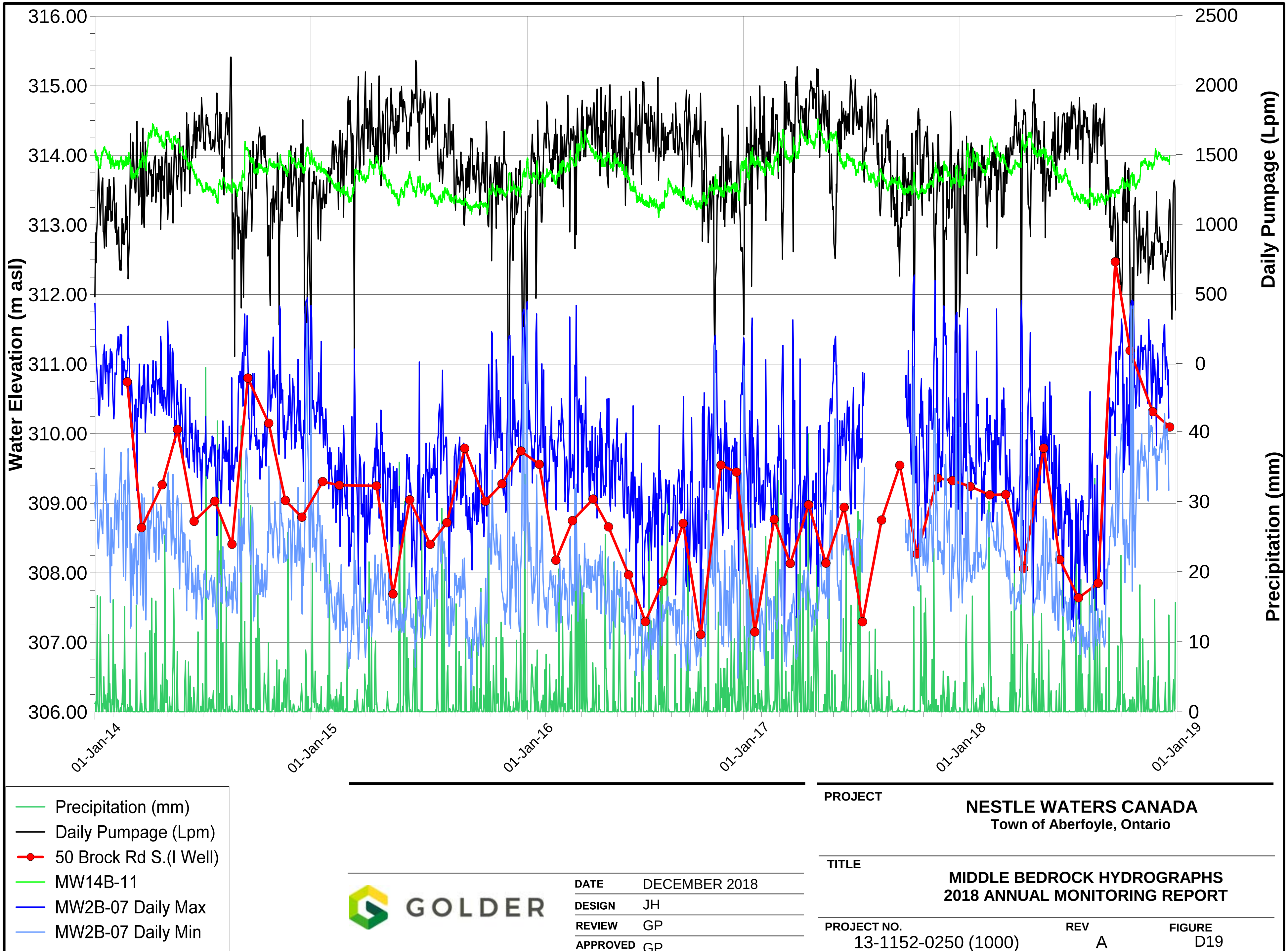
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

LOWER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D18



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

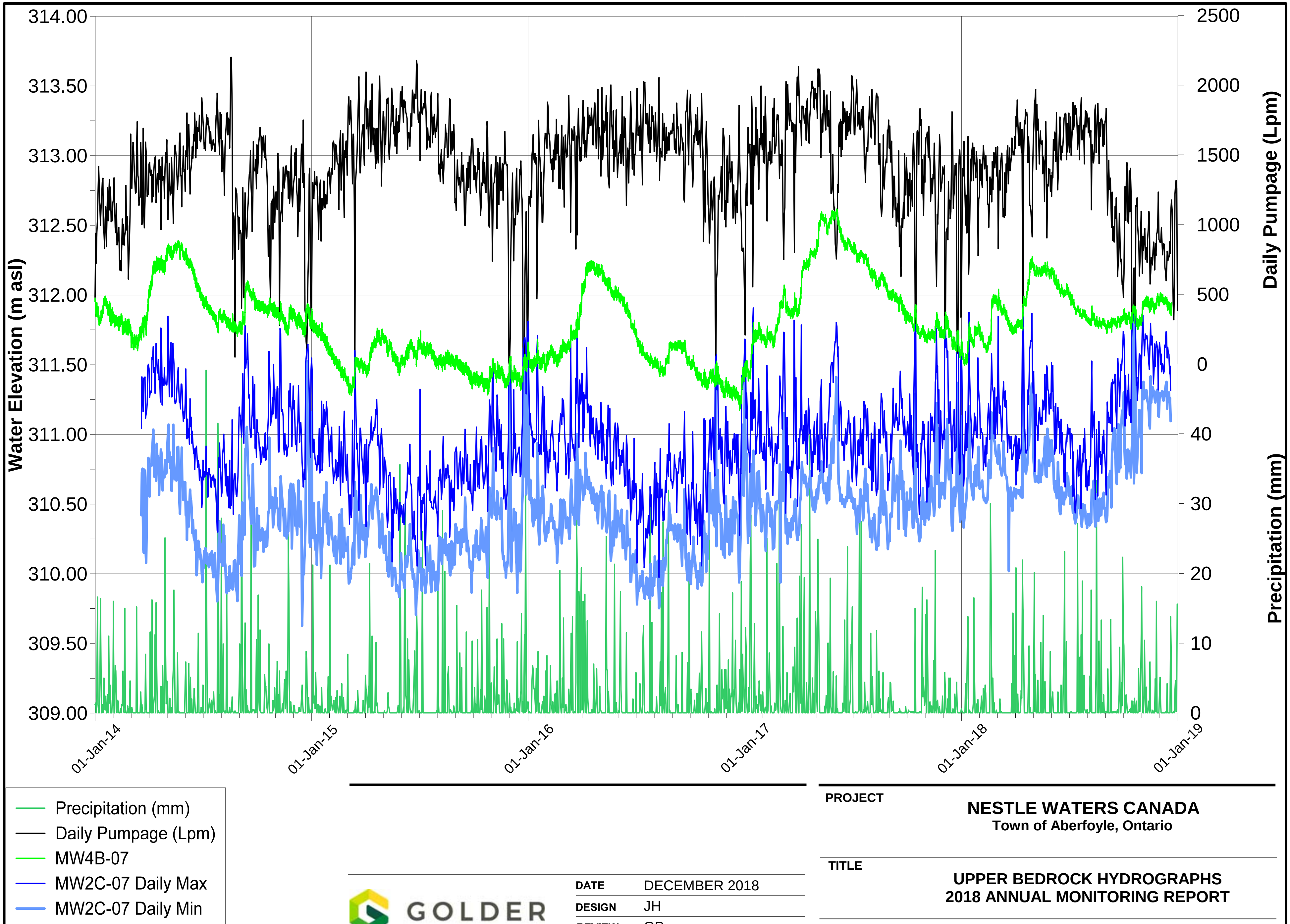
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MIDDLE BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D19



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

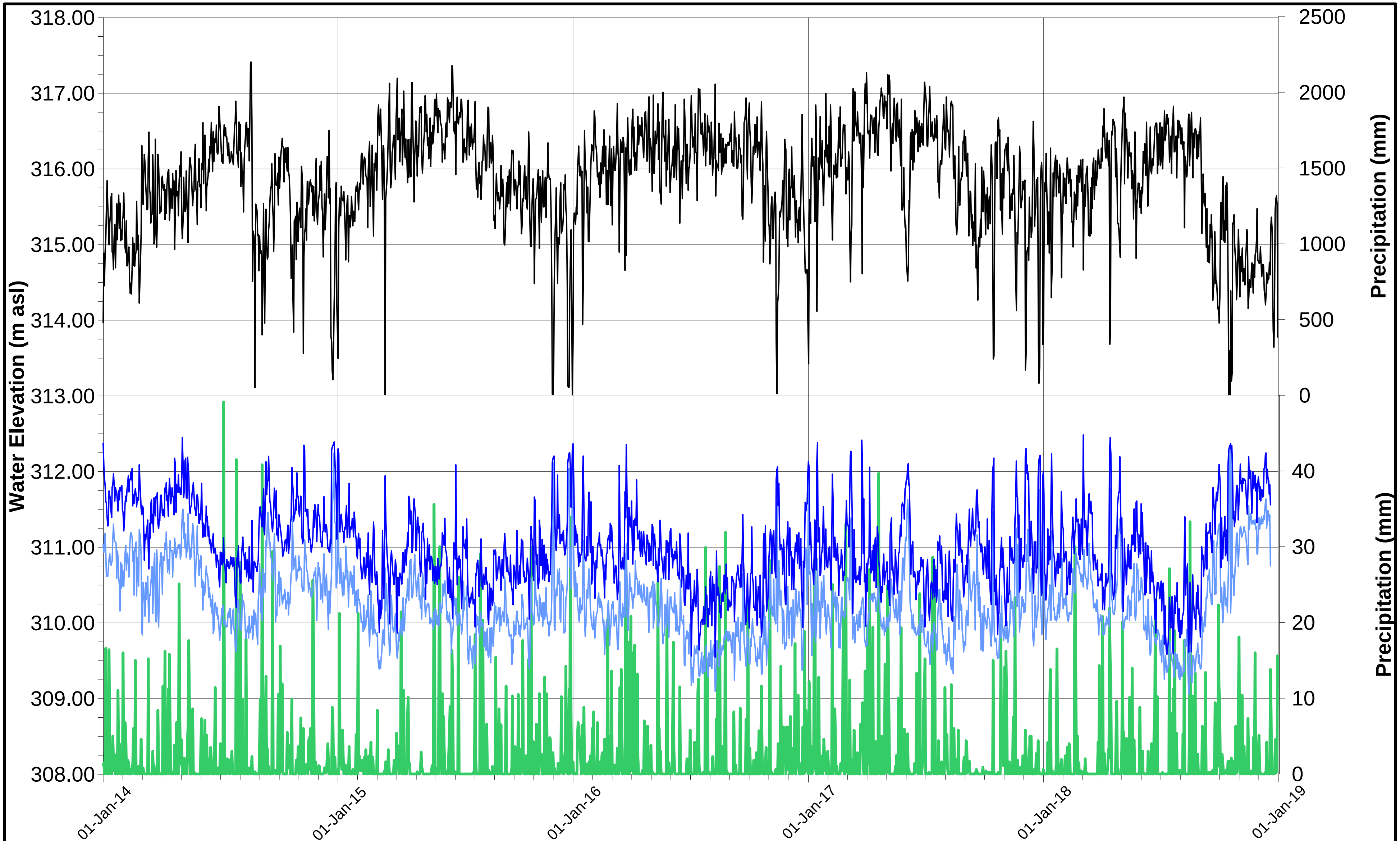
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D20



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

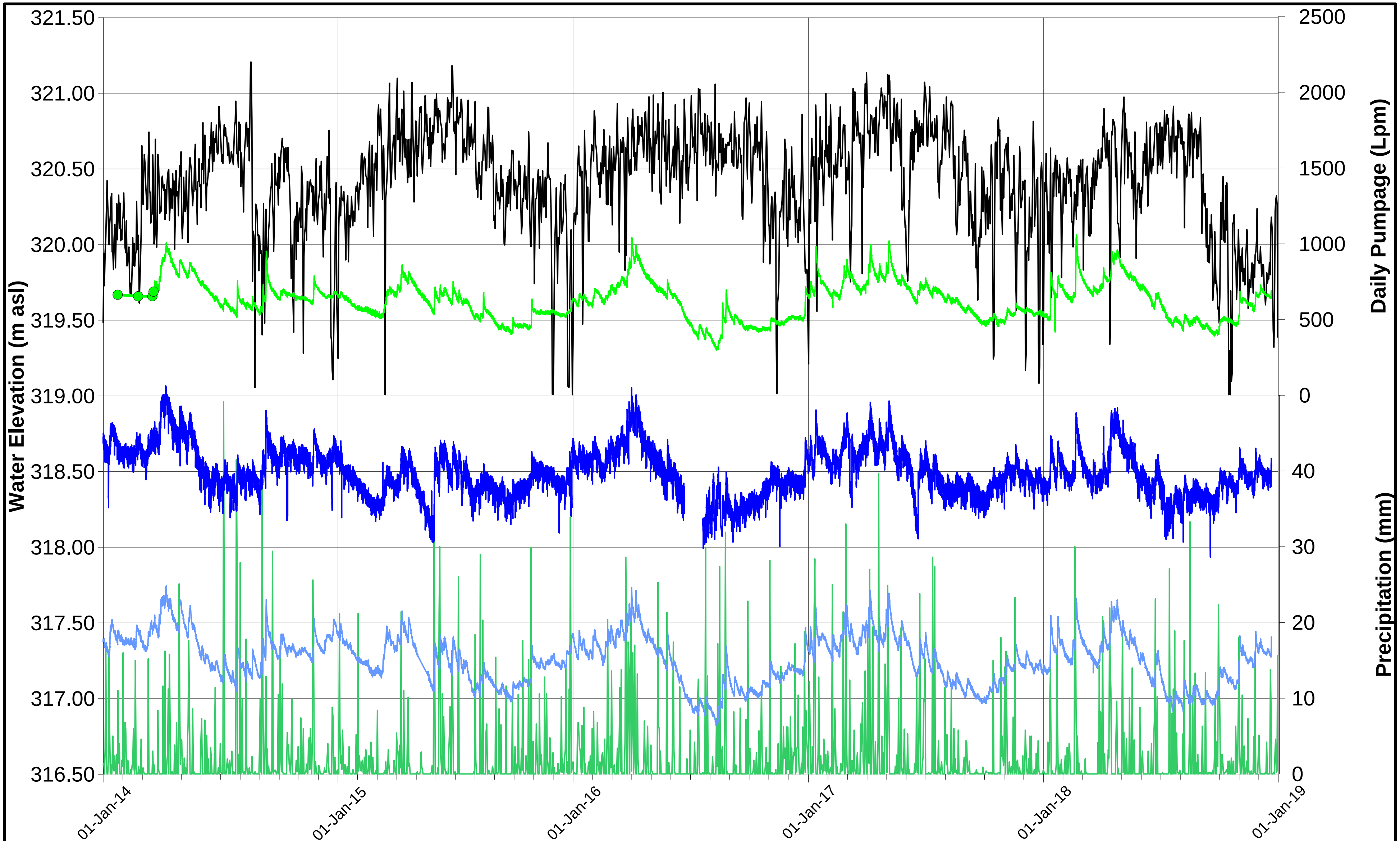
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D21



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

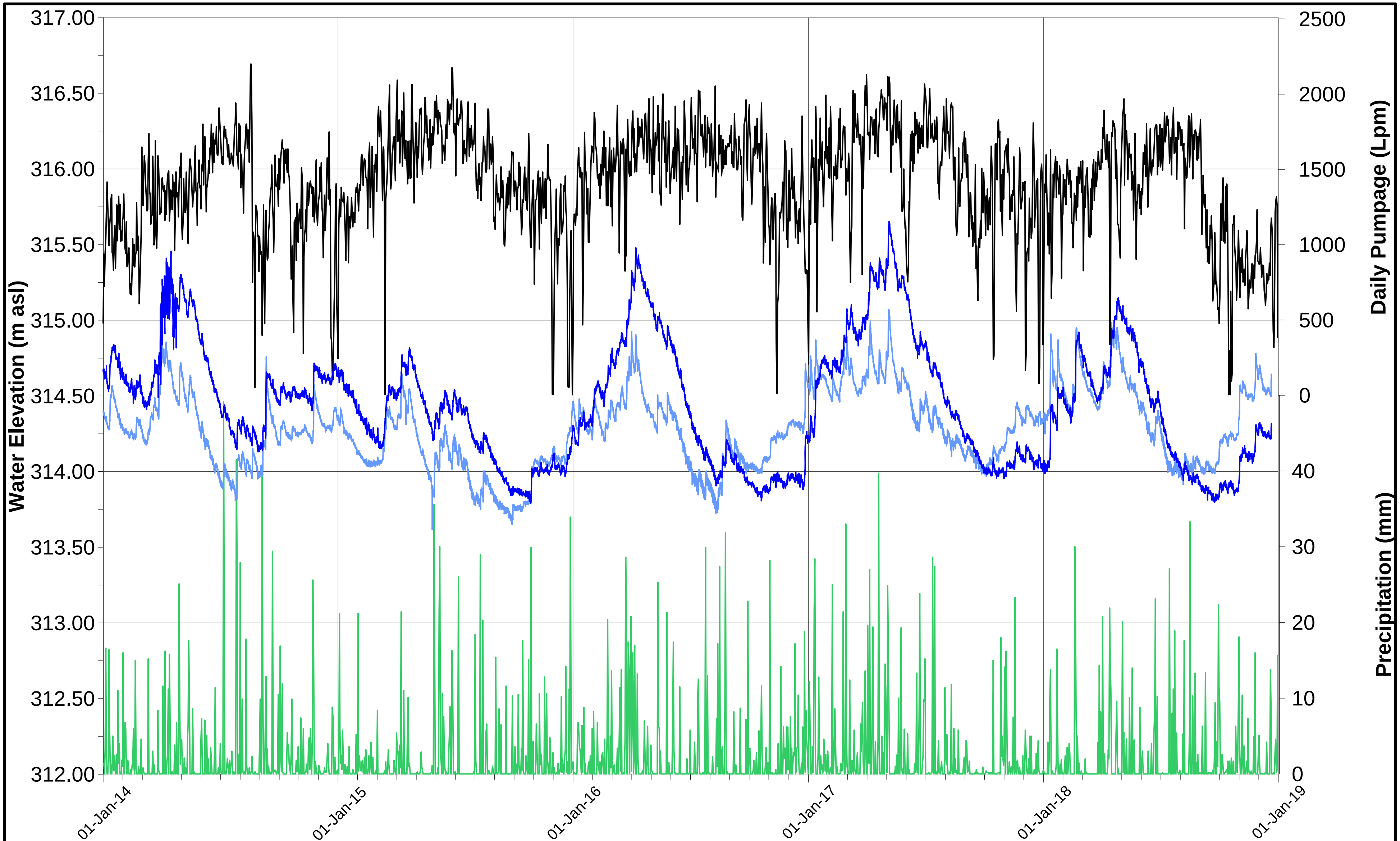
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D22



DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

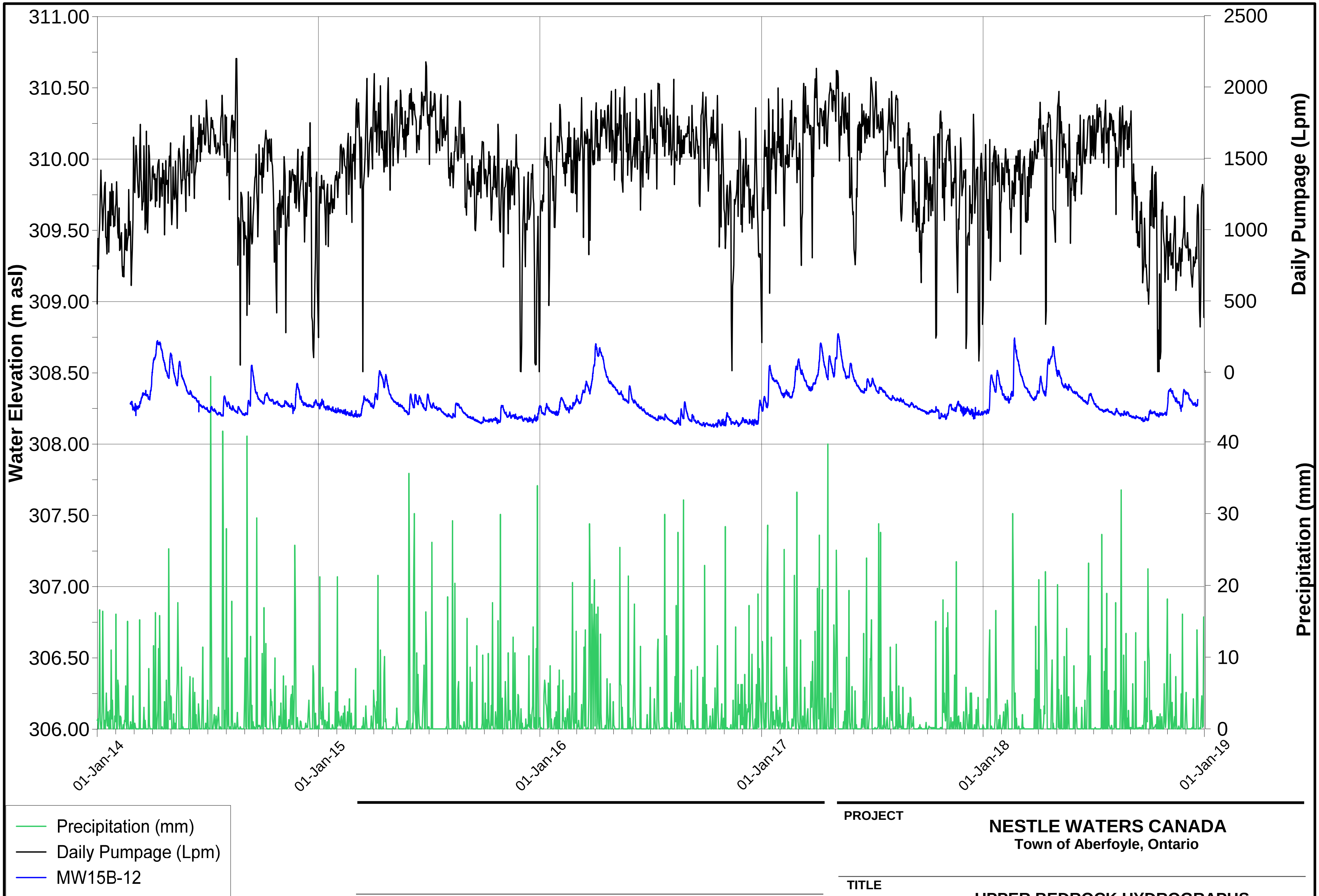
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D23



DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

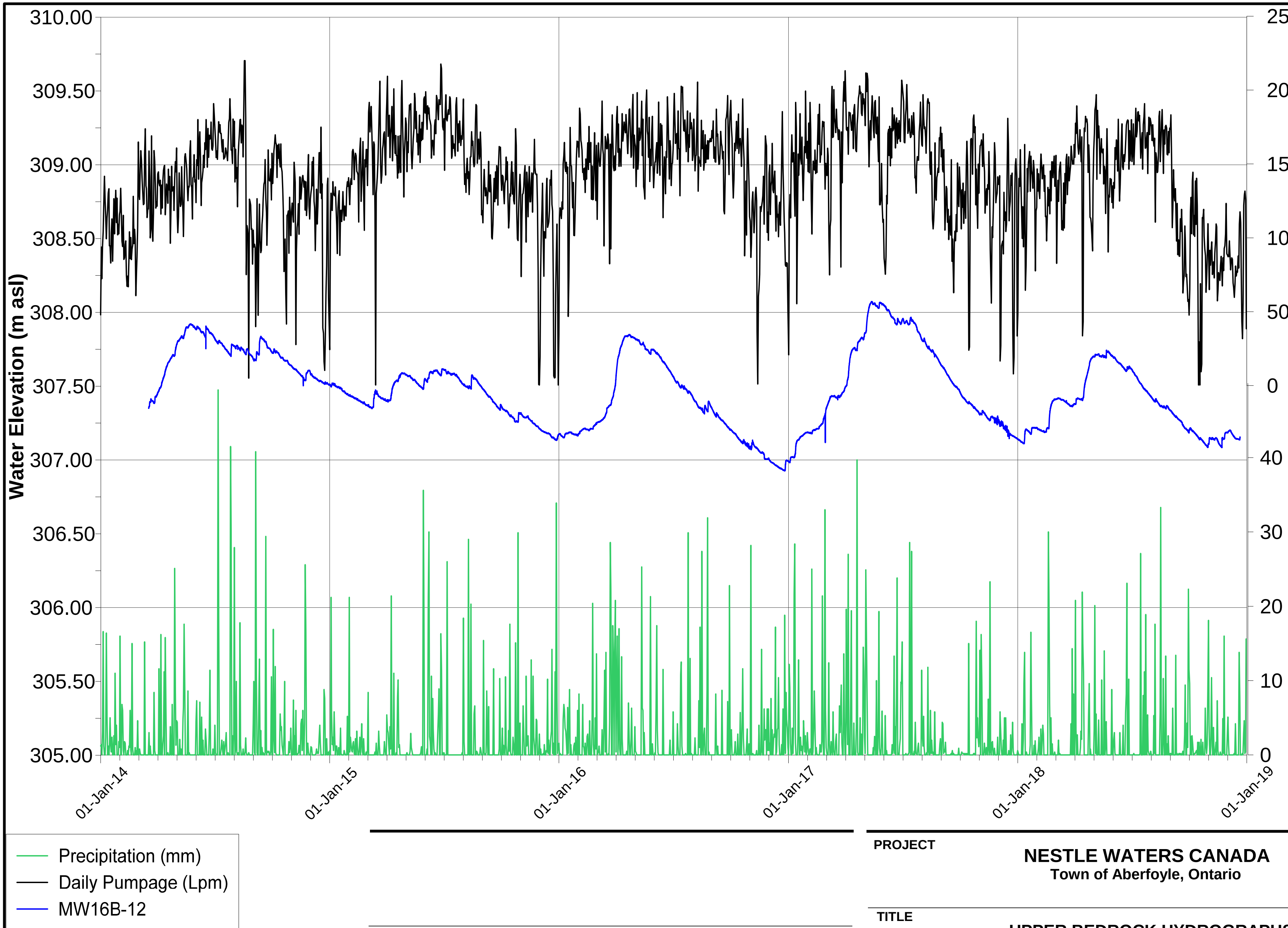
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D24



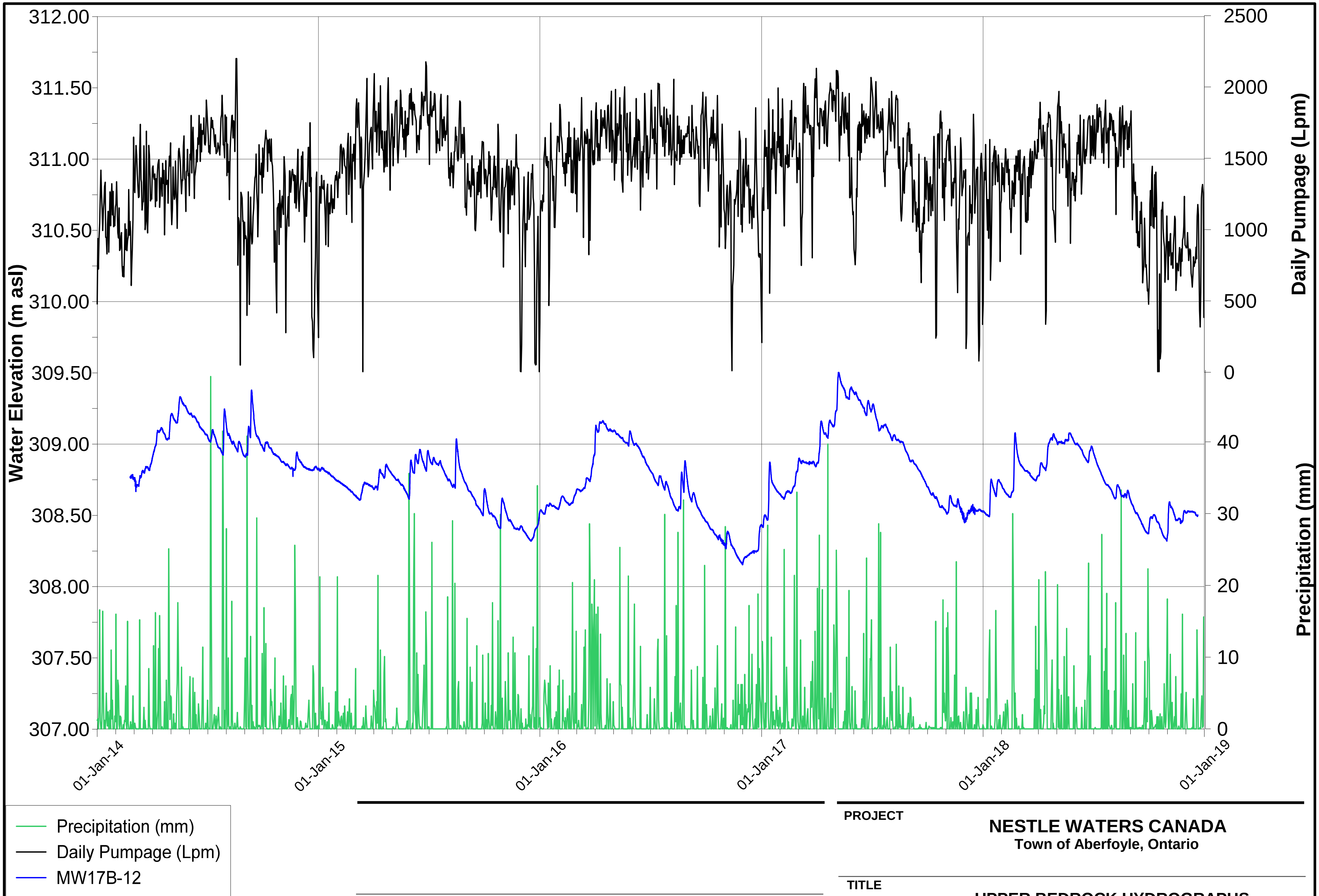
DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

GOLDER

PROJECT
NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE
UPPER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D25



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

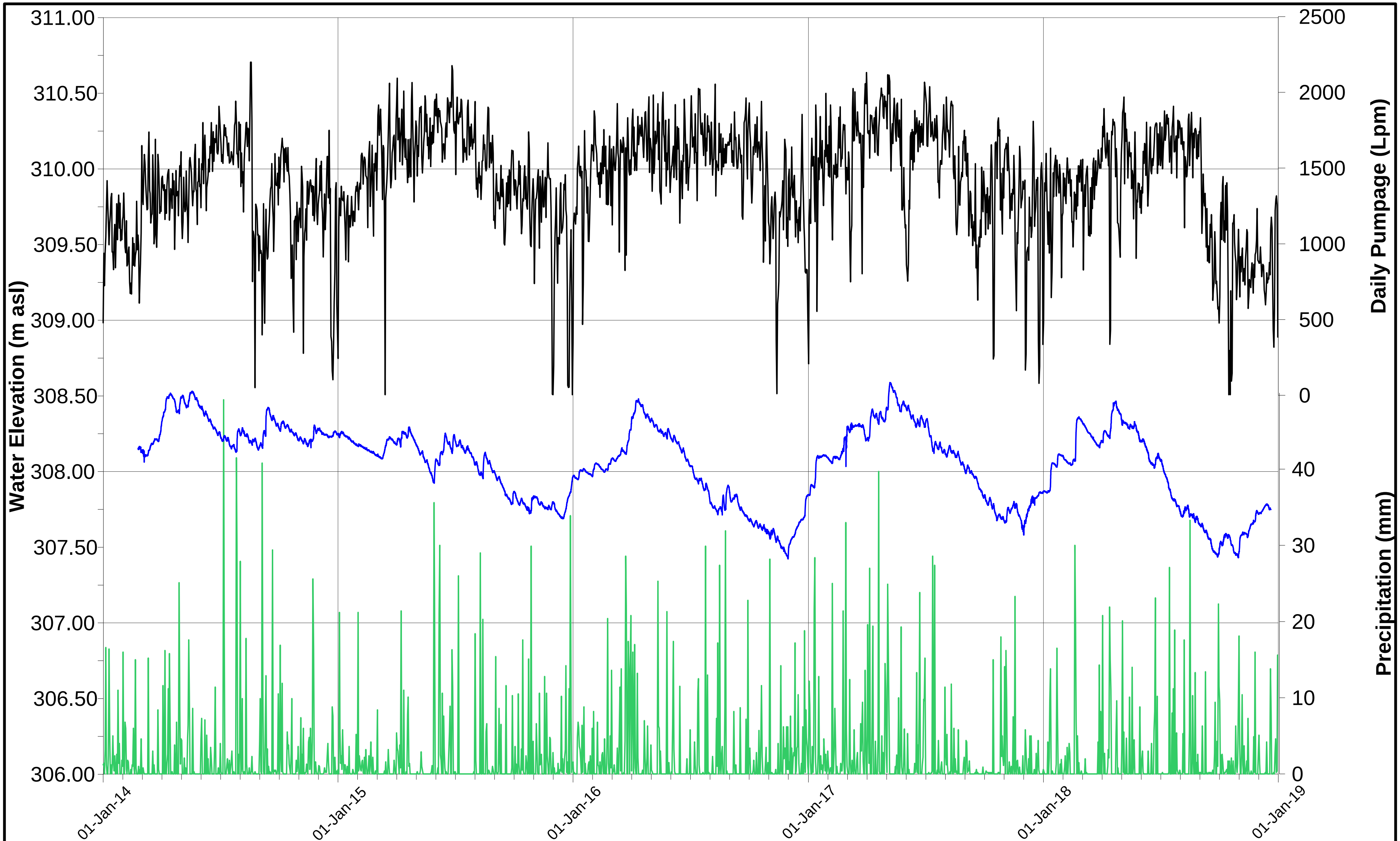
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D26



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

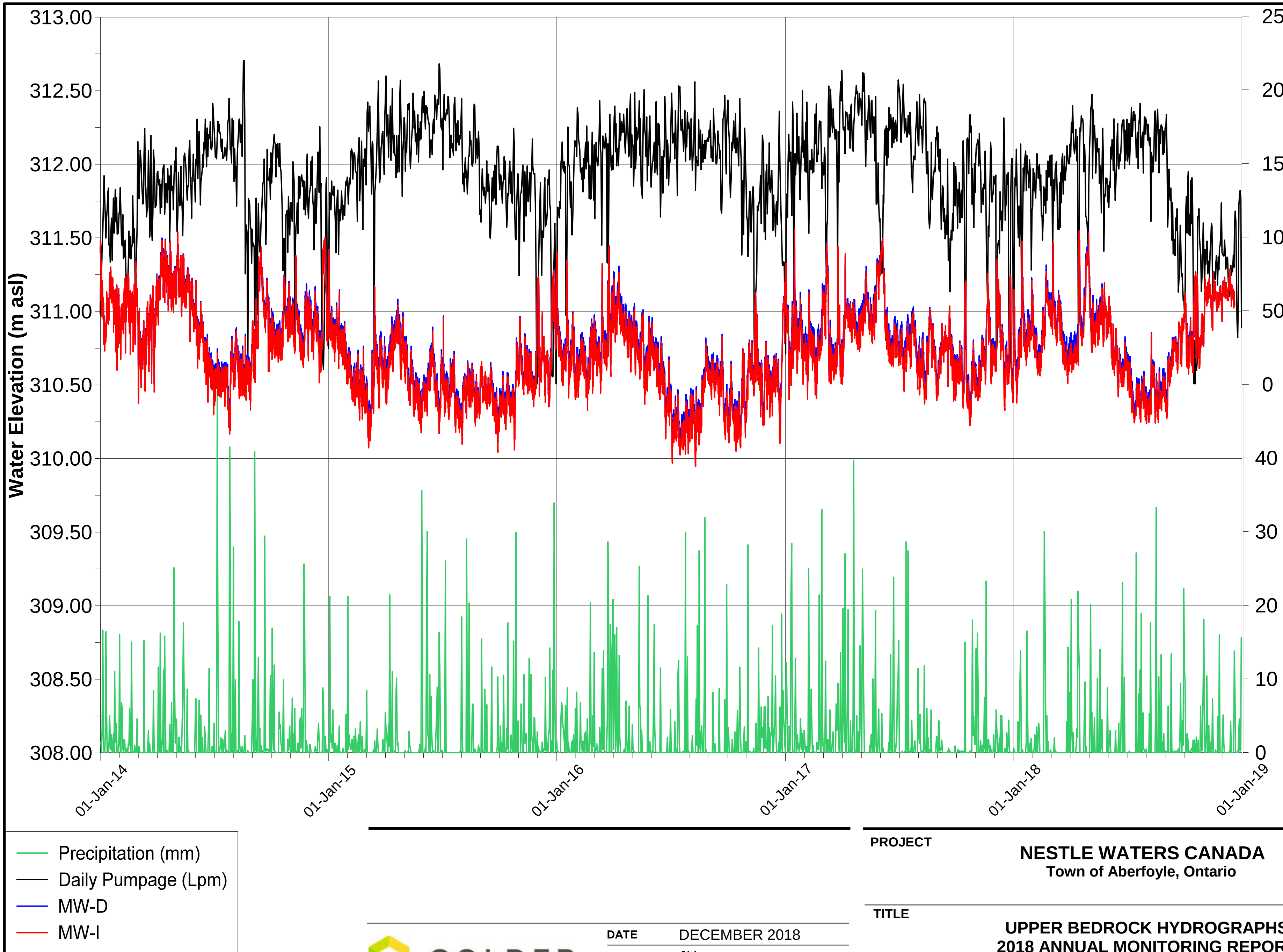
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D27



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

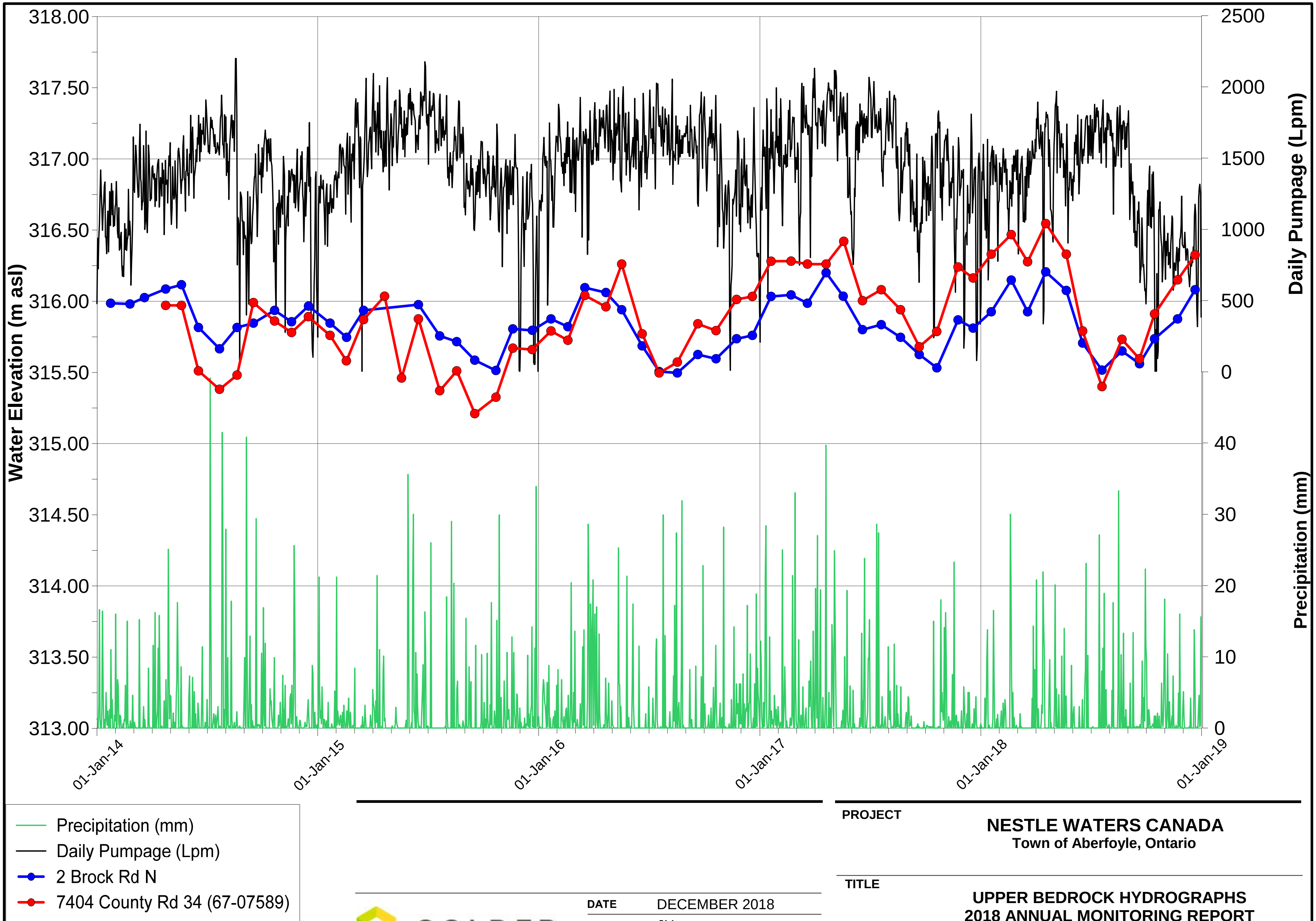
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D28



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

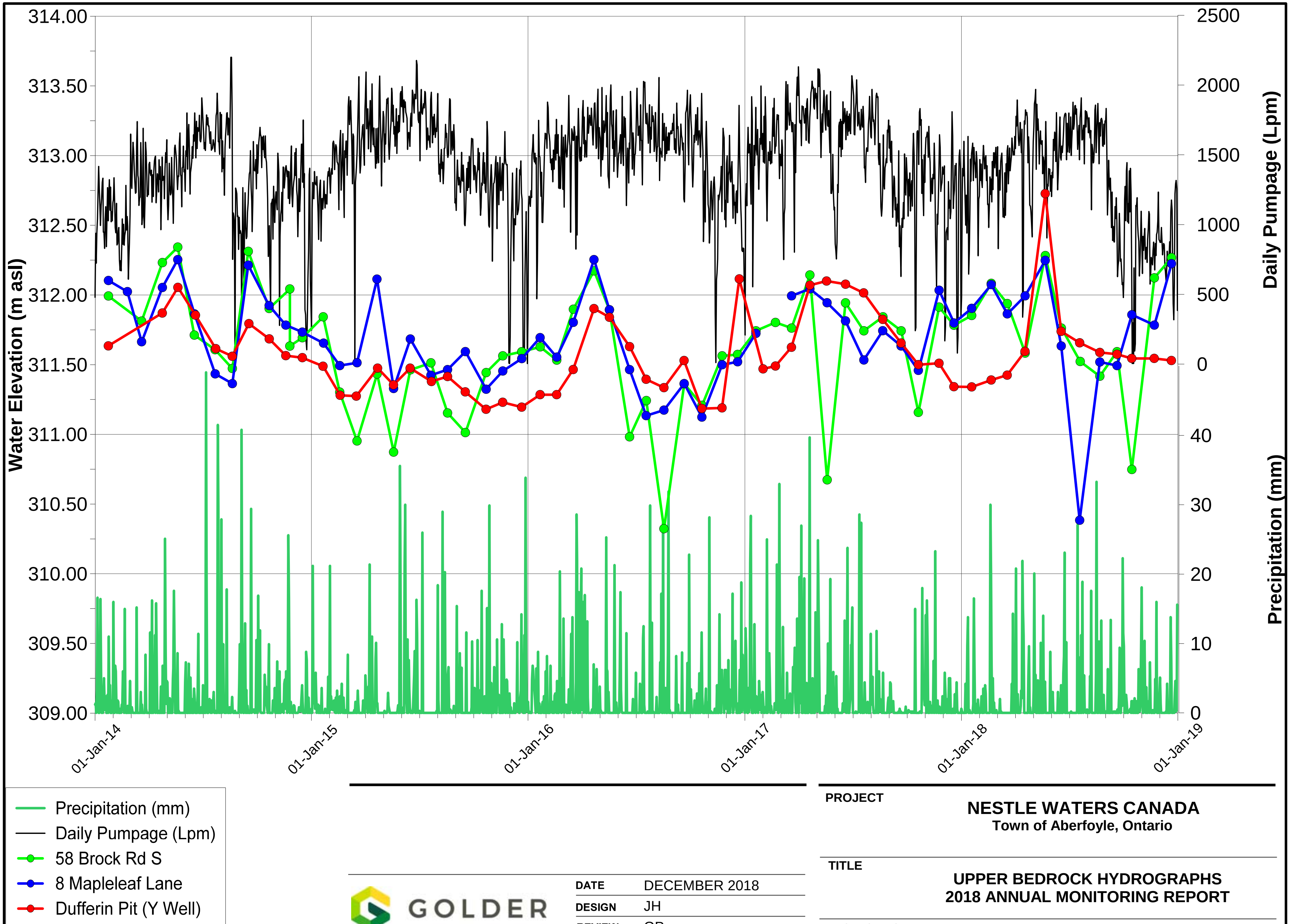
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D29



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

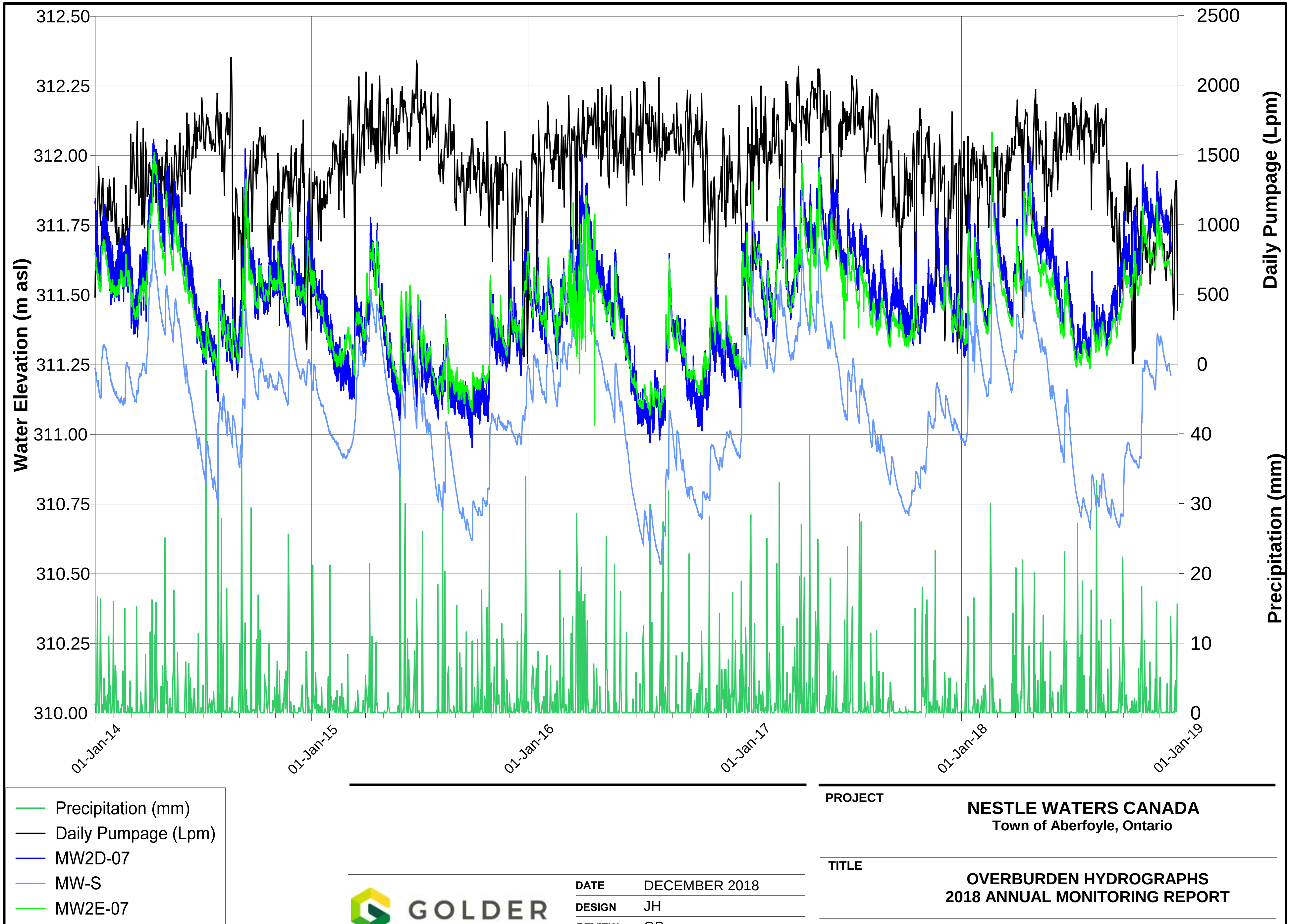
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

UPPER BEDROCK HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D30



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA

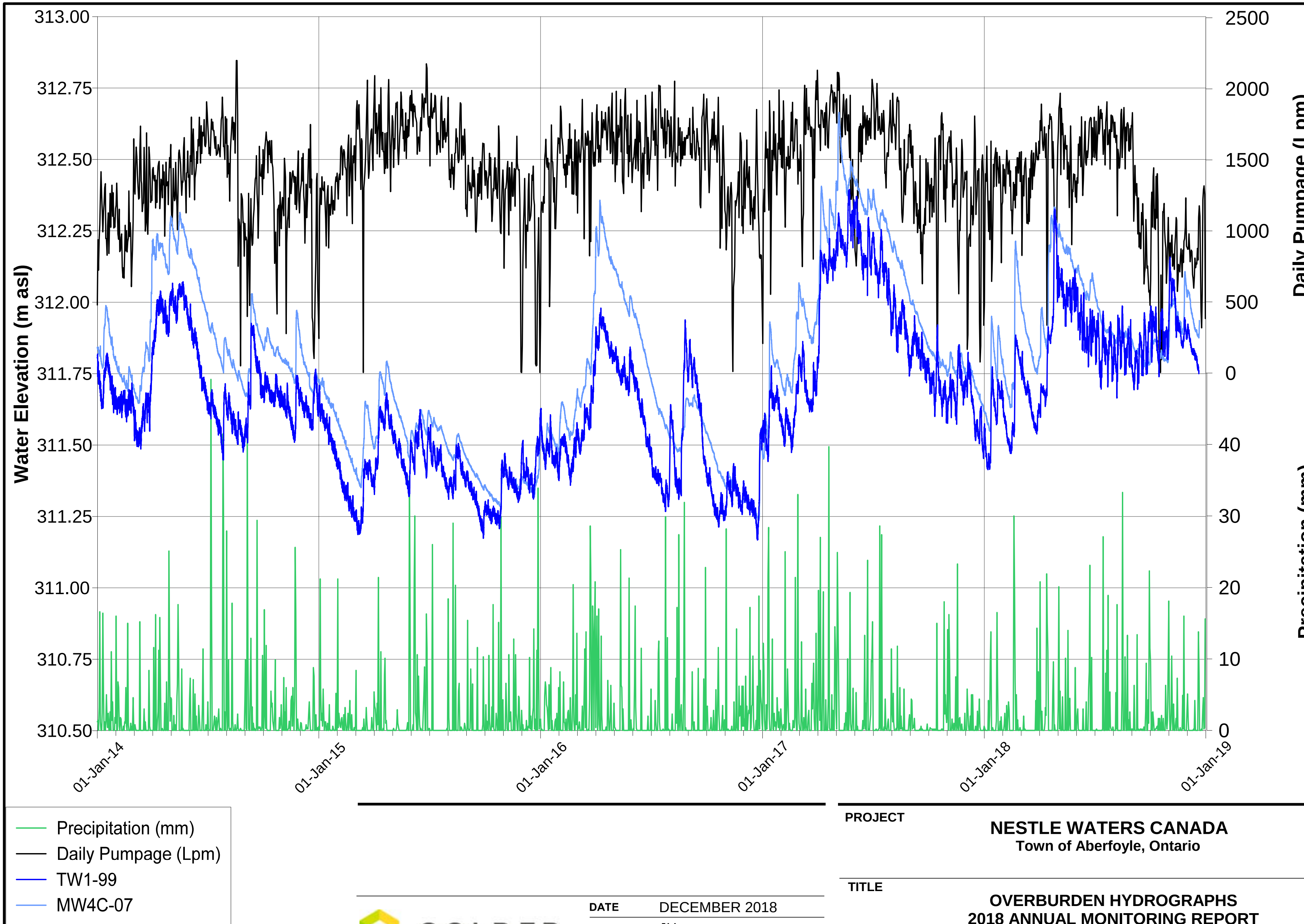
Town of Aberfoyle, Ontario

TITLE

OVERBURDEN HYDROGRAPHS

2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D31



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA

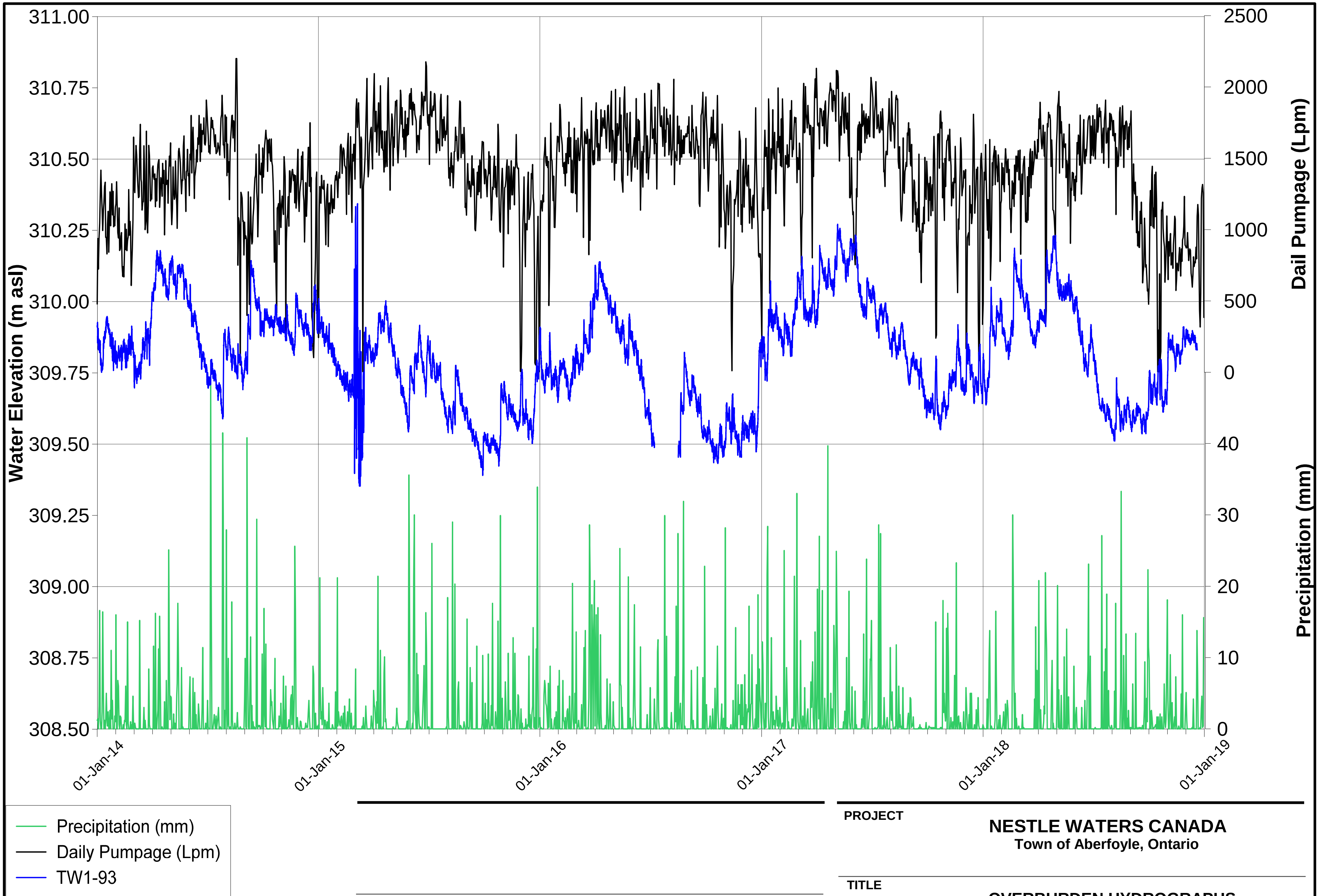
Town of Aberfoyle, Ontario

TITLE

OVERBURDEN HYDROGRAPHS

2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D32



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

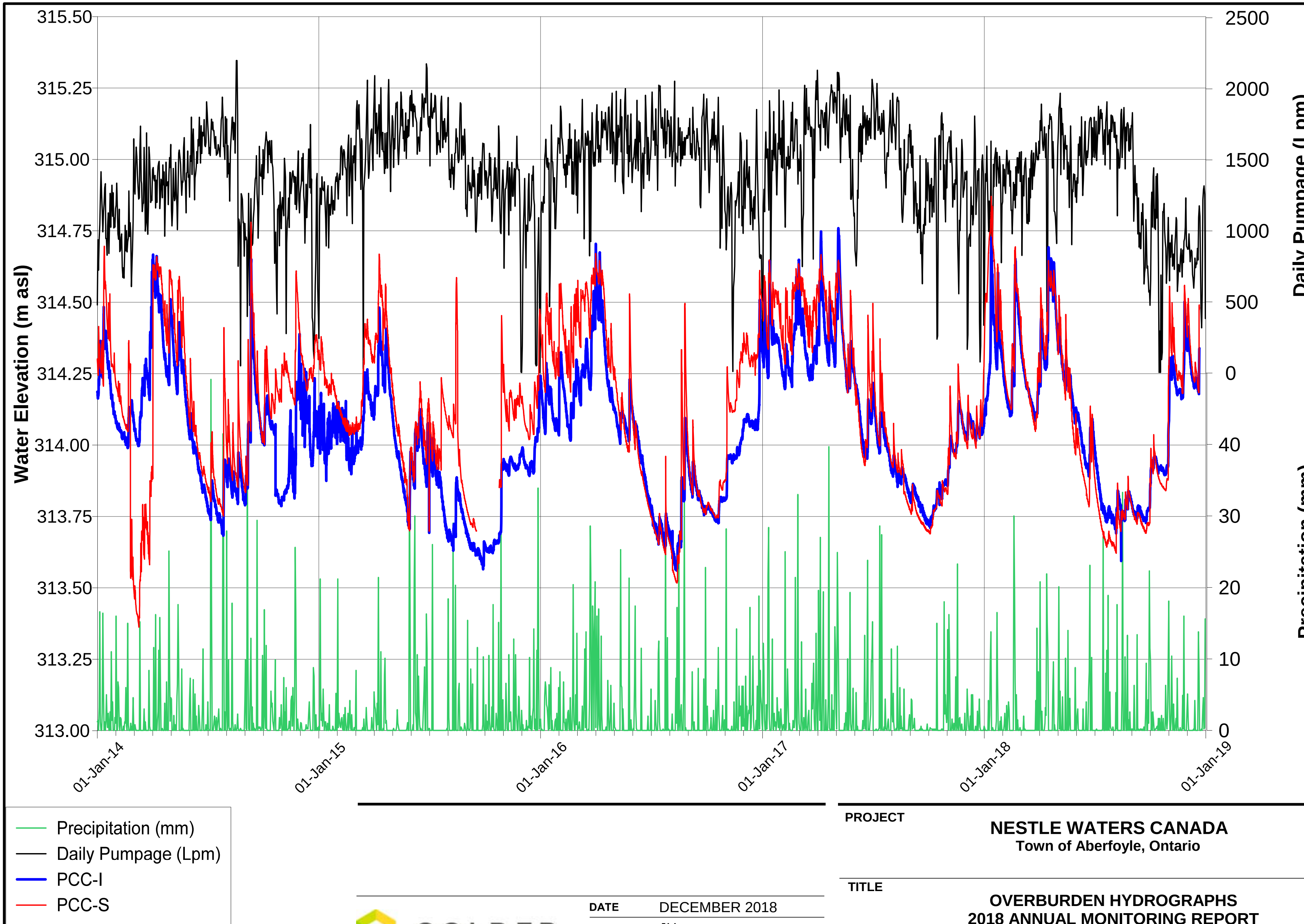
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

OVERBURDEN HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D33



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

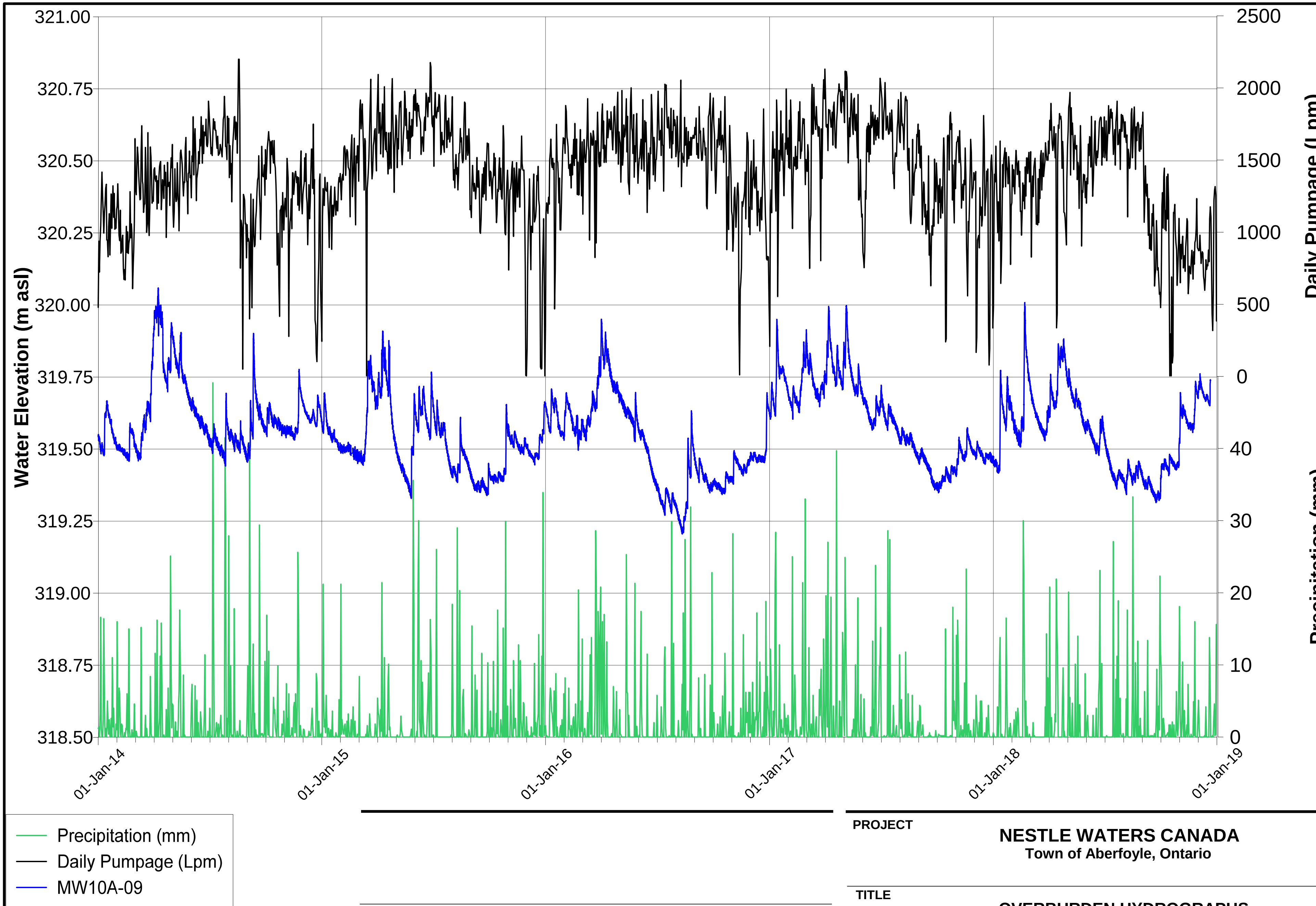
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

OVERBURDEN HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D34



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

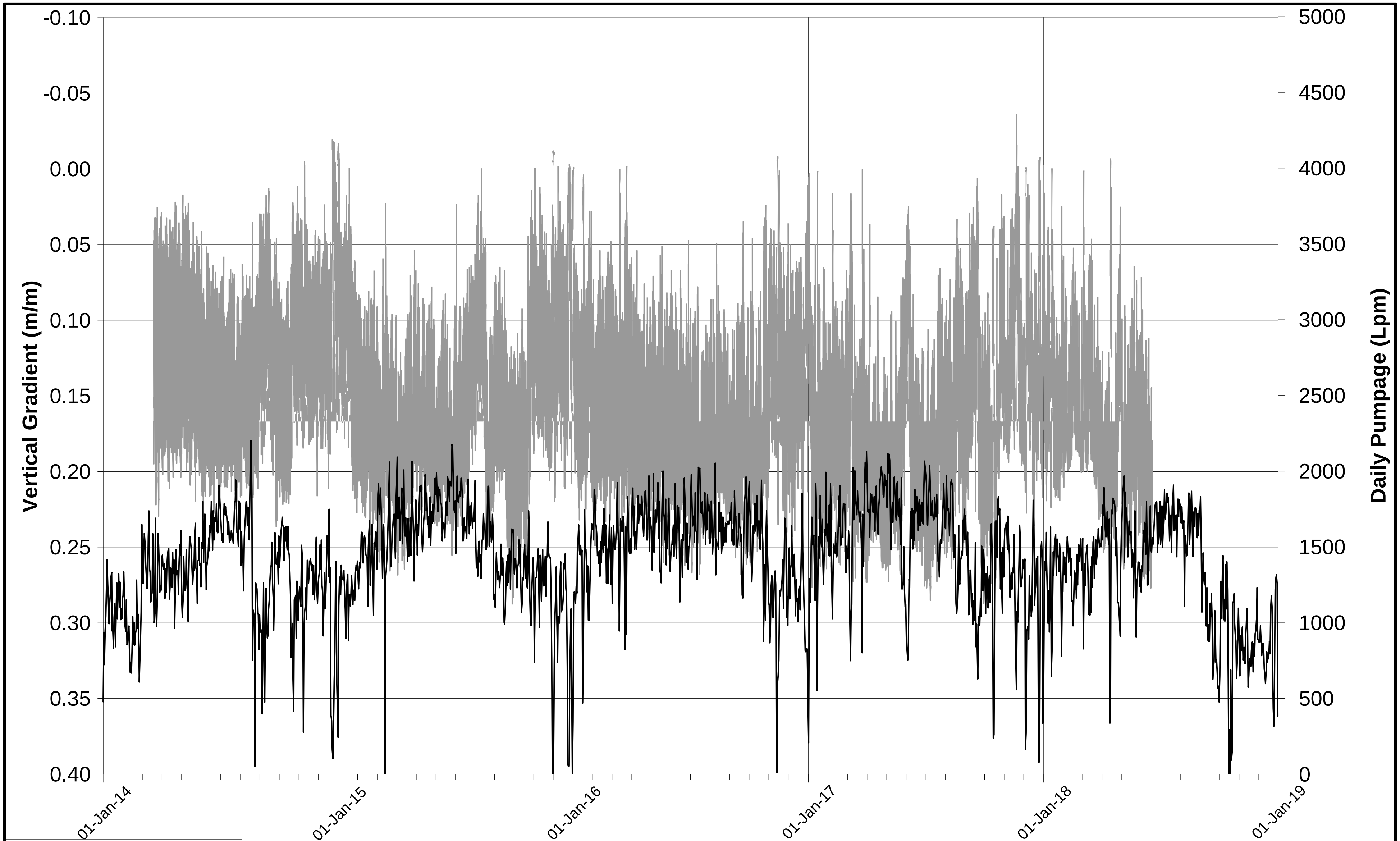
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

OVERBURDEN HYDROGRAPHS
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D35



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

GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

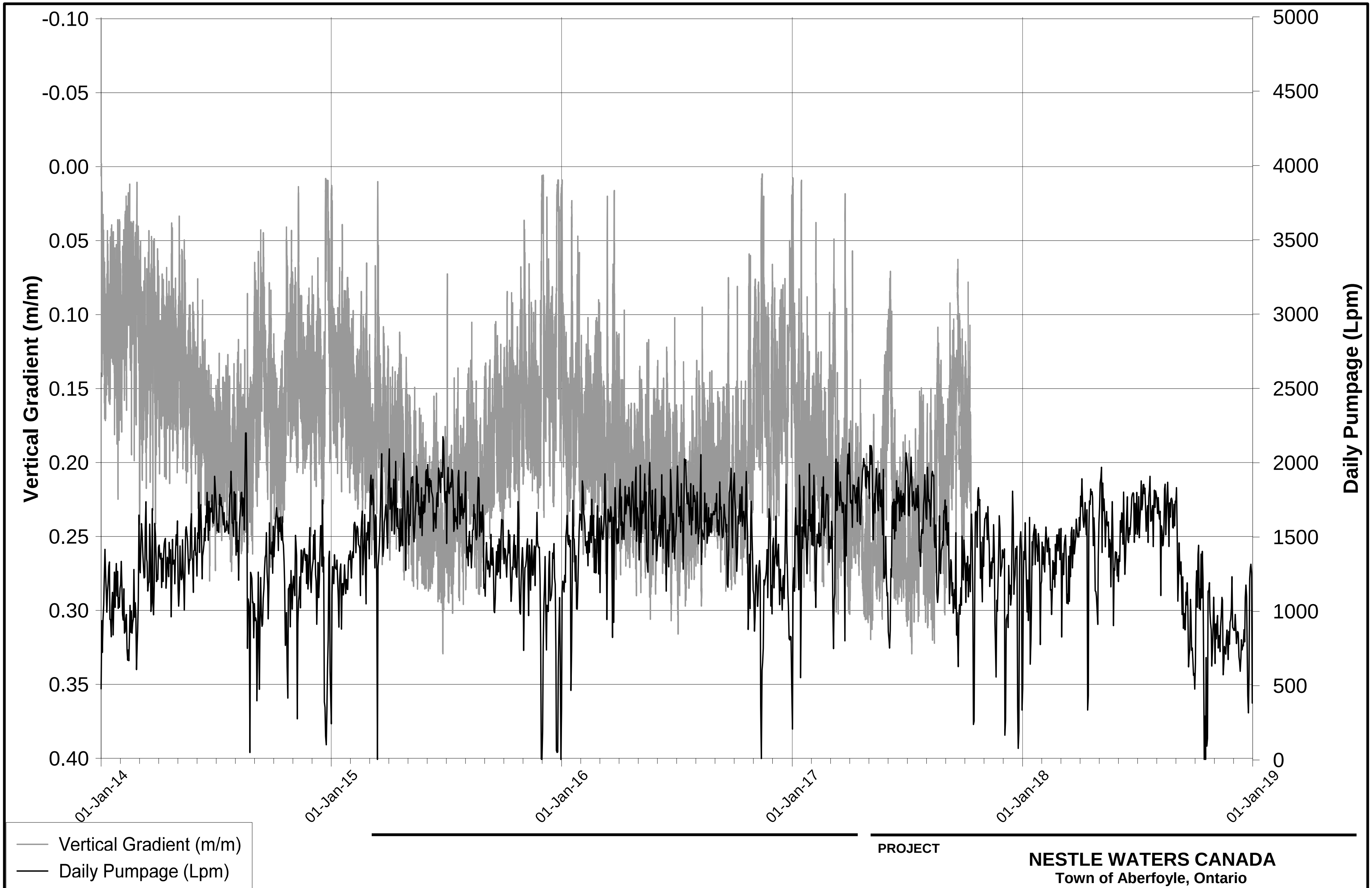
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MW2 VERTICAL GRADIENT
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D36



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

GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

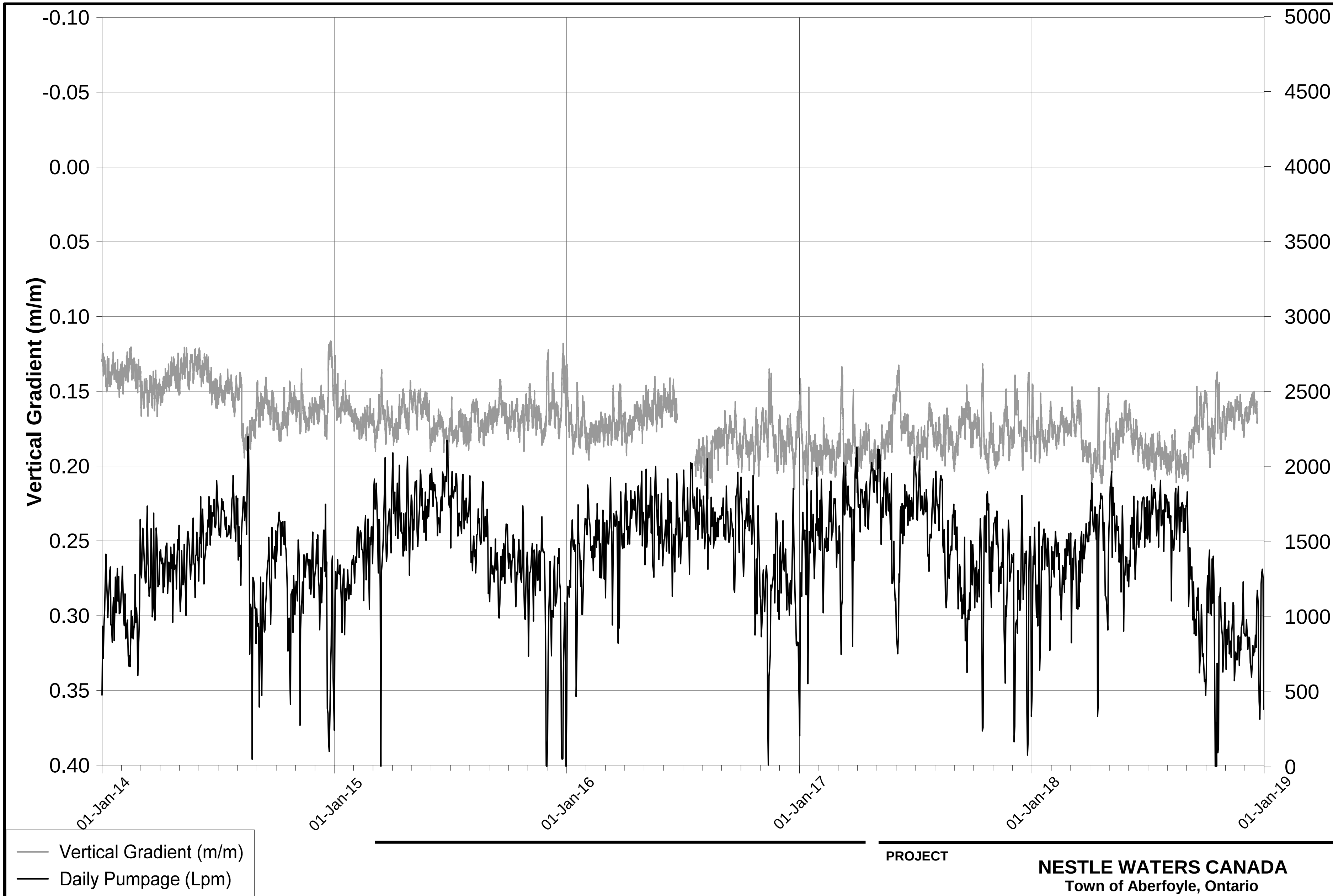
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MW4 VERTICAL GRADIENT
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D37



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

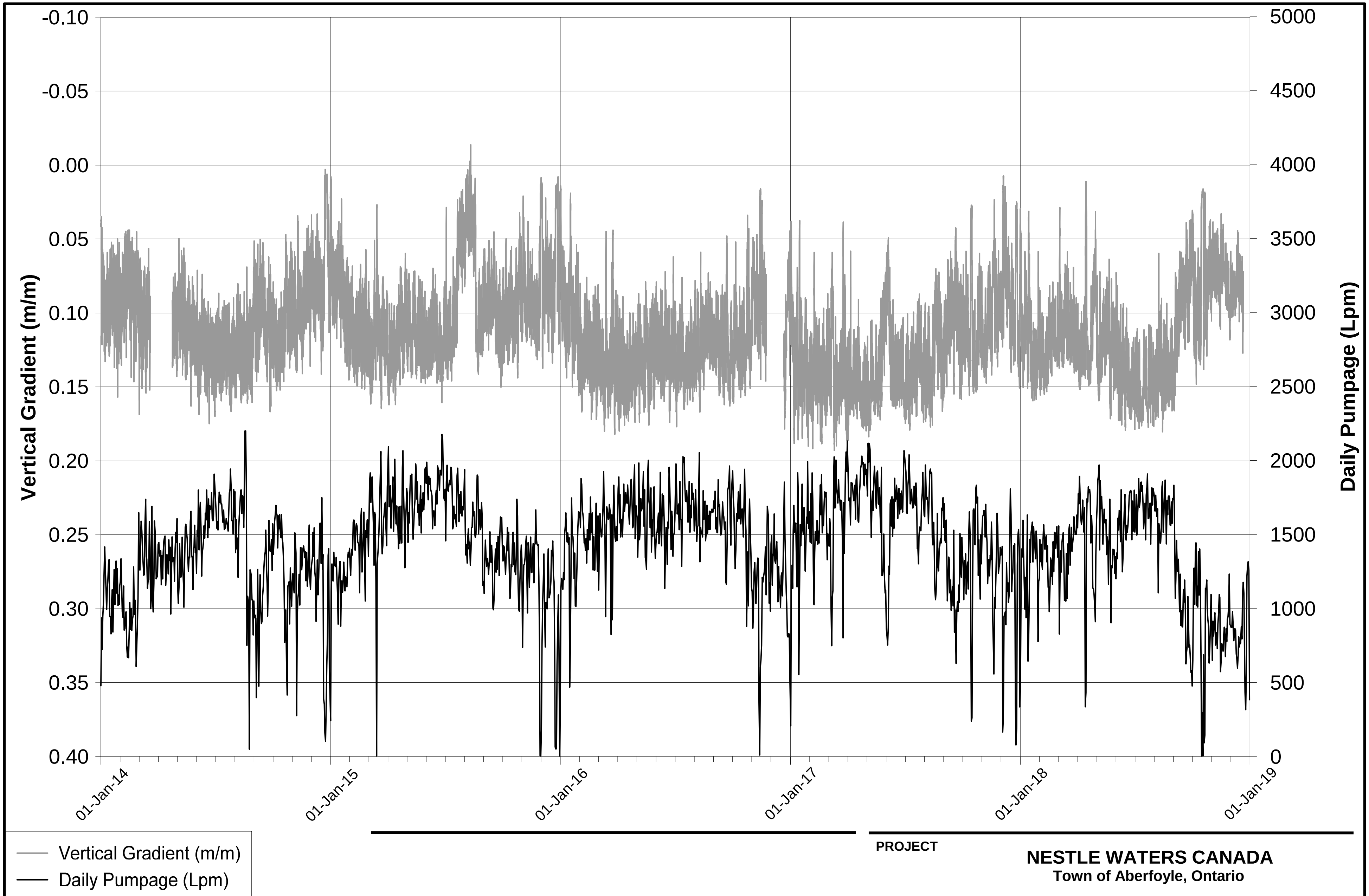
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MW6 VERTICAL GRADIENT
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D38



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

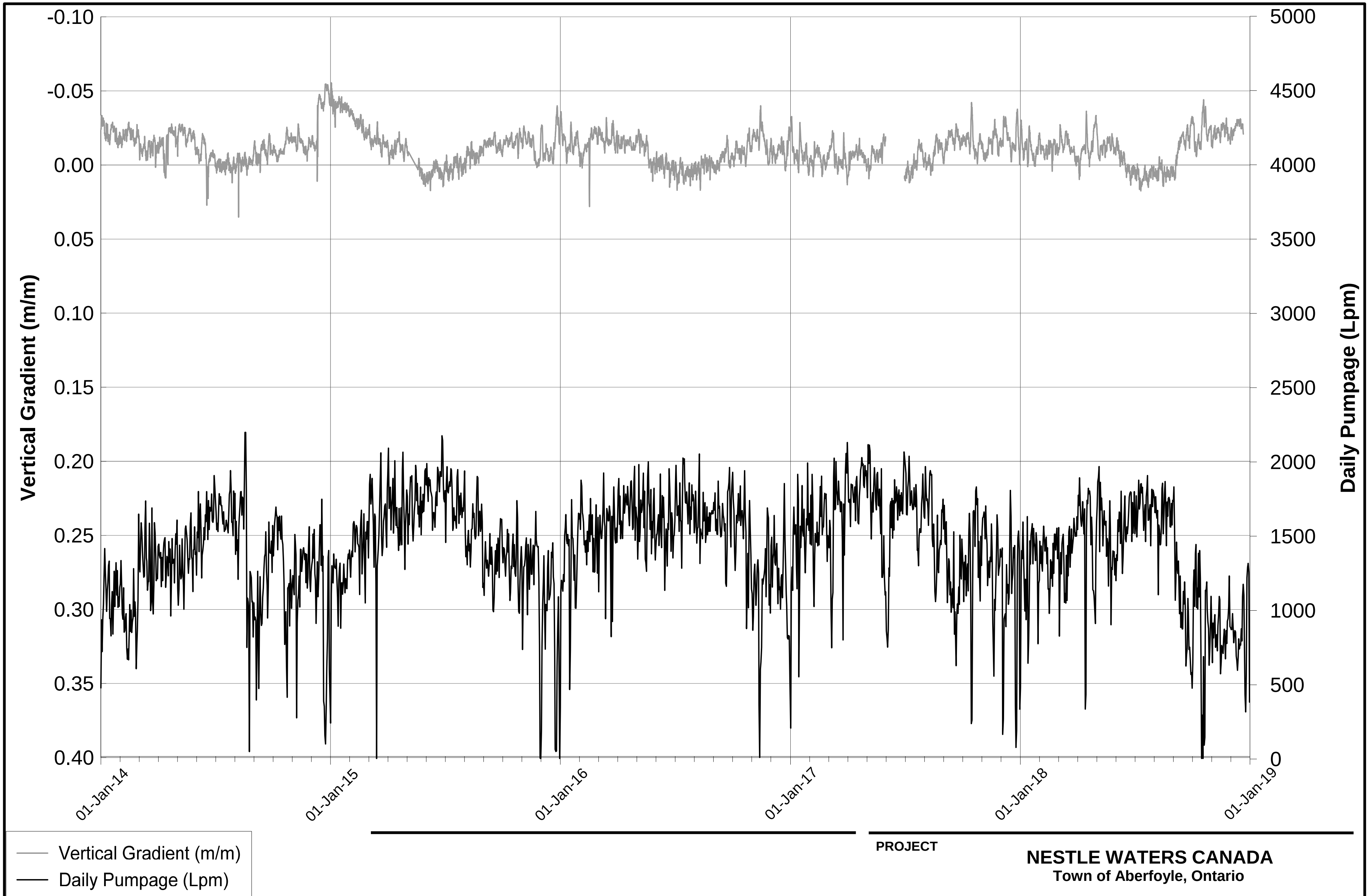
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MW7 VERTICAL GRADIENT
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D39



DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

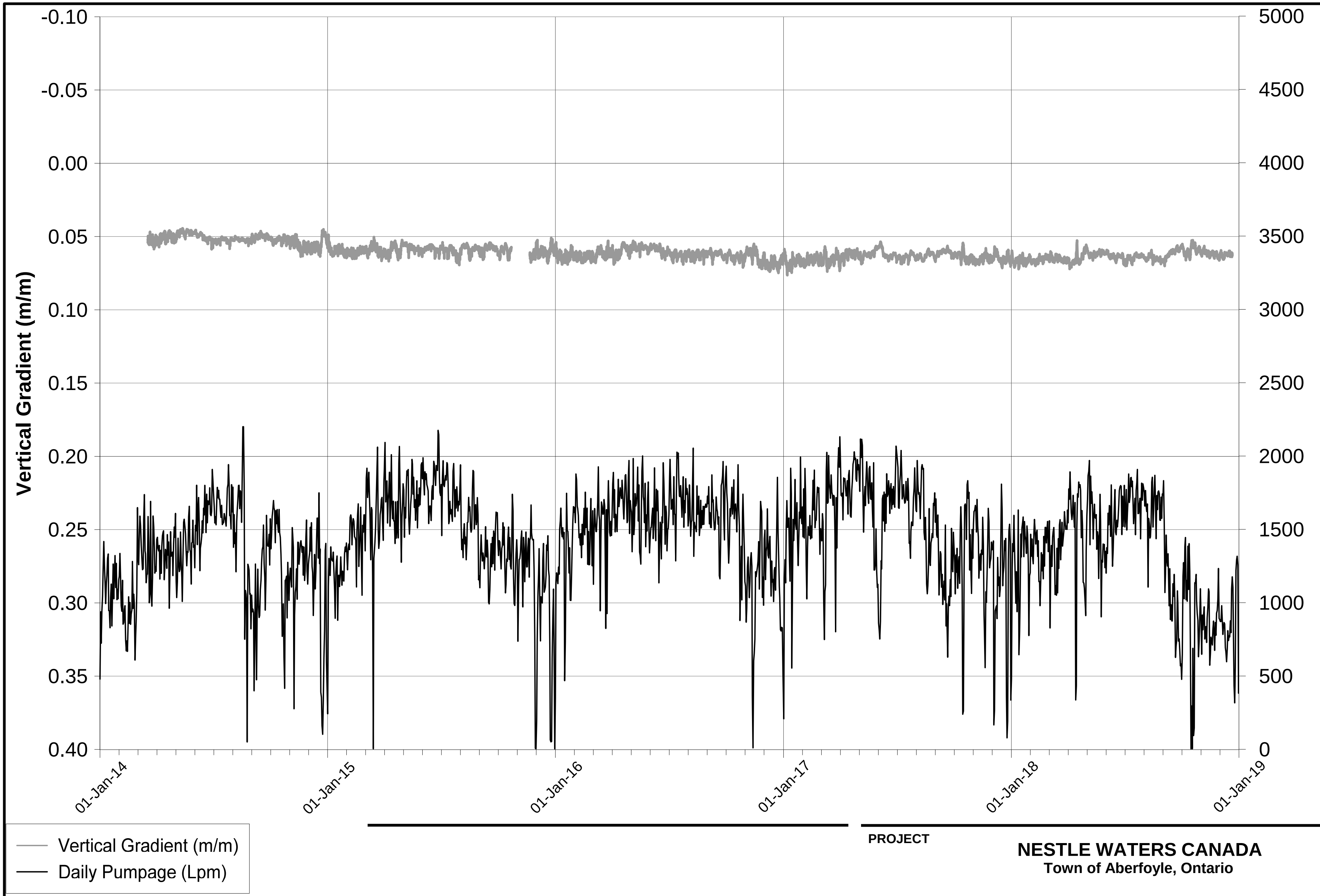
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MW8 VERTICAL GRADIENT
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D40



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

GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

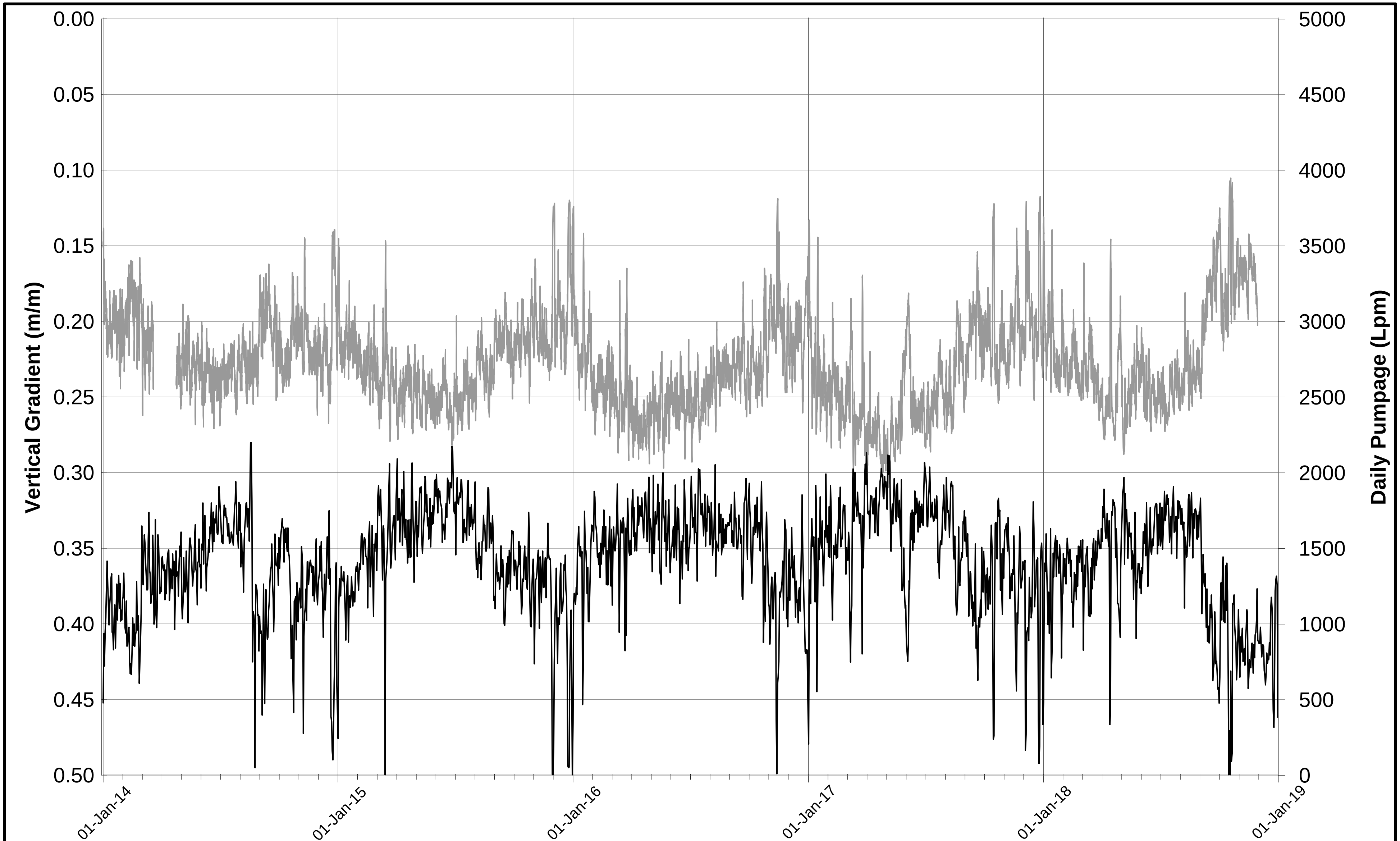
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MW10 VERTICAL GRADIENT
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D41



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

GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

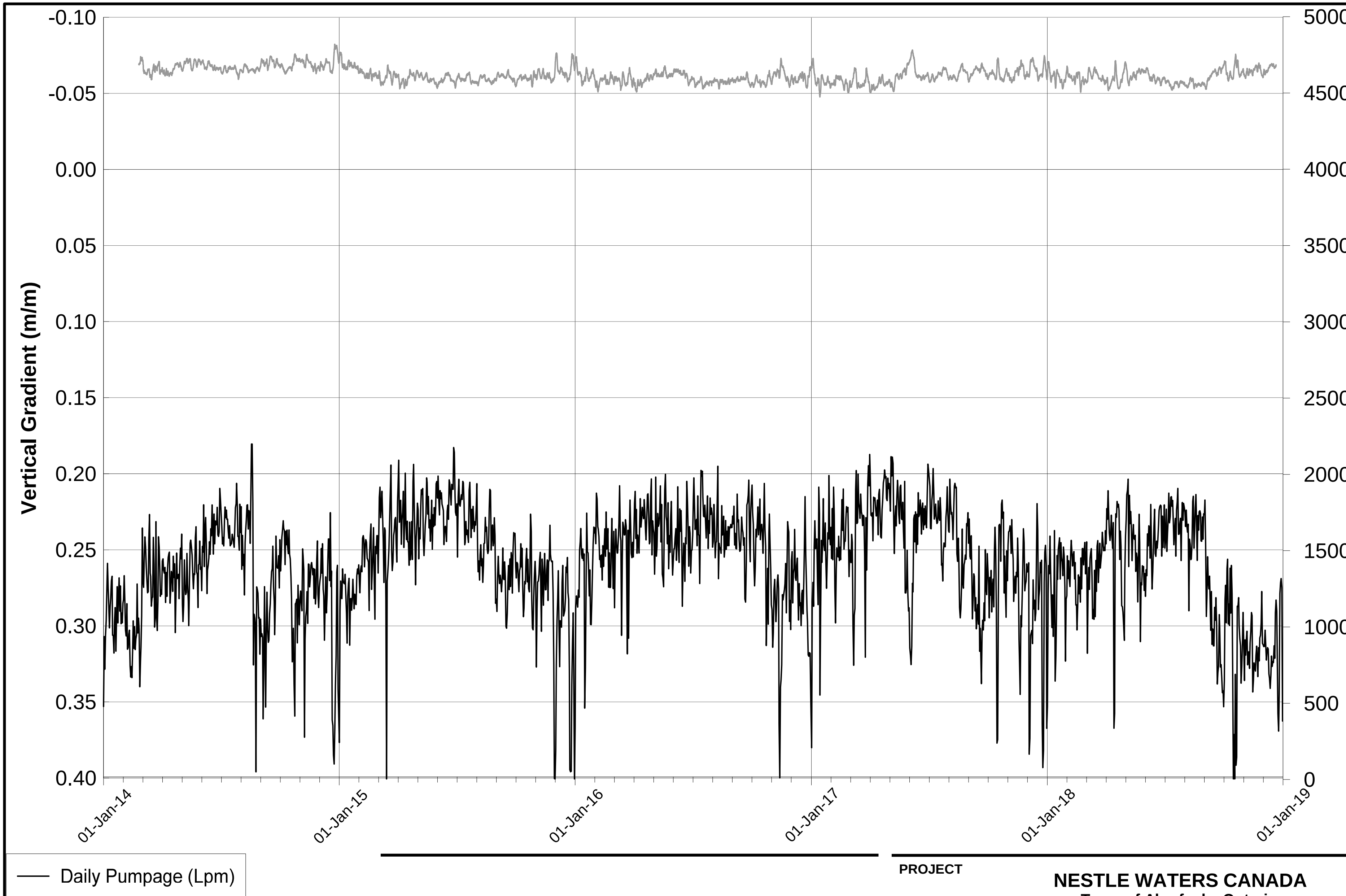
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MW14 VERTICAL GRADIENT
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D42

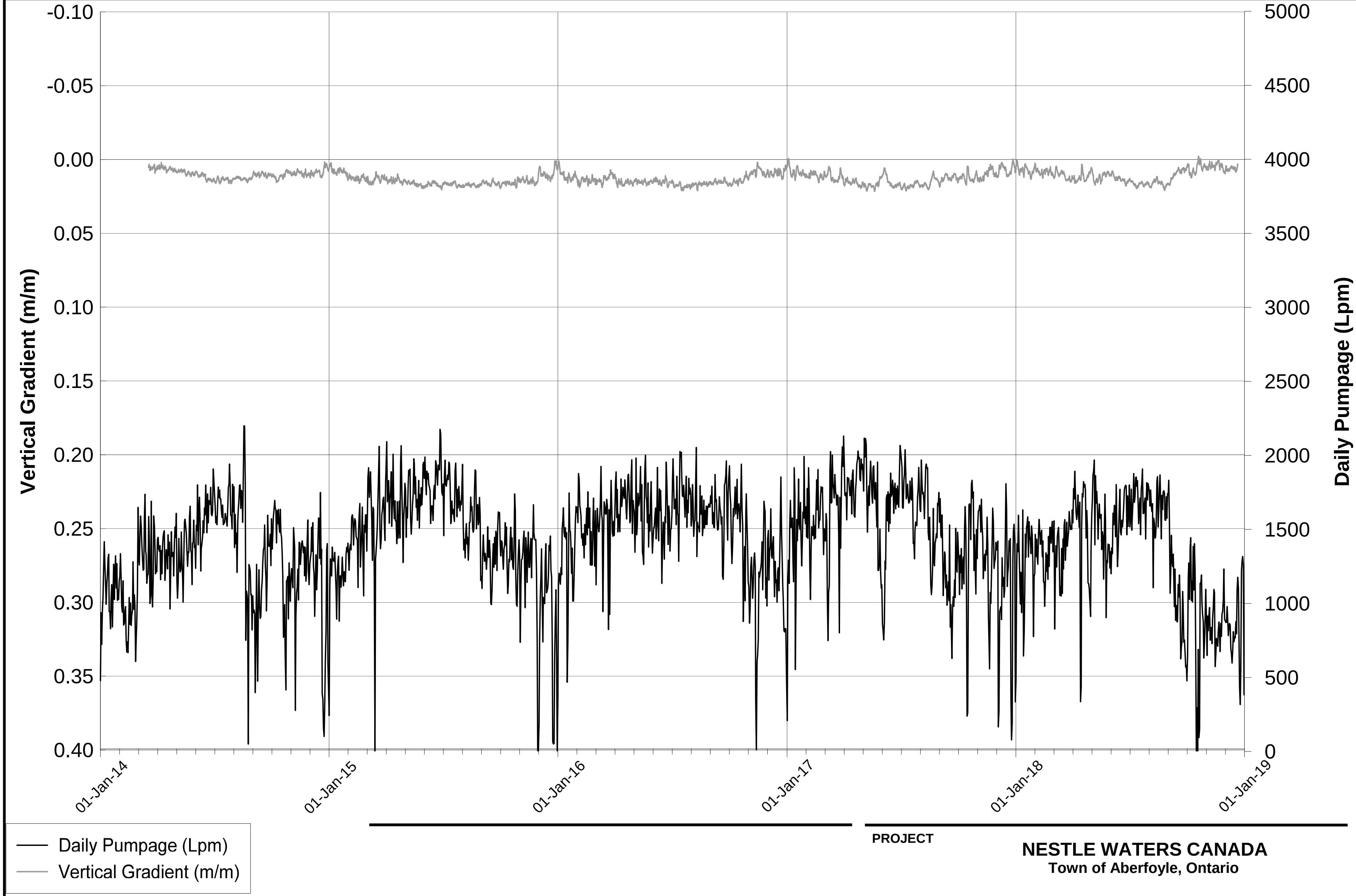


DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT
NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE
MW15 VERTICAL GRADIENT
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D43



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

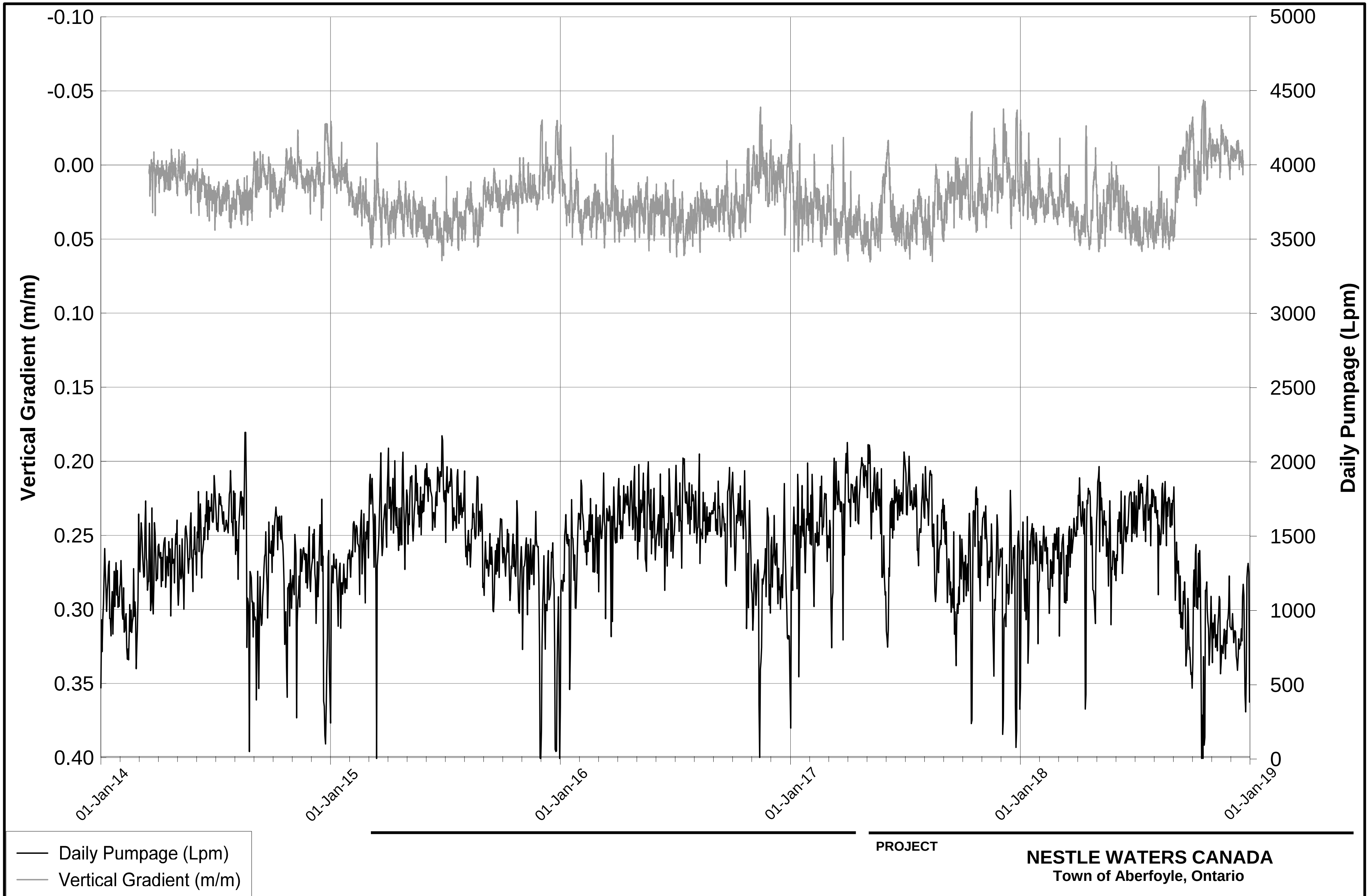
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MW16 VERTICAL GRADIENT
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D44



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

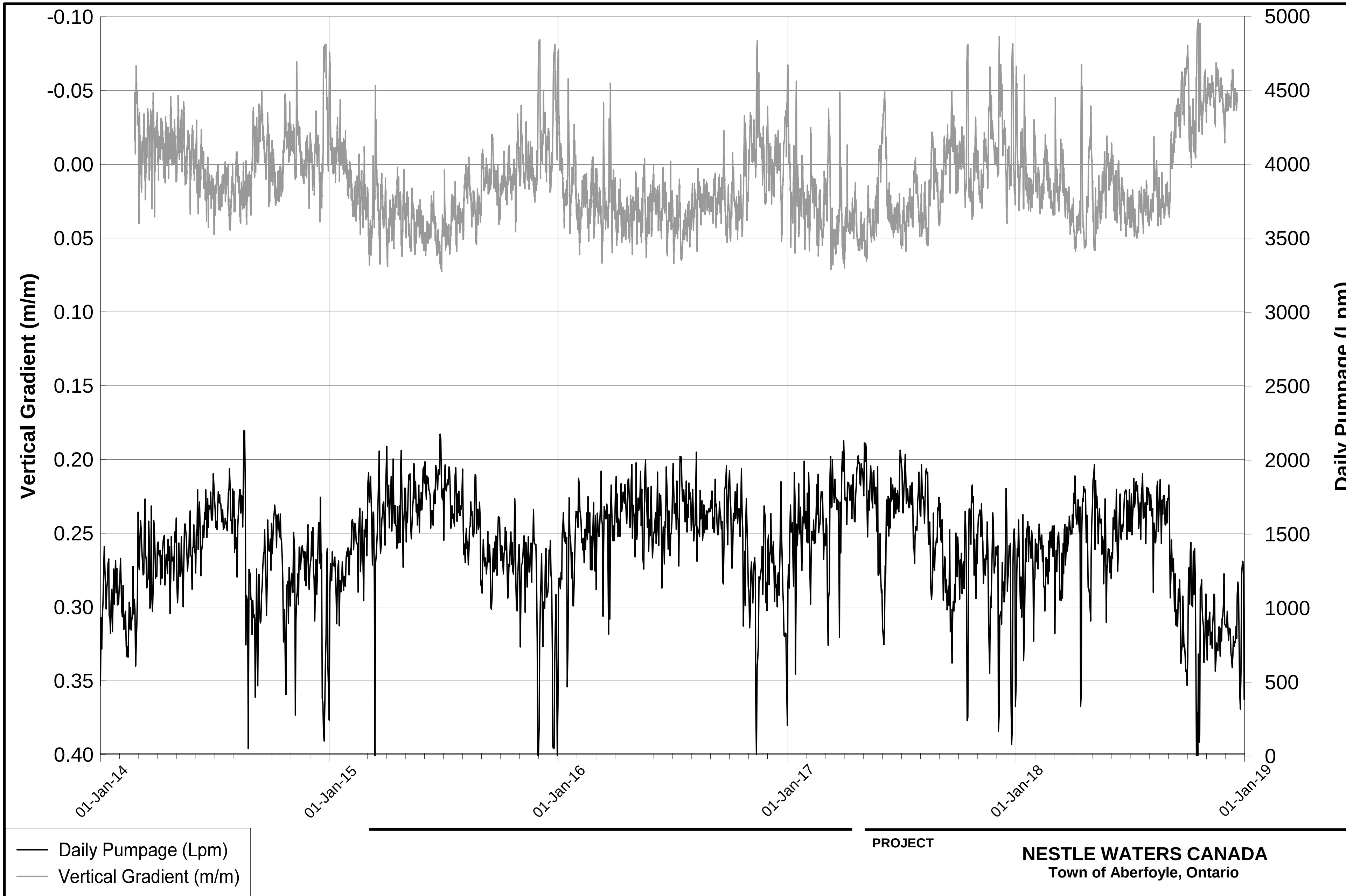
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MW17 VERTICAL GRADIENT
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D45



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MW18 VERTICAL GRADIENT
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	D46

TABLE D1
Manual Groundwater Elevations
2018 Annual Report

Date	Water Level (masl)							
	TW3-80	MW02A-07	MW02B-07	MW02C-07	MW02D-07	MW02E-07	MW04A-07	MW04B-07
18-Jan-18	302.45	307.70	308.72	310.84	311.58	311.54	308.64	311.67
20/22-Feb-18	304.85	308.18	309.15	311.18	311.95	311.98	309.04	311.82
18/19/20-Mar-18	303.35	308.90	309.19	310.76	311.52	311.46	307.85	311.82
18/19-Apr-18	305.04	306.89	308.13	310.84	311.76	311.73	307.72	311.94
22/23-May-18	303.24	306.56	307.85	310.71	311.66	311.59	309.00	312.21
18/19-Jun-18	302.47	307.12	308.27	310.71	311.49	311.41	307.91	312.01
19/20-Jul-18	303.99	306.27	307.42	310.35	311.31	311.27	307.87	311.86
22/23/27-Aug-18	303.44	306.64	307.71	310.42	311.40	311.36	307.89	311.82
18/20-Sep-18	308.58	308.84	309.61	310.99	311.49	311.38	309.24	311.78
15/16-Oct-18	311.20	311.43	311.49	311.62	311.69	311.54	310.93	311.85
22/23-Nov-18	307.75	309.92	310.43	311.41	311.74	311.61	310.37	311.89
20/21-Dec-18	306.71	308.09	308.92	311.00	311.65	311.57	310.10	311.93

TABLE D1
Manual Groundwater Elevations
2018 Annual Report

Date	Water Level (masl)							
	MW04C-07	MW06A-08	MW06B-08	MW07A-08	MW07B-08	MW08A-08	MW08B-08	MW10A-09
18-Jan-18	311.81	315.34	318.50	308.46	310.38	317.52	317.30	319.68
20/22-Feb-18	312.05	315.57	318.72	309.38	311.00	317.57	317.56	319.79
18/19/20-Mar-18	311.83	315.49	318.40	309.22	310.69	317.48	317.25	319.57
18/19-Apr-18	312.18	315.23	318.79	308.28	310.44	317.70	317.53	319.92
22/23-May-18	312.19	315.75	318.59	310.78	311.01	317.67	317.38	319.81
18/19-Jun-18	312.01	315.07	318.30	308.47	310.29	317.03	317.09	319.49
19/20-Jul-18	311.90	314.87	318.27	307.99	310.03	316.81	316.96	319.38
22/23/27-Aug-18	311.91	315.02	318.36	308.17	310.08	317.03	317.07	319.49
18/20-Sep-18	311.79	315.06	318.05	309.25	310.61	317.14	316.96	319.37
15/16-Oct-18	311.82	315.16	318.36	310.85	311.56	317.33	317.13	319.46
22/23-Nov-18	311.90	315.45	318.38	310.32	311.35	317.57	317.23	319.56
20/21-Dec-18	311.94	315.56	318.54	310.57	311.62	317.71	317.38	319.74

TABLE D1
Manual Groundwater Elevations
2018 Annual Report

Date	Water Level (masl)							
	MW10B-09	MW10C-09	MW10D-09	MW14A-11	MW14B-11	MW14C-11	MW15A-12	MW15B-12
18-Jan-18	319.66	316.83	316.26	309.66	313.91	314.37	310.60	308.42
20/22-Feb-18	319.84	317.03	316.48	309.89	314.08	314.73	310.57	308.46
18/19/20-Mar-18	319.66	316.94	316.36	309.22	313.82	314.56	310.55	308.35
18/19-Apr-18	319.89	317.04	316.44	309.43	314.10	314.89	310.71	308.58
22/23-May-18	319.77	317.25	316.76	310.34	314.11	314.92	310.66	308.89
18/19-Jun-18	319.64	316.94	316.43	309.36	313.67	314.48	310.28	308.30
19/20-Jul-18	319.48	316.89	316.33	309.09	313.38	314.11	310.19	308.23
22/23/27-Aug-18	319.55	316.82	316.26	309.31	313.41	313.97	310.15	308.23
18/20-Sep-18	319.46	316.83	316.28	309.70	313.39	313.82	310.32	308.17
15/16-Oct-18	319.53	316.87	316.30	310.14	313.57	313.90	310.29	308.19
22/23-Nov-18	319.59	316.89	316.28	310.43	313.83	314.07	310.50	308.17
20/21-Dec-18	319.69	317.06	316.47	310.33	314.02	314.31	310.68	308.31

TABLE D1
Manual Groundwater Elevations
2018 Annual Report

Date	Water Level (masl)							
	MW16A-12	MW16B-12	MW17A-12	MW17B-12	MW18A-12	MW18B-12	MW-D	MW-I
18-Jan-18	307.05	307.20	308.19	308.69	307.90	308.05	310.90	310.83
20/22-Feb-18	307.04	307.27	308.11	308.69	307.89	308.16	311.20	311.15
18/19/20-Mar-18	307.11	307.39	308.11	308.79	307.83	308.21	310.88	310.83
18/19-Apr-18	307.21	307.52	307.82	308.98	307.44	308.38	310.91	310.81
22/23-May-18	307.44	308.06	308.86	309.32	308.54	308.45	311.04	311.00
18/19-Jun-18	307.22	307.63	308.17	308.91	307.65	308.04	310.65	310.63
19/20-Jul-18	307.02	307.50	307.66	308.79	307.30	307.82	310.41	310.35
22/23/27-Aug-18	306.86	307.37	307.77	308.66	307.46	307.71	310.46	310.39
18/20-Sep-18	306.98	307.25	308.26	308.44	306.31	307.53	310.71	310.69
15/16-Oct-18	306.89	307.16	308.41	308.46	308.43	307.58	310.98	310.98
22/23-Nov-18	307.01	307.09	308.72	308.47	308.66	307.66	310.98	310.98
20/21-Dec-18	307.05	307.16	308.58	308.50	308.64	308.03	310.61	311.04

TABLE D1
Manual Groundwater Elevations
2018 Annual Report

Date	Water Level (masl)							
	MW-S	PCC-D	PCC-I	PCC-S	TW1-93	TW1-99	TW2-11	PW5 Meadows of Aberfoyle
18-Jan-18	311.34	Frozen	314.40	Frozen	309.89	311.65	309.55	309.57
20/22-Feb-18	311.63	Frozen	314.52	Frozen	309.99	311.68	309.70	309.72
18/19/20-Mar-18	311.23	Frozen	314.13	314.13	309.93	311.62	309.41	309.73
18/19-Apr-18	311.51	314.44	314.59	315.19	310.07	311.87	309.08	308.88
22/23-May-18	311.30	314.57	314.24	313.79	310.08	311.97	309.43	310.22
18/19-Jun-18	310.96	314.21	313.92	313.84	309.80	311.82	309.18	308.88
19/20-Jul-18	310.73	314.02	313.75	313.72	309.61	311.87	309.05	308.62
22/23/27-Aug-18	310.81	314.07	313.82	313.83	309.64	311.77	308.95	308.74
18/20-Sep-18	310.70	314.00	313.73	313.71	309.58	311.83	309.49	309.78
15/16-Oct-18	310.92	314.21	313.92	313.89	309.71	311.79	311.01	311.28
22/23-Nov-18	310.92	314.48	314.18	314.24	309.80	311.85	310.43	310.73
20/21-Dec-18	311.21	314.64	314.34	314.48	309.83	312.45	310.21	310.68

TABLE D1
Manual Groundwater Elevations
2018 Annual Report

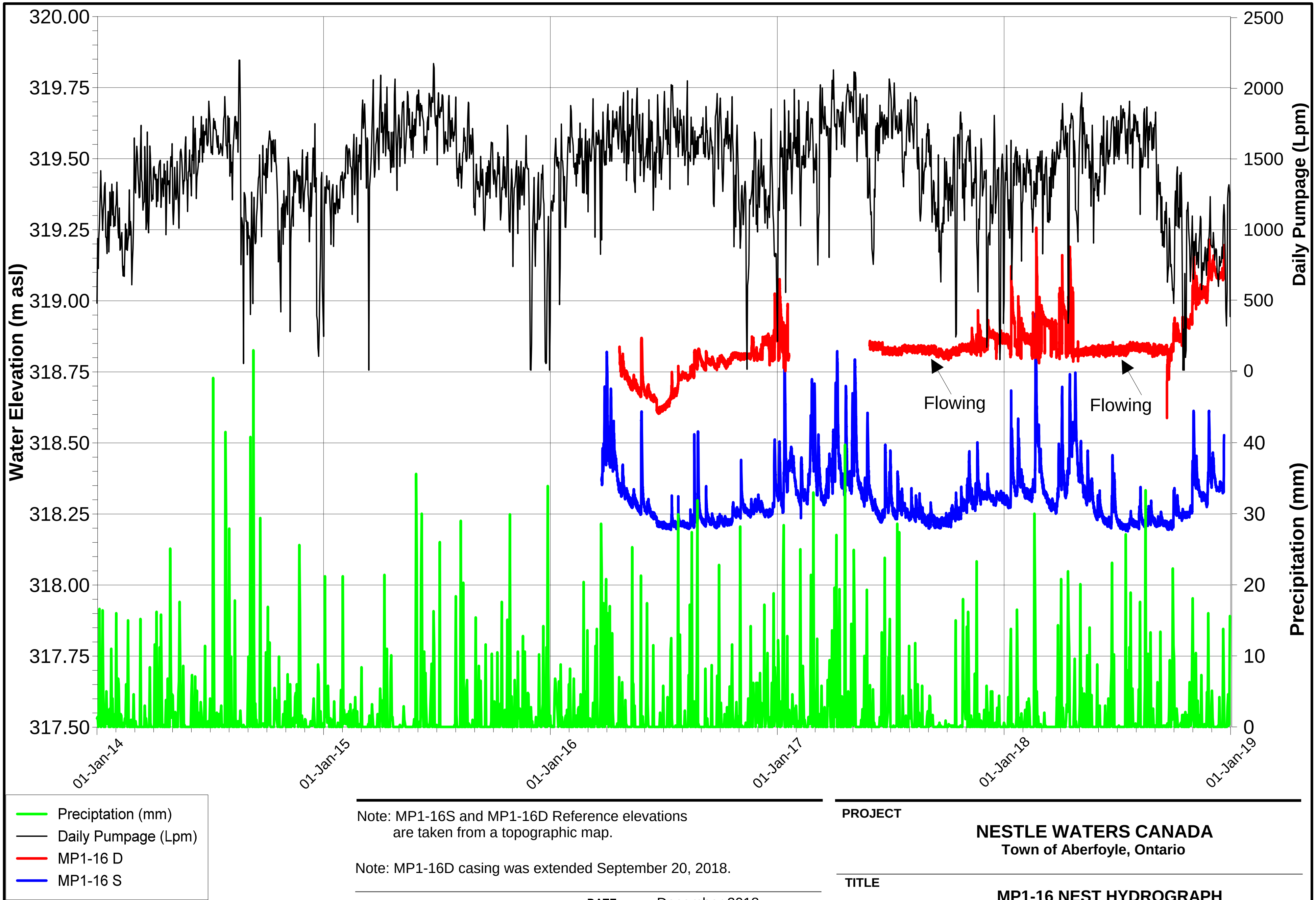
Date	Water Level (masl)							
	#125 Brock S. (Y Well)	#2 Brock N.	#27 Old Brock	#50 Brock S. (I Well)	#58 Brock S.	#7404 Rd. 34	#7425 Rd. 34 (B Well)	#8 Maple Leaf Lane
18-Jan-18	311.34	315.93	309.22	309.24	311.85	316.33	309.86	311.90
20/22-Feb-18	311.39	316.15	309.03	309.12	312.08	316.47	309.93	312.07
18/19/20-Mar-18	311.43	315.93	309.11	309.13	311.94	316.28	309.71	311.86
18/19-Apr-18	311.60	316.21	308.02	308.06	311.58	316.55	309.52	311.99
22/23-May-18	312.73	316.08	309.79	309.79	312.28	316.33	310.52	312.25
18/19-Jun-18	311.74	315.71	308.22	308.19	311.76	315.79	309.33	311.63
19/20-Jul-18	311.66	315.52	307.79	307.64	311.52	315.40	309.41	310.38
22/23/27-Aug-18	311.59	315.65	307.86	307.85	311.42	315.73	309.37	311.52
18/20-Sep-18	311.58	315.56	308.71	312.47	307.82	315.60	309.83	311.49
15/16-Oct-18	311.55	315.74	311.24	311.20	310.75	315.91	310.17	311.86
22/23-Nov-18	311.55	315.88	310.32	310.32	312.12	316.15	310.63	311.78
20/21-Dec-18	311.53	316.08	310.09	310.10	312.27	316.33	310.49	312.22

TABLE D1
Manual Groundwater Elevations
2018 Annual Report

Date	Water Level (masl)		
	#80 Brock S. (W2 Well)	#98 Brock S. (M1 Well)	Fireflow
18-Jan-18	312.74	309.14	309.73
20/22-Feb-18	312.55	309.49	309.79
18/19/20-Mar-18	309.08	309.53	309.67
18/19-Apr-18	307.83	308.41	309.53
22/23-May-18	309.59	310.04	309.88
18/19-Jun-18	307.92	308.39	309.45
19/20-Jul-18	307.51	308.07	309.13
22/23/27-Aug-18	not available	308.26	309.14
18/20-Sep-18	not available	309.48	309.76
15/16-Oct-18	not available	311.33	310.42
22/23-Nov-18	not available	310.63	310.19
20/21-Dec-18	not available	310.46	310.06

APPENDIX E

Surface Water Level Monitoring



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

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

GOLDER

DATE	December 2018
DESIGN	KJ
REVIEW	GP
APPROVED	GP

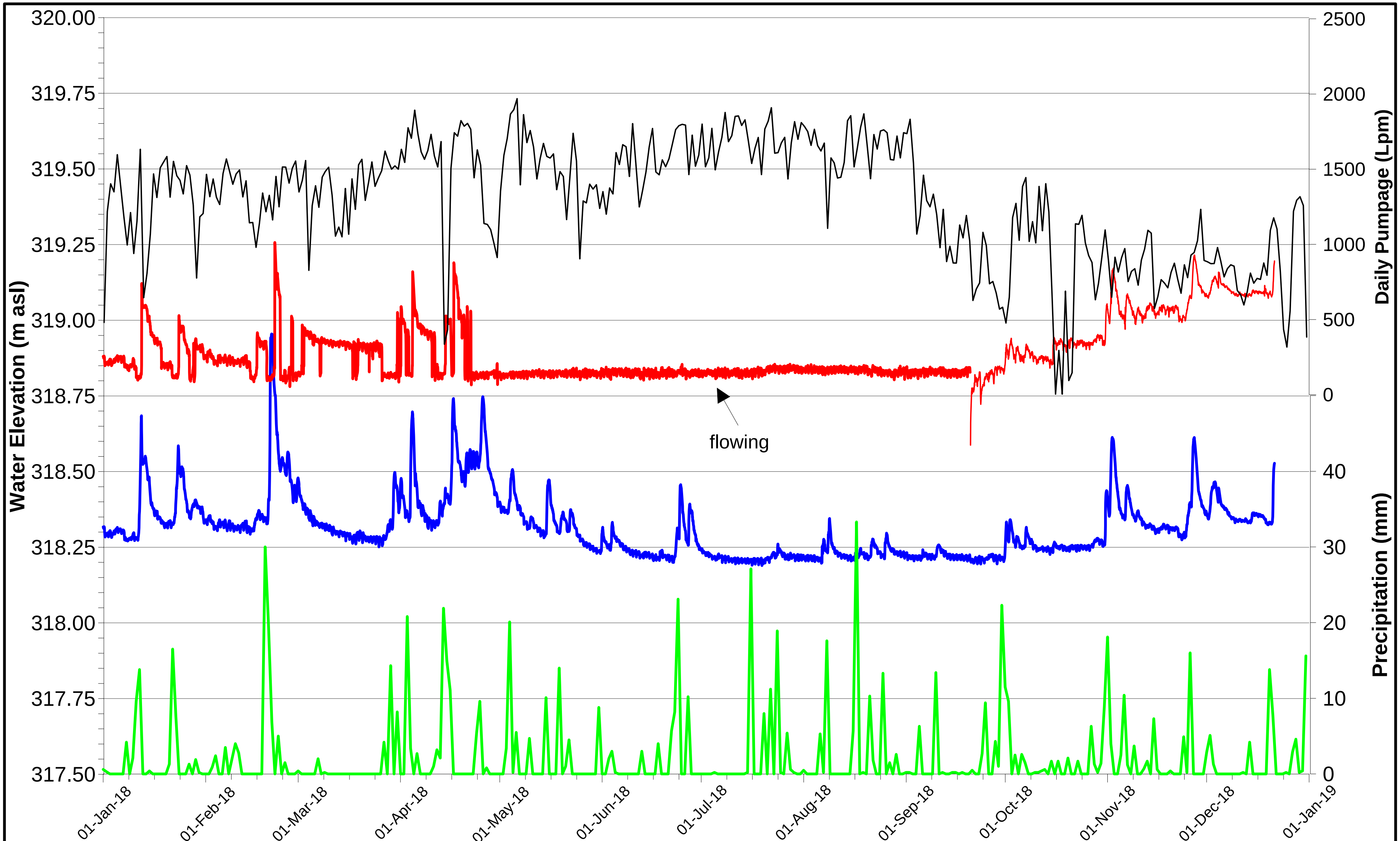
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MP1-16 NEST HYDROGRAPH
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E1a



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

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

GOLDER

DATE	DECEMBER 2018
DESIGN	KJ
REVIEW	GP
APPROVED	GP

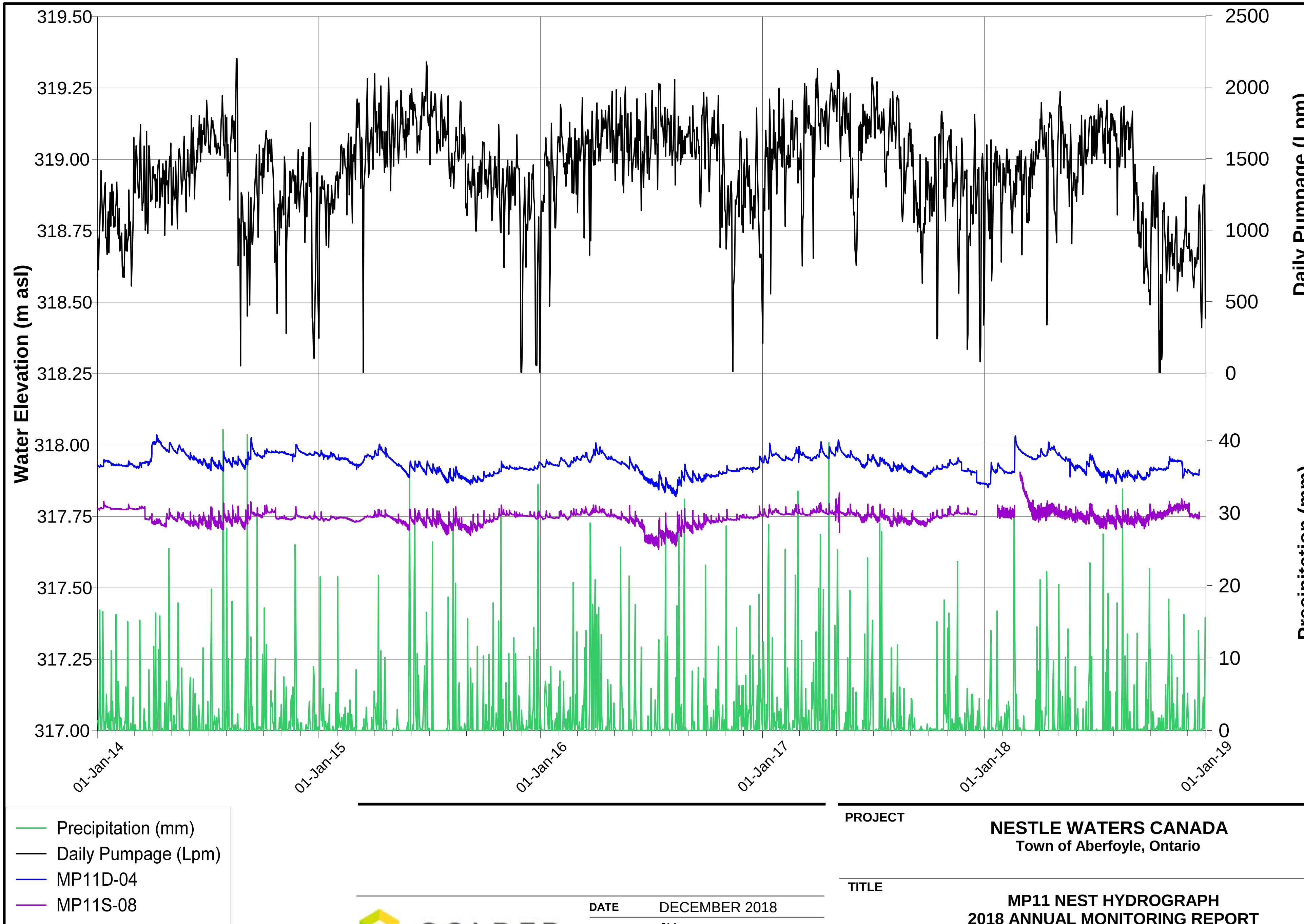
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MP1-16 NEST HYDROGRAPH (2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E1b



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA

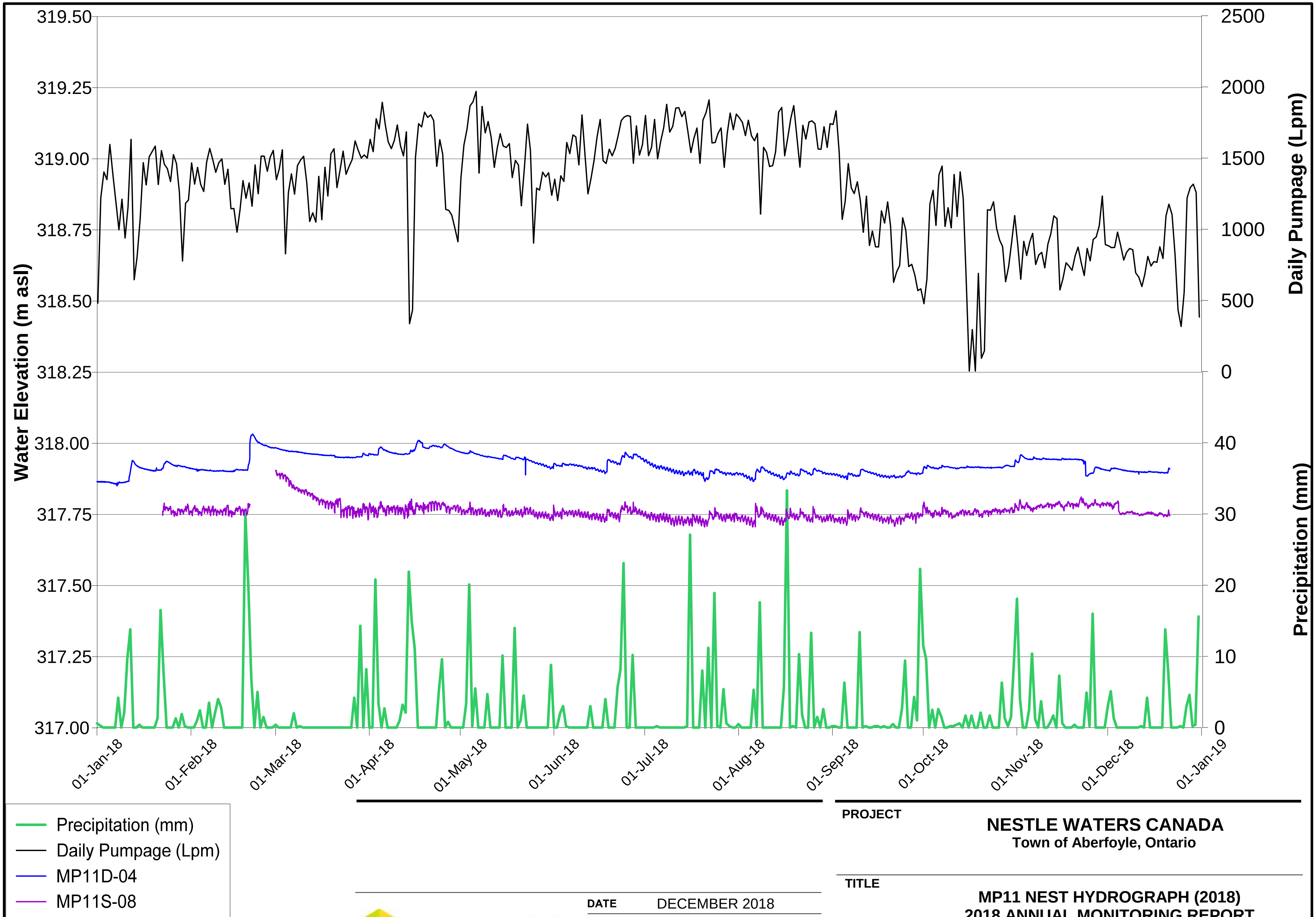
Town of Aberfoyle, Ontario

TITLE

MP11 NEST HYDROGRAPH

2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E2a



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

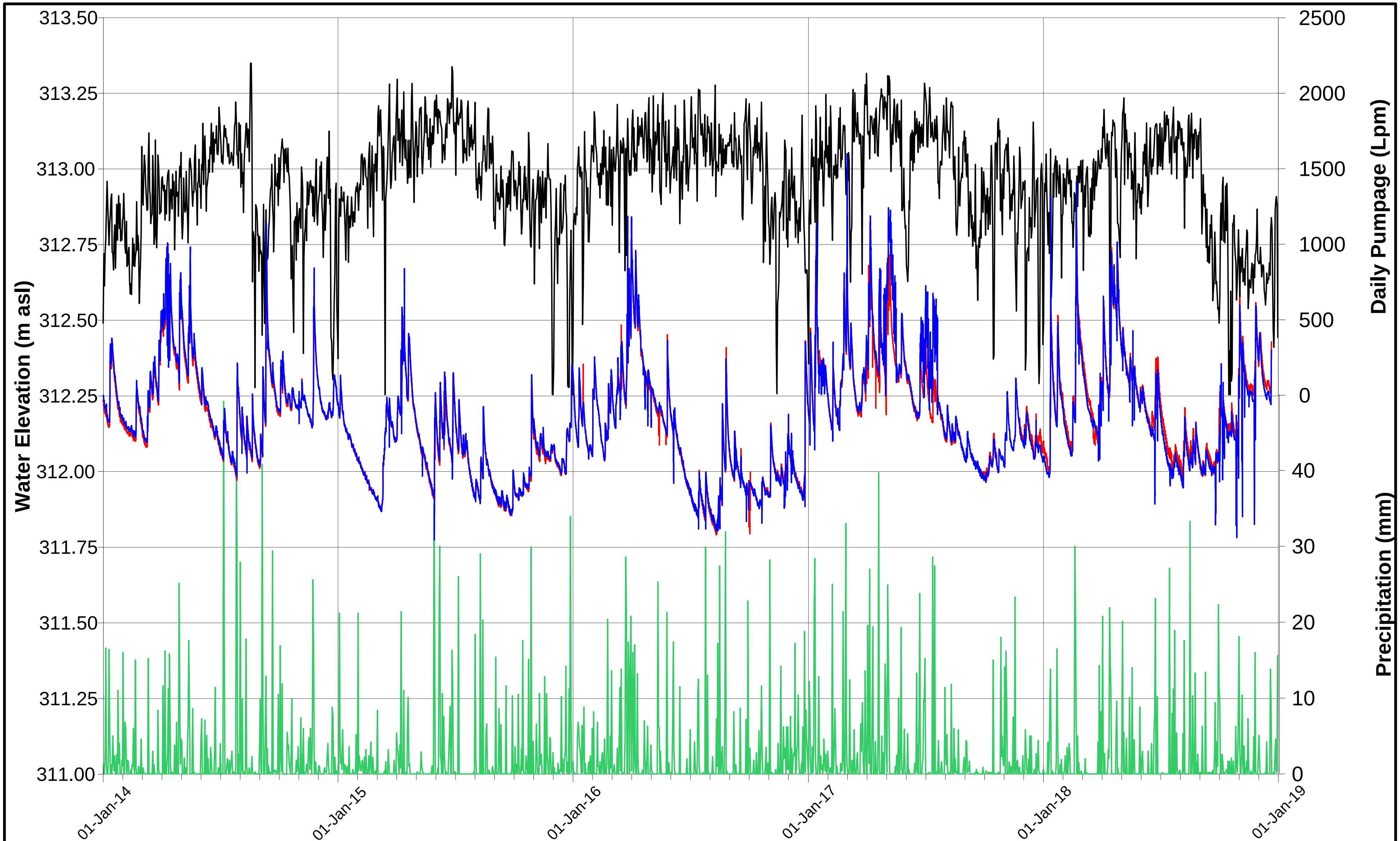
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MP11 NEST HYDROGRAPH (2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E2b



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA

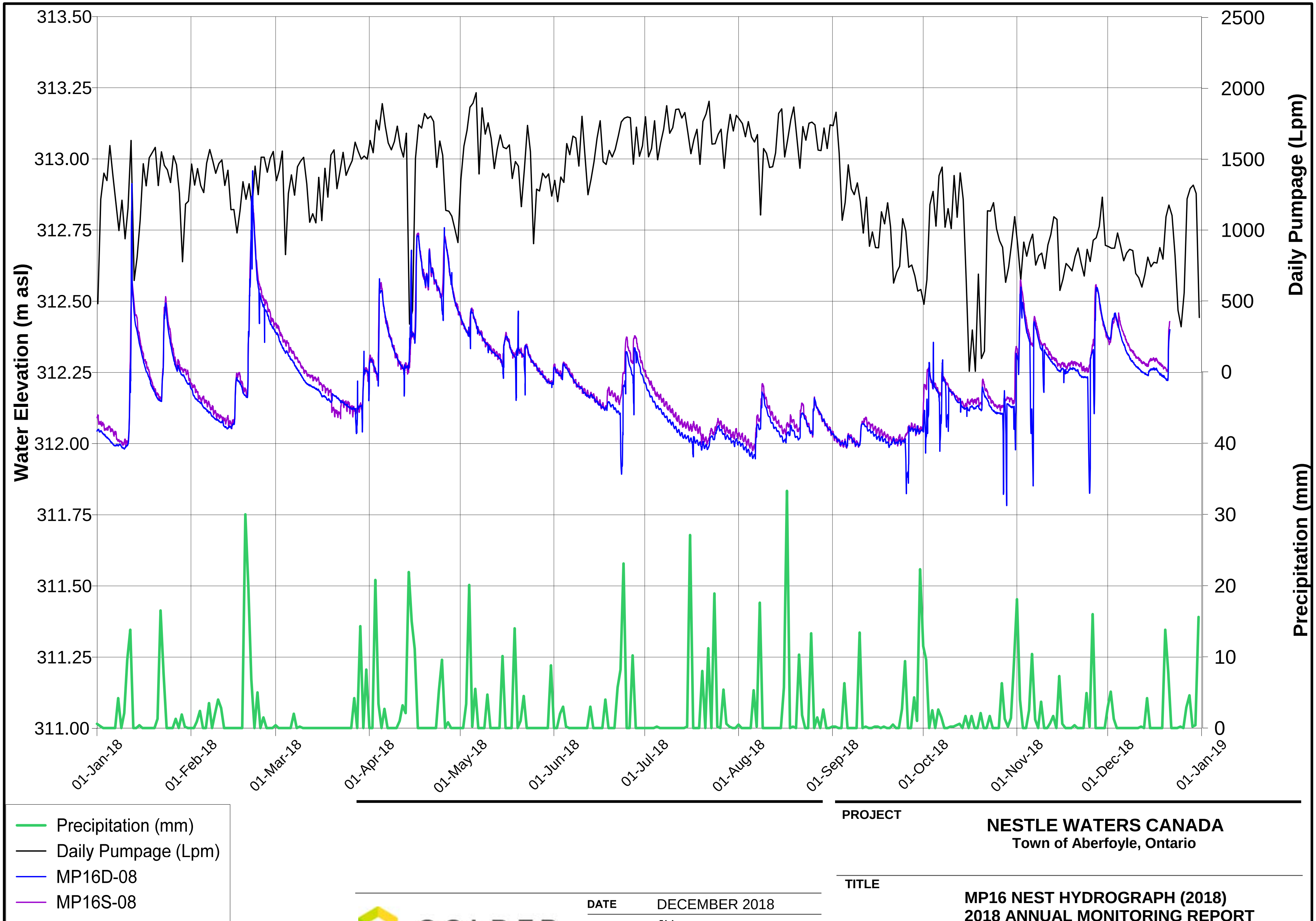
Town of Aberfoyle, Ontario

TITLE

MP16 NEST HYDROGRAPH

2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E3a



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

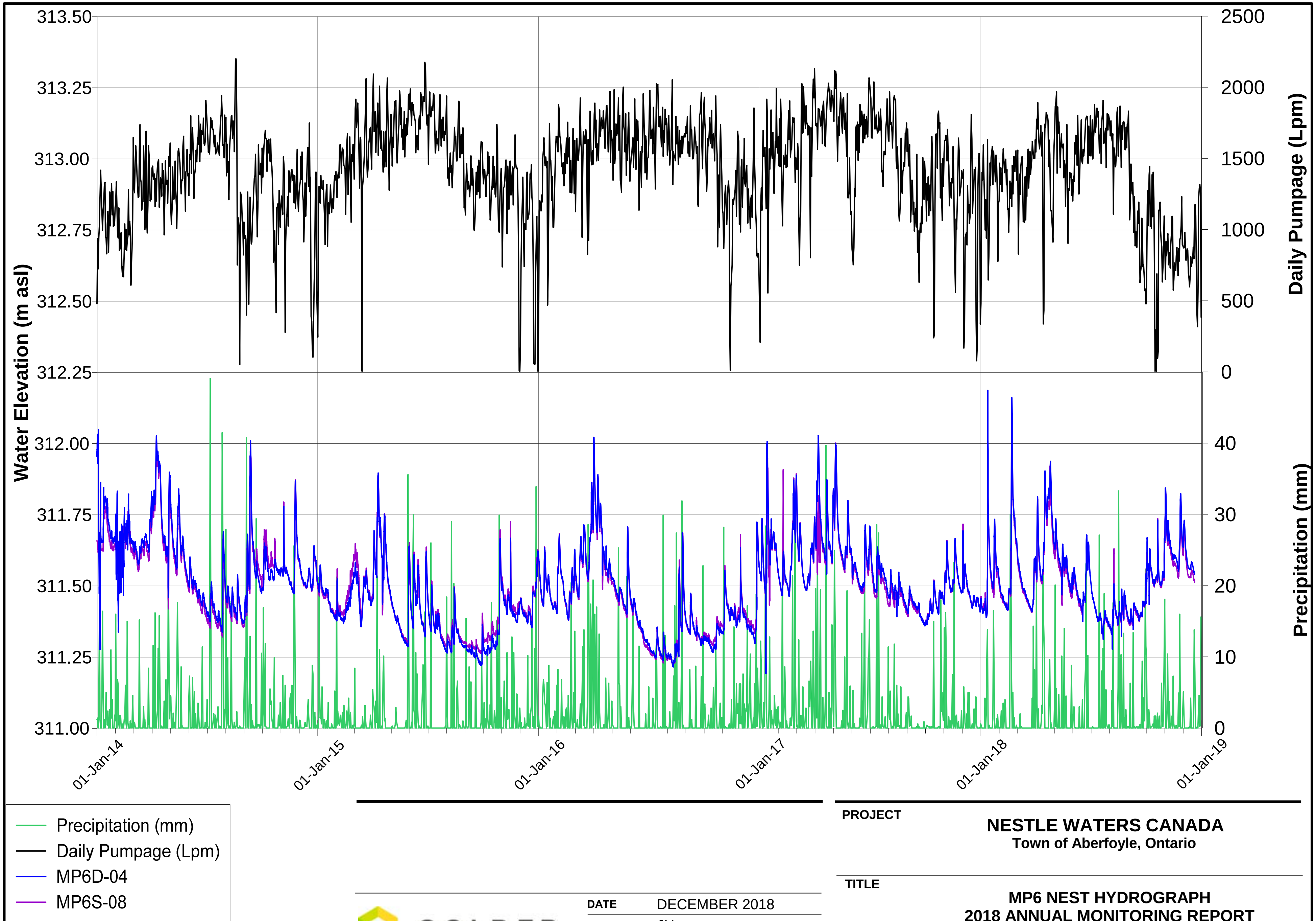
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MP16 NEST HYDROGRAPH (2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E3b



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

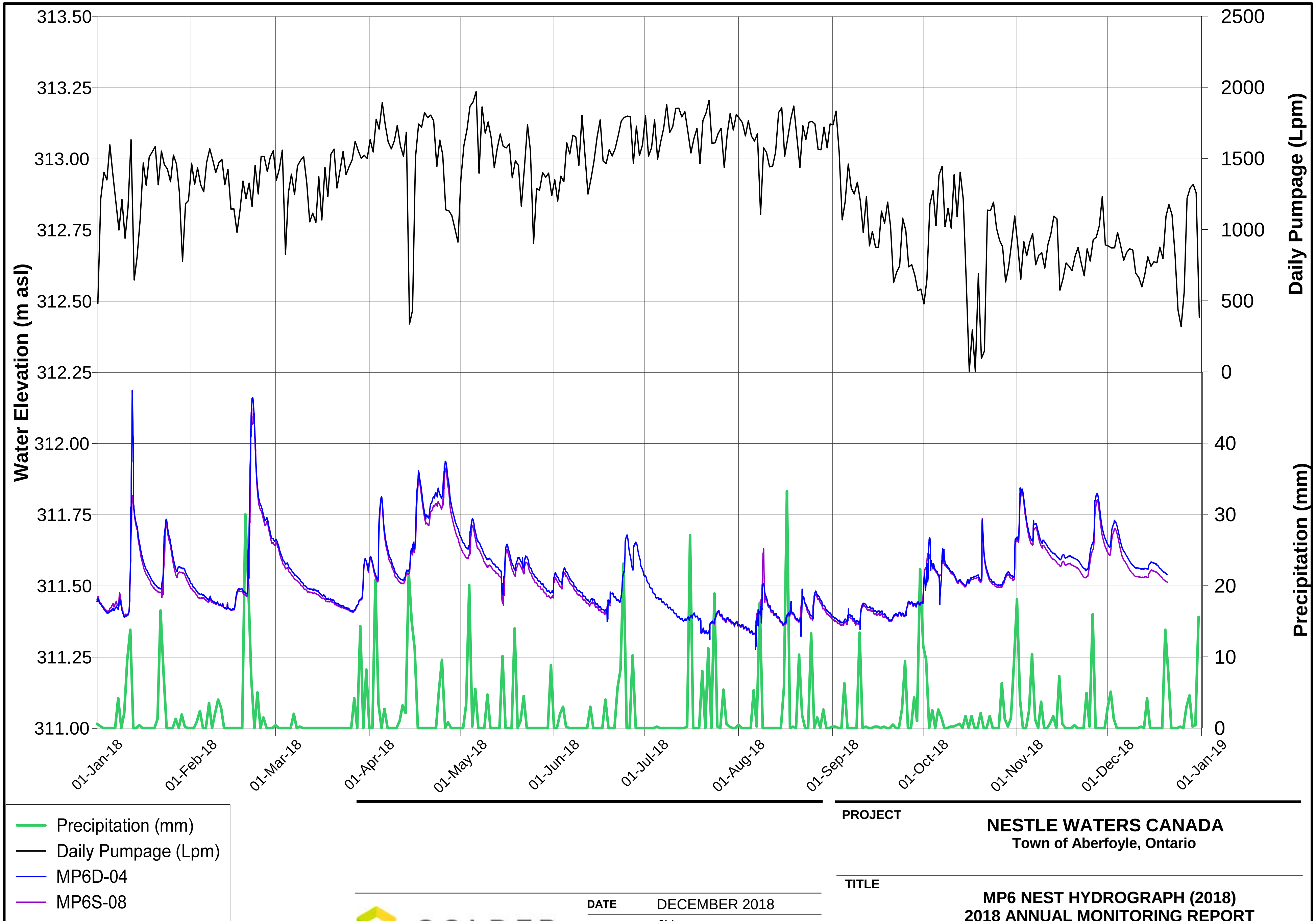
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MP6 NEST HYDROGRAPH
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E4a



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

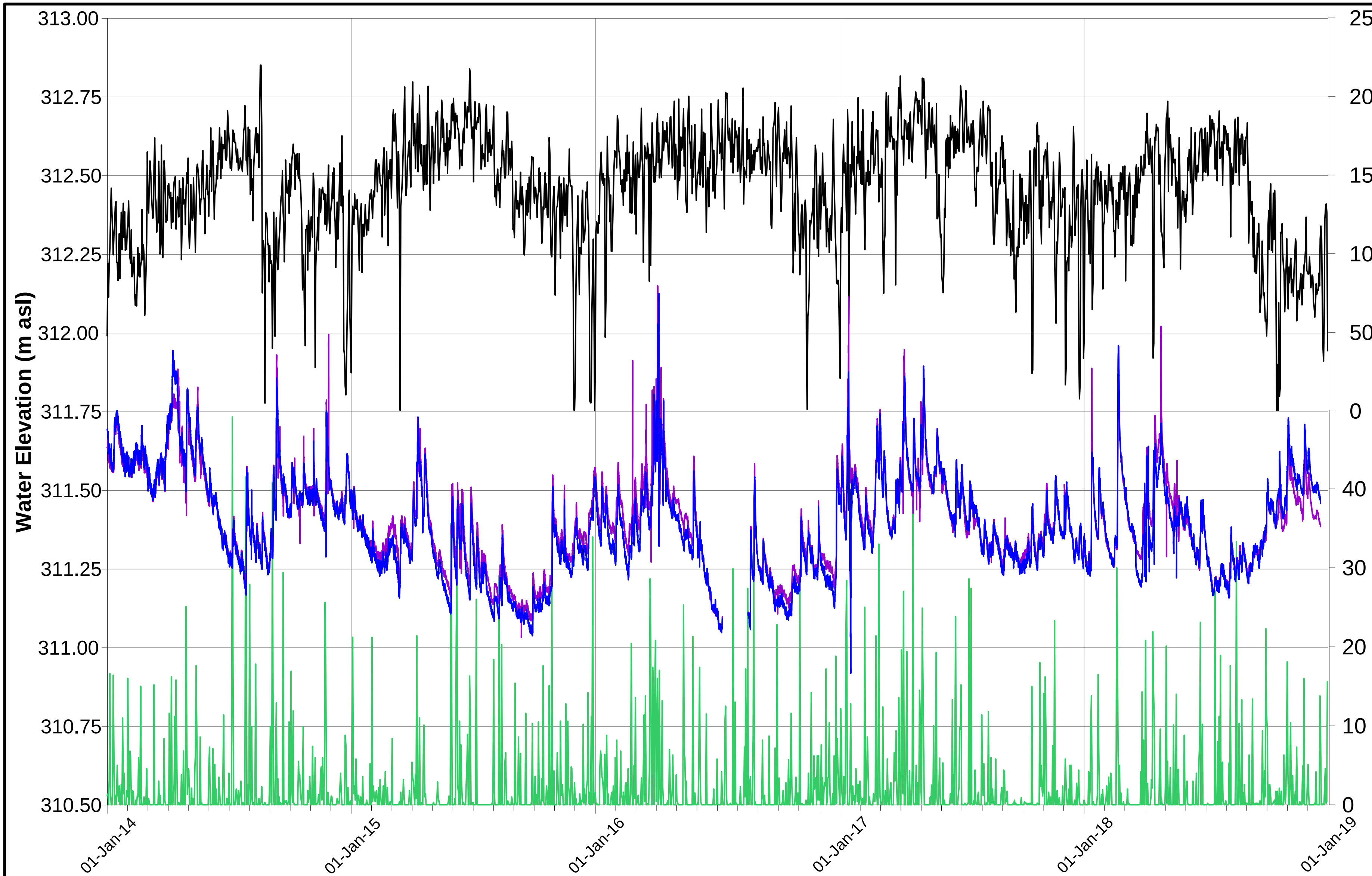
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MP6 NEST HYDROGRAPH (2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E4b



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

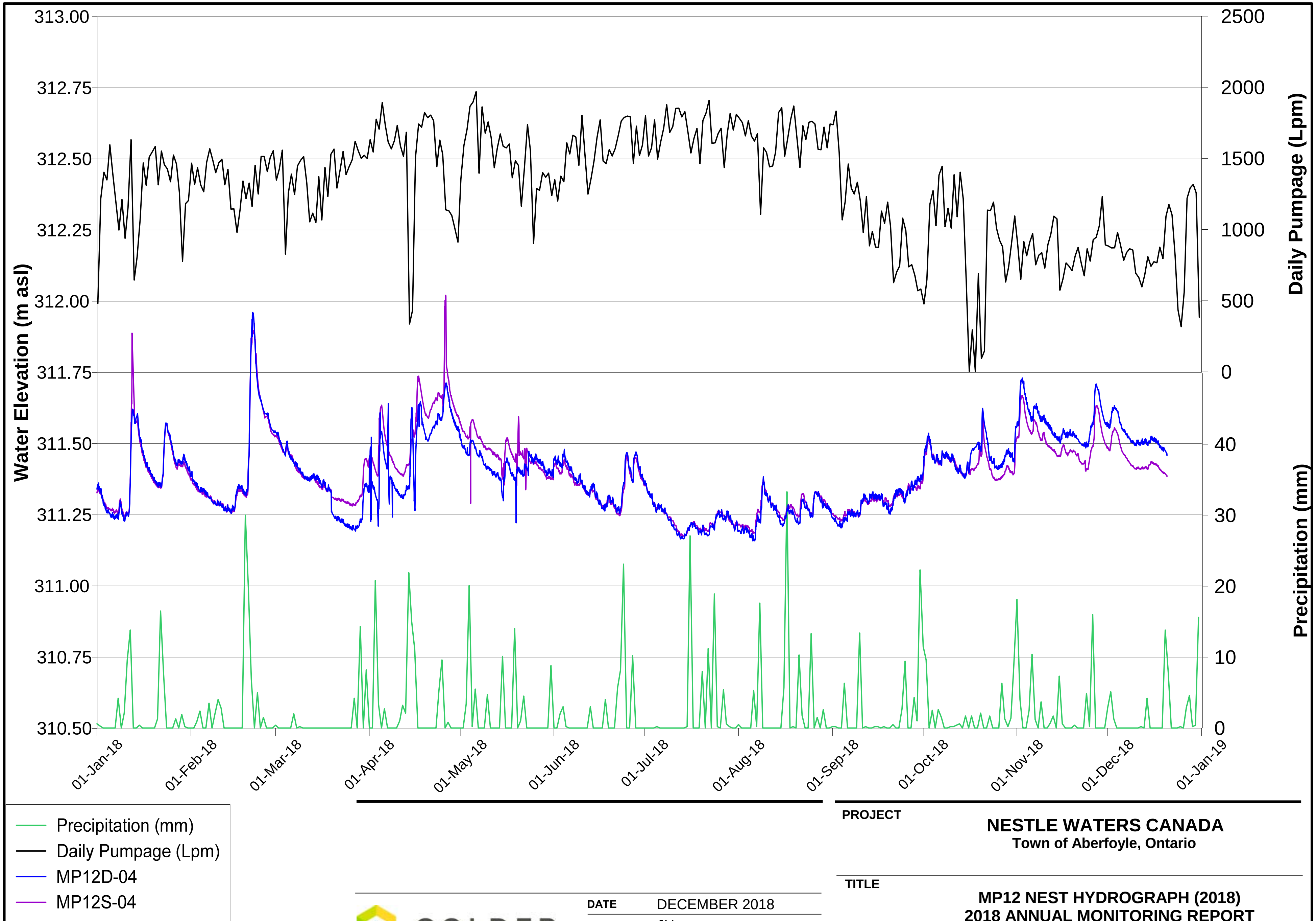
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MP12 NEST HYDROGRAPH
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E5a



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

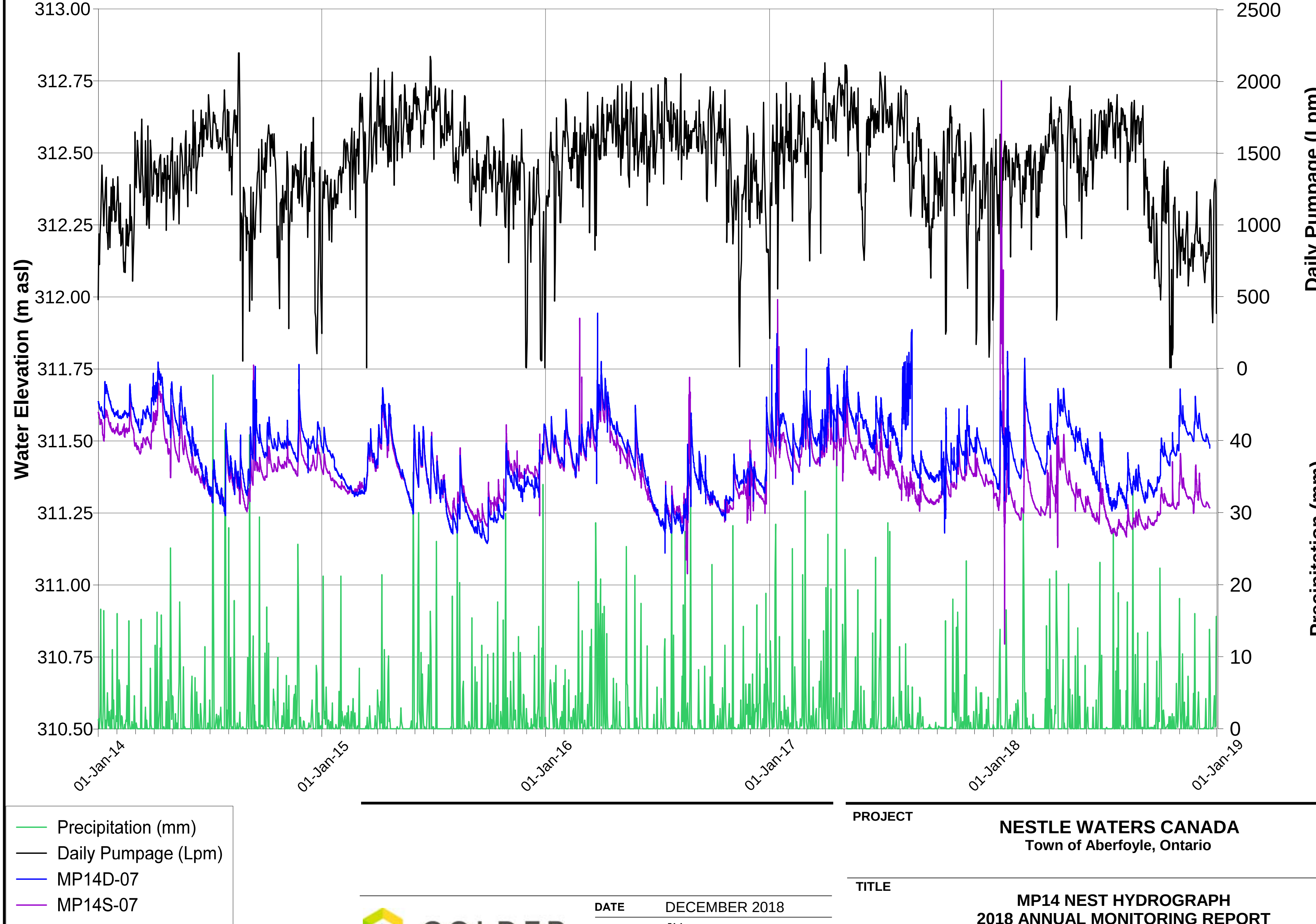
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MP12 NEST HYDROGRAPH (2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E5b



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA

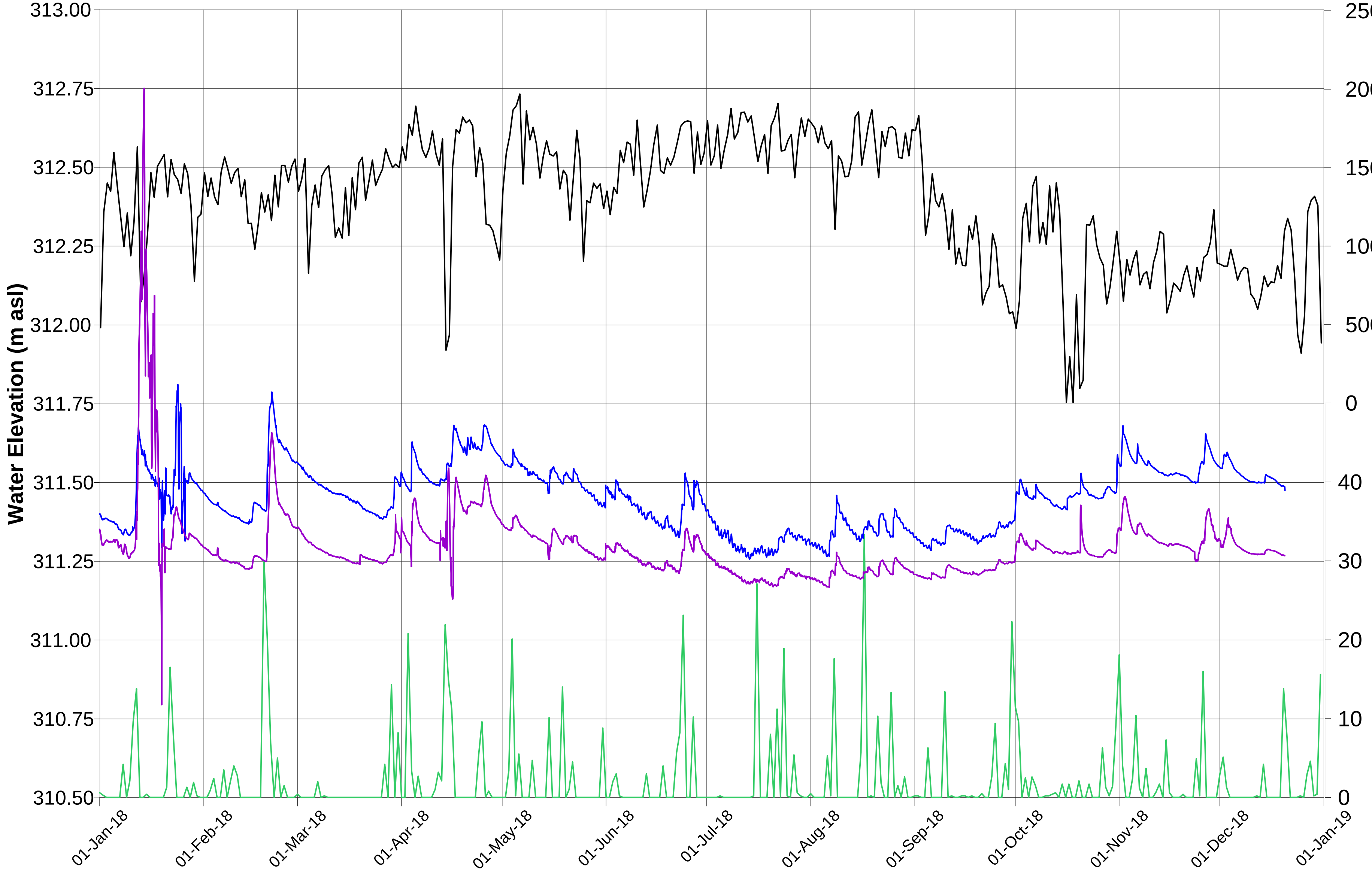
Town of Aberfoyle, Ontario

TITLE

MP14 NEST HYDROGRAPH

2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E6a



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

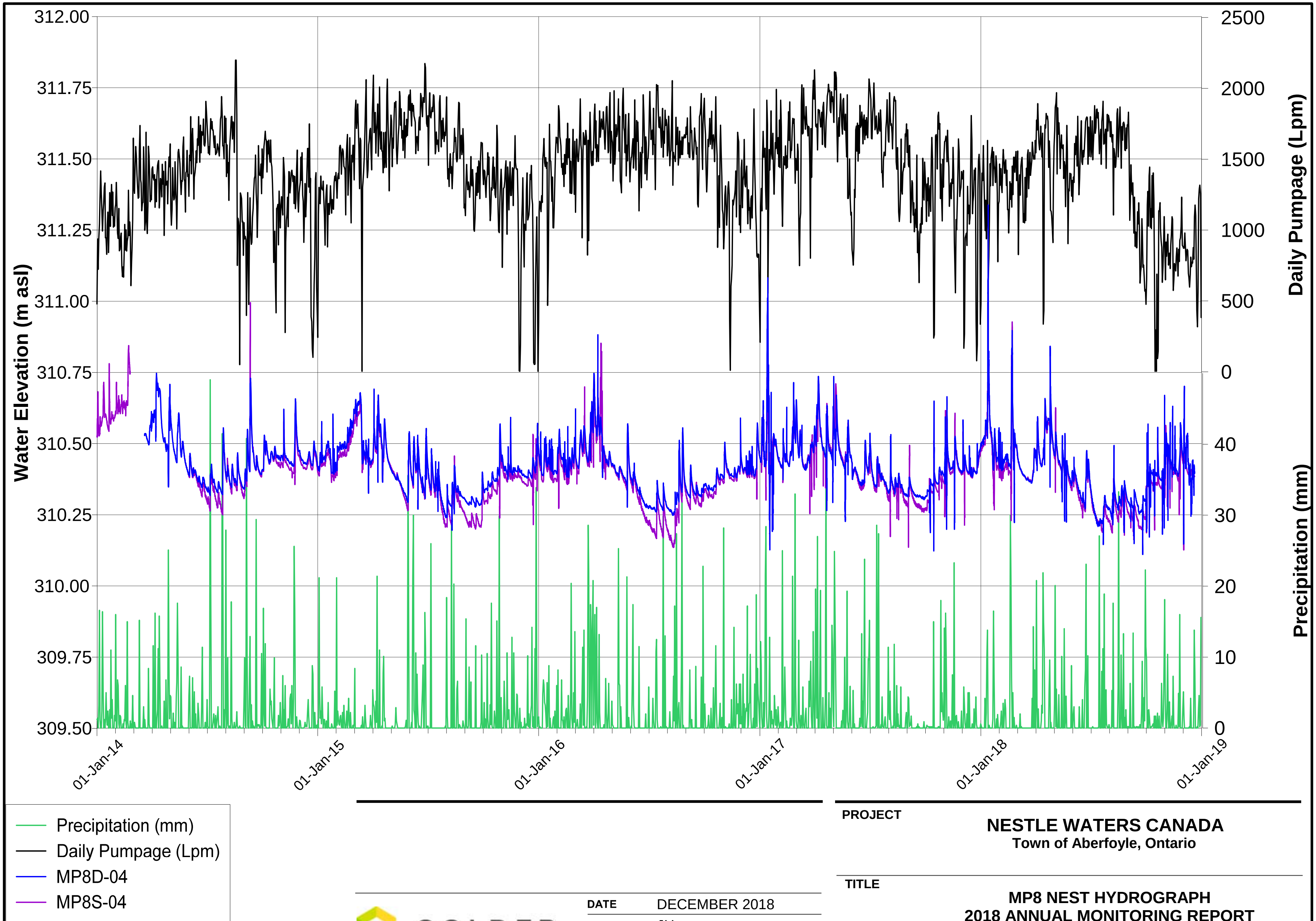
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MP14 NEST HYDROGRAPH (2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E6b



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

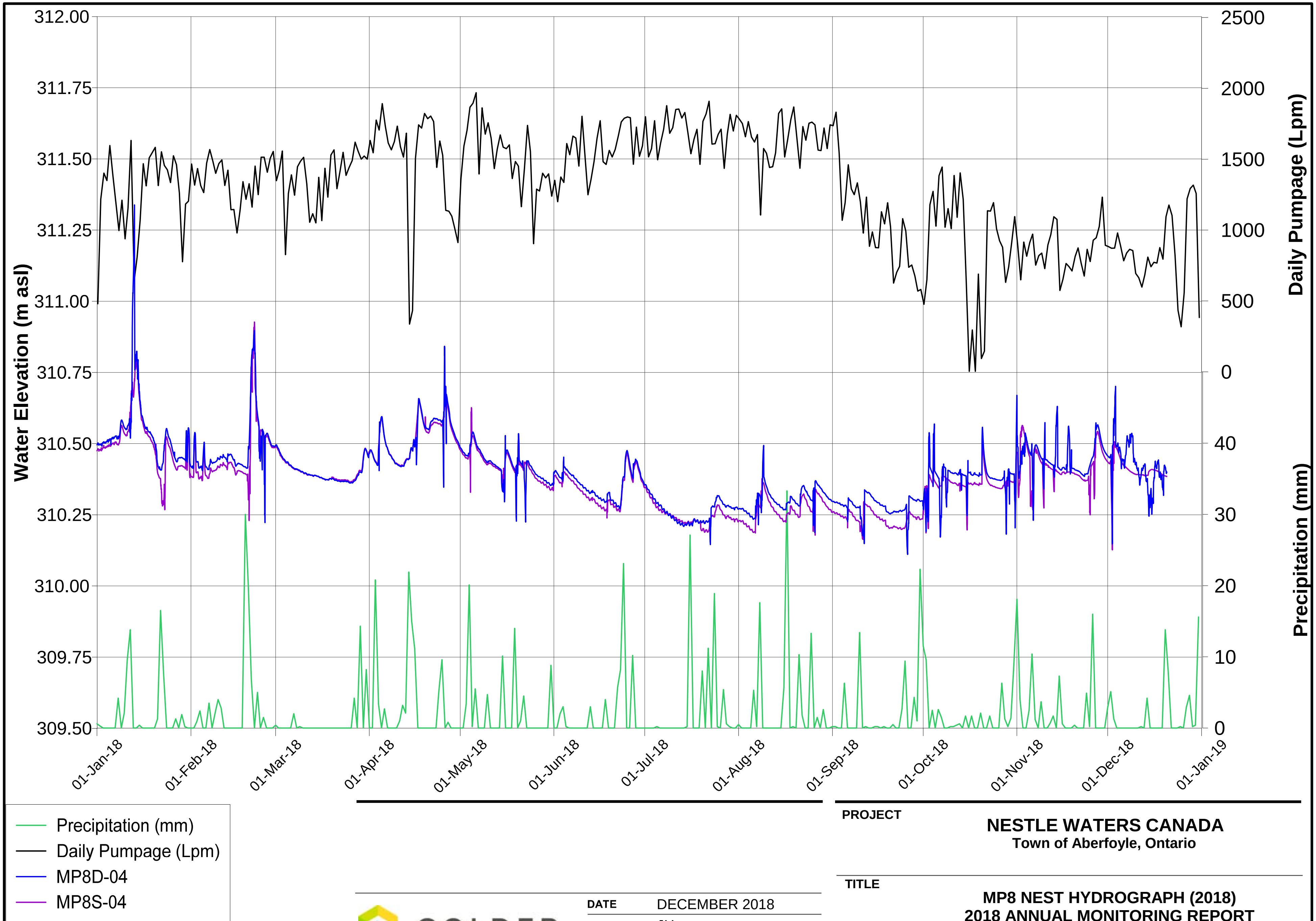
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MP8 NEST HYDROGRAPH
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E7a



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

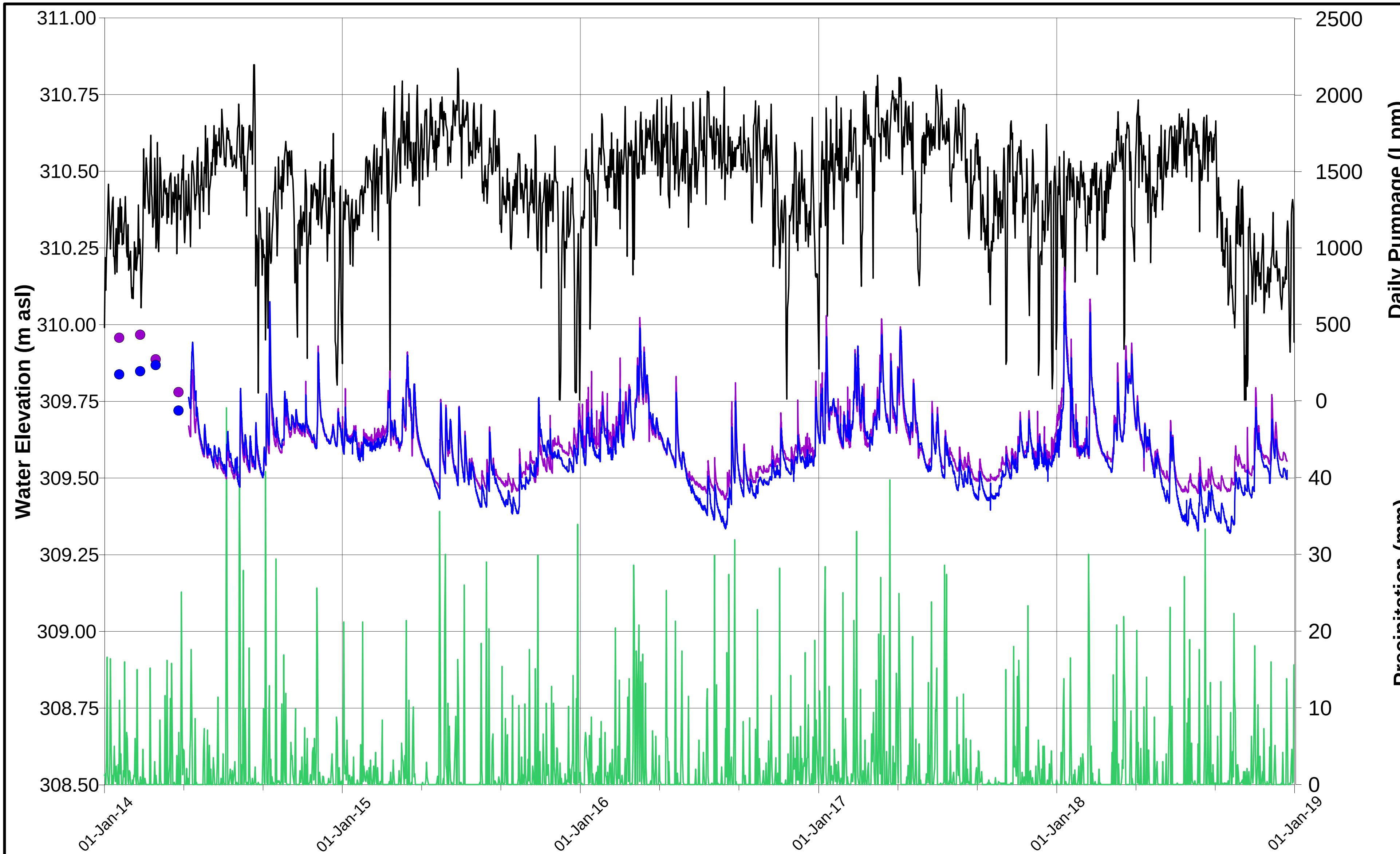
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MP8 NEST HYDROGRAPH (2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E7b



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA

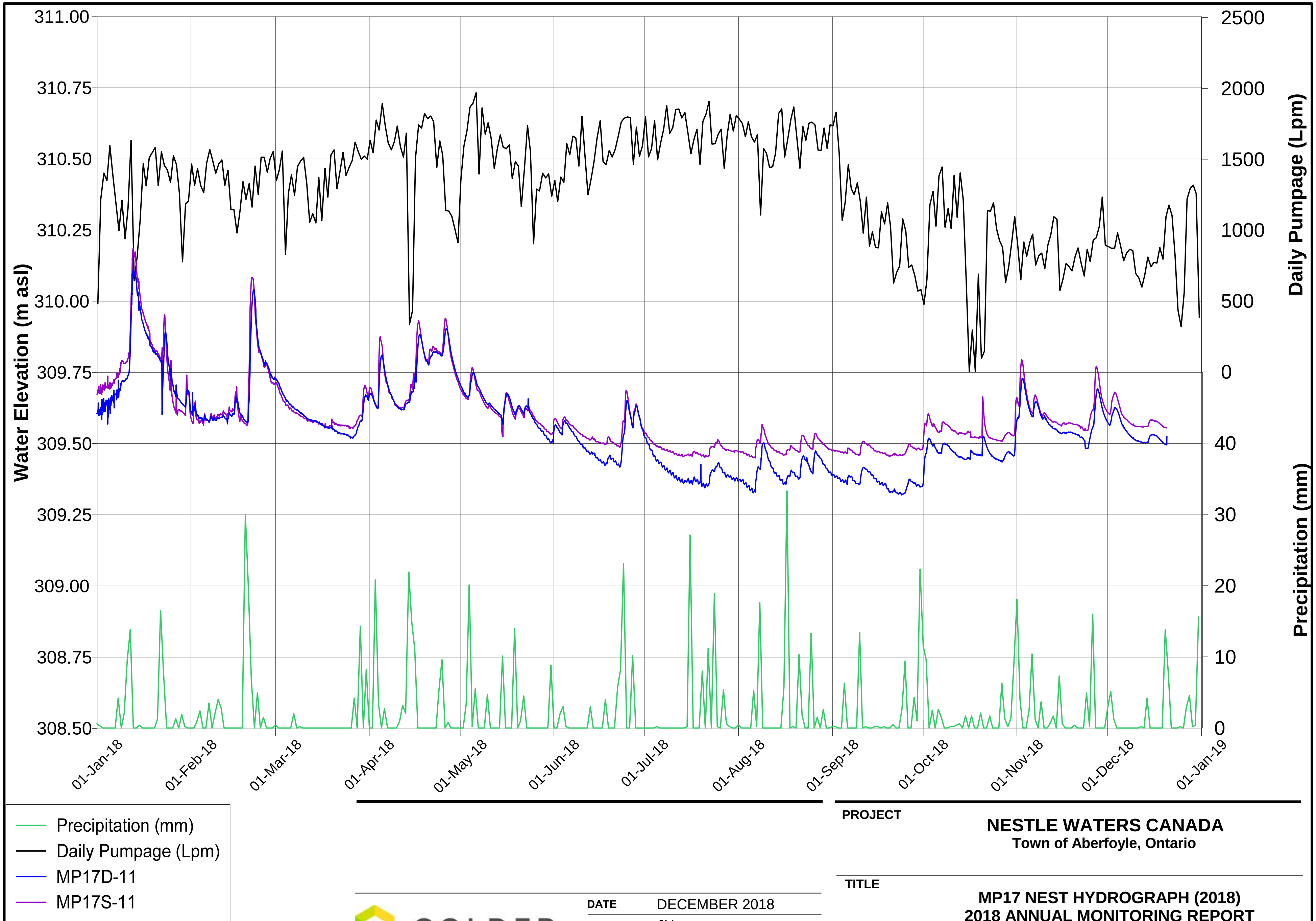
Town of Aberfoyle, Ontario

TITLE

MP17 NEST HYDROGRAPH

2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E8a



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

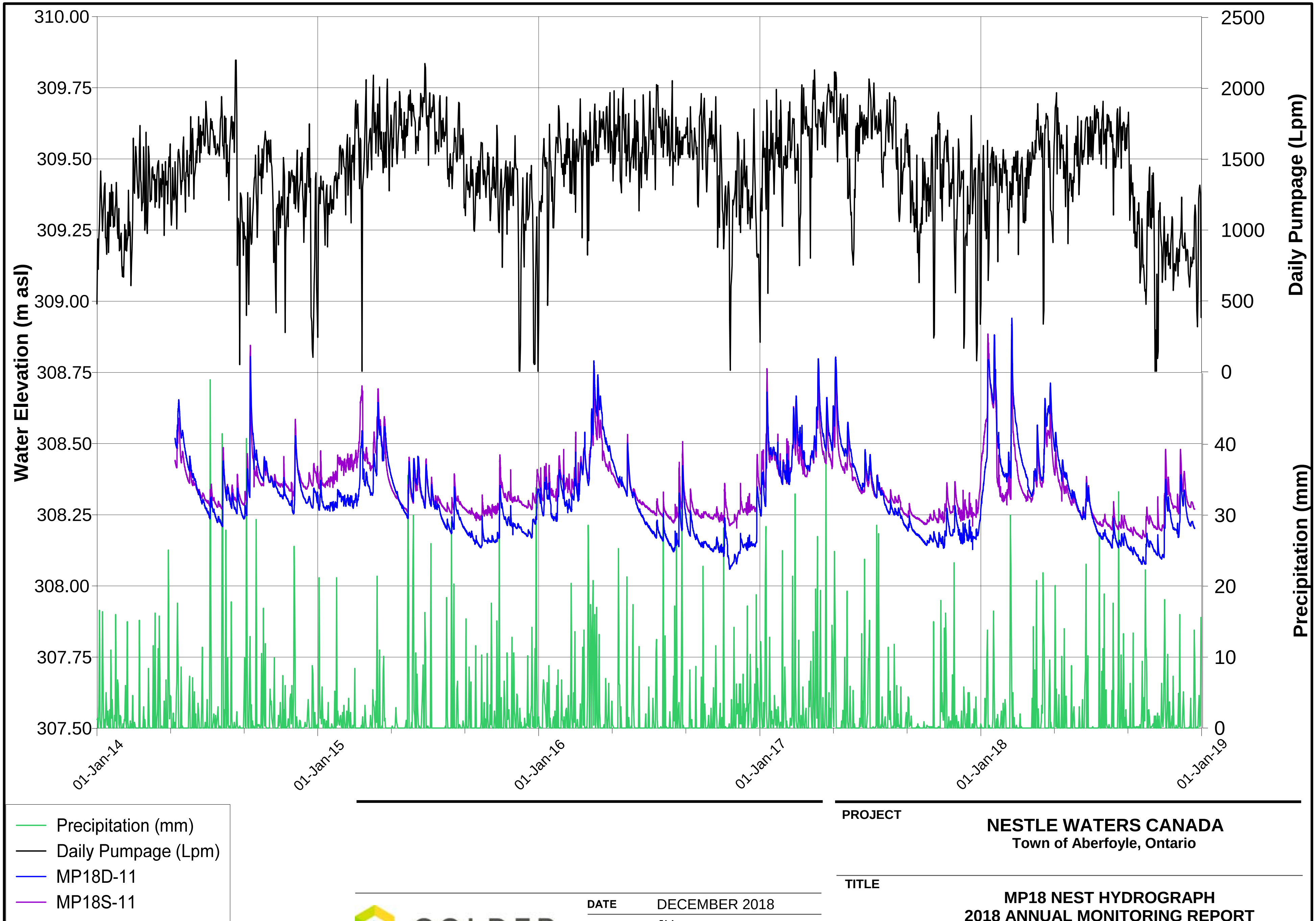
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MP17 NEST HYDROGRAPH (2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E8b



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA

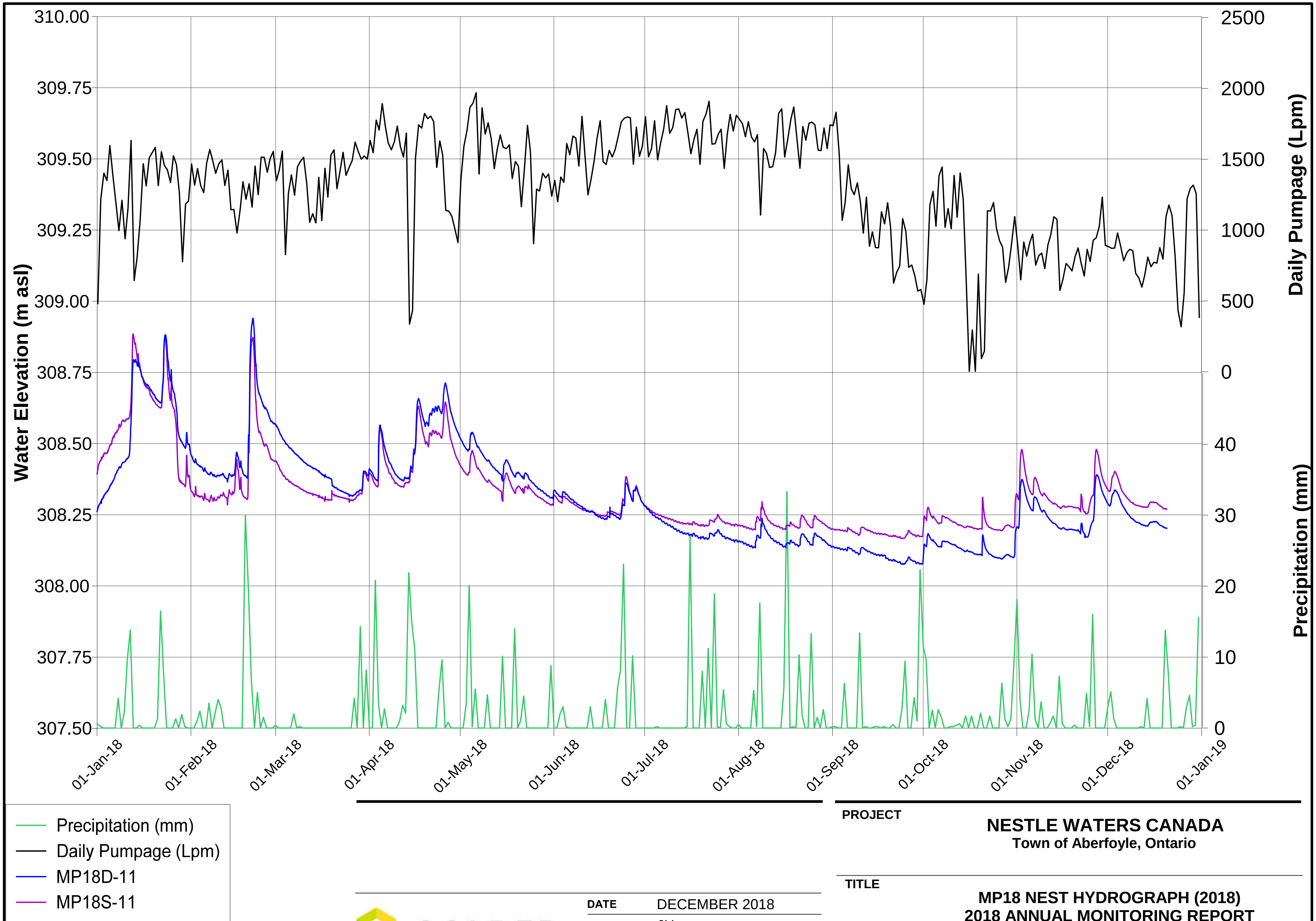
Town of Aberfoyle, Ontario

TITLE

MP18 NEST HYDROGRAPH

2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E9a



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

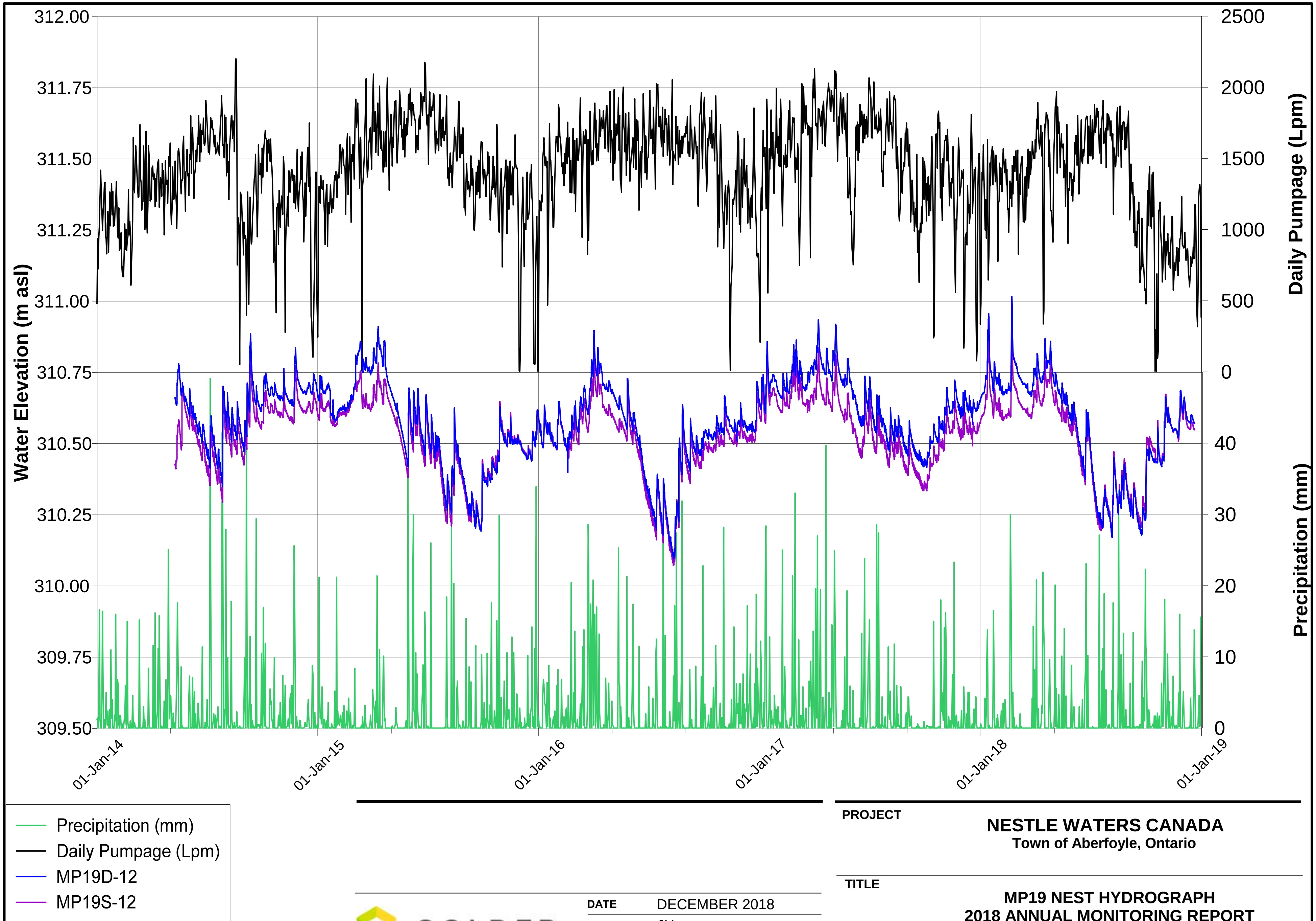
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

MP18 NEST HYDROGRAPH (2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E9b



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

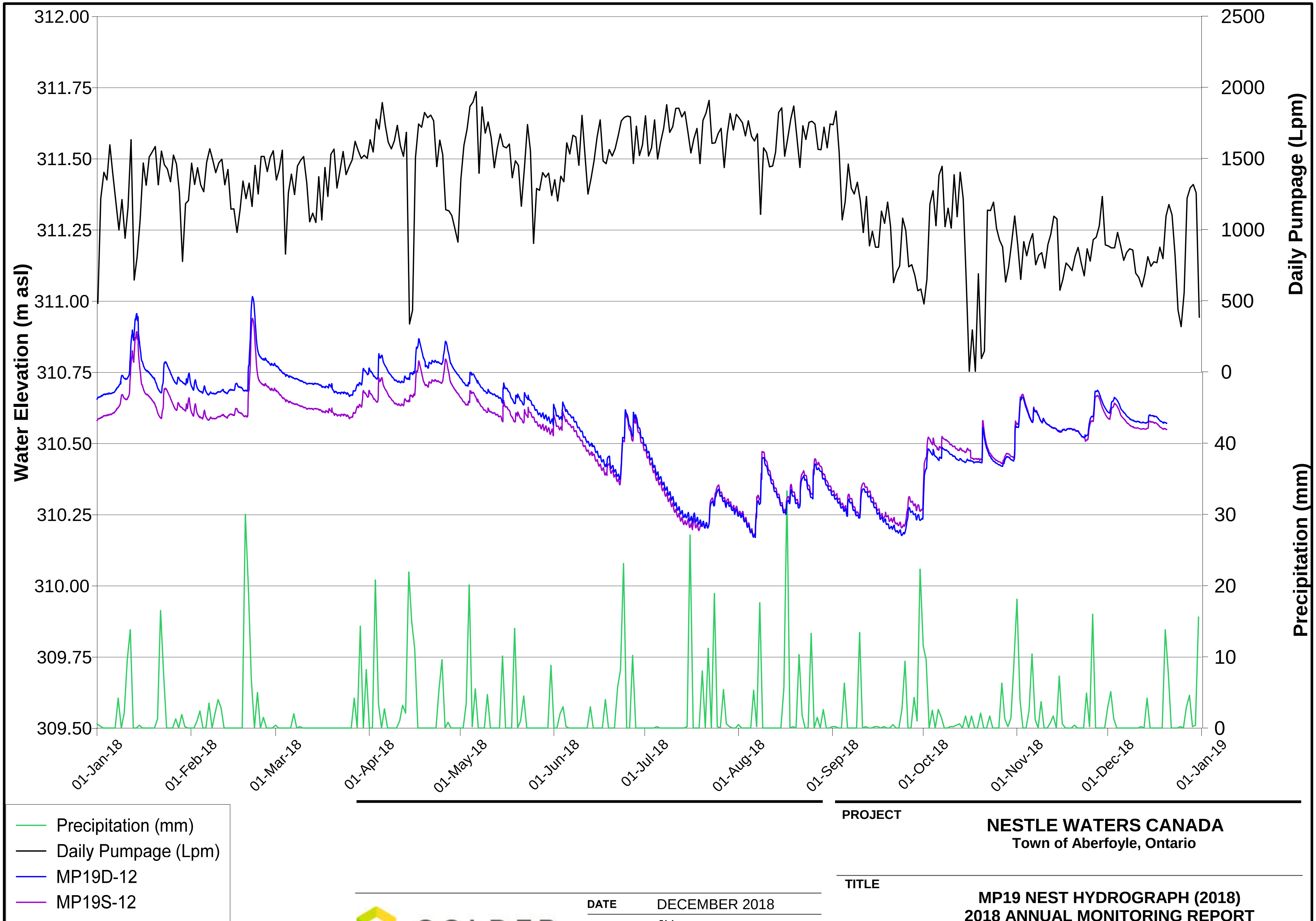
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

MP19 NEST HYDROGRAPH
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E10a



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

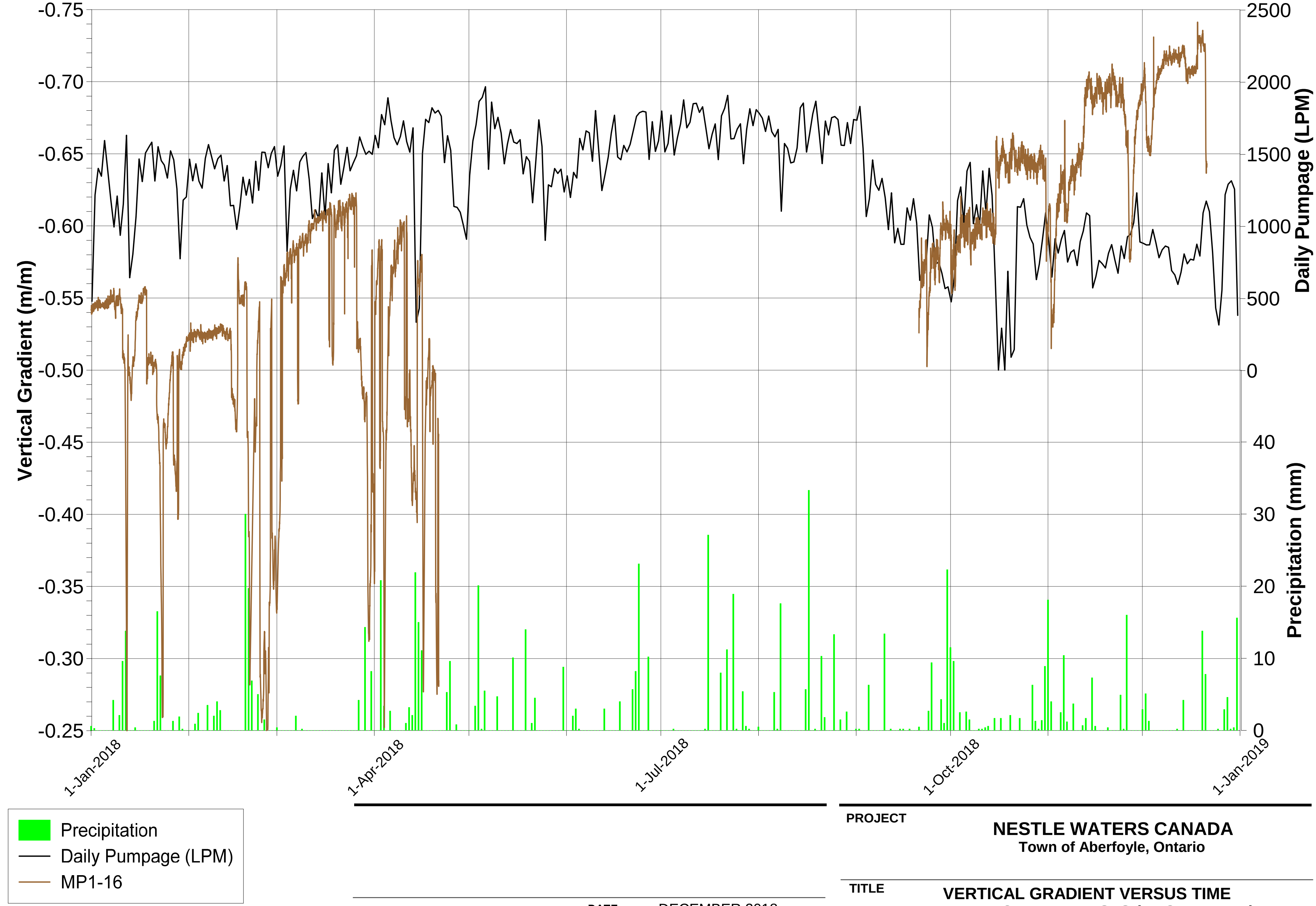
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

MP19 NEST HYDROGRAPH (2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E10b



DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

GOLDER

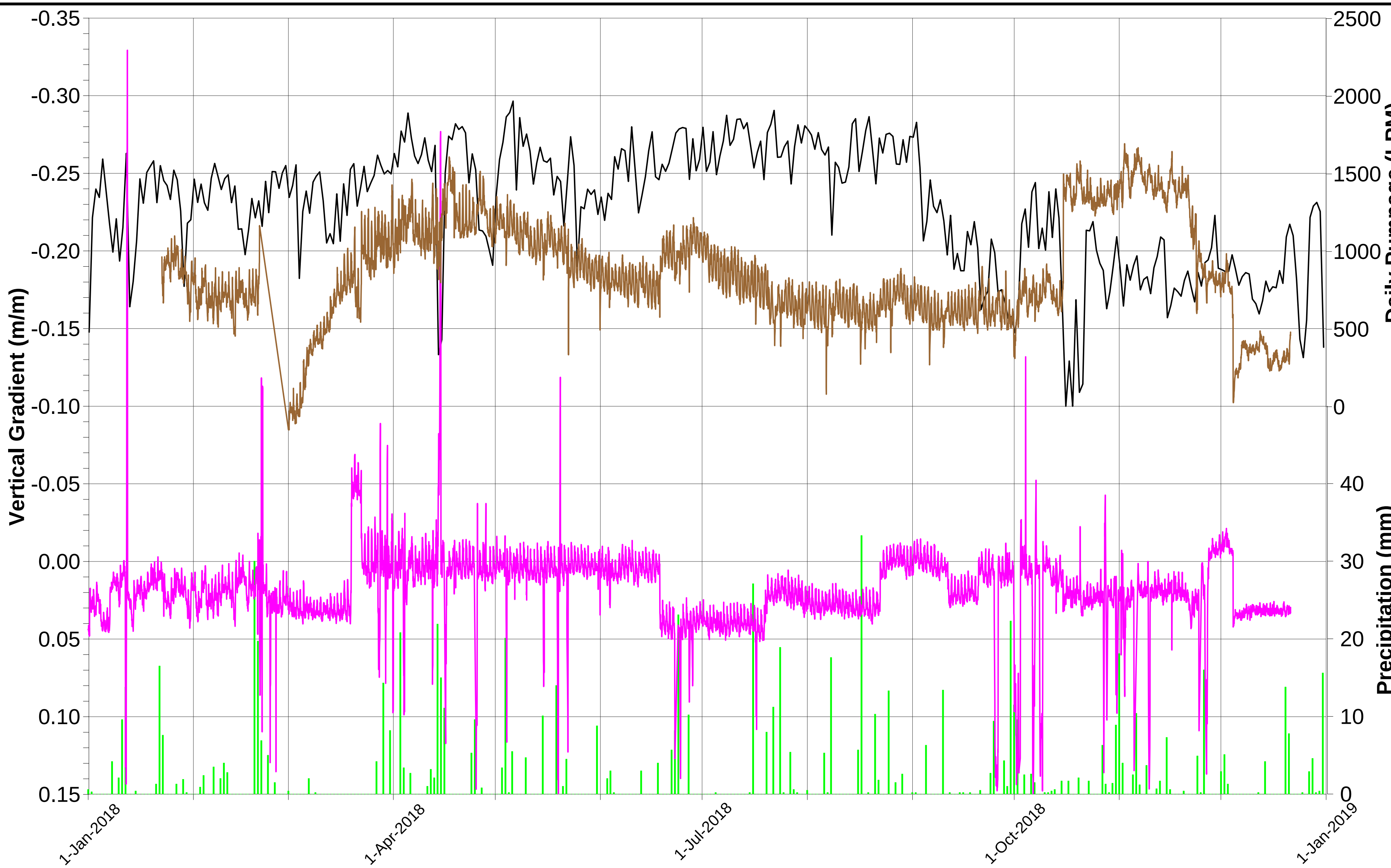
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

VERTICAL GRADIENT VERSUS TIME
MINI-PIEZOMETER NESTS (UPGRADIENT)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E11a



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

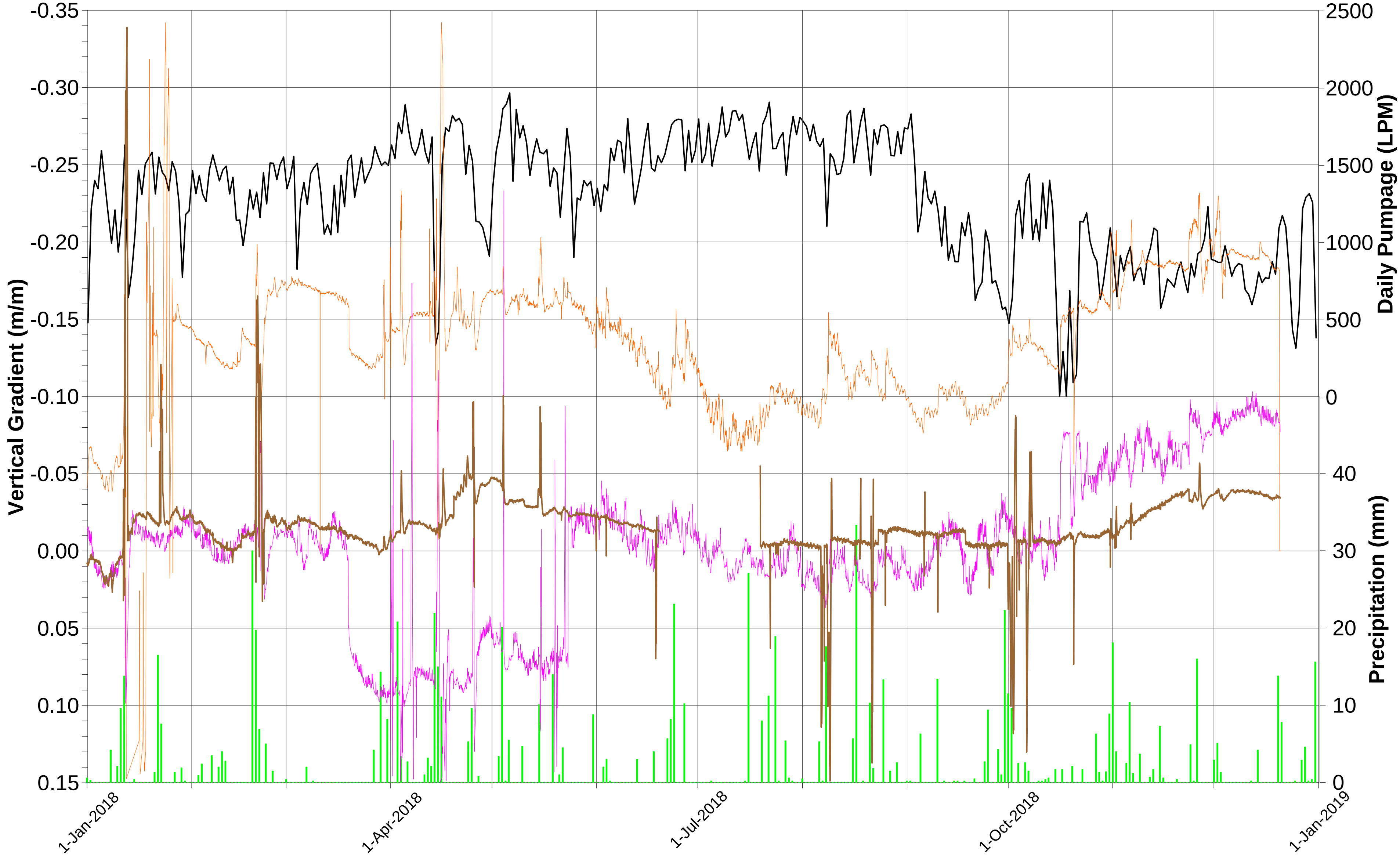
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

VERTICAL GRADIENT VERSUS TIME
MINI-PIEZOMETER NESTS (UPGRADIENT)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E11b



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

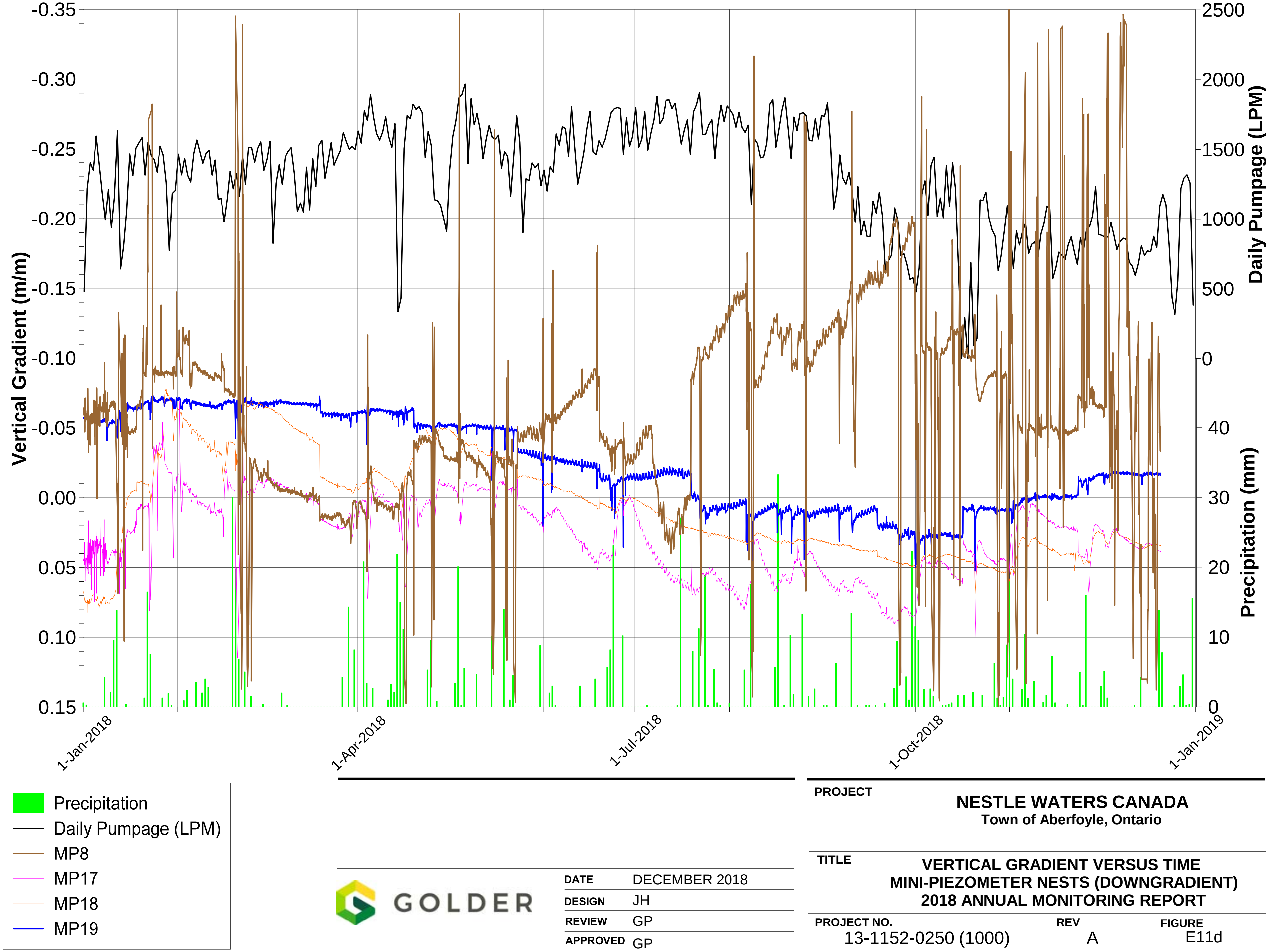
NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

VERTICAL GRADIENT VERSUS TIME
MINI-PIEZOMETER NESTS (ONSITE)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E11c



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

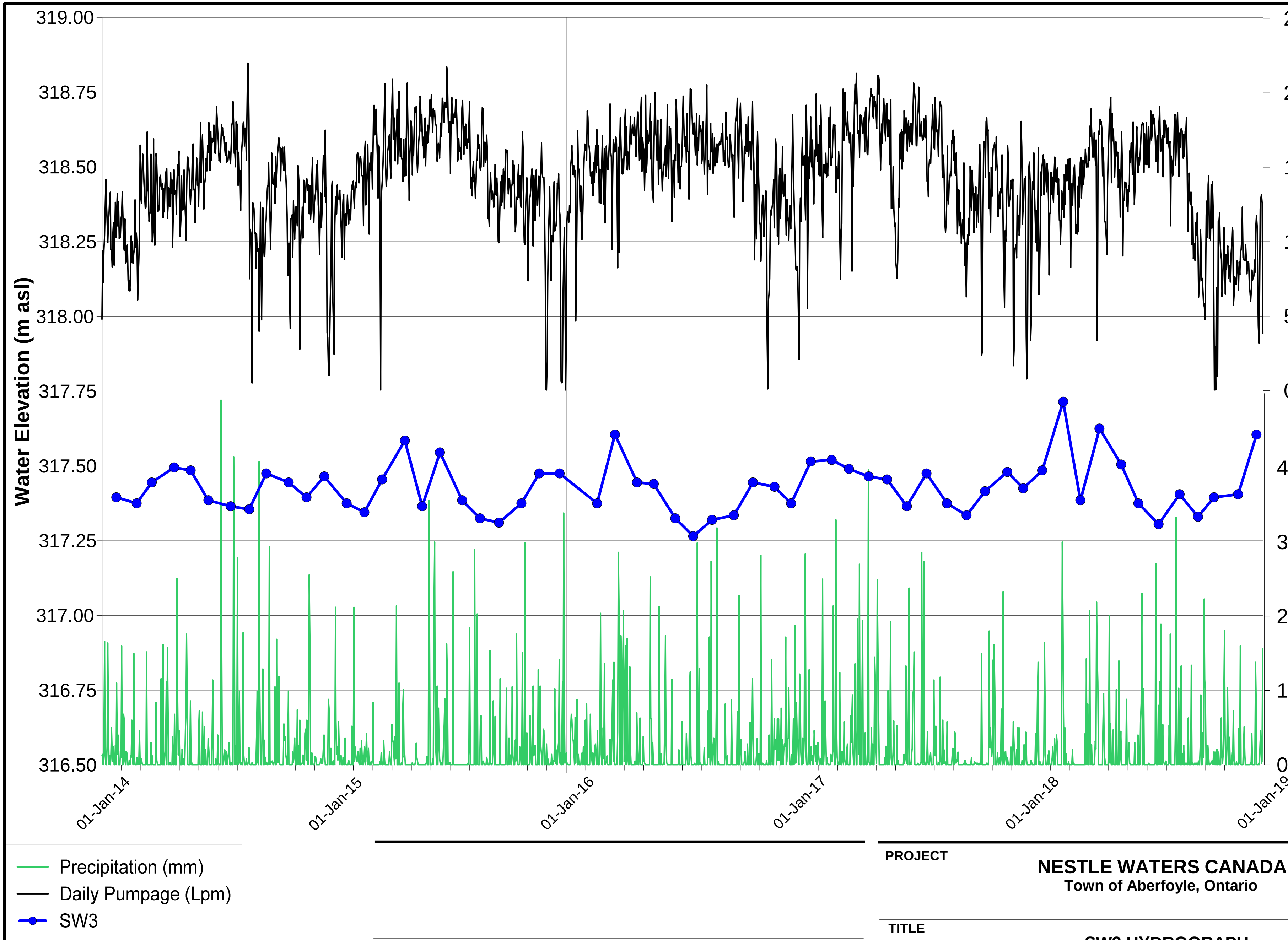
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

VERTICAL GRADIENT VERSUS TIME
MINI-PIEZOMETER NESTS (DOWNGRADIENT)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E11d



DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

GOLDER

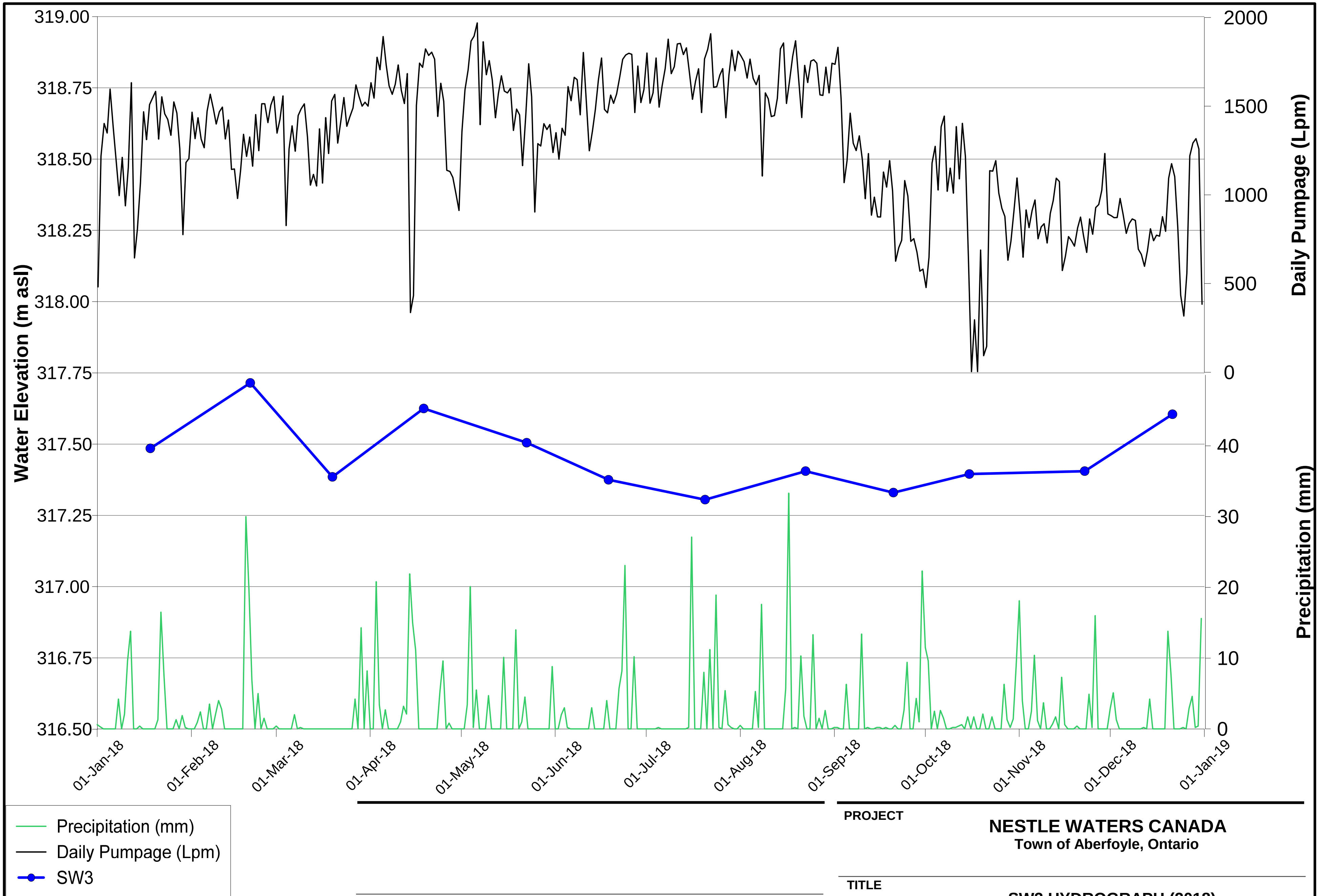
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SW3 HYDROGRAPH
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E12a



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

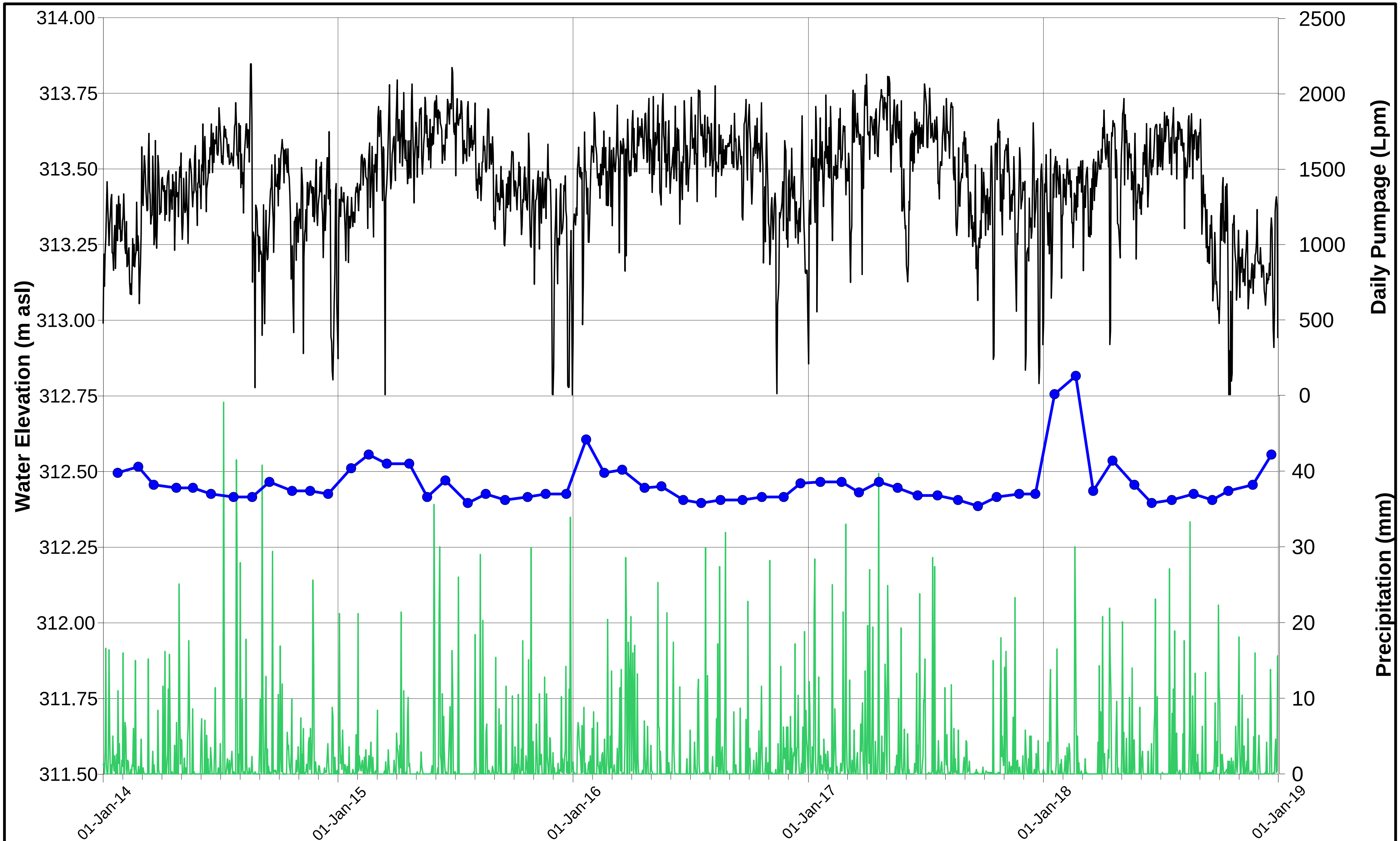
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SW3 HYDROGRAPH (2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E12b



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

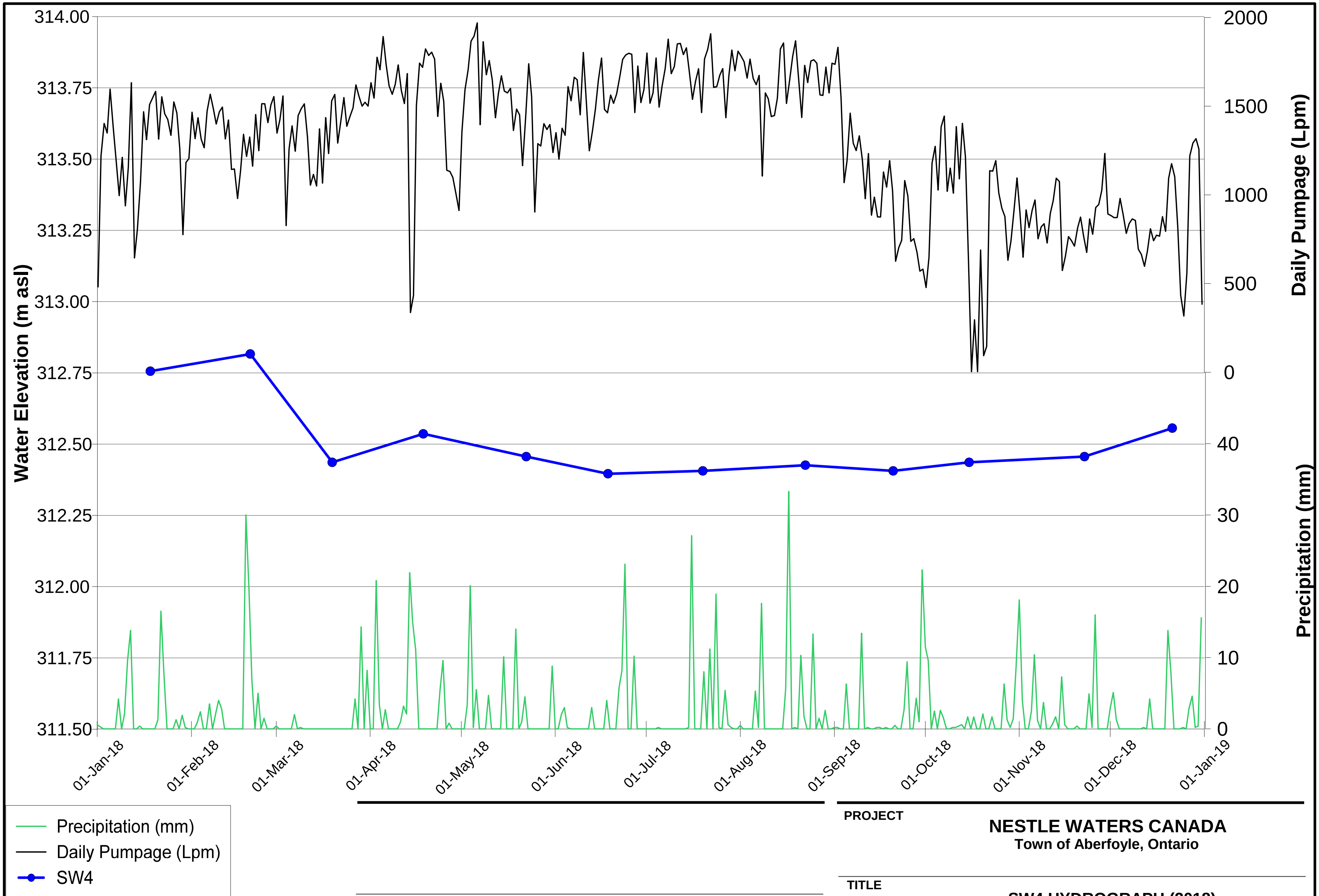
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SW4 HYDROGRAPH
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E13a



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

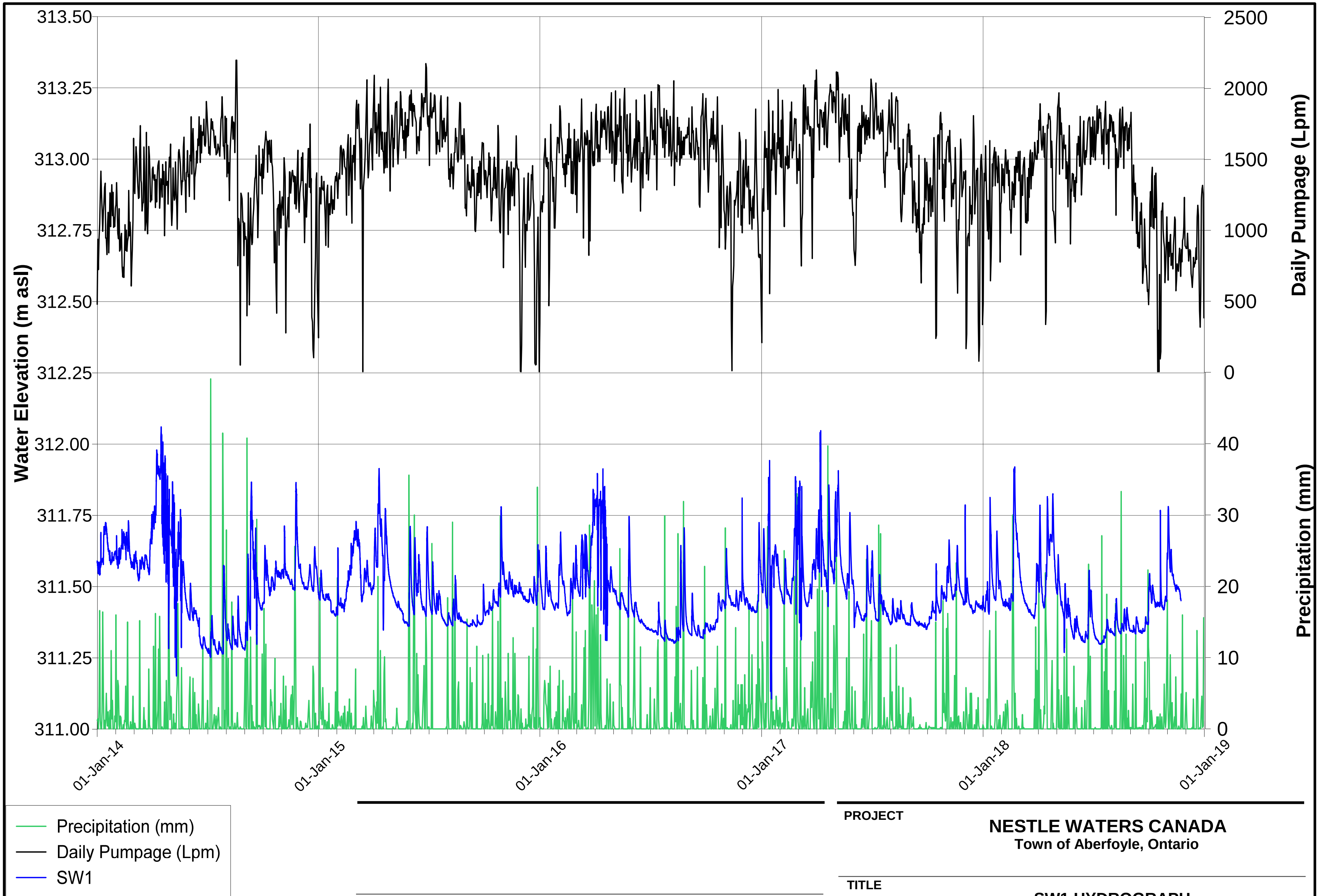
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SW4 HYDROGRAPH (2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E13b



DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

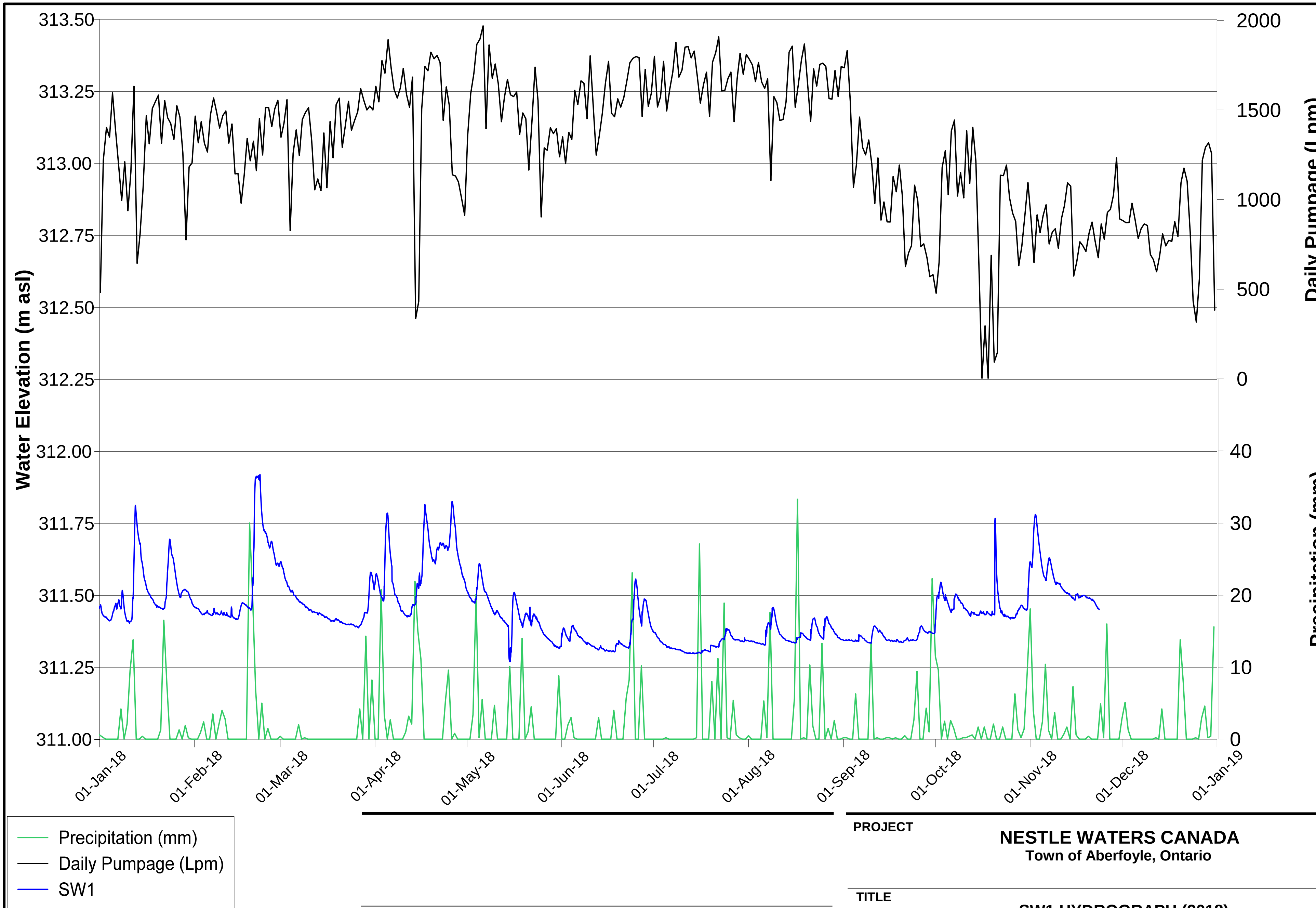
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SW1 HYDROGRAPH
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E14a



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

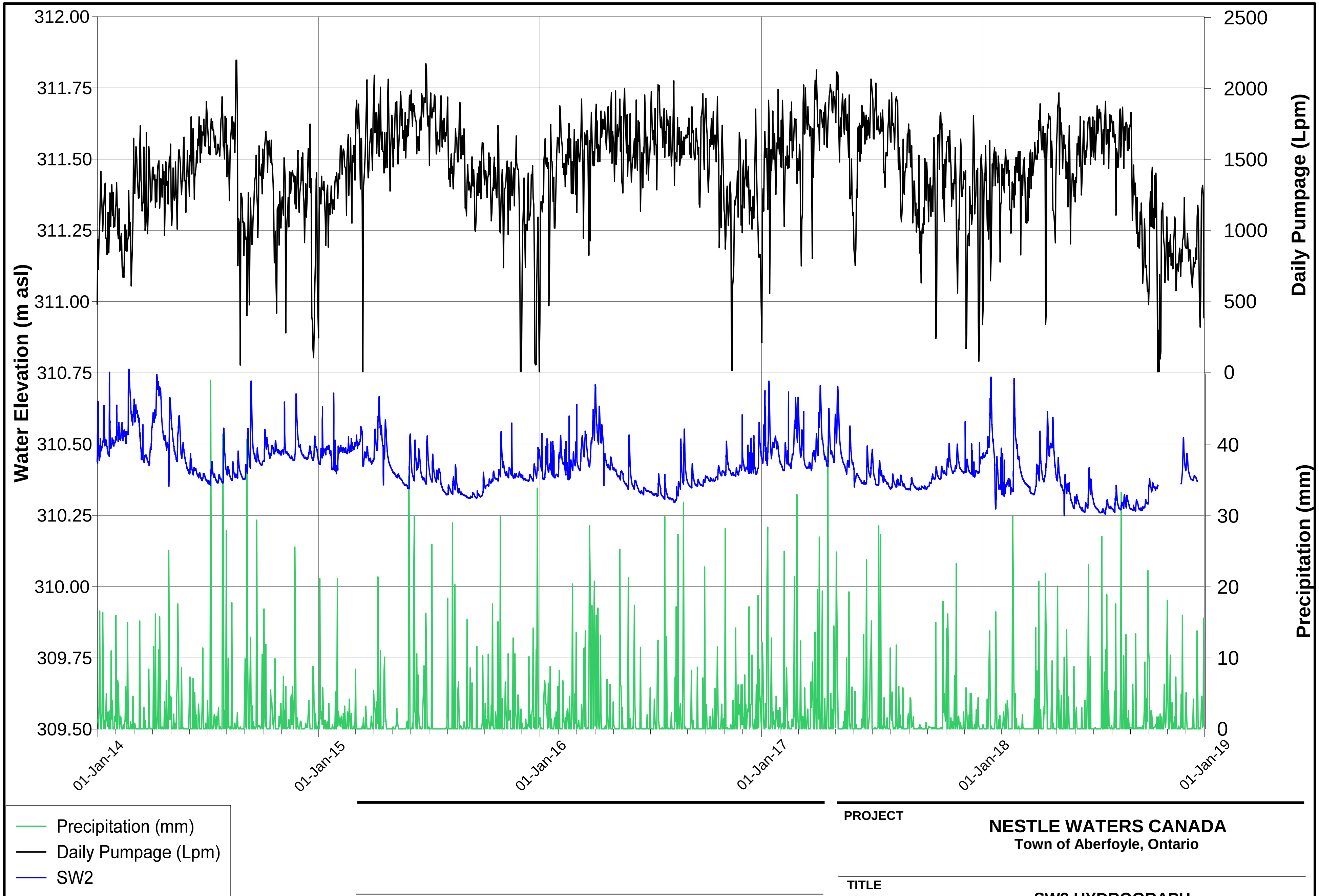
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SW1 HYDROGRAPH (2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E14b



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

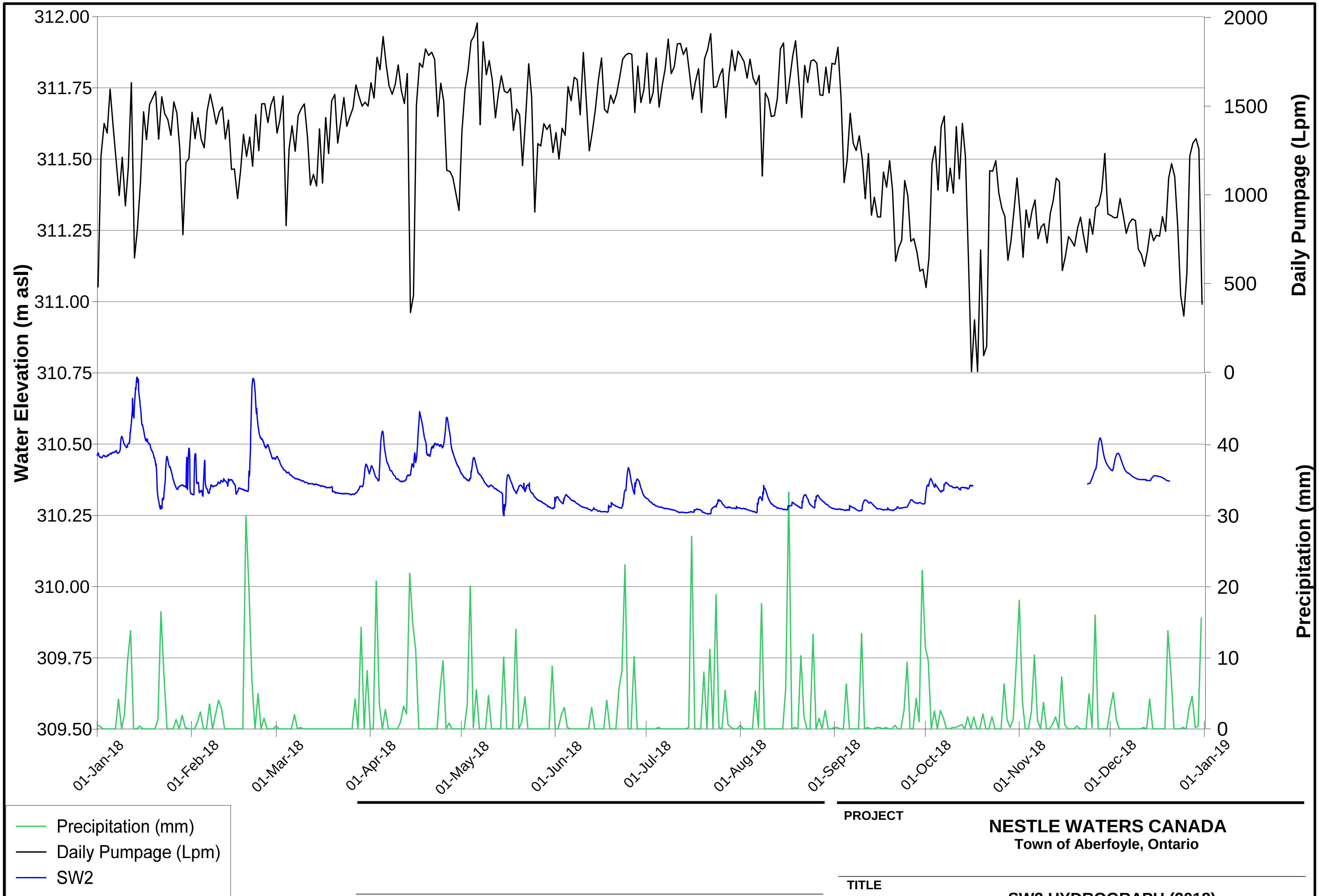
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SW2 HYDROGRAPH
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E15a



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

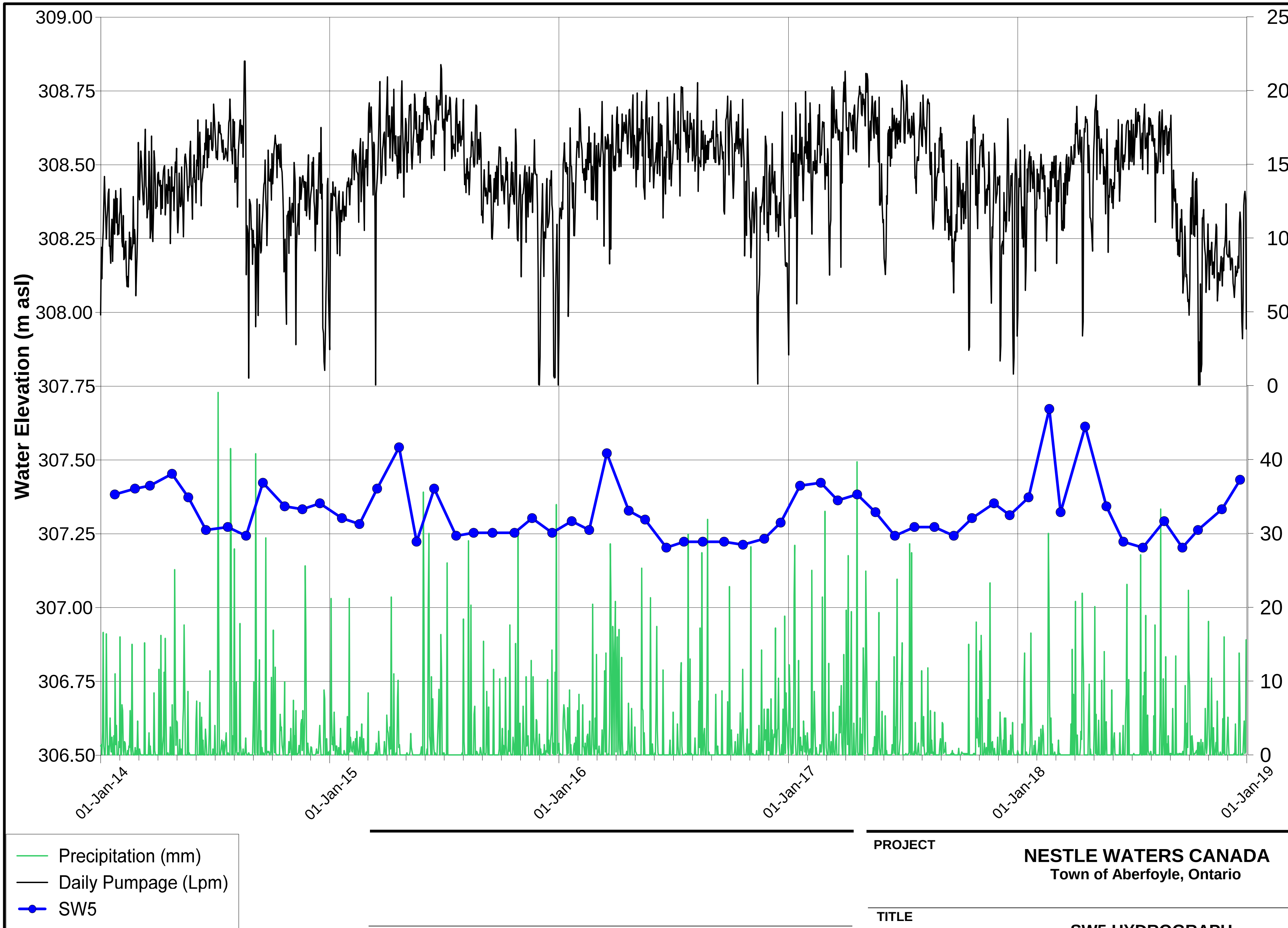
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SW2 HYDROGRAPH (2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E15b



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

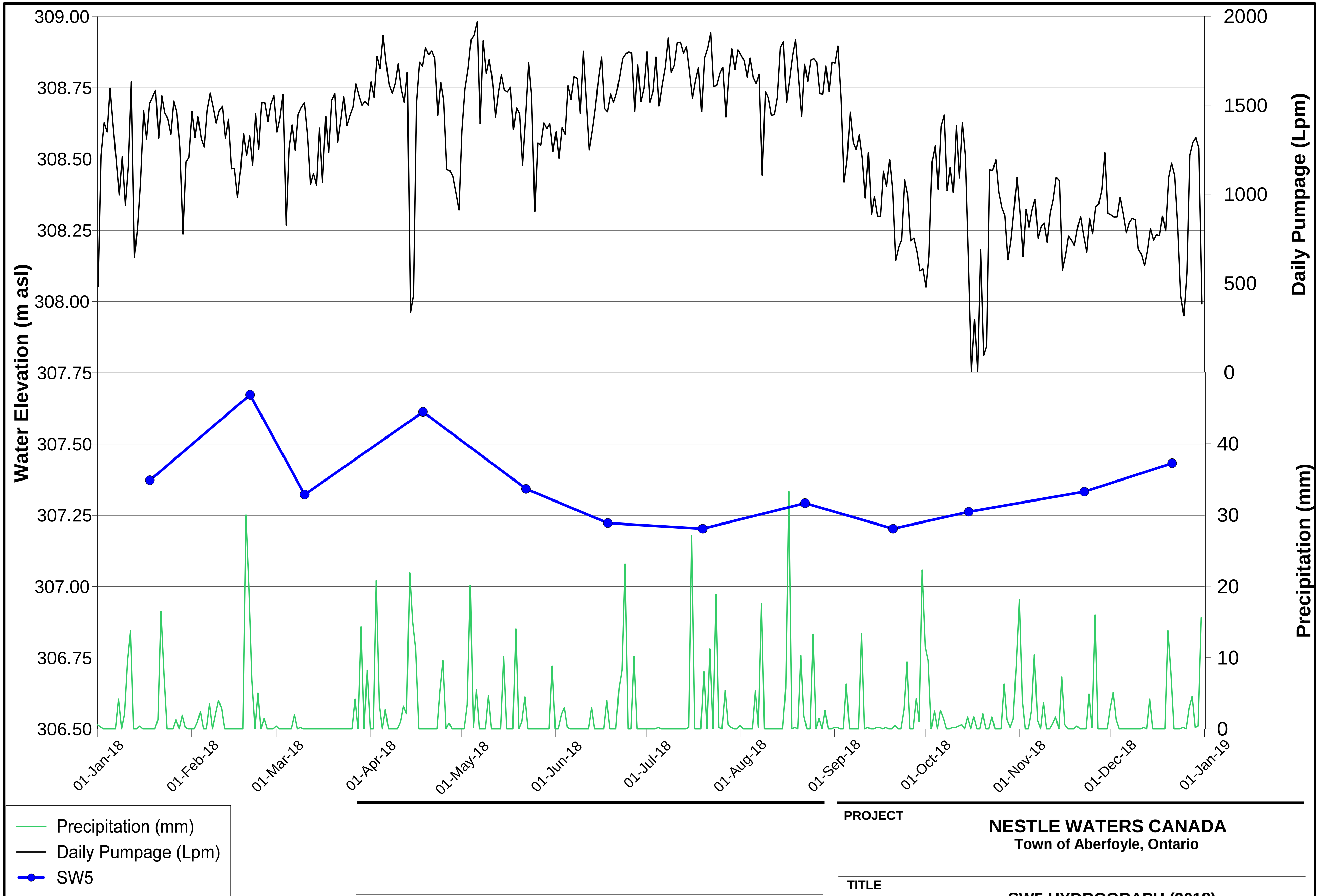
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SW5 HYDROGRAPH
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E16a



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

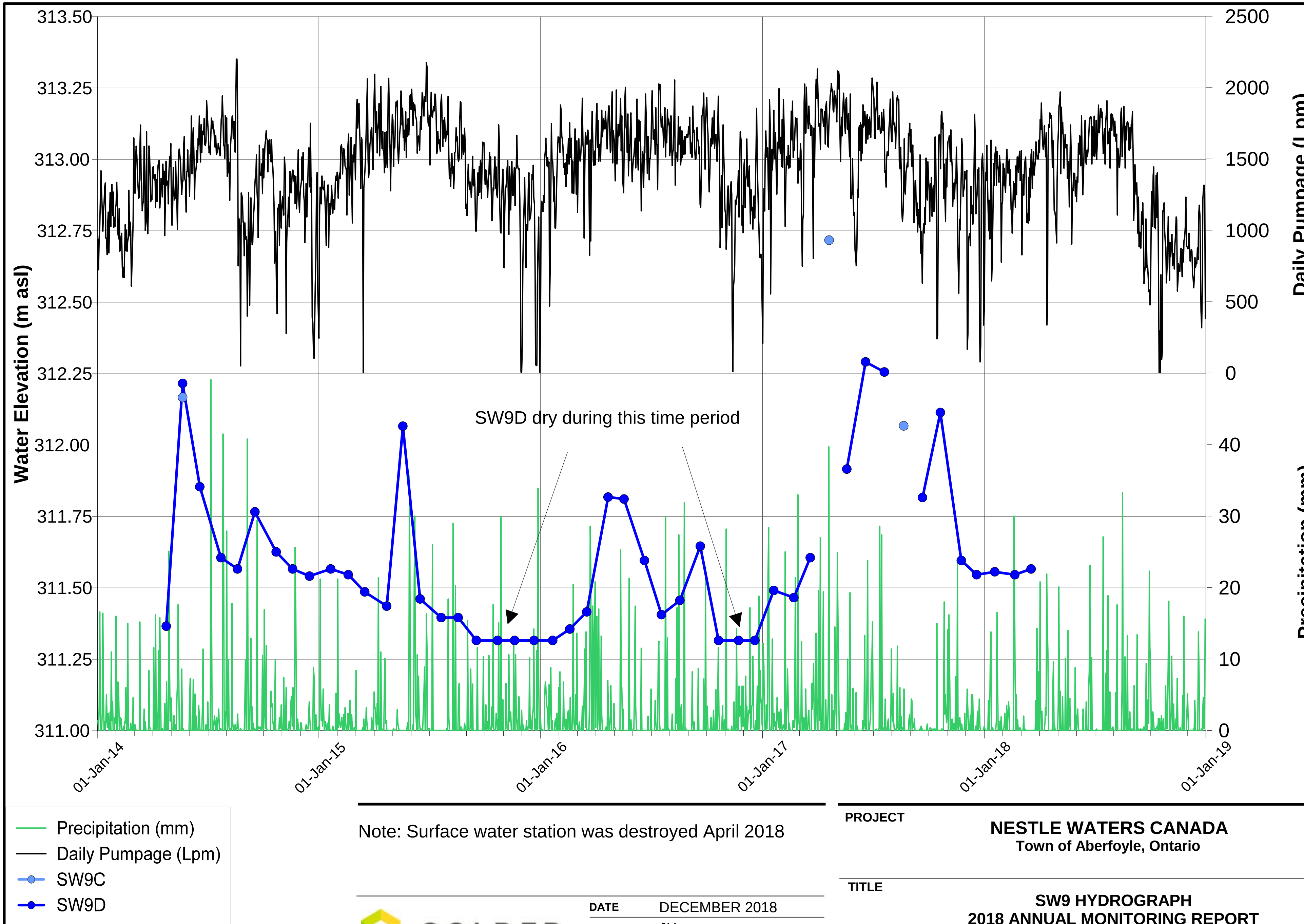
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SW5 HYDROGRAPH (2018)
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E16b



Note: Surface water station was destroyed April 2018

GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA

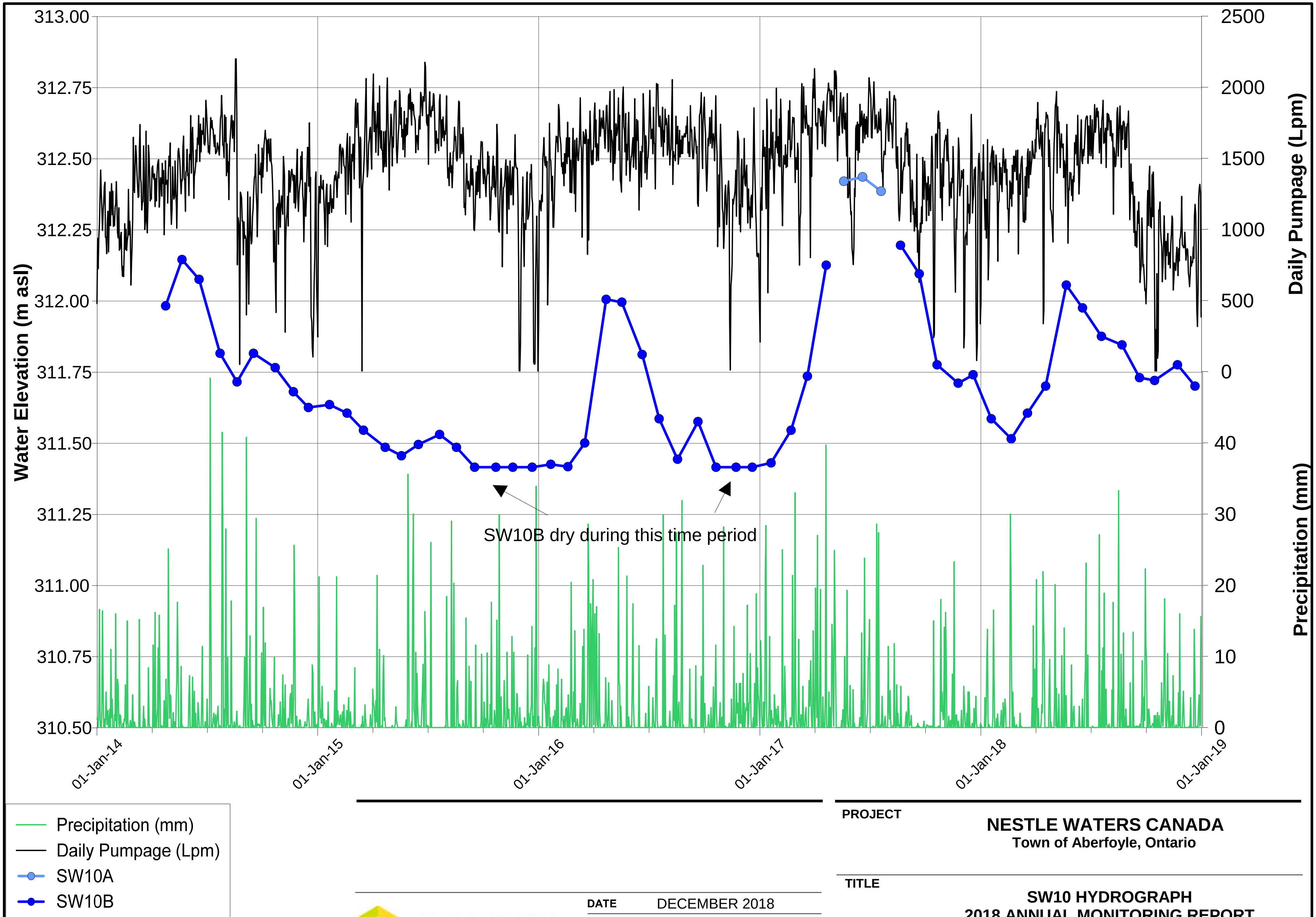
Town of Aberfoyle, Ontario

TITLE

SW9 HYDROGRAPH

2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E17



DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

GOLDER

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SW10 HYDROGRAPH
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	E18

TABLE E1
Manual Surface Water Elevations (Mini Piezometers)
2018 Annual Report

Date	Water Level (masl)							
	MP1D-16	MP1S-16	MP11D-04	MP11S-08	MP16D-08	MP16S-08	MP06D-04	MP06S-08
18-Jan-18	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen
20/22/26-Feb-18	Frozen	318.49	317.96	317.79	312.64	312.65	311.97	311.98
19/20-Mar-18	Frozen	318.28	Frozen	317.76	312.15	312.18	311.45	311.44
18/19-Apr-18	Frozen	318.53	317.91	317.76	312.55	312.55	311.74	311.72
22/23-May-18	318.85	318.37	317.95	317.75	312.35	312.34	311.58	311.56
18/19-Jun-18	318.82	318.23	317.90	317.76	312.12	312.13	311.44	311.43
19/20-Jul-18	318.80	318.21	317.90	317.71	312.06	312.03	311.38	311.34
22/23-Aug-18	318.83	318.25	317.57	318.09	311.96	312.28	311.43	311.43
18/20-Sep-18	318.45	318.21	317.89	317.72	312.01	312.02	311.40	311.39
15/16-Oct-18	318.86	318.24	317.92	317.75	312.13	312.13	311.53	311.52
22/23-Nov-18	Frozen	Frozen	Frozen	317.73	Frozen	Frozen	Frozen	311.46
20/21-Dec-18	318.45	318.47	317.91	317.75	312.41	312.40	311.54	311.40

TABLE E1
Manual Surface Water Elevations (Mini Piezometers)
2018 Annual Report

Date	Water Level (masl)							
	MP12D-04	MP12S-04	MP14D-07	MP14S-07	MP08D-04	MP08S-04	MP17D-11	MP17S-11
18-Jan-18	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen
20/22/26-Feb-18	311.80	311.80	Frozen	311.50	311.00	310.33	310.16	309.72
19/20-Mar-18	Frozen	311.34	Frozen	Frozen	310.38	310.38	309.56	309.56
18/19-Apr-18	311.52	311.60	311.60	311.41	310.56	310.55	309.80	309.80
22/23-May-18	311.48	311.46	311.53	311.33	310.44	310.43	309.63	309.62
18/19-Jun-18	311.32	311.31	311.40	311.24	310.33	310.29	309.46	309.52
19/20-Jul-18	311.20	311.20	311.27	311.19	310.23	310.22	309.37	309.50
22/23-Aug-18	311.28	311.29	311.38	311.24	310.33	310.30	309.44	309.51
18/20-Sep-18	311.29	311.28	311.33	311.21	310.28	310.23	309.38	309.48
15/16-Oct-18	311.41	311.41	311.43	311.27	310.40	310.36	309.47	309.54
22/23-Nov-18	Frozen	311.44	Frozen	311.27	310.39	310.34	309.51	309.50
20/21-Dec-18	311.34	311.39	311.48	311.22	310.40	310.39	309.53	309.56

TABLE E1
Manual Surface Water Elevations (Mini Piezometers)
2018 Annual Report

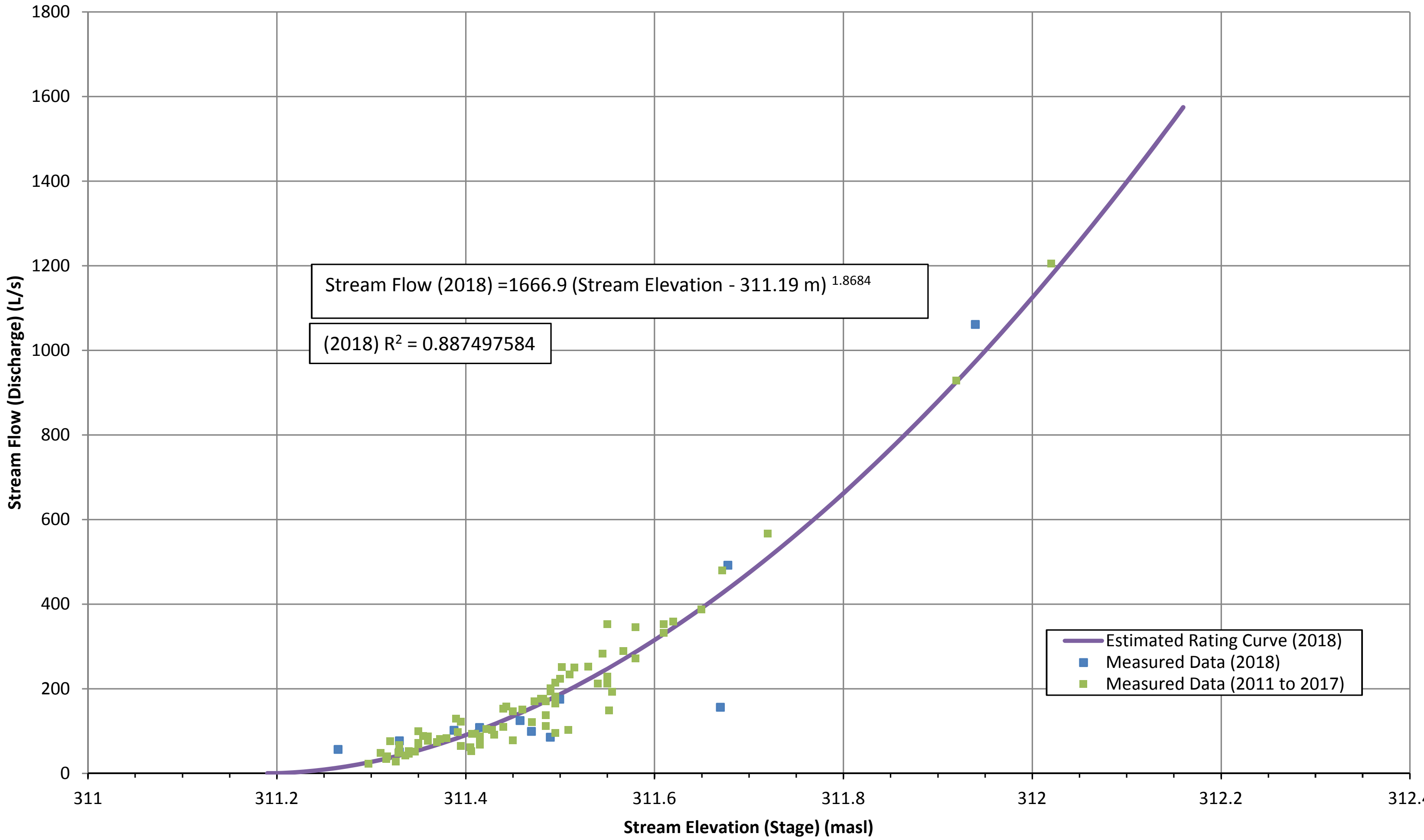
Date	Water Level (masl)			
	MP18D-11	MP18S-11	MP19D-12	MP19S-12
18-Jan-18	Frozen	Frozen	Frozen	Frozen
20/22/26-Feb-18	Frozen	308.65	310.80	310.73
19/20-Mar-18	308.24	308.31	Frozen	Frozen
18/19-Apr-18	308.56	308.50	310.79	310.71
22/23-May-18	308.39	308.35	310.66	310.58
18/19-Jun-18	308.24	308.26	310.46	310.43
19/20-Jul-18	308.17	308.21	310.23	310.21
22/23-Aug-18	308.17	308.23	310.39	310.39
18/20-Sep-18	308.11	308.18	310.26	310.25
15/16-Oct-18	308.12	308.21	310.73	310.48
22/23-Nov-18	308.17	308.24	310.51	310.52
20/21-Dec-18	308.20	308.27	310.60	310.55

TABLE E2
Manual Surface Water Elevations (Surface Water Stations)
2018 Annual Report

Date	Water Level (masl)						
	SW1	SW2	SW3	SW4	SW5	SW9	SW10
18-Jan-18	Frozen	Frozen	317.49	Frozen	307.37	Frozen	Frozen
20/22-Feb-18	311.94	310.61	317.72	312.82	307.67	311.09	311.52
19/20-Mar-18	311.42	Frozen	317.39	312.44	307.32	311.07	Frozen
18/19-Apr-18	311.68	310.48	317.63	312.54	307.61	Destroyed	311.70
22/23-May-18	311.50	310.36	317.51	312.46	307.34	Destroyed	312.06
18/19-Jun-18	311.33	310.28	317.38	312.40	307.22	Destroyed	311.98
19/20-Jul-18	311.33	310.27	317.31	312.41	307.20	Destroyed	311.88
22/23-Aug-18	311.39	310.31	317.41	312.43	307.29	Destroyed	311.85
18/20-Sep-18	311.27	310.27	317.33	312.41	307.20	Destroyed	311.73
15/16-Oct-18	311.49	310.36	317.40	312.44	307.26	Destroyed	311.72
22/23-Nov-18	311.47	310.34	317.41	312.46	307.33	Destroyed	Frozen
20/21-Dec-18	311.46	310.37	317.61	312.56	307.43	Destroyed	311.70

APPENDIX F

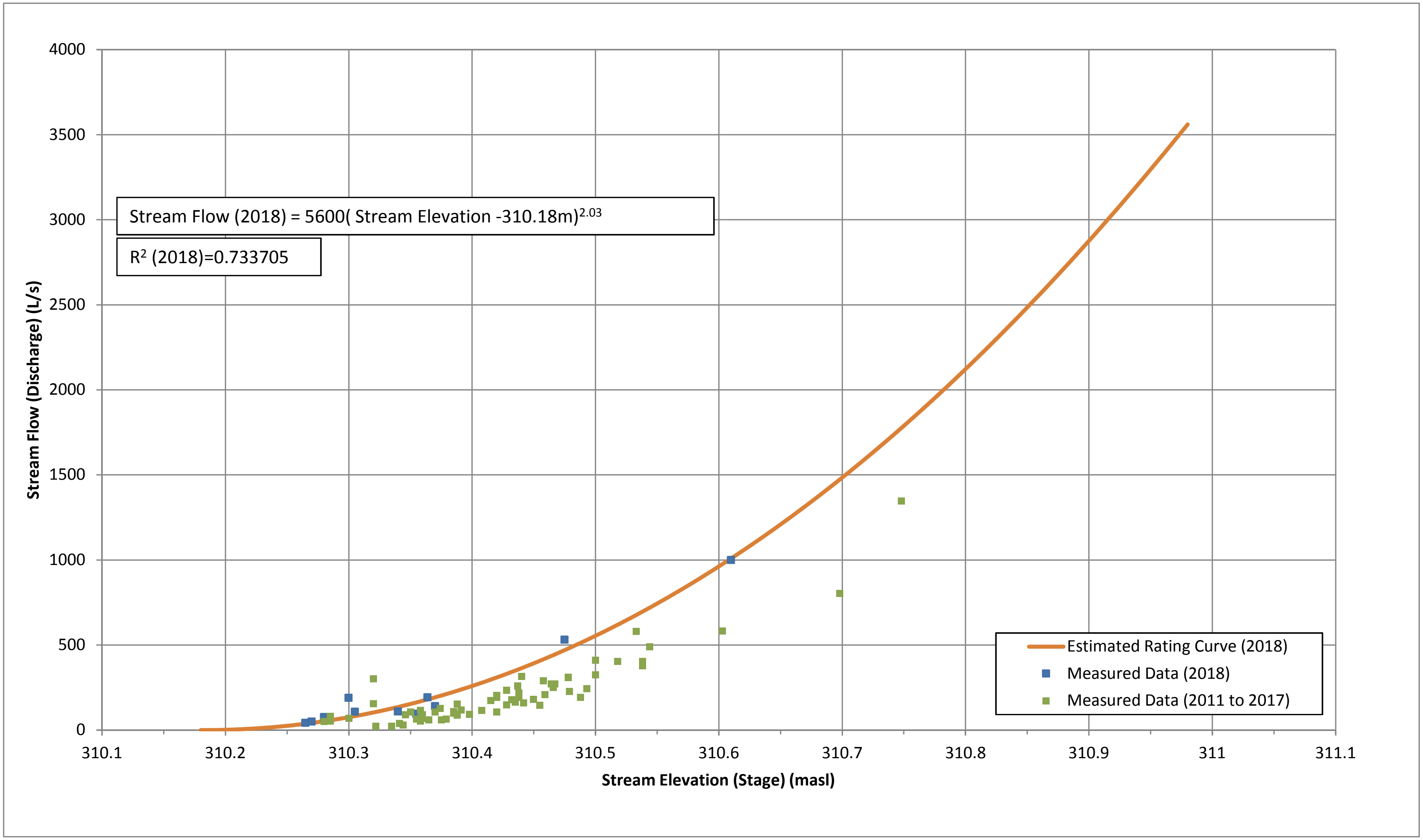
Surface Water Flow Monitoring



2018 Data Notes:
In 2018, the range of water levels recorded during manual flow measurements (and used to determine the stage-discharge relationship) = ~311.265 to 311.94 masl. The full range of water levels recorded in 2018 = ~311.27 to 311.94 masl.

GOLDER

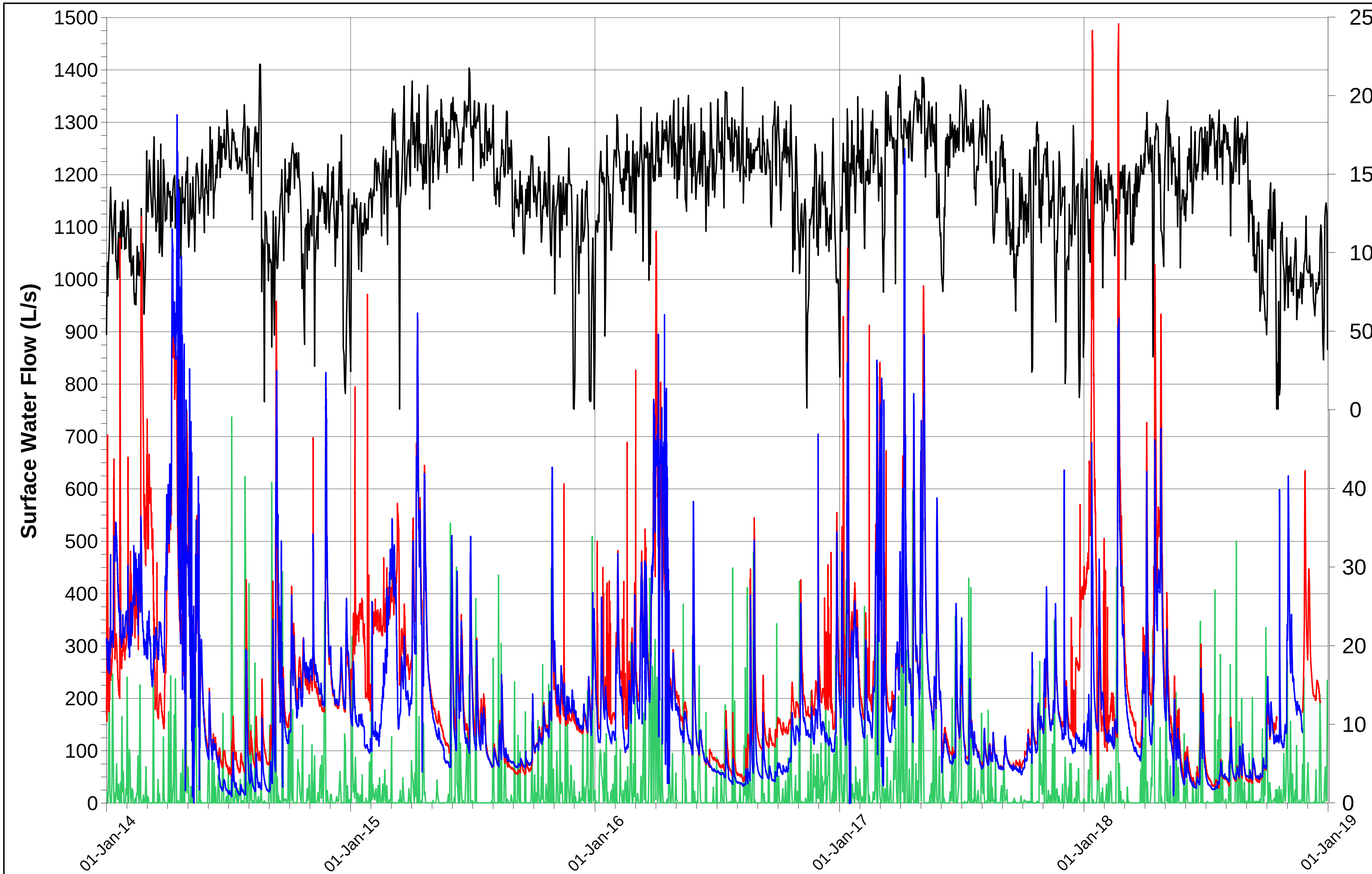
Figure. F1
STAGE-DISCHARGE MEASUREMENTS FOR SW1 (2018)
2018 ANNUAL MONITORING REPORT
NESTLE WATERS CANADA
Aberfoyle, Ontario



2018 Data Notes:
In 2018, the range of water levels recorded during manual flow measurements = 310.27 to 310.61 masl. The full range of water levels recorded in 2018 = ~310.25 to 310.73 masl.

GOLDER

Figure. F2
STAGE-DISCHARGE MEASUREMENTS FOR SW2 (2018)
2018 ANNUAL MONITORING REPORT
NESTLE WATERS CANADA
Aberfoyle, Ontario



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

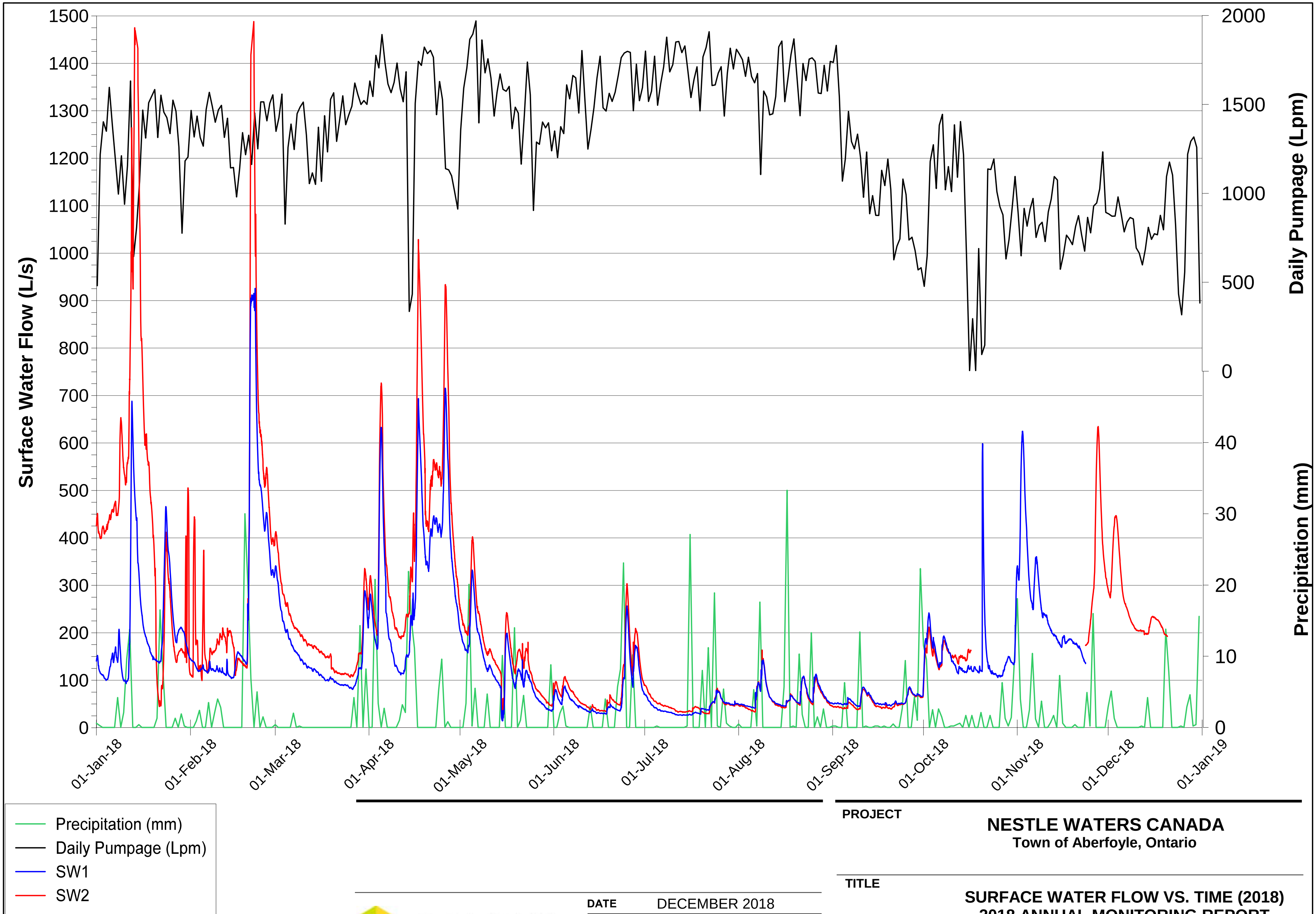
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SURFACE WATER FLOW VS. TIME
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	F3a



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SURFACE WATER FLOW VS. TIME (2018)
2018 ANNUAL MONITORING REPORT

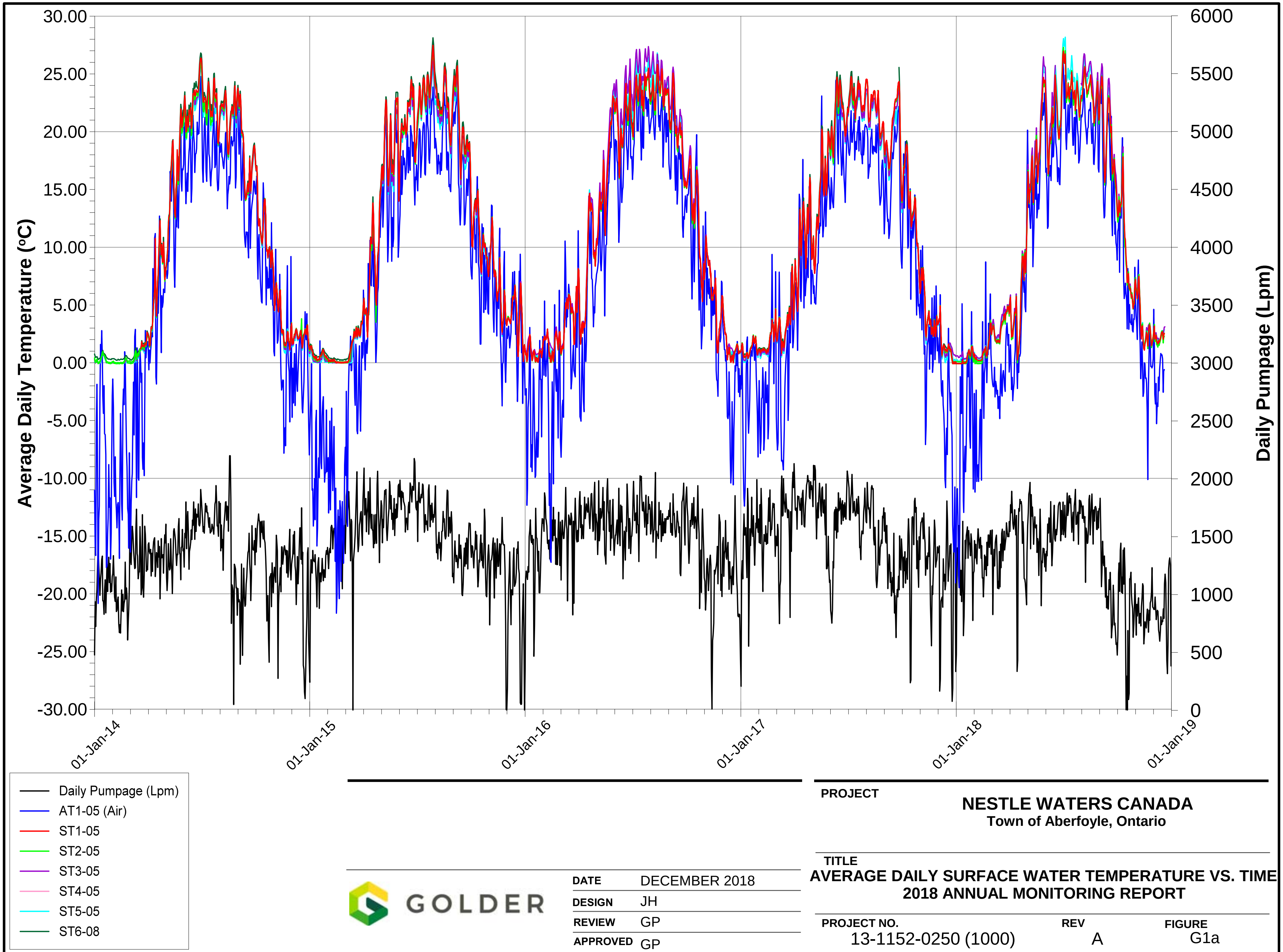
PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	F3b

TABLE F1
Surface Water Flow
2018 Annual Report

DATE	SW-1 Flow (L/sec)	SW-2 Flow (L/sec)	COMMENT
18-Jan-18	155.4	NA	Frozen channel at SW-2
22-Feb-18	1060.6	998.1	
19-Mar-18	107.5	188.7	
19-Apr-18	491.5	530.6	
24-May-18	174.7	192.3	
19-Jun-18	75.9	75.6	
19-Jul-18	50.1	41.5	
23-Aug-18	100.8	106.4	
18-Sep-18	55.8	49.6	
16-Oct-18	84.7	95.8	
23-Nov-18	98.5	108.4	
20-Dec-18	123.8	139.3	

APPENDIX G

Stream Temperature Monitoring



GOLDER

DATE	DECEMBER 2018
DESIGN	JH
REVIEW	GP
APPROVED	GP

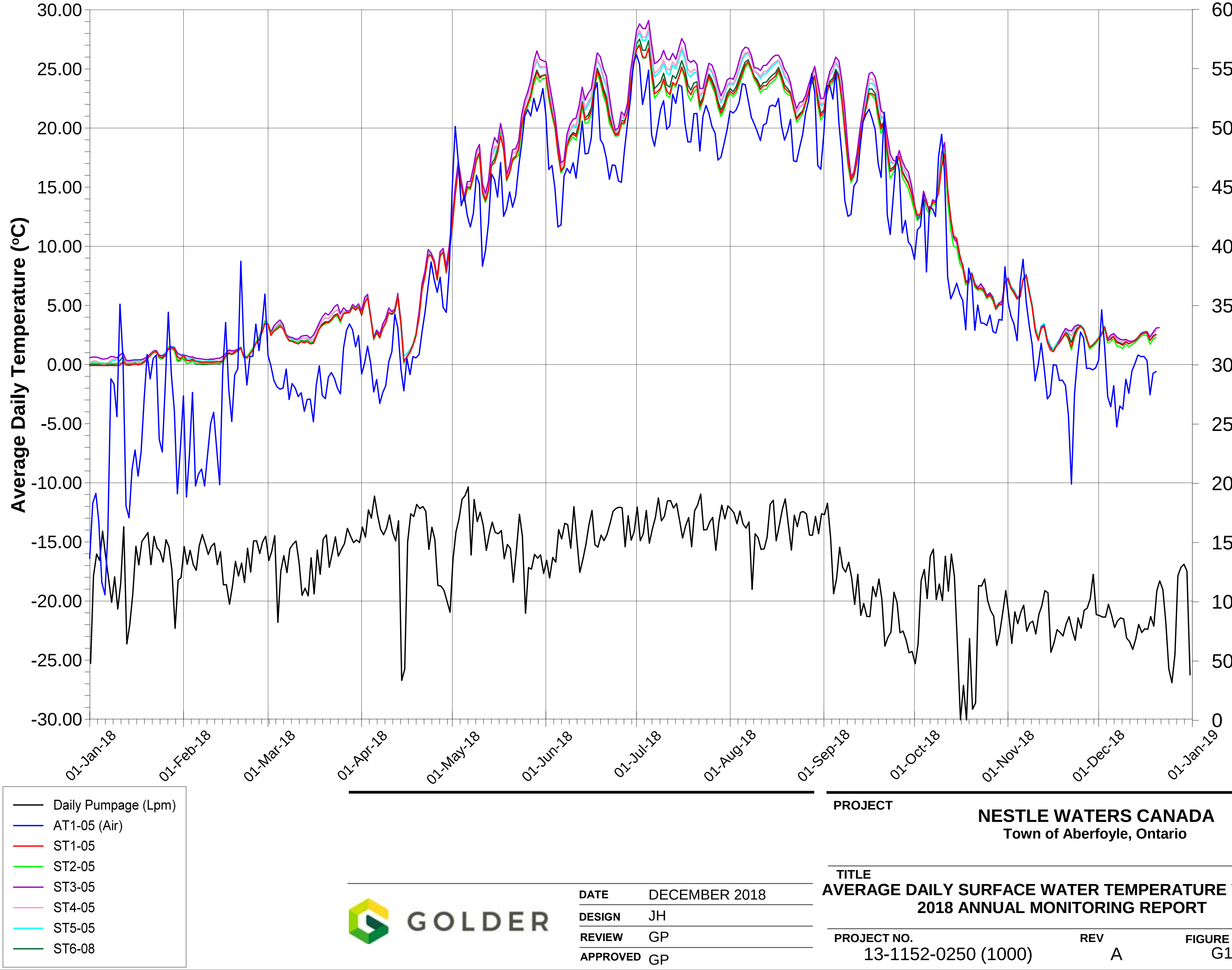
PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

AVERAGE DAILY SURFACE WATER TEMPERATURE VS. TIME
2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	G1a



DATE	DECEMBER 2018	
DESIGN	JH	
REVIEW	GP	
APPROVED	GP	

PROJECT

NESTLE WATERS CANADA

Town of Aberfoyle, Ontario

TITLE

AVERAGE DAILY SURFACE WATER TEMPERATURE VS. TIME

2018 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	G1b

Examination of the Temperature Suitability of Aberfoyle Creek for Resident Fishes: 2006-2018

Prepared for Nestlé Waters Canada

Prepared by Cam Portt and Jim Reid

C. Portt and Associates

February 2019

Table of Contents

Introduction ... 1

Methods ... 1

Results ... 4

Discussion ... 5

Conclusions ... 6

References ... 6

APPENDIX A ... 14

List of Tables

Table 1. Indices used to evaluate the thermal suitability for individual fish species. ... 3

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. ... 3

List of Figures

Figure 1. Temperature logging locations used in the Nestlé Waters Canada monitoring program in Aberfoyle Creek. ... 8

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. ... 9

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. ... 10

Figure 4. Percent of temperature measurements within ±2°C of the final temperature preferendum (%FTP) during the period June 1 to August 31, by species, station and year. ... 11

Figure 5. Percent of temperature measurements within ±2°C of the optimal temperature for growth (%OTG) during the period June 1 to August 31, by species, station and year. ... 12

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, by year. The lines and R^2 values are for second order polynomial regressions. ... 13

Introduction

Condition 4.4 of the Permit to Take Water (PTTW Number 1763-8FXR29) issued to Nestlé Waters Canada (Nestlé) 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 analysis of the earlier data (2006-2012) was reported in Portt and Reid (2013). That analysis was conducted using ThermoStat Version 2 (Ontario Ministry of Natural Resources and the Institute for Watershed Science, Trent University, 2010 http://people.trentu.ca/ nicholasjones/tools.htm). The software was updated to Version 3.1 (Version 3.1, Jones and Schmidt, http://people.trentu.ca/nicholasjones/thermostat.htm) prior to the analysis of the 2013 data. The update corrected errors in the calculations by the previous version of the software and eliminated the calculation of the summer temperature suitability index. Therefore the 2006 – 2012 data were reanalyzed using ThermoStat Version 3.1 and subsequent years' data have been analyzed and reported annually using that version (Portt and Reid, 2014, 2015, 2016, 2017, 2018). This report presents the results of the analyses of the 2018 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). The loggers have an accuracy of ±0.2°C between 0°C and 50°C and drift is 0.1°C per year. Monitoring at Stations 1 – 5 began in 2005; monitoring at Station 6, which is the station furthest upstream, began in 2008.

Temperature is typically logged at 30 minute intervals, but was logged at 60 minute intervals for a period of time at some locations during some years. The ThermoStat software requires that the time interval be consistent during the period covered by each analysis. Therefore, in cases where temperature at a location was logged at half-hour intervals during part of the period and at one-hour intervals during another part, every second recorded temperature was deleted from the half-hour interval portion, so that the values were at one-hour intervals through the entire period. All of the 2018 data were logged at half-hour intervals.

The data were analyzed using ThermoStat Version 3.1 temperature analysis software. 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-1) 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.

Optimal Range Indices	
%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%.
Lethal Threshold Indices	
%>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 of 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.

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

The mean air temperature at the Guelph Turfgrass Institute, 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 2011-2018. 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 decreases 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 19.51°C in 2018, which is the highest for the period 2007 – 2018 (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; 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, creek chub and white sucker. In 2018, the upper incipient lethal temperature for brook trout and brown trout was exceeded more than 40% of the time at the farthest upstream station and 16% of the time for brook trout and 14% of the time for brown trout at the station farthest downstream. The *CTMax* was exceeded for brief periods for brook trout, brown trout, blacknose dace and bluntnose minnow, at some stations in 2018 (Figure 3).

The percentage of the time, from June 1st to August 31st, that water temperature is within 2C° of the final temperature preferendum (%FTP) is lowest for brown trout and brook trout (Figure 4) which have the lowest preferred temperatures (Table 2). The next lowest %FTP values are for pumpkinseed and largemouth bass, (Figure 4), which have the highest preferred temperatures (Table 2). As in past years, the %FTP was highest in 2018 for species with intermediate temperature requirements. In 2018, the %FTP was lower than it was in 2017 for species with cool preferred temperatures such as blacknose dace, rainbow darter, and common shiner, and higher for species with higher preferred temperatures such as largemouth bass, pumpkinseed, and rock bass.

The percentage of the time, from June 1st to August 31st, that water temperature was within 2C° 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). The next lowest value is for rock bass, which is the species with the highest optimum temperature for growth (Table 2). The highest mean %OGT in 2018 was for pumpkinseed.

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 Nestlé property (Figure 6) and 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 (%>UIL) 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 air temperature accounted for more than 90% of the variation in mean water temperature. The rate of increase in water temperature with air temperature tended to decrease in a downstream direction, as did the r^2. The 2018 mean air temperature was the highest for the period 2008-2018. The relationship between mean air temperature and mean water temperature was consistent with previous years and the r^2 of the relationship increased slightly at all six locations with the addition of the 2018 data.

Discussion

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. It is 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.

The 2018 results were consistent with those from previous years. In the reach of Aberfoyle Creek that flows through the Nestlé 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 2018 results continue to support the previously expressed opinion that water temperature is the principal factor limiting trout abundance in the Nestlé 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 correlations between annual mean June - August air temperature at the Guelph Turf Grass Institute and the annual mean June - August water temperature in the Nestlé branch of Aberfoyle Creek remain high and were slightly higher for all of the six locations after the 2018 data were added, indicating that the 2018 data were consistent with the previously described relationships. The strength of the correlations is strongly influenced by the data from the coolest year (2009), but the relationships remain strong even if the 2009 data are removed.

Conclusions

In 2018, mean summer (June – August) air temperature and water temperatures were high relative to most other years in the period 2007 – 2017. 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 Nestle property in 2018 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.

References

Hasnain S., Minns C. and B. Shuter. 2010. Key Ecological Temperature Metrics for Canadian Freshwater Fishes. Climate change research report: CCRR-17. Applied Research and Development Branch, Ontario Ministry of Natural Resources, Canada. 54 p.

Jobling, M. 1981. Temperature tolerance and the final preferendum -- rapid methods for the assessment of optimum growth temperatures. J. Fish Biol. 19: 439-455.

McCauley, R.W. and J.M. Casselman 1980. The final preferendum as an index of the temperature for optimum growth in fish. Pp 83-93 In United Nations Food and Agriculture Organization, European Inland Fisheries Advisory Commission, Symposium 80/E76, Rome, Italy.

Post, J.R., and Evans, D.O. 1989. Size-dependent overwinter mortality in young-of-the-year yellow perch (Perca flavescens): laboratory, in situ enclosure, and field experiments. Can. J. Fish. Aquat. Sci. 46: 1958–1968.

Portt, C. 2011. Review of the Aberfoyle Creek Water Temperature Monitoring Program. Report prepared for Nestle Waters Canada by C. Portt and Associates. 15p.

Portt, C. and J. Reid. 2013. Examination of the Temperature Suitability of Aberfoyle Creek for Resident Fishes. Report prepared for Nestle Waters Canada by C. Portt and Associates. 25p.

Portt, C. and J. Reid. 2014. Examination of the Temperature Suitability of Aberfoyle Creek for Resident Fishes: 2006-2013. Report prepared for Nestle Waters Canada by C. Portt and Associates. 22p.

Portt, C. and J. Reid. 2015. Examination of the Temperature Suitability of Aberfoyle Creek for Resident Fishes: 2006-2014. Report prepared for Nestle Waters Canada by C. Portt and Associates. 22p.

Portt, C. and J. Reid. 2016. Examination of the Temperature Suitability of Aberfoyle Creek for Resident Fishes: 2006-2015. Report prepared for Nestle Waters Canada by C. Portt and Associates. 21p.

Portt, C. and J. Reid. 2017. Examination of the Temperature Suitability of Aberfoyle Creek for Resident Fishes: 2006-2016. Report prepared for Nestle Waters Canada by C. Portt and Associates. 21p.

Portt, C. and J. Reid. 2018. Examination of the Temperature Suitability of Aberfoyle Creek for Resident Fishes: 2006-2017. Report prepared for Nestle Waters Canada by C. Portt and Associates. 22p.

Spotila, J.R., K.N. Terpin, R.R. Koons and R.L. Bonati. 1979. Temperature requirements of fishes from eastern Lake Erie and the upper Niagara River: A review of the literature. Env. Biol. Fish. 4: 281-307.

Wehrly, K.E., L. Wang, and M. Mitro. 2007. Field-based estimates of thermal tolerance limits for trout: incorporating exposure time and temperature fluctuation. Transactions of the American Fisheries Society. 136: 365-374.

Wismer, D.A. and A.E. Christie. 1987. Temperature relationships of Great Lakes fishes: A data compilation. Great Lakes Fishery Commission, Ann Arbor, MI. Spec. Publ. 87-3. 196 p.

Figure 1. Temperature logging locations used in the Nestlé Waters Canada monitoring program in Aberfoyle Creek.

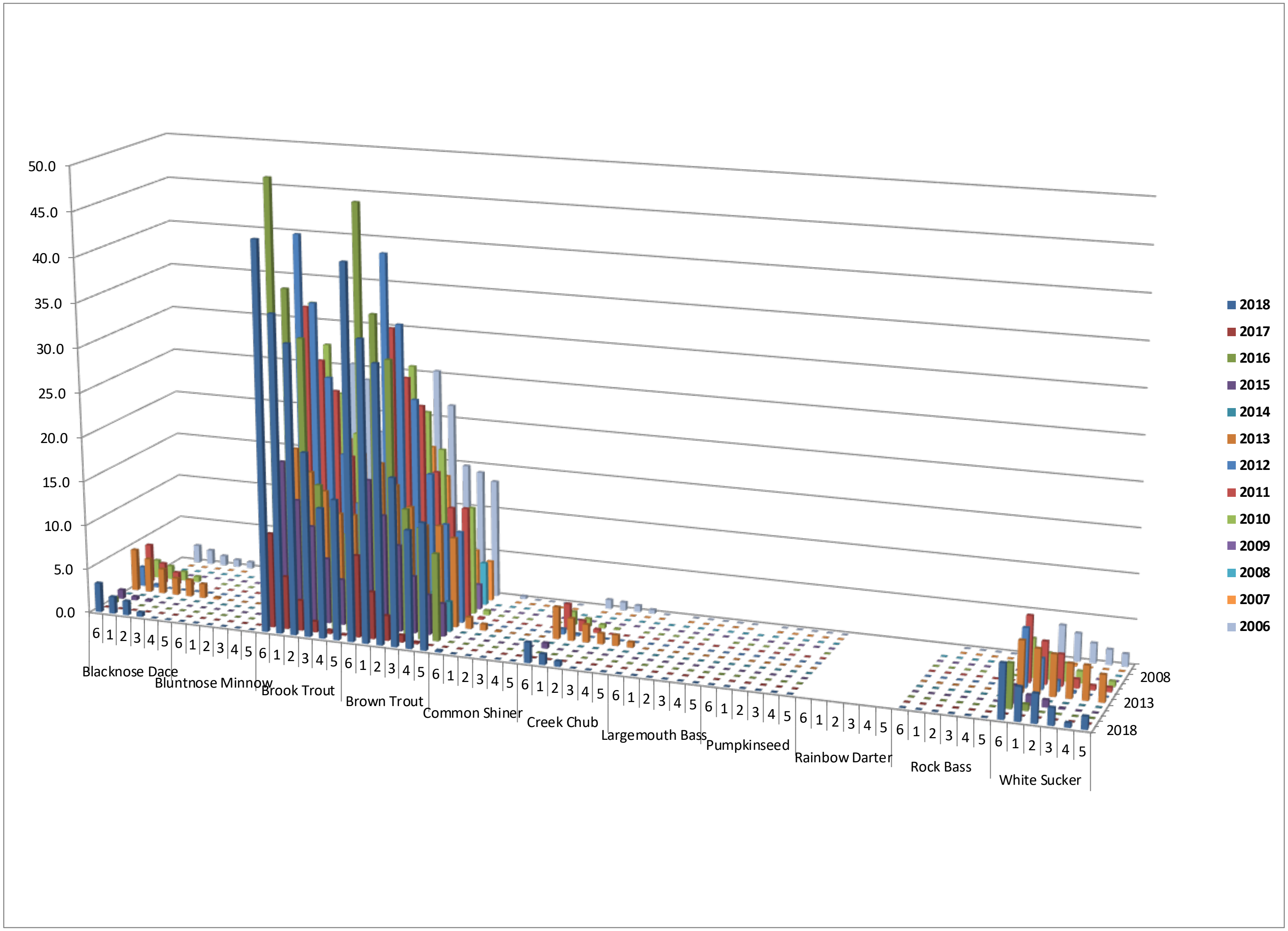


Figure 2. Percent of temperature measurements that exceed the ultimate upper incipient lethal temperature (%>UILT) during the period June 1 to August 31, by species, station and year.

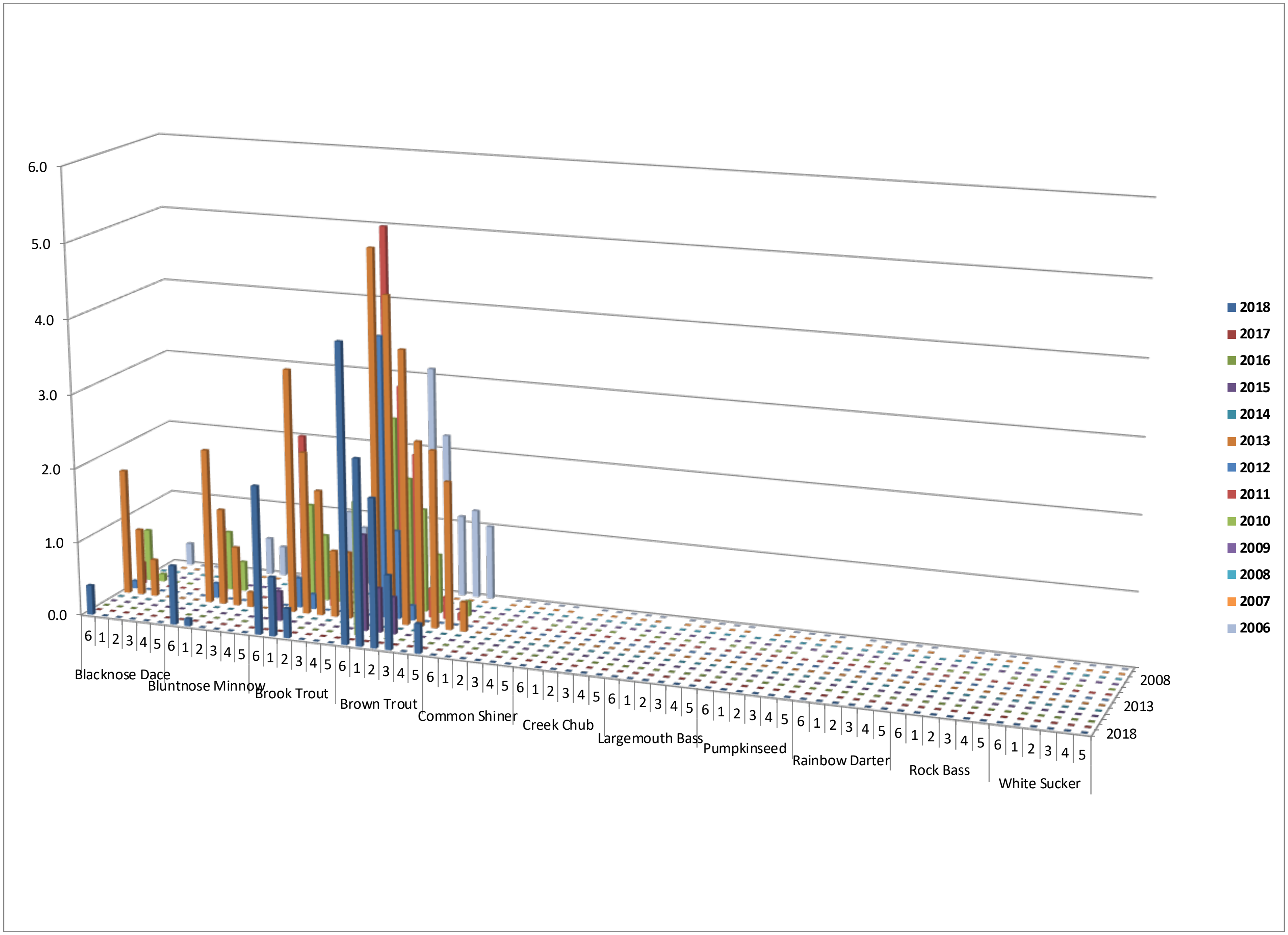


Figure 3. Percent of temperature measurements that exceed the critical thermal maximum temperature (%>CTmax) during the period June 1 to August 31, by species, station and year.

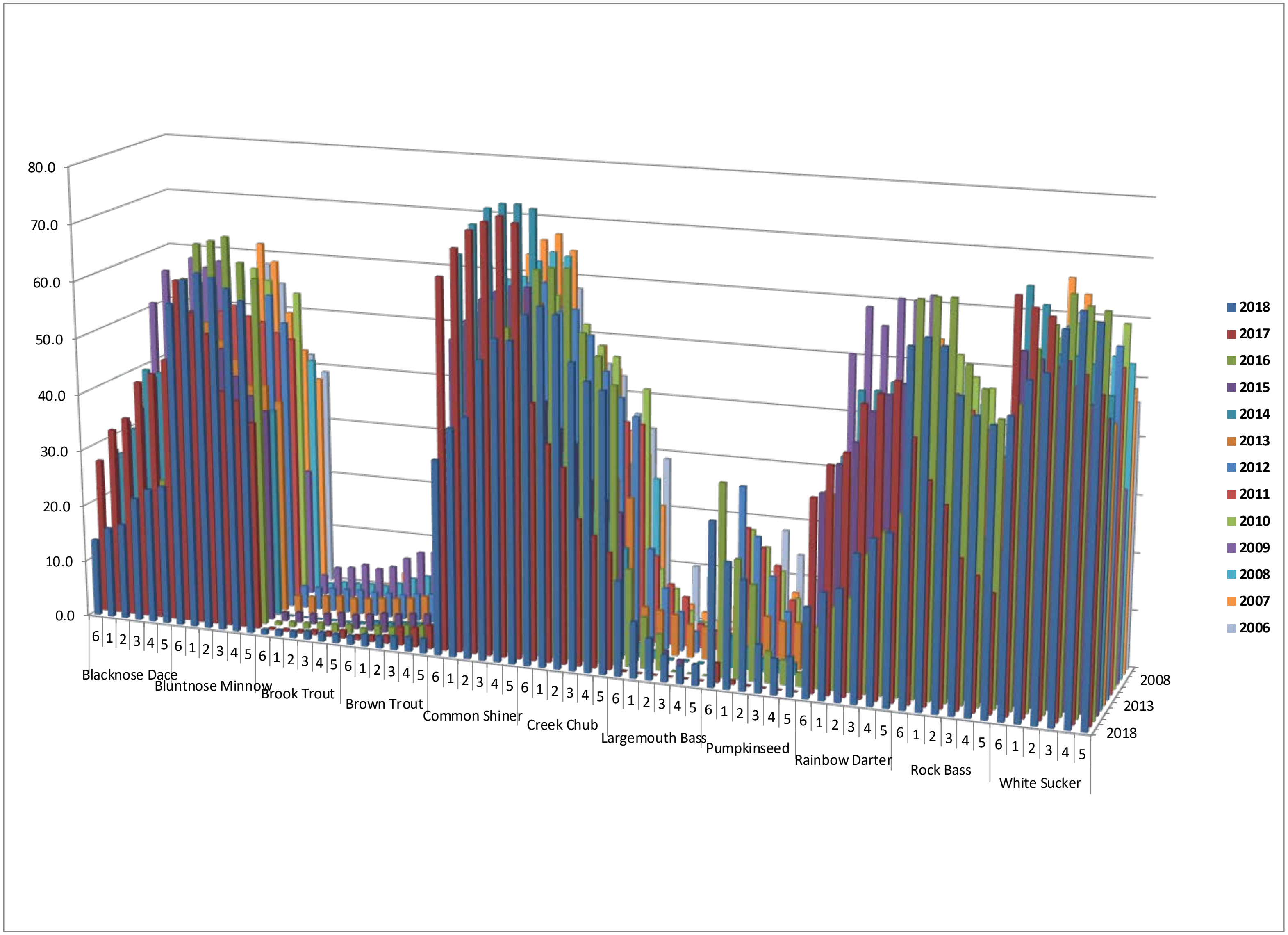


Figure 4. Percent of temperature measurements within ±2°C of the final temperature preferendum (%FTP) during the period June 1 to August 31, by species, station and year.

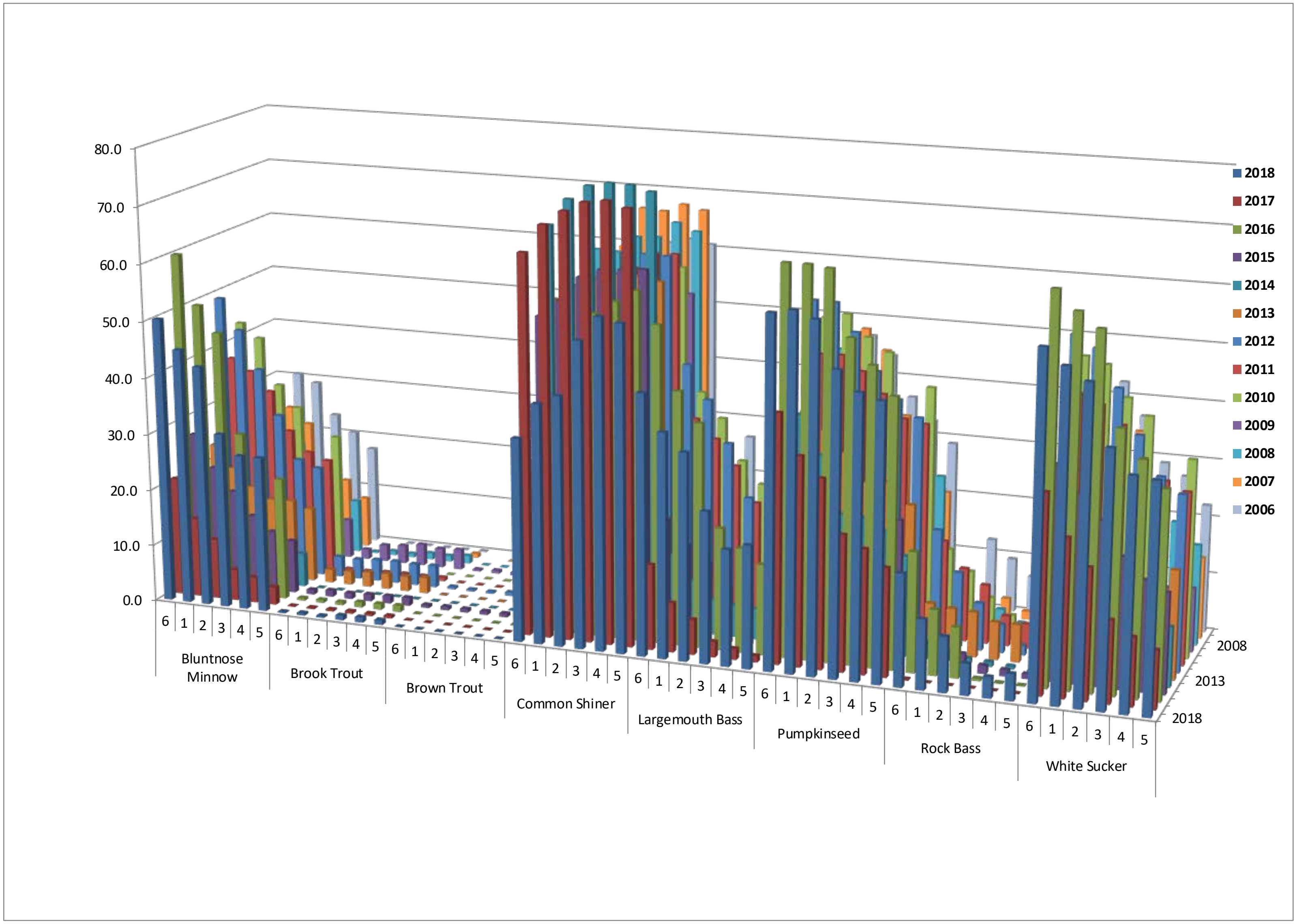


Figure 5. Percent of temperature measurements within ±2°C of the optimal temperature for growth (%OTG) during the period June 1 to August 31, by species, station and year.

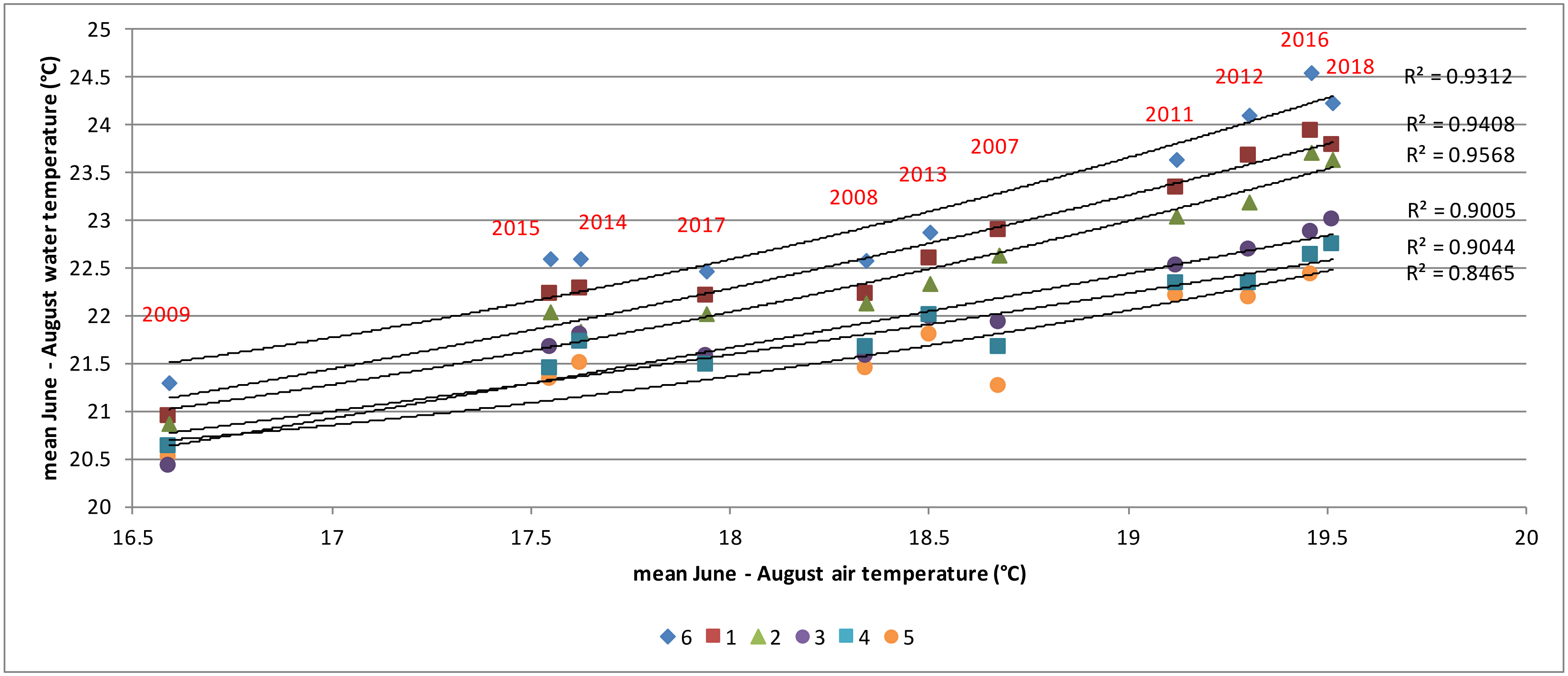


Figure 6. Plot of the mean June 1 - August 31 water temperature at each site versus mean June – August air temperature at the Guelph Turfgrass Institute, by year. The lines and R^2 values are for second order polynomial regressions.

APPENDIX A

Thermal suitability indices

Percent of temperature measurements within ±2°C of the optimum growth temperature (%OGT)															
	Year														
Species	Station	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	Mean
Blunt-nose Minnow	6	50.3	20.9	60.1	27.0	18.2	23.2	49.2	37.4	43.1	12.3	26.2			34.9
	1	45.2	14.0	51.4	21.3	13.0	19.3	43.7	35.3	40.6	8.5	19.3	25.0	30.5	29.5
	2	42.5	10.6	46.8	17.3	8.5	16.2	36.8	31.9	32.2	7.2	19.3	22.2	29.1	25.9
	3	30.9	5.5	29.0	13.2	7.9	14.2	28.7	24.9	28.3	5.9	11.7	15.1	23.3	19.3
	4	27.4	4.5	24.9	10.7	7.0	14.3	20.9	21.3		7.0	11.9	12.1	20.3	16.1
	5	27.4	3.1	21.6	9.4	5.9	13.2	19.7	20.1	23.5	6.9	9.5	9.0	17.5	15.3
	Mean	37.3	9.8	39.0	16.5	10.1	16.7	33.2	28.5	33.5	8.0	16.3	16.7	24.1	23.3
Brook Trout	6	0.2	0.1	0.4	0.8	0.0	2.3	3.6	0.2	0.0	1.7	0.2			0.8
	1	0.4	0.2	0.5	1.1	0.0	2.4	3.5	0.2	0.0	2.9	0.7	0.0	0.0	0.9
	2	0.3	0.3	0.5	1.0	0.0	2.6	3.8	0.4	0.0	3.2	0.6	0.0	0.0	0.9
	3	0.8	0.4	0.9	1.2	0.0	2.7	3.9	0.5	0.0	3.8	1.1	0.1	0.0	1.2
	4	0.9	0.4	1.0	1.3	0.0	2.6	3.8	0.5		3.4	1.0	0.2	0.0	1.2
	5	0.8	0.4	1.1	1.4	0.0	2.8	3.9	0.6	0.0	3.6	1.4	0.7	0.1	1.3
	Mean	0.6	0.3	0.7	1.1	0.0	2.6	3.8	0.4	0.0	3.1	0.8	0.2	0.0	1.0
Brown Trout	6	0.0	0.0	0.0	0.5	0.0	0.0	0.4	0.0	0.0	0.3	0.0			0.1
	1	0.0	0.0	0.0	0.6	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.0	0.0	0.1
	2	0.0	0.0	0.0	0.6	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.0	0.0	0.1
	3	0.0	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.0	0.1
	4	0.0	0.0	0.0	0.6	0.0	0.0	0.3	0.0		0.6	0.0	0.0	0.0	0.1
	5	0.0	0.0	0.2	0.6	0.0	0.0	0.5	0.0	0.0	0.6	0.1	0.0	0.0	0.1
	Mean	0.0	0.0	0.0	0.6	0.0	0.0	0.4	0.0	0.0	0.5	0.0	0.0	0.0	0.1
Common Shiner	6	35.4	66.0	29.5	53.7	68.5	55.0	36.4	47.3	44.8	63.9	60.0			49.7
	1	41.6	70.9	38.8	56.7	73.1	57.7	43.1	51.0	47.0	60.8	59.8	60.1	56.3	54.2
	2	43.3	73.4	42.4	60.9	75.6	59.1	51.8	53.4	54.8	62.8	62.7	67.1	61.5	58.0
	3	52.9	75.1	55.8	62.4	76.3	60.1	56.8	59.7	56.7	51.4	62.9	66.8	60.5	60.7
	4	57.2	75.6	58.1	62.7	76.2	60.1	63.1	62.5		57.9	65.7	68.2	61.4	63.5
	5	56.4	74.6	60.2	63.0	75.3	59.4	63.0	62.6	59.6	54.2	64.4	67.4	60.7	62.7

	Mean	47.8	72.6	47.5	59.9	74.2	58.6	52.4	56.1	52.6	58.5	62.6	65.9	60.1	58.3
Large-mouth Bass	6	45.1	14.8	54.8	20.6	13.4	17.5	44.6	34.2	38.0	9.0	19.6			29.7
	1	38.8	8.6	43.9	16.5	9.1	15.1	38.8	31.0	33.7	6.8	15.1	19.9	26.6	24.5
	2	35.8	6.1	38.8	13.6	6.2	13.4	31.5	26.6	26.5	4.4	14.8	18.7	25.5	21.3
	3	26.2	2.7	21.2	9.5	5.6	11.3	22.3	20.4	22.7	4.3	8.9	12.1	20.2	15.3
	4	20.1	1.9	18.1	7.7	5.3	11.3	15.8	16.9		5.2	8.9	9.3	17.6	12.2
	5	21.2	1.1	15.7	6.4	4.7	10.2	15.0	16.3	18.0	4.6	7.0	6.4	15.3	11.7
	Mean	31.2	5.9	32.1	12.4	7.4	13.1	28.0	24.2	27.8	5.7	12.4	13.3	21.0	18.9
Pumpkin-seed	6	60.2	42.9	66.8	42.5	39.8	39.5	57.5	47.5	53.0	23.4	45.8			48.3
	1	60.9	36.0	66.8	38.3	33.2	36.5	57.4	47.6	53.8	18.3	38.3	48.8	46.8	46.0
	2	59.7	32.6	66.4	35.8	23.5	33.0	52.6	45.1	50.1	15.4	38.2	45.3	43.6	42.9
	3	51.8	23.5	55.3	29.3	23.3	28.2	46.3	41.5	47.8	13.7	29.0	34.1	36.5	36.6
	4	48.4	21.5	51.1	26.6	21.4	28.6	41.8	37.6		14.4	29.5	27.2	32.6	33.0
	5	47.4	18.7	46.3	24.6	17.4	25.1	39.0	37.0	42.4	14.2	25.0	21.2	28.9	31.0
	Mean	54.7	29.2	58.8	32.9	26.4	31.8	49.1	42.7	49.4	16.6	34.3	35.3	37.7	39.5
Rock Bass	6	19.3	0.2	20.7	5.5	3.1	8.5	20.1	17.1	14.6	1.6	5.4			11.3
	1	12.0	0.0	11.3	3.3	1.9	8.0	13.1	12.7	11.1	1.0	2.5	3.8	12.4	7.5
	2	9.5	0.0	8.7	3.0	1.0	7.8	8.2	10.2	6.9	0.8	2.5	3.3	9.3	5.8
	3	5.4	0.0	0.4	1.4	0.8	6.5	4.9	5.2	4.2	0.2	0.5	1.4	6.5	3.1
	4	3.6	0.0	0.1	1.1	0.5	6.5	1.7	4.2		0.3	0.5	0.6	6.0	2.2
	5	4.6	0.0	0.1	0.8	0.2	5.7	2.3	3.3	2.5	0.3	0.2	0.1	4.7	2.1
	Mean	9.1	0.0	6.9	2.5	1.3	7.2	8.4	8.8	7.9	0.7	1.9	1.8	7.8	5.2
White Sucker	6	58.3	34.0	65.9	36.6	30.4	33.6	55.3	44.6	50.0	18.0	37.3			43.5
	1	55.6	26.9	62.6	32.0	23.7	30.0	53.3	43.0	48.9	15.0	27.5	37.0	42.4	39.5
	2	53.4	22.4	60.1	28.0	15.7	25.8	47.0	39.9	43.6	12.8	28.5	35.1	36.8	35.9
	3	43.2	14.1	44.4	22.4	14.9	20.8	39.5	34.6	40.8	9.5	19.4	21.9	29.0	28.4
	4	39.1	11.7	39.7	18.9	12.8	21.1	32.9	31.2		10.8	21.1	18.9	27.0	24.9
	5	38.7	10.0	35.3	17.2	10.3	18.7	30.3	29.7	34.2	11.1	17.5	14.2	22.3	23.4
	Mean	48.1	19.9	51.3	27.6	18.0	25.0	43.1	37.2	43.5	12.9	25.2	25.4	31.5	32.5

Percent of temperature measurements within ±2°C of the final temperature preferendum (%FTP)															
		Year													
Species	Station	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	Mean
Black-nose Dace	6	13.7	27.4	9.2	28.0	26.7	26.9	10.2	21.6	21.1	51.1	30.5			23.3
	1	16.1	33.2	12.0	33.3	31.4	30.7	12.9	24.7	22.5	57.2	35.1	24.9	24.8	26.8
	2	17.0	35.5	13.6	36.1	42.3	34.0	17.1	28.4	24.8	53.2	34.1	26.7	26.5	29.0
	3	22.0	42.2	20.6	41.7	42.0	38.9	22.9	34.1	29.2	59.9	40.2	37.8	37.7	35.1
	4	23.9	43.9	24.1	45.0	43.9	38.6	27.4	36.4		58.4	39.6	41.2	42.2	37.6
	5	24.7	46.6	26.9	46.9	48.7	42.1	30.9	38.9	34.1	59.7	43.3	49.8	48.4	40.4
	Mean	19.6	38.1	17.7	38.5	39.2	35.2	20.2	30.7	26.3	56.6	37.1	36.1	35.9	32.2
Blunt-nose Minnow	6	57.3	60.8	60.5	54.3	58.7	51.1	57.0	52.0	57.4	33.9	56.3			54.7
	1	61.6	55.3	66.8	50.5	52.9	48.1	60.7	53.2	58.8	28.9	53.8	62.2	58.0	55.2
	2	63.0	51.8	67.5	48.0	43.0	44.9	59.9	51.5	59.5	26.6	52.5	59.1	54.6	53.2
	3	62.4	41.9	68.4	43.3	42.3	40.5	57.6	50.7	57.5	23.6	47.4	50.0	47.6	49.7
	4	60.7	40.5	64.1	40.1	40.9	40.7	56.2	48.9		23.4	46.1	43.4	42.0	46.7
	5	58.8	36.9	61.5	37.6	37.1	38.0	51.5	48.0	55.6	22.6	42.3	38.3	39.0	44.7
	Mean	60.6	47.9	64.8	45.6	45.8	43.9	57.2	50.7	57.8	26.5	49.7	50.6	48.2	50.7
Brook Trout	6	0.9	0.3	0.6	1.5	0.0	2.9	3.9	0.8	0.0	3.5	1.2			1.4
	1	1.1	0.4	0.9	1.8	0.0	3.0	3.9	0.8	0.0	5.2	1.7	0.2	0.0	1.4
	2	1.2	0.5	1.0	1.8	0.0	3.4	4.0	1.0	0.0	5.5	1.6	0.3	0.0	1.5
	3	1.5	0.8	1.3	2.1	0.1	3.7	4.1	1.2	0.0	6.3	1.9	0.5	0.1	1.8
	4	1.6	0.8	1.4	2.6	0.1	3.6	4.3	1.2		5.8	1.8	1.7	0.2	2.1
	5	1.6	1.4	1.6	2.5	0.3	3.8	4.2	1.2	0.0	6.5	2.6	3.8	0.4	2.3
	Mean	1.3	0.7	1.1	2.1	0.1	3.4	4.1	1.0	0.0	5.5	1.8	1.3	0.1	1.7
Brown Trout	6	1.6	0.8	1.2	2.9	0.8	4.2	4.3	2.3	0.7	8.3	3.8			2.7
	1	2.1	1.1	2.0	3.4	0.9	4.4	4.3	2.3	0.6	9.7	4.5	2.6	0.2	2.9
	2	2.1	1.4	2.0	3.5	1.2	4.8	4.8	2.6	1.1	10.1	4.7	2.8	0.4	3.1
	3	2.4	3.2	2.7	3.9	1.4	5.4	5.0	3.1	1.4	11.6	5.6	4.0	1.0	3.8
	4	2.6	3.4	2.9	4.1	1.4	5.4	5.4	3.1		10.5	5.1	5.0	1.6	4.1
	5	2.6	4.1	3.4	4.4	1.8	5.9	5.3	3.3	2.1	11.8	5.9	6.6	2.8	4.5

	Mean	2.2	2.3	2.4	3.7	1.3	5.0	4.9	2.8	1.2	10.3	4.9	4.2	1.2	3.5
Common Shiner	6	34.3	65.0	28.1	53.2	67.2	54.2	34.8	46.0	43.9	62.5	57.2			48.4
	1	40.0	70.0	37.1	56.6	72.5	56.9	41.5	50.3	46.2	60.8	59.8	60.1	56.3	53.4
	2	42.1	73.2	40.7	60.5	75.4	59.1	50.7	52.6	53.0	62.8	60.5	63.9	58.9	56.8
	3	52.1	74.8	54.0	62.0	76.3	60.4	55.9	59.1	55.7	56.5	63.4	66.6	61.4	60.7
	4	56.0	75.9	56.6	63.1	76.4	60.3	61.9	62.0		60.5	65.2	67.8	62.2	63.4
	5	55.8	74.9	59.0	63.1	75.8	59.3	62.1	62.1	58.9	56.3	64.6	65.1	57.9	62.2
	Mean	46.7	72.3	45.9	59.8	73.9	58.4	51.2	55.4	51.5	59.9	61.8	64.7	59.3	57.6
Creek Chub	6	60.4	44.9	66.8	43.9	42.1	40.5	57.4	47.9	53.6	23.3	45.2			48.9
	1	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	46.6
	2	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	43.9
	3	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	37.6
	4	50.1	23.1	53.1	27.8	23.3	30.0	43.5	38.6		16.2	32.1	30.1	34.1	34.8
	5	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	32.3
	Mean	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	40.6
Large-mouth Bass	6	16.7	0.1	17.1	4.8	2.4	8.0	17.5	15.4	12.4	1.1	4.4			9.7
	1	9.9	0.0	9.0	2.9	1.4	7.7	10.8	10.7	9.1	0.5	2.5	3.8	10.0	6.3
	2	7.3	0.0	6.3	2.5	0.3	7.2	6.9	8.7	5.4	0.5	1.8	2.7	8.3	4.7
	3	4.8	0.0	0.1	1.2	0.3	5.8	3.7	4.2	3.6	0.2	0.5	1.4	6.5	2.7
	4	3.1	0.0	0.0	0.7	0.2	5.7	1.1	3.3		0.2	0.2	0.4	5.4	1.8
	5	3.7	0.0	0.0	0.5	0.0	5.1	1.5	2.6	2.1	0.1	0.2	0.1	4.7	1.7
	Mean	7.6	0.0	5.4	2.1	0.8	6.6	6.9	7.5	6.5	0.4	1.6	1.7	7.0	4.4
Pumpkinseed	6	28.6	3.4	33.6	9.8	5.4	10.0	30.1	22.1	21.0	3.6	9.4			17.1
	1	21.9	0.7	20.8	6.3	3.9	9.7	21.6	18.9	18.2	2.7	5.6	8.1	18.1	12.7
	2	19.2	0.1	16.7	5.2	2.2	8.7	14.9	16.0	14.2	2.3	5.9	8.0	14.0	10.5
	3	8.4	0.0	5.5	2.9	2.1	8.2	9.0	10.2	9.7	0.7	2.2	3.1	9.8	5.7
	4	6.3	0.0	4.3	2.1	2.0	8.2	5.3	7.7		0.9	2.5	2.4	9.1	4.4
	5	6.9	0.0	2.4	1.6	1.6	7.8	5.7	6.3	5.5	0.6	1.0	0.8	6.8	3.9
	Mean	15.2	0.7	13.9	4.7	2.9	8.8	14.4	13.5	13.7	1.8	4.4	4.5	11.6	8.9
Rainbow Darter	6	15.7	33.4	10.6	32.7	32.2	31.0	12.9	25.4	23.7	52.3	31.5			26.4
	1	18.5	39.1	14.4	37.8	38.4	34.7	15.9	28.1	25.6	60.5	37.5	29.1	29.4	30.5
	2	19.4	41.4	16.3	41.7	49.7	38.2	21.0	32.5	28.8	57.5	36.8	31.4	31.9	33.3
	3	25.6	49.7	23.9	47.1	49.9	43.6	27.9	38.4	33.7	62.3	45.2	42.5	42.7	39.9
	4	28.4	51.6	28.0	50.1	51.5	43.3	31.9	41.1		62.2	43.7	46.5	46.8	42.6
	5	29.6	53.9	31.3	52.1	55.6	45.7	35.6	42.9	37.4	63.2	49.0	54.7	52.3	45.2

	Mean	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	36.5
Rock Bass	6	60.4	44.9	66.8	43.9	42.1	40.5	57.4	47.9	53.6	23.3	45.2			48.9
	1	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	46.6
	2	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	43.9
	3	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	37.6
	4	50.1	23.1	53.1	27.8	23.3	30.0	43.5	38.6		16.2	32.1	30.1	34.1	34.8
	5	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	32.3
	Mean	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	40.6
White Sucker	6	50.5	69.2	51.1	59.1	69.0	57.1	52.3	54.7	56.2	43.5	59.9			56.1
	1	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	58.2
	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	57.8
	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	57.3
	4	68.1	57.4	67.7	51.3	57.2	50.0	62.7	57.0		33.6	54.8	54.0	49.7	56.3
	5	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	54.4
	Mean	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	56.7

Percent of temperature measurements that exceed the ultimate upper incipient lethal temperature (%>UILT)															
		Year													
Species	Station	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	Mean
Black-nose Dace	6	3.3	0.0	0.6	1.0	0.0	4.7	2.2	4.3	2.0	0.0	0.0			1.8
	1	1.9	0.0	0.0	0.4	0.0	3.8	0.3	2.3	1.5	0.0	0.0	0.0	2.0	1.0
	2	1.6	0.0	0.0	0.2	0.0	2.8	0.0	1.4	1.0	0.0	0.0	0.0	1.6	0.7
	3	0.5	0.0	0.0	0.0	0.0	1.9	0.0	0.3	0.6	0.0	0.0	0.0	1.1	0.4
	4	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0		0.0	0.0	0.0	0.8	0.2
	5	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.2
	Mean	1.2	0.0	0.1	0.3	0.0	2.8	0.4	1.4	1.0	0.0	0.0	0.0	1.2	0.7
Blunt-nose Minnow	6	0.0	0.0	0.0	0.0	0.0	0.2	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
	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
	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
	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
	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
	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
Brook Trout	6	43.4	10.6	49.4	17.8	9.9	18.4	42.0	33.6	33.7	7.9	17.7			27.3
	1	35.5	5.9	37.5	13.6	7.1	15.9	34.5	27.7	29.1	4.9	11.6	17.1	25.4	21.5
	2	32.4	3.4	32.2	10.8	5.0	13.9	26.3	24.4	23.7	3.5	11.2	15.5	23.7	18.5
	3	20.6	1.2	16.1	7.3	4.8	11.5	17.8	17.1	19.3	3.1	7.2	9.8	17.8	12.4
	4	14.6	0.4	13.8	5.1	4.5	11.5	12.4	13.1		3.4	7.0	6.8	15.4	9.4
	5	15.7	0.1	11.0	4.1	3.9	10.5	11.2	13.3	13.0	2.9	5.3	4.5	13.3	8.9
		27.0	3.6	26.7	9.8	5.9	13.6	24.0	21.5	23.8	4.3	10.0	10.7	19.1	16.2
Brown Trout	6	41.7	9.2	47.4	16.7	9.1	17.7	40.6	32.0	31.7	7.0	15.6			25.9
	1	33.6	5.3	35.5	12.9	6.5	15.4	32.9	26.6	27.5	4.9	11.6	17.1	25.4	20.6
	2	31.1	2.8	30.7	9.7	4.6	13.1	24.7	23.6	22.5	3.5	10.0	13.9	21.6	17.4
	3	18.8	0.8	14.4	6.4	4.4	11.2	16.5	16.3	18.4	2.2	5.3	7.0	14.8	11.1
	4	13.2	0.2	12.5	4.5	4.3	11.3	11.0	12.4		2.9	6.0	5.6	14.2	8.6
	5	14.2	0.0	9.8	3.7	3.4	10.1	10.3	12.5	12.1	2.8	4.8	4.5	13.3	8.3

	Mean	25.4	3.1	25.1	9.0	5.4	13.1	22.7	20.6	22.4	3.9	8.9	9.6	17.9	15.1
Common Shiner	6	0.2	0.0	0.0	0.0	0.0	1.3	0.0	0.2	0.5	0.0	0.0			0.2
	1	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1
	2	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
	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
	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
	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
	Mean	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0
Creek Chub	6	2.3	0.0	0.0	0.6	0.0	3.6	0.6	2.9	1.5	0.0	0.0			1.2
	1	1.2	0.0	0.0	0.0	0.0	2.5	0.2	1.2	0.9	0.0	0.0	0.0	1.0	0.6
	2	0.6	0.0	0.0	0.0	0.0	2.0	0.0	0.4	0.4	0.0	0.0	0.0	0.9	0.4
	3	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.1	0.0	0.0	0.0	0.7	0.1
	4	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0		0.0	0.0	0.0	0.4	0.1
	5	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean	0.7	0.0	0.0	0.1	0.0	1.9	0.1	0.8	0.6	0.0	0.0	0.0	0.6	0.4
Large-mouth 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
	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
	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
	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
	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
	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
	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
Pumpkin-seed	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
	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
	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
	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
	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
	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
	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
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
	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
	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
	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
	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
	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

	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
White Sucker	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	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	2.1
	2	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	1.6
	3	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	0.9
	4	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	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	0.6
	Mean	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	1.5

Percent of temperature measurements that exceed the critical thermal maximum temperature (%>Ctmax)															
		Year													
Species	Station	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	Mean
Black-nose Dace	6	0.4	0.0	0.0	0.0	0.0	1.7	0.1	0.3	0.7	0.0	0.0			0.3
	1	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.1
	2	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
	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
	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
	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
	Mean	0.1	0.0	0.0	0.0	0.0	0.5	0.0	0.1	0.2	0.0	0.0	0.0	0.1	0.1
Blunt-nose Minnow	6	0.8	0.0	0.0	0.0	0.0	2.1	0.2	0.9	0.8	0.0	0.0			0.5
	1	0.1	0.0	0.0	0.0	0.0	1.3	0.0	0.2	0.4	0.0	0.0	0.0	0.5	0.2
	2	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1
	3	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
	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
	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
	Mean	0.2	0.0	0.0	0.0	0.0	0.7	0.0	0.2	0.2	0.0	0.0	0.0	0.2	0.1
Brook Trout	6	2.0	0.0	0.0	0.4	0.0	3.3	0.4	2.3	1.3	0.0	0.0			1.0
	1	0.8	0.0	0.0	0.0	0.0	2.2	0.2	0.6	0.9	0.0	0.0	0.0	1.0	0.5
	2	0.4	0.0	0.0	0.0	0.0	1.7	0.0	0.4	0.4	0.0	0.0	0.0	0.8	0.3
	3	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1
	4	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0		0.0	0.0	0.0	0.1	0.1
	5	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
	Mean	0.5	0.0	0.0	0.1	0.0	1.6	0.1	0.6	0.5	0.0	0.0	0.0	0.4	0.3
Brown Trout	6	4.0	0.0	1.8	1.3	0.0	5.0	3.8	5.2	2.6	0.0	0.0			2.3
	1	2.5	0.0	0.0	0.6	0.0	4.4	1.2	3.1	1.8	0.0	0.0	0.0	3.1	1.4
	2	2.0	0.0	0.0	0.5	0.0	3.7	0.2	2.2	1.4	0.0	0.0	0.0	2.2	1.0
	3	1.0	0.0	0.0	0.0	0.0	2.5	0.0	0.4	0.8	0.0	0.0	0.0	1.1	0.5
	4	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.3		0.0	0.0	0.0	1.2	0.3
	5	0.4	0.0	0.0	0.0	0.0	2.0	0.0	0.1	0.2	0.0	0.0	0.0	1.0	0.3

	Mean	1.7	0.0	0.3	0.4	0.0	3.3	0.9	1.9	1.4	0.0	0.0	0.0	1.7	0.9
Common Shiner	6	0.0	0.0	0.0	0.0	0.0	0.4	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
	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
	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
	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
	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
	Mean	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
Creek Chub	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
	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
	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
	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
	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
	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
	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
Large-mouth 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
	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
	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
	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
	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
	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
	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
Pumpkin-seed	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
	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
	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
	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
	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
	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
	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
Rainbow Darter	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
	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
	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
	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
	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
	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

	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
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
	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
	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
	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
	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
	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
	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
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
	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
	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
	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
	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
	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
	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

APPENDIX H

Biological Monitoring

BEACON ENVIRONMENTAL

GUIDING SOLUTIONS IN THE NATURAL ENVIRONMENT

2018 Biological Monitoring Program
Nestlé Waters Canada
Aberfoyle Property

Prepared For:

Nestlé Waters Canada

Prepared By:

Beacon Environmental Limited
C. Portt and Associates

Date: **February, 2019**

Project: **216114**

MARKHAM
80 Main Street North
Markham, ON L3P 1X5
T)905.201.7622 ❖ F)905.201.0639

BRACEBRIDGE
126 Kimberley Avenue
Bracebridge, ON P1L 1Z9
T)705.645.1050

GUELPH
373 Woolwich Street
Guelph, ON N1H 3W4
T)519.826.0419

PETERBOROUGH
305 Reid Street
Peterborough, ON K9J 3R2
T) 705.243.7251

Table of Contents

page

1. Introduction 1
2. Methods 3
   - 2.1 Aquatic Survey 3
   - 2.2 Amphibian Surveys 3
   - 2.3 Breeding Bird Surveys 4
   - 2.4 Basking Turtle Survey 5
   - 2.5 Other Wildlife Observations 6
3. Results 6
   - 3.1 Aquatic Survey 6
   - 3.2 Breeding Amphibians 6
   - 3.3 Breeding Birds 7
   - 3.4 Basking Turtle Survey 9
   - 3.5 Other Wildlife Species Observations 9
4. Conclusion and Recommendations 10
5. References 12

Figures

Figure 1. Site Location ..... after page 2
Figure 2. Biological Monitoring Locations ..... after page 4
Figure 3. Nocturnal Amphibian Call Survey Locations (2018) ..... after page 6

Tables

Table 1. Summary of Biological Monitoring Program (2007-2018) 2
Table 2. Amphibian Survey Details 4
Table 3. Breeding Bird Survey Details 5
Table 4. Basking Turtle Survey Details 5
Table 5. Breeding Amphibian Survey Results 7
Table 6. Breeding Bird Monitoring Results (2008-2018) 7
Table 7. Basking Turtle Survey Results 9

Appendices

A. Breeding Bird Checklist
B. Breeding Bird Field Notes

1. Introduction

Beacon Environmental Limited (Beacon) and C. Portt and Associates were retained by Nestlé Waters Canada (NWC) 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**). 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 (#1381-95ATPY).

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 MOECP 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 2018, biological monitoring has included the following:

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

A summary of all biological monitoring activities completed on the property between 2007 and 2018 is presented in **Table 1**.

Table 1. Summary of Biological Monitoring Program (2007-2018)

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	

The 2017 Aberfoyle Biological Monitoring Program Report (Beacon 2018) recommended that the following biological monitoring be undertaken on the property in 2018:

1. Salmonid spawning (redd) surveys in Aberfoyle Creek; and
2. Core wildlife monitoring (amphibian, reptiles and birds).

All of the recommended biological monitoring activities listed above were completed in 2018 and are discussed in this report. C. Portt and Associates was responsible for completing aquatic monitoring, consisting of salmonid spawning (redd) surveys. Beacon was responsible for the terrestrial monitoring which included wildlife monitoring.

This report summarizes the methods and findings of the 2018 biological monitoring program and compares and contrasts the data with previous years to identify changes or trends in selected monitoring parameter or indicators over the long term.

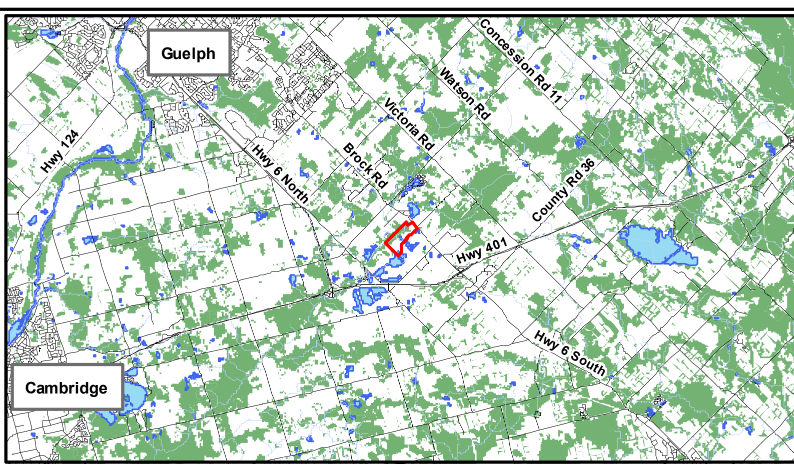


Figure 1 **Site Location**

Aberfoyle 2018 Biological Monitoring Program

Client: Nestlé Waters Canada

First Base Solutions
Web Mapping Service 2010

UTM Zone 17 N, NAD 83

0 350 700 1,400 Metres

1:40,000

N W E S

BEACON ENVIRONMENTAL

Project 216114
December, 2018

2. Methods

2.1 Aquatic Survey

C. Portt and Associates 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 Nestlé property (**Figure 2**), on October 25, 2018, and November 12, 2018. On these dates, this entire reach of the creek was walked and searched for areas of disturbed substrate that could be indicative of salmonid spawning.

2.2 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.

Call surveys were performed on April 30th, May 16th, and June 26th, 2018 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 ½ hour 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 2**. 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; and
- 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 2018 surveys are summarized in **Table 2**.

Table 2. Amphibian Survey Details

	Survey 1	Survey 2	Survey 3
Date:	April 30, 2018	May 16, 2018	June 26, 2018
Start time:	21:48	22:08	22:31
Temperature (°C):	11 °C	16 °C	17-18 °C
Wind speed (km/h):	1-11 km/h	0-5	6-11 km/h
Cloud cover (%):	<5%	5%	100%
Precipitation	None	None	None

2.3 Breeding Bird Surveys

Breeding bird surveys were undertaken in 2018 by Beacon to document the diversity and abundance of avian populations associated with the subject property. Previous surveys were completed in 2008, 2009, 2010, 2011, 2015, 2016 and 2017. 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 2**. 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 approached 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 Nestlé Waters Canada property in Aberfoyle is relatively small, a randomized site selection approach will not be required. The majority of natural features are covered by the 5- point count station survey areas.
- Survey duration for each point count will be 10 minutes, consistent with the Forest Bird Monitoring Program (CWS 2006) and Howe *et al.* (1997) and will not be restricted to forested habitats.
- The location of each individual adult bird will be 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 will be transferred into a summary table. All birds observed or heard within suitable habitat were assumed to be breeding.
- Breeding evidence is to be documented according to the Ontario Breeding Bird Atlas protocols (Cadman *et al.* 2007).

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

Figure 2

Monitoring Station and Survey Locations

Aberfoyle 2018 Biological Monitoring Program

Legend

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

Client: Nestlé Waters Canada

First Base Solutions Web Mapping Service 2010

UTM Zone 17 N, NAD 83

N W E S

0 50 100 200 Metres

1:5,000

BEACON ENVIRONMENTAL

Project 216114
January, 2019

Weather conditions (i.e., air temperature, precipitation, wind speed, and cloud cover) at the time of survey were recorded (see **Table 3**).

Table 3. Breeding Bird Survey Details

	Survey 1	Survey 2
Date:	June 8, 2018	June 21, 2018
Start time:	7:00	5:50
End Time:	9:30	7:15
Temp (º C):	14 °C	16 °C
Wind (km/h):	0-5 km/h	1-11 km/h
Cloud cover (%):	10%	0%
Precipitation	None	None

2.4 Basking Turtle Survey

The subject property is 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 2**. Surveys were completed in 2010, 2015, 2016 and 2017 to determine the level of use of this habitat by Snapping Turtle. No Snapping Turtles were observed in 2010. One Snapping Turtle was observed on two separate occasions in 2015. In 2016, four Snapping Turtles were seen in May, and one was seen in June. Snapping Turtle was observed three times over the course of the 2017 monitoring program. Once during basking turtle surveys and twice during the completion of other surveys.

Basking turtle surveys on the property focus on Pond 1. The surveys consist of slowly travelling along the outer edge of the pond using binoculars to scan its perimeter and other potential basking sites within the pond. Surveys were completed between 8:00 am and 5:00 pm during sunny periods when the air temperature was greater than water temperature and after inclement weather. Brief surveys of the other ponds on the subject property were also completed at the time of this survey. Details of these surveys, including weather conditions, are included in **Table 4.**

Table 4. Basking Turtle Survey Details

	Survey 1	Survey 2	Survey 3
Date:	May 1, 2018	June 5, 2018	Sept.13, 2018
Start time:	10:30	15:00	14:45
End time:	11:30	16:00	15:45
Temp (º C):	20 °C	15 °C	23 °C
Wind (km/h):	1-11 km/h	1-5 km/h	6-11 km/h
Cloud cover (%):	25-50%	90%	40%
Precipitation	None	None	None

2.5 Other Wildlife Observations

Other wildlife and habitat structures encountered over the course of the 2018 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 between the confluence of the Aberfoyle Branch and the upstream limit of the Nestlé property in 2018. This is consistent with the 2007 – 2017 results for this reach of Aberfoyle Creek.

3.2 Breeding Amphibians

A total of three frog and one toad species were recorded on the subject property during the 2018 nocturnal amphibian call surveys. These species included American Toad (*Anaxyrus americanus*), Gray Tree Frog (*Hyla versicolor*), Green Frog (*Rana clamitans*) and Spring Peeper (Pseudacris crucifer).

The primary amphibian breeding areas on the property are: Pond 1 at west end of the property and the group of three small ponds/shallow aquatic features ("fire ponds") located just west of the parking lot. The general locations of calling frogs are illustrated in **Figure 3**.

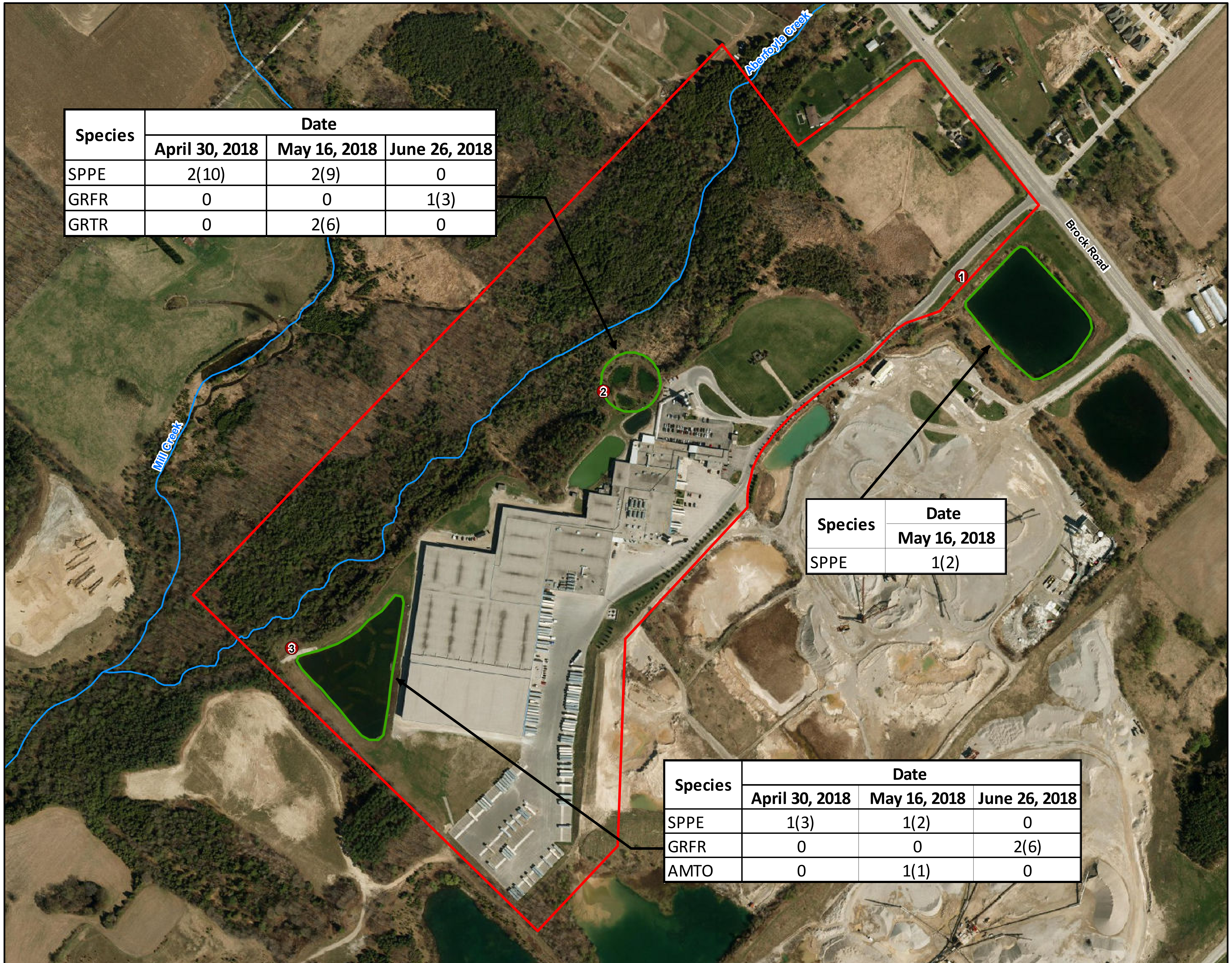
The findings of the amphibian breeding surveys are summarized in **Table 5**. The 2018 amphibian breeding surveys are generally comparable to those of previous years (2008-2011 and 2015-2017). Spring Peeper, Gray Tree Frog, and Green Frog have been observed each year monitoring has been completed. Wood Frog, previously heard only in 2008, was detected again in 2015 and 2017, but not in 2018. Northern Leopard Frog (*Lithobates pipiens*) was observed incidentally on the property in 2010, 2016 and 2018 and was documented calling during the nocturnal amphibian surveys at Pond 1 in 2017. American Bullfrog (*Lithobates catesbeianus*), was heard calling during the third 2017 breeding survey within the pond just east of the property, and incidental observations were recorded in 2015 and 2018.

Amphibians observed during other field surveys included: Green Frog, American Toad, Northern Leopard Frog, American Bullfrog and amphibian egg masses.

Differences in the results of these surveys from year to year are minor and can be attributed to daily and annual species variations that can likely be associated with seasonal temperature variations.

Figure 3 Nocturnal Amphibian Call Survey Locations

Aberfoyle 2018 Biological Monitoring Program



Species	Date		
	April 30, 2018	May 16, 2018	June 26, 2018
SPPE	2(10)	2(9)	0
GRFR	0	0	1(3)
GRTR	0	2(6)	0

Species	Date
	May 16, 2018
SPPE	1(2)

Species	Date		
	April 30, 2018	May 16, 2018	June 26, 2018
SPPE	1(3)	1(2)	0
GRFR	0	0	2(6)
AMTO	0	1(1)	0

Legend

- Subject Property
- Nocturnal Amphibian Call Survey Observations
- Amphibian Call Monitoring Station
- Watercourse

Species Codes:
WOFR - Wood Frog
SPPE - Spring Peeper
GRTR - Grey Treefrog
GRFR - Green Frog
AMTO - American Toad
BULL - Bull Frog
NLFR - Northern Leopard Frog

Abundance Codes:
- First number is is Call Level Code.
- Second number (in brackets) is number of individuals recorded.

Call Level Codes:
1 - Calls not simultaneous, number of individuals can be accurately counted.
2 - Some calls simultaneous, number of individuals can be reliably estimated.
3 - Full chorus, call continuously overlapping, number of individuals cannot be reliably estimated.

Client: Nestle Waters Canada

First Base Solutions
Web Mapping Service 2010

UTM Zone 17 N, NAD 83

N W E S

0 50 100 200 Metres

1:5,000

BEACON ENVIRONMENTAL

Project 216114
December, 2018

C:\Dropbox\Dropbox (Beacon)\All GIS Projects\2016\216114\MXD\Aberfoyle\Report Figures\2018 PTTW Report\216114_Fig3NestleAberfoyleAmphibianLocations_2018-12-18.mxd

Table 5. Breeding Amphibian Survey Results

Location (Figure 2)	Round 1 (April 30, 2018)	Round 2 (May 16, 2018)	Round 3 (June 26, 2018)
1	SPPE - 1(3) (Offsite)	SPPE - 1(2) GRTR - 2(3) (Offsite)	0
2	SPPE - 2(10)	SPPE - 2(9) GRTR - 2(6)	GRFR - 1(3)
3	SPPE - 1(3)	AMTO - 1(1) SPPE - 1(2) GRTR (Offsite)	GRFR - 2(6)

SPPE = Spring Peeper, GRTR = Gray Tree Frog, GRFR = Green Frog, AMTO = American Toad
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.

3.3 Breeding Birds

A total of 39 species of birds (**Appendix A**) were documented on and directly adjacent to the subject property in 2018. Of the 39 species documented, 32 exhibited evidence of breeding and are considered to be breeding on the subject property. These numbers, which are similar those obtained from 2008 (40 total / 34 breeding) and 2015 (39 total / 33 breeding) breeding bird surveys, are at the lower end of the range of birds that have been recorded / recorded as breeding on the property since the implementation of the wildlife monitoring program in 2008. A detailed comparison of number of birds recorded each year on and directly adjacent to he subject property is shown in **Table 6**.

Table 6. Breeding Bird Monitoring Results (2008-2018)

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

The lower number of total birds is due to a decrease in incidental observations of migrating waterfowl and foraging swallow species from what was observed in previous years. 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. In addition to this construction near point count stations 4 during the surveys made it difficult to hear birds calling from at or beyond the outer edge of the point count station.

In 2018, species that were observed flying or foraging over the property, or observed during migration and not considered to be breeding on the property, included: Common Loon (*Gavia immer*), Double-crested Cormorant (*Phalacrocorax auritus*), Great Blue Heron (*Ardea Herodias*), Osprey (*Pandion haliaetus*), Red-tailed Hawk (*Buteo jamaicensis*), Ring-billed Gull (*Larus delawarensis*), Ruby-crowned Kinglet (*Regulus calendula*) and Bank Swallow (*Riparia riparia*). These species were either observed flying overhead or were using the property to forage (e.g. swallow species).

Of the 32 species that exhibited breeding evidence, there is one species that has conservation status. 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). No other breeding species are designated as Special Concern, Threatened or Endangered. All have a conservation rank of S5 (Secure) or S4 (Apparently Secure) (NHIC 2019).

Four of the 32 bird species that displayed some level of breeding evidence on the property are considered to be “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). Species include:

1. Eastern Wood-Pewee;
2. Eastern Kingbird (*Tyrannus tyrannus);*
3. Black-and-white Warbler (*Mniotilta varia*); and
4. Baltimore Oriole (*Icterus galbula*).

One Eastern Wood-Pewee was incidentally noted during breeding bird surveys in the forest west of the subject property. One Eastern Kingbird was recorded near breeding bird monitoring station 3. Three Black-and-white Warblers were noted during breeding bird surveys at station 2 and 3. Three Baltimore Orioles were noted incidentally at station 5.

Five of the 32 breeding bird species are considered significant in Wellington County (D&A 2008). These species included:

1. Eastern Wood-Pewee;
2. Eastern Kingbird;
3. Black-and-white Warbler;
4. American Redstart (*Setophaga ruticilla*); and
5. Baltimore Oriole.

Three American Redstarts were documented on the property at breeding bird monitoring stations 1 and 4.

Three of the 32 breeding bird species observed in 2018 are considered area-sensitive. These species included:

1. White-breasted Nuthatch (*Sitta carolinensis*);
2. Black-and-white Warbler; and
3. American Redstart.

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. Both species are associated with the forested habitats on the site.

The results of the breeding bird surveys in 2018 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 minor variations in survey techniques, daily and annual species variations.

3.4 Basking Turtle Survey

The results of the basking turtle surveys are shown below in **Table 7**.

Table 7. Basking Turtle Survey Results

	Survey 1 (May 1, 2018)		Survey 2 (June 5, 2018)		Survey 3 (Sept 13, 2018)	
	Pond 1	*Pond 2*	*Pond 1*	*Pond 2*	*Pond 1*	*Pond 2*
Midland Painted Turtle	13	0	10	0	7	0
Snapping Turtle	0	0	0	1	0	0

The majority of the turtles that were observed on the subject property were Midland Painted Turtle, all of which were observed in Pond 1 (**Figure 2**). This species is not considered significant at the local (Dougan & Associates 2009), regional (Plourde et al. 1989), or provincial (NHIC 2018) 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 has not created a schedule yet for Midland Painted Turtle.

Snapping Turtle was observed once over the course of the 2018 monitoring program during basking turtle surveys on June 5, 2018. It was seen swimming near the surface in Pond 2 near the central, northern section of the subject property. This is typical basking behaviour for Snapping Turtles, which typically only leave the water to migrate between suitable habitats or to lay their eggs. An area of predated Snapping Turtle nests was located during basking turtle surveys in 2018 adjacent this pond. Staff at Nestlé had stated they often saw Snapping Turtles within the areas of these predated nests. On June 21, 2018, another Snapping Turtle nest was located closer to Pond 1.

3.5 Other Wildlife Species Observations

Other wildlife that were recorded on the subject property, during the 2018 field season included:

- Coyote - (*Canis latrans*);
- Eastern Cottontail - (*Sylvilagus floridanus*);
- Eastern Gartersnake (*Thamnophis sirtalis*):
- Eastern Brown Snake (*Pseudonaja textilis*);
- Largemouth Bass (*Micropterus salmoides*); and
- Racoon (*Procyon lotor*).

The Coyote, Eastern Cottontail, Eastern Gartersnake and Eastern Brown Snake were noted incidentally on the subject property during basking turtle surveys on May 1, 2018. The Racoon was an incidental observation during breeding bird surveys on June 8, 2018. It was located near breeding bird monitoring station 3.

Largemouth Bass was noted within Pond 2 that is located centrally north on the subject property during the basking turtle survey on September 13, 2018.

4. Conclusion and Recommendations

The 2018 annual monitoring report describes the methods and summarizes the findings of aquatic and terrestrial monitoring completed during the 2018 season at Nestlé Waters Canada's property in Aberfoyle. Monitoring completed in 2018 included salmonid spawning (redd) surveys in Aberfoyle Creek, nocturnal amphibian surveys, breeding bird surveys, and basking turtle surveys.

Consistent with the recommended aquatic monitoring program, salmonid spawning surveys were completed along Aberfoyle Creek in 2018 by C. Portt and Associates. The 2018 results are consistent with the 2007 – 2017 outcomes for this reach of Aberfoyle Creek.

Three nocturnal amphibian surveys were conducted in 2018. Four species were recorded on the subject property during the amphibian monitoring, including American Toad, Spring Peeper, Gray Tree Frog, and Green Frog. Green Frog, American Toad, Northern Leopard Frog and American Bullfrog were also observed during basking turtle surveys. The results are consistent with previous surveys.

Two breeding bird surveys were completed in 2018. Thirty-nine species of birds were recorded, 32 of which were breeding on the property. These numbers, which are similar those obtained from 2008 (40 total / 34 breeding) and 2015 (39 total / 33 breeding) breeding bird surveys, are at the lower end of the range of birds that have been recorded / recorded as breeding on the property since the implementation of the wildlife monitoring program in 2008. The variation in the number of bird species documented on the subject property from year to year is not considered to be significant.

Three basking surveys for turtles were completed in 2018. Two species, Painted Turtle and Snapping Turtle were recorded. Thirteen (13) Midland Painted Turtles were observed in the Pond 1 during the first spring survey. One Snapping Turtle was observed on the property in 2018 within Pond 2 located north/central on the subject property. The number of Midland Painted Turtles observed in the pond was lower than the number observed during the 2017 survey (25 Painted Turtles observed during a single visit) but was higher than what was recorded during the 2010 monitoring (5 Painted Turtle observed during a single visit). The number of Snapping Turtles observed was lower than 2016 and 2017 (4 and 3 Snapping Turtles, respectively), but was similar to the number observed in 2008 and 2015 (1 Snapping Turtle observed). The variation in the number of turtles documented on the subject property from year to year is not considered to be significant.

In summary, the results of the biological monitoring at the Aberfoyle property to date indicate that there have not been any significant changes to the terrestrial and aquatic monitoring parameters that would suggest altered hydrology. The 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.

Based on findings of the 2018 biological monitoring program, we recommend that the following monitoring activities be completed in 2019:

1. Salmonid spawning surveys in Aberfoyle Creek (C. Portt and Associates);
2. Core wildlife monitoring (amphibian, reptiles and birds);
3. Vegetation Plot Sampling; and
4. Flora survey and Ecological Land Classification (ELC) review/update.

Prepared by:
Beacon Environmental

Anna Corrigan, B.Sc.(Hons)
Ecologist

Prepared by:
Beacon Environmental

Rob Aitken, B.Sc.
Ecologist

Reviewed by:
Beacon Environmental

Ken Ursic
Senior Ecologist

Reviewed by:
Beacon Environmental

Dan Westerhof, B.Sc., MES
Terrestrial Ecologist,
Certified Arborist (ON-1536A)

5. References

Beacon Environmental. 2018.
2017 Biological Monitoring Program Nestlé Waters Canada Aberfoyle Property. 38 pp.

Bird Studies Canada, 2009.
Marsh Monitoring Program Participant's Handbook for Surveying Amphibians. 2009 Edition. 13 pages. Published by Bird Studies Canada in cooperation with Environment Canada and the U.S. Environment Protection Agency. February 2009.

Cadman, M.D., D.A. Sutherland, G.G. Beck, D. Lepage, and A.R. Couturier (eds.) 2007.
Atlas of the Breeding Birds of Ontario, 2001 – 2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologist, Ontario Ministry of Natural Resources, and Ontario Nature, Toronto. Xxii + 706 pp.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2018.
Canadian Wildlife Species at Risk. Committee on the Status of Endangered Wildlife in Canada. Web Site: https://wildlife-species.canada.ca/species-risk-registry/sar/index/default_e.cfm [Accessed November 2018]

Dougan & Associates. 2009.
Guelph Natural Heritage Strategy. Phase 2: Terrestrial Inventory & Natural Heritage System Updates. Volume 2 – Appendices.

Canadian Wildlife Services. 2006.
Forest Bird Monitoring Program: Site Set-up and Bird Survey Instructions. 6p.

Howe, R.W., G.J. Niemi, S.J. Lewis, and D.A. Welsh. 1997.
A standard method for monitoring songbird populations in the Great Lakes Region. The Passenger Pigeon 59(3): 189-194.

NHIC. 2018.
Natural Heritage Reference Center. Available at: https://www.ontario.ca/page/natural-heritage-information-centre [Accessed November 2018]

Oldham, M.J. and S.R. Brinker, S.R. 2009.
Rare Vascular Plants of Ontario. Fourth Edition. Natural Heritage information Centre, Ontario Ministry of Natural Resources, Peterborough, Ontario. 188 pages.

Ontario Ministry of Natural Resources. 2000. Significant Wildlife Habitat Technical Guide. 151 pp.

Ontario Partners in Flight. 2008.
Ontario Land Bird Conservation Plan: Lower Great Lakes / St. Lawrence Plain, North American Bird Conservation Region 13. Ontario Ministry of Natural Resources, Bird Studies Canada, Environment Canada. Final Draft, June 2008.

Plourde, S.A., E.L. Szepesi, J.L. Riley, M.J. Oldham and C. Campbell. 1989. Distribution and Status of the Herpetofauna of Central Region, Ontario Ministry of Natural Resources and Recreational Areas Section, OMNR, Open File Ecological Report SR8903, Central Region, Richmond Hill, Ontario. 27 pp.

Appendix A

Breeding Bird Checklist

Appendix A

Breeding Bird Checklist

Common Name	Scientific Name	Status					May 1, 2018 Incidentals	June 5, 2018 Incidentals	June 8, 2018						June 21, 2018					
		National Species at Risk COSEWIC[a]	Species at Risk in Ontario Listing [b]	Provincial breeding season SRANK[c]	Wellington Regional Status[d]	Area-sensitive (OMNR)[e]			PCS #1	PCS #2	PCS #3	PCS #4	PCS #5	Incidentals	PCS #1	PCS #2	PCS #3	PCS #4	PCS #5	Incidentals
Common Loon	*Gavia immer*			S5		A											F			
Double-crested Cormorant	*Phalacrocorax auritus*			S5					F											
Great Blue Heron	*Ardea herodias*			S4	S,R															F
Canada Goose	*Branta canadensis*			S5			1													
Mallard	*Anas platyrhynchos*			S5																F
Osprey	*Pandion haliaetus*			S5	S,R															F
Red-tailed Hawk	*Buteo jamaicensis*			S5										F						
Killdeer	*Charadrius vociferus*			S5							1	F	1	F						F
Ring-billed Gull	*Larus delawarensis*			S5	S,R		x						F							
Rock Pigeon	*Columba livia*			SNA											F					
Downy Woodpecker	*Picoides pubescens*			S5			1													
Eastern Wood-Pewee	*Contopus virens*	SC	SC	S4	S									1						
Great Crested Flycatcher	*Myiarchus crinitus*			S4							1								1	
Eastern Kingbird	*Tyrannus tyrannus*			S4	S															1
Bank Swallow	*Riparia riparia*	THR	THR	S4	S									F						F
Blue Jay	*Cyanocitta cristata*			S5					1		1		1				1	1	1	
American Crow	*Corvus brachyrhynchos*			S5			x		1	F					1	1				
Black-capped Chickadee	*Poecile atricapillus*			S5			x			1				1		1	2	1		
White-breasted Nuthatch	*Sitta carolinensis*			S5		A		x			1		1							
Ruby-crowned Kinglet	*Regulus calendula*			S4	S,R		x													
American Robin	*Turdus migratorius*			S5			x	x	1		1	1			1		1	2		
Gray Catbird	*Dumetella carolinensis*			S4					1		1									
Cedar Waxwing	*Bombycilla cedrorum*			S5					F		1		1		1					
European Starling	*Sturnus vulgaris*			SE			x							2	F			F		
Red-eyed Vireo	*Vireo olivaceus*			S5							1		1							
Yellow Warbler	*Setophaga petechia*			S5			x		3					1	2	1				
Black-and-white Warbler	*Mniotilta varia*			S5	S	A				1						1	1			
American Redstart	*Setophaga ruticilla*			S5	S	A			1						1			1		
Northern Waterthrush	*Parkesia noveboracensis*			S5			x										1	1	1	
Common Yellowthroat	*Geothlyphis trichas*			S5					1	1			1		3	2	2		1	
Northern Cardinal	*Cardinalis cardinalis*			S5			x			1				1			1	1		1
Chipping Sparrow	*Spizella passerina*			S5			1													
Song Sparrow	*Melospiza melodia*			S5			x		1				1		3	1		1	1	
Swamp Sparrow	*Melospiza georgiana*			S5							1	1	1							
Red-winged Blackbird	*Agelaius phoeniceus*			S4			x	x	6	1	2	1	1		4	1	1		2	
Brown-headed Cowbird	*Molothrus ater*			S4			x		1	1			1						1	1
Baltimore Oriole	*Icterus galbula*			S4	S			x						1					1	

Common Name	Scientific Name	Status					May 1, 2018 Incidentals	June 5, 2018 Incidentals	June 8, 2018						June 21, 2018					
		National Species at Risk COSEWIC[a]	Species at Risk in Ontario Listing [b]	Provincial breeding season SRANK[c]	Wellington Regional Status[d]	Area-sensitive (OMNR)[e]			PCS #1	PCS #2	PCS #3	PCS #4	PCS #5	Incidentals	PCS #1	PCS #2	PCS #3	PCS #4	PCS #5	Incidentals
House Finch	*Haemorhous mexicanus*			SNA			1													
American Goldfinch	*Spinus tristis*			S5					2	1	1				1	1	1	1	1	

KEY

a - COSEWIC = Committee on the Status of Endangered Wildlife in Canada

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)

e - 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.

d - Ontario Ministry of Natural Resources (OMNR). 2000. Significant Wildlife Habitat Technical Guide (Appendix G). 151 p plus appendices.

Beacon Breeding Status classifications:

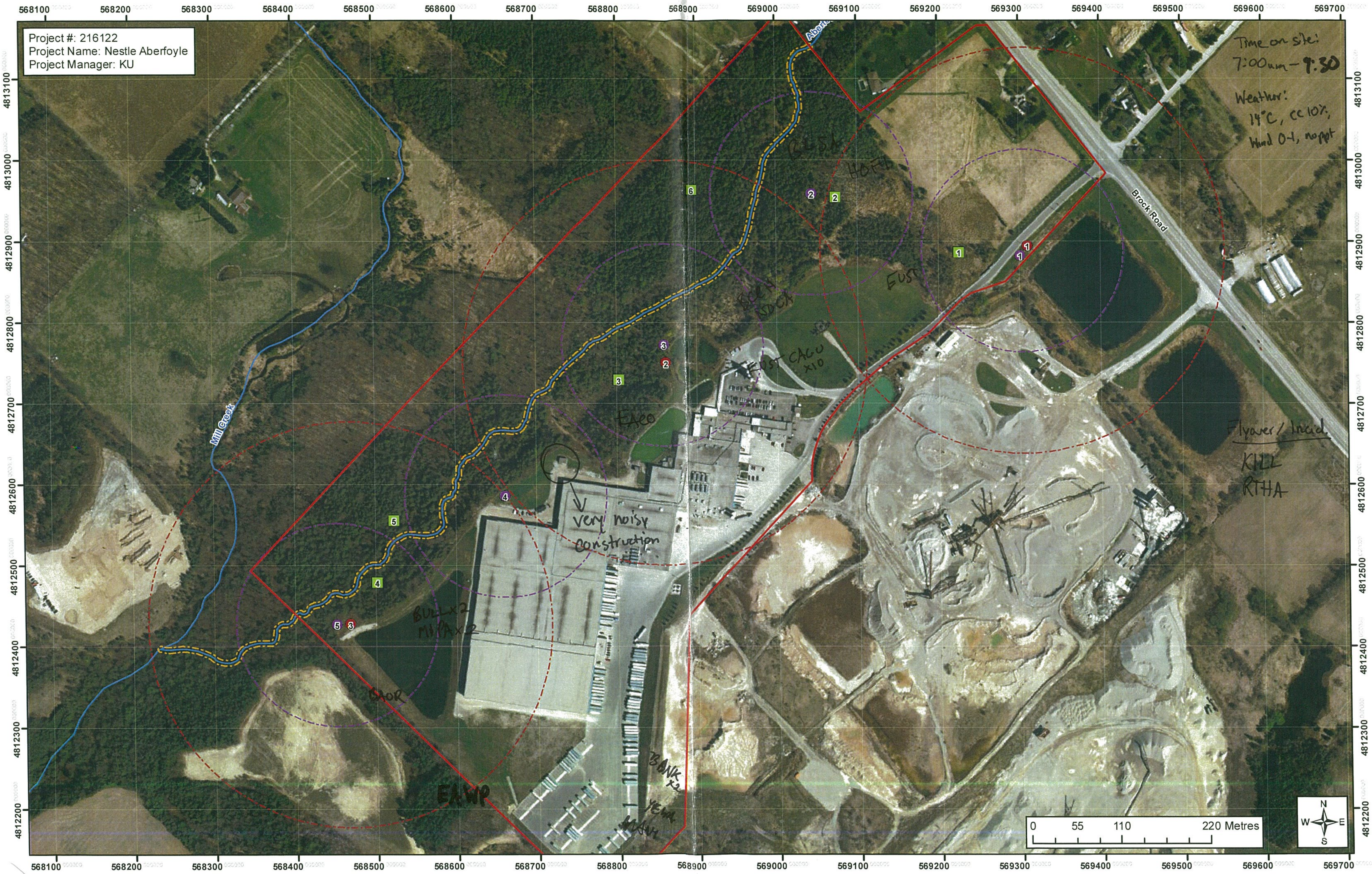
- breeding pair

F- foraging/flyover

x- Species observed not breeding

Appendix B

Breeding Bird Field Notes



Project #: 216122
Project Name: Nestle Aberfoyle
Project Manager: KU
568100
568200
568300
568400
568500
568600
568700
568800
568900
569000
569100
569200
569300
569400
569500
569600
569700
4813100
4813000
4812900
4812800
4812700
4812600
4812500
4812400
4812300
4812200
Mill Creek
Brock Road
Time on site:
7:00am - 9:30
Weather:
14°C, CC 10%,
Wind 0-1, no ppt
Flyover / Incid.
KILL
RTHA
very noisy
construction
EAEO
EUST CACU
x10
EUST
HOFI
BULAx2
MIMAx2
EAWP
0
55
110
220 Metres
N
S
E
W

BEACON ENVIRONMENTAL

Breeding Bird Station Mapping Card

Project #: 216114 **Project Name:** Nestle Aberfoyle **GPS Co-ord.:** see map

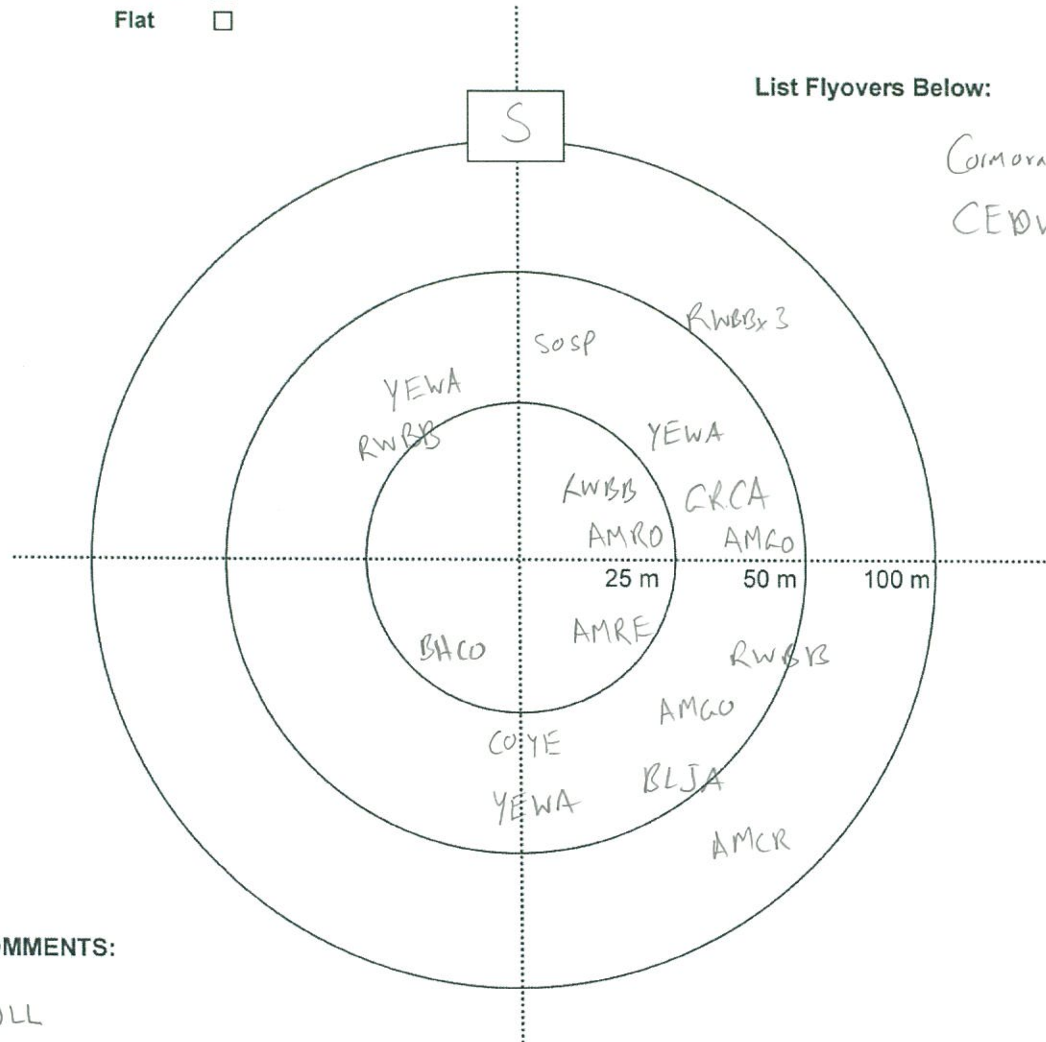
Date: June 8, 2018 **Surveyor:** RA, AC

Time Started: 7:12 **Time Ended:** 7:22 **Point Number:** 1

Slope: Vertical ☐ Steep ☐ Gentle ☐ Flat ☐

Direction slope faces (Aspect) (ex. NE): ____________

Background Noise -> 3



List Flyovers Below:

Cormorant

CEDW

COMMENTS:

BULL

GRFR

CLASSIFY HABITAT (within 100 m):

BEACON ENVIRONMENTAL

Breeding Bird Station Mapping Card

Project #: 216114 **Project Name:** Nestle Aberfoyle **GPS Co-ord.:** See map
Date: June 8, 2019 **Surveyor:** RA, AC
Time Started: 7:30 **Time Ended:** 7:40 **Point Number:** 2

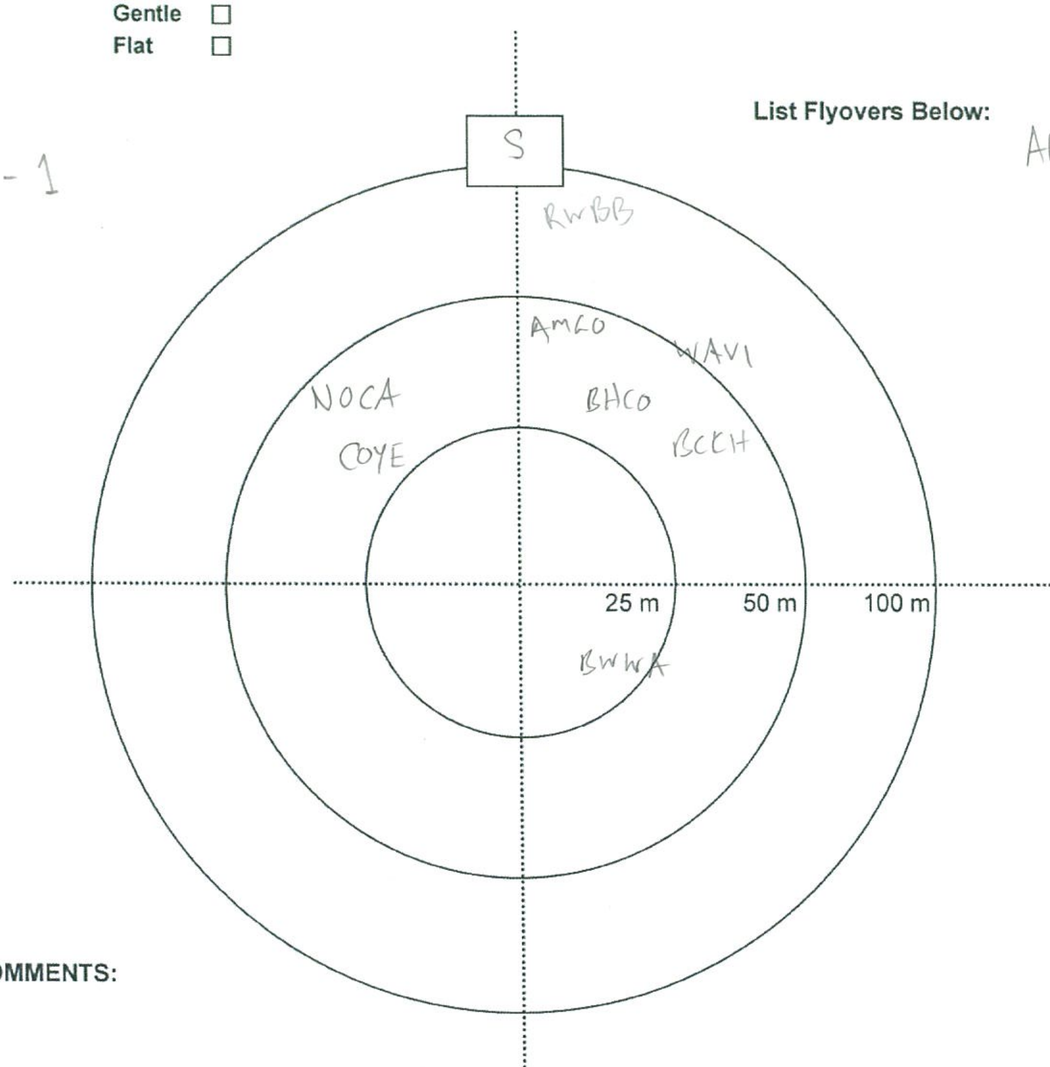
Slope:
- Vertical ☐
- Steep ☐
- Gentle ☐
- Flat ☐

Direction slope faces (Aspect) (ex. NE): ____________

Background Noise - 1

List Flyovers Below:

AMCR



COMMENTS:

CLASSIFY HABITAT (within 100 m):

BEACON ENVIRONMENTAL

Breeding Bird Station Mapping Card

Project #: 216114 **Project Name:** Nestle Aberfoyle **GPS Co-ord.:** see map

Date: June 8, 2018 **Surveyor:** RA, AC

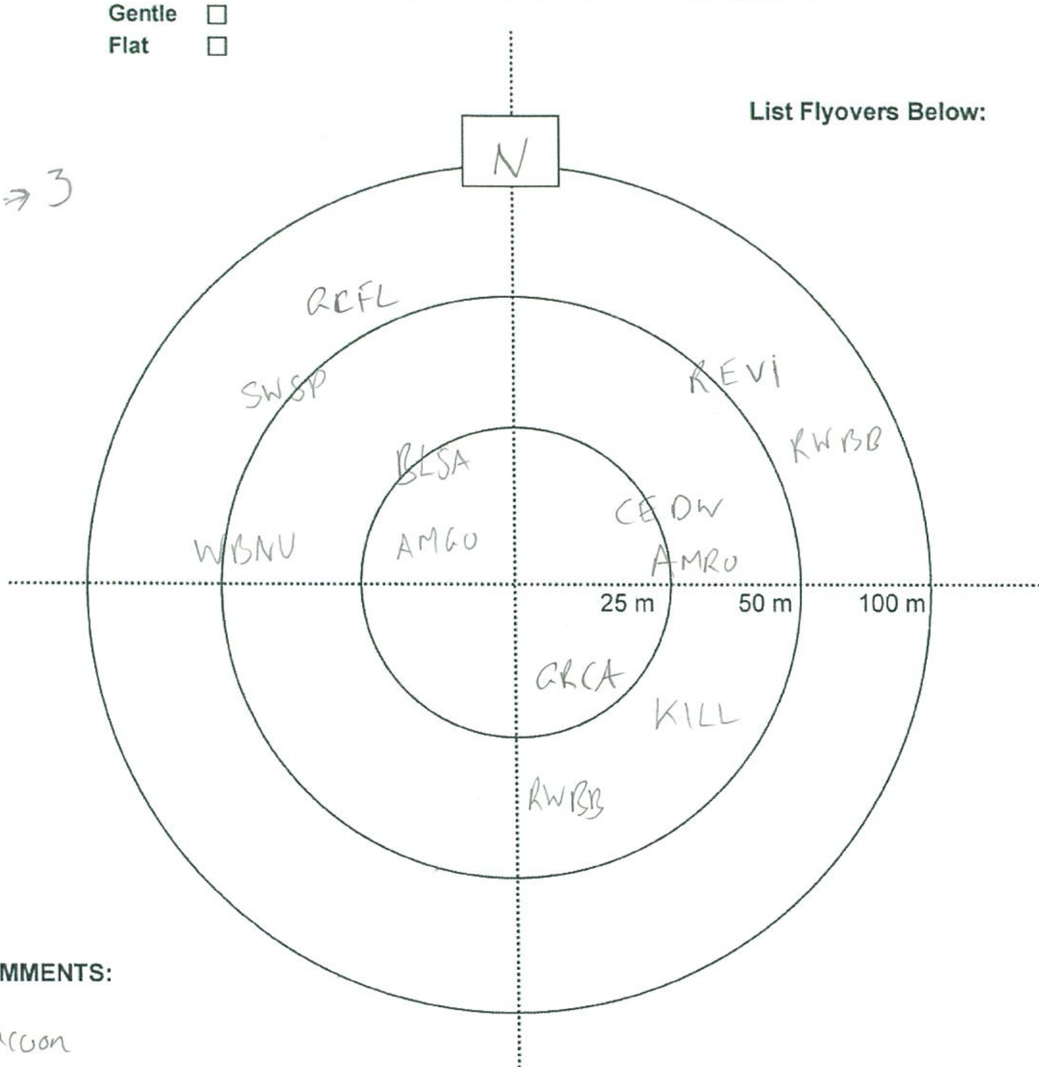
Time Started: 7:54 **Time Ended:** 8:04 **Point Number:** 3

Slope: Vertical ☐ Steep ☐ Gentle ☐ Flat ☐

Direction slope faces (Aspect) (ex. NE): ____________

List Flyovers Below:

Background Noise ⇒ 3



COMMENTS:

Racoon

CLASSIFY HABITAT (within 100 m):

BEACON ENVIRONMENTAL

Breeding Bird Station Mapping Card

Project #: 216114 **Project Name:** Nestle Aberfoyle **GPS Co-ord.:** see map

Date: June 8, 2018 **Surveyor:** RA, AC

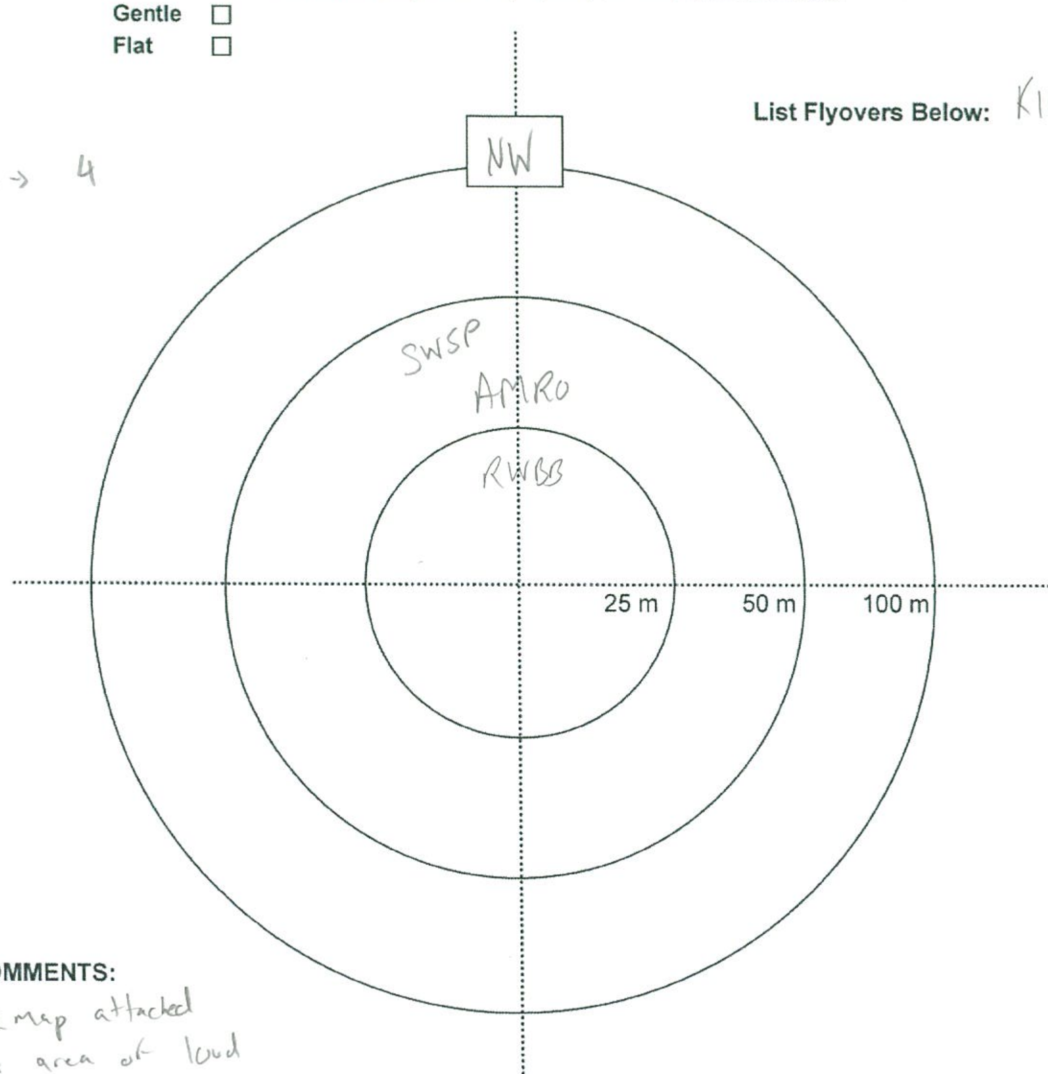
Time Started: 8:44 **Time Ended:** 8:54 **Point Number:** 4

Slope: **Vertical** ☐
Steep ☐ **Direction slope faces (Aspect)** (ex. NE): ____________
Gentle ☐
Flat ☐

List Flyovers Below: KILL

Background Noise → 4

Active Construction



COMMENTS:
see map attached for area of loud construction

CLASSIFY HABITAT (within 100 m):

BEACON ENVIRONMENTAL

Breeding Bird Station Mapping Card

Project #: 216114 **Project Name:** Nestle Aberfoyle **GPS Co-ord.:** See map

Date: June 8, 2018 **Surveyor:** RA, AC

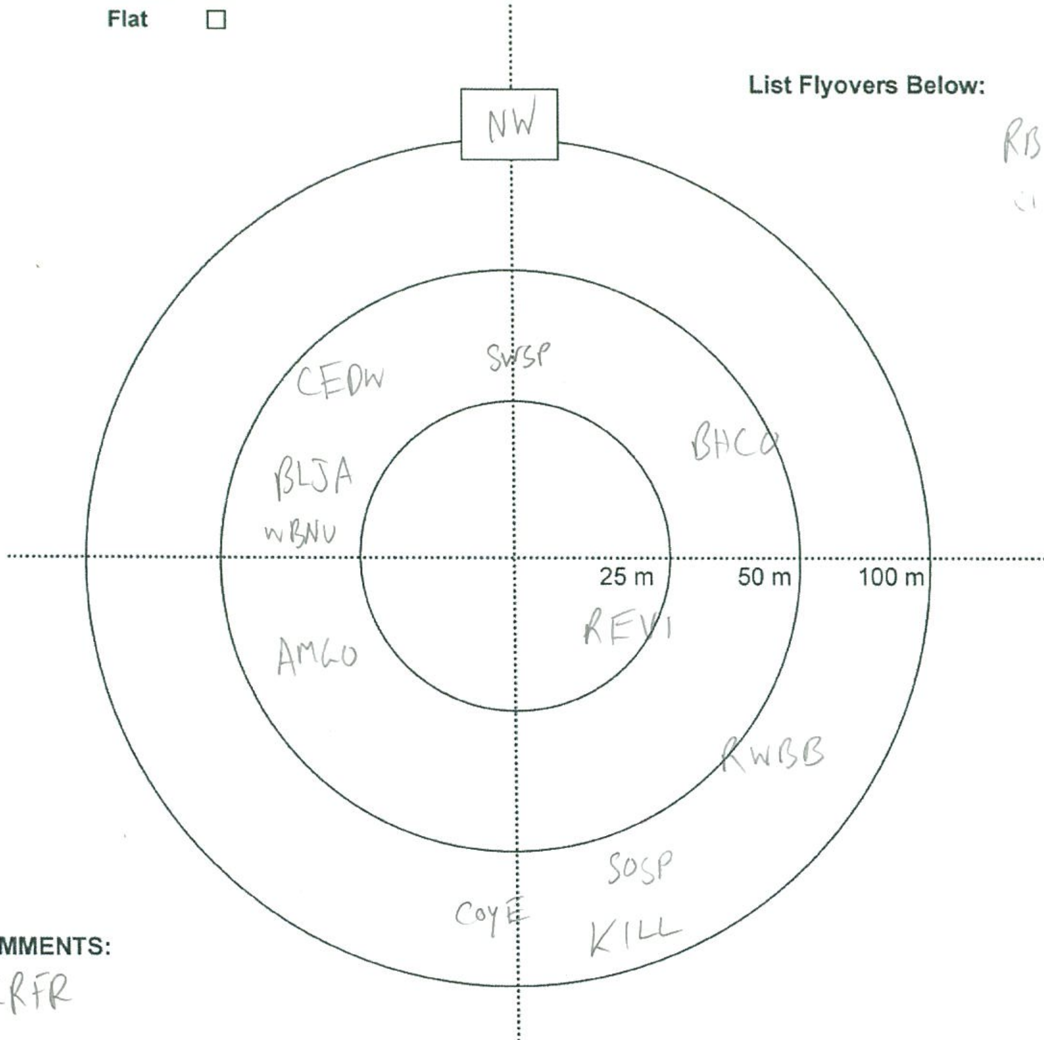
Time Started: 8:58 **Time Ended:** 9:08 **Point Number:** 5

Slope: Vertical ☐ Steep ☐ Gentle ☐ Flat ☐

Direction slope faces (Aspect) (ex. NE): ____________

List Flyovers Below:

RBGU



COMMENTS:

GRFR

CLASSIFY HABITAT (within 100 m):

Project #: 216122
Project Name: Nestle Aberfoyle
Project Manager: KU
June 21, 2018
RA
June 21, 2018
5:50am 7:15am
T:16°C BF:2
CC:0% BN:2/3
Flyovers
-GBHE
-BAUK
-HILL
-OSPR
Mill Creek
Brock Road
0 55 110 220 Metres
N
S
E
W
568100
568200
568300
568400
568500
568600
568700
568800
568900
569000
569100
569200
569300
569400
569500
569600
569700
4813100
4813000
4812900
4812800
4812700
4812600
4812500
4812400
4812300
4812200

BEACON ENVIRONMENTAL

Breeding Bird Station Mapping Card

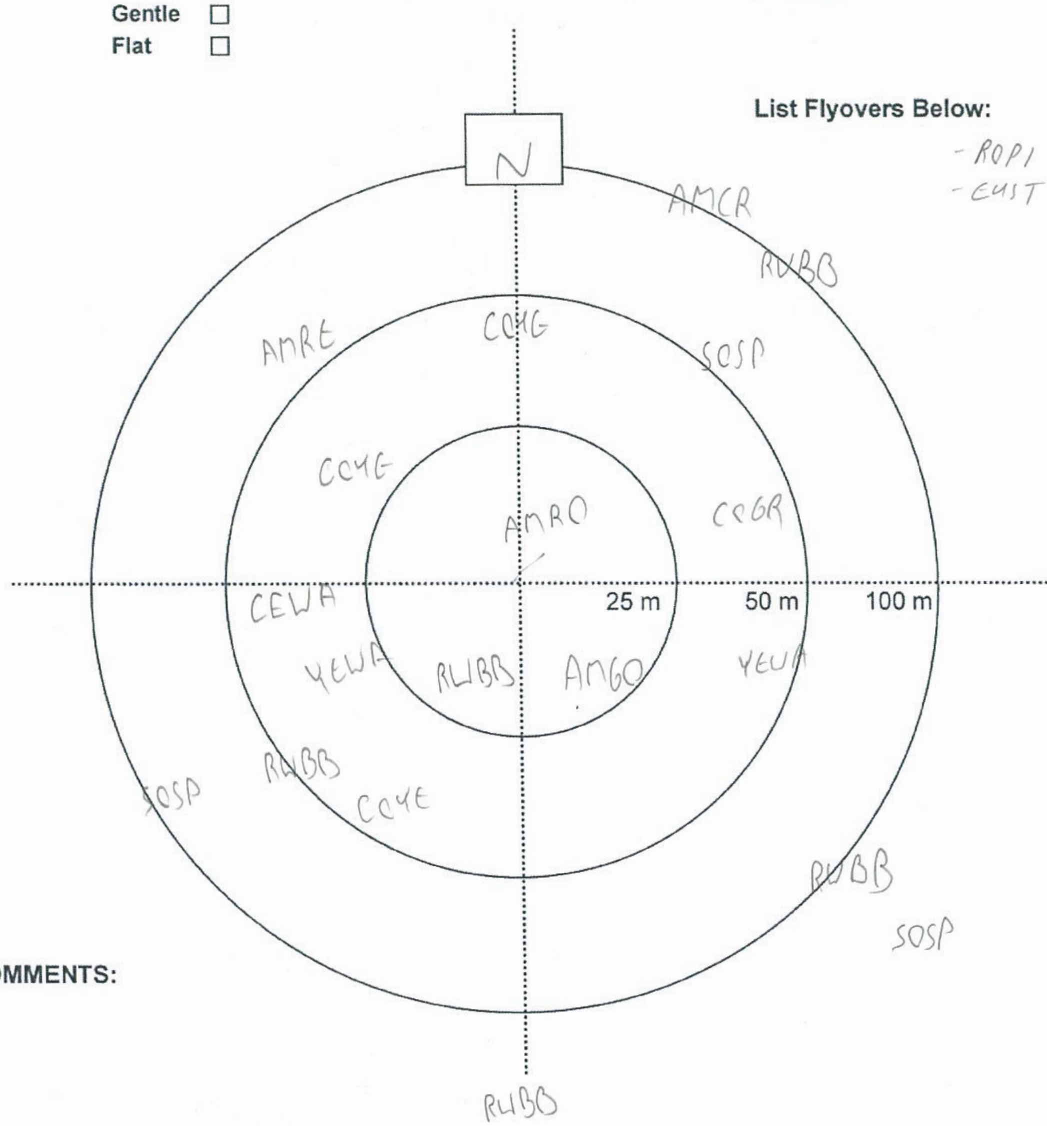
Project #: 216114 **Project Name:** Aberfoyle **GPS Co-ord.:** See Map

Date: June 21, 2018 **Surveyor:** RA, GC

Time Started: 5:59 **Time Ended:** 6:09 **Point Number:** 1

Slope: Vertical ☐ Steep ☐ Gentle ☐ Flat ☐

Direction slope faces (Aspect) (ex. NE): ____________



List Flyovers Below:

- ROPI
- EUST

COMMENTS:

CLASSIFY HABITAT (within 100 m):

BEACON ENVIRONMENTAL

Breeding Bird Station Mapping Card

Project #: 216114 **Project Name:** Aberfoyle **GPS Co-ord.:** See Map

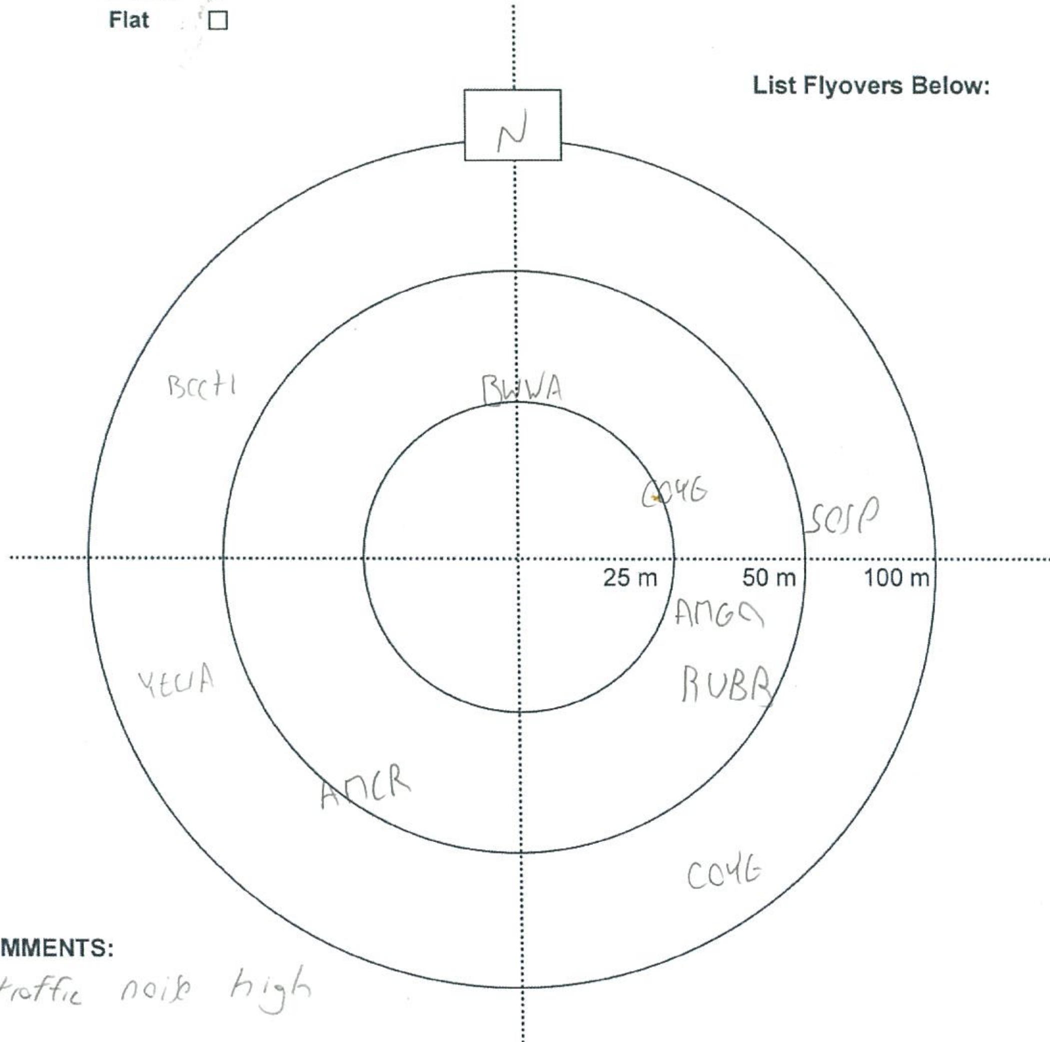
Date: June 21, 2018 **Surveyor:** RA, GC

Time Started: 6:17 **Time Ended:** 6:27 **Point Number:** 2

Slope:
- Vertical ☐
- Steep ☐
- Gentle ☐
- Flat ☐

Direction slope faces (Aspect) (ex. NE): ____________

List Flyovers Below:



COMMENTS:

-traffic noise high

CLASSIFY HABITAT (within 100 m):

BEACON ENVIRONMENTAL

Breeding Bird Station Mapping Card

Project #: 216114 **Project Name:** Aberfoyle **GPS Co-ord.:** See Map

Date: June 21, 2018 **Surveyor:** RA AC

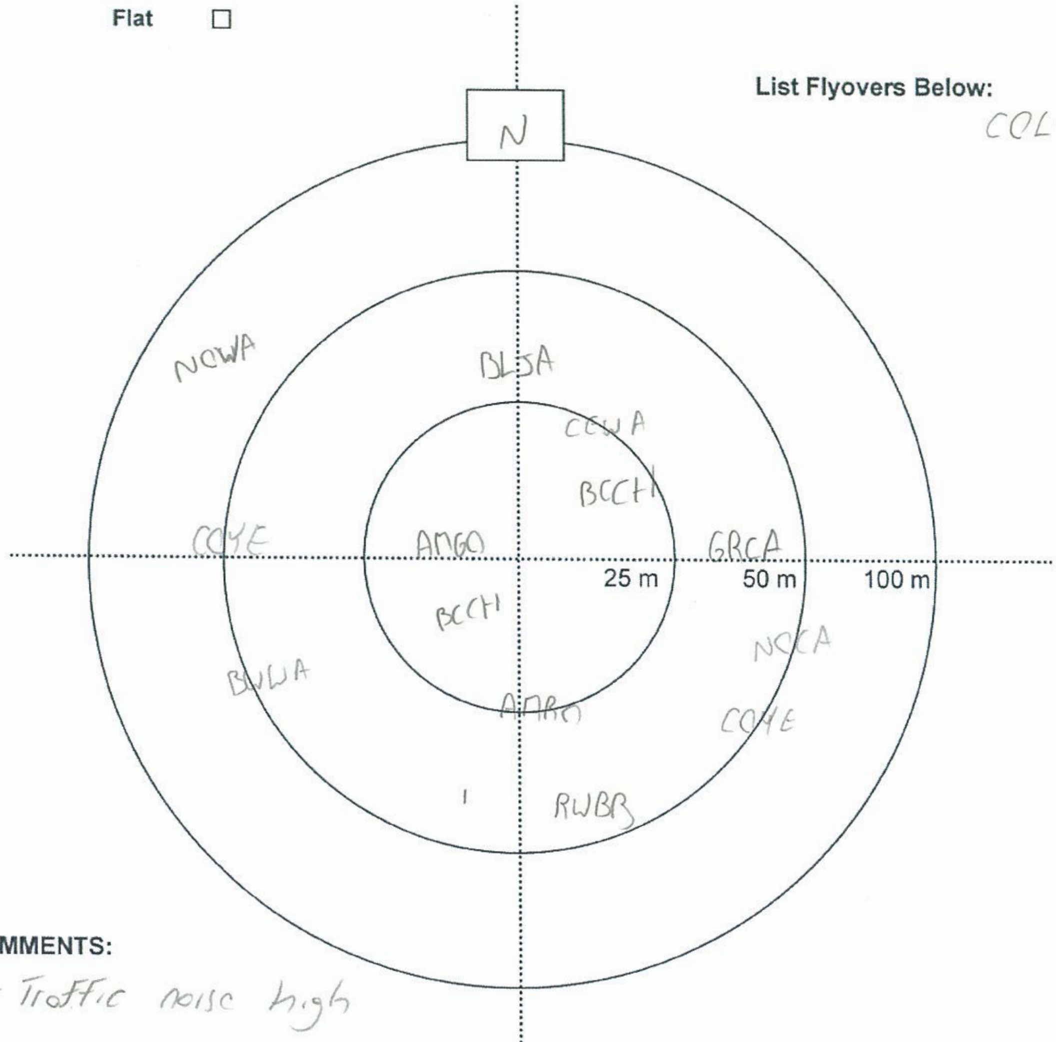
Time Started: 6:38 **Time Ended:** 6:48 **Point Number:** 3

Slope:
- Vertical ☐
- Steep ☐
- Gentle ☐
- Flat ☐

Direction slope faces (Aspect) (ex. NE): ___________

List Flyovers Below:

COLO



COMMENTS:

- Traffic noise high

CLASSIFY HABITAT (within 100 m):

____

____

____

____

____

BEACON ENVIRONMENTAL

Breeding Bird Station Mapping Card

Project #: 216114 **Project Name:** Aberfoyle **GPS Co-ord.:** See Map

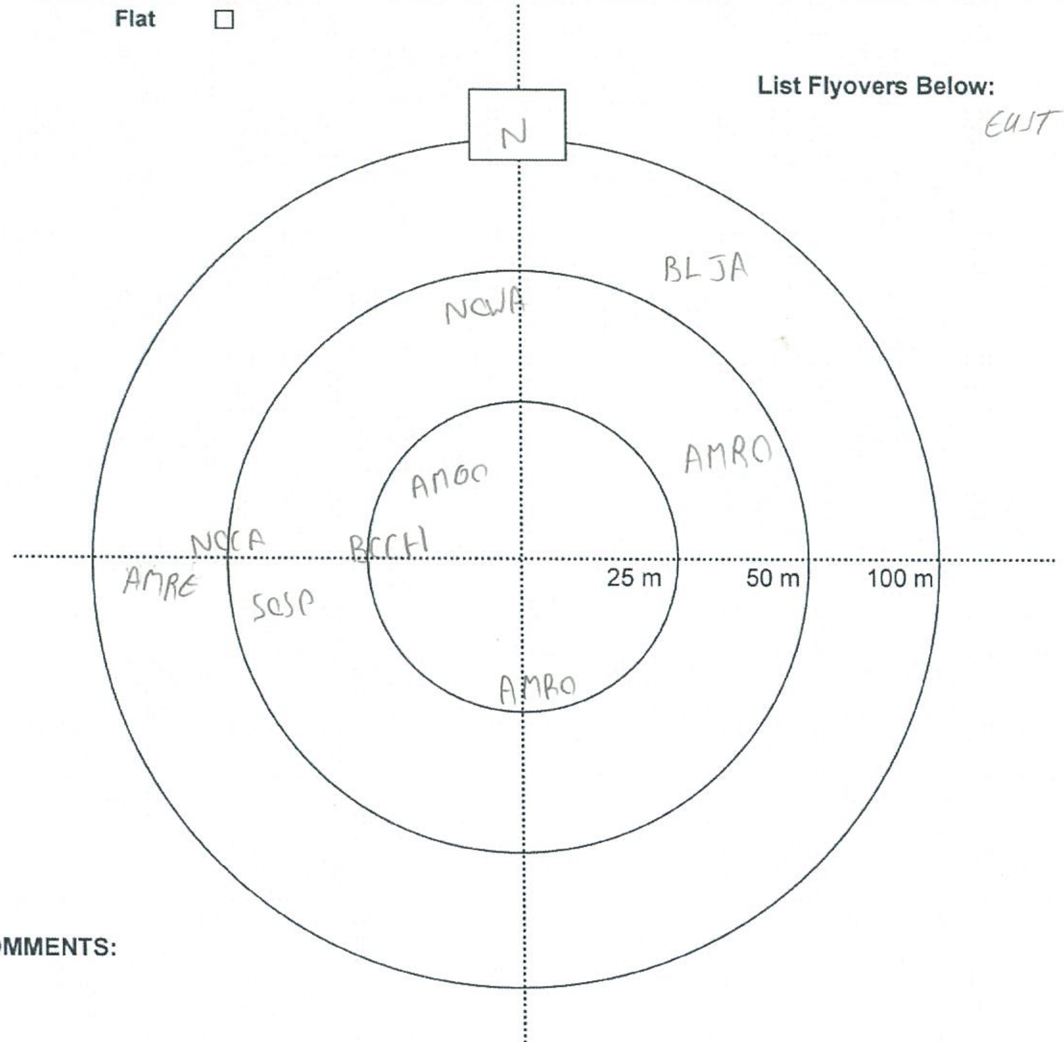
Date: June 21, 2018 **Surveyor:** RA, BC

Time Started: 6:54 **Time Ended:** 7:04 **Point Number:** 4

Slope: Vertical ☐ Steep ☐ Gentle ☐ Flat ☐

Direction slope faces (Aspect) (ex. NE): ____________

List Flyovers Below:
EUST



COMMENTS:

CLASSIFY HABITAT (within 100 m):

BEACON ENVIRONMENTAL

Breeding Bird Station Mapping Card

Project #: 216114 **Project Name:** Aberfoyle **GPS Co-ord.:** See Map

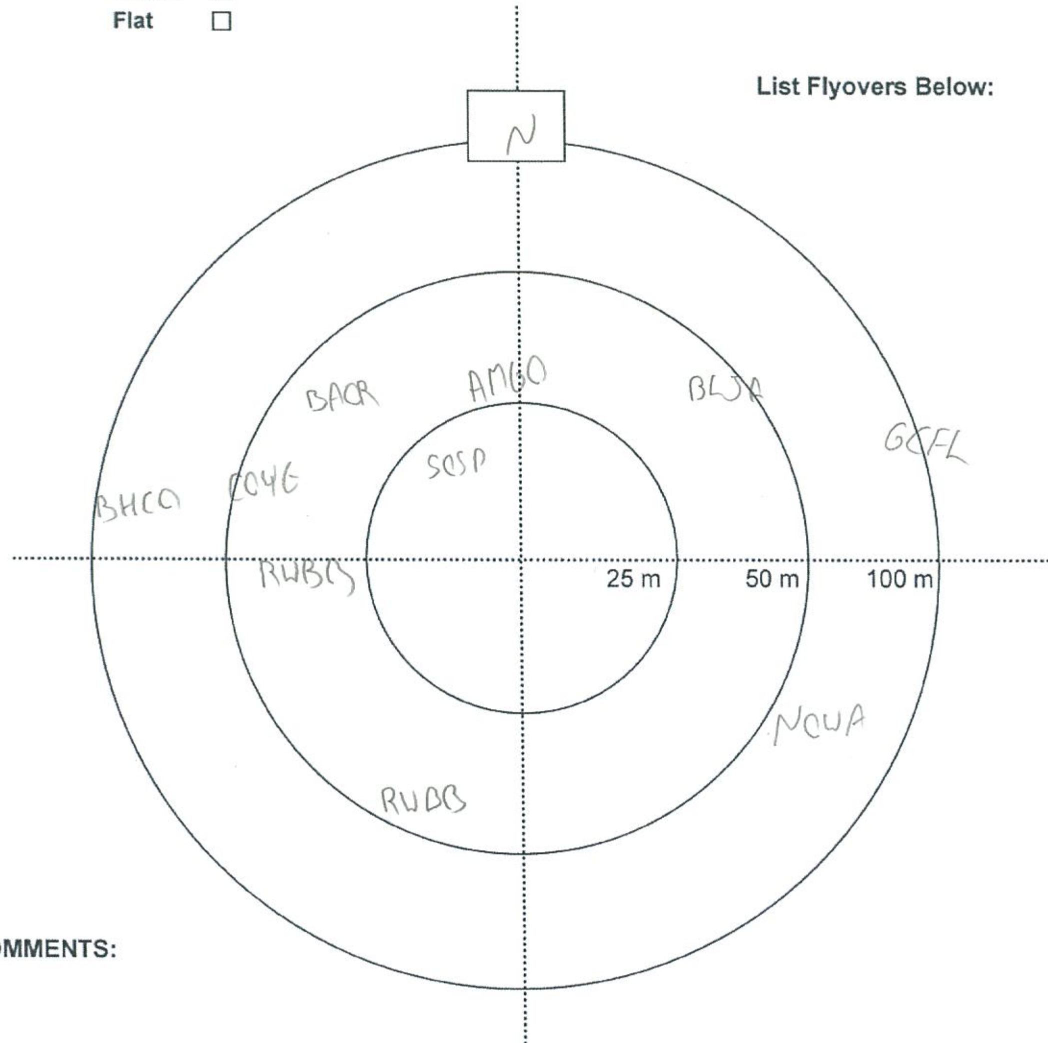
Date: June 21, 2018 **Surveyor:** BA, GC

Time Started: 7:10 **Time Ended:** 7:20 **Point Number:** 5

Slope: Vertical ☐ Steep ☐ Gentle ☐ Flat ☐

Direction slope faces (Aspect) (ex. NE): ____________

List Flyovers Below:



COMMENTS:

CLASSIFY HABITAT (within 100 m):

APPENDIX I

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

S.S. PAPADOPULOS & ASSOCIATES, INC.
Environmental & Water-Resource Consultants

Memorandum

Date: March 7, 2019

From: Christopher Neville and Xiaomin Wang

To: File

Project: SSP-994-33: Nestle Ontario - Aberfoyle

Subject: **Estimation of infiltration at Aberfoyle with the SWB model**

Overview

The SWB model of the United States Geological Survey has been applied to estimate infiltration in the area that surrounds the Nestlé Waters Canada (NWC) Aberfoyle facility. The SWB model has been applied to assess the likely variability in annual infiltration and how the infiltration is distributed across the area around the NWC production well TW3-80.

The SWB model refers consistently to “recharge”. In fact, the quantity that is reported as “recharge” should be interpreted as “infiltration”. The SWB model does not account for the flow mechanism in the vadose zone. 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 right beneath the bottom of the root zone, the SWB model would perform well and infiltration and recharge would be expected to coincide. For cases in which there is a significant travel time between the bottom of the root zone to the top of water table, the SWB result may not match actual groundwater recharge in time or in space.

Using the same precipitation data as reported in the NWC Aberfoyle 2018 Annual Monitoring Report, it is estimated that over the past 11 years the annual infiltration has ranged from about 100 mm to 240 mm and is approximated relatively closely as about 20% of the total annual precipitation.

This memorandum documents the application of the SWB model and consists of five main sections:

- Introduction;
- Model input;
- Sources of input data;
- Results for the Aberfoyle area; and
- Checks on the results.

1. Introduction

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.

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:

$$infiltration = (precip + snowmelt + inflow) - (interception + outflow + ET) - \Delta\, soil\ moisture$$

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;

ET – daily values of evapotranspiration. There are five methods included in the SWB code. The simplest method is Thornthwaite-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-Mather (1957) procedure.

2. Model Input

The datasets required for the application of the SWB model are listed below.

Gridded (ESRI ASCII or Surfer)
Land-use classification
Hydrologic soil group
Flow direction
Available soil-water capacity
Tabular
Climate data (e.g. precipitation and temperature)
Soil and land use property lookup table
Soil-water retention table (Thornthwaite-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 Thornthwaite-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.

3. 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.

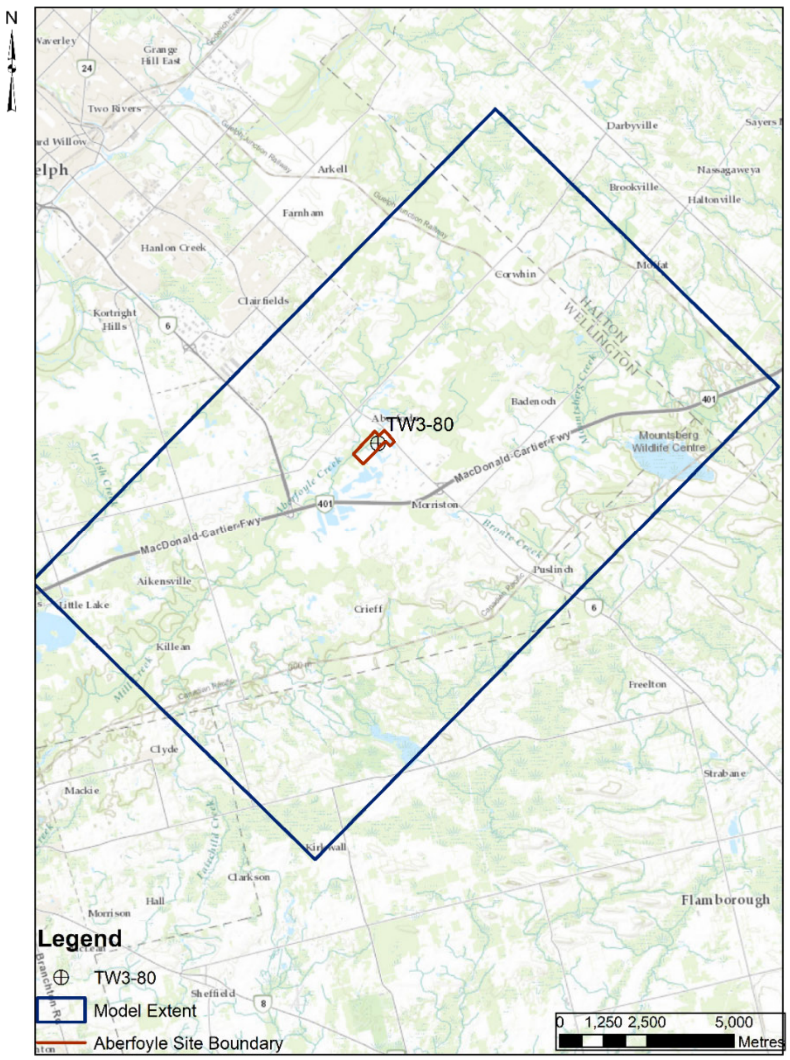


Figure 1. Model limits

Climate data

Two types of climate data are required: precipitation and temperature. Both sets of data are obtained from Environment Canada. For this analysis, 11 years of climate data between 2008 and 2018 are considered.

Where available, the daily precipitation data from the Kitchener/Waterloo (KW) Station are specified as input. When data are missing from the station during 2010 and 2018, the gap is filled in using data from Roseville or Elora RCS meteorological stations. Prior to 2010, the precipitation data are primarily obtained from the Waterloo Wellington 2 Station.

Daily minimum and maximum temperature data are obtained from the from Guelph Turfgrass (GT) Station. When data are missing from the record for the GT station, gaps are filled using data from Waterloo Airport, Elora RCS, Roseville and KW meteorological stations.

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

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.

4. Results (1): Calculated distributions of annual infiltration for the Aberfoyle area

The calculated distributions of annual infiltration from 2008 to 2018 are shown in Figures 2 to 12. To simplify comparison of the distributions of estimated infiltration, the map of the results for each year are plotted at the same scale and with the same ranges of infiltration.

- Figure 2: 2008
- Figure 3: 2009
- Figure 4: 2010
- Figure 5: 2011
- Figure 6: 2012
- Figure 7: 2013
- Figure 8: 2014
- Figure 9: 2015
- Figure 10: 2016
- Figure 11: 2017
- Figure 12: 2018

To: File
Date: March 7, 2019
Page: 9

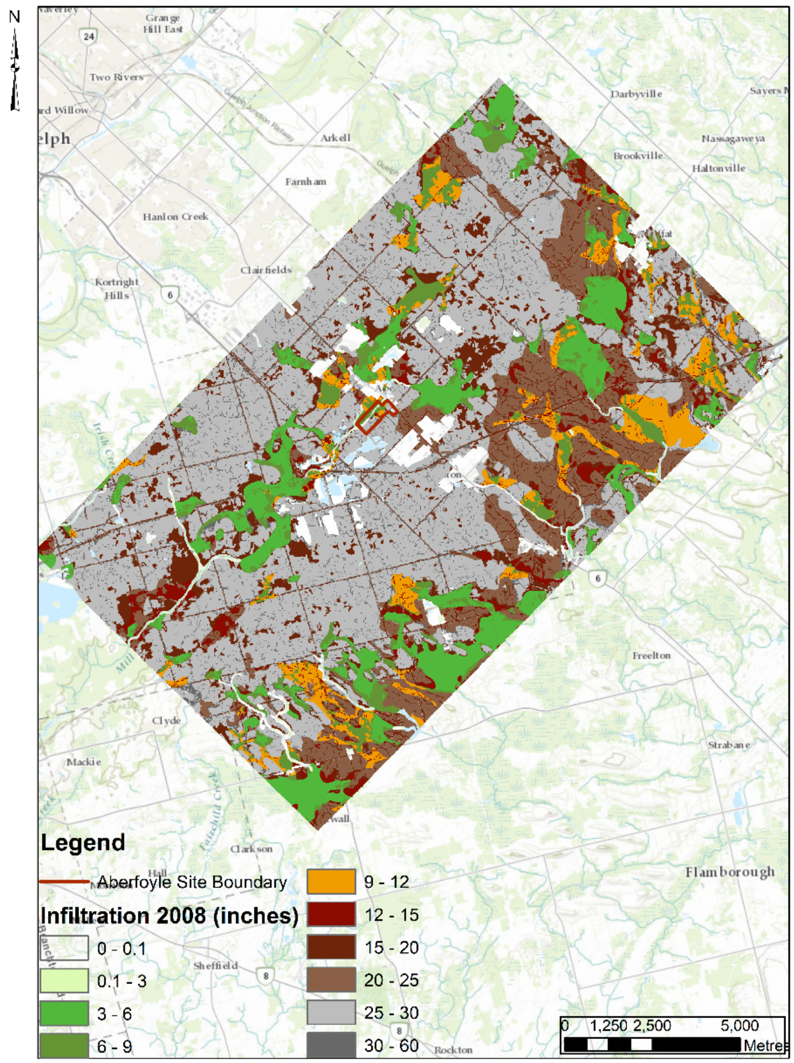


Figure 2. Calculated distribution of annual infiltration for 2008

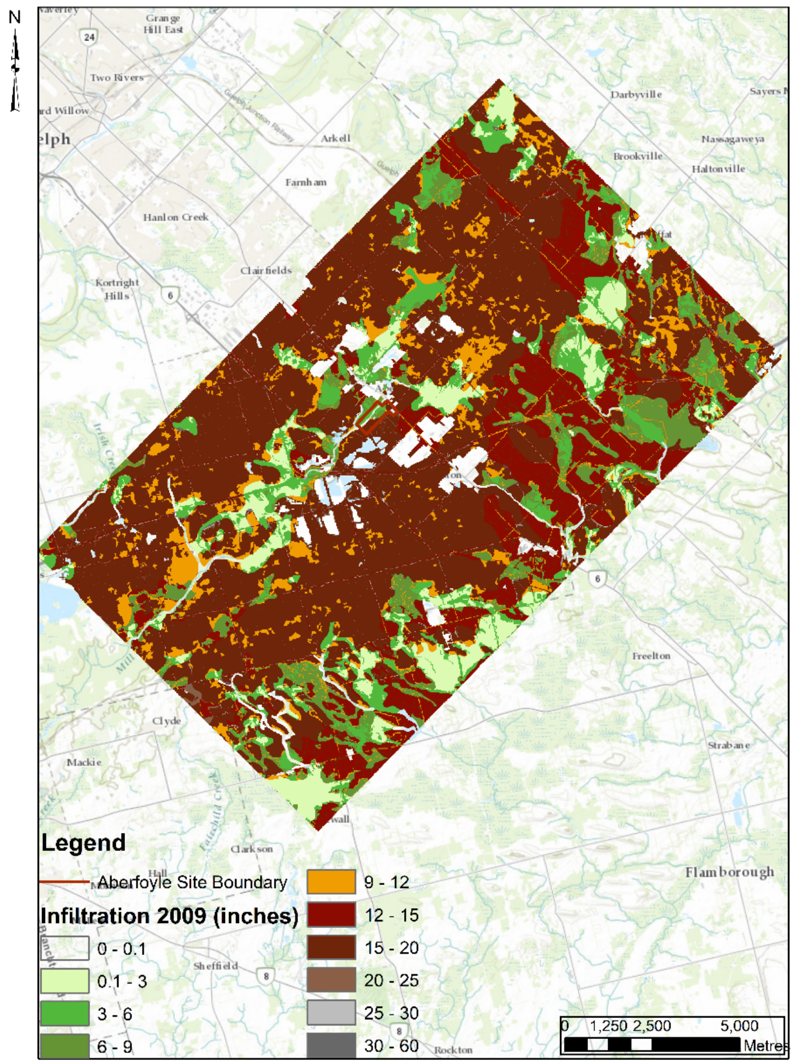


Figure 3. Calculated distribution of annual infiltration for 2009

To: File
Date: March 7, 2019
Page: 11

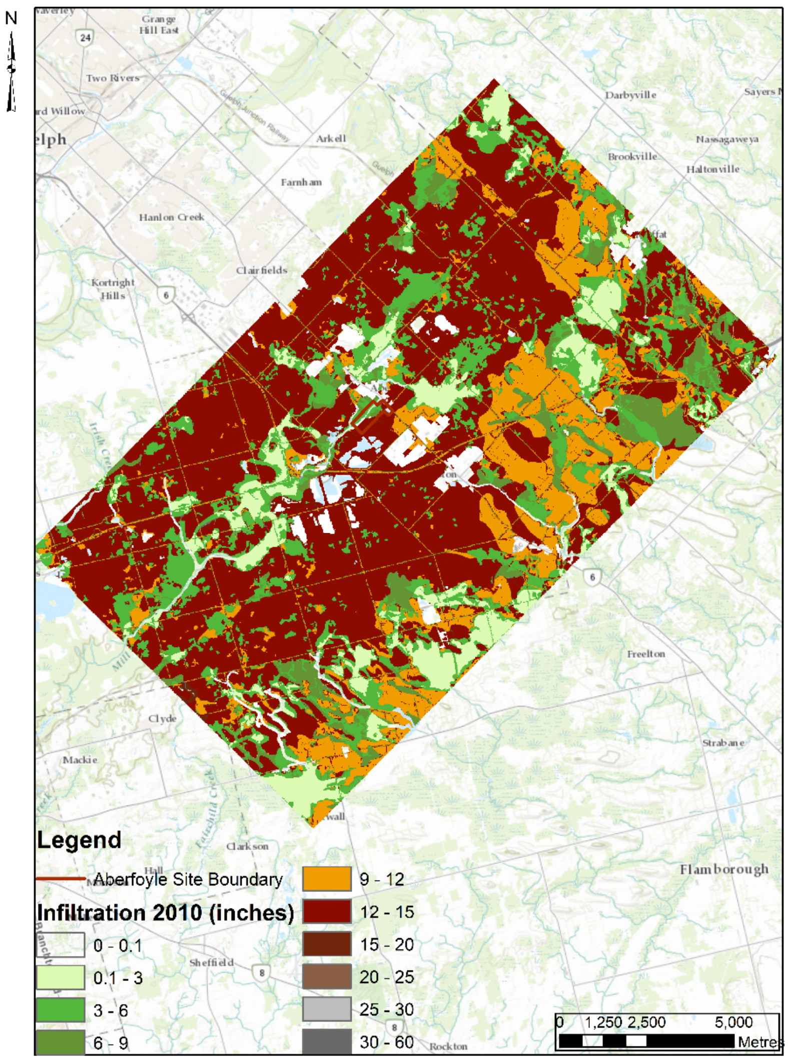


Figure 4. Calculated distribution of annual infiltration for 2010

S.S. PAPADOPULOS & ASSOCIATES, INC.
Environmental & Water-Resource Consultants

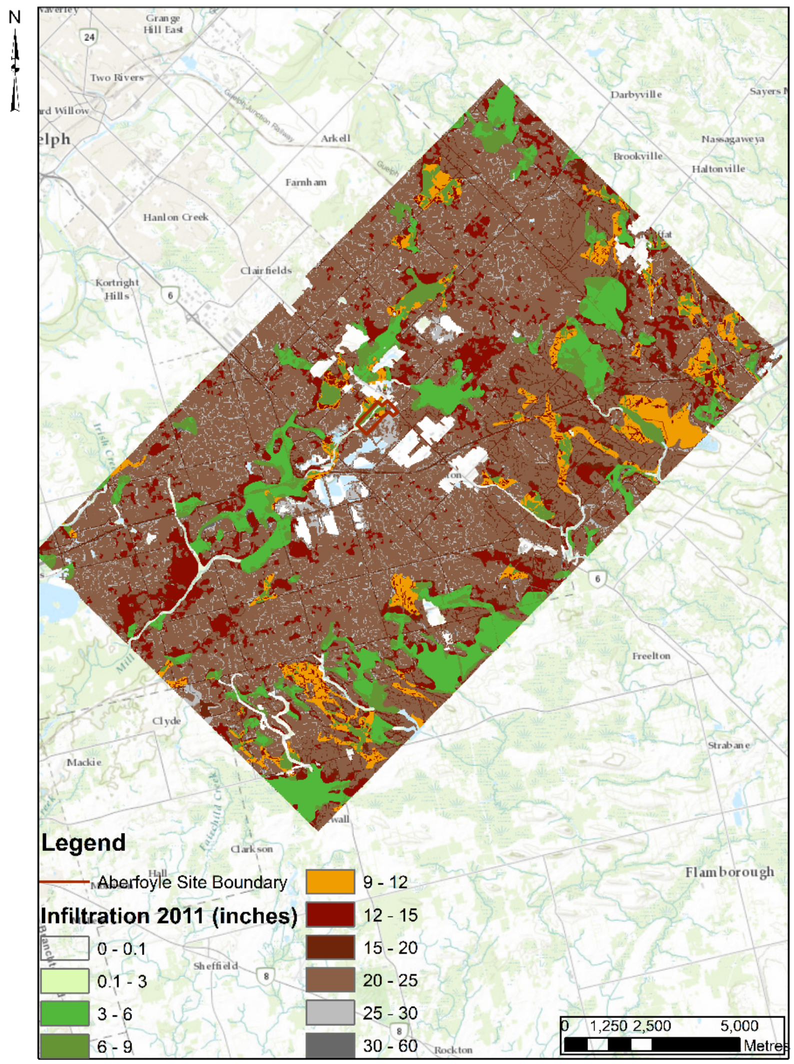


Figure 5. Calculated distribution of annual infiltration for 2011

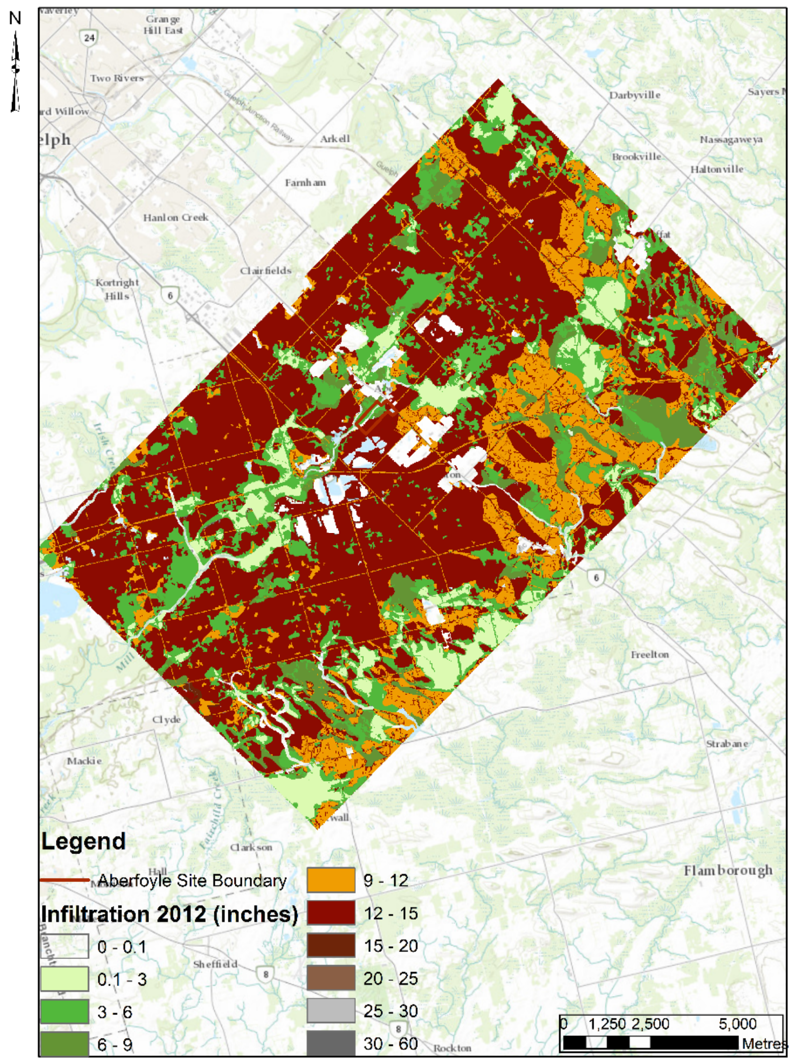


Figure 6. Calculated distribution of annual infiltration for 2012

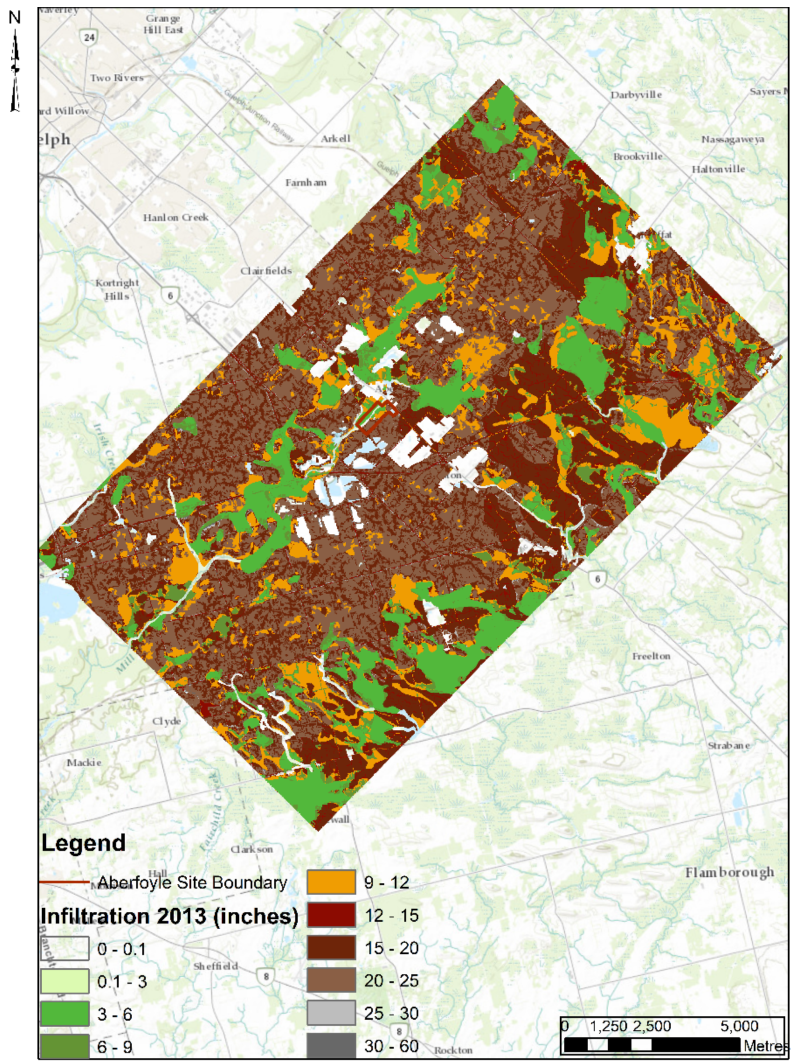


Figure 7. Calculated distribution of annual infiltration for 2013

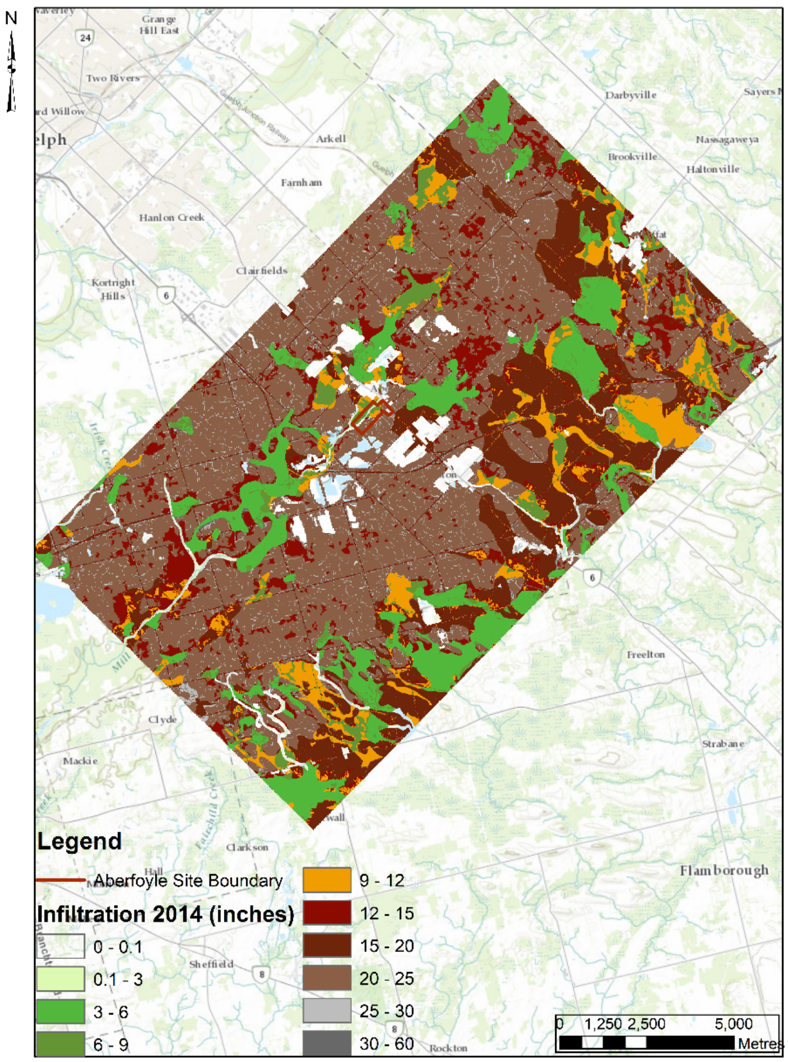


Figure 8. Calculated distribution of annual infiltration for 2014

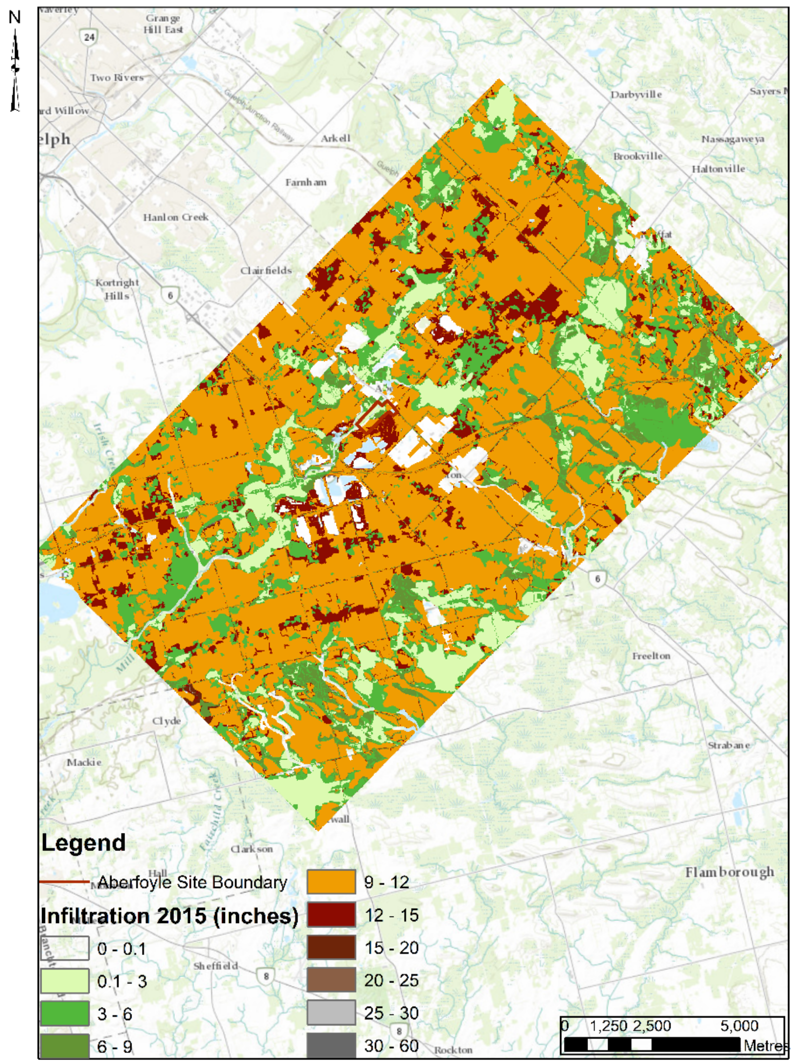


Figure 9. Calculated distribution of annual infiltration for 2015

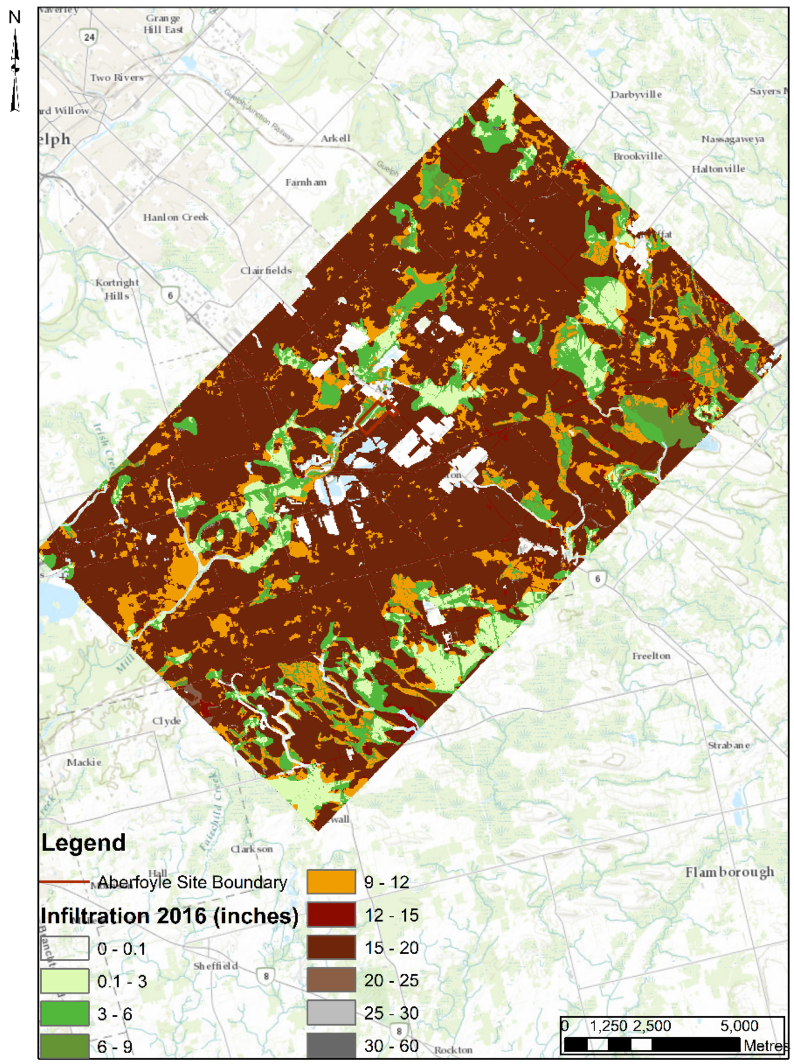


Figure 10. Calculated distribution of annual infiltration for 2016

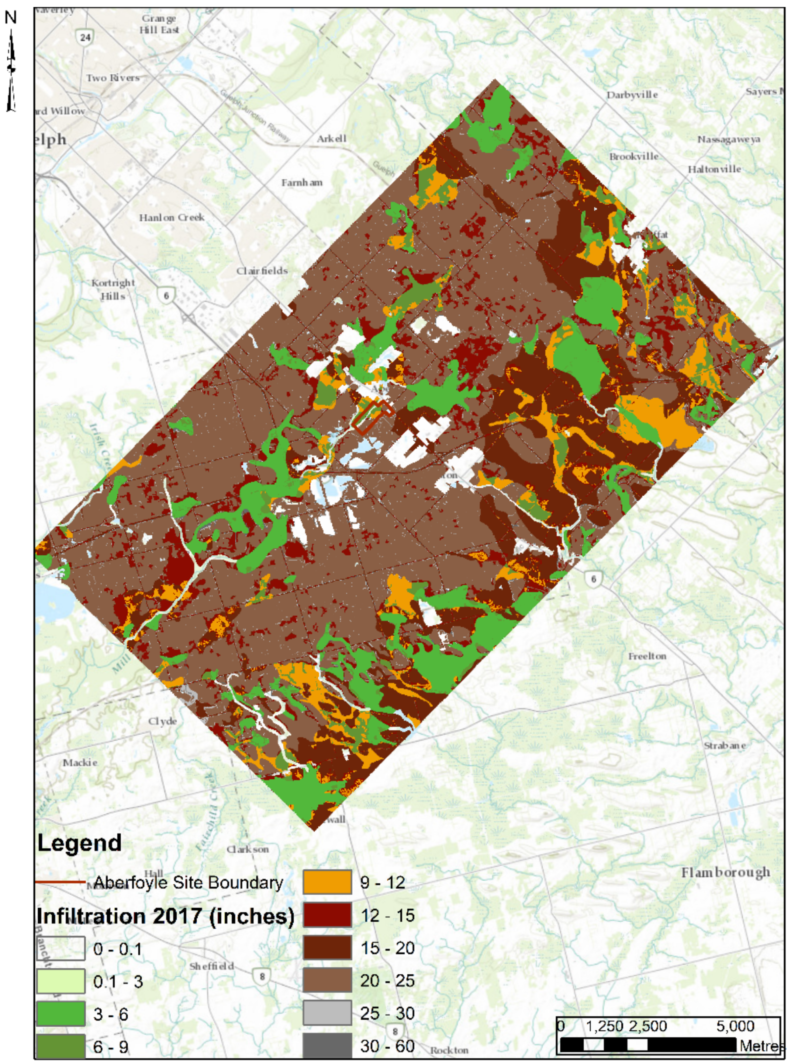


Figure 11. Calculated distribution of annual infiltration for 2017

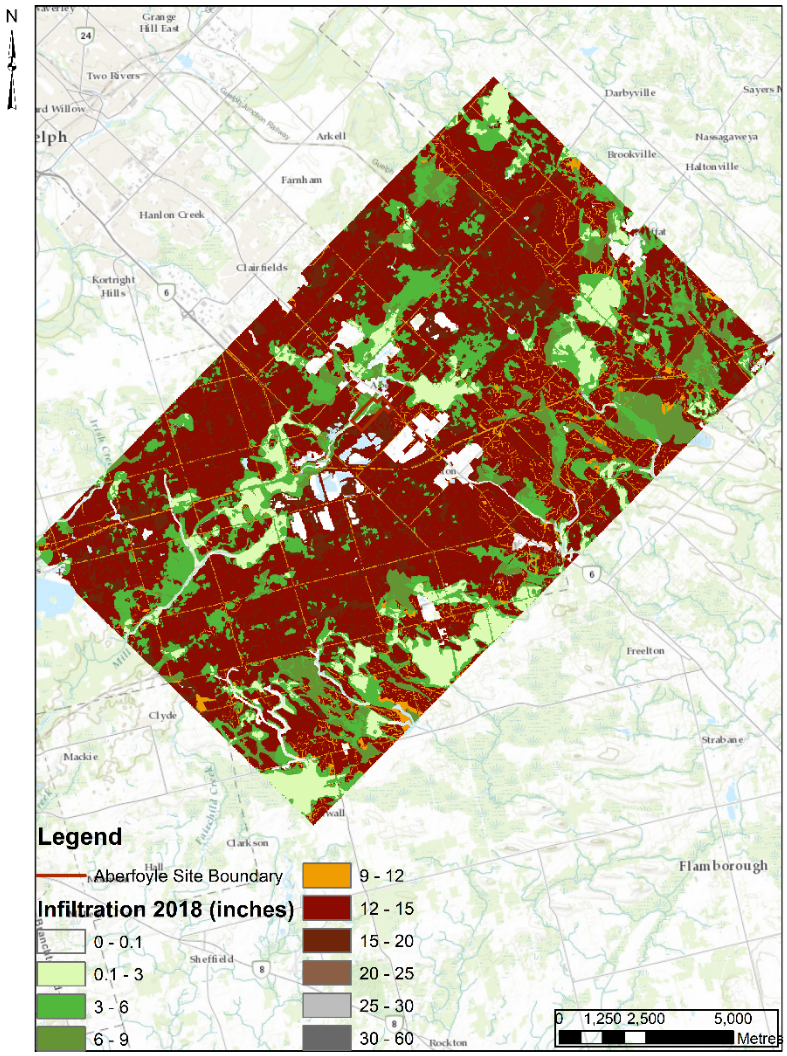


Figure 12. Calculated distribution of annual infiltration for 2018

5. Results (2): Calculated average annual infiltration for the Aberfoyle area, 2008-2018

The annual average infiltration distribution is shown in Figure 13.

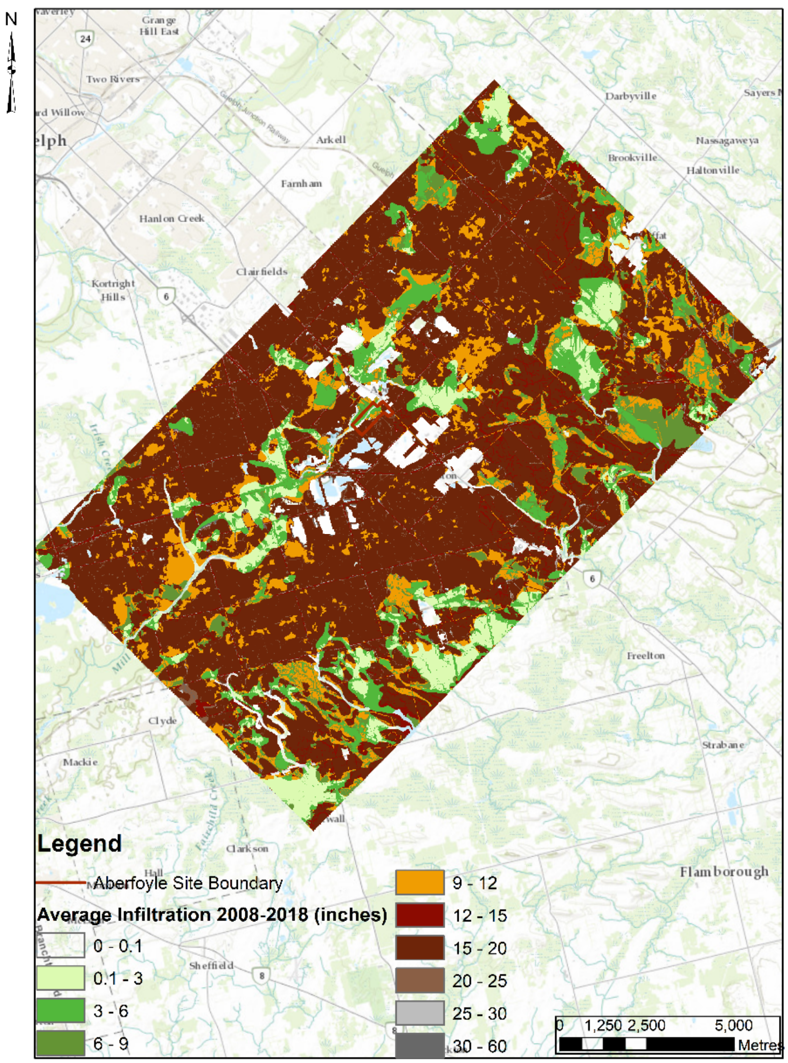


Figure 13. Calculated distribution of annual average infiltration from 2008 to 2018

6. Inferred relation between annual infiltration and total annual precipitation

The annual total precipitation and the estimated annual total infiltration using the SWB model are assembled on the following table. The mean and median vales of the annual precipitation and annual infiltration are also presented on the table. Over the 11-year period of the analysis, annual precipitation has varied over a relatively wide range, from about 770 mm to 1300 mm. Over this period the estimates of the annual infiltration range from about 100 mm (97.2 mm) to 240 mm (242.6 mm), a range of about ±70 mm from the median value.

Year	Annual total precipitation (mm)	Annual total infiltration (mm)
2008	1304.7	242.6
2009	964.9	160.0
2010	833.1	113.7
2011	1081	217.9
2012	770.6	113.7
2013	1088.6	175.5
2014	973.8	201.1
2015	795.8	97.2
2016	931.9	161.9
2017	949.4	195.6
2018	807.1	126.9
Mean	954.6	164.2
Median	949.4	161.9

The values of annual infiltration estimated with the SWB are plotted against the total annual precipitation in Figure 14. The following simple regression equation approximates the relation between estimated annual infiltration (*INF*) and between the annual precipitation (*P*) relatively well:

$$INF = 0.17\,P; \qquad R^2 = 0.98$$

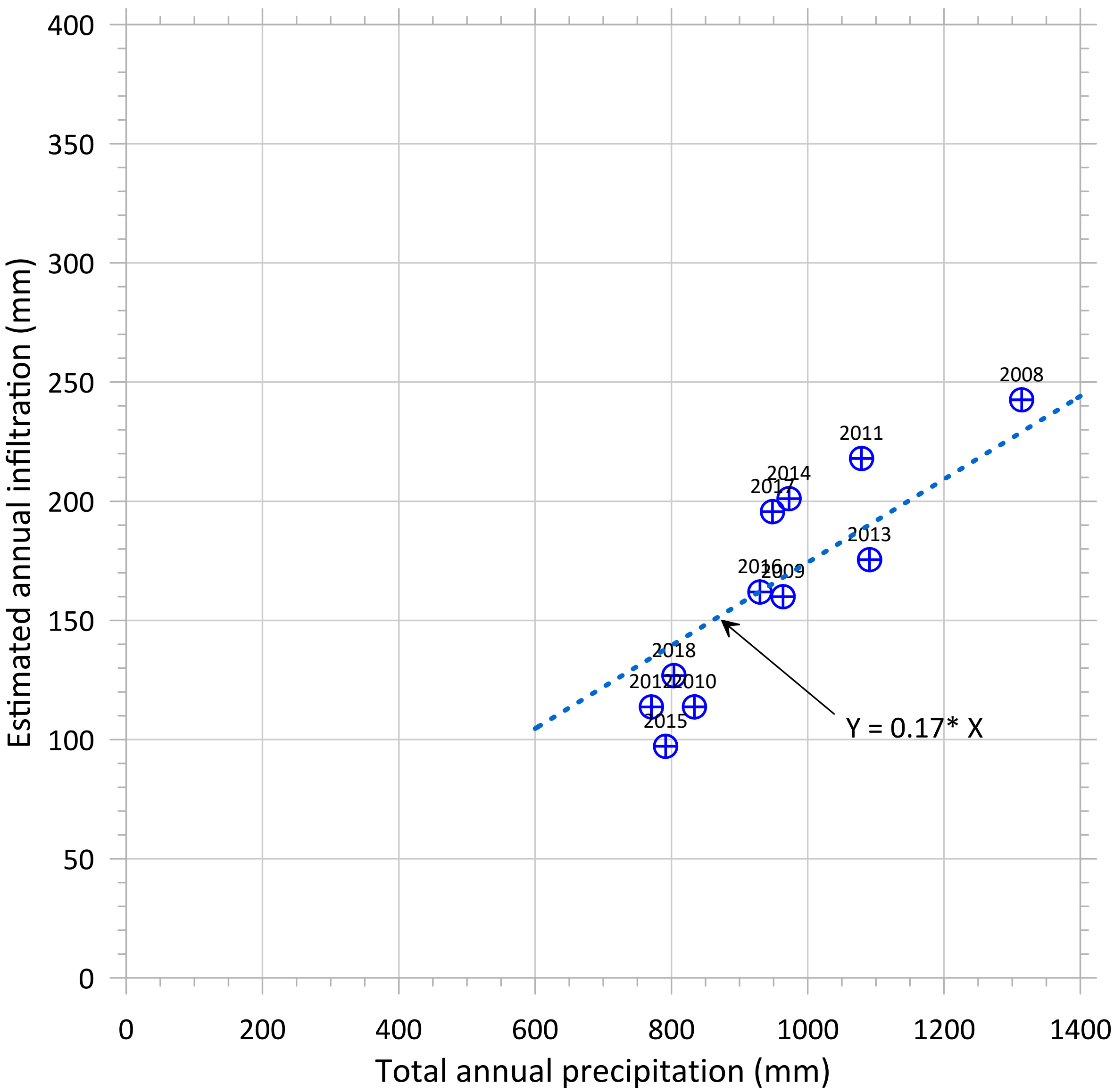


Figure 14. Relationship between infiltration and precipitation

7. Checks on the results of the demonstration application for Aberfoyle

Three checks on the results have been made. These checks are not intended to be definitive. Rather, they have been developed to assess in a general sense whether the results of the infiltration calculations are reasonable.

Check #1: Consistency of calculated infiltration rates with reported values for the University of Guelph's Elora Research Station

Values of annual recharge estimated McCoy et al. (2006) for the University of Guelph's Elora Research Station are reproduced below.

Year	Conventional Tillage (inches)	Non-conventional Tillage (inches)
2001	8.74	8.27
2002	8.03	6.16
2003	8.11	8.19

The reported annual recharge estimates vary over a relatively narrow range, from about 6 inches (150 mm) to 9 inches (230 mm). The reported estimates are consistent with the bulk of the values of annual infiltration over the 11 years of analyses calculated by the SWB model.

Check #2: Consistency of the calculated evapotranspiration with the potential evapotranspiration estimated with the de Marsily (1986) implementation of the Thornthwaite-Mather method

As a check on the evapotranspiration calculations, the de Marsily (1986) implementation of the Thornthwaite-Mather method has been applied to estimate potential evapotranspiration. The mathematical formulation is reproduced below.

The potential evapotranspiration (ET_p) per month or ten days is given by:

$$ET_p = 16(10\theta/I)^a \times F(\lambda)$$

Here, ET_p is given in millimeters per month.

θ mean temperature of the period in question (°C) measured under shelter,

a $6.75 \times 10^{-7} I^3 - 7.71 \times 10^{-5} I^2 + 1.79 \times 10^{-2} I + 0.49239$

I annual thermal index, sum of twelve monthly thermal indexes i,

i $(\theta/5)^{1.514}$

$F(\lambda)$ correction coefficient, function of the latitude and the month, given by Table A.1.1.

For completeness, de Marsily (1986) Table A.1.1 is reproduced below. The complete reference for the table provided in de Marsily (1986) is:

Brochet, P., and N. Gerbier, 1974: L'evapotranspiration. Aspect agrométérologique, évaluaton pratique de l'évapotranspiration potentielle. Monographe 65, Météorologie Nationale, Paris, France.

Kevin MacKenzie, Golder Associates, has indicated that the values on Table A.1.1 are day-length adjustment factors. Multiplication of the values by on Table A.1.1 by 12 hours yields the approximate daylight hours by latitude.

Potential evapotranspiration with the de Marsily implementation has been calculated with the monthly mean temperatures reported in 2016 at the Kitchener-Waterloo weather station. The calculated evapotranspiration obtained with the de Marsily implementation is about 620 mm. This value is within the range calculated with the SWB model, 533 mm to 632 mm.

Table A.1.1.
Correction Coefficient $F(\lambda)$ Depending on the Latitude and the Month[a]

Lat. N.	J	F	M	A	M	J	J	A	S	O	N	D
0	1.04	0.94	1.04	1.01	1.04	1.01	1.04	1.04	1.01	1.04	1.01	1.04
5	1.02	0.93	1.03	1.02	1.06	1.03	1.06	1.05	1.01	1.03	0.99	1.02
10	1.00	0.91	1.03	1.03	1.08	1.06	1.08	1.07	1.02	1.02	0.98	0.99
15	0.97	0.91	1.03	1.04	1.11	1.08	1.12	1.08	1.02	1.01	0.95	0.97
20	0.95	0.90	1.03	1.05	1.13	1.11	1.14	1.11	1.02	1.00	0.93	0.94
25	0.93	0.89	1.03	1.06	1.15	1.14	1.17	1.12	1.02	0.99	0.91	0.91
26	0.92	0.88	1.03	1.06	1.15	1.15	1.17	1.12	1.02	0.99	0.91	0.91
27	0.92	0.88	1.03	1.07	1.16	1.15	1.18	1.13	1.02	0.99	0.90	0.90
28	0.91	0.88	1.03	1.07	1.16	1.16	1.18	1.13	1.02	0.98	0.90	0.90
29	0.91	0.87	1.03	1.07	1.17	1.16	1.19	1.13	1.03	0.98	0.90	0.89
30	0.90	0.87	1.03	1.08	1.18	1.17	1.20	1.14	1.03	0.98	0.89	0.88
31	0.90	0.87	1.03	1.08	1.18	1.18	1.20	1.14	1.03	0.98	0.89	0.88
32	0.89	0.86	1.03	1.08	1.19	1.19	1.21	1.15	1.03	0.98	0.88	0.87
33	0.88	0.86	1.03	1.09	1.19	1.20	1.22	1.15	1.03	0.97	0.88	0.86
34	0.88	0.85	1.03	1.09	1.20	1.20	1.22	1.16	1.03	0.97	0.87	0.86
35	0.87	0.85	1.03	1.09	1.21	1.21	1.23	1.16	1.03	0.97	0.86	0.85
36	0.87	0.85	1.03	1.10	1.21	1.22	1.24	1.16	1.03	0.97	0.86	0.84
37	0.86	0.84	1.03	1.10	1.22	1.23	1.25	1.17	1.03	0.97	0.85	0.83
38	0.85	0.84	1.03	1.10	1.23	1.24	1.25	1.17	1.04	0.96	0.84	0.83
39	0.85	0.84	1.03	1.11	1.23	1.24	1.26	1.18	1.04	0.96	0.84	0.82
40	0.84	0.83	1.03	1.11	1.24	1.25	1.27	1.18	1.04	0.96	0.83	0.81
41	0.83	0.83	1.03	1.11	1.25	1.26	1.27	1.19	1.04	0.96	0.82	0.80
42	0.82	0.83	1.03	1.12	1.26	1.27	1.28	1.19	1.04	0.95	0.82	0.79
43	0.81	0.82	1.02	1.12	1.26	1.28	1.29	1.20	1.04	0.95	0.81	0.77
44	0.81	0.82	1.02	1.13	1.27	1.29	1.30	1.20	1.04	0.95	0.80	0.76
45	0.80	0.81	1.02	1.13	1.28	1.29	1.31	1.21	1.04	0.94	0.79	0.75
46	0.79	0.81	1.02	1.13	1.29	1.31	1.32	1.22	1.04	0.94	0.79	0.74
47	0.77	0.80	1.02	1.14	1.30	1.32	1.33	1.22	1.04	0.93	0.78	0.73
48	0.76	0.80	1.02	1.14	1.31	1.33	1.34	1.23	1.05	0.93	0.77	0.72
49	0.75	0.79	1.02	1.14	1.32	1.34	1.35	1.24	1.05	0.93	0.76	0.71
50	0.74	0.78	1.02	1.15	1.33	1.36	1.37	1.25	1.06	0.92	0.76	0.70
Lat. S.												
5	1.06	0.95	1.04	1.00	1.02	0.99	1.02	1.03	1.00	1.05	1.03	1.06
10	1.08	0.97	1.05	0.99	1.01	0.96	1.00	1.01	1.00	1.06	1.05	1.10
15	1.12	0.98	1.05	0.98	0.98	0.94	0.97	1.00	1.00	1.07	1.07	1.12
20	1.14	1.00	1.05	0.97	0.96	0.91	0.95	0.99	1.00	1.08	1.09	1.15
25	1.17	1.01	1.05	0.96	0.94	0.88	0.93	0.98	1.00	1.10	1.11	1.18
30	1.20	1.03	1.06	0.95	0.92	0.85	0.90	0.96	1.00	1.12	1.14	1.21
35	1.23	1.04	1.06	0.94	0.89	0.82	0.87	0.94	1.00	1.13	1.17	1.25
40	1.27	1.06	1.07	0.93	0.86	0.78	0.84	0.92	1.00	1.15	1.20	1.29
42	1.28	1.07	1.07	0.92	0.85	0.76	0.82	0.92	1.00	1.16	1.22	1.31
44	1.30	1.08	1.07	0.92	0.83	0.74	0.81	0.91	0.99	1.17	1.23	1.33
46	1.32	1.10	1.07	0.91	0.82	0.72	0.79	0.90	0.99	1.17	1.25	1.35
48	1.34	1.11	1.08	0.90	0.80	0.70	0.76	0.89	0.99	1.18	1.27	1.37
50	1.37	1.12	1.08	0.89	0.77	0.67	0.74	0.88	0.99	1.19	1.29	1.41

[a] Thornthwaite's formula, from Brochet and Gerbier (1974).

Check #3: Consistency of the estimated infiltration with the Maxey-Eakin correlation between recharge and annual precipitation

Figure 15 was developed from correlations between recharge and annual precipitation presented in Maxey and Eakin (1949) and Farvolden (1967). The total precipitation between 2008 and 2018 ranged from 770.6 mm to 1304.7 mm. Referring to the plot, the fraction of precipitation that recharges the groundwater system is expected to be about 25%. This value is relatively close to the fraction of precipitation predicted to infiltrate that has been inferred from the simple regression shown in Figure 14 (17%).

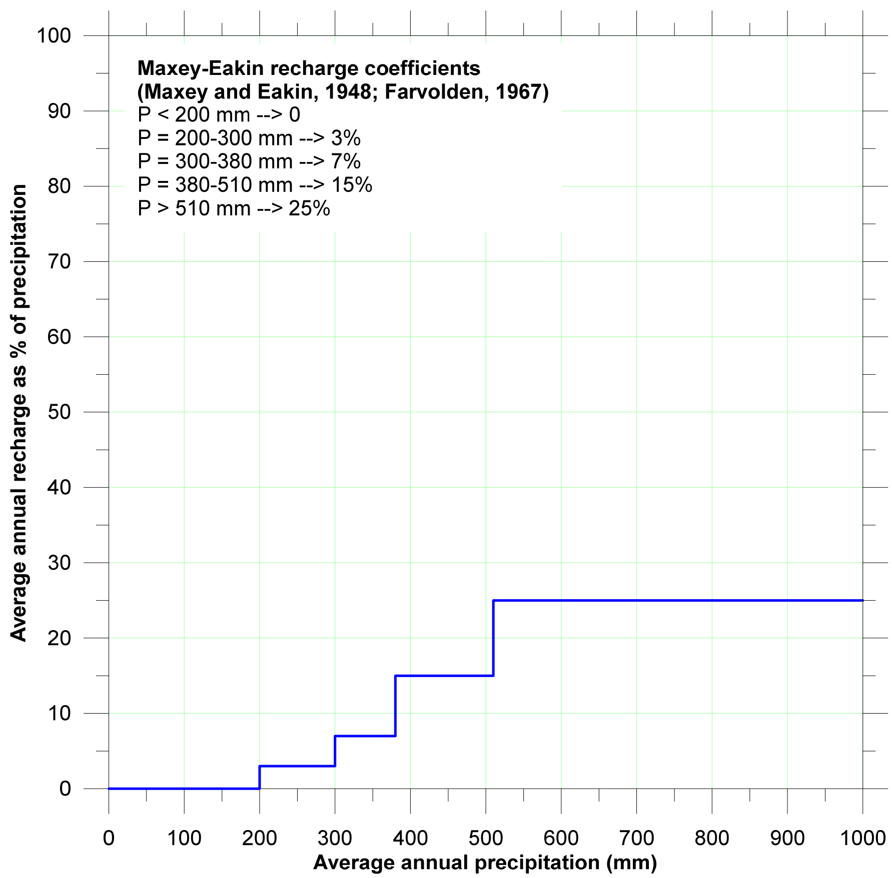


Figure 15. Correlations between recharge and annual precipitation presented in Maxey and Eakin (1949) and Farvolden (1967)

Check #4: Comparison with the basin yield

The 30-year average precipitation in the study area is 916.5 mm. The average evapotranspiration estimated from the 2008 - 2018 SWB model analysis is 587.2 mm. The basin yield is estimated by subtracting the evapotranspiration from the precipitation, 329.3 mm/yr.

The average observed basin yield from the Mill Creek at Sideroad Rd 10 02GAC19 between 1991 and 2005 according to Figure 3.12 of Appendix B1 of AquaResource (2011) ranges between 0.4 m^3/s to 1 m^3/s. The basin area is approximately 82.3 km^2. The rate of basin yield per unit area is therefore calculated as between 153 mm/yr and 383 mm/yr. The basin yield inferred from the SWB analysis falls within the range of the reported in AquaResource (2011).

8. References

AquaResource Inc., 2011: City of Guelph Tier Three Water Budget and Local Area Risk Assessment, Appendix B – Groundwater Flow Model Report, Appendix B1 – Hydrological Model Update (GASWER), August 18, 2011.

Cronshey, R., R. McCuen, N. Miller, W. Rawls, S. Robbins, and D. Woodward, 1986: Urban hydrology for small watersheds – TR-55 (2nd ed.), Washington, D.C., U.S. Dept. of Agriculture, Soil Conservation Service, Engineering Division, Technical Release 55, 164p.

de Marsily, G., 1986: **Quantitative Hydrogeology**, Academic Press, Inc., Orlando, Florida, Appendix 1, page 403.

Earthfx, 2016: Whitemans Creek Tier Three Local Area Water Budget and Risk Assessment, Draft Model Development and Calibration Report, prepared for Grand River Conservation Authority, Toronto, Ontario.

Farvolden, R.N., 1967: Methods of study of the ground-water budget in North America, International Association of Scientific Hydrology, General Assembly of Bern, September 25-October 7, 1967, Publication No. 77, pages 108-125.

Maxey, G.B. and Eakin, T.E., 1949: Ground Water in White River Valley, White Pine, NYE, and Lincoln Counties, Nevada, prepared in cooperation with the United Stated Department of the Interior Geological Survey, Water Resources Bulletin No. 8.

McCoy, A.J., Parkin, G., Wagner-Riddle, C., Warland, J., Lauzon, J., von Bertoldi, P., Fallow, D., and Jayasundara, S., 2006: Using automated soil water content measurements to estimate soil water budges, *Canadian Journal of Soil Science*, vol. 86, pp. 47-56.

Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), 2012: Land Information Ontario, Soil Survey Complex.

Ontario Minister of Natural Resources and Forestry (OMNRF), 2012: Ontario Integrated Hydrology Data.

Ontario Minister of Natural Resources and Forestry (OMNRF), 2015: Southern Ontario Land Resource Information System (SOLRIS) Version 2.0.

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 25, 2019 **Project No.** 13-1152-0250 (1000)

TO Andreanne Simard, Ph.D., Natural Resource Manager
Nestle Waters North America

CC John Piersol, GAL Chris Neville, SSP&A

FROM Joel Henry, Greg Padusenko **EMAIL Gregory_Padusenko@golder.com**

TW3-80 DRAWDOWN ANALYSIS

Withdrawals from well TW3-80 by Nestlé Waters Canada (NWC) are authorized by Permit to Take Water (PTTW) number 1381-95ATPY. 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 12 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 marked declines 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 accurately accounted 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 and 2018. Overall the water taking has been similar from 2015 to 2017. The water taking in 2018 was similar to that in 2014. The volume of groundwater withdrawn from TW3-80 in each of the last eight years are listed in Table 1.

Table 1: Annual TW3-80 Withdrawal Volumes

Year	Annual Volume (litres)
2011	568,025,080
2012	583,823,567
2013	600,537,587

2014	**678,452,126**
2015	**762,363,664**
2016	**783,540,441**
2017	**767,883,336**
2018	**676,946,402**

To quantitatively demonstrate the degree to which the water levels are directly related to pumping rates, the following analysis evaluates the relationship between monthly average pumping rates with monthly average water levels in TW3-80.

Analysis

The TW3-80 transducer dataset currently extends from September 2005 through December 2018. 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 152 months of data, every 100 L/min increase in pumping results in a 0.64 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, 140 of the 152 data points (92%) are within 1 m of the expected water level, defined by the regression.

The goodness-of-fit of the regression (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 aquifer recharge 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. 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, 140 of 152 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

Groundwater withdrawals from TW3-80 account for 90% of the influence on 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 0.64 m. The effects of precipitation deficits that have been observed, affecting recharge volumes to the deep aquifer, have been inferred to have no greater impact than about 1 m of additional decline on TW3-80 water levels.

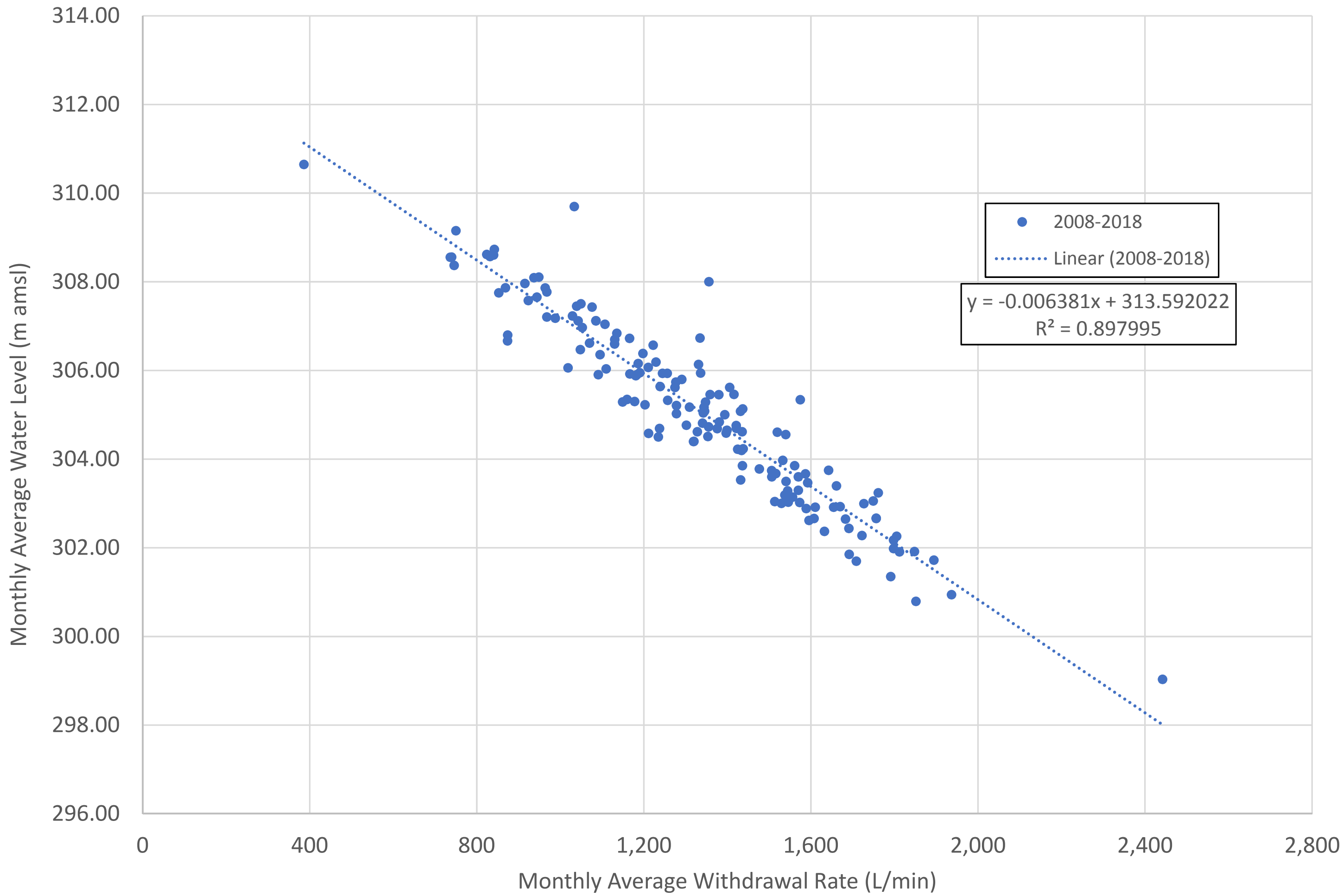
\\golder.gds\gal\mississauga\active\2013\1152\13-1152-0250 nestle waters ws s. ontario\aberfoyle\reports\2018 annual report\draft report\app i technical memo\13-1152-0250 (1000) tm 28jan2019 tw3-80 analysis.docx

ATTACHMENT

Figure 1

Figure 1

Relationship between TW3-80 Withdrawal Rate and Water Level



APPENDIX J

Letters to MECP

April 30, 2018 Project No. 13-1152-0250 (1000)

Director, Ministry of the Environment and Climate Change
West Central Region
119 King Street West, 12th Floor
Hamilton, Ontario
L8P 4Y7

INACCESSIBLE MONITORING LOCATIONS
CONDITION 4.7 OF PERMIT TO TAKE WATER NUMBER 1381-95ATPY
NESTLÉ CANADA INC. – ABERFOYLE SUPPLY WELL TW3-80

Dear Director:

On behalf of Nestlé Waters Canada (Nestlé), Golder has prepared this letter to provide information to the MOECC on monitoring locations that have become inaccessible along with a recommended replacement monitoring location to comply with Permit to Take Water 1381-95ATPY (PTTW).

Condition 4.7 states:

> *The Permit Holder shall identify to the Director in writing, within 15 days of any monthly monitoring event, any monitoring locations identified in Condition 4.2 and 4.3 which become inaccessible and/or abandoned along with a recommendation for replacement monitoring locations. Upon approval of the Director the monitoring program shall be appropriately modified.*

SW9 is a staff gauge where water levels are measured on a monthly basis as part of the PTTW requirements. SW9 is located in a wash pond on the Dufferin property south of the Nestlé property (Figure 1). Golder was unable to measure a water level at SW9 during the April monitoring event on April 18, 2018 due to the staff gauge being inaccessible. During the monitoring event, it was noted that the wash pond where SW9 is situated was partially filled in. The portion that was filled in covered staff gauge SW9, making the monitoring location permanently inaccessible/destroyed.

At this time, we would recommend that no additional monitoring locations be established for the following reasons:

- The station is situated in a wash pond where the water levels change due to the water taking from the wash pond;
- There does appear to be an influence on the water levels in the pond from pumping the Nestlé production well, TW3-80 (Figure 2); and
- Monitoring station, SW10, on the Dufferin property, provides surface water level information on the Dufferin property in close proximity to SW9 that can be used to track changes in surface water levels in the area.

As such, no replacement monitoring location is recommended at this time, and SW9 should be removed from the PTTW.

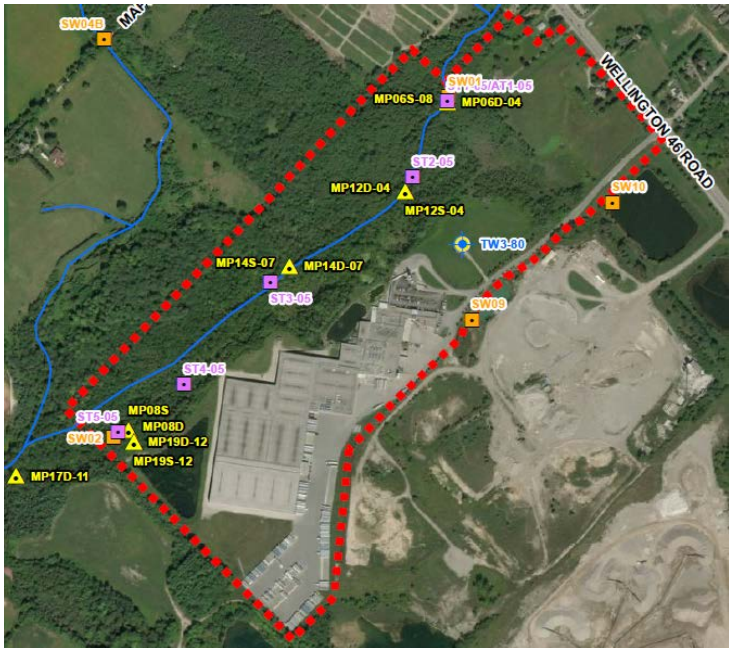


Figure 1. SW9 Location

In addition, Golder has prepared this letter to provide information to the MOECC on locations where monthly water levels were not obtained or a transducer had failed during this monitoring event. This information is typically provided in our Annual Reports but we will provide monthly updates until we receive clarification of Condition 4.7 of the PTTW as requested in our email dated February 27, 2017.

It is our understanding that missed measurements only need be reported in the Annual Report rather than under Condition 4.7 when the wells have not become inaccessible such that a replacement is needed, but rather temporarily frozen or blocked during a monitoring event or transducer failure. Golder has identified locations of any missing data in the Annual Reports since 2014. Golder sent an email to the MOECC on February 27, 2017 to request clarification as to what constitutes an inaccessible monitor under Condition 4.7. Until the intent of the Condition has been clarified in writing from the MOECC, Nestlé will notify the MOECC of any and all water levels not obtained on a monthly basis.

Golder has identified the following monitoring locations where a water level could not be measured during this monthly event, however it is anticipated that monitoring will continue at these locations and no replacement wells are needed:

- MP1D-16 – the water was frozen and a water level was measured to the top of the ice. The transducer could not be removed from the well to download. We note that this station is not part of the Conditions of the PTTW.

If you should have any questions on the above, please do not hesitate to contact us. Please confirm that SW9 can be removed from the PTTW monitoring and not be replaced with an additional staff gauge.

Yours truly,

Golder Associates Ltd.

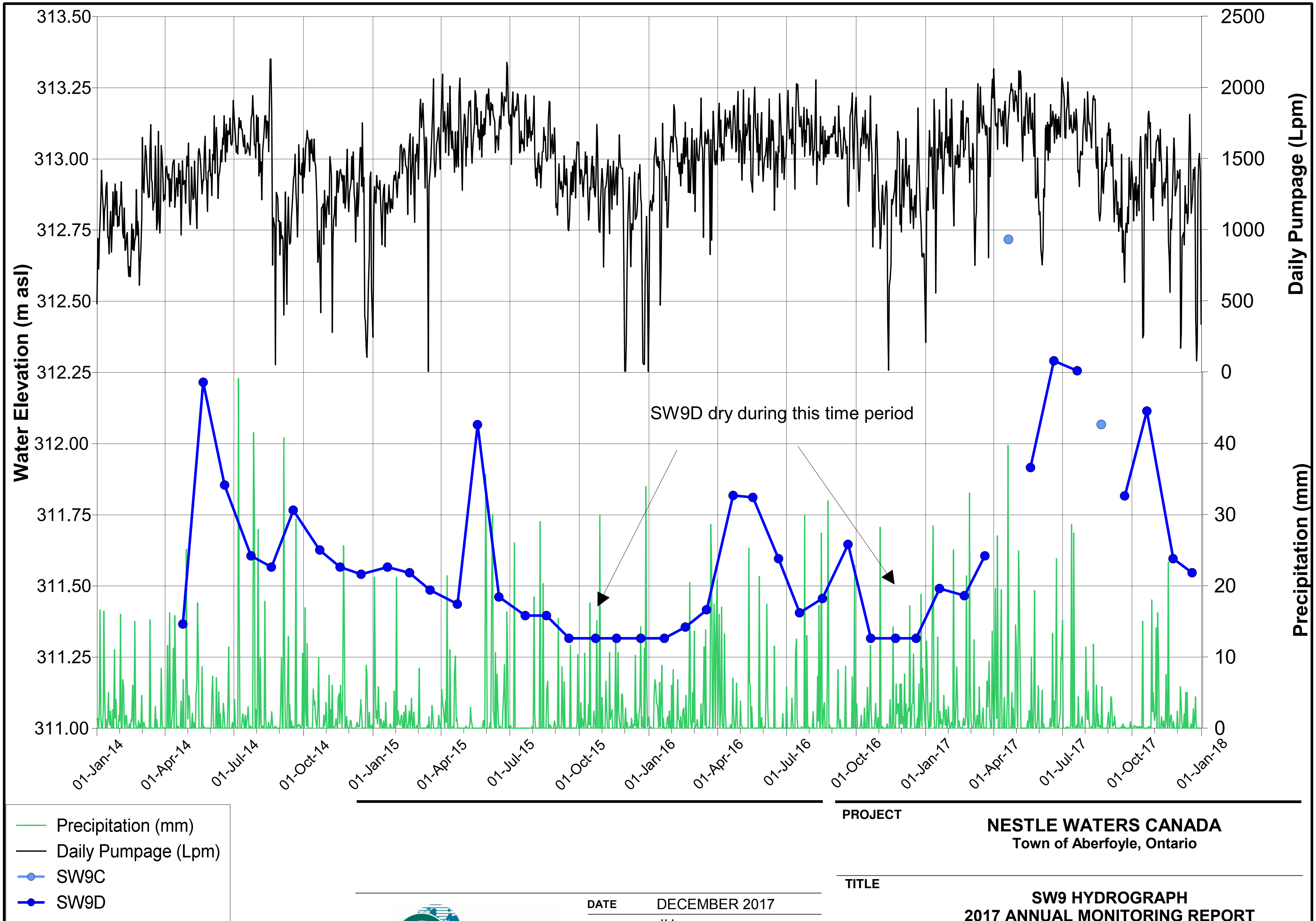
Greg Padusenko, M.Sc., P.Eng., P.Geo.
Hydrogeologist

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

GRP/JAP/ll

CC: Andreanne Simard, Nestlé Waters Canada
Abdul Quyum, Ministry of the Environment and Climate Change
Lynnette Armour, Ministry of the Environment and Climate Change

\\golder.gds\gal\mississauga\active\2013\1152\13-1152-0250 nestle waters ws s. ontario\aberfoyle\letters to moe\2018\monitoring issues apr 2018\13-1152-0250 ltr 2018apr30 april monitoring update aberfoyle.docx



Golder Associates

DATE	DECEMBER 2017
DESIGN	JH
REVIEW	GP
APPROVED	GP

PROJECT

NESTLE WATERS CANADA
Town of Aberfoyle, Ontario

TITLE

SW9 HYDROGRAPH
2017 ANNUAL MONITORING REPORT

PROJECT NO.	REV	FIGURE
13-1152-0250 (1000)	A	2

August 9, 2018 Project No. 13-1152-0250 (1000)

Director, Ministry of the Environment, Conservation and Parks
West Central Region
119 King Street West, 12th Floor
Hamilton, Ontario
L8P 4Y7

INACCESSIBLE MONITORING LOCATIONS
CONDITION 4.7 OF PERMIT TO TAKE WATER NUMBER 1381-95ATPY
NESTLÉ CANADA INC. – ABERFOYLE SUPPLY WELL TW3-80

Dear Director:

On behalf of Nestlé Waters Canada (Nestlé), Golder has prepared this letter to provide information to the MECP on monitoring locations that have become inaccessible along with a recommended replacement monitoring location to comply with Permit to Take Water 1381-95ATPY (PTTW).

Condition 4.7 states:

> *The Permit Holder shall identify to the Director in writing, within 15 days of any monthly monitoring event, any monitoring locations identified in Condition 4.2 and 4.3 which become inaccessible and/or abandoned along with a recommendation for replacement monitoring locations. Upon approval of the Director the monitoring program shall be appropriately modified.*

W2 is the supply well for the Aberfoyle Mill Restaurant located approximately 500 m northeast of the Nestlé production well (TW3-80) as shown on Figure 1. The well is completed in the lower bedrock aquifer to a depth of approximately 55.5 m below ground surface. Water levels are measured in the well on a monthly basis as part of the PTTW requirements. Nestlé was contacted by the property owner of the Aberfoyle Mill on August 8, 2018 requesting that Nestlé no longer monitor their well (W2). Nestlé had previously reached out the property owner to request installing a monitoring well on the property to replace private well W2, however, the property owner did not want a monitoring well on their property. As such, Nestlé is looking for a new location to replace W2, which includes the property across the road from the Aberfoyle Mill Restaurant.

Due to the difficulty in getting access to private land in the area, Nestlé will continue to make their best effort to obtain a suitable location to install a replacement monitoring well at a location close to W2. This may include drilling on the northeast boundary of the Nestlé property. Nestlé will provide the proposed location to the MECP.

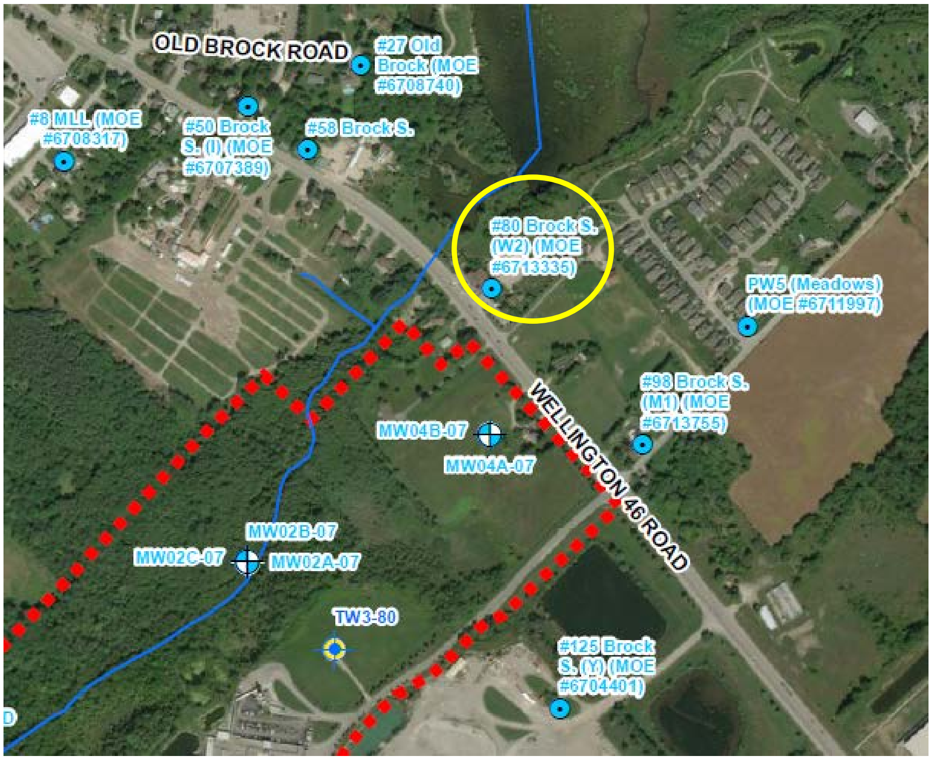


Figure 1. W2 Location

If you should have any questions on the above, please do not hesitate to contact us.

Yours truly,

Golder Associates Ltd.

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

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

GRP/JAP/ll

CC: Andreanne Simard, Nestlé Waters Canada
Abdul Quyum, Ministry of the Environment, Conservation and Parks
Lynnette Armour, Ministry of the Environment, Conservation and Parks

\\golder.gds\gal\mississauga\active\2013\1152\13-1152-0250 nestle waters ws s. ontario\aberfoyle\letters to moe\2018\monitoring issues aug 2018 w2\13-1152-0250 ltr 2018aug9 aberfoyle well w2.docx

GOLDER

golder.com